1EW03 - Enabling Works Central

AWH - Survey Report for Woodlands Evaluation

Site Codes: 1C20JHWHL, 1C20WIFHL, 1C20FCWHL, 1C20HACHL, 1C20FCGHL, 1C20WIHHL

MDL:

Document no.: 1EW03-FUS_IFA-EV-REP-C000-000004

Revision	Date	Author	Checked by	Approved by	Revision Details:
C01	17/09/2021	G. Crees	S. Roper	D. Bonner	For acceptance

Contents

List of Tables

List of Figures

1 Summary of Archaeological Works

1.1.1 During November 2020 to May 2021, an archaeological test pit evaluation, topographic survey and woodland survey was undertaken to investigate woodland history and the pre-woodland land use potential of six areas of woodland across four counties (hereafter referred to as 'the Site(s)') within HS2 Phase 1 Central Route (Figure 1). Each of the Sites was allocated a unique site code for the work. The Site Codes and locations of the Sites are summarised in table 1.

Table 1: Summary of Woodland Sites Location and Site Code

Land Parcel	Name	County	Nat Grid Ref	Site Code
C21022	Jones Hill Wood	Buckinghamshire	488715, 204367	1C20JHWHL
C25071	Widmore Farm	Oxfordshire	462565, 232083	1C20WIFHL
C30031	Fox Covert Whitfield	Northants	459403, 239482	1C20FCWHL
C30027	Halse Copse Farm	Northants	457383, 241481	1C20HACHL
C32033	Fox Covert (Glyn Davies Wood)	Northants	446235, 253548	1C20FCGHL
C32030	Windmill Hill Spinney	Warwickshire	442524, 259279	1C20WIHHL

1.1.2 The Woodlands evaluation and survey was implemented to address the Project Plan (Document Ref: 1EW03-FUS-EV-REP-C000-000007) and followed the methodology laid out in the Location Specific Written Scheme of Investigation (Document Ref: 1EW03-FUS_IFA-EV-REP-C000-000001).

1.1.3 A total of 40 test pits were excavated, targeted upon LiDAR anomalies. No cut features were identified. The only positive feature identified by the test pitting was part of a woodland bank recorded in one test pit at the Jones Hill Wood Site (C21022).

1.1.4 A topographic survey and detailed woodland survey (aboricultural and botanical survey) was also undertaken across each of the Sites. The topographic survey recorded numerous earthwork features. Some can be understood as being anthropogenic, for example linear banks in association with ditches and extant linear ridge and furrow, others are likely natural in origin. The woodland survey described the composition of the woodland and any evidence for woodland management. Evidence for woodland management was represented by coppice stools identified at two of the Sites, these were probably associated with later post-medieval woodland management, other evidence for woodland management appeared to be of modern date. There was no evidence of pre-woodland activity detected by the investigation.

2 Survey Methodology

2.1 Test Pits - Setting Out

2.1.1 Setting out is necessary for intrusive archaeological investigations including archaeological test pit investigation.

2.1.2 In regard to the setting out of test pits, the purpose is to position the test pits prior to excavation and any uncovered archaeological features excavated within the test pits on a location plan. The location, size and objectives of the test pits were set out in the Project Plan in agreement with the GWSI:HERDS. Each test pit was assigned a unique ID in accordance with the HS2 Ltd Asset Information Management System (AIMS). Test pits which differed from the Project Plan were set out as per the approved change control.

2.1.3 All spatial setting out and recording was undertaken using a GNSS TST in accordance with good survey practise using the Ordnance Survey National Grid and Ordnance Survey Newlyn Datum (ODN) as defined by the OS Active Global National Satellite System (GNSS) network and use of a Virtual reference system.

2.2 Topographic Survey – Setting Out

2.2.1 The topographical survey sought to provide an accurate map of the woodland terrain and to record any potential earthworks. For the survey a series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point

2.3 Surveying

2.3.1 Two Permanent Ground Markers (PGM) were established for the duration of each Site, shown in Figures 3, 5, 7, 9, 11 and 13 as per technical standards. The PGMs were set up using a Trimble S5 Robotic Total station with Auto Target Recognition capability, calibrated on 18th September 2020, and their locations were established using the Trimble Access software on Trimble Tablet, TSC3 or TSC7 controllers and R10 or R8s GNSS antennae, calibrated on 16th March and 6th April 2020. The survey used reference stations provided by Ordnance Survey. The OS Net base stations used for the survey were Oxford (E449130.188623, N214164.351931, 72.159934m AOD), Princes Risborough (E481016.735053, N202913.238152, 145.659487m AOD) and Amersham (E499706.540008, N198584.695216, 87.682022m AOD).

Table 2: List of PGM co-ordinates

Site	Station	Easting	Northing	Height aOD (m)
C21022	STNJ1	488680.84	204309.43	192.261
C21022	STNJ2	488760.5	204319.14	200.632
C25071	STNW10	462583.94	232143.25	121.467
C25071	STNW11	462608.17	232068.33	121.397

C30031	STNS1	459311.99	239521.6	146.962
C30031	STNS3	459362.46	239356.63	140.542
C30027	STNH3	457313.81	241585.16	159.549
C30027	STNH4	457366.66	241596.88	158.866
C32033	STNS1	446137.7	253661.64	142.231
C32033	STNS2	446124.92	253596.35	140.822
C32030	STNS3	442441.16	259210.71	122.912
C32030	STNS1	442628.93	259244.46	123.006

2.3.2 A baseline of two stations was used as the reference to Ordnance Survey National Grid, at each Site these were located outside the woodland canopy. The total station was set up on those PGM stations in order to obtain their coordinates. Both PGM's were reoccupied during each survey to check the accuracy of the equipment.

2.3.3 A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. Closed loop spirit levelling was used for this project between J1 and J2 the two stations that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations,trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

2.3.4 The survey equipment was purchased or hired from Korec who certified the accuracy of the equipment and performed regular maintenance.

2.3.5 All staff using the equipment were appropriately trained and the survey was undertaken in accordance with the sub-contractor's standards for surveying.

2.3.6 All test pits, interventions and topographic survey data was located to a horizontal accuracy of +/-500mm in relation to the detail illustrated in the contract drawing(s). The corner points of each test pit at modern ground surface level were surveyed with Real Time Kinematic (RTK) Global Navigation Satellite System (GNSS) equipment or other suitable automated equipment referenced from the PGM's.

2.3.7 Surface heights and levels at the base of trenches were recorded using RTK GNSS and related to PGMs. Ordnance Survey Benchmarks (OSBM) were not used. Levelling accuracy was within 10 mm/k: where 'k' is the total distance levelled in kilometres.

2.3.8 INFRA ensured that all test pit, excavation limits and significant archaeology detail was surveyed 'as dug' in relation to the project grid before leaving the Site. Ground level height data were recorded for each intervention.

2.4 Site Location Plan: Archaeological Contexts

2.4.1 A 'site location plan', indicating site north was prepared at 1:1250. Individual 'trench plans' at 1:200 (or 1:100) were prepared and show the location of archaeology investigated in relation to the investigation area. The location of the site plans is identified using OSGB co-ordinates, as required by technical standards.

2.4.2 Section drawings are located on the relevant plan and OSGB co-ordinates recorded using a GNSS system.

2.4.3 A record was made 'in plan' of all archaeological deposits as revealed in the investigation. These plans were normally based on digital survey data (digital planning methods were agreed in advance with the HS2 Ltd) supplemented where appropriate by hand drawn records on polyester based drawing film (at a scale of 1:10 or 1:20 unless otherwise agreed with HS2 Ltd). All hand drawn information was digitised (or preferably generated from the digital data in the first instance). Final deliverables will be supplied in an Esri format and adhere to standards set out in the HS2 Ltd Cultural Heritage GIS Standard (HS2-HS2-GI-SPE-000-000004).

3 Standards and Guidance

3.1 Overview

3.1.1 HS2 Ltd has developed a robust suite of technical standards which supports existing archaeological guidance to ensure that works are delivered in a consistent and cohesive manner that reflects the Secretary of State's commitments to the historic environment.

3.1.2 To implement the GWSI:HERDS, the sub-contractor complied with and used for the development of historic environment works; the strategies, technical standards and guidance notes set out below in section 3.2.

3.2 References

3.2.1 All relevant HS2 standards, guidance and procedures in relation to the production of documents and digital materials were followed. This list is not exhaustive:

- HS2 Cultural Heritage GIS Specification (HS2-HS2-GI-SPE-000-000004)
- The BIM documents set out in High Speed Two Phase One Project Requirements Specification (PRS) (HS2-HS2-SA-SPE-000-000008) (section 2.1.4 Information Management).

3.2.2 The following documents provided background information:

- Historic Environment Physical Archiving Strategy (HS2-HS2-EV-STR-000-000018)
- Historic Environment Digital Data Management and Archiving Strategy (HS2-HS2-EV-STR-000-000019)
- Information Paper E8: Archaeology. (LWM-HS2-HY-PPR-000-000042)

- AWH Route-wide Project Plan for Woodland Evaluation (Document Ref: 1EW03-FUS-EV-REP-C000-000007)
- AWH - Route-wide LSWSI for Woodland Evaluation (Document Ref: 1EW03-FUS_IFA-EV-REP-C000-000001)
- GWSI:HERDS (HS2-HS2-EV-STR-000-000015)

3.2.3 The Sub-Contractor Survey reports for each Site were as follows:

- Survey Report for Woodlands Survey at Jones Hill Wood (Met Geo Environmental P20-01357)
- Survey Report for Woodlands Survey at Widmore Farm (Met Geo Environmental P20-01356)
- Survey Report for Woodlands Survey at Fox Covert Whitfield (Met Geo Environmental P20-01358)
- Survey Report for Woodlands Survey at Halse Copse Farm (Met Geo Environmental P20-01349)
- Survey Report for Woodlands Survey at Fox Covert/Glyn Davies Wood (Met Geo Environmental P20-01359)
- Survey Report for Woodlands Survey at Windmill Hill Spinney (Met Geo Environmental P20-01360)

4 Archive deposition

4.1.1 Following completion of the archaeological evaluation, the subcontractor will provide the contractor with the required data, metadata and digital material as specified in the Historic Environment Digital Data Management and Archiving Procedure (C262-ARP-EV-SPE-000-000003) and the Historic Environment Digital Data Management and Archiving Strategy (HS2 Ltd, 2015a).

4.1.2 The security and stability of the digital archive will be ensured from fieldwork through to deposition.

4.1.3 The survey data will be edited to ensure that the archive deposited into the public domain is fit for purpose both as a record of the archaeology removed by excavation and to enhance understanding about the site from which it came.

4.1.4 The report will be uploaded to the OASIS database as required by HS2.

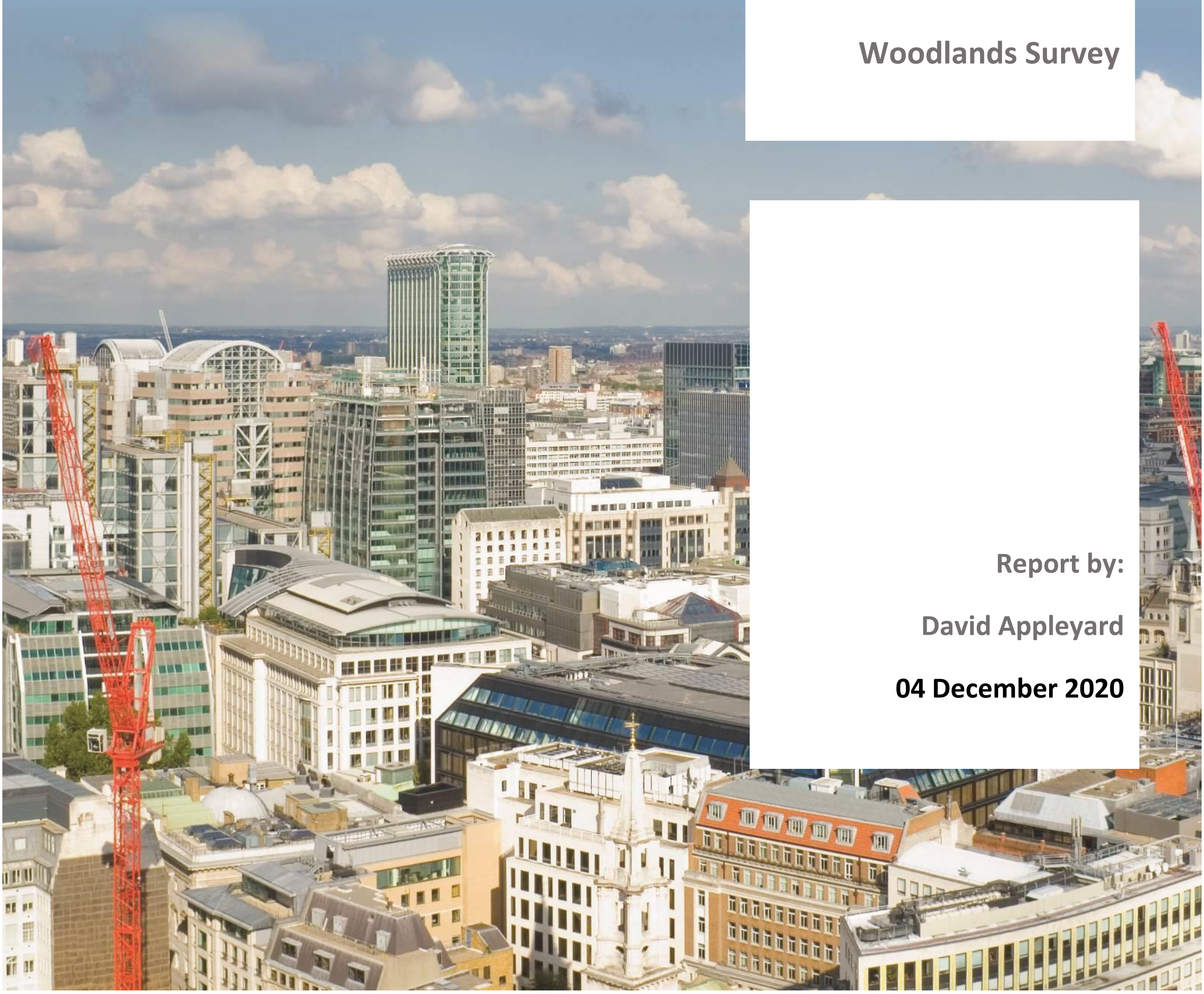
4.1.5 File-level metadata requirements for spreadsheets and databases are specified in the ADS *Guidelines for Depositors* (2014) Spreadsheets, Databases and Statistics Guidelines. These guidelines include a metadata template that can be downloaded in XLS, ODS and CSV formats.

5 Glossary of terms

5.1.1 The following terms have been used in this report:

- **Generic Written Scheme of Investigation: Historic Environment Research and Delivery Strategy (GWSI: HERDS)** – the framework for delivering all historic environment investigations undertaken as part of the HS2 Phase 1 programme.
- **Location** – a specific HS2 worksite or group of worksites that are being addressed as a combined historic environment investigation programme of assessment, evaluation and investigation.
- **Location Specific Written Scheme of Investigation (LSWSI)** - specification document assembling one or more Project Plans within an area of land defined primarily for construction programme purposes. The LS-WSIs will be agreed with the Project Manager and would provide a costed and programmed approach to delivering outcomes.
- **Project Plan** – specification document for each specific package of activity (e.g. a survey, desk-based assessment, excavation, recoding project). The plans would respond to the Specific Objectives set out in the GWSI: HERDS and be delivered within an agreed budget.
- **Works** – the specific historic environment assessment, evaluation or investigation works at each location.

Appendix 1 – Survey Reports



Network Archaeology Limited

P20-01357

Jones Hill Wood

Survey Report

Woodlands Survey

Report by:

David Appleyard

04 December 2020

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01357 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Final	04/12/2020	David Appleyard	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**David Appleyard (Training & Quality Manager)** *Tel* : [redacted] *Mob*: [redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

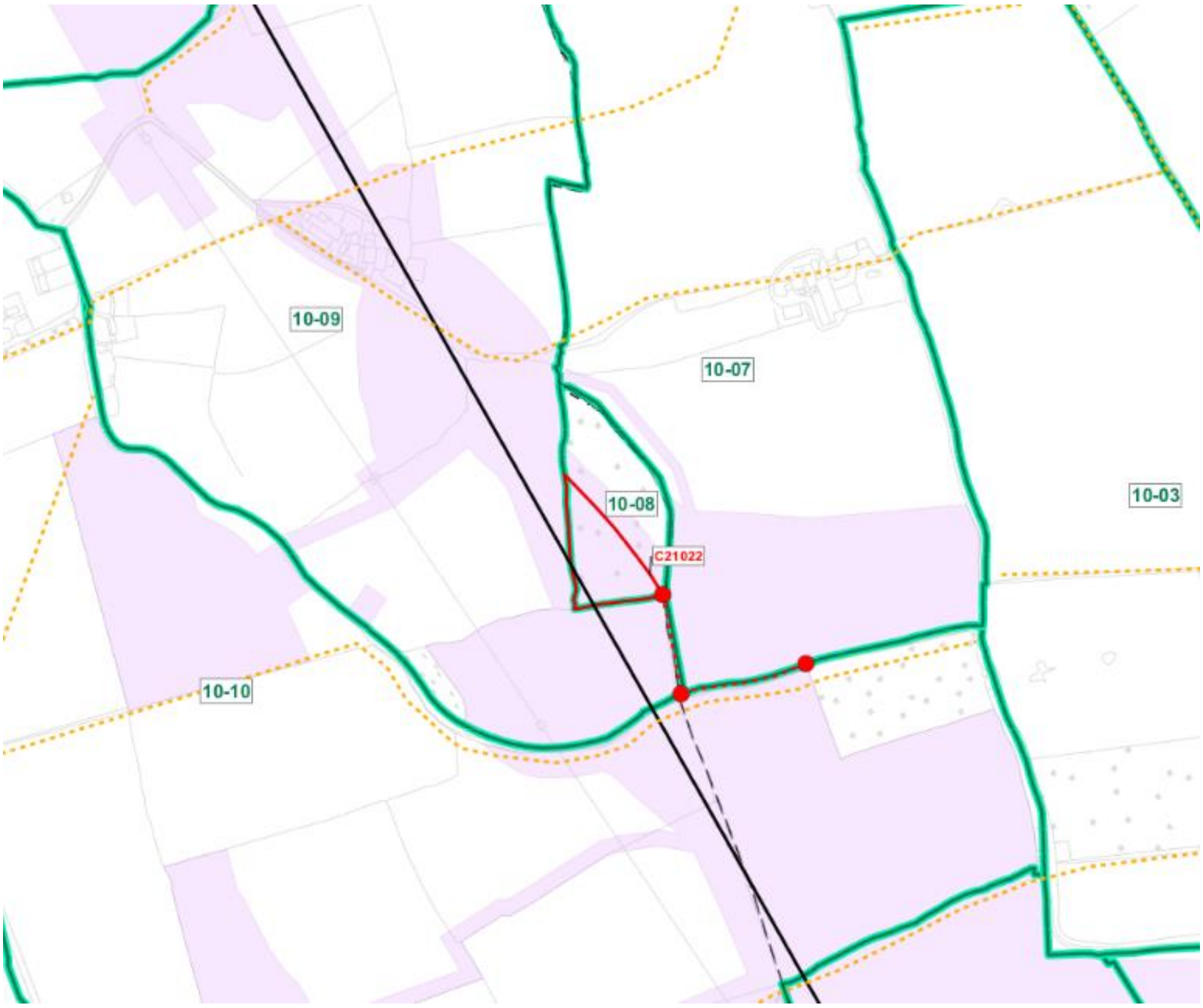
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Jones Hill Wood, Wendover HP22 6PT (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network Archaeology Ltd.



The deliverables provided were to be the topographical survey of the woodland terrain and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laserscanning survey were not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the Detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work, was carried out during day shifts from 26/11/2020 to 27/11/2020 and the subsequent deliverables were despatched to Network Archaeology Ltd on 01/12/2020.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Malcolm Bouleau-Pendlington (CSCS)	-	Topographical Surveyor.
Chris Carter (CSCS)	-	Topographical Surveyor.

6. Methodology - Control

A baseline of two stations J1 and J2 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for the satellite configuration to change.

J1 and **J2** were also used as PGMs for the site. These PGMs were ground anchors with steel pins, located on the southern edge of the site, on the southern side of the track beyond the redline boundary.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between J1 and J2 the two stations that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control values of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

No difficulties were encountered during the survey.

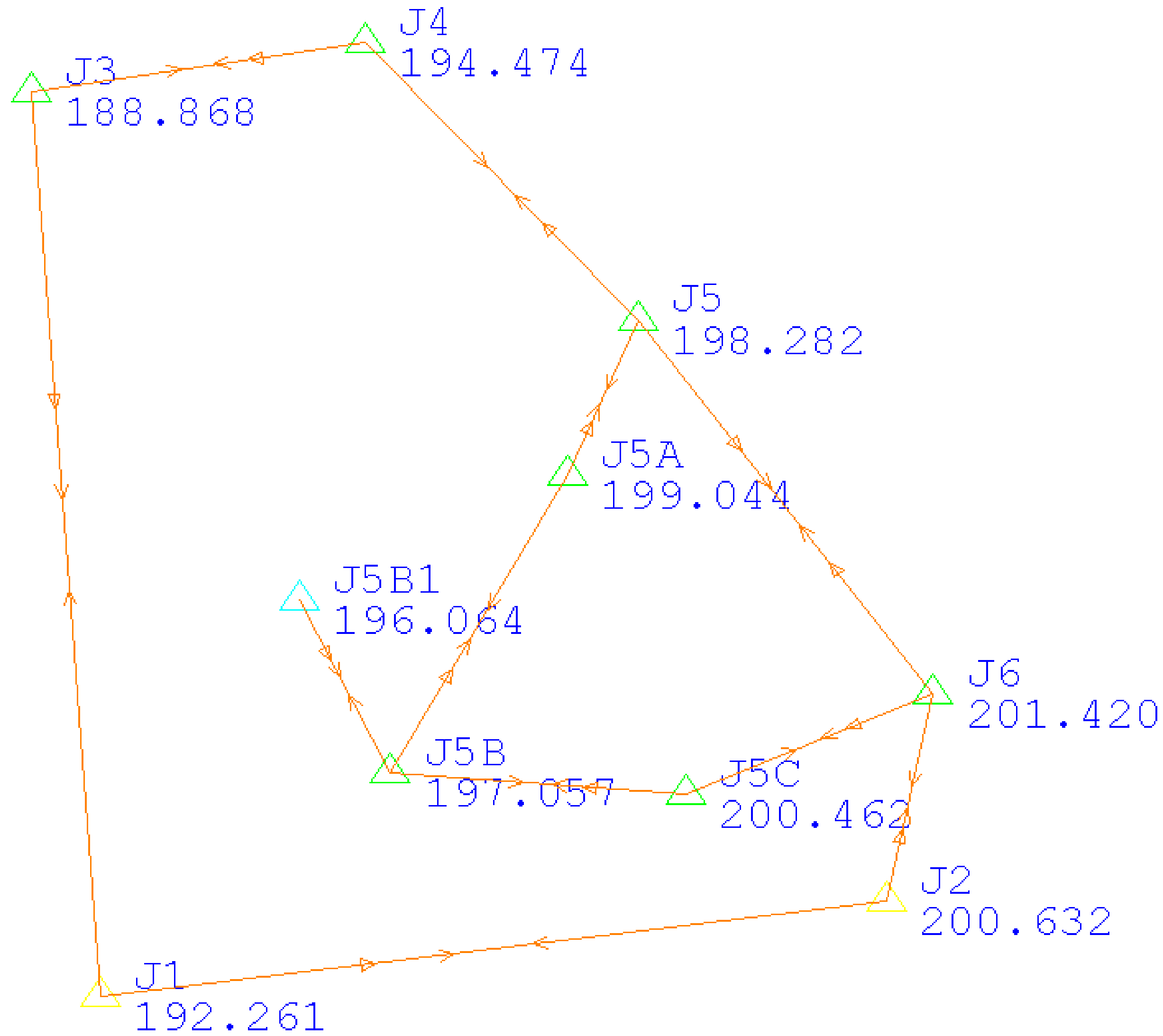
9. Quality Assurance Procedures

All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 10mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked..

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagrams



Appendix B: Traverse Report

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
J1	1000.000	1000.000	100.000	272 35 50		
					91.984	-3.399
J3	993.014	1091.718	96.601	265 58 20		
					34.152	5.606
J4	1026.801	1096.697	102.207	233 46 34		
					39.456	3.808
J5	1054.508	1068.608	106.015	186 22 03		
					48.219	3.138
J6	1084.354	1030.735	109.153	230 49 18		
					21.534	-0.795
J2	1079.663	1009.719	108.358	250 27 54		
					80.254	-8.357
J1	1000.000	1000.002	100.002			
Stored	1000.000	1000.000	100.000			
----------	------------	------------	--------	----------		
Misclosure	0.000	0.002	0.002	0 00 00		

After angular misclosure adjustment :-

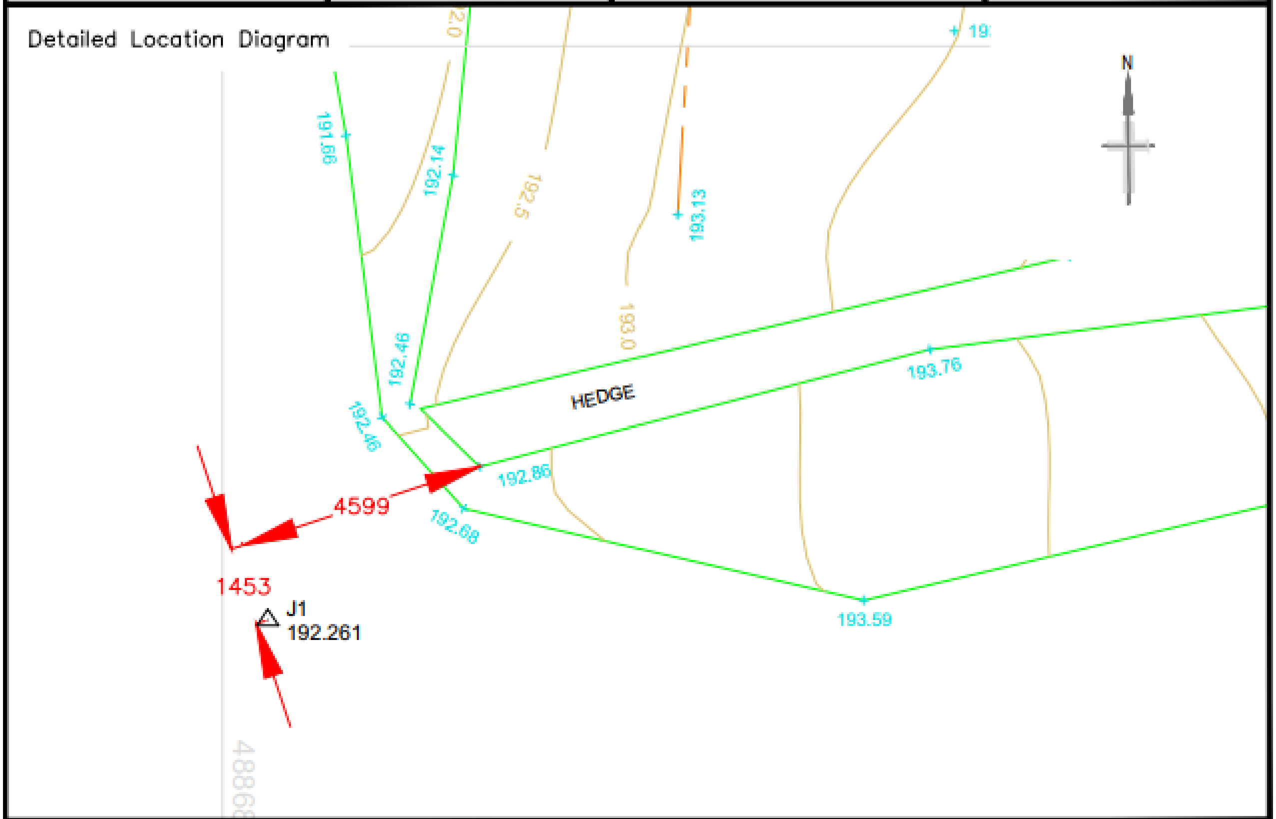
Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
J5	1054.509	1068.606	106.014	62 47 32		
					17.272	0.761
J5A	1047.332	1052.896	106.775	186 05 25		
					35.132	-1.988
J5B	1029.426	1022.670	104.787	63 25 02		
					29.924	3.405
J5C	1059.275	1020.552	108.191	153 51 10		
					27.068	0.957
J6	1084.356	1030.730	109.148	73 50 51		
Stored	1084.354	1030.734	109.152	73 50 51		
----------	------------	------------	--------	----------		
Misclosure	0.002	-0.004	-0.004	0 00 00		

Appendix C: Schedule of Survey Control Station.

Schedule of Permanent Survey Control Stations – Jones Hill Wood					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	J1	488680.835	204309.425	192.261	Ground Anchors
New Station	J2	488760.499	204319.141	200.632	Ground Anchors

Appendix D: PGM Witness Diagrams

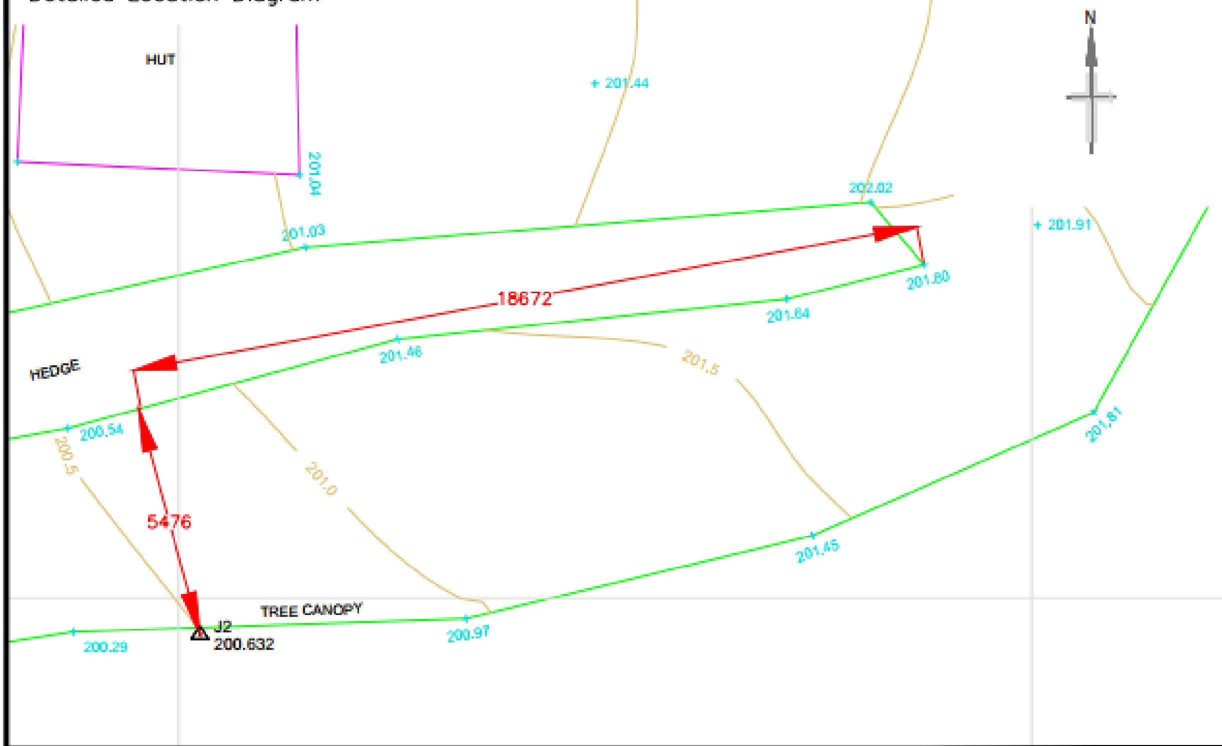
PERMANENT GROUND MARKER RECORD SHEET			Page 1 of 2
Location: South west corner of the woodland, western edge of the track.			Job Ref: P30–01357
PGM No./Name J1			
Description of PGM: Ground Anchors (Yellow)			
Arbitrary/N.G.Coordinates	E 488680.835	N 204309.425	Level 192.261
Detailed Location Diagram			



Marker Established By CC	Date 26/11/2020
Record Prepared By CC	Date 26/11/2020
Revisited By	Date
Remarks	

PERMANENT GROUND MARKER RECORD SHEET			Page 2 of 2
Location: Southern edge of site, south edge of the track.			Job Ref: P30-01357
PGM No./Name J2			
Description of PGM: Ground Anchors (Yellow)			
Arbitrary/N.G.Coordinates	E 488760.499	N 204319.141	Level 200.632

Detailed Location Diagram



Marker Established By CC	Date 26/11/2020
Record Prepared By CC	Date 26/11/2020
Revisited By	Date
Remarks	

Appendix E: Control Observation Report

```
 McCarthy Taylor Systems Ltd.                      MET GEO ENVIRONMENTAL LTD                                           Page : 001
 LSS v10.01.17 /  153.03                                                                                        2020.12.01 11:07
                                                      C21022  -  C21022

                                             SURVEY CONTROL OBS. DIFFERENCES LIST

Control obs. tolerances - warnings : 0.010(?) and errors : 0.030(!).
Horizontal / Distance components may be ignored (x).

Reporting all control obs. differences above 0.010

Set-up : 1       Set on     J1       E  488680.8350  N  204309.4250  L  192.2530
                 Backsight J2        E  488760.4987  N  204319.1412  L  200.6240
                 Set-up HA = 83 02 49, IH = 1.566, VA Col = 90 00 00, SF = 1.00000000

Control obs to J2
               HA F1       HA F2       VA F1       VA F2          SD        HD   HD diff        LD   LD diff        TH   3D diff
            83 02 49                84 06 45                  80.682    80.256     0.002     8.359    -0.012     1.483     0.012 ?
                       263 02 47               275 53 05      80.683    80.258     0.004     8.355    -0.016     1.483     0.016 ?

Mean        83 02 49   263 02 47    84 06 45   275 53 05      80.682    80.257               8.357
Max Dev      0 00 00     0 00 00     0 00 00     0 00 00       0.001     0.001     0.004     0.002    -0.016 ?             0.016 ?
Combined    83 02 48                84 06 50
Dev         -0 00 01      VA Col    89 59 55


Set-up : 2       Set on     J1       E  488680.8350  N  204309.4250  L  192.2530
                 Backsight J2        E  488760.4987  N  204319.1412  L  200.6240
                 Set-up HA = 83 02 49, IH = 1.566, VA Col = 90 00 00, SF = 1.00000000

Control obs to J2
               HA F1       HA F2       VA F1       VA F2          SD        HD   HD diff        LD   LD diff        TH   3D diff
            83 02 49                84 06 45                  80.681    80.255     0.001     8.359    -0.012     1.483     0.012 ?
                       263 02 48               275 53 05      80.682    80.257     0.003     8.355    -0.016     1.483     0.016 ?

Mean        83 02 49   263 02 48    84 06 45   275 53 05      80.681    80.256               8.357
Max Dev      0 00 00     0 00 00     0 00 00     0 00 00       0.001     0.001     0.003     0.002    -0.016 ?             0.016 ?
Combined    83 02 48                84 06 50
Dev         -0 00 01      VA Col    89 59 55


Set-up : 3       Set on     J1       E  488680.8350  N  204309.4250  L  192.2530
                 Backsight J2        E  488760.4987  N  204319.1412  L  200.6240
                 Set-up HA = 83 02 49, IH = 1.566, VA Col = 90 00 00, SF = 1.00000000

Control obs to J2
               HA F1       HA F2       VA F1       VA F2          SD        HD   HD diff        LD   LD diff        TH   3D diff
            83 02 49                84 06 44                  80.682    80.256     0.002     8.359    -0.012     1.483     0.012 ?
                       263 02 47               275 53 06      80.682    80.257     0.003     8.355    -0.016     1.483     0.016 ?

Mean        83 02 49   263 02 47    84 06 44   275 53 06      80.682    80.257               8.357
Max Dev      0 00 00     0 00 00     0 00 00     0 00 00       0.000     0.000     0.003     0.002    -0.016 ?             0.016 ?
Combined    83 02 48                84 06 49
Dev         -0 00 01      VA Col    89 59 55


Set-up : 4       Set on     J1       E  488680.8350  N  204309.4250  L  192.2530
                 Backsight J2        E  488760.4987  N  204319.1412  L  200.6240
                 Set-up HA = 83 02 49, IH = 1.566, VA Col = 90 00 00, SF = 1.00000000
```

McCarthy Taylor Systems Ltd. MET GEO ENVIRONMENTAL LTD Page : 002
LSS v10.01.17 / 153.03 2020.12.01 11:07

C21022 - C21022

SURVEY CONTROL OBS. DIFFERENCES LIST - contd.

Control obs to J2

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	83 02 49		84 06 45		80.681	80.255	0.001	8.359	-0.012	1.483	0.012 ?
		263 02 47		275 53 05	80.682	80.257	0.003	8.355	-0.016	1.483	0.016 ?
Mean	83 02 49	263 02 47	84 06 45	275 53 05	80.681	80.256		8.357			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.001	0.003	0.002	-0.016 ?		0.016 ?
Combined	83 02 48		84 06 50								
Dev	-0 00 01	VA Col	89 59 55								

Set-up : 5 Set on J3 E 488673.8493 N 204401.1422 L 188.8605
Backsight J1 E 488680.8350 N 204309.4250 L 192.2530
Set-up HA = 175 38 37, IH = 1.338, VA Col = 90 00 00, SF = 1.00000000

Control obs to J1

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	175 38 37		87 44 21		92.057	91.985	0.002	3.407	0.014 ?	1.563	0.014 ?
		355 38 34		272 15 23	92.056	91.985	0.002	3.399	0.007	1.563	0.007
Mean	175 38 37	355 38 34	87 44 21	272 15 23	92.056	91.985		3.403			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.000	0.002	0.004	0.014 ?		0.014 ?
Combined	175 38 35		87 44 29								
Dev	-0 00 01	VA Col	89 59 52								

Set-up : 6 Set on J3 E 488673.8493 N 204401.1422 L 188.8605
Backsight J1 E 488680.8350 N 204309.4250 L 192.2530
Set-up HA = 175 38 37, IH = 1.338, VA Col = 90 00 00, SF = 1.00000000

Control obs to J1

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	175 38 37		87 44 21		92.056	91.984	0.001	3.407	0.014 ?	1.563	0.014 ?
		355 38 33		272 15 24	92.057	91.986	0.003	3.400	0.007	1.563	0.008
Mean	175 38 37	355 38 33	87 44 21	272 15 24	92.056	91.985		3.403			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.001	0.003	0.003	0.014 ?		0.014 ?
Combined	175 38 35		87 44 28								
Dev	0 00 02	VA Col	89 59 52								

Set-up : 7 Set on J3 E 488673.8493 N 204401.1422 L 188.8605
Backsight J1 E 488680.8350 N 204309.4250 L 192.2530
Set-up HA = 175 38 37, IH = 1.338, VA Col = 90 00 00, SF = 1.00000000

Control obs to J1

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	175 38 37		87 44 21		92.058	91.986	0.003	3.406	0.014 ?	1.563	0.014 ?
		355 38 33		272 15 24	92.057	91.986	0.003	3.400	0.007	1.563	0.008
Mean	175 38 37	355 38 33	87 44 21	272 15 24	92.058	91.986		3.403			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.000	0.003	0.003	0.014 ?		0.014 ?
Combined	175 38 35		87 44 29								
Dev	-0 00 02	VA Col	89 59 53								

McCarthy Taylor Systems Ltd. MET GEO ENVIRONMENTAL LTD Page : 003
LSS v10.01.17 / 153.03 2020.12.01 11:07

C21022 - C21022

SURVEY CONTROL OBS. DIFFERENCES LIST - contd.

Set-up : 8 Set on J3 E 488673.8493 N 204401.1422 L 188.8605
Backsight J1 E 488680.8350 N 204309.4250 L 192.2530
Set-up HA = 175 38 37, IH = 1.338, VA Col = 90 00 00, SF = 1.00000000

Control obs to J1

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	175 38 37		87 44 21		92.058	91.986	0.003	3.407	0.014 ?	1.563	0.015 ?
		355 38 33		272 15 24	92.057	91.986	0.003	3.400	0.007	1.563	0.008
Mean	175 38 37	355 38 33	87 44 21	272 15 24	92.058	91.986		3.403			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.000	0.003	0.004	0.014 ?		0.015 ?
Combined	175 38 35		87 44 29								
Dev	0 00 02	VA Col	89 59 52								

Set-up : 24 Set on J2 E 488760.4987 N 204319.1412 L 200.6240
Backsight J6 E 488765.1894 N 204340.1583 L 201.4123
Set-up HA = 12 37 46, IH = 1.480, VA Col = 90 00 00, SF = 1.00000000

Control obs to J1

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	263 05 42		95 52 18		80.677	80.254	0.000	-8.354	0.017 ?	1.581	0.017 ?
		83 05 35		264 07 32	80.677	80.253	-0.001	-8.358	0.013 ?	1.581	0.013 ?
	263 05 42		95 52 18		80.678	80.255	0.001	-8.354	0.017 ?	1.581	0.017 ?
		83 05 35		264 07 31	80.676	80.252	-0.002	-8.358	0.013 ?	1.581	0.013 ?
	263 05 43		95 52 18		80.677	80.254	0.000	-8.354	0.017 ?	1.581	0.017 ?
		83 05 35		264 07 32	80.676	80.252	-0.002	-8.358	0.013 ?	1.581	0.013 ?
Mean	263 05 42	83 05 35	95 52 18	264 07 32	80.677	80.253		-8.356			
Max Dev	0 00 01	0 00 00	0 00 00	0 00 00	0.001	0.001	-0.002	0.002	0.017 ?		0.017 ?
Combined	263 05 39		95 52 23								
Dev	0 00 05	VA Col	89 59 55								

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

PURPOSE

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

SCOPE

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd
2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

CALIBRATION PROCEDURE – TOTAL STATIONS

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60”) in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer’s recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

CALIBRATION PROCEDURE – LEVELS

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus

introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

CALIBRATION PROCEDURE – LASER SCANNERS

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

   a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
   b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

   Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

   1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
   2. Make sure that you have a good stable setup on a tripod
   3. Level the scanner using the electronic bubble as well as possible
   4. Turn the instrument 180deg

5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

5. Record the check on the JIF.

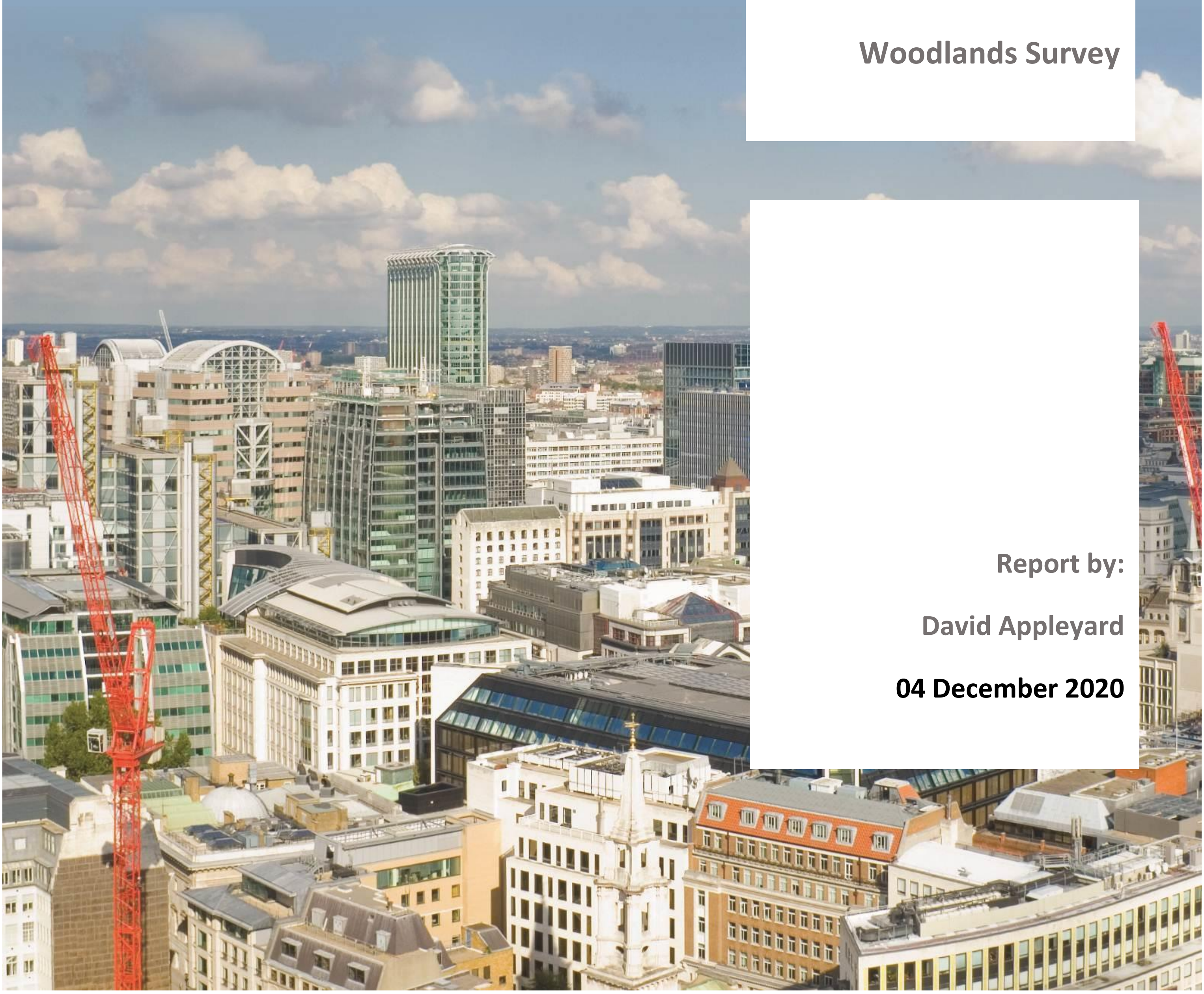
Network Archaeology Limited

P20-01356

Widmore Farm

Survey Report

Woodlands Survey



Report by:

David Appleyard

04 December 2020

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01356 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Final	04/12/2020	David Appleyard	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**David Appleyard (Training & Quality Manager)** *Tel* : [redacted] *Mob*: [redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

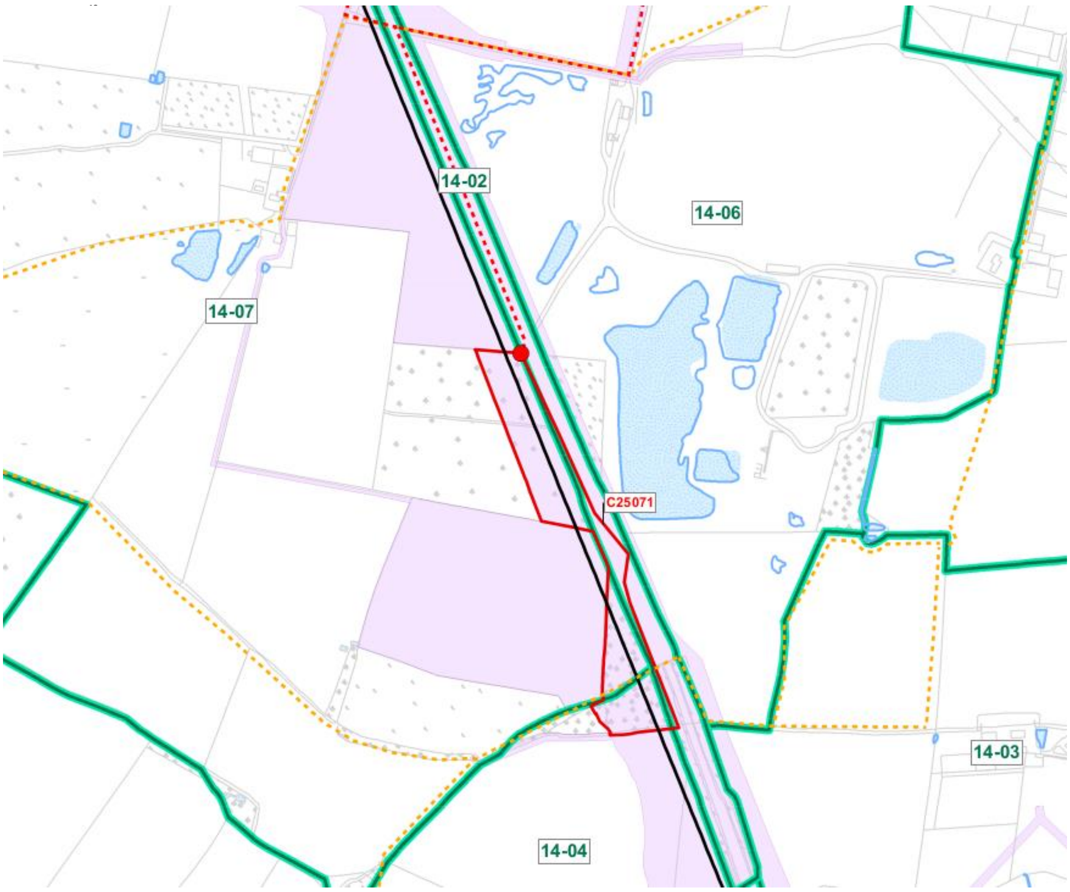
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Widmore Farm, Brackley MK18 4AJ (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network A



The deliverables provided were to be the topographical survey of the woodlands and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laserscanning survey were not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the Detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work, was carried out during day shifts from 19/11/2020 to 25/11/2020 and the subsequent deliverables were despatched to Network Archaeology Ltd on 01/12/2020.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Malcolm Bouleau-Pendlington (CSCS)	-	Topographical Surveyor.
Chris Carter (CSCS)	-	Topographical Surveyor.

6. Methodology - Control

A baseline of two stations W1 and W2 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for the satellite configuration to change.

Control was transferred into the woodland and the stations **W10** and **W11** were used as PGMs for the site. These PGMs were ground anchors with steel pins, located on the disused railway cutting on the eastern boundary of the site.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between W1 and W2 the two station that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control value of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

No difficulties were encountered during the survey.

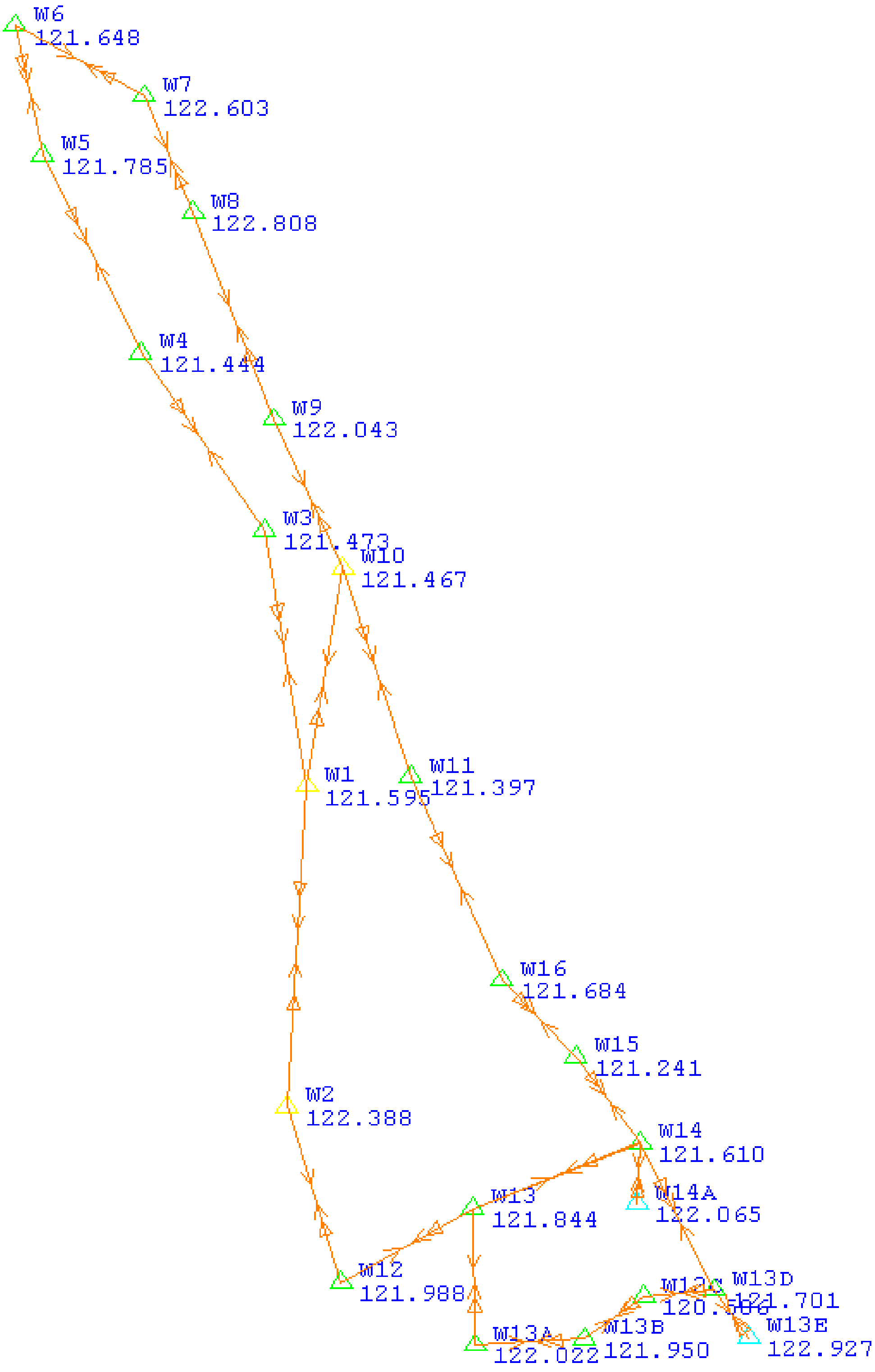
9. Quality Assurance Procedures

All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 5mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked.

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagrams



Appendix B: Traverse Report

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
W1	462570.839	232065.185	121.595	341 16 53		
					92.685	-0.121
W3	462556.037	232156.680	121.474	154 07 45		
					77.658	-0.029
W4	462511.426	232220.246	121.444	188 52 41		
					78.916	0.341
W5	462476.606	232291.065	121.786	193 59 57		
					47.374	-0.137
W6	462466.608	232337.372	121.649	310 47 32		
					52.759	0.955
W7	462512.926	232312.110	122.604	218 52 17		
					45.119	0.205
W8	462530.206	232270.431	122.809	181 06 23		
					79.554	-0.765
W9	462559.251	232196.369	122.044	176 27 32		
					58.545	-0.576
W10	462583.952	232143.290	121.468	214 28 58		
					79.196	0.129
W1	462570.843	232065.186	121.596			
Stored	462570.839	232065.185	121.595			
Misclosure	0.003	0.001	0.001	0 00 00		

After angular misclosure adjustment :-

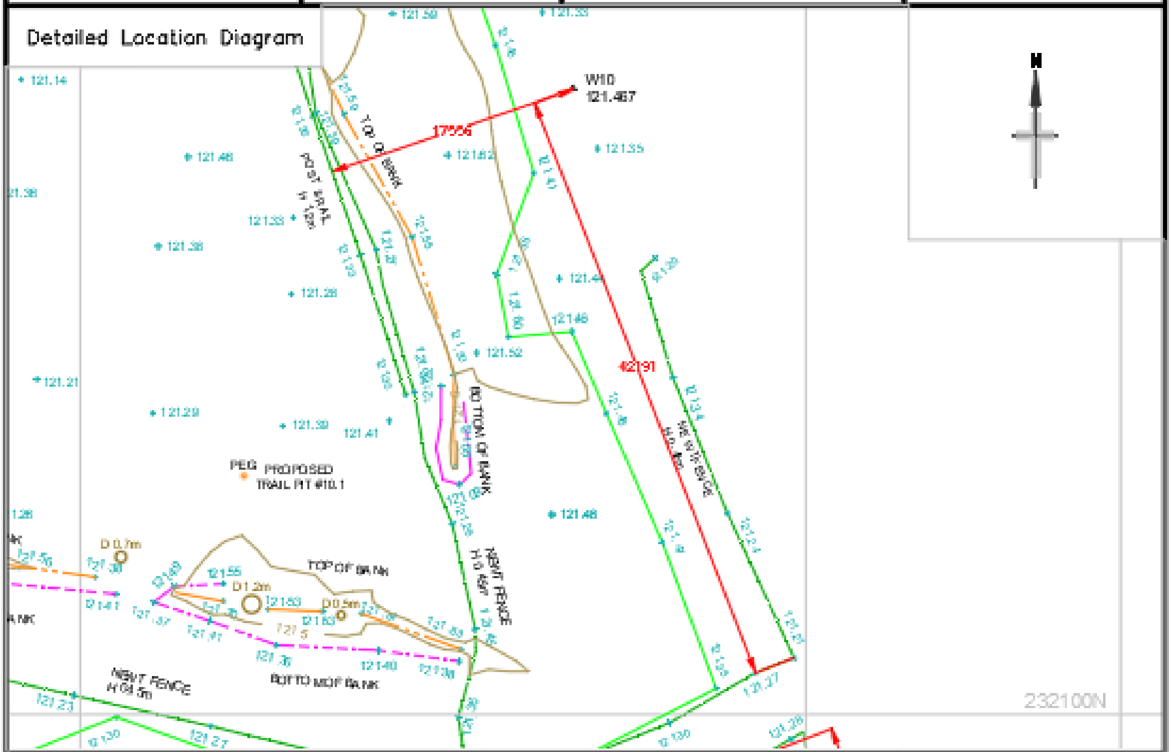
Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
W1	462570.839	232065.185	121.595	173 57 56		
					114.912	0.793
W2	462563.836	231950.486	122.388	159 28 10		
					65.937	-0.399
W12	462583.155	231887.443	121.989	77 37 51		
					54.133	-0.144
W13	462630.313	231914.021	121.845	188 05 20		
					64.511	-0.233
W14	462690.410	231937.473	121.612	74 19 50		
					38.411	-0.369
W15	462667.302	231968.154	121.243	173 11 58		
					38.054	0.443
W16	462640.969	231995.626	121.687	199 31 05		
					79.781	-0.286
W11	462608.178	232068.357	121.401	186 21 07		
					78.747	0.070
W10	462583.952	232143.285	121.470	27 26 42		
Stored	462583.949	232143.289	121.467	27 26 42		
Misclosure	0.003	-0.004	0.004	0 00 00		

Appendix C: Schedule of Survey Control Station.

Schedule of Permanent Survey Control Stations – Widmore Farm					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	W10	462583.939	232143.251	121.467	Ground Anchors
New Station	W11	462608.173	232068.325	121.397	Ground Anchors

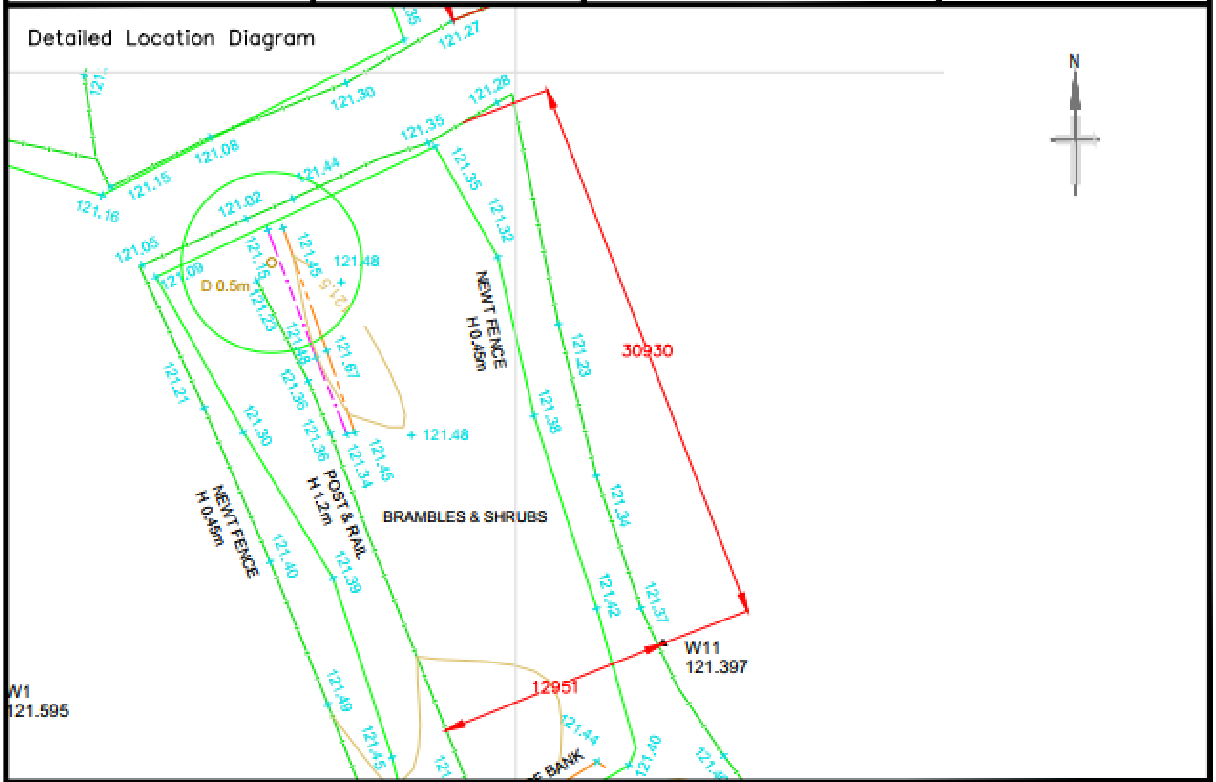
Appendix D – Witness Diagrams

PERMANENT GROUND MARKER RECORD SHEET			Page 1 of 2
Location: On old rail cutting, approx. 42m north of quarry access track			Job Ref: P20-01356
PGM No./Name W10			
Description of PGM: Ground Anchors (Yellow)			
Arbitrary/N.G.Coordinates	E 462583.939	N 232143.251	Level 121.467
Detailed Location Diagram			



Marker Established By CC	Date 23/11/2020
Record Prepared By CC	Date 30/11/2020>
Revisited By	Date
Remarks	

PERMANENT GROUND MARKER RECORD SHEET			Page 2 of 2
Location: On old rail cutting, approx. 42m south of quarry access track			Job Ref: P20-01356
PGM No./Name W11			
Description of PGM: Ground Anchors (Yellow)			
Arbitrary/N.G.Coordinates	E 462608.173	N 232068.325	Level 121.397
Detailed Location Diagram			
Marker Established By CC			Date 23/11/2020
Record Prepared By CC			Date 30/11/2020>
Revisited By			Date
Remarks			



Appendix E: Control Observation Report

```
McCarthy Taylor Systems Ltd.                    MET GEO ENVIRONMENTAL LTD                                   Page : 001
LSS v10.01.17 /  153.03                                                                              2020.12.01 10:28
                                                  C25071  -  C25071

                                           SURVEY CONTROL OBS. DIFFERENCES LIST

Control obs. tolerances - warnings : 0.010(?) and errors : 0.050(!).
Horizontal / Distance components may be ignored (x).

Reporting all control obs. differences above 0.010

Set-up : 69      Set on     W13D    E  462716.8569  N  231884.7156  L  121.7007
                 Backsight W13C    E  462691.8072  N  231882.4358  L  120.5861
                 Set-up HA = 264 47 49, IH = 1.192, VA Col = 90 00 00, SF = 1.00000000

Control obs to W14
               HA F1       HA F2       VA F1       VA F2          SD        HD   HD diff        LD   LD diff        TH   3D diff
           333 22 18               89 57 01                   58.983    58.983    -0.006    -0.090     0.001     1.333     0.006
                       153 21 39               270 02 54      58.985    58.985    -0.004    -0.091    -0.001     1.333     0.010
           333 21 36               89 57 00                   58.984    58.984    -0.005    -0.089     0.001     1.333     0.011 ?
                       153 21 35               270 02 50      58.984    58.984    -0.005    -0.092    -0.002     1.333     0.012 ?
           333 21 34               89 57 00                   58.985    58.985    -0.004    -0.089     0.001     1.333     0.011 ?
                       153 21 35               270 02 51      58.984    58.984    -0.005    -0.092    -0.001     1.333     0.012 ?

Mean       333 21 49   153 21 36   89 57 00    270 02 52      58.984    58.984              -0.091
Max Dev      0 00 29     0 00 03    0 00 01      0 00 02       0.001     0.001    -0.006     0.002    -0.002               0.012 ?
Combined   333 21 43               89 57 04
Dev          0 00 35      VA Col   89 59 56
```

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

PURPOSE

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

SCOPE

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd
2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

CALIBRATION PROCEDURE – TOTAL STATIONS

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60”) in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer’s recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

CALIBRATION PROCEDURE – LEVELS

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus

introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

Calibration Procedure – Laser Scanners

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

    a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
    b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

    Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

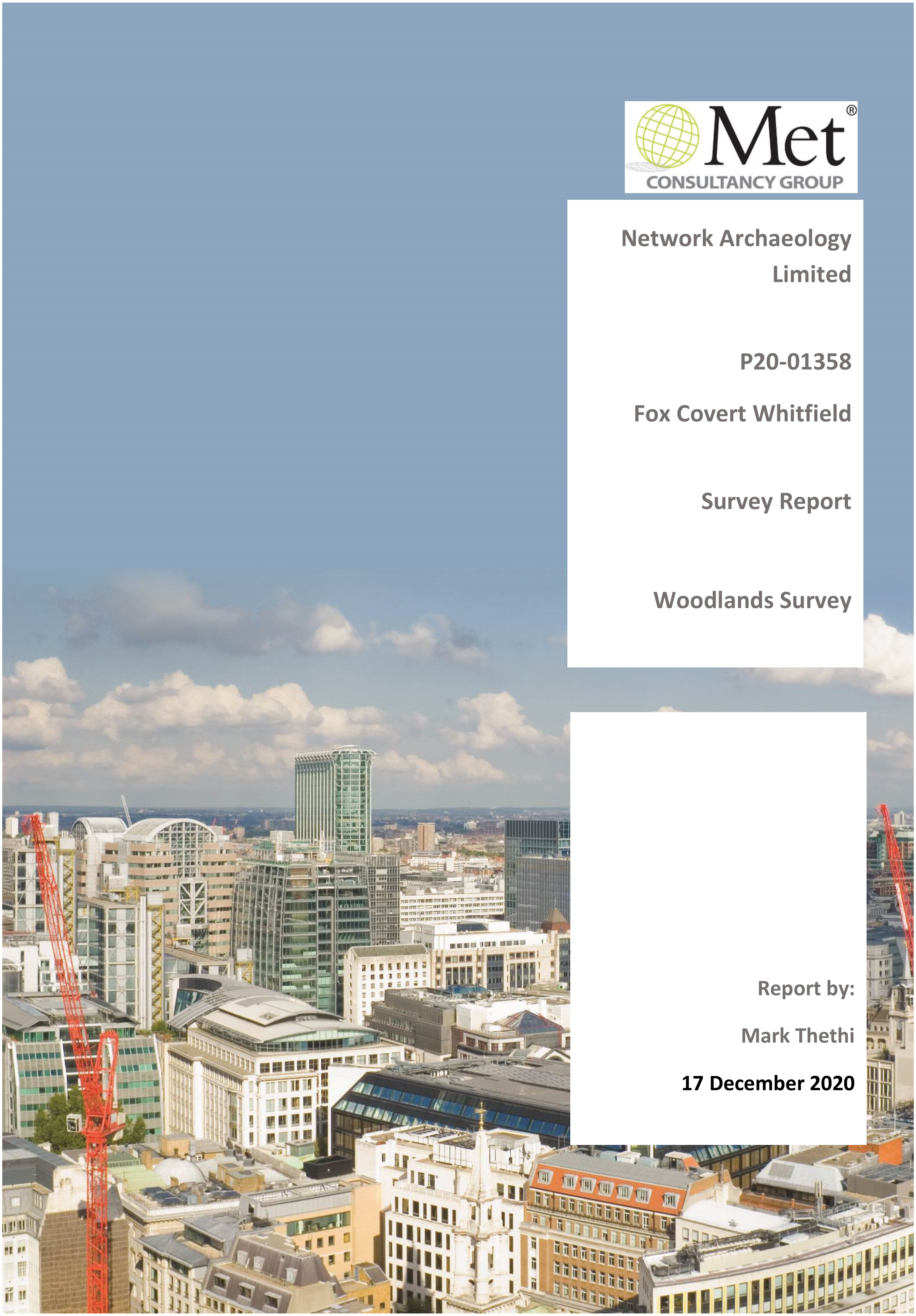
    1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
    2. Make sure that you have a good stable setup on a tripod
    3. Level the scanner using the electronic bubble as well as possible
    4. Turn the instrument 180deg

5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

Record the check on the JIF.



Network Archaeology Limited

P20-01358

Fox Covert Whitfield

Survey Report

Woodlands Survey

Report by:

Mark Thethi

17 December 2020

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01358 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Final	17/12/2020	Mark Thethi	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**Mark Thethi (Land and Building Surveyor)** *Tel* : [redacted] *Mob*: [redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

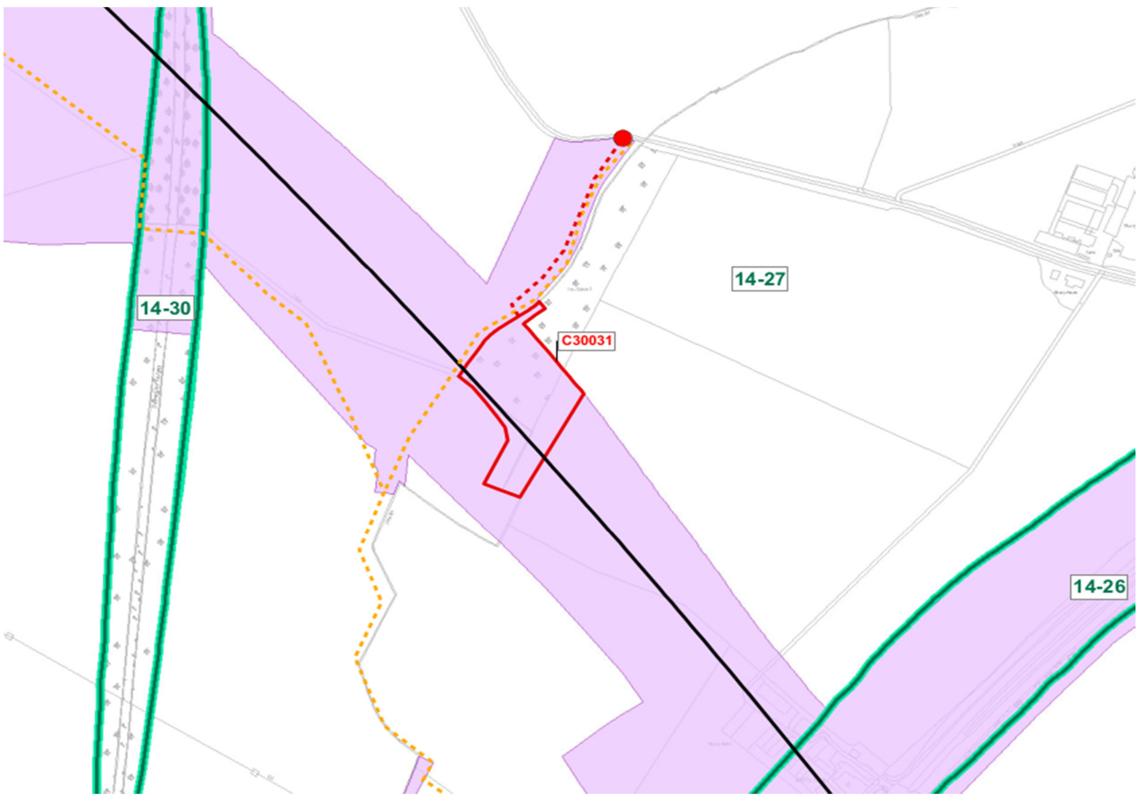
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Fox Covert Whitfield, Brackley NN13 5GJ (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network Archaeology Ltd.



The deliverables provided were to be the topographical survey of the woodland terrain and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laserscanning survey were not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work was carried out during day shifts from 30/11/2020 to 02/12/2020 and the subsequent deliverables were despatched to Network Archaeology Ltd on 14/12/2020.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Mark Thethi (CSCS)	-	Topographical Surveyor.
Mark Richardson (CSCS)	-	Topographical Surveyor.

6. Methodology – Control

A baseline of two stations S1 and S3 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for different satellite geometry.

Control was transferred into the woodland and the stations **S1** and **S3** were established as PGMs for the site. These PGMs were ground anchors with steel pins, located on the west and south side of the field outside the wood.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between S1 and S3 the two station that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control value of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

A small area to the east of the woodland was inaccessible at the time of survey due to a drilling contractor at work.

9. Quality Assurance Procedures

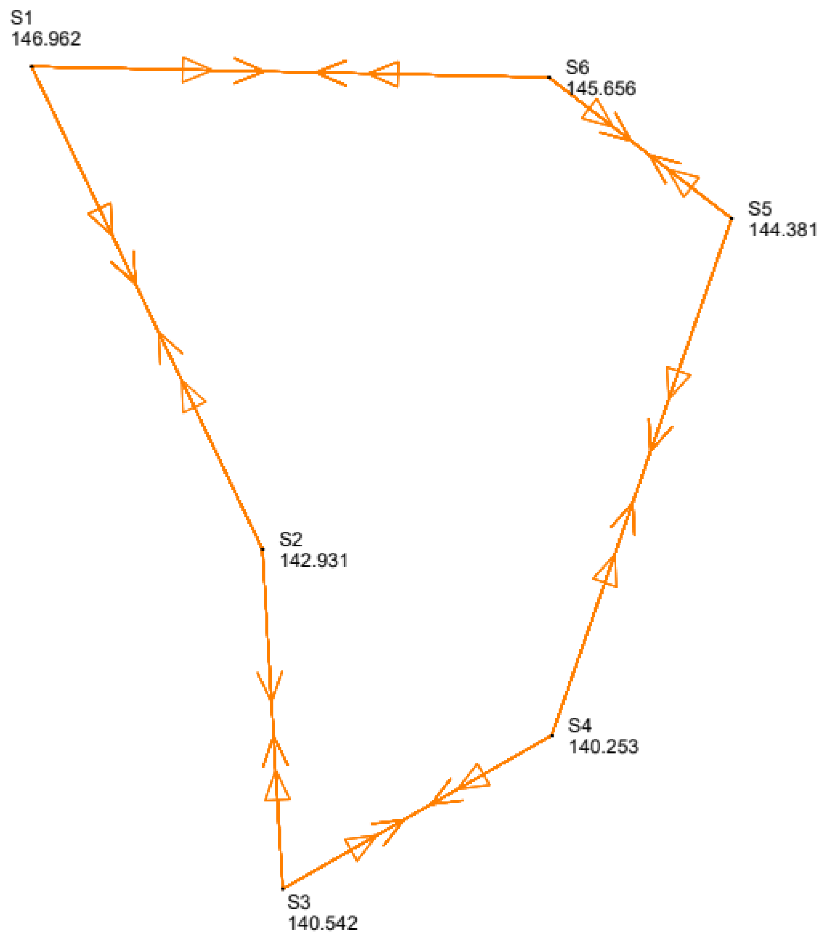
All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 10mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked.

Thorough checks were carried out by cross referencing the total station and laser scan data to ensure common detail points matched each other in both plan position and level; these checks showed the data to correspond within a tolerance of +/-10mm which was acceptable for the scope of works.

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagrams



Appendix B: Traverse Reports

LSS v10.01.17 / 153.12 2020.12.09 15:49

TRAVERSE ADJUSTMENT

The survey default scale factor of 1.000000 has been applied throughout the traverse.

Meaned Data:

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S2	1000.000	1000.000	100.000	202 09 39		
					68.312	-2.389
S3	974.232	936.735	97.611	63 45 55		
					62.211	-0.289
S4	1036.287	941.154	97.321	138 53 20		
					109.818	4.127
S5	1113.688	1019.057	101.448	108 25 14		
					46.329	1.275
S6	1092.826	1060.423	102.723	143 34 13		

					104.016	1.305
S1	999.987	1107.331	104.028	63 12 10		
					107.316	-4.031
S2	999.971	1000.015	99.997			
Stored	1000.000	1000.000	100.000			
----------	------------	------------	--------	----------		
Misclosure	-0.029	0.015	-0.003	0 00 32		

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S2	1000.000	1000.000	100.000	202 09 34		
					68.312	-2.389
S3	974.234	936.734	97.611	63 45 51		
					62.211	-0.289
S4	1036.288	941.156	97.321	138 53 16		

					109.818	4.127
S5	1113.685	1019.064	101.448	108 25 10		
					46.329	1.275
S6	1092.818	1060.428	102.723	143 34 08		
					104.016	1.305
S1	999.974	1107.326	104.028	63 12 06		
					107.316	-4.031
S2	999.972	1000.011	99.997			
Stored	1000.000	1000.000	100.000			
----------	------------	------------	--------	----------		
Misclosure	-0.028	0.011	-0.003	0 00 00		

Length of traverse 498.002

Accuracy, 1 in 16666

Bowditch adjusted Data :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S2	1000.000	1000.000	100.000	202 09 34		
					68.312	-2.389
S3	974.238	936.733	97.611	63 45 51		
					62.215	-0.289
S4	1036.295	941.154	97.322	138 53 16		
					109.820	4.128
S5	1113.698	1019.059	101.450	108 25 10		
					46.327	1.275
S6	1092.834	1060.422	102.725	143 34 08		
					104.010	1.306
S1	999.996	1107.318	104.031	63 12 06		
					107.318	-4.031
S2	1000.000	1000.000	100.000			

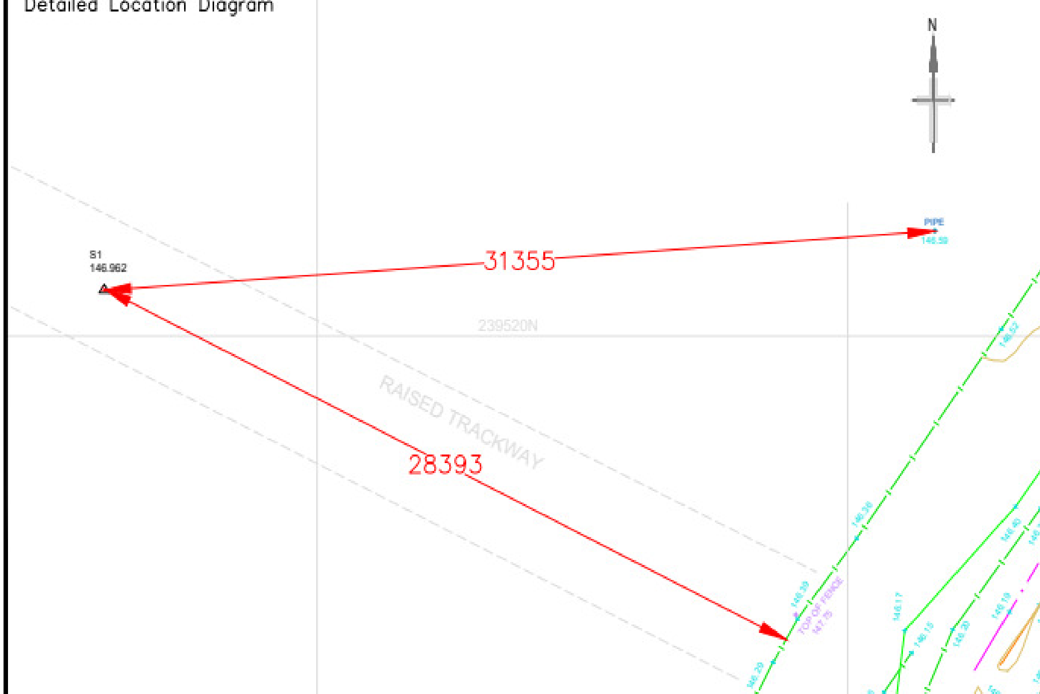
Appendix C: Schedule of Survey Control Station.

Schedule of Survey Control Stations					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	S1	459311.990	239521.598	146.962	Ground Anchors
New Station	S3	459362.464	239356.628	140.542	Ground Anchors

Appendix D: PGM Witness Diagrams

PERMANENT GROUND MARKER RECORD SHEET			Page 1 of 2
Location: Middle of raised trackway to west of woodland.			Job Ref: P20–01358
PGM No./Name S1			
Description of PGM: Ground Anchor (Yellow)			
Arbitrary/N.G.Coordinates	E 459311.990	N 239521.598	Level 146.962

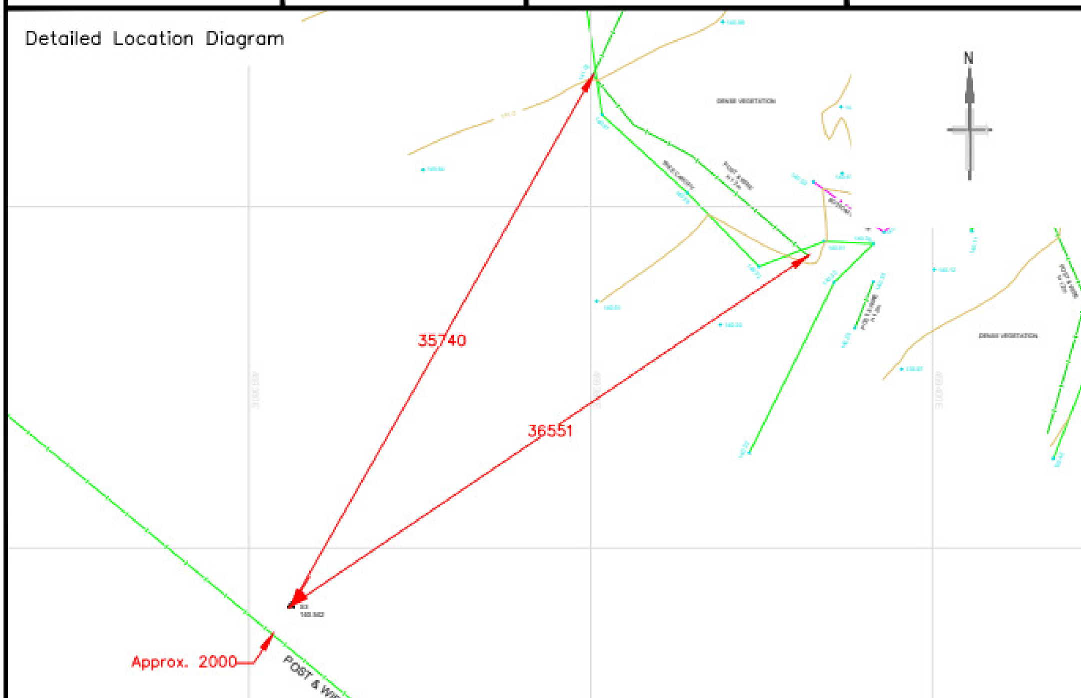
Detailed Location Diagram



Marker Established By MT	Date 30/11/2020
Record Prepared By MT	Date 11/12/2020
Revisited By	Date
Remarks	

PERMANENT GROUND MARKER RECORD SHEET			Page 2 of 2
Location: Near Post & Wire fence to south of woodland.			Job Ref: P20-01358
PGM No./Name S3			
Description of PGM: Ground Anchor (Yellow)			
Arbitrary/N.G.Coordinates	E 459362.464	N 239356.628	Level 140.542

Detailed Location Diagram



Marker Established By MT	Date 30/11/2020
Record Prepared By MT	Date 11/12/2020
Revisited By	Date
Remarks	

Appendix E: Control Observation Report

SURVEY CONTROL OBS. DIFFERENCES LIST

Control obs. tolerances - warnings : 0.010(?) and errors : 0.150(!).

Horizontal / Distance components may be ignored (x).

Reporting all control obs. differences above 0.010

Set-up : 5 Set on S1 E 459311.9903 N 239521.5981 L 146.9616

Backsight S2 E 459358.3620 N 239424.8158 L 142.9310

Set-up HA = 180 00 00, IH = 1.424, VA Col = 90 00 00, SF = 1.00000000

Control obs to S6

HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
116 47 49		90 49 36		104.026	104.015	0.005	-1.306	0.000	1.229	0.011 ?
	296 47 59		269 10 38	104.027	104.016	0.006	-1.299	0.007	1.229	0.010 ?
116 47 51		90 49 29		104.026	104.015	0.005	-1.302	0.003	1.229	0.011 ?
	296 48 02		269 10 42	104.027	104.016	0.006	-1.297	0.009	1.229	0.011 ?

Mean 116 47 50 296 48 01 90 49 32 269 10 40 104.026 104.016 -1.301

Max Dev -0 00 01 -0 00 01 0 00 04 -0 00 02 0.001 0.001 0.006 0.005 0.009 0.011 ?

Combined 116 47 55 90 49 26

Dev 0 00 07 VA Col 90 00 06

Set-up : 6 Set on S6 E 459415.9775 N 239519.4174 L 145.6560

Backsight S1 E 459311.9903 N 239521.5981 L 146.9616

Set-up HA = 296 47 50, IH = 1.230, VA Col = 90 00 00, SF = 1.00000000

Control obs to S1

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

296 47 50 89 10 17 104.028 104.017 0.007 1.312 0.006
1.423 0.009

116 47 56 270 49 53 104.028 104.017 0.007 1.316 0.011 ?
1.423 0.013 ?

Mean 296 47 50 116 47 56 89 10 17 270 49 53 104.028 104.017 1.314

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 0.007 0.002 0.011
? 0.013 ?

Combined 296 47 53 89 10 12

Dev 0 00 03 VA Col 90 00 05

Set-up : 7 Set on S6 E 459415.9775 N 239519.4174 L 145.6560

Backsight S1 E 459311.9903 N 239521.5981 L 146.9616

Set-up HA = 296 47 50, IH = 1.230, VA Col = 90 00 00, SF = 1.00000000

Control obs to S1

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

296 47 50 89 10 20 104.028 104.017 0.007 1.310 0.004
1.423 0.008

116 47 56 270 49 46 104.028 104.017 0.007 1.313 0.007
1.423 0.011 ?

Mean 296 47 50 116 47 56 89 10 20 270 49 46 104.028 104.017 1.311

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 0.007 0.002 0.007
0.011 ?

Combined 296 47 53 89 10 17

Dev 0 00 03 VA Col 90 00 03

Set-up : 8 Set on S6 E 459415.9775 N 239519.4174 L 145.6560

Backsight S1 E 459311.9903 N 239521.5981 L 146.9616

Set-up HA = 296 47 50, IH = 1.230, VA Col = 90 00 00, SF = 1.00000000

Control obs to S1

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

296 47 50 89 10 16 104.028 104.017 0.007 1.312 0.007
1.423 0.010

116 48 00 270 49 48 104.028 104.017 0.007 1.314 0.008
1.423 0.012 ?

Mean 296 47 50 116 48 00 89 10 16 270 49 48 104.028 104.017 1.313

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 0.007 0.001 0.008
0.012 ?

Combined 296 47 55 89 10 14

Dev 0 00 05 VA Col 90 00 02

Set-up : 20 Set on S3 E 459362.4640 N 239356.6276 L 140.5421

Backsight S2 E 459358.3620 N 239424.8158 L 142.9310

Set-up HA = 356 33 30, IH = 1.444, VA Col = 90 00 00, SF = 1.00000000

Control obs to S4

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

60 18 49 90 23 41 62.212 62.211 -0.004 -0.296 -0.007 1.311
0.017 ?

240 19 01 269 36 11 62.212 62.211 -0.004 -0.298 -0.009
1.311 0.015 ?

60 18 49 90 23 40 62.213 62.212 -0.003 -0.295 -0.007
1.311 0.017 ?

240 19 01 269 36 11 62.212 62.211 -0.004 -0.298 -0.009
1.311 0.015 ?

Mean 60 18 49 240 19 01 90 23 41 269 36 11 62.212 62.211 -0.297

Max Dev 0 00 00 0 00 00 0 00 00 -0 00 00 0.001 0.001 -0.004 0.001 -
0.009 0.017 ?

Combined 60 18 55 90 23 45

Dev 0 00 06 VA Col 89 59 56

Set-up : 23 Set on S4 E 459416.5200 N 239387.4275 L 140.2532

Backsight S3 E 459362.4640 N 239356.6276 L 140.5421

Set-up HA = 240 18 50, IH = 1.304, VA Col = 90 00 00, SF = 1.00000000

Control obs to S5

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

19 12 50 87 49 56 109.897 109.818 -0.002 4.127 -0.001
1.334 0.020 ?

199 12 59 272 10 07 109.895 109.816 -0.004 4.129 0.001
1.334 0.025 ?

19 12 48 87 49 55 109.897 109.818 -0.002 4.127 0.000
1.334 0.019 ?

199 12 58 272 10 08 109.895 109.816 -0.004 4.129 0.001
1.334 0.025 ?

Mean 19 12 49 199 12 59 87 49 56 272 10 08 109.896 109.817 4.128

Max Dev 0 00 01 0 00 00 0 00 00 -0 00 00 0.001 0.001 -0.004 0.001 0.001
0.025 ?

Combined 19 12 54 87 49 54

Dev -0 00 06 VA Col 90 00 02

Set-up : 31 Set on S1 E 459311.9903 N 239521.5981 L 146.9616

Backsight S6 E 459415.9775 N 239519.4174 L 145.6560

Set-up HA = 91 11 47, IH = 1.424, VA Col = 90 00 00, SF = 1.00000000

Control obs to S6

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH 3D diff

91 11 47 90 48 39 104.018 104.008 -0.002 -1.317 -0.011 1.269 0.012 ?

271 11 54 269 11 41 104.019 104.009 -0.001 -1.307 -0.002 1.269 0.004

Mean 91 11 47 271 11 54 90 48 39 269 11 41 104.019 104.008 -1.312

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.001 -0.002 0.005 -0.011 ? 0.012 ?

Combined 91 11 51 90 48 29

Dev -0 00 04 VA Col 90 00 10

Set-up : 32 Set on S1 E 459311.9903 N 239521.5981 L 146.9616

Backsight S6 E 459415.9775 N 239519.4174 L 145.6560

Set-up HA = 91 11 47, IH = 1.424, VA Col = 90 00 00, SF = 1.00000000

Control obs to S2

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH 3D diff

154 23 06 92 09 03 107.384 107.308 -0.010 -4.030 0.000
1.424 0.020 ?

334 23 17 267 50 55 107.384 107.308 -0.010 -4.031 -0.001
1.424 0.015 ?

154 23 05 92 09 03 107.384 107.308 -0.010 -4.030 0.000
1.424 0.020 ?

334 23 18 267 50 55 107.384 107.308 -0.010 -4.031 0.000
1.424 0.015 ?

Mean 154 23 06 334 23 17 92 09 03 267 50 55 107.384 107.308 -4.031

Max Dev 0 00 01 -0 00 00 0 00 00 -0 00 00 0.000 0.000 -0.010 0.001 -
0.001 0.020 ?

Combined 154 23 12 92 09 04

Dev -0 00 07 VA Col 89 59 59

Control obs to S6

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

91 11 47 90 48 39 104.018 104.008 -0.002 -1.317 -0.011
1.269 0.011 ?

271 11 56 269 11 37 104.018 104.008 -0.002 -1.309 -0.003
1.269 0.006

Mean 91 11 47 271 11 56 90 48 39 269 11 37 104.018 104.008 -1.313

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.002 0.004 -
0.011 ? 0.011 ?

Combined 91 11 51 90 48 31

Dev -0 00 04 VA Col 90 00 08

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

PURPOSE

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

SCOPE

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd
2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

Calibration Procedure – Total Stations

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60") in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer's recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

Calibration Procedure – Levels

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus

introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

CALIBRATION PROCEDURE – LASER SCANNERS

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

   a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
   b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

   Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

   1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
   2. Make sure that you have a good stable setup on a tripod
   3. Level the scanner using the electronic bubble as well as possible
   4. Turn the instrument 180deg

5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

5. Record the check on the JIF.

Network Archaeology Limited

P20-01349

Halse Copse

Survey Report

Woodlands Survey

Report by:

David Appleyard

02 December 2020

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01349 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Final	02/12/2020	Chris Carter	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**David Appleyard (Training and Quality Manager)** *Tel* : [redacted] *Mob*: [redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

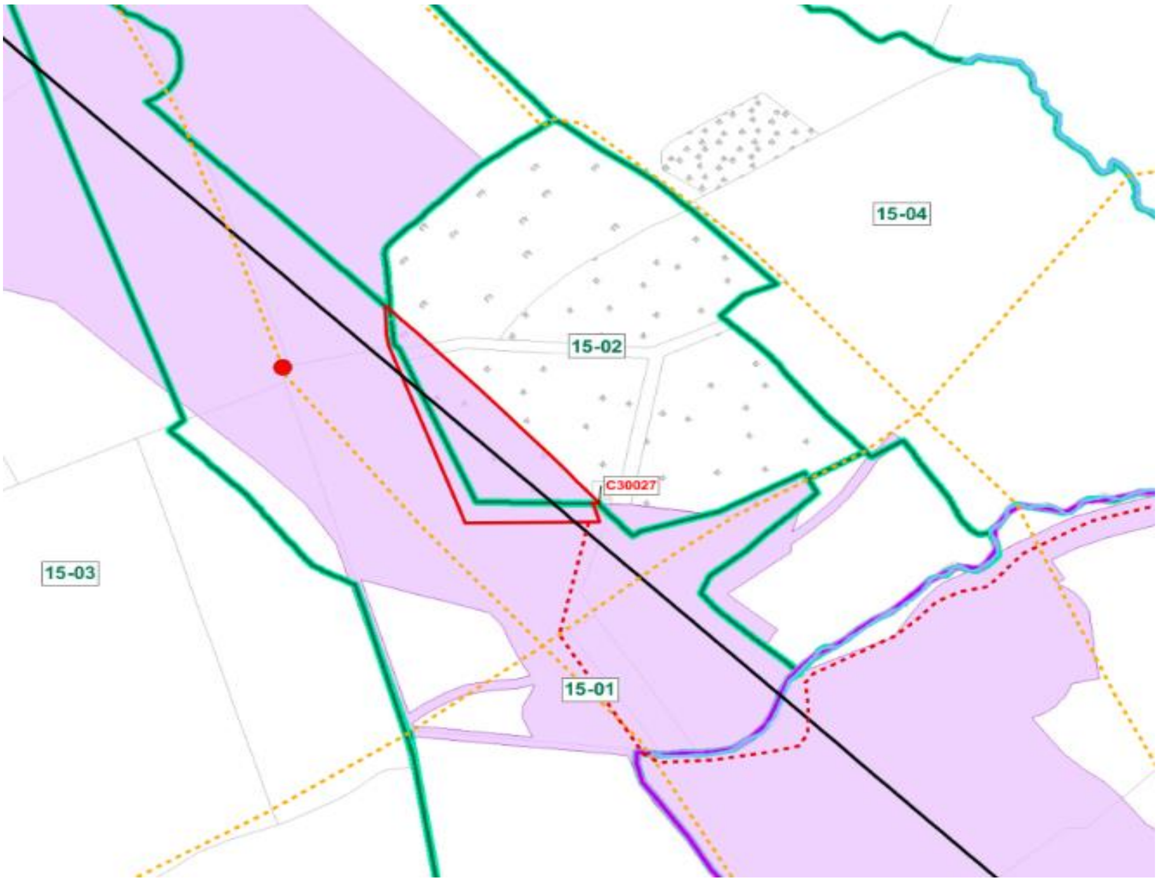
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Halse Copse, Brackley NN13 6DZ (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network Archaeology Ltd.



The deliverables provided were to be the topographical survey of the woodland terrain and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laserscanning survey were not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work, was carried out during day shifts from 16/11/2020 to 18/11/2020 and the subsequent deliverables were despatched to Network Archaeology Ltd on 24/11/2020.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Malcolm Bouleau-Pendlington (CSCS)	-	Topographical Surveyor.
Chris Carter (CSCS)	-	Topographical Surveyor.

6. Methodology - Control

A baseline of two stations H1 and H2 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for different satellite geometry.

Control was transferred into the woodland and the stations **H3** and **H4** were established as PGMs for the site. These PGMs were ground anchors with steel pins, located on the north side of the track inside the wood.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between H1 and H2 the two station that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to a achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control value of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

No difficulties were encountered during the survey.

9. Quality Assurance Procedures

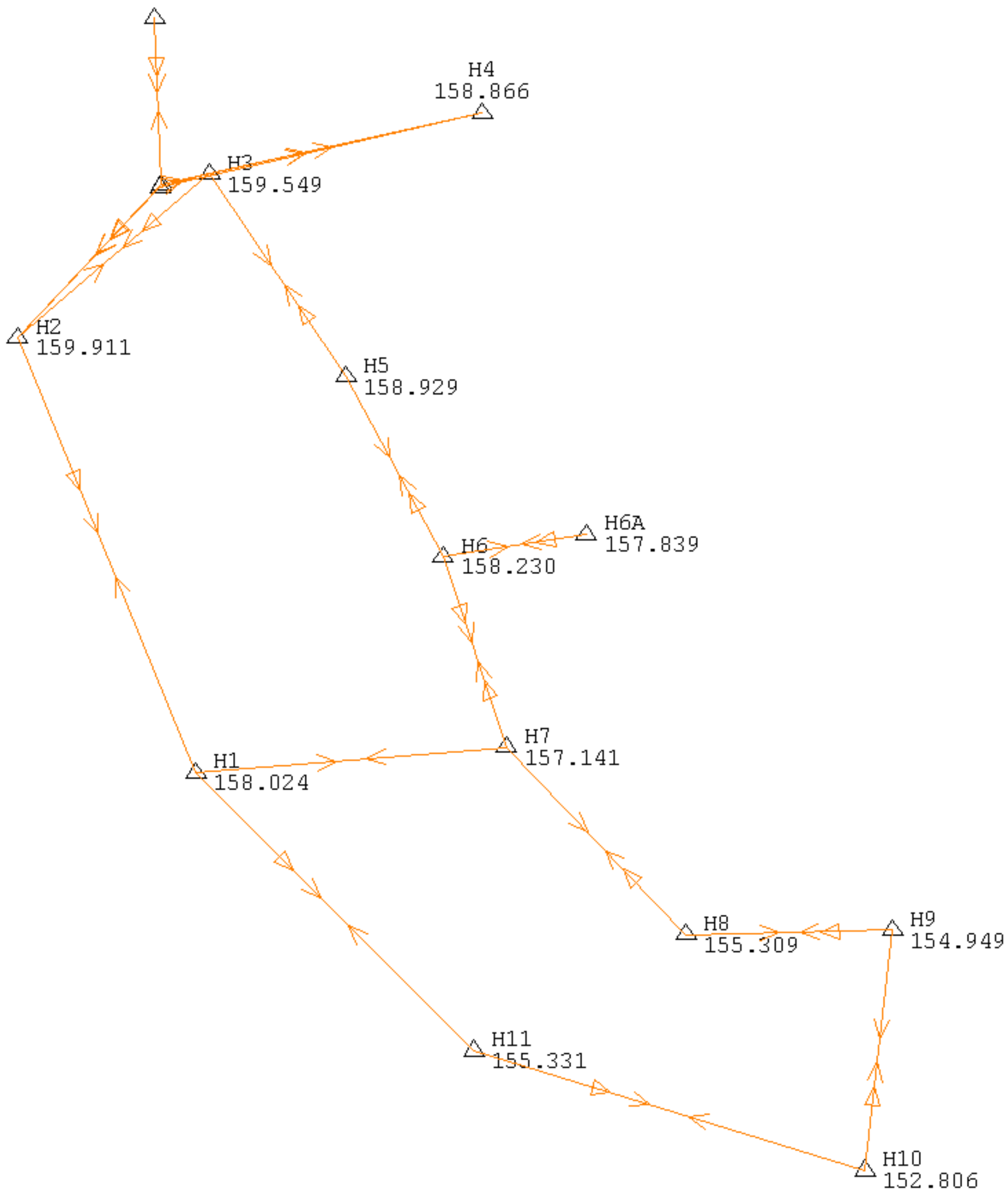
All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 10mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked.

Thorough checks were carried out by cross referencing the total station and laser scan data to ensure common detail points matched each other in both plan position and level; these checks showed the data to correspond within a tolerance of +/-10mm which was acceptable for the scope of works.

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagrams



Appendix B: Traverse Reports

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
H2	1000.000	1000.000	100.000	251 49 16		
					48.882	-0.354
H3	1037.182	1031.733	99.646	276 25 06		
					47.362	-0.619
H5	1063.708	992.496	99.028	185 45 50		
					39.647	-0.698
H6	1082.502	957.587	98.329	189 53 19		
					38.985	-1.089
H7	1094.813	920.598	97.240	154 36 09		
					50.284	-1.831
H8	1129.621	884.308	95.409	132 33 55		
					40.040	-0.360
H9	1169.651	885.175	95.049	277 49 08		
					46.864	-2.144
H10	1164.283	838.620	92.906	280 25 50		
					79.328	2.526
H11	1088.425	861.824	95.431	208 00 52		
					76.200	2.691
H1	1034.565	915.727	98.122	202 40 37		
					91.097	1.883
H2	999.997	1000.011	100.005			
Stored	1000.000	1000.000	100.000			
Misclosure	-0.003	0.011	0.005	0 00 00		

Length of traverse 558.688
Accuracy, 1 in 50461

Appendix C: Schedule of Survey Control Station.

Schedule of Survey Control Stations - SPC3-35 Newtons					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	H3	457313.811	241585.164	159.549	Ground Anchors
New Station	H4	457366.658	241596.882	158.866	Ground Anchors

Appendix D: PGM Witness Diagrams

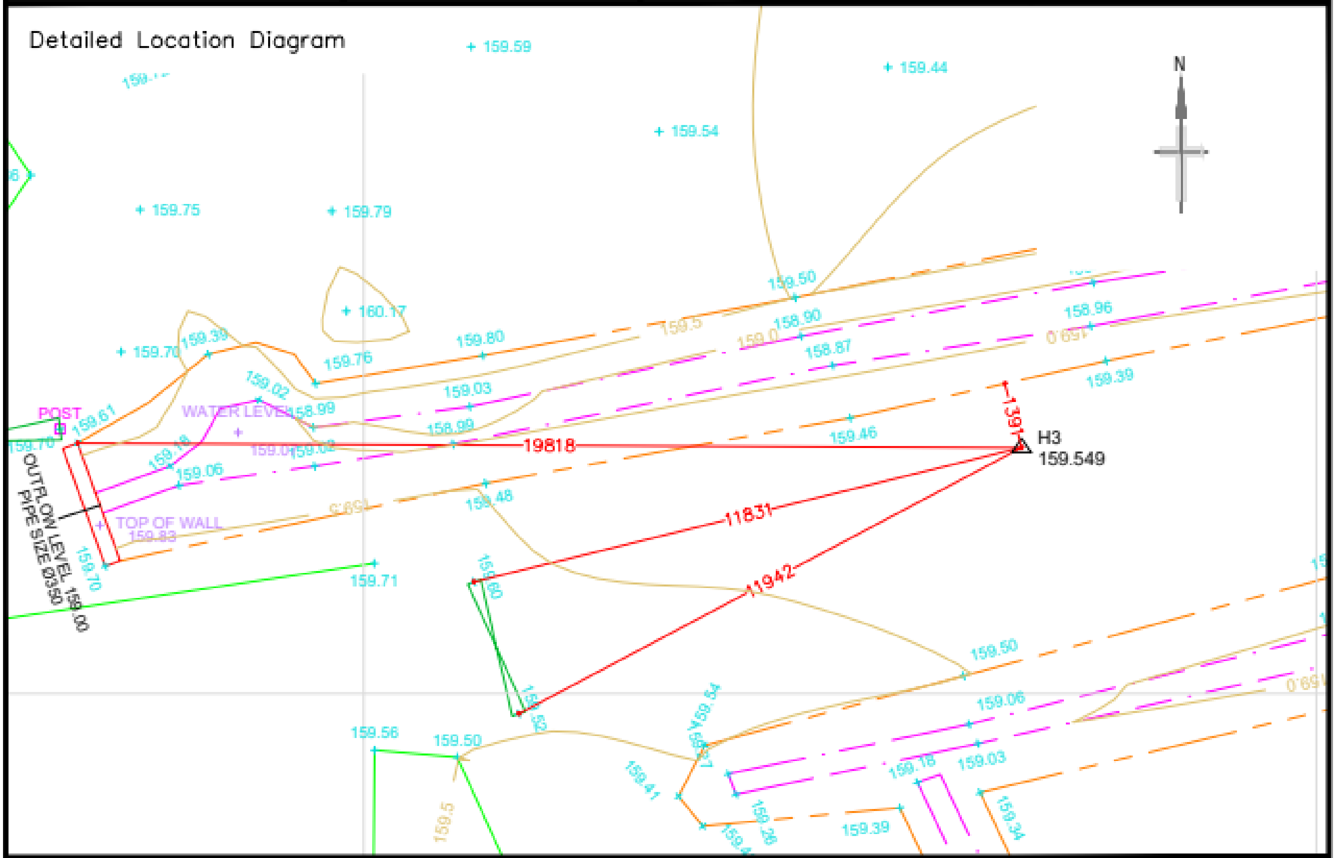
PERMANENT GROUND MARKER RECORD SHEET	Page 1 of 2
Location: On the North side of track when entering the forest.	Job Ref: P20-01349

PGM No./Name H3

Description of PGM: Ground Anchors (Yellow)

Arbitrary/N.G.Coordinates	E 457313.811	N 241585.164	Level 159.549

Detailed Location Diagram



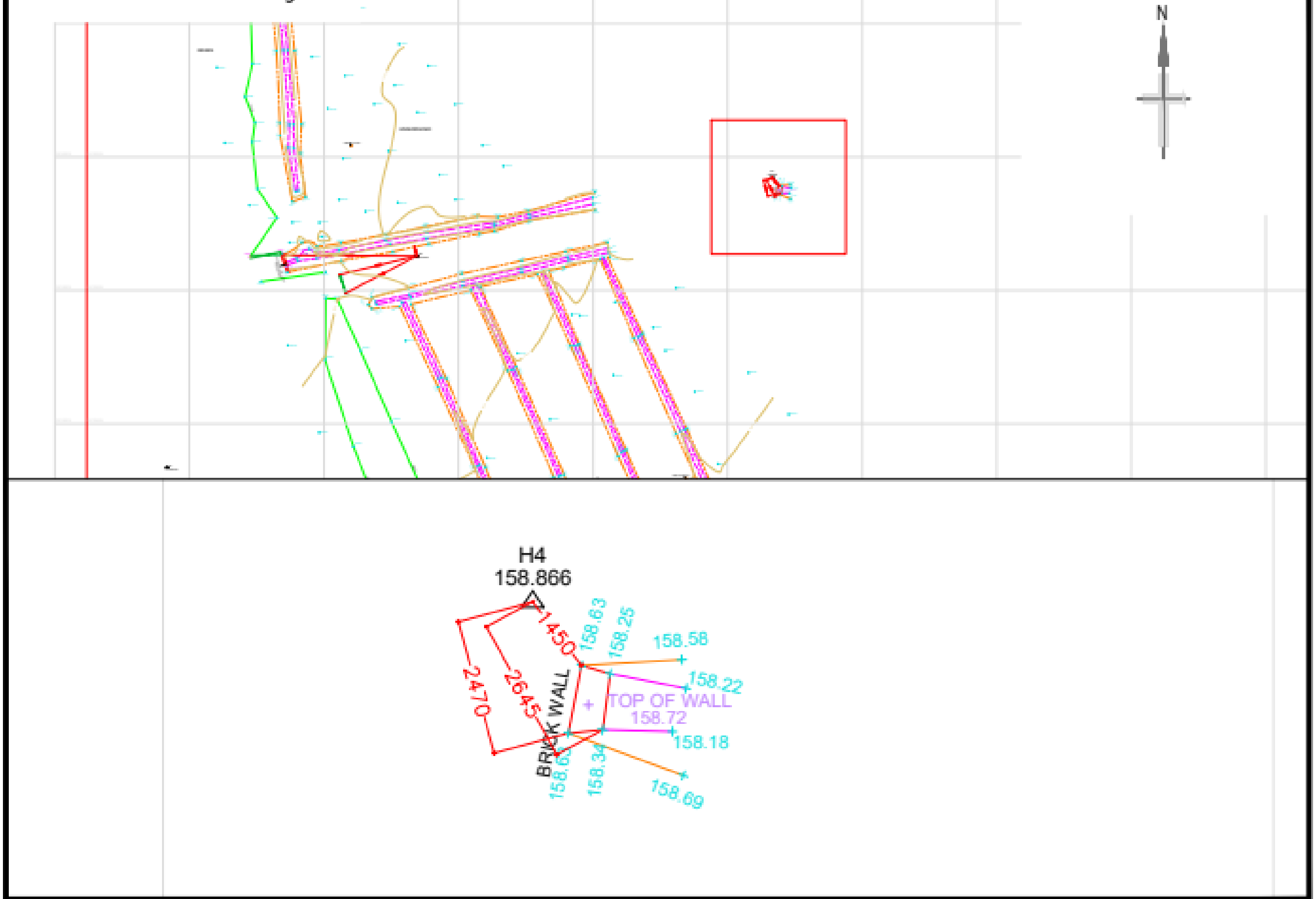
Marker Established By MBP	Date 16/11/2020
Record Prepared By MBP	Date 23/11/2020
Revisited By	Date

Remarks

PERMANENT GROUND MARKER RECORD SHEET

Location: In front of the brick wall located on the North side of the track.	Job Ref: P20–01349
PGM No./Name H4	
Description of PGM: Ground Anchors (Yellow)	
Arbitrary/N.G.Coordinates E 457366.658 N 241596.882	Level 158.866

Detailed Location Diagram



Marker Established By MBP	Date 16/11/2020
Record Prepared By MBP	Date 23/11/2020
Revisited By	Date
Remarks	

Appendix E: Control Observation Report

McCarthy Taylor Systems Ltd. | MET GEO ENVIRONMENTAL LTD | Page : 001
LSS v10.01.17 / 153.02 | | 2020.12.01 08:11

C30027 - COPY - halse

SURVEY CONTROL OBS. DIFFERENCES LIST

Control obs. tolerances - warnings : 0.010(?) and errors : 0.060(!).
Horizontal / Distance components may be ignored (x).

Reporting all control obs. differences above 0.010

Set-up : 4 Set on H2 E 457276.6279 N 241553.4330 L 159.9110
Backsight H1 E 457311.1955 N 241469.1517 L 158.0240
Set-up HA = 157 41 58, IH = 1.326, VA Col = 90 00 00, SF = 1.00000000

Control obs to H3

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	49 31 19		90 15 35		48.883	48.882	0.000	-0.353	0.010	1.457	0.010
		229 31 12		269 44 21	48.883	48.882	0.000	-0.354	0.009	1.457	0.009
	49 31 18		90 15 34		48.883	48.882	0.000	-0.352	0.010 ?	1.457	0.010 ?
		229 31 12		269 44 20	48.883	48.882	0.000	-0.354	0.009	1.457	0.009
	49 31 18		90 15 34		48.884	48.883	0.001	-0.352	0.010 ?	1.457	0.010 ?
		229 31 12		269 44 22	48.883	48.882	0.000	-0.353	0.009	1.457	0.009
Mean	49 31 18	229 31 12	90 15 34	269 44 21	48.883	48.883		-0.353			
Max Dev	-0 00 00	-0 00 00	0 00 01	0 00 01	0.001	0.001	0.001	0.001	0.010 ?		0.010 ?
Combined	49 31 15		90 15 37								
Dev	0 00 04	VA Col	89 59 58								

Set-up : 45 Set on R1 E 457304.5483 N 241583.1044 L 161.0826
Backsight H2 E 457276.6279 N 241553.4330 L 159.9110
Set-up HA = 223 15 30, IH = 0.000, VA Col = 90 00 00, SF = 1.00000000

Control obs to H2

	HA F1	HA F2	VA F1	VA F2	SD	HD	HD diff	LD	LD diff	TH	3D diff
	223 15 30		89 49 07		40.744	40.744	0.001	-1.179	-0.007	1.308	0.008
		43 15 20		270 10 40	40.743	40.743	0.000	-1.182	-0.010	1.308	0.010 ?
Mean	223 15 30	43 15 20	89 49 07	270 10 40	40.743	40.743		-1.180			
Max Dev	0 00 00	0 00 00	0 00 00	0 00 00	0.001	0.000	0.001	0.001	-0.010 ?		0.010 ?
Combined	223 15 25		89 49 14								
Dev	0 00 05	VA Col	89 59 54								

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

PURPOSE

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

SCOPE

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd
2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

CALIBRATION PROCEDURE – TOTAL STATIONS

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60") in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer's recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

CALIBRATION PROCEDURE – LEVELS

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus

introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

Calibration Procedure – Laser Scanners

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

    a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
    b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

    Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

    1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
    2. Make sure that you have a good stable setup on a tripod
    3. Level the scanner using the electronic bubble as well as possible
    4. Turn the instrument 180deg

5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

5. Record the check on the JIF.

Network Archaeology Limited

P20-01359

Fox Covert

Glynn Davies Wood

Survey Report

Woodlands Survey

Report by:

Caleigh Clark

30 March 2021

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01358 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Prelim	11/12/2020	Mark Thethi	Dave Booker-Smith	
1	Completed Survey	26/03/2021	Caleigh Clark	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**Caleigh Clark (Land Surveyor)** *Tel* : [redacted] *Mob:* [redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

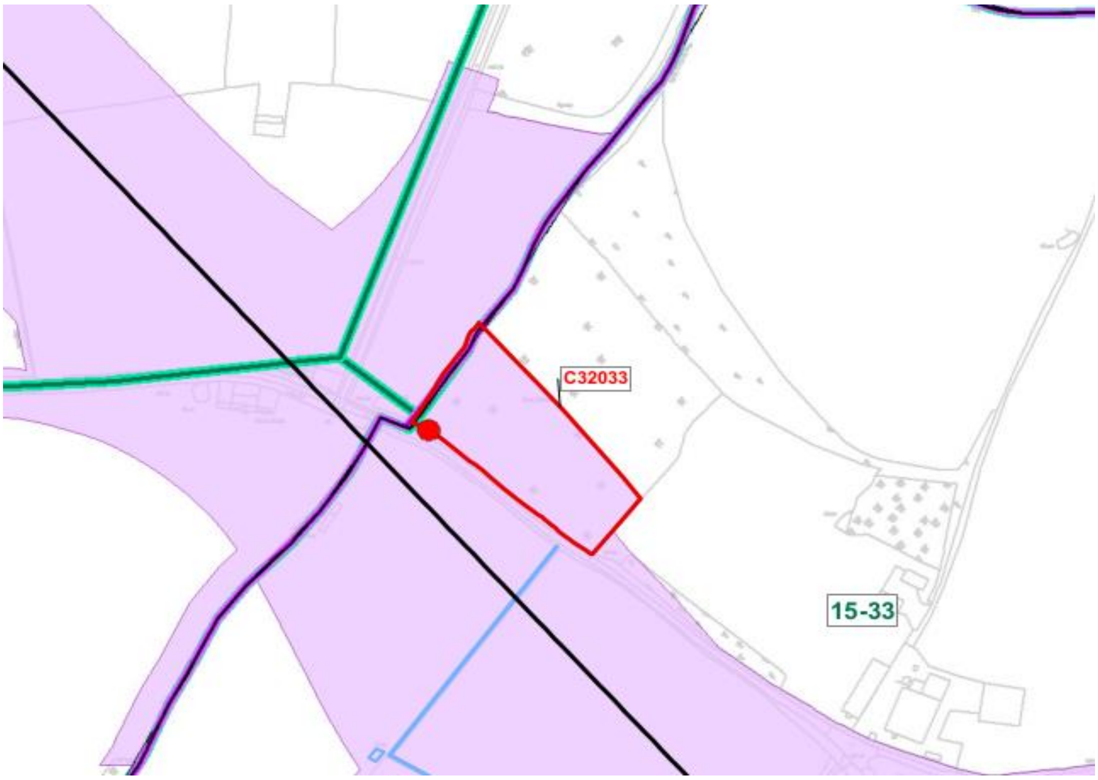
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Fox Covert Glynn Davies Wood Boddington, Daventry NN11 6HF (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network Archaeology Ltd.



The deliverables provided were to be the topographical survey of the woodland terrain and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laser scanning survey was not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work was carried out during day shifts from 08/12/2020 to 09/12/2020 and 24/03/2021 to 25/03/2021 and the subsequent deliverables were despatched to Network Archaeology Ltd on 30/03/2021.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 1No Leica NA720 Automatic Level
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Mark Thethi (CSCS)	-	Topographical Surveyor.
Malcolm Beaulieu-Pendlington (CSCS)	-	Topographical Surveyor.
Caleigh Clark (CSCS)	-	Topographical Surveyor
Chris Carter (CSCS)	-	Topographical Surveyor

6. Methodology – Control

A baseline of two stations S1 and S2 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for different satellite geometry.

Control was transferred/ into the woodland and the stations **S1** and **S2** were established as PGMs for the site. These PGMs were ground anchors with steel pins, located in the field to the west of the wood.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between S1 and S2 the two station that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control value of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

Work was halted on 09/11/2020. Work resumed on 24/03/2021.

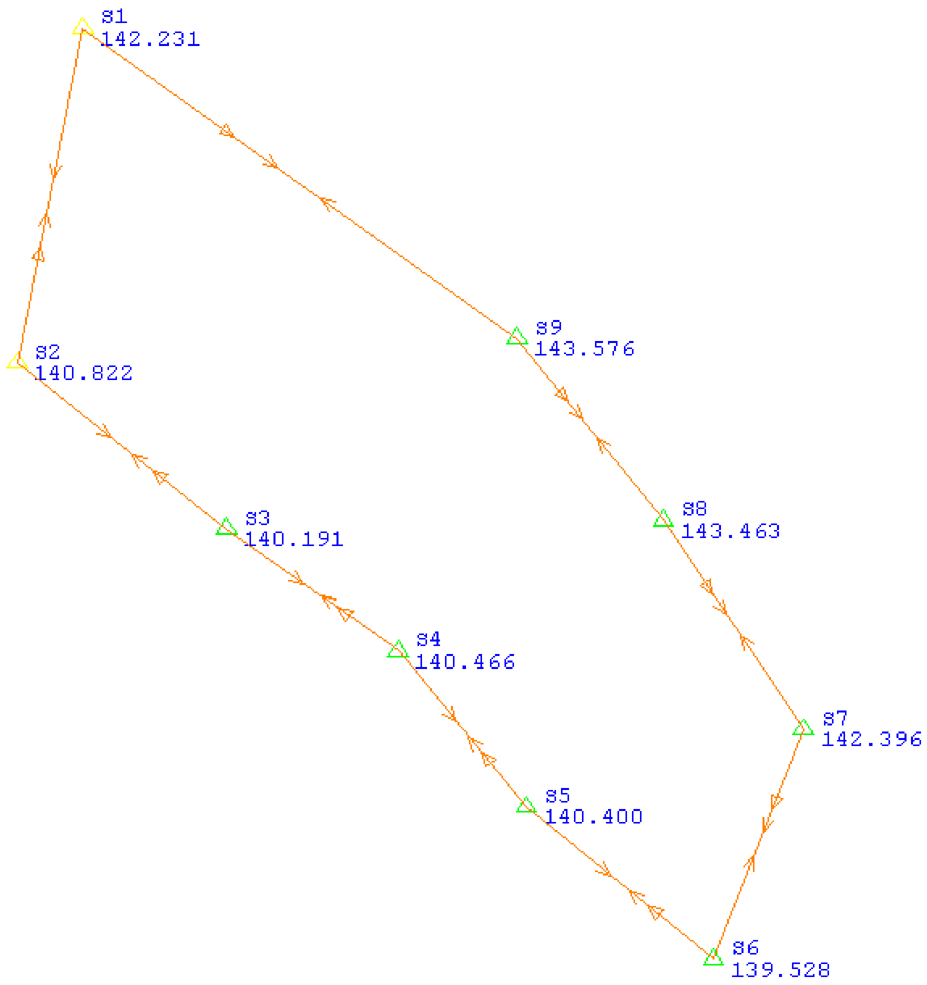
9. Quality Assurance Procedures

All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 10mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked.

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagrams



Appendix B: Traverse Reports

TRAVERSE ADJUSTMENT. The survey default scale factor of 1.000000 has been applied throughout the traverse.

Meaned Data :-

Station	Easting	Northing	Level	Angle	Distance	Level Diff
	(m)	(m)	(m)	(dms)	(m)	(m)
S2	925.779	1056.012	100.348	117 15 09	51.935	-0.631
S3	966.521	1023.805	99.717	177 06 26	41.078	0.275
S4	999.990	999.989	99.992	195 10 25	39.363	-0.066
S5	1024.971	969.568	99.926	168 27 49	47.015	-0.872
S6	1061.471	939.935	99.055	72 17 22	48.069	2.868
S7	1078.980	984.702	101.923	124 48 57	49.068	1.066
S8	1051.667	1025.466	102.989	175 00 56	45.477	0.114
S9	1023.166	1060.904	103.103	164 19 16	103.959	-1.345
S1	938.546	1121.293	101.758	65 33 35	66.526	-1.408
S2	925.769	1056.006	100.349			

Stored 925.779 1056.012 100.348

---------- ------------ ------------ -------- ----------

Misclosure -0.010 -0.007 0.001 -0 00 05

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S2	925.779	1056.012	100.348	117 15 10	51.935	-0.631
S3	966.521	1023.805	99.717	177 06 27	41.078	0.275
S4	999.990	999.989	99.992	195 10 26	39.363	-0.066
S5	1024.971	969.568	99.926	168 27 49	47.015	-0.872
S6	1061.471	939.934	99.055	72 17 22	48.069	2.868
S7	1078.980	984.701	101.923	124 48 57	49.068	1.066
S8	1051.667	1025.465	102.989	175 00 57	45.477	0.114
S9	1023.167	1060.904	103.103	164 19 17	103.959	-1.345

S1	938.548	1121.295	101.758	65 33 36	66.526	-1.408
S2	925.769	1056.008	100.349			
Stored	925.779	1056.012	100.348			
----------	------------	------------	--------	----------		
Misclosure	-0.010	-0.005	0.001	0 00 00		

Length of traverse 492.490

Accuracy, 1 in 45926

McCarthy Taylor Systems Ltd. MET GEO ENVIRONMENTAL LTD Page : 002

LSS v10.01.17 / 153.03 2021.03.25 09:38

2ND VISIT - 2ND VISIT

TRAVERSE ADJUSTMENT – contd.

Bowditch adjusted Data :-

Station	Easting	Northing	Level	Angle	Distance	Level Diff
	(m)	(m)	(m)	(dms)	(m)	(m)
S2	925.779	1056.012	100.348	117 15 10	51.935	-0.631
S3	966.522	1023.805	99.717	177 06 27	41.078	0.275
S4	999.992	999.990	99.992	195 10 26	39.363	-0.066
S5	1024.973	969.569	99.926	168 27 49	47.015	-0.872
S6	1061.474	939.936	99.054	72 17 22	48.070	2.868
S7	1078.984	984.703	101.922	124 48 57	49.068	1.066
S8	1051.673	1025.468	102.989	175 00 57	45.477	0.114
S9	1023.173	1060.907	103.102	164 19 17	103.958	-1.345
S1	938.557	1121.299	101.757	65 33 36	66.525	-1.409
S2	925.779	1056.012	100.348			

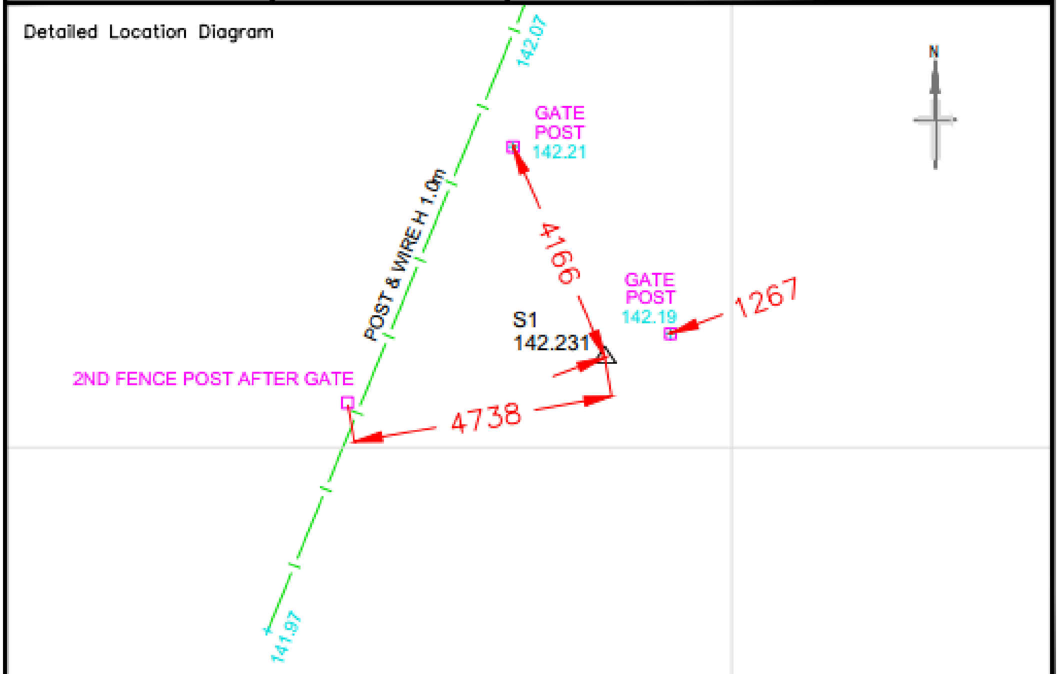
Appendix C: Schedule of Survey Control Station.

Schedule of Survey Control Stations					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	S1	446137.702	253661.636	142.231	Ground Anchors
New Station	S2	446124.918	253596.350	140.822	Ground Anchors

Appendix D: PGM Witness Diagrams

PERMANENT GROUND MARKER RECORD SHEET			Page 1 of 2
Location: Off gateway in post & wire fence in field to north-west of woodland.			Job Ref: P20-01359
PGM No./Name S1			
Description of PGM: Ground Anchor (White)			
Arbitrary/N.G.Coordinates	E 446137.702	N 253661.636	Level 142.231

Detailed Location Diagram



Marker Established By MT	Date 08/12/2020
Record Prepared By CAC	Date 26/03/2021
Revisited By	Date
Remarks	

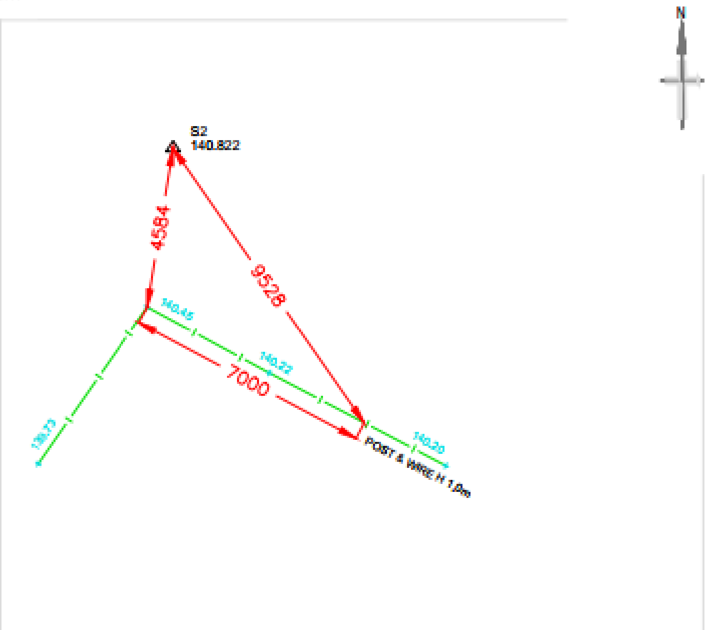
Met GEO ENVIRONMENTAL

Southgate House
Pontefract Road
Stourton
Leeds
West Yorkshire
LS10 1SW

T: +44 (0) 1132 008 900
F: +44 (0) 1132 008 901
E: admin@metgeoenvironmental.com
W: www.metgeoenvironmental.com

PERMANENT GROUND MARKER RECORD SHEET			Page 2 of 2
Location: Off corner of post & wire fence in field to south-west of woodland.			Job Ref: P20-01359
PGM No./Name S2			
Description of PGM: Ground Anchor (White)			
Arbitrary/N.G.Coordinates	E 446124.918	N 253596.350	Level 140.822

Detailed Location Diagram



Marker Established By MT	Date 08/12/2020
Record Prepared By CAC	Date 26/03/2021
Revisited By	Date
Remarks	

Met GEO ENVIRONMENTAL
Southgate House
Pontefract Road
Stourton
Leeds
West Yorkshire
LS10 1SW
T: +44 [0] 1132 008 900
F: +44 [0] 1132 008 901
E: admin@metgeoenvironmental.com
W: www.metgeoenvironmental.com

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

Purpose

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

Scope

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd

2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

CALIBRATION PROCEDURE – TOTAL STATIONS

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60”) in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer’s recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

CALIBRATION PROCEDURE – LEVELS

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

Calibration Procedure – Laser Scanners

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
2. Make sure that you have a good stable setup on a tripod
3. Level the scanner using the electronic bubble as well as possible

4. Turn the instrument 180deg
5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

5. Record the check on the JIF.

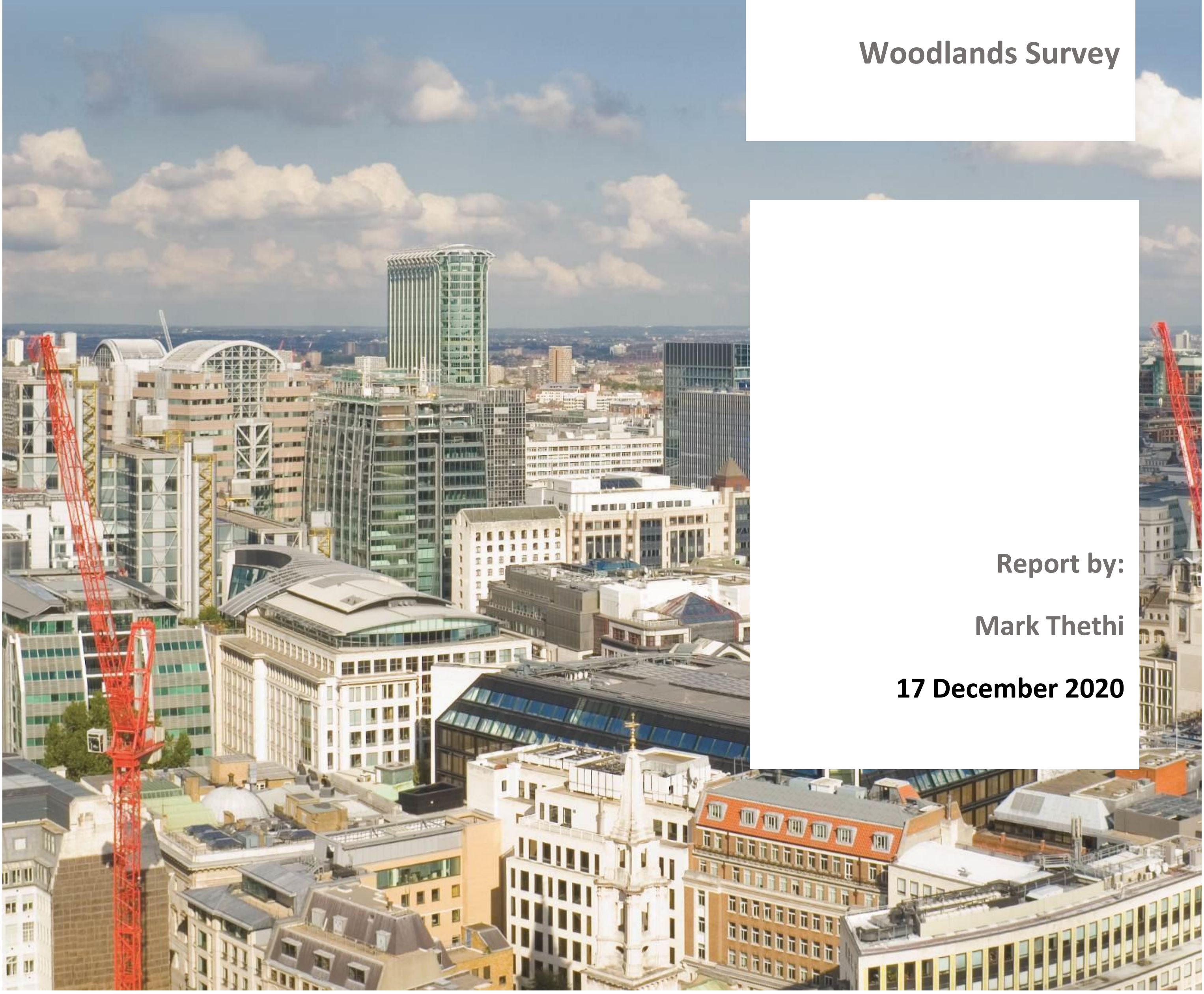
Network Archaeology Limited

P20-01360

Windmill Hill Spinney

Survey Report

Woodlands Survey



Report by:

Mark Thethi

17 December 2020

About Us

Part of Met Consultancy Group, Met Geo Environmental provides a range of solutions and survey consultancy services in the following key areas:

Geophysical, Environmental Investigations, Archaeological Assessments, Utility Mapping, Topographical, Measured Building, Laser Scanning, Monitoring, Railway, Inland Waterway and Asset Surveys.

Taking time to understand you, the client, your project requirements and problems, is a crucial part of the way we work. It allows us to provide you with a tailored, reasoned and sensible solution followed by the delivery of a service that is flexible, of excellent quality and designed to cope with specific circumstance.

CONTENTS

Revision Record

Report Ref: P20-01358 Topographical Survey					
Rev	**Description**	**Date**	**Originator**	**Checked**	**Approved**
0	Final	17/12/2020	Mark Thethi	Dave Booker-Smith	

Prepared For:	**Prepared By:**
Graham Cruse	**Mark Thethi (Land and Building Surveyor)** *Tel* : [redacted] *Mob*[redacted] [redacted]
Network Archaeology Ltd 15 Beaumont Fee Lincoln LN1 1UH	**Met Geo Environmental Ltd** Southgate House Pontefract Road Leeds West Yorkshire LS10 1SW

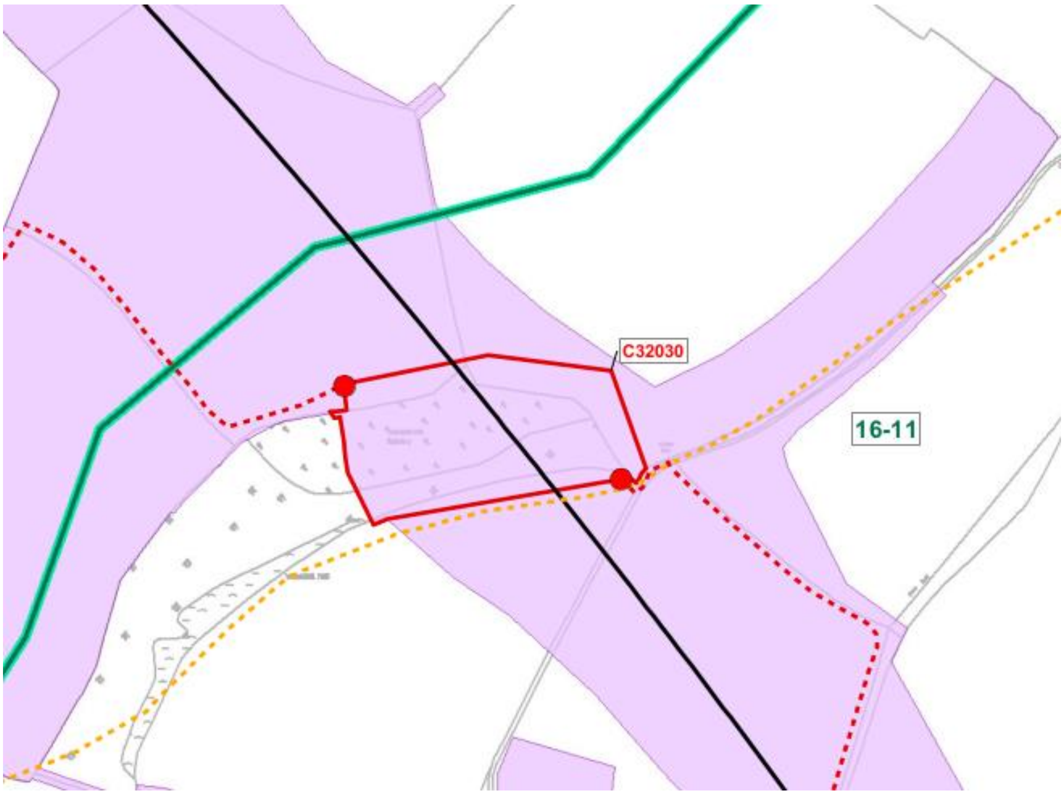
1. Introduction

This document represents a report for undertaking a topographical survey of the woodlands located at Windmill Hill Spinney Ladbroke, Southam CV47 2BW (being the nearest location to the site).

2. Scope

The scope of instructed works was as follows;

- Topographical survey of the red line area as per the plan provided by Network Archaeology Ltd.



The deliverables provided were to be the topographical survey of the woodland terrain and recording any potential earthworks. These were to be issued in AutoCAD 2018 and PDF format.

NB. A laserscanning survey were not a requirement of this survey as established on site after induction.

3. Statement of Compliance

The survey has been carried out in accordance with the detailed topographic survey summary specification, provided by the client, where possible.

4. Programme of Works

The site work was carried out during day shifts from 02/12/2020 to 08/12/2020 and the subsequent deliverables were despatched to Network Archaeology Ltd on 14/12/2020.

5. Equipment and Personnel

The following equipment was used to record data on site:

- 1No Trimble S5 Robotic Total station with Auto Target Recognition capability.
- Leica GPS Antenna Viva Gs14 and Controller CS20
- 2x Leica SNLL 121 laser plummets.
- 3x wooden tripods

The following survey software was used for either capture or processing of survey data:

- Trimble Access Field and Leica Captivate (capture).
- LSS (topographical data processing)
- AutoCAD 2020 (topographical draughting)

Staff members who carried out the site work were;

Mark Thethi (CSCS)	-	Topographical Surveyor.
Mark Richardson (CSCS)	-	Topographical Surveyor.
Malcolm Beaulieu-Pendlington (CSCS)	-	Topographical Surveyor.

6. Methodology – Control

A baseline of two stations S1 and S3 was used as the reference to Ordnance Survey National Grid as these were located outside the woodland. In line with the specification the GPS observations were carried out twice at different times of the day to allow for different satellite geometry.

Control was transferred into the woodland and the stations **S1** and **S3** were established as PGMs for the site. These PGMs were ground anchors with steel pins, located on the south-east and south-west of the woodland, respectively.

The total station was set up on those PGM stations in order to obtain their coordinates. Site measurements can be seen in the Control Observation Report - **Appendix E.**

A closed traverse was carried out through the wood to ensure the quality of the station positions by using multiple two face measurements and so eliminate the risk of angular error of the instrument. All EDM measurements were carried out using ATR (Auto Target Recognition). Each traverse was computed in LSS. All traverse reports can be seen in **Appendix B**.

Closed loop spirit levelling was used for this project between S1 and S3 the two station that were GPS. As a suitable alternative to achieve reliable, +/- 10mm accuracy for new control stations, trigonometrical, reciprocal (measurements in both directions) levelling was utilised, calculated in LSS software. A GHT196 / GHM007 Height Meter for accurate station height measuring was used at each instrument set up and target height to achieve an accurate reliable double check on station heights to eliminate gross errors.

Final control value of all permanent stations can be viewed in **Appendix C.**

7. Methodology – Topographical Survey

A series of total station set ups was used to measure all detail on the topographical survey. For accessible points, EDM measurements were used with a detail pole and 360 prism. For points that could not be reached due to height or other reasons, remote laser measurements were used to obtain 3d coordinates of the point.

8. Survey Difficulties encountered.

No difficulties were encountered during the survey.

9. Quality Assurance Procedures

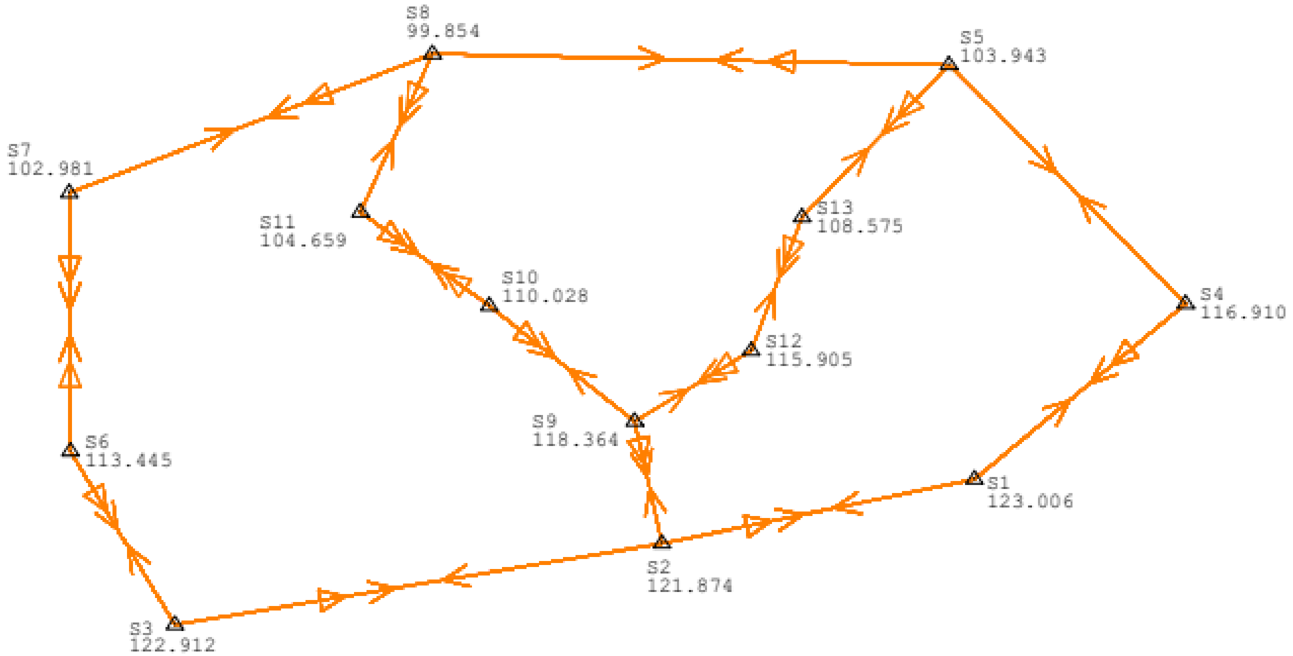
All total station set ups were verified on site before commencing with detail measurement. This requires a check against stored coordinates by using the measured slope distance with the calculated (set) bearing. If the residuals from this process exceed 10mm in E/N/L then the set up cannot commence. This same process is summarised in the Control Observation Report - **Appendix E** which lists all stations measurements compared against their stored coordinate values in the LSS software.

To check visually that no erroneous pole heights were entered on site, contours were set to 0.1m intervals and any anomalies to the expected pattern of contours is checked.

Thorough checks were carried out by cross referencing the total station and laser scan data to ensure common detail points matched each other in both plan position and level; these checks showed the data to correspond within a tolerance of +/-10mm which was acceptable for the scope of works.

All our surveys are scrutinised by a senior surveyor who follows the applicable procedures outlined in **3_QA_1.00_Quality Assurance Procedure.pdf** lists the checks that are carried out on this type of survey.

Appendix A: Horizontal Control Network Diagram



Appendix B: Traverse Reports

LSS v10.01.17 / 153.12 2020.12.03 17:48

TRAVERSE ADJUSTMENT

The survey default scale factor of 1.000000 has been applied throughout the traverse.

Meaned Data:

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S1	442628.931	259244.456	122.991	207 53 57		
					74.883	-1.132
S2	442555.546	259229.552	121.859	182 07 48		
					115.930	1.036
S3	442441.156	259210.717	122.895	247 58 30		
					47.138	-9.467
S6	442416.614	259250.962	113.428	211 06 50		
					59.923	-10.465
S7	442416.341	259310.884	102.964	249 32 49		

					91.195	-3.128
S8	442501.640	259343.141	99.836	201 55 51		
					121.302	4.087
S5	442622.915	259340.567	103.923	223 40 23		
					78.487	12.967
S4	442678.521	259285.176	116.890	275 43 28		
					64.151	6.095
S1	442628.939	259244.469	122.985			
Stored	442628.931	259244.456	122.991			
----------	------------	------------	--------	----------		
Misclosure	0.008	0.013	-0.006	-0 00 25		

After angular misclosure adjustment :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S1	442628.931	259244.456	122.991	207 54 00		

					74.883	-1.132
S2	442555.546	259229.553	121.859	182 07 51		
					115.930	1.036
S3	442441.156	259210.721	122.895	247 58 32		
					47.138	-9.467
S6	442416.615	259250.967	113.428	211 06 52		
					59.923	-10.465
S7	442416.345	259310.889	102.964	249 32 52		
					91.195	-3.128
S8	442501.646	259343.141	99.836	201 55 54		
					121.302	4.087
S5	442622.921	259340.557	103.923	223 40 26		
					78.487	12.967
S4	442678.521	259285.161	116.890	275 43 31		
					64.151	6.095
S1	442628.936	259244.459	122.985			

Stored	442628.931	259244.456	122.991	
----------	------------	------------	--------	----------
Misclosure	0.005	0.003	-0.006	0 00 00

Length of traverse 653.008

Accuracy, 1 in 114569

Bowditch adjusted Data :-

Station	Easting (m)	Northing (m)	Level (m)	Angle (dms)	Distance (m)	Level Diff (m)
S1	442628.931	259244.456	122.991	207 54 00		
					74.884	-1.132
S2	442555.545	259229.553	121.859	182 07 51		
					115.931	1.037
S3	442441.154	259210.720	122.897	247 58 32		
					47.138	-9.466

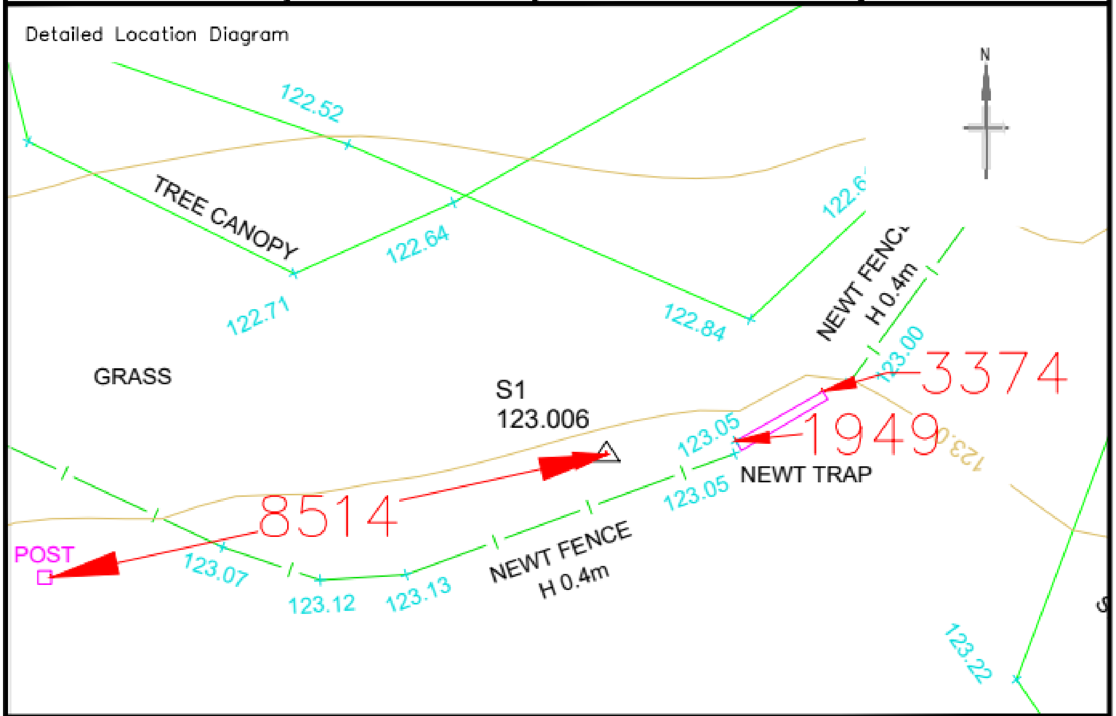
S6	442416.614	259250.966	113.430	211 06 52		
					59.923	-10.464
S7	442416.343	259310.888	102.966	249 32 52		
					91.194	-3.127
S8	442501.643	259343.139	99.839	201 55 54		
					121.301	4.088
S5	442622.917	259340.554	103.928	223 40 26		
					78.486	12.967
S4	442678.517	259285.158	116.895	275 43 31		
					64.152	6.096
S1	442628.931	259244.456	122.991			

Appendix C: Schedule of Survey Control Station.

Schedule of Survey Control Stations					
Origin	**PGM ID**	**Easting (m)**	**Northing (m)**	**Level (m)**	**Type**
New Station	S1	442628.933	259244.457	123.006	Ground Anchors
New Station	S3	442441.157	259210.714	122.912	Ground Anchors

Appendix D: PGM Witness Diagrams

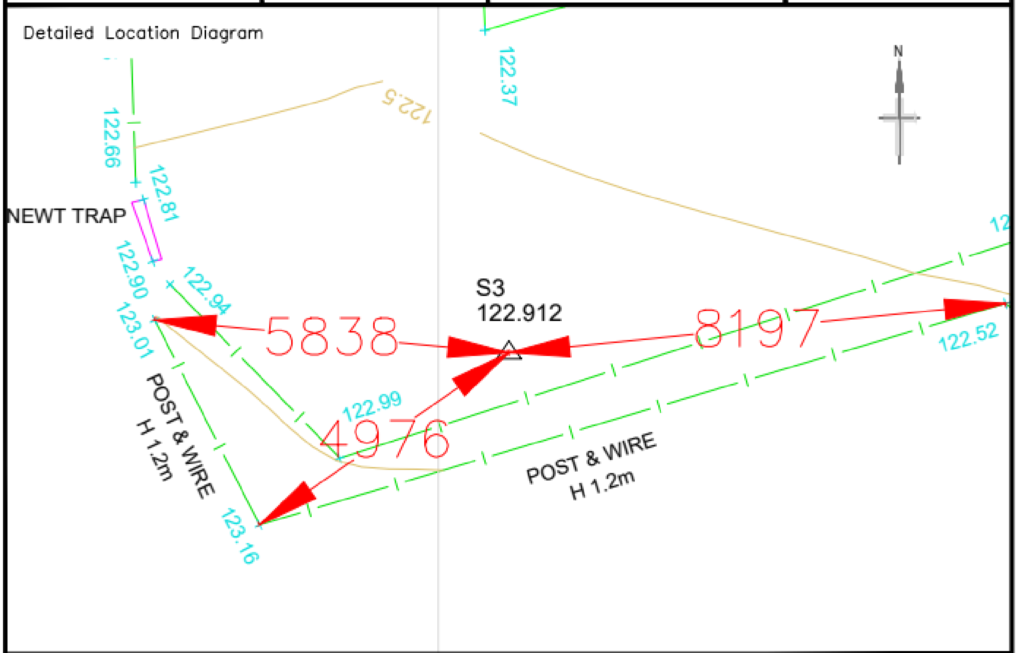
PERMANENT GROUND MARKER RECORD SHEET			Page 1 of 2
Location: Between fence post and newt trap to south-east of woodland.			Job Ref: P20-01360
PGM No./Name S1			
Description of PGM: Ground Anchor (Yellow)			
Arbitrary/N.G.Coordinates	E 442628.933	N 259244.457	Level 123.006
Detailed Location Diagram			



Marker Established By MT	Date 02/12/2020
Record Prepared By MT	Date 11/12/2020
Revisited By	Date
Remarks	

PERMANENT GROUND MARKER RECORD SHEET			Page 2 of 2
Location: Near post & wire fence and newt trap to south–west of woodland.			Job Ref: P20–01360
PGM No./Name S3			
Description of PGM: Ground Anchor (Yellow)			
Arbitrary/N.G.Coordinates	E 442441.157	N 259210.714	Level 122.912

Detailed Location Diagram



Marker Established By MT	Date 02/12/2020
Record Prepared By MT	Date 11/12/2020
Revisited By	Date
Remarks	

Appendix E: Control Observation Report

SURVEY CONTROL OBS. DIFFERENCES LIST

Control obs. tolerances - warnings : 0.010(?) and errors : 0.090(!).

Horizontal / Distance components may be ignored (x).

Reporting all control obs. differences above 0.010

Set-up : 1 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 00 190.778 190.778 -0.005 -0.099 -0.004
1.441 0.007

79 48 57 269 57 07 190.777 190.777 -0.006 -0.092 0.002
1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 00 269 57 07 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.000 -0.006 0.003 -
0.004 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 2 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.779 190.779 -0.004 -0.099 -0.005
1.441 0.007

79 48 58 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -
0.005 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 3 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.100 -0.005
1.441 0.007

79 48 57 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -
0.005 0.011 ?

Combined 259 48 52 90 02 58

Dev -0 00 05 VA Col 90 00 04

Set-up : 4 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.099 -0.005
1.441 0.007

79 48 58 269 57 06 190.776 190.776 -0.007 -0.093 0.001
1.441 0.013 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.001 -0.007 0.003 -
0.005 0.013 ?

Combined 259 48 53 90 02 58

Dev -0 00 06 VA Col 90 00 03

Set-up : 31 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH 3D diff

259 48 47 90 03 00 190.778 190.778 -0.005 -0.099 -0.004 1.441 0.007

79 48 57 269 57 07 190.777 190.777 -0.006 -0.092 0.002 1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 00 269 57 07 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.000 -0.006 0.003 -0.004 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 32 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.779 190.779 -0.004 -0.099 -0.005
1.441 0.007

79 48 58 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -
0.005 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 33 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.100 -0.005
1.441 0.007

79 48 57 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -0.005 0.011 ?

Combined 259 48 52 90 02 58

Dev -0 00 05 VA Col 90 00 04

Set-up : 34 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH 3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.099 -0.005 1.441 0.007

79 48 58 269 57 06 190.776 190.776 -0.007 -0.093 0.001 1.441 0.013 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.001 -0.007 0.003 -0.005 0.013 ?

Combined 259 48 53 90 02 58

Dev -0 00 06 VA Col 90 00 03

Set-up : 81 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 00 190.778 190.778 -0.005 -0.099 -0.004
1.441 0.007

79 48 57 269 57 07 190.777 190.777 -0.006 -0.092 0.002
1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 00 269 57 07 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.000 -0.006 0.003 -
0.004 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 82 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.779 190.779 -0.004 -0.099 -0.005
1.441 0.007

79 48 58 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -
0.005 0.011 ?

Combined 259 48 52 90 02 57

Dev -0 00 05 VA Col 90 00 03

Set-up : 83 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.100 -0.005
1.441 0.007

79 48 57 269 57 06 190.778 190.778 -0.005 -0.093 0.001
1.441 0.011 ?

Mean 259 48 47 79 48 57 90 03 01 269 57 06 190.778 190.778 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.000 0.000 -0.005 0.003 -
0.005 0.011 ?

Combined 259 48 52 90 02 58

Dev -0 00 05 VA Col 90 00 04

Set-up : 84 Set on S1 E 442628.9330 N 259244.4570 L 123.0060

Backsight S3 E 442441.1574 N 259210.7144 L 122.9118

Set-up HA = 259 48 47, IH = 1.509, VA Col = 90 00 00, SF = 1.00000000

Control obs to S3

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH 3D diff

259 48 47 90 03 01 190.778 190.778 -0.005 -0.099 -0.005 1.441 0.007

79 48 58 269 57 06 190.776 190.776 -0.007 -0.093 0.001 1.441 0.013 ?

Mean 259 48 47 79 48 58 90 03 01 269 57 06 190.777 190.777 -0.096

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.001 -0.007 0.003 -0.005 0.013 ?

Combined 259 48 53 90 02 58

Dev -0 00 06 VA Col 90 00 03

Set-up : 148 Set on S13 E 442588.4483 N 259305.2508 L 108.5746

Backsight S12 E 442576.4575 N 259274.2526 L 115.9053

Set-up HA = 201 09 54, IH = 1.245, VA Col = 90 00 00, SF = 1.00000000

Control obs to S5

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

44 19 55 95 15 57 49.550 49.341 0.001 -4.633 -0.001 1.330
0.002

224 20 25 264 44 20 49.551 49.342 0.003 -4.629 0.003
1.330 0.010

44 19 53 95 15 57 49.551 49.342 0.002 -4.633 -0.001 1.330
0.002

224 20 24 264 44 24 49.552 49.343 0.004 -4.628 0.004
1.330 0.010 ?

44 19 58 95 15 52 49.550 49.341 0.001 -4.631 0.001 1.330
0.003

224 20 24 264 44 22 49.551 49.342 0.003 -4.628 0.004
1.330 0.010

Mean 44 19 55 224 20 24 95 15 55 264 44 22 49.551 49.342 -4.630

Max Dev -0 00 03 0 00 01 -0 00 03 -0 00 02 0.001 0.001 0.004 0.002 0.004
0.010 ?

Combined 44 20 10 95 15 47

Dev -0 00 17 VA Col 90 00 09

Set-up : 151 Set on S5 E 442622.9158 N 259340.5550 L 103.9427

Backsight S13 E 442588.4483 N 259305.2508 L 108.5746

Set-up HA = 224 17 54, IH = 1.331, VA Col = 90 00 00, SF = 1.00000000

Control obs to S13

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

224 17 54 84 44 34 49.551 49.343 0.003 4.627 -0.005
1.244 0.006

44 18 12 275 15 09 49.550 49.342 0.002 4.623 -0.009
1.244 0.010 ?

Mean 224 17 54 44 18 12 84 44 34 275 15 09 49.550 49.342 4.625

Max Dev 0 00 00 0 00 00 0 00 00 0 00 00 0.001 0.000 0.003 0.002 -
0.009 0.010 ?

Combined 224 18 03 84 44 43

Dev -0 00 09 VA Col 89 59 51

Set-up : 152 Set on S5 E 442622.9158 N 259340.5550 L 103.9427

Backsight S13 E 442588.4483 N 259305.2508 L 108.5746

Set-up HA = 224 17 54, IH = 1.331, VA Col = 90 00 00, SF = 1.00000000

Control obs to S8

HA F1 HA F2 VA F1 VA F2 SD HD HD diff LD LD diff TH
3D diff

271 12 51 91 55 08 121.369 121.301 0.000 -4.086 0.002
1.353 0.021 ?

91 13 00 268 04 54 121.372 121.304 0.003 -4.085 0.004
1.353 0.026 ?

271 12 50 91 55 08 121.372 121.304 0.003 -4.086 0.003
1.353 0.021 ?

91 13 00 268 04 54 121.370 121.302 0.001 -4.085 0.004
1.353 0.026 ?

271 12 50 91 55 08 121.371 121.303 0.002 -4.086 0.002
1.353 0.021 ?

91 13 01 268 04 55 121.370 121.302 0.001 -4.085 0.004
1.353 0.027 ?

Mean 271 12 51 91 13 00 91 55 08 268 04 54 121.371 121.303 -4.085

Max Dev 0 00 01 0 00 01 -0 00 00 0 00 00 0.002 0.002 0.003 0.001 0.004
0.027 ?

Combined 271 12 55 91 55 07

Dev 0 00 06 VA Col 90 00 01

Appendix F: Calibration Procedures

Calibration Procedure for Measuring & Test Equipment

SOUTHGATE HOUSE

PONTEFRACT ROAD

STOURTON

LEEDS

WEST YORKSHIRE LS10 1SW

T – 0113 2008900

F – 0113 2008901

E MAIL – admin@metconsultancygroup.com

WEBSITE: - www.metconsultancygroup.com

PURPOSE AND SCOPE

PURPOSE

1. The purpose of this procedure is to define the calibration, maintenance and control of measuring and test equipment used within Met Consultancy Group (comprising Met Engineers Ltd and Met GeoEnvironmental Ltd).
2. This procedure includes the process for conducting internal and external calibration activities.
3. This procedure calls for the clear identification of all measuring and test equipment used within the group.

SCOPE

1. This procedure shall apply to all measuring and test equipment used in the provision of services offered by Met Engineers Ltd and Met GeoEnvironmental Ltd
2. All equipment must be repaired and calibrated to traceable standards.

MET GEOENVIRONMENTAL LTD – SURVEY UNIT

CALIBRATION PROCEDURE – TOTAL STATIONS

1. Calibration and servicing of all total stations must be carried out by an external, accredited company. All equipment must be repaired and calibrated to traceable standards. This will be carried out for all total stations at approximate annual intervals but will be dependent upon the amount of daily use, condition and presence of system warnings or errors.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. In-house Check and Adjust must be carried out on each total station at the start of each project. Measure multiple face left / face right to the first back sight to confirm the calibration status of the instrument. Record the check on the JIF.

4. Check and Adjust angles of more than 1 minute (60") in Horizontal and / or Vertical require the instrument to be removed from service and sent to for inspection by an external, accredited company. This is the manufacturer's recommendation.

5. Parameters tested in the check & adjust routine can also be assessed in project survey data. If project data quality checks highlight potential calibration errors, the instrument must be tested and a check & adjust routine carried out.

6. If equipment is found to be malfunctioning it should be removed from service and handed to the Quality Manager or Line Manager for initial assessment.

7. All documentation relating to equipment repair must be scanned and tagged against the asset in question (Met Equipment) and company responsible for repair.

CALIBRATION PROCEDURE – LEVELS

1. All spirit levels must be calibrated by an external, accredited company. This will be carried out for all spirit levels at approximate annual intervals but not exceeding 13 months. All spirit levels must be repaired and calibrated to traceable standards.

2. Actions will be created in Union Square to inform the Quality Manager that equipment is due for calibration. Equipment must be calibrated when this prompt is received.

3. Surveyors should carry out their own two peg tests on site before commencing levelling runs. Sprit levels can be knocked in the car boot at any time, thus

introducing a collimation error. If a level is found to be out of collimation then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

4. The results of the two peg test **must** be recorded in the field book adjacent to the project levelling data. Record the check on the JIF.

Calibration Procedure – Laser Scanners

1. All laser scanners must be calibrated by an external, accredited company. Laser scanner calibration is not undertaken on a defined chronological cycle – advice from Leica is as follows:

    a. With scanners most people don't tend to have them calibrated on a yearly basis so I hadn't taken this into account. This is normally quite a long process with the scanner needing to be shipped out to Cologne at quite a substantial cost.
    b. What most people tend to do with the scanner is just have the extended warranty (which was included in the sale) for peace of mind should anything break. With a scanner it is very apparent when they go out of calibration (you will see steps in the data) but it takes somewhat of a knock to put them out. I did carry out tests with the scanner prior to delivery to ensure there was no issues. The scanner also has its own built-in check and adjust for the tilt compensator so running this periodically also helps in keeping things as accurate as possible. All laser scanners must be repaired and calibrated to traceable standards.

    Karl White, Leica GeoSystems 13 July 2016

2. Mechanical shock, heat cycle stress or heavy use can affect the calibration of the tilt compensator. This can be adjusted and improved quickly and easily using the 'Check tilt compensator' function. It is recommended to incorporate this into your workflow, once a week or once a month depending on use, and always after shipping.

3. Prior to scanning on site, Surveyors should:

    1. Run the 'Check tilt compensator' function or do a simple check to see if it needs to be done on your first setup.
    2. Make sure that you have a good stable setup on a tripod
    3. Level the scanner using the electronic bubble as well as possible
    4. Turn the instrument 180deg

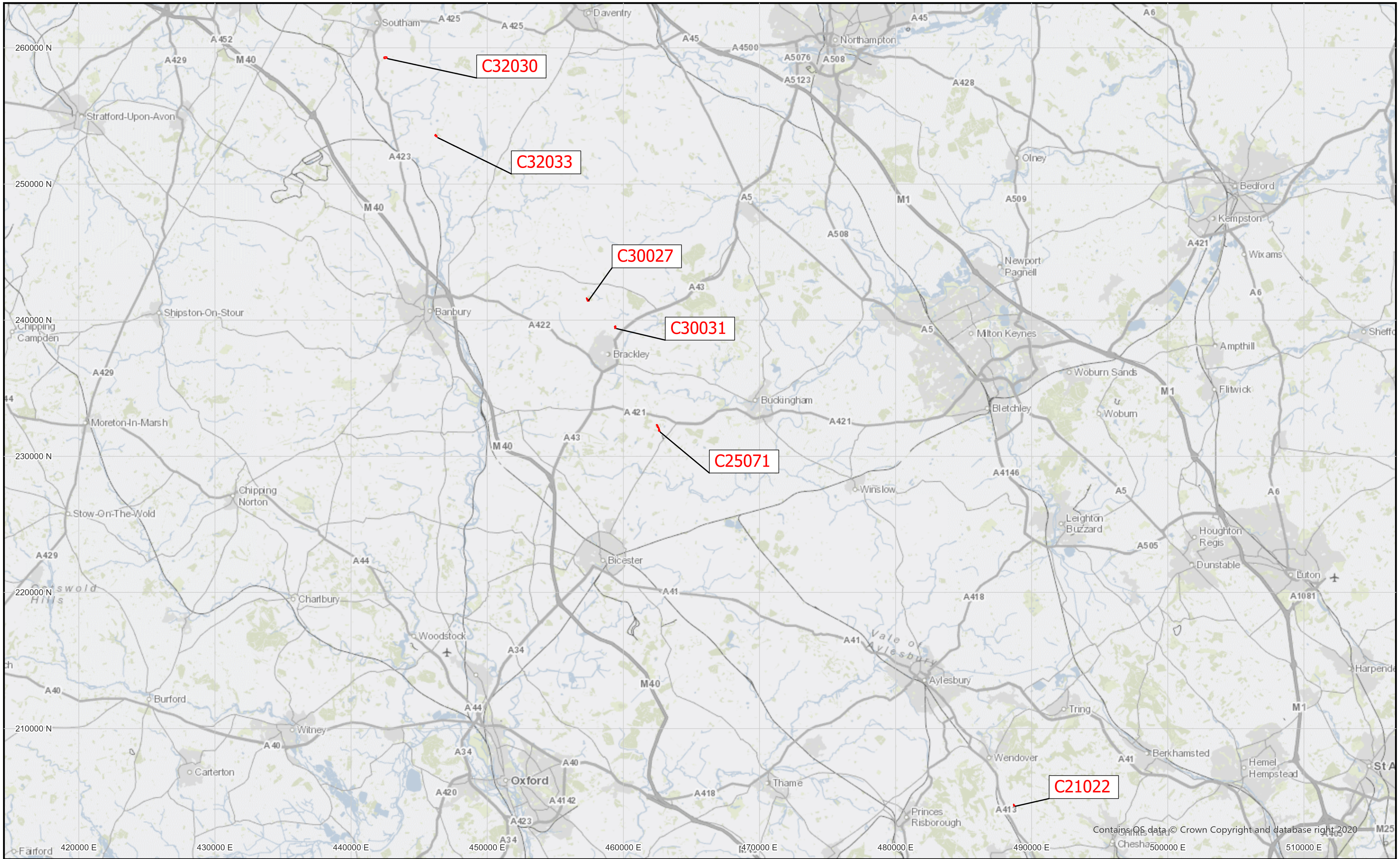
5. If the difference of the electronic bubble is >8" then the 'Check tilt compensator' function should be executed.

   The 'Check tilt compensator' function is found in:
   Tool - Check & Adjust - Check Tilt Compensator
   Remember to 'Set' the results at the end.

4. If a scanner is found to be out of calibration then it should not be used but immediately taken out of service. The level should then be handed to the Quality Manager or Line Manager for assessment.

5. Record the check on the JIF.

Appendix 2 – Figures



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

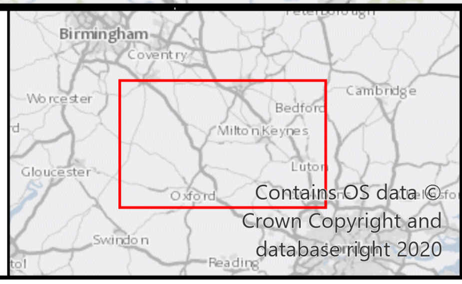
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 1 - site locations

Published

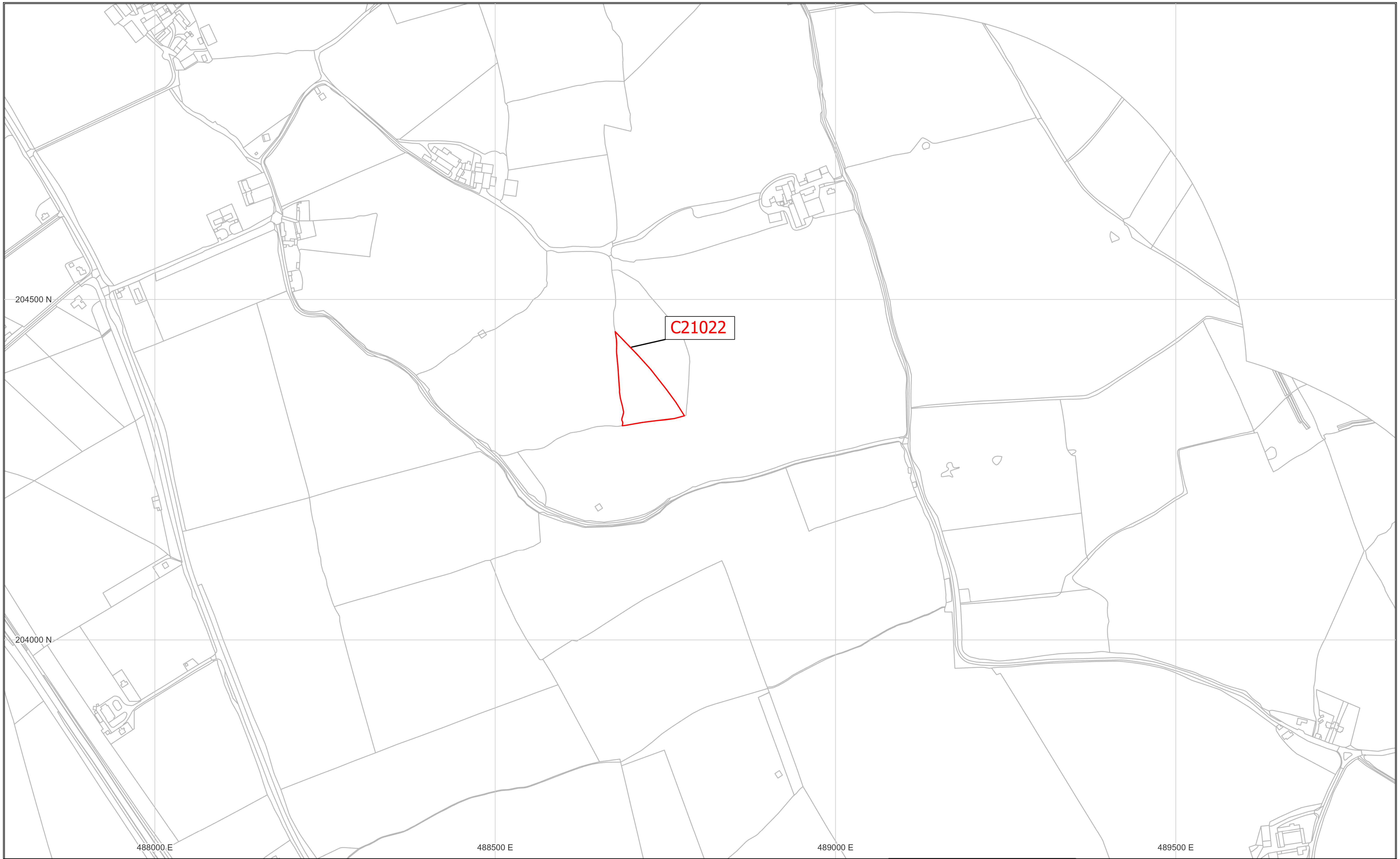
HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Scale at A3: 1:250,000

0 2 4 6 8 10
Kilometres

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it is issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

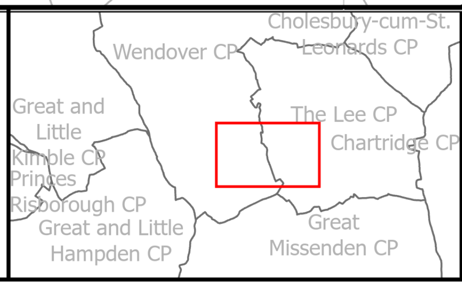
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 2 - C21022 site location

Published

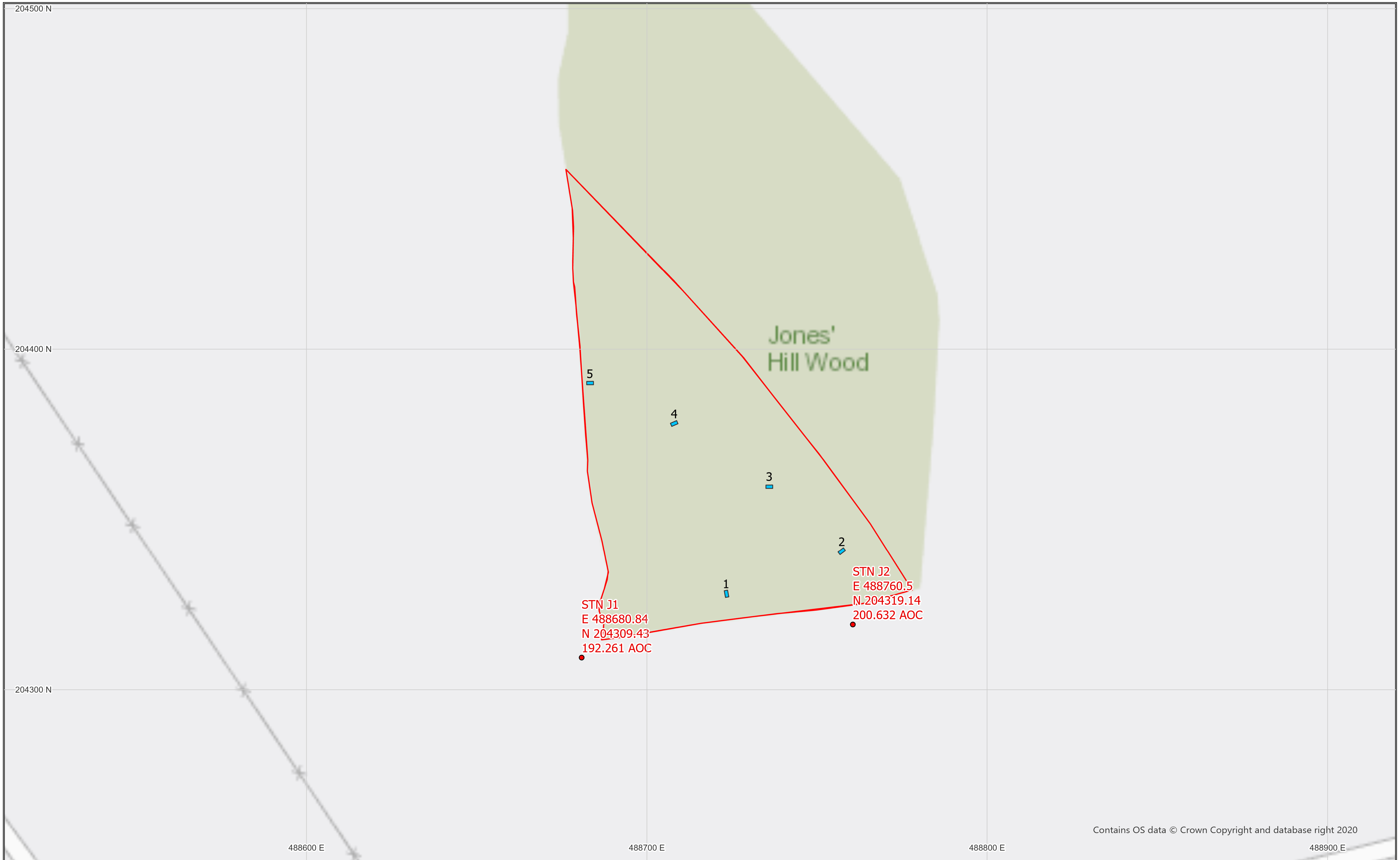
HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

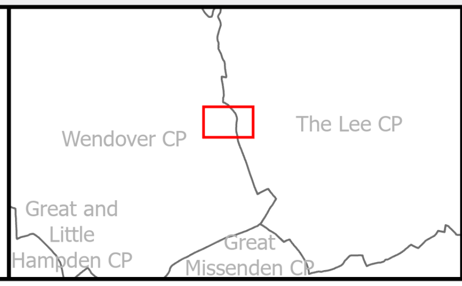
Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



Site extent
Control points
Test pits



High Speed Two
HS2C184 Woodlands
C21022 Jones Hill Wood
Figure 3 -
Location of control points and test pits

Published

HS2

Scale at A3: 1:1,000

0 10 20
Meters

HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

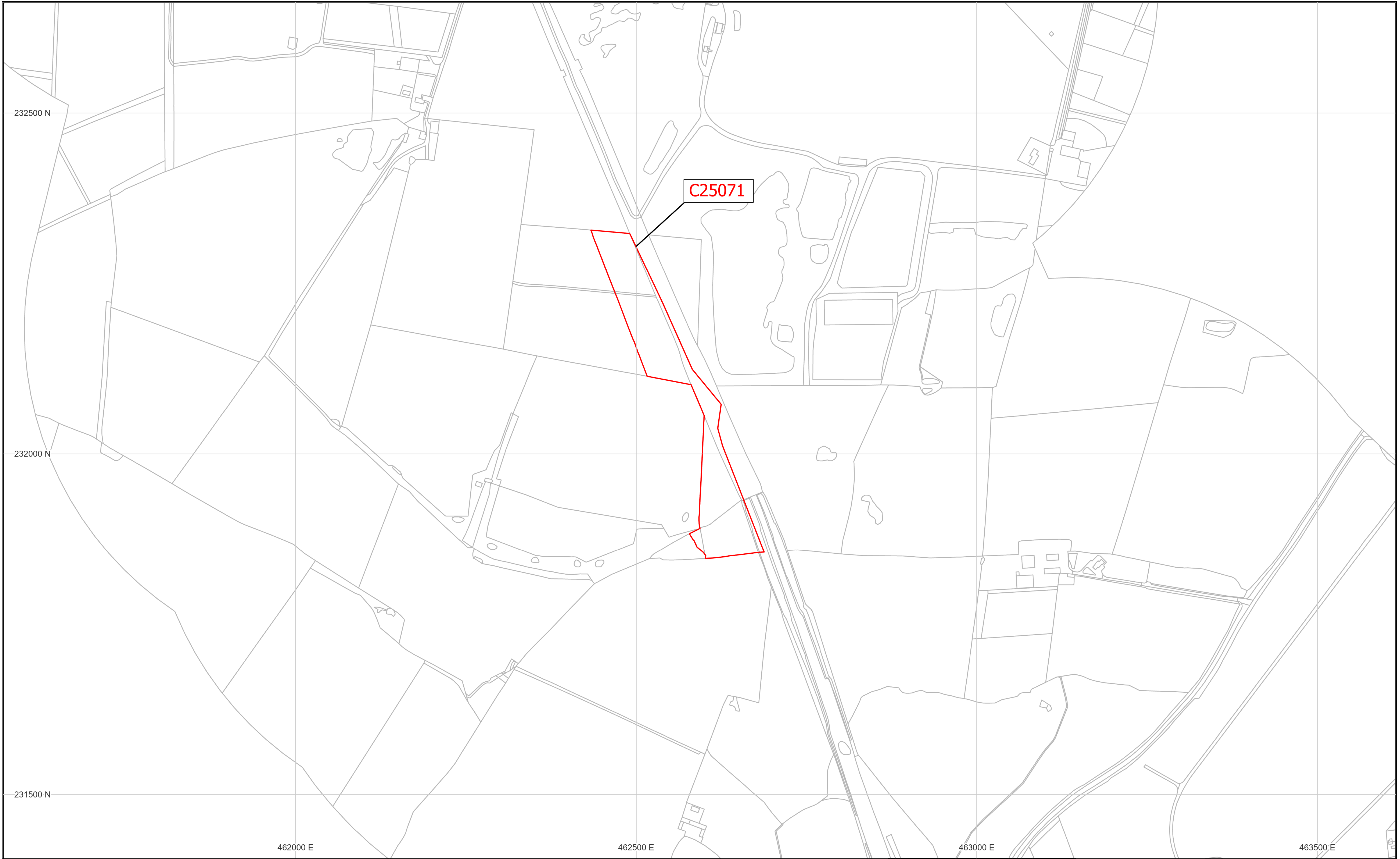
Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

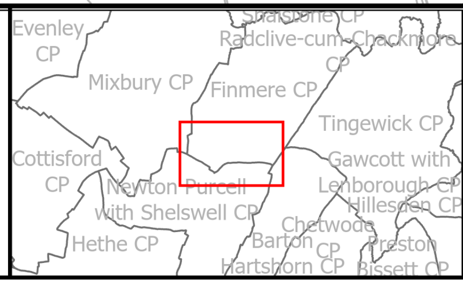
This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 4 - C25071 site location

Published

HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21

HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

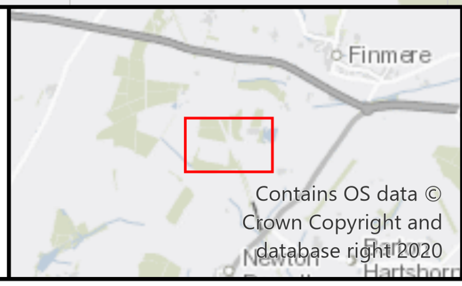
© Crown copyright and database rights 2021
OS 100049190

Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent
Control points
Test pits

High Speed Two
HS2C184 Woodlands
C25071 Widmore Farm
Figure 5 -
Location of control points and test pits

Published

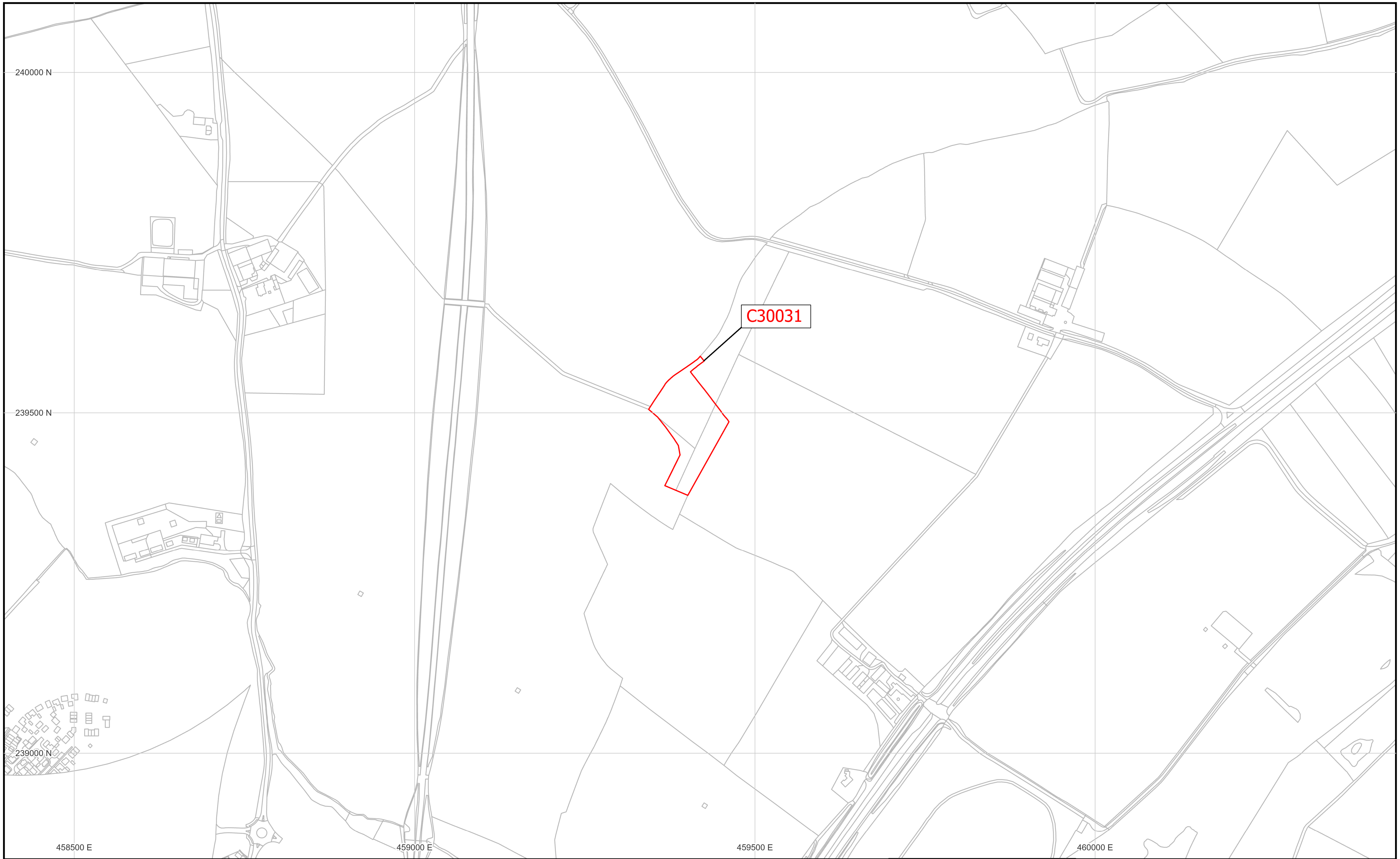
HS2

Scale at A3: 1:2,000

0 10 20 30 40 50
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

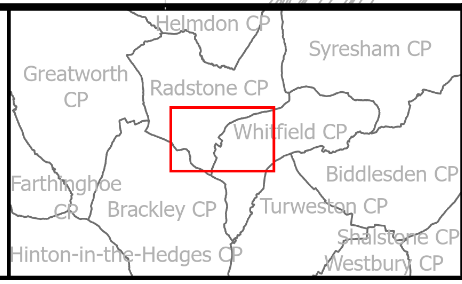
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 6 - C30031 site location

Published

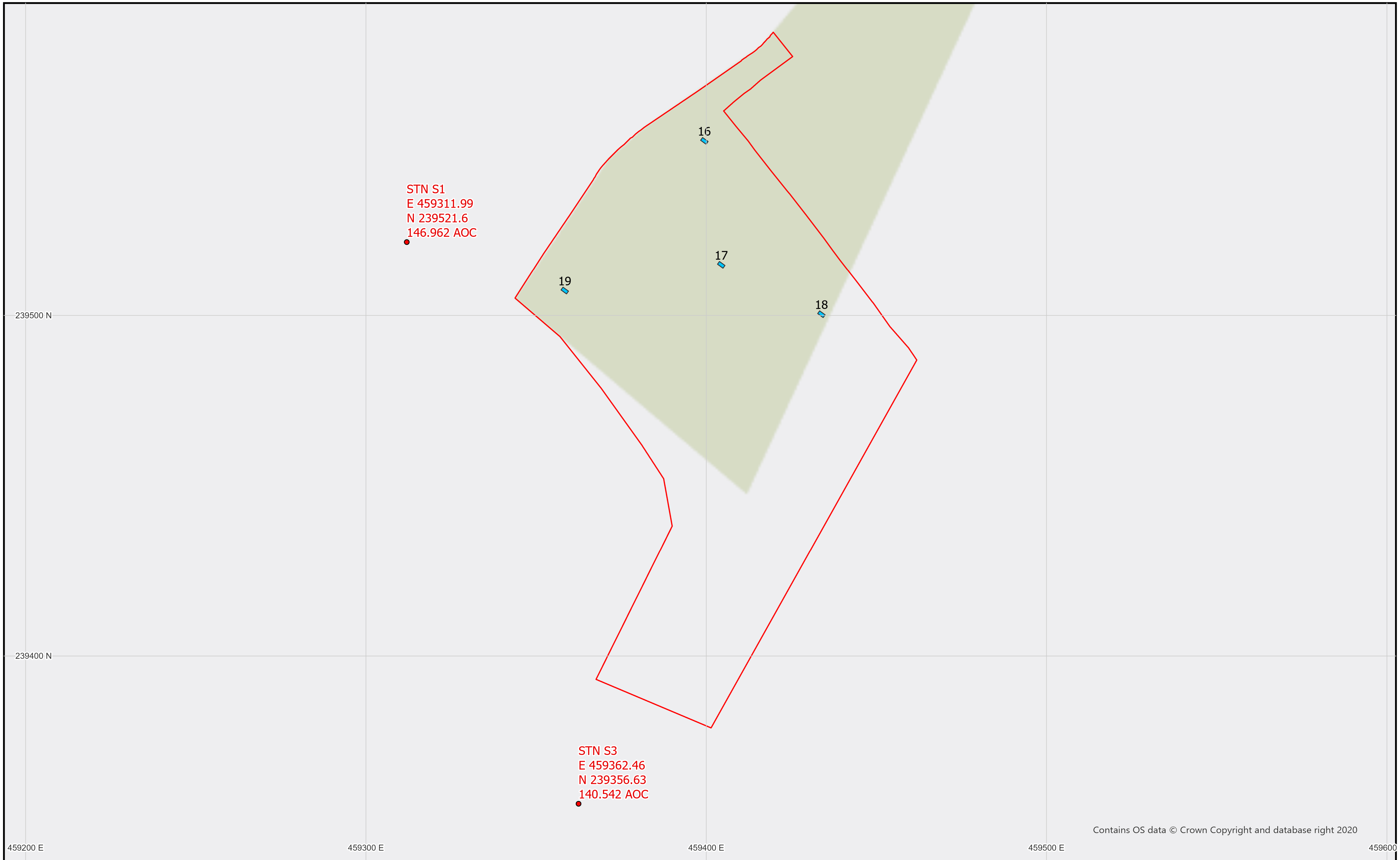
HS2

Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

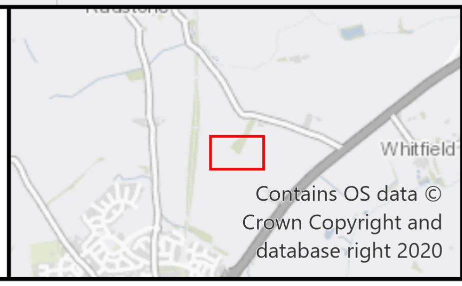
© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent

Control points

Test pits



High Speed Two
HS2C184 Woodlands
C30031 Fox Covert Whitfield
Figure 7 -
Location of control points and test pits

Published

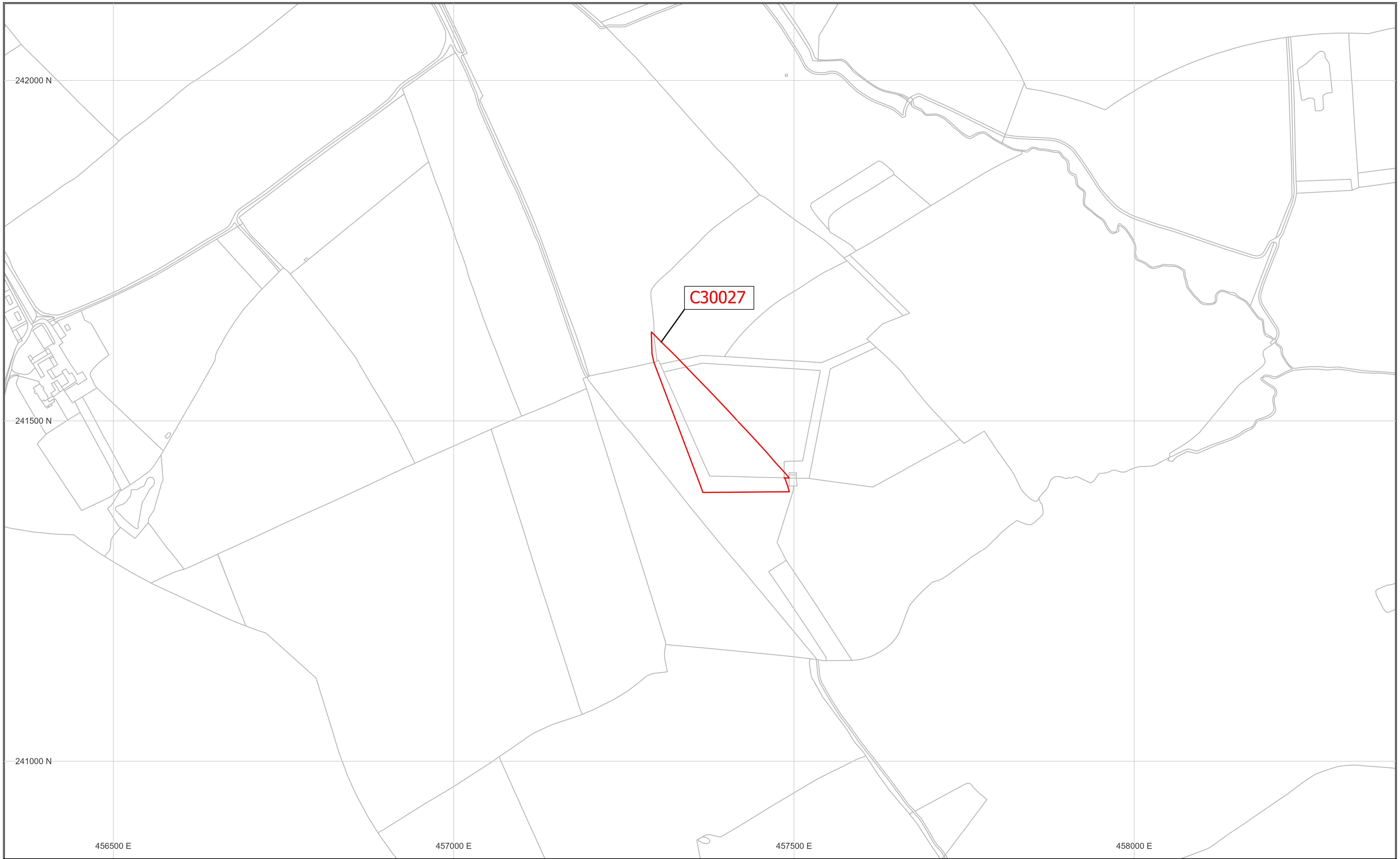
HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Scale at A3: 1:1,000

0 10 20 30
Meters

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

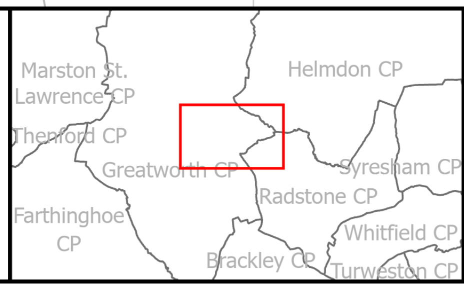
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 8 - C30027 site location

Published

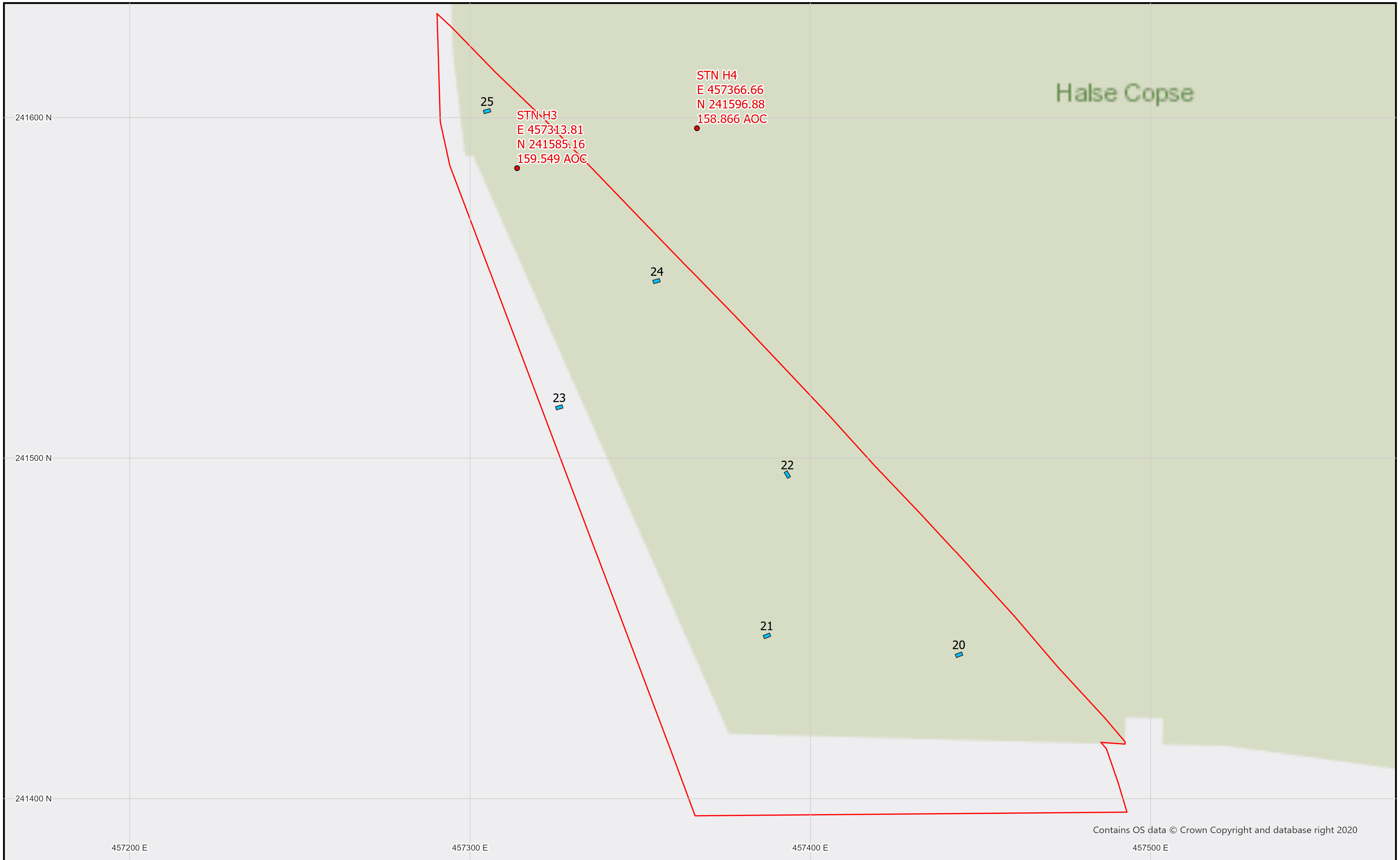
HS2

Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

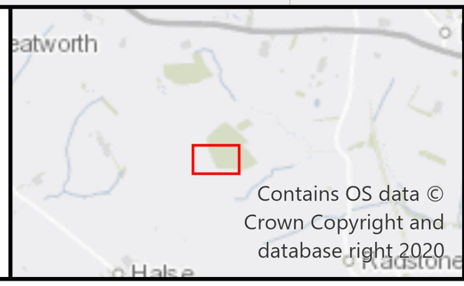
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

- Site extent
- Control points
- Test pits



High Speed Two
HS2C184 Woodlands
C30027 Halse Copse Farm
Figure 9 -
Location of control points and test pits

Published

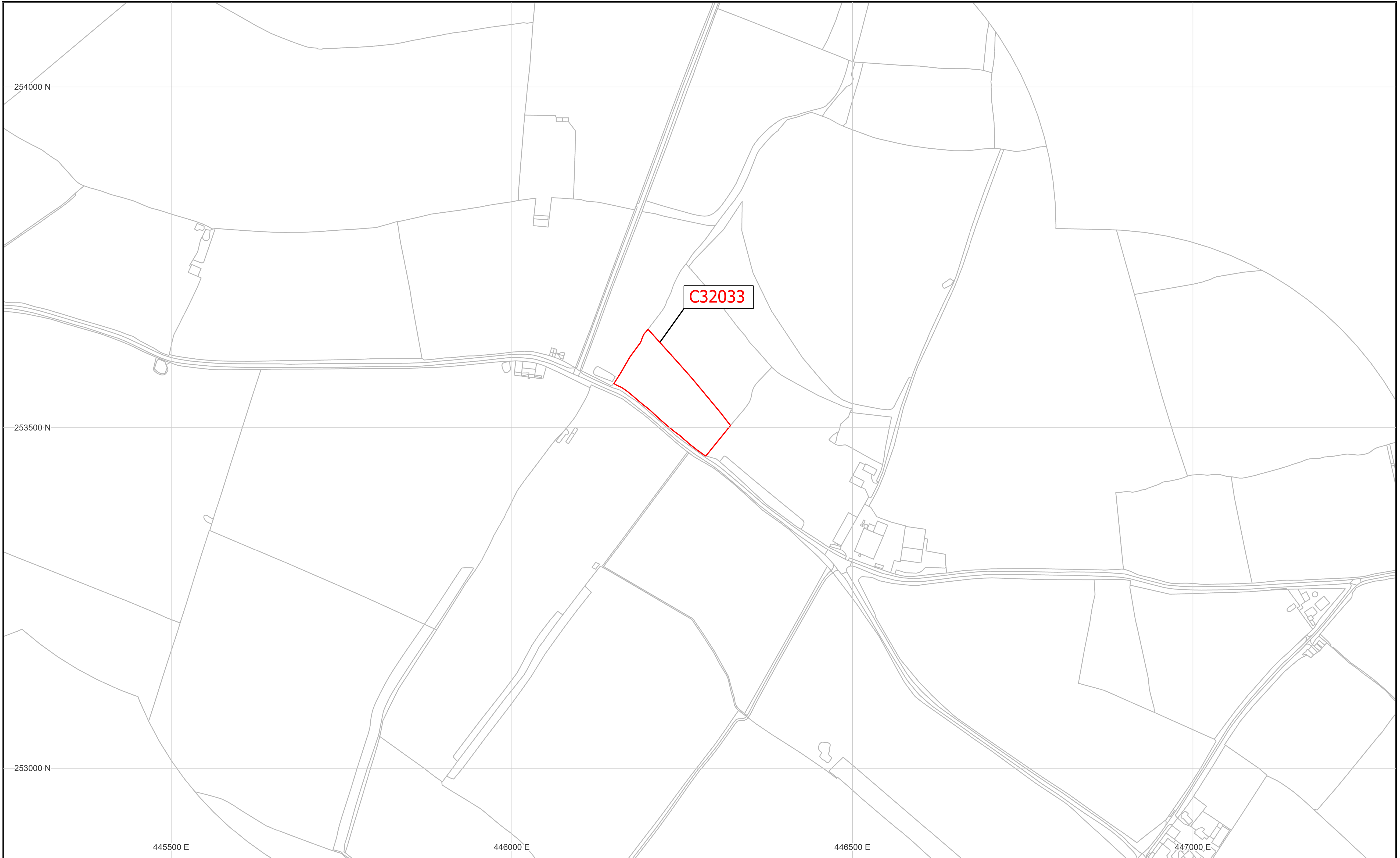
HS2

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Scale at A3: 1:1,000

0 10 20 30 40 50
Meters

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

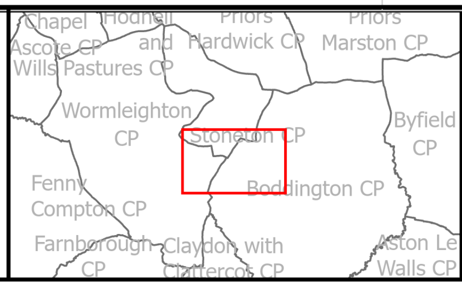
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 10 - C32033
site location

Published

HS2

Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21

HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

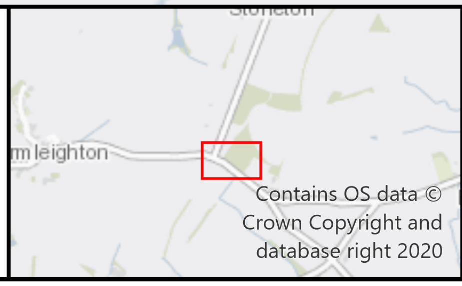
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

- Site extent
- Control points
- Test pits

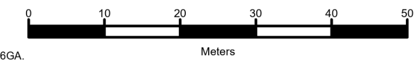


High Speed Two
HS2C184 Woodlands
C32033 Fox Covert
Figure 11 -
Location of control points and test pits

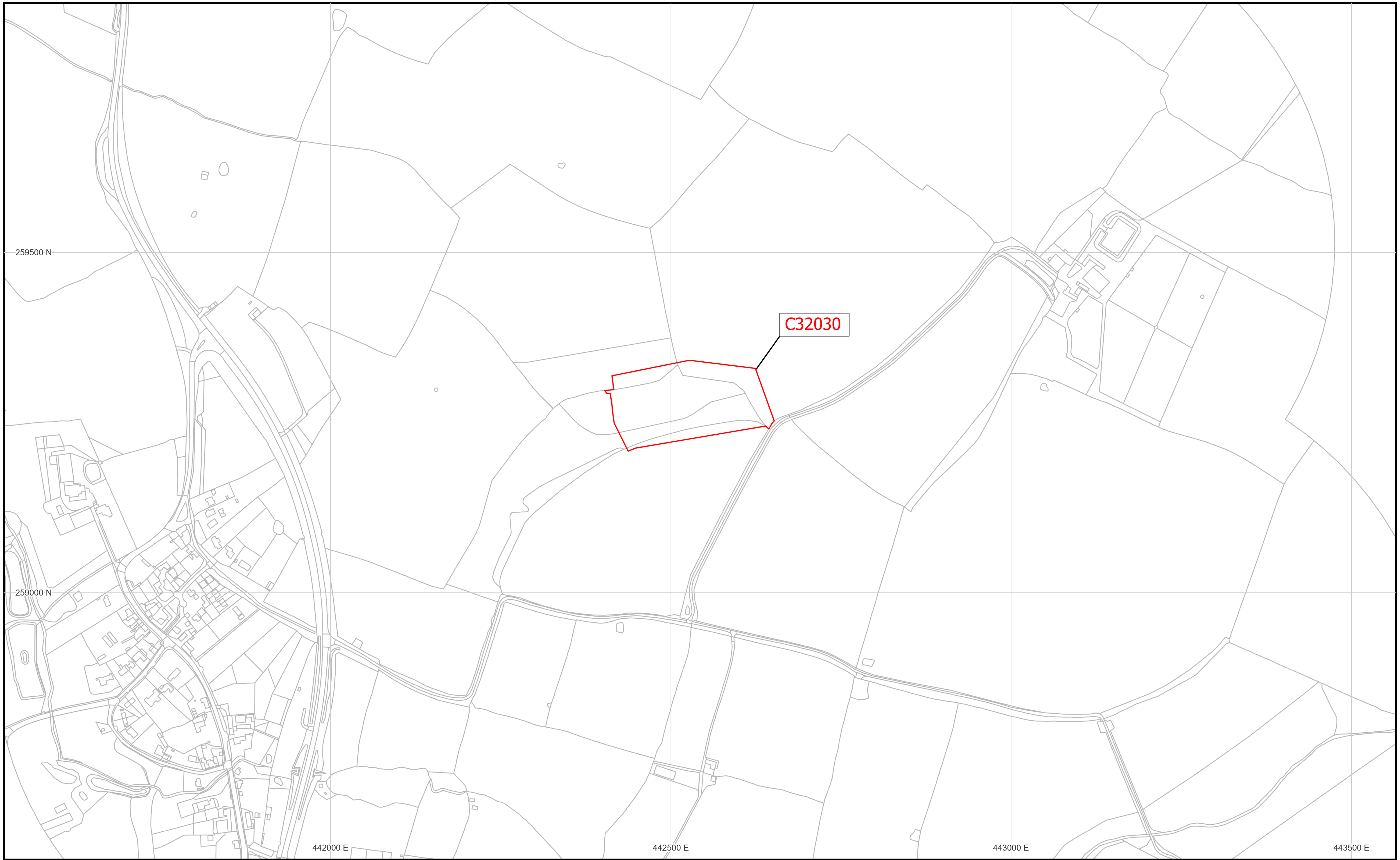
Published

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Scale at A3: 1:1,000



Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21



HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

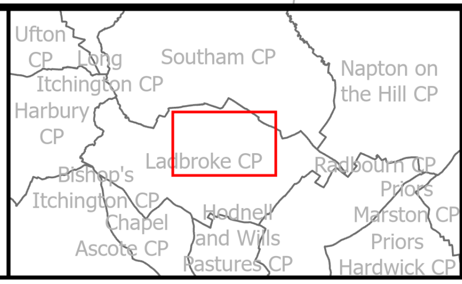
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent



High Speed Two
HS2C184 Woodlands Survey
Figure 12 - C32030 site location

Published

Scale at A3: 1:5,000

0 40 80 120 160 200
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21

HS2 Ltd accept no responsibility for any circumstances, which arise from the reproduction of this map after alteration, amendment or abbreviation or if it issued in part or issued incomplete in any way.

© Crown copyright and database rights 2021
OS 100049190

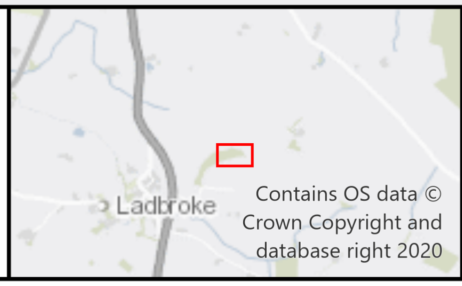
Derived from (...cite the scale of the BGS data used...) scale BGS Digital Data under licence 2011/111 BP British Geological Survey. © NERC.

Contains Environment Agency information © Environment Agency and database right.

© Crown copyright material is reproduced with the permission of Land Registry under delegated authority from the Controller of HMSO.

This material was last updated on [date] and may not be copied, distributed, sold or published without the formal permission of Land Registry and Ordnance Survey. Only an official copy of a title plan or register obtained from the Land Registry may be used for legal or other official purposes. © Crown Copyright Ordnance Survey.

Site extent
Control points
Test pits



High Speed Two
HS2C184 Woodlands
C32030 Windmill Hill Spinney
Figure 13 -
Location of control points and test pits

Published

Scale at A3: 1:750

0 10 20 30 40 50
Meters

Registered in England. Registration number 06791686.
Registered office: 2 Snowhill, Queensway, Birmingham B4 6GA.

Doc Number: 1EW03-FUS_IFA-GI-MAP-C000-000004 **Date:** 24/08/21