



CHALK MINE STABILISATION PROJECT HIGHBARNNS, HEMEL HEMPSTEAD

Treatment Area 6: Nos. 30 and 32 Highbarnns

Report Number: 0013-UA000857-TR-01-TAR-0006

OCTOBER 2015



Incorporating

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Drawing TA06-01 – Treatment Area Plan for TAR0006 with Grout Holes

Drawing TA06-02 – Treatment Area Plan for TAR0006 with Validation Probes

1 INTRODUCTION

Dacorum Borough Council (DBC) has commissioned Arcadis Consulting (UK) Ltd (Arcadis) (formerly Hyder Consulting (UK) Limited) to oversee the treatment and validation of abandoned chalk mines identified beneath residential areas in the Nash Mills area of Hemel Hempstead, Hertfordshire. The mine workings identified at the site have been assessed to comprise a single level of chalk mine galleries in the vicinity of Highbarns, Pond Road and East Green Road junction. The mine treatment has been funded under the Land Stabilisation Programme (LSP), administered by the Homes and Communities Agency (HCA).

The background to the scheme, interpretation of the mine, and treatment works are set out in the overarching treatment report (Arcadis, 2015). This report forms an addendum to the above report and should be read in conjunction with it.

The objective of this report is to set out the works that were undertaken to treat the mines and provide the results of post mine treatment validation probing. The properties discussed in this report are as follows:

- No. 30 and 32 Highbarns

The broader site location, treatment areas and interpreted extent of mine workings within the Derelict Land Clearance Order site boundary are shown in the overarching Treatment Report (Arcadis, 2015), Appendix A.

This Treatment area, validation probes and extent of grouting work specific to this treatment area are shown on drawings TA0006-01 and 02 in Appendix A.

Factual information relating to the investigative probes, validation probes and extent of grouting work are contained in the BAM Ritchies Sectional Validation Report for the treatment works (BAM Ritchies, 2015).

2 SUBSURFACE INVESTIGATIONS

The subsurface investigations at these properties were undertaken in response to historical subsidence events across the site.

The pre-contract investigations were undertaken by Soil Engineering Ltd in 2012 and included investigative dynamic probes and dynamic windowless sampled boreholes. A review of historical information, the natural topography and the geotechnical investigations were used to identify zones of probable mining related disturbed ground.

Following and during each stage of the treatment works, validation dynamic probing was undertaken to establish the effectiveness of the mine treatment.

The scope of the validation dynamic probing completed during and following the treatment works for 30 and 32 Highbarns are summarised in Table 1 below.

Table 1: Summary of Validation Investigation

Type of Investigations	Number
Total No. of External Validation Dynamic Probes (VP)	52
Total No. of Internal Validation Dynamic Probes (VP)	0

The results of the validation dynamic probes undertaken during and after treatment works are presented in the relevant sectional factual report VR006 for this treatment area (BAM Ritchies, 2015). For the purposes of this report, additional dynamic probes

undertaken concurrently with the grouting works in order to further investigate the extent of mine workings are designated validation probes.

Findings of the pre-contract design phase ground investigation undertaken by Soil Engineering and subsequent interpretations are contained in the Interpretive Ground Investigation Report for the site (Hyder, 2012a).

3 TREATMENT RECORDS

Mine treatment works have been undertaken in accordance with the Hyder Specification for site works (Hyder, 2012b). The techniques of mine treatment adopted at the site consisted of bulk infilling of open voids and compaction grouting of collapsed ground.

A summary of the treatment works are set out in Table 2 below.

Table 2: Summary of Treatment Works

Property	Location	Type of Hole	Number of Holes	Range of Grout volumes ¹ (m ³)	Total Grout volume ¹ (m ³)
No. 30 Highbarns (Total Grout Holes = 30, Total Grout Volume = 742.40m ³)	Beneath the property	Inclined compaction grout holes	6	5.6 (CGI660) to 69.71 (CGI629)	189.91
	Rear garden	Vertical compaction grout holes	22	1.93 (CGV385) to 124.06 (CGV659)	529.38

Notes:

The above extract is based on data from BAM Ritchies' Sectional Validation Report for Nos 30 and 32 Highbarns (BAM, 2015). The factual report should be referenced for further details of treatment works including the volumes of grout injected and injection pressures per grout hole.

The treatment was undertaken in a phased approach with several stages of grouting and validation dynamic probe testing. Additional stages of grouting and validation testing were completed where validation testing raised doubts as to the extent of the grout penetration beneath properties or where additional mining related disturbed ground was identified.

4 VALIDATION

Validation of the treatment works has been based upon a combination of factors including a comparison of pre-treatment investigations, validation probing and grout volumes recorded during treatment. The number of grout holes, their location and the phasing of the grouting was adjusted as the work proceeded in order to accommodate the findings of the treatment works. A correlation of dynamic probe blow values of less than 3 per 100mm penetration and the presence of workings was the specified approach. Based on the results of the pre-contract ground investigation, blow counts greater than 3 per 100mm were determined to be acceptable.

A detailed scope of validation procedures adopted during the treatment works is presented in the Highbarns Chalk Mine Stabilisation Treatment Report (Arcadis, 2015).

Findings from grout treatment works and validation testing both confirmed the location of the anticipated mine layout but the extent has been confirmed as terminating within the boundary of No 30 Highbarns and so none of the programmed grouting works within the rear garden of No.32 was deemed necessary following the results of both the grouting at No 30 and validation probes in both of the gardens of Nos. 32 and 34 Highbarns. Detailed findings are discussed in the following sections.

4.1 No. 30 Highbarns

Treatment works at No. 30 Highbarns commenced with bulk infilling at the location identified as possible voids related to mining assessed from the pre-treatment ground investigation. The resultant grout volumes at BG027 (5.5m³) and BG028 (40.2m³) confirmed poor ground along the back garden of the property. Planned treatment along the back garden also confirmed the presence of a mine junction with high grout volumes at CGV375 (120m³), CGV371A (36m³) and CGV376 (30.6m³).

Further investigative probing (VP505 – VP510) and subsequent grouting at CGI629 (69.7m³) and CGV622 (103m³) close to the property confirmed a mine passage extending from the mine junction heading towards the property. A row of dynamic probes carried out along the front of the property uncovered further evidence of voided ground at VP745. Grouting at probe location VP745 resulted in a total grout volume at CGV655 of 124.06m³ and was similar to the volumes injected at the front of the property. Further inclined grouting aimed beneath the property was carried out to ensure complete the treatment at No. 30 Highbarns.

4.2 No. 32 Highbarns

The conclusions of the grouting and validation probing at No 30 Highbarns indicated that the mine did not extend beyond the boundary of No 30. While it was original planned to carry out treatment works along the back garden of No. 32, these were replaced with several rows of dynamic probing. No of these successive rows of dynamic probing indicated weak ground that would be indicative of collapsed mining as and a consequence no grouting was deemed necessary.

Further dynamic probing was undertaken along the back garden of No. 34 Highbarns to investigate cracking to a temporary structure located in the back garden. Initial dynamic probing in the area failed to penetrate down to the suspected depth of mine workings in the area.

Subsequent dynamic probing (VPM147, VPM154, VPM155) located along the anticipated mine gallery extents were all found to terminate at the suspected mine roof depth (around 12m bgl). A final dynamic probe, VPM173, managed to penetrate through the anticipated mine depth and did not reveal any weak ground that would be indicative of collapsed mine workings.

5 CONCLUSIONS

Grouting has been completed within No 30 Highbarns Pond Road to stabilise mining related disturbed ground due to former chalk mining. From the investigations and treatment work undertaken and the subsequent validation testing it can be reasonably concluded that;

- based upon the evidence, all mined ground encountered has been treated and that compaction and consolidation of void | collapsed voids has taken place;
- as a result of the above assessment, the risk of settlement from chalk mine workings within the treatment area has reduced to an acceptably low level following treatment;
- there is no evidence of any adverse impacts on groundwater quality beneath the site as a consequence of the work;
- there is no evidence of any significant movement or other adverse effects on buildings or infrastructure during the works; and
- the risks from further untreated workings in the treatment area is considered to be no higher than elsewhere in Hemel Hempstead.

The grouting work undertaken has only targeted the treatment of mined ground for the current site use and building layout. It is still the responsibility of the land owner to seek appropriate design advice prior to future development.

Dacorum Borough Council Building Control should be informed if any evidence of mine workings (such as shafts, voids or collapsed ground) is found during any future works undertaken as part of redevelopment.

6 REFERENCES

1. Arcadis Consulting (UK) Limited (2015), Chalk Mine Stabilisation Project, Highbarns, Hemel Hempstead, Treatment Report, No 0013-UA000857-TR-01, October 2015.
2. BAM Ritchies (2015), *Highbarns Sectional Validation Reports ref. BBK704U, VR-001 to 012*. March 2015.
3. Hyder Consulting (UK) Limited (2012a), *Highbarns Chalk Mines Project, Interpretive Ground Investigation Report*, No 0010-UA000857-GDR-01, September 2012.
4. Hyder Consulting (UK) Limited (2012b), Highbarns, Hemel Hempstead, Chalk Mine Stabilisation Project, Specification for Site Works, No 0007-UA000857-GDR-01, September 2012.

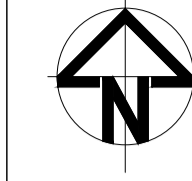
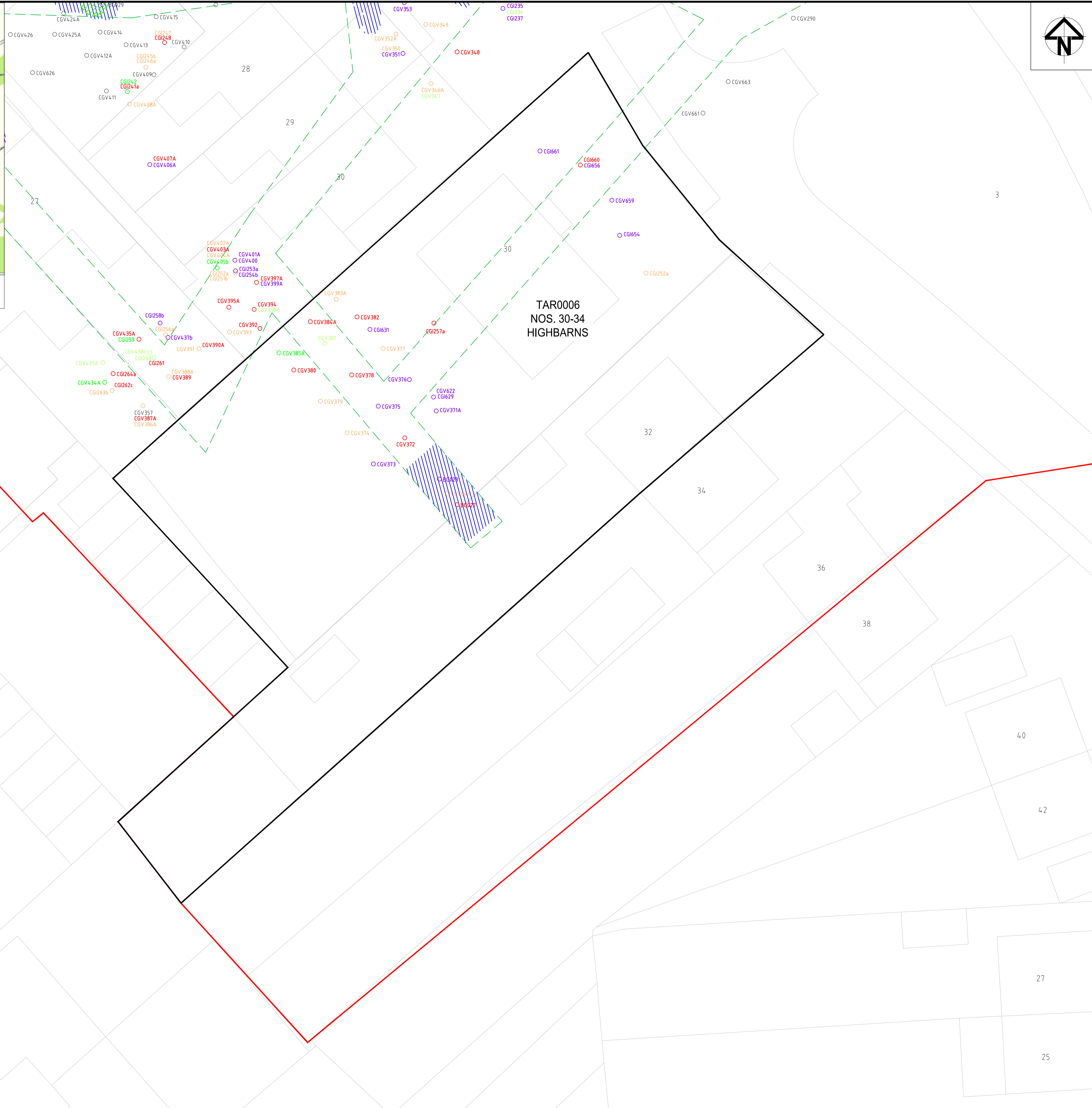
APPENDIX A

**Drawing TA06-01 – Treatment Area Plan for TAR0006
with Grout Holes**

**Drawing TA06-02 – Treatment Area Plan for TAR0006
with Validation Probes**



SITE MAP
NTS



- NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. ALL LEVELS IN METRES UNLESS NOTED OTHERWISE.
 3. VALIDATION AND GROUTING DATA BASED ON BAM RITCHIES' SECTIONAL VALIDATION REPORT (IBBK706E VR0001 TO VR00012) AND DATED APRIL 2015.
 4. VOIDS IDENTIFIED BY LASER SURVEYS UNDERTAKEN IN 2008 AND REMEDIATED IN 2008 ARE BASED ON PETER BRETT ASSOCIATES (2008), INTERPRETATIVE GEOTECHNICAL REPORT - PHASE 1, NO 2024.7/004.3/INT01/REV.2, JULY 2008.
 5. VOIDS IDENTIFIED BY LASER SURVEYS UNDERTAKEN IN 2012 ARE BASED ON INSPECTA HIRE (2012), CALS AND CCTV INSPECTION OF VOIDS REPORT NO 6658, ISSUE 02, AUGUST 2012.

LEGEND	
PATTERN	DETAIL
	TREATMENT AREA BOUNDARY
	DERELICT LAND CLEARANCE ORDER BOUNDARY
	INTERPRETED MINE EXTENTS FOLLOWING TREATMENT
	VOIDS IDENTIFIED BY LASER SURVEYS UNDERTAKEN IN 2012 (SEE NOTE 5)
	VOIDS IDENTIFIED BY LASER SURVEYS UNDERTAKEN IN 2008 AND REMEDIATED IN 2008 (SEE NOTE 4)
	INTERPRETED SHAFT LOCATION FOLLOWING TREATMENT
	CGV138 / CGVM138 COMPACTION VERTICAL GROUT HOLES
	CGI138 / CGIM138 COMPACTION INCLINED GROUT HOLES (ORIENTATION INDICATED BY DASHED LINE WHERE INFORMATION PROVIDED IN FACTUAL REPORT (SEE NOTE 3))
	CGI38 COMPACTION GROUT HOLES (INCLINED OR VERTICAL (SEE NOTE 3))
	BGI38 / BGHM138 BULK GROUT INFILL HOLES (SEE NOTE 3)

GROUTING LEGEND	
PATTERN	DETAIL
	CGV138 / CGI108 COMPACTION GROUT HOLES (0.0-1.0m ³)
	CGV138 / CGI108 COMPACTION GROUT HOLES (1.0-2.0m ³)
	CGV138 / CGI108 COMPACTION GROUT HOLES (2.0-5.0m ³)
	CGV138 / CGI108 COMPACTION GROUT HOLES (5.0-10.0m ³)
	CGV138 / CGI108 COMPACTION GROUT HOLES (>10.0m ³)

Rev	Date	Auth	Description	Ckd	Apprd
A01	20.10.15	AB	FIRST ISSUE	AH	RB



Project: HIGHBARNES
CHALK MINE STABILISATION PROJECT

Drawing status: PRELIMINARY

Drawing title: TREATMENT AREA PLAN
FOR TAR0006
WITH GROUT HOLES

Drawn by:	Date:	Author:	Date:
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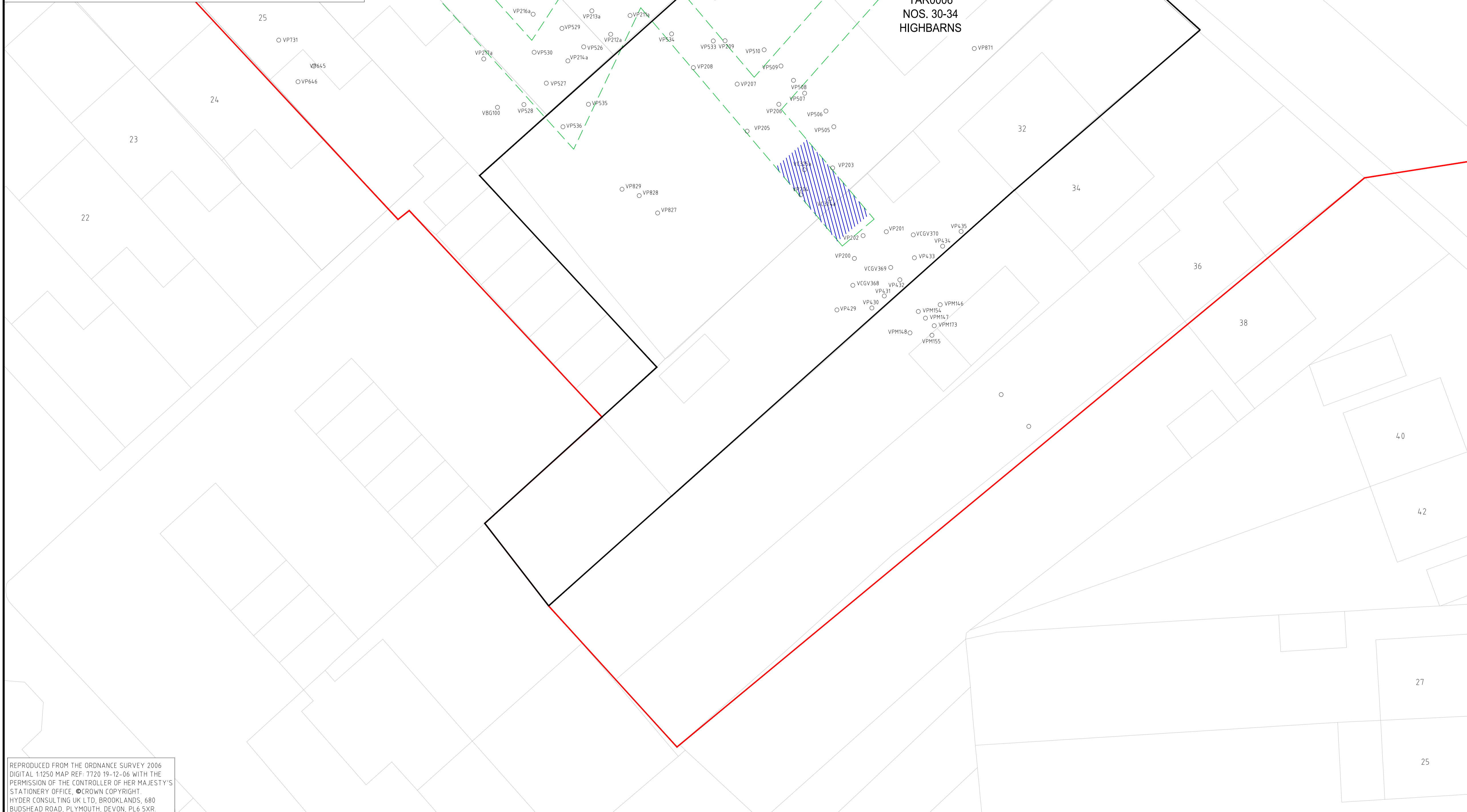
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Drawing No.:	TAR0006-01	Revision:	A01

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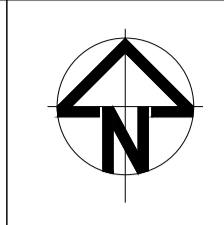
TREATMENT AREA PLAN
SCALE 1:150



SITE MAP
NTS



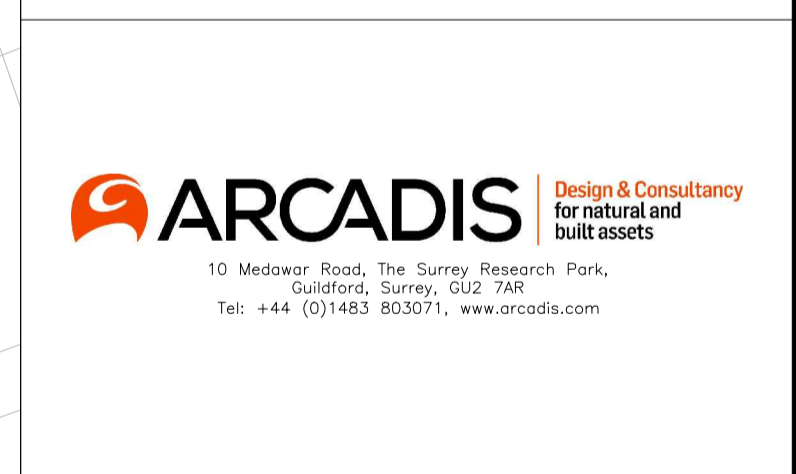
TREATMENT AREA PLAN
SCALE 1:150



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	VOIDS IDENTIFIED BY LASER SURVEYS UNDERTAKEN IN 2008 AND REMEDIATED IN 2008 (SEE NOTE 4)
	INTERPRETED SHAFT LOCATION FOLLOWING TREATMENT
	VP249/VPM249/ DPM249/VPP249
	VALIDATION DYNAMIC PROBES

Rev	Date	Auth	Description	Ckd	Apprd
A01	20.10.15	AB	FIRST ISSUE	AH	RB



Project: HIGHBARNES
CHALK MINE STABILISATION PROJECT

Drawing status: PRELIMINARY

Drawing title: TREATMENT AREA PLAN
FOR TAR0006
WITH VALIDATION PROBES

Drawn by: D.MORE	Date: 20.10.15	Author: A.BLAKE	Date: 20.10.15
Checker: A.HOPE	Date: 20.10.15	Approver: R.BARSBY	Date: 20.10.15

Scale: AS SHOWN ON DRAWING	Sheet No.: 01
Drawing No.: TA0006-02	Revision: A01

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