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Dafydd Edwards  
Senior Architectural Technician  
Blueprint Architectural Services  
Office 3K4  
Redwither Tower  
Redwither Business Park  
Wrexham LL13 9XT

17<sup>th</sup> June 2020

Dear Dafydd,

**RE: BRYN GLAS RHOS: MINING STUDY**

**1.0 Introduction**

It is proposed to develop a site in Bryn Glas in Rhos, Wrexham. This will involve demolition of the existing bungalow on site, which will be replaced with three new houses.

However, following guidance from the Coal Authority, the Local Authority Planning Department have requested further information on the risk of shallow mining at the site.

Blueprint Architectural Services (BAS) are the architects for the scheme and they have appointed GroundSolve Ltd on behalf of the client to investigate the mining risk at the site and give recommendations on what investigation/remedial measures need to be undertaken.

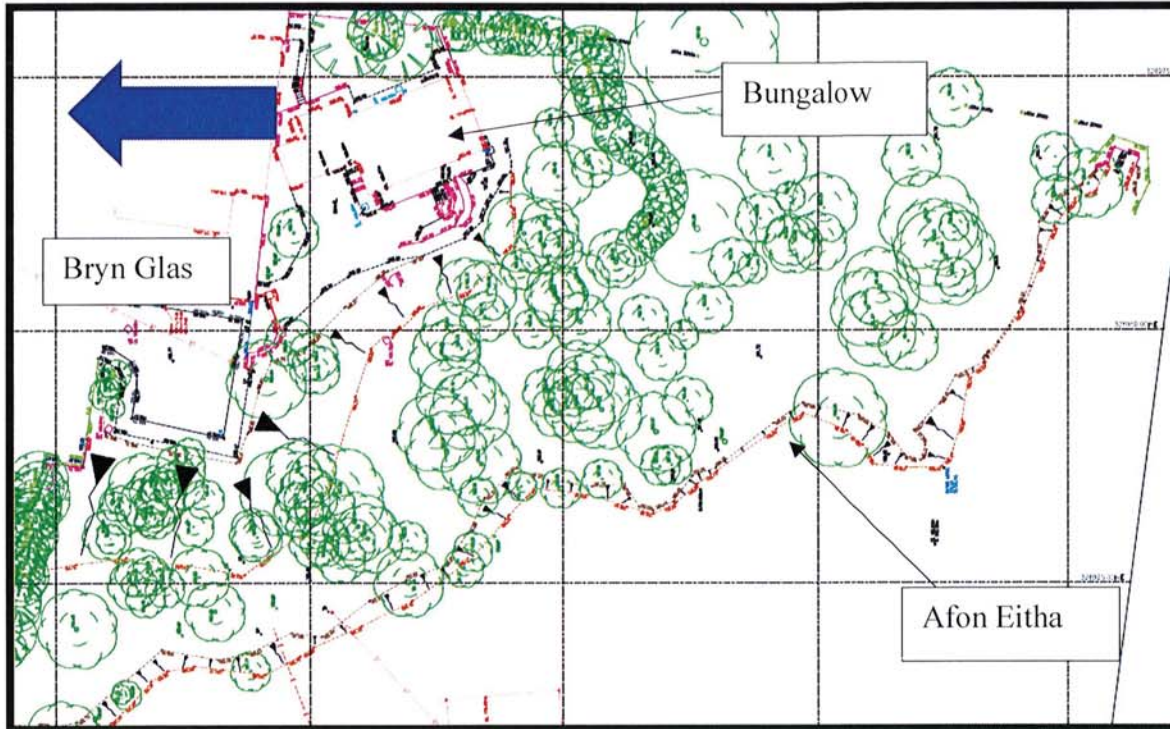
The investigation was initially limited to a desk study, which was followed by several trial pits in the vicinity of a possible shaft location on site. This work was reported in December 2018 and February 2020.

More recently the existing bungalow on site has been demolished, which has enabled a more detailed search for the shaft to be undertaken. In addition, a borehole was drilled to prove if shallow abandoned mine workings was an issue at the site.

This letter report presents the findings of the desk study, shaft searches and site investigations. It discusses the risks posed by shallow abandoned mine workings and gives geotechnical recommendations for the site.

## 2.0 Site Location and Description

The site is located at 57 Bryn Glas, Rhos, in Wrexham at National Grid Reference SJ 289 459. The site was originally occupied by a single brick bungalow, with the rest of the site heavily wooded, see previous site layout below.



### Previous Site Layout

Recently the bungalow has been demolished and many of the trees have been felled.

The site is bounded by housing and Bryn Glas to the north, a footpath along the line of a disused railway to the east, and a stream known as the Afon Eitha to the west.

A topographical survey provided by the client revealed the existing floor slab elevation to be 167mAOD. The ground levels reducing to around 158mAOD on the southern site boundary adjacent to the Afon Eitha.

To the west of the existing house the ground level drops quite steeply, and it appears this section of the site has been filled, as the general slope towards the Afon Eitha is quite gentle.

Photographs of the site prior to / and post demolition are presented in Appendix A.

### 3.0 Geology

The geology of the site has been studied on the following sources:

- 1:50,000 scale geology plan, Sheet 121 Wrexham,
- Historical geology plans at a scale of 1:10,560,
- Wrexham study at a scale of 1:25,000,
- Geological memoirs.

The site is shown to be underlain by glacial till, with the superficial deposits being between 15 to 20m thick.

The Wrexham study shows the Red coal seam outcropping immediately west of the site, which is then underlain by the Fireclay Group.

The 1977 geology plan at a scale of 1:10,560 shows the Red seam outcropping to the east of the site, along the railway line, with the Fireclay Group outcropping immediately downslope of the site.

The memoirs record the following sequence in descending order:

- Red Coal,
- Stone Coal,
- Fireclay,
- Half Yard Coal,
- Fireclay,
- Firedamp Coal

The separation given between the Red Coal and the Firedamp Coal is only 15m.

### 4.0 Mining

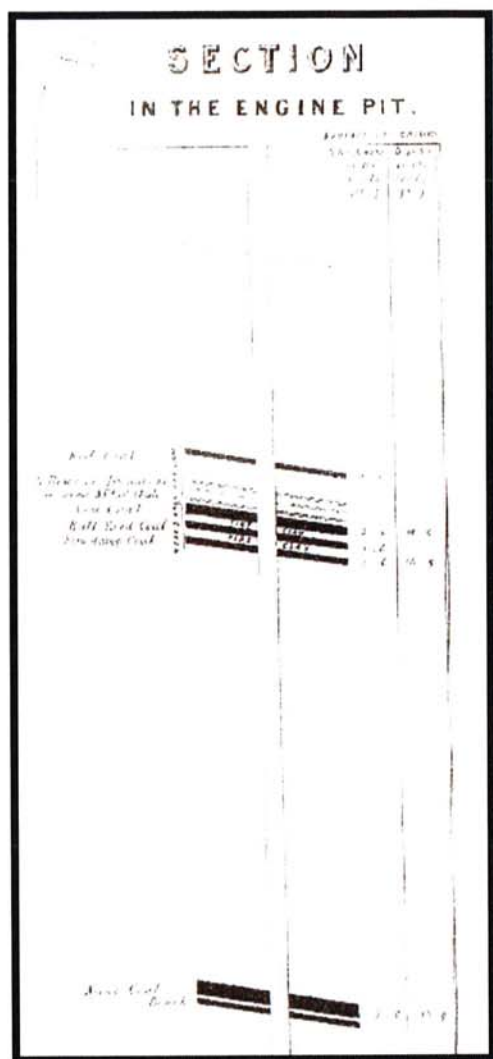
A Coal Consultants report has been obtained from the Coal Authority, the findings are summarised below, and presented in full in Appendix B.

- The site has been undermined in the Ruabon Yard (Soft five quarters) coal at an estimated depth of 17m, last mined in 1872,
- However, it also records it being worked at a depth of 54 beneath the site, last worked in 1862,
- The seam thickness was 1.0m, and dipped at 6° in an easterly direction,
- The outcrop of the Stone coal seam is shown crossing the western section of the site,
- It concluded that there are probably unrecorded mine workings beneath the site,
- A shaft is shown on the site beneath the northern section of the existing building,
- No treatment details are known for the shaft.

A sequence from the engine pit of Afon Eitha Colliery, which was just to the south of the site is presented below.

This shows the Red Seam underlain by three rows of ironstone, the New Coal (Stone), Half Yard Coal and the Firedamp Coal and their fireclays.

Seams at greater depth beneath these include the Nant, Yard, Wall and Bench and the Llwyn Ennion.



### Geological Sequence beneath the site

Mine plans held by GSL show workings from the Rhos Farm Colliery, which was immediately west of the site in the Yard Coal dated 1850, which were pursued by total extraction methods. In addition, the Wall and Bench coal was worked. However, the workings were shown to the west of the site itself.

No records of workings in the Fireclay sequence were encountered.

## 5.0 History

The history of the site has been studied on old Ordnance Survey (OS) plans dating from 1874 through to the present day. In addition, the 1850 Public Health Plan, at a scale of 1:500 in GSL archives has been studied.

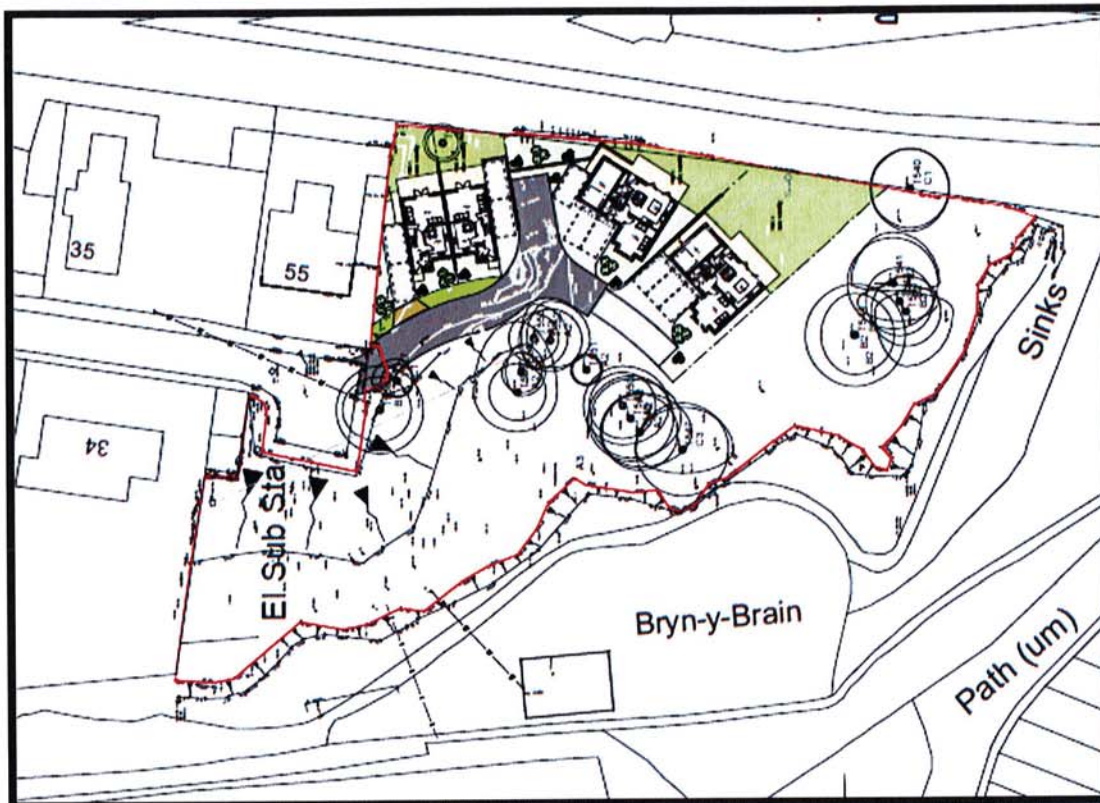
The 1850 Public Health Plan failed to reveal any shaft on site or any evidence of mining close to the site. The closest shafts were to the east of the old railway line, which had been constructed on the eastern site boundary by 1850.

An OS plan dated 1874 shows there to be an active coal shaft immediately west of the site, probably associated with Rhos Farm Colliery, with a disused shaft to the east of the site.

No other changes were noted relating to mining, and the current house had been constructed by the 1976 OS plan.

## 6.0 Proposed Development

The proposed development will comprise three new properties and associated gardens and access roads. The proposed development layout is presented below.



### Proposed Development Layout

## 7.0 Previous Investigation

A borehole found on the BGS website drilled around 100m south of the site proved some 65' (19.80m) of sand and gravel, with 35' (10.67m) of shale proved beneath the sand and gravel, giving a total depth of 100' (30.50m). A total of eight boreholes were drilled with no workings being encountered.

The borehole location and log are presented in Appendix C.

## 8.0 This Investigation

Following submission of the desk study report, the client instructed further investigation prior to demolition of the property to assess the likelihood of the shaft actually being present. This would then enable a decision to be made on the viability of the site's development.

Evidence of the shaft being provided by:

- Brick/masonry liner to the shaft,
- Colliery spoil present around the shaft,
- Other spoil that may have been derived from excavations for the shaft construction.

It comprised five machine excavated trial pits around the existing building to a maximum depth of 1.80m, using a 3T excavator provided by the client. The pits were only excavated to prove the underlying natural ground, as the shaft would have had to pass through this material.

The work was supervised on a full-time basis by a chartered geologist from GSL. The location of the trial pits is presented in Figure 1, along with the plotted location of the shaft, with the trial pit logs presented in Appendix D.

Following demolition of the bungalow and removal of the trees it was possible to carry out a proper search for the shaft and gain access to drill a borehole to investigate the possibility of shallow abandoned mineworking's.

The search was undertaken on the 11<sup>th</sup> March 2020 by excavating to the top of the glacial till over a wide area, using a tracked excavator. The extent of the excavation is presented in Figure 2, with photographs in Appendix E.

As part of this investigation, several machine excavated trial pits were undertaken to enable foundations recommendations to be given. This was considered critical as several of the houses would be in the area where clay was present and trees had been removed, leading to concerns regarding potential ground heave.

The location of the trial pits is shown on Figure 1, with the trial pit logs presented in Appendix F.

To enable geotechnical recommendations to be given, the following physical testing was undertaken:

- Moisture Content 3No,
- Atterberg Limit tests 3 No,
- pH & Sulphate analysis 2No.

The test results are discussed in Section 9.0, with the results presented in full in Appendix G.

Finally, a rotary borehole was drilled by CCG to a maximum depth of 25m on the 17<sup>th</sup> March 2020. The borehole was supervised and logged by an engineer from GSL. Its location is presented on Figure 1, with the log presented in Appendix H.

## 9.0 Ground Conditions

The findings of the trial pits and borehole are summarised in the table below:

| TP/BH No | Topsoil (m) | Made Ground (m) | Old topsoil layer (m) | Glacial Till (m)           | Sand and Gravel (m) |
|----------|-------------|-----------------|-----------------------|----------------------------|---------------------|
| 1        |             | 0.0 – 0.60      |                       | 0.60-1.00                  |                     |
| 2        |             | 0.0-0.90        | 0.90-1.10             | 1.10-1.35                  |                     |
| 3        | 0.0-0.30    |                 |                       | 0.30-0.55                  |                     |
| 4        | 0.0-0.30    |                 |                       | 0.30-0.55                  |                     |
| 5        |             | 0.0-1.10        | 1.10-1.50             | 1.50-1.80                  |                     |
| 6        |             | 0.00-0.60       |                       | 0.60-2.50                  | 2.50-3.0            |
| 7        |             | 0.00 – 0.30     |                       | 0.30 – 1.90                | 1.90 – 2.80         |
| BH1      |             | 0.00 – 1.30     |                       | 1.30 – 2.00<br>11.0 – 25.0 | 2.00 – 11.0         |

### Made Ground

In TP 1 a thin layer of sub base overlay a dark grey to brown, silty clay, with a little gravel, tiles and roots were also observed, suggesting the sub base had been placed on the previous surface level.

TP 2 was excavated in the raised area at the front of the property. It encountered demolition debris, described as loose, brown and orange, brick and tile fragments, in a sandy gravelly matrix. This layer sat on a thin layer of sub base, resting on the old topsoil layer. This proved conclusively that this fill was placed following construction of the property.

TP 3 and 4 were excavated at the rear of the property and encountered topsoil resting directly on the glacial till.

TP 5 excavated at the front of the property, where the fill was thickest, encountered 1.10m of demolition debris, comprising loose, bricks and masonry, overlying the old topsoil layer and the glacial till.

TP 6 & TP 7 excavated post demolition encountered clay with several brick fragments.

### Glacial Till

The glacial till was proved in all of the trial pits and the borehole, where it was described as firm to stiff, orange brown, silty clay, with a little to some sub angular to sub rounded fine to coarse gravel.

It comprised an upper layer, proved to a maximum depth of 2.50m, and a lower layer between at 11.50 and 25m.

Atterberg limit testing recorded liquid limits between 25 and 33%, plastic limits between 16 and 18%, with plasticity indexes between 9 and 15%, indicating a clay of low plasticity. Natural moisture contents were between 13.4 and 19%. TP 6 was excavated as the control pit, with TP 7 excavated in the vicinity of the trees.

pH values in the till were between 6.40 and 6.49, with sulphate values when measured as 2:1 water extract of between 0.018 to 0.025 g/l.

### **Sand and Gravel**

This was described as loose to medium dense, yellowish brown, sand and gravel, in a sandy clay matrix. They were proved between 1.90 and 11.50m depth.

The superficial deposits were proven to a maximum depth of 25m, whereby, it was not possible to progress further as the drillers had run out of casing.

The sequence comprises glacial till deposited beneath advancing ice sheets, with the sand and gravel deposited by glacial meltwaters as the ice sheets retreated.

### **Groundwater**

Groundwater was encountered in the trial pits and borehole on encountering the sand and gravel. Groundwater flows being copious when drilling the borehole.

It should be noted that the sand and gravel was encountered to a depth of 11.50m, given that the Afon Eitha is some 9m below site levels, the sand and gravel must be in hydraulic continuity with the river.

## **10.0 Mining Risk Assessment**

### **Shaft**

The desk study confirmed that the shaft pre dates 1850, as there is no trace of it on the 1850 Public Health Plan or the later OS plans.

In addition, the site investigation failed to reveal any evidence for the shaft, with all of the fill being demolition debris and placed following construction of the property. No colliery spoil or evidence of any other mining fill was encountered.

The site investigation has also confirmed that the development area is free of unrecorded shafts.

Therefore, the shaft is not considered to be present on site. However, the potential for the shaft to exist has to be considered within the wider mining context to allow an assessment of the potential for shallow unrecorded mine workings.

Rhos has been widely mined for shallow coals for many centuries. However, this was largely undertaken in areas where the coal seams outcrop at shallow depth, and whereby drainage of the workings was easy. I.e. over most of the area.

At the time of the possible workings, it would have been standard practice to sink the shaft and then work the coal up dip to ensure that the workings would drain by gravity, as pumping capacity at the time would have been limited. It is therefore considered highly unlikely that this shaft worked the shallow seams, as the dip would have meant working the seam at shallow depth beneath the Afon Eitha, with the inherent risks this would have entailed.

Given the findings of the borehole, which would have meant that extensive pumping would have been required. This would have made this area uneconomic when compared to nearby mines, where coal was easily accessible close to surface. It would also have meant that the shaft would have had to be lined with brick or masonry to penetrate the substantial thickness of superficial deposits.

### **Shallow Abandoned Mine Workings**

BH 1 recorded similar ground conditions to the previous nearby borehole, which proved 19.80m of sand and gravel, with 10.67m of shale proved beneath the sand and gravel, giving a total depth of 30.50m.

The Coal Consultants report records that the site had been undermined in the Ruabon Yard at 17m depth, with the last date of mining being 1872. This is important as 1872 was the year it became legal to deposit mine plans. At this time the mining would have been by total extraction techniques. However, this report is contradictory in that it also records the same seam being worked at 54m beneath the site.

The superficial deposits were encountered to a depth of greater than 25m and the borehole drilled immediately south of the Afon Eitha is roughly along the strike of the bedrock, which dips gently in an easterly direction. Consequently, similar ground conditions would be anticipated beneath the site as in BH 1, see Appendix C.

In the previous investigation a total of eight boreholes were drilled, with no workings being encountered. The other boreholes proved between 12.2 to 24.7m of superficial deposits. In addition, these boreholes were drilled up dip of the sequence anticipated beneath the site, meaning that any coal seams would be anticipated to get shallower in a westerly direction. BH 8 the most westerly borehole drilled some 200m west of the site did not encounter any coal or workings by a depth of 30m, with 18.28m of rock proved. Therefore, given a dip of 6° in an easterly direction the strata at the base of BH 8 would be at a depth of 50m.

Therefore, based on the above, given the thickness of the superficial deposits beneath the site, it is considered unlikely that the recorded seams actually outcrop beneath the site, and if present would have been highly weathered and unlikely to be worked. In addition, the Red seam has not got a reputation for being worked.

In addition, as mentioned above, the presence of the Afon Eitha and the highly permeable sand and gravel means that shallow mining beneath the site is considered highly unlikely.

Given the findings above, the site is not considered to be at risk from shallow abandoned mine workings.

### **Foundations**

The volume change potential of the glacial till is calculated from Table 1 of the NHBC guidance on building near trees, where:

$$I_p = I_p \times \frac{\% \text{ less than } 425\mu\text{m}}{100\%}$$

This gives modified plasticity indices of low volume change potential.

As the site is on clay soils where trees have recently been felled, an assessment of what extent the soils have been affected needs to be undertaken.

Work by the TRRL developed an apparatus that measures the pressure required to drive water out of soil and this was used to determine water content/suction relationships for very plastic soils.

This work resulted in the recommendation that if:

$$W < 0.4 W_L$$

Then significant desiccation of the clay may have occurred.

Where:

$W$  = moisture content,

$W_L$  = liquid limit of the clay.

A review of the test data, confirms that this method fails to record any evidence of the clay being desiccated.

In addition, BRE Digest 412, Desiccation in clay soils 1996, refers to the liquidity index of the soil being used to assess desiccation levels, which is given by the equation.

$$I_L = \frac{W - W_p}{I_p}$$

Where  $I_p$  = the plasticity index of the soil.

$W_p$  = Plastic limit of the clay.

Values of  $I_L = 0$ , means that the soils water content is at the Plastic Limit, while negative values indicate the soil is drier than the Plastic Limit, i.e. showing signs of desiccation.

From the test result, a worst-case value of -0.29 has been calculated, confirming that desiccation needs to be considered. However, this value is not considered to be representative as the near surface sample failed to record any evidence of desiccation and the test at 2.0m is close to the sand and gravel, where water would be easily obtained. In addition, the root system of the trees was observed to be at shallow depth.

The detailed analysis is presented below, which shows those results where probable desiccation has been encountered.

#### SHRINKAGE TEST RESULTS

| TP No | Depth (m) | Ip % | WL % | Wp % | W %  | 0.4WL | <W   | IL=W-Wp | /Ip   |
|-------|-----------|------|------|------|------|-------|------|---------|-------|
| 6     | 1.10-1.10 | 15   | 33   | 18   | 18.2 | 13.2  | -5   | 0.20    | 0.01  |
|       | 2.0-2.10  | 9    | 25   | 16   | 13.4 | 10    | -3.4 | -2.60   | -0.29 |
| 7     | 1.00-1.10 | 14   | 31   | 17   | 19   | 12.4  | -6.6 | 2.00    | 0.14  |

Probable desiccation

The foundation depths for any plots close to remaining trees will have to be calculated in accordance with the NHBC guidelines, which will involve getting the trees identified and determining the distance of the tree from the plot.

For those in areas of felled trees, whilst the risk from ground heave is considered to be low, the consequences of any ground heave are considered to be high.

Therefore, heave protection measures should be placed around the foundations and the floor slab should be designed to be suspended.

An allowable bearing pressure of 100kN/m<sup>2</sup> can be used for the design of any foundations, which should extend a minimum of 1m below final ground levels.

The chemical test information has revealed that chemical attack of buried concrete is not an issue, and buried concrete can be designed in accordance with the following classes.

- AS – 1,
- ACEC -1.

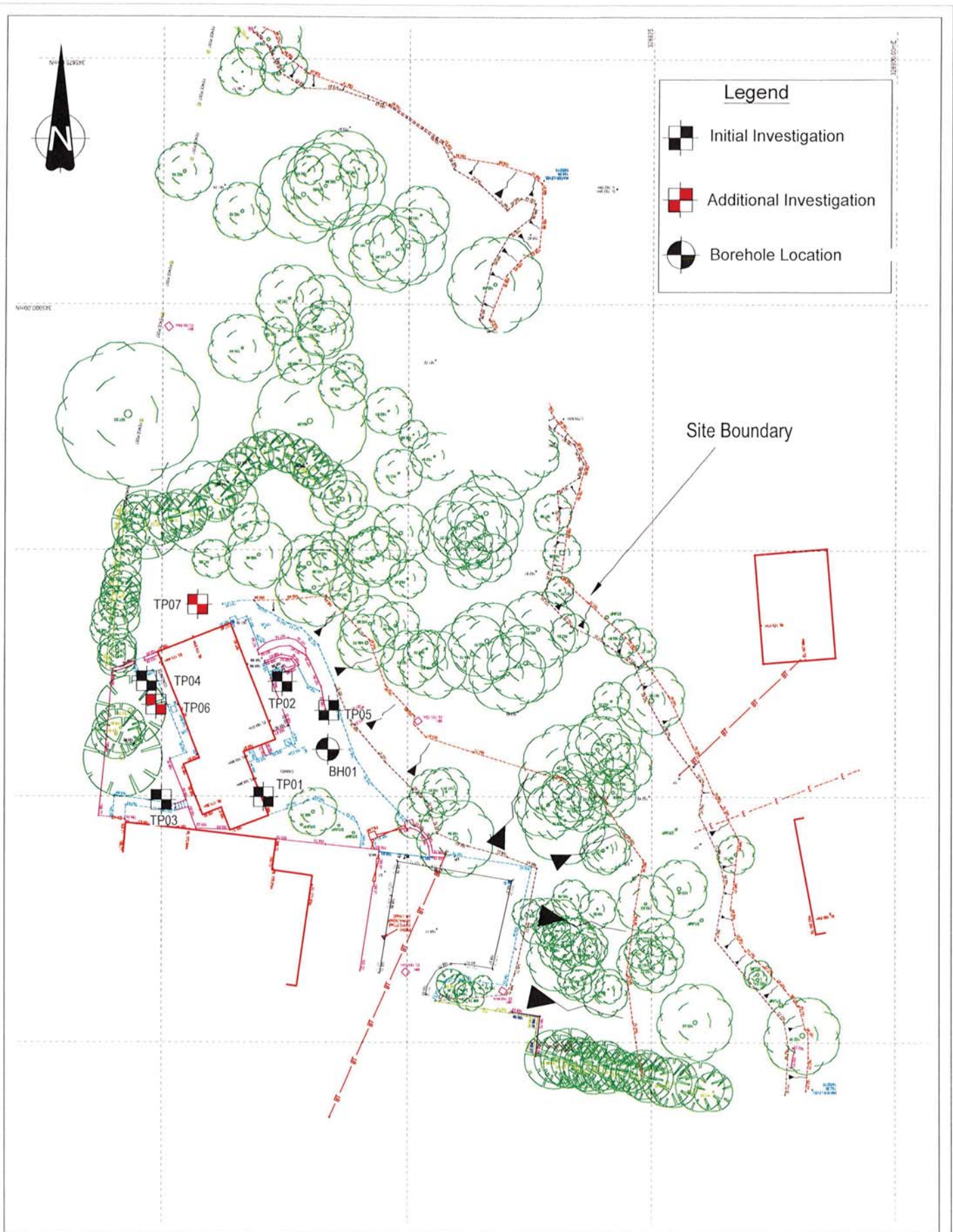
We trust this is satisfactory, should you have any queries please call Mike Scott on 01244 661361.

Yours sincerely



Mike Scott

## FIGURES



SCALE 1:500 @ A4

Figure Title  
LOCATION OF TRIAL PITS

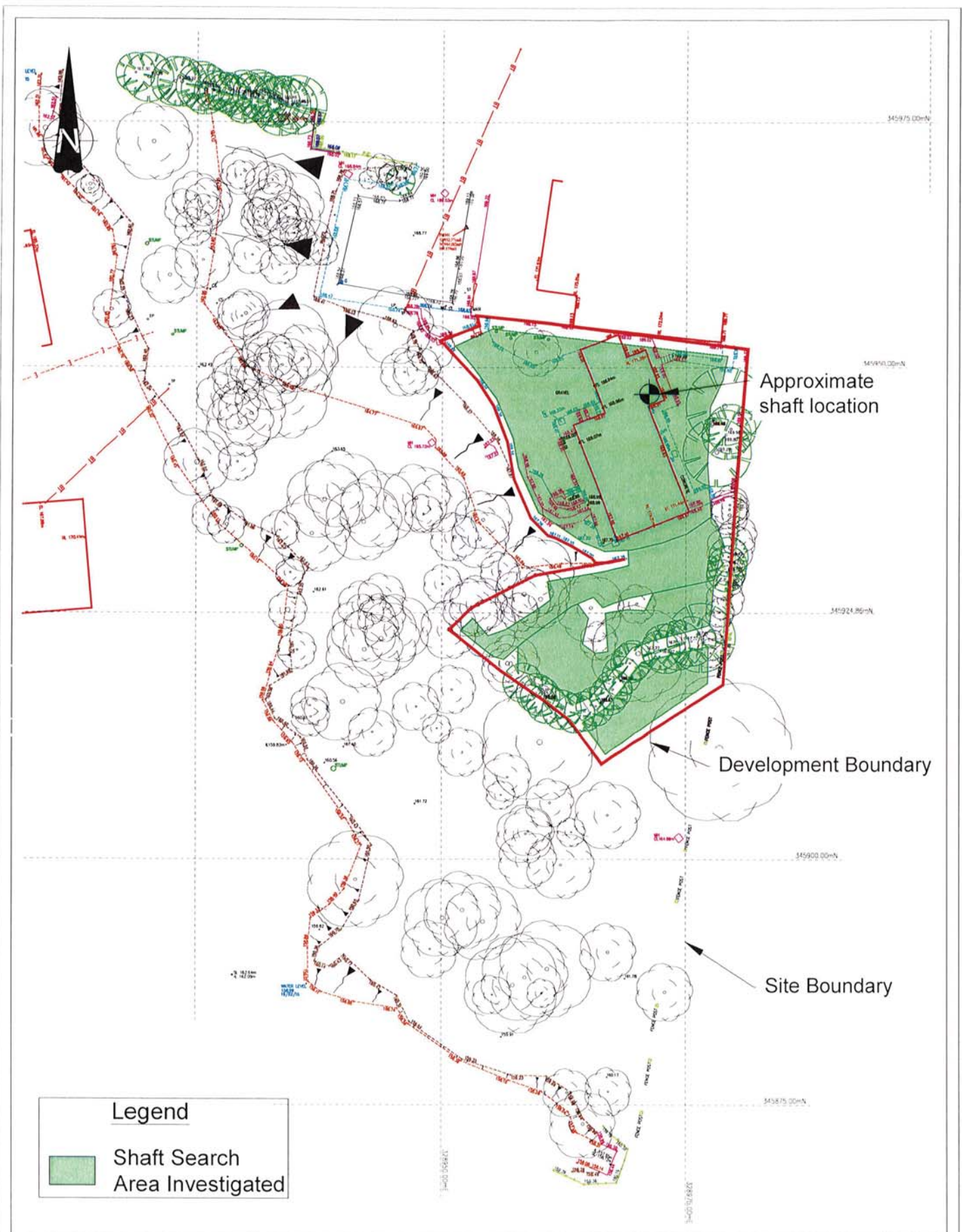


Figure Title

SHAFT SEARCH

FIGURE 2