



## **Harrow Estates**

### **Earthworks Completion Report**

**for**

**Former Brothers Industries,**

**Croesnewydd Road,**

**Wrexham**

**June 2013**

**REPORT NO: 11HEY002/EW**

- *Phase 1 Desk Studies and Site Walkovers*
- *Phase 2 Intrusive Contaminated Land Investigations*
- *Geotechnical Appraisals and Ground Investigations*
- *Landfill Gas Assessments and Remedial Design*
- *Remediation Design and Implementation*
- *Remediation Project Management and Supervision*
- *Site Abnormal Assessments (Foundations and contaminated land)*
- *Ecological Surveys (Bats, Badgers, Newts, Japanese Knotweed etc)*

**GEOTECHNICAL - CONTAMINATED LAND - ECOLOGY - FLOOD RISK**

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**DOCUMENT ISSUE RECORD**

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## SUMMARY

Harrow Estates (The Client) propose to redevelop a parcel of land Former Brothers Industries, located off Croesnewydd Road, Wrexham. LL11 3BN.

The site comprises the former Brother Industries Factory, constructed on a 'Greenfield' site in 1986 and was used as a typewriter assembly and distribution plant until 1994. The factory was then occupied by a company called SPi Europe who manufactured blown plastic toys who vacated the site in 1999.

Harrow purchased the site on the 19th August 2005 and since this date has undertaken site investigation, site clearance, asbestos removal and demolition works between 2006 and 2007.

CMR (Demolitions) Ltd carried out the demolition of the Brother's Industries Factory site with all above ground structures were demolished and all foundations and underground obstructions were excavated where encountered to a depth of 2m below existing ground level. The only exceptions to this were the former substation building (which remains on site but has now been fully decommissioned) and boulders identified within the infilled pond area.

The infilled pond, backfilled with large limestone boulders, was to be dealt with in this earthworks to allow residential end use, following reclamation via a removal and crushing of the boulders within the pond controlled followed by redistributing a large bund across the site and within the former pond via engineering filling operation.

Betts Geoenvironmental Ltd was requested by the Client in April 2011 to produce a specification for the re-compaction of site won fill materials and in September 2011 to monitor the earthworks, via daily visual inspection of the filling operations and witnessing of the earthworks verification testing, which was undertaken by Murray Rix Ltd (to the instruction of the contractor Buckingham's).

The site was restored via the excavation, crushing, removal of unsuitable material and controlled engineered filling exercise.

The earthworks operations undertaken by Buckingham's (the contractor), under the supervision of the Betts Geoenvironmental.

In order to remove the potential foundation obstructions posed by the boulders within the former pond, excavation of the boulders was undertaken, boulders crushed on site to 6F2 grading and resultant void backfilled. The crushed aggregate from the boulders was to be stockpiled on site for future reuse.

In order to provide a development platform, the large mound of material in the south of the site was excavated and placed in layers and compacted to create a new site surface in accordance with agreed contours for future redevelopment to a level of around 97mAOD for the main development area. The area of the former pond receiving engineered fill as a priority to ensure settlement of the backfilled area was acceptable for development and site development 'abnormal' removed.

The materials were classified in accordance with the Specification for Highway Works as stony cohesive materials. Based upon laboratory test data (Undertaken by Betts Geoenvironmental April 2011) an upper limit for moisture content of 17% was specified and an average optimum dry density of 1.63Mg/m<sup>3</sup> initially adopted.

The laboratory data was provided to Buckingham's and suitable compaction plant selected.

Prior to undertaking the major earthworks, a field trial test panel compaction was undertaken due to variable natural moisture content. Compactions were recorded by sand replacement tests, Dry Density Moisture Content relationships and CBRs, all proved to be acceptable. To aid speed of field testing calibration of a nuclear density meter was undertaken on the test panel; however compaction within the pond area also contained sand replacement tests on selected layers to provide further confidence with the NDT calibration results.

Prior to earthworks CBR's were undertaken on the proposed basal layer for placement with the majority of

CBRS being >5% prior to proof rolling. During the earthworks the majority of the placed moisture contents were recorded at or below the conformance criteria, with 100% of the dry density test results were found to be greater than 95% of the optimum dry density criteria 1.8Mg/m<sup>3</sup>

Verification testing comprising Plate Load Tests and NDM tests were undertaken at selected locations across the site confirming the compaction.

It is anticipated that foundations will be deepened through the fill into competent undisturbed natural clay (around 95 - 96mAOD) and raft solution adopted in the infilled pond area (50kN/m<sup>2</sup> bearing capacity applicable).

Based upon site observations during the reclamation operation, a review of the available earthworks control and verification test data it is considered that the site is suitable for the residential development and associated highway construction.

**CONTENTS****1.0 INTRODUCTION****2.0 BACKGROUND**

- 2.1 Site location and description
- 2.2 Site History
- 2.3 Geology

**3.0 ENGINEERED FILLING WORKS**

- 3.1 Earthworks
- 3.2 Earthworks Control Testing
- 3.3 Verification Testing

**4.0 SUMMARY****5.0 REFERENCES****APPENDIX A**

- Figure 1 - Site Location Plan
- Figure 2 - Proposed Development Plan
- Figure 3 - Pond Excavation Plan
- Figure 4 - As-built Topographic Survey

**APPENDIX B COMPACTION TEST RESULTS****APPENDIX C PLATE LOAD TEST RESULTS****APPENDIX D NUCLEAR DENSITY TEST RESULTS****APPENDIX E SITE PHOTOGRAPHS**

## **1.0 INTRODUCTION**

- 1.0.1 Harrow Estates Ltd (The Client) propose to redevelop the parcel of land, which comprises the former Brother Industries Factory. The former Works are situated off, Croesnewydd Road, Wrexham. LL11 3BN (331850E, 350580N)
- 1.0.2 Betts Geoenvironmental Ltd (BGE) was requested by the Client in April 2011 to produce a specification for the re-compaction of site won fill materials. The earthworks operations were undertaken by Buckingham Ltd (the principal contractor), the bulk of which was undertaken within September 2011, under the supervision of BGE
- 1.0.3 BGE was requested to monitor the earthworks, via periodic visual inspection of the filling operations and witnessing of the earthworks verification testing, which was undertaken by Murray Rix Ltd (to the instruction of the Contractor).
- 1.0.4 The client intends to develop the site for residential end-use. It is understood that the development will comprise 76No residential properties with associated car parking and landscaping.
- 1.0.5 This report provides a review of the earthworks/filling operations, earthworks control and verification test results with respect to the proposed residential development.

## **2.0 BACKGROUND**

### **2.1 SITE LOCATION AND DESCRIPTION**

- 2.1.1 The former Brother Industries Factory was constructed on a 'Greenfield' site in 1986 and was used as a typewriter assembly and distribution plant until 1994. The factory was then occupied by a company called SPi Europe who manufactured blown plastic toys who vacated the site in 1999.

Harrow purchased the site on the 19th August 2005 and since this date has undertaken site investigation, site clearance, asbestos removal and demolition works between 2006 and 2007

The site is accessed via Croesnewydd Road which forms the sites eastern boundary. Its other boundaries consist of the River Gwenfro to the south, commercial / offices to the north and the A483 which is elevated above the site to the west.

The proposed works are:

A large mound of material is to be excavated and placed in layers and compacted to create a new site surface in accordance with agreed contours for future redevelopment.

Excavation of boulders within a former pond, crushing to aggregate for stockpiling and future reuse on site and backfilling the resultant void with reengineered fill compacted to create a new site surface in accordance with agreed contours for future redevelopment.

Works also include the demolition of a small former substation building and removal of the ground slab, crushing of the material and stockpiling for reuse on site

### **2.2 BRIEF SITE HISTORY**

- 2.2.1 The site remained undeveloped until 1986 when the Brother Industries Factory was constructed on a 'Greenfield' site in 1986 and was used as a typewriter assembly and distribution plant until 1994. The factory was then occupied by a company called SPi Europe who manufactured blown plastic toys who vacated the site in 1999.

Prior to the purchase of the site in 2005 a Site Investigation comprising of a Phase 1 and 2 was carried out by Listers Geotechnical Consultants for the previous owners. Following the purchase, Harrow Estates appointed WSP Environmental to carry out additional investigations that superseded the Listers reports.

A WSP Geo-Environmental Investigation was carried out in November 2005 and reported in January 2006. Following demolition, an additional Trial Pit investigation was carried out in May 2007 to investigate areas beneath the floor slab of the former factory building that were inaccessible during the

first phase of works.

- 2.2.2 The site underwent decommissioning and reclamation during 2006/7. CMR (Demolitions) Ltd carried out the demolition of the Brother's Industries Factory site with all above ground structures were demolished and all foundations and underground obstructions were excavated where encountered to a depth of 2m below existing ground level. The only exceptions to this were the former substation building (which remains on site but has now been fully decommissioned) and boulders identified within the infilled pond area.

An additional ground investigation was under taken in April 2011 by Betts to establish the extents of the infilled pond/boulders and confirmation of materials within the earthworks mound to the south for suitability for spreading across site under a controlled engineered fill.

## 2.0 BACKGROUND - CONTINUED

## 2.3 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

### 2.3.1 Geology

The British Geological Survey (BGS) sheet at 1:50,000 scale, Sheet 121 (Wrexham) has been consulted. This shows the site to be directly underlain by superficial drift deposits comprising Glacial Till and Sands and Gravels, the thickness of which could not be ascertained from the available geology maps. Alluvium drift deposits are shown towards the site's southern boundary, which are associated with the River Gwenfro, observed encroaching on to the site's western boundary.

The superficial deposits are shown to be underlain by the Carboniferous Coal Measures at depth.

A Coal Authority Mining Report was commissioned for the site. This states that:

- The property is within the likely zone of influence on the surface from workings in 3 seams of coal at 240m to 280m depth, the last date of working being 1932. Ground movement from the past coal workings should have ceased.
- The property is not within the zone of likely physical influence on the surface from present underground coal workings.

### 2.3.2 Hydro-geology

The Environment Agency (EA) Groundwater Vulnerability Map and Regional Appendices, which make up part of the published Policy and Practice for the Protection of Groundwater, divide the underlying strata in England and Wales into major, minor and non aquifers dependent upon their potential for potable water supply. Based on the EA Groundwater Vulnerability map for the area Sheet 16, (West Cheshire) the strata underlying the site are classified as minor aquifer (Carboniferous Coal Measures) overlain by soils of high leaching potential (Alluvium and Glacial Drift Deposits). Minor aquifers are considered fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although these aquifers will seldom produce large quantities of water for abstraction, they are important both for local supplies and in supplying base flow to rivers. The overlying high leaching potential soils have little ability to attenuate diffuse source pollutants and will readily transmit liquid discharges.

The map also shows the site to have variable permeability, with possibly water bearing drift deposits occurring at the surface.

Review of the Environment Agency website identifies that the site does not lie within a Groundwater Source Protection Zone.

There are two licensed groundwater abstractions with a 1 km radius of the site, both of which are not

attributable to the site and are for industrial use. No potable water abstractions have been identified within 2km of the site.

### 2.3.3 Hydrology

The nearest identifiable surface watercourse to the subject site is the River Gwenfro, observed encroaching onto the site along its southern boundary (partially in-culvert). The River Gwenfro is classified under the Environment Agency's General Quality Assessment scheme:

- River Gwenfro Grade B (good) On site
- River Gwenfro Grade E (poor) Southeast 186m
- River Gwenfro (1993 – 2000) Grade A (very good) to Grade B (good) East 527m

### 3.0 ENGINEERED FILLING WORKS

#### 3.1 EARTHWORKS

- 3.1.1 Owing to the various historic phases of reclamation works at the site, which included the demolition and removal of the superstructure and foundations (by others), the near surface deposits have been significantly reworked.
- 3.1.2 The site was restored via the controlled engineered filling exercise in September 2011, the earthworks operations being undertaken by Buckingham Ltd (the principal contractor), under the supervision of BGE.
- 3.1.3 The placement of the fill was carried out in accordance with a method specification. The method-based specification criteria for the materials were initially based on the results of compaction tests, Plasticity tests, organic content and Particle Size Distributions undertaken by BGE, on samples of stony cohesive material within the mound in the south of the site.
- 3.1.4 The materials were classified in accordance with the Specification for Highway Works (SHW) as Class 2C Stony Cohesive fill materials. The available laboratory test results recorded optimum moisture contents and maximum dry densities of between 9-17% and of 1.63-2.01Mg/m<sup>3</sup>, respectively. Based upon these compaction results an upper limit for moisture content of 17% was specified and an average optimum dry density of 1.63Mg/m<sup>3</sup> initially adopted.
- Due to the potential variable nature of the 2C material a test bed was constructed with verification compaction testing and Nuclear Density Testing calibrated against field results to aid speed of testing / placement.
- 3.1.5 The compacted soils were placed in layers not exceeding 275mm thick and compacted by a minimum of four passes with D61px Komatsu towing a 5.9t dynapac roller operating with vibration (in accordance with SHW).
- 3.1.6 Excavated material within the former pond area and the mound to be used as fill were assessed for suitability prior to re-use. Materials that were deemed too wet (e.g. Moisture content >17%) were temporarily stockpiled and allowed to dry or improve. Moisture contents were checked within placed materials to ensure compliance with the specification.

- 3.1.7 In addition to the method-based specification, control testing criteria were defined and included compaction testing to check the general acceptance criteria (greater than 95% of the optimum dry density achieved).

### **3.2 EARTHWORKS CONTROL TESTING**

- 3.2.1 The densities of the compacted soils were generally tested via the sand replacement method and NDT as filling proceeded, together with measurements of the placement moisture content. Insitu density and moisture content determination tests were undertaken on samples of soils as filling proceeded.
- 3.2.2 The placed moisture contents fell below the <17% criteria, and hence satisfy the conformance criterion adopted for the site.
- 3.2.3 the recorded in-situ dry densities were found generally to range between 1.80 and 1.92Mg/m<sup>3</sup>, with dry density test results greater than 95% of the optimum dry density criteria, which had been initially set at 1.63Mg/m<sup>3</sup>.
- 3.2.4 On this basis, 100% of the in-situ density test results recorded greater than 95% of the optimum dry density criteria, which given the scale of the earthworks operations, variations within the materials and range of optimum dry density results obtained is considered acceptable.

### **3.3 VERIFICATION TESTING**

#### **3.3.1 Plate Load Tests**

Incremental plate load tests were undertaken at selected locations across the site as the filling operations progressed across the site and upon completion of the filling exercise. The plate load tests comprised an 0.3m diameter plate loaded to a maximum of 140kN/m<sup>2</sup>, utilising a 360 tracked machine as kentledge, with settlements measured at each of the seven increments.

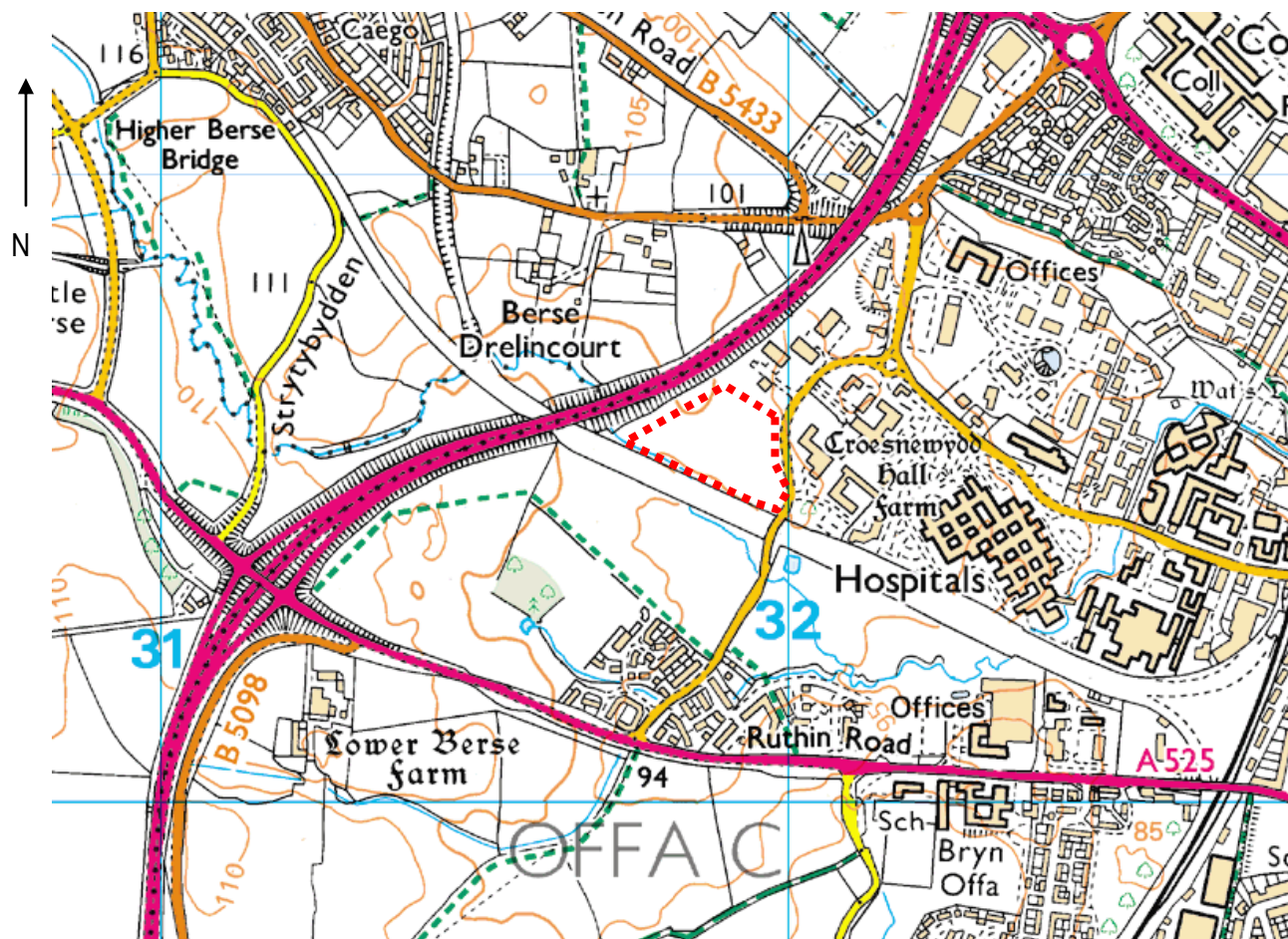
Settlements ranged from 1.73 to 6.9 and CBR ranging from 3.6 to 36% (85% of which are >5%)

#### 4.0 CONCLUSION

- 4.0.1 The proposed development is to comprise the construction of residential properties with associated car parking and landscaping. It is anticipated that column and line loads will be supported on conventional foundations through the fill into competent undisturbed glacial till (detailed zoning plan is required). Rafts are deemed applicable upon the compacted fill within the former pond providing that a bearing capacity of 50kN/m<sup>2</sup> is adopted.
- 4.0.2 Based upon BGE site observations during the reclamation operation, a review of the available earthworks control and verification test data it is considered that the site is generally suitable for the intended end use.
- 4.0.3 It should be noted that the clay material is prone to deterioration during periods of inclement weather and hence a surface sacrificial layer of unsuitable material may be present. A nominal surface scrape and inspection by the Engineer prior to the placement of the granular sub-base for roads should be undertaken during the construction phase.

## APPENDIX A FIGURES

## (i) Site Location Plan

**Site Location Plan**

11HEY002 Croesnewydd Road,  
Wrexham. LL11 3BN  
(331850E, 350580N)

(ii) Figure 2 - Proposed Development Plan



| House Name          | Beds | Storey | Type     | Total area/<br>dwelling | Total no.<br>of dwellings | %<br>of dwellings                | Total area  |
|---------------------|------|--------|----------|-------------------------|---------------------------|----------------------------------|-------------|
| BA - Banbury        | 03   | 02     | Semi     | 956 sqft                | 16                        | 21                               | 15,296 sqft |
| KT - Kingston       | 03   | 02     | Detached | 962 sqft                | 13                        | 17                               | 12,506 sqft |
| EV - Evesham        | 04   | 02     | Detached | 1,028 sqft              | 10                        | 14                               | 10,280 sqft |
| BE - Beaumont       | 04   | 02     | Detached | 1,040 sqft              | 3                         | 3                                | 3,120 sqft  |
| RICH - Richmond     | 04   | 02     | Detached | 1,138 sqft              | 12                        | 16                               | 13,656 sqft |
| WEN - Wentworth     | 04   | 02     | Detached | 1,275 sqft              | 9                         | 12                               | 11,475 sqft |
| ED - Edinburgh      | 04   | 02     | Detached | 1,368 sqft              | 9                         | 12                               | 12,312 sqft |
| GL - Glastonbury    | 04   | 02     | Detached | 1,447 sqft              | 4                         | 5                                | 5,788 sqft  |
| TOTAL DWELLINGS: 76 |      |        |          |                         |                           | Total Floor Area:<br>84,433 sqft |             |

Rev F: Amended to planning officer's comments 17.12.12  
Rev E: Plot 60 & 69 adjusted. Driveways clarified. 11.07.12  
Rev D: Re-titled 07.06.12  
Rev C: Mix revised 01.05.12  
Rev B: Legend added 30.04.12  
Rev A: Preliminary Issue 16.04.12

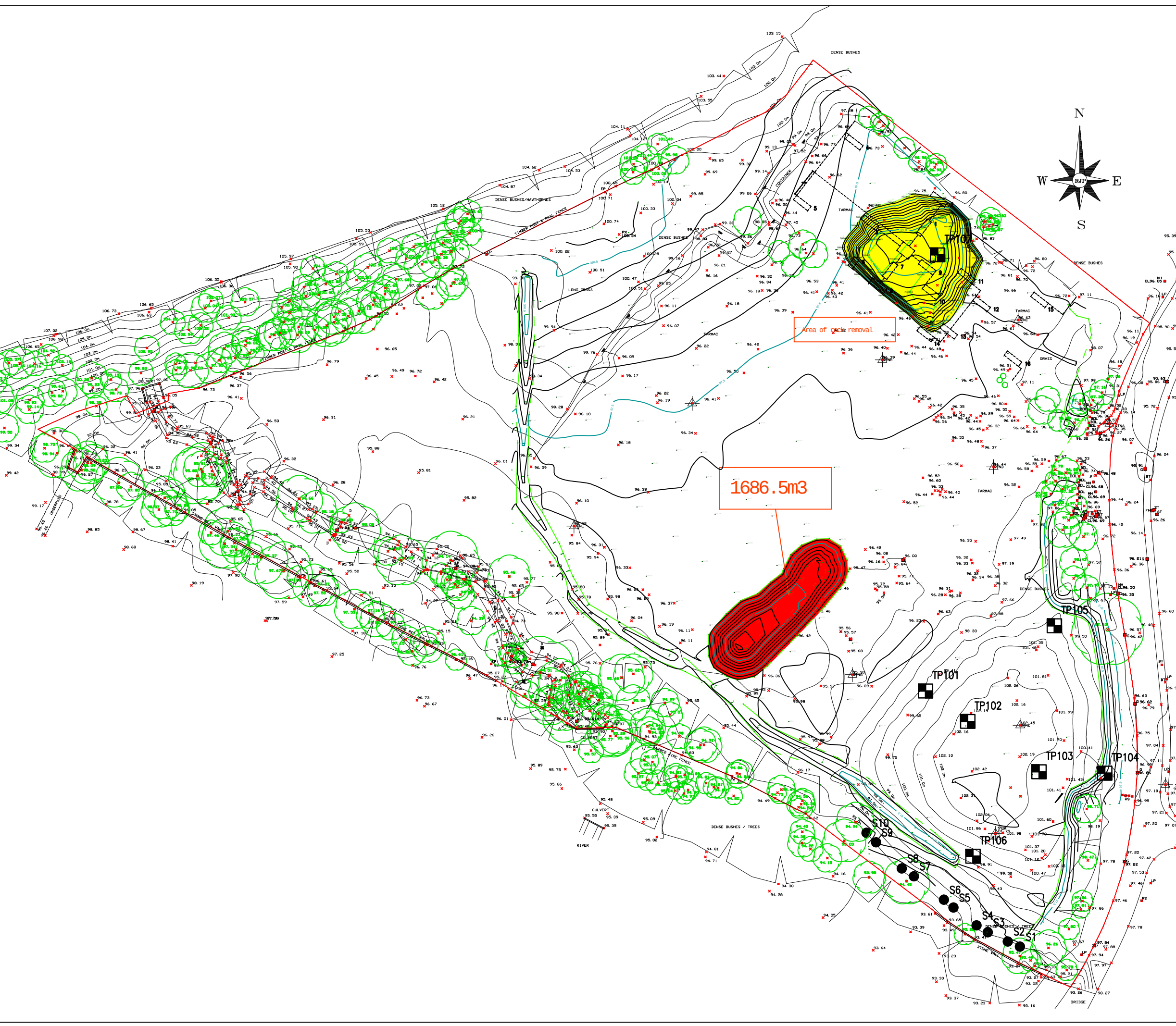
Proposed Development  
at  
Croesnewydd Road,  
Wrexham  
LL11 1BN

Site Layout Plan

Date 07.06.12 Scale 1: 500 @ A1 Drawing Number SLP 01 Rev F



(iii) Figure 3 - Pond Excavation Plan



DO NOT SCALE

NOTES

THIS DRAWING SHOWS THE INDICATIVE LOCATION OF TRIAL PITS UNDERTAKEN BY BETTS GEO ENVIRONMENTAL FOR HARROW ESTATES LTD IN MARCH 2011.

THE DRAWING ALSO DISPLAYS AN AREAS OF ROCK REMOVAL AND STORED MATERIAL ON SITE. THIS INFORMATION OVERLAYS THE TOPOGRAPHICAL SURVEY.

KEY

- SITE OUTLINE
- TP106 MACHINE EXCAVATED TRIAL PIT
- S5 SOIL SAMPLE
- AREA OF ROCK REMOVAL
- AREA OF STORED MATERIAL

| REV | DATE | BY | DESCRIPTION | CHK |
|-----|------|----|-------------|-----|
|     |      |    |             |     |
|     |      |    |             |     |
|     |      |    |             |     |
|     |      |    |             |     |

DRAWING STATUS: PRELIMINARY



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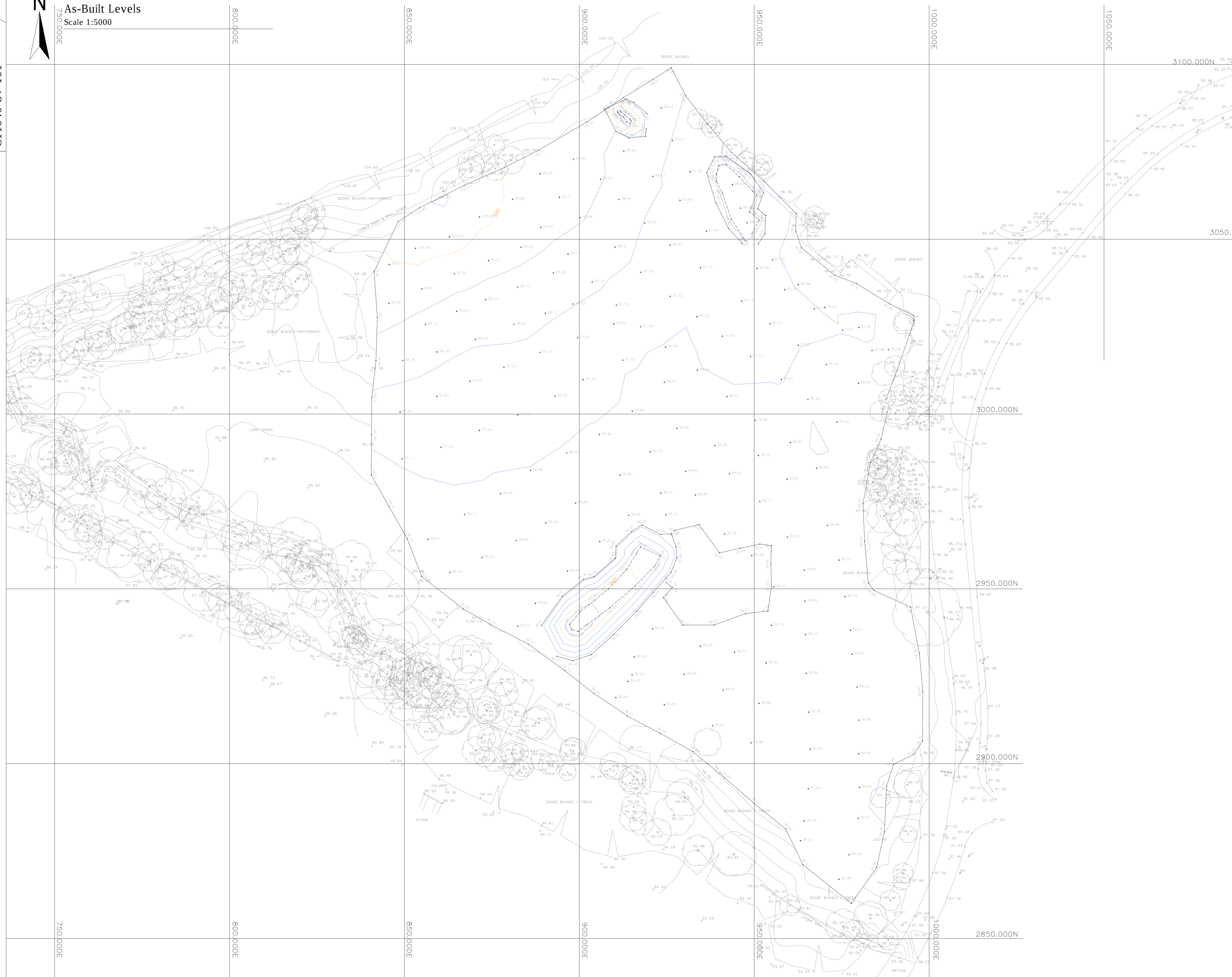
HARROW ESTATES

PROJECT:  
FORMER BROTHER SITE-  
WREXHAM

TITLE:  
EARTHWORKS  
PLAN

|                         |                              |              |                 |
|-------------------------|------------------------------|--------------|-----------------|
| DATE:<br>26/06/13       | SCALE @ SIZE:<br>1:1000 @ A3 | DRAWN:<br>PH | CHECKED:<br>MJF |
| PROJECT No:<br>11HEY002 | DRAWING No:<br>001           | REV:<br>0    |                 |

(iv) Figure 4 - As- built Topographic Survey



Job Title

Croesnewydd Road  
- Site Regrade

Location

Wrexham

Client

Harrow Estates plc

## Notes

| Rev | Date | Description |
|-----|------|-------------|
|-----|------|-------------|

Drawing Status

## Information Only

Drawing Title

As-Built Levels

|                         |               |             |
|-------------------------|---------------|-------------|
| Buckingham Project Code | Scale         | 1:500       |
|                         | Date Drawn    | 03-May-2013 |
|                         | Drawn By      | NDS         |
|                         | Reviewed By   | NDS         |
|                         | Original Size | A11         |

|                |     |
|----------------|-----|
| Drawing Number | Rev |
| C11040-SV-101  | -   |

## **APPENDIX B COMPACTION TEST RESULTS**

## **APPENDIX C PLATE LOAD TEST RESULTS**

## **APPENDIX D NUNCLEAR DENSITY TEST RESULTS**

## APPENDIX E SITE PHOTOGRAPHS

## NOTES ON LIMITATIONS

This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese knotweed). It is recommended that these are considered as part of the assessment of development constraints for the site.

The assessment and judgements given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. The data essentially comprised a study of available documented information from various sources (including Client Furnished reports) together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our environmental conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information. Actual risks can only be assessed following a physical investigation of the site.

The site investigation has been carried out to provide information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. Betts Geo Environmental Ltd undertake to exercise all reasonable skill, care and due diligence in the exercise of the investigation with respect to sampling techniques, sample storage and report interpretation.

The assessments and judgement given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. Data acquisition is subject to the limitations of the methods of investigation used. Exploratory holes undertaken during fieldwork investigate small a small volume of ground in relation to the size of the site and as such can only provide an indication of site conditions. There may be conditions pertaining to the site and the proposed development i.e. localised "hotspots" of contamination, which have not been disclosed by the investigations.

The findings and opinions are relevant to the dates of our site works and should not be relied upon to represent conditions at substantially later dates. Conditions at the site will change over time due to natural variations and anthropogenic activities. Groundwater, surface water and soil gas conditions should be anticipated to change with diurnal, seasonal and meteorological variations.

The opinions expressed in this report regarding any contamination are based on simple statistical analysis and comparison with available guidance values. No liability can be accepted for the retrospective effects of any changes or amendments to these values.

This report was prepared by Betts Geo Environmental Ltd for the sole and exclusive use of Harrow Estates in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

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