



GOWER HOMES

PROPOSED RESIDENTIAL DEVELOPMENT BOOZEY FIELDS, STANSTY, WREXHAM

DRAINAGE STRATEGY & FLOOD CONSEQUENCES ASSESSMENT

**OCTOBER 2015
Ref: 4037**

OFFICES AT:

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RICHARD BROUN
A S S O C I A T E S
Chartered Engineers & Architects

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1.0 INTRODUCTION

- 1.1 Gower Homes are seeking Planning Consent for a development of 57 homes at Boozey Fields, Griffiths Road, Stansty, Wrexham, LL11 4YG. A site location plan is included in **Appendix A**.
- 1.2 This document, prepared by Consulting Engineers RBA Ltd, presents a Drainage Strategy for the site, considering options for the disposal of both foul and surface water.

2.0 DESCRIPTION OF THE SITE / PROPOSED DEVELOPMENT

- 2.1 The site has an east-west orientation and is bounded to the south by Griffiths Road, to the west by Summerhill Road and to the east by Old Mold Road. The northern boundary faces onto the rear gardens of properties in Glascoed Way and The Meadows. The site is roughly triangular in shape, with an area of 2.4 hectares (5.9 acres) and falls from west to east by 17m.
- 2.2 According to records provided by Dŵr Cymru-Welsh Water (DCWW) the Public Sewer Network (PSN) bisects the site.
- 2.3 The proposed development consists of:
- Two bedroom terraced houses - 15
 - Three bedroom semi-detached houses - 6
 - Three bedroom detached houses - 14
 - Four bedroom detached houses - 22
- 2.4 The envisaged rate of development is:
- 2017: 13 houses
 - 2018: 22 houses
 - 2019: 19 houses
- 2.5 A drawing showing the proposed layout of the site is included in **Appendix B**.

3.0 FOUL DRAINAGE

- 3.1 Any development of the Boozey Fields site needs to be connected to the PSN. Copies of record information held by DCWW have been obtained and a Pre Planning Enquiry (DCWW reference PPA0000837, included in **Appendix C**) has also been made.
- 3.2 The advice contained in the response provided by DCWW to the Pre Planning Enquiry is that the flows from a proposed development of 57 houses can be accommodated by the existing PSN in the vicinity of Boozey Fields and no problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from the site.
- 3.3 The layout of the PSN, shown on the drawing accompanying the Pre Planning Enquiry, has been verified by inspection and the details are as follows:

DCWW Chamber Reference	Location	Cover Level m AOD	Invert Level m AOD	Depth to Invert m
SJ 31527401	Griffiths Road	103.54	102.54	1.00
SJ 31528402	Centre of Boozey Fields	103.26	101.70	1.56
SJ 31528502	Northern Boundary Boozey Fields	101.08	100.20	0.88
SJ 31529503	Rear Garden 17 The Meadows	Not surveyed		
SJ 32520601	Old Mold Road (north of Boozey Fields)	95.14	92.84	2.30

- 3.4 The proposed layout of the site is ideal from a drainage perspective, with the levels falling from west to east and a central access road. Given that the site is bisected by a PSN it would be logical to connect the properties at the western end of the site into the PSN, either at Chambers 8402 or 8502, or at a new chamber on the interconnecting sewer.
- 3.5 A separate connection is required for the properties to the east of the PSN. Two options are available to form a connection, Chamber 9503 in the rear garden of 17 The Meadows or Chamber 0601 which is located on the east side of Old Mold Road (not the west side as shown on the PSN records).
- 3.6 At Chamber 9503 the depth to invert is not known, nor is the attitude of the owners of 17 The Meadows to forming a connection in their garden.
- 3.7 If a connection is made to Chamber 9503 a 6m wide easement will be required following the line of any new sewer from the northern boundary to the access road.

3.0 FOUL DRAINAGE (continued)

- 3.8 While Chamber 0601 is comparatively deep (at 2.30m) a 150mm diameter sewer, laid at a 1 in 150 gradient in Old Mold Road will have an invert level of 93.32m AOD at the point of entry to the site and approximately 0.4m of cover. Consequently it will not have sufficient cover to comply with the requirements in Sewers for Adoption 7 (SfA 7) for a sewer laid beneath a highway. An alternative approach of providing a 225mm diameter sewer, laid at a gradient of 1 in 250 will increase the cover depth.
- 3.9 Further discussion with DCWW is required to establish if this alternative is acceptable. It may be possible to increase the depth of cover marginally if a connection is made to Chamber 0602, which is a short distance downstream of Chamber 0601.

4.0 SURFACE WATER DRAINAGE

- 4.1 Consideration will be given to the disposal of surface water via a series of soakaways.
- 4.2 A ground investigation has been conducted and the results are included in **Appendix D**. Ten trial holes have been excavated, to a maximum depth of 3.40m. While some sands and gravels were found by the investigation, the site is underlain by glacial deposits, predominantly clays. No percolation tests have been conducted to date but, from observation, the Geotechnical Engineers have concluded that the ground is relatively impermeable and soakaways are unlikely to be effective.
- 4.3 The site generally falls from west to east. The lowest point surveyed (93.95m AOD) is at the eastern boundary to Old Mold Road.
- 4.4 Old Mold Road itself has a low spot opposite the Boozey Fields site where two gullies are present on the east side of the carriageway with cover levels of 93.99m and 93.89m AOD.
- 4.5 On first sight there is no visible watercourse serving Boozey Fields, although the topography of the site means that surface water will flow from west to east and accumulate at the low point of the field, which is adjacent to the low point (and gully locations) in Old Mold Road. The impression gained is that water should accumulate at this location.
- 4.6 The Ordnance Survey map included in **Appendix E** shows a watercourse on the east side of the A541. The upstream end of this watercourse is an old headwall to a culvert. When inspected, on 13 March 2015, the headwall was submerged to above soffit level.
- 4.7 The results of an inspection and dye test tracing exercise, carried out on 13 March 2015, is included in **Appendix F** and confirms that both the drainage from the yard at Stansty Park and the highway drainage from Old Mold Road into Chamber SW1 in the footway of Old Mold Road discharge to the culvert.
- 4.8 There is also a 150mm diameter pipe into Chamber SW1 which appears to extend upstream to the low point on the Boozey Fields site. A CCTV survey conducted on 24 March confirmed that a section of this pipe has collapsed under Old Mold Road.
- 4.9 A CCTV survey was also undertaken downstream of Chamber SW1. This survey was abandoned after 37.7m with the camera being submerged and no further progress being possible.
- 4.10 Two other connections were noted to the downstream culvert, at Ch 31.17m which may serve a cottage and the former highway (which is still present alongside the cottage) and/or land drains at the foot of the A541 embankment.

5.0 FOUL WATER DRAINAGE STRATEGY

- 5.1 Three potential locations for the discharge of foul water to the PSN have been identified at:
- Either Chamber 8402 or 8502 on the connecting foul sewer which bisects the site
 - Chamber 9503 in the rear garden of 17 The Meadows
 - Chamber 0601 or 0602 in Old Mold Road
- 5.2 Connection to Chamber 9503 will require the consent of the landowner.
- 5.3 Connection to Chamber 0601 or 0602 will require a sewer to be installed in Old Mold Road. At the upstream end of this sewer run the depth of cover available is below that normally required by DCWW and suitable structural protection (ie concrete surround or similar) will need to be agreed as part of the adoption process.
- 5.4 It is possible that two connections to the PSN will be required to serve the west and east ends of the site, but again this will need to be agreed with DCWW as part of the adoption process.

6.0 SURFACE WATER DRAINAGE STRATEGY

- 6.1 The results of the site investigation indicate that the ground forming Boozey Fields comprises glacial materials, including till and clays. It is unlikely that this ground will be suitable for the installation of conventional soakaways.
- 6.2 The watercourse visible on the east side of the A541 passes below the dual carriageway in a culvert. The drainage network upstream of this culvert connects to Boozey Fields, but the existing pipe run below Old Mold Road cannot be surveyed as it has collapsed.
- 6.3 Whilst a route for the disposal of surface water from the site has been established, the discharge rate to the culvereted watercourse will need to be restricted to the "greenfield run-off" of the site which has been calculated as 5 l/s (see **Appendix G**).
- 6.4 The surface water drainage system serving the proposed development will therefore need to include on-site storage which must be capable of retaining the run-off from a 1 in 30 year return period storm. Consideration also needs to be given to providing additional storage facilities to ensure that the run-off from storms up to and including a 1 in 100 year return period is retained within the site boundary and does not result in internal flooding of the new properties.

6.0 SURFACE WATER DRAINAGE STRATEGY (continued)

6.5 Two alternative drainage strategies are available:

- Discharge all surface water to the existing culvert via a flow restrictor, limited to the existing greenfield run-off rate. Below ground storage to be provided for storm events with a return period up to 1 in 30 years and above ground storage with capacity for storm events between 1 in 30 year to 1 in 100 year return period.
- Provide a series of linked "soakaways" throughout the site with final discharge to the culverted watercourse.

Such infiltration devices would normally be designed to store the run-off from a 1 in 30 year return period storm and to half empty in 24 hours. Whilst the first criteria can be achieved the ground conditions within the site suggest that the second is not possible.

However if a hybrid system is adopted where the "soakaways" are provided with high level outlets, then during significant storm events water can overflow from one device to another, maximising the available storage within the system. In the event of a series of extreme storms then water that cannot be contained within the system would discharge to the culverted watercourse. This scenario may also require a flow restrictor and additional storage but this would only be determined during the detailed design stage.

6.6 Both alternatives require the provision of the following features:

- Reinstatement of culvert below Old Mold Road.
- Design of a drainage system with a restricted discharge rate of 5 l/s.
- Provision of detention basin, capable of storing the run-off from storms between 1 in 30 year and 1 in 100 year return period.

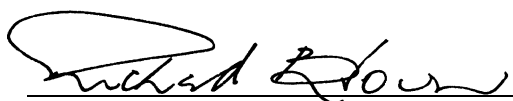
6.7 As the Boozey Fields site slopes from west to east it is likely that the detention basin will be provided at the east end of the site, adjacent to Old Mold Road.

7.0 FLOOD CONSEQUENCES ASSESSMENT

- 7.1 The site is located on higher ground relative to its surroundings and slopes from west to east with ground levels between 111.40m to 93.95m AOD at the eastern boundaries.
- 7.2 As shown on **Drawing 4037/SK02**: Welsh Government TAN 15 Development and Flood Risk Advice Map in **Appendix H**, the site is situated within Zone A: "considered to be at little or no risk of fluvial or coastal / tidal flooding in accordance with TAN 15."
- 7.3 Areas at risk of flooding in Wales are shown on maps produced by Natural Resources Wales (NRW). These maps are updated on a three monthly basis and therefore represent the best information currently available. **Drawing 4037/SK03** Natural Resources Wales (NRW) Indicative Assessment of the risk of Flooding from surface water in **Appendix H** shows the site is situated in an area which is not affected by flooding from surface water. Flooding from surface water is evident to Old Mold Road to the east of the site and within the low lying area of land between Old Mold Road and the embankment to the A541 to the east. The site is significantly elevated relative to this area of potential flooding and will not be affected.
- 7.4 Proposed site levels will follow existing site levels falling to the eastern boundary where a detention basin is proposed within public open space. Any flooding from extreme storm events from surface water run-off or in the unlikely event of infrastructure failure will flow to this detention basin and will therefore not adversely affect the proposed dwellings.

8.0 SUMMARY

- 8.1 DCWW have confirmed that there is sufficient capacity in the PSN and waste water treatment works to allow the discharge of foul water from a proposed development of up to 57 houses at Boozey Fields, Stansty.
- 8.2 It is possible to provide a gravity sewer connection from the Boozey Fields site to the PSN. If a connection is formed to chambers 0601 or 0602 protection of the new sewer will need to be agreed with DCWW.
- 8.3 An option of connecting to chamber 9503 may also be practical, but the depth of this chamber has not been confirmed.
- 8.4 The PSN crosses the site from SW to NE. It is possible for properties to the east of this sewer to connect into a new chamber located between the existing chambers 8402 and 8502.
- 8.5 Trial pits excavated on the site have revealed that the underlying ground is dominated by clays, which will have very low permeability values. The use of conventional soakaways is therefore unlikely to prove effective.
- 8.6 A route for the discharge of surface water from the site exists to the small, open watercourse located to the east of the A541. The greenfield run-off for the site for a 1 in 1 year return period event has been calculated to be 5 l/s.
- 8.7 Two alternative drainage strategies are viable. Both restrict the run-off from the site to greenfield rates and provide below ground storage to cater for storm events up to 1 in 30 year return period.
- 8.8 For storm events with a return period in excess of 1 in 30 years a detention basin will be provided adjacent to Old Mold Road with sufficient capacity to store the run off from a 1 in 100 year return period storm. The detention basin will discharge via a headwall or gully to the surface water sewer upstream of the flow restrictor, such that the facility will empty once the storm event has subsided.
- 8.9 The site not located in a flood risk area as shown on the NRW and WG maps on Drawings 4037/SK02 and SK03 in **Appendix H** and will not be affected by flooding from surface water on the site or from the surrounding area and highways due to the topography and elevated position of the site.



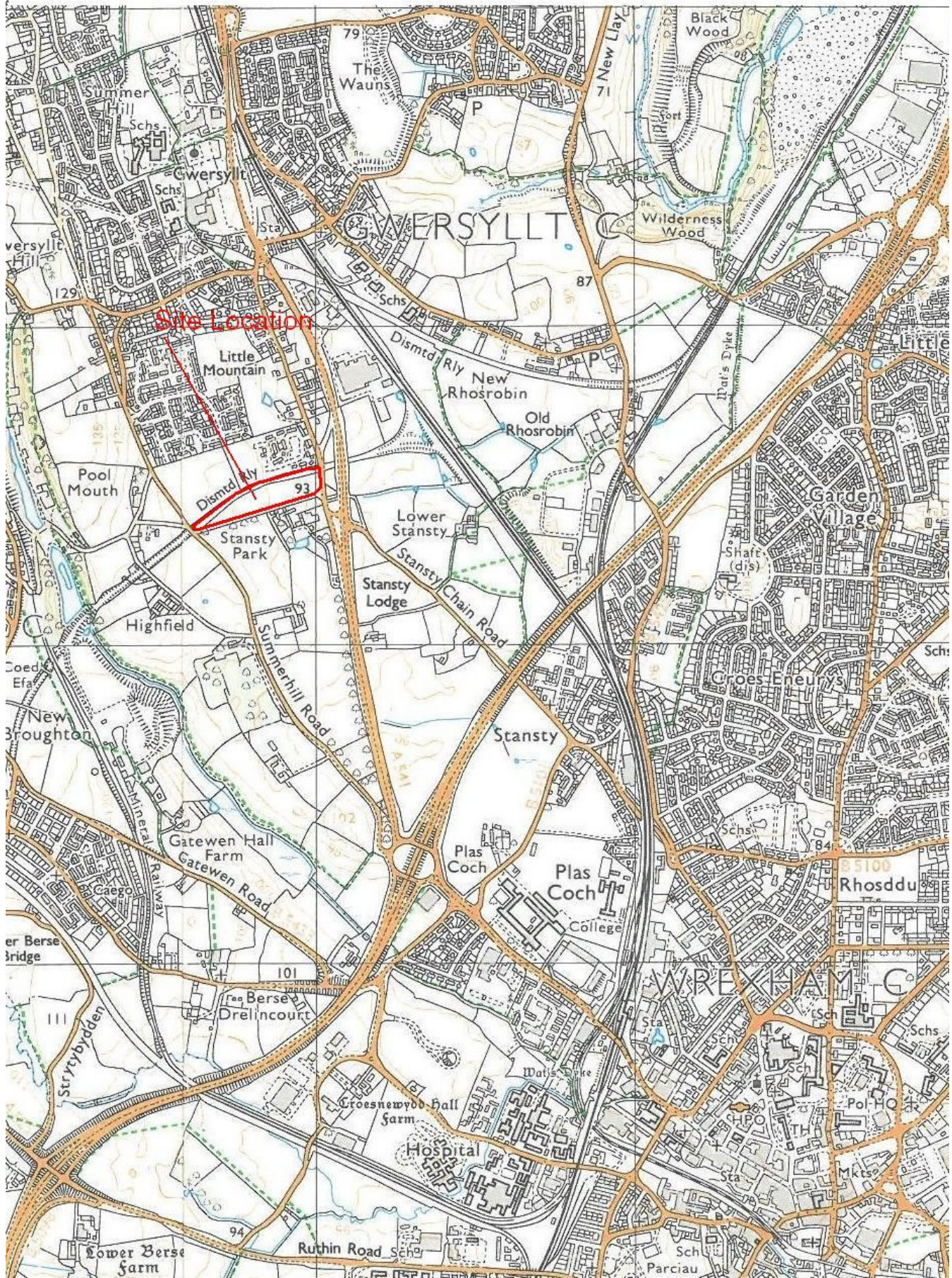
RICHARD BROUN ASSOCIATES
October 2015

APPENDIX A:
Site Location Plan

Boozey Fields, Stansty Park

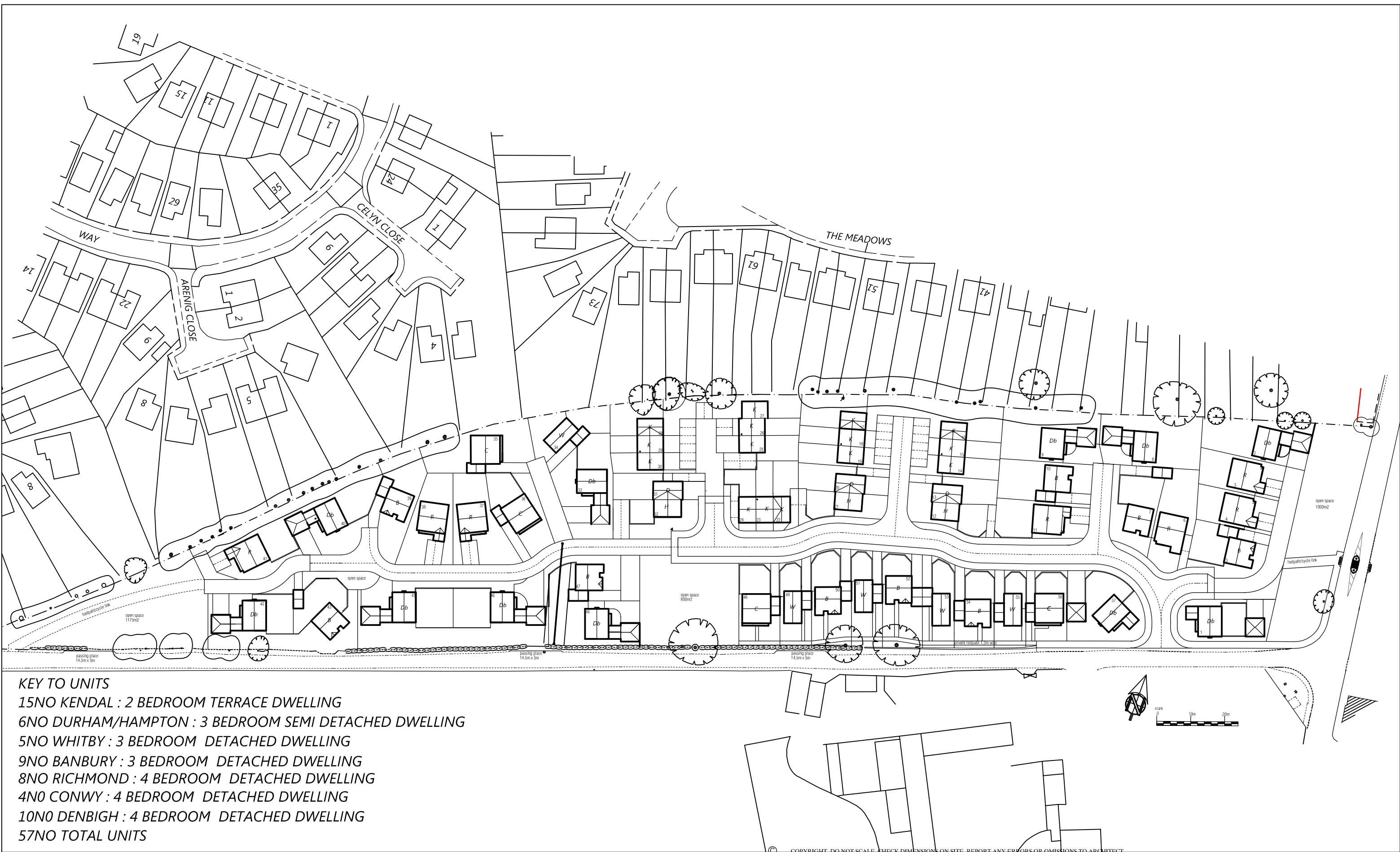
Site Location

4037/ Appendix A



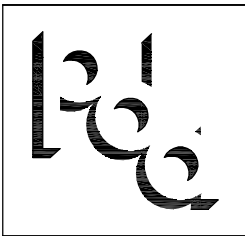
APPENDIX B:

Proposed Site Layout



KEY TO UNITS
15NO KENDAL : 2 BEDROOM TERRACE DWELLING
6NO DURHAM/HAMPTON : 3 BEDROOM SEMI DETACHED DWELLING
5NO WHITBY : 3 BEDROOM DETACHED DWELLING
9NO BANBURY : 3 BEDROOM DETACHED DWELLING
8NO RICHMOND : 4 BEDROOM DETACHED DWELLING
4NO CONWY : 4 BEDROOM DETACHED DWELLING
10NO DENBIGH : 4 BEDROOM DETACHED DWELLING
57NO TOTAL UNITS

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Parry Davies Architects.

Chartered Architects.

PROJECT TITLE
LAND AT BOOZEY FIELD STANSTY WREXHAM

DATE
APRIL 2005

SCALE
1:1000@A3

DRWN
RSG

CHK

DRWG. TITLE
SITE LAYOUT PLAN

DRWG. NOS.
12.5539/1

REV

Barclays Buildings, High Street, St Asaph, LL17 ORF

Tel: 01745 585517 Fax: 01745 582162. E-mail: PDPArchitects@aol.com

APPENDIX C:

DCWW Pre Planning Enquiry

Boozey Fields, Wrexham - Pre Planning Advice

Section	Proposed Answer
Applicant Details:	- Gower Homes 8 Temple Row WREXHAM LL13 8LY - Mr Michael Forgrave 01978 340824 or 01978 291364 michael.forgrave@gowerhomes.co.uk
Name & Address of Agent:	- Richard Broun Associates 26 Mostyn Road Colwyn Bay Conwy LL29 8PB - Mr David High 01492 533117 broun@rba.ltd.uk
Development Details:	- Proposed new housing development of 65 homes - Boozey Fields Griffiths Road Stansty Wrexham LL11 4YG - National Grid Ref: SJ 320 525
Quantity of Water:	N/A
Development Supply / Demand:	Existing DCWW supply? No
Domestic Development:	65 housing units 2.4 ha site area 15 terraced units 50 semi-detached units - Comprised of 45 (1 - 3 bedroom) units 20 (4 + bedrooms) units - No flats
Drainage Details:	- Method of soakaway water disposal? Soakaways - Surface water attenuation? Yes - SUDs? Soakaways - Method of foul water disposal? to PSN - Method of highway drainage disposal? Soakaways - New / amended effluent consent? No - Use of Industrial / Commercial? N/A - Potable water in treatment / cleaning? No

Boozey Fields, Wrexham - Pre Planning Advice

Section	Proposed Answer
Proposed Development Programme:	• 2015 ▸ Type of Development? Housing ▸ Units? 15 ▸ Area? 0.6ha • 2016 ▸ Type of Development? Housing ▸ Units? 24 ▸ Area? 0.9ha • 2017 ▸ Type of Development? Housing ▸ Units? 25 ▸ Area? 0.9ha
Planning Status:	• Site allocated in a Development Plan? No
Historical Information:	• Not a brownfield site
File Uploads:	• Location plan provided by Gower Homes previously showing site boundary, PSN records but excluding proposed layout drawing



LEGEND(Representative of most common features)

- [illegible]

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only, on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or any other activity of the Company's apparatus and any loss of locating the underground apparatus before carrying out the excavation. The onus must be understood that the furnishing of the information is entirely without prejudice to the rights of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.

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Map scale: 1:2,000

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Parry Davies Architects.		Chartered Architects.	
PROJECT TITLE	LAND AT BOOZEY FIELD STANSTY WREXHAM	DATE	NOV 2014
DRAWING TITLE	LOCATION PLAN	SCALE	1:1250 @ A3
		DRAWN	RSG
		REV	
		DRAWING NO.	14.5539/1
		Studio 55:20 North Wales Business Park Abergele LL18 7LJ	
		Tel: 01745 585517 E-mail: PDA@parrydavis.co.uk	

Mr M Forgrave
Gower Homes
8 Temple Row
Wrexham
LL13 8LY

Date: 02/03/2015
Our Ref: PPA0000837

Dear Sir

Grid Ref: SJ3185152464 331846 352463

Site: Boozey Fields, Griffiths Road, Stansty, Wrexham, LL11 4YG
Development: Proposed development of 65 homes

We refer to your planning consultation relating to the above site, and we can provide the following comments in respect to the proposed development.

SEWERAGE

In relation to capacity to accept sewage flows from the proposed development we would confirm the following:

As indicated on the attached public sewer record the development site is crossed by a public sewer. Please note that no development (including the raising or lowering of ground levels) will be permitted within the safety zone of the sewer which are as follows:

150mm public foul sewer - 3 metres either side of the centreline of the public sewer

As you may observe from the attached public sewer record plan, the public sewerage system in the vicinity of the proposed development is generally of a separate type.

The foul only discharge from the proposed development for 65 houses can be accommodated within the public sewerage system.

In relation to the surface water flows from the proposed development, these will have to be disposed of separately by other means, such as using soakaways or discharging directly to a watercourse. Permissions to connect to a watercourse may need to be sought from the Land Drainage Authority and / or Environment Agency. Please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system

With reference to the surface water flows from the proposed development, you are required to fully exhaust all technical options outlined under Sections 3.2 and 3.4 of Part H of the publication 'Building Regulations 2000; Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to watercourses in liaison with the Land Drainage Authority and/or the Environment Agency.

Other methods of SUDS must also be investigated. SUDS is an approach to managing surface water run-off which seeks to imitate natural drainage systems and retain water on or near the site as opposed to traditional drainage approaches which involve piping water off site as quickly as possible.

SUDS involve a range of techniques including green roofs, rainwater harvesting, permeable pavements, etc. SUDS offer significant advantages over conventional piped drainage systems in reducing flood risk by attenuating the rate and quantity of surface water run-off from a site, promoting groundwater recharge, and improving water quality and amenity.

The variety of SUDS techniques available means that virtually any development should be able to include a scheme based around these principles. Good justification would be required not to incorporate a SUDS scheme on the site.

If any onsite or offsite sewers are to be offered for adoption they must be constructed to conform with the publication "Sewers for Adoption"- 7th Edition.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

ADVISORY

Some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect your proposal. In order to assist us in dealing with the proposal we request that you contact our Operations Contact Centre on 0800 085 3968 to establish the location and status of the sewer. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

Please note that in order to make a connection to the public sewerage system, it may be necessary to cross third party land, for which you must first gain permission from all the relevant landowners. Should you encounter difficulties in gaining the permission to do so, it may be possible to requisition a new sewer under Sections 98 to 101 of the Water Industry Act 1991 from the boundary of the proposed development to the public sewerage system. Should you require further information please write to us at the address given above.



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
Mae Dwr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

The Welsh Government have introduced new legislation that will make it mandatory for all developers who wish to communicate with the public sewerage system to obtain an adoption agreement for their sewerage with Dwr Cymru Welsh Water (DCWW). The Welsh Ministers Standards for the construction of sewerage apparatus and an agreement under Section 104 of the Water Industry Act (WIA) 1991 will need to be completed in advance of any authorisation to communicate with the public sewerage system under Section 106 WIA 1991 being granted by DCWW.

Welsh Government introduced the Welsh Ministers Standards on the 1st October 2012 and we would welcome your support in informing applicants who wish to communicate with the public sewerage system to engage with us at the earliest opportunity. Further information on the Welsh Ministers Standards is available for viewing on our Developer Services Section of our website - www.dwrcymru.com or on the Welsh Government website - www.wales.gov.uk

Our response is based on the information provided by your application. Should the proposal alter during the course of the application process we kindly request that we are re-consulted and reserve the right to make new representation.

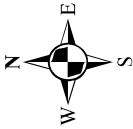
If you have any queries please contact the undersigned on 0800 917 2652 or via email at developer.services@dwrcymru.com

Please quote our reference number in all communications and correspondence.

Yours faithfully,



Henry Jones-Hughes
Development Control Officer
Developer Services



LEGEND (Representative of most common features)

- Waste networks**
- Fuel chamber
 - Surface water chamber
 - Combined chamber
 - Storm overflow
 - Rilling main
 - Special purpose chamber
 - Treatment works
 - Private sewer
 - Private sewer subject to Sect. 104 agreement
 - Private Sewer Transfer
 - Lateral drain
 - Inspection Chamber
- Other features**
- Outfall
 - Lamp pole
 - Storm overflow
 - Rilling main
 - Gravity sewer
 - Private sewer
 - Private sewer subject to Sect. 104 agreement
 - Private Sewer Transfer
 - Lateral drain
 - Inspection Chamber
- Notes:**
- NB: Sewer symbol colour indicates the type.
 - RED - Combined
 - GREEN - Surface Water
 - BLUE - Storm
 - Purple - Private
 - Orange - Former S21 sewer (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch fibre) has been incorrectly recorded. DCWW does not accept any liability for any damage or loss arising from the possible presence of AC or PF pipes being anticipated and considered as part of any risk assessment prior to excavation.

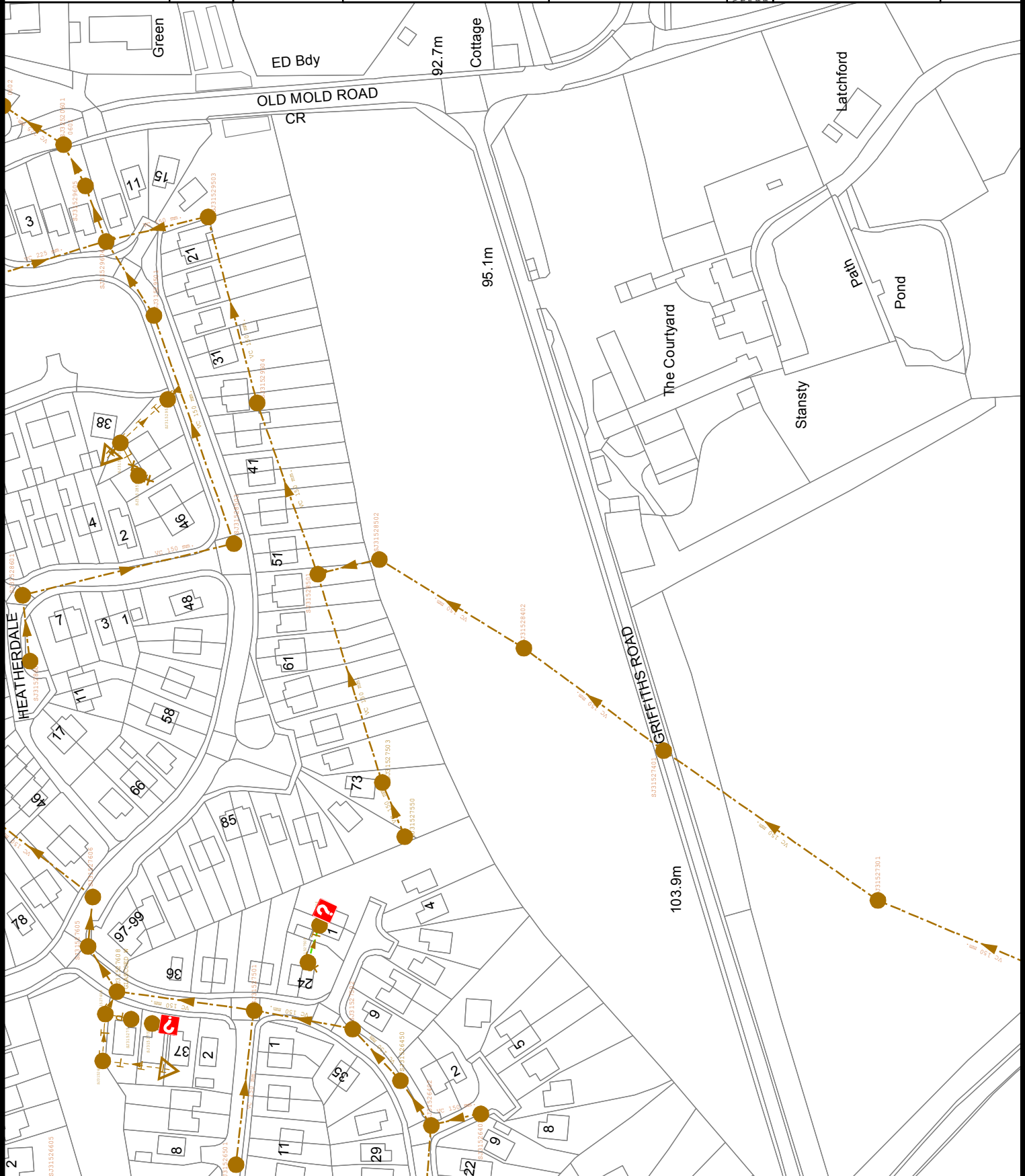
Dŵr Cymru/CW gives this information as to the location of the underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other operations. It is the responsibility of the excavator to ensure that the correct location of the apparatus is ascertained before carrying out any excavations. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Water Act 1989 and of this Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

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Map Ref: 331851, 352464
Map scale: 1:1,750
Printed by:
Printed on:



APPENDIX D:
Ground Investigation

Mob: 07977 218184

Email: mikescott@groundsolve.com

REF: 1669/SP/Let Rep/mjs

Mike Forgrave
Gower Homes
8 Temple Row
Wrexham LL13 8LY

11th March 2015

Dear Mike,

RE: BOOZEY FIELDS, WREXHAM: GEO-ENVIRONMENTAL REPORT

Introduction

Gower Homes (GH) propose to purchase a site known as Boozey Fields immediately north of Wrexham Town centre.

Prior to purchase GH have appointed GroundSolve Ltd (GSL) to carry out a preliminary site investigation to investigate the ground conditions. No desk study has been undertaken at this stage.

This letter report presents the findings of the site investigation and gives geotechnical recommendations. In addition, environmental comments are given.

Site Location and Description

The site is located off the Old Mold Road, which defines the eastern site boundary. Griffiths Road links Old Mold Road and Summerhill Road to the west of the site and defines the southern site boundary, with Stansty Park immediately south of the road. To the north of the site lies existing housing.

The site is long and thin being approximately 400m long and up to 70m wide. The site slopes from the west to the east and there is a pronounced break in slope across the site. Two spot heights on Griffiths Road show a difference in elevation from 103.90mOD to 95.1mOD in an eastward direction along the road.

A topographic survey provided by the client revealed a ground level of 111mOD on the western site boundary, around half way across the site the pronounced drop in elevation fell to around 99mOD, before gently sloping to an elevation of 94mOD on the eastern site boundary. Griffiths Road is lower than the adjacent site levels. While on the northern site boundary the remains of an old railway embankment can still be seen, which is several metres higher than the site, see Figure 1.

The site is bounded by mature trees and an overhead electricity cable is present. In addition, a foul drain is known to cross the central section of the site.

Photographs of the site are presented in Appendix A.

Geology

The geology of the site has been studied on the 1:50,000 scale geology plan, Sheet 121 and the Wrexham Applied mapping study at a scale of 1:25,000.

The geology plan shows the western (higher) section of the site to be underlain by glacial sand and gravel, with the lower eastern section underlain by glacial till. The old railway embankment is shown immediately north of the site.

This is confirmed by the Wrexham study which also shows three nearby Kettle Holes. It also shows the drift deposit to be between 15 and 20m thick.

The site is underlain by the Bettisfield Formation, which is the main coal bearing strata, although, no coals seams are shown outcropping nearby. However, the Wrexham study shows the Upper Stinking coal seam well to the west of the site and the Alpha to Delta seams are shown to the east of the site. The Upper Stinking seam is overlain by a significant thickness of sandstone.

History

Plans in GSL archives at a scale of 1:10,560 revealed that Stansty Park, Griffiths Road and Old Mold Road were already in existence in 1879. The site was open fields, with a field boundary cutting it, trending roughly north to south.

By 1900, the railway line on the northern site boundary had been constructed and was a Mineral line directly off the Wrexham, Mold and Connah's Quay Railway. No changes were shown on the later maps.

Proposed Development

The proposed development comprises some 64 conventional two storey houses. The proposed layout is presented on Figure 2. The location of the sewer is largely Public Open space with a gap through the houses where necessary. The overhead power cables follow the approximate line of the road.

It is likely that low retaining walls will be necessary in the central section of the site between plots where the gradient is up to 1 in 10 (6°).

Based on previous experience foundation loads are unlikely to exceed 50kN/m run, with floor slab loadings not exceeding 5kN/m².

Previous Investigation

A nearby trial pit and borehole have been identified on the BGS web site.

The trial pit excavated adjacent to Griffiths Road (about half way up) encountered topsoil overlying sand to a depth of 0.90m, which in turn overlies glacial till described as stiff to very stiff to 2m

before encountering sand with occasional gravel to 3.50m. No groundwater was encountered in this pit.

The borehole immediately north of the site proved glacial till to 3.9m, with gravel to 4.8m and clay again to 7.90m, with gravel again to 9.30m, sandstone bedrock was encountered at 9.40m. The trial pit and borehole logs are presented in Appendix B.

This Investigation

This investigation was undertaken on the 9th February 2015 and comprised ten machine dug trial pits to a maximum depth of 3.40m. The trial pits were logged by a chartered geologist from GSL in general accordance with BS 5930. The location of the trial pits is shown on Figure 1 and the logs presented in Appendix C.

Samples were taken from the trial pits and taken for the following physical and chemical testing.

Physical Testing

- Atterberg limit,
- Moisture content,
- pH,
- Sulphate (2:1 water extract).

The testing was carried out in accordance with BS 1377. It is discussed below and presented in full in Appendix D.

Chemical Testing

Samples for chemical testing were taken, placed in the appropriate containers and a cool box and taken immediately to the laboratories of Alcontrol in Chester for the following testing.

CLEA Contaminants – Arsenic (As), Cadmium (Cd), Mercury (Hg), Nickel (Ni), Lead (Pb), Selenium (Se), Phenol, Cresols, Benzene, MTBE, Toluene, Ethylbenzene, m, p-Xylene, o-Xylene.

GAC Contaminants – Boron (B), Copper (Cu), Zinc (Zn), Chromium total (Cr), Chromium (Hexa), Chromium (Triv), PAH (Speciation), TPHCWG.

Other Contaminants

Sulphide, Sulphate (wat sol), Cyanide total, pH, Sulphur elemental, Soil Organic Matter.

In addition, asbestos screening was carried out on all samples, none being encountered. The results are summarised below and the results presented in full in Appendix E.

Ground Conditions

The investigation proved the ground conditions to be highly variable, comprising topsoil overlying glacial sand and gravels, glacial deposits (undifferentiated) and glacial till.

Topsoil

The topsoil was between 0.15 and 0.30m thick and was generally described as, loose, brown, slightly clayey, gravelly silt.

Glacial Sand and Gravel

This was encountered in thin bands in most trial pits and was described as loose to medium dense, brown, sandy, fine to coarse gravel, with a little cobble and occasional boulder. They were typically saturated and caused instability of the pits.

Glacial Deposits

These are considered likely to be the finer fragment of glacial outwash deposits. They ranged between a silty clay and a clayey silt and as such ranged between loose to medium dense to firm. With depth on encountering groundwater they were soft to firm, brown, clayey silts.

Glacial Till

This was generally described as firm to stiff, slightly sandy, silty clay, with some fine to coarse gravel. It had grey streaking along fissures with some pockets of sand.

Atterberg limit testing recorded liquid limits between 26 and 31%, plastic limits between 10 and 13%, with plasticity indices of between 15 and 18%, indicating a lay of low plasticity. Natural moisture contents were between 14 and 17%.

pH values were between 5.66 and 7.01, with sulphate values when measured as 2:1 water extract between 0.021 and 0.027g/l.

Groundwater

Groundwater was only encountered as follows:

TP 3 at 2.50m in a saturated sand deposit, fast inflow.

TP 4 2.80m in sand, slow inflow.

TP 5 at 2.20m in thin sand layer, slight water inflow.

Summary of Chemical Test Results

The soil samples were taken from the made ground. The results of the soil analyses are presented below where they compared to human health critical values (CVs) for initial screening purposes. The CVs adopted are for residential land use with home grown produce.

They are taken primarily from CLEA Soil Guideline Values (SGVs) published by the Environment Agency (2009), and LQM/CIEH Generic Assessment Criteria (GACs-2nd edition 2009). These criteria are derived using the CLEA model under a standard default residential land use scenario, assuming that the potentially contaminated soil is present in gardens and beneath houses, and assuming worst case soil organic matter levels where these affect the critical value.

The lead values were withdrawn in 2009 and have recently been replaced by new C4SL values, which are presented in the table below. In addition, the benzo (a) pyrene values have recently been

updated and these are used in the analysis. Where published human health critical values are unavailable or inappropriate, then other widely-used screening values are used, as noted below.

CLEA SGV Contaminants

Determinant	No of Tests	Range (mg/kg) (Mean)	CLEA SGV Guidelines A*		% exceeding CLEA SGV
Arsenic	3	9.35 – 18.8(12.8)	1	32	0
Cadmium	3	0.341-0.447(0.36)	1	10	0
Lead	3	67.1 – 88 (76)	1	200	0
Mercury	3	<0.14-0.141	1	1	0
Nickel	3	11.9 – 16.7 (14.2)	1	130	0
Selenium	3	<1-1.21	1	350	0
Phenol	3	<0.01*	1	420	0
Cresols	3	<0.01*		NA	
MTBE	3	<0.005*		NA	
Benzene	3	<0.01*	1	0.33	0
Toluene	3	<0.002*	1	610	0
Ethylbenzene	3	<0.003*	1	350	0
M, p-Xylene	3	<0.006*	1	230-240	0
o-xylene	3	<0.003*	1	250	0
Notes A* 1 SGV for residential use. * - mean value not applicable since all or most values below laboratory detection levels					

No test results exceeded the CLEA SGV values for residential land use with home grown produce.

GAC Contaminants

Determinant (GAC Metals)	No of Tests	Range (Mean) (mg/kg)	GAC Value (mg/kg)	% exceeding GAC
Zinc	3	70.8 – 84.4 (77)	3750	0
Boron	3	2.09 – 2.45 (2.24)	291	0
Chromium	3	14.4 -18.7 (17)	NA	
Chromium _(Hex)	3	<0.60-<1.2	4.3	0
Chromium _(Triv)	3	14.4 -18.7 (17)	3000	0
Copper	3	18.6 – 23.8 (21.7)	2330	0

None of the above values exceed the relevant guidelines.

PAH Speciation

Determinant (GAC Speciated PAH)	No of Tests	Range (mg/kg)	GAC Value (mg/kg)	% exceeding GAC
Anthracene	3	<0.016	4900	0
Acenaphthylene	3	<0.012	400	0
Acenaphthene	3	<0.008	480	0
Benz(a)anthracene	3	0.052-0.095	4.7	0
Benzo(a)pyrene	3	0.05-0.106	5.0 (C4SL)	0
Benzo(b)fluoranthene	3	0.077-0.177	6.5	0
Benzo(ghi)perylene	3	0.053-0.101	46	0
Benzo(k)fluoranthene	3	0.027-0.053	9.6	0
Chrysene	3	0.052-0.10	8.0	0
Dibenzo(ah)anthracene	3	<0.023	0.86	0
Fluoranthene	3	0.069 – 0.146	460	0
Fluorene	3	<0.01	380	0
Indeno(123cd)pyrene	3	0.038-0.078	3.9	0
Naphthalene	3	0.0159– 0.0169	3.7	0
Phenanthrene	3	0.048 – 0.065	200	0
Pyrene	3	0.063 – 0.13	1000	0

The above guidance values are based on a SOM of 2.5%, which is the lower bound, as determined by testing. No values exceeded the relevant GAC/C4SL values for residential use.

Other Contaminants

Determinant	No of Tests	Range (Mean) (mg/kg unless otherwise stated)	Published Guidelines
Sulphide	3	<15	1000 (ICRCL)
Sulphur	3	<10 – 160 (60)	0.5% (UU)
Sulphate (wat sol)	3	<0.004 g/l	N/A
Total Cyanide	3	<1	NA
pH	3	6.48 – 6.6 (6.53)	<5 (UU)
Soil Organic Matter %	3	2.57 -5.24 (4)	6% (EA)

Notes.

UU United Utilities

EA Environment Agency

The test results have not revealed any concentrations above the indicated guidance levels for residential land use.

Hydrocarbons

LQM 2.5% Organic Content	No of Tests	Range (mg/kg)	Published Guidelines (mg/kg)
Aliphatic EC 5-6	3	<0.01	55
Aliphatic EC >6-8	3	<0.01	160
Aliphatic EC >8-10	3	<0.01	46
Aliphatic EC >10-12	3	<0.01	230
Aliphatic EC >12-16	3	<0.10	1700
Aliphatic EC >16-35	3	<0.10-5.77	64000
Aliphatic EC >35-44	3	<0.01	64000
Aromatic EC 5-7(benzene)	3	<0.01	130
Aromatic EC >7-8(toluene)	3	<0.01	270
Aromatic EC >8-10	3	<0.01	65
Aromatic EC >10-12	3	<0.01	160
Aromatic EC >12-16	3	<0.10	310
Aromatic EC >16-21	3	0.863-2.30	480
Aromatic EC >21-35	3	8.74- 11.7	1100
Aromatic EC >35-44	3	1.94-3.10	1100

None of the above values exceeded the relevant guidance.

The asbestos screening failed to reveal the presence of any asbestos.

Geotechnical Recommendations

Site Preparation and Earthworks

Firstly it will be necessary to strip the topsoil, which can be stored on site for later re use.

Excavations will be in glacial deposits, sands and gravels and glacial till and will be possible using conventional earthmoving equipment.

The trial pits confirmed that excavations encountering granular material will become unstable quickly and all excavations deeper than 1.20m will need to be battered back or shored for safety reasons.

Groundwater seepages are anticipated to be slight and easily catered for by pumping from sumps cut within the excavation.

Excavations for services in the road should start in the eastern side of the site to ensure that all excavations are self draining. Consequently, it makes sense to develop this side of the site first. If this is the case surface run off can be expected during heavy rain and drainage grips should be installed to protect all works downslope.

Shallow Mining

The only workable seam in the vicinity of the site (Upper Stinking) is shown to the west of the site in the bottom of the valley by Pool's Mouth. This seam is the top seam in the sequence and with the difference in elevation is not considered likely to be at shallow enough depth to influence the site. A Coal Authority report should be obtained to ensure that this is the case.

Foundations and Floor Slabs

The investigation has proven the ground conditions to be highly variable, which is consistent with the complex glacial history of this area.

Despite this conventional strip foundations are recommended for the development. However, due to the high variability in ground conditions it is recommended that the allowable bearing pressure be limited to 100kN/m². In addition, an allowance for lightly reinforcing some plots should be allowed where the ground conditions vary across the foundation excavation.

The atterberg limit testing has revealed the underlying clay to be of low shrinkability. While trees surround the site they are generally not in influencing distance of the houses, except possibly in the area of Plots 2, 9, 10, 17, 19 and 37. However, these are believed to be rooted in the old railway embankment and therefore will not affect the new properties, although this should be confirmed by on site inspection.

Floor slabs can be designed to be ground bearing, designed assuming the "poor formation" as described in Deacon.

Access Roads and Hardstandings

It is anticipated that following stripping of the topsoil the road formation will largely be in silt and clay from the glacial deposits/glacial till. In which case, a CBR value of 3% can be used for initial costing purposes. These will need to be confirmed by on site testing.

However, it should be noted that the formation in these materials will be prone to rapid deterioration on exposure to wet weather and trafficking. Formations should therefore be left slightly high until construction is imminent. In addition, it would be prudent to ensure the formation is protected from surface run off. The formation should be proof rolled and any soft/loose areas identified excavated, typically an additional 300mm and replaced with well compacted granular material

Protection of Buried Concrete

Chemical testing has revealed that chemical attack of buried concrete is not an issue. Buried concrete can be designed as the following classes in accordance with BRE guidance.

- DS – 1,
- AC – 1s.

Drainage

The site investigation has failed to reveal any strata that is consistent across the site that can be deemed suitable for soakaways. While isolated areas of granular material were encountered that may be suitable they were generally already saturated. It is also likely given the findings of the site investigation that any suitable material is probably limited in thickness and extent.

However, the general stratigraphy of the area means that if the site cannot be drained by other techniques such as attenuation and slow off site flows then boreholes can be considered to investigate the materials at depth. It is known that sandstone bedrock lies beneath the site and this is the same sandstone used to drain many sites in Wrexham. Therefore deep boreholes or shafts could be considered for drainage.

Radon

According to the BRE guidance on radon the site is in an area where full radon protection measures will be required. This will need to be confirmed if the site is purchased.

Suitability of Material for Re use

It has already been established that the topsoil is suitable for re use at the site and there is likely to be an abundance of material that can be used on future Gower Homes developments.

It is likely that some cut/fill will be required to provide level building areas. Any sand and gravel arising's will be suitable as a structural fill beneath roads and hardstandings, and also behind minor retaining walls, although this will depend on whether the roads are adoptable. The test results have shown that the glacial till will be suitable as a general cohesive fill. However, it should be noted that this material is subject to rapid deterioration on exposure to wet weather and trafficking. Consequently, these materials should be placed immediately following excavation.

Environmental Issues

While no desk study has been carried out to date the information available indicates that the site is a Greenfield site, with the only nearby development the railway embankment on the northern site boundary which was on embankment.

No visual or olfactory evidence of contamination was encountered in any of the trial pits and the chemical testing failed to reveal any evidence of contamination.

The site can therefore be considered to be uncontaminated and suitable for the proposed end use.

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

Yours sincerely

M J Scott

FIGURES

APPENDIX A

Site Photographs



Photograph 1 Looking east from western site boundary



Photograph 2 Bottom section of site looking down break in slope



Photograph 3 Western half of the site



Photograph 4 Site from eastern site boundary



Photograph 5 Griffiths Road



Photograph 6 bottom section of Griffith's road



Photograph 7 Old Mold Road

APPENDIX B

Previous Investigations

APPENDIX C

Trial Pit Logs

APPENDIX D

Physical Test Results

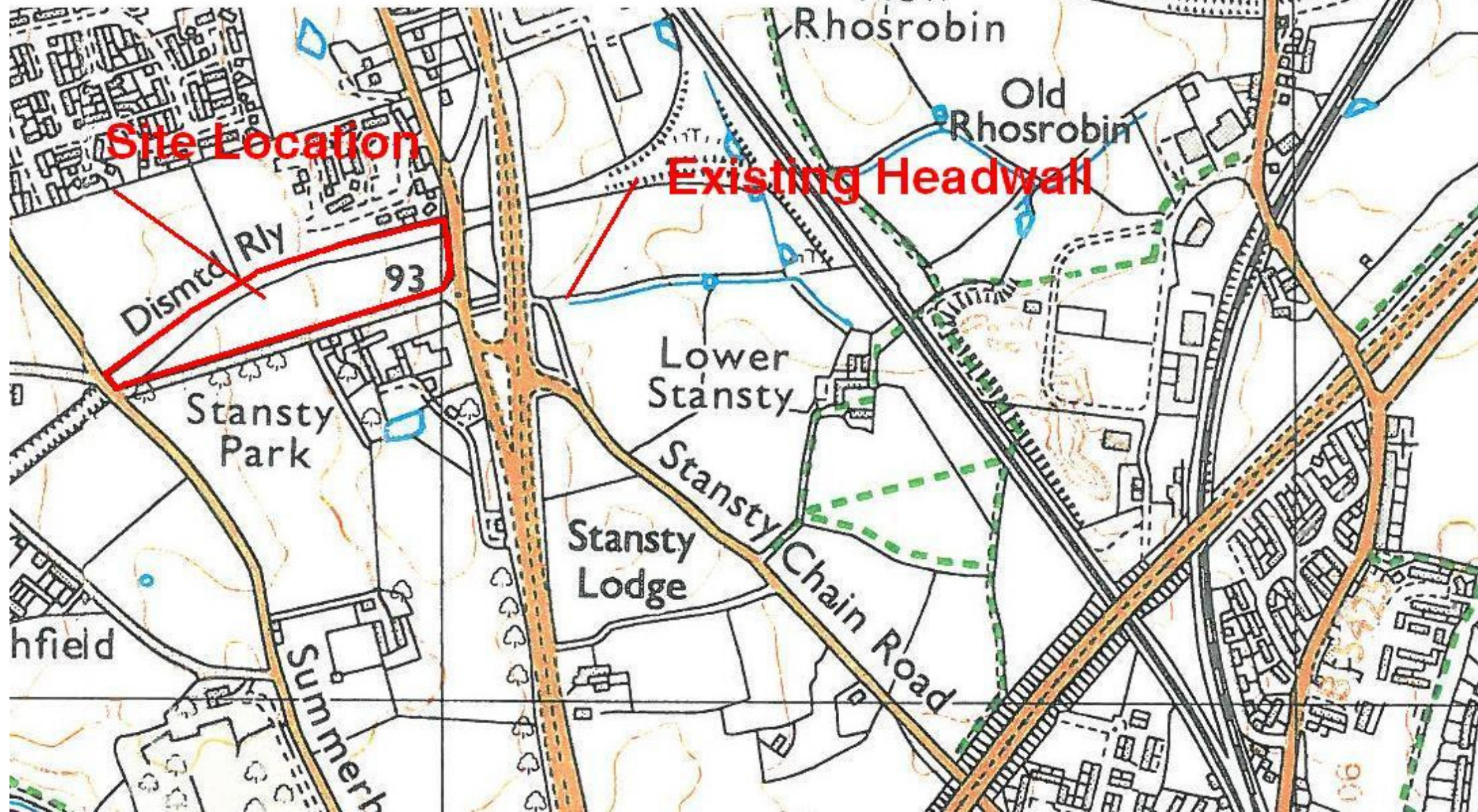
APPENDIX E

Chemical Test Results

APPENDIX E:

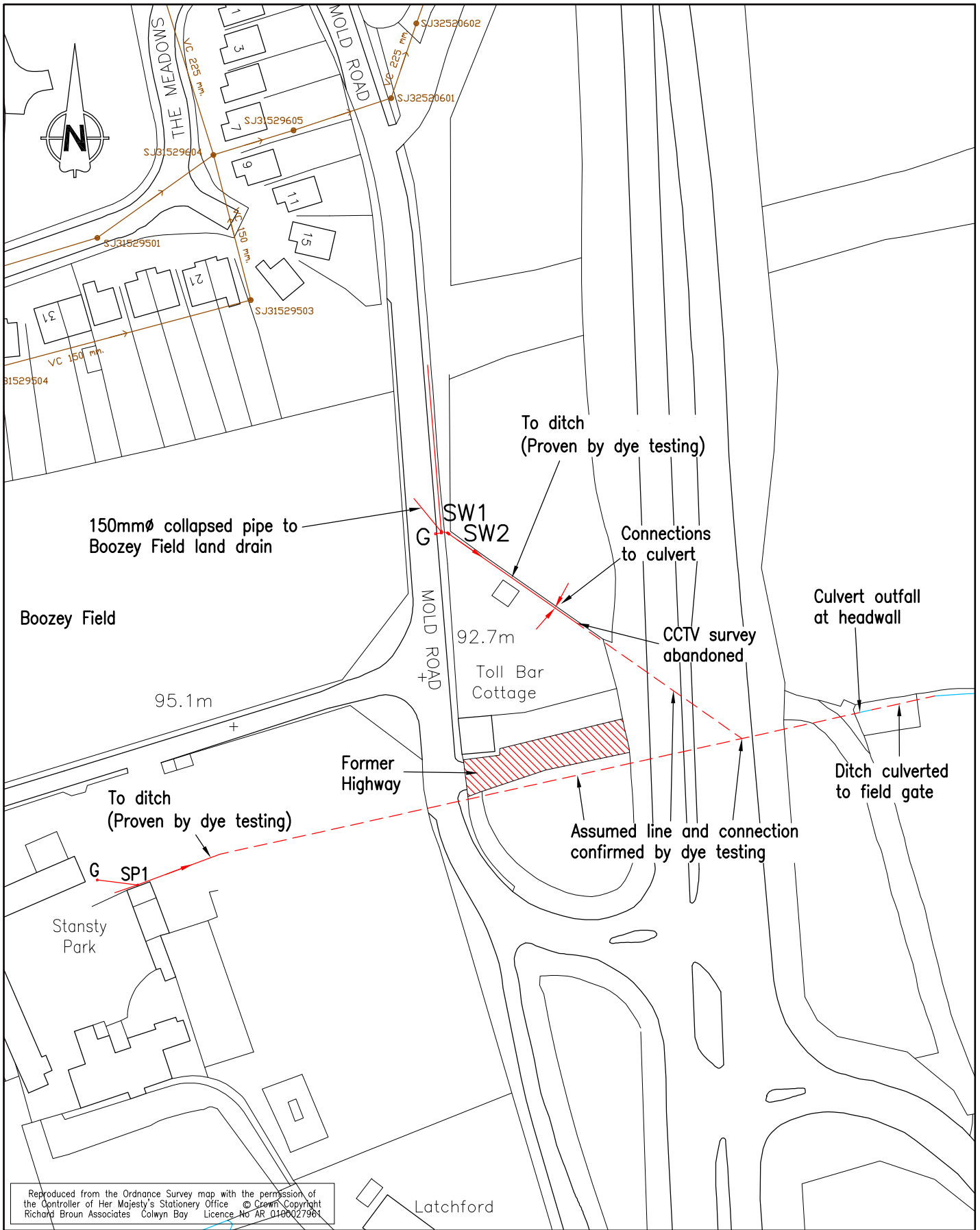
Ordnance Survey Map

Boozey Fields, Stansty Park Downstream Watercourse 4037/ Appendix E



APPENDIX F:

Drainage Investigation



					CLIENT	GOWER HOMES																							
						PROJECT	PROPOSED RESIDENTIAL DEVELOPMENT , BOOZEY FIELD, STANSTY, WREXHAM																						
REV	DATE	NATURE OF REVISION		BY			CHECKED																						
DO NOT SCALE THIS DRAWING. THIS DRAWING IS COPYRIGHT. CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE. ARCHITECT / ENGINEER TO BE NOTIFIED OF ANY DISCREPANCIES.															DRAWING	DRAINAGE INVESTIGATION													
Chartered Engineers & Architects																SCALE	1:1250	SIZE	A4	DRAWN		CHKD	DATE	JOB No	4037	DRG No	SK01	REV	
26 Mostyn Road Colwyn Bay Conwy LL29 8PB T: (01492) 533117 F: (01492) 530895 E: broun@rba.ltd.uk																	JME			05.15									
RICHARD BROUN ASSOCIATES																													

DRAINAGE SURVEY RECORD SHEET



Client GOWER HOMES LTD			Site BOOZEY FIELDS, GWERSYLLT, WREXHAM	Job N° 4037
By RW	Date 13.03.15	Time PM	Rainfall <i>Heavy / Average / Light / Nil</i> <i>[Delete as appropriate]</i>	MH Ref: SJ31529604

CHAMBER DETAILS

Location: Verges on east side of 'The Meadows' between No 7 & 9			Grid Ref: 331972, 352604 (SJ 331972 52604)		
Function ☐	F / C	Construction	CONCRETE	Cover Size	575Ø
Shape	<i>Circular/Rectangular</i> <i>[Delete as appropriate]</i>	Size	1050mmØ	Cover Level	UK

INCOMING PIPES

P i p e N o	Depth (m)	Invert level (m AOD)	Upstream MH ref	Size (mm)		Flow Depth (mm)	F u n c t i o n ☐	S h a p e *	M a t e r i a l #	Back Drop (Diam) mm
1	2.730		SJ31529603	150	x	25	F / C	C	VC	
2	2.635 / 1.910		SJ31529501	150	x	15	F / C	C	VC	150
3	2.730			150	x	?	F / C	C	VC	
4	1.840		SJ31529503	150	x	15	F / C	C	VC	
5					x					
6					x					

OUTGOING PIPES

A	2.875		SJ31529605	225	x	50	F / C	C	VC
B					x				

* **SHAPE:** Circular = C Egg = E Rectangular = R Trapezoidal = T
 # **MATERIAL:** Concrete = CO Vitriified clay = VC Polyvinyl chloride = PC Cast iron = CI Pitch fibre = PF
☐ **FUNCTION:** Foul = F Surface water = S Combined = C House connection = H

Distance downstream to MH No.	A	
	B	

Gradient downstream to MH No.	A	
	B	

Location: 	Details:
---------------	--------------

DRAINAGE SURVEY RECORD SHEET



Client GOWER HOMES LTD			Site BOOZEY FIELDS, GWERSYLLT, WREXHAM		Job N° 4037
By RW	Date 13.03.15	Time	Rainfall <i>Heavy / Average / Light / Nil</i>	MH Ref: SJ32520601	
			<i>[Delete as appropriate]</i>		

CHAMBER DETAILS

Location: Verges on west side of Mold Road adj minor road junction			Grid Ref: 332014, 352617 (SJ32014 52617)		
Function ☐	F / C	Construction	CONCRETE	Cover Size	UK
Shape	<i>Circular/Rectangular</i> <i>[Delete as appropriate]</i>	Size	1050mmØ	Cover Level	UK

INCOMING PIPES

P i p e N o	Depth (m)	Invert level (m AOD)	Upstream MH ref	Size (mm)			Flow Depth (mm)	F u n c t i o n ☐	S h a p e*	M a t e r i a l#	Back Drop (Diam) mm
1	2.270		SJ31529605	225	x		25	F / C	C	VC	
2					x						
3					x						
4					x						
5					x						
6					x						

OUTGOING PIPES

A	2.300		SJ32520602	225	x		25	F / C	C	VC
B					x					

- * **SHAPE:** Circular = C Egg = E Rectangular = R Trapezoidal = T
MATERIAL: Concrete = CO Vitrified clay = VC Polyvinyl chloride = PC Cast iron = CI Pitch fibre = PF
☐ **FUNCTION:** Foul = F Surface water = S Combined = C House connection = H

Distance downstream to MH No.	A	
	B	

Gradient downstream to MH No.	A	
	B	

Location: 	Details:
----------------------	---------------------

DRAINAGE SURVEY RECORD SHEET



Client GOWER HOMES LTD			Site BOOZEY FIELDS, GWERSYLLT, WREXHAM	Job N° 4037
By RW	Date 13.03.15	Time PM	Rainfall <i>Heavy / Average / Light / Nil</i> <i>[Delete as appropriate]</i>	MH Ref: SJ32520602

CHAMBER DETAILS

Location: Verges on NW side of 'Old Mold Road'			Grid Ref: 332020, 352635 (SJ32020 52635)		
Function ☐	F / C	Construction	CONCRETE	Cover Size	685 x 685
Shape	<i>Circular/Rectangular</i> <i>[Delete as appropriate]</i>	Size	900mmØ	Cover Level	UK

INCOMING PIPES

P i p e N o	Depth (m)	Invert level (m AOD)	Upstream MH ref	Size (mm)		Flow Depth (mm)	F u n c t i o n ☐	S h a p e*	M a t e r i a l #	Back Drop (Diam) mm
1	1.765		SJ32520601	225	x	25	F / C	C	VC	
2	1.425				x					
3					x					
4					x					
5					x					
6					x					

OUTGOING PIPES

A	1.750 (sloping cover)		SJ32520603	225	x	25	F / C	C	VC
B					x				

* **SHAPE:** Circular = C Egg = E Rectangular = R Trapezoidal = T
 # **MATERIAL:** Concrete = CO Vitrified clay = VC Polyvinyl chloride = PC Cast iron = CI Pitch fibre = PF
☐ **FUNCTION:** Foul = F Surface water = S Combined = C House connection = H

Distance downstream to MH No.	A	
	B	

Gradient downstream to MH No.	A	
	B	

Location: 	Details:
---------------	--------------

DRAINAGE SURVEY RECORD SHEET



Client GOWER HOMES LTD			Site BOOZEY FIELDS, GWERSYLLT, WREXHAM	Job N° 4037
By RW	Date 13.03.15	Time AM	Rainfall Heavy / Average / Light / Nil [Delete as appropriate]	MH Ref: SP1

CHAMBER DETAILS

Location: Adjacent gable end of Stansty Park outbuilding			Grid Ref: 331953, 352427 (SJ3195352427)		
Function ☐	S	Construction	BRICK	Cover Size	~400x300mm
Shape	~~Circular~~ /Rectangular [Delete as appropriate]	Size	450 x 300mm	Cover Level	UK

INCOMING PIPES

P i p e N o	Depth (m)	Invert level (m AOD)	Upstream MH ref	Size (mm)			Flow Depth (mm)	F u n c t i o n ☐	S h a p e*	M a t e r i a l#	Back Drop (Diam) mm
1	0.725		Gully	150	x		20	S	C	VC	
2	~0.400		Unknown	150	x		5	S	C	PVC	
3					x						
4					x						
5					x						
6					x						

OUTGOING PIPES

A	0.725		Ditch	150	x		20	S	C	VC
B					x					

* **SHAPE:** Circular = C Egg = E Rectangular = R Trapezoidal = T
 # **MATERIAL:** Concrete = CO Vitrified clay = VC Polyvinyl chloride = PC Cast iron = CI Pitch fibre = PF
☐ **FUNCTION:** Foul = F Surface water = S Combined = C House connection = H

Distance downstream to MH No.	A	
	B	

Gradient downstream to MH No.	A	
	B	

Location: 	Details:
----------------------	---------------------

DRAINAGE SURVEY RECORD SHEET



Client GOWER HOMES LTD			Site BOOZEY FIELDS, GWERSYLLT, WREXHAM	Job N° 4037
By RW	Date 13.03.15	Time PM	Rainfall <i>Heavy / Average / Light / Nil</i> <i>[Delete as appropriate]</i>	MH Ref: SW1

CHAMBER DETAILS

Location: Footway east side of Mold Road opposite the site			Grid Ref: 332026, 352513 (SJ3202652513)		
Function ☐	S	Construction	BRICK	Cover Size	UK
Shape	<i>Circular/Rectangular</i> <i>[Delete as appropriate]</i>	Size	800 x 450	Cover Level	UK

INCOMING PIPES

P i p e N o	Depth (m)	Invert level (m AOD)	Upstream MH ref	Size (mm)		Flow Depth (mm)	F u n c t i o n ☐	S h a p e*	M a t e r i a l #	Back Drop (Diam) mm
1	~ 0.625		gully	150	x	5	S	C	VC	
2	1.590		H'way MH	225	x	40	S	C	VC	
3	~ 1.500		Site?	150	x	5	S	C	VC	
4					x					
5					x					
6					x					

OUTGOING PIPES

A	1.660		Ditch	150	x	100	S	C	VC
B					x				

* **SHAPE:** Circular = C Egg = E Rectangular = R Trapezoidal = T
 # **MATERIAL:** Concrete = CO Vitrified clay = VC Polyvinyl chloride = PC Cast iron = CI Pitch fibre = PF
☐ **FUNCTION:** Foul = F Surface water = S Combined = C House connection = H

Distance downstream to MH No.	A	
	B	

Gradient downstream to MH No.	A	
	B	

Location: 	Details:
---------------	--------------

APPENDIX G:

Greenfield Run-Off Calculation

Site name: Boozey Fields
Site location: Stansty

Site coordinates
Latitude: 53.06537° N
Longitude: 3.01784° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcmvgk62pjzq / 2.4
Date: 9 Feb 2015

Site characteristics

Total site area	2.4	ha
Significant public open space	0.4	ha
Area positively drained	2	ha

Methodology

Greenfield runoff method	IH124
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	2
HOST class	N/A
SPR	0.30

Hydrological characteristics

	Default	Edited	
SAAR	802	802	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.3	0.3	
FEH/FSR conversion factor	0.99	0.99	
Hydrological region	9	9	
Growth curve factor: 1 year	0.88	0.88	
Growth curve factor: 10 year	1.42	1.42	
Growth curve factor: 30 year	1.78	1.78	
Growth curve factor: 100 year	2.18	2.18	

Greenfield runoff rates

	Default	Edited	
Qbar	4.27	4.27	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	7.61	7.61	l/s
1 in 100 years	9.32	9.32	l/s

Please note that a minimum flow of 5 l/s applies to any site

Site name: Boozey Fields
Site location: Stansty

Site coordinates
Latitude: 53.06537° N
Longitude: 3.01784° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: gcmvgk62pjzq / 2.4
Date: 9 Feb 2015

Site characteristics

Total site area	2.4	ha
Significant public open space	0.4	ha
Area positively drained	2	ha

Methodology

Greenfield runoff method	FEH	
Qmed estimation method	Calculate from BFI and SAAR	
BFI and SPR estimation method	Calculate from dominant HOST	
HOST class	N/A	
BFI / BFIHOST	0.00	
Qmed	N/A	l/s
Qbar / Qmed Conversion Factor	N/A	

Hydrological characteristics

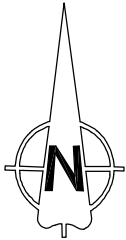
	Default	Edited	
SAAR	802	802	mm
M5-60 Rainfall Depth	17	17	mm
'r' Ratio M5-60/M5-2 day	0.3	0.3	
FEH/FSR conversion factor	0.99	0.99	
Hydrological region	9	9	
Growth curve factor: 1 year	0.88	0.88	
Growth curve factor: 10 year	1.42	1.42	
Growth curve factor: 30 year	1.78	1.78	
Growth curve factor: 100 year	2.18	2.18	

Greenfield runoff rates

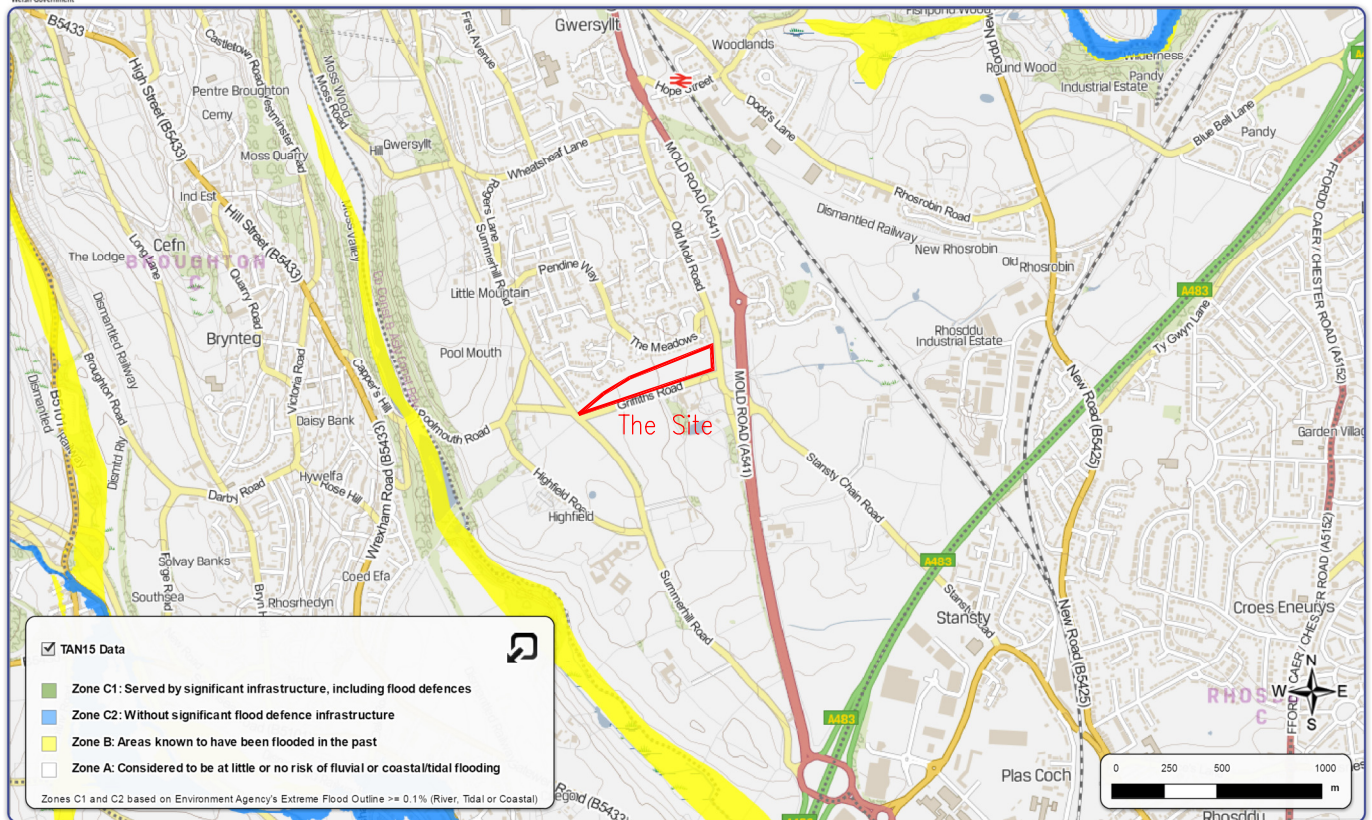
	Default	Edited	
Qbar	---	---	l/s
1 in 1 year	---	---	l/s
1 in 30 years	---	---	l/s
1 in 100 years	---	---	l/s

Please note that a minimum flow of 5 l/s applies to any site

APPENDIX H:
Flood Map Drawings



TAN 15 Development and Flood Risk
Development Advice Map



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Developed by Cartographics, Welsh Government

REV	DATE	NATURE OF REVISION	BY	CHECKED

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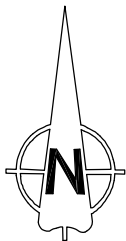
Chartered Engineers & Architects

26 Mostyn Road Colwyn Bay Conwy LL29 8PB

T: (01492) 533117 F: (01492) 530895 E: broun@rba.ltd.uk



CLIENT	GOWER HOMES				
PROJECT	PROPOSED RESIDENTIAL DEVELOPMENT, BOOZEY FIELD, STANSTY, WREXHAM				
DRAWING	WELSH GOVERNMENT TAN 15 DEVELOPMENT AND FLOOD RISK ADVICE MAP				
SCALE	NTS	SIZE	A4	DRAWN	CHKD
				DATE	10.15
JOB NO	4037	DRG NO	SK02	REV	



Legend

— The Site

REV	DATE	NATURE OF REVISION	BY	CHECKED

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CLIENT	GOWER HOMES											
PROJECT	PROPOSED RESIDENTIAL DEVELOPMENT, BOOZEY FIELD, STANSTY, WREXHAM											
DRAWING	NATURAL RESOURCES WALES INDICATIVE ASSESSMENT OF THE RISK OF FLOODING FROM SURFACE WATER											
SCALE	1:10000	SIZE	A4	DRAWN	CHKD	DATE	JOB No	4037	DWG No	SK03	REV	