Appendix B
Ground Investigations – Report Extracts

Redrow Homes Limited

WINDMILL LANE, COWBRIDGE

Site Investigation Report

12569/JJ/20/SI

Intégral
Géotechnique

CLIENT:	**Redrow Homes Limited**
PROJECT:	**Windmill Lane, Cowbridge**
TITLE:	**Site Investigation Report**
JOB NO:	**12569**
DOCUMENT REF:	**12569/JJ/20/SI**

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1.0 INTRODUCTION

1.1 GENERAL

Redrow Homes are proposing to acquire and develop a site situated off Windmill Lane, Cowbridge for residential end-use. The location of the site is indicated on Figure 1.

Intégral Géotechnique (Wales) Limited have been appointed as the Geotechnical Engineers to undertake an intrusive site investigation to enable a geotechnical and geoenvironmental appraisal of the site and provide a basis for design.

This report presents the findings of the intrusive site investigation and gives recommendations for the design of foundations, floor slabs and other geotechnical and geoenvironmental aspects of the project.

1.2 PROPOSED DEVELOPMENT

The proposed development will likely comprise the construction of a number of traditional residential dwellings with private gardens and associated infrastructure including access roads, car parking areas and driveways. Areas of landscaping, public open space (POS) and surface water attenuation are also likely to be included as part of the development.

The approximate ‘red line’ development boundary (herein referred to as ‘the site’ area) is indicated on Figure 2. However, it is understood that there is an option for Redrow Homes to also acquire land situated immediately to the south of the site for POS/surface water attenuation end use (see Figure 2).

1.3 SCOPE OF WORKS

The work instructed included a desk study of available information, site reconnaissance and intrusive site investigation. This was followed by laboratory testing and geotechnical and geoenvironmental reporting.

1.3 SCOPE OF WORKS (CONTINUED)

The desk study comprised a review of:

- An Envirocheck Report obtained for the site;
- Old Ordnance Survey maps covering the site, included within the Envirocheck Report;
- A Radon Georeport obtained from the British Geological Survey (BGS);
- Geological maps of the area provided by the BGS; and
- the Natural Resources Wales (NRW) groundwater vulnerability map and aquifer database for the area.

The desk study information was used to make an initial assessment of the site and to design an intrusive investigation to be carried out by Intégral Géotechnique. The intrusive site investigation was designed in accordance with BS5930+A2:2010, the Code of Practice for Site Investigations, BS10175:2011, the Code of Practice for Investigation of potentially contaminated sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

The intrusive site investigation comprised:

- 23 No. trial pits excavated during November 2019;
- Soakaway testing undertaken within 7 No. trial pits;
- Indicative mexecone penetrometer testing in selected trial pits;
- Sampling of soil for laboratory chemical testing (including bioaccessibility testing and WAC analysis); and
- Sampling of soil for laboratory geotechnical testing.

1.4 LIMITATIONS

This document is intended to be a working document for further development in discussion with all concerned including the Local Planning Authority, Natural Resources Wales (NRW), and the NHBC as appropriate.

It should be noted that vertical and lateral changes in ground conditions may be present between exploratory hole locations.

Access for the intrusive site investigation across large areas of the option land situated to the south of the site was limited due to flooding.

1.4 LIMITATIONS (CONTINUED)

"Contamination" is taken throughout the report to mean the "presence of one or more potentially harmful substances as a result of human activity". The use of the term in this way does not imply that harm is being or might be caused by the contamination. It should be noted that "contamination" can have different meanings under different regulatory regimes, for example, planning, building control and Part IIA of the Environmental Protection Act 1990. Naturally elevated concentrations of potentially harmful substances may also be of concern and the significance of any that have been found is also evaluated in this report.

It is important to recognise that there may be areas of contamination that have not been found, or that contaminants are present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences other than by chance.

7.0 GROUND CONDITIONS

The site has been zoned in order to reflect variations in the observed ground conditions encountered during the intrusive site investigation. The variations in the encountered ground conditions correlate with the changes in the published geology shown on the geological map.

The approximate zones (referred to as Geology Zone A and Geology Zone B) are indicated on Figure 3.

Geology Zone A comprises the majority of the site area, as indicated by the green shaded area on Figure 3. Within the trial pits excavated across Geology Zone A (see TP01 to TP09, TP13 to TP16, and SA1, SA2, SA3 and SA6) the ground conditions generally comprised a thin layer of topsoil over a variable thickness of firm clay deposits, over weathered limestone bedrock strata, typically comprising dense clayey cobbles and boulders grading into medium strong thinly bedded limestone with depth. It should be noted that across the more elevated areas of Geology Zone A, very shallow bedrock strata was encountered. Locally, weathered bedrock strata was encountered as shallow as 0.10m bgl, immediately below the overlying topsoil. In the lower lying areas of Geology Zone A, the limestone bedrock strata was encountered at greater depths, up to approximately 1.6m bgl.

Geology Zone B comprises the southern and eastern extents of the southern field parcel, as indicated by the pink shaded area on Figure 3. Within the trial pits excavated across Geology Zone B (see TP10 to TP12, and SA7), the ground conditions generally comprised a thin layer of topsoil over firm, becoming soft, orange brown fissured silt/clay, over loose sand deposits, over firm red brown clay deposits.

The variations in ground conditions between Geology Zones A and B is considered representative of the published geology change (indicated on the geological map) from the Lower Lias Limestones into the underlying Penarth Group and Mercia Mudstone Formation.

7.1 GEOLOGY ZONE A

A summary of the ground conditions encountered across Geology Zone A is presented below in Table 7.

Table 7: Summary of Ground Conditions (Geology Zone A)

Depth (m) From	To	Stratum
0.00	0.10/0.30	TOPSOIL: Soft brown silty CLAY with rootlets.
0.00	0.50/0.60	Localised MADE GROUND: Reworked COBBLES and BOULDERS of angular limestone in a soft clay matrix. *Encountered at TP06 and TP07 only.*
0.10/0.20	0.50/1.60	Firm brown or orange brown silty CLAY.
0.10/1.60	0.40/1.90	(Dense) brown and grey clayey gravelly COBBLES and BOULDERS of angular limestone [weathered limestone bedrock].
0.40/1.90		(Medium strong) grey thinly bedded LIMESTONE.

TP06 and TP07 were positioned in the vicinity of the densely vegetated surface depression present along the north-eastern boundary of the northern field parcel. At both trial pits locations, the ground surface was underlain by a thin layer of made ground comprising reworked cobbles and boulders of limestone in a clay matrix. The base of the made ground at these locations was proven at depths of between approximately 0.50m and 0.60m bgl.

TP16 was an elongated trial pit (approximately 6m in length) positioned at the location of a small circular surface depression (approximately 1.2m in diameter) along the north-eastern boundary of the southern field parcel. The purpose of the trial pit was to investigate the nature of the small surface depression at this location. The ground conditions encountered at TP16 comprised a thin layer of topsoil, over a layer of firm brown silty clay, over variable weathered limestone bedrock strata encountered at depths ranging between approximately 1.2m and 1.6m bgl. Note that the depth to the weathered bedrock strata was recorded to be deepest (i.e. 1.6m bgl) local to the surface depression. It is considered that the surface depression at this location may be associated with a solution feature formed by the suffosion/wash out of soils in the underlying bedrock strata.

The trial pits excavated across Geology Zone A all terminated due to difficult dig / rock break conditions within the encountered limestone bedrock strata. The trial pit termination depths varied between approximately 0.5m bgl (at TP01) and 2.0m bgl (at SA3).

7.1 GEOLOGY ZONE A (CONTINUED)

The shallowest depths to limestone bedrock were generally encountered within the trial pits excavated in the elevated north-western extents of Geology Zone A. The greatest depths to limestone bedrock were generally encountered in the low-lying south-eastern extents of Geology Zone A.

It has not been possible to prove thickness of the limestone bedrock. However, it is considered that the thickness of the limestone bedrock strata (i.e. the rock cover above the underlying Triassic and Carboniferous bedrock strata) will decrease towards the south and southeast (i.e. in low-lying areas).

Overbreak of excavation sides was noted within the trial pits.

Groundwater was not encountered within the excavated depths of the trial pits positioned across Geology Zone A.

The laboratory plasticity test results indicate that the clay component of the weathered bedrock strata (comprising clayey cobbles and boulders of angular limestone), have plasticity indices ranging between 11 to 38%, and modified plasticity indices ranging between non-plastic to 37%. Based on the results of the plasticity testing, the weathered bedrock strata (comprising clayey cobbles and boulders of angular limestone) are considered to have a medium volume change potential. The underlying, less weathered, medium strong thinly bedded limestone bedrock (i.e. the strata that the trial pits positioned across Geology Zone A were terminated in) is considered to be non-plastic.

7.2 GEOLOGY ZONE B

A summary of the ground conditions encountered across Geology Zone B is presented below in Table 8.

Table 8: Summary of Ground Conditions (Geology Zone B)

Depth (m) From	Depth (m) To	Stratum
0.00	0.20	TOPSOIL: Soft brown silty CLAY with rootlets.
0.20	0.80/1.50	Firm or soft to firm orange or light brown silty CLAY - Fissured.
0.80/1.50	1.70/2.50	Soft brown SILT/CLAY – Fissured.

7.2 GEOLOGY ZONE B (CONTINUED)

Depth (m) From	To	Stratum
1.70/2.50	2.20/>3.20	(Loose) brown slightly clayey slightly silty fine to coarse SAND.
2.20/2.40		Firm to stiff red brown CLAY.

The trial pits excavated across Geology Zone B were terminated at depths ranging between approximately 2.5m (at SA7 – to undertake a soakaway test), and 3.2m bgl (at TP10 – due to reach limitations of the excavator).

It should be noted that loose sand deposits were encountered at TP10 and TP11 at depths of 2.5m and 1.7m bgl respectively. These deposits could potentially represent decalcified Rhaetic sandstone deposits of the Penarth Group. As detailed above in Section 4.2, the Rhaetic sandstones in the Vale of Glamorgan are susceptible to the decalcification resulting in the formation of uncemented loose sand deposits and the potential formation of subsurface voids and cavities. A phenomenon that is well documented within these deposits near Cowbridge.

Hand shear vane testing recorded undrained shear strength values ranging between approximately 25kPa and 50kPa within the cohesive deposits.

Overbreak and significant spalling/instability of excavation sides was noted within the trial pits. Running sand conditions were also observed within TP10 and TP11.

Moderate to fast groundwater inflow were encountered from depths ranging between approximately 1.7m bgl and 2.5m bgl.

The laboratory plasticity test results indicate that the clay soils underlying Geology Zone B, have plasticity indices ranging between 14 to 24%, and modified plasticity indices ranging between 14 to 20%. Based on the results of the plasticity testing, the clay soils underlying Geology Zone B are considered to have a medium volume change potential.

7.3 SOAKAWAY TEST RESULTS

Soakaway testing was undertaken within 7 No. trial pits (SA1 to SA7). The soakaway test calculation sheets are presented in Appendix D.

The results of the trial pit soakaway tests are summarised in Table 9.

7.3 SOAKAWAY TEST RESULTS (CONTINUED)

Table 9: Trial Pit Soakaway Test Results				
Trial Pit Reference	Excavation Depth (m bgl)	Calculated Infiltration Rate (m/s)		
		Cycle 1	Cycle 2	Cycle 3
SA1	1.90	$2.4x10^{-4}$	$8.5x10^{-5}$	$8.1x10^{-5}$
SA2	0.80	$2.3x10^{-4}$	$1.2x10^{-4}$	$8.0x10^{-5}$
SA3	2.00	$5.6 x10^{-6}$	$3.8 x10^{-6}$	n/a
SA4	2.50	n/a – no infiltration	n/a	n/a
SA5	1.50	n/a – no infiltration	n/a	n/a
SA6	2.50	$8.3 x10^{-6}$	$5.9 x10^{-6}$	n/a
SA7	2.50	n/a – no infiltration	n/a	n/a

Note that the trial pit soakaway test results are specific to the locations and depths of the tests undertaken.

11.5 ACCESS ROADS AND CAR PARKING AREAS (CONTINUED)

After proof rolling, the pavement formations, any 'soft spots/areas' should be removed and replaced with well-compacted imported granular materials. Department of Transport (DTp) Type 1 Sub-Base, or similar approved, could be used and should be compacted in layers in accordance with the current DTp Specification for Highway Works.

Formations within cohesive deposits should be regarded as frost susceptible.

11.6 DRAINAGE

Soakaway testing has been undertaken at 7 No. trial pit locations across the site (SA1 to SA7), as indicated on Figure 2.

Five of the soakaway tests (SA1 to SA3, SA6 and SA7) were positioned across the site area. Two of the soakaway tests (see SA4 and SA5) were situated on the option land to the south of the site.

The results of soakaway tests are summarised in Section 7.3 above (see Table 9).

Note that the soakaway test results are specific to the locations and depths of the tests undertaken. The soakaway results should be provided to a suitably qualified drainage engineer so that a soakaway design specific to the development can be completed and provided.

Due to the nature of the geology underlying the site, a potential solution feature risk has been identified. As such, control of site drainage is considered to be of critical importance. Care should be exercised to ensure that all the drainage and water services are constructed properly, such that there would be no future leakage of water from these pipes near the building foundations.

The use of soakaway drainage systems within the shallow silt/clay/sand soils beneath the site is not recommended due to the potential for solution features and the risk of suffusion/wash out of the overlying soils into any potential dissolution widened fissures/joints in the underlying bedrock.

If soakaway drainage systems are to be utilised on site, then all soakaway chambers should be set away from the proposed buildings by a minimum of 5.0m, be socketed into limestone bedrock and the chamber sides cased such that no concentrated discharges of water are able to wash into the overlying soils (which could result in suffosion/wash out into the underlying limestone).

11.6 DRAINAGE (CONTINUED)

The detailed design of any soakaway will need to robustly seal off any silt/clay/sand deposits overlying the infiltration zone within the underlying limestone bedrock. This is in order to avoid washout/suffosion and collapse of the overlying clay deposits.

11.7 RECOMMENDED FURTHER WORKS

Due to the susceptibility of the bedrock strata underlying the site to dissolution weathering and decalcification, and the potential formation of solution features, it is recommended that a geophysical survey is undertaken across the proposed development areas in order to identify any potential anomalous ground responses which could be indicative of potential shallow solution features.

Any anomalous ground readings identified from the geophysical survey (which could be indicative of potential solution features which may require remedial works) should be further investigated using targeted intrusive ground investigation techniques including trial pits and rotary boreholes.

In order to further delineate / refine (and potentially reduce) the area of the site requiring a 600mm garden capping layer, it is recommended that supplementary grid sampling of the topsoil and subsoil deposits is undertaken across the site. The supplementary soil samples should be tested for lead (including bioaccessible lead) and beryllium. Following assessment of the results, the risk assessments and preliminary remedial recommendations detailed in Section 11 should be reviewed.

APPENDIX D

SOAKAWAY TEST RESULTS

BRE365 SOIL INFILTRATION RATE TEST - SA1

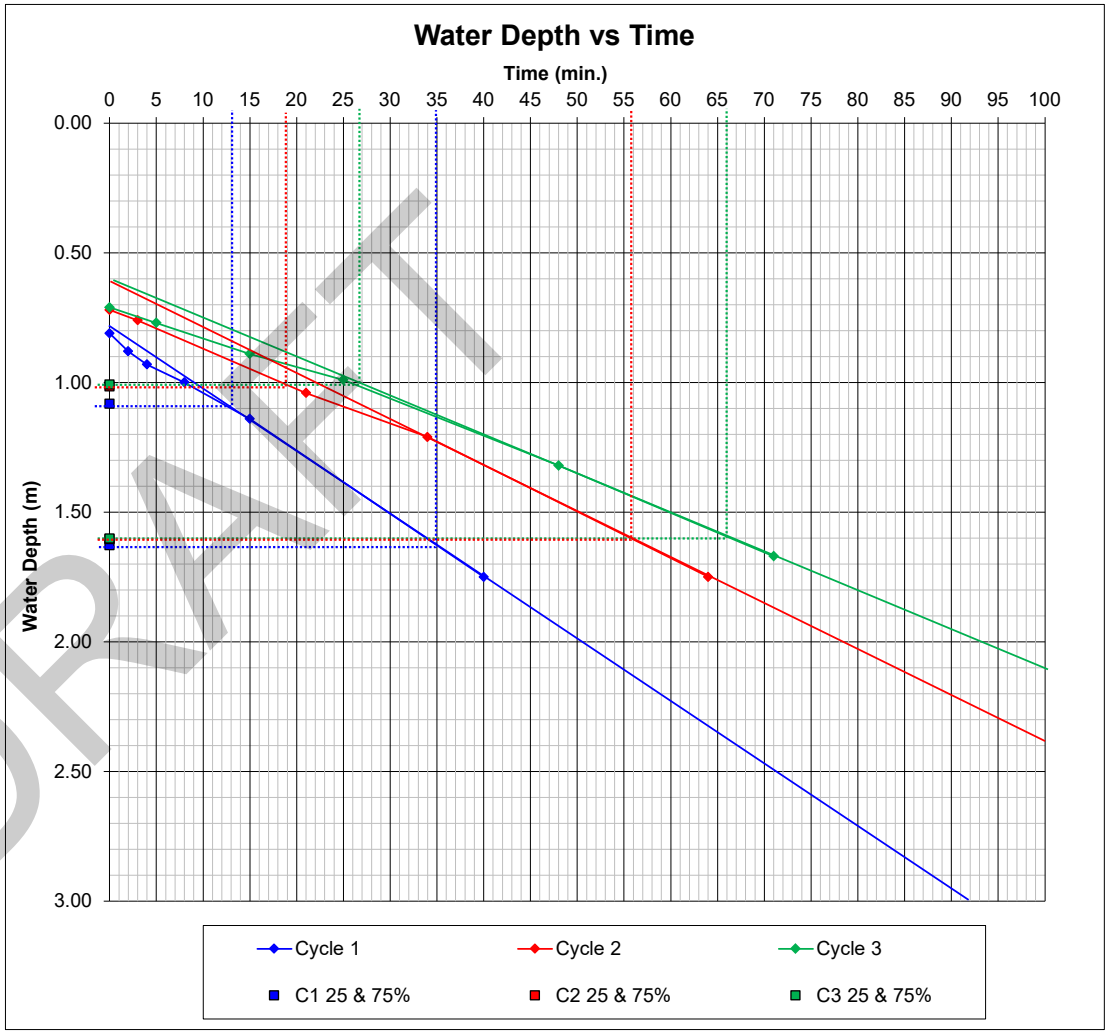
12569 Land at Windmill Lane, Cowbridge

Trial Pit Information	
Length (m)	2.10
Width (m)	0.75
Depth (m)	1.90
Groundwater	n/a
Weather Conditions	dry
Date	28-Nov-19

Remarks

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.81	0	0.72	0	0.71
2	0.88	3	0.76	5	0.77
4	0.93	21	1.04	15	0.89
8	1.00	34	1.21	25	0.99
15	1.14	64	1.75	48	1.32
40	1.75			71	1.67

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	1.90	1.90	1.90
Water Depths (m)			
Water depth at start of test	0.81	0.72	0.71
Water depth at end of test	1.75	1.75	1.67
Effective depth (measured)	0.94	1.03	0.96
% Effective storage depth	0.86	0.87	0.81
Effective Storage Depths (m)			
Effective storage depth (100%)	1.09	1.18	1.19
Effective storage depth (75%)	0.82	0.89	0.89
Effective storage depth (50%)	0.55	0.59	0.60
Effective storage depth (25%)	0.27	0.30	0.30
Outflow Time (min)			
Time for measured outflow	40	64	71
Time for 100% outflow	46	72	93
Time for 75-25% outflow	13	37	39
Volume of Outflow (m^3)			
Over measured effective depth	1.48	1.62	1.51
Over 100% effective depth	1.72	1.86	1.87
From 75% - 25% effective depth	0.86	0.93	0.94
Surface Area (m^2)			
For 100% effective storage	7.79	8.30	8.36
For 50% effective storage	4.68	4.94	4.97
Over measured depth	6.93	7.45	7.05
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	8.0E-05	5.2E-05	4.0E-05
Over measured depth	8.9E-05	5.7E-05	5.0E-05
Over 75% - 25% effective depth	**2.4E-04**	**8.5E-05**	**8.1E-05**



Design Soil Infiltration Rate: 8.1E-05 m/s

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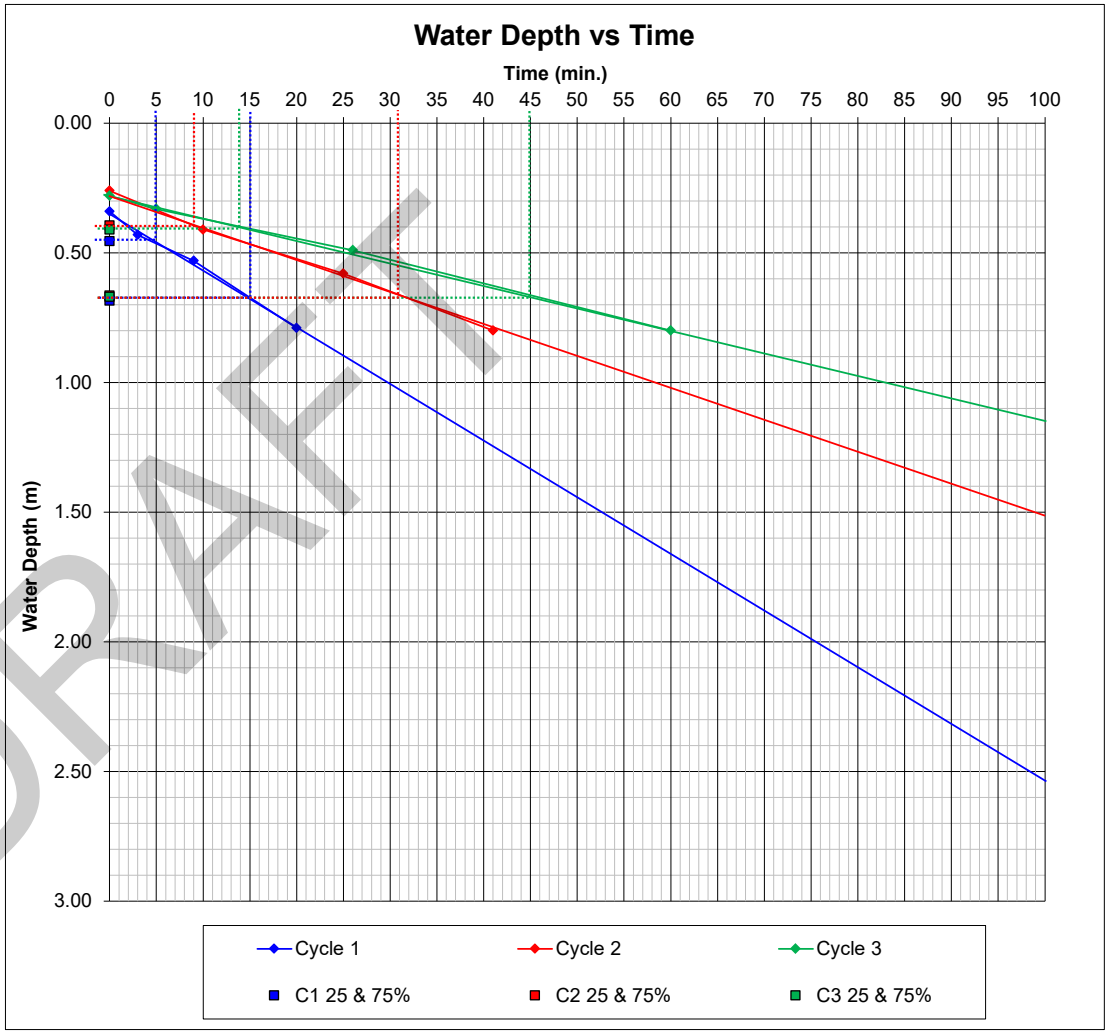
BRE365 SOIL INFILTRATION RATE TEST - SA2

12569 Land at Windmill Lane, Cowbridge

Trial Pit Information	
Length (m)	2.40
Width (m)	1.00
Depth (m)	0.80
Groundwater	n/a
Weather Conditions	dry
Date	28-Nov-19

Remarks

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.34	0	0.26	0	0.28
3	0.43	10	0.41	5	0.33
9	0.53	25	0.58	26	0.49
20	0.79	41	0.80	60	0.80



Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	0.80	0.80	0.80
Water Depths (m)			
Water depth at start of test	0.34	0.26	0.28
Water depth at end of test	0.79	0.80	0.80
Effective depth (measured)	0.45	0.54	0.52
% Effective storage depth	0.98	1.00	1.00
Effective Storage Depths (m)			
Effective storage depth (100%)	0.46	0.54	0.52
Effective storage depth (75%)	0.35	0.41	0.39
Effective storage depth (50%)	0.23	0.27	0.26
Effective storage depth (25%)	0.12	0.14	0.13
Outflow Time (min)			
Time for measured outflow	20	41	60
Time for 100% outflow	20	41	60
Time for 75-25% outflow	10	22	31
Volume of Outflow (m^3)			
Over measured effective depth	1.08	1.30	1.25
Over 100% effective depth	1.10	1.30	1.25
From 75% - 25% effective depth	0.55	0.65	0.62
Surface Area (m^2)			
For 100% effective storage	5.53	6.07	5.94
For 50% effective storage	3.96	4.24	4.17
Over measured depth	5.46	6.07	5.94
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	1.7E-04	8.7E-05	5.8E-05
Over measured depth	1.6E-04	8.7E-05	5.8E-05
Over 75% - 25% effective depth	**2.3E-04**	**1.2E-04**	**8.0E-05**

Design Soil Infiltration Rate: 8.0E-05 m/s

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BRE365 SOIL INFILTRATION RATE TEST - SA3

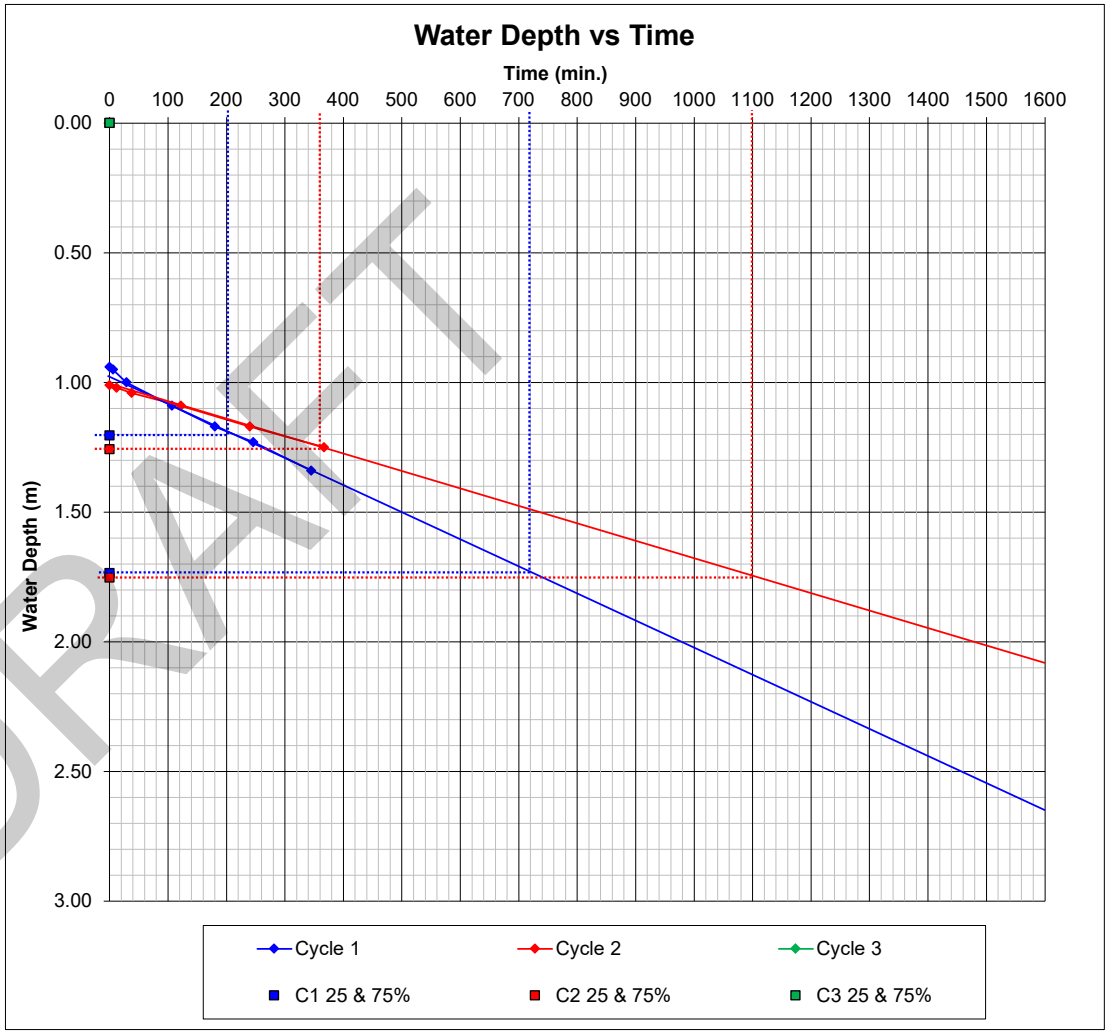
12569 Land at Windmill Lane, Cowbridge

Trial Pit Information	
Length (m)	2.00
Width (m)	0.70
Depth (m)	2.00
Groundwater	n/a
Weather Conditions	dry
Date	28/11/2019-29/11/2019

Remarks

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.94	0	1.01		
6	0.95	12	1.02		
29	1.00	38	1.04		
107	1.09	122	1.09		
180	1.17	240	1.17		
246	1.23	367	1.25		
345	1.34				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.00	2.00	
Water Depths (m)			
Water depth at start of test	0.94	1.01	
Water depth at end of test	1.34	1.25	
Effective depth (measured)	0.40	0.24	
% Effective storage depth	0.38	0.24	
Effective Storage Depths (m)			
Effective storage depth (100%)	1.06	0.99	
Effective storage depth (75%)	0.80	0.74	
Effective storage depth (50%)	0.53	0.50	
Effective storage depth (25%)	0.27	0.25	
Outflow Time (min)			
Time for measured outflow	345	367	
Time for 100% outflow	980	1480	
Time for 75-25% outflow	520	740	
Volume of Outflow (m^3)			
Over measured effective depth	0.56	0.34	
Over 100% effective depth	1.48	1.39	
From 75% - 25% effective depth	0.74	0.69	
Surface Area (m^2)			
For 100% effective storage	7.12	6.75	
For 50% effective storage	4.26	4.07	
Over measured depth	3.56	2.70	
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	3.5E-06	2.3E-06	
Over measured depth	7.6E-06	5.7E-06	
Over 75% - 25% effective depth	**5.6E-06**	**3.8E-06**	



Design Soil Infiltration Rate: 3.8E-06 m/s

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BRE365 SOIL INFILTRATION RATE TEST - SA4

12569 Land at Windmill Lane, Cowbridge

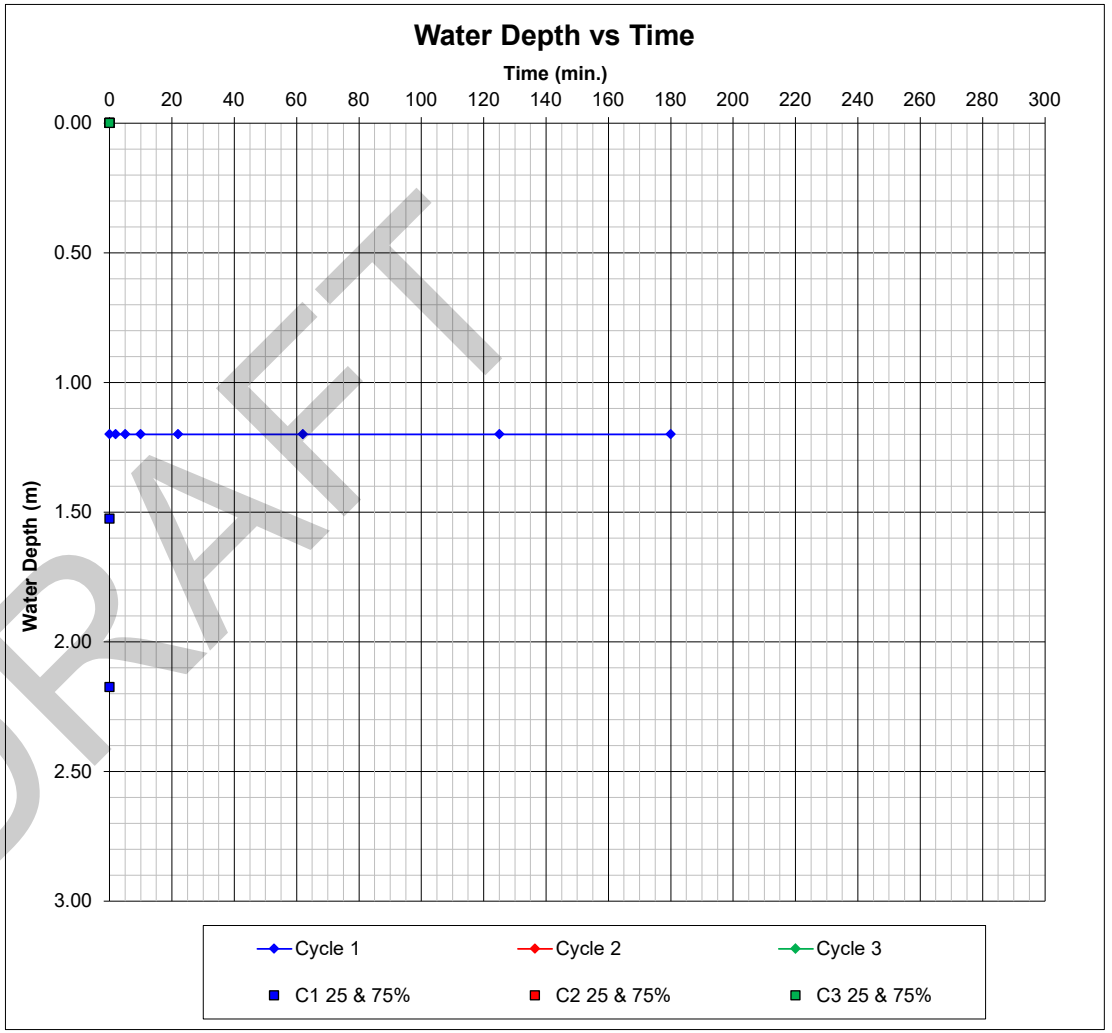
Trial Pit Information	
Length (m)	2.00
Width (m)	0.70
Depth (m)	2.50
Groundwater	1.7
Weather Conditions	dry
Date	29-Nov-19

Remarks

No infiltration. Unable to calculate soil infiltration rate.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.20				
2	1.20				
5	1.20				
10	1.20				
22	1.20				
62	1.20				
125	1.20				
180	1.20				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.50		
Water Depths (m)			
Water depth at start of test	1.20		
Water depth at end of test	1.20		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	1.30		
Effective storage depth (75%)	0.98		
Effective storage depth (50%)	0.65		
Effective storage depth (25%)	0.33		
Outflow Time (min)			
Time for measured outflow	180		
Time for 100% outflow	n/a		
Time for 75-25% outflow	n/a		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	1.82		
From 75% - 25% effective depth	0.91		
Surface Area (m^2)			
For 100% effective storage	8.42		
For 50% effective storage	4.91		
Over measured depth	1.40		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	n/a		
Over measured depth	0.0E+00		
Over 75% - 25% effective depth	**n/a**		



Design Soil Infiltration Rate: 0.0E+00 m/s

Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SA5

12569 Land at Windmill Lane, Cowbridge

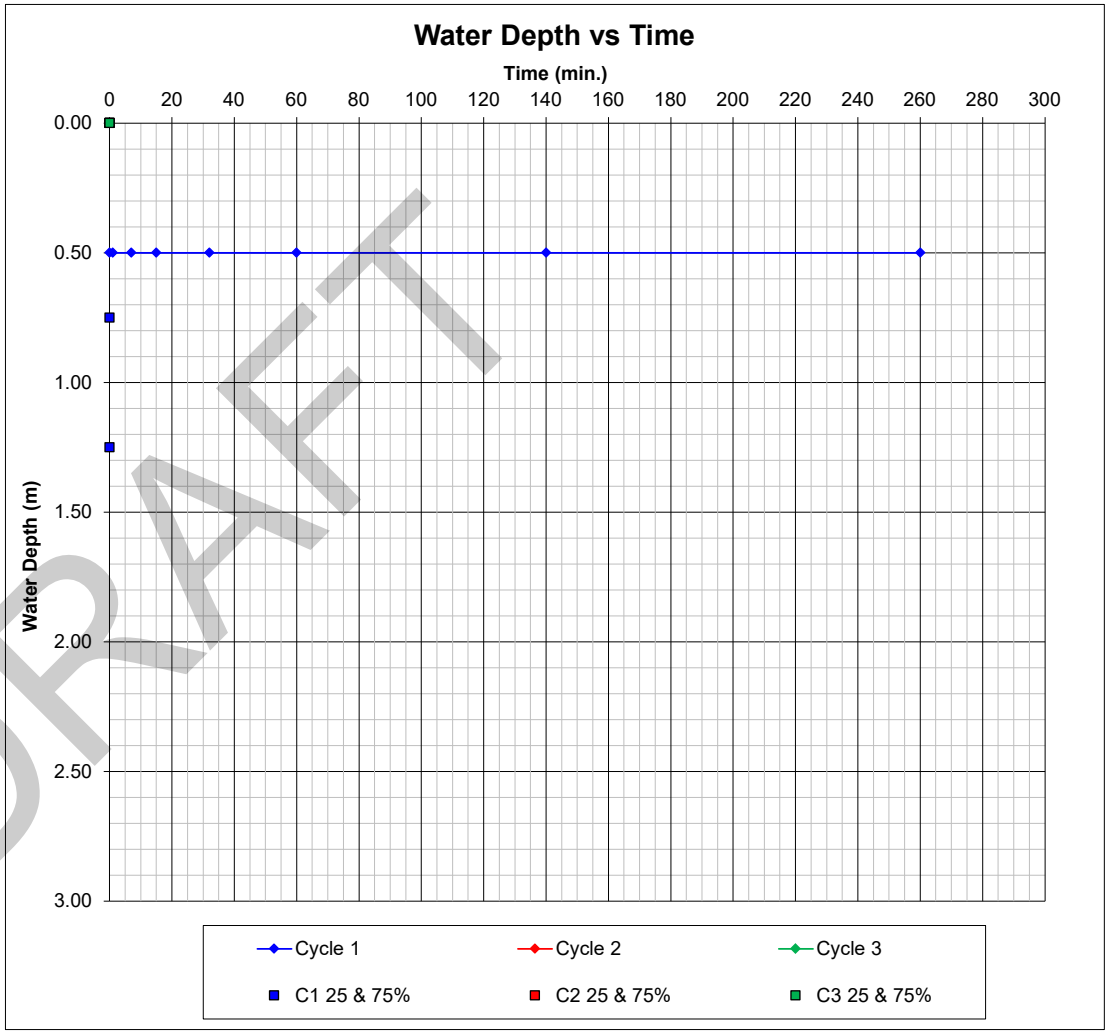
Trial Pit Information	
Length (m)	2.00
Width (m)	0.70
Depth (m)	1.50
Groundwater	1.5
Weather Conditions	dry
Date	29-Nov-19

Remarks

No infiltration. Unable to calculate soil infiltration rate.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.50				
1	0.50				
7	0.50				
15	0.50				
32	0.50				
60	0.50				
140	0.50				
260	0.50				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	1.50		
Water Depths (m)			
Water depth at start of test	0.50		
Water depth at end of test	0.50		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	1.00		
Effective storage depth (75%)	0.75		
Effective storage depth (50%)	0.50		
Effective storage depth (25%)	0.25		
Outflow Time (min)			
Time for measured outflow	260		
Time for 100% outflow	n/a		
Time for 75-25% outflow	n/a		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	1.40		
From 75% - 25% effective depth	0.70		
Surface Area (m^2)			
For 100% effective storage	6.80		
For 50% effective storage	4.10		
Over measured depth	1.40		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	n/a		
Over measured depth	0.0E+00		
Over 75% - 25% effective depth	**n/a**		



Design Soil Infiltration Rate: 0.0E+00 m/s

Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SA6

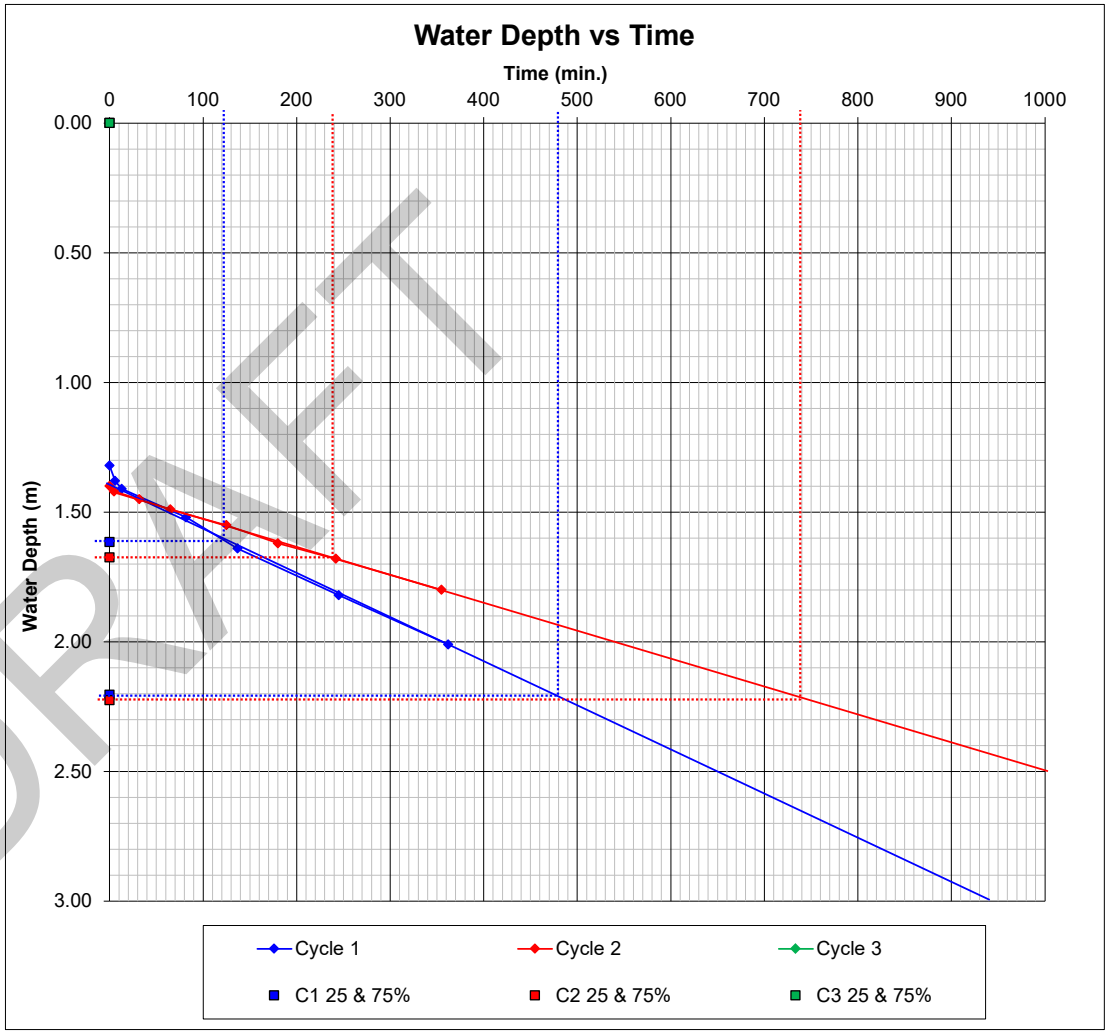
12569 Land at Windmill Lane, Cowbridge

Trial Pit Information	
Length (m)	2.00
Width (m)	0.70
Depth (m)	2.50
Groundwater	n/a
Weather Conditions	dry
Date	28/11/2019-29/11/2019

Remarks

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.32	0	1.40		
6	1.38	5	1.42		
13	1.41	32	1.45		
82	1.52	65	1.49		
137	1.64	125	1.55		
245	1.82	180	1.62		
362	2.01	242	1.68		
		355	1.80		

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.50	2.50	
Water Depths (m)			
Water depth at start of test	1.32	1.40	
Water depth at end of test	2.01	1.80	
Effective depth (measured)	0.69	0.40	
% Effective storage depth	0.58	0.36	
Effective Storage Depths (m)			
Effective storage depth (100%)	1.18	1.10	
Effective storage depth (75%)	0.89	0.83	
Effective storage depth (50%)	0.59	0.55	
Effective storage depth (25%)	0.30	0.28	
Outflow Time (min)			
Time for measured outflow	362	355	
Time for 100% outflow	650	1000	
Time for 75-25% outflow	360	500	
Volume of Outflow (m^3)			
Over measured effective depth	0.97	0.56	
Over 100% effective depth	1.65	1.54	
From 75% - 25% effective depth	0.83	0.77	
Surface Area (m^2)			
For 100% effective storage	7.77	7.34	
For 50% effective storage	4.59	4.37	
Over measured depth	5.13	3.56	
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	5.5E-06	3.5E-06	
Over measured depth	8.7E-06	7.4E-06	
Over 75% - 25% effective depth	**8.3E-06**	**5.9E-06**	



Design Soil Infiltration Rate: 5.9E-06 m/s

Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SA7

12569 Land at Windmill Lane, Cowbridge

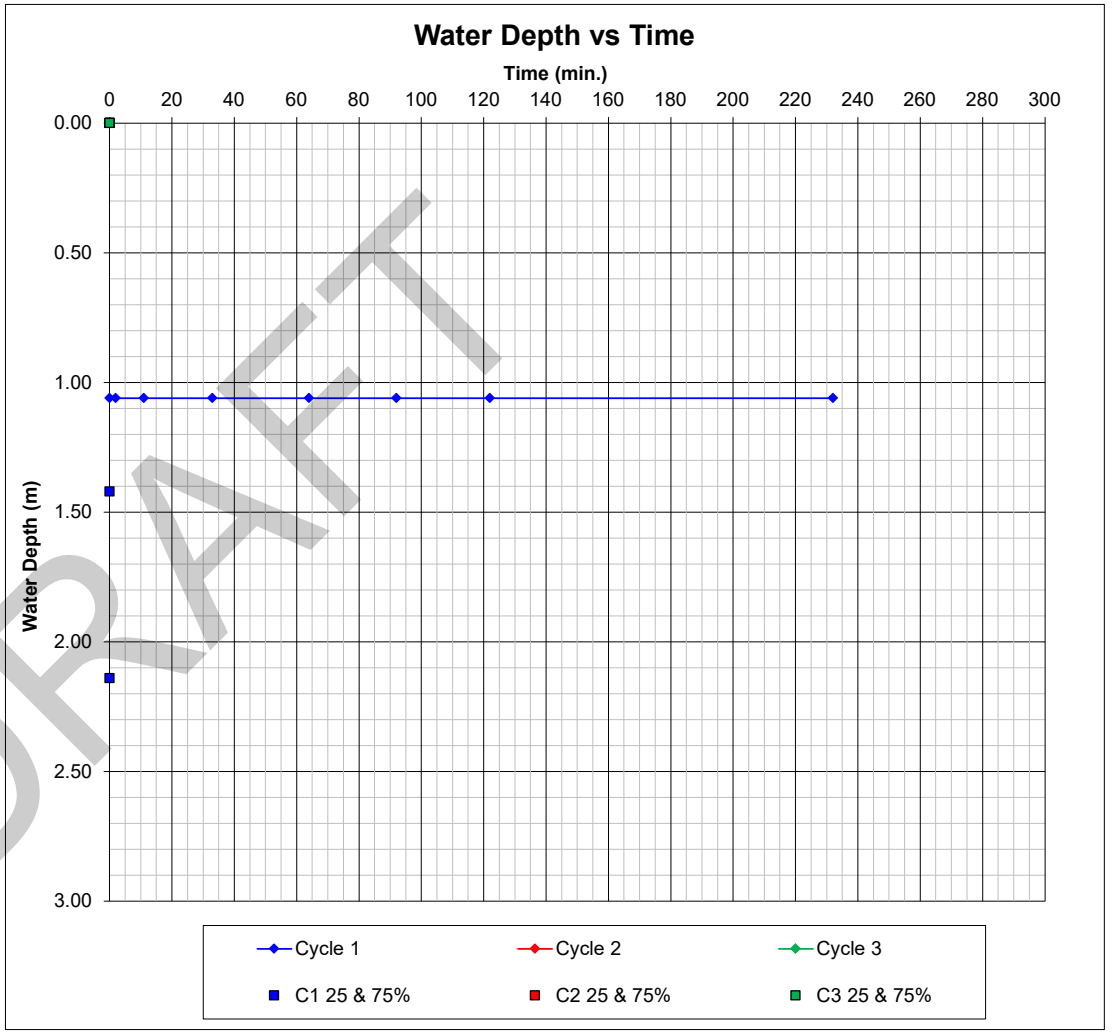
Trial Pit Information	
Length (m)	2.00
Width (m)	0.70
Depth (m)	2.50
Groundwater	n/a
Weather Conditions	dry
Date	29-Nov-19

Remarks

No infiltration. Unable to calculate soil infiltration rate.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.06				
2	1.06				
11	1.06				
33	1.06				
64	1.06				
92	1.06				
122	1.06				
232	1.06				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.50		
Water Depths (m)			
Water depth at start of test	1.06		
Water depth at end of test	1.06		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	1.44		
Effective storage depth (75%)	1.08		
Effective storage depth (50%)	0.72		
Effective storage depth (25%)	0.36		
Outflow Time (min)			
Time for measured outflow	232		
Time for 100% outflow	n/a		
Time for 75-25% outflow	n/a		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	2.02		
From 75% - 25% effective depth	1.01		
Surface Area (m^2)			
For 100% effective storage	9.18		
For 50% effective storage	5.29		
Over measured depth	1.40		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	n/a		
Over measured depth	0.0E+00		
Over 75% - 25% effective depth	**n/a**		



Design Soil Infiltration Rate: 0.0E+00 m/s

Intégral Géotechnique

FIGURES

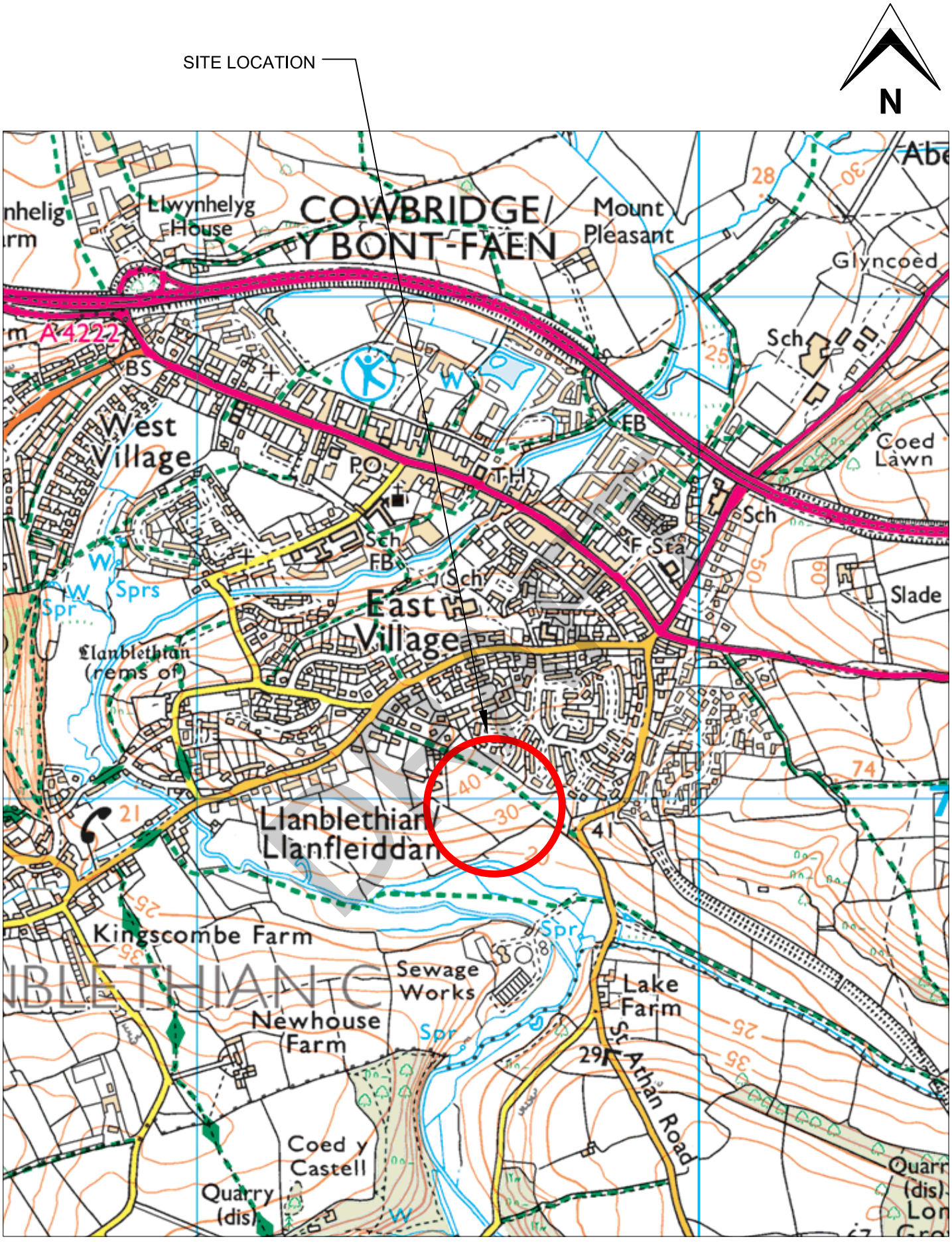


Figure 1: Site Location

Project: Windmill Lane, Cowbridge	Job no.: 12569	Intégral Géotechnique	Integral House, 7 Beddau Way, Castlegate Business Park, Caerphilly, CF83 2AX. Tel: 029 2080 7991
Client: Redrow Homes	Scale: 1:10,000 at A4		

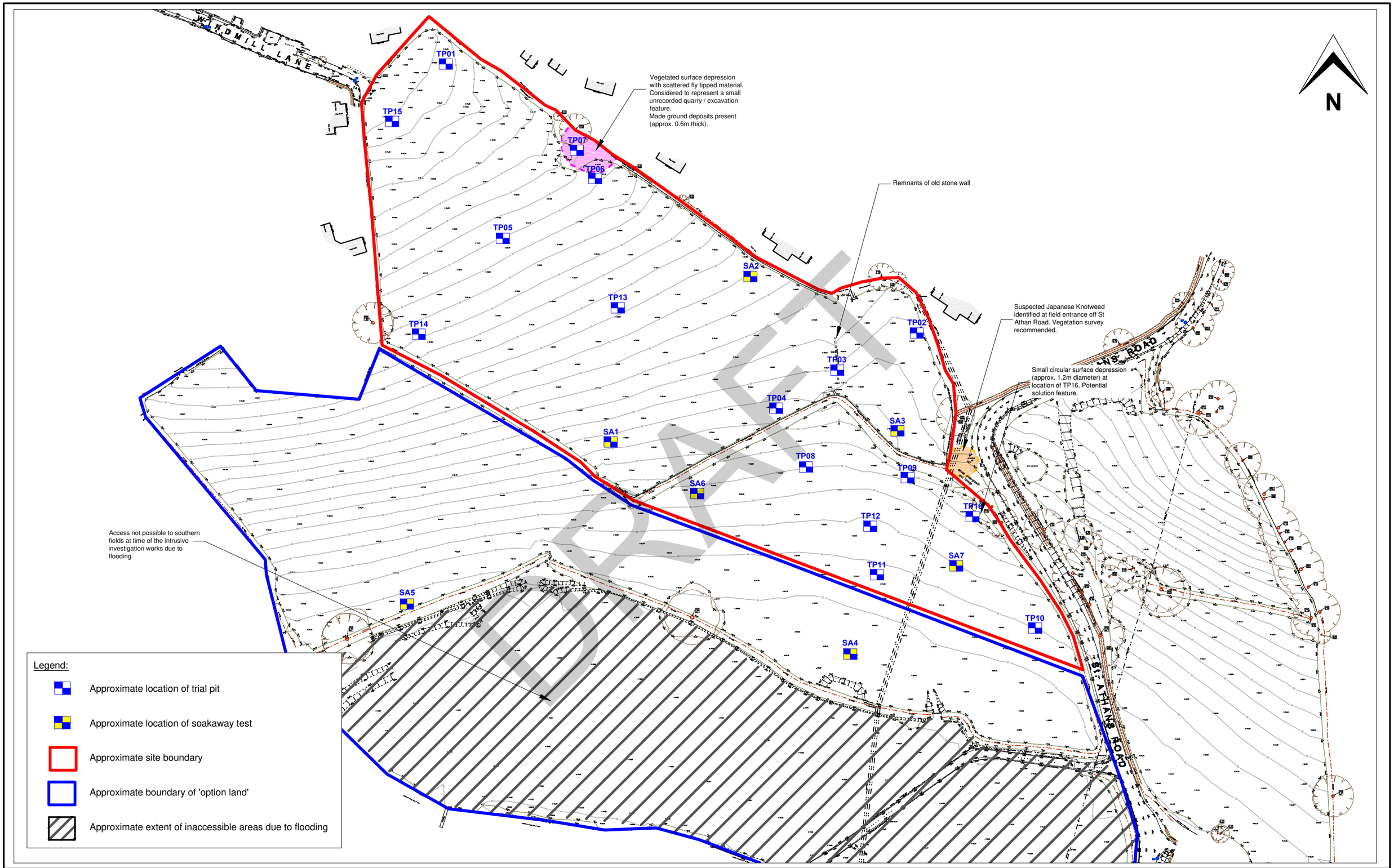


Figure 2: Site Plan

Project: Windmill Lane, Cowbridge	Job No.: 12569	Intégral Géotechnique	Integral House, 7 Beddau Way, Castlegate Business Park, Caerphilly, CF83 2AX. Tel: 029 2080 7991
Client: Redrow Homes	Scale: NTS		