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Flood Consequence Assessment

Report

on

Mill Street, Tonyrefail

for

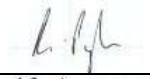
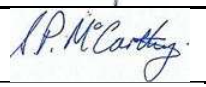
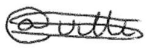
Lewis Homes

Date	November 2020
Project no.	16189 Rev 0

Project 16189

Flood Consequence Assessment

Document Control

Responsible for	Job Title	Name	Date	Signature
Content	Project Engineer	Rhys Pugh	02.11.20	
Checked	Director	Steve McCarthy	03.11.20	
Approval	Director	Andrew Villis	03.11.20	
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Revision History

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4			
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6			

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1			
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3			

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References

Planning Policy Wales Technical Advice Note (TAN) 15 Development and Flood Risk
Planning Policy Wales Edition 4 Chapter 4 Planning for Sustainability
Development Advice Maps

Abbreviations

A.O.D	Above Ordnance Datum
FW	Foul Water
SW	Surface Water
Ha	Hectares
BGL	Below Ground Level
NRW	Natural Resources Wales
FCA	Flood Consequence Assessment
DCWW	Dwr Cymru Welsh Water

1.0 INTRODUCTION

1.1 QuadConsult Ltd has been commissioned by Lewis Homes to prepare a Flood Risk Assessment in support of a full planning application for a new residential development situated adjacent Mill Street, Tonyrefail.

1.2 This report aims to review existing potential flood risks with proposals for new SW/FW drainage and any mitigation measures required in accordance with Technical advice note 15, development and flood risk (TAN 15) and Natural Resources Wales (NRW).

1.3 A location plan is included in Appendix A.

2.0 SITE LOCATION & DESCRIPTION

2.1 The application site is approximately 1.59ha in area, it is situated adjacent Mill Street in Tonyrefail. The site is irregular in shape with topography falling from south east to north west from circa 135.5m to 124.80m A.O.D. at gradients varying on average from 1:8 in the southern section and 1:36 in the northern area towards the site access.

2.2 The site is a mixture of Greenfield (1.32ha) and Brownfield (0.27ha) in nature consisting of open ground primarily used for grazing and a former building with associated car parking.

2.3 Following an analysis of Flood maps it is found that the site lies largely within Flood Zone A, with parts of the site access within Zone C2; the development Advice maps can be found in Appendix B.

3.0 TAN 15 AND EXISTING FLOOD RISK

3.1 The main area of the proposed residential development lies within Zone A of the Development advice map (Appendix B), with the site access road and associated roundabout works within Zone C2 - as such, mitigation measures and management of emergency access routes shall be considered within this report. TAN 15 includes areas of low vulnerability as transport and utilities infrastructure.

3.2 Due to the proposed sites location in relation to the coast and further confirmed by a review of the NRW Development Advice Map data, the site is not believed to be vulnerable to coastal flooding and so can be deemed negligible in terms of residual risk.

3.3 The closest river, namely River Ely is circa 150m west of the development and deemed negligible in terms of risk with site levels far above any threat.

3.4 There is an unnamed watercourse directly to the north of the development with a number of tributaries within the development boundary capturing small areas of land drainage; the smaller features shall be obsolete following the development build out. The aforementioned watercourse is a tributary of Ely river and is culverted under Mill Street, with a larger Bridge also within the vicinity to access existing car parking. It is understood at t

3.5 he time of writing that previous maintenance issues have caused the area to flood, which are believed to be those held on the DAM, with appropriate maintenance regimes this flooding shall likely to be lessened.

3.6 Other sources of flooding shall be considered later in the report.

4.0 ASSESSING FLOOD CONSEQUENCES

4.1 Considering the site access and the nature of works within the vicinity of the Zone 2 flood area, there shall be no threat to proposed properties and no increased flood risk to existing properties. QuadConsult Ltd have obtained Product 4 Flood Data (Appendix C) from Natural Resources Wales to assess flood levels within the vicinity of the site area. It is evident that there is a maximum flood level of 124.650m for the 100 Year Storm with an allowance for climate change and 125.060m for the 1000 Year event. When considering the extent of flooding within the access road area (and following analysis of existing topographical survey) levels range from 124.80m AOD and 125.0m AOD within proposed highway extents, it is proposed that the new highway levels are similar to the existing with maximum water levels in the vicinity of 0.2m. With reference to TAN 15 A1.15 a maximum depth of flooding of 0.6m is allowable for General Infrastructure, it is therefore deemed the site access is suitable for development and subsequent access/egress.

The remainder of the site falls within the Zone A flood zone, it is considered to be at little or no risk of fluvial or tidal / coastal flooding. This ensures that the justification test is not applicable and there is no need to consider flood risk further from these sources. It is however deemed appropriate to ensure that all finished floor levels are set to a minimum of 0.60m above the highest flood level, therefore minimum finished floor levels are proposed to be 25.660m AOD satisfying the TAN 15 guidance.

4.2 OTHER SOURCES OF FLOODING

4.3 The other potential sources of flooding apart from fluvial are via groundwater or surface, foul and combined drainage infrastructure.

4.4 The proposed development has no basements and the likelihood of groundwater flows breaking the surface and affecting properties are deemed to negligible.

4.5 The adjacent properties and highway infrastructure are served by a DCWW adopted combined sewers, there are no know existing SW/FW effluent escape issues. These highways are of standard highway cross section with kerb upstands etc, any SW escape shall be contained within the highway and pose no threat to the proposed development.

4.6 Pluvial Flood risk – there is an existing culvert that runs underneath Mill Street which is circa 750mm circular. It is believed that this is the primary cause for the minimal flooding within its vicinity for storms of lesser probability. As a result of the redevelopment of the site it is proposed to extend the existing culvert, matching or increasing its capacity and gradient upstream to allow for the access road to be constructed over. The result of the extension shall have no detrimental effects on SW capacity and as a result no increased flooding issues. Any proposed levels shall ensure that no surface water is directed toward the new development and following a review of topographical survey this can be assured.

4.7 Any new FW and SW features shall be maintained by DC/WW OR the Local Highways Authority, as such shall be maintained to ensure the likelihood of drains blocking or surcharging is considered negligible.

5.0 FLOOD FLOW PATHS AND IMPACT OF DEVELOPMENT

5.1 OUTLINE DRAINGE STRATEGY

5.2 Following the sequential process adopted by Building Regulations Part H a site investigation report was produced to assess the existing ground conditions and subsequent ability to allow an infiltration-based system to dispose of Surface water generated by the development. With reference to Appendix D 6 number infiltration tests were carried out and only one had provided a positive result, it is therefore deemed that the existing strata is inadequate to support a strategic infiltration strategy. Following the sequential process it is clear there is a watercourse to the north of the development where existing and previous SW has been discharged too. It is therefore proposed that surface water generated by the development is discharged to Qbar Greenfield runoff rates and surplus volumes of water attenuated within a detention Basin. The surface water shall be restricted using a hydrobrake or similar flow control device.

5.3 The re-development of the site yields an increase in impermeable areas, however the SW shall be designed to discharge to Qbar rates and volumes of attenuation within the basin to accommodate storms up to the 100 Year event plus 40% climate change. These principles shall provide a betterment to the existing unrestricted scenario of both greenfield and brownfield rates and reduce flood risk downstream of the new development.

5.4 Proposed discharge rates – Proposed Greenfield runoff rates calculated to ICP SUDS methodology can be found held within Appendix E, it is calculated that the Greenfield runoff rate of 14.6l/s contributes to the overland flow off site. Furthermore it is calculated that with an existing brownfield area of 0.27ha the runoff rate currently contributing to the northern stream is 37.5 l/s (2700 x 50 divided by 3600), with providing a 30% betterment this value would be 26.25 l/s. It is therefore proposed that a total discharge rate of 40.85 l/s is suitable for the proposed development. Preliminary Calculations indicate a storage volume of 597m3 is required for the 100 Year event (+40%cc).

5.5 Site levels shall be designed to ensure no property on site is affected in an unlikely event of SW escape, with flow paths ensuring SW events over and above the 100 Year (+cc) are held within the highway and not affecting on or off site properties.

5.6 As a result of the proposed access to the development and subsequent arrangement of proposed Roundabout, it is proposed to extend the existing culvert upstream to match the existing size and capacity, allowing for the development but having no detrimental effect on the existing scenario.

5.7 Foul water generated by the new development are proposed to drain via a gravity network and discharge to the existing DC/WW combined system situated to the north of the development, subject to confirmation that DC/WW are satisfied with proposed flows.

6.0 FLOOD MITIGATION MEASURES

6.1 The proposed properties of the new development are in Zone A and therefore considered at no risk of Flooding. However, the developer may wish to utilise measures to ensure occupants are aware of potential issues in the wider area in particular the site access.

6.2 To safeguard against future access / egress route issues, it is recommended that the future occupant utilise any flood warning systems available. Design levels within the site entrance are proposed to be kept similar to existing with depths of flooding kept to a minimum, falling well within the allowable 0.6m depth of SW within TAN 15 guidance.

6.3 The NRW has an established flood warning service which potential purchaser/operator may wish to be made aware of any flood risk in the town and the available warning systems.

7.0 SUMMARY & CONCLUSIONS

7.1 SUMMARY OF FLOOD RISK

7.2 In all scenarios the residential section of the site is at NULL risk of flooding and entirely within Flood Zone A. It is therefore no subject to the justification test detailed in Section 6 TAN 15. The site entrance which is located within the vicinity of the Zone C2 flooding is deemed to be manageable and allows for safe access / egress for all residents and emergency services.

7.3 Flood risk via other mechanisms such as coastal, groundwater or surface, foul and combined sewer infrastructure flows have been considered and deemed negligible and manageable.

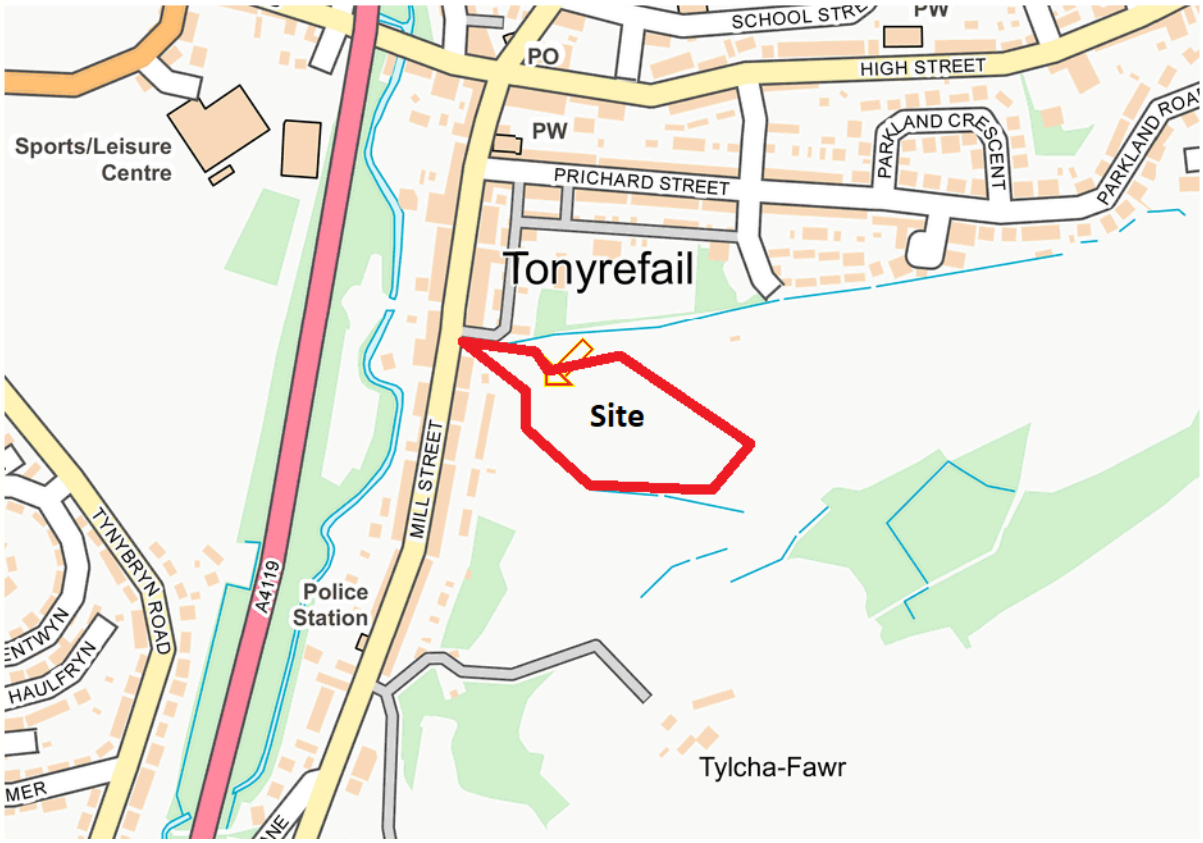
7.4 MITIGATION MEASURES

7.5 No formal mitigation measures are required; however, the future occupants may benefit from signing up to flood warning services provided by the NRW for incidents in the wider area.

7.6 CONCLUSION

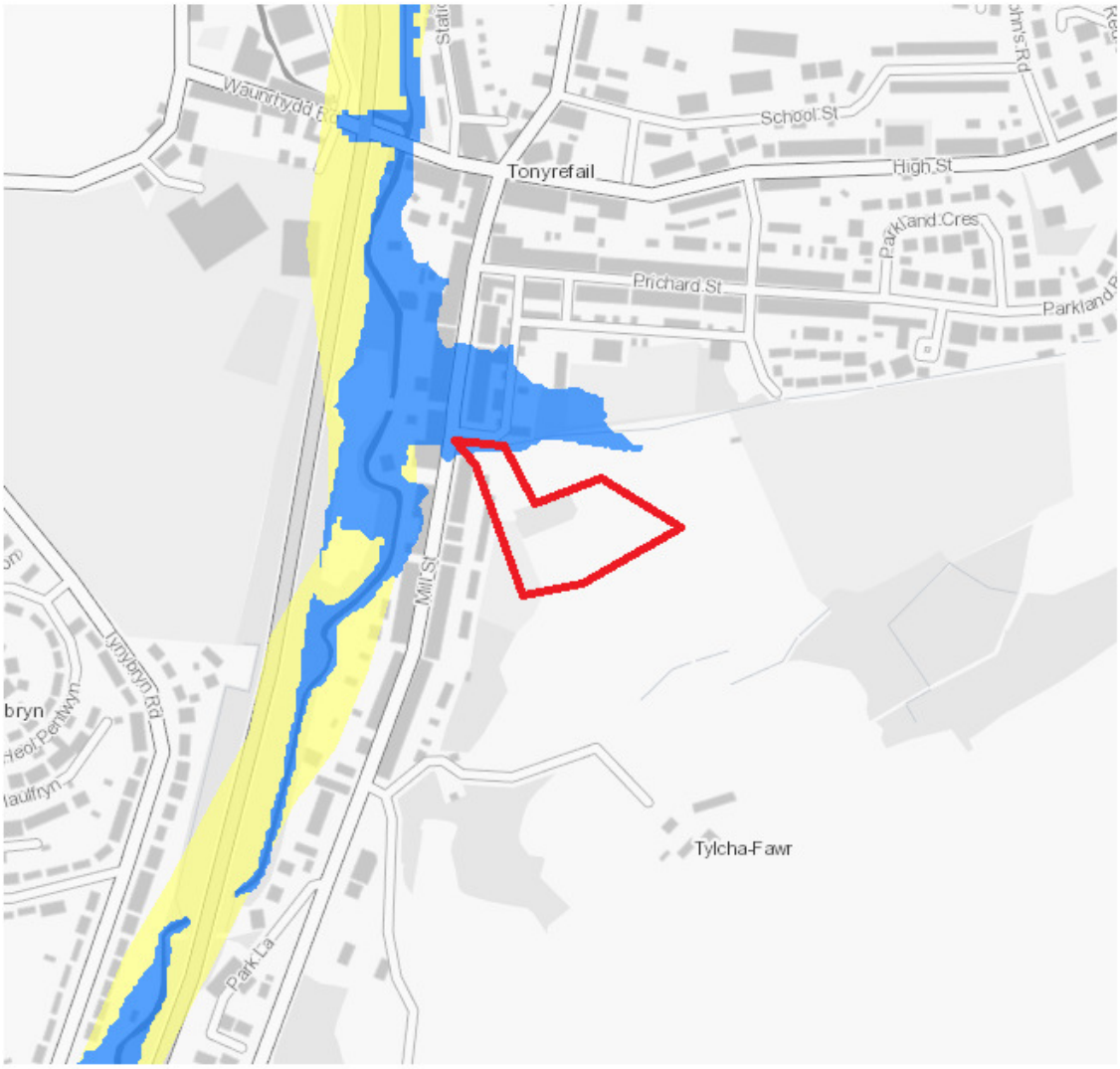
7.7 The proposed development complies with the criteria when assessing flood consequences as laid out in Section 7 and Appendix 1 of TAN 15. The site layout considers the conveyance of escaped Surface water that shall be directed away from the development with attention at detailed design stage.

APPENDIX A
SITE LOCATION PLAN

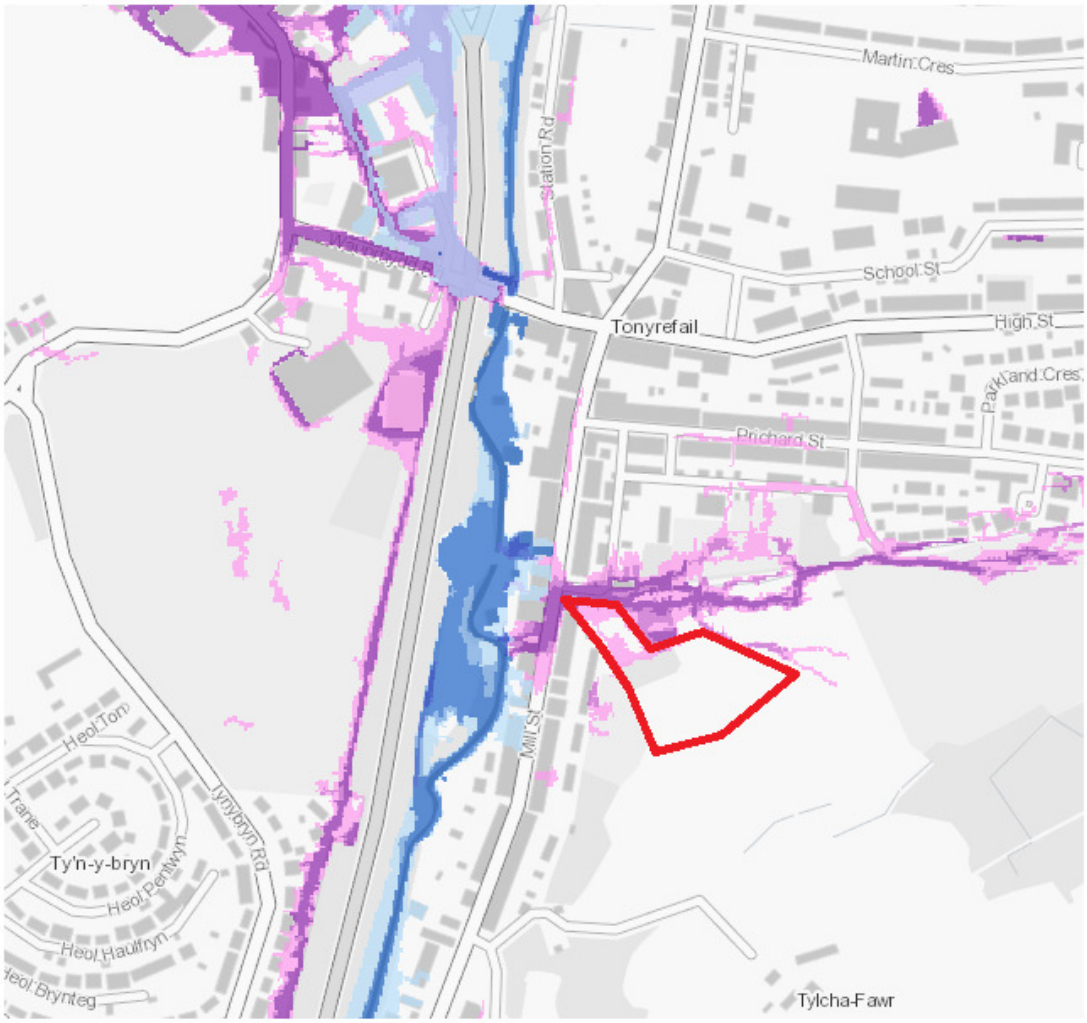


The map indicates an indicative site boundary.

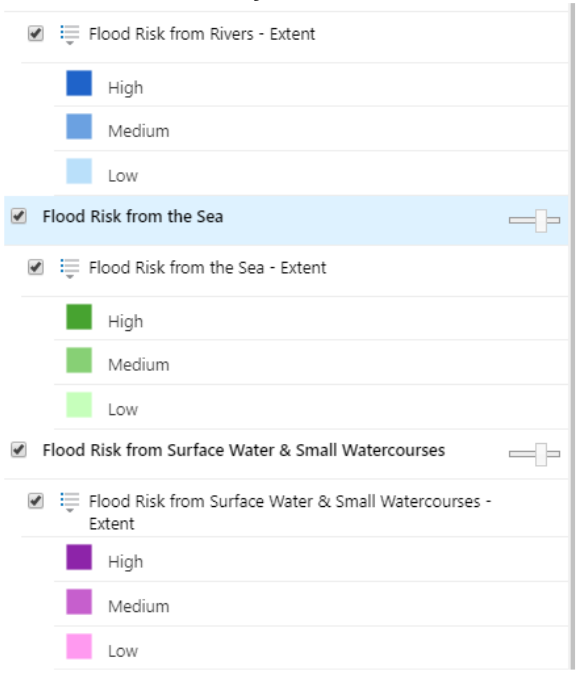
APPENDIX B
Development Advice Map



The map indicates an indicative site boundary.



The map indicates an indicative site boundary.



APPENDIX C
NRW Flood Data

ATI-18933a – Mill Street, Tonyrefail

E: 301021 N: 187946

1.0 Current Flood Map

Figure 1 shows the current Flood Map (version 202001) at this location. The Flood Map represents a combination of the undefended fluvial and tidal flood extents derived from a combination of detailed local modelled and nationally generalised modelled data.

More information on the Flood Map can be obtained from the Natural Resources Wales website http://www.naturalresources.wales/floodriskmap

2.0 Local Flood Risk Mapping Study

Model Summary

The results summarised below are TuFLOW results taken from the River Ely Velocity Depth Mapping study undertaken by Atkins in 2008-2009. This study builds on the existing Section 105 flood risk mapping model for the River Ely and the River Clun and has been converted into ISIS format. In Cardiff and Pontyclun the 1D ISIS model has been linked to 2D Tuflow modelling on the floodplain. This was updated by Atkins in January 2011 to fix an error with the Z line data near the Millennium stadium in Cardiff.

The results are taken from version 4.2 of the hydraulic model, dated January 2011. The flows were estimated based on FEH. The downstream boundary applied to the model is defined by the joint probability work carried out by HR Wallingford ("A new joint probability appraisal of flood risk", P.G Samuels and N. Burt).

Critical storm duration tests were undertaken to identify the storm duration which produces the peak water levels across the catchment. The catchment was split into two storm areas; the Upper Ely and Clun with a storm area of 68km², and the whole catchment from Cardiff Bay with a storm area of 163km².

For this location the Upper Ely and Clun storm produced the peak water levels and results have been provided accordingly.

1D Results

Tables 1-2 show the defended modelled water levels (mAOD) and flows (m^3/s) for the model node points in the site vicinity, including a 1 in 100 year scenario with climate change (+20% flow). We are aware that there are some discrepancies between the cross sections in this area which may need further investigation. **Figure 2** shows the location of these ISIS node points.

Table 1: Defended Design Levels

Peak Water Levels (mAOD)									
Cross-Section	Q5	Q10	Q20	Q50	Q75	Q100	Q100+ CC	Q200	Q1000
ELY00010	127.06	127.13	127.19	127.37	127.39	127.42	127.50	127.50	127.8
ELY00210	124.20	124.33	124.50	124.83	124.92	125.04	125.39	125.39	126.26
ELY00220	124.10	124.20	124.29	124.44	124.47	124.51	124.65	124.65	125.06
ELY00500	118.80	118.90	118.98	119.11	119.14	119.17	119.29	119.29	119.66
ELY00650	115.48	115.62	115.72	115.89	115.94	116.00	116.15	116.15	116.56

Table 2: Defended Design Flows

Peak Water Flows (m^3/s)									
Cross-Section	Q5	Q10	Q20	Q50	Q75	Q100	Q100+ CC	Q200	Q1000
ELY00010	11.9	13.8	15.3	18.8	19.7	21.0	25.2	25.2	39.1
ELY00210	11.9	13.8	15.3	18.7	19.7	21.0	25.2	25.2	39.9
ELY00220	11.9	13.8	15.3	18.7	19.7	21.0	25.2	25.2	38.9
ELY00500	11.9	13.8	15.3	18.7	19.7	21.0	25.1	25.1	38.9
ELY00650	11.9	13.8	15.3	18.7	19.7	21.0	25.1	25.1	38.9

*Null values show that the site is flood free for that return period.

4.0 Additional Information

We hold no data to show historic flood events in the area.
The local authority may be able to provide information on issues such as localised flooding from sewers, drains and culverts.

5.0 References

1. Tidal Flood Mapping Study (Penarth and Chepstow), Study report Issue 1, Atkins July 2008
2. Department for Environment, Food and Rural Affairs, 2011. *Technical Report Design sea levels*. R&D Report SC060064. Defra/Environment Agency
3. Flood and Coastal Defence Appraisal Guidance: FCDPAG3 Economic Appraisal. Supplementary Note to Operating Authorities – Climate Change Impacts; October 2006; Department for Environment, Food and Rural Affairs.
4. Using the national coastal flood boundary data for England and Wales, Environment Agency Operational Instruction 490_11, Issued 4/2/2011
5. River Ely and Tributaries: Model Update and Hazard Mapping, Atkins. Final Issue, July 2009

6.0 Notes

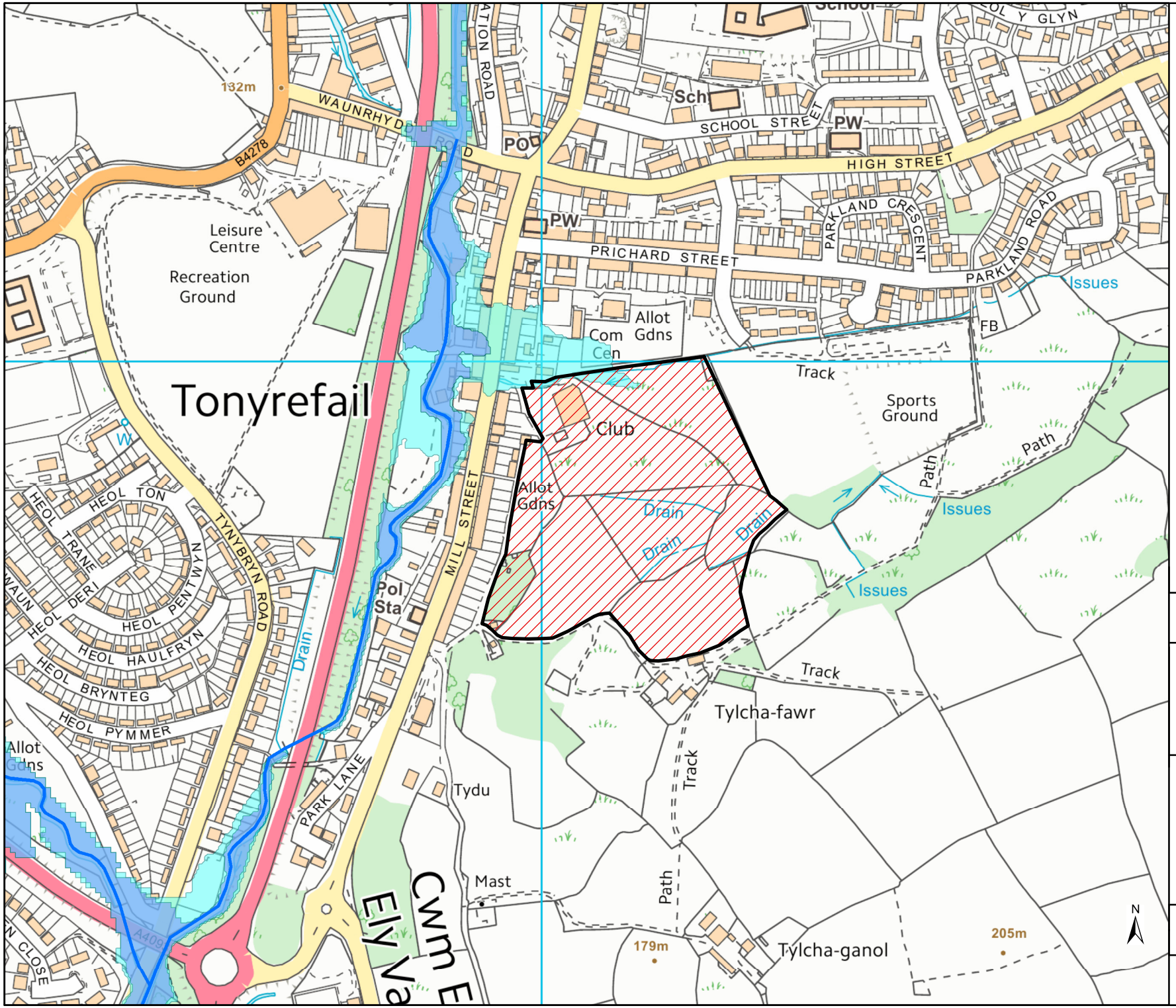
Undefended scenarios are provided as being a possible worst case scenario in the event of defence failure. They are used as the basis of the Flood Map.

The scope of the model is the mapping of flood risk, it is not intended for detailed design. The model should be considered as the starting point for more detailed modelling, commensurate with the consequences of flooding at the site of interest.

NRW models are available under licence agreement for the purpose of further development. Contact Natural Resources Wales Access to Information team for details of terms, conditions and pricing.

If the data is used in support of an FCA, please include the reference number.
Please refer to NRW standard terms and conditions.

Flood Risk Analysis
09/03/2020



Legend

- Site Location
- Flood Zone 3 (1 in 100 year undefended fluvial and 1 in 200 year undefended tidal extents)
- Flood Zone 2 (1 in 1000 year undefended fluvial and tidal extents)
- Areas benefiting from defences
- Defences
- Flood Storage Area
- Main Rivers

Cyfoeth Naturiol Cymru
Natural Resources Wales

Project

Mill Street, Tonyrefail
[Ref: ATI-18933a]

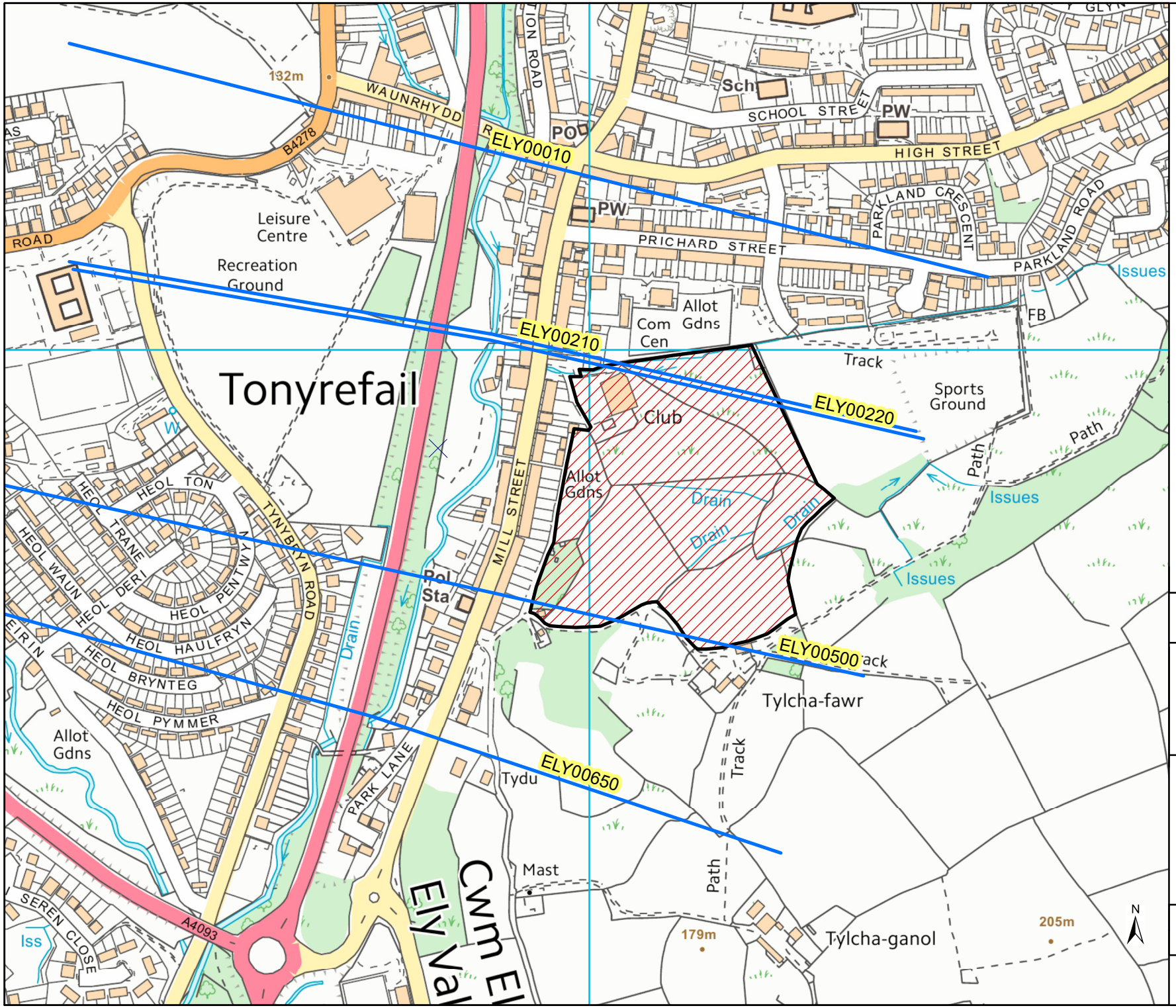
Drawing

Figure 1:
Current Floodmap
[v202001]

Date

09 Mar 2020

Scale 1:5,000



Legend

Site Location

1D Cross Sections

Cyfoeth Naturiol Cymru
Natural Resources Wales

Project

Mill Street, Tonyrefail
[Ref: ATI-18933a]

Drawing

Figure 2:
Cross Section locations

Date

09 Mar 2020

Scale 1:5,000

APPENDIX D
Site Investigation report Soakaway Test Extract

7.5 GROUNDWATER (CONTINUED)

The groundwater conditions are based on observations made at the time of the fieldwork. It should be noted that groundwater levels may vary due to seasonal and other effects.

7.6 SOIL INFILTRATION TESTING

Trial pit locations SAA, SAB, SAC, SAD, SAE and SAF were subjected to indicative infiltration testing to inform on the permeability of the near surface strata. The following provides a summary:

Table 8 – Soil Infiltration Test Summary

Location	Base depth (mbgl)	Results
SAA	1.5	No infiltration observed – Test failed
SAB	1.4	Negligible infiltration observed – Test failed
SAC	1.5	1.1×10^{-5} m/s
SAD	1.5	Negligible infiltration observed – Test failed
SAE	1.4	No infiltration observed – Test failed
SAF	1.5	No infiltration observed– Test failed **Significant water run-off from GL*

As detailed above, SAC was the only location which exhibited sufficient infiltration to calculate an indicative infiltration rate. The test was undertaken within the soft glacial till and underlying loose becoming medium dense gravels.

It should be noted that this initial testing should only be regarded as indicative and that the test are location and depth specific. If it should be proposed to use soakaways for this site, then more extensive follow-up tests will be required and should fully comply with BRE 365, in order to confirm the suitability of the site and to satisfy the local authority.

7.7 STOCKPILED MATERIALS

In the northern portion of the site a stockpile approximately 30m long by 15m wide and up to 3m in height was present, see Figure 2. Two excavations were undertaken into the stockpile to provide information of the materials and collect samples for chemical analysis.

The soils descriptions are detailed below:

- SP1: MADE GROUND: Grey brown slightly silty very sandy angular to rounded GRAVEL and COBBLES of sandstone, brick, concrete with ceramic fragments, timber and plastic fragments.

APPENDIX E

SOIL INFILTRATION TEST RESULTS

BRE365 SOIL INFILTRATION RATE TEST - SAA

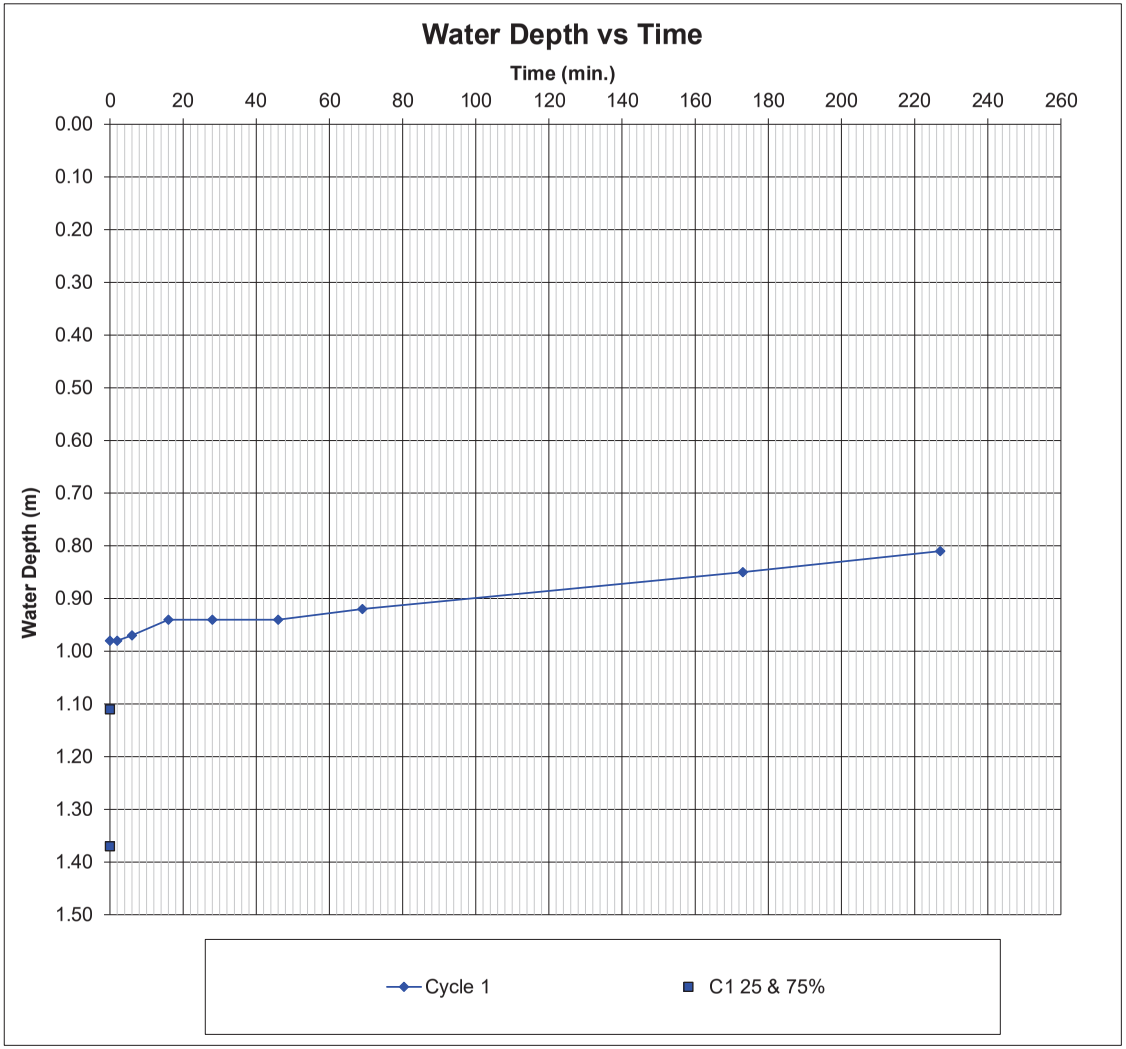
12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.20
Width (m)	0.80
Depth (m)	1.50
Groundwater	1.41
Weather Conditions	Heavy Rain
Date	18-Jun-20

Remarks

Water standing at 1.41m pre-testing.
Water level rose during testing, no infiltration observed - Test Failed.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.98				
2	0.98				
6	0.97				
16	0.94				
28	0.94				
46	0.94				
69	0.92				
173	0.85				
227	0.81				



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	0.98		
Water depth at end of test	0.98		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.52		
Effective storage depth (75%)	0.39		
Effective storage depth (50%)	0.26		
Effective storage depth (25%)	0.13		
Outflow Time (min)			
Time for measured outflow	227		
Time for 100% outflow	-		
Time for 75-25% outflow	-		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	0.92		
From 75% - 25% effective depth	0.46		
Surface Area (m^2)			
For 100% effective storage	4.88		
For 50% effective storage	3.32		
Over measured depth	1.76		
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**		

Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SAB

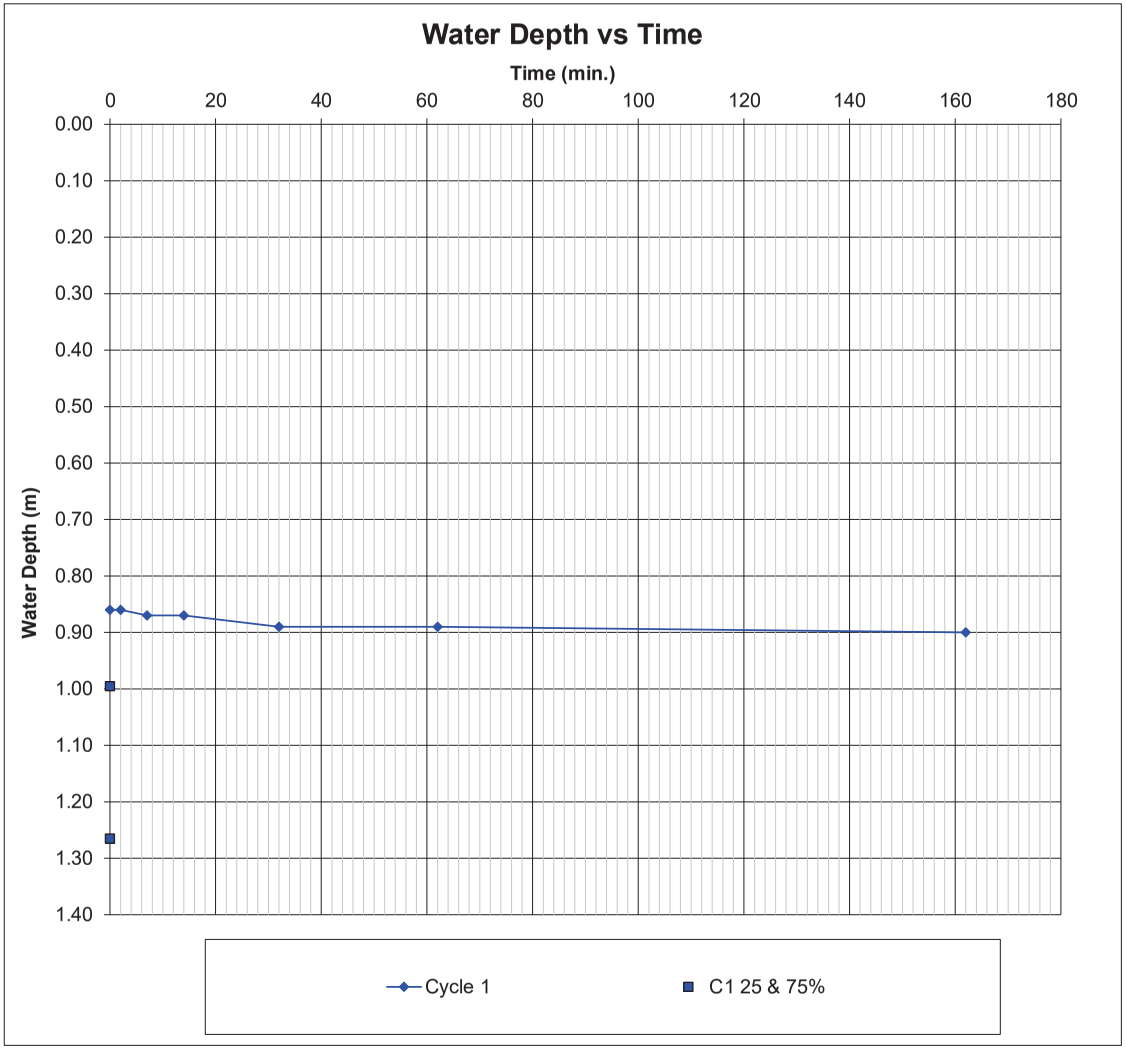
12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.10
Width (m)	0.80
Depth (m)	1.40
Groundwater	1.25
Weather Conditions	Heavy rain
Date	18-Jun-20

Remarks
Water standing at 1.25m pre-testing. Negligible infiltration observed - Test Failed.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.86				
2	0.86				
7	0.87				
14	0.87				
32	0.89				
62	0.89				
162	0.90				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	1.40		
Water Depths (m)			
Water depth at start of test	0.86		
Water depth at end of test	0.90		
Effective depth (measured)	0.04		
% Effective storage depth	0.07		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.54		
Effective storage depth (75%)	0.41		
Effective storage depth (50%)	0.27		
Effective storage depth (25%)	0.14		
Outflow Time (min)			
Time for measured outflow	162		
Time for 100% outflow	-		
Time for 75-25% outflow	-		
Volume of Outflow (m^3)			
Over measured effective depth	0.07		
Over 100% effective depth	0.91		
From 75% - 25% effective depth	0.45		
Surface Area (m^2)			
For 100% effective storage	4.81		
For 50% effective storage	3.25		
Over measured depth	1.91		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	N/A		
Over measured depth	3.6E-06		
Over 75% - 25% effective depth	**N/A**		



Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SAC

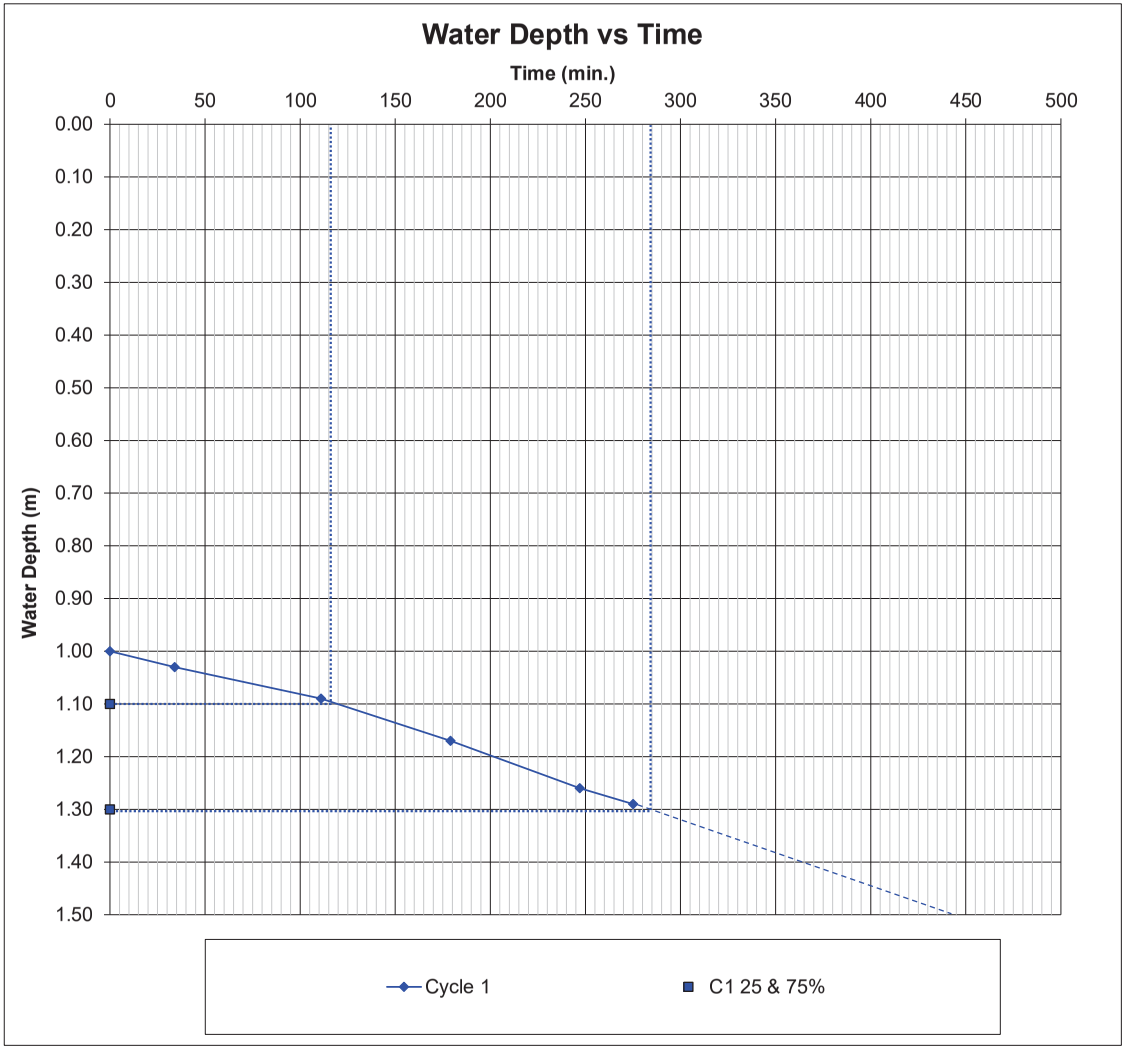
12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.40
Width (m)	0.70
Depth (m)	1.50
Groundwater	NE
Weather Conditions	Rain
Date	15-Jun-20

Remarks
Some spalling during testing - Final depth of 1.40m.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.00				
34	1.03				
111	1.09				
179	1.17				
247	1.26				
275	1.29				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	1.40		
Water Depths (m)			
Water depth at start of test	1.00		
Water depth at end of test	1.29		
Effective depth (measured)	0.29		
% Effective storage depth	0.73		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.40		
Effective storage depth (75%)	0.30		
Effective storage depth (50%)	0.20		
Effective storage depth (25%)	0.10		
Outflow Time (min)			
Time for measured outflow	275		
Time for 100% outflow	440		
Time for 75-25% outflow	170		
Volume of Outflow (m^3)			
Over measured effective depth	0.49		
Over 100% effective depth	0.67		
From 75% - 25% effective depth	0.34		
Surface Area (m^2)			
For 100% effective storage	4.16		
For 50% effective storage	2.92		
Over measured depth	3.48		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	6.1E-06		
Over measured depth	8.5E-06		
Over 75% - 25% effective depth	**1.1E-05**		



Design Soil Infiltration Rate: 1.1E-05 m/s

Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SAD

12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.40
Width (m)	0.80
Depth (m)	1.50
Groundwater	1.47
Weather Conditions	Rain
Date	15-Jun-20

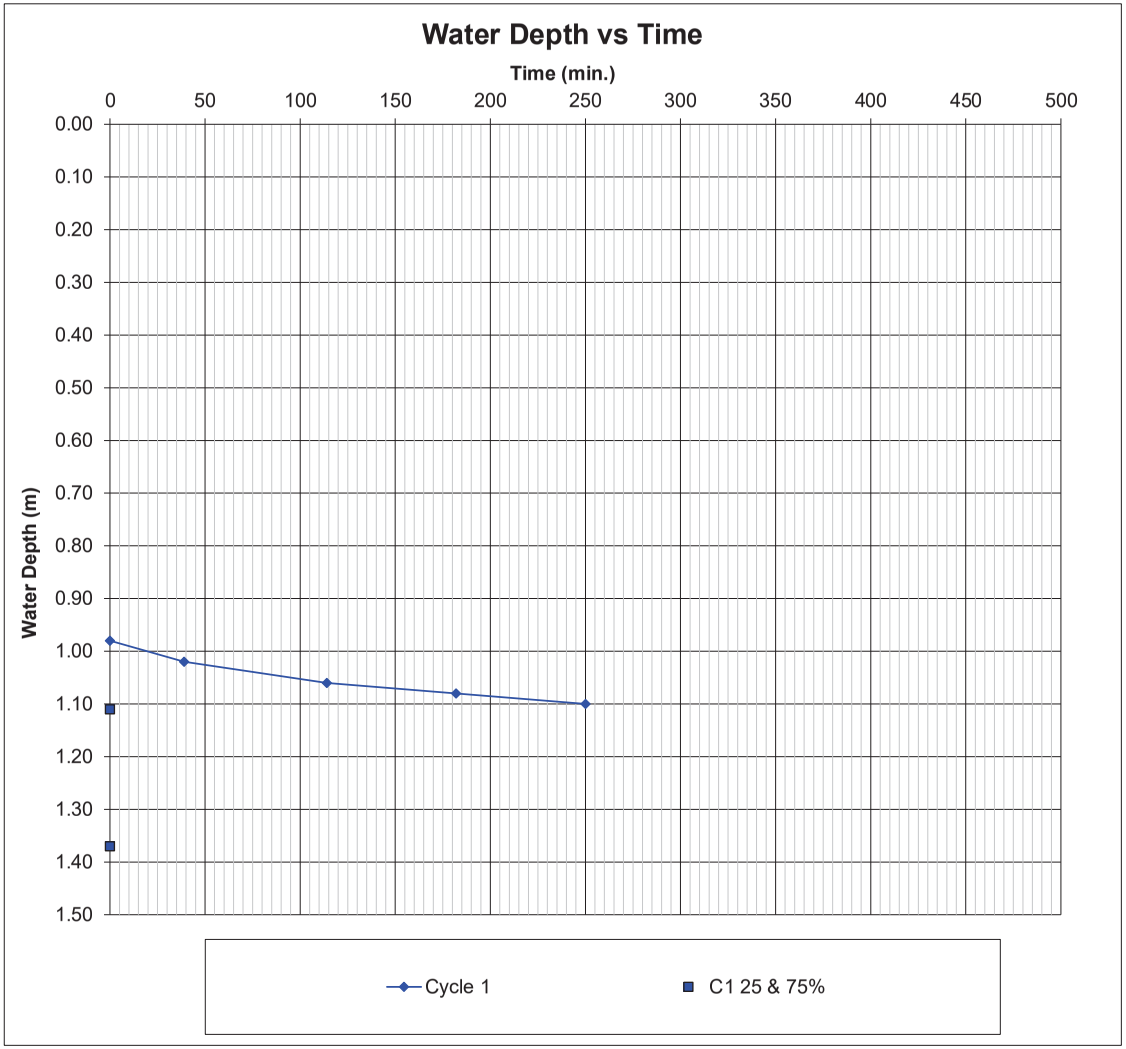
Remarks

Several centimetres of water standing at the base of the trial pit pre-testing.

Little infiltration observed - Test failed first cycle. Infiltration rate cannot be calculated.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.98				
39	1.02				
114	1.06				
182	1.08				
250	1.10				

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	0.98		
Water depth at end of test	1.10		
Effective depth (measured)	0.12		
% Effective storage depth	0.23		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.52		
Effective storage depth (75%)	0.39		
Effective storage depth (50%)	0.26		
Effective storage depth (25%)	0.13		
Outflow Time (min)			
Time for measured outflow	250		
Time for 100% outflow	-		
Time for 75-25% outflow	-		
Volume of Outflow (m^3)			
Over measured effective depth	0.23		
Over 100% effective depth	1.00		
From 75% - 25% effective depth	0.50		
Surface Area (m^2)			
For 100% effective storage	5.25		
For 50% effective storage	3.58		
Over measured depth	2.69		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	N/A		
Over measured depth	5.7E-06		
Over 75% - 25% effective depth	**N/A**		



Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SAE

12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.60
Width (m)	0.80
Depth (m)	1.40
Groundwater	NE
Weather Conditions	Rain
Date	15-Jun-20

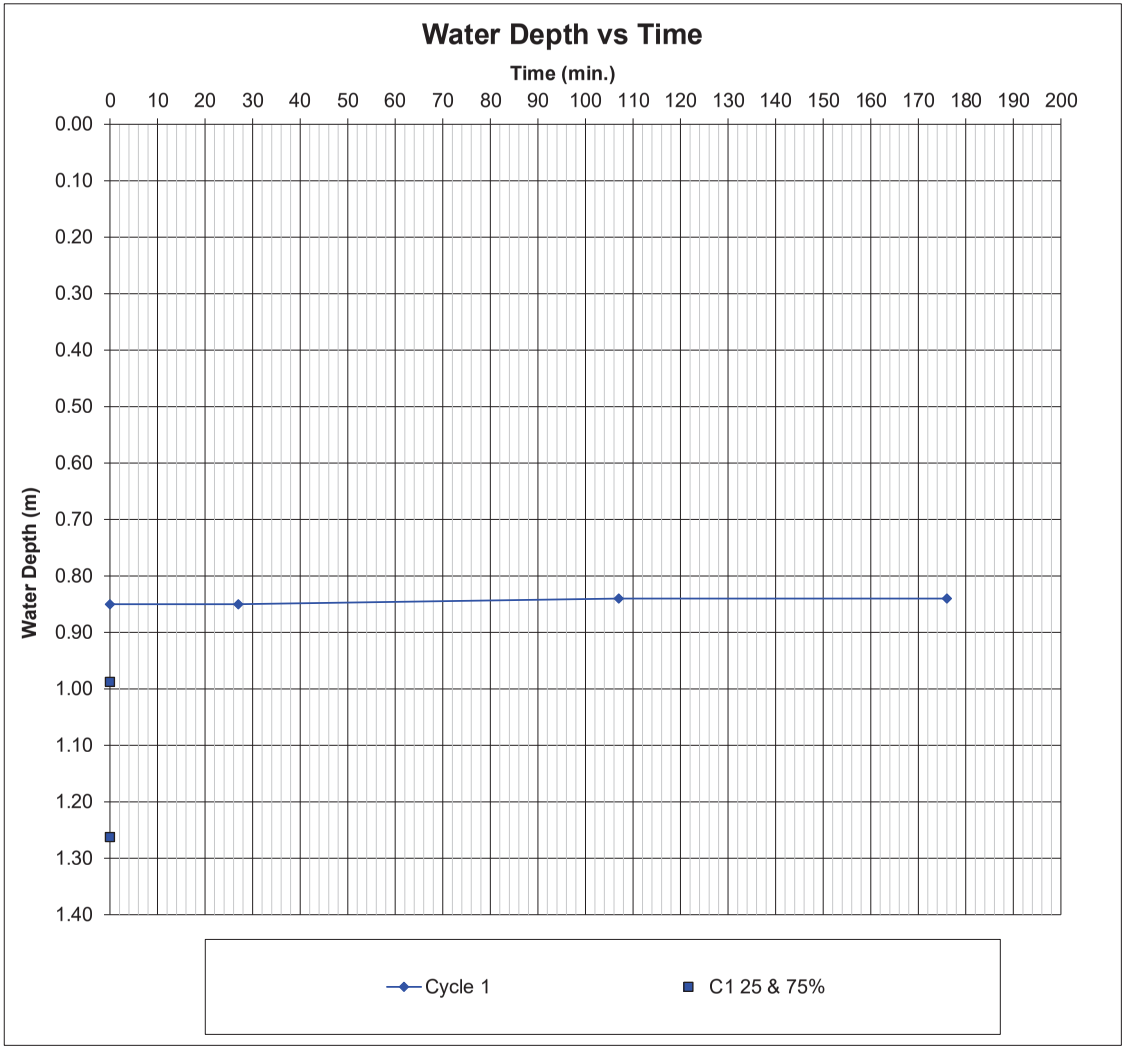
Remarks

Very slight seepage observed during excavation at 0.6mbgl.

Negligible infitlration observed - Test failed first cycle. Infiltration rate cannot be calculated.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.85				
27	0.85				
107	0.84				
176	0.84				

Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	1.40		
Water Depths (m)			
Water depth at start of test	0.85		
Water depth at end of test	0.85		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.55		
Effective storage depth (75%)	0.41		
Effective storage depth (50%)	0.28		
Effective storage depth (25%)	0.14		
Outflow Time (min)			
Time for measured outflow	176		
Time for 100% outflow	-		
Time for 75-25% outflow	-		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	1.14		
From 75% - 25% effective depth	0.57		
Surface Area (m^2)			
For 100% effective storage	5.82		
For 50% effective storage	3.95		
Over measured depth	2.08		
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**		



Intégral Géotechnique

BRE365 SOIL INFILTRATION RATE TEST - SAF

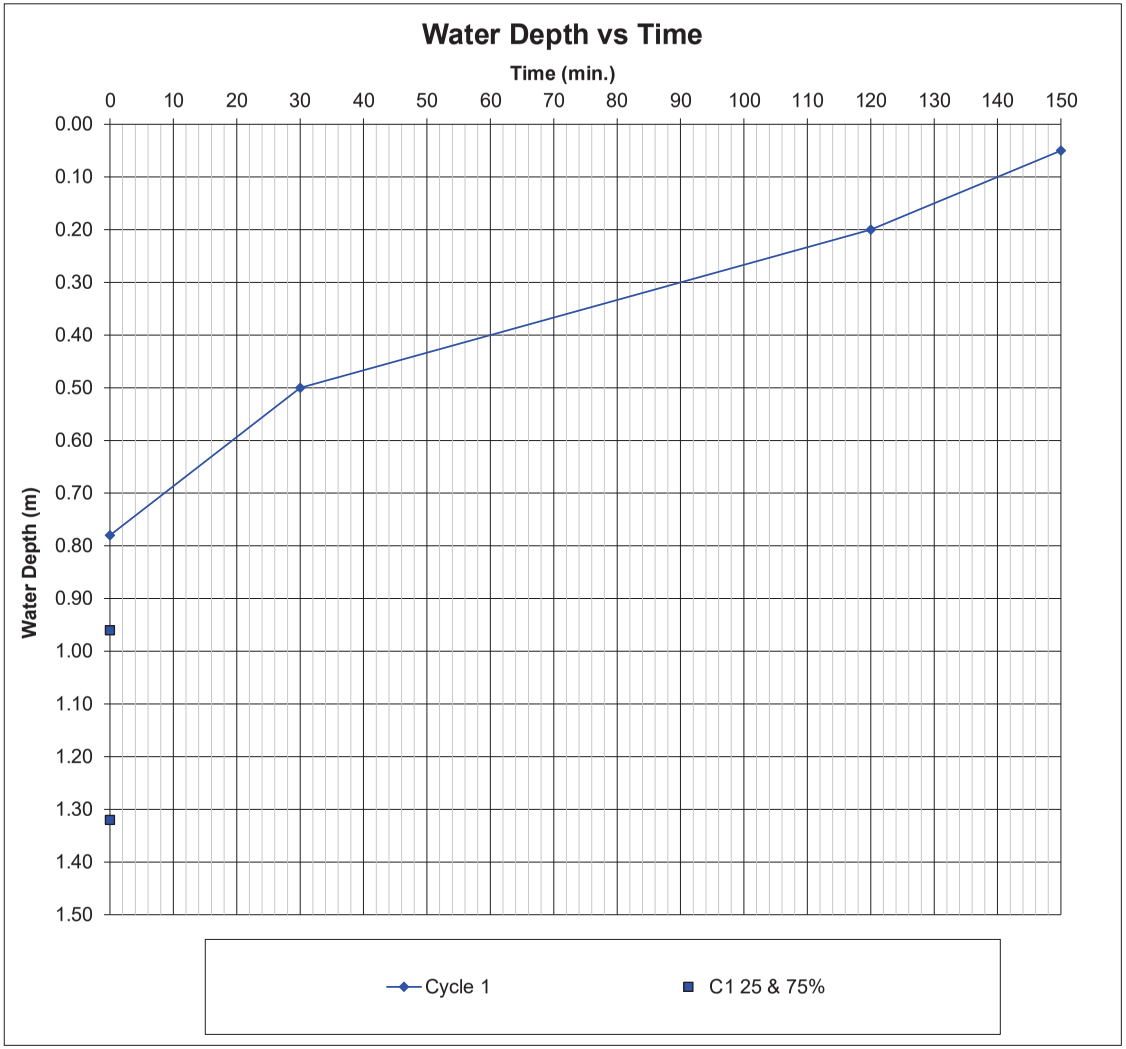
12612 Mill Street, Tonyrefail

Trial Pit Information	
Length (m)	2.10
Width (m)	0.80
Depth (m)	1.50
Groundwater	NE
Weather Conditions	Heavy Rain
Date	18-Jun-20

Remarks
Significant water run-off from ground level - Test terminated. No infiltraiton observed.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	0.78				
30	0.50				
120	0.20				
150	0.05				

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	0.78		
Water depth at end of test	0.78		
Effective depth (measured)	0.00		
% Effective storage depth	0.00		
Effective Storage Depths (m)			
Effective storage depth (100%)	0.72		
Effective storage depth (75%)	0.54		
Effective storage depth (50%)	0.36		
Effective storage depth (25%)	0.18		
Outflow Time (min)			
Time for measured outflow	150		
Time for 100% outflow	-		
Time for 75-25% outflow	-		
Volume of Outflow (m^3)			
Over measured effective depth	0.00		
Over 100% effective depth	1.21		
From 75% - 25% effective depth	0.60		
Surface Area (m^2)			
For 100% effective storage	5.86		
For 50% effective storage	3.77		
Over measured depth	1.68		
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	N/A		
Over measured depth	N/A		
Over 75% - 25% effective depth	**N/A**		



Design Soil Infiltration Rate: 1.7E-04 m/s

Intégral Géotechnique

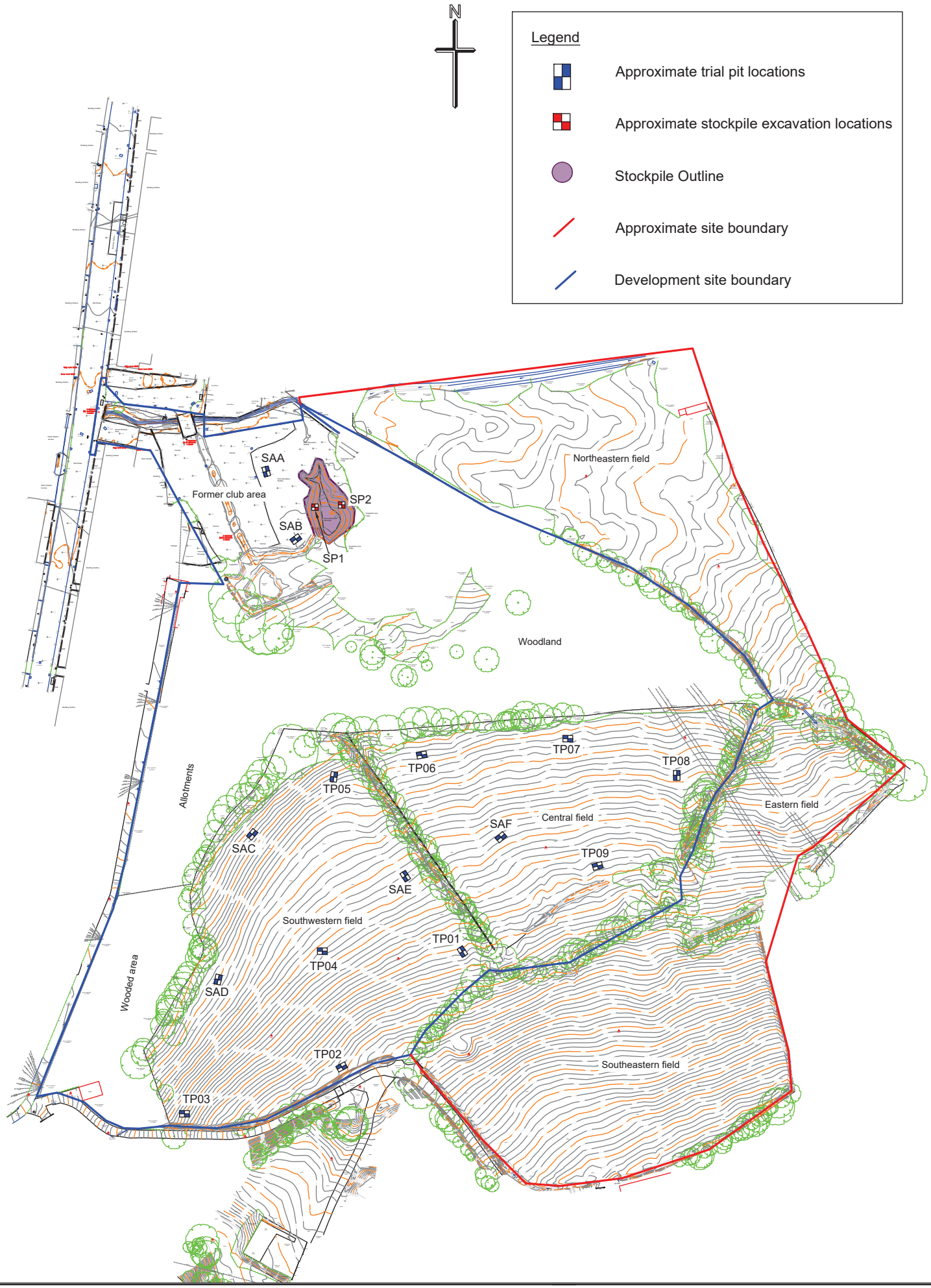


Figure 2: Exploratory Hole Location Plan

Project: Mill Street, Tonyrefail	Job No.: 12612	Intégral Géotechnique	Integral House, 7 Beddau Way, Castlegate Business Park, Caerphilly, CF83 2AX. Tel: 029 2080 7991
Client: Lewis Homes	Scale: 1:1,250 at A3		

APPENDIX E
Greenfield Runoff Calculation

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	1.320	Urban	0.000
SAAR (mm)	1543	Region Number	Region 9

Results l/s

QBAR Rural	14.6
QBAR Urban	14.6
Q2 years	13.6
Q1 year	12.9
Q30 years	25.8
Q100 years	31.9