



Holt Road Residential Site, Wrexham

Flood Consequence Assessment & Drainage Strategy

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Executive Summary

The proposal is for a residential development with associated access and landscaping on greenfield land off Holt Road, Wrexham.

The information from the Technical Advice Note 15: Development and Flood Risk (TAN15) and Natural Resources Wales Flood Zones has determined that the site is located within Zone A, i.e. considered to be at little or no risk of fluvial or tidal/coastal flooding.

The site has been assessed against the requirements of Natural Resources Wales flood mapping and TAN15 Flood Risk Vulnerability and Flood Zone Compatibility matrix. Taking into consideration that the application is for a residential development (highly vulnerable development) in Zone A, the TAN15 Flood Risk Vulnerability and Zone Compatibility matrix indicates that this vulnerability would be appropriate within Zone A.

The British Geological Survey information indicates that the underlying geology of the site is Glaciofluvial Sheet Deposits, comprised of sand and gravel. The Salop Formation also underlies the site comprised of mudstone, sandstone and conglomerate. Further infiltration testing indicated that soakaways are a viable SuDS technique for the discharge of surface water. No watercourses are identified in close proximity to the site.

There is an existing 1300mm diameter Dŵr Cymru Welsh Water Combined Water Sewer running within the eastern boundary which will be subject to a development easement. The site will discharge via infiltration, with each individual plot having an individual soakaway in the gardens and the highway drainage discharging to an elongated soakaway in the east of the site.

There is no residual flood risk from the development site to the surrounding district due to the restriction of surface water runoff prior to discharge. Therefore, the development does not increase the risk of flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100 year plus climate change event may occur within the development site and is classed as exceedance flows. Flood water from this event will be where possible contained within the development site and directed away from the residential dwellings to the external hard and soft landscaped areas. Attenuation of surface water flows will take the form of a geocellular soakaway.

Foul water generated by the development will be discharged into the Dŵr Cymru Welsh Water Combined Water Sewer that runs along the eastern boundary of the site. The foul discharge does not present an increased flood risk to the surrounding district.

1.0 Introduction

- 1.1 Scott Hughes Design (SHD) has been appointed by Wrexham Glyndwr University to prepare this Flood Consequence Assessment to support an outline planning submission for the proposed residential development with associated access, gardens and hard and soft landscaping on land off Holt Road, Wrexham. The assessment has been undertaken in line with Technical Advice Note 15: Development and Flood Risk (TAN15) and information from Natural Resources Wales.
- 1.2 This Flood Consequence Assessment (FCA) has been commissioned by Wrexham Glyndwr University and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.
- 1.3 The report has been commissioned to identify any flood related issues associated with the proposed development and any likely constraints that could be imposed plus to consider the drainage strategy for it. The following issues have been suggested by Natural Resources Wales, Wrexham County Borough Council Preliminary Flood Risk Assessment & Management of Surface Water Guidance Document and subsequently addressed within this report:
- Identify available data relating to flood risk at the site.
 - Determine whether the site is at risk from flooding from all sources, including from breach or overtopping of any existing flood defences, surface water flooding and/or groundwater flooding.
 - Consider the flood risk from all other sources.
 - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
 - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
 - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
 - Consider the recommendations of the Wrexham County Borough Council Preliminary Flood Risk Assessment (PFRA) and Wrexham County Borough Council Management of Surface Water Guidance Document.
 - Assess mitigation measures & off-site impacts and define any residual risks.

2.0 Development Description and Location

2.1 Site Location

The site is referenced in Table 1, and a site location map is provided in Appendix A.

Table 1: Site Referencing Information

Item	Brief Description
Site name	Holt Road Residential Site
Site address and location	Land off Holt Road, Wrexham, LL13 9EF
Council Area	Wrexham County Borough Council
Approximate Grid Reference	OS: 335201, 351454
General Locality	The proposed development site is located some 2.7km to the northeast of Wrexham Town Centre.

2.2 Existing site Description

- 2.2.1 The proposed development site is currently predominantly undeveloped grassland which is used as playing fields. There is also a building associated with the Day Care Centre, located in the west of the site.
- 2.2.2 The site is surrounded entirely by residential properties, with Holt Road forming a portion of the southeastern boundary.
- 2.2.3 Figure 1 below identifies the overall site location details. Topographical information indicates that the site slopes to the east. The highest level of approximately 82.28m AOD is located in the northwest of the site and the lowest level of approximately 78.20m AOD is located in the southeast of the site.

Figure 1: Site Location



2.3 Development Proposals

2.3.1 As discussed in the earlier sections, the report is prepared to support an outline planning application for the proposed residential development at Holt Road, Wrexham.

2.3.2 The site at Holt Road is largely owned by the University but a smaller section of the site, which is not part of this planning application, is owned by the Council. The Council land sits to the west and includes the surface car park and the majority of the existing single storey buildings to the north west. The University own a small element of the existing buildings as indicated on the ownership plan but this building is currently surplus to University requirements and is not in use.

The site is surrounded by existing residential properties and is used as informal public open space and sports pitches. It is proposed that a development of 77 residential units including 23 affordable units is developed to the east of the site leaving a substantial amount of land to the west for use by the community as public open space or sports pitch usage. Within the proposed residential layout is a further provision of public open space focused on the area adjacent to the proposed access onto Holt Road.

2.3.2 The site area is approximately 3.269ha.

2.3.3 The outline Site Layout as indicated in Appendix A provides details of the proposed development intent.

3.0 Planning Policy and Consultation

3.1 Planning Policy Framework

- 3.1.1 The Development Advice Map contained within Technical Advice Note 15: Development and Flood Risk (TAN15) and based on National Resources Wales Flood Zones has determined that the site is located within Zone A, i.e. considered to be at little or no risk of fluvial or tidal/coastal flooding (as shown in table 2 below).

Table 2: National Resources Wales Flood Zones

Natural Resources Wales Flood Zones		
Description	Zone	Notes
Considered to be at little or no risk of fluvial or tidal/coastal flooding	A	Used to indicate that justification test is not applicable and no need to consider flood risk further
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

Table 3: Natural Resources Wales Flood Zones

- 3.1.2 The proposed residential development is considered a “highly vulnerable development” in terms of flood risk. The TAN15 Flood Risk Vulnerability and Flood Zone Compatibility matrix indicates that a highly vulnerable development in Zone A is appropriate. A justification test is not requested for sites in Flood Zone A.

3.2 Preliminary Flood Risk Assessment (PFRA)

3.2.1 The Lead Local Flood Authority (LLFA) of Wrexham County Borough Council is required by the Flood Risk Regulations (2009) and EU Floods Directive 2007/60/EC to prepare a Preliminary Flood Risk Assessment (PFRA). PFRAs assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area; how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The purpose of the PFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.3 A summary of the main elements from the PFRA are detailed below. The full report can be obtained from the Wrexham County Borough Council website.

- PFRA provides a detailed understanding of flood risks across the borough from all sources.
- Surface Water flooding is the most prominent cause of flooding within the County Borough.
- The report identified no records of past groundwater flooding within the County Borough.
- There are no historic records of canal overtopping or flooding of a canal within the Borough.

3.3 Statutory Authority Correspondence

3.3.1 Wrexham County Borough Council confirmed that:

- Discharge rates and volumes are usually required to be limited to greenfield runoff rate, with on-site attenuation for all events up to the 1 in 100 year rainfall event plus climate change.
- The practicable minimum limit on the discharge rate from the site is 5l/s, using an appropriate vortex flow control device.
- The minimum size of pipe discharging from an attenuation device should be 150mm laid at a gradient not flatter than 1 in 150.
- An explanation of how it is proposed to manage and fund the maintenance of the proposed system over the lifetime of the development is required. This should consider the requirement to ensure that access is physically possible for such maintenance works.

3.3.2 Owain George from Welsh Water confirmed that foul flows from the development can be accommodated within the public sewerage system.

3.3.3 Mr Neil Taunt, Senior Flood Management Officer, at Wrexham County Borough Council confirmed within his planning response that infiltration testing is to be carried out to confirm whether they are suitable.

4.0 Definition of Flood Hazard

4.1 Sources of information

TAN15 requires the developer to consider the impact of runoff generated by the proposed development onto the downstream catchment, and to assess the risk of runoff from the surrounding district impacting on the developments footprint. Furthermore, the report is to consider flood risk from all other sources. The following section defines the flood risk receptors and anticipated flood risk. Section 5 then discusses in further detail the probability of flooding and the likely impacts.

Table 3: Sources of information used in the identification of flood risk

Source of Information	Details
Natural Resources Wales	Flood Risk Map
Dŵr Cymru Welsh Water	Sewer Records
Historic Maps	From various websites

4.2 Flooding from Rivers (Fluvial)

- 4.2.1 There are no watercourses in close proximity to the site. The closest watercourse is the River Gwenfro, located approximately 1.5km to the south of the site.
- 4.2.2 Figure 2 below locates the site on the Natural Resources Wales flood risk map. It is clear from this that the red line area sits outside of the influence of flood water from any identified water body or river and is located within Flood Zone 1 i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 in any year (<0.1%).
- 4.2.3 Based on the available information, the site lies within Flood Zone 1 and is classified as Zone A. According to TAN15 Flood Risk Vulnerability and Flood Zone Compatibility Matrix, a justification test is not requested for sites in Flood Zone A. Therefore, there is no need to consider fluvial flood risk any further.

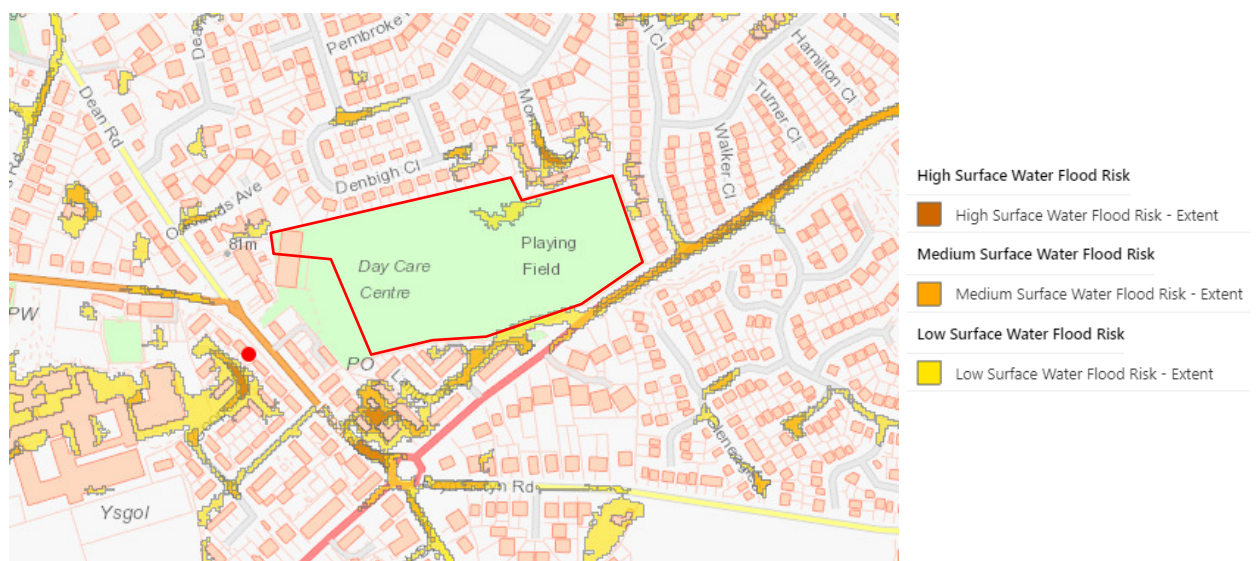
Figure 2 – Natural Resources Wales Risk of Flooding from Rivers & Sea Maps



4.3 Flooding From Land (Overland Flow)

- 4.3.1 The main development site slopes to the east. Any surface water runoff from the surrounding area will be prevented from entering the site by the existing drainage associated with the surrounding residential developments and highways.
- 4.3.2 Furthermore, a review of the Natural Resources Wales Surface Water Flood Risk maps indicates that the site is predominantly at very low risk of flooding (see Figure 3 below). However, there is an area that is shown as being at low risk, meaning that the area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%). The installation of new surface water drainage networks as part of the new development will ensure flood risk to the site is very low.

Figure 3 – Natural Resources Wales Surface Water Flood Risk Maps



4.4 Flooding from Sewers and Private Drainage

- 4.4.1 The Dŵr Cymru Welsh Water sewer records have been reviewed and confirm that there is a 1300mm diameter Combined Water Sewer running inside the eastern boundary of the site (see Figure 4 below). This sewer will be subject to a Dŵr Cymru Welsh Water development easement, in this case a total easement of 13m (6.5m either side) or a potential diversion subject to final housing layout by developer.
- 4.4.2 The extensive Dŵr Cymru Welsh Water adopted drainage network serving the surrounding urban district ensures that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the highway areas above the sewers. However, this is expected to be localised and restricted to the location of specific manhole covers located away from the development footprint. Thus flood risk to the site from sewers is diminished to acceptable levels.

Figure 4 – Dŵr Cymru Welsh Water Sewer Records Extract



4.5 Flooding from Groundwater

- 4.5.1 The British Geological Survey mapping indicates that the site is underlain by Glaciofluvial Sheet Deposits, comprised of sand and gravel. The site is also underlain by the Salop Formation, comprised of mudstone, sandstone and conglomerate. According to the Environment Agencies Aquifer Designation Map, both the Glaciofluvial Sheet Deposits and the Salop Formation are classified as

Secondary A Aquifers, comprised of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

4.5.2 The PFRA identified no records of past groundwater flooding within the County Borough.

4.5.3 Based on the available information the risk of flooding from groundwater is considered to be low.

4.6 Flooding from Artificial Sources

4.6.1 There are no canals or reservoirs in close proximity to the red line area. Therefore the risk of flooding from artificial sources is low.

5.0 Assessment of Flood Risk on the Development Site (Probability)

5.1 Summary

Section 4 has defined the anticipated flood risks from all sources. Table 4 below considers each of the sources and defines in tabular format the Probability of Flood Risk associated to each and the likely impacts.

Below is a table summary of the flood risks associated with the development site.

Table 4 – Flood Risk Summary

Source	Flood Risk	Likely Impacts	Remarks
Tidal	Low	Low	The site is not tidally influenced.
Fluvial (Watercourse)	Low	Low	The site is in Zone A.
Surface (Overland Flood Flow)	Low	Low	The Natural Resources Wales flood maps show the majority of the site at very low risk of surface water flooding with two small areas at low risk.
Sewers	Low	Low	There is an existing Dŵr Cymru Welsh Water sewer that runs along the eastern boundary. The required easement will be applied to this sewer or it may be subject to a potential diversion, dependent on final housing layout proposed by developer.
Groundwater	Low	Low	The site is at low risk of groundwater flooding.
Artificial Sources	Low	Low	There are no artificial sources in close proximity.

6.0 Outline Drainage Strategy

6.1 Existing Surface Water Runoff

- 6.1.1 The existing site is greenfield and slopes to the east. As the site is greenfield, greenfield runoff rates will apply as calculated in Table 5 below.

Table 5 – Existing Greenfield Runoff Rates

	Residential Site Area (m ²)	1 Year (l/s)	Qbar (l/s)	30 Year (l/s)	100 year (l/s)
Open Land	24550	11.0	12.5	22.1	27.3

6.2 Geology

- 6.2.1 The superficial geology of the site is Glaciofluvial Sheet Deposits comprised of sand and gravel. The bedrock geology is the Salop Formation comprised of mudstone, sandstone and conglomerate.
- 6.2.2 The underlying geology indicates that infiltration is a viable SuDS technique for the discharge of surface water, this has been confirmed with further infiltration testing (See Appendix F for further details).

6.3 Sustainable Drainage Systems

6.3.1 SuDS Objectives:

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

6.3.2 SuDS's Design Themes

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individuals plot structure, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area.

6.3.3 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

6.3.4 SuDS Site Constraints

SuDS techniques are not suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- Land Use Characteristics: The size and type of the development plot allows a range of source control and site control SuDS devices to be considered both above and below ground.
- Site Characteristics: The underlying geology indicates that infiltration is a viable SuDS technique, this has been confirmed by the results of further infiltration tests.
- Catchment Characteristics: The site is currently greenfield and greenfield runoff rates will apply.
- Environmental and Amenity Performance: Safety to all future users is paramount when including SuDS within the overall development and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

6.3.5 SuDS Methods

Tables 6 and 7, below, provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the development.

Table 6: Surface SuDS Methods

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> - Architectural proposals for the development and maintenance issues deem this unsuitable. - Additional costs of installation would have severe effect on viability of the development.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Suitable:</u> To be located at the base of downspouts. Subject to client approval.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site, and reduces treated water consumption.	<u>Not Suitable:</u> - Additional costs of installation would have severe effect on viability of the development. - The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs. - Running and maintenance costs would not be acceptable to the client or future residents.
Infiltration Options	Reduces total run off volume from the development.	<u>Suitable:</u> Infiltration tests confirmed suitability.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Suitable:</u> Infiltration tests confirmed suitability.
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or use of plastic box stems.	<u>Suitable:</u> Infiltration tests confirmed suitability.

	Impermeable membrane at base of construction to prevent impact on pavement stability.	
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also allow filtering of particulate matter, improving water quality	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.

Table 7: Sub-Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<u>Suitable:</u> - The use of geocellular attenuation may be possible to retain excess storm water. - Cannot be used in Public Highways or adopted by WW.
Large Diameter Pipes, Culverts or Tanks	- Suitable for sites with insufficient space for basins etc. - Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. - Generally be suitable for adoption by the statutory water company (e.g. Dŵr Cymru Welsh Water).	<u>Suitable:</u> - The use of oversized pipes may be possible to retain excess storm water. - Used primarily on adopted drainage networks.

6.3.6 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 6 and 7, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below.

Table 8: SuDS Hierarchal Approach

Method	Suitability	Suitability for Development
Infiltration to Ground	Yes	Infiltration testing confirmed that soakaways are a viable option for the site.
Connection to Watercourse	No	There are no watercourses in close proximity to the site.
Connection to Surface Water Sewer	No	There are no surface water sewers in close proximity to the site.
Connection to a Combined Sewer	No	There are other suitable options that would take precedence.

6.3.7 SuDS Design Philosophy

The SuDS assessment and hierarchal approach discussed in Tables 6, 7 and 8 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the main development site is the promotion of Source Control and Site Control techniques, to reduce the risk of both site and downstream flooding.

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the ground.
- Site control in the form of individual plot soakaways and a separate highways soakaway.
- Infiltration testing confirmed that soakaways are a viable option.
- Aim to limit where possible the impermeable fraction of development.

6.4 Outline Surface Water Drainage Strategy

6.4.1 The outline strategy is to collect runoff from the roof and external areas and direct it to new below ground surface water drainage networks that will discharge into individual soakaways located in the gardens of each plot. All highway drainage is to be diverted to an elongated soakaway in the east of the site.

6.4.2 The proposed drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance and Sewers for Adoption, i.e. up to the 30-

year storm return period criterion and tested for the 1 in 100 year return period including a 40% increase to account for climate change to confirm that there is no flood risk to the buildings.

- 6.4.3 Flooding can occur on a local scale beyond the 30-year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Sewers for Adoption (SfA) 7th Edition (WRc, 2006) states that developments should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.
- 6.4.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Sewers for Adoption guidance. Using storage within the external areas would be achievable and would direct flood water away from the residential buildings, with flows directed back into the surface water drainage network as water levels in the sewers receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development and due to the fall across the site, consideration will be given to make sure all water is controlled so that it does not impact on any adjoining properties.
- 6.4.5 Based on the infiltration results in Appendix F, a rate of 1.77×10^{-05} has been used to calculate the required volume for the highway drainage soakaway. The outline attenuation volume in Appendix E has been derived using Microdrainage Source Control Software. The volumes identified are preliminary for this outline assessment and are likely to alter at detailed design stage.
- 6.4.6 Any future drainage calculations carried out as part of a site-wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate Change allowances.

6.5 Pollution Control

- 6.5.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, French drains with silt traps or by the use of Sustainable Drainage techniques. If appropriate, oil separators in line with Pollution Prevention Guidance 3 (PPG 3) criteria will be provided (it is acknowledged that PPG 3 has been withdrawn, however as no replacement has been released it is still best practice guidance).

6.6 Foul Water Strategy

- 6.6.1 The outline foul water drainage strategy is to connect into the combined sewer located to the east of the proposed development. There would be very limited increase in the foul water discharge rates generated by the new development.

7.0 Management Measures, Off Site Impacts and Residual Risk

7.1 Flood Risk Management Measures

- 7.1.1 The report has found the main development site to be at low risk of flooding from all sources.
- 7.1.2 The surface water drainage strategy for the new development site will be to discharge to ground. The new surface water networks will be designed in line with current British Standard and Sewers for Adoption Guidance up to the 100-year storm return period including an allowance for climate change. Beyond the 30-year criterion out of chamber flooding may occur and flood water will be directed away from the residential buildings to the external areas, where it will then be directed back into the drainage network as pipe water levels recede.
- 7.1.3 The use of SuDS in the form of Prevention and Site Control measures, with controlled outflow, in line with the required reduction in runoff rates, will help to minimise the flood risk impact to the surrounding sewer networks.
- 7.1.4 There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains and drainage facilities such as the channels, gullies, pipes, manholes and all SUDS facilities.
- 7.1.5 A new Management Company, the local Highway Authority and WW will be responsible for site cleanliness, gully emptying and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.
- 7.1.6 Should any flooding occur from the new sewers and drains it will be directed away from the residential buildings to external areas and soft landscaping areas.

7.2 Off Site Impacts

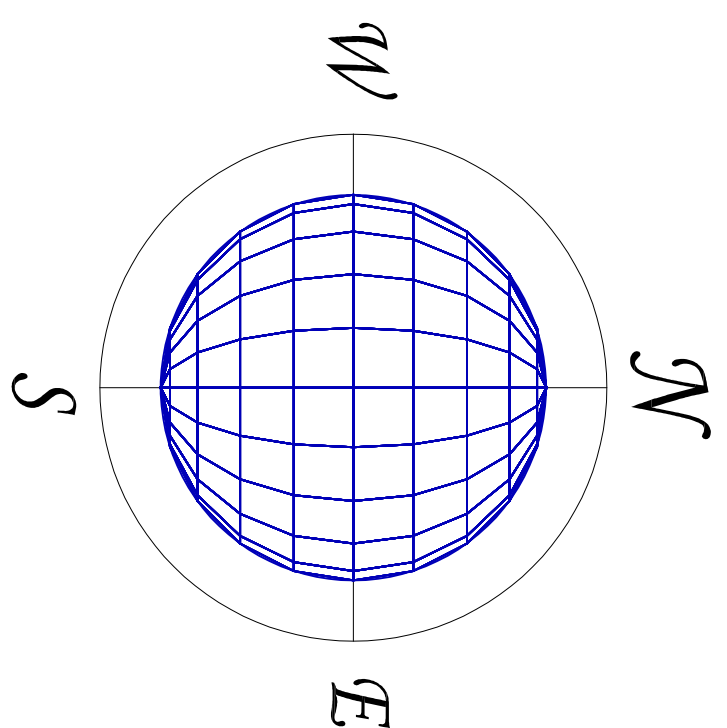
- 7.2.1 Up to and including the 100-year plus increase in rainfall allowance due to climate change (CC) event, the report has justified that there is no risk of flooding.
- 7.2.2 The development footprint does not cross or cover any existing or declared future catchment flood defences. Consequently, the Applicant does not propose to augment or compromise any existing catchment defences.
- 7.2.3 By mimicking the pre-development peak runoff at its point of discharge by the inclusion of SuDS, this will reduce surface water flooding impact onto the downstream sewer network and satisfies the site constraints.
- 7.2.4 As there is no flood displacement or increased rate of runoff as part of this proposal into the adjacent sewers, the proposed development will therefore not increase flood risk in its locality.

7.3 Residual Risk

- 7.3.1 With careful design of the drainage elements as described above there will be no residual flood-related risks that will remain after the development has been completed.
- 7.3.2 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. The only known flood related risk that will remain will be the risk of out of manhole flooding within both the existing private and public sewer network beyond the 30 year design criterion. Should exceedance occur, out of chamber flood water will be directed to the external hard standing areas and roads but will not be a flood risk generator.

Appendix A – Architectural Site Layout

Appendix B – Topographical Survey



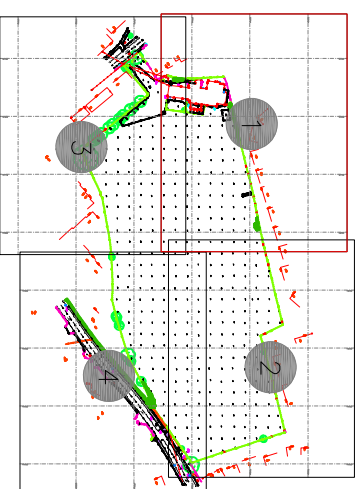
Symbols/Abbreviations (Where Applicable):

[illegible]

	DEFINED POINT
X	CONTROL POINT
A	TREE (CONIFEROUS)
	TREE (DECIDUOUS)
	FOLIAGE
	HERB
	DPC PROOF COURSE LEVEL
EL 99.99m	EMMS LEVEL
FL 99.99m	FLOOR LEVEL
RI 99.99m	RIDGE LEVEL
SI 99.99m	SOFFIT LEVEL
TL 99.99m	THRESHOLD LEVEL

L/PAL: BARBED WIRE FENCE
 B/W: CLOSE BOARDED FENCE
 C/D: CHAIN LINK FENCE
 C/L: CHESTNUT PALD FENCE
 CONC/P: CONCRETE PAVED FENCE
 I/R: IRON RAILING FENCE
 P/R: POST AND RAIL FENCE
 P/W: POST AND WIRE FENCE
 P/C: POST AND CHAIN FENCE
 S/PAL: STEEL PALISADE FENCE
 S/B: SAFETY BARRIER
 T/PAL: TIMBER PALISADE FENCE

SITE LAYOUT



Revision Information	

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

- 1) Ordnance Survey coordinates, and levels are denoted here GCS2002 and OSGM02, transformed from WGS84.
- 2) Only services located during the site survey are shown on this plan. Further investigation may be required to ascertain the full extent of the site services.
- 3) Copyright of this drawing remains the property of PA Swirey UK Ltd. Do not scale from the drawing, in the event of any discrepancy, refer query to PA Swirey UK Ltd.

Ordnance Survey Bench Mark Used			
#	Location	Type	Value (m)
2			



PM Surveys UK Ltd
Unit 3, Queensferry Industrial Estate
Pentre
Flintshire, CH5 2DJ
Tel: 01244 952477
Email: info@pmsurveys.co.uk

Client info

Day Architectural Ltd
22nd Floor Lancaster Building
77 Deansgate
Manchester
M3 9LQ
03
-architectural.com

Holt Road
Topographic Survey

Project No PMS18062	Sheet: A0 Scale: 1:200	Surveyed By: AL
		Drawn By: JW
PMS18062-01		Approved By: PM
		Issued: 09/04/18

Appendix C – Statutory Authority Correspondence

Cerys Jones

From: Philip Forster
Sent: 09 October 2018 12:22
To: planning_admin
Subject: FW: P/2018/0673

Flood officer response

From: Philip Forster
Sent: 11 September 2018 08:27
To: planning_admin
Subject: FW: P/2018/0673

Flood officer response

From: Neil Taunt
Sent: 07 September 2018 11:15
To: Philip Forster
Subject: P/2018/0673

Hi Phil,

Thank you for the recent consultation on the above application.

The site is located in DAM Zone A as defined within TAN15, small and localised areas of the site are identified as being at risk of surface water flooding on NRW updated flood map for surface water.

A Flood Consequence Assessment and Drainage Strategy has been submitted in support of the site. With regards to the management of surface waters generated by new impermeable surfaces the drainage strategy proposes to use soakaway. If soakaway is shown not to be suitable then it is proposed to discharge all surface waters to the locally combined sewer network. No infiltration testing has been undertaken to demonstrate that soakaway is a feasible means of surface water disposal and WW/DC have indicated that no surface water will be permitted to be discharge into the combined sewer network. As such it is fundamental that, prior to determination of the outline application, it is demonstrated that infiltration rates across the site are suitable for the use of soakaways as no other means of surface water disposal is available to the site. An indicative drainage proposal should be submitted, as detailed in the attached guidance note, including percolation tests carried out in accordance with the latest BRE365 guidance.

In the absence of this information it has not been demonstrated that surface water flood risk both to the development site and surrounding area can be sustainably managed into the future and I would request the application be refused.

In addition, the applicant should be made aware that the commencement of schedule 3 of the Flood and Water Management Act 2010 (the Act) was signed 1 May 2018. This will mean that from the 7 January 2019 any new development that satisfy the criteria will require SuDS Approval Body (SAB) approval prior to the commencement of development. It is proposed to make transitional arrangements as follows:

- Existing sites and developments with planning permission granted or deemed to be granted (whether or not subject to any conditions as to a reserved matter – but see also below) or for which a valid application has been received but not determined by 7 January 2019, will not be required to apply for SAB approval.
- SAB approval will still be required if the planning permission was granted subject to a condition as to a reserved matter and an application for approval of the reserved matter is not made before 7 January 2020.

It is reasonable to assume that, if the development were to progress, and any associated drainage conditions not be discharged prior to the January 2020 date, then SAB approval would be required prior to the commencement of any works on site.

If you have any question on the above please let me know.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci

Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



01978 729734 / 07808 787632



Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wrecsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wrecsam, Wrecsam LL13 9PW



Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW



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Ms Eleanor Dale
Scott Hughes Design
The Flint Glass Works
64 Jersey Street
Manchester
M4 6JW

Date: 12/06/2018
Our Ref: PPA0003119

Dear Ms Dale

Grid Ref: 335178 351448
Site Address: Site off Dean Road/Holt Road, Wrexham
Development: Residential development – 62 units

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

ASSET PROTECTION

The proposed development site is crossed by a 100mm and 1300mm diameter combined gravity public sewer with their approximate positions being marked on the attached Statutory Public Sewer Record. Under Section 159 of the Water Industry Act 1991, Dwr Cymru Welsh Water has rights of access to its apparatus at all times, and as such would require an easement of 3m either side of the centreline of the 100mm pipe and a 6.5m easement either side of the centreline of the 1300mm pipe. Should the proposed development be located within the protection zones of the sewers crossings, there would be a requirement to divert the public sewers, which can be applied for under Section 185 of the Water Industry Act 1991.

SEWERAGE

The foul flows only from the proposed development can be accommodated within the public sewerage system. We advise that the flows should be taken to the foul sewer at manhole SJ35513450 which is located in Holt Road.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account.

However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

Advisory Notes

The applicant may need to apply to Dwr Cymru / Welsh Water for any connection to the public sewer under S106 of the Water Industry Act 1991. If the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Gravity Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com.

The applicant is also advised that 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 the proposal. In order to assist us in dealing with the proposal the applicant may contact Dwr Cymru Welsh Water. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SURFACE WATER

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 Natural Resources Wales.

Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note. In addition, please note that no surface water, highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

SEWAGE TREATMENT

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

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.



Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at developer.services@dwrcymru.com

Please quote our reference number in all communications and correspondence.

Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

Appendix D – Scott Hughes Design Drawings



GENERAL NOTES

- 1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
- 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- 3. DO NOT SCALE FROM THIS DRAWING. WORK TO DIMENSIONS OR CO-ORDINATES PROVIDED. ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS, SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY.
- 4. INFORMATION CONTAINED ON THIS DRAWING IS SCHEME DESIGN ONLY AND REQUIRES FURTHER DETAILED DESIGN AND CO-ORDINATION WITH THE CONTRACTOR, DESIGN TEAM AND APPROPRIATE SUB-CONTRACTORS.

DRAINAGE KEY

- EXISTING CW SEWER
- EXISTING CW SEWER MANHOLE
- PROPOSED FW SEWER
- PROPOSED FW SEWER MANHOLE
- PROPOSED SW SEWER
- PROPOSED SW SEWER MANHOLE
- SITE BOUNDARY

P2	07.06.19	EJD	PG	LAYOUT UPDATED
P1	25.05.18	JS	PG	PRELIMINARY ISSUE
No	DATE	DRAWN	REV'D ENG.	AMENDMENT

STATUS	PURPOSE OF ISSUE
S2	FOR INFORMATION

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Scott Hughes Design Ltd.
The Flint Glass Works,
64 Jersey Street,
Manchester M4 6JW
t. 0161 605 0831
f. 0161 605 0832
e.mail@scotthughesdesign.co.uk
Reg No. 4899745

CLIENT	GLYNDWR UNIVERSITY		
PROJECT	HOLT ROAD, WREXHAM		
DRAFTER	JS	ENGINEER	PG
TITLE	PROPOSED DRAINAGE GA		
PROJECT REFERENCE: 3352			

SCALE	SHEET	DRAWING No	REV
1-500	A1	3352-SHD-00-ZZ-DR-C-0102	P2

Appendix E – Hydraulic Calculations

Scott Hughes Design Ltd		Page 1
The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Holt Road Wrexham	
Date 07/06/2019 File	Designed by EJD Checked by PG	
Micro Drainage Source Control 2018.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	2.455	Urban	0.000
SAAR (mm)	796	Region Number	Region 9

Results l/s

QBAR Rural	12.5
QBAR Urban	12.5
Q1 year	11.0
Q1 year	11.0
Q30 years	22.1
Q100 years	27.3

©1982-2018 Innovyze

Scott Hughes Design Ltd				Page 1																																																																																																																																																																																																																			
The Flint Glass Works 64 Jersey Street Manchester M4 6JW		Holt Road Wrexham																																																																																																																																																																																																																					
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Micro Drainage		Source Control 2018.1																																																																																																																																																																																																																					
<u>Summary of Results for 30 year Return Period</u> Half Drain Time : 1013 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>76.078</td><td>1.078</td><td>1.1</td><td>61.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>76.451</td><td>1.451</td><td>1.2</td><td>82.7</td><td>O K</td></tr><tr><td>60 min Summer</td><td>76.860</td><td>1.860</td><td>1.4</td><td>106.0</td><td>O K</td></tr><tr><td>120 min Summer</td><td>77.289</td><td>2.289</td><td>1.5</td><td>130.5</td><td>O K</td></tr><tr><td>180 min Summer</td><td>77.533</td><td>2.533</td><td>1.6</td><td>144.4</td><td>O K</td></tr><tr><td>240 min Summer</td><td>77.692</td><td>2.692</td><td>1.7</td><td>153.4</td><td>O K</td></tr><tr><td>360 min Summer</td><td>77.885</td><td>2.885</td><td>1.8</td><td>164.4</td><td>O K</td></tr><tr><td>480 min Summer</td><td>77.996</td><td>2.996</td><td>1.8</td><td>170.8</td><td>O K</td></tr><tr><td>600 min Summer</td><td>78.057</td><td>3.057</td><td>1.8</td><td>174.2</td><td>O K</td></tr><tr><td>720 min Summer</td><td>78.085</td><td>3.085</td><td>1.8</td><td>175.9</td><td>O K</td></tr><tr><td>960 min Summer</td><td>78.111</td><td>3.111</td><td>1.8</td><td>177.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>78.108</td><td>3.108</td><td>1.8</td><td>177.2</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>78.032</td><td>3.032</td><td>1.8</td><td>172.8</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>77.921</td><td>2.921</td><td>1.8</td><td>166.5</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>77.707</td><td>2.707</td><td>1.7</td><td>154.3</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>77.509</td><td>2.509</td><td>1.6</td><td>143.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>77.328</td><td>2.328</td><td>1.6</td><td>132.7</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>77.163</td><td>2.163</td><td>1.5</td><td>123.3</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>77.012</td><td>2.012</td><td>1.4</td><td>114.7</td><td>O K</td></tr><tr><td>15 min Winter</td><td>76.211</td><td>1.211</td><td>1.2</td><td>69.0</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>63.525</td><td>0.0</td><td>53</td></tr><tr><td>30 min Summer</td><td>42.780</td><td>0.0</td><td>67</td></tr><tr><td>60 min Summer</td><td>27.653</td><td>0.0</td><td>94</td></tr><tr><td>120 min Summer</td><td>17.374</td><td>0.0</td><td>150</td></tr><tr><td>180 min Summer</td><td>13.092</td><td>0.0</td><td>206</td></tr><tr><td>240 min Summer</td><td>10.657</td><td>0.0</td><td>264</td></tr><tr><td>360 min Summer</td><td>7.937</td><td>0.0</td><td>376</td></tr><tr><td>480 min Summer</td><td>6.438</td><td>0.0</td><td>490</td></tr><tr><td>600 min Summer</td><td>5.470</td><td>0.0</td><td>604</td></tr><tr><td>720 min Summer</td><td>4.785</td><td>0.0</td><td>708</td></tr><tr><td>960 min Summer</td><td>3.873</td><td>0.0</td><td>816</td></tr><tr><td>1440 min Summer</td><td>2.870</td><td>0.0</td><td>1070</td></tr><tr><td>2160 min Summer</td><td>2.124</td><td>0.0</td><td>1484</td></tr><tr><td>2880 min Summer</td><td>1.713</td><td>0.0</td><td>1904</td></tr><tr><td>4320 min Summer</td><td>1.264</td><td>0.0</td><td>2732</td></tr><tr><td>5760 min Summer</td><td>1.018</td><td>0.0</td><td>3536</td></tr><tr><td>7200 min Summer</td><td>0.861</td><td>0.0</td><td>4336</td></tr><tr><td>8640 min Summer</td><td>0.751</td><td>0.0</td><td>5120</td></tr><tr><td>10080 min Summer</td><td>0.669</td><td>0.0</td><td>5880</td></tr><tr><td>15 min Winter</td><td>63.525</td><td>0.0</td><td>53</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	76.078	1.078	1.1	61.4	O K	30 min Summer	76.451	1.451	1.2	82.7	O K	60 min Summer	76.860	1.860	1.4	106.0	O K	120 min Summer	77.289	2.289	1.5	130.5	O K	180 min Summer	77.533	2.533	1.6	144.4	O K	240 min Summer	77.692	2.692	1.7	153.4	O K	360 min Summer	77.885	2.885	1.8	164.4	O K	480 min Summer	77.996	2.996	1.8	170.8	O K	600 min Summer	78.057	3.057	1.8	174.2	O K	720 min Summer	78.085	3.085	1.8	175.9	O K	960 min Summer	78.111	3.111	1.8	177.3	O K	1440 min Summer	78.108	3.108	1.8	177.2	O K	2160 min Summer	78.032	3.032	1.8	172.8	O K	2880 min Summer	77.921	2.921	1.8	166.5	O K	4320 min Summer	77.707	2.707	1.7	154.3	O K	5760 min Summer	77.509	2.509	1.6	143.0	O K	7200 min Summer	77.328	2.328	1.6	132.7	O K	8640 min Summer	77.163	2.163	1.5	123.3	O K	10080 min Summer	77.012	2.012	1.4	114.7	O K	15 min Winter	76.211	1.211	1.2	69.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	63.525	0.0	53	30 min Summer	42.780	0.0	67	60 min Summer	27.653	0.0	94	120 min Summer	17.374	0.0	150	180 min Summer	13.092	0.0	206	240 min Summer	10.657	0.0	264	360 min Summer	7.937	0.0	376	480 min Summer	6.438	0.0	490	600 min Summer	5.470	0.0	604	720 min Summer	4.785	0.0	708	960 min Summer	3.873	0.0	816	1440 min Summer	2.870	0.0	1070	2160 min Summer	2.124	0.0	1484	2880 min Summer	1.713	0.0	1904	4320 min Summer	1.264	0.0	2732	5760 min Summer	1.018	0.0	3536	7200 min Summer	0.861	0.0	4336	8640 min Summer	0.751	0.0	5120	10080 min Summer	0.669	0.0	5880	15 min Winter	63.525	0.0	53
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30 min Summer	42.780	0.0	67																																																																																																																																																																																																																				
60 min Summer	27.653	0.0	94																																																																																																																																																																																																																				
120 min Summer	17.374	0.0	150																																																																																																																																																																																																																				
180 min Summer	13.092	0.0	206																																																																																																																																																																																																																				
240 min Summer	10.657	0.0	264																																																																																																																																																																																																																				
360 min Summer	7.937	0.0	376																																																																																																																																																																																																																				
480 min Summer	6.438	0.0	490																																																																																																																																																																																																																				
600 min Summer	5.470	0.0	604																																																																																																																																																																																																																				
720 min Summer	4.785	0.0	708																																																																																																																																																																																																																				
960 min Summer	3.873	0.0	816																																																																																																																																																																																																																				
1440 min Summer	2.870	0.0	1070																																																																																																																																																																																																																				
2160 min Summer	2.124	0.0	1484																																																																																																																																																																																																																				
2880 min Summer	1.713	0.0	1904																																																																																																																																																																																																																				
4320 min Summer	1.264	0.0	2732																																																																																																																																																																																																																				
5760 min Summer	1.018	0.0	3536																																																																																																																																																																																																																				
7200 min Summer	0.861	0.0	4336																																																																																																																																																																																																																				
8640 min Summer	0.751	0.0	5120																																																																																																																																																																																																																				
10080 min Summer	0.669	0.0	5880																																																																																																																																																																																																																				
15 min Winter	63.525	0.0	53																																																																																																																																																																																																																				
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Scott Hughes Design Ltd				Page 2	
The Flint Glass Works 64 Jersey Street Manchester M4 6JW		Holt Road Wrexham			
Date 04/02/2019 File 30YR SOAKAWAY.SRCX		Designed by EJD Checked by PG			
Micro Drainage		Source Control 2018.1			
<u>Summary of Results for 30 year Return Period</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	76.631	1.631	1.3	93.0	O K
60 min Winter	77.092	2.092	1.5	119.2	O K
120 min Winter	77.580	2.580	1.7	147.0	O K
180 min Winter	77.860	2.860	1.8	163.0	O K
240 min Winter	78.046	3.046	1.8	173.6	O K
360 min Winter	78.277	3.277	1.9	186.8	O K
480 min Winter	78.416	3.416	2.0	194.7	O K
600 min Winter	78.499	3.499	2.0	199.4	O K
720 min Winter	78.545	3.545	2.0	202.0	O K
960 min Winter	78.572	3.572	2.0	203.6	O K
1440 min Winter	78.561	3.561	2.0	203.0	O K
2160 min Winter	78.455	3.455	2.0	196.9	O K
2880 min Winter	78.295	3.295	1.9	187.8	O K
4320 min Winter	77.951	2.951	1.8	168.2	O K
5760 min Winter	77.655	2.655	1.7	151.3	O K
7200 min Winter	77.390	2.390	1.6	136.2	O K
8640 min Winter	77.154	2.154	1.5	122.8	O K
10080 min Winter	76.943	1.943	1.4	110.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	42.780	0.0	67		
60 min Winter	27.653	0.0	94		
120 min Winter	17.374	0.0	150		
180 min Winter	13.092	0.0	204		
240 min Winter	10.657	0.0	260		
360 min Winter	7.937	0.0	372		
480 min Winter	6.438	0.0	482		
600 min Winter	5.470	0.0	594		
720 min Winter	4.785	0.0	704		
960 min Winter	3.873	0.0	906		
1440 min Winter	2.870	0.0	1126		
2160 min Winter	2.124	0.0	1592		
2880 min Winter	1.713	0.0	2048		
4320 min Winter	1.264	0.0	2928		
5760 min Winter	1.018	0.0	3776		
7200 min Winter	0.861	0.0	4616		
8640 min Winter	0.751	0.0	5392		
10080 min Winter	0.669	0.0	6184		
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The Flint Glass Works 64 Jersey Street Manchester M4 6JW		Holt Road Wrexham
Date 04/02/2019 File 30YR SOAKAWAY.SRCX		Designed by EJD Checked by PG
Micro Drainage		Source Control 2018.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.327	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.538

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.054	12 16	0.054	24 28	0.054	36 40	0.053
4 8	0.054	16 20	0.054	28 32	0.054		
8 12	0.054	20 24	0.054	32 36	0.053		

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Holt Road Wrexham	
Date 04/02/2019 File 30YR SOAKAWAY.SRCX	Designed by EJD Checked by PG	
Micro Drainage Source Control 2018.1		

Model Details

Storage is Online Cover Level (m) 80.000

Cellular Storage Structure

Invert Level (m) 75.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.06372 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.06372

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	60.0	60.0	5.200	0.0	190.1
0.400	60.0	72.4	5.600	0.0	190.1
0.800	60.0	84.8	6.000	0.0	190.1
1.200	60.0	97.2	6.400	0.0	190.1
1.600	60.0	109.6	6.800	0.0	190.1
2.000	60.0	122.0	7.200	0.0	190.1
2.400	60.0	134.4	7.600	0.0	190.1
2.800	60.0	146.8	8.000	0.0	190.1
3.200	60.0	159.1	8.400	0.0	190.1
3.600	60.0	171.5	8.800	0.0	190.1
4.000	60.0	183.9	9.200	0.0	190.1
4.400	0.0	190.1	9.600	0.0	190.1
4.800	0.0	190.1	10.000	0.0	190.1

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Appendix F – Infiltration Test Results

OUR REF: A2813/19 18th February 2019

18th February 2019

Eleanor Dale
Scott Hughes Design
64 Jersey St
Manchester
M4 6JW

By Email (edale@scotthughesdesign.co.uk)

Dear Eleanor,

Infiltration Testing Letter Report
Wrexham University, Holt Road

Background

A site investigation has been commissioned by Scott Hughes Design on behalf of Wrexham University (the client), to examine ground conditions and soil infiltration rates at land off, Holt Road, Wrexham.

Reference

Earth Environmental and Geotechnical Ltd were commissioned by the client to undertake soakaway testing at the site, in accordance with BRE365.

Proposed Development

A proposed development plan was not available at the time of writing this report.

Fieldwork

The investigation comprised the excavation of five trial pits (TP06 to TP10) over two days, to depths between 1.90m and 2.40m by use of a JCB 3CX. Detailed exploratory hole logs can be found in Appendix A.

Each of the trial pits were used to carry out infiltration testing, with multiple tests carried out in each of pit, where possible.

The soil infiltration rate was calculated using the data collected from each test. The detailed testing results for these are presented in Appendix B with a summary in Table 1.

Sampling locations are shown overleaf in Figure 1.

Ground Conditions

The sequence of strata encountered was as follows:

- TOPSOIL
- MADE GROUND (TP07, TP08, TP09)
- SAND & GRAVEL
- Clayey SAND (TP10)

Detailed logs of the trial pits are presented in Appendix A.

**CONSULTING
ENGINEERS**

Geotechnical
Environmental
Ecology
Geology
Drainage
Mining

Earth Environmental &
Geotechnical Ltd
Houldsworth Mill Business
& Arts Centre
Houldsworth Street
Stockport
SK5 6DA

Tel: 0161 975 6088

www.earthenvironmental.co.uk
info@earthenvironmental.co.uk

ALSO AT:

Kingsbury House
Kingsbury Square
Melksham
Near Bath
SN12 6HL
Tel: 01225 434237

Albany House
14 Shute End
Wokingham, Berks
RG40 1BJ
Tel: 0845 2508100

Hudson House
8 Albany Street
Edinburgh,
EH1 3QB
Tel: 0131 5641789

Earth Environmental & Geotechnical
Ltd
Registered Office:
Mentor House, Ainsworth Street,
Blackburn, Lancashire, BB1 6AY
Registered in England
No: 8436152

Figure 1 Infiltration Testing Location Plan



Soakaway Testing

Each of the soakaway pits were excavated into natural strata and filled with water from a 9000 litre water bowser.

Due to the slow rate of infiltration observed in areas across the site, the infiltration rates for the one test; SA10 was unable to be calculated.

Table 1 below provides a summary of each of the soakaway infiltration rate results.

Table 1 Soakaway Infiltration Rates

Location/Test	Infiltration Rate (m/s)
TP06/SA06	7.14E-06
TP07/SA07	6.69E-06
TP08/SA08	2.92E-05
TP09/SA09	2.64E-05
TP10/SA10	Infiltration too slow to calculate

Conclusions

Based on the results of the field testing, the natural strata are suitable for the installation of soakaway drainage in the areas of TP6, TP7, TP08 and TP09.

Please do not hesitate to contact me should there be any queries.

Yours sincerely,



Nigel Ramsumair

Operations Manager

For and on behalf of Earth Environmental & Geotechnical Ltd

*Enclosed: Appendix A Exploratory Hole Logs
Appendix B Infiltration Testing Results*



EARTH ENVIRONMENTAL
& GEOTECHNICAL

EARTH ENVIRONMENTAL & GEOTECHNICAL
Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA

Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Holt Road)

Date: 10/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

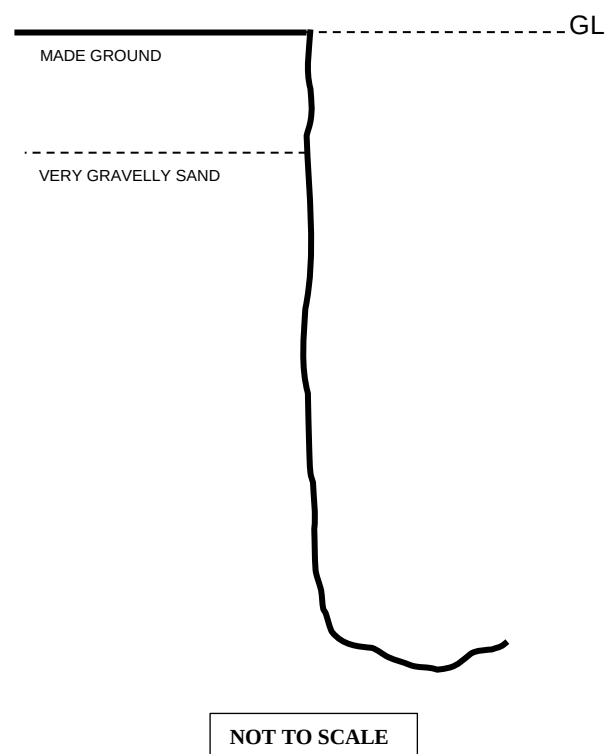
Hole Number: TP06

Logged By: J Cummins

Total Depth: 2.00m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-2.40	Orangish brown very gravelly fine to coarse SAND. Gravel is fine to coarse rounded to subrounded of mudstone, quartz, carbonaceous fragments.
		Trial pit stable. No groundwater emergence.

Trial pit terminated at 2.40m.

Pictures:



Soakaway Pit 06: Internal view of excavation.



Soakaway Pit 06: Excavation spoil.



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EARTH ENVIRONMENTAL & GEOTECHNICAL
Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA

Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Holt Road)

Date: 16/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

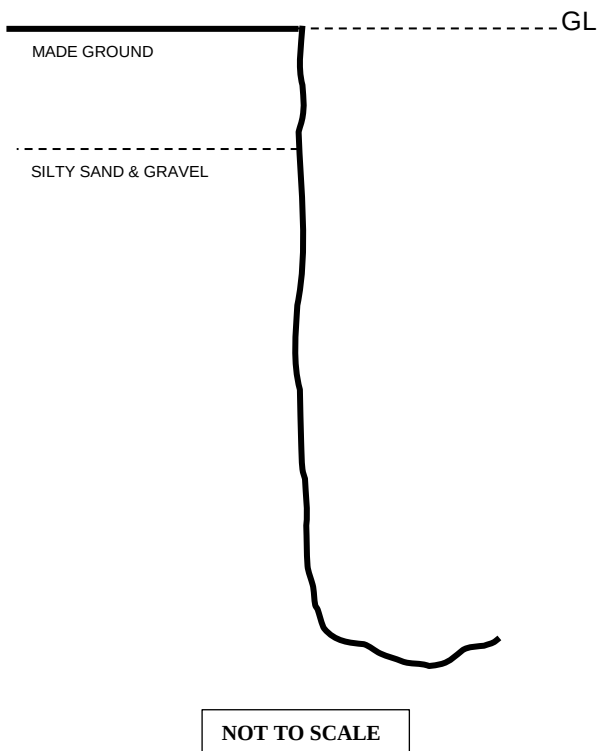
Hole Number: TP07

Logged By: L Glover

Total Depth: 2.40m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.45	MADE GROUND: Grass over dark brown silty sandy slightly gravelly TOPSOIL. Gravel is angular to rounded brick, plastic and sandstone. Abundant rootlets.
	0.45-2.40	Orangish silty fine to coarse SAND and GRAVEL. Gravel is sub-rounded to rounded fine to coarse sandstone. Frequent bands of silt. Abundant sandstone cobbles.
		Trial pit stable. No groundwater emergence.

Trial pit terminated at 2.40m.

Pictures:



Soakaway Pit 07: Internal view of excavation.



Soakaway Pit 07: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA

Tel: 0161 975 6088

Email: info@earthenvironmental.co.uk

Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Holt Road)

Date: 16/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

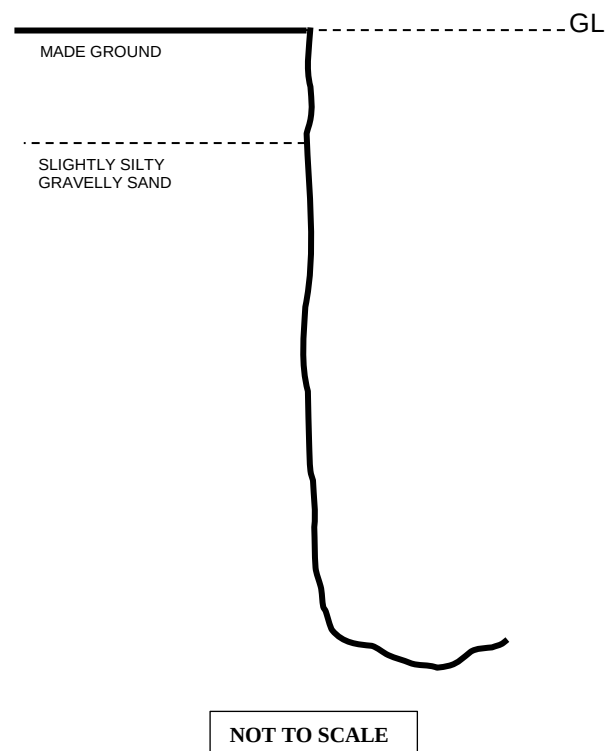
Hole Number: TP08

Logged By: L Glover

Total Depth: 2.10m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.37	MADE GROUND: Dark brown slightly clayey sandy gravelly TOPSOIL. Gravel is angular to rounded brick, plastic and sandstone. Abundant rootlets.
	0.37-2.10	Orangish brown slightly silty gravelly fine to coarse SAND. Gravel is sub-angular to rounded fine to coarse sandstone and quartz. Abundant sandstone cobbles.
		Trial pit unstable in sand and gravel. No groundwater emergence.

Trial pit terminated at 2.10m.

Pictures:



Soakaway Pit 08: Internal view of excavation.



Soakaway Pit 08: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA
Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Holt Road)

Date: 16/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

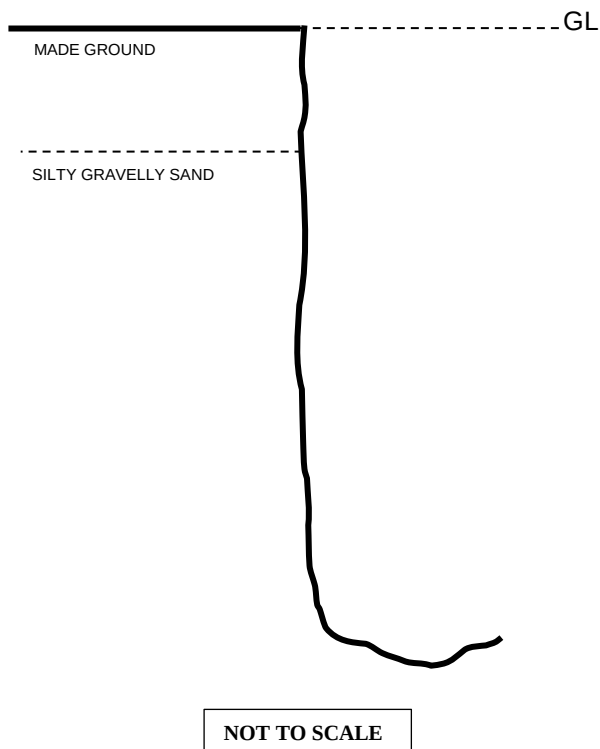
Hole Number: TP09

Logged By: L Glover

Total Depth: 2.10m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.40	MADE GROUND: Dark brown slightly clayey sandy slightly gravelly TOPSOIL. Gravel is angular to sub-rounded fine to coarse brick, pottery, glass and sandstone. Abundant rootlets.
	0.40-2.10	Orangish brown silty gravelly fine to coarse SAND. Gravel is sub-angular to rounded fine to coarse sandstone and quartz with abundant sandstone cobbles and rare silty pockets. Becomes siltier with depth. Abundant sandstone cobbles.
		Trial pit unstable in sand. No groundwater emergence.

Trial pit terminated at 2.10m.

Pictures:



Soakaway Pit 09: Internal view of excavation.



Soakaway Pit 09: Excavation spoil.



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Houldsworth Mill Business & Arts Centre, Houldsworth Street,
Stockport, SK5 6DA
Tel: 0161 975 6088
Email: info@earthenvironmental.co.uk
Web: www.earthenvironmental.co.uk

TRIAL PIT LOG

Project Name: Wrexham University (Holt Road)

Date: 10/01/2019

Project No.: A2813/19

Client: Scott Hughes Design

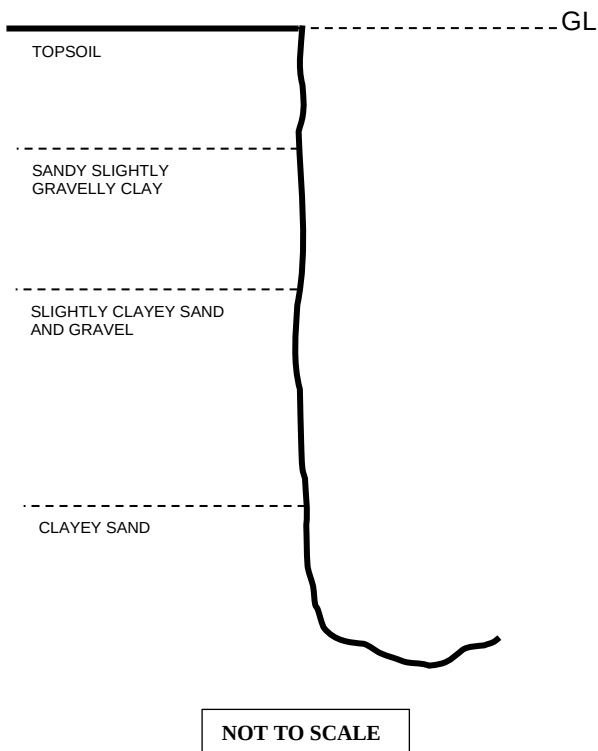
Hole Number: TP10

Logged By: J Cummins

Total Depth: 1.90m

Remarks:

Schematic Profile:



Legend	Depth (m)	Description
	0.00-0.30	Grass over brown clayey fine to coarse SAND. Abundant roots and rootlets. (TOPSOIL)
	0.30-1.00	Soft orangish brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone.
	1.00-1.60	Greyish brown slightly clayey SAND and GRAVEL. Gravel is fine to coarse rounded of quartz and mudstone.
	1.60-1.90	Reddish brown clayey fine to coarse SAND.
		Trial pit unstable. Groundwater emergence at 1.20m.

Trial pit terminated at 1.90m.

Pictures:



Soakaway Pit 10: Internal view of excavation.



Soakaway Pit 10: Excavation spoil.



SOAKAWAY TEST

(To: BRE 365 1991)

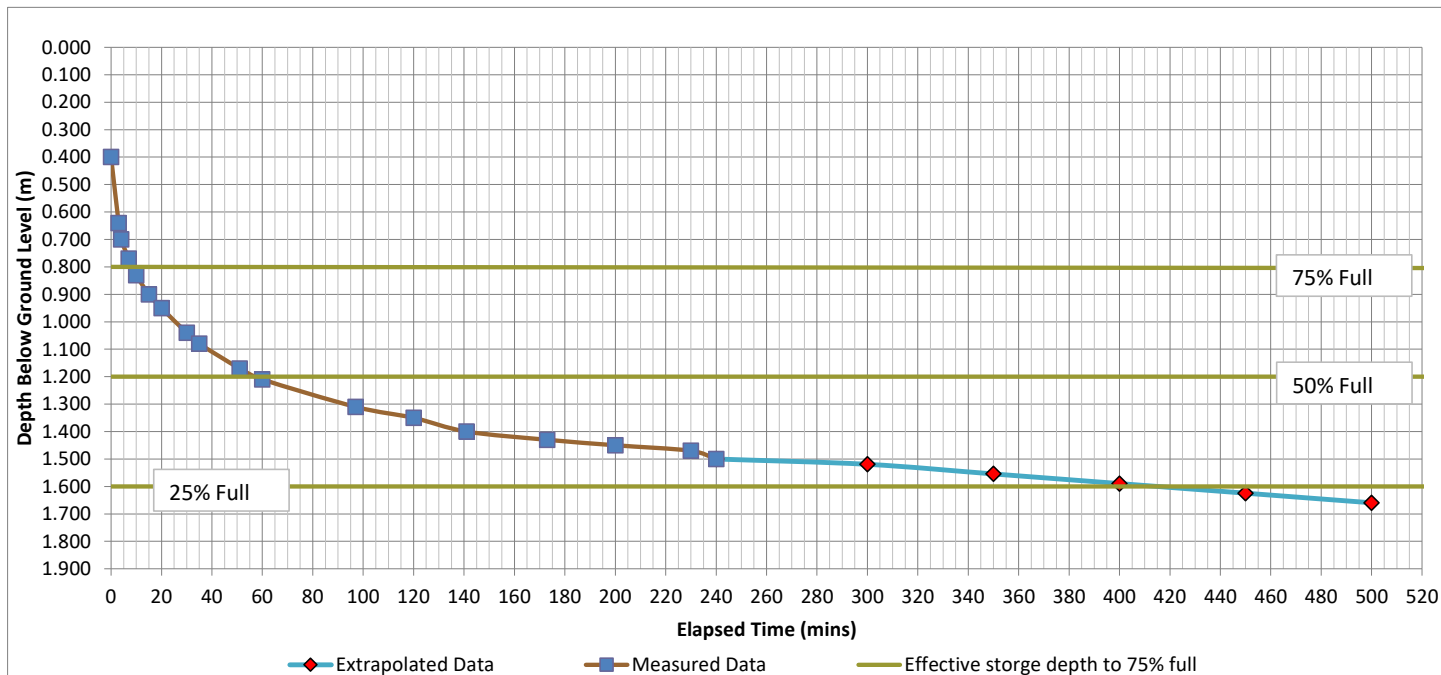
Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

Job No: A2813
Site: Wrexham University (Holt Road)
Client: Scott Hughes Design

Location Reference:	SA06 - Test 1	
Date	08/01/2019	
Geology in test section	Gravelly Sand	
Depth to Base of Hole	2.0	m
Effective Depth	1.6	m
Hole width	0.6	m
Hole length	1.7	m
Depth to water at start of test below ground level	0.4	m
Depth to water at end of test below ground level	1.50	m
Effective storage depth to 75% full	1.20	m
(Depth below GL)	0.80	m
Effective storage depth to 50% full	0.80	m
(Depth below GL)	1.20	m
Effective storage depth to 25% full	0.40	m
(Depth below GL)	1.60	m
Height to 50% depth	0.800	m3
Effective Storage Volume Vp75-25	0.82	m3
Time tp25 at which water is 75% of effective depth (minutes)	9.00	mins
Time tp25 at which water is 25% of effective depth (minutes)	414.00	mins
Time for water level to fall between Vp75 -25	405	mins
Time for water level to fall between Vp75 -25	24300	secs
Internal surface area of hole up to 50% depth including base	4.70	m2
Soil Infiltration Rate, f	7.14E-06	m/s

Assumes pit is not filled

Time Elapsed (mins)	Depth of Water below GL (m)	
0	0.400	Measured Data
3	0.640	
4	0.700	
7	0.770	
10	0.830	
15	0.900	
20	0.950	
30	1.040	
35	1.080	
51	1.170	
60	1.210	
97	1.310	
120	1.350	
141	1.400	
173	1.430	
200	1.450	Extrapolated Data
230	1.470	
240	1.500	
300	1.519	
350	1.554	
400	1.590	
450	1.625	
500	1.660	





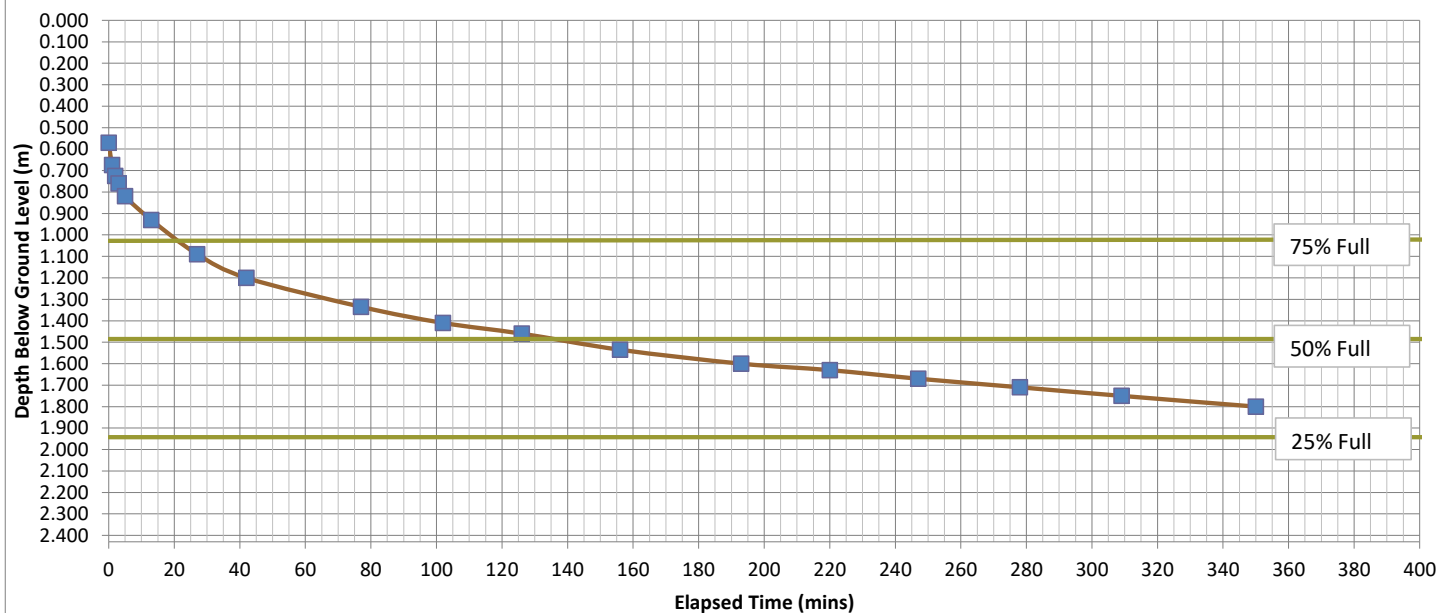
SOAKAWAY TEST

Job No:	A2813
Site:	Wrexham University (Holt Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:	SA07 - Test 1	
Date	16/01/2019	
Geology in test section	Sand and Gravel	
Depth to Base of Hole	2.4	m
Effective Depth	1.83	m
Hole width	0.6	m
Hole length	1.65	m
Depth to water at start of test below ground level	0.57	m
Depth to water at end of test below ground level	1.80	m
Effective storage depth to 75% full	1.37	m
(Depth below GL)	1.03	m
Effective storage depth to 50% full	0.92	m
(Depth below GL)	1.49	m
Effective storage depth to 25% full	0.46	m
(Depth below GL)	1.94	m
Height to 50% depth	0.915	m3
Effective Storage Volume Vp75-25	0.91	m3
Time tp25 at which water is 75% of effective depth (minutes)	21.00	mins
Time tp25 at which water is 25% of effective depth (minutes)	463.00	mins
Time for water level to fall between Vp75 -25	442	mins
Time for water level to fall between Vp75 -25	26520	secs
Internal surface area of hole up to 50% depth including base	5.11	m2
Soil Infiltration Rate, f	6.69E-06	m/s

Assumes pit is not filled





Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

SOAKAWAY TEST

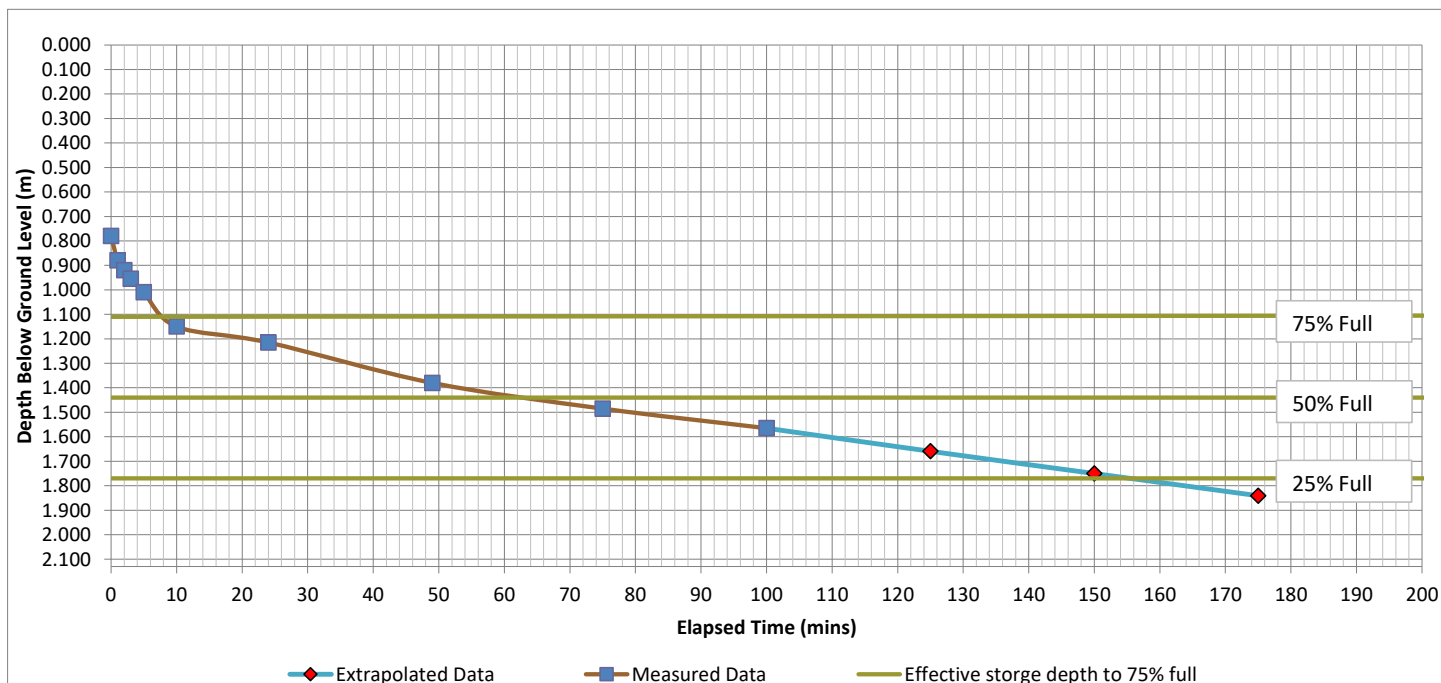
(To: BRE 365 1991)

Job No: A2813
Site: Wrexham University (Holt Road)
Client: Scott Hughes Design

Location Reference:	SA08 - Test 1	
Date	16/01/2019	
Geology in test section	Gravelly Sand	
Depth to Base of Hole	2.1	m
Effective Depth	1.32	m
Hole width	0.6	m
Hole length	1.7	m
Depth to water at start of test below ground level	0.78	m
Depth to water at end of test below ground level	1.565	m
Effective storage depth to 75% full (Depth below GL)	0.99	m
Effective storage depth to 50% full (Depth below GL)	1.11	m
Effective storage depth to 25% full (Depth below GL)	0.66	m
Height to 50% depth	1.44	m
Effective Storage Volume Vp75-25	0.33	m
Time tp25 at which water is 75% of effective depth (minutes)	1.77	m
Time tp25 at which water is 25% of effective depth (minutes)	0.660	m3
Time for water level to fall between Vp75 -25	0.67	m3
Time for water level to fall between Vp75 -25	8.00	mins
Internal surface area of hole up to 50% depth including base	155.00	mins
Soil Infiltration Rate, f	147	mins
	8820	secs
	4.06	m2
	1.88E-05	m/s

Assumes pit is not filled

Time Elapsed (mins)	Depth of Water below GL (m)	Measured Data
0	0.780	
1	0.880	
2	0.920	
3	0.955	
5	1.010	
10	1.150	
24	1.215	
49	1.380	
75	1.485	
100	1.565	
125	1.659	Extrapolated Data
150	1.750	
175	1.841	
Data extrapolated due to pit collapse.		





SOAKAWAY TEST

(To: BRE 365 1991)

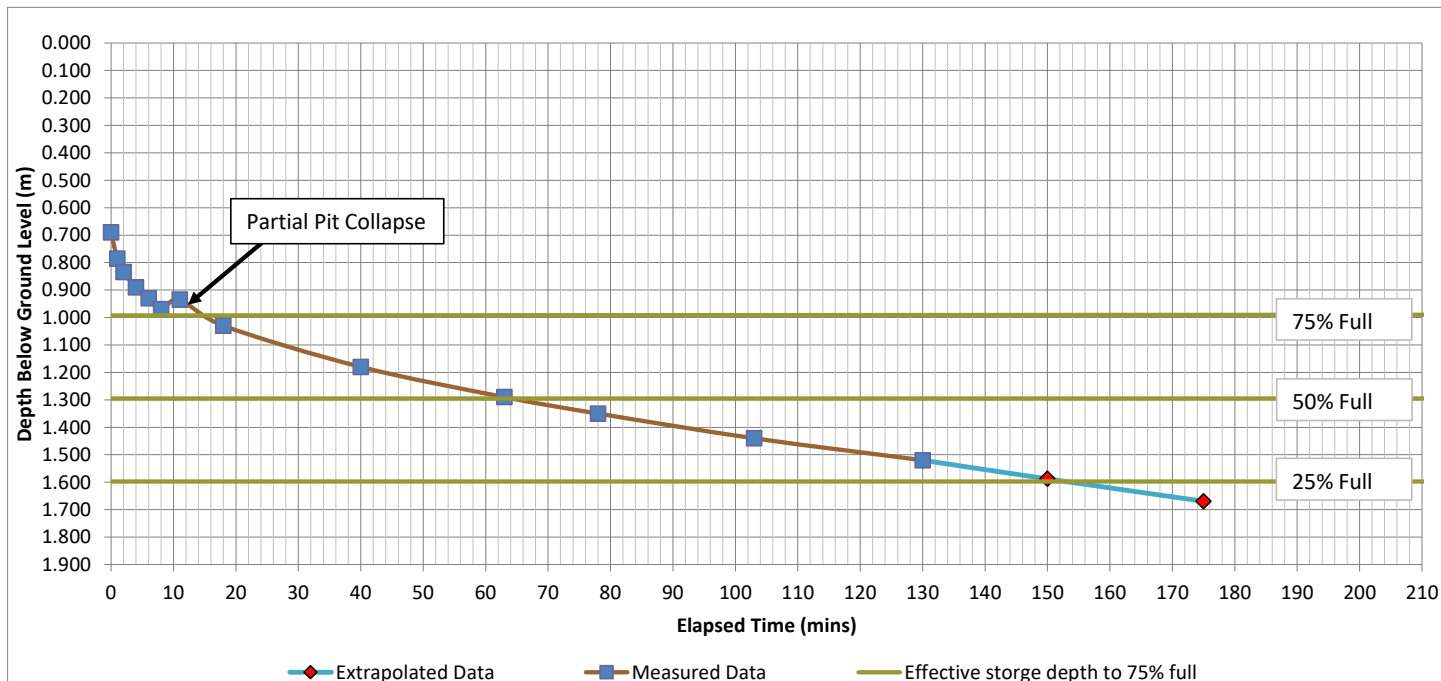
Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

Job No: A2813
Site: Wrexham University (Holt Road)
Client: Scott Hughes Design

Location Reference:	SA08 - Test 2	
Date	16/01/2019	
Geology in test section	Gravelly Sand	
Depth to Base of Hole	1.9	m
Effective Depth	1.21	m
Hole width	1.4	m
Hole length	1.9	m
Depth to water at start of test below ground level	0.69	m
Depth to water at end of test below ground level	1.520	m
Effective storage depth to 75% full (Depth below GL)	0.91	m
Effective storage depth to 50% full (Depth below GL)	0.99	m
Effective storage depth to 25% full (Depth below GL)	0.61	m
Height to 50% depth	1.30	m
Effective Storage Volume Vp75-25	0.30	m
Time tp25 at which water is 75% of effective depth (minutes)	1.60	m
Time tp25 at which water is 25% of effective depth (minutes)	0.605	m3
Time for water level to fall between Vp75 -25	1.61	m3
Time for water level to fall between Vp75 -25	15.00	mins
Time for water level to fall between Vp75 -25	153.00	mins
Time for water level to fall between Vp75 -25	138	mins
Time for water level to fall between Vp75 -25	8280	secs
Internal surface area of hole up to 50% depth including base	6.65	m2
Soil Infiltration Rate, f	2.92E-05	m/s

Assumes pit is not filled

Time Elapsed (mins)	Depth of Water below GL (m)	Measured Data
0	0.690	
1	0.785	
2	0.835	
4	0.890	
6	0.930	
8	0.970	
11	0.935	
18	1.030	
40	1.180	
63	1.290	
78	1.350	
103	1.440	
130	1.520	
150	1.588	
175	1.670	
Data extapolated due to pit collapse.		Extrapolated Data





SOAKAWAY TEST

(To: BRE 365 1991)

Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

Job No: A2813
Site: Wrexham University (Holt Road)
Client: Scott Hughes Design

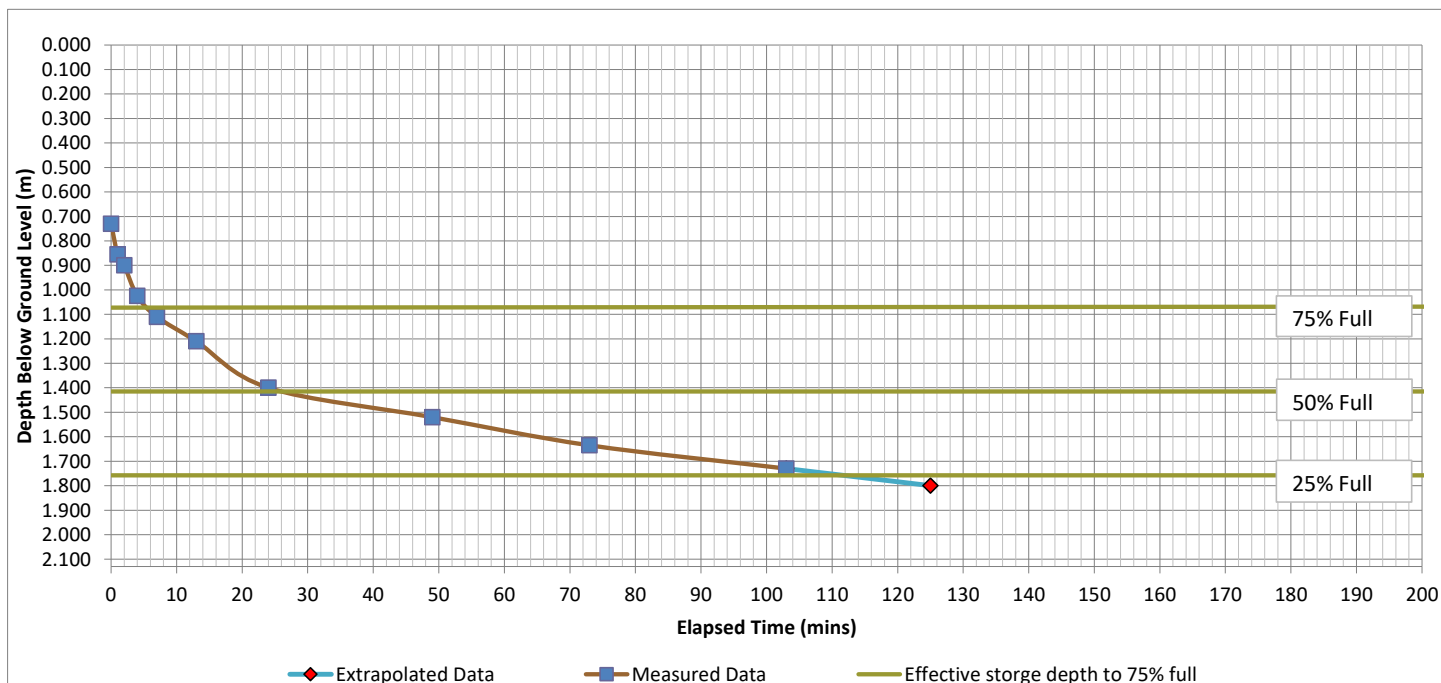
Location Reference:

Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume Vp75-25
Time tp25 at which water is 75% of effective depth (minutes)
Time tp25 at which water is 25% of effective depth (minutes)
Time for water level to fall between Vp75 -25
Time for water level to fall between Vp75 -25
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

SA09 - Test 1	
16/01/2019	
Gravelly Sand	
2.1	m
1.37	m
0.6	m
1.71	m
0.73	m
1.730	m
1.03	m
1.07	m
0.69	m
1.42	m
0.34	m
1.76	m
0.685	m3
0.70	m3
5.00	mins
111.00	mins
106	mins
6360	secs
4.19	m2
2.64E-05	m/s

Assumes pit is not filled

Time Elapsed (mins)	Depth of Water below GL (m)	Measured Data
0	0.730	
1	0.855	
2	0.900	
4	1.025	
7	1.110	
13	1.210	
24	1.400	
49	1.520	
73	1.635	
103	1.730	
125	1.800	Extrapolated Data
Data extrapolated due to pit collapse.		





SOAKAWAY TEST

(To: BRE 365 1991)

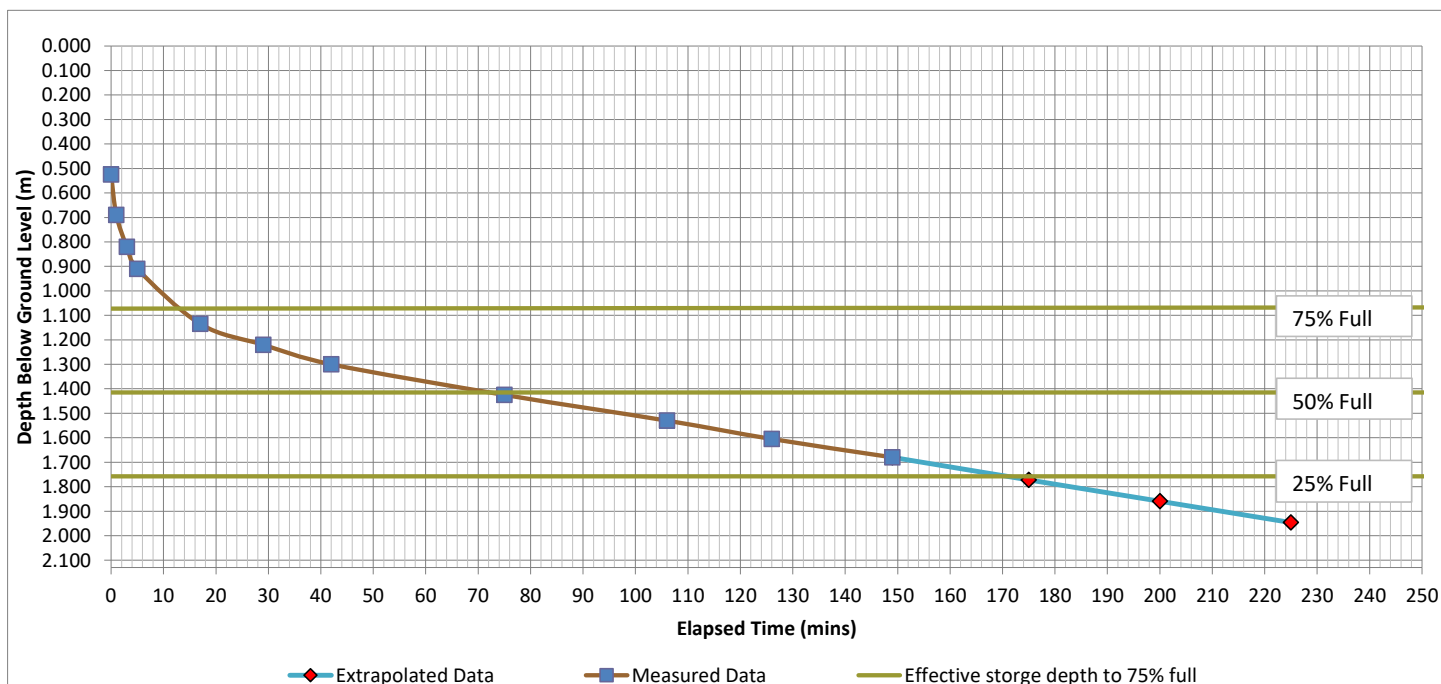
Tel / Fax: 0161 2824518
Web: www.earthenvironmental.co.uk
Email: adam@earthenvironmental.co.uk

Job No: A2813
Site: Wrexham University (Holt Road)
Client: Scott Hughes Design

Location Reference:	SA09 - Test 2	
Date	16/01/2019	
Geology in test section	Gravelly Sand	
Depth to Base of Hole	2.1	m
Effective Depth	1.37	m
Hole width	0.6	m
Hole length	1.71	m
Depth to water at start of test below ground level	0.73	m
Depth to water at end of test below ground level	1.68	m
Effective storage depth to 75% full	1.03	m
(Depth below GL)	1.07	m
Effective storage depth to 50% full	0.69	m
(Depth below GL)	1.42	m
Effective storage depth to 25% full	0.34	m
(Depth below GL)	1.76	m
Height to 50% depth	0.685	m3
Effective Storage Volume Vp75-25	0.70	m3
Time tp25 at which water is 75% of effective depth (minutes)	13.00	mins
Time tp25 at which water is 25% of effective depth (minutes)	171.00	mins
Time for water level to fall between Vp75 -25	158	mins
Time for water level to fall between Vp75 -25	9480	secs
Internal surface area of hole up to 50% depth including base	4.19	m2
Soil Infiltration Rate, f	1.77E-05	m/s

Assumes pit is not filled

Time Elapsed (mins)	Depth of Water below GL (m)	Measured Data
0	0.525	
1	0.690	
3	0.820	
5	0.910	
17	1.135	
29	1.220	
42	1.300	
75	1.425	
106	1.530	
126	1.605	
149	1.680	
175	1.772	
200	1.859	Extrapolated Data
225	1.946	
Data extrapolated due to pit collapse.		





SOAKAWAY TEST

Job No:	A2813
Site:	Wrexham University (Holt Road)
Client:	Scott Hughes Design

[illegible]

Location Reference:
Date
Geology in test section
Depth to Base of Hole
Effective Depth
Hole width
Hole length
Depth to water at start of test below ground level
Depth to water at end of test below ground level
Effective storage depth to 75% full
(Depth below GL)
Effective storage depth to 50% full
(Depth below GL)
Effective storage depth to 25% full
(Depth below GL)
Height to 50% depth
Effective Storage Volume Vp75-25
Time tp25 at which water is 75% of effective depth (minutes)
Time tp25 at which water is 25% of effective depth (minutes)
Time for water level to fall between Vp75 -25
Time for water level to fall between Vp75 -25
Internal surface area of hole up to 50% depth including base
Soil Infiltration Rate, f

SA10 - Test 1	
08/01/2019	
Clay underlain by Sand & Gravel	
1.9	m
1.5	m
0.6	m
1.9	m
0.4	m
0.85	m
1.13	m
0.78	m
0.75	m
1.15	m
0.38	m
1.53	m
0.750	m3
0.86	m3
150.00	mins
N/A	mins
Infiltration too slow to calculate	mins
Infiltration too slow to calculate	secs
4.89	m2
Infiltration too slow to calculate	m/s

Assumes pit is not filled

