

Royal Alexandra Hospital, Rhyl

Flood Consequence Assessment

Curtins Ref: NDCH-CUR-ZZ-XX-RP-C-00_10-0001

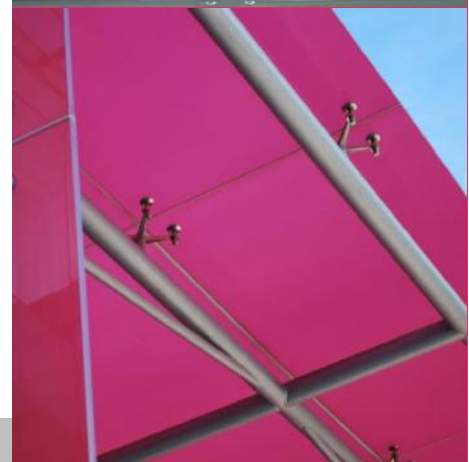
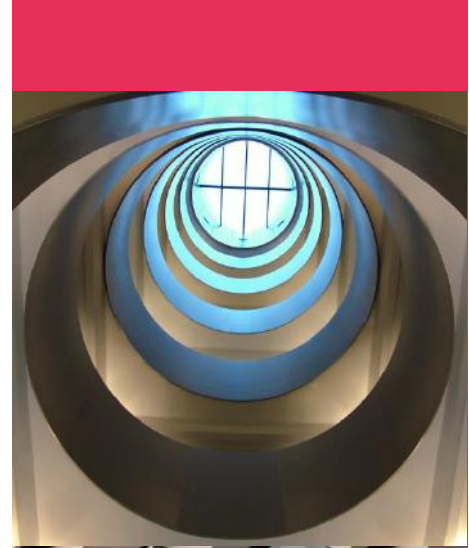
Revision: V01

Issue Date: 08 April 2020

Client Name: Kier Construction, North West

Client Address: Kier Regional Building, 2nd Floor, Optimum House, Salford, M50 3XP

Site Address: Royal Alexandra Hospital, Rhyl, LL18 3AS



Curtins Consulting Limited
51-55 Tithebarn Street
Liverpool
L2 2SB
Tel: 0151 726 2000
Email: liverpool@curtins.com
www.curtins.com

CIVILS & STRUCTURES • TRANSPORT PLANNING • ENVIRONMENTAL • INFRASTRUCTURE • GEOTECHNICAL • CONSERVATION & HERITAGE • PRINCIPAL DESIGNER
Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham



Rev	Description	Issued by	Checked	Date
V01	Draft for Comment	JDB	JDB	08/04/2020

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Hayley Rudge Project Engineer	HR	19/03/2020

Reviewed	Signature	Date
Jake Busby Project Engineer		08/04/2020

Table of Contents

Table of Contents	ii
Tables	iv
1.0 Introduction	1
1.1 Project Background	1
1.2 Scope of the Flood Consequence Assessment	1
2.0 Development and Flood Risk	3
2.1 Planning Policy Wales and TAN 15 Guidance	3
2.2 Local Policy	3
2.3 Proposed Development	3
2.4 Site Specific Flood Risk Classification	3
2.5 Flood Risk Vulnerability	4
3.0 Existing Site Details	5
3.1 Site Description	5
3.2 Topography	5
3.3 Hydrological Setting	6
3.4 Existing Geology	6
3.5 Hydrogeological Setting	7
3.6 Existing Drainage	7
3.6.1 Public Drainage	7
3.6.2 Private Drainage	7
4.0 Assessment of Flood Risk	8
4.1 Sources of Flood Risk	8
4.2 Fluvial Flooding	8
4.2.1 Climate Change	8
4.3 Tidal Flooding	9
4.3.1 Climate Change	9
4.4 Reservoir Flooding	9

4.5	Surface Water Flooding to the Site	9
4.6	Surface Water Flooding from the Site	11
4.7	Groundwater Flooding.....	11
4.8	Public Sewers and Water Mains	12
4.9	Highway Drainage Flooding	12
4.10	Canals, Ponds and Artificial Watercourses	12
4.11	Summary of Flood Risk.....	12
5.0	Drainage Strategy.....	13
5.1	Proposed Foul Water Drainage.....	13
5.2	Proposed Surface Water Drainage – Standard S1	13
6.0	Sustainable Drainage Systems (SuDS)	15
6.1	Water Quantity – Standard S2	15
6.2	Water Quality – Standard S3	16
6.3	Amenity – Standard S4	17
6.4	Biodiversity – Standard S5.....	18
6.5	Potential SuDS Measures	18
6.6	Attenuation Requirements.....	20
7.0	Maintenance	21
7.1	Components	21
7.2	Manhole and Catch Pits	22
7.3	Pipes	22
7.4	Detention Basin	23
7.5	Attenuation Tanks	25
7.6	Permeable Paving.....	26
7.7	Flow Control Units	28
8.0	Residual Risk.....	30
9.0	Conclusions and Recommendations	31
10.0	Appendices.....	32

Figures

Figure 3-1 – Site Location Plan	5
Figure 4-1 Extract of the online Development Advice Map	8
Figure 4-2 Extract of the online Development Advice Map	10
Figure 4-3 Extract of the Areas Susceptible to Groundwater Flooding Map	11
Figure 6-1 Four Pillars of SuDS Design: Taken from The SuDS Manual, Figure 2.1	15

Tables

Table 6-1 Summary of Pollution Indices for Residential Development	17
Table 6-2 SuDS Mitigation Indices for Discharge to Surface Waters	17
Table 6-3 Summary of SuDS measures	19
Table 7-1 Pipe Maintenance Measures	23
Table 7-2 Detention Basin Maintenance Measures	24
Table 7-3 Attenuation Tank Maintenance Measures	26
Table 7-4 Permeable Paving Maintenance Measures	27
Table 7-5 Flow Control Unit Maintenance Measures	28

1.0 Introduction

1.1 Project Background

Curtins has been appointed by Kier Construction North West to prepare a Flood Consequence Assessment (FCA) in support of a planning application for the provision of a new building and car parking at Royal Alexandra Hospital, Rhyl.

The report is based on currently available information.

The FCA provides information on the nature of flood risk at the site and has been prepared in accordance with Technical Advice Note (TAN) 15 'Development and Flood Risk' from Planning Policy Wales (PPW). TAN 15 provides guidance on the requirements for a FCA and the nature of development or land use appropriate for flood risk areas (vulnerability classification).

The proposals for the surface water management strategy are based on the requirements of Denbighshire County Council in their role as the SuDS Approving Body (SAB).

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design of this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the content contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Curtins shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins.

1.2 Scope of the Flood Consequence Assessment

This assessment has been undertaken in accordance with the requirements of TAN 15 (2004) and the guidance documents Flood Consequence Assessment: Climate Change Allowances (2016)

The planning application site is approximately 1.7 (ha) in size and is shown as being located entirely within Flood Zone A (defined as having little or no risk of fluvial or tidal/coastal flooding) by the online Development Advice Map (DAM).

The FCA will:

- Investigate all potential risks of flooding to the site;
- Summarise the requirements of the FCA for the overall development;
- Consider the impact the development may have elsewhere with regards to flooding;
- Consider proposals to mitigate any potential risk of flooding determined to be present;

- Considered the requirements of the Welsh Government's Statutory Standards for Sustainable Drainage Systems and the SuDS Approving Body (SAB) guidance;
- Considered the impacts of climate change;
- Considered the receiving public sewer capacity issues;
- Provide guidance on the proposed foul water strategy;
- Prepare a Drainage Strategy for the surface water systems on the site, making recommendations for outfall, discharge rates, attenuation and forms of SuDS; and,
- Make recommendations as to how surface water drainage features are to be operated and maintained.

This FCA has been based on the following information:

- The online Development Advice Maps;
- Denbighshire County Council's Preliminary Flood Risk Assessment (PFRA), dated June 2011;
- Denbighshire County Council's Strategic Flood Consequence Assessment (SFCA), dated January 2018;
- Welsh Water public sewer records;
- Denbighshire County Council's Local Development Plan (adopted June 2013).

In January 2019, the Welsh Assembly Government (WAG) implemented Schedule 3 of the Flood and Water Management Act (2010) and establishes County Councils as the SuDS Approving Bodies (SABs) which requires SuDS measures to be implemented for the management of surface water. All new developments greater than 1 dwelling or where construction is greater than 100m² will require SuDS and will need to demonstrate compliance with the statutory SuDS standards.

2.0 Development and Flood Risk

This FRA has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:

2.1 Planning Policy Wales and TAN 15 Guidance

Planning Policy Wales (PPW) Edition 10, December 2018 details the current national planning policy for flood risk in Wales. The Welsh Government's objectives requires action through the planning system and moves towards a more positive avoidance of development in areas defined as being at risk of flooding. Section 6.6 of PPW relate specifically to flood risk, SuDS and climate change with paragraph 13.2.4 stating that '*Local planning authorities should take a strategic approach to flood risk ...Development should reduce, and must not increase, flood risk from river and/or coastal flooding on and off the development site itself...Planning authorities should be aware of the risk of surface water flooding, usually caused by heavy rainfall, and ensure developments are designed and planned to minimise the potential impacts. Development should not cause additional runoff, which can be achieved by controlling surface water as near to the source as possible by the use of SuDS*'.

Technical Advice Note 15 (TAN 15) provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. TAN 15 provides guidance on the requirements for a FCA and the nature of development or land use appropriate for flood risk areas (vulnerability classification).

Climate change specific guidance 'Flood Consequence Assessments: Climate Change Allowances' released in December 2016 updates previous climate change allowances in support of TAN 15.

2.2 Local Policy

Planning policy for Rhyl is contained in the Denbighshire County Council's Local Development Plan, adopted in June 2013. The local planning policy does not make specific reference to flood risk however, advises the requirements for the Planning Policy Wales and TAN 15 are followed.

2.3 Proposed Development

The development proposals include for provision of a new hospital building and new car parking facilities at the Royal Alexandra Hospital, Rhyl. The existing hospital building is to remain as existing.

A copy of the development layout plans are included in Appendix A.

2.4 Site Specific Flood Risk Classification

The online Development Advice Map indicates the site is located entirely within Flood Zone A, defined as having little or no risk of flooding from rivers or the sea.

2.5 Flood Risk Vulnerability

TAN 15 follows a risk based approach in determining the suitability of land for development in areas at risk of flooding, with the intention of steering all new development to the lowest flood risk areas. Particular flooding consequences may not be acceptable for particular types of development.

According to the online Development Advice Map, the site is located within Flood Zone A.

In accordance with TAN 15, hospitals are classified as the 'Emergency Services' development category.

There are no specific policy requirements with regards to fluvial/tidal flooding for the area located within Zone A. However, it is pertinent in this area to consider the potential impacts of climate change on fluvial and tidal flood risk and consider the surface water management requirements to avoid increasing flood risk elsewhere.

The site is located entirely within Flood Zone A and as such, a Justification Test is not required.

3.0 Existing Site Details

3.1 Site Description

The site is located at the Royal Alexandra Hospital, Rhyl, LL18 3AS at National Grid Reference (NGR) 301481 (E) 382102 (N). The site area is approximately 1.7 hectares (ha) in size and currently comprises the Royal Alexandra Hospital and associated car parking facilities.

The site is bound by East Parade to the north, Grosvenor Road to the east, Russell Road to the south and Alexandra Road to the west.

A site location plan is presented in Figure 2.1.

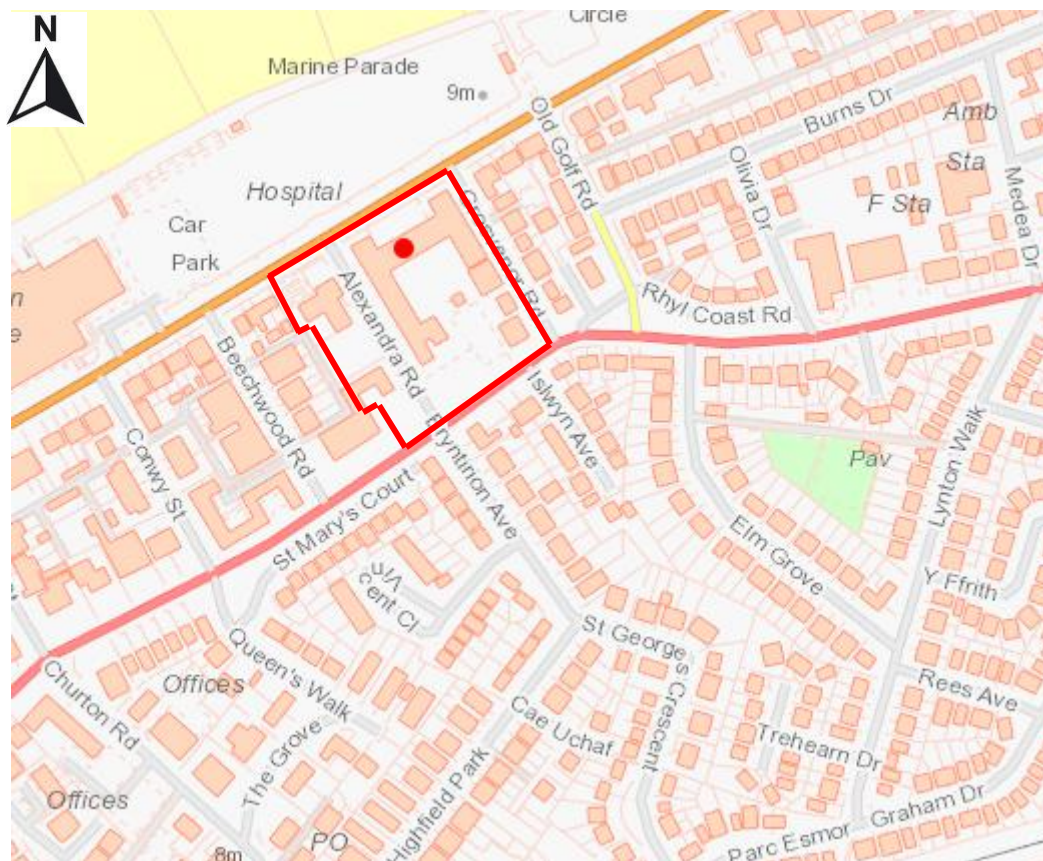


Figure 3-1 – Site Location Plan

© Crown copyright and database rights 2019 OS 0100024198

3.2 Topography

A topographical survey of the site was undertaken by Tower Surveys Ltd in May 2014 and provides level data to OS GPS datum. A copy of the topographical survey is provided in Appendix B.

A review of the survey indicates ground levels generally fall to the south.

Ground levels along the northern boundary are at approximately 9.40 mAOD and fall to approximately 7.60 mAOD along the southern boundary.

Ground levels along the eastern boundary are at approximately 7.90 mAOD and fall to approximately 7.60 mAOD along the western boundary.

Ground levels along East Parade to the north are at approximately 9.20 mAOD, ground levels along Grosvenor Road to the east are at approximately 7.80 mAOD, ground levels along Russell Street to the south are at approximately 7.70 mAOD and ground levels along Alexandra Road to the west are at approximately 7.80 mAOD.

3.3 Hydrological Setting

A review of Ordnance Survey (OS) mapping indicates there are no watercourses located within the immediate vicinity of the site. The closest waterbody to the site is the Irish Sea which is located approximately 150m north of the site.

A watercourse known as 'The Cut' is located approximately 350m south of the site.

3.4 Existing Geology

The online British Geological Survey (BGS) 1:50,000 scale digital viewer indicates the site is underlain by the bedrock geology of the 'Kinnerton Sandstone Formation' comprising of Sandstone.

The online BGS 1:50,000 scale superficial geology maps indicate the site is underlain by 'Blown Sand'.

The National Soil Resources Institute (NSRI) Soilscape viewer indicates the site is situated on 'sandy soils which are freely draining'.

A Ground Investigation was undertaken by the CCG in September 2014 and includes borehole logs which describe the underlying strata as:

- *Tarmac* from depths of 0.00m below ground level (bgl) to a maximum depth of 0.10m bgl;
- *Topsoil* from depths of 0.00m bgl to maximum depths of 0.20m bgl;
- *Made Ground* from depths of 0.10m bgl to a maximum depth of 2.60m bgl;
- *Clay* from depths of 2.60m bgl to a maximum depth of 3.00m bgl;
- *Sand* from depths of 1.20m bgl to a maximum depth of 3.80 bgl;
- *Silty Clay* from depths of 3.45m bgl to maximum depths of 4.00m bgl;
- No information on groundwater levels was included within the borehole logs.

The BGS Geo Report indicates the site is located in an area with potential ground instability. The report also indicates the underlying groundwater is not expected to be especially vulnerable to contamination and states groundwater is likely to be between 3m and 5m bgl. Both the superficial and solid deposits are expected to be free draining however, the site is likely to experience slope instability problems, or they have occurred in the past with the significant possibility for running sands.

A copy of the BGS Geo Report is contained in Appendix C.

3.5 Hydrogeological Setting

Natural Resources Wales (NRW) has classified the solid geology as a Principal Aquifer. This is defined as layers of rock or drift deposits that have high intergranular and/or fracture permeability. NRW has classified the superficial geology as a Secondary A Aquifer. This is defined as 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.

The Groundwater Vulnerability Zone map identifies the site as being located on an Aquifer that has a medium vulnerability of pollution.

The site is not located within a defined Groundwater Source Protection Zone (SPZ).

3.6 Existing Drainage

3.6.1 Public Drainage

Public sewer records have been obtained for the development site from Welsh Water.

There is a 300mm vitrified clay combined sewer which flows south along Grosvenor Road to the east of the site and discharges into a 600mm concrete combined sewer along Russell Road to the south of the site which upsizes to a 675mm sewer. There is a 150mm vitrified clay combined sewer which originates along Alexandra Road to the west of the site and flows south discharging into the 675mm diameter concrete combined sewer located along Russell Road.

3.6.2 Private Drainage

The existing hospital site is served by foul, surface water and combined drainage systems.

Foul water flows from the main hospital building are collected by a foul water system and flow south through the car parking area. Surface water flows from the existing car park are collected by a surface water drainage system and combine with the foul system from the existing building. The majority of this combined system flows south through the car parking area and discharges into the public combined system located along Russell Street to the south.

Surface water flows from the mortuary building are discharged to the public combined system located along Grosvenor Road to the east and foul flows from the office building within the southeast corner of the site are discharged into the public combined sewer system along Russell Street to the south of the site.

A copy of the existing drainage system plan is presented in Appendix B.

4.0 Assessment of Flood Risk

4.1 Sources of Flood Risk

This study assesses the risk from different types of flooding to the development and the risk of flooding from the development, taking climate change into consideration, as well as how flood risk should be managed. The approach to the assessment of flood risk at the development site has been informed by the requirements of PPW/TAN 15 in conjunction with the client and NRW/SAB requirements.

4.2 Fluvial Flooding

The online Development Advice Map indicates the site is located entirely within Flood Zone A, defined as having little or no risk of flooding from rivers or the sea.

An extract of the online Development Advice Map is presented in Figure 4.1.



Figure 4-1 Extract of the online Development Advice Map

© Crown copyright and database rights 2019 OS 0100024198

4.2.1 Climate Change

There are no fluvial watercourses located within the immediate vicinity of the site and therefore climate change from fluvial sources has not been considered further.

4.3 Tidal Flooding

The site is located within Flood Zone A, and is considered to be at little risk of tidal flooding.

4.3.1 Climate Change

TAN 15 states that it is necessary to take account of the potential impact of climate change over the lifetime of the development. In December 2016, the Welsh Government released new guidance for climate change allowances based on varied percentiles dependant on the type of development and the epochs spanned by the design life of the development.

The projections for sea level rise have been provided within the Flood Consequence Assessments: Climate Change Allowances (December 2016) guidance for various epochs for the Welsh coastline and are consistent with the global projections for sea level rise.

As above, as the site is located entirely within Flood Zone A and at a significant distance from the sea, as illustrated by OS mapping. It is considered reasonable to assume that the site is not impacted by tidal flooding when climate change is taken into consideration.

The Denbighshire County Council SFCA confirms the site is considered to be located within Flood Zone A and confirms the site is not considered to be impacted as a result of breach of the Rhyl defences for either the 1 in 200 (0.5%) Annual Probability plus climate change and 1 in 1000 (0.1%) Annual Probability plus climate change events.

4.4 Reservoir Flooding

The online Development Advice Map indicates the risk of flooding in the event of a breach from reservoirs, based only on large reservoirs (over 25,000 cubic metres of water).

The online Development Advice Map indicates the site is not considered to be at risk in the event of reservoir breach.

4.5 Surface Water Flooding to the Site

The online Development Advice Map shows where areas could potentially be susceptible to surface water flooding in an extreme rainfall event. Surface water flooding can be caused when rainwater does not drain away through the normal drainage system or soak into the ground with flooding occurring, principally from manholes and gullies. Surcharging sewers can result in overland flows which if originating at a higher elevation than a development site can potentially pose a flood risk.

An extract of the online Development Advice map is presented in Figure 4.2.

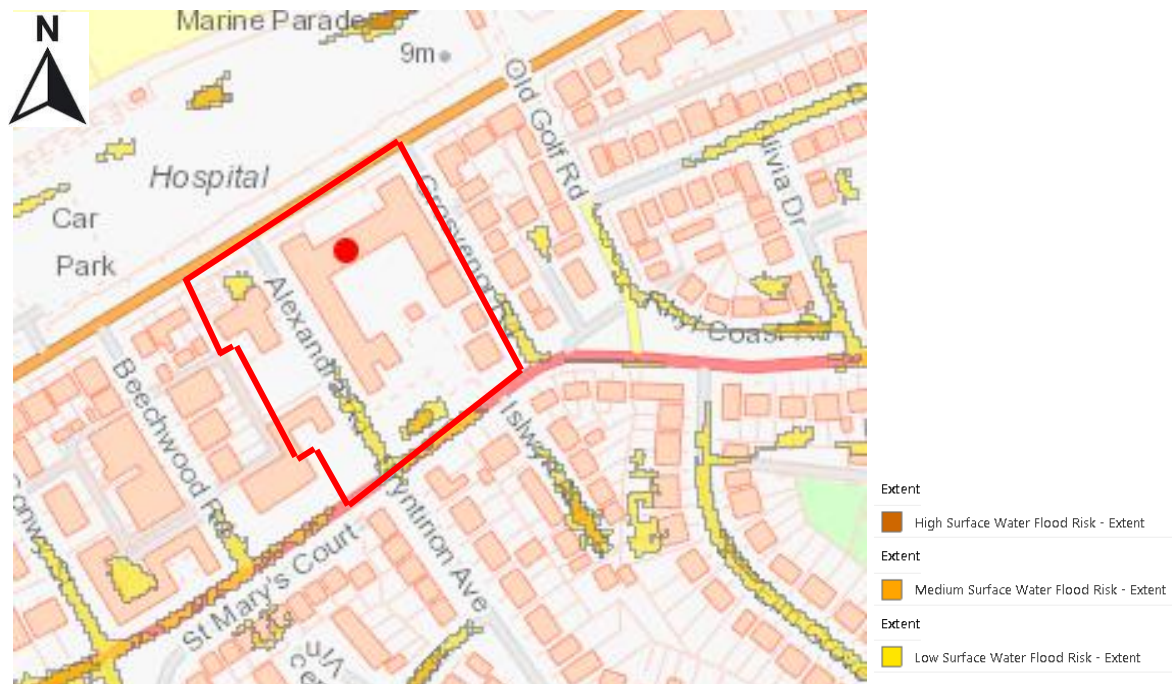


Figure 4-2 Extract of the online Development Advice Map

© Crown copyright and database rights 2019 OS 0100024198

The online map indicates the majority of the site is considered as being at a 'Very Low' susceptibility to surface water flooding. This is defined as having less than a 1 in 1000 (0.1%) Annual Probability of flooding.

The online maps indicate there are areas located along Grosvenor Road, Alexandra Road and within the car parking area to the south which are considered as being at a 'Low' susceptibility to surface water flooding. This is defined as having between a 1 in 1000 and 1 in 100 (0.1%-1%) Annual Probability of flooding.

There is an area located along Russel Road to the south of the site which is considered as being at a 'Medium' susceptibility to surface water flooding. This is defined as having between a 1 in 100 and 1 in 30 (1%-3.3%) Annual Probability of flooding.

It should be noted that these maps are generated using a relatively coarse methodology whereby rainfall inflows are routed over a ground surface model. The analysis assumes a suitable 'typical' approach to represent the effects of urban drainage infrastructure and highlights low lying areas of topography and preferential flow paths that may be more susceptible to surface water flooding in the event of extreme rainfall.

The Denbighshire County Council's PFRA confirms the site is not located within an Indicative Flood Risk Area.

4.6 Surface Water Flooding from the Site

Developers are responsible for ensuring that new development does not increase flood risk elsewhere. The proposed surface water drainage network shall be designed to not flood in the critical 1 in 30 (3.3%) Annual Probability storm event. Flood water generated up to the critical 1 in 100 (1%) Annual Probability plus climate change event shall be constrained within areas on site to not cause damage to buildings, essential services or adjoining developments.

The development has the potential to reduce flood risk through the introduction of landscaping areas. It is therefore encouraged to propose permeable areas, landscaping areas and incorporate sustainable drainage features, where possible.

4.7 Groundwater Flooding

Figure 4.6 of the Denbighshire County Council SFCA 'Areas Susceptible to Groundwater Flooding' map indicates the site is located in an area which is considered susceptible to groundwater flooding with between $\geq 25\%$ - $\leq 50\%$ susceptibility to groundwater flooding within each 1km square.

An extract of the map is presented in Figure 4.3.

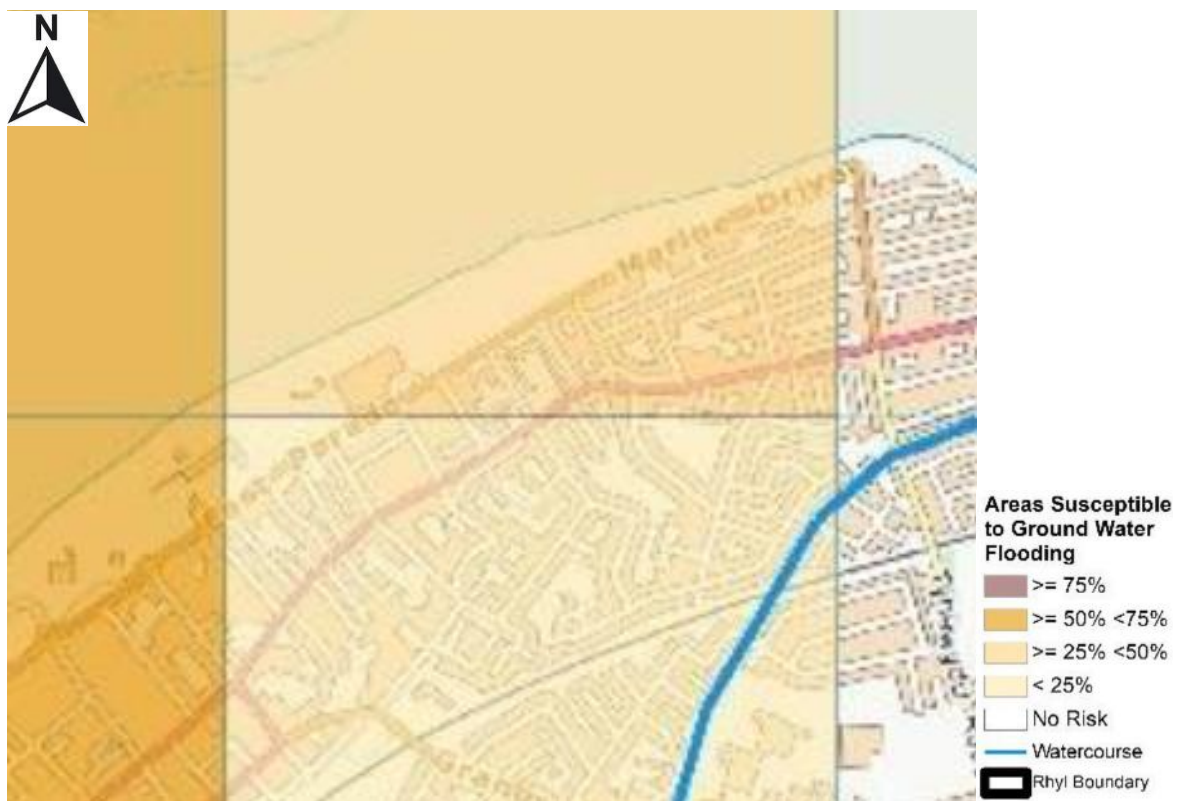


Figure 4-3 Extract of the Areas Susceptible to Groundwater Flooding Map

Denbighshire County Council SFCA, January 2018

The risk from groundwater flooding can be considered as low.

4.8 Public Sewers and Water Mains

There are public sewers within the vicinity of the site which are maintained by Welsh Water. The Denbighshire County Council SFCA indicates there are 149 recorded incidents of sewer flooding within Rhyl however, it is unknown if the site has been impacted by sewer flooding.

Any additional flows to be discharged to the public sewer network will be subject to an impact assessment by Welsh Water. No information has been provided in relation to flood risk from public sewers.

The PFRA and SFCA does not contain any information in relation to flood risk from water mains.

4.9 Highway Drainage Flooding

There are road gullies located within the highways which bound the site. Providing Denbighshire County Council maintain their drainage assets in the vicinity of the site, the risk of flooding to the proposed development site from highway drainage is considered as low.

4.10 Canals, Ponds and Artificial Watercourses

OS mapping and the Denbighshire County Council SFCA indicates there are no other waterbodies that would pose risk to this site.

4.11 Summary of Flood Risk

A summary of the flood risk to the site, based on the information presented above, is below:

- Fluvial flooding – low risk
- Tidal flooding – low risk
- Reservoir flooding – low risk
- Surface water flooding to the site – low risk
- Surface water flooding from the site – low risk
- Groundwater flooding – low risk
- Flooding from public sewers and water mains – low risk
- Flooding from highway infrastructure – low risk
- Flooding from canals, ponds and artificial watercourses – low risk

5.0 Drainage Strategy

5.1 Proposed Foul Water Drainage

The foul drainage from the proposed new building is to be collected by new private foul drains which will connect into the existing Welsh Water public sewer network along Russell Road.

A pre-development enquiry submitted to Welsh Water has confirmed anticipated foul water flows will be allowed to drain to the public sewer network at an unrestricted rate.

A copy of the pre-development enquiry correspondence is contained in Appendix C.

The proposed drainage strategy drawing NDCH-CUR-ZZ-XX-DR-C-50_10-0001 is enclosed in Appendix D.

5.2 Proposed Surface Water Drainage – Standard S1

Any new development site drainage should be designed in accordance with current best practice to provide adequate capacity not to flood for the critical 1 in 30 (3.3%) Annual Probability storm event and flood water generated for the critical 1 in 100 (1%) Annual Probability plus climate change storm event shall be constrained within the site boundary and not cause damage to buildings, essential services or adjoining developments.

A review of the development plans indicates that of the 1.7ha site, 1.2ha will be re-developed with the remaining 0.5ha comprising of the existing building remaining unaltered. Of the 1.2ha to be re-developed, it is considered to be 100% impermeable comprising of either building or car parking areas.

The most appropriate method of surface water discharge has been determined based on the hierarchy of surface water disposal set out in the Statutory Standards for Sustainable Drainage Systems Standards for Wales, 2019.

Surface Water Re-Use

Due to the nature of the building for medical uses, the re-use of water is not considered appropriate.

Infiltration

Due to the underlying strata it is unlikely any real infiltration can be offered as the main method of discharge. Permeable paving in the carpark will be designed to permit infiltration where possible but a positive connection will be provided.

As stated in Section 3.4, there is significant potential for ground instability and for running sands due to the underlying strata with increased rates of infiltration will potentially result in a geohazard.

Further investigation will be undertaken to establish infiltration rates in accordance with BRE 365.

Watercourse

The only open water in the vicinity is the sea, the sea wall is approximately 175m away. The discharge point would need to be located within the tidal range of the sea and would not be permitted to discharge direct to the beach, therefore this is deemed unfeasible.

Surface Water Sewer

There are no recorded surface water sewers within the vicinity of the site.

Combined Sewer

Welsh Water has confirmed there are combined sewers located within the vicinity of the site.

A copy of the correspondence with Welsh Water is contained in Appendix C.

It is therefore proposed to discharge surface water to the public sewer network.

6.0 Sustainable Drainage Systems (SuDS)

Section 1.1 of the SuDS Manual (CIRIA C753) states the following:

“Sustainable drainage systems (SuDS) can deliver multiple benefits.

Surface water is a valuable resource and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.”

“The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water run-off from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk, and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone.”

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in Figure 5.1.

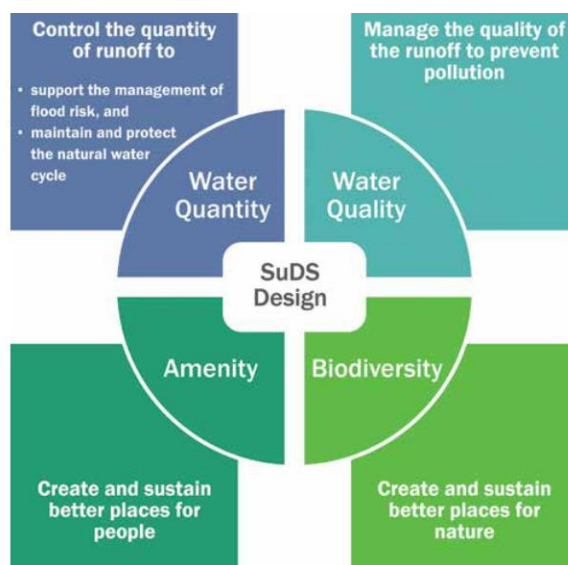


Figure 6-1 Four Pillars of SuDS Design: Taken from The SuDS Manual, Figure 2.1

6.1 Water Quantity – Standard S2

Greenfield runoff rates for the site were calculated using the Institute of Hydrology Report 124 (IoH 124) method. Rainfall and catchment descriptors have been determined using the HR Wallingford data for the area. The calculated greenfield runoff rates are:

- $Q_{bar} = 5.56 \text{ l/s}$
- $Q_1 = 4.9 \text{ l/s}$
- $Q_{30} = 9.92 \text{ l/s}$
- $Q_{100} = 12.15 \text{ l/s}$

The greenfield runoff calculations are enclosed in Appendix D.

In accordance with the Statutory Standards for Sustainable Drainage Systems Standards for Wales, surface water runoff will be discharged at the equivalent Q_{bar} greenfield runoff rate of 5.6 l/s for all events up to and including the 1 in 100 (1%) Annual Probability plus climate change event.

The restriction in discharge rates will result in the requirement for surface water to be attenuated on site prior to discharge. To limit the amount of storage required the extents of new impermeable areas within the development proposals should be kept to a practicable minimum and source control features introduced.

Permeable paving is proposed and as such, the first 5mm of rainfall will be lost through the use of these features. However, this only applies to the carpark area and the development as a whole will continue to discharge flows within the first 5mm of rainfall. Attenuation of additional flows above the Q_{BAR} rate will be provided in the form of a below ground tank, which in extraordinary circumstances will overflow into a shallow depression (detention basin) at surface level. The flow from site will be controlled by a hydrobrake flow control (or similar) designed to manage the build-up of run-off up to the maximum storm.

Control of discharge rates and the management of surface water on site will ensure that there is no increased risk of flooding as a result of the development.

6.2 Water Quality – Standard S3

The SuDS design for the development will ensure that the quality of any receiving system is not adversely affected and preferably enhanced in accordance with CIRIA SuDS Manual C753, Chapter 4.

The recommended approaches for water quality risk management are given in the SuDs Manual C753 Table 26.1. With reference to Table 26.1, the Simple Index approach will be used as the initial Pollution Hazard Index characterisation for this site.

Pollution Hazard Indices are given for different land uses in Table 26.2 of the SuDS Manual C753. In accordance with Table 26.2 of the SuDS Manual, the proposed development will have the pollution hazard indices as shown in Table 6.1.

Table 6-1 Summary of Pollution Indices for Residential Development

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Non-residential car parking with frequent change (e.g. hospitals)	Medium	0.7	0.6	0.7

Table 6.2 presents the mitigation indices provided by each SuDS method proposed as part of the drainage strategy, as set out in Table 26.3 of the SuDs Manual C753 (for surface water).

Table 6-2 SuDS Mitigation Indices for Discharge to Surface Waters

SuDS Measure	TSS	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6

Table 6.2 indicates that the proposed use of permeable paving and detention basin provides adequate water treatment for the proposed development.

The site is at low risk of contamination, there are likely to be more than 50 spaces so CIRIA guidelines suggest the site can be classified as “non-residential car parks” – a pollution hazard level of “medium”. The only discharge available as per Standard 1 is to a combined sewer meaning very low risk of contamination to any water feature in the area. Additionally, a number of sumps will be incorporated to minimise any silts leaving site.

6.3 Amenity – Standard S4

The permeable paving does not offer anything towards amenity, however, the shallow basin offers an opportunity for a landscape design which encourages green planting and can be used when no water is present.

Although the below ground tank does not directly offer any amenity, the extra accessible green space will offer a wellbeing space for patients at the hospital. The shallow depression will only become wet during the critical 1 in 100 (1%) Annual Probability storm event meaning it's mostly accessible during normal rainfall. Education boards can be used to explain the purpose of the detention basin to develop a sense of engagement with the users of the green area. Landscaping can be coordinated above the tank to create a welcoming green space giving no risk to safety.

6.4 Biodiversity – Standard S5

The creation of a detention basin can include landscaping to encourage additional biodiversity. The engineering design does not allow for this but a landscape plan will be available in due course to reflect the provision of ecology in the site strategy. The slopes of the basin will be shallow graded to provide the greatest wildlife value.

6.5 Potential SuDS Measures

There are potential SuDS measures that could be utilised to meet with the recommendations as set out in Table 6.3 below.

Table 6-3 Summary of SuDS measures

Components	Comments	Benefits		
		Quantity	Quality	Amenity & Biodiversity
Green/Blue Roofs	Due to the nature and layout of the roofs, Green/Blue Roofs are not feasible on this development.	✓	✓	✓
Raingardens	The use of rainwater gardens is not considered appropriate for the development.	✓	✓	✓
Basins and Wetlands	A detention basin has been included within the drainage design to manage exceedance flows from the surface water drainage system.	✓	✓	✓
Permeable Paving / Infiltration	Permeable paving is proposed to be used within the car parking area. Due to the nature of the underlying strata, limited infiltration is likely and will therefore be served by a piped drainage system.	✓	✓	
Oversized pipes or proprietary below ground storage and outfall to the nearest public sewer.	Below ground storage will be provided to supplement any other SuDS components.	✓	✓	
Filter Strips/Swale	The use of filter strips and swales are not considered appropriate for the development.	✓	✓	✓
Manhole Catchpits	Manhole catchpits / sumps are to be included in the design to manage silt and reduce maintenance requirements on the attenuation tank.	✓	✓	

6.6 Attenuation Requirements

A volume of surface water attenuation will be required within the surface water drainage system to demonstrate the drainage system accommodates runoff during storm events up to and including the 1 in 100 (1%) Annual Probability plus climate change event.

The proposed drainage strategy has been modelled in the Network module of Micro Drainage using the following parameters:

- FSR Rainfall Method;
- Pipe network design standard for the 1 in 2 year event;
- Assumed discharge limit of 5.6 l/s; and,
- Impermeable area of 1.006 ha.

The Micro Drainage Network model indicates there is limited flooding of the system during the 1 in 100 (1%) Annual Probability plus 40% climate change event. A total flooded volume of approximately 10m³ can be contained within temporary areas of shallow ponding.

The attenuation tank is to provide 485m³ of attenuation working with a 95% void ratio. The permeable paving is not designed for attenuation.

The proposed drainage strategy drawing NDCH-CUR-ZZ-XX-DR-C-50_10-0001 is enclosed in Appendix D.

7.0 Maintenance

This section is intended to give an overview of the operation and maintenance for the drainage features included within the drainage and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operations and then adjusted to suit the site requirements.

The surface water network has been designed to accommodate the 1 in 100 (1%) Annual Probability storm event including an allowance for climate change. It may be that the exceedance flows above the 1 in 30 (3.3%) Annual Probability storm event are stored within the site partially above ground, on non-habitable external landscaping, parking or other space. As the flows are generally being attenuated on site, there will be a period of time after storm events where the network is still partially or fully surcharged and is draining down. Where this surcharging is still present after 48 hours appropriate action should be taken as noted in this section.

7.1 Components

The following components have been included within the drainage design for the proposed development:

- Manholes;
- Pipes;
- Attenuation tank;
- Detention Basin;
- Permeable paving; and,
- Flow control units.

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.

It is assumed that the maintenance of the drainage network will be the responsibility of the land owner as a private network. The land owner may however appoint an on-site facilities management team to be responsible for maintenance.

A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.

Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.

Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris and litter.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, especially where run-off is taken from potentially contaminated areas such as filter drainages and the upstream/downstream chambers.

7.2 Manhole and Catch Pits

Access points have been located at the head of each run, at a change in direction and at a change of pipe size in accordance with Building Regulations – Approved Document H.

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

7.3 Pipes

Pipes are proprietary products and the materials can vary across the site and as such, where used the manufacturer's recommendations should be followed. Regardless of the product used, the pipes will be fully compliant with the Curtins' drainage specification.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleansing where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance are important to identify areas which may have been obstructed/clogged and may not be draining correctly thus exposing the development to a greater level of flood risk.

Table 7-1 Pipe Maintenance Measures

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial inspection should be provided as post construction CCTV survey.	N/A
Regular maintenance\ inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
Remedial Action	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

7.4 Detention Basin

Regular inspection and maintenance is important for the effective operation of detention basins as designed. Maintenance responsibility for a detention basin and its surrounding area should be placed with the assigned Maintenance Manager.

Regular mowing in and around detention basins is required only along maintenance access routes, amenity areas (e.g. footpaths), and across some embankments. The remaining areas can be managed as “meadow”, unless additional management is required or desired for landscaping purposes.

Plant management, to achieve the required habitat/appearance, should be specified clearly in a maintenance schedule by the landscape architect planned to coincide with other site wide maintenance operations.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, especially where run-off is taken from potentially contaminated areas such as car parks/service yards.

Table 7-2 Detention Basin Maintenance Measures

Maintenance Schedule	Required Action	Frequency
Regular maintenance\inspection	Litter and debris removal	Monthly or as required
	Grass cutting – for spillways and access routes	Monthly (during growing season) or as required
	Grass cutting (meadow/long grass)	Half yearly (spring before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants/dead growth.	Monthly
	Inspect inlets, outlets and overflows for blockages and clear if required.	Monthly
	Inspect banksides structures and pipework etc. for evidence of physical damage.	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly for first year then annually or as required
	Check any penstocks and other mechanical devices.	Annually
	Tidy all dead growth before start of growing season.	Annually

	Remove sediment from inlets, outlet.	Annually (or as required after heavy rainfall events)
	Manage wetland plants in outlet pool – where provided.	Annually
Occasional maintenance	Re-seed areas of poor vegetation growth (seed mix to landscape architect's specification).	Annually, or as required. As per landscape architect's specification.
	Prune and trim any trees and remove cuttings.	Every 2 years or as required
	Remove sediment from inlets, outlets, forebay and main basin	Every 5 years (or as required after heavy rainfall events).
Remedial actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required.
	Realignment of rip-rap if present.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Re-level uneven surfaces and reinstate design levels.	As required.

7.5 Attenuation Tanks

Attenuation storage tanks should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top of the surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols.

Table 7-3 Attenuation Tank Maintenance Measures

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build up and remove if necessary.	Every 5 years or as required
Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required
Remedial Action	Repair/rehabilitate inlets, outlets, vents and overflows.	As required

7.6 Permeable Paving

Attenuation storage tanks should be inspected and cleaned in accordance with the manufacturer's details.

Permeable paving needs to be regularly cleaned of silt and other sediments to preserve their infiltration capacity.

Permeable paving should be inspected and cleaned in accordance with the manufacturer's details.

Table 7-4 Permeable Paving Maintenance Measures

Maintenance Schedule	Required Action	Frequency
Regular maintenance\ inspection	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing adjacent areas.	As required
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying.	As required
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required

	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required.
Monitoring	Initial inspection	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three monthly, 48h after large storms in first six months.
	Inspect silt accumulation and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

7.7 Flow Control Units

The flow control units are intended for flood control and flow restriction.

The flow controls are specific as Hydro-brake or similar approved plus an orifice plate and are proprietary products, therefore manufacturers recommendations should also be taken in to consideration.

Access for maintenance has been provided within manhole chambers.

Table 7-5 Flow Control Unit Maintenance Measures

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.

	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and flow control chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

8.0 Residual Risk

It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using appropriate construction and management techniques.

For rainfall events in excess of the design standard of the proposed surface water management system, it is possible that the system capacity will be exceeded.

Site levels should be designed to direct flows away from the building entrances where possible, and towards areas such as car parking or formal landscaping where temporarily shallow flooding may occur to mitigate the residual risk in the event of exceedance flows from the drainage system.

In addition, ongoing management and maintenance of the proposed surface water management systems and existing local drainage assets must be undertaken in accordance with the management schedules which will be defined at the detailed design stage.

Based on the above, the residual risk is considered to be acceptable for the lifetime of the development.

9.0 Conclusions and Recommendations

Curtins has been appointed by Kier Construction North West to prepare an FCA in support of a planning application for the proposed hospital building and car parking facilities at the Royal Alexandra Hospital, Rhyl.

The FCA provides information on the nature of flood risk at the site and follows Government guidance with regards to development and flood risk. The report is based on current available information and preliminary discussions.

The assessment has been undertaken in accordance with the standing advice and requirements of NRW as outlined in the Welsh Assemble Government PPW and accompanying TAN 15 guidance.

The surface water management strategy has been reviewed in relation to the Statutory Standards for Sustainable Drainage Systems in Wales and the SABs guidance with respect to surface water methods, SuDS provision and outfall options.

The report concludes that:

- The site is located entirely within Flood Zone A, defined as having a little or no risk of flooding from rivers or the sea.
- In accordance with TAN 15, hospital uses are classified as 'Emergency Services' development. According to TAN 15, this land use is appropriate for Flood Zone A without the need to apply the Justification Test.
- The site is considered as being at a low risk of flooding from all other sources.
- Surface water discharge from the proposed development will be restricted to 5.6 l/s for all events up to and including the 1 in 100 (1%) Annual Probability plus climate change event. This represents the equivalent Qbar greenfield runoff rate for the site.
- Surface water attenuation will be provided for all events up to and including the 1 in 100 (1%) Annual Probability plus climate change event with exceedance flows managed on site so not to increase flood risk elsewhere.
- Attenuation will be provided within attenuation tanks with the car parking areas comprising of permeable paving which is to be positively drained. Exceedance flows will be managed on site and held within low spots temporarily.
- Foul flows from the site will be discharged at an unrestricted rate to the combined public sewer.

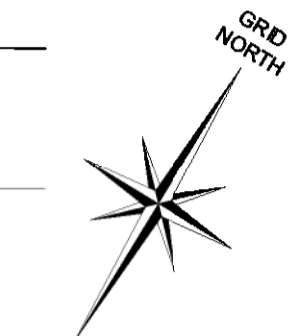
10.0 Appendices

Appendix A Proposed Layout Plans

Cars	Proposed	70 no. parking spaces overall
	Existing	108 no. parking spaces based on 1 per 60sqm office space
Total Cars		178 no. parking spaces (incl. 13 electric, 9 disabled & 9 family spaces)
		Planning guidance states that the disabled requirement for existing buildings is 2% of total car park capacity and the requirement for new buildings is 5% of total parking capacity.
Motorcycles		9 no. spaces (calculated as 5% of total overall spaces provided)

Existing	<p>Staff - 49 secure staff spaces, calculated as 1 per 10 staff members. (Existing Building Staff No. = 326 full time & 168 part time)</p> <p>Visitors/building users - 50 visitor cycle spaces (to be confirmed) (calculated as 1 per 10 users (up to 500 users in total)</p>
Proposed	<p>Staff - 32 secure staff spaces, calculated as 1 per 10 staff members. (Proposed Building Staff No. = 320 TBC)</p> <p>Visitors/building users - 50 visitor cycle spaces, calculated as 1 per 10 users - up to 500 users in total. (no. of building users to be confirmed)</p>

Tree Type 2 - 14 no. Ulmus Lutece
This is another medium sized fast growing species with a mature height of 17m and an approximate height of 1.8m to the underside of the crown. Similar in height to Tree Type 1, the slightly smaller crown of the Ulmus Lutece will help reduce the scale of the development within the central 'courtyard' and to the rear of the proposed building.



NB
SITE PLAN TO BE REVIEWED AGAINST PHASE 2 INVESTIGATION,
ECOLOGY & ARBORICULTURAL REPORTS ON RECEIPT OF
SURVEYS

Drawing Number:
NDCH-GDA-00-ZZ-DR-A-05_20-0004

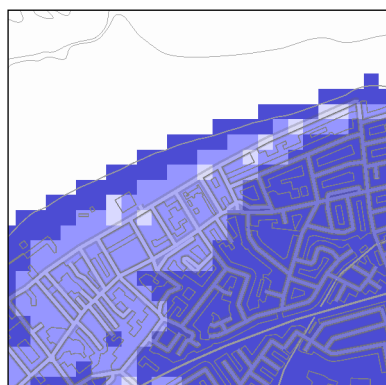
Appendix B Site Surveys

Appendix C Stakeholder Correspondence





PART 1: SUMMARY DATA

This section provides a summary of the data.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?







Contains OS data © Crown Copyright and database right 2020

-  Highly compatible for infiltration SuDS.
The subsurface is likely to be suitable for free-draining infiltration SuDS.
-  Probably compatible for infiltration SuDS.
The subsurface is probably suitable although the design may be influenced by the ground conditions.
-  Opportunities for bespoke infiltration SuDS.
The subsurface is potentially suitable although the design will be influenced by the ground conditions.
-  Very significant constraints are indicated.
There is a very significant potential for one or more hazards associated with infiltration.

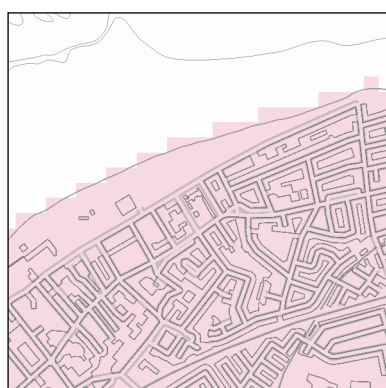
Is ground instability likely to be a problem?







Contains OS data © Crown Copyright and database right 2020

-  Increased infiltration is very unlikely to result in ground instability.
-  Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability.
-  Ground instability problems are probably present.
Increased infiltration may result in ground instability.
-  There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



Contains OS data © Crown Copyright and database right 2020

-  The groundwater is not expected to be especially vulnerable to contamination.
-  The groundwater may be vulnerable to contamination.
-  The groundwater is likely to be vulnerable to contaminants.
-  Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

PART 2: DETAILED DATA



This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

Section 1. Very significant constraints

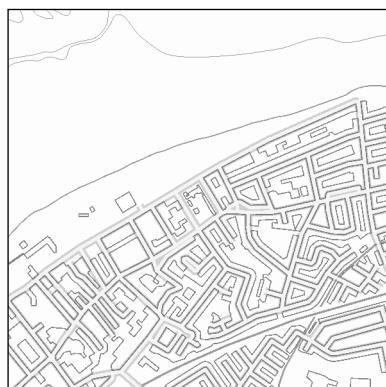
Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard	
 <p>Contains OS data © Crown Copyright and database right 2020</p>	<p><input checked="" type="checkbox"/> Very significant soluble rock hazard. Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.</p>
	<p><input type="checkbox"/> Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.</p>
Landslide hazard	
 <p>Contains OS data © Crown Copyright and database right 2020</p>	<p><input checked="" type="checkbox"/> Very significant landslide hazard. Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.</p>
	<p><input type="checkbox"/> Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.</p>

Shallow mining hazard



Contains OS data © Crown Copyright and database right 2020



Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.



Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater



Contains OS data © Crown Copyright and database right 2020



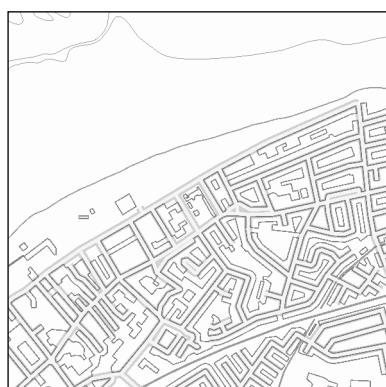
Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.



See Part 2 for the likely depth to water table.

Made ground



Contains OS data © Crown Copyright and database right 2020



Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.



None recorded





Section 2. Drainage potential

The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

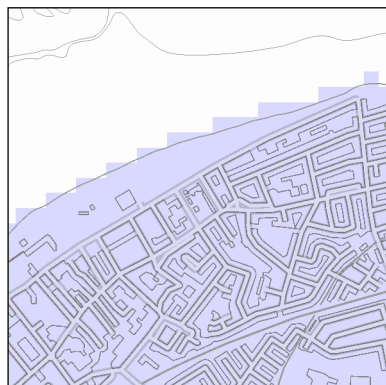
- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table	
 <p>Contains OS data © Crown Copyright and database right 2020</p>	 Groundwater is likely to be more than 5 m below the ground surface throughout the year.
	 Groundwater is likely to be between 3 and 5 m below the ground surface for at least part of the year.
	 Groundwater is likely to be less than 3 m below the ground surface for at least part of the year.

Superficial deposit permeability



Contains OS data © Crown Copyright and database right 2020



Superficial deposits are likely to be **free-draining**.



The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.



Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

- Very Low
- Low
- Moderate
- High
- Very High

Minimum



Contains OS data © Crown Copyright and database right 2020

Maximum



Contains OS data © Crown Copyright and database right 2020

Superficial deposit thickness



Contains OS data © Crown Copyright and database right 2020

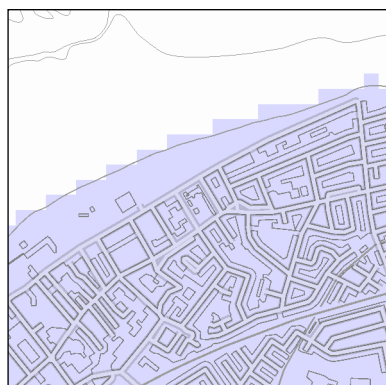


The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).



The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

Bedrock permeability



Contains OS data © Crown Copyright and database right 2020



Bedrock deposits are likely to be **free-draining**.



The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.



Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

Key

- Very Low
- Low
- Moderate
- High
- Very High

Minimum



Contains OS data © Crown Copyright and database right 2020

Maximum



Contains OS data © Crown Copyright and database right 2020

Geological indicators of flooding



Contains OS data © Crown Copyright and database right 2020



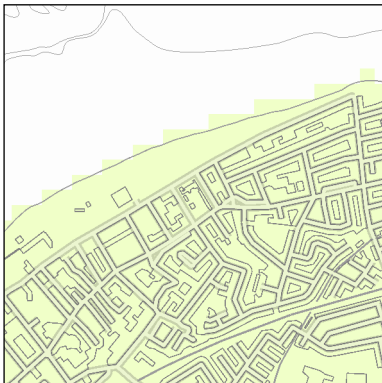
Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground





In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks	
 <p>Contains OS data © Crown Copyright and database right 2020</p>	<div>Increased infiltration is unlikely to result in subsidence.</div>
	<div>Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.</div>
	<div>Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.</div>
	<div>Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.</div>

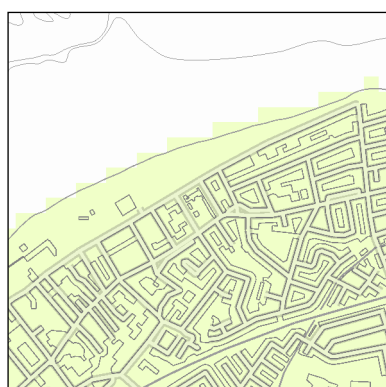
Landslides







Contains OS data © Crown Copyright and database right 2020

-  Increased infiltration is unlikely to lead to slope instability.
-  Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
-  Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
-  Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining






Contains OS data © Crown Copyright and database right 2020

-  Increased infiltration is unlikely to lead to subsidence.
-  Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
-  Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

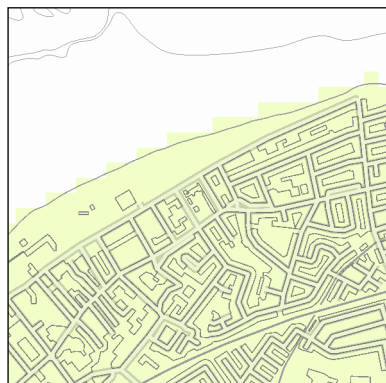
Running sand



Contains OS data © Crown Copyright and database right 2020

-  Increased infiltration is unlikely to cause ground collapse associated with running sands.
-  Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

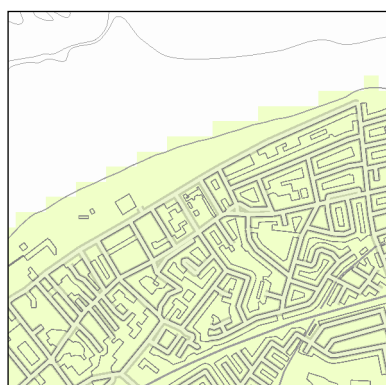
Swelling clays



Contains OS data © Crown Copyright and database right 2020

- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

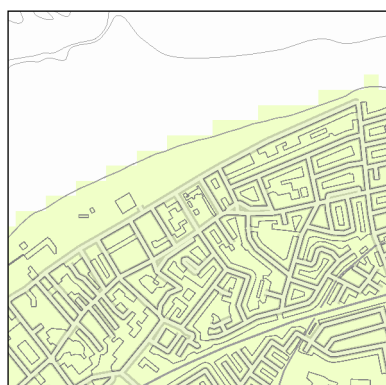
Compressible ground



Contains OS data © Crown Copyright and database right 2020

- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



Contains OS data © Crown Copyright and database right 2020

- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground






For more information read 'Explanation of terms' at the end of this report.

Groundwater source protection zones

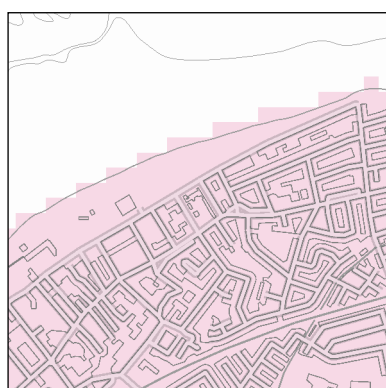


Contains OS data © Crown Copyright and database right 2020



Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2020.

-  Groundwater is not within a source protection zone.
-  Source protection zone IV
-  Source protection zone III
-  Source protection zone II
-  Source protection zone I

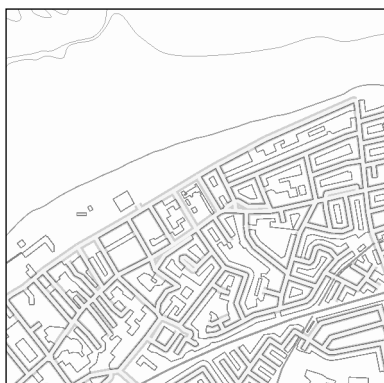
Predominant flow mechanism



Contains OS data © Crown Copyright and database right 2020

-  Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
-  Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

Made ground



Contains OS data © Crown Copyright and
database right 2020

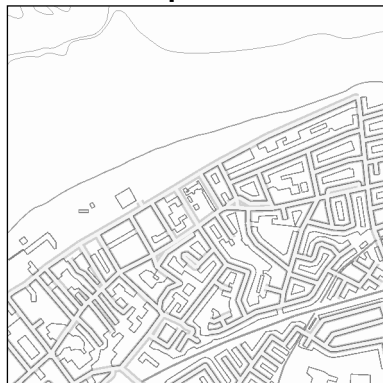


Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

Section 5. Geological Maps

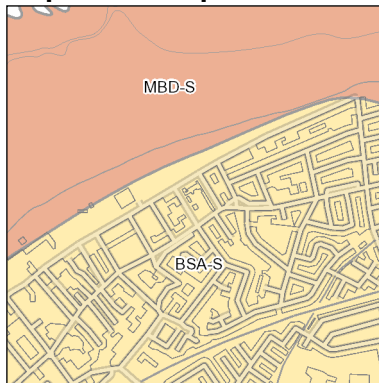
The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



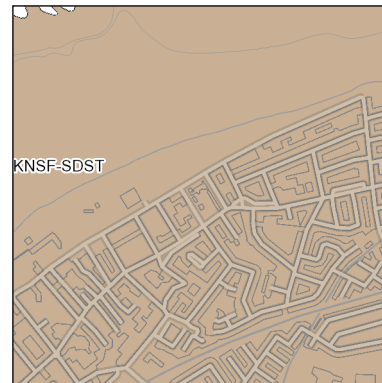
Contains OS data © Crown Copyright and database right 2020

Superficial deposits



Contains OS data © Crown Copyright and database right 2020

Bedrock



Contains OS data © Crown Copyright and database right 2020



Fault





Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:

No deposits recorded by BGS in the search area

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	BSA-S	BLOWN SAND	SAND
	MBD-S	MARINE BEACH DEPOSITS	SAND

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	KNSF-SDST	KINNERTON SANDSTONE FORMATION	SANDSTONE



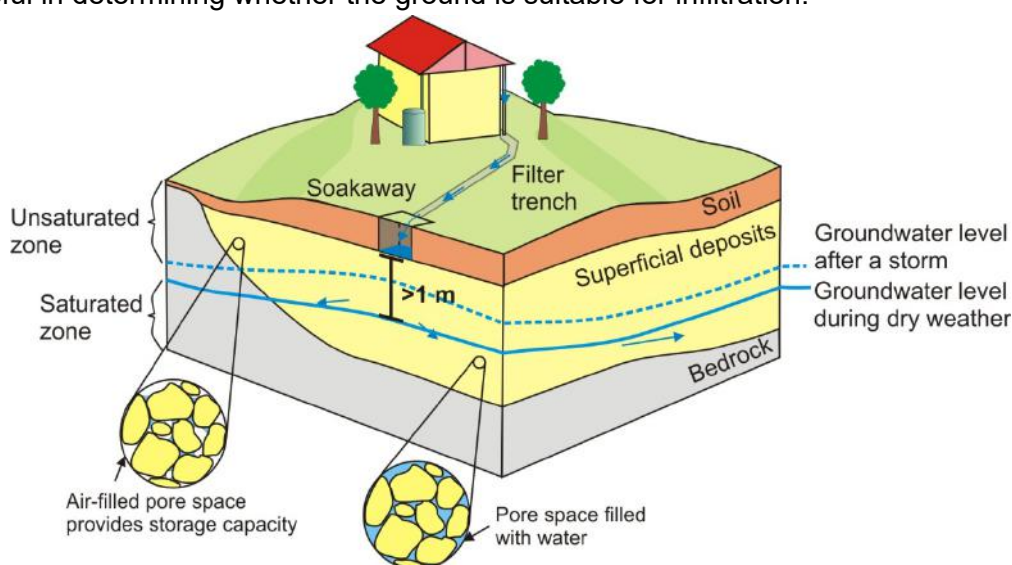
Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
 - previous land use,
 - potential for, or presence of contaminated land
 - presence of perched water tables
 - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
 - made ground, where not recorded
 - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
 - zones around private water supply boreholes that are susceptible to groundwater contamination.
- This report is supplied in accordance with the GeoReports Terms & Conditions available separately, and the copyright restrictions described at the end of this report

Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

Compressible ground

Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits

Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand

Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.



Shallow mining hazards (non coal)

Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.



For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk. For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)



Contact Details

Keyworth Office

British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Email: enquiries@bgs.ac.uk

Wallingford Office

British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Email: hydroenq@bgs.ac.uk

Edinburgh Office

British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk



Terms and Conditions

General Terms & Conditions

This Report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at <https://shop.bgs.ac.uk/georeports> and also available from the BGS Enquiry Service at the above address.

Important notes about this Report

- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Copyright:

Copyright in materials derived from the British Geological Survey's work, is owned by UK Research and Innovation (UKRI) and/or the authority that commissioned the work. You may not copy or adapt this publication, or provide it to a third party, without first obtaining UKRI's permission, but if you are a consultant purchasing this report solely for the purpose of providing advice to your own individual client you may incorporate it unaltered into your report to that client without further permission, provided you give a full acknowledgement of the source. Please contact the BGS Copyright Manager, British Geological Survey, Environmental Science Centre, Nicker Hill, Keyworth, Nottingham NG12 5GG. Telephone: 0115 936 3100.

© UKRI 2020 All rights reserved.

This product includes mapping data licensed from the Ordnance Survey® with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright 2020. All rights reserved. Licence number 100021290 EUL



**Report issued by
BGS Enquiry Service**

Mr Jake Busby
Curtins
51-55 Tithebarn Street
Liverpool
Merseyside
L5 1AB

Date: 24/02/2020
Our Ref: PPA0004613

Dear Mr Busby

Grid Ref: 301504 382072

Site Address: Royal Alexandra Hospital, Marine Drive, Rhyl

Development: New car park and hospital building

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.

APPRAISAL

Firstly, we note that the proposal relates to a newly formed car park and hospital building at the Royal Alexandra Hospital, Marine Drive, Rhyl and acknowledge that the site comprises of a potential windfall development with no allocated status in the Local Development Plan (LDP). Accordingly, whilst it does not appear an assessment has been previously undertaken of the public sewerage system, we offer the following comments as part of our appraisal of this development.

Please note, notwithstanding the following assessment, we would advise there is also a mandatory requirement to undertake pre-application consultation with all 'Specialist Consultees', including Dwr Cymru Welsh Water as the statutory water and sewerage undertaker, in accordance with Schedule 4 of Town & Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2016. As a major development, you will be statutorily required to consult Welsh Water and a substantive response will be issued within 28 days from the date of the notice as per the requirements of Article 2E.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a predominantly combined public sewerage system which drains to Kinmel Bay Wastewater Treatment Works (WwTW).

This site is crossed by a 150mm combined public sewer with the approximate position being marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building will be permitted within the protection zone of the public sewer measured 3 metres either side of the centreline. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

You are 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 you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

Surface Water Drainage

As of 7th January 2019, this proposed development is subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore requires approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy which states that discharge to a combined sewer shall only be made as a last resort. Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to a surface water drainage body in liaison with the Land Drainage Authority and/or Natural Resources Wales.

As part of this pre-planning enquiry we acknowledge receipt of a 'Drainage Outline Strategy' (Drawing No. 076057-CUR-00-XX-DR-C-C-04001-P01) which indicates proposals to discharge surface water flows into the public combined sewer. With respect to the accompanying correspondence 6th February 2020, whilst we acknowledge the proposal looks to subdivide the site area into separate drainage sub-catchments and the existing hospital building will discharge to the combined sewer in Grosvenor Road, we remind that there is a duty to explore and exhaust all surface water drainage options in accordance with the aforementioned hierarchy and would advise there is no agreement to communicate the additional 5.6 l/s of surface water flows from the newly formed development area into the combined sewer in Russell Road.



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

We welcome correspondence in
Welsh and English

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

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

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

It is therefore recommended that the developer consult with Denbighshire County Council, as the determining SuDS Approval Body (SAB), in relation to their proposals for SuDS features. Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals by response to SAB consultation. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note. In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

Foul Water Drainage – Sewerage Network

With respect to the supporting correspondence received 21st February 2020, we have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system. Whilst the submitted 'Drainage Outline Strategy' refers to a new point of connection along Russell Road, we would advise that the sewer comprises a strategic asset, in the form of a 675mm combined sewer, and therefore recommend that the flows should instead connect to the 150mm combined sewer in Grosvenor Road located to the east. 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.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water Industry Act 1991. However, 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 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.

If the development will give rise to a new discharge (or alter an existing discharge) of trade effluent, directly or indirectly to the public sewerage system, then a Discharge Consent under Section 118 of the Water Industry Act 1991 is required from Dwr Cymru / Welsh Water. Please note that the issuing of a Discharge Consent is independent of the planning process and a consent may be refused although planning permission is granted.

Foul Water Drainage – Sewerage Treatment

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



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

We welcome correspondence in
Welsh and English

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

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

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

Potable Water Supply

Given there is currently no information relating to the anticipated potable water consumption rate, in order to establish what would be required to serve the site with an adequate water supply, it may be necessary for the developer to fund the undertaking of a hydraulic modelling assessment on the water supply network. For the developer to obtain a quotation for the hydraulic modelling assessment, we will require a fee of £250 + VAT.

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.

PPA0004671



LEGEND(Representative of most common features)

Waste networks			
Foul chamber	Surface water chamber	Combined sewer overflow	Special purpose chamber
Treatment works	Pumping station	Private sewer subject to Sect. 104 adoption agreement	Private Sewer Transfer
Outfall	Lamphole	Storm Overflow	Rising main
Gravily sewer	Private sewer	Private sewer subject to Sect. 104 adoption agreement	Private Sewer Transfer
Inspection Chamber			

NB: Sewer symbol colour indicates the type.
 RED - Combined
 GREEN - Surface water
 BLUE - Foul
 Purple - Former S24 sewers (for indicative purposes only)

Notes:

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

Dŵr Cymru Cylfyngedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and is not warranted as to its correctness in the event of excavations or other works made in the vicinity of the company's apparatus. The error of location of apparatus is not warranted and any excavations made entirely on your. The information which is supplied by the Company is done so in accordance with statutory requirements of sections 104 and 105 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of water mains, surface water drains, surface drains or other apparatus and any excavations made in the vicinity of the water mains, surface water drains, surface drains or other apparatus should be made with caution. It must be understood that the furnishing of this information is entirely without prejudice to the provisions of the New Roads and Street Works Act 1991 and the Company's rights to be compensated for any damage to its apparatus.

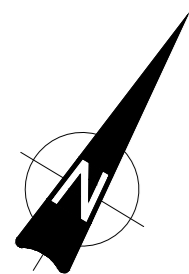
**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

Reproduced by permission of the Ordnance Survey on behalf of
HMSSO. © Crown copyright and database right 2017.
All rights reserved.
Ordnance Survey Licence number 100019534

Map Ref: 301508,382072
Map scale: 1:1250
Printed by: Gough Jasmin
Printed on: 13 Mar 2020



Appendix D- Drainage Strategy



GENERAL NOTES:

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING.
- DESIGN BASED ON TOPOGRAPHICAL SURVEY INFORMATION AVAILABLE AT THE TIME OF DESIGN. ANY VARIANCE FROM THE INFORMATION SHOWN SHOULD BE REPORTED TO THE ENGINEER FOR REVIEW.
- NOT TO BE USED FOR CONSTRUCTION, FOR COORDINATION ONLY.
- EXISTING DRAINAGE SHOWN INDICATIVE FROM HISTORIC PLANS. ALL EXISTING CONNECTIONS TO BE CONFIRMED BY CCTV.

KEY

- RED LINE BOUNDARY
- EXISTING DRAINAGE NETWORK
- PROPOSED COMBINED DRAINAGE
- EXISTING WELSH WATER ASSETS
- PRIVATE SW SEWER
- PRIVATE FW SEWER
- PROPOSED ROAD GULLY
- EXISTING ROAD GULLY - CONNECT TO NEW NETWORK
- SURFACE WATER ATTENUATION TANK 340 m² x 1.5m HEIGHT
- DRY DETENTION BASIN
- DARK GREEN - 1 in 5
- LIGHT GREEN - 1 in 10
- BLUE - BASE REQUIREMENT "WETLAND" PLANTING
- PROPOSED SLOT DRAIN
- PERFORATED PIPE WITHIN PERMEABLE PAVING

OTHER DISCIPLINE DRAWING REFERENCES

THE DESIGN OF THIS SCHEME HAS BEEN DESIGNED IN ACCORDANCE WITH THE BELOW DRAWINGS AND INFORMATION

TOPOGRAPHICAL SURVEY REF: TOWER SURVEYS R\N9891-201-202_18su001

ARCHITECTS DRAWING REF: GDA NDCH-GDA-01-00-DR-A-25-80-0001_P02

LANDSCAPE ARCHITECTS DRAWING REF: GDA NDCH-GDA-00-22-DR-A-10-35-0004_P05

OTHER DRAWINGS REF: ROOF AREAS - NDCH-GDA-01-22-DR-A-20-05-0001_P02 EX-05 EXISTING SITE PLAN (1997) DRAINAGE LAYOUT

DESIGN PHILOSOPHY

SURFACE WATER DESIGN
THE DESIGN PROVIDES CAPACITY UP TO THE 100 YEAR STORM WITH MINOR CONTROLLED EXCEEDANCE DURING THE 100 YEAR + 40% CLIMATE CHANGE EVENT.
SW FLOW RATE: 5.6 L/S (BASED ON GREENFIELD RATE)
APPROXIMATE STORAGE TANK REQUIREMENT: 485m³
OUTFALL: WW SEWER (TO BE AGREED WITH WW AND SAGI) LEVELS INDICATE THAT PUMPING WILL NOT BE REQUIRED. TBC FOLLOWING FURTHER DESIGN AND SURVEY WORK.
POLLUTION TREATMENT: PERMEABLE PAVING TO CAR PARK INFILTRATION IS NOT CONSIDERED APPROPRIATE FOR THIS SCHEME. TESTING TO BE DIGEST 365 ARE REQUIRED TO CONFIRM INFILTRATION RATES FOR DESIGN.

FOUL WATER DESIGN
INTERNAL POP-UPS TO BE ACCESSIBLE FROM ABOVE SLAB LEVEL THROUGH ROOFING EYE. NO INTERNAL CHAMBERS / ALL CONNECTIONS BELOW SLAB TO BE BLIND. DRAINAGE TO PASS BELOW GROUND BEAT AT BUILDING EXENTS.
OUTFALL TO EXISTING WW NETWORK. APPROVED IN PRINCIPLE FOR ANTICIPATED FLOWS FROM DEVELOPMENT.

P03	NOTATION ADDED (S4)	06/04/20	NIB	JDB
P02	STAGE 3 (S4)	03/04/20	JDB	AF
P01	WP (S0)	27/03/20	JDB	-
Rev	Description	Date	By	Chkd
<div><div></div><div>11-55 Tinsam Street, Liverpool, L2 2SB 0151 709 3889 liverpool@curtins.com www.curtins.com</div></div>				
Status: SUITABLE FOR STAGE APPROVAL				
Project: ROYAL ALEXANDRA HOSPITAL, RHYL				
Dwg Title: DRAINAGE PROPOSED DRAINAGE STRATEGY				
Size:	Date:	Drawn By:	Designed By:	Checked By:
AO	27/03/2020	JDB	JDB	AF
Scale: 1:200				
Project No:	Originator	Volume	Level	Type
NDCH - CUR - ZZ - XX - DR - C - 50-10-1001 - P03				

DRAINAGE NOTES:

- ALL ADAPTABLE DRAINAGE WORKS INCLUDING WORKS TO EXISTING PUBLIC SEWERS TO BE UNDERTAKEN IN ACCORDANCE WITH "SEWERS FOR ADOPTION 8th EDITION" AND "CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY 7th EDITION", BS EN 752:2017 "DRAIN AND SEWER SYSTEMS OUTSIDE BUILDINGS" AND THE BUILDING REGULATIONS APPROVED DOCUMENT H.
- DESIGN BASED ON TOPOGRAPHICAL SURVEY AND CCTV SURVEY INFORMATION AVAILABLE AT THE TIME OF THE DESIGN.
- OUTFALL CONNECTION(S) SUBJECT TO AGREEMENT WITH THE APPROVING AUTHORITY.
- COVER LEVELS, GULLY POSITIONS, AND BUILDINGS LOCATION ARE APPROXIMATE AND SHALL BE CONFIRMED BY ARCHITECT/ LANDSCAPE ARCHITECT. CONTRACTOR TO ALLOW FOR ADJUSTMENT TO SUIT AGREED POSITIONS AND FINISHED LEVELS, AND CONFIRM ALL COVER LEVELS ON SITE.
- ALL INTERNAL DRAINAGE CONNECTIONS ARE PROVIDED TO THE PENETRATION POSITIONS SHOWN ON ARCHITECT AND M&E DRAWINGS. REFER TO DIMENSIONED LOCATIONS AND DIMETERS ON ARCHITECTS GROUND FLOOR SETTING-OUT PLANS.
- ALL UNDERGROUND FOUL DRAINAGE SHOULD BE SUITABLY VENTED AT OR NEAR TO THE HEAD OF RUNS.
- ALL ACCESS FITTINGS, STACKS, R/WPS AND GULLIES TO BE RODDABLE. ALL TO HAVE LOW LEVEL RODDING ACCESS PLATES UNLESS AN ALTERNATIVE MEANS OF ACCESS IS AGREED. ACCESS POINT TO BE ABOVE ANY GROUND FLOOR CONNECTED APPLIANCE SPILL LEVEL.
- LARGE ACCESS FITTING REQUIRED ABOVE GROUND WHERE GREATER THAN 12M UP TO 22M TO A JUNCTION. SMALL ACCESS FITTING REQUIRED UP TO 12M TO A JUNCTION.
- ALL GULLY AND CHANNEL DRAIN OUTLETS AND TERMINATION POINTS TO BE TRAPPED AND RODDABLE. INTERNAL GULLIES AND CHANNEL DRAINS TO BE SPECIFIED BY OTHERS.
- WHERE NO W/C'S ARE CONNECTED UPSTREAM, UNDERSLAB FW DRAINAGE TO BE LAID AT 1:40 MIN. AFTER THE CONNECTION AT AT LEAST TWO W/C, A MIN. FALL OF 1:80 APPLIES.
- ALL CONNECTIONS FROM POP-UPS TO BE LAID AT A CONSTANT GRADIENT TO JUNCTION/ INSPECTION CHAMBER MANHOLE UNLESS NOTED OTHERWISE. ANY ISSUES RELATING TO CLASSES WITH FOUNDATIONS ARE TO BE FORWARDED TO THE ENGINEER, ALLOWING SUFFICIENT TIME FOR AN ALTERNATIVE SOLUTION TO BE PROVIDED.
- INVERT LEVELS AT MANHOLES/ INSPECTION CHAMBERS TO BE USED TO SET OUT PIPEWORK. PIPE GRADIENTS ARE SHOWN INDICATIVELY ONLY.
- ALL PIPE DIAMETERS GIVEN ARE NOMINAL INTERNAL PIPE DIAMETERS.
- ALL SEWERS UNLESS AGREED OTHERWISE STATED, SHALL BE:
 - FW TO BE PVC.
 - SW 100mm to 225mm to BE VITRIFIED CLAY.
 - 300mm DIA AND GREATER TO BE CLASS 120 CONCRETE PIPES.
- AS AN ALTERNATIVE THE CONTRACTOR MAY USE AN APPROVED UNPLASTICISED POLYVINYL CHLORIDE (PVCU) WITH APPROVAL FROM THE ENGINEER.
- SEWER PIPES TO BE LAID IN MAXIMUM 3 METRE LENGTHS UNLESS THERE IS A SPECIFIC OPERATIONAL NEED TO LAY LONGER LENGTHS.
- THE FIRST PIPE OUT OF MANHOLES TO BE AS SHORT AS PRACTICABLE SO AS TO PROVIDE A FLEXIBLE JOINT AS CLOSE AS POSSIBLE TO THE OUTSIDE FACE OF THE CONCRETE SURROUND AND CONNECTED TO A LENGTH OF ROCKER PIPE.
- ALL NEW CONNECTIONS INTO EXISTING MANHOLES (OR INTO EXISTING SEWERS) TO BE SOFFITS LEVEL UNLESS OTHERWISE NOTED.
- ALL ADAPTABLE DRAINAGE PIPES WILL REQUIRE A MINIMUM OF 1200mm COVER. IN ACCORDANCE WITH SEWAGE UNDERTAKERS REQUIREMENTS. WHERE THIS IS NOT ACHIEVED, IT WILL BE

NECESSARY TO AGREE THE BED AND SURROUND DETAIL.

- ALL PRIVATE DRAINAGE PIPES WITH A COVER OF LESS THAN 600mm IN NON-TRAFFICKED AREAS AND LESS THAN 1200mm IN TRAFFICKED AREAS TO BE BEDDED AND SURROUNDED IN CONCRETE (CLASS Z). COMPRESSIBLE MATERIAL SHALL BE PROVIDED AT EVERY PIPE JOINT. WHERE COVER EXCEEDS THIS DEPTH, PIPES ARE TYPICALLY BEDDED AND SURROUNDED IN CLASS 5. REFER TO PIPE EMBEDMENT DETAILS DRAWING FOR SPECIFIC TYPES.
- WHERE DRAINAGE PIPES ARE LESS THAN 300mm BELOW THE UNDERSIDE OF THE GROUND FLOOR SLAB, CONCRETE ENCASEMENT IS REQUIRED (CLASS Z). COMPRESSIBLE JOINTS ARE TO BE PROVIDED AT EVERY PIPE JOINT WITHIN THE CONCRETE.
- WHERE PIPES ARE MORE THAN 300mm BELOW THE UNDERSIDE OF THE SLAB, CLASS 5 BEDDING IS ACCEPTABLE.
- SULPHATE RESISTANT CEMENT (C20-0C2) AND PRECAST CONCRETE PRODUCTS MUST BE USED OR A LABORATORY REPORT PROVIDED TO PROVE THAT SUCH PRECAUTIONS ARE NOT REQUIRED.
- WHERE PEAT IS ENCOUNTERED DURING THE SITE INVESTIGATION, ADDITIONAL NOTES WILL BE REQUIRED AND DESIGN ADJUSTED TO SUIT.
- WHERE FOUL SEWERS RUN ABOVE SURFACE SEWERS, CONCRETE PROTECTION MAY BE REQUIRED AT CROSSEOVERS TO PREVENT ANY POTENTIAL CONTAMINATION.
- ALL CONNECTIONS PASSING THROUGH BASES OR EDGE BEAMS TO BE IN SEALED SLEEVES. ALTERNATIVELY CONNECTIONS MAY BE CAST-IN WITH FLEXIBLE JOINTS NOT GREATER THAN 150MM FROM FACE OF CONCRETE.
- THE CHAMBER SIZE OF MANHOLES WITH MORE THAN ONE CONNECTION MAY NEED TO BE INCREASED TO ACCOMMODATE THE CONNECTIONS AND BENDS.
- ALL MANHOLE COVERS IN BLOCKSLAB AND EXTERNAL PAVING AREAS TO HAVE RECESSED COVERS OF THE APPROPRIATE GRADE TO ACCEPT ARCHITECT'S PAVING PROPOSAL.
- ALL INTERNAL COVERS TO HAVE MECHANICALLY JOINTED CORNERS AND DOUBLE SEALED WITH RECESSED TRAY TO ALLOW FOR FINISHES.
- UNLESS NOTED OTHERWISE IN THE MANHOLE SCHEDULE, ALL MANHOLE, GULLY AND CHANNEL COVERS (IRONWORK) SHOULD BE THE FOLLOWING SPECIFICATION:
 - B/125 LOAD CLASS IN PEDESTRIAN AREAS.
 - D400 LOAD CLASS IN VEHICULAR AREAS.
- ALL PROPRIETARY PRODUCTS TO BE INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURERS REQUIREMENTS, INSTRUCTIONS AND RECOMMENDATIONS.
- GREASE TRAPS SHOULD BE PROVIDED ABOVE GROUND WITHIN AN ENZYME TREATMENT SYSTEM BY APPROPRIATE SPECIALIST DESIGNER. WHERE A BELOW GROUND GREASE TREATMENT SYSTEM IS REQUIRED - ADDITIONAL NOTES REQUIRED AND DESIGN ADJUSTED TO SUIT.
- THE DESIGN IS BASED ON A GRAVITY RAINWATER SYSTEM, WHERE A SIPHONIC SYSTEM IS PROPOSED ADDITIONAL NOTES REQUIRED AND DESIGN ADJUSTED TO SUIT.
- INTERNAL DRAINAGE (BELOW SLAB) TO BE 150mm DIA WHERE MORE THAN 1 CONNECTION AND 100mm DIA WHERE SINGLE CONNECTION.
- ALL RWP CONNECTIONS ASSUMED TO BE 100mm DIA PENDING DETAILED DESIGN BY SPECIALIST ROOF DESIGNER.
- PROPOSED FOUL BELOW SLAB DRAINAGE TO BE RATIONALISED AT STAGE 4.

INFORMATION REQUIRED SCHEDULE

- UPDATED CCTV DRAINAGE SURVEY WITH CONFIRMATION OF EXISTING WELSH WATER DRAINAGE ASSET LEVELS.
- UPDATED TOPOGRAPHICAL SURVEY TO INCLUDE CAR PARK TO WEST.
- INFILTRATION TESTING TO BRE 365

RESIDUAL HAZARD REGISTER (RELATES TO CIVIL/STRUCTURAL MATTERS ONLY)		
MUST BE READ IN CONJUNCTION WITH CURTINS RESIDUAL HAZARD REGISTER NDCH-CUR-XX-XX-HA-Z-001-001.		
HAZARDS THAT SHOULD BE OBVIOUS TO A COMPETENT CONTRACTOR HAVE NOT BEEN INDICATED ON THIS DRAWING. SHOULD ANY ADDITIONAL HAZARDS BE IDENTIFIED, THE CONTRACTOR SHOULD NOTIFY ALL		
HAZARD REF. No.	ITEM (FEATURE, ELEMENT OR ACTIVITY)	RESIDUAL HAZARD
1.1	Services within existing highway	Damage to or striking of existing services. Concrete protection may be required.
1.2	Drainage connections	Unable to connect SW and FW on site drainage to Welsh Water sewers.
2.1	Existing structures	Damage to existing listed building.
2.2	Varying ground conditions	Potential for unexpected ground conditions such as unstable ground.
2.3	Groundwater	Attenuation tank may require weighting to resist floatation.
3.1	Buried Services	Operatives exposure to live services during excavation works.
4.1	Earthworks & excavations	Potential for undermining of existing structure due to excavation works.
5.1	Ground contamination	Operatives exposure to ground contamination.

MAXIMUM PERMISSIBLE DRAIN DOWN RATE FROM SPRINKLER TANKS TO BE 5 l/s INTO SW NETWORK. TANKS NOT TO BE EMPTIED DURING HEAVY RAINFALL EVENTS.

PROPOSED ATTENUATION FEATURE: ATTENUATION REQUIRED = 485m³. DEPTH = 1.5m. CELLULAR STORAGE 95% VOID RATIO. BASE IL = 5.327m AOD. TANK TO MEET REQUIREMENTS OF CIRIA C880

SHALLOW DRY DETENTION BASIN. MAX SIDE SLOPE = 1 in 5 (DARK GREEN). UTILISED DURING 100+CC STORM EVENT ONLY. MAX WATER DEPTH = 300mm

NEW MH CONSTRUCTED ON EXISTING CONNECTION INTO SITE. IL TO BE CONFIRMED. IF INSUFFICIENT DEPTH TO EXISTING MH THEN NEW CONNECTION REQUIRED TO WW SEWER WITHIN RUSSELL ROAD.

NEW MH CONSTRUCTED ON EXISTING WW SEWER. NO INVERT INFORMATION AVAILABLE. TBC. MH SUBJECT TO S106 AGREEMENT WITH WW. MAX SW FLOW = 5.6 l/s

Calculated by:	Jake Busby
Site name:	RAH
Site location:	Rhyl

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.32645° N
Longitude:	3.48035° W
Reference:	1751781334
Date:	Feb 06 2020 08:52

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1.2
-----------------------	-----

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	677	677
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes**(1) Is $Q_{BAR} < 2.0$ l/s/ha?**

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	5.57	5.57
1 in 1 year (l/s):	4.9	4.9
1 in 30 years (l/s):	9.92	9.92
1 in 100 year (l/s):	12.15	12.15
1 in 200 years (l/s):	13.71	13.71

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SSW14, DS/PN: S1.008, Volume (m³): 5.2

Unit Reference	MD-SHE-0093-5600-2400-5600
Design Head (m)	2.400
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	5.181
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.400	5.6	Kick-Flo®	0.832	3.4
Flush-Flo™	0.410	4.3	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	3.6	2.000	5.1	4.000	7.1	7.000	9.3
0.200	3.9	1.000	3.7	2.200	5.4	4.500	7.5	7.500	9.6
0.300	4.2	1.200	4.1	2.400	5.6	5.000	7.9	8.000	9.9
0.400	4.3	1.400	4.4	2.600	5.8	5.500	8.3	8.500	10.2
0.500	4.2	1.600	4.6	3.000	6.2	6.000	8.6	9.000	10.5
0.600	4.1	1.800	4.9	3.500	6.7	6.500	9.0	9.500	10.7

Storage Structures for Storm

Complex Manhole: STANK, DS/PN: S1.006

Cellular Storage

Invert Level (m) 5.327 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	340.0	0.0	1.500	340.0	0.0	1.501	0.0	0.0

Tank or Pond

Invert Level (m) 7.390

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	16.0	0.300	65.0	0.301	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

			Pipe			
US/MH Flow / Overflow			Flow	Level		
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded
S1.008	SSW14	0.03		4.3	SURCHARGED	1

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

			Pipe			
US/MH Flow / Overflow			Flow	Level		
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded
S1.008	SSW14	0.03		4.3	SURCHARGED	1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

				Pipe		
US/MH Flow / Overflow			Flow	Level		
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded
S1.008	SSW14	0.04		5.6	FLOOD	1

Our Locations

Birmingham

2 The Wharf
Bridge Street
Birmingham
B1 2JS
T. 0121 643 4694
birmingham@curtins.com

Bristol

Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ
T. 0117 302 7560
bristol@curtins.com

Cambridge

50 Cambridge Place
Cambridge
CB2 1NS
T. 01223 631 799
cambridge@curtins.com

Cardiff

3 Cwrt-y-Parc
Earlswood Road
Cardiff
CF14 5GH
T. 029 2068 0900
cardiff@curtins.com

Douglas

Varley House
29-31 Duke Street
Douglas
Isle of Man
IM1 2AZ
T. 01624 624 585
douglas@curtins.com

Dublin

11 Pembroke Lane
Dublin 2
D02 CX82
Ireland
T. +353 1 507 9447
dublin@curtins.com

Edinburgh

1a Belford Road
Edinburgh
EH4 3BL
T. 0131 225 2175
edinburgh@curtins.com

Glasgow

Queens House
29 St Vincent Place
Glasgow
G1 2DT
T. 0141 319 8777
glasgow@curtins.com

Kendal

Units 24 & 25 Riverside Place
K Village
Lound Road
Kendal
LA9 7FH
T. 01539 724 823
kendal@curtins.com

Leeds

Ground Floor
Rose Wharf
78-80 East Street
Leeds
LS9 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool

51-55 Tithebarn Street
Liverpool
L2 2SB
T. 0151 726 2000
liverpool@curtins.com

London

40 Compton Street
London
EC1V 0BD
T. 020 7324 2240
london@curtins.com

Manchester

Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG
T. 0161 236 2394
manchester@curtins.com

Nottingham

56 The Ropewalk
Nottingham
NG1 5DW
T. 0115 941 5551
nottingham@curtins.com