



Plas Coch Campus,
Mold,
Wrexham

Flood Consequence Assessment &
Drainage Strategy

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Dŵr Cymru Welsh Water

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Executive Summary

The proposal is for three developments within the overall Wrexham Glyndwr University Plas Coch Campus site, namely Northern Quarter, Plas Coch Academic Campus Redevelopment and Wrexham Student Village. The Northern Quarter development is a proposed residential development of circa 400 Keyworker apartments. The Plas Coch Academic Campus redevelopment is comprised of several new build structures and refurbishments. The Wrexham Student Village area comprises proposed student accommodation of 197 new build student bedrooms.

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

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

The British Geological Survey information indicates that the underlying geology of the site is sand, gravels, siltstones and mudstones. Therefore, soakaways are unlikely to be a viable SuDS technique, subject to the results of further infiltration testing and groundwater monitoring. No watercourses are identified in close proximity to the site.

The site comprises existing university buildings and external hardstanding areas. Given that the site is already positively drained, the site will discharge into the existing site drainage before ultimately outfalling into Dŵr Cymru Welsh Water sewers in the roads. In line with Wrexham County Borough Council Guidance, a betterment on the existing brownfield runoff rates is to be provided. Therefore, a 30% reduction on the existing brownfield runoff rates will apply. Any areas of greenfield land will be restricted to greenfield runoff rates.

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

Foul water generated by the development will be discharged into the Dŵr Cymru Welsh Water Foul Sewer in the surrounding roads via the sites existing connection. The foul discharge does not present an increased flood risk to the surrounding district.

1.0 Introduction

- 1.1 Scott Hughes Design (SHD) has been appointed by Wrexham Glyndwr University to prepare this Flood Consequence Assessment to support a planning submission for the three proposed developments that form the Plas Coch Campus Development, namely Plas Coch Academic Campus Re-development, Northern Quarter and Wrexham Student Village 2. The assessment has been undertaken in line with Technical Advice Note 15: Development and Flood Risk (TAN15) and information from Natural Resources Wales.
- 1.2 This Flood Consequence Assessment (FCA) has been commissioned by Wrexham Glyndwr University and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.
- 1.3 The report has been commissioned to identify any flood related issues associated with the proposed development and any likely constraints that could be imposed plus to consider the drainage strategy for it. The following issues have been suggested by Natural Resources Wales, Wrexham County Borough Council Preliminary Flood Risk Assessment & Management of Surface Water Guidance Document and subsequently addressed within this report:
- Identify available data relating to flood risk at the site.
 - Determine whether the site is at risk from flooding from all sources, including from breach or overtopping of any existing flood defences, surface water flooding and/or groundwater flooding.
 - Consider the flood risk from all other sources.
 - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
 - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
 - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
 - Consider the recommendations of the Wrexham County Borough Council Preliminary Flood Risk Assessment (PFRA) and Wrexham County Borough Council Management of Surface Water Guidance Document.
 - Assess mitigation measures & off-site impacts and define any residual risks.

2.0 Development Description and Location

2.1 Site Location

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

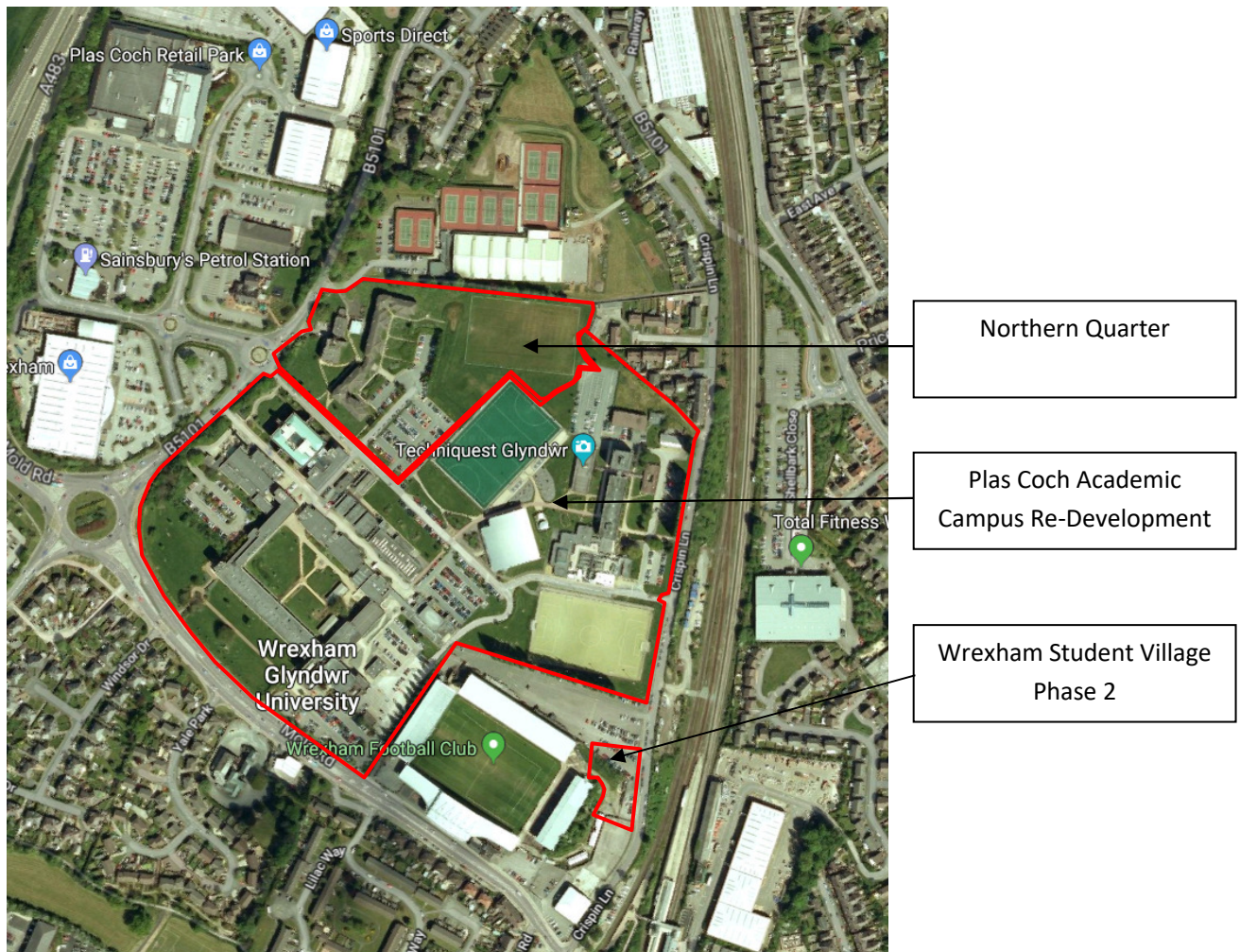
Table 1: Site Referencing Information

Item	Brief Description
Site name	Plas Coch Campus
Site address and location	Plas Coch Campus, Mold, Wrexham, LL11 2AW
Council Area	Wrexham County Borough Council
Approximate Grid Reference	OS: 332660, 351274
General Locality	The proposed development site is located some 2km to the northwest of Wrexham Town Centre.

2.2 Existing site Description

- 2.2.1 All sites are predominantly hardstanding, comprised of the existing Wrexham University facility buildings and hard landscaped areas. There are also some areas of soft landscaping.
- 2.2.2 The sites are bordered by Mold Road to the south, Crispin Lane to the east, the B5101 to the west and existing University Buildings to the north.
- 2.2.3 Figure 1 below identifies the overall site location details. Topographical information indicates that the site is undulating with the existing buildings sitting at a variety of different finished floor levels. The highest level of approximately 91.5m AOD is located in the southeast of the site and the lowest level of approximately 86.0m AOD is located in the east of the site.

Figure 1: Site Location



2.3 Development Proposals

- 2.3.1 As discussed in the earlier sections, the report is prepared to support three planning applications for the redevelopment of the Plas Coch Campus, Wrexham. This application consists of the Northern Quarter, Plas Coch Academic Campus Re-Development and Wrexham Student Village Developments.
- 2.3.2 The Plas Coch Academic Campus Re-development is comprised of a proposed new Learning Gateway Building, Inner Gateway Building, Engineering Building, Sports Hall Extension, refurbishment of social learning and academic tuition space within the existing buildings, extensive parking, infrastructure and public realm works as well as demolition of several redundant buildings. The site area for the Plas Coch Academic Campus Re-development is 11.023ha.
- 2.3.3 The Northern Quarter development is a proposed private residential development of circa 400 Keyworker apartments that have been subdivided into a number of smaller individual built forms that respond to each other and their context. The site access is off the existing B5101 roundabout

which would now be limited to serving the residential development and service requirements of the University only. The internal residential access roads are all designed to adoptable standards with a secondary emergency vehicle access point. The site area for the Northern Quarter development is 3.1ha.

2.3.4 The Wrexham Student Village Phase 2 is the new build second phase of Wrexham Student Village comprising a further 197 new build student bedrooms. A “T” shaped building footprint with a central vertical access core extends across six and seven stories to fully enclose the internal car parking courtyard. To the south of this building form is a circa 3m wide pedestrian access footpath leading from the adjacent football stand to Crispin Lane providing an emergency escape route. The site area for the Wrexham Student Village Phase 2 is 0.193ha.

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

3.0 Planning Policy and Consultation

3.1 Planning Policy Framework

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

Table 2: National Resources Wales Flood Zones

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

Table 3: Natural Resources Wales Flood Zones

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

3.2 Preliminary Flood Risk Assessment (PFRA)

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

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

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

3.3 Statutory Authority Correspondence

3.3.1 Wrexham County Borough Council confirmed that:

- Developer is asked to calculate the existing brownfield runoff rates and to improve the existing situation. This should aim to be as close as reasonably practicable to the greenfield runoff rates.
- Development should be designed so that there is no flooding to the development in a 1 in 30 year event and so that there is no property flooding in a 1 in 100 year plus climate change event.
- The practicable minimum limit on the discharge rate from the site is 5l/s, using an appropriate vortex flow control device.
- The minimum size of pipe discharging from an attenuation device should be 150mm laid at a gradient not flatter than 1 in 150.
- An explanation as to how it is proposed to manage and fund the maintenance of the proposed system over the lifetime of the development should be provided. This should consider the requirement to ensure that access is physically possible for such maintenance works.

4.0 Definition of Flood Hazard

4.1 Sources of information

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

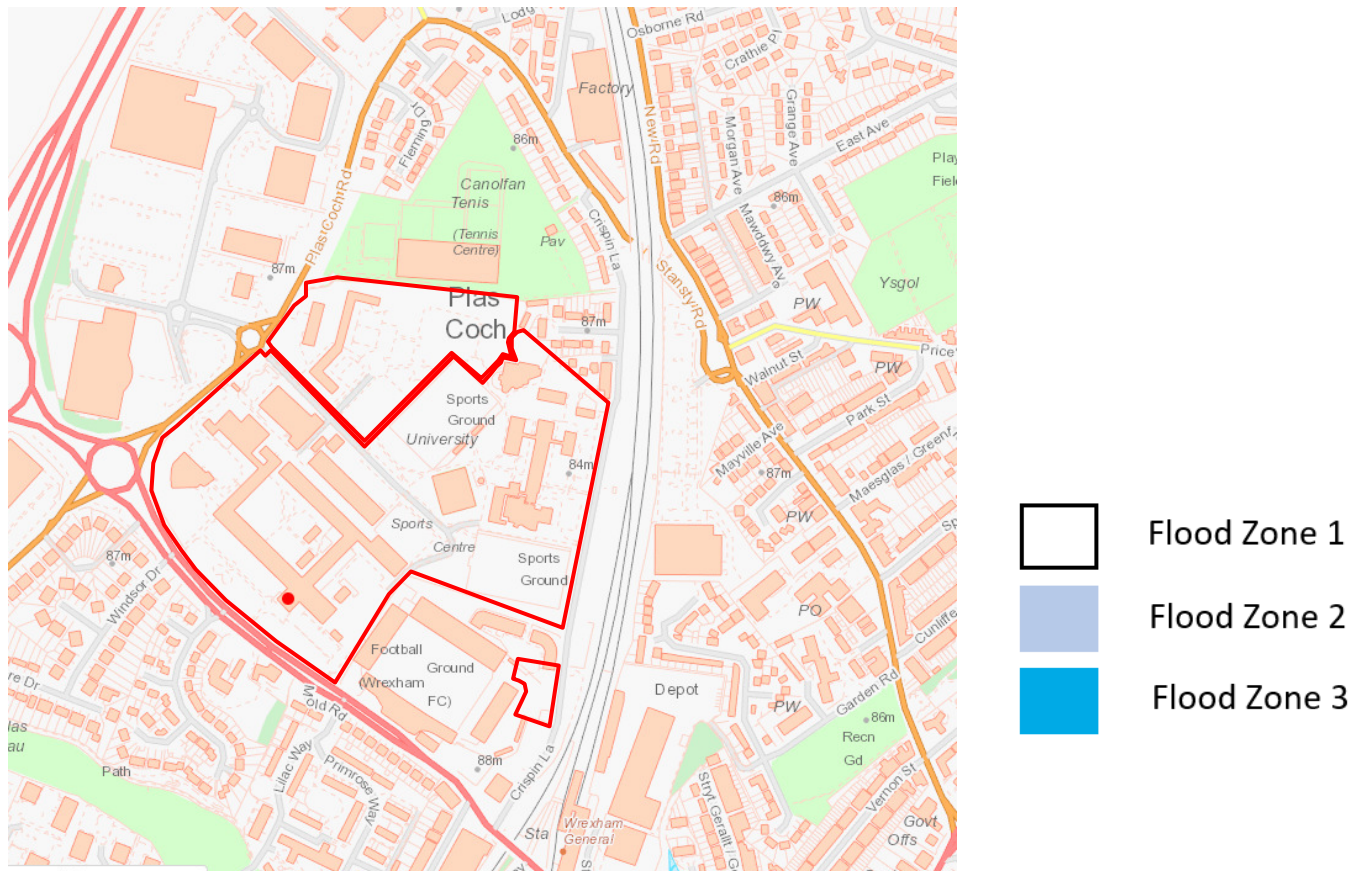
Table 3: Sources of information used in the identification of flood risk

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

4.2 Flooding from Rivers (Fluvial)

- 4.2.1 There are no watercourses in close proximity to the sites. The closest watercourse is an unnamed watercourse approximately 513m to the west. The River Gwenfro is also located approximately 855m to the south.
- 4.2.2 Figure 2 below locates the three development areas on the Natural Resources Wales flood risk map. It is clear from this that all three sit outside of the influence of flood water from any identified water body or river and is located within Flood Zone 1 i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 in any year (<0.1%).
- 4.2.3 Based on the available information, the site lies within Flood Zone 1 and is classified as Zone A. According to TAN15 Flood Risk Vulnerability and Flood Zone Compatibility Matrix, a justification test is not requested for sites in Flood Zone A. Therefore, there is no need to consider fluvial flood risk any further.

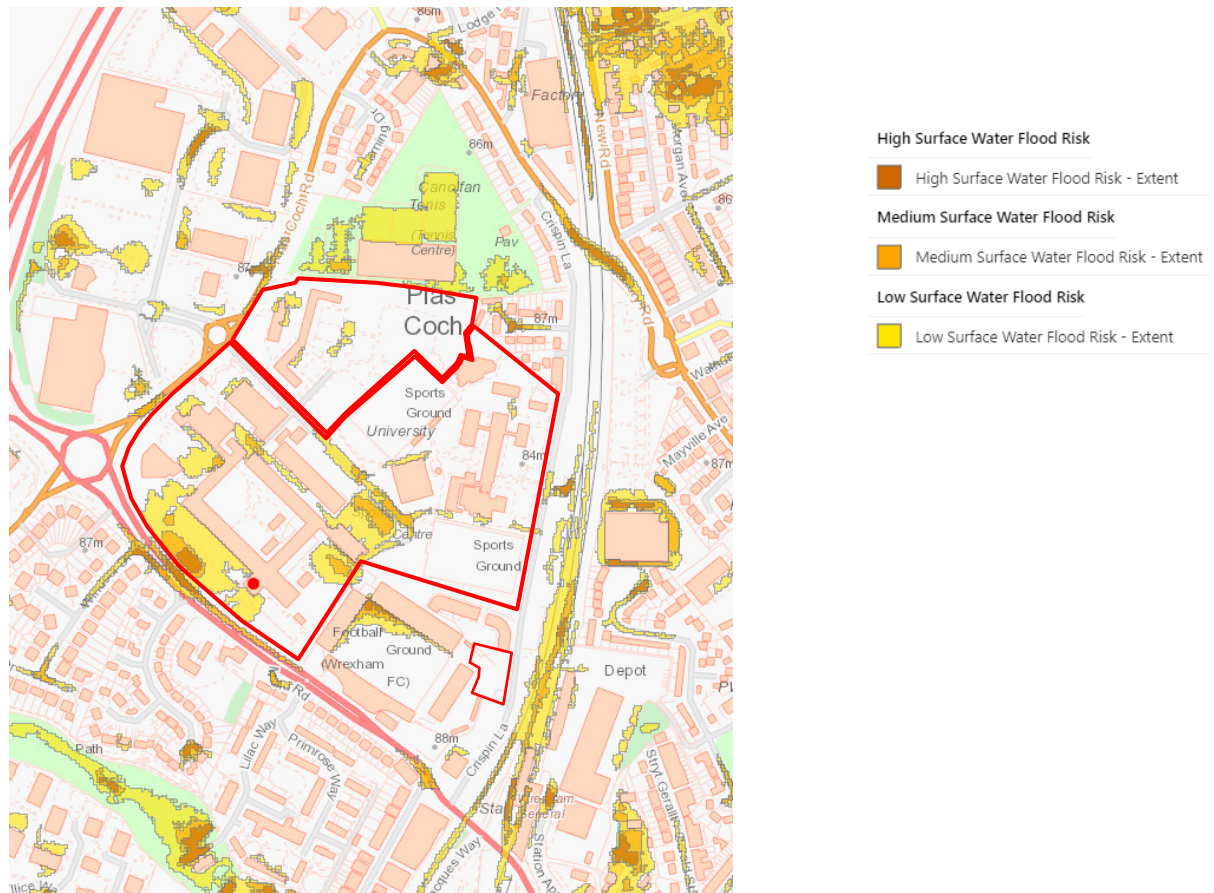
Figure 2 – Natural Resources Wales Risk of Flooding from Rivers & Sea Maps



4.3 Flooding From Land (Overland Flow)

- 4.3.1 The main development site benefits from an existing positive drainage network that is connected into the surrounding adopted sewers. Any surface water runoff from the surrounding area will be prevented from entering the site by the existing drainage associated with the surrounding developments and highways.
- 4.3.2 Furthermore, a review of the Natural Resources Wales Surface Water Flood Risk maps indicates that the majority of all three sites are at low risk of flooding, meaning that each year the areas have a chance of flooding of less than 1 in 1000 (0.1%) for Surface Water (see Figure 3 below). There are areas of medium risk of flooding on the Plas Coch Campus and Wrexham Student Village sites, meaning that each year these have a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) for the medium risk with small areas at high risk.
- 4.3.3 The areas shown at medium/high risk on the Plas Coch Campus and Wrexham Student Village sites are associated with topographical low points and existing external hardstanding areas. These areas are predominantly located away from the proposed development areas for each site. However, there is an area of medium surface water flooding situated where the proposed engineering building is to be located. The proposed building will feature an improved drainage network to ensure the risk of flooding from surface water in this area becomes low.

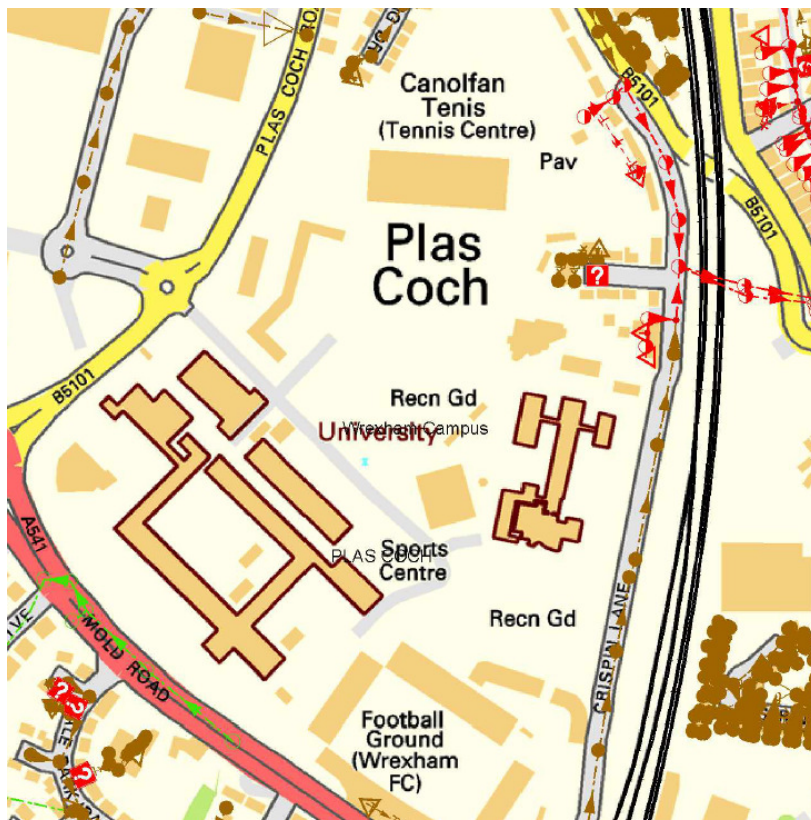
Figure 3 – Natural Resources Wales Surface Water Flood Risk Maps



4.4 Flooding from Sewers and Private Drainage

- 4.4.1 The Dŵr Cymru Welsh Water sewer records confirm that there are no public sewers within the site boundary. There is an existing Surface Water Sewer in Mold Road to the south. There is also an existing Foul and also a Combined Water Sewer within Crispin Road to the east. There is an extensive network of private drainage on site associated with the existing university buildings.
- 4.4.2 The extensive Dŵr Cymru Welsh Water adopted drainage network serving the surrounding urban district ensures that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the highway areas above the sewers. However, this is expected to be localised and restricted to the location of specific manhole covers located away from the development footprint. Thus flood risk to the site from sewers is diminished to acceptable levels.

Figure 4 – Dŵr Cymru Welsh Water Sewer Records Extract



4.5 Flooding from Groundwater

4.5.1 The British Geological Survey mapping indicates that the superficial geology of the site is Glaciofluvial Sheet Deposits, comprised of sand and gravel. The bedrock geology of the site is the Etruria Formation, comprised of mudstone. There is also a small area in the west underlain by the Pennine Lower Coal Measures Formation, comprised of mudstone, siltstone and sandstone. According to the Environment Agencies Aquifer Designation Map, both the superficial and bedrock geology of the site are classified as a Secondary A Aquifers, comprised of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The PFRA identified no records of past groundwater flooding within the County Borough.

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

4.6 Flooding from Artificial Sources

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

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

5.1 Summary

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

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

Table 4 – Flood Risk Summary

Source	Flood Risk	Likely Impacts	Remarks
Tidal	Low	Low	The site is not tidally influenced.
Fluvial (Watercourse)	Low	Low	The site is in Flood Zone 1.
Surface (Overland Flood Flow)	Medium	Low	The Natural Resources Wales flood maps show the majority of areas of proposed development are located in areas at low risk. There is an area of medium risk where the proposed engineering building is to be located; this will be mitigated by the proposed new drainage.
Sewers	Low	Low	There are no public sewers within the site.
Groundwater	Low	Low	The site is at low risk of groundwater flooding.
Artificial Sources	Low	Low	There are no artificial sources in close proximity.

6.0 Outline Drainage Strategy

6.1 Existing Surface Water Runoff

- 6.1.1 The existing site is brownfield and brownfield runoff rates will apply. In accordance with the Guidance provided by Wrexham County Borough Council, a betterment on existing runoff rates will be applied for the proposed new development, as calculated in Table 5 below.

Table 5 – Existing Runoff Rates

	Existing Brownfield Area (m ²)	Existing Greenfield Area (m ²)	Greenfield Runoff Rate for Qbar (l/s)	Existing Brownfield Discharge Rate - (Imp Area x 65mm/hr) ÷ 3600 (l/s)	Allowable Discharge Rate (30% Reduction from Existing)	Total Allowable Discharge Rate (l/s)
Plas Coch Academic Campus	9910	8750	2.4	158	110	112.4
Wrexham Student Village Phase 2	1930	-	-	34.8	17.4	17.4
Northern Quarter	15,800	15,200	3.7	285.2	199.7	203.4

6.2 Geology

- 6.2.1 The superficial geology of the site is Glaciofluvial Sheet Deposits comprised of sand and gravel. The bedrock geology is the Etruria comprised of mudstone. There is also a small area of the Pennine Lower Coal Measures Formation, comprised of mudstone, siltstone and sandstone in the west of the site.
- 6.2.2 The underlying geology indicates that infiltration is unlikely to be a potentially viable SuDS technique for the discharge of surface water due to the cohesive nature of the underlying geology.

6.3 Sustainable Drainage Systems

6.3.1 SuDS Objectives:

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever

possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

6.3.2 SuDS's Design Themes

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

6.3.3 The SuDS Management Train

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

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

6.3.4 SuDS Site Constraints

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

- Land Use Characteristics: The size and type of the development plot restricts the range of source control and site control SuDS devices to be considered both above and below ground.
- Site Characteristics: The underlying geology indicates that infiltration is unlikely to be a viable SuDS technique.
- Catchment Characteristics: The site is currently both brownfield and greenfield. Brownfield runoff rates will apply with a reduction, there are also areas that will be reduced to greenfield runoff rates.
- Environmental and Amenity Performance: Safety to all future users is paramount when including SuDS within the overall development and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for

significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

6.3.5 SuDS Methods

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

Table 6: Surface SuDS Methods

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> - Architectural proposals for the development and maintenance issues deem this unsuitable. - Additional costs of installation would have severe effect on viability of the development.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Suitable:</u> To be located at the base of downspouts. Subject to client approval.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site, and reduces treated water consumption.	<u>Not Suitable:</u> - Additional costs of installation would have severe effect on viability of the development. - The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs. - Running and maintenance costs would not be acceptable to the client or future residents.
Infiltration Options	Reduces total run off volume from the development.	<u>May be Suitable:</u> Subject to the results of infiltration testing and groundwater monitoring.

Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>May be Suitable:</u> Subject to the results of infiltration testing and groundwater monitoring.
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or use of plastic box stems. - Impermeable membrane at base of construction to prevent impact on pavement stability.	<u>May be Suitable:</u> Subject to the results of infiltration testing and groundwater monitoring.
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also allow filtering of particulate matter, improving water quality	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Suitable:</u> - The size of the development may allow for large above ground areas for surface water storage. - Dependent upon final development layout.

Table 7: Sub-Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<u>Suitable:</u> - The use of geocellular attenuation may be possible to retain excess storm water. - Cannot be used in Public Highways or adopted by WW.

Large Diameter Pipes, Culverts or Tanks	• Suitable for sites with insufficient space for basins etc. • Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. • Generally be suitable for adoption by the statutory water company (e.g. Dŵr Cymru Welsh Water).	<u>Suitable:</u> • The use of oversized pipes may be possible to retain excess storm water. • Used primarily on adopted drainage networks.
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6.3.6 SuDS Hierarchal Approach

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

Table 8: SuDS Hierarchal Approach

Method	Suitability	Suitability for Development
Infiltration to Ground	Maybe	Subject to further infiltration testing and ground water monitoring.
Connection to Watercourse	No	There are no watercourses in close proximity to the site.
Connection to Surface Water Sewer	Yes	There are existing surface water drains on site which connect into the existing surface water sewer in Mold Road.
Connection to a Combined Sewer	No	There are other options which take precedent.

6.3.7 SuDS Design Philosophy

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

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the ground.

- Site control in the form of attenuation ponds, permeable paving, geocellular storage and oversized pipes.
- Surface water will discharge into the existing onsite surface water drainage, at a restricted rate, prior to connecting into the Dŵr Cymru Welsh Water surface water sewer in Mold Road, via an existing connection.
- Aim to limit where possible the impermeable fraction of development.

6.4 Outline Surface Water Drainage Strategy

- 6.4.1 The outline strategy is to collect runoff from the roof and external areas and direct it to new below ground surface water drainage networks that will discharge via the existing site drainage into Dŵr Cymru Welsh Water surface water sewer in Mold Road, via an existing connection. Attenuation will be provided by a combination of attenuation ponds, geocellular storage and attenuation pipes. Permeable parking bays will also be used within the car parks.
- 6.4.2 The proposed drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance and Sewers for Adoption, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100 year return period including a 40% increase to account for climate change to confirm that there is no flood risk to the buildings.
- 6.4.3 Flooding can occur on a local scale beyond the 30-year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Sewers for Adoption (SfA) 7th Edition (WRc, 2006) states that developments should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.
- 6.4.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Sewers for Adoption guidance. Using storage within the external areas would be achievable and would direct flood water away from the buildings, with flows directed back into the surface water drainage network as water levels in the sewers receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development and due to the fall across the site, consideration will be given to make sure all water is controlled so that it does not impact on any adjoining properties.
- 6.4.5 Table 9 below defines the post-development attenuation volumes associated with the site and the method of attenuating (further details can be found on drawing PCC-SHD-00-ZZ-DR-C-0101 in Appendix D). The volumes identified below are preliminary for this outline assessment and are likely to alter at detailed design stage. The outline attenuation volumes in Table 9 have been derived using Microdrainage Source Control Software.

- 6.4.6 Any future drainage calculations carried out as part of a site-wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate Change allowances.

Table 9: Outline Attenuation Volumes

	New Impermeable Area (m²)	Proposed Discharge Rate (l/s)	1 in 30 year attenuation (m³)	1 in 100 year attenuation + 40% Climate Change Allowance (m³) (extra over from 30yr retained on the surface)
Plas Coch Academic Campus	18,660	112.4	179	492
Wrexham Student Village Phase 2	1930	17.4	16	42
Northern Quarter	21,700	203.4	170	316

6.5 Pollution Control

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

6.6 Foul Water Strategy

- 6.6.1 The outline foul water drainage strategy is to connect into the existing site drainage prior to discharge into the existing Dŵr Cymru Welsh Water Sewers via an existing connection. There would be very limited increase in the foul water discharge rates generated by the new development.

7.0 Management Measures, Off Site Impacts and Residual Risk

7.1 Flood Risk Management Measures

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

7.2 Off Site Impacts

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

7.3 Residual Risk

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

Appendix A – Architectural Site Layout

Appendix B – Topographical Survey

Appendix C – Statutory Authority Correspondence

Appendix D – Scott Hughes Design Drawings

Appendix E – Hydraulic Calculations