AECOM

Plasyfelin Primary School

Flood Risk & Drainage Statement

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Quality information

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Introduction

This document has been prepared by AECOM to accompany the Pre-application Consultation process to summarise the existing flood risk to the site and outline drainage strategy to provide a new Two Form Entry Primary School on the site of the existing Plasyfelin Primary School.

The existing site consists of two main buildings within a higher-level plateau towards the western side of the site. Levels fall away to the east across green spaces towards the Nant yr Aber main river which runs along the eastern site boundary.

The site occupies an overall area of 2.68 hectares, located at an OS Grid Reference of ST152877.

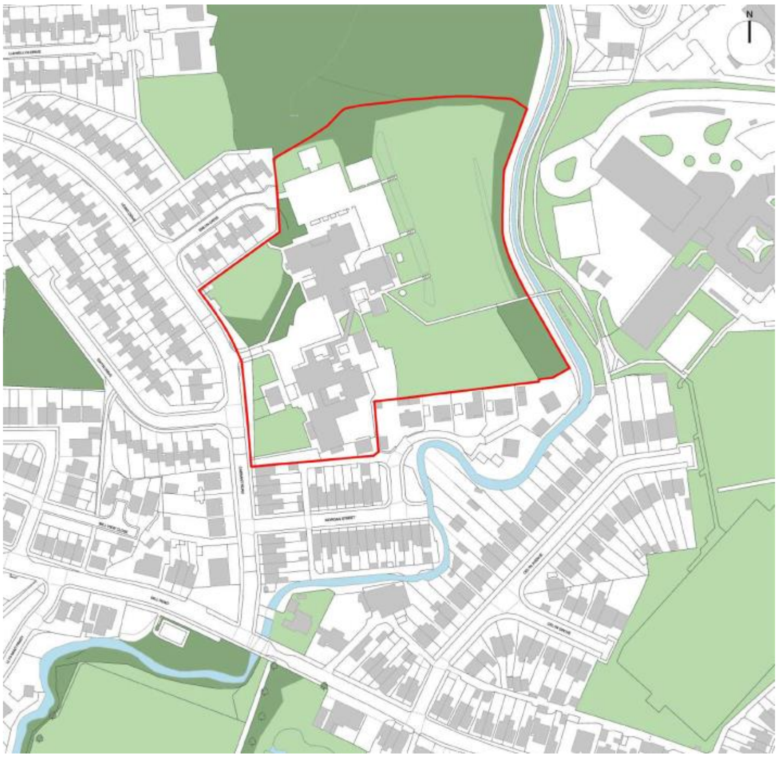

Figure 1. Site location

Flooding

The existing school site is bound to the east by the Nant yr Aber which is designated as a main river.

A review of the Flood Maps produced by Natural Resources Wales has been undertaken. This indicates that the majority of the site is contained within Flood Zone A, which is land at a risk of flooding of less than 0.1% AER (1 in 1000 years). There is a small section of the site along the eastern edge of the site adjacent to the watercourse that is shown at a high risk of flooding. However due to the site topography, this is contained in close proximity to the watercourse and does not have any impact on the development footprint of the scheme.

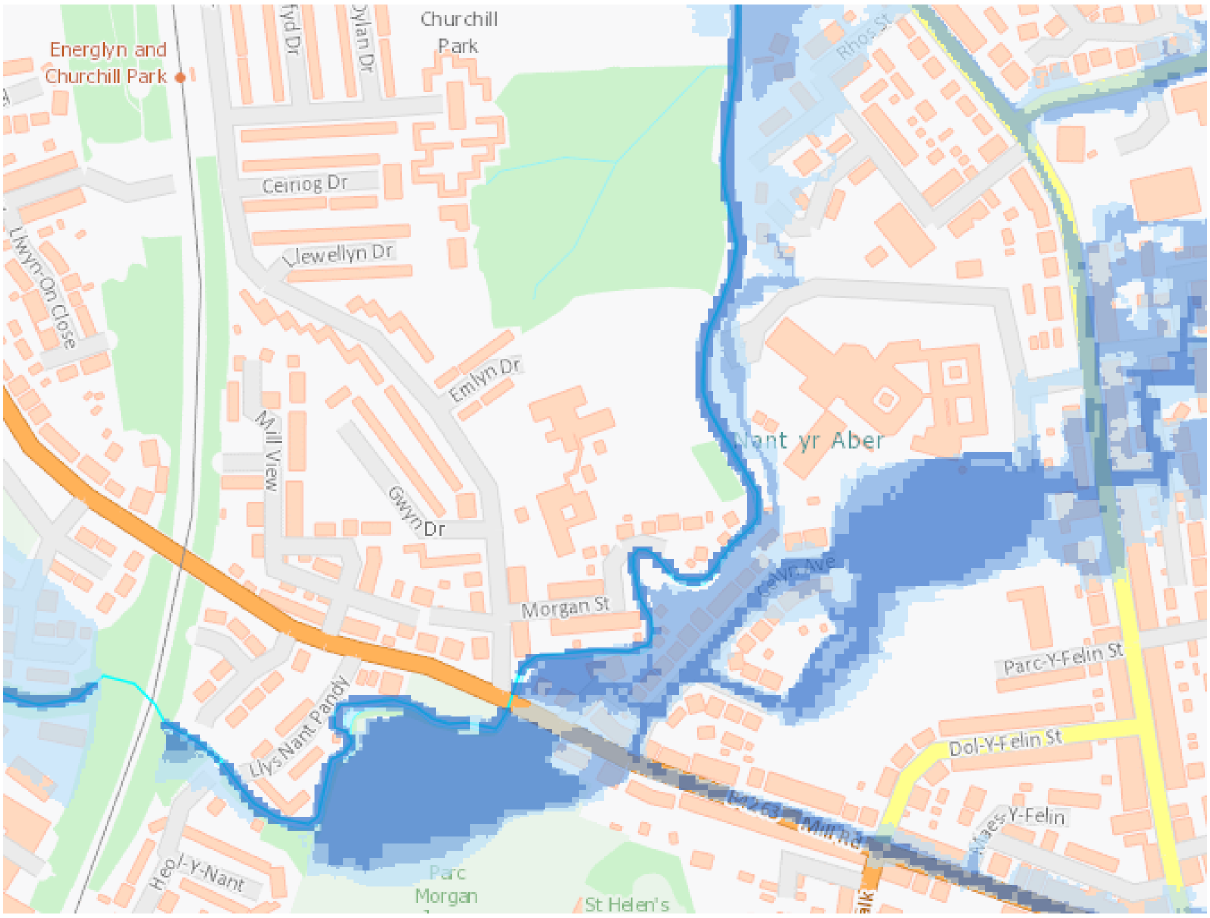

Figure 2. Extract of Natural Resources Wales flood mapping for rivers

The surface water flood maps do not indicate any flooding within the boundary of the site.

No other flooding mechanisms, such as reservoirs or artificial sources have been identified in close proximity to the site.

Existing Drainage

A topographic survey has been undertaken across the site area which identifies limited routes of existing sewers for both foul and surface water drainage. The results of the survey have been cross-referenced to the Dwr Cymru Welsh Water (DCWW) record drawings to identify which of the sewers form part of the public sewerage network and which are within private ownership serving the existing school buildings. This highlighted several discrepancies that should be verified via a GPR survey across the site.

The surveys and records indicate that there is a DCWW foul water sewer located between the nursery and infants school buildings. This route crosses the site from Emlyn Drive to the north to Morgan Street to the south, with an additional connection entering the site from Lewis Drive. Where public sewers cross private land ownership, there is normally a requirement for an easement, typically 6.0m total width, to grant access to the authority for maintenance. This will impact positioning of structures and types of planting within this zone.

The records also identify a DCWW surface water sewer. This follows a route from Emlyn Drive crossing the site to the southern boundary, prior to routing along the rear access to the properties to an outfall into the Nant-yr-Aber river in Morgan Street. The record indicates the route within the site crossing to the front of the nursey building, however there is no evidence of the manholes on the topographical survey. The survey does show partial evidence that this may follow a similar route to the foul water sewer.

The survey indicates partial drainage networks for foul and surface water sewers serving the buildings. It is currently assumed that the drainage from the schools enters the DCWW sewer networks within the site boundary.

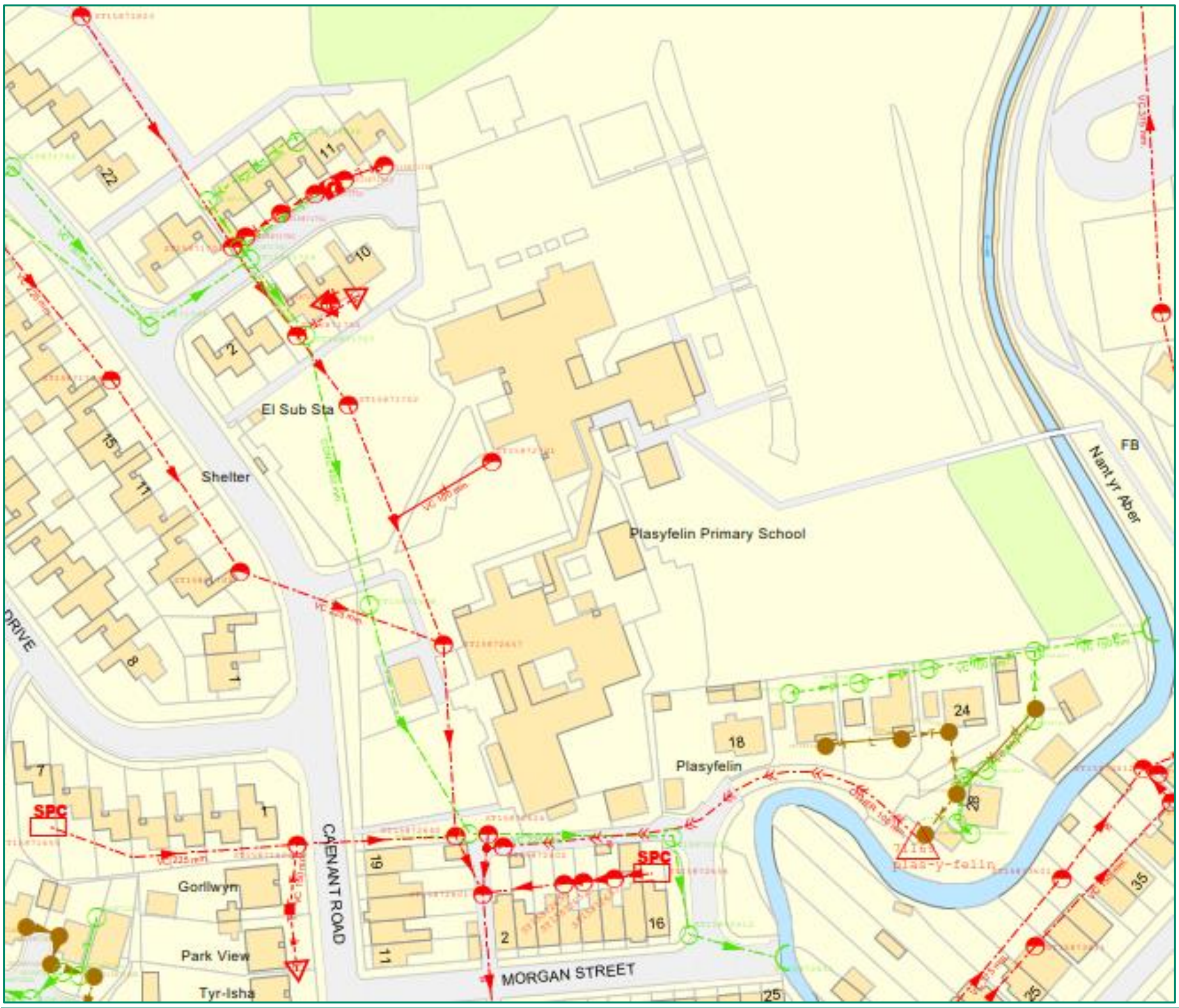

Figure 3. Extract of Dwr Cymru Welsh Water record drawing

Surface Water Drainage Strategy

The development of the site wide surface water management strategy should be based on the principals and standards contained within the Statutory Nation Standards for Sustainable Drainage Systems. This defines a drainage hierarchy as summarised below to determine the preference of design in terms of water reuse and destination:

- Collection of water for use within the development;
- Discharge via infiltration to underlying ground;
- Discharge to a watercourse or water body;
- Discharge to a surface water sewer;
- Surface water discharged to a combined sewer.

The use of rainwater harvesting to provide non-potable water for WC flushing or landscaping maintenance is not considered appropriate for use on this site. It may be possible to install localised water butts to provide a source of water for landscaping as part of the curriculum.

From a preliminary assessment of British Geological Survey data, the underlying geology is defined as the Grovesend Formation, comprising of mudstones, siltstones and sandstone. Local historic borehole records describe the shallow ground conditions predominantly as clay or silt. It is therefore not anticipated that the ground will prove suitable for infiltration drainage, however in-situ testing should be carried out during the next design stage to verify this is the case.

There is a watercourse (Nant-yr-Aber) which flows in a southerly direction along the eastern boundary of the site. This may provide a suitable outfall location for the surface water drainage, subject to limiting of flows to greenfield flow rates. Since the existing public surface water sewers discharge to the watercourse downstream of the site, it is therefore noted that an existing discharge rate to the watercourse has been established.

Due to the current site arrangement, it may be preferable for the surface water runoff to maintain an outfall into the public sewer network to replicate the existing arrangement. This will avoid risks associated with forming a new outfall to the watercourse and any ecological impact on the existing trees and planting along the riverbank. The final approval of the drainage design will require consent from the Caerphilly Council SAB and agreement from DCWW.

The current development proposals are located predominantly on brownfield land, with some areas on greenfield land. To advise further assessment, brownfield and greenfield run-off rates for the existing scenario have been calculated. Due to the phased nature of the redevelopment, it may be necessary to separately assess sections of the site and determine a suitable strategy to ensure that the permitted discharge rates are not exceeded.

Run-off rates

The following rainfall parameters have been used to determine rainfall events and run-off, with the main rainfall parameters based on FEH data at this site being as follows:

C (1 km) = -0.026 D3 (1 km) = 0.373

D1(1 km) = 0.448 E (1 km) = 0.288

D2(1 km) = 0.426 F (1 km) = 2.52

SAAR = 1507

SOIL = 0.3

Region Number = 9

Typically for the brownfield assessment of sites, the proposed development is limited to the run-off rate occurring during the 1:1 year return period for all storms. The assessment is based on a 1:1 year, 15-minute duration storm. In the absence of detailed site layout information, the flow rates have been determined for a nominal area to determine a per hectare figure. These can then be scaled using measured areas to determine run-off from areas that are to be assessed as brownfield. The brownfield run-off rates for the different return periods have been shown in Table 1.

Table 1: Brownfield runoff Rates

Return Period (1:x years)	Average Rainfall (mm/hr)	Peak Rainfall (mm/hr)	Flow Rate (l/s/ha)
1:1 year	26.635	94.129	261.5
1:2 years	33.343	117.834	327.3
1:10 years	55.227	195.172	542.1
1:30 years	79.750	281.836	782.9
1:100 years	118.260	417.930	1160.9

The derived greenfield runoff rates for the different return periods are summarised in Table 2. The figures have been given as a l/s/ha equivalent and should be scaled using the final areas that are to be assessed as greenfield.

Table 2. Greenfield runoff rates

Return Period (1:x years)	Growth Factor	Flow Rate (l/s/ha)
Qbar	-	4.47
1:1 year	0.88	3.93
1:2 years	0.93	4.16
1:10 years	1.42	6.35
1:30 years	1.76	7.87
1:100 years	2.18	9.74

Indicative Attenuation Volumes

The requirement to achieve betterment of the existing flows will require the provision of attenuation within the drainage network for the proposed development.

Typically for the brownfield assessment of sites, the proposed development is limited to the run-off rate occurring during the 1:1 year return period for all storms. The inclusion of an additional allowance for climate change is also included for the proposed scenario, together with a reduction in existing flows to achieve betterment. This is currently advised as 50%, however this will be confirmed in more detail with the SAB under a pre-app enquiry.

The anticipated attenuation volumes required to limit to greenfield and brownfield rates of runoff are given in tables 3 and 4. The volumes are based on an arbitrary site impermeable area of 1ha and give a per hectare figure in the absence of detailed site layout information.

Table 3: Estimated Attenuation Volumes - Brownfield

Return Period (1:x)	Climate Change Allowance (%)	Discharge Rate, l/s	Storage Volume, m^3/ha		
			Minimum	Maximum	Outline Design Allowance
1 year	0	131	0	21	13
10 year	5	131	9.2	92	59
30 year	10	131	56	172	126
100 year	20	131	164	331	264
100 year	40	131	217	420	339

The site layout and topography are not amenable to the provision of long-term storage of to accommodate any increase in the impermeable runoff from the site. It would therefore be necessary to limit surface water runoff from increased impermeable areas to Qbar where greenfield runoff rates are used.

Table 4: Estimated Attenuation Volumes - Greenfield

Return Period (1:x)	Climate Change Allowance (%)	Discharge Rate, l/s	Storage Volume, m^3/ha		
			Minimum	Maximum	Outline Design Allowance
1 year	0	4.5	155	356	260
10 year	5	4.5	371	704	571
30 year	10	4.5	571	996	826
100 year	20	4.5	997	1483	1289
100 year	40	4.5	1175	1823	1564

The drainage approach will be based on a series of sustainable drainage features across the site to intercept run-off from the roofs and pavements to provide treatment and attenuation of flows. At this stage, a summary table of possible options has been provided to determine the viability of inclusion within the overall strategy.

SuDs Drainage Options

Table 5: SuDS Options

Type of SuDS	Advantages	Disadvantages	Source Control	Educational Benefit	Water re-use	Principal attenuation	Supplementary storage
Green roof	May be able to be used as educational space Utilises existing roof space Opportunity for enhanced ecology/ habitat	Building design to allow for additional loading – cost implications. Coordination with roof sited plant	✓	✕	✓	✓	✕
Rainwater harvesting	Water reuse	Supplementary treatment may be required for reuse.	✕	✓	✓	✕	✕
Permeable paving	Makes use of large car parking space		✓	✕	✕	✓	✕
Swale	Allows conveyance. Opportunity for enhanced ecology/ habitat	Space requirements Would need to be shallow in order to not present a safety hazard May require piped sections	✓	✓	✕	✕	✕
Attenuation basin	Secondary treatment. Opportunity for enhanced ecology/ habitat	Unlikely to be suitable due to safety concerns and space constraints	✓	✓	✕	✓	✓
Attenuation crates	Usually more space efficient to construct than attenuation basin	No treatment or water quality benefit Can fill with sediment and be difficult to maintain	✕	✕	✕	✓	✓

At this stage, the use of permeable paving, bioretention planters or shallow swales are considered most appropriate as part of the management train. Further details of these systems are given in the following paragraphs.

Where these are unable to fully achieve the required storage, the use of cellular below ground attenuation systems may be necessary to supplement the volumes.

Bioretention

Bioretention areas, also referred to as bioretention filters or rain gardens, are surface runoff controls that capture and treat stormwater runoff from frequent rainfall events. Excess runoff from extreme events is passed forward to other drainage facilities. The surface runoff is treated using soils and vegetation in shallow basins or landscaped areas to remove pollutants. The filtered runoff is then collected and returned to the conveyance system. Part of the runoff volume will be removed through evaporation and plant transpiration. Suitable flow routes or overflows are required to convey water in excess of the design volumes to appropriate receiving drainage systems safely.

Due to their nature, bioretention areas can be integrated into external areas within the site and are suited to fitting around parking bays without excessive land-take. They allow small areas of landscaping to be incorporated into what could otherwise be a hard-landscaped site.

Figure 4. Typical Bioretention Arrangements

Engineered tree trenches constructed with the so-called “Stockholm system” can contribute to storm water management by providing water retention to the surface runoff from the adjacent paved areas and water treatment. The tree pits will also provide amenity and biodiversity benefits.

The construction of Stockholm tree pits involves the use of structural soil formed by large stone aggregate material (CIRIA C768, 2017). Subsequent layers of planting soil and structural soil in the pits create good conditions for the trees’ growth and the associated void volume constitutes available storage of the incoming runoff. The pits can be constructed with additional concrete boxes to provide support to the paved surface. A conventional gully pot with perforated base will allow the water to enter the system, at the same time serving as an aeration inlet (“*Trees and Stormwater Management. The Stockholm solution*”, B. Embrén).

Pervious pavements

Pervious pavements provide a surfacing suitable for pedestrian and/or vehicular traffic that allow rainwater to infiltrate through the surface and into the underlying layers, where water is temporarily stored before infiltration to the ground, reuse or release to a drainage system. If the permeability of the soil is insufficient to allow infiltration, or if there are contamination or shallow groundwater issues, a lined system would be required with eventual connection onto the drainage system.

Pervious pavements can be made of porous material or constructed as a permeable surface as described below:

- Porous pavements infiltrate water across their entire surface material, e.g. reinforced grass or gravel surfaces, porous concrete and porous asphalt.
- Permeable pavements are formed of material that is itself impervious. However, the materials are laid to allow surface water to infiltrate through the joints or voids between the blocks into the underlying pavement structure, intercepting surface water runoff and providing a pollutant treatment medium prior to discharge to the downstream system. Treatment processes that occur within the surface structure, the subsurface matrix and the geotextile layers include; filtration, adsorption, biodegradation and sedimentation.

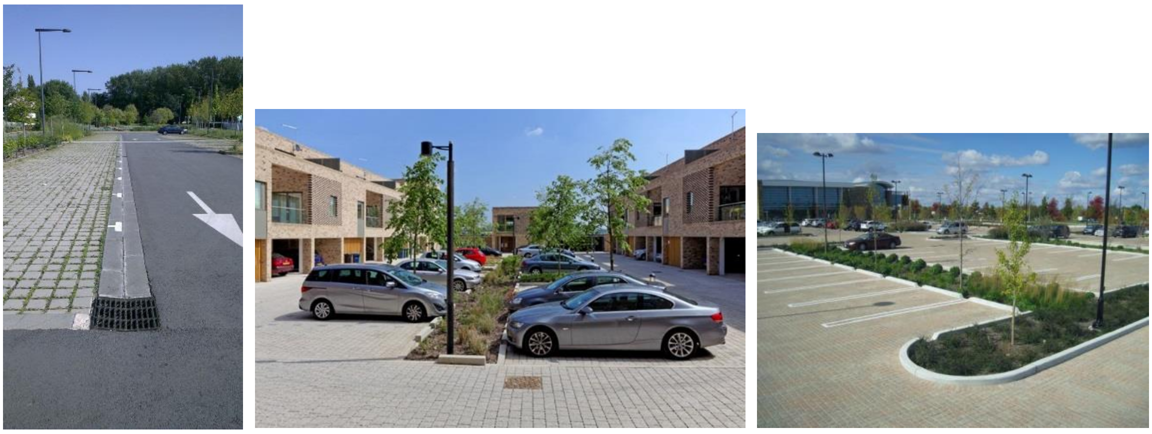

Figure 5. Typical Pervious Payment Arrangements

For this site, it is considered that permeable pavements, constructed using interlocking block paving over some or all of the surfacing, would be the most appropriate method within the private parking areas. The use of different surfacing can help, for example, to distinguish between the parking areas and the roadways within the site.

In addition, a positive strategy is required to promote SuDS and raise awareness. The site owners, occupiers and developers should be made aware of the purpose and importance of SuDS drainage and the maintenance requirements if the system is to remain private.

Channels and Swales

The vegetated channels or landscaped depressions will drain water evenly off impermeable areas. Rainwater runs through the vegetation alongside the channel which slows and filters the flow. They are designed to convey water but can also provide the benefits of detention and treatment of runoff. Incorporation of check dams or pools can slow flows, increase attenuation and promote deposition of suspended solids.

Channels and swales can be incorporated into road verges and areas of public open space to provide an amenity as well as the SuDS function. In such locations they are likely to be dominated by fine-grass species and regularly mown.

Figure 6. Typical Urban Channel and Swale Arrangements

Green/ Blue Roofs

Where there is limited space on the site, the option of providing green roofs on some of the buildings may be considered to increase the biodiversity on the site and also assist in reducing the volume of runoff and attenuating peak flows.

There are three main type of green roof, as follows:

- Extensive Green Roofs – the whole roof is covered in low growing, low maintenance plants, such as mosses, succulents, herbs and grasses. The growing medium is 25-125mm thick and the roof is intended to be largely self-sustaining, with access required only for occasional maintenance. This type of green roof can be used on flat or sloping roofs and are lightweight and cost effective.
- Intensive Green Roofs (roof gardens) – these roofs are intended to be accessed and provide high amenity benefits. They can include planters, trees and even water features. The loads imposed by these green roofs are much greater than extensive green roofs and they require significant ongoing maintenance.
- Simple Intensive Green Roofs – as with the intensive green roofs, these can be assessed, but are generally vegetated with lawns or ground covering plants, which do require regular maintenance. The structural loading associated with these green roofs is lower, so they are less expensive than standard roof gardens.

Blue roofs are an extension of the green roof approach and incorporate cellular storage systems within the overall structure to achieve attenuation of run-off at roof level, reducing the requirement for buried storage structures.

On this site, extensive or simple intensive green roofs are more likely to be the favoured solutions due to the relative low costs. It is recommended that the design of these features is considered at an early stage, with the input of a horticulturalist and structural engineer to ensure the most effective and successful solution is provided.

Figure 7. Typical Green Roof Planting

Proposed Foul Water Drainage

The proposed foul water from the school site will discharge into the existing public sewer network that runs through the school grounds.

Dwr Cymru Welsh Water have a legal obligation to accept domestic waste from development into their network, however a capacity assessment may be necessary to determine whether there is capacity within the local sewer network.

The overall number of students accommodated by the school will be increasing as part of the redevelopment of the school. There will therefore be an anticipated increase in foul water flows from the site. An initial assessment of the increased foul discharge from the site has been shown in Table 6.

Table 6: Estimated Foul Water Flows

Number of Students	Number of Staff	Flow Allowance l/head/day *(1)*	Foul Flow Rate (l/s) *(2)*	Peak Flow Rate (l/s) *(3)*
490	45	50	0.75	2.25

1 Based on British Water guidance 'Flows and Loads for Sewage Treatment Works, 4th Edition' for a school without a canteen

2 Assuming a 10 hour operational day for the school

3 Peak flow factor of 3

CCTV surveys have not currently been commissioned; therefore, the specific condition of the drainage is unknown. Since the two school buildings are being combined into a single building, it is likely that the foul flows from the school at the point of discharge will be increased compared to the current scenario. Therefore, it may not be possible to utilise the existing private connection from the southern school building into the public sewer. Detailed survey of the existing pipe network and modelling of the flows will be needed to confirm this. If the modelling confirms that this is not possible, the private connections should be abandoned, and new drainage installed to suit the scheme.

Conclusions

In summary, the following conclusions can be determined from the preparation of this document:

1. The site is largely within Flood Zone A, with a localised section of higher risk flooding following the river bank;
2. There is an existing surface water outfall arrangement to the DCWW public sewer system;
3. The preferred drainage strategy will be to retain this arrangement to avoid impacting the trees and risks associated with forming a new outfall direct to the river. The DCWW sewer outfalls to the river downstream of the site;
4. The use of SuDS will be included within the site drainage to intercept and treat run-off, with attenuation required to accommodate betterment of run-off rates;
5. Foul water drainage will be constructed to outfall to the existing DCWW network;
6. There will be an increase in the foul water discharge from the site due to increased student numbers.

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