AtkinsRéalis

Drainage Strategy

Coleg Gwent

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COLEG GWENT MASTERPLAN

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1. Introduction

AtkinsRéalis, on behalf of Coleg Gwent has prepared a drainage strategy, which incorporates a Surface Water Management Plan (SWMP) for the proposed development of Coleg Gwent Masterplan at Risca Road, Crosskeys. The strategy will focus on the disposal of surface water run-off and foul effluent, by detailing the planned use of the scheme and its anticipated impact on the site's existing drainage regime. It has been produced to be compliant with the Statutory National Standards for Sustainable Drainage Systems (SuDS) in Wales. This report will focus on Phases 2 to 4 of the masterplan, Phase 1 has been addressed in the 5228425-ATK-XX-XX-T-C-900001 Drainage Strategy document.

1.1 Background

AtkinsRéalis formed part of the consultant team to review the current Crosskeys campus performance in its entirety and formulate an operational Net Zero Carbon masterplan in line with the college vision. Key aspirations of the master planning included: improving current access, circulation, and landscape areas on campus, reviewing under-performing buildings and maintenance issues, and aligning with Welsh Government published guidance "Net Zero Carbon Status by 2030".

The masterplan was issued in 2023 and involves the phased development and refurbishment of the Crosskeys Campus. Phases 1-3 are planned for delivery (subject to funding approvals) over 9 years up to 2032, based upon space requirements, cost estimates and the phasing/decant strategy. Phases 4-6 are anticipated over 2 years each, taking the indicative completion of the masterplan to 2038.

The document "Crosskeys Campus, Coleg Gwent Net Zero Carbon Masterplan" should be referred to for further details on the overall phasing strategy plan.

1.2 Report Scope

The scope of this report is to provide a drainage strategy to support the planning application for Crosskeys Campus, Coleg Gwent Masterplan. This will be achieved by providing detail on how the surface water runoff and foul effluent will be managed in accordance with local and national guidance. Development of the strategy includes the following:

- Review of relevant local and national development guidance stated in Table 3-2.
- Review of pre-development topographical survey data.
- Review of factual ground investigation data.
- Undertake an assessment of pre-development surface water runoff rates.
- Identify existing drainage regime, systems and assets.
- Identify potential outfalls from the site for both foul effluent and surface water runoff.
- Calculate the additional foul load anticipated and identify the most appropriate discharge point.
- Consider future maintenance requirements.

1.3 Proposed Development

The proposal is to redevelop the existing site as described in section 1.1 to modernise the teaching facilities. As part of the hard and soft landscaping proposals there will be the introduction of SuDS features across the site which will provide betterment to the existing surface water regime. The works will be completed using a phased approach as shown in Figure 1-1.

Figure 1-1 - Extract from Stride Treglown drawing 155663-STL-XX-XX-DR-L-09000 Landscape Masterplan

2. Flood Risk Assessment

Coleg Gwent Campus is not located within a Flood Zone, therefore there is no requirement for a Flood Risk Assessment to be carried out. Figure 2-1 shows an extract from the Flood Zone Map from Natural Resource Wales. Refer to Appendix A to view the layout in full.

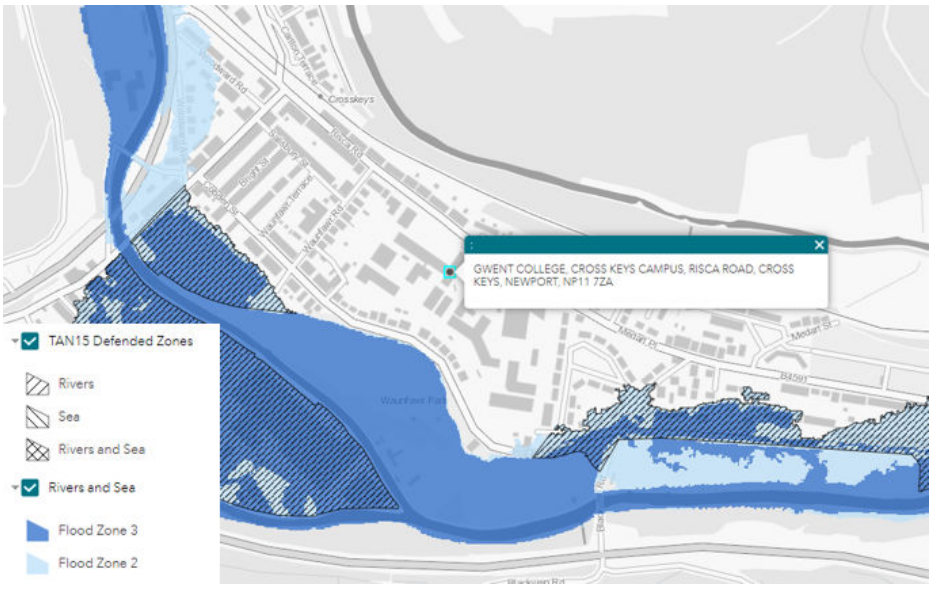


Figure 2-1 - Flood Zone Map Extract from Natural Resources Wales

Figure 2-2 shows that the site is not at risk from flooding from rivers or the sea. There are multiple areas at low to medium flood risk of surface water flooding located sporadically throughout the site. These are small and not considered a concern. Any surface water flood risks will be mitigated through the proposed surface water management plan (SWMP). Refer to Appendix A to view the layout in full.

Figure 2-2 - Flood Risk Map Extract from Natural Resource Wales

3. Policy Context

3.1 Rainfall Return Periods

Rainfall is a natural process that can present a range of different risks depending on its form. The Department for Environment, Food and Rural Affairs (DEFRA) define the risks presented by rainfall and associated flood risk according to an Annual Exceedance Probability (AEP), or as having a 'return period'.

Return period includes the statistical probability of an event occurring and the scale of the potential consequences. The 10-Year, 50-Year and the 100-Year return periods have a 10%, 2% and 1% chance of occurring in any given year, respectively. However, over a longer period the probability of flooding is considerably greater.

Table 3-1 below provides a summary of the relevant AEP and corresponding return period events of sensitivity.

Table 3-1 - Definition of AEP and 'Return Period' Rainfall Events

AEP (%)	Return Period (Years)
100%	1 in 1 Year
10%	1 in 10 Years
2%	1 in 50 Years
3%	1 in 30 Years
1%	1 in 100 Years
0.5%	1 in 200 Years
0.1%	1 in 1000 Years

3.2 Local Development Policies

The design of surface water drainage systems for all developments in Wales that are larger than 100 square metres must conform to Schedule 3 of the Flood and Water Management Act 2010. The development must seek approval from the SuDS Approval Body (SAB) before construction can commence. The SAB in this instance is Caerphilly County Council.

In addition, the design of all sewers and lateral drains must conform to BS EN 752, Building Regulations 2010 Part H, planning policy and best practice guidelines (such as Sewers for Adoption 7th Edition) wherever applicable.

In order to inform the strategy, a review has been undertaken of relevant local and national development policies as detailed in Table 3-2.

Table 3-2 - Local Development Policies and National Guidance to Inform the Report

Document Name	Published By	Date
Statutory Standards for Sustainable Drainage Systems - designing, constructing, operating and maintaining surface water drainage systems (SDSSW)	Welsh Government	2018

The key points extracted from the guidance pertinent to the proposed development are summarised in the following sections.

3.2.1 The Statutory Technical Standards for Sustainable Drainage Systems

The requirements are described in the Statutory Standards for Sustainable Drainage Systems for Wales, which also references the CIRIA SuDS Manual (C753).

There are criteria for prioritising the choice of destination for runoff, followed with standards which state the design criteria and how SuDS should be built, maintained, and operated.

A summary of the criteria is provided below:

Runoff Destination (Standard S1)
Surface water runoff destination priority levels:

Level 1 - Collected for use
Level 2 - Infiltrated to ground
Level 3 - Discharge to surface water body
Level 4 - Discharge to surface water sewer or drainage system
Level 5 - Discharge to combined sewer

Hydraulic Control (Standard S2)
A summary of standards and guidance on hydraulic criteria follows:

- Interception

Surface water should be managed to prevent, so far as possible, any discharge from the site for the majority of rainfall events of less than 5 mm. A suggested target is 80% compliance in summer and 50% compliance in winter.

- Run-off rate control

For previously developed sites, runoff rates should be reduced to the greenfield rates wherever possible. Betterment of at least 30% should be considered as a minimum requirement for Brownfield sites.

- Run-off volume control

For previously developed sites, the surface water management system should be designed so the volume of runoff discharged for the 1 in 100 year, 6-hour event is as close to greenfield conditions as possible. Where volumes cannot be sufficiently reduced, they should be discharged at a rate of 2 l/s/ha, or the average annual peak flow (QBAR), whichever is greater.

- Flood protection

Protection against flooding for external areas should be ensured for events up to 1 in 30-year return period event. Protection against flooding of buildings should be ensured for events up to the 1 in 100-year return period event.

Water Quality (Standard S3)
Treatment of surface water runoff should be provided to prevent negative impacts on the receiving water quality. The simple index approach in the SuDS manual should be followed.

Amenity & Biodiversity (Standards S4 and S5)
The design of surface water management systems should maximise amenity and biodiversity benefits.

Construction, Operation and Maintenance, and Structural Integrity (Standard S6)
All elements of the surface water drainage system should be designed so that they can be constructed, maintained and operated easily, safely and cost-effectively. Structural integrity of all elements under anticipated loading conditions should be ensured.

3.2.2 Climate Change

Planning Policy Wales advises an uplift on rainfall intensities of 40% for climate change when designing for 2085 and beyond.

Planning policy requires all surface water drainage systems to be designed to retain runoff on the site up to a 1 in 100-year rainfall event, with an allowance for climate change.

3.2.3 Hydraulic Criteria

3.2.3.1 Surface Water

The minimum size of a gravity surface water sewer is to be 100 mm diameter. To provide a self-cleansing flow regime, the minimum velocity should be 1 m/s at pipe full flow.

The system should be designed so pipework is just full, not surcharged, in events up to and including a 1 in 2 year design storm.

The system should be designed not to flood the site in events up to and including a 1 in 30 year design storm. During events exceeding that threshold, consideration should be given to the flow paths of any water escaping from the system onto the site to ensure it is contained above ground temporarily.

To ensure sufficient treatment takes place in swales, the maximum velocity should be 0.3 m/s and the residence time should be at least 9 minutes in 1-year 15-minute rainfall events.

3.2.3.2 Foul Water

The minimum size of a gravity foul water lateral drain is to be 100 mm diameter, and the minimum size of a gravity foul water sewer is to be 150 mm diameter. To provide a self-cleansing flow regime, the minimum velocity should be 0.75 m/s at one third design flow.

3.2.4 Physical Criteria

Where possible, drainage systems outside of buildings will be designed with a minimum depth of cover as follows, or protected with concrete bedding and surround:

- 0.35 m in pathways without any possibility of vehicular access.
- 0.5 m in parking area with height restriction and max gross vehicle weight of 7.5 tonnes.

- 0.9 m in parking area with limited access for vehicles in excess of 7.5 tonnes, or public open spaces.
- 1.2 m in highways or unrestricted parking areas.

Sewers and lateral drains should be positioned such that the external face is:

- At least 1.2 m from a building or structure, or a distance equivalent to the depth of the sewer below the foundation, whichever is greater.
- At least 1 m from any kerb line.

The design of all drains must conform to BS EN 752, Building Regulations 2010 Part H, planning policy and best practice guidelines (such as Sewers for Adoption 7th Edition) wherever applicable. Sanitary systems within buildings should be designed in accordance with BS EN 12056-2.

4. Existing Site Information

4.1 Site Location

Coleg Gwent, Crosskeys Campus is located adjacent to Risca Road in the centre of Crosskeys, South Wales. Grid Ref: ST 22367 91680. The site is a brownfield site and home to the current college campus. The site, along with indicative boundary line, is shown in Figure 4-1.

Figure 4-1 - Location with Campus Boundary

4.2 Topography and Site Features

The site currently consists of several college buildings car parks and landscaped areas.

The site is relatively flat, with levels falling generally from Northwest to Southeast, varying from approximately 62.50mAOD to 59.29mAOD across Phases 2 to 4. The topography survey used for reference is “Coleg Gwent Crosskeys Campus Site Survey” carried out by John Vincent Surveys Ltd, however this was completed in 2007. A new topography survey has been commissioned to establish current site levels and features in detail, however this has not been received at the time of writing.

A GPR utility survey has been commissioned to determine underground services and has not been received at the time of writing. The impact of the survey results on drainage proposals cannot be determined until such survey is received and reviewed.

4.3 Ground Investigations and Geology

At time of writing, there is no Ground Investigation (GI) information to inform the drainage design. As a result, infiltration will not be considered viable as part of the surface water management plan. Infiltration potential will be assessed as soon as the relevant information becomes available.

4.4 Water Environment

4.4.1 Existing Water Features

The closest river to the site is the Ebbw River, approximately 350m to the south, measured from Risca Road, which equates to approximately 150m south of the site boundary.

4.4.2 Existing Drainage Features

This preliminary assessment is based on historic drainage survey information. The information contains cover levels, depths, and pipe sizes; however the information is incomplete and engineering assumptions have been made.

4.4.2.1 Surface Water

The existing area of the site is served by 100mm diameter surface water drains. The majority of the Surface Water (SW) network within Phase 2 and 3 connects Rainwater Pipes (RWPs) and road gullies from the site to the highway network in Risca Road to the north. The depths of this surface water network range from approximately 0.5m to 2.9m deep at the boundary with Risca Road. The SW network within the Phase 4 areas drain towards the south to the SW network in Waunfawr Park Rd. The depths of this network range from approximately 0.4m to 1.28m deep at the south end of the Phase 4 boundary.

4.4.2.2 Foul Drainage

The existing area of the site is served by 100mm diameter foul water drains. Approximately half of the site discharges to the Dwr Cymru Welsh Water (DCWW) combined sewer in Risca Road, and half to the DCWW foul network within Waunfawr Park Rd to the south. The depths of the FW network range from approximately 0.5m to 2.1m deep.

A CCTV and drainage survey scope will be issued. The results from the survey will be used to determine the levels, capacity, condition and connectivity for both surface water and foul water networks on site, and within Risca Road and Waunfawr Park Rd where the proposed discharge points are located. Drainage information resulting from these surveys will inform later design stages.

4.5 Existing Surface Water Runoff

The existing surface water runoff has been calculated using the modified rational method. The calculations can be found in Appendix B and are summarised in table 4-1.

Table 4-1 - Discharge rates from the existing site

Return Period	Phase 2 (2763m^2) l/s	Phase 3 (2541m^2) l/s	Phase 4 (7355m^2) l/s
15min 2year	29.1	19.7	66.6
15min 30year	57.2	38.6	130.7
15min 100year	70.8	47.8	161.9

5. Drainage Strategy

5.1 Surface Water Drainage Proposals

This is a brownfield site; therefore the drainage proposal will require a minimum of 40% betterment on existing discharge rates.

5.1.1 Runoff destination (Standard S1)

The following runoff destinations have been considered:

Level 1	Collected for use	Assumed not to be appropriate in this instance due to the site use. The use of rainwater harvesting would need to be justified in conjunction with one of the below methods.
Level 2	Infiltrated to ground	Infiltration testing is yet to be carried out, therefore infiltration has been assumed to be not viable. Soakaway infiltration testing is advised as part of the ground investigation to determine infiltration potential.
Level 3	Discharge to surface water body	Not viable as the Ebbw River is not within reasonable distance and would involve crossing third party land, not within control of the client.
Level 4	Discharge to surface water sewer or drainage system	The proposal for each phase is to connect into existing on-site surface water sewer. For phases 2 and 3 discharge will be into the highway sewer in Risca Road, running along the Northern boundary of the site. For phase 4 the discharge will be into the highway sewer in Waunfawr Park Rd to the south.
Level 5	Discharge to combined sewer	N/A based on the above.

5.1.2 Surface Water Runoff Hydraulic Control (Standard 2)

5.1.2.1 Interception

Interception will need to be considered under the statutory standards. Interception aims to mimic greenfield runoff conditions by preventing runoff from the majority of all small rainfall events. This can contribute to reducing pollution load to receiving surface water bodies. Meeting the Interception criterion is not expected during particularly wet periods, when permeable surfaces and subsoils are saturated, so a suggested target is that 80% compliance should be achieved during the summer and 50% in winter. Refer to table G2.1 in the Statutory Standards for Sustainable

Drainage Systems 2018 document published by Welsh Government for details of interception mechanisms and their assumed compliance with the standards.

The SuDS systems in each phase will be sized appropriately to the size of the contributing area as specified in the Sustainable Drainage Systems Standards for Wales to ensure interception of the first 5 mm of runoff. Table 4-1 provides further detail on each feature type and the plan in appendix D provides indicative locations for features in each phase.

Table 4-1 – Interception summary

Interception method	Interception comments
Attenuation basins	To be fully compliant, contributing areas are to be no larger than five times the basin base area. The basin has been sized to achieve the 5:1 ratio.
Bioretention systems	To be fully compliant, contributing areas are to be no larger than five times the bioretention system surface area. Bioretention systems have been sized to achieve the 5:1 ratio.
Permeable paving	To be fully compliant, contributing areas are to be no larger than two times the bioretention system surface area. The permeable paving systems have been sized to achieve the 2:1 ratio.

5.1.2.2 Hydraulic Control

For the purposes of this section of the report, infiltration will not be accounted for as a means of disposing surface water runoff generated from the development, therefore the discharge volume for the site will not decrease.

As the site is brownfield in nature the statutory standards requires that the discharge rate for the site to be limited to provide a 40% betterment on the existing runoff as a minimum requirement. However, in order to provide further betterment, it is proposed to restrict the proposed discharge rates to the existing greenfield runoff rates (refer to table 5-1) which has been calculated using FEH rainfall data and the Wallingford website. The calculation output can be found in Appendix B.

Table 5-1 –Proposed discharge rates by phase

Return Period	Phase 2 (l/s)	Phase 3 (l/s)	Phase 4 (l/s)
Q2	1.67	1.49	4.48
Q30	1.67	1.49	4.48
Q100	1.67	1.49	4.48

For each phase the limited discharge will be controlled by a flow control chamber upstream of the discharge location into the existing surface water network with the proposed discharge rate being maintained for all storm events up to

and including a 1 in 100 year return period event with 40% allowance for climate change. Table 5-2 provides the levels of betterment achieve for each return period.

Table 5-2 - Proposed betterment by return period

Return Period	Phase 2 l/s (%)	Phase 3 l/s (%)	Phase 4 l/s (%)
Q2	27.4 (94)	18.2 (92)	62.1 (93)
Q30	55.5 (97)	37.1 (96.1)	126.2 (97)
Q100	69.1 (98)	46.3 (96.9)	157.4 (97)

5.1.2.3 Flood Risk and Storage

In accordance with statutory guidelines, the development of this site should not increase flood risk elsewhere and as such, all runoff from attenuated areas on site should be contained within the site boundary for up to and including a 1 in 100 year design period storm, plus 40% climate change and urban creep allowance. These allowances will have to be agreed with the SAB prior to detailed design. It is proposed to discharge surface water runoff from the developments via gravity to the highway sewer in Risca Road to the north, and Waunfawr Park Rd to the south, with runoff rates being restricted to those stated in Table 5-1 this will need to be agreed with the adopting SAB's authority and local authority's drainage department.

Storage will be required to attenuate flows above the restricted discharge rate. InfoDrainage modelling software will be used to make an estimate of storage requirements at each phase. SuDs features, such as attenuation basins, bioretention areas and permeable paving, will be sized appropriately to provide the required storage.

InfoDrainage has been used to make an estimate of the attenuation storage requirements for each phase. The estimated total volume of storage required for the 100-year return period event for each phase has been summarised in table 5-3 and a copy of the calculation outputs can be found in Appendix C.

Table 5-3 - Storage Estimate per phase

Phase / Area	Estimated Storage requirement (m^3)
Phase 2	233 - 319
Phase 3	208 - 285
Phase 4	607 - 837

Areas of the existing campus outside Phases 2 - 4 will remain unchanged; these areas will not be requiring SuDS design as the existing drainage will remain intact.

5.1.3 Water quality (Standard S3)

This standard requires treatment of surface water runoff to prevent negative impacts on the receiving water quality and/or protect downstream drainage systems including sewers. The only exception to this standard is where

drainage connects directly to a combined sewer, where the quality requirements are limited to preventing the discharge of oil and sediments to the sewer system.

The aim of the surface water management strategy with regards to water quality is to follow the guiding principles of the SDSSW and use simple, natural processes that promote biodiversity and long-term sustainability. As such, it employs a SuDS management train approach, providing drainage components in series.

The management trains to be used on the project will be assessed using the Simple Index Assessment (SIA) tool available publicly (http://www.ukSuDS.com/drainage-calculation-tools/water-quality-assessment-for-SuDS-developments) which is built around the principles for simple assessment outlined in CIRIA C753 to assess the levels of treatment provided by the proposals.

Planting within the SuDS features should form part of the water quality strategy. SuDS components like bio retention areas provide water quality improvements by reducing sediment and contaminants from runoff either through settlement or biological breakdown of pollutants as part of their interceptor function, so only robust and tolerant species of planting should be specified. Once these species establish this will decrease the flow rate of water travelling through and filter pollutants and contaminants before entering the downstream network.

5.1.4 Amenity (Standard S4)

The primary amenity focus of the SuDS scheme should be to improve the health and well-being of the users. The scheme will need to be based on natural forms that mimic natural landscapes found within the region and the vegetated bioretention planting areas are designed with locally contextual species that will encourage natural colonisation. Other key amenity benefits should include improving air quality around the development, increasing carbon sequestration and improving water quality through removal of pollutants via bioretention areas and the attenuation basins.

5.1.5 Biodiversity (Standard S5)

The SuDS scheme biodiversity strategy should revolve around the creation of significant and varied habitat to increase the overall biodiversity of the site and ecological value. The inclusion of plant species that will enhance the general eco system and simultaneously act as a water filtration system to clean pollutants and contaminants should be used where possible.

The plant species selected should be both locally contextual and appropriate for the varied habitat zones including primary characteristics that shall ensure:

- Good soil binding and filtration species
- Minimised erosion
- Improved filtration via dense root and stem species
- Tolerance to seasonal variations including droughts and inundations
- Good suspended-solids retention
- Pollutant tolerant
- Emergent and pioneering species for natural ecological colonisation
- The creation of diverse, self-sustaining and resilient ecosystems for high species biodiversity
- Support for local and regional habitat strategies

In general, the proposed bioretention areas and attenuation basin will be the focal habitat for the site and will enhance the site over the current site layout by adding areas of water and damp soils. Exposed areas of rain

gardens will attract certain species and shaded areas under adjacent buildings and trees will further enhance the varied ecosystem potential.

5.1.6 Design of Drainage for Construction and Maintenance and Structural Integrity (Standard 6)

The surface water drainage system should be designed with the overriding ethos of simplicity in construction, use and maintenance. This then allows a very simple translation from the principles described within standard S6, namely that all elements of the surface water drainage system should be designed so that they can be constructed, as well as maintained and operated "…easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy)." (SDSSW).

The proposed system will be managed by the client as they will be the sole landowner and will be managing all the elements within the site boundary, therefore the client's maintenance team will be responsible for the maintenance of all elements of the system to ensure it continues to comply with SuDS standards.

Information with regards to the construction methodology and requirements of the proposed system will be developed as part of the detailed design stage of the project. Likewise, the maintenance requirements and regime of the proposed system will be developed into the full maintenance strategy for the site during the next phase of design development. This will be developed in conjunction with the client's maintenance team, as it is not considered appropriate for these details to be developed by the design team in isolation from the end users. This will then need to be confirmed and submitted for approval to the SAB prior to construction commencing on site.

6. Foul Water Drainage Proposals

6.1 Design summary

The proposed foul water strategy is to collect the flows from the buildings and discharge them via new connections into the existing on-site sewer system. It is proposed to route all below ground drainage in such a way as to avoid the location of the future phase buildings to ensure there are no clashes in the future.

Though there are several new buildings proposed for phases 2 to 4, the overall capacity of the college is not set to increase, so there will be minimal increase in flows into the existing DCWW system.

The existing pipework downstream of the connection point will need to be surveyed to confirm the level at the proposed new manhole location. A CCTV survey will also be required to establish the existing pipes condition and suitability for reuse by the new phase of works. These investigation works will need to be carried out during Stage 3 to inform the detailed design.

A Pre Planning Advice (PPA) will need to be submitted to DCWW at each phase of works to confirm the capacity within the existing system to accept the flows from the development.

All on site sewerage systems will be designed and constructed to comply with building regulations requirements with any adopted elements in accordance with the latest edition of “Sewers for Adoption” and any of the adopting authority’s (DCWW) specific requirements.

6.2 Capacity of receiving network

The existing college is currently connected into the existing combined network which is owned by DCWW. A Pre Planning Advice (PPA) was submitted to DCWW for phase 1 of the works where they confirmed capacity was available within the existing system to accept the flows from the development. Given the length of time to deliver all the phases a (PPA) submission maybe required for each phase of the development to confirm the capacity within the public network – given the minimal changes in staff and student numbers over the phases we would envisage no capacity issues at the time of writing this report.

6.3 Adoption

It is necessary to apply to DCWW for any connection to the public sewer under Section 106 of the Water Industry Act 1991. If the connection to the public sewer network will be via a lateral drain extending beyond the property boundary, it is mandatory to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). It is not currently anticipated that a Section 104 will be required.

All on site sewerage systems will be designed and constructed to comply with building regulations requirements with any adopted elements in accordance with the latest edition of “Sewers for Adoption” and any of the adopting authority’s (DCWW) specific requirements.

7. Summary

The aim of the surface water drainage strategy is to mimic the natural catchment processes as closely as possible. The proposed system will need to be designed in accordance with the statutory (SDSSW) document 2018 and any local authority's SAB requirements and CIRIA's C753 SuDS Manual as well as meeting the requirements of Building Regulations, Document H.

In determining a suitable methodology for disposal of surface water flows from this development, it is necessary to explore the technical options outlined under Standard S1 in the statutory (SDSSW) document 2018 published by the Welsh Government. Based on the hierarchy it is proposed to discharge surface water runoff from the development to the existing surface water sewer.

Surface water runoff is to be attenuated from site by phase, to the figures stated in Section 5. These run-off rates will then be maintained for all rainfall events up to and including a 100YRP with 40% allowance for climate change and urban creep. Given the proposed site layout, storage could be provided in the form of bioretention areas, permeable paving and attenuation basins. The main storage features for the site will be attenuation basins. All drainage features will be developed further at detailed design stage.

As the scheme is a education development it has been considered that the use of a grey water system would not be suitable due to there being periods of very low demand, which may result in legionella issues. However, other basic forms of rainwater harvesting could be incorporated into the development in the form of rainwater butts that will collect water from rainwater downpipes and store it for irrigation of the soft landscaped areas and planting beds, however these areas will be accepting runoff for the adjacent hard paved areas, the feasibility of this will be determined at later stages of design.

Amenity and biodiversity benefits to the site will be provided by incorporating bioretention areas. These will form part of the attenuation storage for the site along with the attenuation basins. Bioretention areas will maximise the available green infrastructure within the development, which will improve air quality and water quality of the site.

All on site surface water drainage systems will be designed and constructed to comply with the (SDSSW) and building regulations requirements. The detailed design of the scheme will incorporate the philosophies outlined in this report regarding standards S1-S6 listed in section 5 of this report.

The proposed foul drainage strategy is to collect the flows from the building and discharge them via a new connection into the existing on-site sewer system to avoid any offsite connections to the public sewer network. It is proposed to route all below ground drainage in such a way as to avoid the location of the future phase buildings to ensure there are no clashes in the future.

We would envisage no capacity issues at the time of writing this report based on the minimal changes in staff and student numbers over the phases however given the length of time to deliver all the phases a (PPA) submission maybe required for each phase of the development to confirm the capacity within the public network.

All on site sewerage systems will be designed and constructed to comply with building regulations requirements with any adopted elements in accordance with the latest edition of "Sewers for Adoption" and any of the adopting authority's (DCWW) specific requirements.

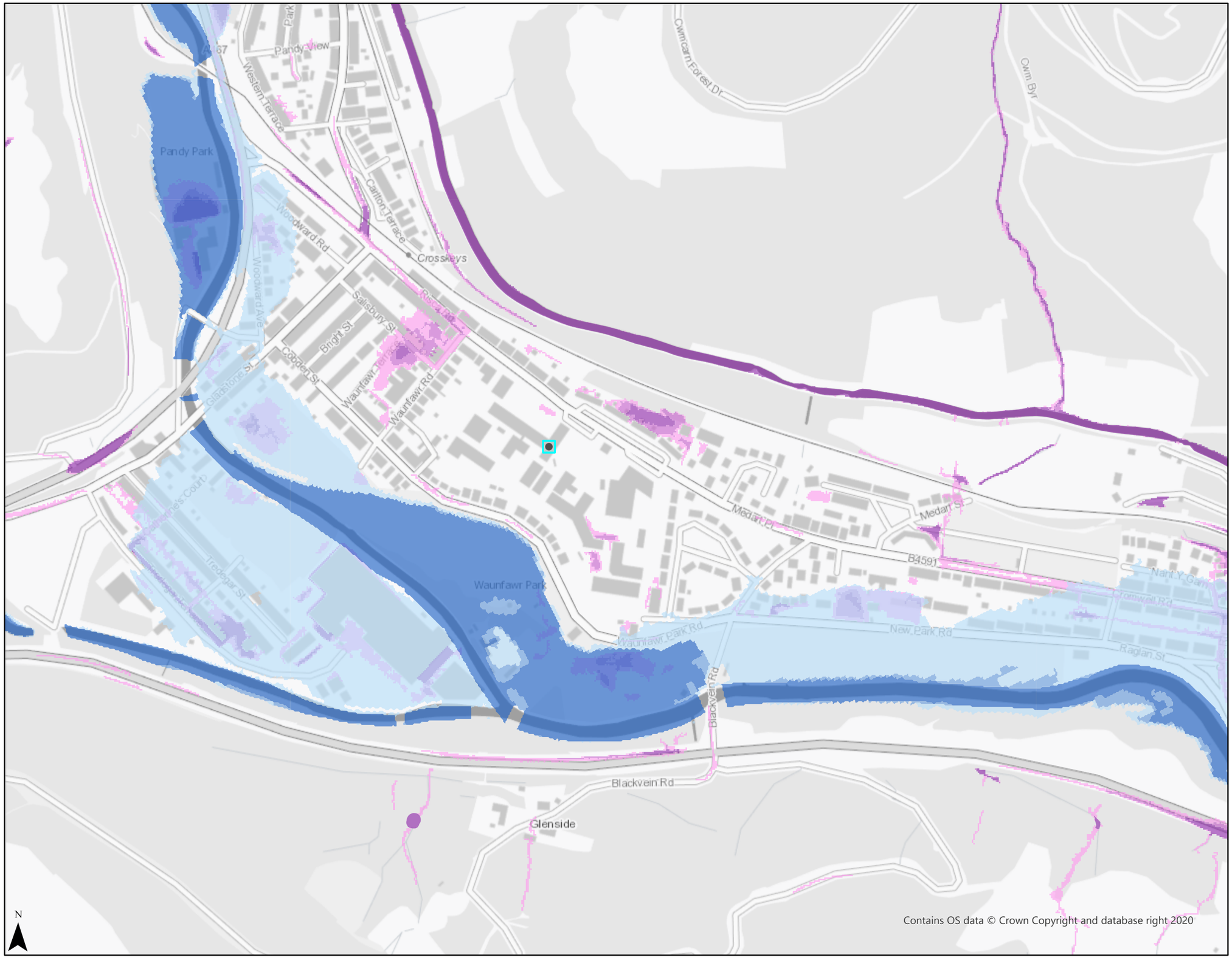
APPENDICES

Appendix A. Existing Flood Maps

Cyfoeth Naturiol Cymru
Natural Resources Wales

Flood Risk Maps

Coleg Gwent Flood Risk Map



Legend

Flood Risk from Rivers
- High
- Medium
- Low

Flood Risk from the Sea
- High
- Medium
- Low

Flood Risk from Surface Water & Small Watercourses
- High
- Medium
- Low
- Risk Level Under Review

Scale at A3: 1:5,000

Date: 26/03/2024

0.2 0.1 0 0.2
km

British National Grid

Disclaimer

https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

Cyfoeth Naturiol Cymru
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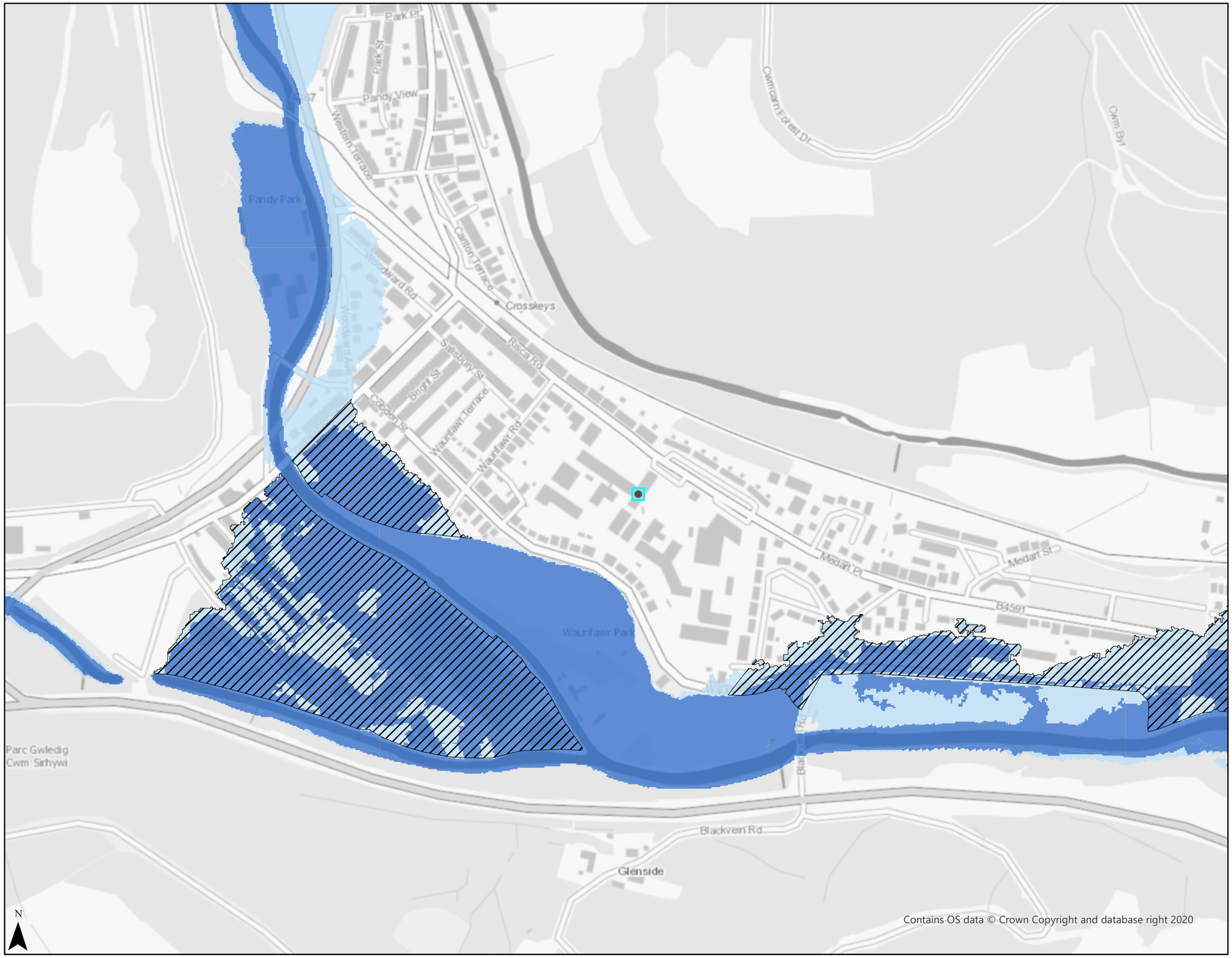
Flood Map for Planning - Basic

Coleg Gwent Flood Zone



Legend

TAN15 Defended Zones

- Rivers
- Sea
- Rivers and Sea

Rivers and Sea

- Flood Zone 3
- Flood Zone 2

Scale at A3: 1:5,000

Date: 26/03/2024

0.2 0.1 0 0.2

km

British National Grid

Disclaimer

https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

Appendix B. Existing Runoff Rate Calculations

ATKINS	Project: Coleg Gwent Phase 2			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations	Output
	The Modified Rational Method	Input
Ref	*Wallingford Procedure - Vol 4 - The Modified Rational method*	Calc
	The Rational Formula **Qp = C i A**	Linked
	Qp = Peak Discharge (l/s)	
	C = Dimensionless Coefficient	
	i = Average Rainfall Intensity during time of Concentration (mm/hour)	
	A = Contributing Catchment Area (ha)	
	If the Area (A) is expressed in Hectares and the rainfall intensity (i) in mm/ hr the equation becomes	
	Qp = 2.78 C i A	
	$C = C_v C_R$ C_v = proportion of rainfall on catchment which appears as surface runoff in storm drainage system = average 0.75 (0.6 in rapidly draining soils & 0.9 in heavy soils)	
	C_R = constant value of 1.30	
	C_v = 1.00	
	C_R = 1.3	
	C = 1.3	
	Applying the dimensionless coefficient using the parameters above gives a revised equation of:	
	Qp = 2.71 i A	
	Time of Concentration (Tc)	

ATKINS	Project: Coleg Gwent Phase 2			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations	Output

$t_c = t_e + t_f$

t_c = Time of Concentration

t_e = Time of Entry - represents delay & attenuation of flow over ground surface

t_f = Time of Flow through pipe system to point under consideration

The Wallingford Procedure would recommend the following t_e values:

Return Period	*t_e (mins)*
5 yrs	3 - 6
2 yrs	4 - 7
1 yr	4 - 8
1 mth	5 - 10

Use longer times of entry at each return period for large flat subcatchments (area > 400m^2, slope <1:50)

Use smaller values for small steep subcatchments (area <200m^2, slope >1:30)

t_e =	10	mins
t_f =	5	mins
t_c =	15	mins

assume 15min event is appropriate design event - see pg 5

Assessment of Rainfall Intensity

Step 1 Determine M5-60 min rainfall and the coefficient r for the

Ref	Calculations	Output

site from the mapping included in the Wallingford Procedure

M5 - 60mins = 5 year return period and 60 minute duration rainfall depth - Use M5-60 Map

M5-60 min Rainfall 19.6 (mm - Total rainfall)

r = ratio of 5yr - 60min duration and 5 yr - 2 day duration rainfall depth - Use r map

r 0.247

Step 2 Determine rainfall depths for 5 year return period for all required return periods, D = M5 - D

Using the r value above establishing the Z1 value from the graph in the Wallingford procedure (Fig A.3a)

r = 0.247

Return Period	Duration (D)		Z1	M5-D (mm total)
M5	5	Min	0.28	5.49
M5	10	Min	0.49	9.60
M5	15	Min	0.56	10.98
M5	30	Min	0.72	14.11
M5	1	Hour	1.00	19.60
M5	2	Hour	1.20	23.52
M5	4	Hour	1.60	31.36
M5	6	Hour	1.80	35.28
M5	10	Hour	2.20	43.12

M5-D values are calculated by factoring the M5-60 value by Z1

Step 3 Determine MT-D

This is determined from the relationship

ATKINS	Project: Coleg Gwent Phase 2			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
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Ref	Calculations	Output

MT - D = Z2 (M5-D)

Z2 Values for Rainfall Depths

M5 Rainfall (mm)	M1	M2	M5	M10	M20	M30	M50	M100
5	0.62	0.79	1.02	1.19	1.36	1.46	1.56	1.79
10	0.61	0.79	1.03	1.22	1.41	1.55	1.69	1.91
15	0.62	0.80	1.03	1.24	1.44	1.57	1.70	1.99
20	0.64	0.81	1.03	1.24	1.45	1.56	1.66	2.03
25	0.66	0.82	1.03	1.24	1.44	1.54	1.64	2.01
30	0.68	0.83	1.03	1.24	1.42	1.52	1.61	1.97
40	0.70	0.84	1.02	1.19	1.38	1.47	1.56	1.89
50	0.72	0.85	1.02	1.17	1.34	1.43	1.52	1.81
75	0.76	0.87	1.02	1.14	1.28	1.37	1.45	1.64
100	0.78	0.88	1.02	1.13	1.25	1.33	1.40	1.54
150	0.78	0.88	1.01	1.12	1.21	1.27	1.33	1.45
200	0.78	0.88	1.01	1.11	1.19	1.25	1.30	1.40

Table A1 Relationship between rainfall of return period T(MT) and M5

Ref Wallingford Procedure Vol 4

100 Year

M5 - D Event		M5-D	Z1 values for 100 year event					M100 - D Event	
		Total rainfall	Lower		Higher		Interpolated	Total rainfall	Intensity
		mm	mm	Z2	mm	Z2	Z2	mm	mm/hr
5	Min	5.49	5	1.79	10	1.91	1.80	9.89	118.67
10	Min	9.60	5	1.79	10	1.91	1.90	18.25	109.49
15	Min	10.98	10	1.91	15	1.99	1.93	21.14	84.56
30	Min	14.11	10	1.91	15	1.99	1.98	27.89	55.77

ATKINS

Project: Coleg Gwent Phase 2			Job ref: 5228425	
Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations													Output			
	1	Hour	19.60	15	1.99	20	2.03	2.03		39.73		39.73
	2	Hour	23.52	20	2.03	25	2.01	2.02		47.42		23.71
	4	Hour	31.36	25	2.01	30	1.97	1.96		61.43		15.36
	6	Hour	35.28	25	2.01	30	1.97	1.93		68.02		11.34
	10	Hour	43.12	30	1.97	40	1.89	1.87		80.42		8.04
30 Year																	
	M5 - D Event		**M5-D**	**Z1 values for 30 year event**						**M30 - D Event**			
			Total rainfall mm	Lower		Higher		Interpolated		Total rainfall mm		Intensity mm/hr
				mm	Z2	mm	Z2	Z2				
	5	Min	5.49	5	1.46	10	1.55	1.47		8.06		96.74
	10	Min	9.60	5	1.46	10	1.55	1.54		14.82		88.91
	15	Min	10.98	10	1.55	15	1.57	1.55		17.06		68.23
	30	Min	14.11	10	1.55	15	1.57	1.57		22.10		44.20
	1	Hour	19.60	15	1.57	20	1.56	1.56		30.60		30.60
	2	Hour	23.52	20	1.56	25	1.54	1.55		36.36		18.18
	4	Hour	31.36	25	1.54	30	1.52	1.52		47.51		11.88
	6	Hour	35.28	25	1.54	30	1.52	1.50		52.88		8.81
	10	Hour	43.12	30	1.52	40	1.43	1.40		60.45		6.05
2 Year																	
	M5 - D Event		**M5-D**	**Z1 values for 2 year event**						**M2 - D Event**			
			rainfall mm	Lower		Higher		Interpolated		rainfall mm		Intensity mm/hr
				mm	Z2	mm	Z2	Z2				
	5	Min	5.49	5	0.79	10	0.79	0.79		4.34		52.03
	10	Min	9.60	5	0.79	10	0.79	0.79		7.59		45.52
	15	Min	10.98	10	0.79	15	0.8	0.79		8.69		34.77
	30	Min	14.11	10	0.79	15	0.8	0.80		11.26		22.52
	1	Hour	19.60	15	0.8	20	0.81	0.81		15.86		15.86
	2	Hour	23.52	20	0.81	25	0.82	0.82		19.22		9.61
	4	Hour	31.36	25	0.82	30	0.83	0.83		26.12		6.53
	6	Hour	35.28	25	0.82	30	0.83	0.84		29.67		4.95
	10	Hour	43.12	30	0.83	40	0.84	0.84		36.35		3.64
	Calculation of Runoff for Site / Catchment																
			Qp = 2.78 C i A														
			Qp = 2.78 Cv Cr i A														
	C_v	=	1.00														
	C_r	=	1.3														
	t_c		15	Assume 15min duration event appropriate													

ATKINS	Project: Coleg Gwent Phase 2			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations	Output
	i = 84.56	M100 - 15 appropriate for t_c
	68.23	M30 - 15 appropriate for t_c
	34.77	M2 - 15 appropriate for t_c
	A = 2762.69 m^2	Catchment area for developed site
	= 0.276 ha	
	Qp = 84.3 l/s	100 year
	68.1 l/s	30 year
	34.7 l/s	2 year
	Note the above value considers that the catchment as 100% impermeable. The value needs to be factored by an appropriate value to account for the surface type	
Ref	McGhee: Water Supply and Sewerage Table 13-3 Runoff coefficients for different areas	

TABLE 13-3
Runoff coefficients for different areas[3]

Description of area	C
Business	
Downtown area	0.70–0.95
Neighborhood area	0.50–0.70
Residential (urban)	
Single-family area	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (surburban)	0.25–0.40
Apartment areas	0.50–0.70
Industrial	
Light	0.50–0.80
Heavy	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yards	0.20–0.40
Unimproved areas	0.10–0.30

Pre Development				
Permeable Area =	20.00%	Unimproved areas C =	0.2	Undeveloped Land
Impermeable Area =	80.00%	All Run-off C =	1	Asphalt Road, existing plot
Runoff Coefficient = permeable area x C + impermeable area x C				
Selected runoff coefficient	0.84			
	Residential - Multiunits, attached			
Factored runoff from Site				

ATKINS	Project: Coleg Gwent Phase 2			Job ref: 5228425	
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Ref	Calculations	Output
	Qp = 70.8 l/s 100 year	
	57.2 l/s 30 year	
	29.1 l/s 2 year	

ATKINS	Project: Coleg Gwent Phase 3			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations	Output
	The Modified Rational Method	Input
Ref	*Wallingford Procedure - Vol 4 - The Modified Rational method*	Calc
	The Rational Formula **Qp = C i A**	Linked
	Qp = Peak Discharge (l/s)	
	C = Dimensionless Coefficient	
	i = Average Rainfall Intensity during time of Concentration (mm/hour)	
	A = Contributing Catchment Area (ha)	
	If the Area (A) is expressed in Hectares and the rainfall intensity (i) in mm/ hr the equation becomes	
	Qp = 2.78 C i A	
	$C = C_v C_R$ C_v = proportion of rainfall on catchment which appears as surface runoff in storm drainage system = average 0.75 (0.6 in rapidly draining soils & 0.9 in heavy soils)	
	C_R = constant value of 1.30	
	C_v = 1.00	
	C_R = 1.3	
	C = **1.3**	
	Applying the dimensionless coefficient using the parameters above gives a revised equation of:	
	Qp = 2.71 i A	
	Time of Concentration (Tc)	

ATKINS	Project: Coleg Gwent Phase 3			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
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Ref	Calculations	Output

$t_c = t_e + t_f$

t_c = Time of Concentration

t_e = Time of Entry - represents delay & attenuation of flow over ground surface

t_f = Time of Flow through pipe system to point under consideration

The Wallingford Procedure would recommend the following t_e values:

Return Period	*t_e (mins)*
5 yrs	3 - 6
2 yrs	4 - 7
1 yr	4 - 8
1 mth	5 - 10

Use longer times of entry at each return period for large flat subcatchments (area > 400m^2, slope <1:50)

Use smaller values for small steep subcatchments (area <200m^2, slope >1:30)

t_e =	10	mins
t_f =	5	mins
t_c =	15	mins

assume 15min event is appropriate design event - see pg 5

Assessment of Rainfall Intensity

Step 1 Determine M5-60 min rainfall and the coefficient r for the

Ref	Calculations	Output

site from the mapping included in the Wallingford Procedure

M5 - 60mins = 5 year return period and 60 minute duration rainfall depth - Use M5-60 Map

M5-60 min Rainfall 19.6 (mm - Total rainfall)

r = ratio of 5yr - 60min duration and 5 yr - 2 day duration rainfall depth - Use r map

r 0.247

Step 2 Determine rainfall depths for 5 year return period for all required return periods, D = M5 - D

Using the r value above establishing the Z1 value from the graph in the Wallingford procedure (Fig A.3a)

r = 0.247

Return Period	Duration (D)		Z1	M5-D (mm total)
M5	5	Min	0.28	5.49
M5	10	Min	0.49	9.60
M5	15	Min	0.56	10.98
M5	30	Min	0.72	14.11
M5	1	Hour	1.00	19.60
M5	2	Hour	1.20	23.52
M5	4	Hour	1.60	31.36
M5	6	Hour	1.80	35.28
M5	10	Hour	2.20	43.12

M5-D values are calculated by factoring the M5-60 value by Z1

Step 3 Determine MT-D

This is determined from the relationship

ATKINS	Project: Coleg Gwent Phase 3			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
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Ref	Calculations	Output

MT - D = Z2 (M5-D)

Z2 Values for Rainfall Depths

M5 Rainfall (mm)	M1	M2	M5	M10	M20	M30	M50	M100
5	0.62	0.79	1.02	1.19	1.36	1.46	1.56	1.79
10	0.61	0.79	1.03	1.22	1.41	1.55	1.69	1.91
15	0.62	0.80	1.03	1.24	1.44	1.57	1.70	1.99
20	0.64	0.81	1.03	1.24	1.45	1.56	1.66	2.03
25	0.66	0.82	1.03	1.24	1.44	1.54	1.64	2.01
30	0.68	0.83	1.03	1.24	1.42	1.52	1.61	1.97
40	0.70	0.84	1.02	1.19	1.38	1.47	1.56	1.89
50	0.72	0.85	1.02	1.17	1.34	1.43	1.52	1.81
75	0.76	0.87	1.02	1.14	1.28	1.37	1.45	1.64
100	0.78	0.88	1.02	1.13	1.25	1.33	1.40	1.54
150	0.78	0.88	1.01	1.12	1.21	1.27	1.33	1.45
200	0.78	0.88	1.01	1.11	1.19	1.25	1.30	1.40

Table A1 Relationship between rainfall of return period T(MT) and M5

Ref Wallingford Procedure Vol 4

100 Year

M5 - D Event		M5-D	Z1 values for 100 year event					M100 - D Event	
		Total rainfall	Lower		Higher		Interpolated	Total rainfall	Intensity
		mm	mm	Z2	mm	Z2	Z2	mm	mm/hr
5	Min	5.49	5	1.79	10	1.91	1.80	9.89	118.67
10	Min	9.60	5	1.79	10	1.91	1.90	18.25	109.49
15	Min	10.98	10	1.91	15	1.99	1.93	21.14	84.56
30	Min	14.11	10	1.91	15	1.99	1.98	27.89	55.77

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Ref	Calculations	Output

	1	Hour	19.60	15	1.99	20	2.03	2.03		39.73		39.73
	2	Hour	23.52	20	2.03	25	2.01	2.02		47.42		23.71
	4	Hour	31.36	25	2.01	30	1.97	1.96		61.43		15.36
	6	Hour	35.28	25	2.01	30	1.97	1.93		68.02		11.34
	10	Hour	43.12	30	1.97	40	1.89	1.87		80.42		8.04

30 Year

	M5 - D Event		**M5-D**	**Z1 values for 30 year event**						**M30 - D Event**	
			Total rainfall mm	Lower		Higher		Interpolated		Total rainfall mm	Intensity mm/hr
				mm	Z2	mm	Z2	Z2			
	5	Min	5.49	5	1.46	10	1.55	1.47		8.06	96.74
	10	Min	9.60	5	1.46	10	1.55	1.54		14.82	88.91
	15	Min	10.98	10	1.55	15	1.57	1.55		17.06	68.23
	30	Min	14.11	10	1.55	15	1.57	1.57		22.10	44.20
	1	Hour	19.60	15	1.57	20	1.56	1.56		30.60	30.60
	2	Hour	23.52	20	1.56	25	1.54	1.55		36.36	18.18
	4	Hour	31.36	25	1.54	30	1.52	1.52		47.51	11.88
	6	Hour	35.28	25	1.54	30	1.52	1.50		52.88	8.81
	10	Hour	43.12	30	1.52	40	1.43	1.40		60.45	6.05

2 Year

	M5 - D Event		**M5-D**	**Z1 values for 2 year event**						**M2 - D Event**	
			rainfall mm	Lower		Higher		Interpolated		rainfall mm	Intensity mm/hr
				mm	Z2	mm	Z2	Z2			
	5	Min	5.49	5	0.79	10	0.79	0.79		4.34	52.03
	10	Min	9.60	5	0.79	10	0.79	0.79		7.59	45.52
	15	Min	10.98	10	0.79	15	0.8	0.79		8.69	34.77
	30	Min	14.11	10	0.79	15	0.8	0.80		11.26	22.52
	1	Hour	19.60	15	0.8	20	0.81	0.81		15.86	15.86
	2	Hour	23.52	20	0.81	25	0.82	0.82		19.22	9.61
	4	Hour	31.36	25	0.82	30	0.83	0.83		26.12	6.53
	6	Hour	35.28	25	0.82	30	0.83	0.84		29.67	4.95
	10	Hour	43.12	30	0.83	40	0.84	0.84		36.35	3.64

Calculation of Runoff for Site / Catchment

$Qp = 2.78\ C\ i\ A$

$Qp = 2.78\ Cv\ Cr\ i\ A$

C_v	=	1.00	
C_r	=	1.3	
t_c		15	Assume 15min duration event appropriate

ATKINS	Project: Coleg Gwent Phase 3			Job ref: 5228425	
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Ref	Calculations	Output
	i = 84.56	M100 - 15 appropriate for t_c
	68.23	M30 - 15 appropriate for t_c
	34.77	M2 - 15 appropriate for t_c
	A = 2540.96 m^2	Catchment area for developed site
	= 0.254 ha	
	Qp = 77.6 l/s	100 year
	62.6 l/s	30 year
	31.9 l/s	2 year
	Note the above value considers that the catchment as 100% impermeable. The value needs to be factored by an appropriate value to account for the surface type	
Ref	McGhee: Water Supply and Sewerage Table 13-3 Runoff coefficients for different areas	

TABLE 13-3
Runoff coefficients for different areas[3]

Description of area	C
Business	
Downtown area	0.70–0.95
Neighborhood area	0.50–0.70
Residential (urban)	
Single-family area	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (surburban)	0.25–0.40
Apartment areas	0.50–0.70
Industrial	
Light	0.50–0.80
Heavy	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yards	0.20–0.40
Unimproved areas	0.10–0.30

Pre Development				
Permeable Area =	48.00%	Unimproved areas C =	0.2	Undeveloped Land
Impermeable Area =	52.00%	All Run-off C =	1	Asphalt Road, existing plot
Runoff Coefficient = permeable area x C + impermeable area x C				
Selected runoff coefficient	0.616			
	Residential - Multiunits, attached			
Factored runoff from Site				

ATKINS	Project: Coleg Gwent Phase 3			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations				Output
	Qp =	**47.8**	**l/s**	100 year	
		38.6	**l/s**	30 year	
		19.7	**l/s**	2 year	
	Post Development				
	Permeable Area =		Unimproved areas C =	0.2	Undeveloped Land
	Impermeable Area =		All Run-off C =	1	Asphalt Road, existing plot
	Runoff Coefficient = permeable area x C + impermeable area x C				
	Selected runoff coefficient	0			
	Factored runoff from Site				
	Qp =	**0.0**	**l/s**	100 year	
		0.0	**l/s**	30 year	
		0.0	**l/s**	2 year	

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Ref	Calculations	Output
	The Modified Rational Method	Input
Ref	*Wallingford Procedure - Vol 4 - The Modified Rational method*	Calc
	The Rational Formula **Qp = C i A**	Linked
	Qp = Peak Discharge (l/s)	
	C = Dimensionless Coefficient	
	i = Average Rainfall Intensity during time of Concentration (mm/hour)	
	A = Contributing Catchment Area (ha)	
	If the Area (A) is expressed in Hectares and the rainfall intensity (i) in mm/ hr the equation becomes	
	Qp = 2.78 C i A	
	$C = C_v C_R$ C_v = proportion of rainfall on catchment which appears as surface runoff in storm drainage system = average 0.75 (0.6 in rapidly draining soils & 0.9 in heavy soils)	
	C_R = constant value of 1.30	
	C_v = 1.00	
	C_R = 1.3	
	C = 1.3	
	Applying the dimensionless coefficient using the parameters above gives a revised equation of:	
	Qp = 2.71 i A	
	Time of Concentration (Tc)	

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Ref	Calculations	Output

$t_C = t_e + t_f$

t_C = Time of Concentration

t_e = Time of Entry - represents delay & attenuation of flow over ground surface

t_f = Time of Flow through pipe system to point under consideration

The Wallingford Procedure would recommend the following t_e values:

Return Period	*t_e (mins)*
5 yrs	3 - 6
2 yrs	4 - 7
1 yr	4 - 8
1 mth	5 - 10

Use longer times of entry at each return period for large flat subcatchments (area > 400m^2, slope <1:50)

Use smaller values for small steep subcatchments (area <200m^2, slope >1:30)

t_e =	10	mins
t_f =	5	mins
t_c =	15	mins

assume 15min event is appropriate design event - see pg 5

Assessment of Rainfall Intensity

Step 1 Determine M5-60 min rainfall and the coefficient r for the

Ref	Calculations	Output

site from the mapping included in the Wallingford Procedure

M5 - 60mins = 5 year return period and 60 minute duration rainfall depth - Use M5-60 Map

M5-60 min Rainfall 19.6 (mm - Total rainfall)

r = ratio of 5yr - 60min duration and 5 yr - 2 day duration rainfall depth - Use r map

r 0.247

Step 2 Determine rainfall depths for 5 year return period for all required return periods, D = M5 - D

Using the r value above establishing the Z1 value from the graph in the Wallingford procedure (Fig A.3a)

r = 0.247

Return Period	Duration (D)		Z1	M5-D (mm total)
M5	5	Min	0.28	5.49
M5	10	Min	0.49	9.60
M5	15	Min	0.56	10.98
M5	30	Min	0.72	14.11
M5	1	Hour	1.00	19.60
M5	2	Hour	1.20	23.52
M5	4	Hour	1.60	31.36
M5	6	Hour	1.80	35.28
M5	10	Hour	2.20	43.12

M5-D values are calculated by factoring the M5-60 value by Z1

Step 3 Determine MT-D

This is determined from the relationship

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Ref	Calculations	Output

MT - D = Z2 (M5-D)

Z2 Values for Rainfall Depths

M5 Rainfall (mm)	M1	M2	M5	M10	M20	M30	M50	M100
5	0.62	0.79	1.02	1.19	1.36	1.46	1.56	1.79
10	0.61	0.79	1.03	1.22	1.41	1.55	1.69	1.91
15	0.62	0.80	1.03	1.24	1.44	1.57	1.70	1.99
20	0.64	0.81	1.03	1.24	1.45	1.56	1.66	2.03
25	0.66	0.82	1.03	1.24	1.44	1.54	1.64	2.01
30	0.68	0.83	1.03	1.24	1.42	1.52	1.61	1.97
40	0.70	0.84	1.02	1.19	1.38	1.47	1.56	1.89
50	0.72	0.85	1.02	1.17	1.34	1.43	1.52	1.81
75	0.76	0.87	1.02	1.14	1.28	1.37	1.45	1.64
100	0.78	0.88	1.02	1.13	1.25	1.33	1.40	1.54
150	0.78	0.88	1.01	1.12	1.21	1.27	1.33	1.45
200	0.78	0.88	1.01	1.11	1.19	1.25	1.30	1.40

Table A1 Relationship between rainfall of return period T(MT) and M5

Ref Wallingford Procedure Vol 4

100 Year

M5 - D Event		M5-D Total rainfall mm	Z1 values for 100 year event: Lower mm	Lower Z2	Higher mm	Higher Z2	Interpolated Z2	M100 - D Event: Total rainfall mm	Intensity mm/hr
5	Min	5.49	5	1.79	10	1.91	1.80	9.89	118.67
10	Min	9.60	5	1.79	10	1.91	1.90	18.25	109.49
15	Min	10.98	10	1.91	15	1.99	1.93	21.14	84.56
30	Min	14.11	10	1.91	15	1.99	1.98	27.89	55.77

ATKINS

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Ref	Calculations												Output			
	1	Hour	19.60	15	1.99	20	2.03	2.03					39.73		39.73	
	2	Hour	23.52	20	2.03	25	2.01	2.02					47.42		23.71	
	4	Hour	31.36	25	2.01	30	1.97	1.96					61.43		15.36	
	6	Hour	35.28	25	2.01	30	1.97	1.93					68.02		11.34	
	10	Hour	43.12	30	1.97	40	1.89	1.87					80.42		8.04	
30 Year																
	M5 - D Event		**M5-D**	**Z1 values for 30 year event**									**M30 - D Event**			
			Total rainfall mm	Lower		Higher		Interpolated					Total rainfall mm		Intensity mm/hr	
				mm	Z2	mm	Z2	Z2								
	5	Min	5.49	5	1.46	10	1.55	1.47					8.06		96.74	
	10	Min	9.60	5	1.46	10	1.55	1.54					14.82		88.91	
	15	Min	10.98	10	1.55	15	1.57	1.55					17.06		68.23	
	30	Min	14.11	10	1.55	15	1.57	1.57					22.10		44.20	
	1	Hour	19.60	15	1.57	20	1.56	1.56					30.60		30.60	
	2	Hour	23.52	20	1.56	25	1.54	1.55					36.36		18.18	
	4	Hour	31.36	25	1.54	30	1.52	1.52					47.51		11.88	
	6	Hour	35.28	25	1.54	30	1.52	1.50					52.88		8.81	
	10	Hour	43.12	30	1.52	40	1.43	1.40					60.45		6.05	
2 Year																
	M5 - D Event		**M5-D**	**Z1 values for 2 year event**									**M2 - D Event**			
			rainfall mm	Lower		Higher		Interpolated					rainfall mm		Intensity mm/hr	
				mm	Z2	mm	Z2	Z2								
	5	Min	5.49	5	0.79	10	0.79	0.79					4.34		52.03	
	10	Min	9.60	5	0.79	10	0.79	0.79					7.59		45.52	
	15	Min	10.98	10	0.79	15	0.8	0.79					8.69		34.77	
	30	Min	14.11	10	0.79	15	0.8	0.80					11.26		22.52	
	1	Hour	19.60	15	0.8	20	0.81	0.81					15.86		15.86	
	2	Hour	23.52	20	0.81	25	0.82	0.82					19.22		9.61	
	4	Hour	31.36	25	0.82	30	0.83	0.83					26.12		6.53	
	6	Hour	35.28	25	0.82	30	0.83	0.84					29.67		4.95	
	10	Hour	43.12	30	0.83	40	0.84	0.84					36.35		3.64	
	Calculation of Runoff for Site / Catchment															
			Qp = 2.78 C i A													
			Qp = 2.78 Cv Cr i A													
	C_v =		1.00													
	C_r =		1.3													
	t_c		15	Assume 15min duration event appropriate												

ATKINS	Project: Coleg Gwent Phase 4			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
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Ref	Calculations	Output
	i = 84.56	M100 - 15 appropriate for t_c
	68.23	M30 - 15 appropriate for t_c
	34.77	M2 - 15 appropriate for t_c
	A = 7355.1 m^2	Catchment area for developed site
	= 0.736 ha	
	Qp = 224.9 l/s	100 year
	181.5 l/s	30 year
	92.5 l/s	2 year
	Note the above value considers that the catchment as 100% impermeable. The value needs to be factored by an appropriate value to account for the surface type	
Ref	McGhee: Water Supply and Sewerage Table 13-3 Runoff coefficients for different areas	

TABLE 13-3
Runoff coefficients for different areas[3]

Description of area	C
Business	
Downtown area	0.70–0.95
Neighborhood area	0.50–0.70
Residential (urban)	
Single-family area	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (surburban)	0.25–0.40
Apartment areas	0.50–0.70
Industrial	
Light	0.50–0.80
Heavy	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yards	0.20–0.40
Unimproved areas	0.10–0.30

Pre Development				
Permeable Area =	35.00%	Unimproved areas C =	0.2	Undeveloped Land
Impermeable Area =	65.00%	All Run-off C =	1	Asphalt Road, existing plot
Runoff Coefficient = permeable area x C + impermeable area x C				
Selected runoff coefficient	0.72			
	Residential - Multiunits, attached			
Factored runoff from Site				

ATKINS	Project: Coleg Gwent Phase 4			Job ref: 5228425	
	Proposed Development Site Modified Rational Method			Calc sheet no of 6	rev 0
	Drawing ref.	Calc by SF	Date 03/12/2024	Check by	Date

Ref	Calculations					Output
	Qp =	**161.9**	**l/s**	100 year		
		130.7	**l/s**	30 year		
		66.6	**l/s**	2 year		
	Post Development					
	Permeable Area =		Unimproved areas C =		0.2	Undeveloped Land
	Impermeable Area =		All Run-off C =		1	Asphalt Road, existing plot
	Runoff Coefficient = permeable area x C + impermeable area x C					
	Selected runoff coefficient	0				
	Factored runoff from Site					
	Qp =	**0.0**	**l/s**	100 year		
		0.0	**l/s**	30 year		
		0.0	**l/s**	2 year		

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Suzy Facey
Site name:	Phase 2 Coleg Gwent, Crosskeys Campus
Site location:	Crosskeys

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:	51.61857° N
Longitude:	3.12272° W
Reference:	2675060842
Date:	Dec 04 2024 15:13

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 0.28

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	00.639
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1317	1317
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 ≤ 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):		1.9
1 in 1 year (l/s):		1.67
1 in 30 years (l/s):		3.38
1 in 100 year (l/s):		4.14
1 in 200 years (l/s):		4.68

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Suzy Facey
Site name:	Phase 3 Coleg Gwent, Crosskeys Campus
Site location:	Crosskeys

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:	51.61857° N
Longitude:	3.12272° W
Reference:	2372613877
Date:	Dec 04 2024 15:08

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 0.25

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	00.639
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1317	1317
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 ≤ 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):		1.7
1 in 1 year (l/s):		1.49
1 in 30 years (l/s):		3.02
1 in 100 year (l/s):		3.7
1 in 200 years (l/s):		4.18

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Suzy Facey
Site name:	Phase 4 Coleg Gwent, Crosskeys Campus
Site location:	Crosskeys

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:	51.61857° N
Longitude:	3.12272° W
Reference:	3102889182
Date:	Dec 04 2024 15:11

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	0.75

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	00.639
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1317	1317
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 ≤ 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

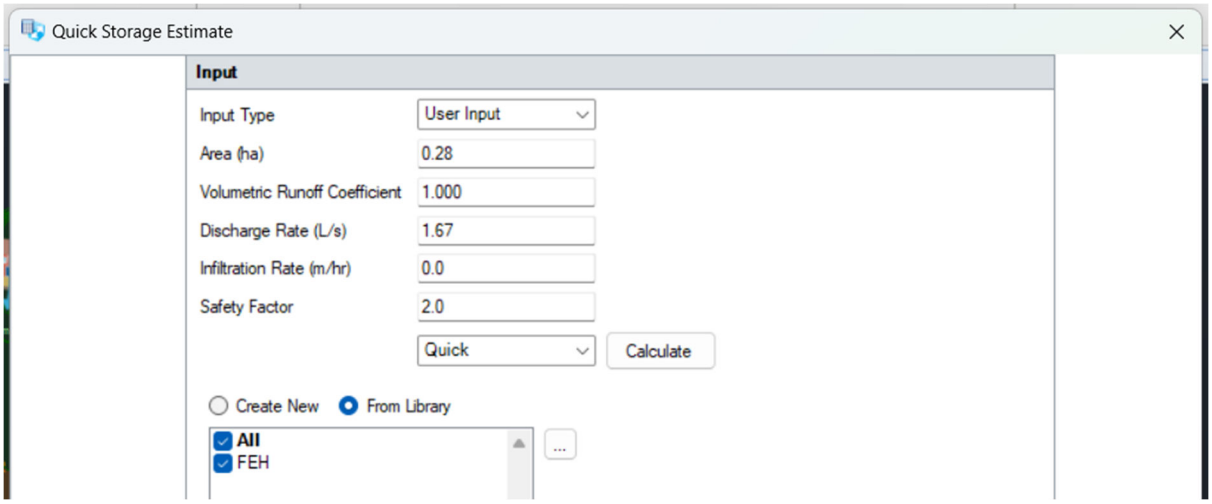
	Default	Edited

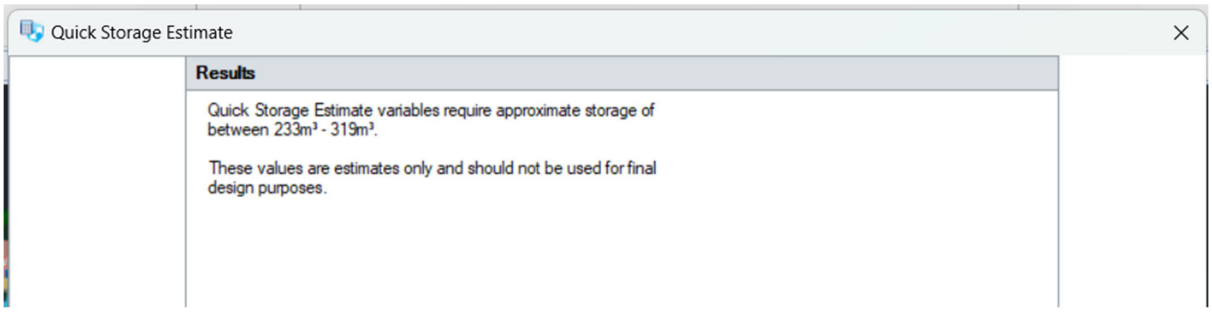
Q_{BAR} (l/s):		5.09
1 in 1 year (l/s):		4.48
1 in 30 years (l/s):		9.06
1 in 100 year (l/s):		11.1
1 in 200 years (l/s):		12.53

Appendix C. Storage Estimate Calculations

Storage estimate Phase 2

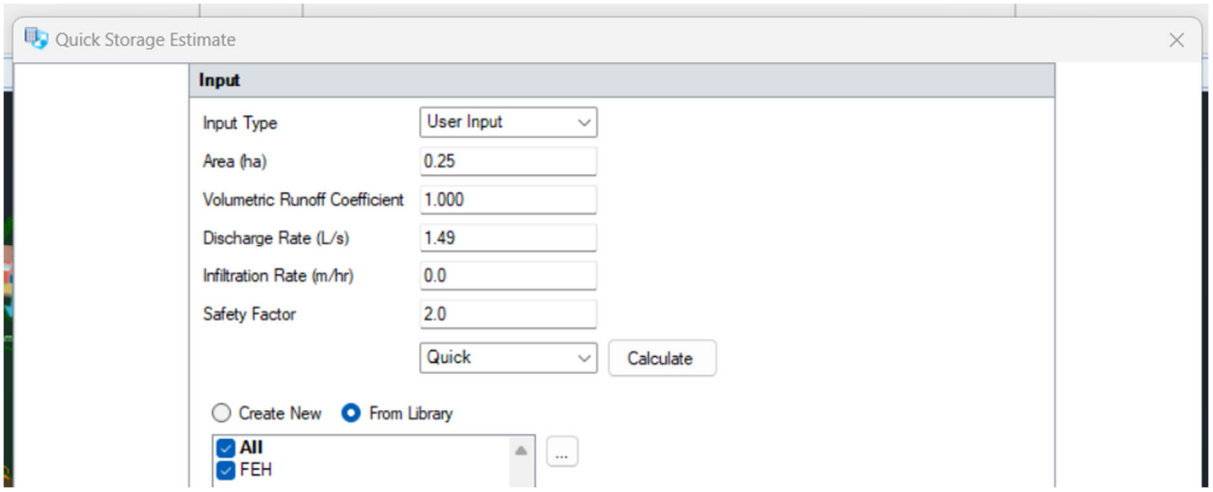
1. Discharge rate = 1.67 l/s
2. Total Area = 2762.6 m2

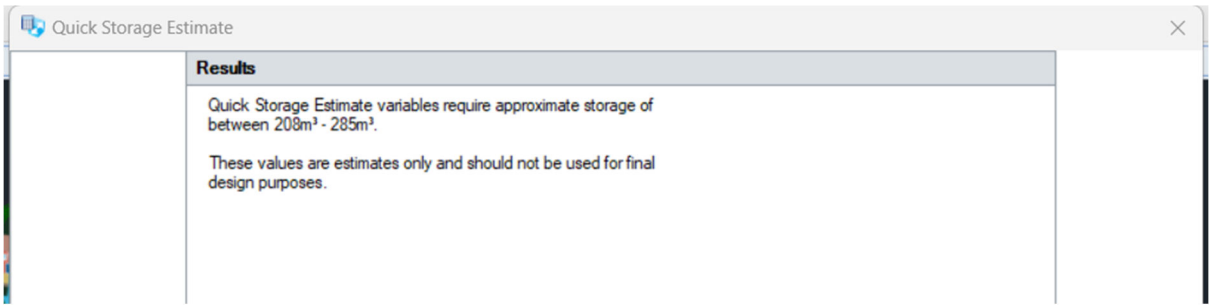




Storage estimate Phase 3

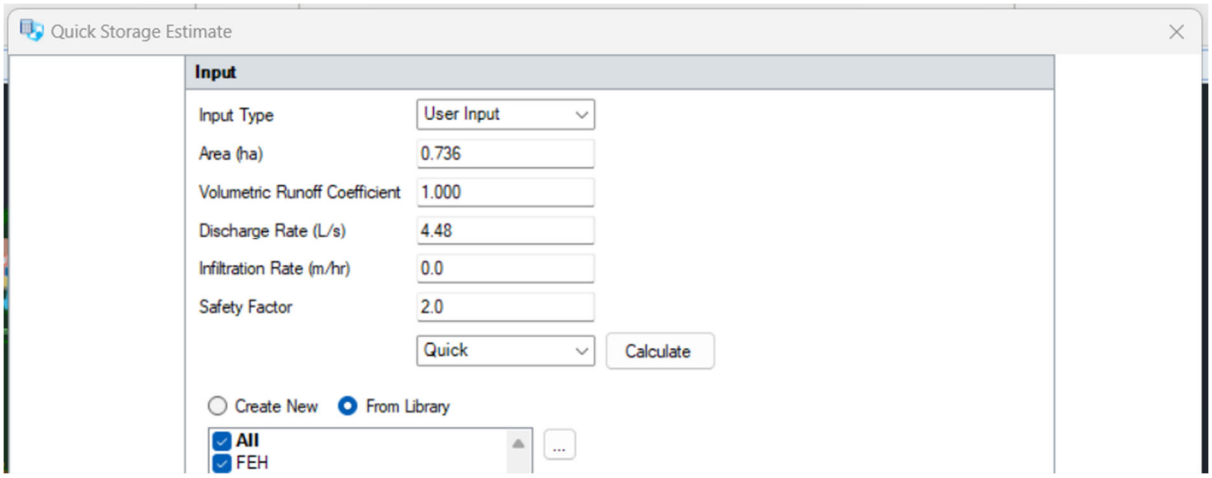
1. Discharge rate = 1.49 l/s
2. Total Area = 2540.9 m2

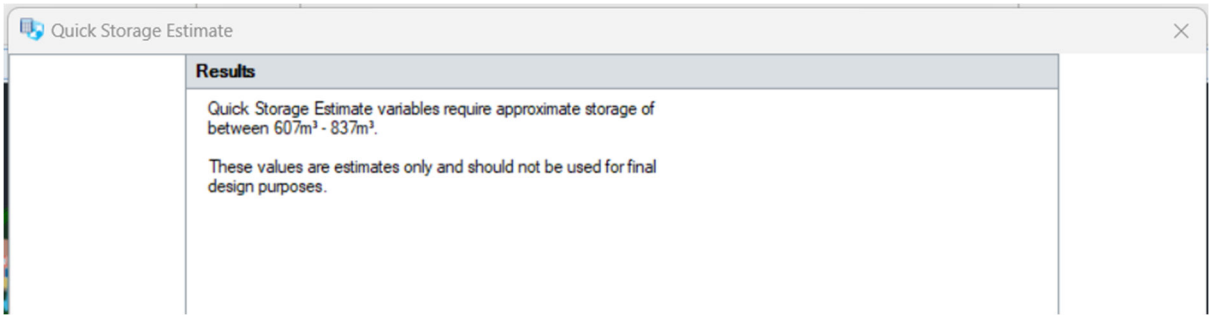




Storage estimate Phase 4

1. Discharge rate = 4.48 l/s
2. Total Area = 7358.5 m2





Appendix D. Drainage Layout Plan

DO NOT SCALE

Millimetres 0 10 100

PHASE 3 SURFACE WATER DISCHARGE POINT (RISCA ROAD)

PHASE 3 FOUL DISCHARGE POINT (RISCA ROAD)

PERMEABLE PAVING TO SERVE PHASE 3 BUILDING

PHASE 4 SURFACE WATER DISCHARGE POINT (RISCA ROAD)

PHASE 4 FOUL DISCHARGE POINT (RISCA ROAD)

PHASE 2 SURFACE WATER DISCHARGE POINT (RISCA ROAD)

PHASE 2 FOUL DISCHARGE POINT (RISCA ROAD)

ATTENUATION BASINS AND BIORETENTION AREAS TO SERVE PHASES 2 AND 4 TO BE INSTALLED WITHIN COMMUNAL SPACE TO SUIT PHASING BOUNDARIES

PROPOSED NEW PARKING BAYS TO BE PERMEABLE PAVING WITH BIO RETENTION AREA ADJACENT

DUE TO LACK OF SPACE AND PHASING RESTRICTIONS GREEN/BLUE ROOF SHOULD BE CONSIDERED FOR PROPOSED BUILDING

PHASE 4 SURFACE WATER DISCHARGE POINT (WAUNFAWR PARK ROAD)

PHASE 2 FOUL DISCHARGE POINT (WAUNFAWR PARK ROAD)

PHASE 2 SURFACE WATER DISCHARGE POINT (WAUNFAWR PARK ROAD)

Risca Road

Waunfawr Park Road

B A J Z Y C T X R

service yard

ENERGY CENTRE

MUGA

OUTDOOR LEARNING AREA

Skip compound

Cycles

KEY

- ATTENUATION BASIN
- BIO RETENTION AREA
- PERMEABLE PAVING
- GREEN ROOF

Rev.	Date	Description	By	Chk'd	App'd
P01	06/12/24	FIRST ISSUE	CS	SF	TR

Drawing Status: SUITABLE FOR INFORMATION — Suitability: S2

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Client: COLEG GWENT

Project Title: CROSSKEYS CAMPUS

Drawing Title: MASTER PLAN DRAINAGE LAYOUT

Scale	Designed	Drawn	Checked	Authorised
1:200	SF	CS	SF	CS
Original Size: A1	Date: 06/12/24	Date: 06/12/24	Date: 06/12/24	Date: 06/12/24

Drawing Number: 5228425-ATK-XX-XX-DR-C-900501 — Revision: P01

Internal Project Number: 5228425

USER: GB87317
Date: 06/12/24 14:40:53
Filename: \\wsatkinsprojectGBBSBPDCNDVA PROJECTSBRISTOL PROJECTS\5228425 - Coleg Gwent - Phase 1 Crosskeys Campus\01 WIP\CED\R6425-ATK-XX-XX-DRC-0001 Master Plan Drainage Layout.dwg

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