

EXPEDITE

FLOOD CONSEQUENCE ASSESSMENT

CARDIFF 6TH FORM COLLEGE

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Proposed Development

Cardiff 6th Form College

FLOOD CONSEQUENCE ASSESSMENT

Issued by: Expedite
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Client: Cardiff 6th Form College

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1 Introduction

- 1.1** The purpose of this Flood Consequence Assessment (FCA) is to assess the risk of flooding to the proposed development and where possible provide sufficient mitigation to demonstrate that the future users of the development would remain safe throughout its lifetime, that the development would not increase flood risk on site and elsewhere and, where practicable, that the development would reduce flood risk overall.
- 1.2** This report has been prepared with reference to Technical Advice Note 15 (TAN 15) which supplements Planning Policy in Wales.
- 1.3** The general approach is to advise caution in respect of new development in respect of new developments in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is, in order of preference, to:
- Direct new development away from those areas which are at high risk of flooding.
 - Where development has to be considered in high risk areas (Zone C) only those developments which can be justified on the basis of the tests outlined in TAN 15 are located within such areas.
- 1.4** The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the site.

Site Proposals

- 1.5** The proposed development comprises of a proposed education facility at Merchant Place and Cory's Building, Bute Place and Bute Street, Cardiff. A copy of the proposed development drawings is included within **Appendix A**. The education facility will provide benefits to the wider community.

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2 Site Characteristics

Site Location and Composition

- 2.1** The approximate co-ordinates for the centre of the site are E: 319138; N: 174636, with the nearest postcode of CF10 5BP. The approximate location of the site is shown in **Figure 2.1**.
- 2.2** The current site comprises of three existing buildings and an external area of hardstanding. The site is bound to the north by a building, to the east by Docks Lane, to the south by Bute Place and to the west by Bute Street.

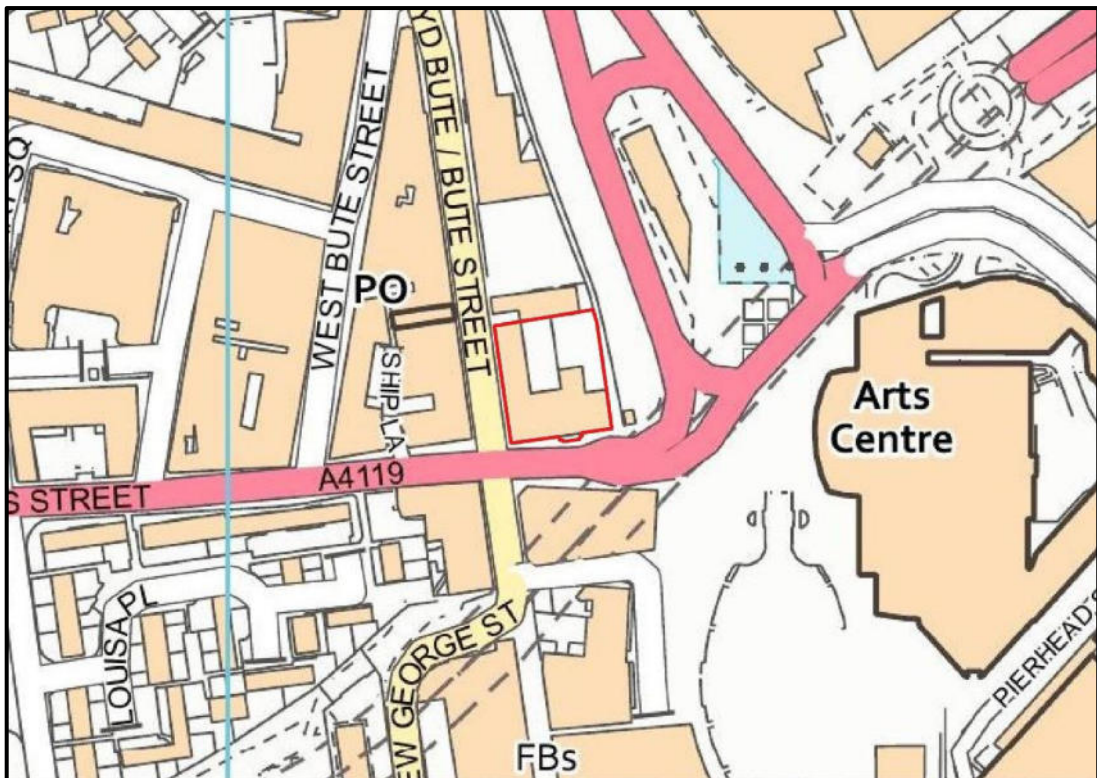


Figure 2.1 Site Location

Topography

- 2.3** A detailed topographic survey was carried out for the site, which indicates ground levels fall in a western direction from 8.50 metres Above Ordnance Datum (mAOD) to 7.82 mAOD.

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Ground Conditions

- 2.4 Geological data held by the British Geological Survey (BGS)¹ shows that the bedrock geology underlying the site is Mercia Mudstone Group – Mudstone. Superficial deposits are recorded as Tidal Flat Deposits – Clay, silt and sand.
- 2.5 The nearest borehole log with freely available information is located approximately 40m southwest of the site and was recorded to a depth of 18m, obtained via online BGS maps. The borehole log reference number is ST17SE131. The log identifies presence of clay and gravel at depths beyond 10.70m.
- 2.6 Soilscales mapping² indicates the underlying soil as loamy and clayey soils of coastal flats with naturally high groundwater.

Existing Drainage & Hydrology

- 2.7 The site is located approximately 225m north of Cardiff Bay and 550m east of the River Taff.
- 2.8 Welsh Water sewer records indicate there is a 150mm combined sewer within Docks Lane to the east of the site. A combined 600mm combined sewer is present within Bute Place to the south of the site which connects to a 975 x 600mm brickwork box sewer within Bute Street to the west of the site. Welsh Water sewer records are provided in **Appendix B**.

¹ https://geologyviewer.bgs.ac.uk/?_ga=2.54316200.1622516172.1658142495-970462165.1658142495

² <http://www.landis.org.uk/soilscales/>

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3 Development Vulnerability & Flood Zone Classification

3.1 TAN 15 categorises flood zones into

- Zone A – considered to be at little or no risk of fluvial or tidal/coastal flooding
- Zone B – Areas known to have been flooded in the past evidenced by sedimentary deposits.
- Zone C – Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)
- Zone C1 – Areas of the floodplain which are developed and served by significant infrastructure, including flood defences
- Zone C2 - Areas of the floodplain without significant flood defence infrastructure

3.2 These flood zones are reflected in the development advice maps which are based on Natural Resources Wales Flood Risk Maps supplemented by sediment data, held by the British Geographic Society (BGS), of historical flooding. The maps adopt the precautionary principle and are based on the best-known information available at the time; however, a detailed examination of a site can refine an area's risk of flooding.

3.3 The proposed development is considered to be 'highly vulnerable' in terms of its land use type flood risk vulnerability as shown in TAN 15 and mostly located in Zone C1, with the eastern boundary of the site within Zone B by the development advice maps (**Figure 3.1**). Therefore, following the principles of TAN 15 an application of justification test including acceptability of consequences would be required.

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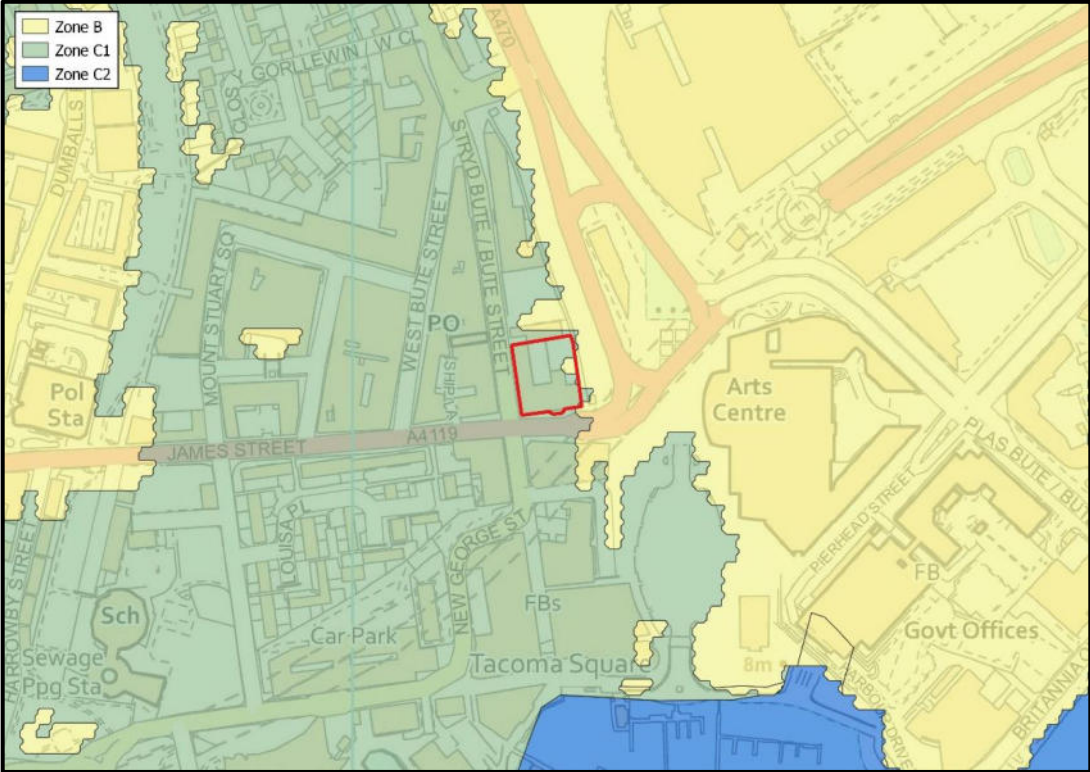


Figure 3.1 Site Location

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4 Site Specific Flooding

Historic Flooding

- 4.1 Natural Resources Wales mapping of historic flood extents does not indicate that the site has been previously impacted by any recent prior flooding incidents.
- 4.2 The Cardiff City Council Strategic Flood Consequence Assessment (SFCA) (2009)³ states that within the region of Cardiff Bay, there are numerous historical records of flooding notably in 1607, 167, 1770 and 1809. No specific information pertaining to any previous instances of flooding at or within the nearby vicinity of the site are made.

Tidal Flooding

- 4.3 Inundation of low-lying coastal areas by the sea may be caused by seasonal high tides, storm surges and storm driven wave action. Tidal flooding is most commonly a result of a combination of two or more of these mechanisms, which can result in the overtopping or breaching of sea defences. River systems may also be subject to tidal influences.
- 4.4 The Flood Risk Assessment Wales Mapping (**Figure 4.1**) indicates that the western half of the site is located within the low-risk tidal flood risk zone, with the eastern half of the site not shown to be within an area at risk of flooding. The western half of the site which is within the low-risk zone is also indicated to be within an area benefitting from defences, providing protection from high risk flood events, making the projected risk residual.
- 4.5 It is noted in the Cardiff Council Flood Risk Management Plan (FRMP) (2015)⁴ that the Cardiff Bay Barrage, completed in November 1999, provides protection from rising sea levels and water levels in the rivers Taff and Ely. The barrage forms a significant section of the Cardiff coastline defence system and is said to provide a standard of protection up to a 1 in 1000-year event. No indication is provided that tidal flooding has occurred within the vicinity of the site following these measures being implemented within the Cardiff Council FRMP or SFCA.

³ <https://docplayer.net/24872339-Cardiff-strategic-flood-consequences-assessment.html>

⁴ <https://www.cardiff.gov.uk/ENG/resident/Community-safety/Flood-and-Coastal-Erosion-Risk-Management/Flood-Risk-Management-Plan/Pages/default.aspx>

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- 4.6** The Cardiff Bay Barrage maintains water levels at a typical level of 4.5mAOD. The level within the bay varies during every tide due to changes in tidal levels and resulting the Rivers Taff and Ely becoming tide locked and not being able to discharge into the sea, as noted in the Cardiff Council SFCA (2009). Defences providing a standard of protection up to a 1 in 200-year tidal flood event and 1 in 100 year fluvial flood event are also present to the west of the site along the eastern bank of the River Taff, protecting the site from flooding from this source induced by tide locking.
- 4.7** Analysis was undertaken of anticipated sea level rises and their impact on the typical water level in Cardiff Bay as part of Cardiff City Council SFCA (2009). The anticipated levels are tabulated below, **Table 4.1**. All levels are shown to be below the lowest point in the site, 7.82mAOD.

Annual Probability Event	Bay Level (mAOD)	
	2007	2060
10%	5.72	6.08
2%	6.04	6.40
1%	6.28	6.64
1% + 20% Climate Change Allowance	6.6	6.96
0.1%	7.06	7.42

Table 4.1 – Estimated Water Levels within Cardiff Bay (SFCA 2009)

- 4.8** Flood model data has been requested from Natural Resources Wales; this will enable further assessment of the risk posed with more up to date projected water levels.
- 4.9** From the information available, the risk from this source is considered low and residual due to the protection provided by the Cardiff Bay Barrage and other tidal defences present within the area.

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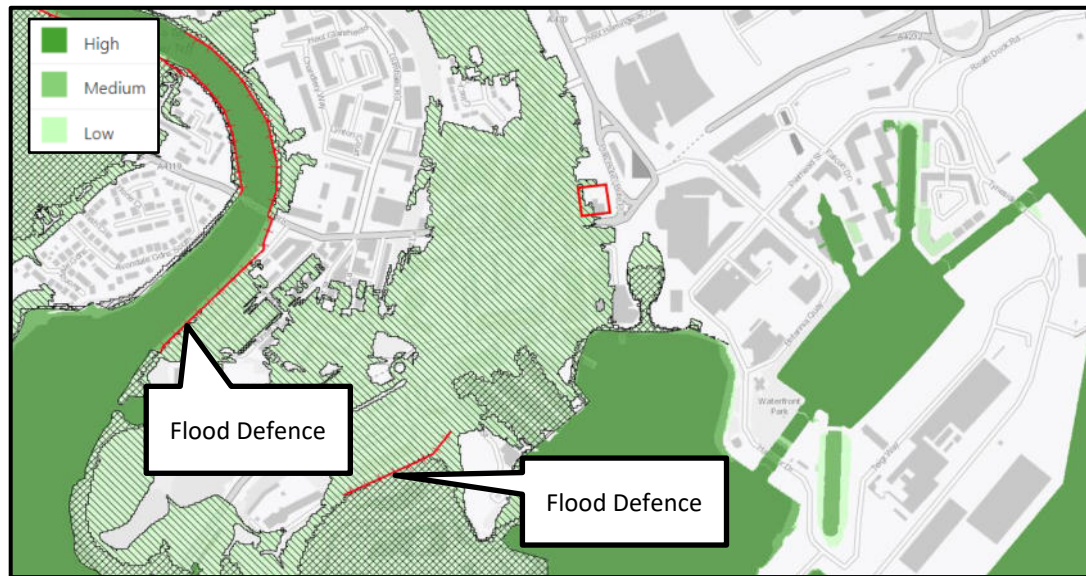


Figure 4.1 Flood Risk from the Sea (Flood Risk Assessment Wales)

Fluvial Flooding

- 4.10** Flooding from watercourses occurs when flows exceed the capacity of the channel, or where a restrictive structure is encountered, which leads to water overtopping the banks into the floodplain. This process can be exacerbated when debris is mobilised by high flows and accumulates at structures.
- 4.11** The site is shown to be located outside of the high, medium, and low risk river flood zones on the Flood Risk Assessment Wales mapping (**Figure 4.2**). As a result, the development of the site will result in no loss of fluvial floodplain.
- 4.12** Fluvial modelling of the River Taff and Ely was undertaken as part of the Cardiff City Council SFCA (2009). The modelling was undertaken for the 1%, 2060 climate change, and 0.1% events and did not indicate any flooding at or within the nearby vicinity of the site. As with the tidal flood modelling, data requested from Natural Resources Wales will help further inform the risk from this source once it has been received.
- 4.13** No additional information alluding to fluvial flooding having occurred at or within the nearby vicinity of the site in recent years was provided in the Cardiff Council SFCA (2009).
- 4.14** Fluvial flood risk for the proposed development is considered to be low.

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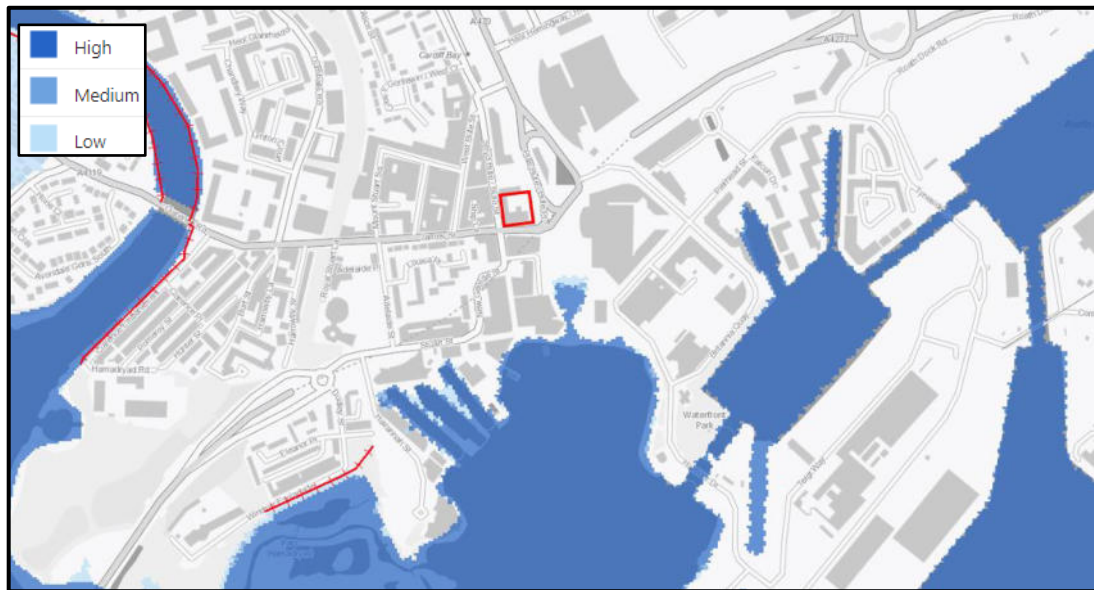


Figure 4.2 Flood Risk from Rivers (Flood Risk Assessment Wales)

Pluvial and Small Watercourses Flooding

- 4.15 Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.
- 4.16 Risk of flooding from surface water and small watercourses mapping has been prepared, this shows the potential flooding which could occur when rainwater does not drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead.
- 4.17 The surface water (pluvial) and small watercourses flood map produced by Natural Resources Wales (**Figure 4.3**) indicates a small area of low and medium risk pluvial flooding is projected in the north of the site. This is aligned with a shallow topographical depression in this area of the site which allows for surface water to pool. There are not indicated to be any small watercourses within nearby vicinity of the site which pose a risk.
- 4.18 No information pertaining to incidents of flooding from surface water or small watercourses is provided in the Cardiff City Council SFCA (2009).
- 4.19 The risk of flooding from small watercourses and surface water to the site is considered to be low.

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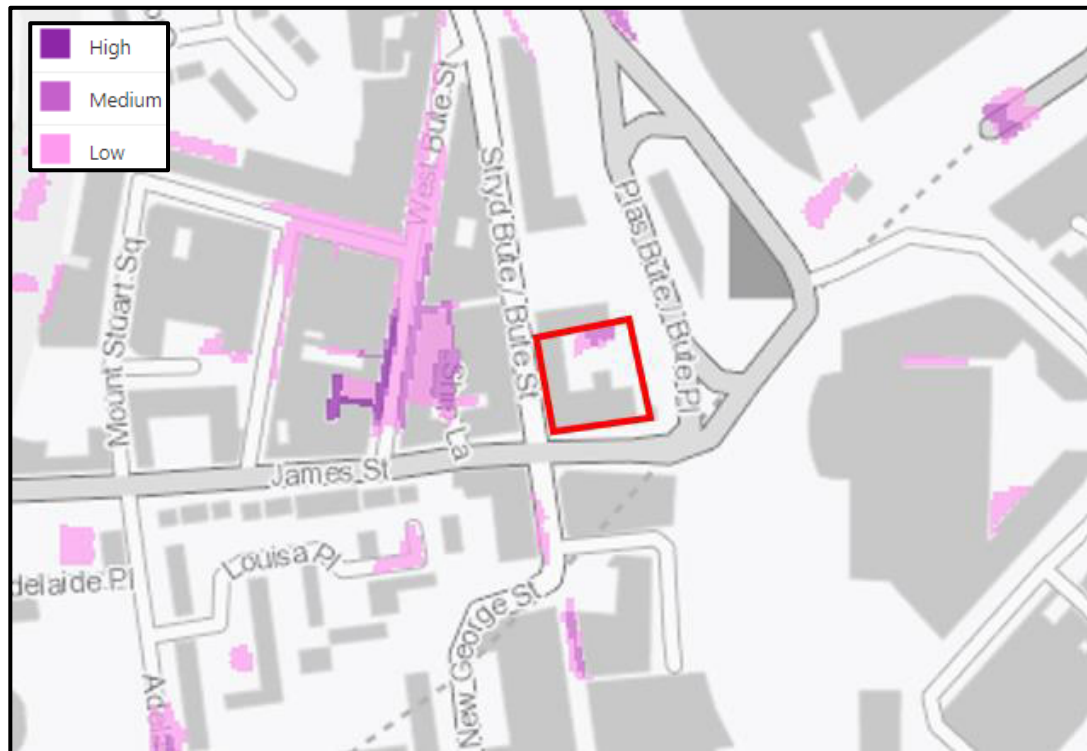


Figure 4.3 Flood Risk from Surface Water and Small Watercourses (Flood Risk Assessment Wales)

Groundwater Flooding

4.20 Groundwater flooding occurs when the water table rises above ground elevations. It is most likely to happen in low lying areas underlain by permeable geology. This may be regional scale chalk or sandstone aquifers, or localised deposits of sands and gravels underlain by less permeable strata such as that in a river valley.

4.21 The Cardiff City Council FRMP (2015) states there is no information on historic groundwater flooding within the city. No information pertaining to groundwater flooding is provided in the Cardiff City Council SFCA (2009).

4.22 The risk of flooding from groundwater at this stage is considered to be low.

Sewer Flooding

4.23 Sewer flooding can occur when the capacity of the infrastructure is exceeded by excessive flows, or as a result of a reduction in capacity due to collapse or blockage, or if the downstream system becomes surcharged. This can lead to sewers flooding onto the surrounding ground via manholes and gullies which can generate overland flows.

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- 4.24** Welsh Water sewer records (**Appendix B**) indicate there is a 150mm combined sewer within Docks Lane to the east of the site. A combined 600mm combined sewer is present within Bute Place to the south of the site which connects to a 975 x 600mm brickwork box sewer within Bute Street to the west of the site.
- 4.25** Any existing private drainage systems within the site will be surveyed to enable detailed design and future connection. It is expected that drainage systems will be upgraded where possible, improving performance and capacity.
- 4.26** Sewer flooding incidents recorded by Welsh Water are noted in the Cardiff City Council SFCA (2009), no instances of flooding are stated to have occurred at or within the nearby vicinity of the site.
- 4.27** The risk of sewer flooding to the site is therefore considered to be low.

Flooding from Artificial Sources

Reservoirs

- 4.28** Flooding can occur from large waterbodies or reservoirs if they are impounded above the surrounding ground levels or are used to retain water in times of flood. Although unlikely, reservoirs and large waterbodies could overtop or breach leading to rapid inundation of the downstream floodplain.
- 4.29** To help identify this risk, reservoir failure flood risk mapping has been prepared, this shows the larger area that might be flooded if a reservoir were to fail and release the water it holds. The map displays a worst case scenario and is only intended as a guide. **Figure 4.4** displays the reservoir risk to the site. This identifies the western half of the site is at risk from this source.
- 4.30** Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers.
- 4.31** Due to the high standards of inspection and maintenance required by legislation, and the role such a risk of flooding is considered to be low.

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Figure 4.4 Flood Risk from Reservoirs (Flood Risk Assessment Wales)

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5 Flood Mitigation Measures

Introduction

- 5.1** It is important to demonstrate that future users will not be at risk from flood hazards during the lifetime of the development, as well as ensuring that flood risk is not increased elsewhere.

Assessment Findings and Implications

- 5.2** This assessment undertaken has identified the site to be at low risk from all sources of flooding. The following measures are set out below to further protect the development during its lifetime.
- 5.3** The site is mostly located within Zone C1 and whilst the eastern side of the development is shown to be located outside of the low tidal risk flood zone. Furthermore, as indicated in the mapping, the western part of the site is protected from the projected tidal risk, making the overall risk from this source residual. The proposed development will not result in any loss of floodplain on this basis.

Finished Floor Levels (FFLs)

- 5.4** Whilst the existing floor levels will be used for the buildings which are to be refurbished, FFLs for new buildings are recommended to be set a minimum of 150-300mm above the proposed ground levels to provide protection against flooding from surface water.

Ground Levels

- 5.5** Ground levels should be profiled to remove hollows/depressions within the site topography and the area of potential risk of pluvial flooding.
- 5.6** Ground levels should be finished so that overland runoff is encouraged to flow away from the proposed new buildings and directed to the nearest on-site drainage system runoff collection point.

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Flood Resilience

- 5.7** Resilience measures are either an integral part of the building or features inside the building. Flood resilient buildings are designed to reduce the impact of flood water entering the building to restrict permanent damage, ensure structural integrity is maintained and to assist with drying and cleaning following flooding.
- 5.8** The following recommendations should be considered:
- a) Low permeability construction
 - b) Temporary flood defence door barriers
 - c) Raised electrical sockets
 - d) Flood resilient flooring

Access and Egress, Flood Warning, & Evacuation Plan

- 5.9** Safe pedestrian access/egress is available onto Bute Place to access the wider road/street network to the southeast of the site and land outside the floodplain.
- 5.10** Despite this, it is advised as a precautionary measure that the end users of the proposed development register for the Natural Resources Wales free Flood Warning/Alert service. This can allow valuable preparation in the event of a flood.
- 5.11** It is recommended that a detailed flood plan for the site should be prepared to minimise the risk of flooding to site users. This should include the actions to be taken before, during and after a flood. Further details for preparing a flood plan can be found at: <https://naturalresources.wales/flooding/preparing-for-a-flood/?lang=en>.
- 5.12** The site should be evacuated if either a flood alert indicates that this is appropriate action, or if advised to do so by Natural Resources Wales, Lead Local Flood Authority, or a Category 1 responder.
- 5.13** Appropriate signage shall be erected around the site/building to advise all users of preparation and action for all flood events. Refer to the below recommended signage which can be downloaded via the NRW flood warning site.

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Groundwater

- 5.14** The potential for shallow groundwater should also be considered during the construction phase of the development, particularly during the excavations. It is recommended that groundwater levels are monitored during the construction phase, and where groundwater is encountered appropriate dewatering should be employed.

Drainage

- 5.15** To mitigate the proposed developments impact on the current runoff regime through the increased rate of runoff that would result due to the impermeable areas introduced; it is proposed to incorporate surface water attenuation and storage as part of the development proposals. The proposed drainage strategy is discussed within ES21.22 Drainage Strategy and SAB Technical Note.

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6 Summary and Conclusions

Summary

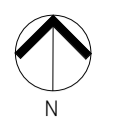
- 6.1** This assessment has considered the risk of all types of flooding to the site including tidal, fluvial, surface water, groundwater, sewer and artificial sources and provides measures to ensure that the flood risk to the site is minimised and that flood risk off-site is not increased.

Conclusions

- 6.2** The site is shown to be located in Zone C1 and indicated to be at low risk of flooding from all sources of flooding based on Flood Risk Assessment Wales mapping, despite being located in the low-risk tidal floodplain the site benefits from flood defences making this risk residual.
- 6.3** Flood model data has been requested from Natural Resources Wales to enable further assessment of the tidal and fluvial risks posed to the area the site is within.
- 6.4** Flood resilience construction methods have been recommended to provide further protection in the event of the worst-case scenario. These include the use of flood resilient flooring and raised electrical sockets.
- 6.5** Suitable pedestrian access is available to and from the site to areas outside of the floodplain. It is recommended that the users of the proposed development register for the Natural Resources Wales free Flood Alert Service and develop a flood plan.

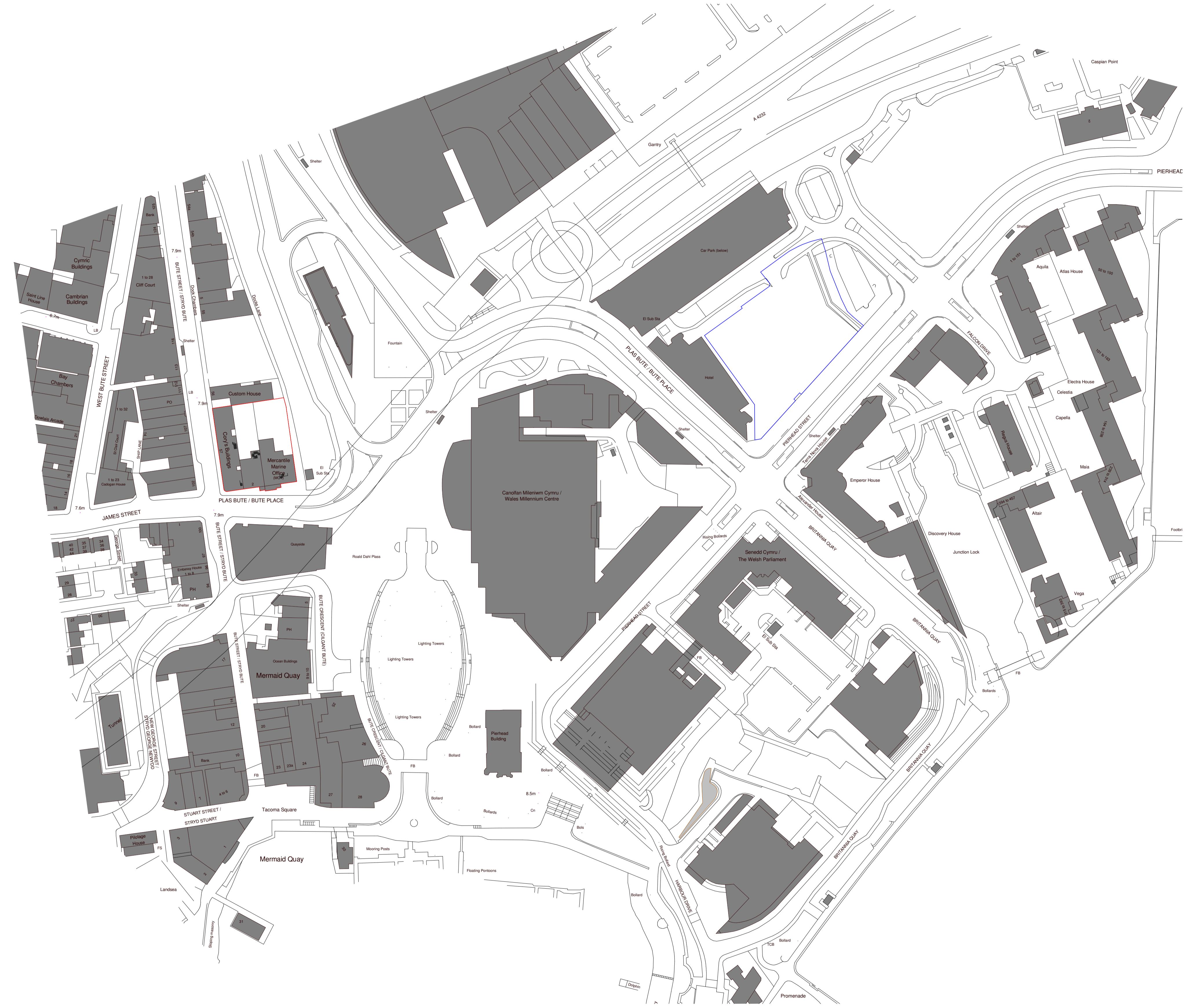
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Appendix A – Proposed Development Plans



VISUAL SCALE 1:1250 @ A1

Key
— Application Boundary (Site 1)
— Boarding Accommodation (Site 2)



01	Pre-planning Update	07.06.22	ML
Revision	Description	Date	Issued



Client's Name
Cardiff 6th Form College

Job Title
Cardiff 6th Form Academic Hub

Status
Planning

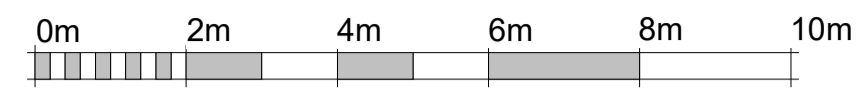
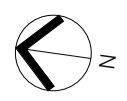
Suitability
S0

Scale
1 : 1250 @

Document Reference
21.22-EDS-XX-ZZ-DR-A-(00)000

Drawing Title
Location Plan

Drawing Number	Revision
(00)000	01



VISUAL SCALE 1:100 @ A1

- Key**
- Existing structure
 - Demolition structure
 - Proposed structure



Revision	Description	Date	Issued
03	Pre-planning Update	07.06.22	ML
02	Issued for client review	20.05.22	ML
01	Issued for client review	30.03.22	ML

EXPEDITE DESIGN SERVICES LTD RIBA # Chartered Practice

Client's Name
Cardiff 6th Form College

Job Title
Cardiff 6th Form Academic Hub

Status: **Preliminary** Suitability: **S0**

Scale
1 : 100 @ A1

Document Reference
21.22-EDS-XX-00-DR-A(01)200

Drawing Title
Proposed Ground Floor Plan

Drawing Number	Revision
(01)200	03

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Appendix B – Sewer Records



LEGEND(Representative of most common features)

Waste networks	
	Foul chamber
	Surface water chamber
	Combined chamber
	Combined sewer overflow
	Special purpose chamber
	Treatment works
	Pumping station
	NB: Sewer symbol colour indicates the type:
	Combined
	Surface Water
	Foul
	Former S20 sewers (for indicative purposes only)
	Outfall
	Lampole
	Storm Overflow
	Rising main
	Gravity sewer
	Private sewer
	Private sewer subject to Sect. 104 adaptation agreement
	Private Sewer Transfer
	Inspection Chamber

Notes:

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

Dŵr Cymru Cŵr (Welsh Water) (the Company) agrees this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and is not warranty as to its correctness or relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The error of locating apparatus makes carrying out any excavations made entirely on one's own. The information which is supplied by the Company is done so in accordance with statutory requirements of sections 103 and 109 of the Water Industry Act 1991 which is based upon the best of information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of water main, service pipes, electric cables, gas pipes, or any other underground apparatus laid before 1 September 1950, or if they do, the location of these apparatus may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provisions of the New Roads and Street Works Act 1991 and the Company's liability is compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map scale: 1:750
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