



Castle Green Homes Limited

Rydal School, Colwyn Bay

Flood Consequence Assessment

680260-R1(02) - FCA





INVESTORS
IN PEOPLE





OCTOBER 2021

RSK GENERAL NOTES

Project No.: 680260-R1(02)-FCA
Site: Rydal School, Colwyn Bay
Title: Flood Consequence Assessment
Client: Castle Green Limited
Date: October 2021
Office: Wigan
Status: Final issue

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Issue No	Version/Details	Date issued	Author	Reviewed by	Approved by
-	Draft for internal review	20.08.21	RW	KJ	IC
00	Draft for Client review	20.08.21	RW	KJ	IC
01	Updated Layout	26.08.21	RW	CW	CW
02	Updated Layout	01.10.21	RW	CW	CW

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK LDE Ltd.

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1 INTRODUCTION

RSK Land and Development Engineering Ltd (RSK) was commissioned to carry out a Flood Consequence Assessment (FCA) on behalf of Castle Green Homes Limited (the 'client'). The assessment is in support of the planning submission for a residential development at land at Rydal School, Colwyn Bay.

This assessment has been prepared in accordance with the Planning Policy Wales¹ and its accompanying Technical Advice Note 15², the Interim Code of Practice for Sustainable Drainage³, BS 8533-2017 Assessing and Managing Flood Risk in Development Code of Practice⁴ and the Recommended Non-Statutory Standards for Sustainable Drainage (SuDS) in Wales⁵.

The PPW / TAN 15 sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. The key definitions are:

- “areas at risk of flooding” means land within Flood Zones B and C; or land within Flood Zone A which has critical drainage problems and which has been notified to the local planning authority by the NRW; and
- “flood risk” means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For this site, the key aspects that require the assessment are:

- The Development Advice Map (**Figure 1.1**) shows the central areas of the site to lie within an area designated as Zone A - Considered to be at little or no risk of fluvial or coastal/tidal flooding;
- The site is more than 1ha in size and therefore requires a flood consequence assessment.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

¹ Welsh Assembly Government (2018) Planning Policy Wales Edition 10

² Welsh Assembly Government (2004), Planning Policy Wales Technical Advice Note 15: Development and Flood Risk

³ DEFRA (2004), 'Interim Code of Practice for Sustainable Drainage Systems' National SUDS Working Group

⁴ BSI (2017), 'BS 8533-2017 Assessing and managing flood risk in development Code of practice'

⁵ Welsh Assembly Government (2016) 'Recommended non-statutory standards for sustainable drainage (SuDS) in Wales – designing, constructing, operating and maintaining surface water drainage systems'

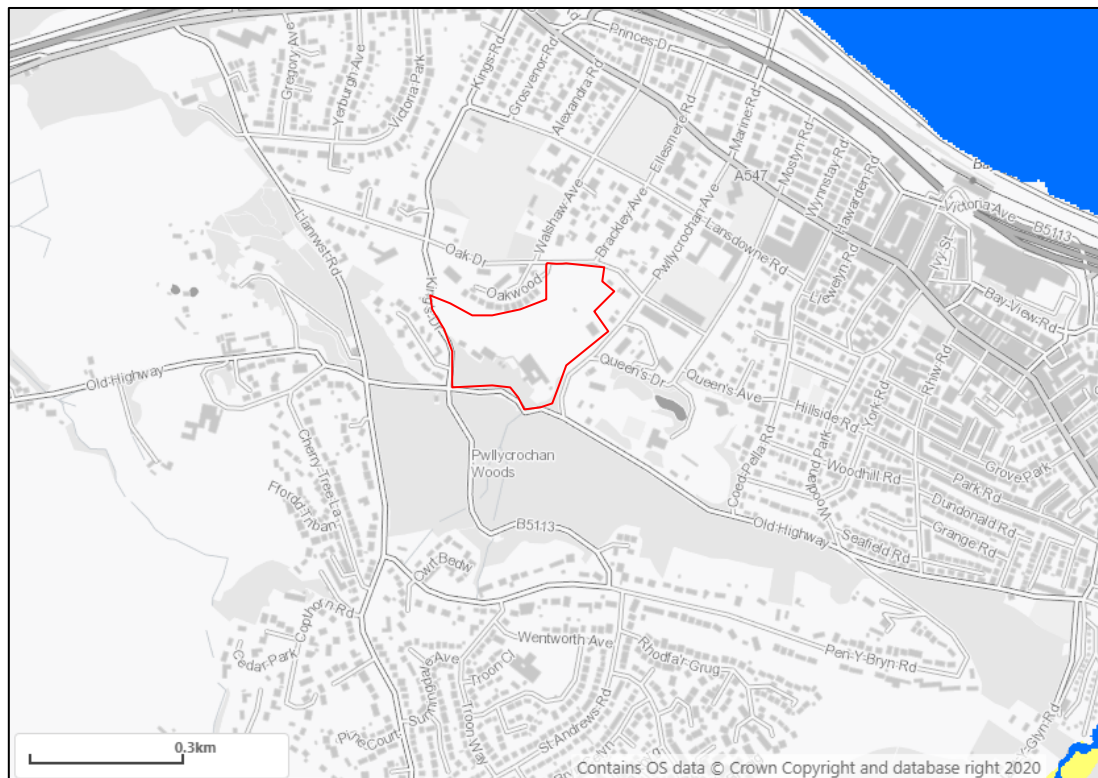


Figure 1.1: Development Advice Map (accessed August 2021)

2 CONTEXT AND SCOPE OF WORK

A key element of project development is to prepare a FCA to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The scope of work relating to a FCA is based on the guidance provided in PPW and its accompanying TAN15.

A site-specific FCA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review architect plans, planning information and other studies to determine existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the NRW / LLFA including scope, location and impacts;
- To determine the extent of flood risk designations and the influence on the site;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100-year period for a residential development.

3 SITE DESCRIPTION

3.1 Location

Site Name: Land at Rydal School, Colwyn Bay

Site Address: Land at Rydal School, Colwyn Bay, LL29 6AE

Site National Grid Reference: 284223 E, 378863 N

The proposed development is located west of King's Drive and south of Oaks Drive within an area of largely undeveloped land. The land area totals 5.98Ha and is comprised of recreational sports pitches, a hard-top tennis court, an existing Listed Building, and an existing residential dwelling. Aerial imagery of the existing site is shown in **Figure 3.1**, the red line boundary of the application boundary is provided in this figure.



Figure 3.1: Site location plan

3.2 Land use and topography

The site is currently of mixed use of developed and undeveloped areas. Developed areas include the listed school building, the separated classrooms, the residential

properties and the tennis courts. The site is predominately undeveloped and consists of recreational sports pitches and open space. The approximate land uses are shown in **Table 3.1**.

The topographic survey is provided in **Appendix B**, this shows the highest areas of the site are at the western and southern boundaries with maximum site levels of approximately 71.0mAOD, though steeply ramping up to approximately 81mAOD in the wooded area west of the school.

The site has a terraced undulating topography, sloping downwards in an eastern direction. The school and classrooms on the western terrace have a ground level of between approximately 71.0mAOD and 65.0mAOD. This slopes down to a central mid-terrace sports pitch with a ground level of approximately 51.5mAOD. Finally this slopes down to the lowest eastern terrace which is approximately 42.0mAOD to 39.0mAOD.

The north-eastern boundary is defined by an approximately 1.5m height retaining wall between the site and Oak Drive.

Table 3.1: Land Use summary

Land use	Area (m ²)	Percentage of total
Impermeable	0.74	12.4%
Permeable	5.24	87.6%
Total	5.98	100%

3.3 Existing Drainage

Existing drainage of the site has been assessed using the topographic survey (**Appendix B**), Welsh Water public sewer records (**Appendix C**) and drainage survey⁶. The details are as follows:

- The topographic survey shows a series of inspection chambers surrounding the school buildings to west of the site, these are thought to be part of the private drainage of the school. No further details are provided.
- The public sewer records show:
 - A 225mm diameter Private surface water pipe within the inside of the northern boundary of the site, flowing west to east, which discharges into the culverted watercourse crossing the site.
 - 300mm diameter combined sewers and 225mm diameter foul sewers outside of the northern boundary within Oak Drive, flowing west to east.
 - There are 225mm diameter foul and surface water sewers within Pwllcrochan Avenue, east of the site, flowing northwards to Oak Drive.

⁶ Invek Surveys Ltd, Rydal School, April 2020
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- A 225mm diameter surface water sewer west of the site in Kings Drive flowing northwards.
- A culverted watercourse crossing the site
- The drainage survey shows a culverted water courses crosses the site, this is discussed in detail in **Section 3.4**.
- The drainage survey shows a 100mm pipe flowing west to east across the lower terrace and joining the culverted watercourse. It is unclear if this sewer may be misrepresented on the Welsh Water records as the 225mm diameter private sewer at the northern boundary. This report assumes the surveyed 100mm private pipe is 225mm diameter private pipe shown on sewer records.

3.4 Hydrology

An unnamed watercourse flows from south to north through Pwllcrochan Woods, south of the site. At the road named Old Highway the watercourse enters a culvert with an invert level of 71.28mAOD. The culvert crosses the highway and issues within the site boundary.

The watercourse then immediately enters another culvert at the inlet structure SH84781671 identified on the survey plan (**Appendix D**, taken from drainage survey report) with an invert level of 66.65mAOD. The culvert is a 600mm diameter plastic pipe that flows approximately 50m north west to the manhole identified as SH84782770, outside of the listed school building.

The culvert from this manhole then becomes a stone masonry box culvert which flows below the listed building. The approximate dimensions of the culvert are identified by the survey as 400Hx350W.

The box culvert extends for approximately 90m north-west and flows to a manhole at the central mid-terrace sports pitch, identified on the survey as SH84782773. The watercourse flows through twin 300mm Victoria clay pipes for a short length of approximately 5m towards another manhole. The watercourse flows into a 450mm diameter pipe and flows north-westwards for approximately 190m to manhole SH84783970.

The watercourse enters a 375mm diameter Victoria clay culvert at the northern boundary of the site. Outside of the site boundary this culvert issues at an outfall at Oak Drive and immediately enters another culvert within the boundary of the substation and flows northwards away from the site.

A 100mm diameter private drain is also shown to enter the side from the western boundary and join the culverted watercourse at the 450mm diameter pipe within the lower terrace.

3.5 Geology

3.5.1 Desk Based

Based on published British Geological Survey online geological records⁷ for the area, the site exhibits the following geology:

⁷ British Geological Survey online mapping, available at <http://mapapps.bgs.ac.uk/geologyofbritain/home.html?location=&gobBtn=go>

- Superficial Geology: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions (U).
- Bedrock Geology: Elwy Formation - Mudstone, Siltstone And Sandstone. Sedimentary Bedrock formed approximately 424 to 427 million years ago in the Silurian Period. Local environment previously dominated by deep seas.

3.5.2 Site Investigation

A Phase 2 Geo-environmental Site investigation⁸ has been undertaken at the site which provides several trial pit logs and infiltration testing to determine the nature of the underlying geology. The general succession of strata encountered is summarised in **Table 3.2**, extracted from Table 16 in the Phase 2 report.

Table 3.2: General Succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven Thickness (m)
Topsoil	All locations	Surface	0.2 (TP3) – 0.8 (TP4)
Made Ground	WS5, TP4, TP5, TP6	Surface	0.25 (WS5) -> 2.5 (TP4)
Till – Sand	WS3, WS5, TP1, TP2, TP3, TP5, TP6, TP7	0.2 (WS4) – 1.4 (TP1)	0.7 (WS3) – 0.9 WS4
Till - Clay	WS1, WS2, WS3, WS4, WS5, TP1, TP2, TP3, TP5, TP4	0.2 – 1.3 (WS5)	>5 (WS4)

Infiltration testing undertaken as part of the site investigation sampled two locations. The western sample location concluded negligible infiltration rates. The sampling undertaken at the central mid-terrace of the site provided an infiltration rate of $3.75 \times 10^{-4} \text{m/s}$.

3.5.3 Hydrogeology

The Phase 2 report described that Groundwater was not generally encountered during the site investigation works. However, wet soils were reported at the base of WS4 during the drilling works.

The report also identifies that the superficial geology underlying the site is classified as secondary undifferentiated aquifer and the bedrock geology is classified as a Secondary B aquifer.

3.6 Climate Change

Within the context of the existing flood risk at the site, and the requirements of the PPW

⁸ RSK Environment Ltd, Phase 2 Geo-environmental Site Investigation, Rydal School, 322706-R01(01)
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and TAN15, climate change impacts from different flood sources have been considered alongside the present day scenario as described in Section 8.

As an overview; Climate change can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

In accordance with the requirements of the PPW and following consultation with Natural Resources Wales the latest climate change predictions will be considered within this assessment.

In line with the Flood Consequence Assessments: Climate Change Allowances⁹ it is noted that “The projected peak river flow change is a range, with the highest estimate equally likely to occur as the lowest estimate. For this reason, it is recommended that the central estimate, or change factor, for the 2080s for the relevant river basin district should be used to assess the potential impact of climate change as part of a flood consequence assessment.”

As such for the Western Wales River Basin District, a climate change factor of 30% will be utilised to assess flood risk associated with climate change increases in flows.

⁹ Welsh Assembly Government (2016) Flood Consequence Assessments: Climate Change Allowances,
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4 DEVELOPMENT PROPOSALS

The proposed development is for a residential development. This report has been prepared to inform a planning application for the residential development of the site in Colwyn Bay. The site proposals and drainage engineering appraisal are shown in **Appendix E**.

5 LEGISLATION AND POLICY CONTEXT

5.1 National policy

Table 5.1: National legislation and policy context

Legislation	Key provisions
Planning Policy Wales Edition 10 (Nov 2018)	<p>The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk.</p> <p>Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.</p>
Technical Advice Note 15 (2004)	PPW is supported by the Technical Advice Note 15, which provide additional guidance on flood risk.
Flood and Water Management Act 2010 ¹⁰	<p>This legislation was formally ratified in May 2010 with the aim is to implementing the findings of the 2007 Pitt Review and co-ordinating control of drainage and flood issues. There are a number of increased responsibilities within the act that affect adoption of Sustainable Drainage Systems (SuDS) features and the role of the NRW to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.</p>
Water Resources Act 1991 ¹¹	<p>Section 24 – NRW is empowered under this Act to maintain and improve the quality of ‘controlled’ waters</p> <p>Section 85 – It is an offence to cause or knowingly permit pollution of controlled waters</p> <p>Section 88 – Discharge consents are required for discharges to controlled waters</p>
Water Framework Directive (2000) ¹²	<p>The Water Framework Directive requires all inland and coastal waters to reach ‘good’ chemical and biological status. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters.</p> <p>The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify</p>

¹⁰ Flood and Water Management Act 2010

¹¹ Water Resources Act 1991

¹² European Commission (2000), ‘Directive 2000/60/EC - Water Framework Directive’

Legislation	Key provisions
	geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.
Planning (Hazardous Substances) (Wales) Regulations 2015 ¹³	<p>These Regulations consolidate, with amendments, the Planning (Hazardous Substances) Regulations 1992 (S.I. 1992/656) and subsequent amending instruments insofar as they apply to Wales. They also include provision relating to the period for determination of procedure under sections 20 and 21 of the Planning (Hazardous Substances) Act 1990 ("the PHSA").</p> <p>The regulations outline the quantity of hazardous substances that can be stored on site prior to the requirement for hazardous substances consent.</p>

5.2 Local policy

Local policies ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and making development safe without increasing flood risk elsewhere and where possible, reducing flood risk. The Local Development Plan will set out a long term spatial vision, objectives and the planning and development strategy for the County. Relevant policies to flood risk, drainage and hydrology are outlined in **Table 5.2** below.

Table 5.2: Local policy context

LDP document	Key provisions and policies
<p>Conwy Local Development Plan 2007-2022</p> <p>Adopted October 2013</p> <p>Conwy County Borough Council</p>	<p>'Strategic Policy Dp/1 – Sustainable Development Principles'</p> <p>'1. Development will only be permitted where it is demonstrated that it is consistent with the principles of sustainable development. All developments are required to:'</p> <p>'f) Take account of and address the risk of flooding and pollution in the form of noise, lighting, vibration, odour, emissions or dust in line with Policies DP/2 and DP/3 -'Promoting Design Quality and Reducing Crime';'</p> <p>'Policy Dp/3 – Promoting Design Quality And Reducing Crime'</p> <p>'1. All new development will be of high quality, sustainable design which provides usable, safe, durable and adaptable places, and protects local character and distinctiveness of the Plan Area's built historic and natural environment. The Council will require development to:'</p>

¹³ The Planning (Hazardous Substances) (Wales) Regulations 2015

LDP document	Key provisions and policies
	<p>'f) Provide sustainable urban drainage systems to limit waste water and water pollution and reduce flood risk in line with national guidance and Policy NTE/8 – 'Sustainable Drainage Systems'</p>

6 TECHNICAL ADVICE NOTE 15

TAN15 provides technical guidance on flood risk and development which supplements the policy set out in Planning Policy Wales.

In line with Figure 2 of TAN15, the development category for the works is Highly Vulnerable Development, which includes all residential premises. In line with Figure 1 of TAN15, Highly Vulnerable Development is acceptable in Flood Zone A. As a result no justification test will be required and there is no need to consider flood risk further.

6.1 Assessing Flood Consequences

To satisfy the criteria of the assessment of flood consequences, the following conditions should be satisfied;

1. Flood defences must be shown by the developer to be structurally adequate;
2. The cost of future maintenance for all new / approved flood mitigation measures, including defences must be accepted by the developer and agreed with NRW;
3. The developer must ensure that future occupiers of the development area are aware of the flooding risk and consequences;
4. Effective flood warnings are provided at the site;
5. Escape / evacuation routes are shown by the developer to be operational under all conditions;
6. Flood emergency plans and procedures produced by the developer must be in place;
7. The development is designed by the developer to allow the occupier the facility for rapid movement of goods to areas away from the floodwaters;
8. Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood;
9. No flooding elsewhere.

7 SOURCES OF INFORMATION

7.1 Introduction

Reliance has been placed on factual and anecdotal data obtained from the sources identified. RSK cannot be held responsible for any omissions, misrepresentations, errors or inaccuracies with the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report in whole or in part.

The information in this report has been prepared following consultation with third party consultees, and receipt of third party information. In some instances, this may only be verbal or informal responses.

Such information and opinions received from third parties are likely to be subjective to the individuals concerned and may not necessarily represent the opinions of the bodies themselves. As such, said opinions may be subject to variation, clarification or expansion upon submission of more detailed proposals from the developer. All opinions expressed are based upon current design standards and policies in force at the date of this report. These standards may be subject to change with the passage of time.

The opinions expressed herein are intended to provide general guidance as to how a problem related to a particular development might be resolved. Given the paucity of the original information, and the often-indirect nature of information received, they should not be relied upon as absolute or definitive guidance as to any particular solution. Such conclusions can only sensibly be arrived at upon detailed design.

As a consequence of the above, RSK LDE will not be held liable for any consequential losses, howsoever caused, as a consequence of inaccurate missing, incomplete, or erroneous data contained in this report, nor any data capable of being subject to variable interpretation by means of its generalised nature.

7.2 NRW consultation

7.2.1 Flood zone maps

NRW Flood Zone mapping study for Wales is available on their website at <https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en>

The Welsh Assembly Government's Development Advice Maps which are available at: <http://data.wales.gov.uk/apps/floodmapping/>

7.3 Relevant Studies

Table 7.1: Relevant studies

LDP document	Key provisions and policies
<p>Conwy Local Flood Risk Management Strategy</p> <p>February 2013</p> <p>Conwy County Borough Council</p>	<p>Figure 4.1 within the strategy documents shows cases of historic flooding from surface water flooding in the Conwy County borough. Due to the course resolution of the mapping it could be indicated that there have been two instances of surface water flooding close to site since 2011, however these are classified as not locally significant.</p> <p>Figure 4.3 within the strategy documents shows cases of historic flooding from ordinary watercourses in the Conwy County borough. The mapping is shown below and does not show any recorded incidents in the location of the site.</p>

8 SOURCES OF FLOOD RISK

8.1 Criteria

In accordance with PPW and advice from NRW, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change, new standard industry guidance recommends consideration of a 30% increase in peak river flows over this timeframe.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the “Forms of Flooding” and are listed as:

- Flooding from Rivers (fluvial flood risk);
- Flooding from the Sea (tidal flood risk);
- Flooding from the Land;
- Flooding from Groundwater;
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc); and
- Flooding from Reservoirs, Canals and other Artificial Structures.

The following section reviews each of these in respect of the subject site.

8.2 Definitions of Risk

Table 8.1: Flood Map for Planning Risk Zoning

Flood Zone	Description
Zone A	Considered to be at little or no risk of fluvial or coastal/tidal flooding
Zone B	Areas known to have flooded in the past
Zone C1	Served by significant infrastructure, including flood defences
Zone C2	Without significant flood defence infrastructure

Table 8.2: Flood Risk from Rivers, Flood Risk from the Sea and Flood Risk from Surface Water & Small Watercourses

Flood Zone	Description
High	Or High means that each year, this area has a chance of flooding of greater than 1 in 30 (3.3%) from Rivers, surface water & small watercourses and Tidal sources
Medium	Medium means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) from Rivers, surface water & small watercourses sources. Or Medium means that each year, this area has a chance of flooding of between 1 in 200 (0.5%) and 1 in 30 (3.3%) for Tidal sources.
Low	Low means that each year, this area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) for Rivers, surface water & small watercourses sources. Or Low means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 200 (0.5%) for Tidal sources.
Very Low	Without significant flood defence infrastructure

Table 8.3: Flood Risk category matrix from Reservoirs, Groundwater, sewers and other artificial sources

Threat Probability	Low Impact	Medium Impact	High Impact
High	Medium	Medium	High
Medium	Low	Medium	Medium
Low	Low	Low	Low
Very Low	Very Low		

8.3 Natural Resources Wales Flood Risk Mapping

The latest Welsh Government Development Advice Maps (**Figure 8.1**) shows that the site is designated as Zone A.

The latest NRW 'Flood Risk from Rivers' map shows the extents of flooding from rivers designated as 'Main Rivers' by the NRW. The mapping (**Figure 8.2**) indicates that the site is located outside of extents classified as being at flood risk from Main Rivers. Therefore, the site should be considered at **very low** risk from Main River flooding.



Figure 8.1: Development Advice Map (accessed August 2021)

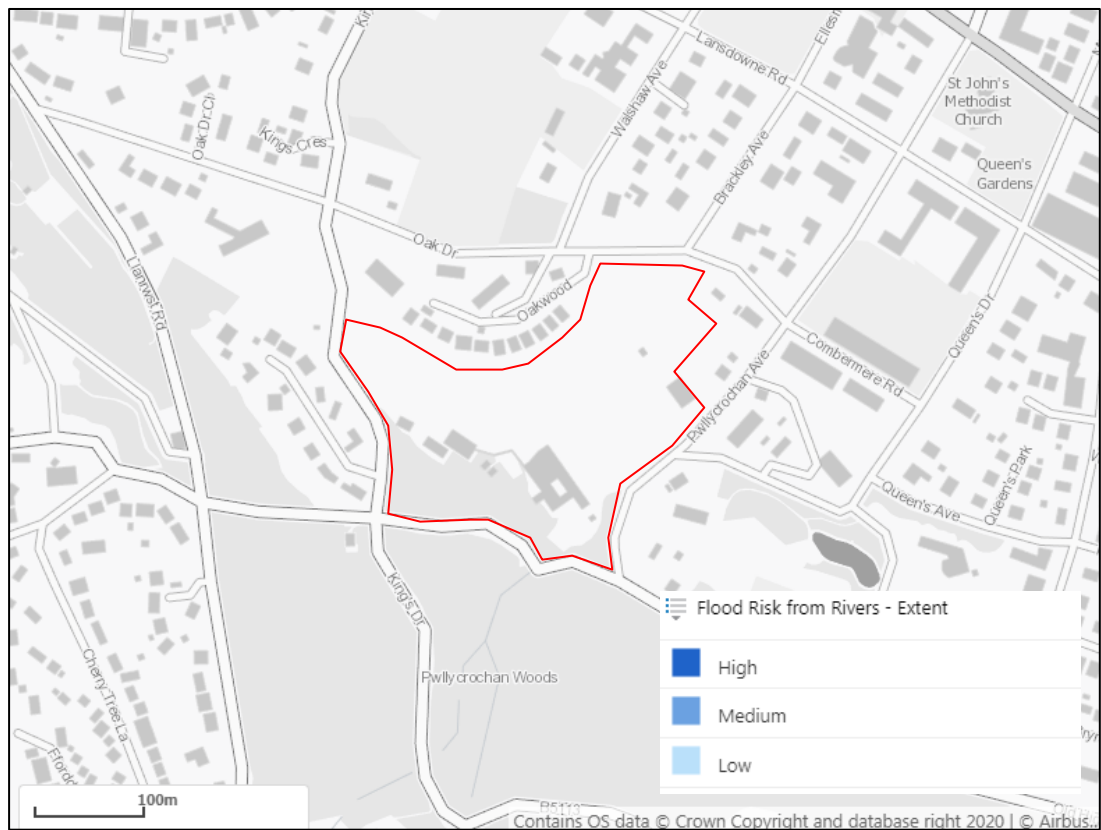


Figure 8.2: NRW Flood Risk From Rivers Extent Map (accessed August 2021)

8.3.1 Climate change

Fluvial flooding is likely to increase as a result of climate change. A greater intensity and frequency of precipitation is likely to raise river levels and increase the likelihood of a river overtopping its banks.

8.4 Flooding from the sea (tidal flood risk)

The NRW tidal flood risk maps (**Figure 8.3**) shows the site to be located outside of the area at risk from this source due its inland and elevated position. Therefore, tidal flood risk is considered **very low**.



Figure 8.3: NRW Tidal food risk map (Accessed August 2021)

8.5 Flooding from Surface Water & Small Watercourses

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff will occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland

flow or through infiltration.

NRW's surface water & small watercourses flood extent mapping (**Figure 8.4**) shows that the site is predominately at very low risk from this source. However, the unnamed watercourses which flows through the woods south of the site is shown to be the source of an overland flow path through the site, showing a limited extent of low-medium flood risk.

As the overland modelling which has been undertaken to produce this mapping is unlikely to take into account the culvert which the ordinary watercourse flows through, then the mapping is likely to show a worst case scenario where the culvert may be blocked or has reached full capacity, resulting in reduced drainage efficiency of the watercourse and exceedance flows to occur.

An isolated area of high flood risk is indicated within a court yard of the listed building. This risk will be due to the limitations of modelling showing that runoff has been unable to leave the court yard. In reality private drainage features will prevent this flooding from occurring such as rain pipes and gullies.

As the risk from culvert exceedance or blockage cannot be discounted then the risk is considered to be **low**. Exceedance flow paths from manholes associated with the culverted watercourse should be considered as part of the design of the development.

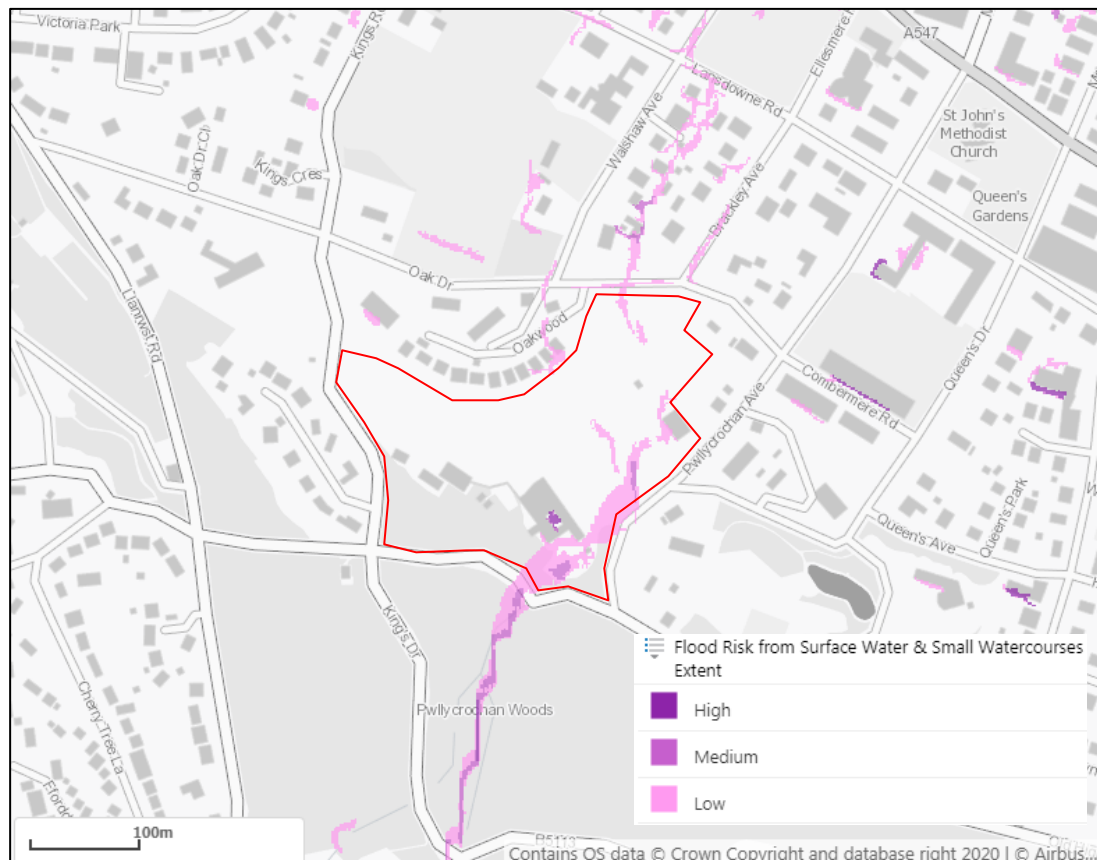


Figure 8.4: NRW surface water flood risk map (Accessed August 2021)

8.5.1 Climate change

Surface water flooding is likely to increase as a result of climate change in a similar ratio to fluvial flooding. Increased intensity and frequency of precipitation is likely to lead to reduced infiltration and increased overland flow.

8.6 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas, the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

The Phase 2 site investigations recorded no instances of Groundwater. Therefore, the risk of groundwater flooding affecting the site is therefore considered **very low**.

8.6.1 Climate change

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

8.7 Flooding from sewers

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption¹⁴. One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

To ensure that sewer and surface water flooding is not exacerbated; surface water must be considered within the design of the site. This ensures that any additional surface water and overland flows are managed correctly, to minimise flood risk to the site and the surrounding area. Any new surface water network on the site should be designed to

¹⁴ WRC (2020), 'Sewers for Adoption' 8th Edition

ensure exceedance of the network has been considered.

At present, there is a 100mm diameter drain confirmed with surveying crossing the lower terrace of the site from west to east which joins the ordinary watercourse culvert. The drainage survey indicates this takes flows from an upstream source, thought to be private drainage. The drainage strategy indicates this private drain is the 225mm diameter pipe and should be confirmed.

The drainage strategy shows the 100mm/225mm private drain is diverted from the existing route. An easement has been provided for this pipe approximately 3m either side of the pipe. Risk from exceedance flows from the surcharged manholes should be considered, though looks likely to be conveyed within highways.

Flooding of the private drainage associated with Rydal School at the top end of the site is unlikely to provide volumes of flooding that could cause significant risk to the proposed development.

The sewer flood risk to the site is considered to be **very low**.

8.7.1 Climate change

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but would not be significant in terms of the proposed development.

8.8 Reservoirs

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures.

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained.

The NRW reservoir flood map (Fig 8.5) shows that the site is not in an area at risk of flooding from this source.

8.8.1 Climate change

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

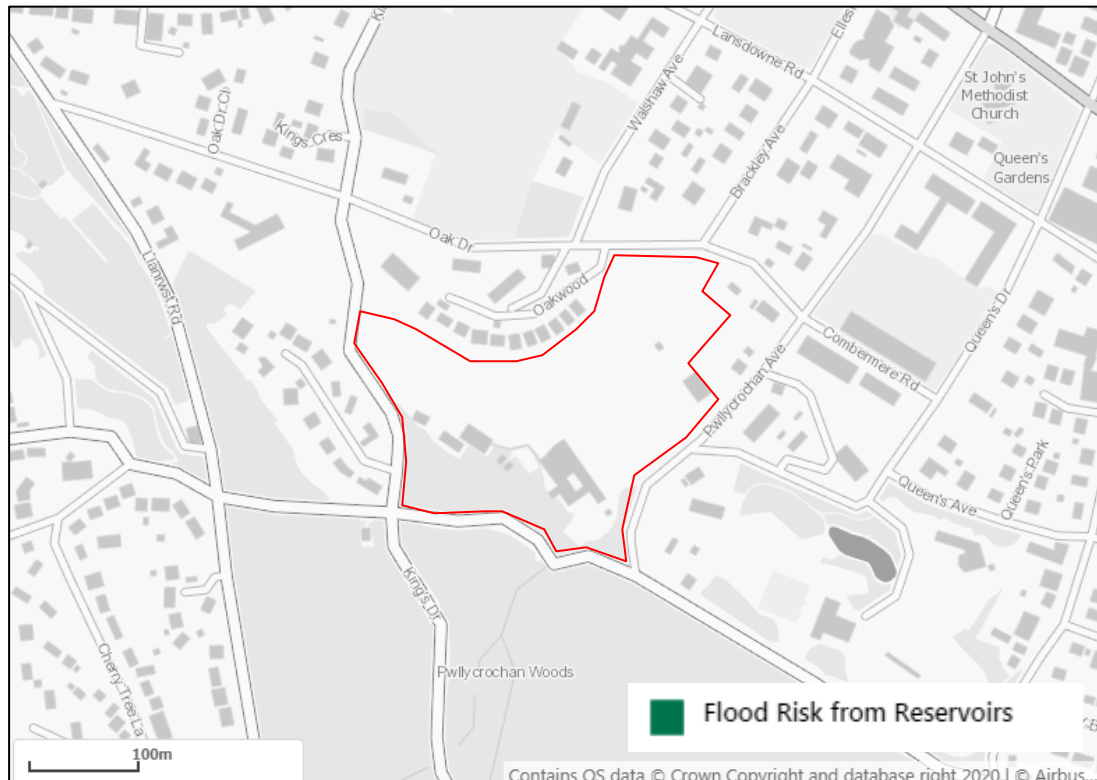


Figure 8.5: NRW Reservoir flood risk map (Accessed August 2021)

8.9 Canals

There are no canals within the vicinity of the site, therefore no risk is attributed to this source.

8.10 Flood risk resulting from the development

The proposed development will use the latest best practice guidance to ensure that flood risk is not increased as a result of the development. The proposed development, shown in the drainage engineering appraisal in **Appendix E**, provides attenuation for the 1 in 100 year plus 40% climate change event.

9 PLANNING CONSIDERATIONS AND MITIGATION OPTIONS

9.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development, and a site specific Flood Consequence Assessment is recommended.

TAN 15 uses a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas.

Waterside areas, or areas along known flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

9.2 Modification of ground levels

Due to the very low risk nature of the site, there is no requirement to raise finished floor levels as a result of fluvial flood risk. However, by raising properties 150mm above the surrounding ground levels reduces the risk of runoff towards individual dwellings.

Due to the undulating topography of the site it is likely that material will be moved around the site in order to provide developable levels and create gravitational falls for the conveyance of surface water.

9.3 Safe access and egress

As the NRW flood map and indicates that the site is located in Flood Zone 1 safe access and egress can be achieved at all times by pedestrians and vehicles.

9.4 Watercourse easements

The culverted watercourse through the site is shown to be considered in development layout. The culverted watercourse is shown to be predominately within the highway, where the culvert must leave the highway an easement has been provided, approximately 3m either side of the pipes. Exceedance flow routes should be considered as part of the development to ensure dwellings are safe from flooding which may result from the culvert.

10 CONCLUSIONS AND RECOMMENDATIONS

This FCA complies with the PPW and its Technical Guidance (TAN15) and demonstrates that flood risk from all sources has been considered in the proposed development. It is also consistent with the Local Planning Authority requirements with regards to flood risk.

The site is shown to lie within Zone A (Considered to be at little or no risk of fluvial or coastal/tidal flooding) in accordance with the Development Advice Maps.

This flood risk assessment has considered multiple sources of flooding and concluded the following:

Table 10.1: Flood risk summary

Source	Level of risk	Mitigation
Fluvial	Very Low	Developable area is shown to be wholly within Zone A and outside of flood risk extents.
Tidal	Very Low	The site is inland and elevated.
Surface water & Small Watercourses	Low	The mapping shows an overland flow path through the site associated with the culverted watercourse through the site. Blockages or exceedances of the culvert capacity could result in overland flows through the site. This should be considered as part of the design.
Groundwater	Very Low	Groundwater levels are thought to be low across the site therefore risk is considered very low.
Sewers	Very Low	Sewer records indicate there are no public sewers which could be a risk to the proposed development due to sewers generally being located in lower topographical areas than the site.
Artificial sources	Very Low	There are no confirmed sources of artificial flood risk such as canals and reservoirs.

Overall, taking into account the above points, the developments at the location outlined should not be precluded on flood risk grounds.

APPENDIX A

SERVICE CONSTRAINTS

RSK Group service constraints

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Castle Green Homes Limited (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the



Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

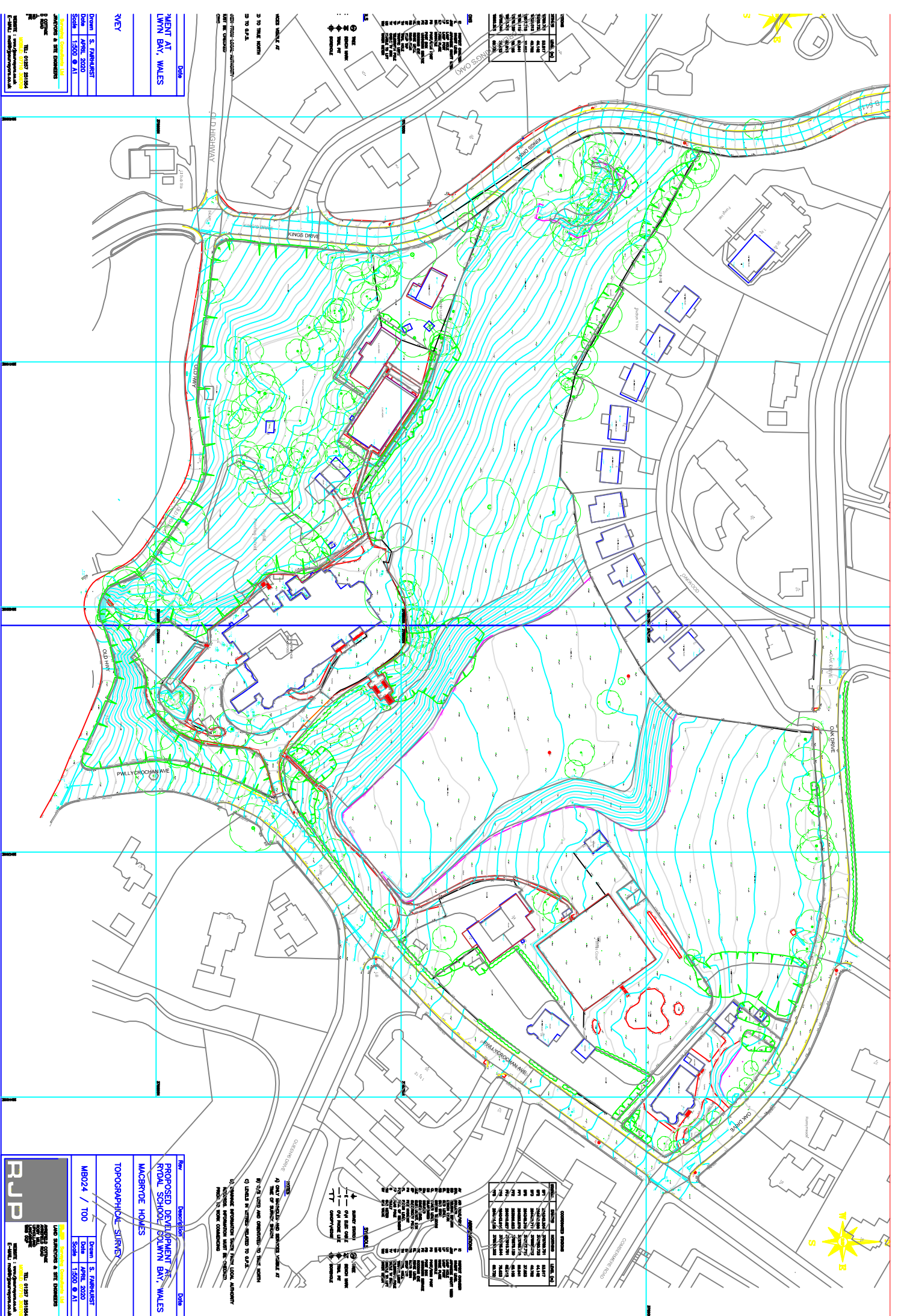
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.



APPENDIX B

TOPOGRAPHIC SURVEY























APPENDIX C

WELSH WATER SEWER RECORDS

PPA0004746



LEGEND(Representative of most common features)

	Foul chamber		Outfall
	Surface water chamber		Lamp hole
	Combined chamber		Storm Overflow
	Combined sewer overflow		Rising main
	Special purpose chamber		Gravity sewer
	Treatment works		Private sewer
	Pumping station		Private sewer subject to Sect. 104 adoption agreement
	NB: Sewer symbol colour indicates the type.		Private Sewer Transfer
RED	- Combined		Lateral Drain
GREEN	- Surface Water		Inspection Chamber
BROWN	- Foul		
Purple	- Former S24 sewers (for indicative purposes only)		

Notes:

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

Dŵr Cymru Cylinddydd (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and is not warranted as to its correctness in the event of excavations or other works made in the vicinity of the company's apparatus. The error of location of apparatus is liable to vary and any excavations made entirely at your risk. 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 information available and, in particular, but without prejudice to the generality of this disclaimer, it should be noted that the records that are available to the Company may not include the whereabouts of water mains, service pipes, drains, lateral drains or disposal mains and any excavation apparatus is liable to be damaged or if they are, the potential for damage and possible injury 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 be anticipated.

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

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Map Ref: 284223,378872
Map scale: 1:1900
Printed by: Jenkins Tegan
Printed on: 03 Apr 2020





APPENDIX D

DRAINAGE SURVEY PLAN



Client
Macbride

Drawing Title

Rydal school
Culvert Survey Plan

Scale(s)	N.T.S	Drawn	PW
Date	21.08.20	Checked	RD
Job Number	1635	Approved	KN

Sheet Size, Drawing Number & Revision

A1_1635/01_Rev_02



APPENDIX D

PROPOSED LAYOUT AND DRAINAGE

STRATEGY

SUBJECT TO DESIGN

The details provided on this drawing are subject to comments by all the relevant approving authorities. Until such time as all comments have been received and incorporated onto the drawings, all the information provided and costings, are used at Castle Green risk and no liability will be accepted by RSK. Scheme based on Castle Green Sketch Scheme site plan Rev F

CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

RSK LDE LTD has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing. Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

Legend:

- Development Boundary
- Proposed Finished Floor Level
- Existing Site Levels
- Proposed adoptable foul water sewer and manhole
- Proposed adoptable surface water sewer and manhole
- S104 Easement
- Infiltration Test Pits and results
- Plot Soakaway
- Highway Soakaway Manhole

All infiltration structures shown indicative only & are subject to design/receipt of additional infiltration rates

All infiltration features to be designed in coordination with manufacturers own design teams and therefore subject to change

The details provided on this drawing are subject to comments by all the relevant approving authorities. Until such time as all comments have been received and incorporated onto the drawings, all the information provided and costings, are used at Castle Green's own risk and no liability will be accepted by RSK.

P3	01.10.21	Updated to new layout Rev I	EP	MAR
P2	20.08.21	Revised following client comments	MAR	MAR
P1	25.08.21	First issue	EP	MAR
Rev.	Date	Amendment	Drawn	CHKD. Appd.



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Client
Castle Green

Project Title
Rydal School
Colwyn Bay

Status
INFORMATION

Drawing Title
Planning Drainage Layout

Drawn	Date	Checked	Date	Approved	Date
EP	AUG 21	MAR	AUG 21		

Scale	Orig Size	Dimensions
1:500	A0	m

Project No.
882085

Drawing No.
10-02

Rev.
P3

Scale 1:500
0 5 10 15 20 25m