Shared Educational Campus,
Old Nangor Road,
Clondalkin,
Dublin 22

Flood Risk Assessment

December 2016

Revision: A

TOBIN CONSULTING ENGINEERS

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REPORT

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Shared Educational Campus,
Old Nangor Road,
Clondalkin,
Dublin 22

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1 INTRODUCTION

TOBIN Consulting Engineers were appointed in December 2016 to carry out a Flood Risk Assessment (FRA) to accompany a planning application for the proposed Shared Educational Campus project on Old Nangor Road, in Clondalkin, Dublin 22.

The development involves the construction of two new sixteen classroom schools (i.e. Gaelscoil na Camóige and Gaelscoil Chluain Dolcain), a playing pitch and the addition of a new PE Hall to the existing Coláiste Chillian. The proposed works will be constructed on the site of an existing school and an adjoining playing pitch site.

Due to the proximity of the site to the Camac River, fluvial flooding was identified as a potential risk to the proposed development.

This FRA has been prepared in accordance with a Stage 2 Initial Flood Risk Assessment as defined by *The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009)*[1] *as follows:*

> *"to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed. In addition, the requirements of the detailed assessment should be scoped."*

The aim of this FRA is to *"appraise the adequacy of existing information"* (extract from PSFRM Guidelines, see above) and to identify the risk, if any, of flooding in relation to the proposed development.

1.1 SITE DESCRIPTION

The site of the proposed works is located on the Old Nangor Road, Clondalkin, Dublin 22 (see Figure 1). The subject site is part brown-field (i.e. the site of the existing Coláiste Chillian) and part green-field (i.e. the existing playing pitch). The existing Coláiste Chillian is located to the eastern end of the site. The site is bounded on three sides by roadway, the R134 to the north, the R113 to the west and the Old Nangor Road to the South. A walkway and cycle path bounds the site to the east. The total site is approximately 5.5 ha in area.

A topographical survey was carried out by D3D Ltd. in 2015 who found that existing ground elevations at the proposed site vary from 63.05 mOD at the east of the site to 64.68mOD at the west of the site. Localised areas of mounded earth were noted along the northern boundary of the site.

At its closest, the Camac River is located approximately 95m from the boundary of the proposed site.

[1] OPW, DoEHLG: "*The Planning System and Flood Risk Management Guidelines for Planning Authorities*", Stationery Office, (November 2009).

Figure 1 Site Location Map (EPA Envision)

2 FLOOD MAPS

2.1 OPW HISTORICAL FLOOD MAPS

The OPW's online National Flood Hazard Mapping database[2] provides information on reported floods, in the form of reports, photos and newspaper articles. While a number of flood events have been recorded in Clondalkin, the database does not provide any record of flood events occurring at the proposed development site (see Figure 2).

One record exists of flooding on the Camac River, recorded on Leinster Terrace and Old Nangor road where the Camac River enters the former site of the Clondalkin Paper Mills (see Figure 2). The flooding occurred after prolonged rainfall spanning two days in June 1993. The Meterological Service indicated that 100mm of rainfall occurred in this 24 hour period, equivalent to a 100 year storm. Although several houses were flooded at the time, the site of the proposed schools was not, although much of Old Nangor Road became impassable.[3]

In response to the June 1993 flood event *The River Camac Improvement Scheme* Phase (i) was designed to alleviate possible future flooding in the area. The following works were carried out as part of the scheme:

1) *"Flood relief culvert and earth embankment in Corkagh Park designed to eliminate any risk of flooding to houses at Cherrywood;*
2) *An upgrading and enhancement of the surface water disposal system at Leinster Terrace, Clondalkin to eliminate the danger of houses being flooded at that location;*
3) *Removal of the factory weir at the Clondalkin Paper Mills to alleviate future flooding in the Leinster Terrace/Beech Row vicinity."*[3]

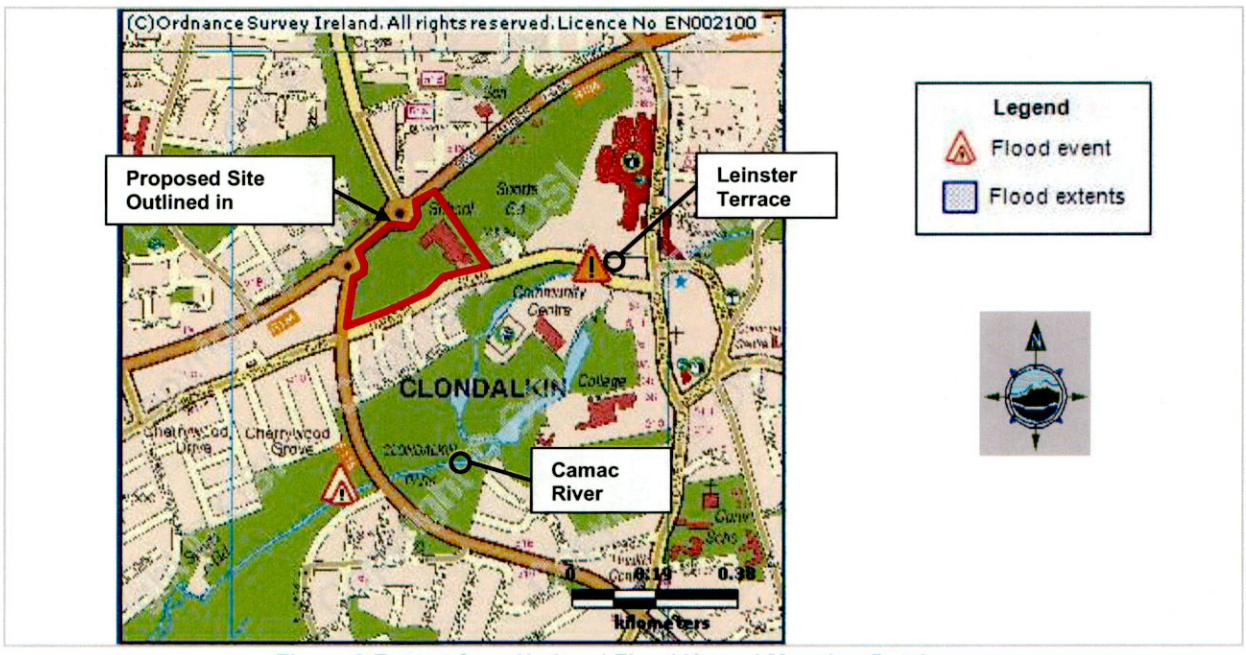

Figure 2 Extract from National Flood Hazard Mapping Database

Further works were carried out in 2001 under The *River Camac Flood Defence Scheme* Stages (ii) to (v) by South Dublin County Council. The works involved the provision of 55,000m^3 of offline flood

[2] www.floodmaps.ie
[3] Senior Engineer, Environmental Services "*River Camac Improvement Scheme Phase II Preliminary Report*" June 1997. Available on www.floodmaps.ie Retrieved December 2016

storage (storage ponds) at Corkagh Park. The works also included river channel widening, construction of flow control structures such as throttles and overflow weirs.[4]

No further flooding events are recorded in the area by the OPW post June 1993.

[4] Available at http://www.jbbarry.ie/projects/flooding/camac.html Retrieved December 2016

2.2 OPW PRELIMINARY FLOOD RISK ASSESSMENT MAPS

The national programme of Catchment Flood Risk Assessment and Management (CFRAM) Studies comprises the execution of three parts:

(1) Preliminary Flood Risk Assessments;
(2) Flood Hazard Mapping; and
(3) The development of Flood Risk Management Plans.

The OPW initially produced a series of maps to assist in the development of the Preliminary Flood Risk Assessment (PFRA) throughout the country. These maps were produced as part of a desktop study of a number of sources. The PRFA Flood Maps- User Notes and Conditions[5] states:

> *"The maps provide only an indication of areas that may be prone to flooding. They are not necessarily locally accurate and should not be used as the sole basis for defining the Flood Zones, nor for making decisions on planning applications."*

The indicative flood mapping of the area shows the proposed site is located approximately 90m outside estimated 100 year fluvial flood extents. The 1000-year flood extent is located approximately 75m from the proposed site. The mapping also shows that pluvial flooding and groundwater flooding is not likely to occur at the site during an extreme rainfall event (see Figure 3).

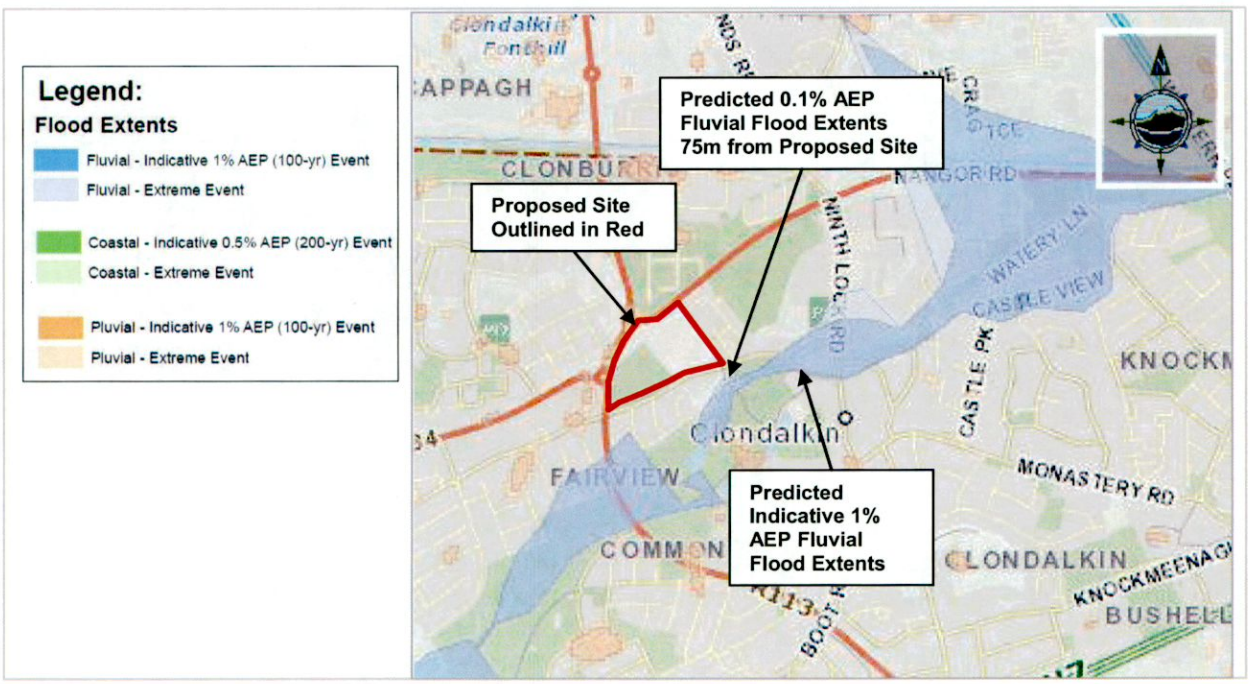

Figure 3 Extract from OPW Preliminary Flood Risk Assessment Mapping (source: MyPlan.ie/viewer)

It should be noted that "*the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location*"[5].

[5] OPW: "*The National Preliminary Flood Risk Assessment (PFRA) Overview Report*", OPW (March 2012).

3 PLANNING AND FLOOD RISK MANAGEMENT GUIDELINES

The proposed site is located within the South Dublin County Council boundary. This section considers the 2016-2022 South Dublin County Development Plan and the 2009 publication *'The Planning System and Flood Risk Management'*.

3.1 THE PLANNING SYSTEM & FLOOD RISK MANAGEMENT GUIDELINES

The *'The Planning System and Flood Risk Management'* (PSFRM) guidance document, published in 2009 by The Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), discuss flood risk in terms of three flood zones. It also identifies vulnerability classes for development in order to define what type of development is suitable within what flood zone and when the Justification Test should be applied.

The flood zones, vulnerability classes and requirement for the *Justification Test* is summarised Table 1.

Table 1 Matrix of vulnerability versus flood zone to illustrate appropriate development and that are required to meet the Justification Test (Extract from the PSFRM Guidelines)

Flood Zone	Probability of Flooding (Return Periods)	Recommendation based on Vulnerability of Development		
		Highly Vulnerable	Less Vulnerable	Water Compatible
A	Highest Probability (more frequent than 1 in 100-yr for river; more frequent than 1 in 200-yr for coastal)	Justification Test	Justification Test	Appropriate
B	Moderate Probability (1 in 100-yr to 1 in 1000-yr for river; 1 in 200-yr to 1 in 1000-yr for coastal)	Justification Test	Appropriate	Appropriate
C	Low Probability (less frequent than 1 in 1000-yr for both river and coastal)	Appropriate	Appropriate	Appropriate

The PSFRM Guidelines consider schools to be a "Highly Vulnerable Development". From Table 1 it is determined that the proposed development should be assessed against a 1-in-1000 year flood event.

3.2 CLIMATE CHANGE

The Flood Risk Management Climate Change Adaptation Plan (published May 2015) has been prepared under the remit of the National Climate Change Adaptation Framework. It sets out the policy on climate change adaptation of the Office of Public Works (OPW), the lead agency for flood risk management in Ireland, based on a current understanding of the potential consequences of climate change for flooding and flood risk in Ireland, and the adaptation actions to be implemented by the OPW and other responsible Departments and agencies in the flood risk management sector.

The document recommends two future flood risk scenarios for considering future implications of factors, including climate change, in relation to future flooding. The Mid-Range Future Scenario (MRFS) recommends a "likely" future scenario while the High-End Future Scenario (HEFS) represents a more "extreme" future scenario. Table 2 sets out the allowances for both of these scenarios.

Table 2 Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	- 0.5 mm / year[1]
Urbanisation	*No General Allowance – Review on Case-by-Case Basis*	*No General Allowance – Review on Case-by-Case Basis*
Forestation	- 1/6 Tp^2	- 1/3 Tp^2 + 10% SPR^3

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.

For the purpose of this flood risk assessment, we have assessed the proposed development against the Mid Range Future Scenario (MRFS) as it represents a likely future scenario.

3.3 SOUTH DUBLIN COUNTY DEVELOPMENT PLAN (2016-2022)

Chapter 7 of the 2016-2022 South Dublin County Development Plan (CDP) deals with the area of flood risk.

Under Infrastructure & Environmental Quality (IE) Policy 3 Flood Risk, the following key objectives are described pertaining to flood risk, relevant to the subject site:

"It is the policy of the Council to continue to incorporate Flood Risk Management into the spatial planning of the County, to meet the requirements of the EU Floods Directive and the EU Water Framework Directive."

IE3 Objective 1:

"To support and co-operate with the Office of Public Works in delivering the Catchment-Based Flood Risk Assessment and Management Programme and in particular the Eastern District CFRAMS and associated Flood Risk Management Plan (FRMP), the River Dodder CFRAMS and associated Flood Risk Management Plan (FRMP). The recommendations and outputs arising from the CFRAM study for the Eastern District shall be considered in preparing plans and assessing development proposals."

IE Objective 2:

"To support the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks and the Flood Risk Regulations (SI No 122 of 2010)."

IE Objective 3:

"To manage flood risk in the County in accordance with the requirements of The Planning System and Flood Risk Management Guidelines for Planning Authorities, DECLG and OPW (2009) and Circular PL02/2014 (August 2014), in particular when preparing plans and programmes and assessing development proposals. For lands identified as being at risk of flooding in (but not limited to) the Strategic Flood Risk Assessment, a site-specific Flood Risk Assessment to an appropriate level of detail, addressing all potential sources of flood risk, is required, demonstrating compliance with the aforementioned Guidelines or any updated version of these Guidelines, paying particular attention to residual flood risks and any proposed site specific flood management measures."

IE SLO 1:

"To require the preparation of a site and catchment specific Flood Risk Assessment and Mitigation Strategy, prepared by a qualified person(s), to be submitted with any proposal for development on the 'EE' zoned lands and demonstration that the development satisfies all the criteria of the Development Management Justification Test as set out in Table 2.3 of the document titled 'Strategic Flood Risk Assessment for SDCC Development Plan - Detailed Report on Flood Risk in the Baldonnell Area'."

The finalised Areas for Further Assessment (AFAs) are listed in the 2016-2022 South Dublin County Development Plan. The Camac River was included as part of the AFAs listed.

A review of historical flood data was carried out as part of the Eastern CFRAMs and included in the South Dublin CDP 2016-2022. Figure 4 below shows an overview of areas of historical flooding identified within the South Dublin CDP boundary. The mapping shows no historical flooding at the proposed site. The main sources of flooding within the CDP boundary were identified as fluvial and pluvial.

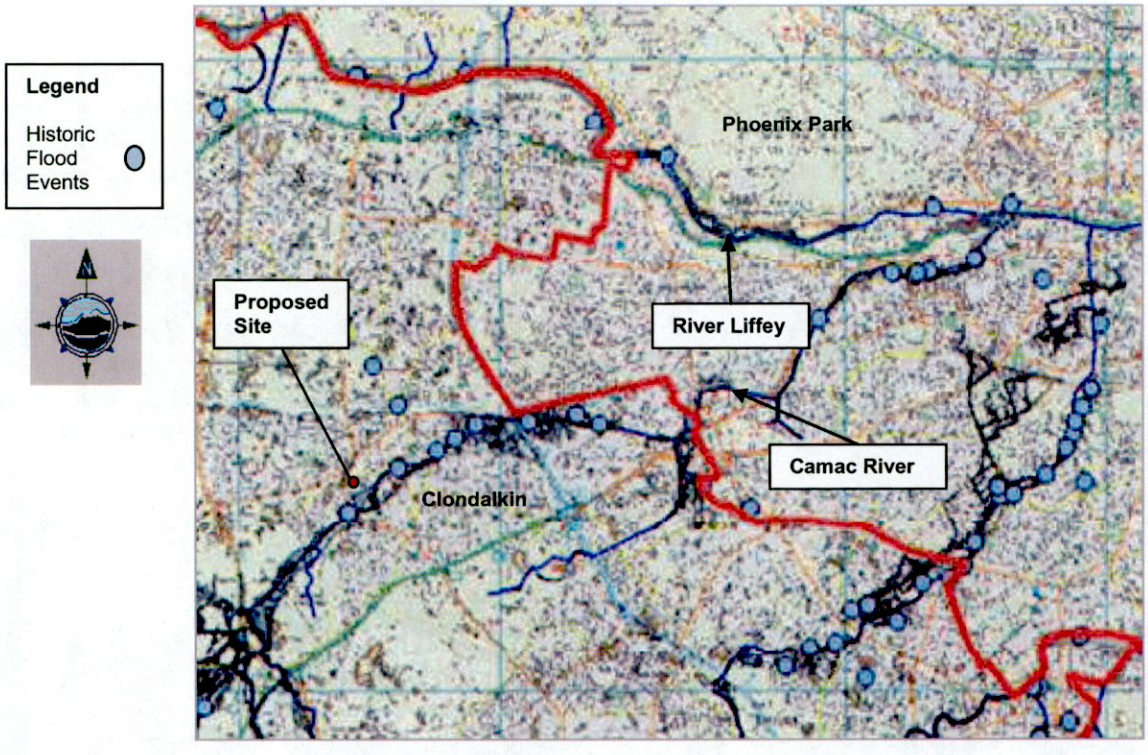

Figure 4 Extract from Figure 5.1 of the South Dublin County Development Plan "Flood Risk Overview"

4 FLOOD RISK ASSESSMENT

In accordance with the PSFRM guidance document, with respect to sensitivity to flooding, the proposed development is considered a "highly **vulnerable development**". The PSFRM guidance document recommends that such developments be constructed in flood zone C, i.e. that there is less than a 0.1% probability of the site flooding. This section will identify the likelihood of flooding at the proposed development from fluvial and pluvial sources.

4.1 FLUVIAL FLOODING FROM RIVERS/STREAMS

A Stage 1 Strategic Flood Risk Assessment (SFRA) was carried out as part of the 2016-2022 South Dublin County Development Plan. An extract from the Fluvial Flood Zone Mapping is included as Figure 5. The mapping shows that the proposed site is outside the predicted 1-in-1000 year flood extents of the River Camac. Predicted water levels adjacent to the proposed development were not quoted.

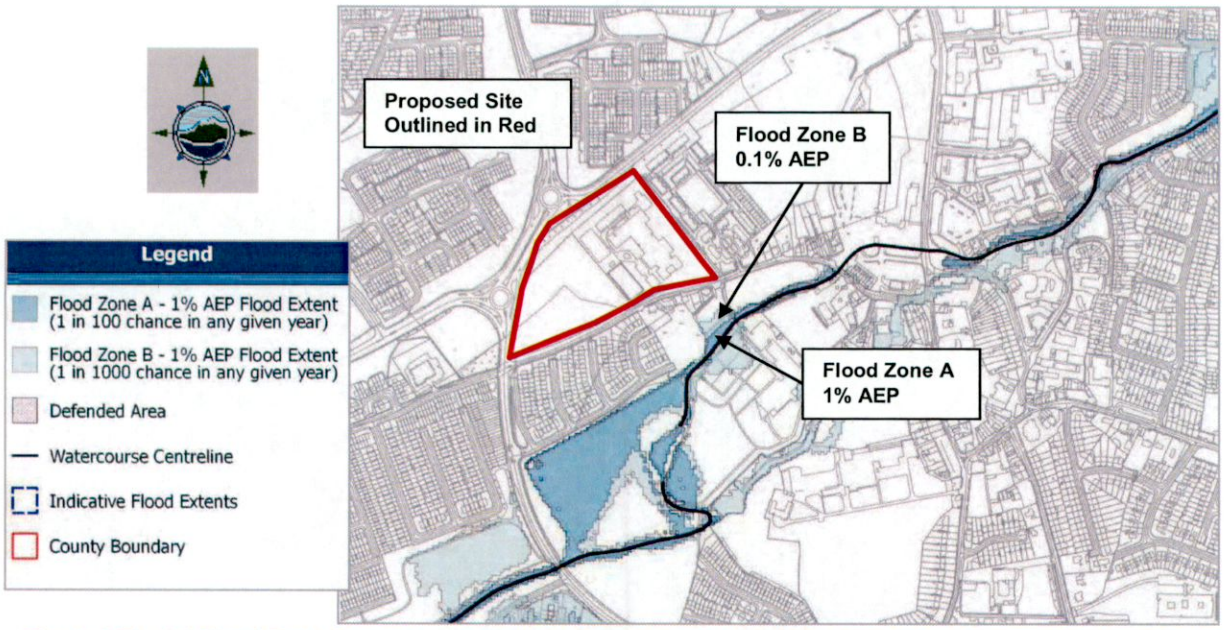

Figure 5 Fluvial Flood Zone Mapping, Appendix B Map 5 Figure MDW657_0005 from the South Dublin County Development Plan SFRA[6]

As part of the Eastern *Catchment Flood Risk Assessment and Management* (CFRAM) study detailed hydraulic modelling of the Camac River was carried out by RPS,2016.The flood mapping produced as part of the study (Figure 6) show the proposed site located outside the estimated 1-in-1000 year flood extents. See Figure 6 below.

[6] Available at: http://www.southdublindevplan.ie/sites/default/files/documents/Strategic%20Flood%20Risk%20Assessment%202016%20LR.pdf

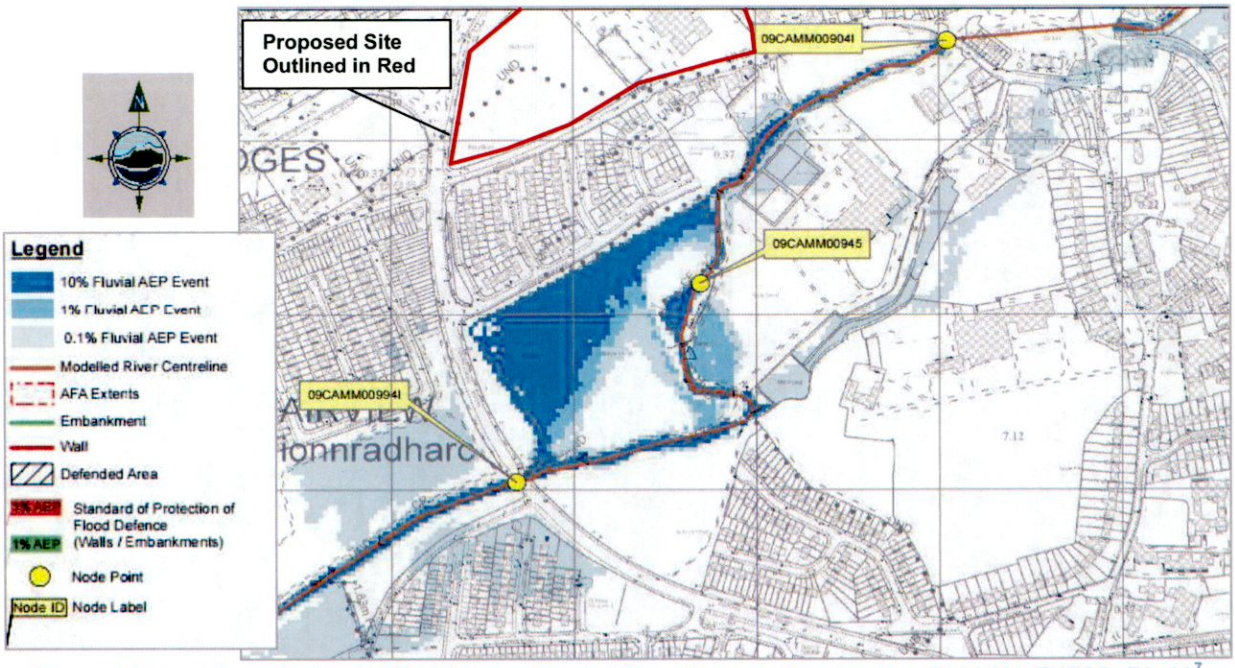

Figure 6 Extract from Eastern CFRAM Camac Fluvial Flood Extents Drawing No.: E09CAM_EXFCD_F0_16[7]

The Eastern CFRAM Camac Fluvial Flood Extents Study provides estimates of design flows in the River Camac. Estimated water levels in the Camac River were taken from Node 09CAMM009041 which is located where the Camac River passes under the Old Nangor Road, approximately 230m downstream from the proposed site. Gauged flows were not available at Node 09CAMM009041, therefore flows were taken from Node 09CAMM00648, approximately 2km downstream from the proposed site. The Design 100 and 1000 year MRFS flows in the Camac River at Node 09CAMM00648 have been estimated at 23.00m^3/s and 29.10m^3/s respectively (see Figure 7).

[7] Available at: http://maps.opw.ie/fhrm_pdf_final//east/uom09/dc_camac/01_ex/fluvial/e09cam_exfcd_f0_16.pdf

Figure 7 Gauge Locations in the Camac River (Eastern CFRAM)[8]

Table 3 Estimated Design Flows (Mid-Range Future Scenario)

	Existing		Mid-Range Future Scenario	
Return Period (years)	**Estimated Flow (m^3/s) @Node 09CAMM00648**	**Estimated Water Level (mOD) @Node 09CAMM009041**	**Mid-Range Future Scenario Flow (m^3/s)**	**Mid-Range Future Scenario Flood Level mOD**
100	23.00	57.47	27.60	58.02
1000	29.10	58.22	34.90	59.24

Based on an extrapolation of the predicted Eastern CFRAM flood levels, the 100 and 1000 year water levels at the proposed site have been estimated at 58.02mOD and 59.24mOD respectively. See Table 3.

Based on the topographical survey carried out by D3D Ltd in December 2015, the lowest ground elevation recorded at the proposed site is 63.05mOD. This is 3.81m above the predicted 1 in 1000 year water level (MRFS) in the Camac River (59.24mOD), approximately 230m downstream of the proposed site. Therefore, it is predicted that the proposed site will not be subject to fluvial flooding during the MRFS 1 in 1000 year storm.

[8] Available at http://maps.opw.ie/floodplans/fhr_map/en/?X=-723905&Y=7033579&Z=11

4.2 PLUVIAL FLOODING AT THE PROPOSED DEVELOPMENT

The OPW have produced a series of maps to assist in the development of a Preliminary Flood Risk Assessment (PFRA) throughout the country (see Section 0). These maps were produced by the collation of information from a number of sources. Pluvial modelling for the PFRA was carried out by HR Wallingford . The 100 and 1000 year flood extents were generated by analysing 1, 3, 6, and 24 hour rainfall events. The design storm rainfall was applied to the National Digital Terrain Model with an allowance for infiltration based on the soil type in the area. The DTM used was generated from RADAR based technology in 2007 and is stated to have a 5m horizontal resolution (re-sampled to 10m resolution) and 0.01m vertical resolution, to quoted vertical accuracy of 0.5m RMSE [9]. It should also be noted that the PFRA pluvial flood maps were adapted to show only the extents where the flood depths were greater than 200mm (on the basis that depths lower than this would not cause significant damage given door-step levels above ground level)[10].

The analysis carried out by HR Wallingford as part of their PFRA study predicted that no pluvial flooding (ponding of surface water) at the proposed site should occur (see Figure 8).

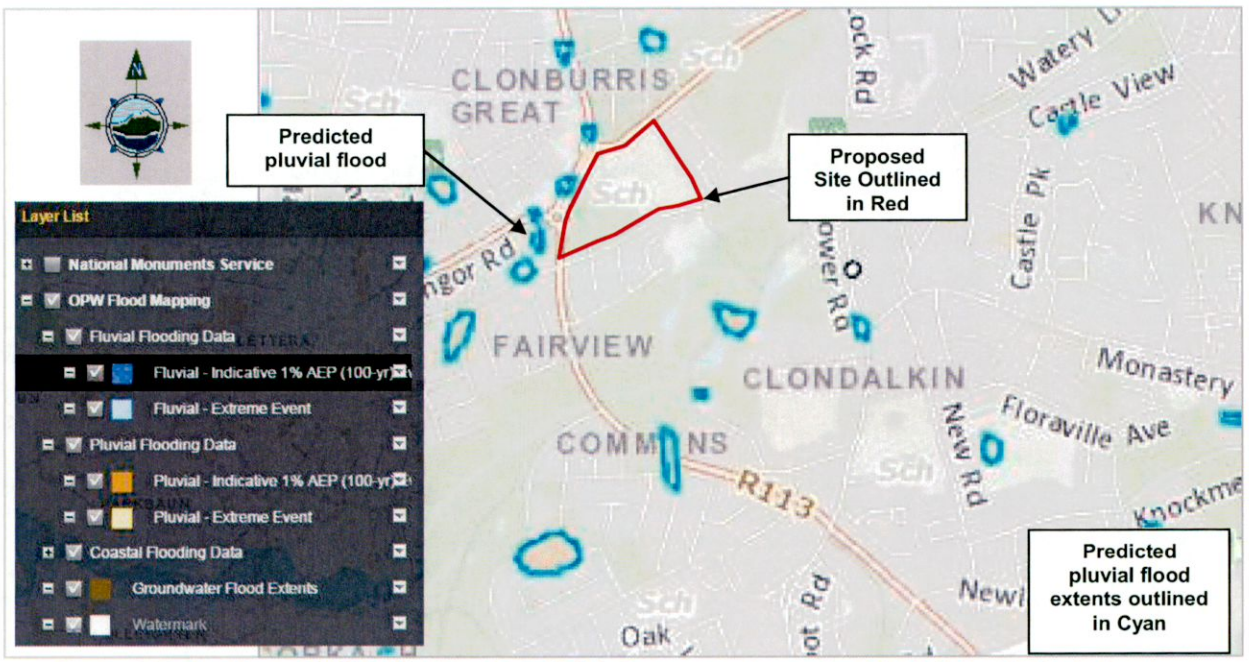

Figure 8 Extract from OPW Preliminary Flood Risk Assessment mapping Pluvial Food Extents (source: MyPlan.ie/viewer)

4.3 COASTAL FLOODING

Due to the distance of the site from the coast, coastal flooding was not examined as a potential risk to the proposed development.

4.4 GROUNDWATER FLOODING

The PFRA study maps (i.e. the MyPlan.ie viewer) were reviewed and the proposed site is not located within a groundwater flood risk zone. There is no evidence of historic groundwater flooding at the site (see Figure 3 and Figure 8).

[9] HR Wallingford: "*Flood Risk Assessment and Management Programme, National Pluvial Screening Project for Ireland*", OPW (November 2010).
[10] OPW: "*The National Preliminary Flood Risk Assessment (PFRA) Overview Report*", OPW (March 2012)

5 CONCLUSION

TOBIN Consulting Engineers were requested to prepare a site-specific Flood Risk Assessment (FRA) for the site of two proposed schools in Clondalkin.

This Flood Risk Assessment (FRA) presents a review of:

- OPW Flood Maps;
- OPW Preliminary Flood Risk Assessment Maps;
- South Dublin County Development Plan (2015-2021);
- The Planning System & Flood Risk Management (PSFRM) Guidelines; and
- Eastern CFRAM Study.

Due to the proximity of the site to the Camac River, fluvial flooding was initially identified as the primary potential risk to the proposed development.

The PSFRM guidance document recommends that **"Highly Vulnerable"** developments, such as the proposed schools, be constructed in flood zone C, i.e. that there is less than a 0.1% probability of the site flooding.

Based on the extrapolation of water levels predicted as part of the Eastern CFRAM study the 100 and 1000 year MRFS flood levels in the River Camac adjacent to the site have been estimated as 58.02mOD and 59.24mOD respectively. This includes an allowance for climate change.

The lowest recorded existing ground elevation at the site (63.05mOD) is 3.81m above the predicted 1-in-1000-year MRFS flood level.

Based on flood analysis carried out as part of the Eastern CFRAM study and recorded elevations at the proposed site, it is estimated that the proposed development at Old Nangor Road is located in Flood Zone C and therefore will not be inundated by flooding during the 1 in 1000 year mid-range-future-scenario.

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