ARUP

Tiznow Property Company Limited (Comer Group Ireland)

City Park Development at the Former Tedcastles Site

Flood Risk Assessment Report

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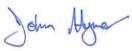
		Signature			
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1. Introduction

1.1 Project background

Arup has been commissioned by Tiznow Property Company Limited (Comer Group Ireland) to provide flood risk advice to inform the master planning of a mixed-use development located in the Cork City Docklands.

This commission includes the preparation of a site-specific flood risk assessment (FRA) to support a Strategic Housing Development (SHD) planning application at the Former Tedcastles Site.

This report takes account of the following:

- Knowledge of the existing site and local constraints.
- Knowledge of current and upcoming CCC studies including but not limited to the CCC South Docklands Levels Drainage Study.
- Requirements of 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DoEHLG), herein referred to as 'The Guidelines'.
- Cork City Development Plan 2015-2021 (including Strategic Flood Risk Assessment).
- Cork City DRAFT Development Plan 2022-2028 (including Strategic Flood Risk Assessment).
- Currently anticipated programme and timescales.

1.2 Scope of the FRA

The scope of the FRA includes the following:

- A review of the availability and adequacy of existing information.
- Confirmation of the sources of flooding which may affect the site.
- A qualitative assessment of the risk of flooding to the site and identification of possible measures which can mitigate the flood risk to acceptable levels.
- Demonstration that the construction of the proposed development will not worsen flood risk elsewhere.
- Preparation of a Justification Test.

1.3 Summary of data used

Flood risk data relevant to the proposed development and surrounding area has been obtained from the following sources:

- Cork City Development Plan 2015-2021 (including Strategic Flood Risk Assessment).
- Cork City DRAFT Development Plan 2022-2028 (including Strategic Flood Risk Assessment).
- Lee CFRAM Hydrology and Hydraulics Reports and predictive flood mapping (https://www.floodinfo.ie/publications/).
- OPW Flood Plans and Flood Maps (www.floodinfo.ie).
- OPW National Flood Hazard Mapping Website (www.floodinfo.ie)
- Preliminary Flood Risk Assessment (PFRA) mapping produced by OPW (www.floodinfo.ie).

- Lower Lee (Cork City) Drainage Scheme Exhibition Drawings and Reports (https://www.floodinfo.ie/frs/en/lower-lee/project-info/project-documents/public-exhibition-interactive-map/).
- Topographical survey of the site.
- Proposed development planning application drawings.
- Feedback from CCC with regards to the preliminary outcomes of the South Docklands Levels Drainage Study.

All levels referred to in this report are to Malin Head Ordnance Datum, unless stated otherwise.

The following documents and drawings are referenced within this report and contained within the appendices to this report:

- Lee CFRAM Flood Extent Maps (Appendix A)
  - Fluvial flood extent (Current)
  - Fluvial flood extent (Mid-Range Future Scenario)
  - Tidal flood extent (Current)
  - Tidal flood extent (Mid-Range Future Scenario)
- Lower Lee (Cork City) Drainage Scheme Exhibition Drawings - Flood Extents Map (Appendix B)

1.4 Site location

The proposed development is located within the South Docklands area to the east of Cork City, approximately 50m south of the River Lee. The location of the site is shown Figure 1 below.

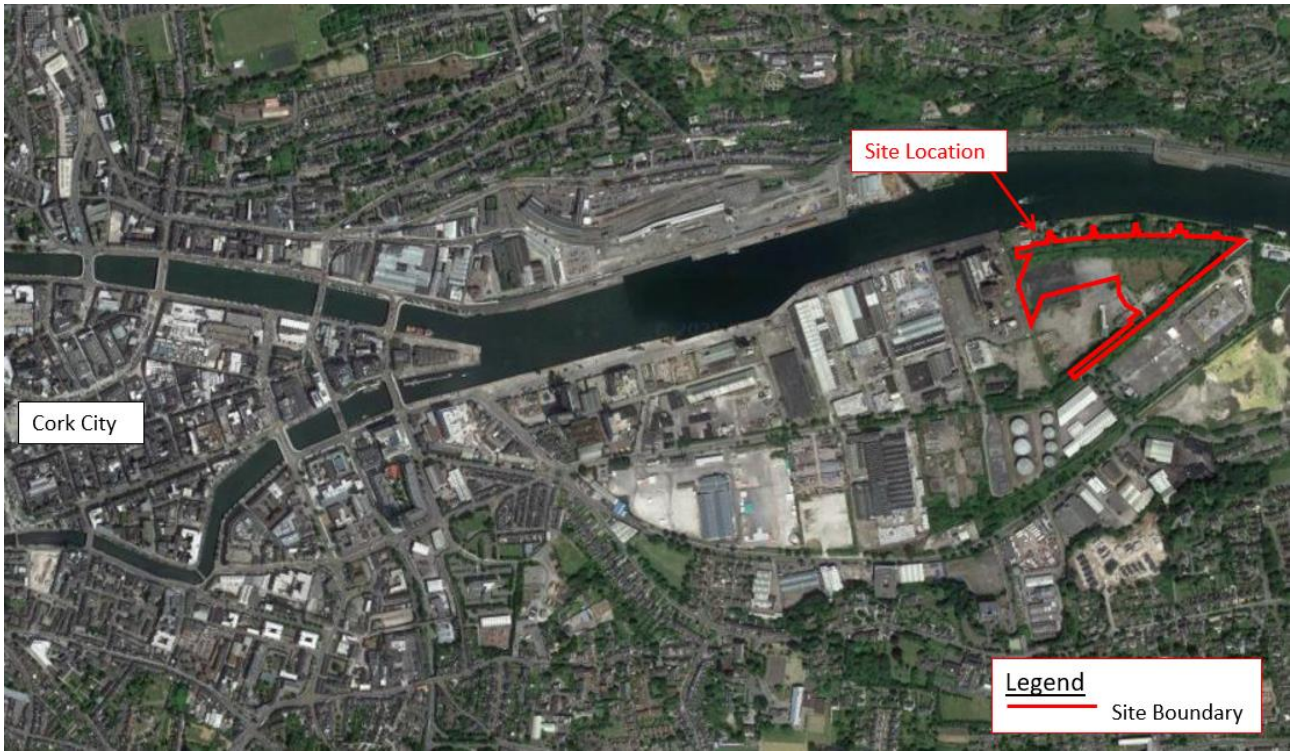


Figure 1: Site location in relation to Cork City

Figure 2 indicates the development boundary (red line). The subject site is bounded by the Marina to the north, Centre Park Road to the south, and the former Marina Generating Station to the west.

The existing topography of site is relatively flat with levels between 1.5 to 2.5mOD, with a slight gradient falling from north to south. The site is currently a mix of greenfield and paved areas. There are existing drainage ditches at the northern and south-eastern boundaries of the site.

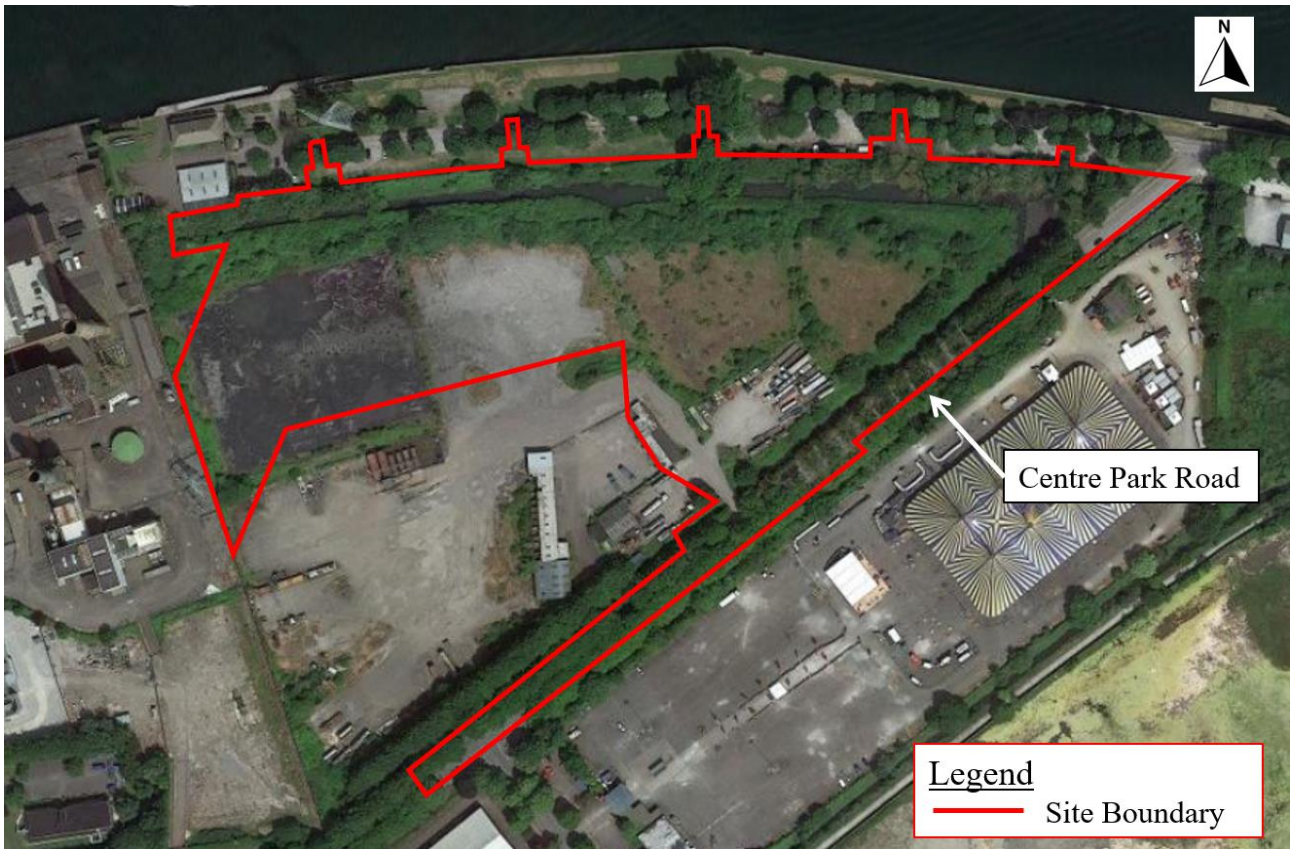


Figure 2: Site boundary

1.5 Proposed development

Planning permission is being sought for a Strategic Housing Development on the subject site. The proposed development comprises demolition of the existing structures on site and the construction of 823 no. apartments, resident amenity and ancillary commercial areas including childcare facilities.

The development will comprise 6 no. buildings ranging in height from part 1 no. to part 35 no. storeys over lower ground floor level. The proposed development also comprises hard and soft landscaping, pedestrian bridges, car parking, bicycle stores and shelters, bin stores, ESB substations, plant rooms and all ancillary site development works. Vehicular access to the proposed development will be provided via Centre Park Road.

Architect's drawings of the proposed development accompany this application.

2. Planning context

2.1 Introduction

Cork City Council aims to regenerate the Cork South Docks area to create a vibrant, innovative, mixed use, sustainable, socially inclusive, urban quarter. City Docks is a regeneration area of national importance and has been identified in the Project Ireland 2040 National Planning Framework (NPF) as a key growth enabler to deliver large scale regeneration in terms of employment, housing and supporting infrastructure.

The following planning policy documents are relevant to the flood risk assessment of the proposed development:

- Cork City Development Plan 2015-2021 (including Strategic Flood Risk Assessment)
- Cork City DRAFT Development Plan 2022-2028 (including Strategic Flood Risk Assessment)
- Cork City Climate Change Adaptation Strategy 2019-2024
- The Planning System and Flood Risk Management Guidelines for Planning Authorities

2.2 Cork City Development Plan 2015-2021

The Cork City Development Plan 2015 – 2021 contains the policies and objectives to guide development and land use in Cork City. The South Docklands area of Cork City is a critical strategic location for development and is identified as such within the zoning map provided in the Cork City Development Plan (2015-2021) displayed in Figure 3. The subject site is zoned for a combination of ‘Mixed-Use Development’, ‘Public Open Space’ and ‘Neighbourhood Centres’.

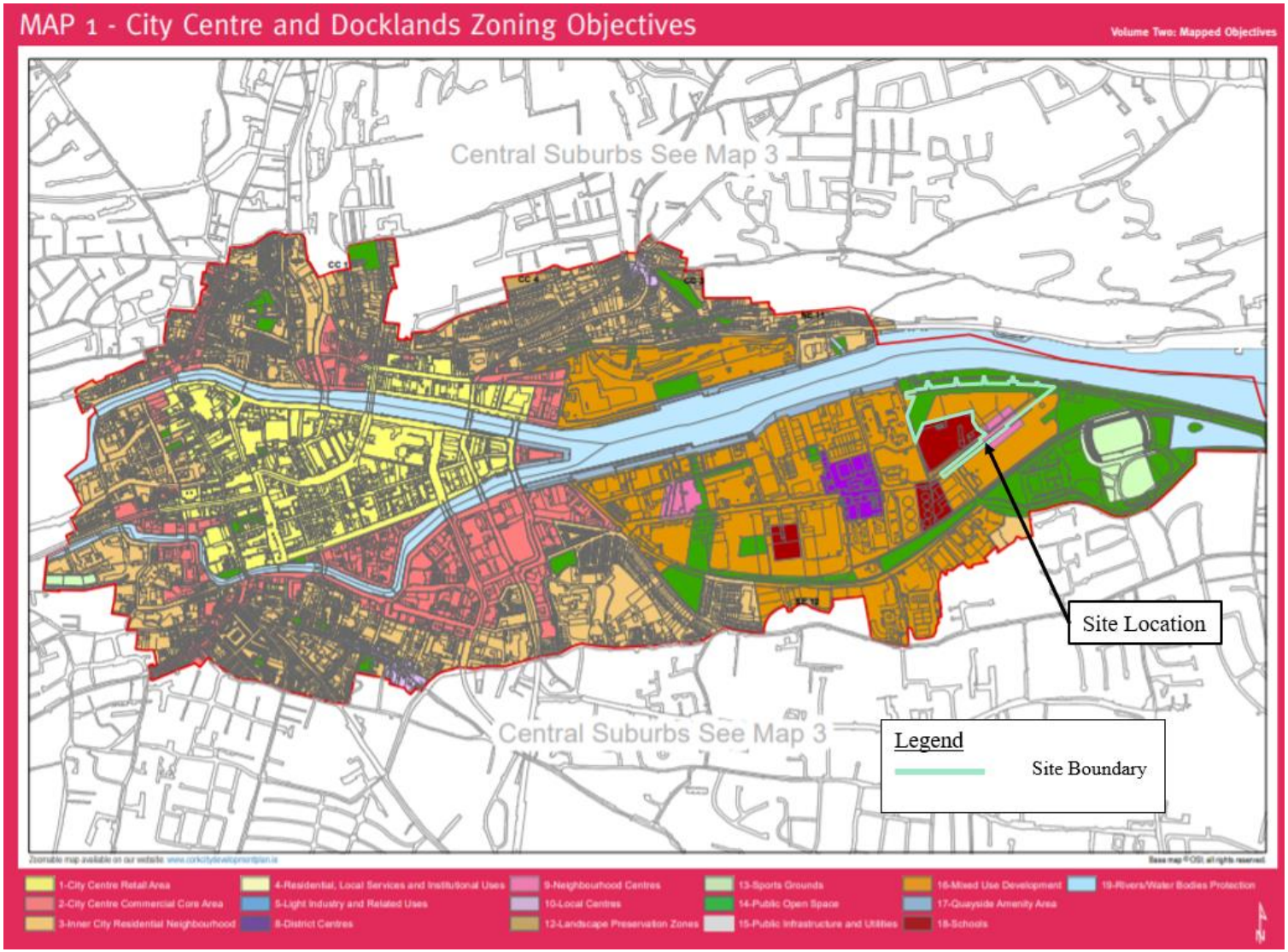


Figure 3: Cork City Development Plan City Centre and Docklands zoning objectives

The Development Plan states that the vision for Cork City will be achieved through a series of interconnected strategic goals and related chapters. Goal 6 is relevant to flood risk and is reproduced in Table 1 below.

Table 1: Cork City Development Plan 2015-2021 Goals

Goal	Details
Goal 6 – Tackle Climate Change Through Reducing Energy Usage, Reducing Emissions, Adapt to Climate Change and Mitigate Against Flood Risk	A key aim of the Plan is to reduce emissions that lead to global warming through sustainable energy usage in transport and buildings. It also aims to mitigate and adapt to the challenges of climate change such as the increased risk of flooding, through the design, layout and location of appropriate land-uses. This is particularly addressed in Chapter 12. Environmental Infrastructure and Management and Chapter 16. Development Management.

The following objectives relevant to flood risk are set out in Chapter 12 of the Development Plan.

Table 2: Cork City Development Plan 2015-2021

Objective	Details
Objective 12.13 Lee Catchment Management Plan / Lower Lee Flood Relief Scheme	Cork City Council shall have regard to the recommendations of the Draft Lee Catchment Flood Risk Assessment and Management Plan and shall incorporate the updated hydraulic modelling, mapping data and recommendations of South West CFRMP / Lee CRFMP (River Catchment Framework Management Plan) and the Lower Lee Flood Relief Scheme as each plan progresses.
Objective 12.14 Flood Risk Management in Development Proposals	Cork City Council will implement The Planning System and Flood Risk Management: Guidelines for Planning Authorities, 2009 in the preparation of land-use plans and determining planning applications.
Objective 12.15 Restrictions on Development in Flood Risk areas	To restrict development in identified flood risk areas, in particular, floodplains, except where the applicant satisfies the Justification Test as outlined in The Planning System and Flood Risk Management: Guidelines for Planning Authorities 2009.
Objective 12.16 Floodplains	To protect, enhance and manage the City's floodplains, wetlands and coastal habitat areas that are subject to flooding as vital 'green infrastructure' which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reduce the need to provide flood defence infrastructures.
Objective 12.17 Flood Impact Assessment	All significant developments impacting on flood risk areas will be required to provide a Flood Impact Assessment to accompany the planning application to identify potential loss of floodplain storage and proposals for the storage or attenuation (e.g. SUDS) of run-off discharges (including foul drains) to ensure development does not increase the flood risk in the relevant catchment.

2.2.1 Cork City Development Plan 2015-2021 Strategic Flood Risk Assessment

In preparation of the Cork City Development Plan 2015 – 2021, a Strategic Flood Risk Assessment (SFRA) was undertaken in accordance with The Guidelines. This includes large areas of the South Docklands, which are referenced as Site 3.1 in Figure 4. In this figure, any site which shows colour, such as the subject site, requires a justification test.

The SFRA included a Justification Test for lands within Flood Zones A and B which are currently zoned for uses categorised as 'Highly Vulnerable' or 'Less Vulnerable' development (Refer to Figure 5 for Development Plan Justification Test).

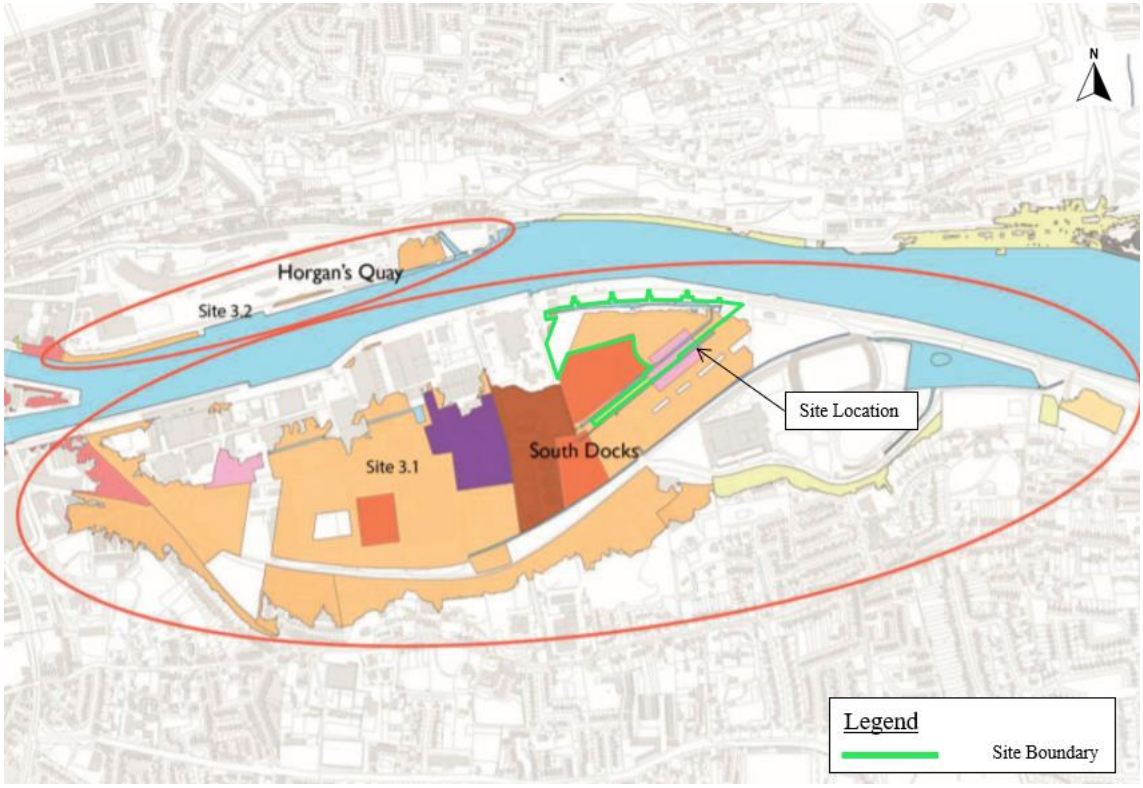


Figure 4: Key plan of sites where a Justification Test is required (extract from the Cork City development plan SFRA)

Justification Test for Development Plans	
1. The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act, 2000, as amended.	Response Yes, Cork is a designated Gateway under the National Spatial Strategy
2. The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:	
(a) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	Response Yes. The said lands adjoin the city centre the most important strategic growth centre.
(b) Comprises significant previously developed and / or under-utilised lands;	Response Yes. The said lands have been subject to significant development.
(c) Is within or adjoining the core of an established or designated urban settlement;	Response Yes. The said lands are within the City Centre.
(d) Will be essential in achieving compact and sustainable urban growth;	Response Yes. The said lands will be served by the proposed route of the planned Bus Rapid Transit corridor (Ballincollig to Mahon), the Commuter Rail Service and all main city bus routes and so accords with sustainable development principles.
(e) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	Response There are alternative residential and commercial zoned lands, but this is a long established urban area.
3. A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere.	Response The Draft Lee CFRAMS (Management Plan) demonstrates that flood risk to the development area can be adequately managed and will not cause unacceptable adverse impacts elsewhere. Actions are recommended that would mitigate significant negative effects.

Figure 5: Justification Test for Cork City Development Plan 2015-2021

2.3 Draft Cork City Development Plan 2022-2028

The Cork City Development Plan 2022-2028 is currently in a draft stage but is expected to be finalised in the coming months. In preparation of the Development Plan, an SFRA was undertaken in accordance with The Guidelines.

2.3.1 Draft Cork City Development Plan 2022-2028 Strategic Flood Risk Assessment

This SFRA is currently a work in progress. The SFRA draws on existing flood risk information to provide recommendations in relation to land use zoning, integration of flood risk management provisions into the plan, and justification tests.

In the SFRA, the Cork South Docks area has been earmarked as an exception to The Guidelines. It has passed a Justification Test which allows it to be zoned for development in an area that would otherwise be considered inappropriate. The SFRA notes that future development in the Cork South Docks will:

- Be subject to a site-specific flood risk assessment
- Comply with the flood risk management provisions of this Plan
- Comply with the relevant measures contained in the Council's 2020 South Docks Drainage Strategy
- Will benefit from Flood Relief Schemes being progressed by the OPW.

2.4 Cork City Climate Change Adaptation Strategy 2019-2024

Cork City Council has developed a climate change adaptation strategy to help increase its resilience in accordance with the provisions of The Climate Action and Low Carbon Development Act 2015 and the National Adaptation Framework (NAF), 2018. This climate change adaptation strategy was adopted by Cork City Council on Monday, 30 September 2019. The purpose of the Strategy is to

(i) ensure a proper comprehension of the key risks and vulnerabilities of climate change

(ii) bring forward the implementation of climate resilient actions in a planned and proactive manner and,

(iii) ensure that climate adaptation considerations are mainstreamed into all operations and functions of Cork City Council.

2.5 The Planning System and Flood Risk Management Guideline for Planning Authorities

In November 2009, the Department of Environment, Heritage and Local Government and the Office of Public Works jointly published a Guidance Document for Planning Authorities entitled 'The Planning System and Flood Risk Management'.

The guidelines are issued under Section 28 of the Planning and Development Act 2000; and Planning Authorities and An Bord Pleanála are therefore required to implement these Guidelines in carrying out their functions under the Planning Acts.

The aim of the guidelines is to ensure that flood risk is neither created nor increased by inappropriate development.

The guidelines require the planning system to avoid development in areas at risk of flooding, unless they can be justified on wider sustainability grounds, where the risk can be reduced or managed to an acceptable level.

They require the adoption of a Sequential Approach (to Flood Risk Management) of Avoidance, Reduction, Justification and Mitigation and they require the incorporation of Flood Risk Assessment into the process of making decisions on planning applications and planning appeals. Fundamental to the guidelines is the introduction of flood risk zoning and the classification of different types of development having regard to their vulnerability. The management of flood risk is now a key element of any development proposal in an area of potential flood risk and should therefore be addressed as early as possible in the site master planning stage.

2.6 Definition of flood zones

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types of flood zones defined in The Guidelines as follows;

Table 3: Flood Zone Categories

Zone Category	Definition
Flood Zone A	Probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding).
Flood Zone B	Probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding).
Flood Zone C	Probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

2.7 Definition of vulnerability classes

The following table summarises the vulnerability classes defined in The Guidelines and provides a sample of the most common type of development applicable to each. The proposed development is categorised as 'Highly Vulnerable' and 'Less Vulnerable' development.

Table 4: Vulnerability Classes

Vulnerability class	Land uses and types of development which include:
Highly Vulnerable Development	Includes Garda, ambulance and fire stations, hospitals, schools, residential dwellings, residential institutions, essential infrastructure, such as primary transport and utilities distribution and SEVESO and IPPC sites, etc.
Less Vulnerable Development	Includes retail, leisure, warehousing, commercial, industrial and non-residential institutions, etc.
Water Compatible Development	Includes Flood Control Infrastructure, docks, marinas, wharves, navigation facilities, water based recreation facilities, amenity open spaces and outdoor sport and recreation facilities.

2.8 Sequential approach and Justification Test

The Guidelines outline the sequential approach that is to be applied to all levels of the planning process.

This approach should also be used in the design and layout of a development and the broad philosophy is shown in Figure 6. In general, development in areas with a high risk of flooding should be avoided as per the sequential approach.

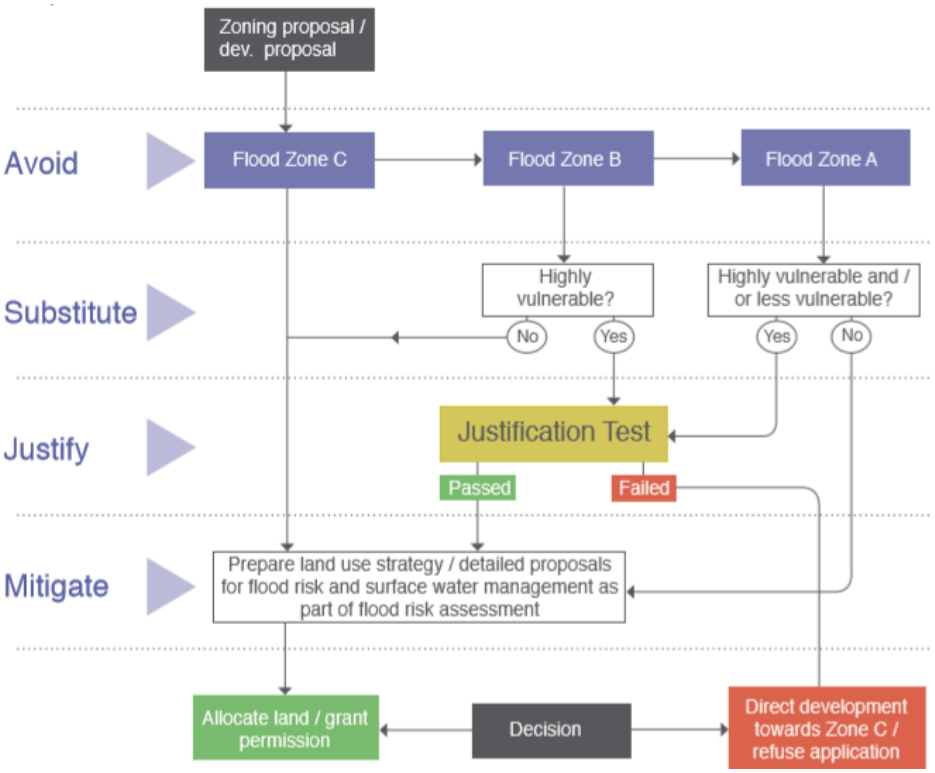


Figure 6: Sequential approach (reproduced from The Guidelines)

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of developments that are being considered in areas of moderate or high flood risk. The test comprises the following two processes.

The first is the Plan-making Justification Test and is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.

The second is the Development Management Justification Test and is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

Table 5 illustrates the different types of vulnerability class appropriate to each zone and indicates where the Justification Test is required.

Table 5: Vulnerability classes

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable	Justification Test	Justification Test	Appropriate
Less Vulnerable	Justification Test	Appropriate	Appropriate
Water Compatible	Appropriate	Appropriate	Appropriate

The Guidelines recognise that there is a need to reconcile the desire to avoid development in areas at risk of flooding while also ensuring sequential and compact urban development as several large urban centres are already located in areas that are at risk of flooding. The following section of The Guidelines is particularly relevant to the proposed development on the subject site:

"*Notwithstanding the need for future development to avoid areas at risk of flooding, it is recognised that the existing urban structure of the country contains many well-established cities and urban centres, which will continue to be at risk of flooding.*

At the same time such centres may also have been targeted for growth in the National Spatial Strategy, regional planning guidelines and the various city and county development plans taking account of historical patterns of development and their national and strategic value.

In addition, development plans have identified various strategically located urban centres and particularly city and town centre areas whose continued growth and development is being encouraged in order to bring about compact and sustainable urban development and more balanced regional development. Furthermore, development plan guidelines, issued by the Minister for the Environment, Heritage and Local Government under Section 28 of the Planning and Development Act 2000, have underlined the importance of compact and sequential development of urban areas with a focus on town and city centre locations for major retailing and higher residential densities."

3. Identification of potential flood mechanisms and historic flooding

3.1 Potential flood mechanisms at the site

The following potential sources and mechanisms of flood risk have been identified at the site:

- Fluvial and/or tidal flooding from high levels in the River Lee resulting in breaching or overtopping of the existing South Docks Polder Defences or overtopping of the quays further west of the site. This risk will increase with climate change, in particular with respect to sea level rise and increasing storm events. This risk is assessed in detail in Section 4 of this report.
- Groundwater flooding / seepage risk – As the site lies within a polder and is underlain by deep gravels known to be in hydraulic continuity with the Lee, the evaluation of groundwater flood risk is an important consideration. This risk is assessed in detail in Section 5 of this report.
- Pluvial and/or surface water drainage flooding – Pluvial flooding can occur due to lack of capacity of the local surface water drainage network during periods of intense rainfall and/or as a result of discharge restrictions such as blockage and/or being tide-locked. The tide-locking aspect means that this risk also has the potential to increase with climate change. This risk is assessed in detail in Section 6 of this report.

3.2 Historic flood data

3.2.1 OPW National Flood Hazard Mapping website

Records of historical flood data were obtained from the OPW National Flood Hazard Mapping website (www.floodinfo.ie) and reports produced as part of the Lee CFRAMS.

According to the website, there is a documented report from Cork City Council noting flooding of Centre Park Road which occurred on 12 January 1988 and concludes that it was a result of high-water levels in the River Lee. This is likely to have been caused by backing up of drains resulting in surface water flooding. An extract from the OPW website indicating the location of the flooding is displayed in Figure 7.

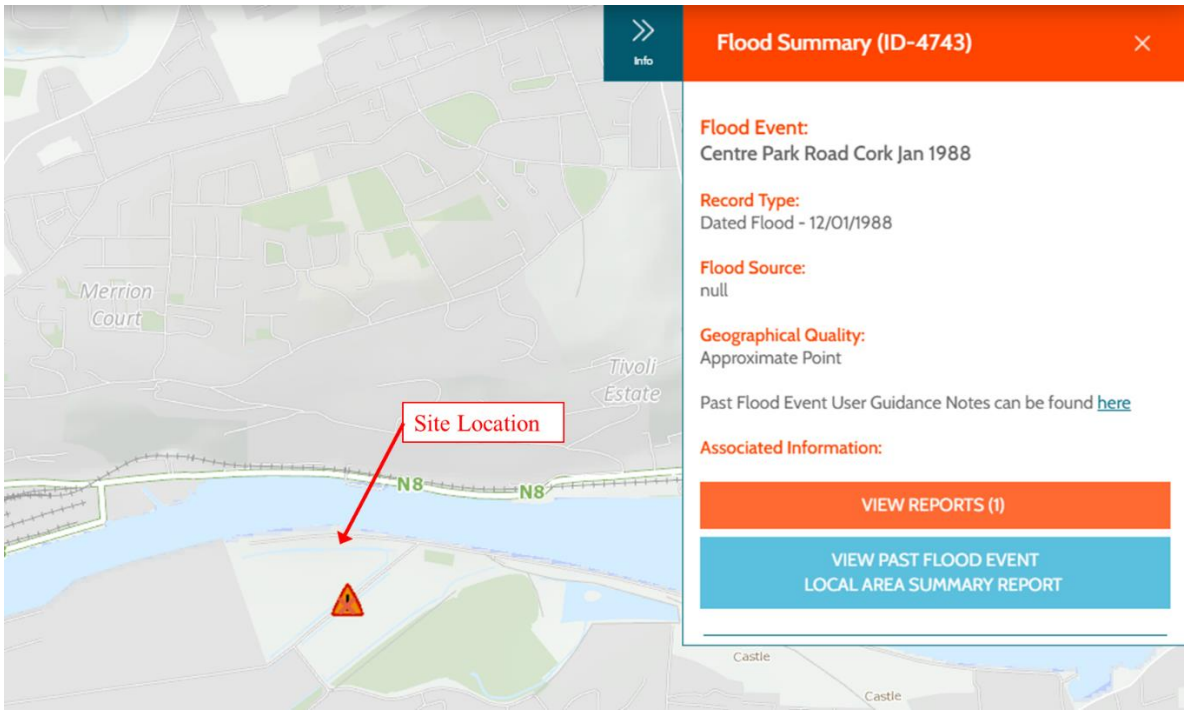


Figure 7: Extract from FloodInfo.ie website

3.2.2 Anecdotal knowledge of historic flooding

In addition to the recorded event above, there is a well-known issue with pluvial flooding on the low-lying roads in the South Docks during periods of heavy rainfall coinciding with extreme tides resulting in tide-locking and backing up of the system.

4. Fluvial and tidal flood risk from the River Lee

4.1 Current fluvial flood risk

An extract from the Lee CFRAMS fluvial flood extent map is presented in Figure 8 below and illustrates the predicted current fluvial flood extents within the South Docklands area (1 in 10, 100, and 1000-year fluvial flood events).

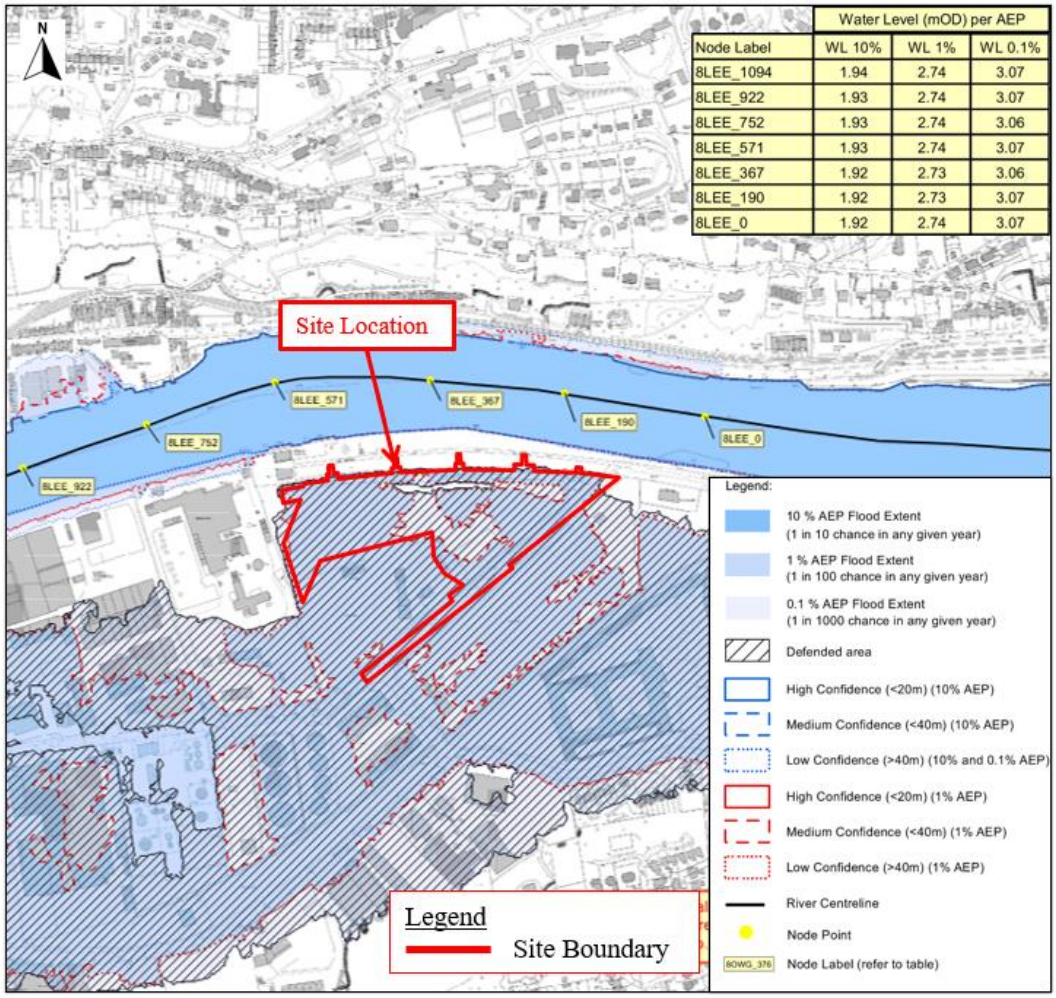


Figure 8: Extract from Lee CFRAMS fluvial flood extent map, current scenario

The flood map indicates that a large proportion of the site is located within Flood Zone A (within the 1 in 100-year undefended fluvial flood extent – dark blue shade). However, the CFRAM maps also confirm that the site lies within a defended area (hatched) due to the presence of the existing polder flood defences at the Marina to the north of the site. The higher levels of the Marina are evidenced by the white coloured area between the river and the flooded area.

Node 8LEE_571 is the model node adjacent to the site with the most conservative levels, it indicates a peak fluvial flood level (1% Annual Exceedance Probability [AEP] or 1 in 100-year event) of 2.74mOD and 0.1% AEP or 1 in 1000-year flood level of 3.07mOD. None of these events overtop the polder defences, which are at an average level of 4.0Mod north of the site.

The low point in the quayside defences is at Albert Quay East (1.3km west of the site). In the 100-year fluvial event, flow paths from Albert Quay East cause flooding along Centre Park Road but do not reach or impact the site. This can be seen in Figure 8 as the light blue shade with no hatch. Inundation of the site is unlikely to occur from the north due to the presence of the higher polder flood defences along Marina Walk, which are generally well above the design fluvial flood level. The existing fluvial flood risk to the site is therefore considered to be low.

The residual risk can be summarised as the risk of a local breach of the polder defence or by overtopping by a design exceedance event. The risk of an exceedance event is extremely low given the high standard of defence provided by the existing polder (in excess of 1 in 200-year tidal event).

The risk of a breach is also considered to be low as the Marina Embankment is quite wide and there is no historic evidence of significant past failures.

4.1.1 Drainage channels

There are existing drainage ditches at the northern and south-eastern boundaries of the site as shown in Figure 9. Both ditches collect storm water from the site which is conveyed in an easterly direction to the north-east corner where then outfalls to the River Lee.

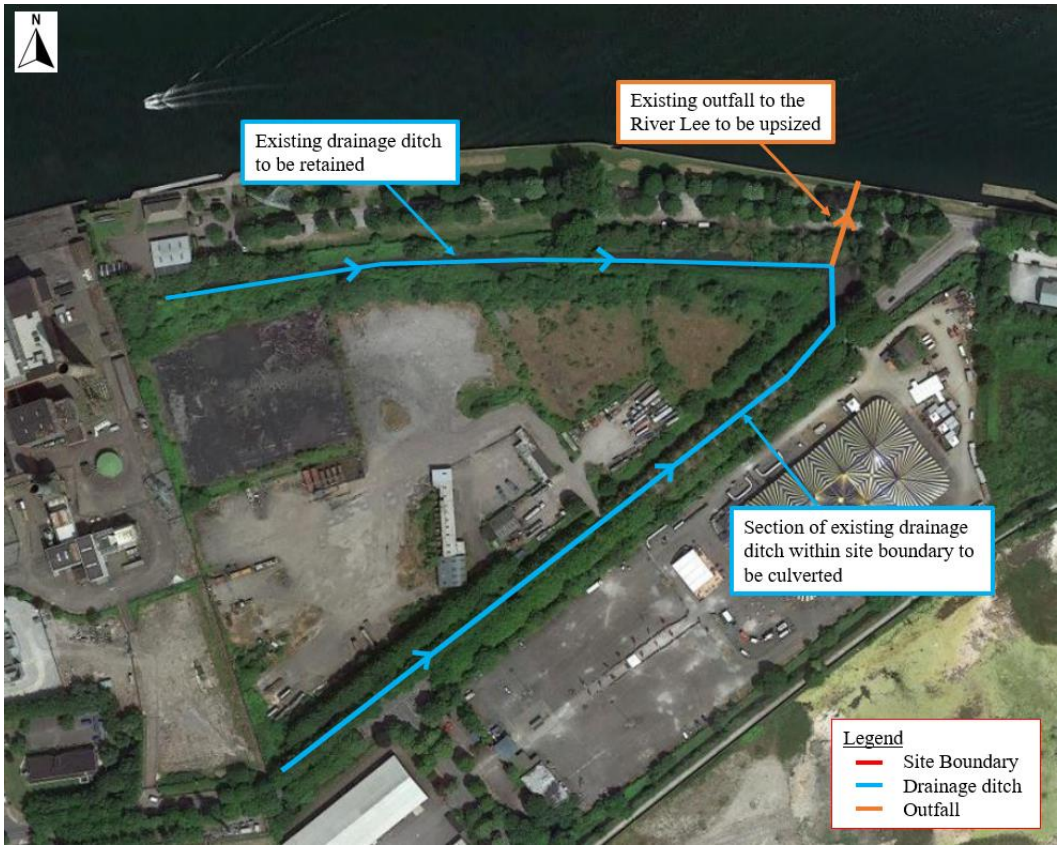


Figure 9:Drainage ditches at the northern and southern site boundaries

As part of the proposed development the northern ditch will be retained, the outfall will be upsized and the portion of the southern drainage ditch which is within the site boundary will be culverted. The ditch and culvert will convey surface water from the proposed development to the River Lee via the upsized outfall. The reader is referred to the accompanying Site Infrastructure Report for further information.

Topographic data for the site shows that if the outfall were to get blocked and the drainage ditch was to overtop its banks, water would flow east onto Centre Park Road which is at a lower elevation than the subject site.

Given this information, flood risk to the site from these ditches is considered to be low.

4.2 Future fluvial flood risk (Mid-Range Future Scenario)

Figure 10 below displays an extract from the Lee CFRAM Mid-Range Future Scenario (MRFS) fluvial flood event in the vicinity of the site. The predicted level for the 1% AEP fluvial flood event is 3.29mOD (node 8LEE_571), which is 0.55m above the equivalent current scenario level.

The MRFS extents were generated by assessing the potential effects of climate change and adopting an assumed increase in river flow of 20% and sea level rise of 500mm.

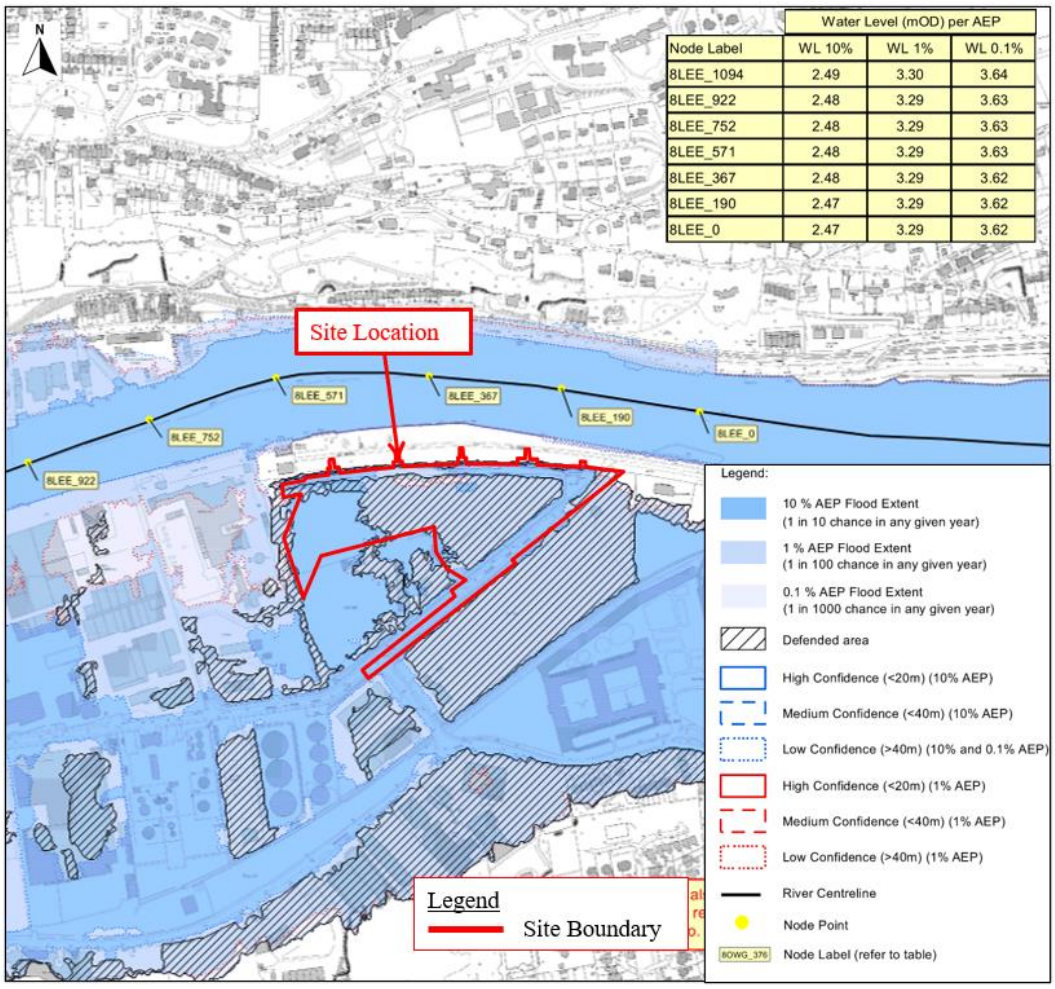


Figure 10: Extract from Lee CFRAMS MRFS fluvial flood extent map

The subject site is indicated as being at risk of fluvial flooding in the MRFS scenario. Flooding to the site during the 1% AEP MRFS scenario originates from a westerly direction, as a result of overtopping of the quayside defences. The eastern area of the site is indicated as being in a 'defended area', which is as a result of its higher topography relative to the lower ground which will flood first. In the MRFS, fluvial flood risk to the site is considered to be high.

Direct overtopping of the polder defence to the north of the site does not occur in this scenario.

It is worth noting that the risk of breach or exceedance will increase over time due to natural degradation of the polder defence (if not maintained) and increasing frequency of extreme river events.

4.3 Current tidal flood risk

An extract from the Lee CFRAMS tidal flood extent map is presented in Figure 11 below and displays the predicted current scenario tidal flood extents within the South Docklands area (1 in 10, 200, and 1000-year tidal flood events).

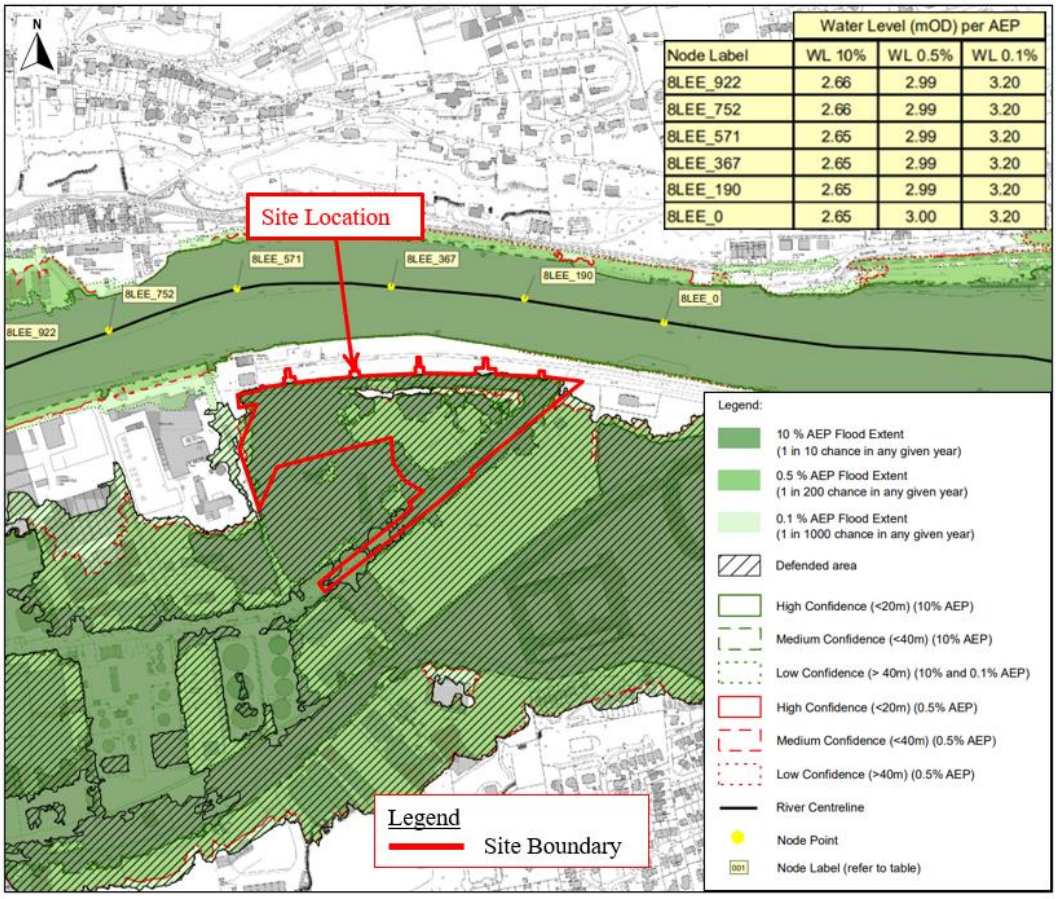


Figure 11: Extract from the Lee CFRAM extent map, current scenario

The flood map indicates that the majority of the site is located within Flood Zone A (1 in 200-year flood extent – dark green shade). However, the CFRAM maps also confirm that the site is within a defended area (hatched)due to the presence of the existing polder flood defences to the north of the site.

Nodes 8LEE_190, LEE_367, LEE_571 are located adjacent to the site and these indicate a peak tidal level (0.5% AEP or 1 in 200-year) of 2.99mOD.

As with the fluvial flooding, inundation of areas near to the site occur from a flow path originating at Albert Quay East west of the site, travelling along Centre Park Road. Flooding is shown on Centre Park Road to the south of the site (not hatched dark green shade); the site itself is defended and not shown inundated (hatched). Flooding is not likely to inundate the site from the north due to the presence of the higher polder flood defences along Marina Walk. Therefore, the existing tidal flood risk to the site is considered to be low.

The findings of the Lower Lee (Cork City) Drainage Scheme reaffirms the findings of the CFRAMS. An extract from the Lower Lee Exhibition drawings for this scheme is shown in Figure 12 below. This confirms that tidal flooding in the vicinity of the site for the 1 in 200-year event is limited to the lower extents of Centre Park Road and the drainage ditch at the northern and eastern extent of the site.

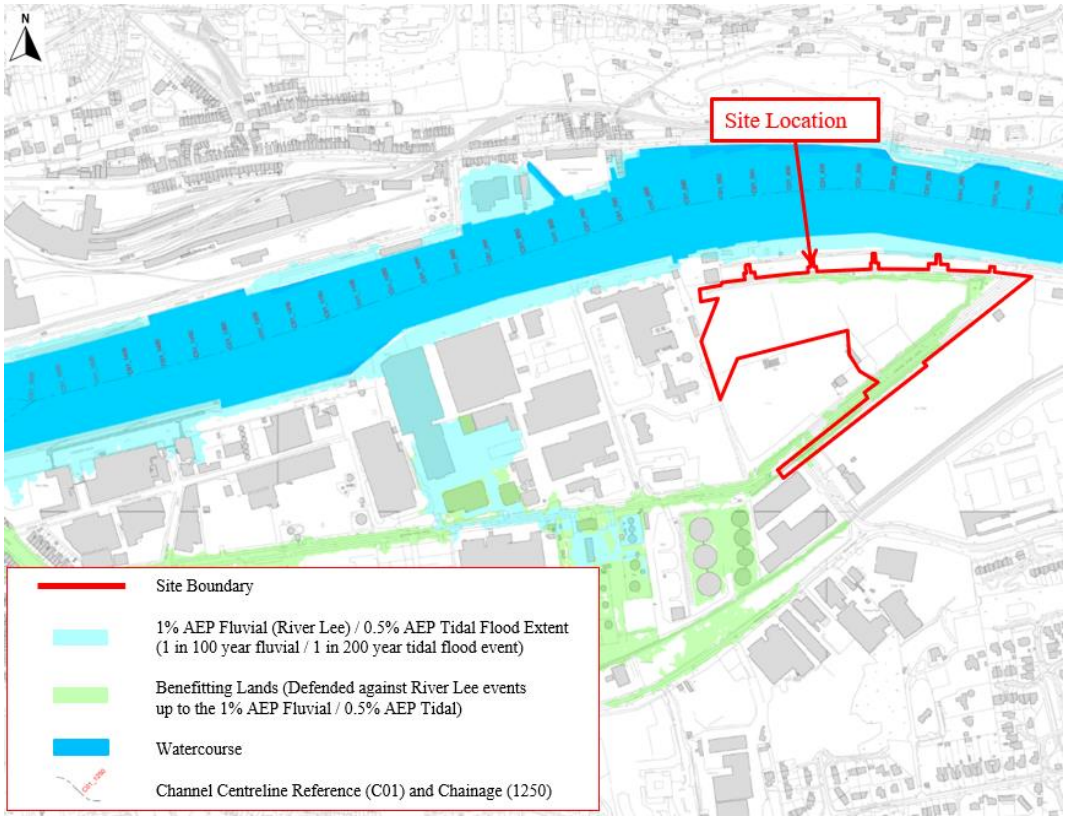


Figure 12: Lower Lee (Cork City) Drainage Flood Extents and Benefitting Areas

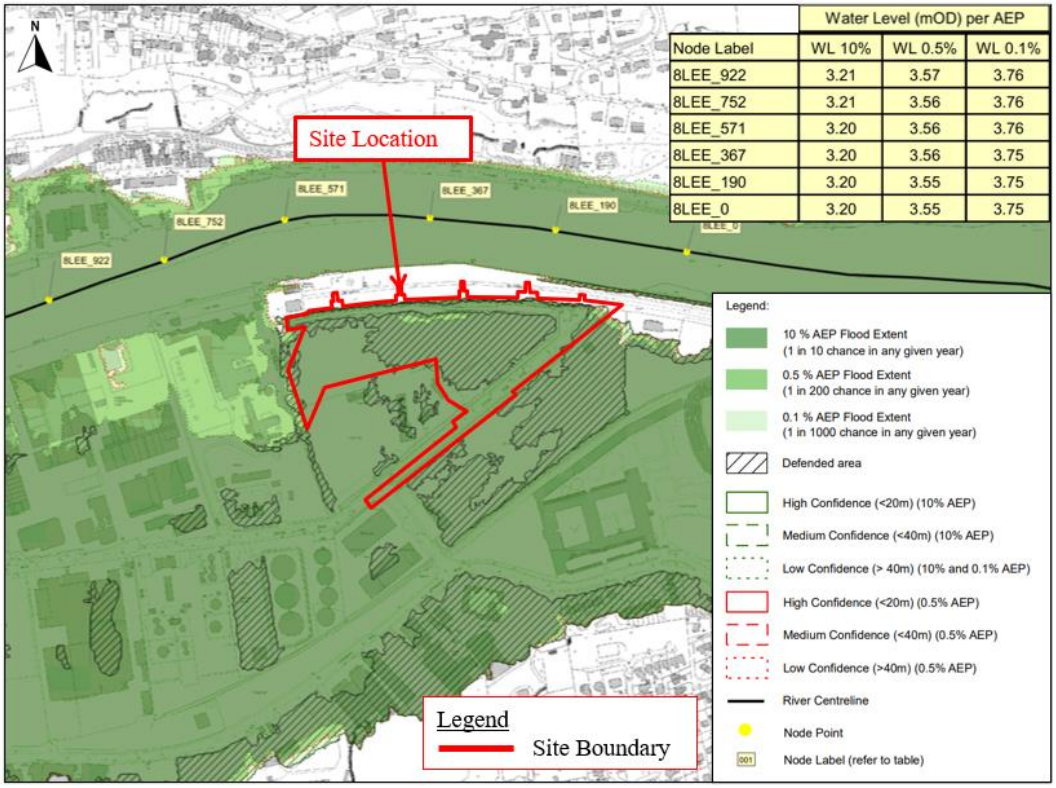
The mapping also demonstrates that the flood risk to Centre Park Road will be removed following implementation of the Lower Lee (Cork City) Drainage Scheme (the green shading indicates the area benefitting from the scheme).

The flooding mapping provides further evidence that flooding from a 1 in 100-year (fluvial) / 200-year (tidal) event is predicted to occur from a westerly direction towards the site. It is noted that a significant period of time is likely to elapse before any significant volumes could reach the site.

The risk of flooding to the site from a tidal/fluvial event is low and is tidally dominated.

4.4 Future tidal flood risk (Mid-Range Future Scenario)

Figure 13 indicates the risk of tidal flooding during the MRFS scenario. The site is shown at risk of tidal flooding during the 10% AEP MRFS event. The predicted MRFS levels (0.5% AEP) in the River Lee in the vicinity of the site is 3.56mOD (node 8LEE_571). This is 0.57m above the equivalent current scenario level.



	Water Level (mOD) per AEP		
Node Label	WL 10%	WL 0.5%	WL 0.1%
8LEE_922	3.21	3.57	3.76
8LEE_752	3.21	3.56	3.76
8LEE_571	3.20	3.56	3.76
8LEE_367	3.20	3.56	3.75
8LEE_190	3.20	3.55	3.75
8LEE_0	3.20	3.55	3.75

Figure 13: Extract from Lee CFRAM MRFS Tidal flood extent map

As above, inundation of the area is noted to occur from a westerly direction and not likely to inundate site from the north due to the presence of the existing polder flood defence. A section of the site is indicated as a 'defended area', with the remainder within the 10% AEP flood extent. Accordingly, the predicted volume of water which may potentially inundate the site is predicted to be moderate and tidal flood risk to the site is considered to be high in the MRFS.

It is worth noting that the risk of breach or exceedance will increase over time due to natural degradation of the polder defence (if not maintained) and increasing frequency of extreme tidal events.

As the dominant risk of flooding from the Lee here is tidal, it is particularly vulnerable to sea level rise as the current standard of protection offered by the polder defence along the working quays is around 1 in 200-years. However, with circa 500mm of sea level rise, the standard of protection would reduce to around 1 in 2-years. Accordingly, it is vital that future raising of the perimeter polder defences advance ahead of the pace of sea level rise.

5. Groundwater flooding/ seepage risk

Similar to many polders, the South Docks area was historically reclaimed from the sea by incrementally depositing dredged estuarine silts atop of the pre-existing mudflats. See Figure 14 below which shows the area prior to reclamation and indicates the presence of 'mud' which is consistent with the description of silts above.

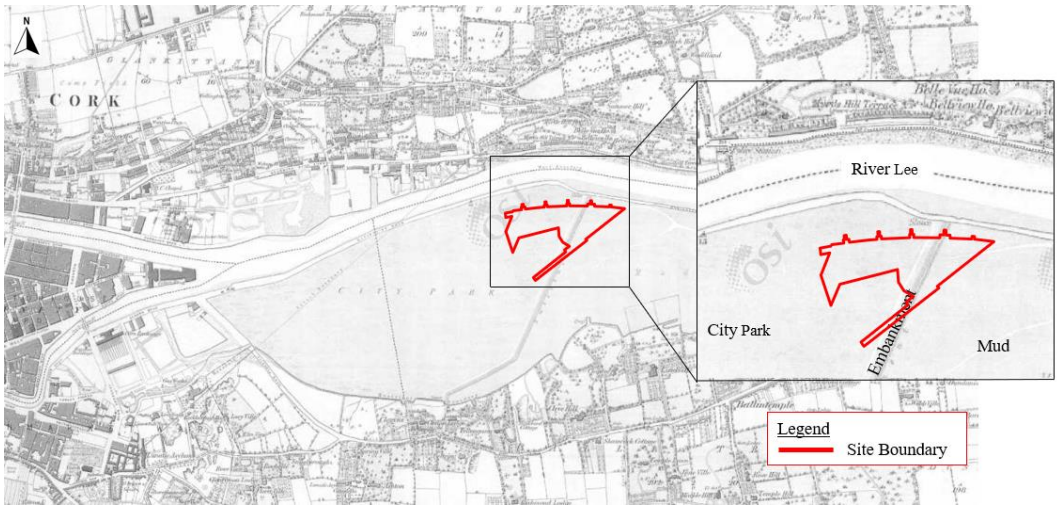


Figure 14: Area prior to reclamation (OSI Historic 6-inch map 1837-1842)

Below these silts, there are great depths of permeable gravels which are hydraulically connected to the Lee. This means that in addition to the risk of overland flow above the surface, there is a risk of seepage underneath polder defences as a result of hydrostatic pressure when river levels are high relative to the much lower polder levels. Due to the increasing hydrostatic head differential, this risk will increase with sea level rise. It is therefore essential that this risk is understood and managed.

5.1.1 PFRA groundwater flood extents

The Preliminary Flood Risk Assessment (PFRA) groundwater mapping undertaken by the OPW has been reviewed and an extract from the PFRA map at the site location is presented in Figure 15. PFRA mapping was the first step in the OPW's CFRAM programme which helped identify areas of flood risk for further assessment.

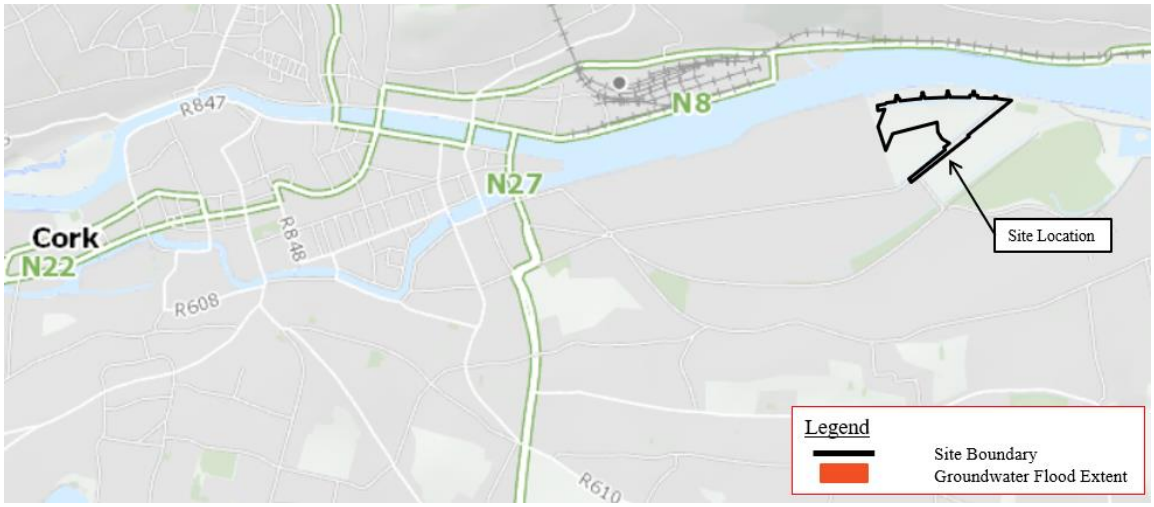


Figure 15: Groundwater Flood Extents extract from PFRA mapping

The map does not show the site or the areas in the vicinity of the site as being at risk of groundwater flooding.

However, it is important to recognise that this mapping was based predominantly on historic anecdotal evidence of flooding and therefore generally mapped areas of turloughs, springs and other groundwater features generally associated with areas of karst limestone where bedrock is close to the surface. This does not apply in the Docklands area.

5.1.2 GSI Mapping

Groundwater vulnerability mapping for the site from the GSI website is presented in Figure 16, annotated with the subject site outlined in red. It is noted that vulnerability of the groundwater within the site boundary is classified as 'moderate'.

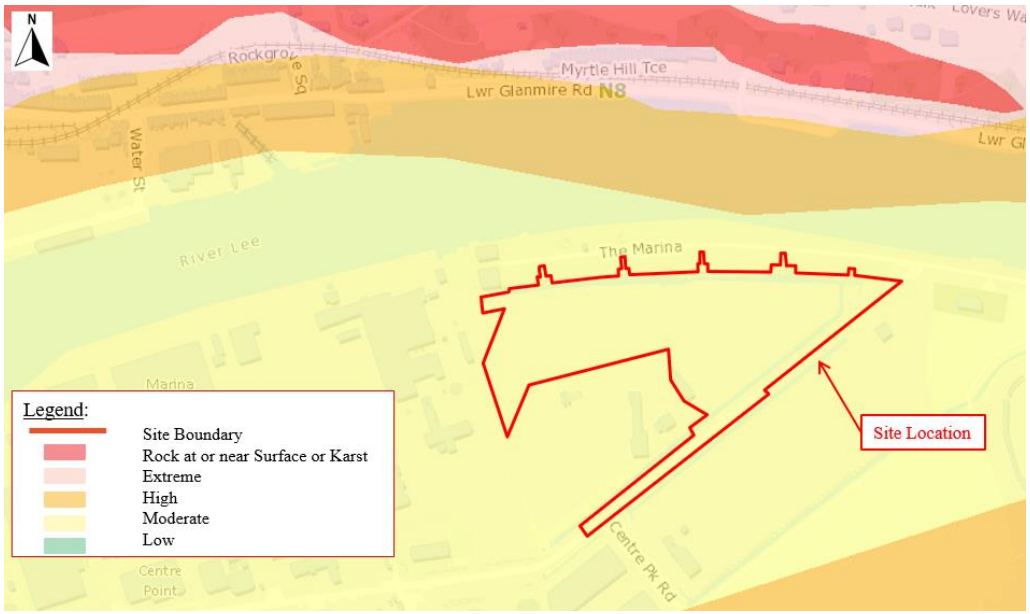


Figure 16: Extract from Groundwater Survey Ireland Vulnerability mapping (www.gsi.ie)

This dataset however is indicative only and does not examine the groundwater regime in detail at the site.

5.1.3 Cork South Docks Levels Strategy

CCC has advised that the preliminary hydrogeology study undertaken as part of the Cork South Docks Levels Strategy (CSDLS) indicates that overlying the deep gravels in the area, is a very low permeability clay layer approximately 3 to 4m thick. The top of this layer is typically about 3m below existing ground levels which were raised, typically with dredged silts and/or other available fill, to reclaim much of the area. Due to the volume and nature of historic site investigation data available to the study, there is a high degree of confidence in this ground profile.

The low permeability clay/silt layers perform a hugely important function as an aquitard in preventing the rapid rise of groundwater in response to fluctuations in the tide. In developing South Docks as a polder, it will be vital that the integrity of this layer is protected to maintain its function, the importance of which will only increase with sea level rise. Due to the nature of the ground conditions and height of the proposed development, construction methods may require piling, and so the detailing of this in a way which maintains the integrity of the clay layer is vital. The requirement to maintain drainage systems at higher levels because of tide locking will also avoid the need to interfere with this aquitard layer.

5.1.4 Review of site investigation data

To inform the ground conditions and groundwater regime of the site, site investigation was undertaken during late 2021 which noted that made ground and gravel was observed throughout the site. Within the made ground and gravel stratigraphy, groundwater was observed and recorded. Figure 17 shows the SI locations at the site.

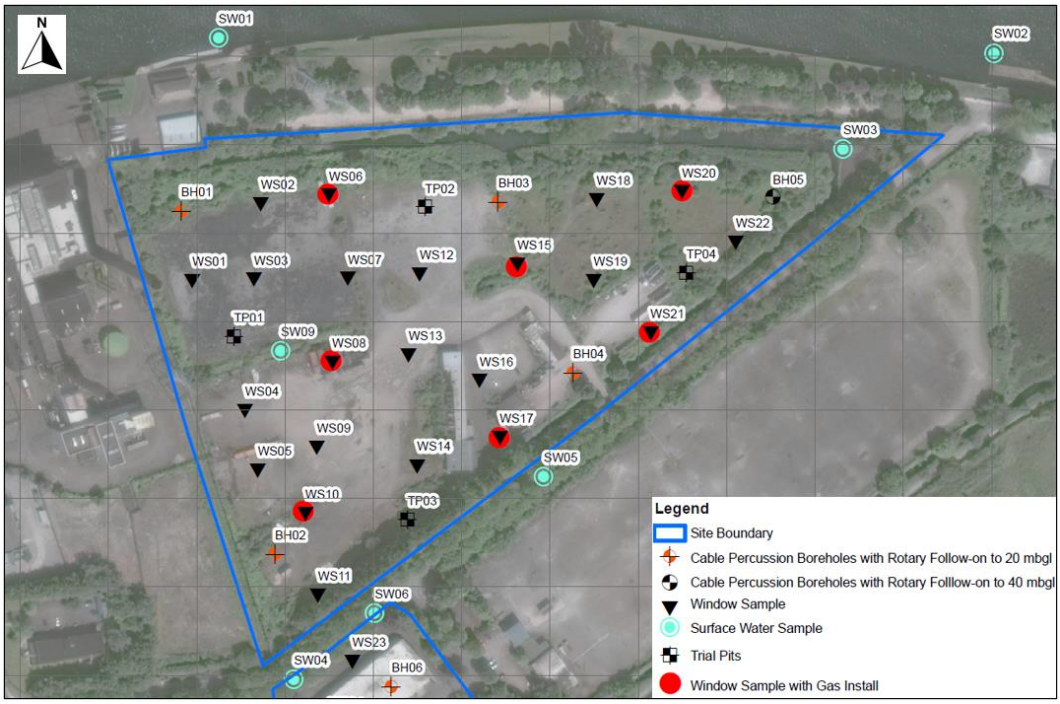


Figure 17: SI Locations

Groundwater was monitored using loggers in 7 standpipes installed in either the made ground or gravel between 10th November 2021 and 8th December 2021. Groundwater monitoring data collected during the 2021 SI is presented in Table 6.

Table 6: Summary of groundwater levels

Lithology monitored	Boreholes	Groundwater level (mbgl)	Groundwater level (mOD)
Made ground	BH04, WS08	0.7 to 1.52	1.25 to -0.24
Gravel	BH01, BH03, WS20, WS17	1.74 to 3.70	0.15 to -1.38

Made Ground

Water levels in the made ground appear to be unaffected by the tide. The water in the made ground is likely to be derived from a mixture of a small amount of surface infiltration, water seeping up through the silt aquitard and potentially small amounts of water seeping through the polder.

Gravel Aquifer

Water levels in the gravel aquifer are tidally influenced and fluctuate during a single cycle by up to 1.3m. Consequently, the groundwater in the gravel is considered to be in direct continuity with the Lee. Net groundwater flow is expected to be towards the Lee and generally to the east.

The difference in groundwater levels between the gravel and made ground suggests that hydraulic continuity between the two units is limited. The layer of silt between the two units is considered to act as at least an aquitard, limiting movement from one body of water to the other.

Given all of the above information, and providing the recommendations from the CSDLS are implemented, groundwater flood risk to the site is considered to be low.

6. Pluvial flood risk

Pluvial flooding typically occurs when extreme rainfall overwhelms drainage systems or soil infiltration capacity, causing excess rainwater to pond above ground at low points in the topography.

Pluvial flood risk can also be directly related to the backwater effects of tide locking on the area where surface water is unable to drain freely due to closure of non-return valves during times of high tides. This is particularly the case in a polder environment such as the South Docks. This impact will increase with future predicted increases in sea level and rainfall intensity.

The existing drainage network servicing the South Docks is known to be laid at shallow gradient and accordingly suffers from siltation, conveyance and capacity problems. As noted earlier, historic pluvial flooding of Centre Park Road is known to occur.

The existing (1.5 to 2.5mOD) and proposed site levels (1.3 to 5.4mOD) are elevated above the levels of Centre Park Road (which range from 0.1mOD at the vehicular entrance to the site to 1.4mOD toward the north east). As a result, offsite water from pluvial flooding will not flow towards the site, but instead west along Centre Park Road or south along Marquee Road, which are both at lower elevations than the subject site. Please refer to the proposed site layout drawings for further context.

As part of the CSDLS, it is proposed to raise the level of Centre Park Road adjacent to the subject site to a minimum of 0.7mOD. In this scenario, site levels are still above the new road level.

The proposed development's surface water drainage network was designed so there is no surface flooding in a 100-year rainfall event (including an allowance for Climate Change). The reader is referred to the accompanying Site Infrastructure Report which details the proposed drainage design for the development.

Future pluvial flood risk to the proposed development will be mitigated through the installation of an appropriately designed surface water drainage system (outlined in the Site Infrastructure Report) in conjunction with the adoption of finished floor levels raised above the surrounding roads will mitigate pluvial flood risk to the site to an acceptable standard.

The risk of pluvial flooding to the site is considered low due to its higher elevation above the lower adjoining road network which will convey flood waters away from the site.

7. Consideration of other studies/projects in developing a Flood Risk Management strategy for the site

In order to inform a suitable and practical flood risk management strategy for the site, it is important to consider the strategy in the context of relevant knowledge gleaned from other relevant studies and of other infrastructure projects currently being planned and/or delivered. Accordingly, the evolution of the flood risk management strategy for the site has considered the following other studies and upcoming projects:

- Preliminary findings of Cork City Council's (CCC) South Docklands Levels Drainage Strategy and as set out in Section 7.1 below.
- Lower Lee Flood Relief Scheme (LLFRS) (currently being finalised for Ministerial Consent)
- Docklands to City Centre Transportation Project (currently being designed)
- Cork City Council Marina Park Phase 1 (recently completed)
- Area Based Transport Assessment (ABTA) Transport Corridors (Currently being finalised)

These are discussed below.

7.1 Cork South Docklands Level Strategy

Arup has liaised extensively with Cork City Council in relation to the outcomes of the Cork South Docklands Levels Strategy (CSDLS), so that the design of the proposed development took account of and is compatible with the City's proposed strategy.

Cork City Council has confirmed that the work underpinning the CSDLS has now been completed, with the production of the Final Report imminent. The key findings and recommendations are summarised below:

- The study confirms that it is feasible to maintain the area as a polder provided that the standard of protection along the quayside is raised over time (as CCC acquires the quayside lands from Port of Cork company, and the owners of quayside fronting landbanks redevelop these lands etc.) and that a compatible surface water drainage strategy is developed which can safely store surface water during periods where the outfalls are tide-locked.
- It recommends a proposed Polder Defence Level of 4.35mOD.
- The CSDLS found that groundwater flood risk is very low, even in future climate change scenarios, due to the presence of a confining aquitard layer of clay/silt which is approximately 3 to 4m thick and has a relatively consistent presence in the South Docks area. A key recommendation of the CSDLS is that all developments must ensure that this layer is not compromised. Furthermore, piled foundations must be designed such that they do not create conduits for groundwater flow from the underlying saturated gravel layers.
- Confirmation that in general, it is proposed to retain ground levels as close as possible to the existing with only localised raising of some particularly low points on the road network to a minimum of circa 0.7mOD and more generally 1mOD. In the vicinity of the subject site, this requires the raising of ground levels on Centre Park Road and Marquee Road to a minimum level of between 0.7m to 1mOD (current minimum level is circa 0.44mOD). CCC intend to raise the low points on Centre Park Road in the medium term and therefore the development will need to function in both the short term with Centre Park Road at current levels as well as also being able to function when the proposed future road raising is implemented.
- To minimise risk of pluvial flooding of buildings and to allow for exceedance events, the CSDLS proposes a minimum development finished floor level of 1.3mOD. In addition, ground floor levels should where possible be set at least 150mm above streetscape levels, with external gradients falling away from building thresholds.

- The CSDLS also includes a preliminary design for the vertical alignment of Centre Park Road and the proposed Monahan Road extension which has been developed by CCC and its agents in consideration of the Eastern Gateway Bridge requirements, the Marina Park development currently on site and the recommended polder defence level along Marina Walk.
- The CSDLS has developed a level and drainage strategy that facilitates a public drainage system that can operate by gravity for up to and including the mid-range future scenario (up to 0.5m of sea level rise). If sea level rise greater than this occurs, it is envisaged that a regional pumping station will be required to augment the gravity system during extreme tidal events.
- The drainage strategy in the CSDLS requires that storage of surface water during periods of tide-locking be shared between private development sites and the public infrastructure. Storage in the public areas forms part of a proposed integrated blue-green infrastructure approach incorporating a combination of piped systems, swales, ponds and floodable green areas.
  This requires that all developments limit discharge to the public system to a specified maximum discharge rate of 68 l/s/ha for events up to the MRFS, to allow the public surface water drainage system to be designed accordingly. CCC has also provided peak downstream water levels in the public surface water storage system so that the backwater impacts can be considered in the design of the site drainage system.

7.2 Lower Lee Flood Relief Scheme (LLFRS)

The Office of Public Works (OPW) in partnership with Cork City Council is currently advancing the Lower Lee Flood Relief Scheme (LLFRS), also known as the Lower Lee (Cork City) Drainage Scheme. This scheme will be designed to provide protection to much of Cork City from the 1 in 100 year fluvial/1 in 200-year tidal flood events.

It is noted that the proposed LLFRS works do not extend significantly into the South Docklands area as this area is already protected to a high standard by the existing quayside defences. However, the LLFRS will still provide a significant benefit to the South Docklands including the subject site, by preventing overland flow from Albert Quay East propagating into the Docklands, thus reducing flood risk to the site. This risk is identified and discussed in Section 4 of this report.

7.3 Docklands to City Centre Transportation Project

As the delivery of the LLFRS is likely to be phased over a number of years, Cork City Council is currently advancing a transportation project which includes the reimagining of Albert Quay East, including new public realm spaces, greater space for pedestrians and cyclists and new river access points. As part of this project, changes have been incorporated to the road levels to provide local perimeter flood protection to a level of 3.4mOD, thus removing the primary flow path for floodwaters into Docklands and significantly reducing flood risk to the subject site. This project is currently being finalised for planning application.

7.4 Marina Park Phase 1

The proposed development needs to be compatible with the recently completed Cork City Council Marina Park Phase 1. The Marina Park Development significantly increases the surface water storage volume within the South Docks and is a key component of the CSDLS approach.

7.5 Cork Area Based Transport Assessment Study

The design is cognisant of the preliminary findings of the Cork Area Based Transport Assessment (ABTA), in particular, the required transport corridor widths on Centre Park Road, Marquee Road and the Monahan Road Extension. These requirements have been incorporated into the design, including the drainage design which will mitigate the risk of pluvial flooding.

8. Summary of overall Flood Risk Management strategy

8.1 Polder context

In considering an appropriate development masterplan and associated flood risk management strategy, it is important firstly to recognise that the proposed development lies within an existing polder, and therefore the approach to flood risk management will differ from many other developments.

The existing polder defences are generally in good condition and provide a high standard of protection to the land bank within the polder. This provides a high degree of confidence that the risk of direct river flooding will be low and will remain low for quite some time. However, the standard of defences will gradually erode over time as the rate of sea level rise increases. Given the planned scale of development in Docklands, and the outcome of the CSDLS, it is clear that Cork City Council intends to, and will have no alternative but to invest in raising the polder defences to ensure that they can continue to act as the primary line of flood defence and continue to provide a high standard of protection, as sea level rise takes place.

Given the firm commitment of Cork City Council to this Strategy, it is entirely reasonable that the flood risk management strategy should assume that the polder defence will remain the primary line of defence into the future.

In order for the development to respond to Cork City Council's polder strategy, to achieve wider strategic planning objectives such as functional streetscapes and transitions to the local transportation corridors, it is necessary to place some aspects of the proposed development at floor levels below the predicted rivers levels in the adjoining Lee estuary.

Whilst the flood risk management strategy recognises the primary defence provided by the polder, it must also recognise the residual risks to the development which in the short to medium term are the risk of overtopping and/or breach, both of which are low. In the longer term, there is the risk that the raising of the polder defences may be delayed, and that the risk of breach and/or overtopping would increase accordingly.

Therefore, the flood risk management strategy for the proposed development adopts a precautionary approach by also incorporating flood risk management proposals and infrastructure at a site level so that flood risk is mitigated to an acceptable level, independent of the City's planned polder defence works.

In this context, it is important to consider vertical differentiation of uses and apply a differing approach to minimum development floor levels for highly vulnerable development (such as residential) versus less vulnerable development (such as commercial or retail etc).

Use of flood resilient approaches is an important aspect of the strategy, as is the use of building perimeter defences and demountable barriers.

All of this strategy will come together as part of the developments Emergency Response Plan. The following sections set out the various components of the strategy both at a regional level within the wider South Docks area and at a development plot level.

8.2 Primary polder flood protection

As noted above, the primary line of flood protection to all development in Docklands will be along the northern perimeter bounding the River Lee.

Currently, the level of the polder defence located north of the site is approximately 4.00mOD (varies) and provides a high level of tidal and fluvial flood defence to the site.

However, the level of protection is lower further west, with an existing level of circa 2.80mOD along Kennedy Quay, with the greatest risk at Albert Quay East where defence levels are circa 2.55mOD.

The existing quayside defences described above generally provide a standard of protection of approximately 1 in 200-years save for the local low point on Albert Quay East. CCC propose to raise this low-lying section in the short term as part of the Docklands to City Centre Transportation project, thus universally ensuring a 1 in 200-year standard of protection to all of Docklands in the current scenario.

Over time, this defence will be raised by CCC to the proposed long-term design defence level of 4.35mOD. This may well be undertaken on a phased basis as land and funding becomes available, with the next lowest lying areas being prioritised where possible.

Whilst the flood risk strategy for the proposed development is not solely reliant on the implementation of other public projects, such as the Docklands Transportation project and the future raising of the polder defences, it is worth noting that the future residual flood risk to the site will be further reduced if, and when these schemes are implemented.

8.3 Precautionary approach to highly vulnerable development

8.3.1 Overview

Given the residual risks identified above, the development proposes to significantly reduce the risk to more vulnerable users by introducing vertical differentiation of uses. It is proposed to only provide less vulnerable and water compatible development at ground level with more vulnerable uses such as residential being provided at first floor level and above, such that these elements are not reliant on the continued function of the polder defences. The basis for establishing a minimum floor level for these higher vulnerability uses is described in the following sections.

8.3.2 Establishment of Design Tidal Level

As noted above, tidal flood risk is the dominant river flooding risk (i.e. the predicted 1 in 200-year (0.5% AEP) current day tidal water level in the vicinity of the site is higher than the corresponding fluvial level). Therefore, predicted tidal levels will be the driver when considering minimum floor levels for highly vulnerable residential development.

As noted in Section 4.3, the design water level (0.5% AEP) indicated on the Lee CFRAM drawings is 2.99mOD. This level will therefore be used as the starting point for the calculation of the design river flood level and thus minimum floor level for highly vulnerable development.

8.3.3 Allowance for Climate Change

In addition to the present-day risk, it is important to recognise the very real risk of sea level rise in choosing an appropriate floor level. Future Climate Change is predicted to result in several effects, including more extreme rainfall, more severe floods, and an increase in mean sea level.

The OPW has published draft guidelines on Climate Change for flood risk management and defines two possible future scenarios of varying severity:

- Mid-range future scenario (MRFS)
- High-end future scenario (HEFS)

The OPW recommended allowance for both scenarios is included in Figure 18.

Table 3.1: 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.

Figure 18: OPW recommended allowances for future scenarios

There are a number of conclusions that may be taken from the predictions of Climate Change implications:

- Increases in sea levels may result in extreme tidal events, with tidal levels increasing by more than 1 metre in the next century.
- Increases in the frequency of extreme events, particularly hydrological extremes, storms and droughts may cause an increase in rainfall intensity, duration and volume, resulting in increased surface water runoff.

CCC has confirmed that the CSDLS has chosen a polder defence level of 4.35mOD on the basis that quayside defences may continue to provide the optimum solution to flood protection for Cork City for sea level rise up to 1m. Beyond this, it is considered likely that a harbour wide solution such as a tidal barrier or barrage may become necessary and/or viable. Based on the same rationale, it is considered that the HEFS can be taken as the upper bound consideration of sea level rise for development on the subject site.

8.3.4 Freeboard allowance

It is generally accepted that a minimum freeboard of 0.3m above predicted flood levels is appropriate for establishing a minimum flood defence level and floor levels.

8.3.5 Recommended finished floor level for highly vulnerable development

Based on the above, it is recommended that all 'highly vulnerable development' have a minimum floor level of 3.80mOD, which provides protection from the 1 in 200-year current tidal flood level (2.99m) plus an allowance of 0.5m for sea level rise to the MRFS and 0.3m for freeboard.

Where possible, it is recommended that floor levels for highly vulnerable development be raised even further to a level equating to the polder defence level of 4.35mOD to provide for sea level rise of 1m to the HEFS, with such development then not being reliant on the polder defence at all.

The development proposal as submitted complies with the above recommendations, with all highly vulnerable aspects of the development being located at 5.4mOD or above, approximately 1m above the proposed long term polder defence level. This provides protection to the circa 1 in 1000-year tidal flood level plus an allowance of 2m (min.) of sea level rise. This implies significant safeguarding and longevity against the potential impacts of climate change and is in line with guidance provided in the OPW guidelines.
It also ensures that protection of the most vulnerable development is not contingent on the future raising of the polder defences.

8.4 Versatile approach to less vulnerable development on Site

In line with Cork City Council's preferred strategy of maintaining existing levels where possible, it is proposed that less vulnerable development (car park, commercial and retail units etc.) be provided at a minimum finished floor level (Level 00) of 1.3mOD. This level complies with CCC's advised minimum floor level of 1.3mOD for less vulnerable development.

This will ensure that the proposed development is protected from pluvial flooding by being elevated by at least 150mm above the external transportation corridors (both existing levels and proposed future raising to circa 0.7m to 1mOD) and above the onsite storage level of the proposed surface water drainage system.

As noted above, the primary flood protection to this level of development will be provided by the polder wide quayside defences which generally provide protection to a standard of approximately 1 in 200-years at present.

Secondary site wide measures have been incorporated into the design of the development to further mitigate the very low residual risk of overtopping or breach. These are described in the following sections of the report.

8.5 Other elements of Flood Risk Management strategy

In addition to the above defence elements, the other aspects of the flood risk management strategy focuses on:

- Preparing and implementing a robust emergency response plan (including provision for safe access and egress)
- Ensuring that the design of the foundations, and drainage systems do not compromise the integrity of the aquitard clay layer underlying the site
- The surface water drainage system will be designed to include sufficient storage to cater for rainfall events up to and including the MRFS whilst complying with Cork City Council's required discharge limits.

9. Proposed on-site flood protection and mitigation measures

9.1 Overview

This section sets out the details of the proposed flood risk management infrastructure on the site.

9.2 Appropriate finished floor levels

As outlined above, to ensure alignment with Cork City Council's preferred strategy of maintaining existing levels where possible and taking into account the key outputs of the South Docks Levels Strategy, it is proposed to locate less vulnerable development at Level 00 (ground floor level) at a minimum finished floor level of 1.30mOD. This includes the retail areas, cafes, bike storage areas, car park, plant and amenity areas.

Highly vulnerable development, such as the creches and residential dwellings, will have a minimum floor level of 5.4mOD, 1.05m above the polder defence level of 4.35mOD. This level allows for sufficient freeboard on top of the 1 in 200-year HEFS tidal event.

Due to the constraints outlined previously, less vulnerable development will be located below the predicted current 1 in 200-year tidal undefended flood level of 3.0mOD. Where this occurs, it is proposed to adopt one of two approaches at a site level. The first is to acknowledge the low residual risk of flooding and adopt a flood resilient approach, allowing water entry, planning for infrequent flooding and making the development resilient to the impacts of same. The second approach is a flood resistant approach, providing a secondary line of defence at building perimeters to prevent water entry. These approaches are described further below.

9.3 Flood resilient strategy

This approach acknowledges and designs for a low residual risk to some less vulnerable commercial units to be located at building perimeters on the Ground Floor Level (Level 00) to tie in with the existing streetscape constraints. This will include appropriate design to incorporate flood resilient construction, measures and finishes. Utility services are to be installed to a level of 3.8mOD or higher, above the design flood level for highly vulnerable development.

Employment of a flood resilient approach includes use of materials and methods that reduce the impact from a flood while ensuring that structural integrity of the development is maintained during any flood event. The choice of finishes aids ease of cleaning up in a safe and efficient manner following a flood event and prior to re-occupation. This can include both external and internal flood resilient finishes. Typical external finishes include use of materials such as concrete and stainless steel which are resilient to flooding.

Typical internal resilient features would include installing water resistant surfaces (e.g. tiles rather than carpet etc.) on floors and walls which facilitates ease of cleaning after any flood event, installation of floor drains to aid drainage of flood water, washing points such as taps and cleaning apparatus within strategic locations of the building to facilitate clean-up operations, use of flood resilient finishes on doors, skirting boards and internal finishes (PVC, plastics etc.), avoiding the use of unsuitable materials such as chipboard or similar materials and raising electrical sockets and mechanical equipment above flood level and facilitates to store valuables (food etc.) above flood level.

To minimise the risk of an electrical fire being caused by a flood, all electrical systems at the lower levels will be designed to be flood proof and not to ignite in the event of a flood. Sumps can be located within lift shafts to ease drainage once flood levels have receded and the design of the lifts will be such to minimise damages during flooding.

Applying flood resilient methods and measures as outlined above aligns with the recommendations as highlighted in the Cork City Council Adaptation Strategy 2019-2024.

9.4 Flood resistant strategy: On-site flood defences

The alternative approach to flood resilience is to provide a secondary line of defence to some ground floor (Level 00) elements such as the car park areas, plant and some commercial units to prevent water entry.

As the Docklands area is quite large, it is highly unlikely that there would be a sufficient volume of inundation to result in flood levels within the polder reaching the same level as in the river. For this reason, given the primacy of the polder flood defences, a lower flood defence height is deemed to be acceptable.

For this secondary line of flood defence, a minimum level of 1.9mOD is recommended by the CSDLS. In most cases, this will be provided predominantly by waterproofing of the perimeter up to the 1.9mOD level, design of the structure to withstand the relevant hydrostatic load and protecting openings with demountable flood defences of up to 600mm in height.

The number of demountable defences incorporated into the development has been minimised and limited to strategic locations within the development. This reduces the risk of human error in erecting active flood defences for the development and allows efficient deployment in advance of a flood event. An emergency response plan will be developed for the site, which will include the location of demountable flood defences and responsibility to erect them following a flood warning. More information is included in Section 11.

Large parts of the development which are at 1.3mOD (e.g., the carparks) are often surrounded by ground levels greater than 1.9mOD which would prevent water ingress and therefore do not require flood defences. Refer to Appendix C for a proposed plan alignment of flood defences to the site which includes demountable defences, permanent defences and indicates areas of proposed flood resilient construction.

9.5 Mitigation of groundwater flood risk

The foundation design will ensure that no conduit is created to the higher permeability gravels. This is being achieved by omitting basement structures, ensuring that all drainage infrastructure is kept at the highest elevation possible, as well as designing a piling methodology which does not create preferential flow paths for groundwater. Accordingly, the development will not compromise the integrity of the aquitard layer.

9.6 Mitigation of pluvial/surface water flood risk

The proposed minimum finished floor level (Lower Ground Floor of 1.30mOD) and proposed surface water drainage system will minimise the risk of pluvial flooding. The residual risk will be further minimised by making ground levels on site slope away from all building entrance points or making building entrances 150mm higher than the external surrounding ground.

9.7 Surface water drainage design

Please refer to the accompanying Site Infrastructure Report and drawings for details on the proposed surface water drainage design.

9.8 Other penetrations

All services entering the development will be sealed to prevent ingress of floodwaters into the buildings. If any air vents or openings are proposed, they shall be placed above the secondary flood defence level of 1.9mOD.

10. Residual risks

10.1 Residual risk of breach or overtopping of polder defences

Given its location in a polder, it is important to recognise, mitigate and plan for the residual risk associated with a breach or overtopping of the polder defence.

The probability of the risk arising will be a function of the extent to which sea level rise occurs, the upkeep of the defences and the timing of CCC's raising of the quayside defences.

These issues will be documented in the Emergency Response Plan and reviewed annually.

The risk is mitigated to a high degree through either the adoption of a flood resilient approach or the use of secondary defences along building perimeters.

The risk will be further mitigated through the implementation of the Emergency Response Plan and associated procedures as set out in Section 11.

10.2 Residual risk of rainfall exceedance event

Whilst the proposed surface water drainage system and associated storage has been designed to a very high standard of protection, including an allowance for climate change, there remains a risk of a rainfall event in excess of the design standard. In practice, this risk is quite small as the design event assumes a conservative joint probability of extreme rainfall event and high tide. In all likelihood, these will not coincide and therefore the on-site storage tanks will have sufficient capacity to deal with many rainfall exceedance events. If not, by raising the buildings above external ground levels and generally having ground levels which fall away from the buildings to the lower road levels, the residual risk of surface water/pluvial flooding will be very low.

11. Emergency planning

11.1 Flood Emergency Response Plan

A flood emergency response plan will be developed for the site and will be implemented in the event of a significant flood event being forecast for Cork City.

Cork City Council currently operate a tidal flood forecasting and warning system which provides warnings of extreme tidal flooding which will be the critical risk for the Docklands area.

Currently, no fluvial flood forecasting system is in place for Cork. However, the ESB issues warnings to Cork City Council in advance of releasing large volumes of water from Inniscarra dam. Cork City Council in turn distribute these warnings to the public. It is worth noting that a formal fluvial flood forecasting system is being developed as part of the proposed Lower Lee (Cork City) Drainage Scheme. In any event, river levels in the Lee at this location are not particularly sensitive to river flows and therefore, in the absence of high tides, large river flows will not of themselves create a major threat.

As part of the emergency response plan, the management staff of the proposed development will be required to maintain awareness of flood and weather forecasts on an ongoing basis as well as receive warnings from Cork City Council and Met Éireann. Occupants of the buildings will be provided with sufficient notice to either leave in advance of the flood or stay in the building until the flood recedes, if needed. The likelihood of a need for evacuation is considered extremely low.

On receipt of a forecast or warning from Cork City Council, the management staff at the development will provide advance warning to allow users/residents to remove vehicles from the car parks at the site in advance of deploying flood demountable barriers, if they so wish.

A Flood Awareness Plan will be developed, whereby building users will be made aware that the building is located in a potential flood zone and that, in the same way as they must always be aware of the possibility of fire and of fire escape procedures, they also need to understand the procedures to be followed if a flood occurs. Similar to fire notices, flood information and evacuation notices will be posted throughout each building. Flood response drills will be conducted on a regular basis. The implications of flood events will need to be addressed in the Safety Plans of individual tenants.

In the event of forecasts of significant or severe flooding, the general response plan will be as follows:

- Warnings of the impending flood with details of timings and likely levels of impact will be communicated to all building users.
- Where possible, building users will remain inside until any flood recedes. This is normal practice in Cork City.
- As with the general population of Cork City in this situation, people choosing to leave the building during a flood would be responsible for their own safety and would have to exercise appropriate care and caution. They would be advised of the best route to take to get to higher ground.
- Where an individual or individuals are required to leave the building due to a medical emergency, depending on the severity of the flooding, they would be evacuated by emergency vehicle as required.
- The development will have its own first aid equipment (including defibrillators) and procedures, and the staff will be trained to respond as required.
- The development management and management of the individual tenancies will, as part of their Emergency Evacuation Plans, be connected to the medical services at appropriate hospitals and will have a plan to deal with the treatment and evacuation of a medical emergency during a flood.
- In the extremely unlikely event of a fire breaking out during a flood and a building having to be evacuated, people will be advised of the optimum route to take on exiting the building to get to higher ground. Management staff will be trained to deal with such an emergency evacuation.

- In the event of an extreme flood being forecast, then it is likely that advisories will be issued by Cork City Council and the Emergency Authorities for the prior evacuation of all vulnerable parts of the city, and that such evacuation will be carried out in a safe and timely manner.
- The development management will develop a Flood Emergency Plan in accordance with the OPW Planning Guidelines which will be updated annually to take account of the latest knowledge on flooding, the latest situation on flood protection for Cork City and the latest Cork City Emergency Plan. The Flood Emergency Plan will be informed by the Emergency Response Plans of Cork City and Cork County Councils.

11.2 Safe access and egress

In general, emergency egress is to be directed to areas of higher ground. The proposed access and egress arrangements are described below for the development. The egress routes will be further elaborated on as part of the development of the Flood Emergency Response Plan. Figure 19 shows emergency egress routes for the development in the event of a flood.

- The design will facilitate emergency egress to the south of the development along Centre Park Road. Emergency egress will then proceed further south along Marquee Road, east along Monahan Road towards higher ground and then south along Maryville road to move away from the River Lee.
- Emergency egress will also be possible to the north, onto the higher ground of the Marina.
- As flood risk to the site is predominantly tidal, advance warning of flood events is predictable. Therefore, advance warnings will be issued for development users to remove vehicles in advance of possible flood events in the short term.
- It is worth reinforcing the point that whilst it is proposed to incorporate these emergency provisions, they would only need to be implemented in the highly unlikely scenario of a tidal flood event having a return period greater than 1 in 200-years and/or in the case of a breach of the existing polder defence.
- Emergency services access would exist via the junction of Centre Park Road and an internal road, where three access points to the carpark will be present for all vehicles.

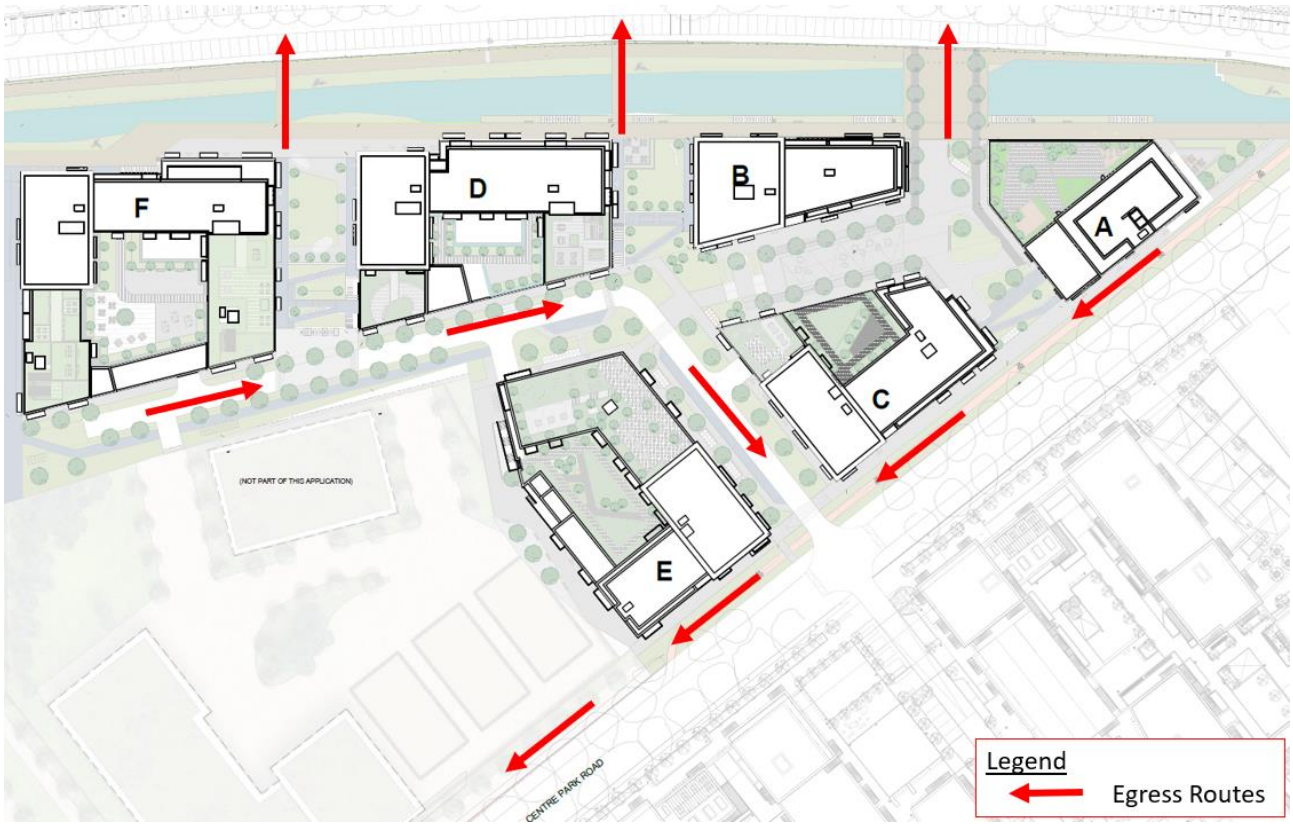


Figure 19: Emergency egress routes

12. Justification Test

12.1 Flood zones

The proposed development is located within Flood Zone A (i.e. within the 1 in 200-year tidal flood extent, assuming no defence in place).

12.2 Vulnerability classification

The proposed development at Ground Level consists of a combination of 'Less Vulnerable' development such as commercial and retail space; and 'Highly Vulnerable' development such as residential accommodation at Upper Ground Level and above.

This has been justified by increasing the FFL of all 'Highly Vulnerable' development to a minimum of 5.4mOD, which provides a 1 in 1000-year level of protection in the current tidal scenario plus an allowance of 2m for sea level rise.

12.3 Sequential approach and Justification Test

As the site lies within Flood Zone A and includes in part some development classified as either 'Less Vulnerable' and 'Highly Vulnerable', a Justification Test is required in accordance with The Guidelines.

12.3.1 Application of the Justification Test

The applicable Justification Test is the 'Development Management' Justification Test described in Section 5 of The Guidelines.

The Justification Test is adopted by a planning authority when developments vulnerable to flooding are proposed in areas at moderate or high risk of flooding (Flood Zones A and B). Prior to granting permission for the development, the planning authority must be satisfied that the development meets the criteria set out in the Development Management Justification Test in The Guidelines. These criteria are included in Figure 20.

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
   - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
   - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
   - (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
   - (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 20: Justification Test for development management (extract from The Guidelines)

12.3.1.1 Justification Test – Part 1

The current Development Plan (2015 – 2021 Cork City Development Plan) was informed by a Strategic Environmental Assessment (SEA), which considered flood risk through the preparation of an SFRA in accordance with The Guidelines.

The subject site is zoned for a combination of 'Mixed-Use Development', 'Public Open Space' and 'Neighbourhood Centres' in the Development Plan. The proposed development is of mixed-use (including commercial and residential accommodation), open space and will provide local shopping. It is deemed to be compatible with the current Development Plan zoning.

Therefore, it is considered that the proposed development satisfies the criteria of Part 1 of the development management Justification Test.

12.3.1.2 Justification Test – Part 2(i)

In terms of assessing whether the development would increase flood risk elsewhere, the three key elements to consider are conveyance, storage and surface water runoff.

As noted above, the site is protected to the north by the existing polder defence and is within a 'defended area' as noted in the CFRAM study flood extent mapping for current scenarios.

Accordingly, the site can no longer be considered a natural flood plain as it is protected by existing polder flood defences and therefore the issue of flood storage or conveyance is not considered to be relevant.

In relation to surface water runoff, the design of the surface water drainage systems to serve the proposed development will limit post development run-off in accordance with Cork City Council requirements. As the site already consists of areas of hardstanding, the proposed development will reduce the burden on the existing public surface water system and thus improve the situation both in the short and longer terms.

In summary, the proposed development will not have a significant impact on flood risk off site as the primary flood risk to the site is tidal and the site is already protected to a high standard by the existing quayside defences. As such, the site does not provide any current significant benefit in terms of either conveyance of flood storage. Accordingly, its development will not increase off site impacts.

Therefore, it is considered that the proposed development satisfies the criteria of Part 2(i) of the development management Justification Test.

12.3.1.3 Justification Test – Part 2(ii)

Significant mitigation measures are proposed to minimise flood risk to people, property, the economy and the environment. These are described in detail in Section 9 and 11 of this report.

Accordingly, it is considered that the proposed development satisfies the criteria of Part 2(ii) of the development management Justification Test.

12.3.1.4 Justification Test – Part 2(iii)

The measures to ensure that residual risks to the area and/or development will be managed to an acceptable level as regards the adequacy of existing flood protection measures and/or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access are addressed in Section 10 and 11 of this report.

Accordingly, it is considered that the proposed development satisfies the criteria of Part 2(iii) of the development management Justification Test.

12.3.1.5 Justification Test – Part 2(iv)

The proposed development is consistent with the objectives of the Cork City Development Plan 2015 – 2021 in terms of providing high quality mixed-use development whilst also satisfying the requirements to maintain the landscape and visual character of the area by tying into the existing streetscape levels and being respectful to the heritage of the area.

It is considered that the proposed development satisfies the criteria of Part 2(iv) of the development management Justification Test.

13. Discussion and conclusion

The site of the proposed development is benefitting from flood defences against fluvial and tidal flooding. The risk of pluvial and groundwater flooding is considered low. The site is located within Flood Zone A, as it is located within the 1 in 200-year tidal flood extent according to CFRAM mapping. However, it is protected to a high standard by the existing polder defences along the quayside. Cork City Council intend to raise this polder defence in the future to ensure the existing standard of protection is maintained or increased. Accordingly, it will be the primary flood protection measure for the Docklands.

The recommended minimum finished floor level for highly vulnerable uses is 3.8mOD. In practice, an even higher level of protection is being provided by locating 'Highly Vulnerable' development at first floor level which is at 5.4mOD in the current scheme. This provides protection to the circa 1 in 1000-year tidal flood level plus an allowance of greater than 2m for sea level rise. This implies significant safeguarding and longevity against the potential impacts of climate change and is line with guidance provided in the OPW guidelines. It also ensures that protection of the most vulnerable development is not contingent on the future raising of the polder defences.

To comply with Cork City Council's strategy of maintaining existing road levels where possible and creating appropriate streetscape relationships between developments and the transportation corridors, it is necessary to construct less vulnerable development such as car parks and commercial units at lower ground floor level at a finished floor level of 1.30mOD.

To mitigate the residual risk to this development, the development will incorporate appropriate flood resistant and resilient construction, measures and finishes. Utilities are to be installed above a level of 3.8mOD, to be above the 1 in 200-year tidal flood level with allowance for sea level rise. This will be combined with demountable flood defence barriers at strategic openings in the defence perimeter and will include appropriate design of the structure to withstand the relevant hydrostatic load for up to 600mm of flood depth.

The development will not compromise the integrity of the existing aquitard layer. The foundation design will ensure that no conduit is created to the higher permeability gravels. This is being achieved by omitting basement structures, ensuring that all drainage infrastructure is kept as high as possible, and designing a piling methodology which does not create preferential flow paths for groundwater.

A Flood Emergency Response Plan will be developed, whereby building users will be made aware that the building is located in a potential flood zone. In the event of forecasts of significant flooding the general response plan will be enacted which will entail the deployment of flood defence measures at the development perimeter.

Where possible building users will stay inside until the flood recedes which is common practice in Cork City. Early flood warning will allow users to leave their building if they wish to do so, before the flood occurs. Due to advance warning, users have the option of leaving before the flood occurs.

A Justification Test has been carried out in Section 12.3 of this report. It has been demonstrated that the proposed development satisfies the criteria of the Development Management Justification Test.

This FRA has demonstrated that the risks relating to flooding to the proposed development can be managed and mitigated to acceptable levels and therefore comply with DoEHLG / OPW and Cork City Council planning guidance.

Appendix A

Lee CFRAMS flood extents maps

N

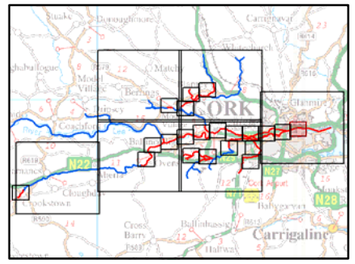
Node Label	Water Level (mOD) per AEP		
	WL 10%	WL 1%	WL 0.1%
8LEE_1094	1.94	2.74	3.07
8LEE_922	1.93	2.74	3.07
8LEE_752	1.93	2.74	3.06
8LEE_571	1.93	2.74	3.07
8LEE_367	1.92	2.73	3.06
8LEE_190	1.92	2.73	3.07
8LEE_0	1.92	2.74	3.07

8LEE_571
8LEE_367
8LEE_190
8LEE_0
8LEE_752
8LEE_922
8LEE_1094

Tidal flooding may also occur within the area shown on this map. Please refer to the tidal flood extent map. Figure No. M9/UA/EXT/CURS/005

0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometres

Location Plan :



EXTENT MAP

Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 1 % AEP Flood Extent (1 in 100 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (>40m) (10% and 0.1% AEP)
- High Confidence (<20m) (1% AEP)
- Medium Confidence (<40m) (1% AEP)
- Low Confidence (>40m) (1% AEP)
- River Centreline
- Node Point
- 8OWG_376 Node Label (refer to table)

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Dublin 2
Ireland

Project :
LEE CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map :
CORK CITY

Map Type :	FLOOD EXTENT		
Source :	FLUVIAL FLOODING		
Map area :	URBAN AREA		
Scenario :	CURRENT		
Figure By :	Valeria Medina	Date :	10 March 2014
Checked By :	Ricardo Santaella	Date :	10 March 2014
Approved By :	Clare Dewar	Date :	10 March 2014

Figure No. : M8/UA/EXT/CURS/012
Revision : 2

Drawing Scale : 1:5,000
Plot Scale : 1:1 @ A3

N

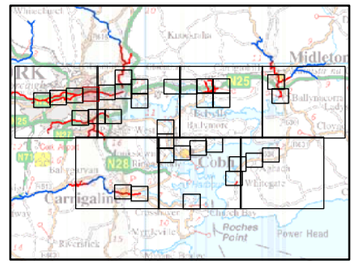
8LEE_922
8LEE_752
8LEE_571
8LEE_367
8LEE_190
8LEE_0

Fluvial flooding may also occur within the area shown on this map. Please refer to the fluvial flood extent map. Figure No. M8/UA/EXT/CURS/012

	Water Level (mOD) per AEP		
Node Label	WL 10%	WL 0.5%	WL 0.1%
8LEE_922	2.66	2.99	3.20
8LEE_752	2.66	2.99	3.20
8LEE_571	2.65	2.99	3.20
8LEE_367	2.65	2.99	3.20
8LEE_190	2.65	2.99	3.20
8LEE_0	2.65	3.00	3.20

0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometres

Location Plan :



EXTENT MAP

Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 0.5 % AEP Flood Extent (1 in 200 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (> 40m) (10% and 0.1% AEP)
- High Confidence (<20m) (0.5% AEP)
- Medium Confidence (<40m) (0.5% AEP)
- Low Confidence (>40m) (0.5% AEP)
- River Centreline
- Node Point
- 001 Node Label (refer to table)

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Project :
LEE CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map :
CORK CITY

Map Type :	FLOOD EXTENT		
Source :	TIDAL FLOODING		
Map area :	URBAN AREA		
Scenario :	CURRENT		
Figure By :	Valeria Medina	Date :	10 March 2014
Checked By :	Ricardo Santaella	Date :	10 March 2014
Approved By :	Clare Dewar	Date :	10 March 2014

Figure No. : M9/UA/EXT/CURS/005
Revision : 2

Drawing Scale : 1:5,000
Plot Scale : 1:1 @ A3

N

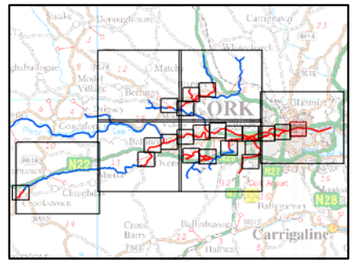
	Water Level (mOD) per AEP		
Node Label	WL 10%	WL 1%	WL 0.1%
8LEE_1094	2.49	3.30	3.64
8LEE_922	2.48	3.29	3.63
8LEE_752	2.48	3.29	3.63
8LEE_571	2.48	3.29	3.63
8LEE_367	2.48	3.29	3.62
8LEE_190	2.47	3.29	3.62
8LEE_0	2.47	3.29	3.62

8LEE_1094
8LEE_922
8LEE_752
8LEE_571
8LEE_367
8LEE_190
8LEE_0

Tidal flooding may also occur within the area shown on this map. Please refer to the tidal flood extent map. Figure No. M9/UA/EXT/MRFS/005

0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometres

Location Plan :



EXTENT MAP

Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 1 % AEP Flood Extent (1 in 100 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (>40m) (10% and 0.1% AEP)
- High Confidence (<20m) (1% AEP)
- Medium Confidence (<40m) (1% AEP)
- Low Confidence (>40m) (1% AEP)
- River Centreline
- Node Point
- 8OWG_376 Node Label (refer to table)

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Project :
LEE CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map :
CORK CITY

Map Type :	FLOOD EXTENT		
Source :	FLUVIAL FLOODING		
Map area :	URBAN AREA		
Scenario :	MID RANGE FUTURE SCENARIO		
Figure By :	Valeria Medina	Date :	10 March 2014
Checked By :	Ricardo Santaella	Date :	10 March 2014
Approved By :	Clare Dewar	Date :	10 March 2014

Figure No. : M8/UA/EXT/MRFS/012
Revision : 2

Drawing Scale : 1:5,000
Plot Scale : 1:1 @ A3

N

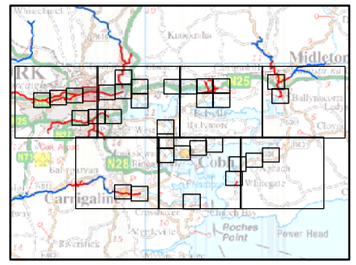
8LEE_922
8LEE_752
8LEE_571
8LEE_367
8LEE_190
8LEE_0

Fluvial flooding may also occur within the area shown on this map. Please refer to the fluvial flood extent map. Figure No. M8/UA/EXT/MRFS/012

0.1 0.05 0 0.1 0.2 0.3 0.4 Kilometres

Node Label	Water Level (mOD) per AEP		
	WL 10%	WL 0.5%	WL 0.1%
8LEE_922	3.21	3.57	3.76
8LEE_752	3.21	3.56	3.76
8LEE_571	3.20	3.56	3.76
8LEE_367	3.20	3.56	3.75
8LEE_190	3.20	3.55	3.75
8LEE_0	3.20	3.55	3.75

Location Plan :



EXTENT MAP

Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 0.5 % AEP Flood Extent (1 in 200 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (> 40m) (10% and 0.1% AEP)
- High Confidence (<20m) (0.5% AEP)
- Medium Confidence (<40m) (0.5% AEP)
- Low Confidence (>40m) (0.5% AEP)
- River Centreline
- Node Point
- 001 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

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Project :
LEE CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map :
CORK CITY

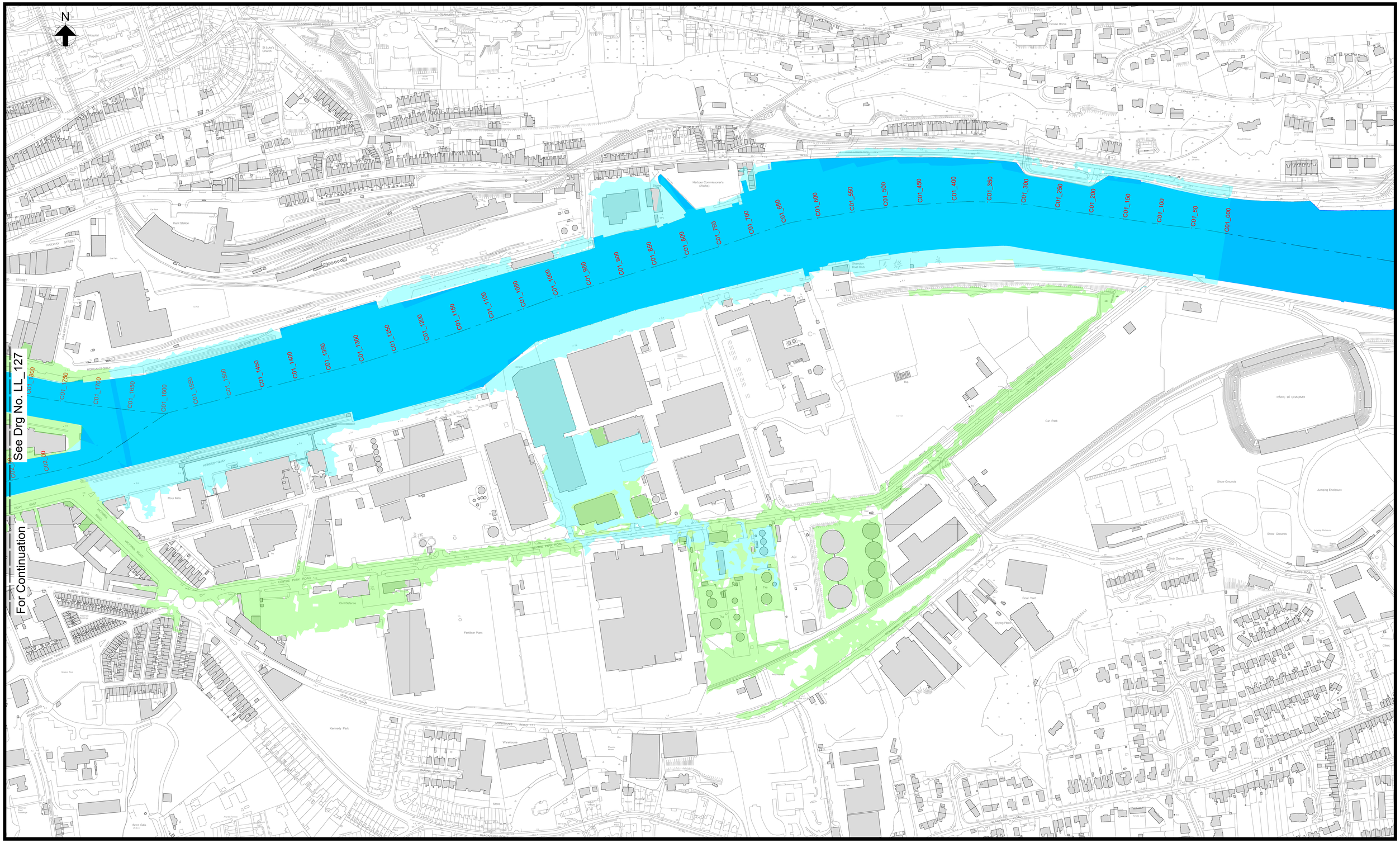
Map Type :	FLOOD EXTENT		
Source :	TIDAL FLOODING		
Map area :	URBAN AREA		
Scenario :	MID RANGE FUTURE SCENARIO		
Figure By :	Valeria Medina	Date :	10 March 2014
Checked By :	Ricardo Santaella	Date :	10 March 2014
Approved By :	Clare Dewar	Date :	10 March 2014

Figure No. : M9/UA/EXT/MRFS/005
Revision 2

Drawing Scale : 1:5,000
Plot Scale : 1:1 @ A3

Appendix B

Lower Lee (Cork City) Drainage Scheme exhibition drawings



Location Plan

0 25 50 100 Metres

Legend:

- 1% AEP Fluvial (River Lee) / 0.5% AEP Tidal Flood Extent (1 in 100 year fluvial / 1 in 200 year tidal flood extent)
- Benefitting Lands (Defended against River Lee events up to the 1% AEP Fluvial / 0.5% AEP Tidal)
- Watercourse
- C01_1250 — Channel Centreline Reference (C01) and Chainage (1250)

Scale 1:2,500 at A1
Scale 1:5,000 at A3

Notes:
1. Do not scale from drawing.
2. The channels on this drawing have been assigned colours for the purpose of assigning identification labels and interference references.
3. This drawing should be read in conjunction with all other Lower Lee (Cork City) Drainage Scheme Exhibition Drawings and Schedules.

Drg. No. LL_128 Flood Extents and Benefitting Areas (Sheet 9 of 9)

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Appendix C

Proposed flood defence alignment

North

Proposed ground levels on northern side of the car park of circa 5.4mOD, acting as a defence for the lower car park level

Car park at 1.3mOD is largely surrounded on all sides by higher ground (>1.9mOD) which acts as a flood defence

Flood defences to tie into proposed street level of 1.9mOD

Proposed ground levels are higher than 1.9mOD, acting as a defence for the lower car park level

Proposed ground levels are higher than 1.9mOD, acting as a defence for the lower car park level

FORMER FORD FACTORY
SITE GRANTED PERMISSION APRIL 2021

SITE BOUNDARY LINE
LANDS IN APPLICANT'S OWNERSHIP

AREA TYPES

- 1 BED
- 2 BED
- 3 BED
- CAR PARK
- SERVICES
- CIRCULATION
- COMMERCIAL
- COMMUNAL AMENITY
- BAR/ CAFE
- CRECHE
- BIKE

NOTE: This drawing is for indicative purposes only and is subject to further development in detailed design

Legend

- Proposed demountable flood defence barrier (to 1.90 mOD minimum)
- Proposed flood defence structure (to 1.90 mOD minimum)
- Indicates areas of proposed flood resilient measures/construction

1 SITE GA PLAN - LOWER GROUND LEVEL
1 : 500

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Status	For Information
Job Title	Former Tedcastles Site
Drawing Title	Appendix C
Scales	NTS
File Ref.	
Drn	DW
Date	09/02/22
Checked	RG/JH
Job No.	267365-00
Drg. No.	
Rev.	A