

STRATEGIC HOUSING DEVELOPMENT AT LANDS AT THE FORMER GREENPARK RACECOURSE, LIMERICK CITY

FLOOD RISK ASSESSMENT

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FLOOD RISK ASSESSMENT

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NON-TECHNICAL SUMMARY

RPS were commissioned to carry out a Flood Risk Assessment (FRA) in support of a strategic housing development (SHD) for Greenpark, Limerick. The purpose of this assessment is to ensure that the proposed development takes cognisance of the existing flood risk and does not result in increased flood risk elsewhere. This report has been prepared in accordance with the requirements of 'The Planning System and Flood Risk Management' Guidelines (DEHLG 2009).

The River Shannon flows at a distance to the north of the site and a small tributary, the Ballynaclogh River, flows to the west of the site. Both of these rivers can be considered to be tidal at this location. There are flood embankments along both the River Shannon and the Ballynaclogh River.

The Shannon Catchment Flood Risk Assessment and Management (CFRAM) Study maps indicate that the 0.5% AEP coastal flood event does not reach the application site. This is because of the protection afforded by the existing flood defences. Following the sequential approach as set out in 'The Planning System and Flood Risk Management Guidelines' the effects of any existing defences must be ignored when establishing flood zoning. Using this approach, the majority of the SHD site is considered at low risk and in Flood Zone C. However, areas of the site are in Flood Zone A, with a very small section of the land being contained within Flood Zone B. In accordance with 'The Planning System and Flood Risk Management Guidelines' a Development Management Justification Test to be carried for a residential development within Flood Zones A and B.

In accordance with Paragraph 5.16 of the Guidelines, a precautionary approach to development behind existing defences is to raise the finished levels to at least the 1% fluvial or 0.5% AEP coastal flood level with an appropriate allowance for freeboard and climate change. This approach has been adopted for the SHD area where a freeboard of 500mm and allowance for climate change (sea level rise) of 500mm has been provided to all Finished Floor Levels. This provides a minimum of a 1m elevation to all new properties above the 0.5% AEP breach flood level, thus providing a very high standard of protection.

Modelling of the impact of raising the proposed development was then undertaken considering both the 0.5% AEP and 0.5% AEP climate change (MRFS) flood events when a breach of the defences occurs. The results of the modelling showed that there was no identified increase in risk to existing development as a result of the site raising, either in the present day or climate change scenarios.

A nursing home is proposed adjacent to the SHD site. This is a separate planning application, however this FRA has included an assessment of the cumulative impact of both developments. The nursing home site will be filled to a FFL of 6.3m OD. This development is already in flood zone C and already has levels in the vicinity of this. Breach analysis has confirmed that there is no increase in flood risk to existing

developments with both the nursing home and SHD sites raised, either in the present day or climate change scenarios.

A new surface water sewer network shall be provided for the proposed development which will be entirely separate from the foul water sewer network. Surface water run-off from roof areas and hardstanding areas are designed to be collected by a gravity pipe network. Surface water will be collected and discharged via a mixture of traditional and Sustainable urban Drainage System (SuDS) to the existing 1350mm/ 1500mm diameter surface water sewer. This sewer discharges the existing lagoon adjacent to the Ballynaclogh River. Both the pipe and the lagoon were designed to take into account future developments. The lagoon attenuates flows to Greenfield discharge rate and discharges to the Ballynaclogh River through the use of a penstock structure. SuDS measures include green roofs, tree pit systems, permeable surfacing, infiltration trenches, swales, rain gardens and attenuation tanks.

Based on the proposed mitigation measures, consideration of the designated zoning and the proposed urban design, each of criteria in the Development Management Justification Test was shown to be satisfied. Therefore it was concluded that the proposed development complies with the requirements of the Development Management Justification Test and hence is compliant with 'The Planning System and Flood Risk Management Guidelines'.

1 INTRODUCTION

Voyage Property Limited intend to apply to An Bord Pleanála (the Board) for permission for a strategic housing development (SHD) with a total application site area of c.10.5 ha (with a substantive residential site development area of c.7.9 ha), on lands at the former Greenpark Racecourse, located off Dock Road (N69), Limerick. The strategic housing development will consist of the provision of 371 no. residential units and a childcare facility, along with a new access road. The general location of the site is shown in Figure 1.1.

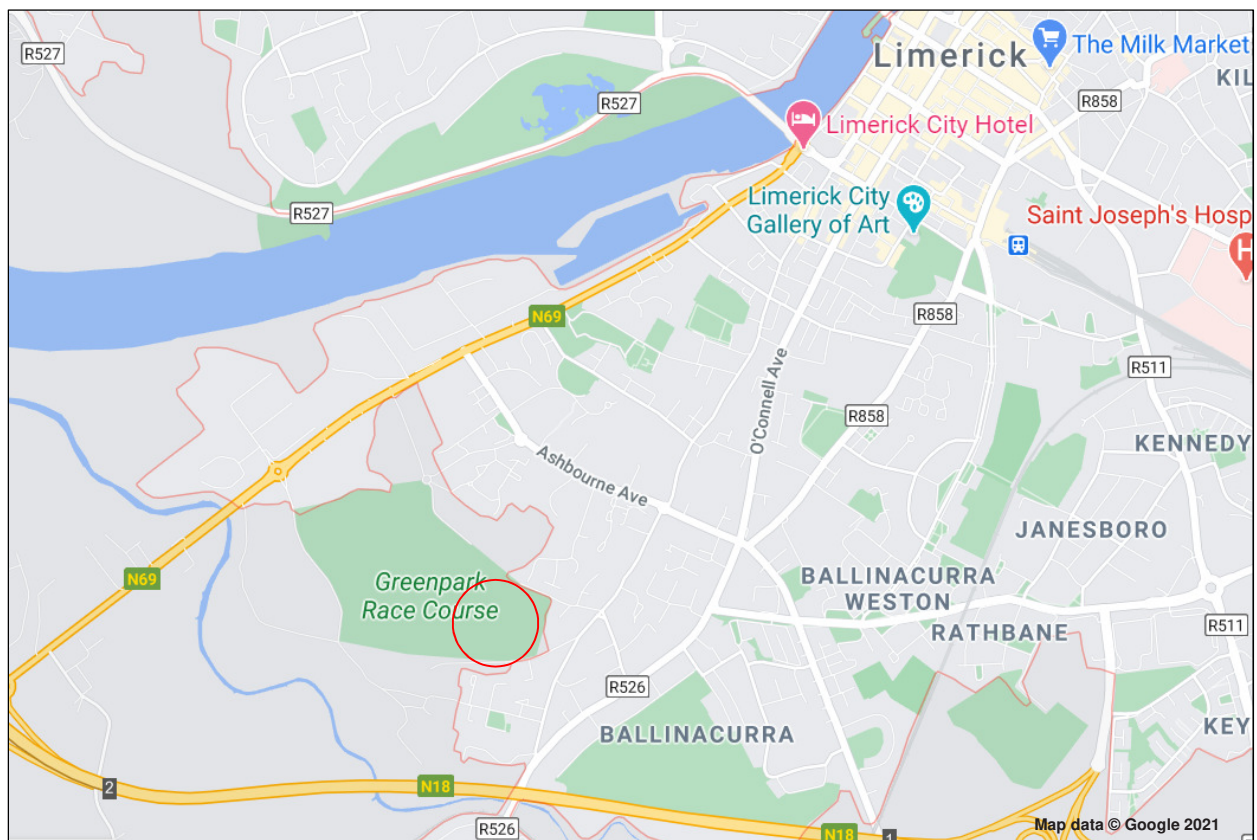


Figure 1.1 Location map

RPS were commissioned by Voyage Property Limited to carry out a Flood Risk Assessment (FRA) in support of the strategic housing development application. The purpose of this FRA is to define the flood risk to the proposed development and demonstrate that, with appropriate mitigation, the subject lands can

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be safely developed as housing in accordance with the requirements of 'The Planning System and Flood Risk Management' Guidelines¹.

¹ The Planning System and Flood Risk Management Guidelines, DEHLG (2009)

2 SITE DESCRIPTION

The strategic housing development site has a total application site area of c.10.5 ha (with a substantive residential site development area of c.7.9 ha), on lands at the former Greenpark Racecourse, located off Dock Road (N69), Limerick. The site is principally bounded by existing undeveloped lands to the north, south and west and the adjoining Log na gCapall Housing Estate to the east. The application site includes the proposed access road which joins into the Dock Road at the north-western corner of the former Greenpark Racecourse lands and runs adjacent to the Limerick Greyhound Track. A location map showing the site boundary is shown in Appendix A. Figure 2.1 shows an aerial photo of the development site with the SHD site extent highlighted in red.



Figure 2.1 Aerial photograph indicating the extent of the SHD site

The River Shannon flows at a distance of approximately 500m to the north, and one of its tributaries, the Ballynaclogh River, flows to the west of the site. There is a line of existing flood defences along both the Ballynaclogh River and the River Shannon which offer a good standard of protection to this area of Limerick. More details on the defences is provided in Section 3.

3 EXISTING FLOOD RISK

The National Catchment-based Flood Risk Assessment and Management (CFRAM) Programme was developed by the Office of Public Works (OPW) to meet national policy needs and the requirements of the EU Floods Directive. As part of the Shannon Catchment-based Flood Risk Assessment and Management (CFRAM) Study, Limerick was identified as an Area for Further Assessment (AFA). This meant that the watercourses in the area were modelled and flood maps produced which can be used to establish the existing flood risk at a site. The maps are available to download from the OPW Flood Info website².

3.1 Existing Flood Defences

The defences along the Ballynaclogh River and the Shannon Estuary were built by the OPW under the Arterial Drainage Act, 1945. Arterial Drainage Schemes were carried out to improve land for agriculture and to mitigate flooding. The intention of building the embankments was initially to provide protection against the 3 year flood but in many locations the embankments have been raised further over time and a much higher standard of protection is provided. That can be said of the embankments at this location which have been constructed along the estuary to a height of approximately 5.2m OD and along the Ballynaclogh River to a height in excess of 6m OD. Figure 3.1 has been extracted from the floodinfo.ie website which provides records of the various drainage districts and the embankments located within them. At this location there are three embankments which offer protection to the SHD area denoted on Figure 3.1 as E1A, E1 and E2. The defences also continue further into Limerick towards Ted Russell Dock but these are in private ownership and are therefore not shown on this mapping.

² OPW Flood Maps available at <http://www.floodinfo.ie/map/floodmaps/>

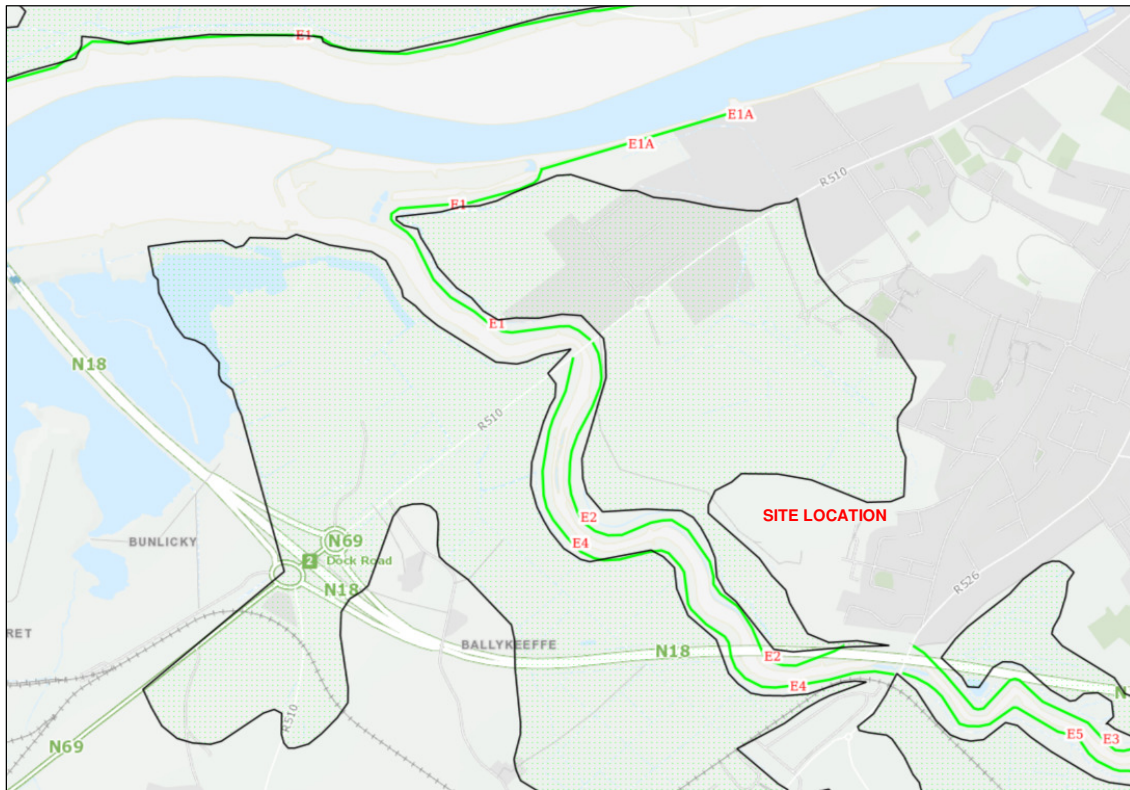


Figure 3.1 Extract of Arterial Drainage Districts mapping showing defences and benefitting areas

The embankments are constructed of unknown material, and indeed it can be assumed that they are constructed of varying grades and types of strata including estuarine mud, which is known to have been used at various points along the estuary. These defences extend for miles down the estuary on both banks. At this particular location the embankments provide a good standard of protection to all properties along the Dock Road which would otherwise be frequently inundated to a significant depth. Despite there being no historical risk of breach at this location, it remains a possibility and therefore will be addressed in the mitigation measures required to ensure the safety of the SHD site. RPS have not carried out any visual or intrusive testing of the embankments, instead the strategy is to propose a series of mitigation measures which in no way rely on the protection afforded by these existing defences.

3.2 Fluvial Flood Risk

The CFRAMS maps show that the site is not at risk of fluvial flooding. An extract from the CFRAM Study Fluvial Flood Extents Map is shown in Figure 3.2, and the full map is shown in Appendix B. Fluvial flooding is not therefore considered further in this report.

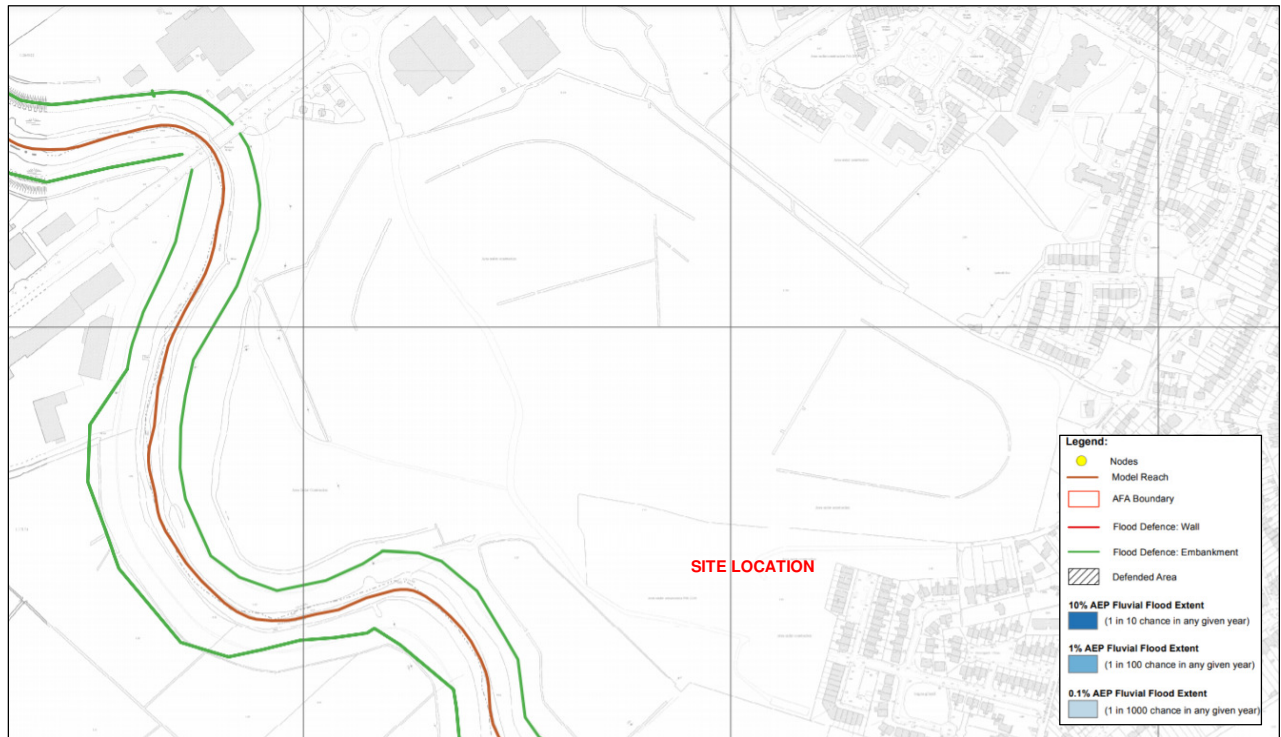


Figure 3.2 Extract from CFRAMS fluvial flood extents map

3.3 Coastal Flood Risk

The CFRAMS maps show that the site has some areas which are defended from coastal flooding by flood embankments along the Ballynaclogh River which have a standard of protection of 0.5% AEP. There are some areas of the site which are at risk of coastal flooding in a 0.5% AEP event from the River Shannon to the north, as the defences in this area only have a standard of protection of 2% AEP. There are also some areas within the site that are not at risk of coastal flooding. Extracts from the CFRAM Study Tidal Flood Extents Maps are shown in Figures 3.3 and 3.4, and the full maps are shown in Appendix B.

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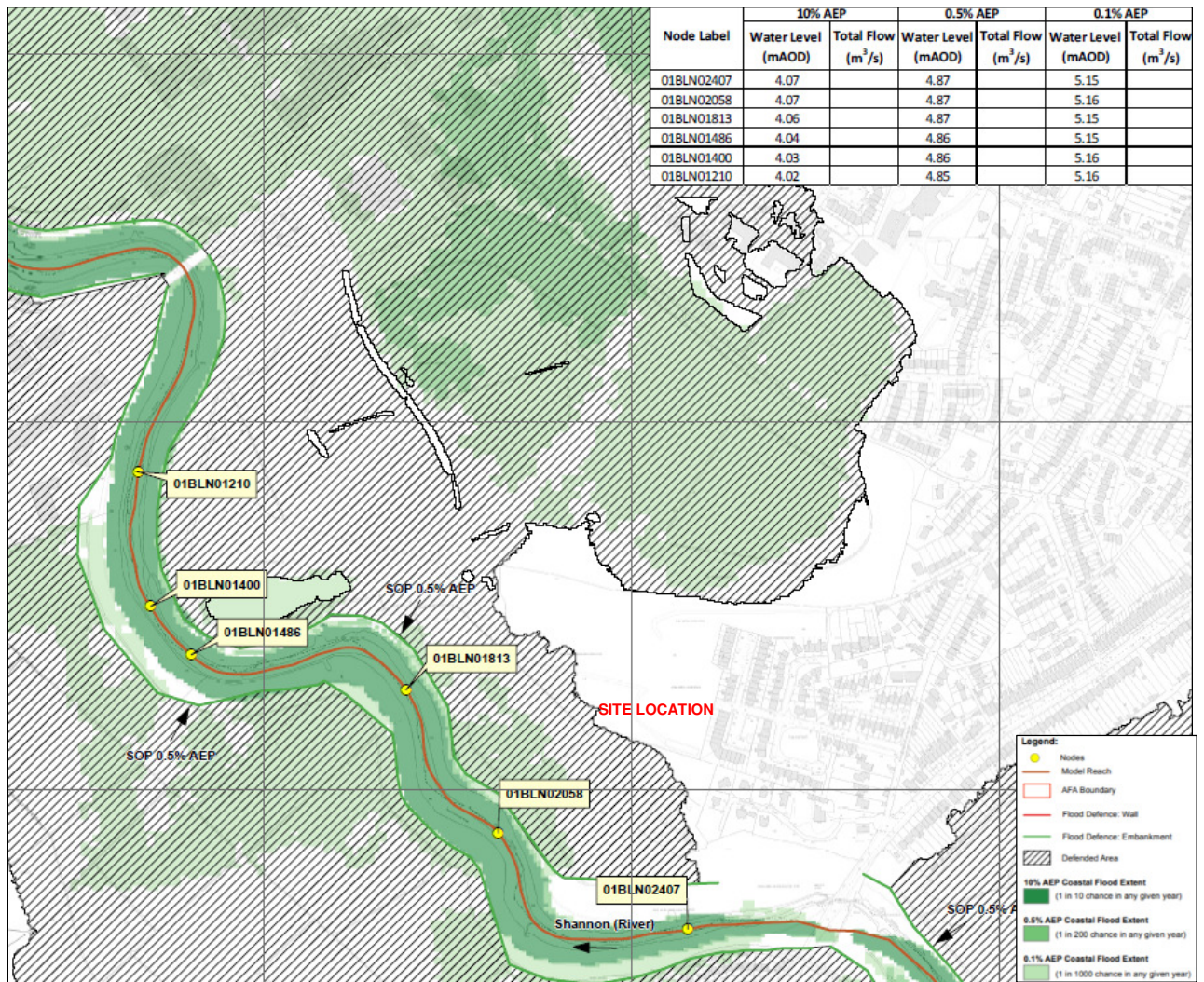


Figure 3.3 Extract from CFRAMS tidal flood extents map (Ballynaclogh River)

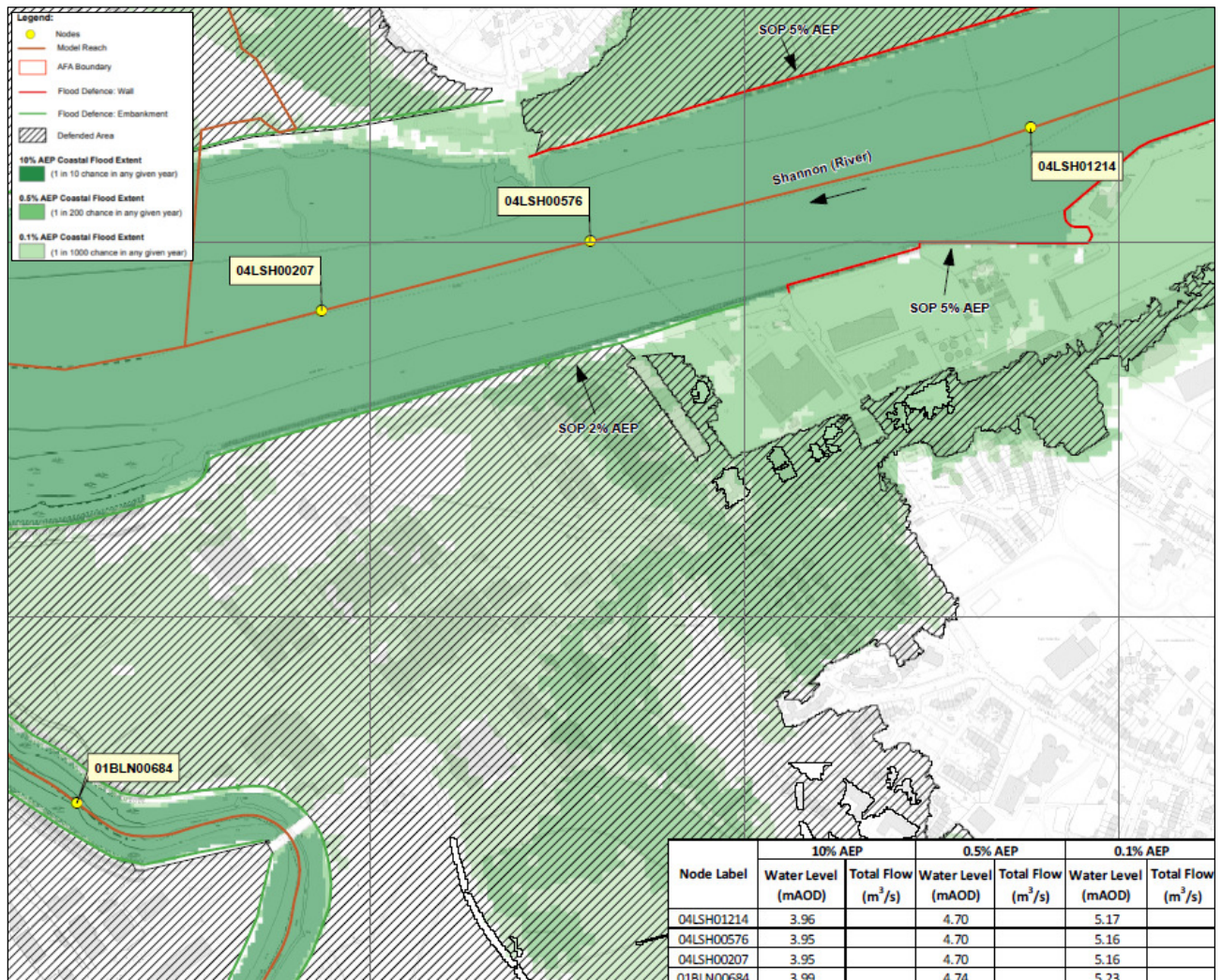


Figure 3.4 Extract from CFRAMS tidal flood extents map (River Shannon)

3.4 Flood Zones

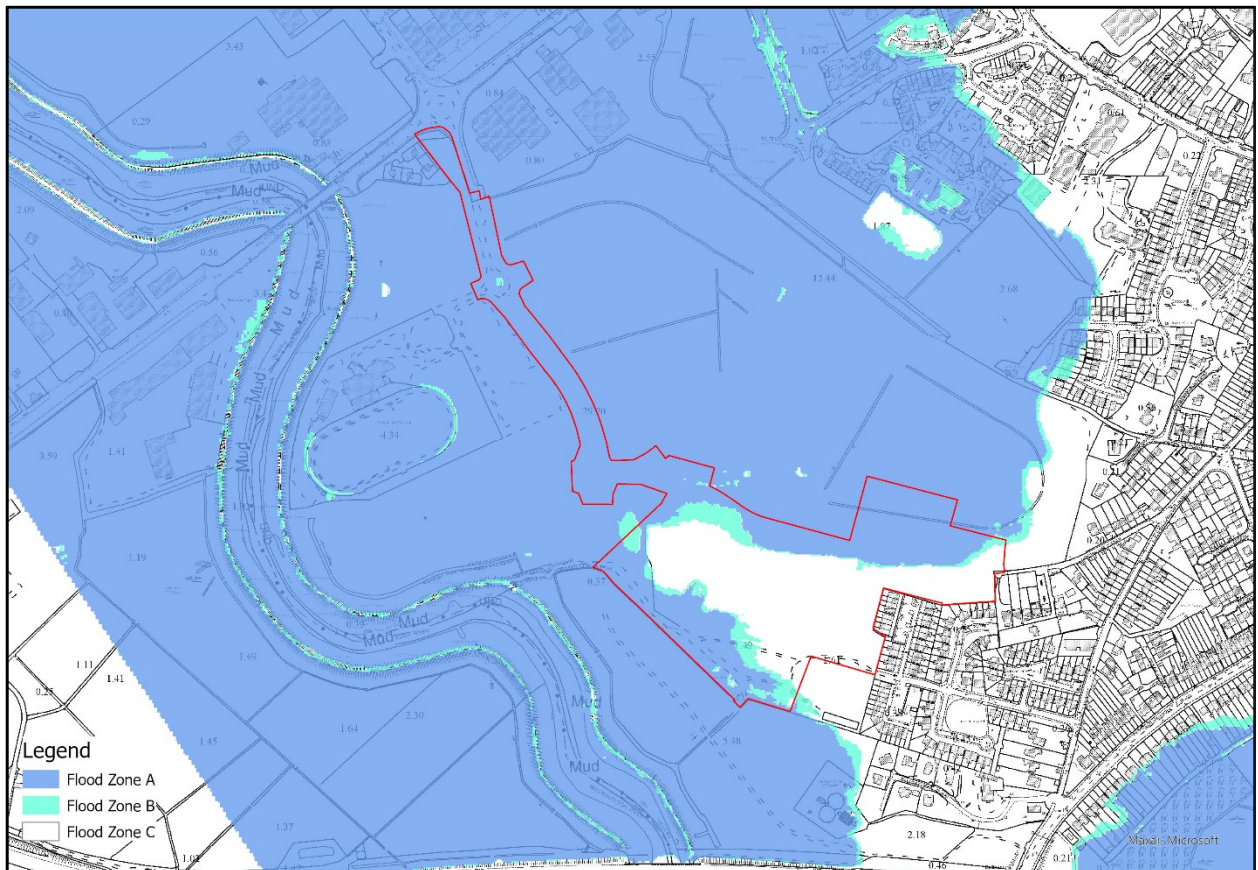
Under the requirements of 'The Planning System and Flood Risk Management' Guidelines (2009), when considering existing flood risk it is necessary to assign flood zoning to the proposed development site. Flood zoning is defined as:

- **Flood Zone A:** areas where the probability of flooding from rivers and the sea is highest (greater than 1% for river flooding or 0.5% for coastal flooding);
- **Flood Zone B:** areas where the probability of flooding from rivers and the sea is moderate (between 0.1% and 1% for river flooding, and between 0.1% and 0.5% for coastal flooding);

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- **Flood Zone C:** Areas where the probability of flooding from rivers and the sea is low (less than 0.1% for both river and coastal flooding).

An important consideration for this particular location is the presence of the existing defences which, although offering a good standard of protection even during extreme flood events, must be ignored for the purpose of flood zoning. This is stated in Paragraph 2.25 of the Guidelines and is required because areas protected by flood defences still carry a residual risk of flooding from overtopping or breach of defences, and there is no guarantee that the defences will be maintained in perpetuity. Figure 3.5 shows the flood zones for the site, as determined by RPS based on the CFRAMS information. Figure 3.5 shows that the majority of the site where housing is being proposed is in Flood Zone C (white areas), however areas of the site can be considered to be in Flood Zone A (dark blue), with a very small section of the land being contained within Flood Zone B (light blue).



Given the flood zoning identified in Figure 3.5, the Planning System and FRM Guidelines provide direction on the type of development appropriate to each flood zone. This is shown in Table 3.2 in Guidelines, which is reproduced in this report as Figure 3.6.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Figure 3.6 Flood zones and appropriate development

As described above, a large part of the SHD site is in Flood Zone C, however there are some areas that can be considered to be in Flood Zones A and B. Table 3.2 of the Guidelines (Figure 3.6) shows that for residential development (highly vulnerable) in Flood Zones A and B, the Justification Test will need to be applied and fully satisfied before development can be permitted.

3.5 Justification Test Application

The Greenpark Lands have been zoned for both General Mixed Use, Neighbourhood Centre and Residential uses since 2010 as per the Limerick City Development Plan 2010-2016³, which was adopted with the benefit of the application of the provisions of the Planning System and Flood Risk Management Guidelines for Planning Authorities 2009. Page 12.19 of the Limerick City Development Plan 2010-2016 states:

“Limerick City Council shall have full regard to these guidelines within the Limerick City Development Plan 2010-2016, with particular reference to lands zoned for development. In this regard Limerick City Council has provided Map 2 - Flood Risk Areas in Appendix I. This map indicates the zones of High Probability and Moderate Probability of flooding as set out in Chapter 3 of the guidelines. Proposed developments in these zones must have regard to the guidance provided”.

³ Limerick City Development Plan 2010-2016 (as extended)

The portion of Map 2 (referred to in the extracted text above) relating to the Greenpark lands is shown in Figure 3.7, and this shows an almost identical flood extent to the flood zoning produced by RPS as shown in Figure 3.5.

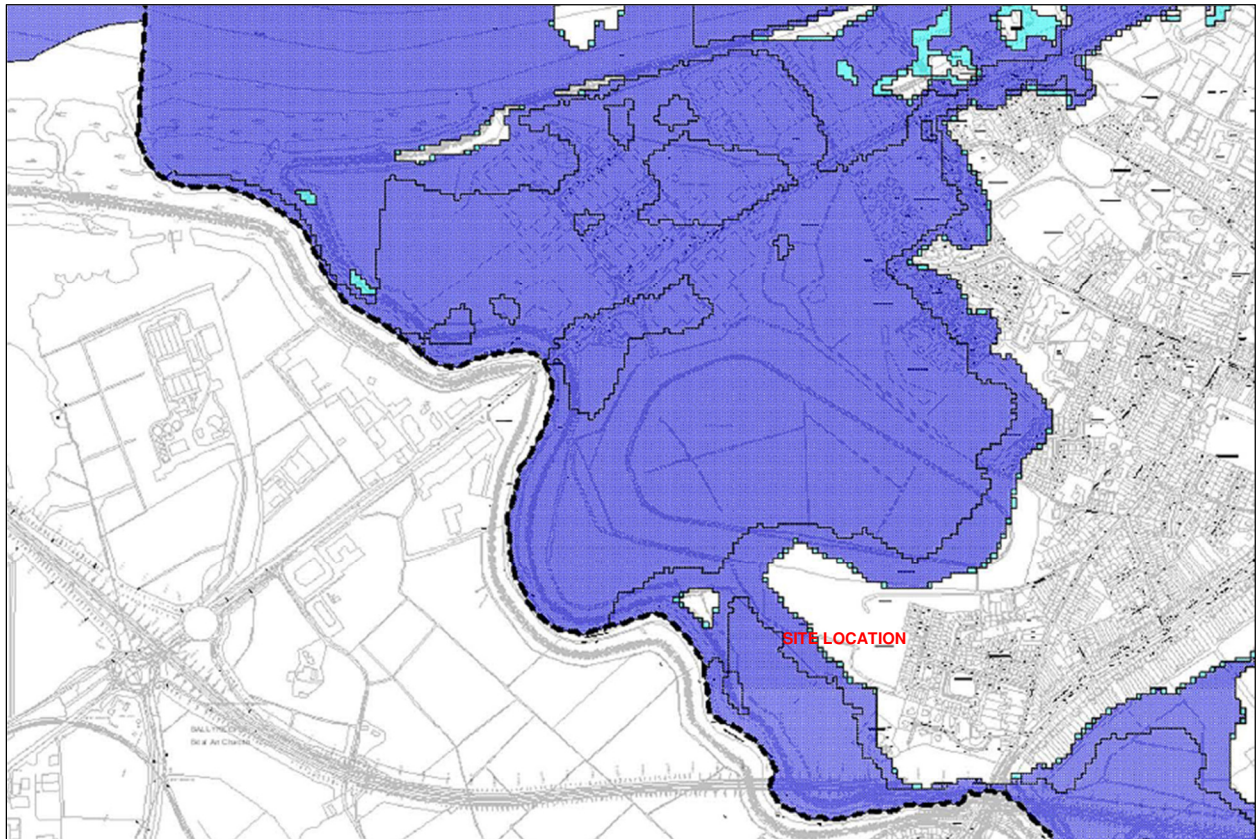


Figure 3.7 Extract of Map 2 from the Limerick City Development Plan 2010-2016

This demonstrates that the flood risk which informed the 2010-2016 Development Plan was accurate and well documented. Subsequently, the Development Plan Justification Test must have been applied and passed in order for the General Mixed Use, Neighbourhood Centre and Residential uses zonings to be established for the Greenpark Lands. Given that the Development Plan Justification Test has been applied there is only a need to comply with the Development Management Justification Test as part of this application.

RPS have reviewed a number of recent planning decisions (typically over the last 4- 5 years and as recently as 2020) in the LCCC administrative area, all located within Flood Zones A/ B. It would appear that all FRAs submitted with these applications applied the Development Management Test only (see Figure 3.8 showing the approximate locations and related planning reference numbers). This approach seems to have been accepted by LCCC based on the internal Council assessments in each case as being the

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appropriate methodology. This would support RPS' position that the use of the Development Management Justification Test is similarly correct in relation to the FRA for the SHD site at Greenpark.

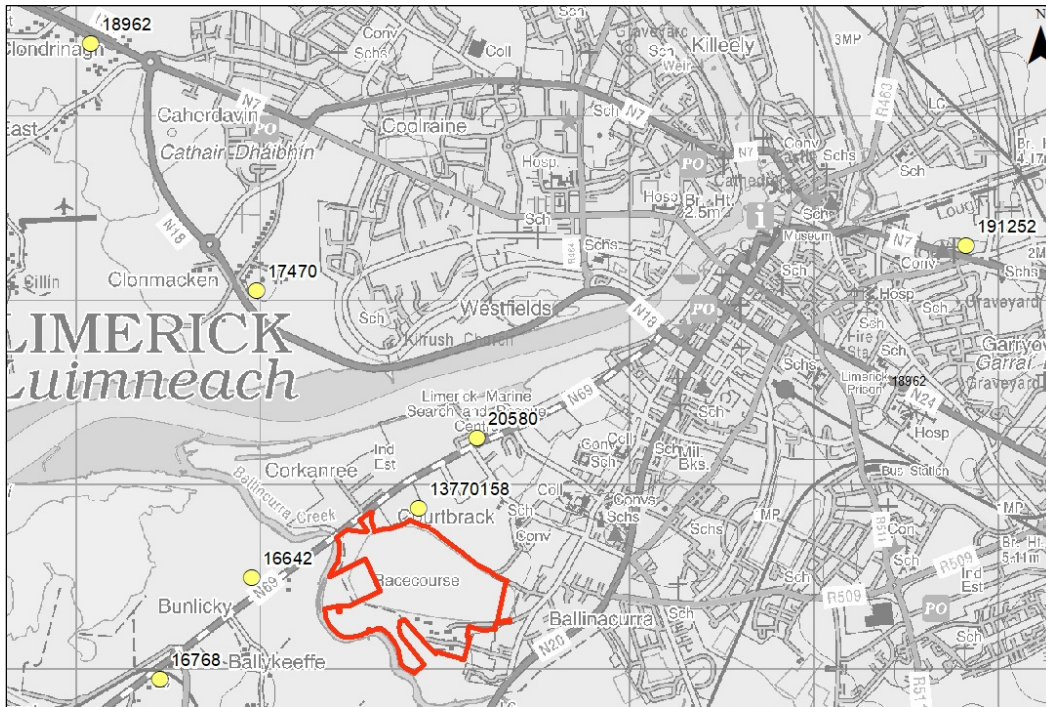


Figure 3.8 Locations and planning reference numbers of recent applications

4 PROPOSED DEVELOPMENT

4.1 Masterplan Development

The SHD site is part of the overall development of the Greenpark lands. A wider masterplan has been prepared of these lands in their entirety and it encompasses multi-phased residential development and office campus, neighbourhood centre and public open spaces adjacent to Bord na gCon greyhound stadium along Ballynaclogh River. The office floor plates will be designed with greater flexibility and adaptability to local and multinational demands. A neighbourhood centre will be strategically located to serve the need of the local community and residents.

The residential component of the Masterplan consists of 920 dwelling units, crèche and residential amenity spaces. The development will be carried out in several phases. The first phase of the development includes a strategic housing development application for 371 dwelling units with a residential density of 47 units/ha, crèche and other associated ancillary uses in line with the Masterplan. The overall Masterplan is shown in Figure 4.1. Note that the Masterplan has been updated since the original masterplan document (Nov 2019) was issued in order to reflect the changes to the SHD site.

An FRA in support of the Masterplan for the Greenpark area was previously prepared by RPS and has been reviewed by Limerick City and County Council Water Services Department, who in a meeting with RPS confirmed verbally that they accepted the technical work presented and mitigation measures proposed. The flood risk assessment accompanying the Masterplan sets out how the lands can be developed safely in accordance with the Planning System and Flood Risk Management Guidelines. It demonstrates the necessary mitigation measures to ensure the entire Masterplan area can be protected to the required standard (including considering the breach scenario and climate change) and importantly that there is no increase in risk to existing developments. The flood risk mitigation measures that are proposed for the SHD site will align with those from the FRA prepared in support of the overall Masterplan from November 2019.



Figure 4.1 Overall Masterplan

4.2 Strategic Housing Development (SHD)

The strategic housing development with a total gross floor area of c. 36, 329 sq m will consist of the provision of 371 no. residential units comprising 157 no. two storey houses (consisting of 10 no. 4 bedroom units, 110 no. 3 bedroom units and 37 no. 2 bedroom units); 76 no. three storey duplex units (consisting of 14 no. 3 bedroom units, 38 no. 2 bedroom units and 24 no. 1 bedroom units) and 138 no. apartments (consisting of 92 no. 2 bedroom units and 46 no. 1 bedroom units arranged in 3 no. blocks ranging between 4 and 5 storeys together with communal amenity space) and a childcare facility (550 sq m), including all private, communal and public open space provision (including balconies and terraces to be provided on to front and rear elevations and related play areas); surface car parking (510 no. spaces in total, including car sharing and accessible spaces); electric vehicle charging points; bicycle parking (long and short stay spaces including secure stands); storage areas; internal roads and pathways; hard and soft landscaping and boundary treatments; piped infrastructural services and connections; plant; revised entrances and tie-

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in arrangements to adjoining roads, including emergency access via Log na gCapall and Greenpark Avenue; waste management provision; solar panels; attenuation tank and related SUDS measures; signage; public lighting; bulk earthworks; and all site development and excavation works above and below ground. Vehicular access to the site will be from Dock Road, via the proposed access road. The proposed layout for the SHD site is shown in Figure 4.2 and in Appendix C.



Figure 4.2 Proposed SHD layout

This FRA report has been prepared in accordance with the Masterplan FRA, ensuring that all developments constructed in the short term do not compromise the flood protection afforded to buildings constructed in the future or vice versa.

The purpose of this FRA is to demonstrate how, given the flood risk identified in Section 3, the strategic housing development area can be safely developed in a manner that is fully compliant with the Planning System and Flood Risk Management Guidelines. In that respect there are a number of key principles which must be addressed in order to pass the Development Management Justification Test, these are:

- Firstly, demonstrating that during a 200 year (0.5% AEP) event and during a 200 year (0.5% AEP) Climate Change event there is no risk to the proposed development or increase in flood risk elsewhere.
- Secondly, Paragraph 5.16 of the Guidelines states that a precautionary approach should be applied for developments located behind existing defences. It suggests that an appropriate mitigation measure would be to set floor levels above the 0.5% AEP flood level (for a site affected by coastal flooding) and to include for the effects of climate change. When determining this 0.5% AEP level the effect of defences should be ignored.

Addressing these key issues is best practice in demonstrating compliance with the Development Management Justification Test as set out in Box 5.1 of the Planning system and Flood Risk Management Guidelines. Section 5 of this report describes the mitigation measures that address these criteria and the numerical modelling undertaken to demonstrate their effectiveness. Section 6 describes compliance with the Justification Test.

4.3 Nursing Home

A nursing home is proposed adjacent to the SHD site. This is a separate planning application that has been submitted to LCCC for their consideration (Ref. no. 21/1222). In order to complete a comprehensive assessment, this FRA for the SHD site has considered the cumulative impact of both developments.

The nursing home is 4 storeys in height with a total gross floor area of c.5,237 sq m, consisting of 123 no. rooms, comprising 126 no. bedspaces (120 no. single rooms and 3 no. double rooms) and ancillary facilities, including 777 sq m of day space. The nursing home development will also consist of soft and hard landscaping, car and bicycle parking spaces; 3 no. electric parking spaces; bicycle parking; internal roads and pathways. The location of the Nursing Home development in relation to the SHD site is shown in Figure 4.3, and its proposed layout is shown Figure 4.4.



Figure 4.3 Location of Nursing Home Development with respect to the SHD site



Figure 4.4 Proposed Nursing Home ground floor layout

5 PROPOSED MITIGATION MEASURES

Any mitigation measures proposed must be robust, sustainable with respect to climate change, and not place any burden on the city of Limerick, whereby there would be a requirement in the future to provide additional flood defences and capital expenditure to protect this development. It is also acknowledged that under the CFRAM process, where Limerick was an Area for Further Assessment (AFA), a significant capital scheme was proposed. This scheme is currently being progressed under the OPW Capital Works Framework and should be developed over the next 10-15 years. While there is no doubt a scheme of this nature would further benefit the Masterplan lands, RPS also recognise there is no guarantee a scheme will be developed as it will be subject to a cost-benefit analysis and availability of government funding. Conversely there is also a need to ensure mitigation measures proposed as part of this SHD application in no way compromise the development of a suitable flood alleviation scheme for Limerick.

5.1 Model Construction

In order to be able to assess the impact of any proposed mitigation measures RPS have developed a site specific model incorporating the Masterplan area. As the SHD lands are located behind existing defences it is obvious there is no impact on the Ballynaclogh River either upstream or downstream, or the Shannon Estuary. Instead the model has been developed specifically to understand the impact of the defences overtopping and also breaching, ensuring that the SHD area is resilient to these flooding mechanisms and doesn't adversely affect adjacent property and land.

RPS have constructed an InfoWorks ICM 2D model of this area of Limerick based on a Digital Terrain Model (DTM) constructed from LiDAR data which covers this area of Limerick. This has been supplemented by more detailed topographical survey of the existing flood defences to capture any low points or defects. The LiDAR provides a high-resolution survey that is sufficient for establishing the effects of overtopping and breaching of the existing flood defences. RPS have utilised the 0.5% Annual Exceedance Probability (AEP) flood levels for the Shannon Estuary and for the Ballynaclogh River that were developed in the CFRAM study. These provide the best available estimation of the predicted water level during extreme coastal events for this return period.

In addition, RPS have improved upon the CFRAM inundation modelling by incorporating all of the existing buildings within Dock Road area within the model and blocked these out to prevent flow through them. This is a significant addition to the modelling undertaken during the CFRAM process as it can identify new flow paths as the water passes between buildings.

5.2 Modelling of Existing Situation

As a baseline model run, RPS used the peak tidal levels from the CFRAM study in the estuary and Ballynaclogh River to run a 0.5% AEP flood inundation simulation. This model was run over 72 hours, covering tidal cycles leading up to and after the 0.5% AEP event, with an appropriate tidal curve reflecting the rising and falling level of the flood and ebb tide during an extreme storm surge event. As stated previously, the majority of the defences surrounding the Dock Road area are sufficiently high enough to prevent inundation and overtopping, however there is a lower section near to the Ted Russel Dock where a limited amount of flooding can occur. The flood mapping output from this model simulation is shown in Figure 5.1.

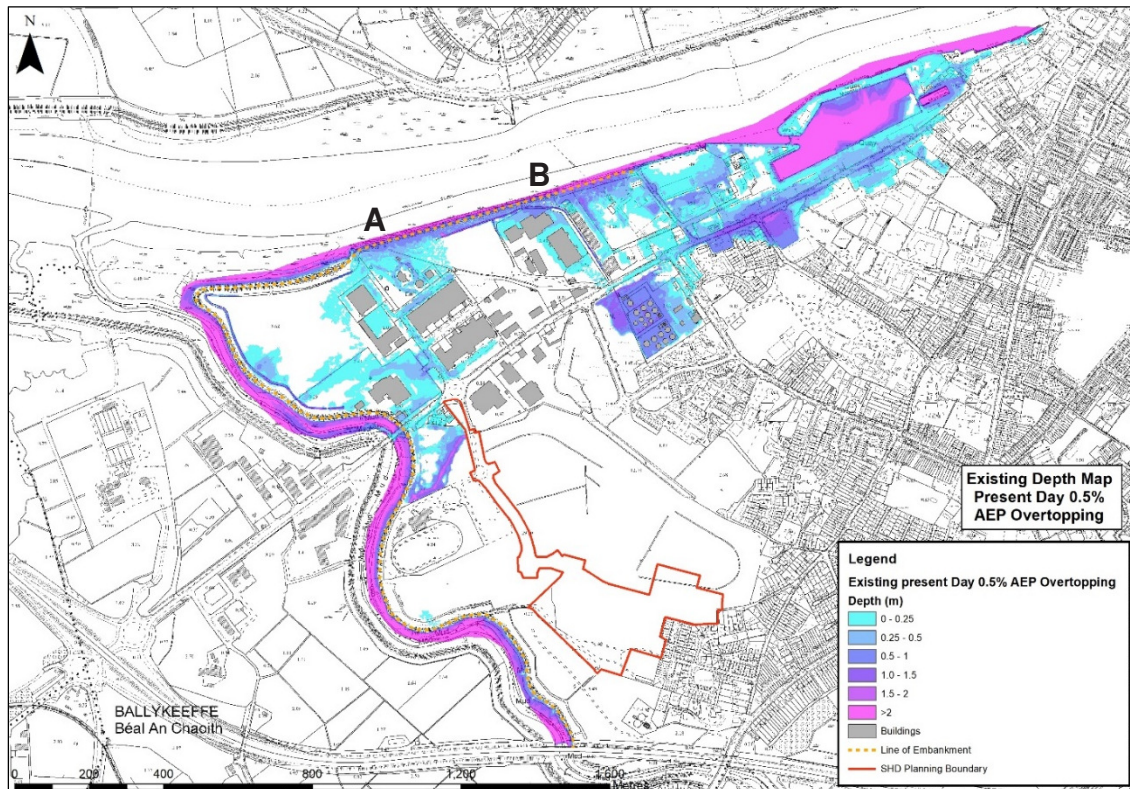


Figure 5.1 Flood depth map showing impact of 0.5% AEP flood inundation simulation

The model simulation indicates overtopping at two locations (Points A and B on Figure 5.1) where the defences are insufficiently high to prevent inundation. From this model run it can be concluded that there is no risk to the SHD lands during a 0.5% AEP flood event, providing defences are only overtopped and not breached. As the 0.5% AEP water level does not inundate the proposed development area in the existing scenario there can be no increase in water level as a result of constructing the proposed development, and therefore no further assessment is required in this regard.

5.3 Development and Modelling of Mitigation Measures

As stated previously in this FRA, when quoting Paragraph 5.16 of the Planning System and Flood Risk Management Guidelines, there is a need to ensure a precautionary approach when developing behind existing defences. It suggests that the mitigation measures for dealing with that risk would be to set finished floor levels at the 0.5% AEP flood level (for coastal flooding) ignoring the moderation effects of flood defences. Following this logic, to address the impact of the inundation from the 0.5% AEP Climate Change event (Mid-range Future Scenario), it is proposed to raise the level of the SHD site to minimise the residual risk. By raising levels on the site it will provide sufficient protection to the proposed development, but it raises the question if it could also increase the risk of flooding to surrounding land and existing development. RPS have therefore carried out a comprehensive modelling exercise focussing on the breach scenario to ensure there is no increase risk to adjacent developments should this occur. This was tested for the 0.5% AEP and 0.5% AEP Mid-range Future Scenario (MRFS) events.

5.4 Breach Analysis of the Flood Defences

Given the number of residential properties in the application, a robust assessment of residual risk is required. The original purpose of the existing defences and the unknown make-up of their construction means it is necessary to undertake a breach analysis at certain locations along both the Ballynaclogh River and the Shannon Estuary to assess the impact of such an event on the proposed and existing developments. Breach analysis was undertaken using the UK Environment Agency's guidance on breach modelling which was also adopted for use during the CFRAM process. It was undertaken at three locations:

Breach 1 – along the Estuary at the rear of McMahon Building Providers;

Breach 2 – along the lower reaches of Ballynaclogh River;

Breach 3 – on the Ballynaclogh River upstream of the Greyhound Stadium.

All breaches were run over a 72 hour tidal cycle, with the breach set to occur 1 hour before the peak of flood. At this time in the simulation a 50m section of the embankment is removed with the spill level being reduced to existing ground levels on either side of the defence. A separate map was produced for each location, i.e. it is assumed only one breach occurred at a time. All three breach locations produced approximately the same flood extent. As an example and for easy reference, the 0.5% AEP extent for the existing lands for Breach Location 2 has been included as Figure 5.2, and the breach maps for Locations 1 and 3 have been provided in Appendix D.

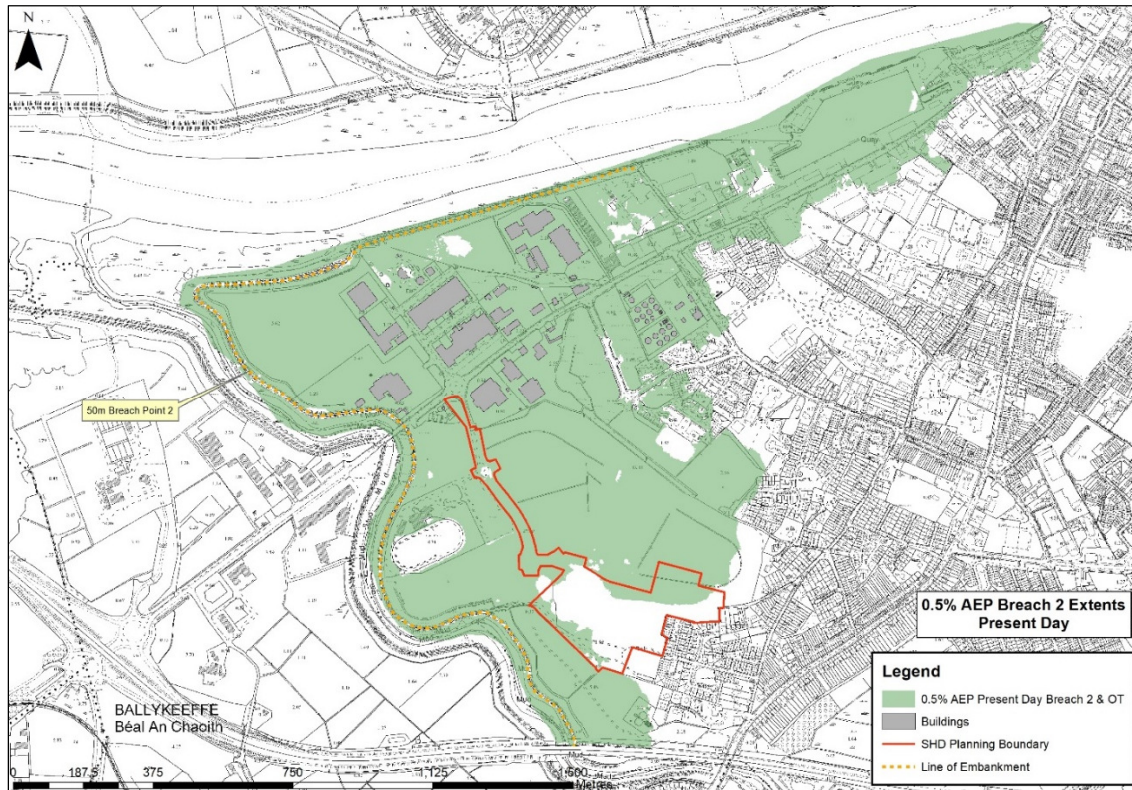


Figure 5.2 Breach location 2- 0.5% AEP event with existing ground levels

5.5 Mitigation Measures for Breach Scenario

5.5.1 Derivation of Design Flood Level

In the Tripartite meeting with Limerick City and County Council (LCCC) and An Bord Pleanála, LCCC stated that their preference was to use the 4.87m OD level as the design flood level for the site. This flood level was derived for the 0.5% AEP flood event in the Ballynaclogh River during the Shannon CFRAM Study. RPS agree that this level can be reached during a 0.5% AEP event in the river when the water is contained by the defences, but it can never be realised at the SHD site during an event of this magnitude. This is because, once the defences are breached, the water spreads out across the entire Dock Road/ Greenpark area resulting in a significant reduction in the 0.5% AEP flood level by the time the water from the breach reaches the proposed development site.

From the three breach simulations (as described in Section 5.4 of this FRA), the maximum derived water level within the immediate vicinity of the SHD was 4.3m OD. This approach in deriving an actual breach flood level at the application site is considered acceptable by Limerick City and County Council as noted in

the draft SFRA completed in support of the current Draft Development Plan 2022-2028⁴, which states in Section 5.8.1:

“Breach modelling – for more complex and higher value developments, bespoke breach modelling can be undertaken in which the overtopping or breach of a flood defence can be investigated with specific reference to a development site.....Breach modelling will also allow a site specific assessment of finished floor levels to be developed, which may be lower than the default standard set out in Section 5.10.”

Having due regard to Section 5.8.1 of the Draft Development Plan, the bespoke breach modelling undertaken by RPS, which included the use of up to date LiDAR, a higher-resolution model and included all of the buildings within the breach area to more accurately capture and derive flood flow paths, endorses the approach set out in the current SFRA for Limerick.

The highest possible flood level for the 0.5% AEP flood event at the application site is 4.3mOD. RPS believes this an accurate, fair and reasonable assessment of the design water level which should be used to establish the mitigation measures.

5.5.2 Establishment of Freeboard

In order to address the risk from the potential flood depths during a breach, the preferred mitigation measure, as advised in the Planning System and Flood Risk Management Guidelines, is to raise the levels of the proposed development. In Paragraph 5.16 this is suggested as being above the 0.5% AEP flood level, even when behind existing defences, and to ensure a precautionary approach it should also include the effects of climate change.

While the Flood Risk Management Guidelines 2009 do not recommend the amount of freeboard to be applied, RPS are proposing a 500mm freeboard as this is currently the freeboard applied by the Office of Public Works (OPW) to all capital flood schemes where earth embankments are being constructed. Given the previously described earth embankments that exist along the Ballnaclogh River and Shannon estuary this would seem to be a reasonable assessment of the freeboard to be applied to the SHD development.

In addition, RPS are proposing a further allowance of 500mm be applied for sea level rise associated with climate change for the Mid Range Future Scenario (MRFS), to ensure a precautionary approach is adhered to.

At the Tripartite meeting LCCC proposed a freeboard of 300mm and a further 500mm for climate change, resulting in a 0.8m freeboard above the design water level. This is less than the 1m freeboard recommended by RPS for the SHD site. This is summarised in Table 5.1.

⁴ Strategic Flood Risk Assessment for Draft Limerick Development Plan 2021-2028, JBA, June 2021

	Freeboard allowance proposed (mm)	Climate change allowance proposed (mm)	Overall allowance (mm)
RPS	500	500	1000
Limerick CCC	300	500	800

Table 5.1 Comparison of RPS and LCCC freeboard recommendations

5.5.3 Proposed Mitigation Measures

The SHD site will be filled to a level to ensure that all roads within the development will be developed to a minimum of 5.0m OD, and then all FFLs will be constructed to a minimum of 5.3m OD. The 5.3m level provides an allowance of 500mm freeboard and 500mm for climate change as described in Section 5.5.2 of this FRA. This provides over 1m freeboard to all new properties which is a very high standard of protection to what is considered ‘highly vulnerable development’ under the Guidelines. Note that the materials being used for filling operations is available within the application site by means of a cut and fill operation.

It is not proposed to raise the access road between the Dock Road and the SHD development. There are numerous reasons for this as follows:

- Firstly, should a breach of the flood defences occur, the Dock Road itself will be flooded to a significant depth in excess of 2m in certain places and completely impassable. Therefore raising the access road between the Dock Road and the SHD development road does not improve access or egress to the proposed development in any way during an event of this magnitude;
- Secondly, should the access road be raised to the minimum recommended 5.0m OD it will effectively create a raised causeway above the surrounding land. During a breach event and the consequential high velocities and flows, a raised causeway of this nature will almost certainly be subject to significant structural damage;
- A final consideration is that the SHD site has been designed so that during a breach event people will remain in their homes, as that is the safest place to be. Providing an access road that is raised may only encourage people to use the access road to travel towards an area that is flooded to a significant depth, or to get a closer look at the flooded areas. This is not behaviour that should be facilitated in any way. RPS would therefore recommend that the access road is maintained at the so ground levels.

The mitigation measures that RPS have proposed to manage the identified risk are described in Table 5.2.

Table 5.2 Summary of proposed mitigation measures to manage the breach scenario

Objective of mitigation measures	Proposed mitigation measures
To raise the proposed development area as far as is reasonably possible, with the focus on protecting people and buildings	The entire development area will be filled, with roads constructed to a level of 5.0m OD and finished floor levels to a level of 5.3m OD. This provides 1m of freeboard above the 0.5% AEP breach flood level. This means that during a breach event, which will cause significant damage to the Dock Road/ Greenpark area and has a high risk to life, residents and their property will remain entirely safe.
Provide egress and access during extreme event to provide access for emergency services and also those wishing to evacuate the area	Designated internal roads should be raised to 5.0m OD. This provides access and egress to all emergency vehicles and pedestrians even during a breach scenario. This road level is over 700mm above the predicted breach level during a 0.5% AEP event.

5.5.4 Modelling of Breach Mitigation Measures

It is recognised in Paragraph 5.16 of the Flood Risk Management Guidelines 2009, that when lands are to be filled behind defences “...the flood risk assessment should be thorough and measures to manage these residual risks carefully detailed”. Furthermore, in the Frequently Asked Questions on page 73 of the Guidelines it states “...the beneficial effects of land-raising should therefore be balanced against potential increased flood risk elsewhere”. It is therefore clear, that although land raising is the preferred approach to mitigate against a potential breach of the defences, the potential to increase flood risk to neighbouring existing development needs to be assessed and mitigated where required.

Based on the proposed development levels for the SHD site, breach modelling has been undertaken for each of the three breach locations using the same boundary conditions as described for the existing scenario in Section 5.4 of this report. This was done for both the present day and climate change scenarios. To provide an easy comparison of the existing and proposed development scenarios a series of combined extent maps have been produced which clearly indicate the impact of infilling in the breach scenario. These comparative maps show three different colours at each breach location as follows:

1. Anywhere shown as green floods only in the existing scenario but not in the proposed scenario, which is reflective of the areas that have been infilled;

2. Anywhere shown as purple floods in both the existing scenario and in the proposed scenario. This means there is no impact of flooding in this area as a result of the proposed development;
3. Anywhere shown as yellow floods only in the proposed scenario and not in the existing scenario.

5.5.4.1 Present Day Scenario Results

All three breach locations produced approximately the same flood extent. As an example and for easy reference, a comparative map is shown in Figure 5.3 for a breach at Location 2. The breach maps for Locations 1 and 3 are provided in Appendix E. Based on the proposed mitigation measures described in Section 5.1, the impact of the raising all of the SHD lands is negligible for all of the breach locations. This is not unsurprising given the relatively small amount of infill required for the SHD site, given that a large portion of the site is already in Flood Zone C.

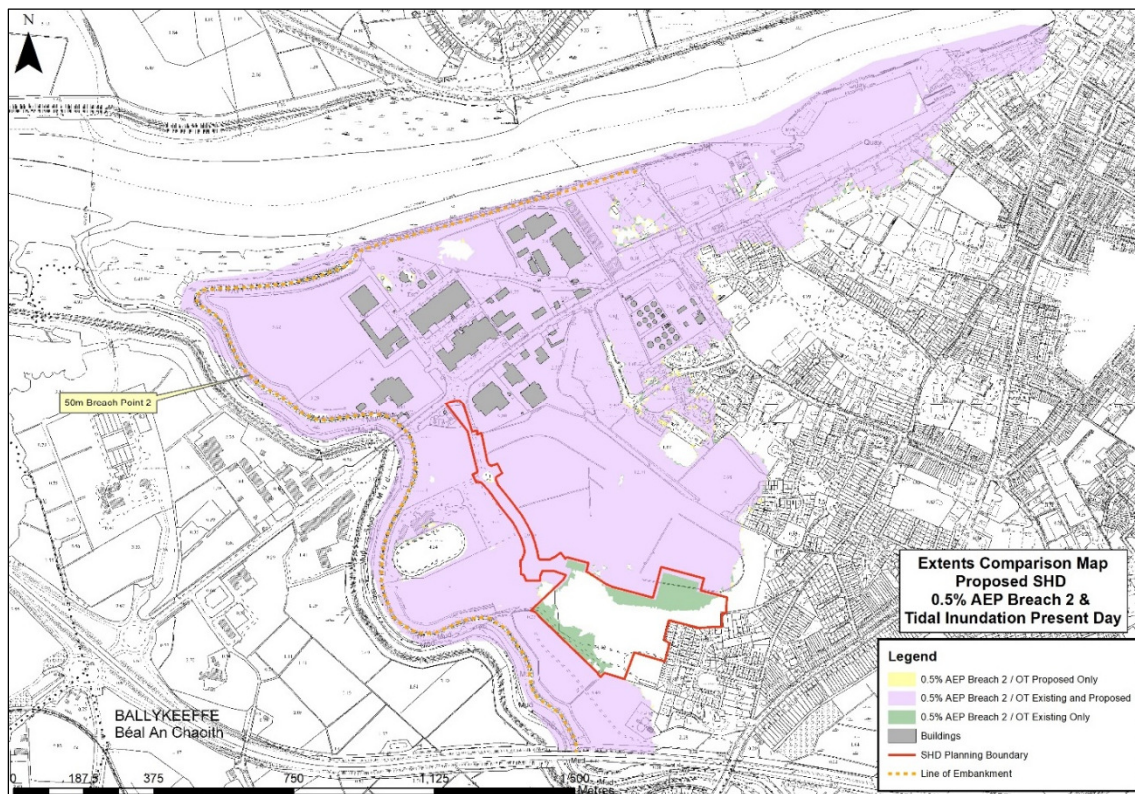


Figure 5.3 Impact of raising proposed development lands at Breach location 2 (Present day)

5.5.4.2 Climate Change Scenario Results

The mitigation measures have also been tested for the 0.5% AEP MRFS event with no impact identified. All three breach locations produced approximately the same flood extent. As an example a comparative

map is shown in Figure 5.4 for a breach at Location 2. The breach maps for Locations 1 and 3 are provided in Appendix F.

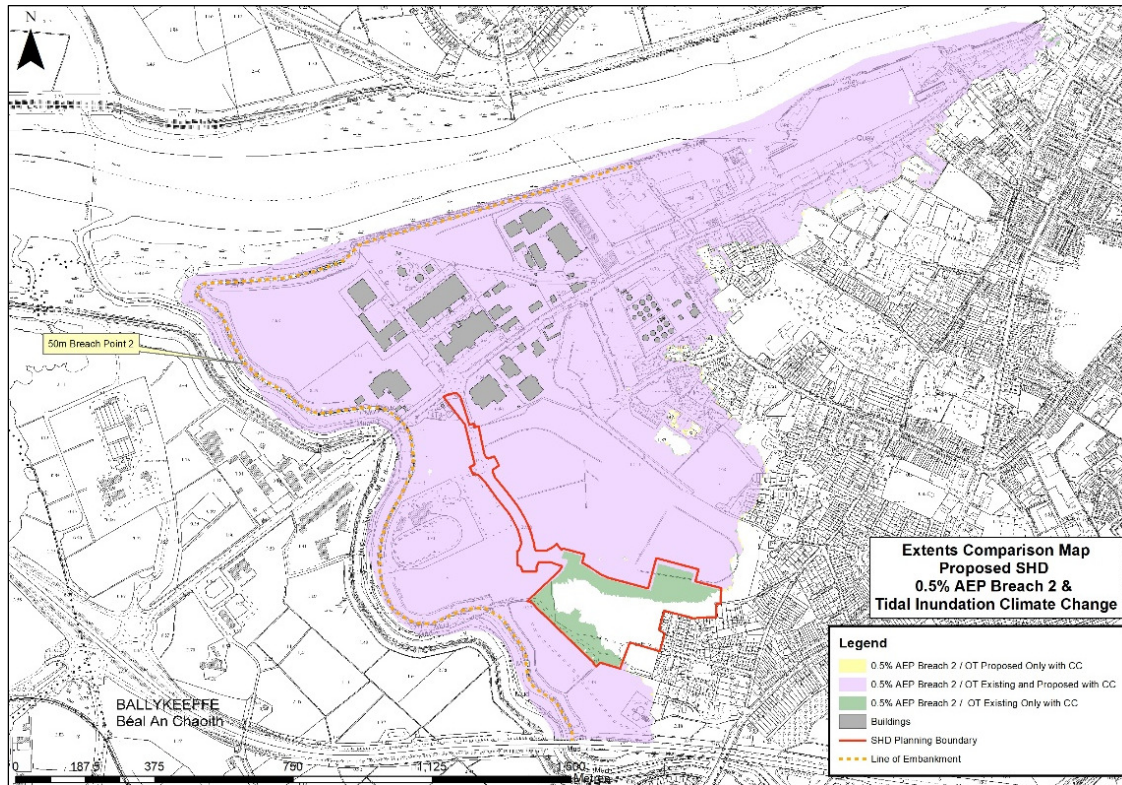


Figure 5.4 Impact of raising proposed development lands at Breach location 2 (Climate change)

5.5.5 Conclusions on Breach Modelling

Based on the analysis, the overwhelming conclusion of the breach modelling is that the proposed development does not create an increase in flood risk to the existing development, either in the present day or climate change scenarios.

As a point of note in relation to the breach maps, it can be seen that along the edges of the flood extent small amounts of yellow and green are visible. This is not an indication of either an increase or a decrease in flood risk extent, instead it occurs as a result of mesh in the 2D domain of the model changing as a result of the new mitigation measures introduced.

5.6 Assessment of Cumulative Impacts

A nursing home is proposed adjacent to the SHD site. This is a separate planning application that has been submitted to LCCC for their consideration (Ref. no. 21/1222). This FRA for the SHD site has included

an assessment of the cumulative impact of both developments. The nursing home site is much smaller in area than the SHD site, and it will be filled to a FFL of 6.3m OD.

Based on the proposed development levels for both the SHD and the nursing home site, breach modelling has been undertaken for each of the three breach locations using the same boundary conditions as described for the existing scenario in Section 5.4 of this report. To provide an easy comparison for the existing and proposed development scenarios a series of combined extent maps have been produced which clearly indicate the impact of infilling in the breach scenario. These comparative maps show three different colours at each breach location:

1. Anywhere shown as green floods only in the existing scenario but not in the proposed scenario, which is reflective of the areas that have been infilled;
2. Anywhere shown as purple floods in both the existing scenario and in the proposed scenario. This means there is no flooding impact in this area as a result of the proposed development.
3. Anywhere shown as yellow floods only in the proposed scenario and not in the existing scenario.

The impact of the raising both the SHD and the nursing home site is shown in Figure 5.5 for a breach at Location 2 for the present day scenario. The breach maps for Locations 1 and 3 are shown in Appendix G.

The impact of the raising both the SHD and the nursing home site is shown in Figure 5.6 for a breach at Location 2 for the climate change scenario. The breach maps for Locations 1 and 3 are shown in Appendix H.

Based on the analysis, the overwhelming conclusion is that the breach modelling indicates that raising of both the nursing home and SHD site does not create an increase in flood risk to existing development, either in the present day or climate change scenarios.

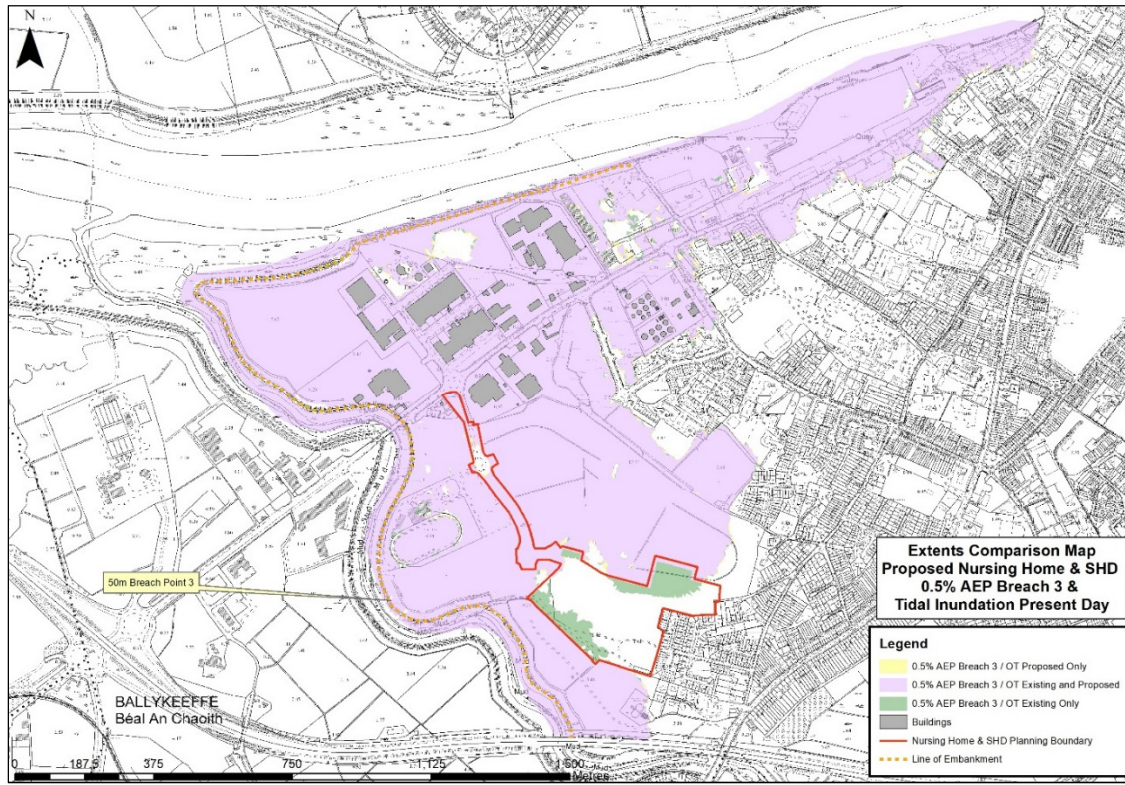


Figure 5.5 Impact of raising nursing home and SHD site levels at Breach location 2 (Present day)

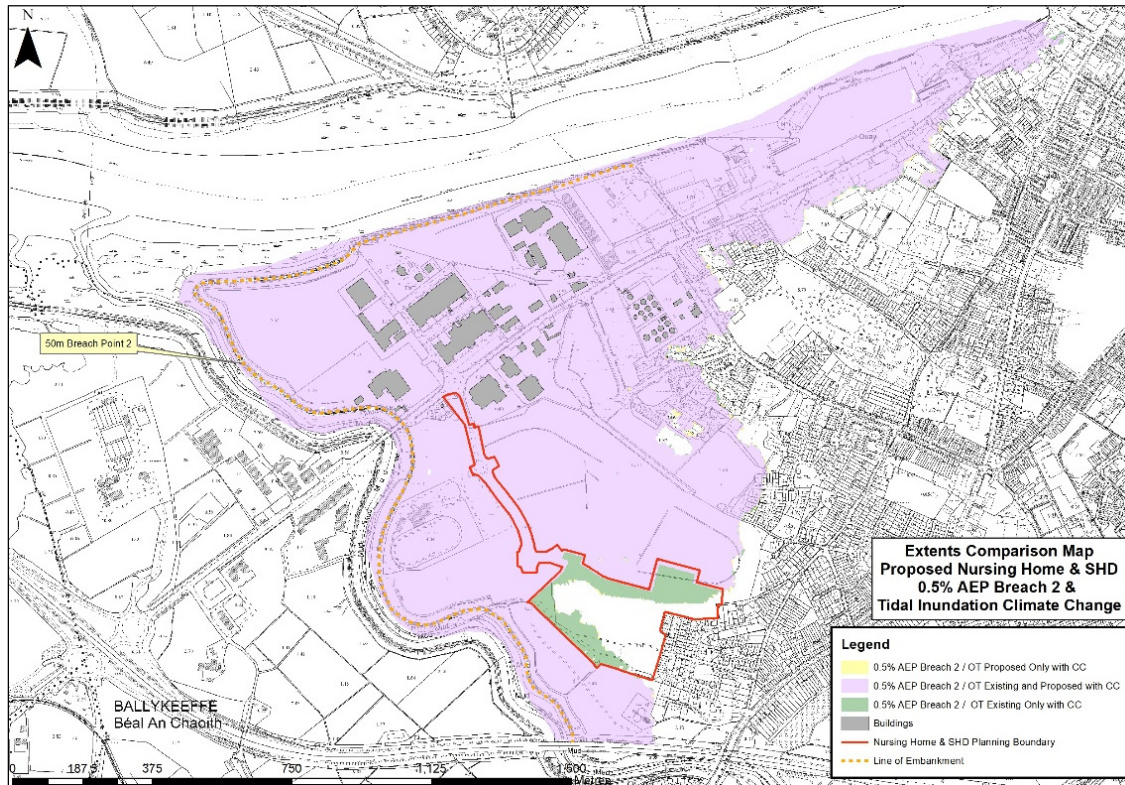


Figure 5.6 Impact of raising nursing home and SHD site levels at Breach location 2 (Climate change)

5.7 Surface Water Drainage Strategy

Given the change from a largely greenfield site to a residential development, there is the potential for an increase in the rate of run off and the need to attenuate flows to the receiving watercourse(s). In order to mitigate this impact the proposed surface water design has been based on the requirement to ensure that the development does not result in increased runoff rates. The surface water drainage design is fully described in the Engineering Planning Report⁵.

A new surface water sewer network shall be provided for the proposed development which will be entirely separate from the foul water sewer network. Each unit will have its own independent connection to the surface water sewer network. Surface water run-off from roof areas and hardstanding areas are designed to be collected by a gravity pipe network. Surface water will be collected and discharged via a mixture of traditional and Sustainable urban Drainage System (SuDS) to the existing 1350mm/ 1500mm diameter

⁵ Proposed SHD at Lands at Former Greenpark Racecourse, Limerick City. PUNCH (September 2021).

surface water sewer. This sewer discharges the existing lagoon adjacent to the Ballynacloagh River. Both the pipe and the lagoon were designed to take into account future developments. The lagoon attenuates flows to Greenfield discharge rate and discharges to the Ballynacloagh River through the use of a penstock structure.

The surface water drainage network has been analysed for the risk of flooding for a 1 in 5-year flood event, 1 in 30-year rainfall event and a 1 in 100-year rainfall event by means of simulating such events in the drainage model with no flooding occurring. An increase of 20% in rainfall has been included to account for climate change and 10% for urban creep.

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS) and a variety of SuDS measures have been adopted including the following:

- Green roofs for the proposed crèche and apartments buildings;
- Tree pit systems in the development's landscaped paved areas;
- Permeable paving for house driveways and the visitor parking;
- Infiltration trenches;
- Swales;
- Rain gardens (dwelling roofs);
- Attenuation tanks (5 no.) located in open spaces throughout the development.

5.8 Access and Egress from the SHD Area

Given the identified mitigation measures which propose to raise all development and finished floor levels above the 0.5% AEP breach level with suitable allowance for climate change and freeboard, there will be no requirement to evacuate the residential development during a 0.5% AEP MRFS (climate change) event, even when a breach occurs. This is an exceptionally high standard of protection given the severity and probability of the event being considered.

Access and egress therefore only needs to be considered in relation to emergency services, e.g. ambulance or fire services, requiring access for a medical emergency or when a fire has occurred concurrently with a breach of the defences. In the unlikely scenario that the main access road leading onto the Dock Road has been flooded, there is still emergency access available in and out of the SHD site along pavements that link to the adjacent Log na gCapall development and to Greenpark Avenue. The pavements are wide enough and have been designed to accommodate emergency vehicles. The routes are shown by red arrows in Figure 5.7.



Figure 5.7 Emergency access and egress routes

6 PLANNING SYSTEM AND FLOOD RISK MANAGEMENT GUIDELINES

6.1 Classification

The ‘Planning System and Flood Risk Management’ Guidelines classify different types of development in terms of their vulnerability class (Table 3.1 of the Guidelines). This table has been reproduced as Table 6.1.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	<p>Garda, ambulance and fire stations and command centres required to be operational during flooding;</p> <p>Hospitals;</p> <p>Emergency access and egress points;</p> <p>Schools;</p> <p>Dwelling houses, student halls of residence and hostels;</p> <p>Residential institutions such as residential care homes, children’s homes and social services homes;</p> <p>Caravans and mobile home parks;</p> <p>Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and</p> <p>Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.</p>
Less vulnerable development	<p>Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions;</p> <p>Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans;</p> <p>Land and buildings used for agriculture and forestry;</p> <p>Waste treatment (except landfill and hazardous waste);</p> <p>Mineral working and processing; and</p> <p>Local transport infrastructure.</p>
Water-compatible development	<p>Flood control infrastructure;</p> <p>Docks, marinas and wharves;</p> <p>Navigation facilities;</p> <p>Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location;</p> <p>Water-based recreation and tourism (excluding sleeping accommodation);</p> <p>Lifeguard and coastguard stations;</p> <p>Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and</p> <p>Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).</p>
*Uses not listed here should be considered on their own merits	

Table 3.1 Classification of vulnerability of different types of development

Figure 6.1 Classification of vulnerability of development

Table 3.2 of the Guidelines identifies the type of development that would be appropriate to each flood zone and those that would need the Justification Test. This table has been reproduced as Figure 6.2.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Figure 6.2 Vulnerability versus flood zones

A large part of the SHD site is in Flood Zone C, however there are some areas that can be considered to be in Flood Zones A and B. Table 3.2 of the Guidelines (Figure 6.2) shows that for residential development (highly vulnerable) in Flood Zones A and B, the Justification Test will need to be applied and fully satisfied before development can be permitted.

6.2 Development Management Justification Test

Where a planning authority is considering proposals for new development in areas at a high or moderate risk of flooding that includes types of development that are vulnerable to flooding and that would generally be inappropriate as set out in Table 3.2 of the Guidelines, the planning authority must be satisfied that the development satisfies all of the criteria of the Development Management Justification Test outlined in Box 5.1 of the Guidelines and reproduced as Figure 6.3.

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 6.3 Justification Test for Development Management

Table 6.1 sets out the response to the criteria in Box 5.1 that must be satisfied. Each of the criteria have been shown to be satisfied and therefore it is concluded that the proposed development complies with the requirements of the Development Management Justification Test.

Table 6.1 Response to Justification Test for Development Management for proposed development

Criteria	Response
1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which takes account of these Guidelines	The lands are zoned for residential use in the Limerick City Development Plan 2010-2016 (as extended). The Development Plan clearly states that the plan was produced taking full account of the Guidelines and was still zoned on that basis. It can be considered that Point 1 of the Development Management Justification Test has therefore been met.
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	<p>During a present day 0.5% AEP flood event and a 0.5% AEP climate change event there is no increase in flood risk elsewhere. This is described in detail in Section 5.2 of this report.</p> <p>Additional modelling has been undertaken to consider the impact of the infilling of the site on the displacement of water during a breach of the existing defences. This was found to not have an increased risk on any existing development. This is described in detail in Section 5.5 of this report.</p> <p>It is therefore considered that Point 2 (i) of the Justification Test has been met.</p>
(ii) The development proposal includes mitigation measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible	<p>The proposed development will not flood during a 0.5% AEP flood event or during a 0.5% AEP flood event plus climate change event. This provides an exceptionally high standard of protection and therefore the risk of flooding to people, property and the environment is very low. This level of protection will ensure that there will be no impact on the economy, i.e. there will not be an unacceptable level of flood risk which might subsequently require government capital expenditure to alleviate the problem to either the proposed development or existing development.</p> <p>It is therefore considered that Point 2 (ii) of the Justification Test has been met.</p>
(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	<p>The residual risk to the proposed development is low, as the development is protected up to a 0.5% AEP plus climate change tidal event, with additional freeboard. This gives added assurance that the proposed mitigation measures are more than adequate to deal with any future flood risk. Designated internal roads will be elevated to ensure free access and egress even during an extreme event. No specific residual risks have been identified that would necessitate a flood evacuation plan for the site.</p>

FLOOD RISK ASSESSMENT

<p>provisions for emergency services access</p>	<p>It is therefore considered that Point 2 (iii) of the Justification Test has been met.</p>
<p>(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</p>	<p>The flood mitigation measures proposed do not materially impact upon the desired layout, orientation or approach to the proposed development. It is considered that the proposed development is compatible with the wider planning objectives in relation to development of good design and planning for the area, and is compliant with the Limerick City Development Plan 2010-2016 (as extended).</p> <p>It is therefore considered that Point 2 (iv) of the Justification Test has been met.</p>

7 CONCLUSION

7.1 Summary of FRA

RPS were commissioned to carry out a Flood Risk Assessment (FRA) in support of a strategic housing development (SHD) for Greenpark, Limerick. The purpose of this assessment is to ensure that the proposed development takes cognisance of the existing flood risk and does not result in increased flood risk elsewhere. This report has been prepared in accordance with the requirements of 'The Planning System and Flood Risk Management' Guidelines (DEHLG 2009).

The River Shannon flows at a distance to the north of the site and a small tributary, the Ballynaclogh River, flows to the west of the site. Both of these rivers can be considered to be tidal at this location. There are flood embankments along both the River Shannon and the Ballynaclogh River.

As part of the Shannon Catchment Flood Risk Assessment and Management (CFRAM) Study, Limerick was identified as an Area for Further Assessment (AFA). This meant that the watercourses in the area were modelled and flood maps produced which can be used to establish the existing flood risk at a site. The CFRAMS maps indicate that the 0.5% AEP flood event does not reach the application site. This is because of the protection afforded by the existing flood defences constructed under the 1945 Arterial Drainage Act.

Following the sequential approach as set out in 'The Planning System and Flood Risk Management Guidelines' the effects of any existing defences must be ignored when establishing flood zoning. Using this approach, a large area of the SHD site is considered at low risk and in Flood Zone C. However areas of the site are in Flood Zone A, with a very small section of the land being contained within Flood Zone B. Applying the sequential approach set out in 'The Planning System and Flood Risk Management Guidelines' requires a Development Management Justification Test to be carried for a residential development within Flood Zones A and B.

The Greenpark Lands have been zoned for General Mixed Use, Neighbourhood Centre and Residential uses since 2010 as per the Limerick City Development Plan 2010-2016, which was adopted with the benefit of the application of the provisions of 'The Planning System and Flood Risk Management Guidelines'. The Development Plan Justification Test must have been applied and passed in order for the General Mixed Use, Neighbourhood Centre and Residential uses zonings to be established for the Greenpark Lands. Given that the Development Plan Justification Test has been applied there is only a need to comply with the Development Management Justification Test as part of this application.

In accordance with Paragraph 5.16 of the Guidelines, a precautionary approach to development behind existing defences is to raise the finished levels to at least the 1% fluvial or 0.5% AEP coastal flood level. This approach has been adopted for the SHD area. The SHD site will be filled to ensure all roads will be

built up to approximately 5.0m OD, and then all FFLs will be constructed to a minimum of 5.3m OD. This provides over 1m freeboard to all new properties above the 0.5% AEP breach flood level, thus providing a very high standard of protection.

Modelling of the impact of raising the proposed development was then undertaken considering both the 0.5% AEP and 0.5% AEP climate change (MRFS) flood events when a breach of the defences occurs. The modelling shows that there was no identified increase in risk to existing development as a result of the proposed SHD site raising, either in the present day or climate change scenarios.

A nursing home is proposed adjacent to the SHD site. This is a separate planning application, however this FRA has included an assessment of the cumulative impact of both developments. The nursing home site will be filled to FFL of 6.3m OD. Breach analysis has confirmed that there is no increase in flood risk to existing developments with both the nursing home and SHD sites raised, either in the present day or climate change scenarios.

A new surface water sewer network shall be provided for the proposed development which will be entirely separate from the foul water sewer network. Each unit will have its own independent connection to the surface water sewer network. Surface water run-off from roof areas and hardstanding areas are designed to be collected by a gravity pipe network. Surface water will be collected and discharged via a mixture of traditional and Sustainable urban Drainage System (SuDS) to the existing 1350mm/ 1500mm diameter surface water sewer. This sewer discharges the existing lagoon adjacent to the Ballynaclogh River. Both the pipe and the lagoon were designed to take into account future developments. The lagoon attenuates flows to Greenfield discharge rate and discharges to the Ballynaclogh River through the use of a penstock structure. SuDS measures include green roofs, tree pit systems, permeable surfacing, infiltration trenches, swales, rain gardens and attenuation tanks.

Based on the proposed mitigation measures, consideration of the designated zoning and the proposed urban design, each of criteria in the Development Management Justification Test was shown to be satisfied. Therefore it was concluded that the proposed development complies with the requirements of the Development Management Justification Test and hence is compliant with 'The Planning System and Flood Risk Management Guidelines'.

7.2 Key Aspects of the Flood Mitigation Measures

The following are the key aspects of the mitigation measures proposed within this Flood Risk Assessment and demonstrate a robust and sustainable approach to developing the SHD site:

1. There is no reliance on the existing OPW maintained flood defences to provide any level of protection to the SHD area;

2. The proposed SHD mitigation measures are sustainable and have been developed with climate change and predicted sea level rise being fully considered. This will ensure that Limerick City and County Council will not be required to provide additional flood defence infrastructure in the future to protect the SHD site;
3. The entire SHD site will remain free from flooding during a 0.5% AEP Mid-Range Future Scenario event where overtopping of the existing defences occurs;
4. All buildings and key internal roads will be protected during a 0.5% AEP Mid-range Future Scenario event, even when a breach of the existing defences has also occurred. A total freeboard of 1m has been applied in this regard. This is a very high standard of defence.
5. It has been robustly demonstrated that there is **no increase** in flood risk, even during a breach event, to surrounding existing developments as a result of the proposed development;
6. A clear access and egress route for emergency vehicles can be provided to the SHD site through Log na gCapall and Greenpark Avenue, even during a breach event;
7. All storm drainage will be attenuated to existing run off rates and therefore will not cause capacity issues on the existing network or raise the increase of flooding elsewhere.

Appendix A

Site location map

NOTES

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Legend: Wayleaves

- Planning Application Boundary 105.105m2 (10.5Ha)
- Lands under ownership of applicant
- Rights-of-way easements
- (A) Foul Sewer Pipe Wayleave
- (B) Surface Water Pipe Wayleave
- (C) 7m wide OPW Right-of-Way to flood embankment
- (D) Surface Water Pipe Route as per 1998
- Deeds
- Surface Water Pipe Route as per 2002
- Deeds
- The new roadway as described in the Deed of Conveyance dated 18/07/2001
- Storm Sewer Wayleave
- LRC Signage Area
- Shared carpark
- Limerick City Council Drainage Wayleave

Legend: Services

- ESB LV 10 KV Underground
- ESB MV 10-20 KV Overhead
- ESB 38 KV Underground
- MPP Storm Sewer (Surveyed)
- Water main
- IW Foul - ss Gravity Main
- MPP Foul Sewer

NO.	DATE	BY	REVISION
1	18/07/2001	REDDY ARCHITECTURE+URBANISM	ISSUE
2	18/07/2001	REDDY ARCHITECTURE+URBANISM	ISSUE

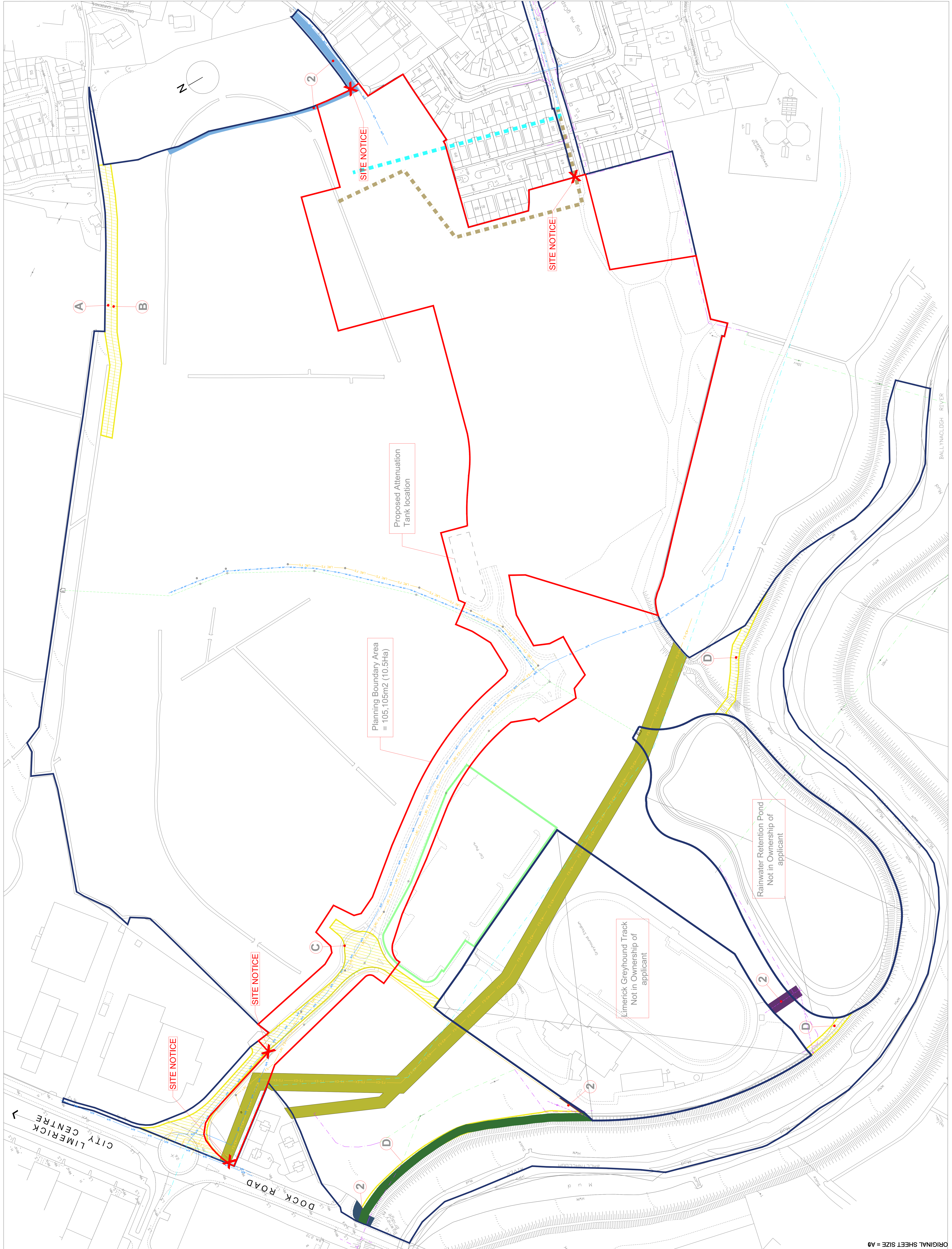
reddy architecture+urbanism

1000 Wellington Road, Dublin 4
 T: +353 (0)1 493 8200
 E: info@reddyarch.com

PLANNING APPLICATION

JOB: Greenpark SHD Limerick City Council
 Client: Voyage Property Limited
 Site: Ashbourne Hall, Dock Rd, Limerick
 Drawing: Site Location Plan

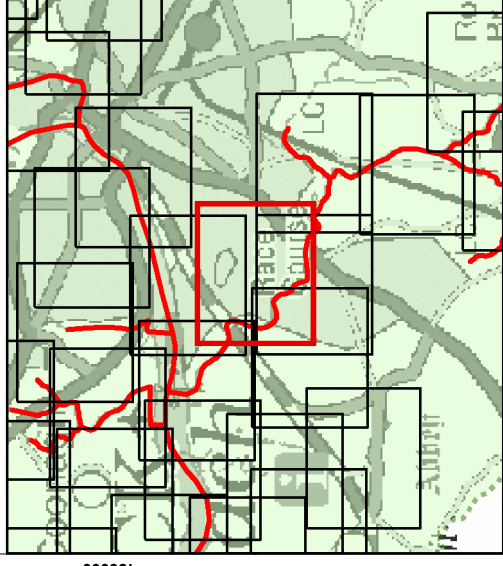
STATUS: 352 JOB NO: P001330
 DATE: 18/07/21 SCALE: 1:1000 @ A0
 DRAWN: J. Brown CHECKED: J. Kennedy
 DESIGNED: J. Kennedy APPROVED: J. Kennedy
 20133-RAU-ZZZZ-UR-A02-1000-B



Appendix B

Flood Maps from Shannon CFRAM Study

Location Plan:



Legend:

- Nodes
- Model Reach
- AFA Boundary
- Flood Defence: Wall
- Flood Defence: Embankment
- Defended Area

10% AEP Fluvial Flood Extent

(1 in 10 chance in any given year)

1% AEP Fluvial Flood Extent

(1 in 100 chance in any given year)

0.1% AEP Fluvial Flood Extent

(1 in 1000 chance in any given year)

IMPORTANT USER NOTE:
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The Office of Public Works
 Jonathan Swift Street
 Trim
 Co. Meath
 C15 NX36



Merrion House
 Merrion Road
 Dublin 4
 D04 R2C5

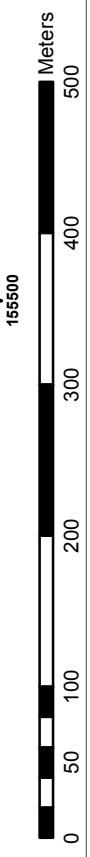
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Map Type:	EXTENT
Source:	FLUVIAL
Area:	LIMERICK

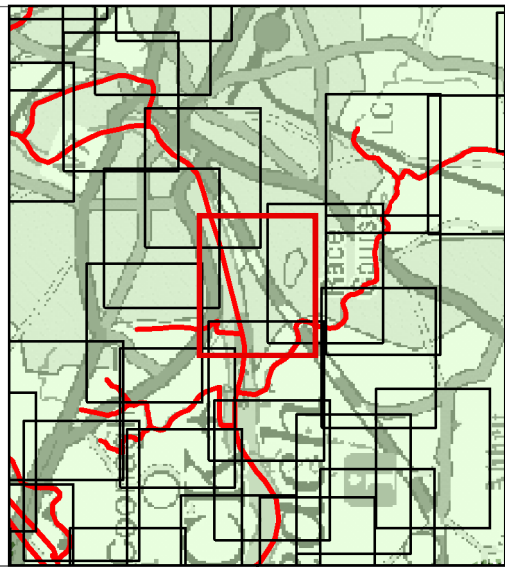
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Drawn by:	EH	Date:	June 2016
Checked by:	KM	Date:	June 2016
Reviewed by:	MC	Date:	June 2016
Approved by:	PS	Date:	June 2016
Map No.:	S2526LIK_EXFCD_F1_65		

Sheet:	65 of 65	Revision:	0
Map Scale:	1: 5000	Plot Scale:	1:1 @ A3



Shannon (River)





Legend:

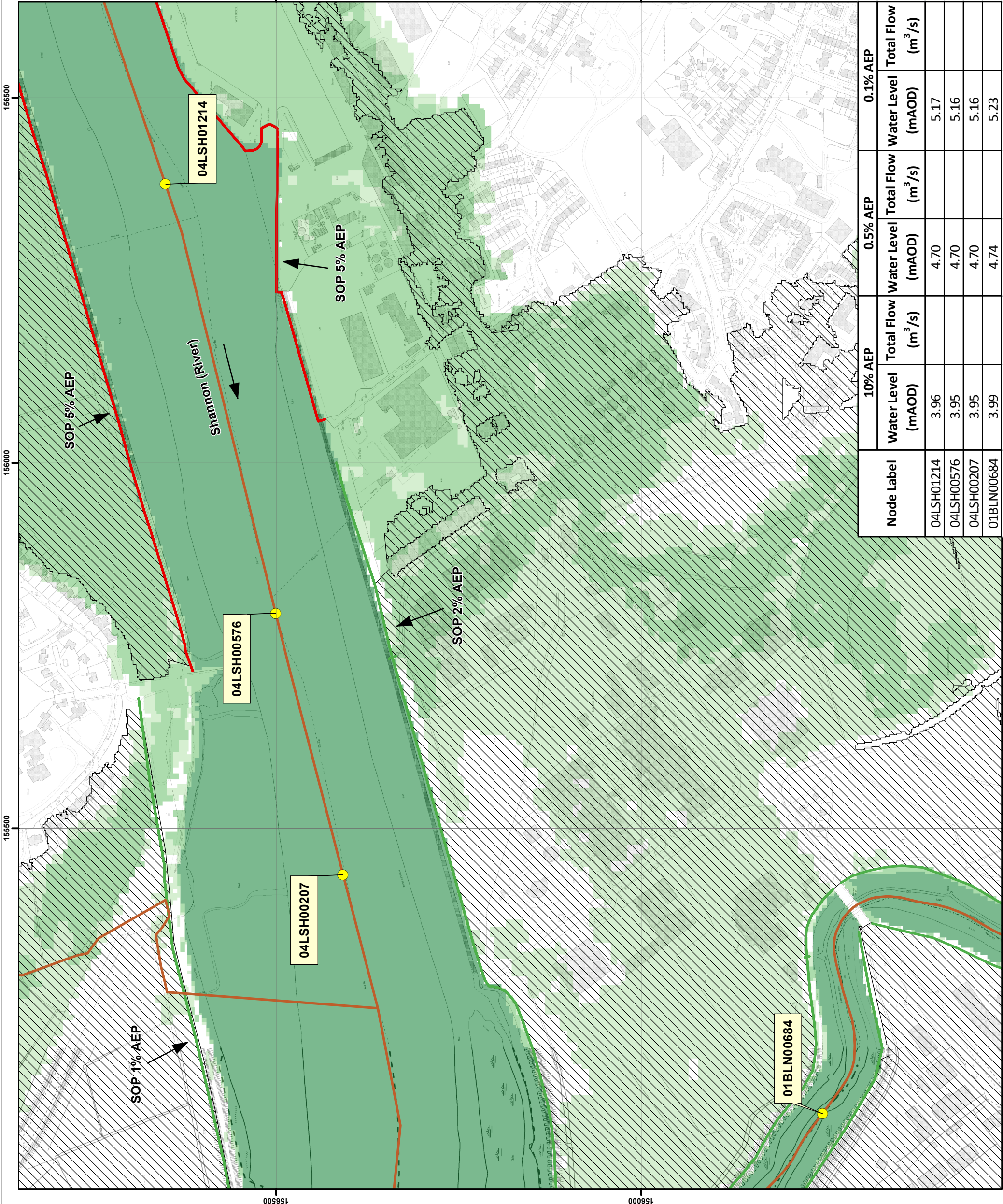
- Nodes
- Model Reach
- AFA Boundary
- Flood Defence: Wall
- Flood Defence: Embankment
- ▨ Defended Area
- 10% AEP Coastal Flood Extent**
(1 in 10 chance in any given year)
- 0.5% AEP Coastal Flood Extent**
(1 in 200 chance in any given year)
- 0.1% AEP Coastal Flood Extent**
(1 in 1000 chance in any given year)

IMPORTANT USER NOTE:
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Merrion Road
Dublin 4
D04 R2C5

Project:	SHANNON CFRAM STUDY
Map Type:	EXTENT
Source:	COASTAL - TIDAL
Area:	LIMERICK
Scenario:	EXISTING
Drawn by:	EH Date: June 2016
Checked by:	KM Date: June 2016
Reviewed by:	MC Date: June 2016
Approved by:	PS Date: June 2016
Map No.:	S2526LIK_EXCCD_F1_26
Sheet: 26 of 65	Revision: 0
Map Scale: 1: 5000	Plot Scale: 1:1 @ A3



Node Label	10% AEP		0.5% AEP		0.1% AEP	
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04LSH01214	3.96		4.70		5.17	
04LSH00576	3.95		4.70		5.16	
04LSH00207	3.95		4.70		5.16	
01BLN00684	3.99		4.74		5.23	

155500

156000

156500

156500

155500

156000

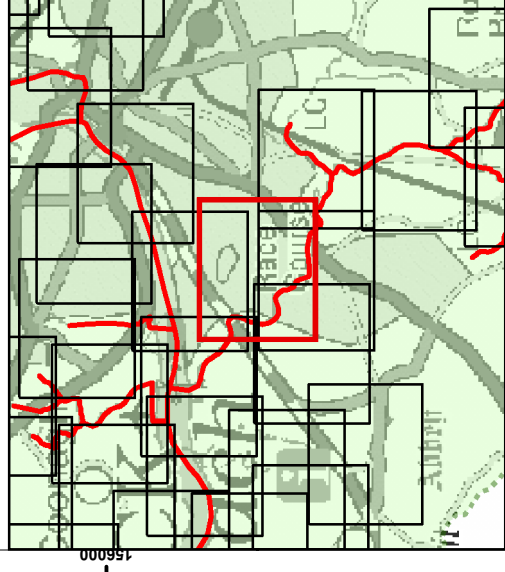
155500

156000

156500

156500





Legend:

- Nodes
- Model Reach
- AFA Boundary
- Flood Defence: Wall
- Flood Defence: Embankment
- Defended Area
- 10% AEP Coastal Flood Extent**
(1 in 10 chance in any given year)
- 0.5% AEP Coastal Flood Extent**
(1 in 200 chance in any given year)
- 0.1% AEP Coastal Flood Extent**
(1 in 1000 chance in any given year)

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Dublin 4
D04 R2C5

Project:	SHANNON CFAM STUDY
Map Type:	EXTENT
Source:	COASTAL - TIDAL
Area:	LIMERICK
Scenario:	EXISTING
Drawn by:	EH
Checked by:	KM
Reviewed by:	MC
Approved by:	PS
Map No.:	S2526LIK_EXCCD_F1_65
Sheet: 65 of 65	Revision: 0
Map Scale: 1: 5000	Plot Scale: 1:1 @ A3

Node Label	10% AEP		0.5% AEP		0.1% AEP	
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01BLN02058	4.07		4.87		5.16	
01BLN01813	4.06		4.87		5.15	
01BLN01486	4.04		4.86		5.15	
01BLN01400	4.03		4.86		5.16	
01BLN01210	4.02		4.85		5.16	

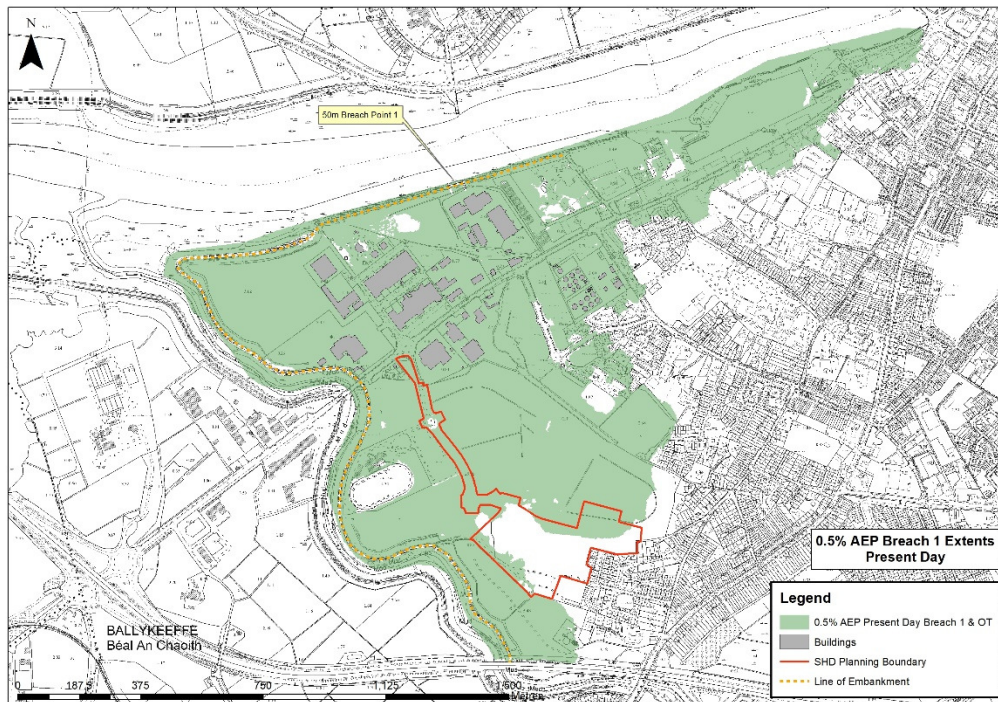


Appendix C

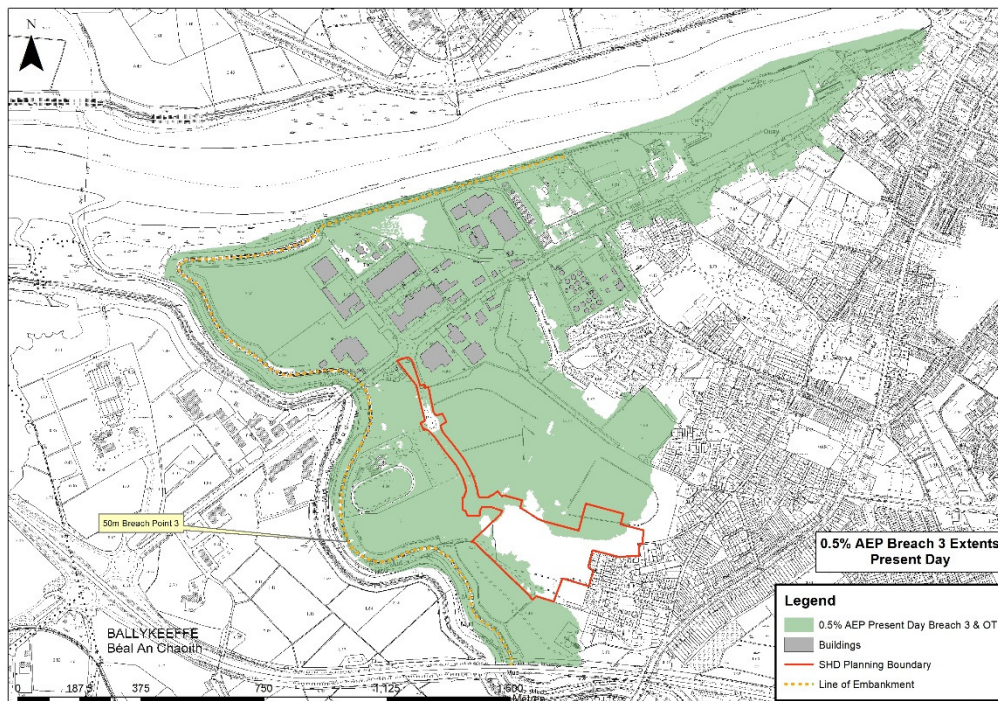
Proposed site layout

Appendix D

Breach modelling results- existing levels, present day scenario



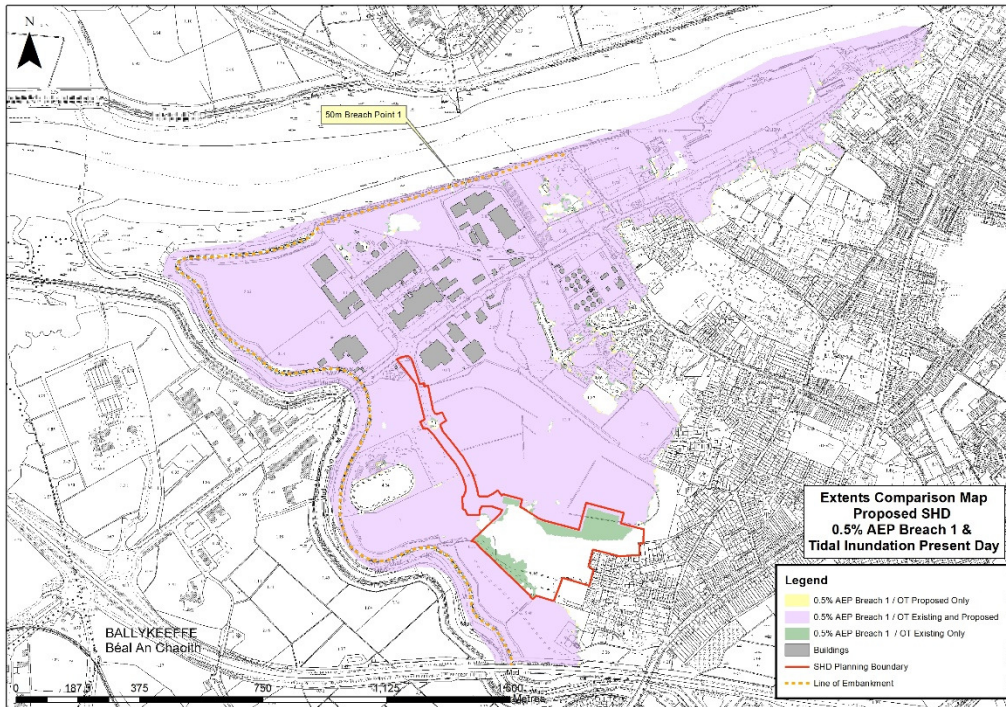
Breach Location 1- 0.5% AEP event with existing ground levels



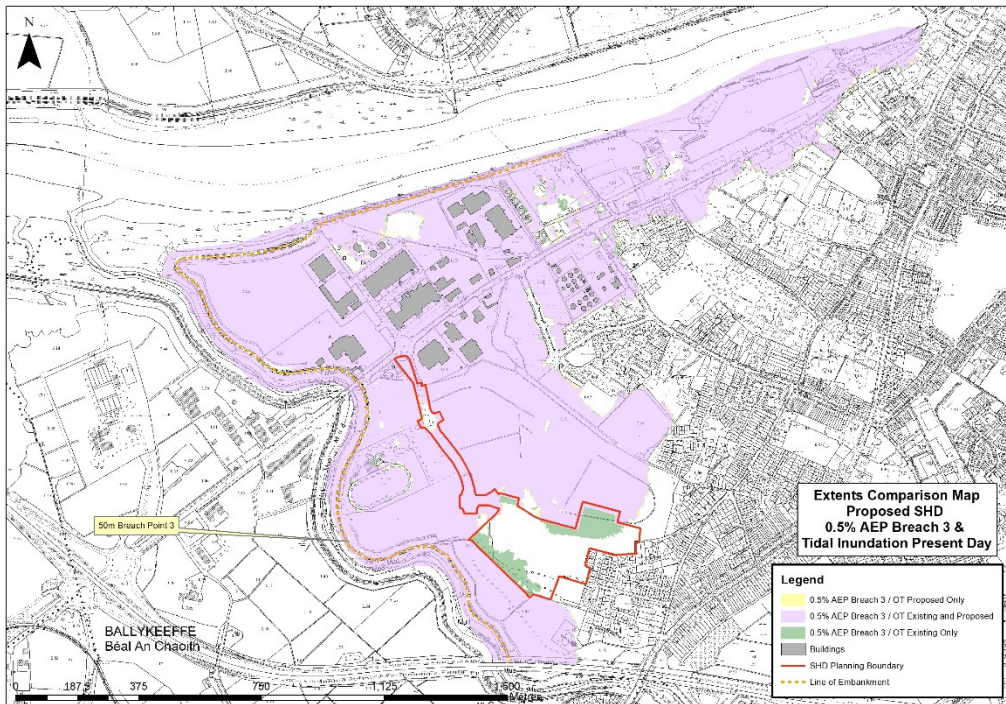
Breach Location 3- 0.5% AEP event with existing ground levels

Appendix E

Breach modelling results- site raised, present day scenario



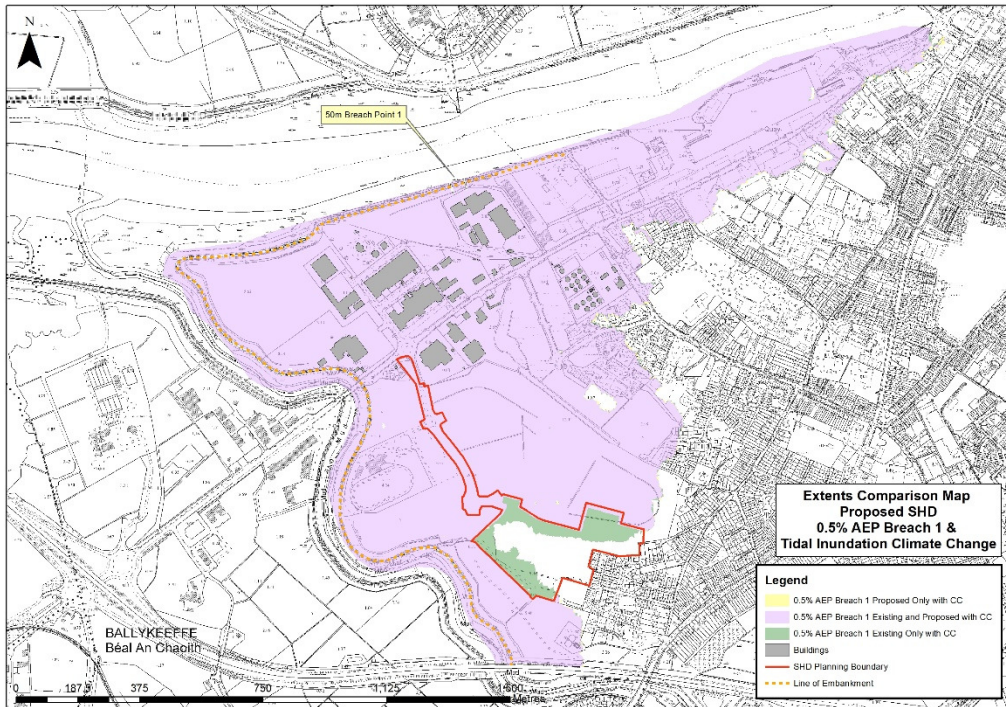
Breach Location 1- Impact of raising proposed development lands (Present day)



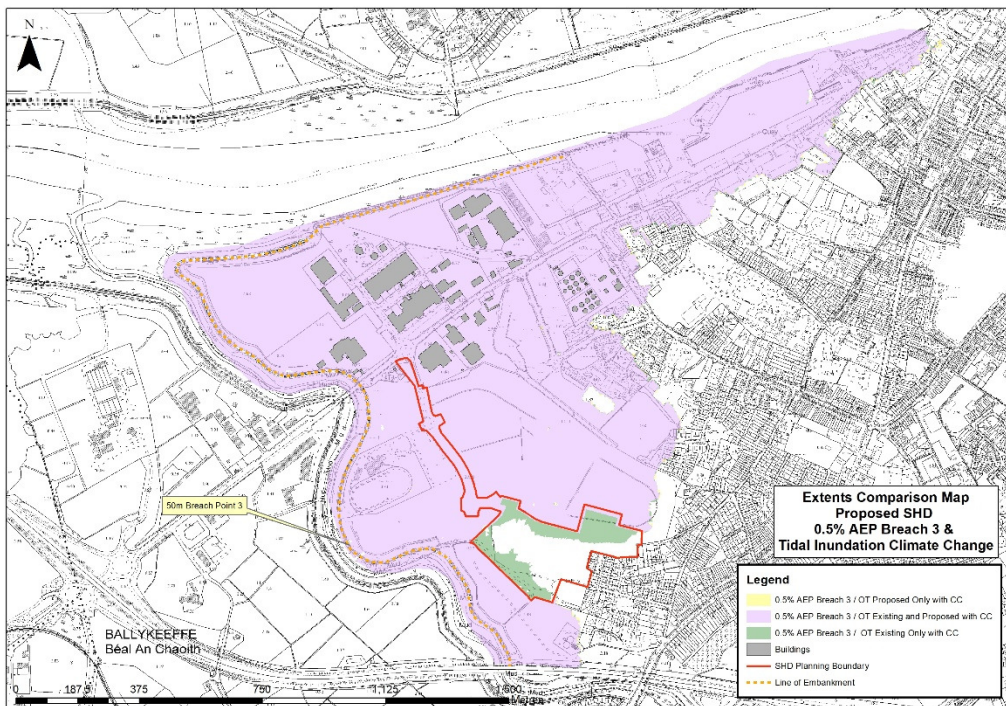
Breach Location 3- Impact of raising proposed development lands (Present day)

Appendix F

Breach modelling results- site raised, climate change scenario



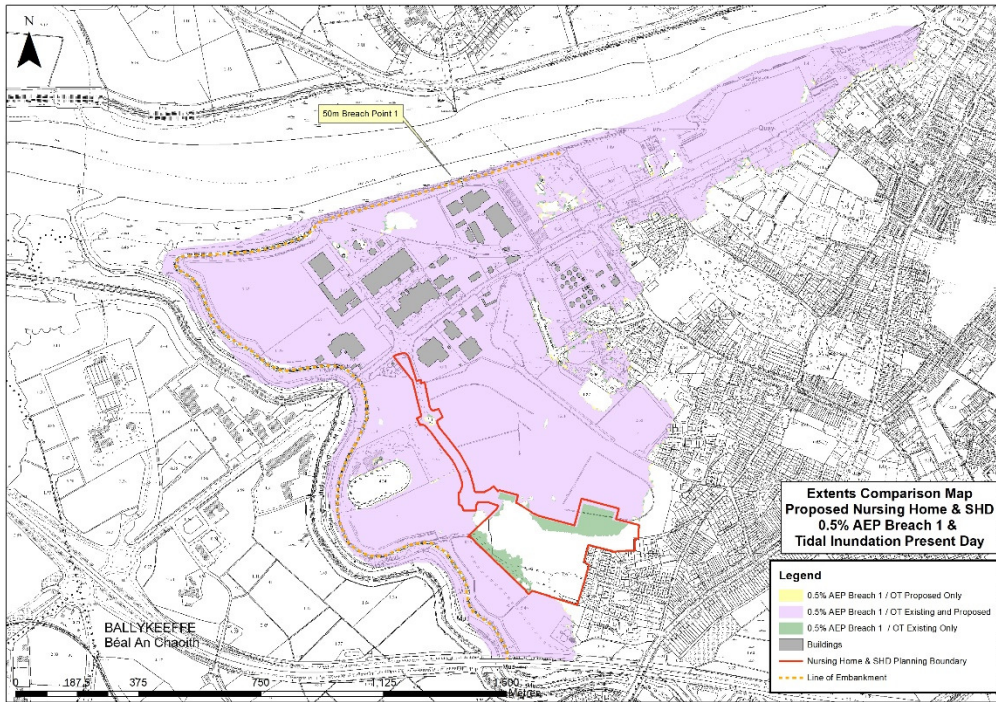
Breach Location 1- Impact of raising proposed development lands (Climate change)



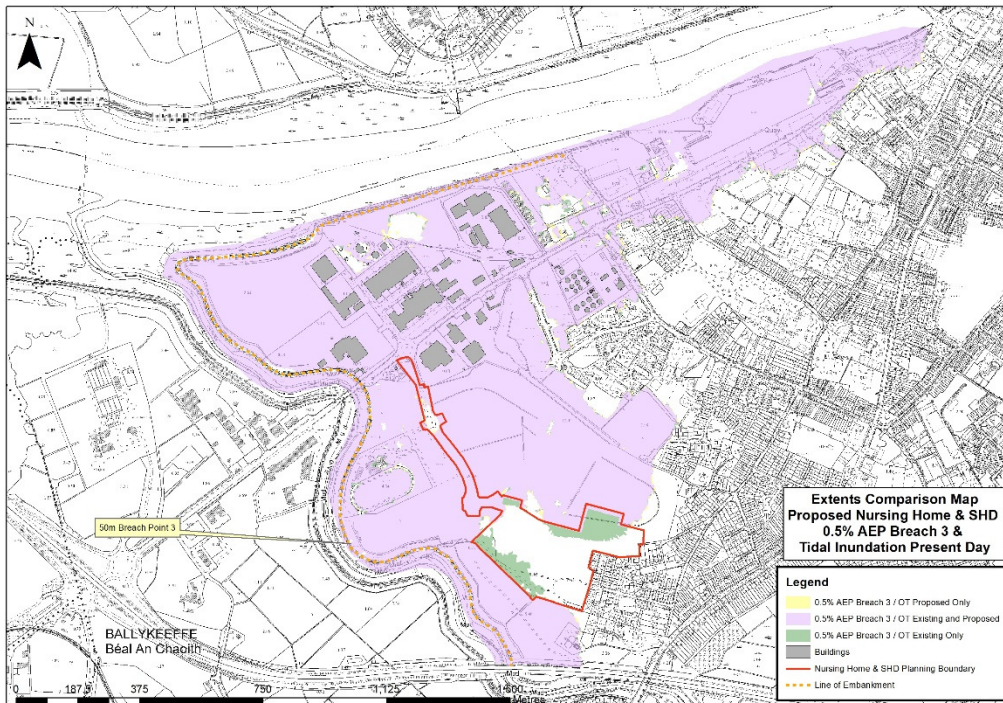
Breach Location 3- Impact of raising proposed development lands (Climate change)

Appendix G

Breach modelling results- Nursing Home & SHD sites raised, present day scenario



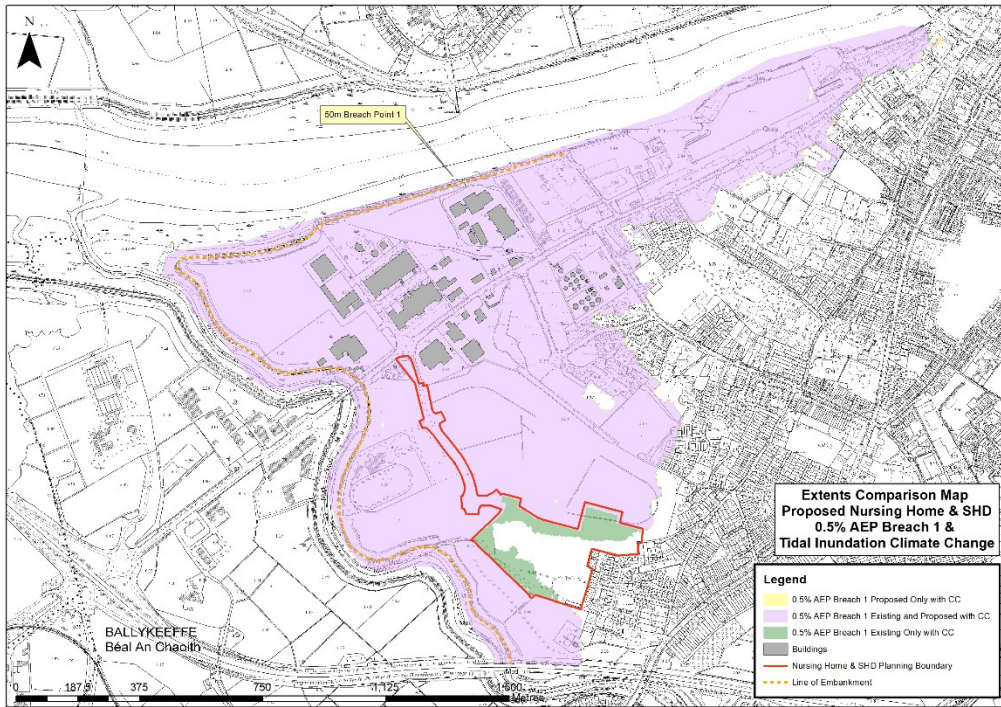
Breach Location 1- Impact of raising nursing home & SHD sites (Present day)



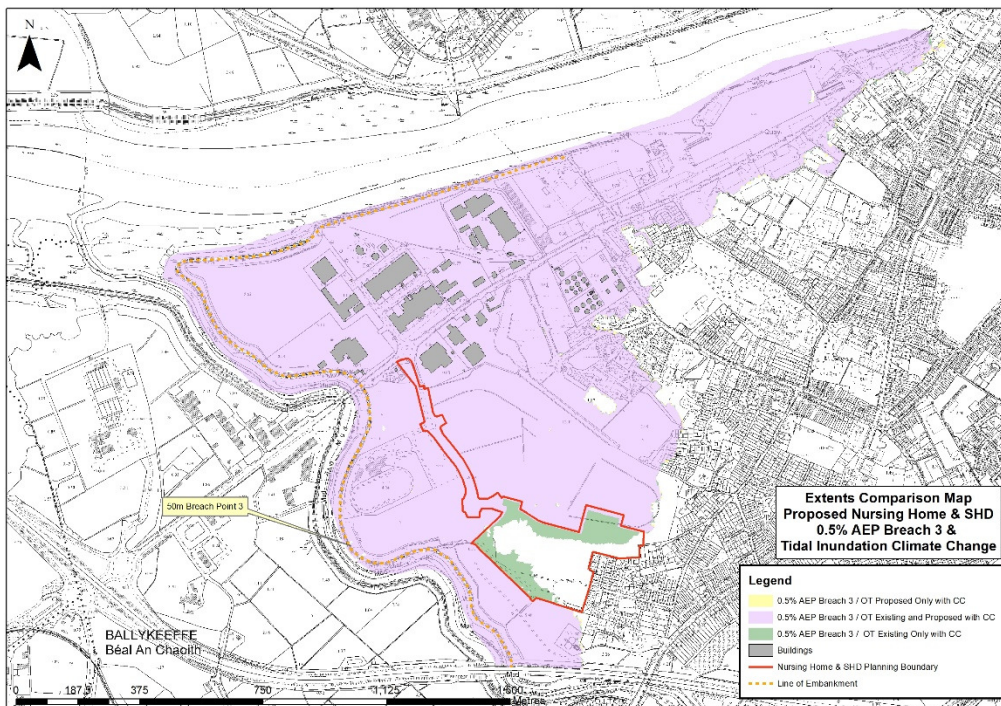
Breach Location 3- Impact of raising nursing home & SHD sites (Present day)

Appendix H

Breach modelling results- Nursing Home & SHD sites raised, climate change scenario



Breach Location 1- Impact of raising nursing home & SHD sites (Climate change)



Breach Location 3- Impact of raising nursing home & SHD sites (Climate change)