Flynn’s Field Flood Risk Assessment

Project No: 32106500
Document Title: Flynn’s Field Flood Risk & Drainage Assessment
Document No.: 
Date: November 2018
Client Name: Leitrim County Council

Jacobs Engineering Ireland Ltd
Merrion House
Merrion Road
Dublin
Ireland
T +353 1 269 5666
F +353 1 269 5497
www.jacobs.com

© Copyright 2017 Jacobs Engineering Ireland Limited. The concepts and information contained in this document are the property of Jacobs. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright.

Limitation: This report has been prepared on behalf of, and for the exclusive use of JacobsTobin’s Client, and is subject to, and issued in accordance with, the provisions of the contract between JacobsTobin and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Document history and status

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
<th>By</th>
<th>Review</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26/11/18</td>
<td>Client Issue</td>
<td>JM</td>
<td>JH/NS</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Contents

1. Introduction & Background ................................................................................................................. 1
  1.1 Project Background ......................................................................................................................... 1
  1.2 Works Description ............................................................................................................................ 2
  1.3 Report Structure ............................................................................................................................... 2
2. Flood Risk Assessment Methodology ................................................................................................. 3
3. Stage 1: Flood Risk Identification ..................................................................................................... 4
  3.1 General ........................................................................................................................................... 4
  3.2 Flood History .................................................................................................................................. 4
  3.2.1 Office of Public Works (OPW) National Flood Hazard Mapping .................................................. 4
  3.2.2 Local Reports ............................................................................................................................. 4
  3.3 Flood Mapping ............................................................................................................................... 5
  3.3.1 OPW PFRA Mapping .................................................................................................................... 5
  3.3.2 OPW Shannon CFRAM Study – Carrick-on-Shannon Flood Risk Review Report .......................... 6
  3.3.3 Other Flood Risk Maps ............................................................................................................... 7
3.4 Stage 1 Assessment Conclusions ..................................................................................................... 7
4. Stage 2: Initial Flood Risk Assessment ............................................................................................... 8
  4.1 Potential Sources of Flooding ........................................................................................................... 8
  4.2 Fluvial Flood Risk ............................................................................................................................ 8
  4.3 Pluvial Flood Risk ........................................................................................................................... 8
  4.4 Artificial Drainage Systems ............................................................................................................. 9
  4.5 Groundwater Flood Risk ................................................................................................................ 10
  4.6 Flood Risk due to Climate Change .................................................................................................. 11
  4.7 Summary of Flood Risk .................................................................................................................. 12
5. Potential Flood Risk Impacts from the Proposed Works .................................................................... 13
  5.1 Impacts on Coastal & Estuarine Flooding ......................................................................................... 13
  5.2 Impacts on Fluvial Flooding ............................................................................................................ 13
  5.3 Impacts on Pluvial Flooding ............................................................................................................ 13
  5.4 Impacts on Flooding from Artificial Drainage Systems .................................................................... 15
  5.5 Impacts on Groundwater Flooding .................................................................................................. 15
  5.6 Summary of Potential Flood Risk Impacts from the Upgrade Works ............................................... 16
6. Flood Risk Management and Evaluation ......................................................................................... 17
  6.1 The Sequential Approach to Development Planning ....................................................................... 17
7. Conclusions and Recommendations ................................................................................................. 19
  7.1 Conclusions ..................................................................................................................................... 19
  7.2 Recommendations ......................................................................................................................... 19

Appendix A. Information Sources Checklist
Appendix B. OPW Preliminary Flood Risk Assessment Mapping
Appendix C. OPW North Eastern – Neagh Bann CFRAM Study Flood Risk Mapping
1. Introduction & Background

1.1 Project Background

Leitrim County Council (CC) have applied to the Department of Housing, Planning and Local Government for funding under the Urban Regeneration and Development Fund for a public realm project in Carrick-on-Shannon, Co Leitrim. As part of the proposal, Leitrim CC are planning to develop the site immediately to the north of the Primary Care Centre, known as Flynn’s Field, for a public car park. Further details of the proposed development are provided in Figure 1.1 below (see also Appendix B1).

This report describes a flood risk assessment that has been prepared in accordance with Section 28 of the Planning and Development Act 2000 and the Guidelines on the Planning System and Flood Risk Management, 2009 (also referred to as the FRM Guidelines) to consider the proposed car park development on Flynn’s Field. In accordance with these requirements, the report considers the flood risk to the proposed works and arising from the proposed works. Mitigation measures, which will form part of the development, to ensure no increase in flood risk are also outlined.

With respect to mitigation measures, a key element of this Flood Risk Assessment is to determine the runoff attenuation requirements for the proposed car park. In accordance with Leitrim CC’s requirements, a high-level design is provided to demonstrate that, based on the surface area of the carpark and circulation space, there will be no increase in surface water runoff as a consequence of the works.
1.2 Works Description

The proposed works comprise construction of a new car park on Flynn’s Field covering an area of approximately 4,400m².

Presently, the site appears to be formed of granular made ground. The works comprise construction of an Asphalt Concrete surfaced car park with 105 No. spaces and associated soft landscaping. The new car park will be raised by around 1.2m from the existing ground levels to tie in to the existing ground level of the adjacent Primary Care Centre, which is located to the south of the site.

Construction of the new car park will result in the creation of approximately 4,440m² of paved impermeable surface. The proposed development also includes the indicative design of a new runoff attenuation tank to maintain existing runoff rates from the site. Flows from the drainage network will discharge to a local storm sewer.

A layout for the proposed works is provided in Appendix B1.

1.3 Report Structure

The flood risk assessment is structured as follows:

- Chapter 2 sets out the Flood Risk Assessment Methodology.
- Chapter 3 outlines the findings of the Stage 1 Flood Risk Assessment.
- Chapter 4 presents the findings of the Stage 2 Flood Risk Assessment for the Flynn’s Field site.
- Chapter 5 details the potential flood risk implications arising from the car park works and the proposed mitigation measures.
- Chapter 6 considers the proposed car park works in accordance with the requirement for a ‘Justification Test’.
- Chapter 7 presents the conclusions.
2. Flood Risk Assessment Methodology

The document *Planning System and Flood Risk Management: Guidelines for Planning Authorities* outlines the key principles that should be used to assess flood risk to proposed development sites. It recommends that a staged approach should be used:

- **Stage 1: Flood risk identification** – to identify whether there may be any flooding or surface water management issues relating to the proposed development site that warrant further investigation.

- **Stage 2: Initial flood risk assessment** – to confirm the sources of flooding that may affect the proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of existing studies to assess flood risk and to assist with the development of FRM measures.

- **Stage 3: Detailed flood risk assessment** – to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impacts on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model across a wide enough area to appreciate the catchment wide impacts and hydrological process involved.

This report represents a **Flood Risk Identification (Stage 1 Assessment)** and **Initial Flood Risk Assessment (Stage 2 Assessment)** and provides an overview of the potential flood risks to the proposed site and assesses the potential impact of the proposed development. In addition, it proposes mitigation principles that should be pursued as the design is progressed.

A Stage 3 Assessment is not proposed, as the results from the Stage 1 and 2 Assessments, as outlined in this report, indicate that a Stage 3 Assessment is not required.
3. Stage 1: Flood Risk Identification

3.1 General

The available flood risk information for the site is listed in Appendix A. As part of the Stage 1: Flood Risk Identification Assessment, this information was reviewed to identify whether there was any flooding or surface water management issues relating to the site, that warranted further investigation. For reference, the reader is advised that the term “site”, where used herein, refers to the footprint of the proposed car park and associated landscaping as indicated in Figure 1.1.

3.2 Flood History

The aim of this section is to outline the flood history of the site. The main historical flood events in the area were identified, assessed and are described below.

3.2.1 Office of Public Works (OPW) National Flood Hazard Mapping

The OPW National Flood Hazard Mapping (www.floodmaps.ie) reports two historic records of flooding affecting Carrick-on-Shannon and are outlined in Table 3.1 below. Neither flood is explicitly reported as affecting the proposed site.

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Date of Flood Event</th>
<th>Address</th>
<th>Description of Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18 November 2009</td>
<td>Carrick on Shannon</td>
<td>Town experienced extensive flooding</td>
</tr>
<tr>
<td>2</td>
<td>30 November 1999</td>
<td>Carrick on Shannon</td>
<td>Severe flooding to town due to heavy rainfall</td>
</tr>
</tbody>
</table>

Table 3.1: Flood events recorded within the area from the OPW Flood Hazard Mapping Report

3.2.2 Local Reports

The following newspaper articles describe flooding which occurred on, or adjacent to, the site during 2009 and 2015.

- An article from The Irish Times, dated 16th December 2015, describes a flood event in Carrick-on-Shannon in 2015 and states that the car park of the back of the Bush Hotel, which is north east of the site, was flooded. Reference: http://www.irishtimes.com/news/environment/carrick-on-shannon-coping-with-second-major-flood-in-six-years-1.2467594


- The Irish Independent newspaper published a report on 9th December 2015 which contains a photograph showing the flooding at the Flynn’s Field site in the 2015 flood event. Reference: http://www.independent.ie/irish-news/flooding-not-set-to-peak-until-sunday-and-threat-will-remain-next-weeknational-emergency-meeting-34272118.html

The 2009 and 2015 events were both associated with significant flow flows in the River Shannon. It is understood that flooding of the site was not caused by the river overtopping its banks, but was more likely to have occurred as a result of groundwater associated with high water levels in the Shannon and/or inundation from Shannon backing-up the storm sewer network, which passes beneath the site.
3.3 Flood Mapping

3.3.1 OPW PFRA Mapping

The OPW Preliminary Flood Risk Assessment (PFRA) considered all types of flooding, including natural sources such as rivers, the sea and estuaries, pluvial and groundwater, and the failure of built infrastructure. The PFRA map is presented in Figure 3.1 below, and Appendix B2, and shows that there is a risk of fluvial flooding near to the site. Fluvial flooding indicated on this mapping has not been used as this OPW PFRA Mapping has been superseded by the more detailed CFRAM mapping, which is referred to in Section 3.3.2 of this report.

The PFRA map does not indicate any risk of pluvial or groundwater flooding directly affecting the site.

Figure 3.1: OPW PFRA Map
3.3.2 OPW Shannon CFRAM Study – Carrick-on-Shannon Flood Risk Review Report

Flood risk along the River Shannon was assessed as part of the OPW Catchment Flood Risk Assessment and Management (CFRAM) Study. The predicted flood extents for the River Shannon in Carrick-on-Shannon are presented in Figure 3.2 below, and Appendix B3, and show that the Flynn’s Field site is located within an area at risk of flooding in a 0.1% Annual Exceedance Probability (AEP) (1 in 1000 year) fluvial event. The site is not at risk from flooding for the 1% AEP (1 in 100) fluvial event.

Figure 3.2: CFRAM FRA Map

Proposed Car Park on Flynn’s Field is within the 0.1% AEP (1 in 1000) flood extent
3.3.3 Other Flood Risk Maps

The OSI Historic 6” map is shown in Figure 3.3 and indicates that the site is located on land that is historically liable to flooding.

![OSI Historic 6” map](image)

**Figure 3.3: OSI Historic 6” map**

3.4 Stage 1 Assessment Conclusions

This Stage 1 Flood Risk Assessment has assessed the flood risk to a site that is being considered for works in Carrick-on-Shannon to develop a new carpark.

From the information obtained it can be concluded that the site is at risk of fluvial flooding from the River Shannon. The proposed development is located within the 0.1% AEP flood extent as seen in the CFRAM study. Historical flooding suggests that the risk could however be more frequent with flooding report in both 2009 and 2015.

Stage 2 of this report provides examination of all sources of flooding that may affect the proposed development.
4. Stage 2: Initial Flood Risk Assessment

This section assesses the risk of flooding to the site once the works have been completed from a range of different sources, which is then used to develop a broad understanding of the risk characteristics to the proposed works.

4.1 Potential Sources of Flooding

The potential sources of flooding are as follows:

- **Coastal** - flooding from the sea;
- **Fluvial** - flooding from rivers and watercourses;
- **Estuarine** - flooding from a combination of fluvial and coastal;
- **Pluvial** - flooding that is caused by runoff during high rainfall events;
- **Artificial Drainage Systems** - flooding that occurs as a result of surcharging or blocking of drainage networks;
- **Groundwater** - flooding when water normally stored below the ground rises above surface level or into underground spaces (such as basements).

Due to its inland location and elevation at around 43mOD, it can be concluded that the site is not at risk from flooding from Coastal or Estuarine sources. Flood risk from these two sources is therefore not considered any further in this assessment. The remaining sources of fluvial, pluvial, flooding from artificial drainage systems and groundwater are discussed in more detail below.

4.2 Fluvial Flood Risk

As discussed in Section 3.2, the CFRAM flood risk maps indicate that the existing site is at risk of flooding from fluvial sources in the 0.1% AEP event. Table 4.1 compares peak flood levels from the CFRAM study against the existing and proposed ground levels for the site.

<table>
<thead>
<tr>
<th>AEP Event</th>
<th>River Shannon Flood Level (mOD)</th>
<th>Existing Site Level (mOD)</th>
<th>Difference between Flood Level and Existing Site Level (m)</th>
<th>Proposed Minimum Site Level (mOD)</th>
<th>Difference between Flood Level and Proposed Site Level (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% (1 in 10)</td>
<td>41.74</td>
<td>41.6</td>
<td>-0.14</td>
<td>43.1</td>
<td>+1.36</td>
</tr>
<tr>
<td>1% (1 in 100)</td>
<td>42.31</td>
<td></td>
<td>-0.71</td>
<td>43.1</td>
<td>+0.79</td>
</tr>
<tr>
<td>0.1% (1 in 1000)</td>
<td>42.86</td>
<td></td>
<td>-1.26</td>
<td>43.1</td>
<td>+0.24</td>
</tr>
</tbody>
</table>

*Table 4.1: River Shannon Flood Level vs Existing and Proposed Site Levels

Note – a positive difference denotes that the ground level is higher than the flood level*

The proposed works will elevate the site to a new minimum level of 43.1m OD, which is a minimum of 0.8m above the 1% AEP flood level and 0.24m above the 0.1% AEP flood level. The risk of fluvial flooding to the proposed car park once the works are complete will therefore be low.

4.3 Pluvial Flood Risk

Pluvial flooding occurs during periods of heavy rainfall, when the rainfall rate is greater than the infiltration capacity. It is usually associated with high intensity rainfall events (typically > 30mm/h) resulting in overland flow and ponding in depressions in the topography. In urban situations underground sewerage/drainage systems and surface watercourses may be completely overwhelmed.

Vector mapping and LiDAR have been used in conjunction with each other to identify the topography of the site.
and the surrounding lands. Figure 4.1 below shows that the site is low lying in relation to the surrounding topography. This means that the potential for overland flow from surrounding land flowing onto the proposed development, and ponding on the site, is high.

Figure 4.1: Existing Ground Profile

The proposed works will elevate the car park above the existing level by some 1.4m to 1.6m to correspond to levels on the adjacent Primary Care Centre Site (located to the south). Raising the car park will bring its level up to meet the surrounding topography to the north, east and west, reducing the risk of runoff from surrounding areas flowing into the car park. The car park will also include the design of its own drainage system to receive rainfall falling directly on the site.

Therefore, the risk of pluvial flooding to the car park, once the works are complete, is considered to be low.

4.4 Artificial Drainage Systems

Flooding occurs from artificial drainage systems during periods of heavy rainfall, when the local drainage system reaches capacity and surcharges from manholes and/or gullies.

Figure 4.2 (see also Appendix B4) shows that there are two 600mm diameter storm pipes crossing the northern and eastern parts of the site. A gravity sewer runs along the western boundary of the site, however its dimensions are not known.

From Jacobs’ previous work in this area, it is understood that previous flooding on Flynn’s Field has coincided with high water levels in the River Shannon with water ponding to a similar level to that in the Shannon. This flooding has not necessarily occurred directly from the River Shannon overtopping it’s banks, therefore, there would appear to be a hydraulic connection between the River Shannon and the site. It is considered highly probable that this connection is via the existing drainage systems which pass beneath the site.
The proposed works will however elevate the site above the water levels in the River Shannon in the 0.1% AEP event. Therefore, flood risk to the site from drainage systems being backed-up by the River Shannon once the works are completed, will be low.

The proposed works will also include the construction of a new surface water drainage system with an underground attenuation tank that discharges to the existing storm drains (see Section 5.3 for further details). These drains will be sized appropriately to receive runoff from the car park area and minimise the risk of flooding on the site during extreme rainfall. These works will also include for the provision of a flap valve to prevent backing-up of the existing storm drains into the new car park drainage when the Shannon is in flood.

It is also understood that non-return valves have been fitted by Leitrim County Council on the existing storm drains prior to them outfalling to the River Shannon. This will further reduce the risk of flooding to Flynn’s Field from the existing artificial drainage systems when water levels in the Shannon are high.

4.5 Groundwater Flood Risk

Groundwater flooding could occur when the River Shannon is in flood, as the site is low lying relative to the surrounding topography. The site surface is formed from made granular fill which would allow for the emergence of groundwater when river levels in the Shannon exceed the site ground level, if there is a hydraulic connection to permeable sub-strata, which are linked to the water table.

Given that the reports of flooding on the site note that water ponds to a similar level as that in the River Shannon, this would suggest that there is a hydraulic connection and that flooding via Artificial Drainage systems is more likely (as noted in Section 4.6) than groundwater. This is due to the site being located some
240m from the river and that a hydraulic headloss would be expected to be observed between the respective flood levels, if the site was subject to flooding from groundwater that was linked to the Shannon.

This, with the addition of the proposed works elevating the site above the flood level in the River Shannon in the 0.1% AEP event, mean that the flood risk to the site from groundwater can be concluded to be low.

4.6 Flood Risk due to Climate Change

Future climate change is predicted to give rise to an increased risk of flooding through rising sea levels, an increase in river flows and the frequency and intensity of extreme rainfall. The OPW has identified two potential scenarios for the impacts of climate change that are known as the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS). Table 4.2 summarises the predicted impacts of both scenarios on predicted river flows and rainfall depths over the next 100 years. The predicted impact on sea level is also provided for completeness however, as noted in Section 4.1, there is no coastal flood risk within Carrick-on-Shannon.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mid-range Future Scenario (MRFS)</th>
<th>High-End Future Scenario (HRFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Sea Level Rise</td>
<td>+500mm</td>
<td>+1000mm</td>
</tr>
<tr>
<td>River Flows</td>
<td>+20%</td>
<td>+30%</td>
</tr>
<tr>
<td>Extreme Rainfall Depths</td>
<td>+20%</td>
<td>+30%</td>
</tr>
</tbody>
</table>

Table 4.2 Climate Change Forecasts

The Mid-Range Future Scenario (MRFS) scenario is intended to represent the ‘likely’ future scenario based on a range of forecasts. The High-End Future Scenario (HEFS) represents a more extreme forecast that is at the upper end of accepted projections. Given the nature of the works and risk from exposure to flooding, the potential impact of climate change on flood risk to the Flynn’s Field Car Park site has been made relative to the more likely MRFS scenario. Table 4.3 summarises the potential impacts of climate change on the Flynn’s Field Car Park site for each potential source of flooding

<table>
<thead>
<tr>
<th>Source of Flooding</th>
<th>Likely Impacts of Climate Change on Flynn’s Field</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal</td>
<td>No Impact</td>
<td>There is no coastal flood risk in Carrick-on-Shannon, even with the effects of future climate change</td>
</tr>
<tr>
<td>Fluvial</td>
<td>No change</td>
<td>See Tables 4.4 and 4.5 below</td>
</tr>
<tr>
<td>Estuarine</td>
<td>No Impact</td>
<td>There is no estuarine flood risk in Carrick-on-Shannon, even with the effects of future climate change</td>
</tr>
<tr>
<td>Pluvial</td>
<td>No change</td>
<td>Whilst future climate change will result in increased rainfall depths over the site, this will not result in an increase in the risk of pluvial flooding. The site is being raised relative to surrounding lands and its design will include new drainage that allows for the effects of future climate change for runoff that will be generated within its catchment area</td>
</tr>
<tr>
<td>Artificial Drainage Systems</td>
<td>No change</td>
<td>A non-return valve will be incorporated into the design of the car park drainage to prevent flows backing-up from the Shannon. The car park drainage will also be designed to be near to the surface e.g. ACO drains or similar to reduce the risk of influence from the Shannon</td>
</tr>
<tr>
<td>Groundwater</td>
<td>No Impact</td>
<td>No change; the elevation of the works mean they will continue to be at a low risk of groundwater flooding</td>
</tr>
</tbody>
</table>

Table 4.3 Climate Change Impacts

A 20% increase in river flows is predicted for the River Shannon due to future climate change. Table 4.4 shows this will result in a 0.38m increase in the 1% AEP flood level and 0.39m increase in the 0.1% AEP flood level. Future climate change will therefore mean a risk of flooding to the car park for a 0.1% AEP flood due to future climate change but the car park will still not be at risk for the 1% AEP & climate change flood level; as outlined in Table 4.5. Section 6 of this report however demonstrates that as the car park will be classified as a ‘less
vulnerable development'; this increase in flood risk would be acceptable, as the car park will still be located in the appropriate flood zone for its development type, in accordance with the ‘Planning System and Flood Risk Management: Guidelines for Planning Authorities’.

<table>
<thead>
<tr>
<th>AEP Event</th>
<th>River Shannon Flood Level (mOD)</th>
<th>Difference (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% (1 in 10)</td>
<td>41.74</td>
<td>+0.28</td>
</tr>
<tr>
<td>1% (1 in 100)</td>
<td>42.31</td>
<td>+0.38</td>
</tr>
<tr>
<td>0.1% (1 in 1000)</td>
<td>42.86</td>
<td>+0.39</td>
</tr>
</tbody>
</table>

Table 4.4: Impact of Climate Change on River Shannon Flood Levels

It can therefore be concluded that future climate change will not significantly change the risk of flooding to the site for Coastal, Estuarine, Pluvial, Artificial Drainage or Groundwater sources.

There is an increased risk of fluvial flooding to the site due to climate change, however this is deemed to be acceptable for this site due to the low vulnerability and resulting flood zone designation of the site with respect to flood risk, in accordance with the ‘Planning System and Flood Risk Management: Guidelines for Planning Authorities’.

4.7 Summary of Flood Risk

Table 4.6 below provides a summary of the outcome of this Stage 2 Initial Flood Risk Assessment. It outlines the potential impact from each of the sources of flooding considered, to the site once the works are completed.

<table>
<thead>
<tr>
<th>Flood Risk Source</th>
<th>Summary of Impact on Flynn’s Field</th>
<th>Summary Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal &amp; Estuarine</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Fluvial</td>
<td>Low</td>
<td>The site will be raised above the level of the 0.1% AEP event. Future climate change will place the site at risk for a 0.1% AEP flood however this will be acceptable as the site will still be located in the appropriate flood zone for its development type.</td>
</tr>
<tr>
<td>Pluvial</td>
<td>Low</td>
<td>The site will be raised above surrounding ground levels and include its own bespoke drainage design</td>
</tr>
<tr>
<td>Artificial Drainage Systems</td>
<td>Low</td>
<td>The site will be raised above surrounding ground levels and include its own bespoke drainage design</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Low</td>
<td>The risk of groundwater flooding is considered to be low. The site will also be raised above the 0.1% AEP flood level.</td>
</tr>
</tbody>
</table>

Table 4.6: Flood Risk Summary
5. Potential Flood Risk Impacts from the Proposed Works

Section 4 considered the flood risk to the site once the works were complete. This section considers the potential change in flood risk to the surrounding areas arising from the proposed works, and outlines any necessary mitigation to ensure no increase in the risk of flooding.

5.1 Impacts on Coastal & Estuarine Flooding

Due to the location and elevation of the site, it will have no effect on the coastal or estuarine flooding.

5.2 Impacts on Fluvial Flooding

The proposed development could result in an increase in the risk of fluvial flooding if it were to:

- Reduce conveyance along any existing watercourses and floodplain network;
- Reduce the volume of floodplain storage available; or
- Increase runoff rates and volume.

Sections 3 showed that the site had been subject to historical flooding due to flows backing-up the existing drainage network. Raising the site level for the construction of the proposed car park will prevent this flooding occurring on the site in the future. It is also understood that non-return valves were fitted to the existing storm sewers at their outfalls to the River Shannon following the 2015 flood, which should already prevent flooding of Flynn’s Field from Shannon flows backing-up the drainage network.

Section 4 outlined that during the 0.1% AEP flood event, direct flooding of the site from the River Shannon overtopping its banks could occur. Raising the level of the site will therefore result in a small loss in floodplain during the 0.1% AEP flood.

Table 5.1 shows that the total floodplain lost during the 0.1% AEP flood is approximately 5,280m$^3$. This is unlikely to impact on flood levels in the River Shannon however as, during the 0.1%AEP flood, this area will be filled in around 18-seconds due to the large flood volumes in the river.

<table>
<thead>
<tr>
<th>Site Details</th>
<th>River Shannon 0.1% AEP Flood Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1% AEP Flood Depth on current Flynn’s Field Car Park site</td>
<td>1.2m</td>
</tr>
<tr>
<td>Flynn’s Field Car Park Car Park Area:</td>
<td>4,400m$^2$</td>
</tr>
<tr>
<td>Floodplain Volume Lost due to Flynn’s Field Car Park raising</td>
<td>5,280m$^3$</td>
</tr>
</tbody>
</table>

Table 5.1: Flood Volume Displacement Assessment

It is therefore concluded that the proposed works do not impact on fluvial flood risk. The impacts on runoff rates and the proposed mitigation are outlined in Sections 5.3 and 5.4 below.

5.3 Impacts on Pluvial Flooding

To assess any impact of the proposed works on pluvial flood risk, the following conditions need to be considered:

- If the proposed upgrade works increase the rainfall runoff rate;
If the proposed upgrade works alter existing flow or drainage paths.

Raising the site and changing its surface to an impermeable material will increase the rainfall runoff rate. To mitigate against this change, attenuation storage will be provided on the site to ensure no increase on the existing runoff rate.

To determine the requirements for onsite attenuation storage, an analysis was completed using the IH 124 small catchments method and found that runoff from the site needed to be capped to 2l/s to ensure no increase in runoff rates from Flynn’s Field.

A 2l/s flow caps runoff to the QBAR rate; this rate was selected as this is the minimum flow that can reasonably be achieved without encountering maintenance issues in the flow control. This figure will be reviewed at detailed design stage with further refinement made as necessary to suit the selected flow control device.

### Runoff Attenuation Design Parameters

<table>
<thead>
<tr>
<th>Runoff Calculation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Site Area</td>
<td>4,482m²</td>
</tr>
<tr>
<td>Greenfield Areas</td>
<td>958m²</td>
</tr>
<tr>
<td>Paved / Impermeable Areas of the Proposed Development</td>
<td>3,524m²</td>
</tr>
<tr>
<td>Soil Factor</td>
<td>0.3</td>
</tr>
<tr>
<td>SAAR</td>
<td>1044</td>
</tr>
<tr>
<td>Maximum Permitted Runoff Rate</td>
<td>2l/s</td>
</tr>
<tr>
<td></td>
<td>(capping to QBAR; 2l/s taken as minimum flow that can sensibly achieved without encountering maintenance issues in the flow control)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storm Tank Sizing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Tank Required Volume (to contain 1% AEP storm &amp; climate change)</td>
<td>201m³</td>
</tr>
<tr>
<td>Top Level of Attenuation Storm Tank</td>
<td>42.4mOD</td>
</tr>
<tr>
<td>Invert of Attenuation Tank</td>
<td>41.2mOD</td>
</tr>
<tr>
<td>Storm Tank Dimensions (Approx - Width x length x depth; based on StormTech Provision)</td>
<td>15.9m x 13.7m x 1.2m</td>
</tr>
<tr>
<td>Minimum cover to top of storm tank (based on use of StormTech units)</td>
<td>0.6m (600mm)</td>
</tr>
<tr>
<td>Approximate depth of excavation (from existing ground levels)</td>
<td>0.4m (400mm)</td>
</tr>
<tr>
<td>Outflow control</td>
<td>Hydrobrake</td>
</tr>
</tbody>
</table>

Table 5.2: Attenuation Tank Design Parameters

Drawings 1 and 2 in Appendix C outline the indicative proposals for an underground attenuation tank that are proposed to be built beneath the car park to receive, store and attenuate runoff from the car park. The
The attenuation tank will have a net storage volume of 201m³ and will be fitted with a hydrobrake (or similar flow control) on its outlet to cap the rate of runoff to the maximum 2l/s. The volume of the attenuation tank is designed to contain the 1% AEP storm with an allowance for future climate change.

The attenuation tank will be connected to an existing 600mm diameter surface water drain that passes beneath the site. A flap valve will be included at this connection to prevent flooding of the attenuation area from the Shannon backing-up this drain. At 600mm diameter, this receiving drain has a capacity of approximately 500l/s and is already receiving flows from Flynn’s Field. The outflow from the car park attenuation tank will use 0.4% of the potential storm drain capacity.

Final elevations and drainage paths for the car park surface are still to be confirmed as part of the car park layout design, however it is recommended that ACO or similar type surface water drains be used to collect and divert runoff to the attenuation tanks. This has two important benefits:

- It minimises the depth of the attenuation tank so reducing the risk of groundwater during excavation;
- It should ensure that a gravity connection to the existing sewer can be made.

Presently, Flynn’s Field is a natural low spot compared to surrounding lands. Raising Flynn’s Field to 43.1mOD to form the car park will ensure that it ties into surrounding lands and will not create any new low spots that might be prone to surface water flooding.

5.4 Impacts on Flooding from Artificial Drainage Systems

As noted, flooding of Flynn’s Field currently occurs from the Shannon backing-up the drainage network. Once the site is elevated above the level of the 0.1% AEP flood, flooding of the site from drainage system for events up to the 0.1% AEP event will not occur. A flap valve will also be included at the connection between the new runoff attenuation area and existing storm drain to prevent flooding of the attenuation area from the Shannon backing-up the existing drains. As noted, non-return valves have already been fitted on these storm drains, which already reduces the risk of flows backing up these drains when the Shannon is in flood.

Flooding from the existing storm drains will not be increased by the Flynn’s Field car park works as the new attenuation tank will ensure existing runoff rates from the site are maintained.

5.5 Impacts on Groundwater Flooding

The indicative design for the storm tank which is presented in Appendix C minimises the need for extensive excavation or any significant groundworks. The tank has been located on the site to take advantage of where existing ground levels are lowest. The indicative design assumes that approximately 400mm of excavation will be required, with 300mm of this made up by a regulating granular fill for the attenuation tank.
5.6  Summary of Potential Flood Risk Impacts from the Upgrade Works

Table 5.3 below provides a summary of the potential flood risk impacts on surrounding areas as a result of the proposed development.

<table>
<thead>
<tr>
<th>Flood Risk</th>
<th>Summary of Impact from Flynn's Field Car Park</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal &amp; Estuarine</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Fluvial</td>
<td>No Impact</td>
<td>Flood risk from fluvial sources to the surrounding area will not be increased</td>
</tr>
<tr>
<td>Pluvial</td>
<td>No Impact</td>
<td>Flood risk from pluvial sources to the surrounding area will not be increased. Mitigation measures are proposed as described in section 5.3</td>
</tr>
<tr>
<td>Artificial Drainage Systems</td>
<td>No Impact</td>
<td>Flood risk from artificial drainage systems sources to the surrounding area will not be increased. This is linked to the runoff mitigation measures described in Section 5.3</td>
</tr>
<tr>
<td>Groundwater</td>
<td>No Impact</td>
<td>Flood risk from Groundwater sources to the surrounding area will not be increased</td>
</tr>
</tbody>
</table>

Table 5.3: Flood Risk Impact Summary
6. Flood Risk Management and Evaluation

6.1 The Sequential Approach to Development Planning

'The Planning System and Flood Risk Management Guidelines for Planning Authorities' recommend that a sequential approach is taken for flood risk management for new developments. This mechanism is summarised in Figure 6.1 below.

![Sequential approach mechanism in the planning process](image)

Table 6.1: Description of Flood Zones (The Planning and Flood Risk Management, Guidelines for Planning Authorities' (2009))

<table>
<thead>
<tr>
<th>Flood Zone</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone A</td>
<td>Where the 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)</td>
</tr>
<tr>
<td>Zone B</td>
<td>Where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 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)</td>
</tr>
<tr>
<td>Zone C</td>
<td>Where the 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.</td>
</tr>
</tbody>
</table>

Flynn’s Field is at risk of fluvial flooding in the 0.1% AEP flood although the exact risk is unknown. Based on the CFRAM mapping the site is located in Flood Zone B although it is possible, given the recent frequency of flooding in 2009 and 2015, that it could be considered to be located in Flood Zone A.
A key part of the proposed works at Flynn’s Field will be to elevate the site so that the finished level of 43.1mOD exceeds the 0.1% AEP flood level. Following completion of the work the site would therefore be located in Flood Zone C, as described in Table 6.1 above.

With reference to Table 3.1 of ‘The Planning System and Flood Risk Management Guidelines for Planning Authorities’ published by the OPW, the proposed scheme falls under the land use and type of “Local transport infrastructure.” In accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities, the proposed scheme is therefore classed as a ‘Less Vulnerable Development’.

Table 6.2, extracted from The Planning System and Flood Risk Management Guidelines for Planning Authorities, illustrates the types of development that are considered appropriate to each Flood Zone. The proposed development on Flynn’s Field is appropriate both for its current designation (Flood Zone B) and also following completion of the works (Flood Zone C).

Therefore, it can be concluded that the Justification Test will not be a requirement as part of this assessment.

<table>
<thead>
<tr>
<th>Highly Vulnerable Development</th>
<th>Flood Zone A (High Probability of Flooding)</th>
<th>Flood Zone B (Moderate Probability of Flooding)</th>
<th>Flood Zone C (Low Probability of Flooding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justification Test</td>
<td>Justification Test</td>
<td>appropriate</td>
<td>appropriate</td>
</tr>
<tr>
<td>Less Vulnerable Development</td>
<td>Justification Test</td>
<td>appropriate (current designation &amp; future climate change)</td>
<td>appropriate (with completed scheme designation)</td>
</tr>
<tr>
<td>Water-Compatible Development</td>
<td>appropriate</td>
<td>appropriate</td>
<td>appropriate</td>
</tr>
</tbody>
</table>

Table 6.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test
7. Conclusions and Recommendations

7.1 Conclusions

This report provides an assessment of the flood risk issues that could affect the development of a proposed car park on Flynn’s Field and the surrounding area. The assessment has included desktop investigations into the potential flood risks and an assessment of the potential impacts the development could have on flood risk in the surrounding areas.

The assessment found that Flynn’s Field had been subject to flooding from the River Shannon due to backing-up of the drainage network which passes beneath the site. This risk has been considered in the design of the new car park and mitigation measures have been considered with the finished ground levels to be elevated above the 0.1% AEP flood to mitigate this risk.

Construction of the new car park will result in the creation of new impermeable surfaces on Flynn’s Field which have the potential to increase flood risk locally from surface water and exceed the capacity of the adjacent storm drains. An indicative design for new runoff attenuation tanks to be built beneath the car park has been provided that will ensure no increase on existing runoff rates following completion of the works. The attenuation tanks will provide 201m³ of storage and cap runoff rates from the car park to 2l/s. The tank has also been designed to minimise the required depth of excavation due to the potential risk of groundwater flooding in the area.

The design of the car park to elevate it above the 0.1% AEP flood level mean it will be located in Flood Zone C following completion of the works and at a low risk of flooding. The risk of fluvial flooding will increase to moderate (Flood Zone B) due to future climate change and will result in the site being at risk for the 0.1% AEP flood in the future. The designation of the site as a ‘less vulnerable development’ in the Planning System and Flood Risk Management Guidelines for Planning Authorities, means that this can be accepted, as proposed car park will still be located in the appropriate flood zone (Flood Zone B, moderate risk).

Therefore, it was concluded that the Justification Test will not be a requirement as part of this assessment.

7.2 Recommendations

It has been concluded that both flood risks and impacts associated with the proposed development are low and negligible. Full mitigation can also be provided to ensure no increase in runoff from the site by the provision of runoff attenuation. Therefore, it is recommended that further detailed modelling, i.e. a Stage 3 Detailed Risk Assessment, is not required.

It should be noted that that the attenuation tank drawings in Appendix C only provide a schematic and indicative details for the proposed works. Further work will be required following confirmation of the finished profile of the car park to allow the nature of its drainage network to be full developed. The indicative design has assumed the provision of ACO or similar surface drains to minimise the required depth of excavation for the attenuation tanks, which is also considered necessary to allow for connection to the existing surface water drainage network. Investigation of the receiving drainage network is also required to verify the design level for the tank.

Further assessment of groundwater pressures will also be required to consider the potential impacts of uplift in the design of the attenuation tank.
### Appendix A. Information Sources Checklist

<table>
<thead>
<tr>
<th>No.</th>
<th>Information Source</th>
<th>Status</th>
<th>Reference/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OPW Preliminary Flood Risk Assessment indicative fluvial flood maps</td>
<td>✓</td>
<td>Please refer to Appendix B</td>
</tr>
<tr>
<td>2</td>
<td>National Coastal Protection Strategy Study flood and coastal erosion risk maps.</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Predictive and historic flood maps, and Benefiting Lands Map</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Predictive flood maps produced under the CFRAM studies</td>
<td>✓</td>
<td>Please refer to Appendix B</td>
</tr>
<tr>
<td>5</td>
<td>River Basin Management Plans and reports</td>
<td>✓</td>
<td>Carrick-on-Shannon Local Area Plan 2010 – 2016 Flood Risk Mapping and Strategic Drainage Area Map</td>
</tr>
<tr>
<td>6</td>
<td>Indicative assessment of existing flood risk under Preliminary Flood Risk Assessment</td>
<td>✓</td>
<td>Shannon CFRAMS Flood Risk Review for Carrick-on-Shannon</td>
</tr>
<tr>
<td>7</td>
<td>Previous Strategic Flood Risk Assessments</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Expert advice from OPW who may be able to provide reports containing the results of detailed modelling and flood-mapping studies including critical damage areas, and information on historic flooding and local studies etc.</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Topographical maps, in particular digital elevation models produced by aerial survey or ground survey techniques.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Information on flood defence condition and performance</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Alluvial deposit maps</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Activity</td>
<td>Status</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>12</td>
<td>‘Liable to Flood’ markings on the old 6” Inch Map</td>
<td>√</td>
<td>Historic OSI 6” Map - Appendix E</td>
</tr>
<tr>
<td>13</td>
<td>Local Libraries and newspaper reports</td>
<td>√</td>
<td>Adequate information on Flooding History was provided by OPW floodmaps.ie</td>
</tr>
<tr>
<td>14</td>
<td>Interviews with local people, local history/natural history societies etc.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Walkover survey to assess potential sources of flooding, likely routes for flood water and the site's key features, including flood defences, and their condition.</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B. Schemes Drawings and Flood Risk Mapping Information

Appendix B1 – Scheme Layout
Appendix B2 – PFRA Flood Mapping
Appendix B3 – CFRAM Flood Mapping
Appendix B4 – Existing Drainage Layout
Restricted access to road

Existing pedestrian access via Archway Apartments to Main Street to be maintained.

Future further development of the area may include upgrading of surfaces, public lighting and alterations to gradients subject to agreement between Leitrim County Council and Carrick on Shannon Archway Management Company (Company Limited by Guarantee).

New 1.2m high retaining wall to west boundary

0.8m high retaining wall

1:2 Embankment

Possible future connection to existing footpath

Possible pedestrian access to Bridge Street

Possible pedestrian access via Archway Apartments to Main Street

New 1.2m high retaining wall to east boundary

New timber post & rail fence with beech hedging to south boundary

New tree planting to car park

Area Under Construction

Additional tree planting to boundary

Proposed perimeter LED lighting scheme to meet SLL code for lighting (2012)

Restricted access to road

New 1.2m high retaining wall

Natural stone paving

100 no. spaces

Proposed Site Plan - Flynn's Field

Archway Apartments

The Bush Hotel

Project: Carrick on Shannon Public Realm

Client: Leitrim County Council

Drawing Title: Proposed Site Plan - Flynn's Field

Scale: 1:500

Drawn by: dhb

Approved by: dhb

Project No.: 18-14-CPR

Date: 19.11.18

Revision: A
No fluvial data available for area.
Appendix C. Indicative Attenuation Storage Drainage Design
Manhole for Attenuation
Tank maintenance

New manhole with Hydrobrake to attenuate carpark runoff to maximum permitted discharge of 2 l/s based on existing runoff rate

Indicative discharge manhole to existing storm drain. Manhole to contain flap valve on incoming pipe to prevent backflows into the storage area when the Shannon is in flood.

Indicative location of manhole receiving carpark drainage network (subject to carpark design)

ACO M150D 0.0 Channel or similar

Existing Storm Drain approximate invert of 40.8m AOD at connection point

Stormtech MC-3500 Attenuation Tanks or similar to provide a volume of 20 m$^3$

Manhole for Attenuation
Tank maintenance

Manhole to contain flap valve on incoming pipe to prevent backflows into the storage area when the Shannon is in flood.

Indicative location of manhole receiving carpark drainage network (subject to carpark design)
Existing Ground Level

Proposed Ground Level

Existing Storm Drain approximate invert of 40.8m AOD at connection point

New manhole with Hydrobrake to attenuate carpark runoff to maximum permitted discharge of 2 l/s based on existing runoff rate

Indicative discharge manhole to existing storm drain.

Indicative location of manhole receiving carpark drainage network (subject to carpark design)

Manhole for Attenuation Tank maintenance

Stormtech MC-3500 Attenuation Tanks
or similar to provide a volume of 201m³

Gravel Fill (300mm Min)

Gravel Fill (230mm Min)

Section 1

Section 2