LLANELLI STAGE 2 STRATEGIC FLOOD CONSEQUENCE ASSESSMENT

LOCAL DEVELOPMENT ORDER SITE

FINAL

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WSP | PARSONS BRINCKERHOFF

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LOCAL DEVELOPMENT ORDER SITE

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APPENDICES

APPENDIX A

1 INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 Carmarthenshire County Council is preparing a Local Development Order (LDO) with a view to promoting and supporting future development within Llanelli town centre. This will grant conditional planning permission for certain types of changes of use within the LDO area. It should be noted that it does not negate the need to attain any permissions relating to regulations etc that are outside of the planning system – eg building regulations.

1.1.2 WSP Parsons Brinckerhoff has been commissioned by Carmarthenshire County Council to prepare a Stage 2 Strategic Flood Consequences Assessment (SFCA) in support of the LDO approval. This document will comply with Planning Policy for Wales, Technical Advice Note 15 (TAN15) and other national, regional and local planning legislation. In particular, the LDO SFCA will seek to clarify and address flood risk and ensure the LDO is deliverable and, ultimately, ensure sustainable future development.

1.1.3 A Stage 1 SFCA for Carmarthenshire was published in June 2011. This was prepared to support the LDP and concluded that a significant area of Llanelli town centre was at risk of fluvial and tidal flooding. The Stage 1 SFCA recommended that a Stage 2 SFCA was prepared to further analyse the flood hazard affecting future development sites in Llanelli. A Stage 2 SFCA was published in August 2013 for five proposed development sites in Llanelli. These sites are not located within the LDO area or Llanelli town centre but the SFCA provides useful information regarding fluvial and tidal flood risk within Llanelli that has been used to inform the LDO SFCA.

1.2 STUDY AREA

1.2.1 The LDO area is located within Llanelli town centre. The site is bound to the north-west by Bridge Street, to the west by Station Road and to the south by the access road leading to the Murray Street Car Park. The boundary of the LDO area is illustrated in Figure 1, with a more detailed map of the extent of the proposed area illustrated in Appendix A-1.

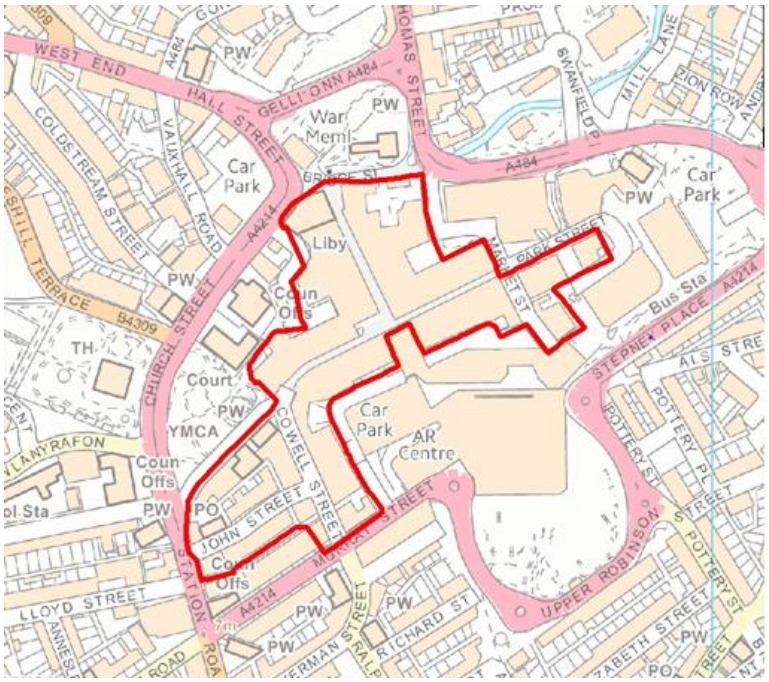

Figure 1: Extent of the LDO area

1.2.2 The LDO area comprises a mixture of existing buildings that include commercial, retail and residential premises. A number of the retail premises are currently vacant as a result of the downturn in retail activities in the town.

1.2.3 The River Lliedi flows in a south-westerly direction through the LDO area. The watercourse is a main river under the jurisdiction of Natural Resources Wales (NRW). The source of the watercourse is located within the hills near Llanelli, flowing south to fill two reservoirs (the Upper Lliedi and Cwm Lliedi) and continuing south-west through Llanelli town centre.

1.2.4 The majority of the watercourse is culverted through the town centre between the A484 Thomas Street and Old Castle Road over a length of approximately 730m. The watercourse opens up at Old Castle Road and continues to flow south-west to discharge to Bury Estuary at the former Carmarthenshire Dock (NGR: 249981, 199564). A map of the watercourses within the vicinity of the LDO area is provided in Section 3 of this document.

1.2.5 The LDO area is relatively flat, with a gentle slope in topography towards the south-west. Review of LiDAR mapping indicates a localised rise in topography within the south-west corner of the site. Topography within the site ranges from approximately 10mAOD to 8.5mAOD.

1.3 PROPOSED CHANGE IN USE OF EXISTING BUILDINGS

1.3.1 The LDO aims to promote and support proposed change in use of existing buildings within the LDO area by streamlining the planning process and removing the need for developers to make a planning application to the local planning authority. Carmarthenshire County Council proposes to permit the following use classes within the Draft LDO:

- A1 - Shops;
- A2 - Financial and professional services;
- A3 - Restaurants and cafes;

- A3 - Drinking establishments (but not night clubs);
- A3 - Hot food takeaways;
- B1 - Business (offices other than those within A2);
- C1 - Hotels, boarding houses and guest houses;
- C3 - Dwellings (residential incl. flats);
- D1 - Non-residential institutions (note LDO excludes law courts, church halls and libraries);
- D2 - Assembly and leisure buildings (note LDO only permits gymnasiums and area for indoor sports or recreation – except for motor sports, or where firearms are used); and
- Other (specified sui) - Launderettes and taxi businesses only.

1.3.2 Details of the spatial areas for the permitted use classes are further discussed in Section 4.2.

1.4 PROJECT AIMS AND OBJECTIVES

1.4.1 The key aims of this Stage 2 LDO SFCA are to clarify the risks and consequences of flooding for the LDO area, and to investigate ways of appropriately managing and mitigating flood risk to enable future sustainable development that is in accordance with Planning Policy Wales and TAN15. The LDO SFCA will give consideration to the development classes proposed within the LDO area and the suitability of these development classes in terms of flood risk vulnerability.

1.4.2 The scope of this Stage 2 LDO SFCA is therefore as follows:

- Summarise the distribution of flood risk across the LDO area, including assessment of the effects of climate change;
- Assess the suitability of change in use of the existing buildings in accordance with Planning Policy Wales and TAN15; and
- Provide guidance on appropriate risk management measures to manage residual flood risks in accordance with TAN15 guidance.

1.4.3 The LDO SFCA is supported by a number of maps, as provided within the Appendices of this report. Reference is also made to a series of other reports that support the LDO – including a Habitats Regulations Assessment Screening Report, Infrastructure Study (inc drainage strategy), and Environmental Impact Assessment Screening Report.

1.4.4 The LDO process is subject to a notification procedure where key stakeholders are advised of applications. This ensures that “mitigation” is built into the LDO process given the strong emphasis on collaboration / engagement and monitoring. No change in use permitted by the LDO shall occur until a certificate of conformity has been approved in writing by CCC, following review of proposals. Physical commencement of any change of use permitted by the LDO shall not commence until any conditions/matters identified in the certificate of conformity have been addressed and approved in writing by CCC and relevant consultees and a Commencement Notice Approval issued.

1.4.5 Based on the number of existing units within the Project site, it is unlikely that more than 180 residential conversions could be physically delivered. In practice, it is highly unlikely that applications for this many conversions would come forward under the LDO. A worst-case scenario of 180 residential units receiving Commencement Notice Approval has therefore been assumed for the purposes of this assessment.

1.4.6 Should a figure of 100 Commencement Notice Approvals for residential units by reached within the 3 year period lifetime, then a moratorium will be placed on the LDO and it will be reviewed with the outcomes reported to full Council. Such a review will be informed by the input of the notification stakeholders (including NRW and DCWW).

2 PLANNING CONTEXT

PLANNING POLICY WALES

2.1.1 Planning Policy Wales[1] sets out the land use planning policies of the Welsh Government and is supplemented by a series of Technical Advice Notes. Planning Policy Wales encourages local planning authorities to take a holistic approach in managing flood risk within a catchment. This should be achieved through the precautionary approach of steering new developments away from areas of high risk of flooding to low risk areas. Development proposals should therefore seek to reduce, and not increase, flood risk arising either from fluvial and/or tidal flooding or from additional runoff from development in any location.

2.1.2 Planning Policy Wales also recognises that not all development can be sited in low flood risk areas and sets out the agenda for development proposals in areas defined as being of high flood hazard. Appropriate mitigation measures should be considered to reduce the flood risk to the development and to other neighbouring developments. Section 13.4 of Planning Policy Wales relates to 'development management and flood risk' and states that:

Development proposals in areas defined as being of high flood hazard should only be considered where:

- *new development can be justified in that location, even though it is likely to be at risk from flooding; and*
- *the development proposal would not result in the intensification of existing development which may itself be at risk; and*
- *new development would not increase the potential adverse impacts of a flood event.*

PPW goes on to state that:

In determining applications for development, local planning authorities should work closely with Natural Resources Wales, drainage bodies, sewerage undertakers, prospective developers and other relevant authorities to ensure that surface water runoff is to be controlled as near to the source as possible by the use of sustainable urban drainage systems. They should also ensure that development does not:

- *increase the risk of flooding elsewhere by loss of flood storage or flood flow route; or*
- *increase the problem of surface water run-off.*

[1] Planning Policy Wales, Edition 9, November 2016

TECHNICAL ADVICE NOTE 15: DEVELOPMENT AND FLOOD RISK

2.1.3 Technical Advice Note 15 (TAN15) provides technical guidance which supplements Planning Policy Wales in relation to development and flood risk. Specifically it provides a precautionary framework within which risks arising from both fluvial and tidal flooding, and from additional runoff from development in any location, can be assessed. The overarching aim of the precautionary framework is, in order of preference, to:

- Direct new development away from those areas which are at high risk of flooding.
- Where development has to be considered in high risk areas (Zone C) only those developments which satisfy the Justification Test are to be located within such areas.

2.1.4 TAN15 is supported by Development Advice Maps (DAMs). These maps are broadly based on the National Resources Wales (NRW) flood outline and the British Geological Survey (BGS) drift data and show the different designated flood zones according to the flood risk associated with them. The different flood zones are summarised in Table 1.

Table 1: TAN15 Development Advice Map Zones

DESCRIPTION OF ZONE		USE WITHIN THE PRECAUTIONARY FRAMEWORK
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits	B	Used as part of a precautionary approach to indicate where site levels should be checked against extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environmental Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

2.1.5 TAN15 recognises that particular flooding consequences may not be acceptable for particular types of development. The precautionary framework is promoted that considers different types of development in terms of their vulnerability as summarised in Table 2.

Table 2: TAN15 Vulnerability of different land uses

DEVELOPMENT CATEGORY	TYPES
Emergency services	Hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood.
Highly vulnerable development	All residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites.
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites.

2.1.6 Section 6 of TAN15 states that new development should be directed away from DAM Zone C and towards suitable land in Zone A, otherwise to Zone B; and that new development should only be permitted within Zones C1 and C2 if determined by the local planning authority to be justified in that location. However, TAN15 also recognises that much urban development in Wales has taken place in areas that are at risk of fluvial and tidal flooding and that it is therefore inevitable, despite the overall aim to avoid flood risk areas, that some existing development will be vulnerable to flooding and fall within Zone C. It states that some flexibility is therefore necessary to enable the risks of flooding to be addressed whilst recognising the negative economic and social consequences if policy were to preclude investment in existing urban areas, and the benefits of reusing previously developed land.

2.1.7 Section 6 of TAN15 therefore states that:

Development, including transport infrastructure, will only be justified if it can be demonstrated that:

i. Its location in Zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement; or,

ii. Its location in Zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region;

and,

iii. It concurs with the aims of Planning Policy Wales and meets the definition of previously developed land; and,

iv. The potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in Sections 5 and 7 and Appendix 1 [of TAN15] found to be acceptable.

2.1.8 Section 8 of TAN15 states that surface water drainage from developments can, if not properly controlled, significantly increase the frequency and size of floods associated with watercourses that receive surface water drainage, as well as risks directly associated with overland flow. TAN15 promotes the use of Sustainable Drainage Systems (SuDS) as a means of managing surface water from developments and states that these should be implemented where possible.

TECHNICAL ADVICE NOTE 15 AND CLIMATE CHANGE

2.1.9 TAN15 recognises that the potential effects of climate change are likely to result in an increase in flood risk to development. As such, it is vital to take account of the potential impact of climate change over the lifetime of the development. Section 2.5 of TAN15 states that winter precipitation may increase by up to 30% by the 2080's. Updated climate change guidelines for peak river flow were published by Welsh Government in August 2016. In accordance with these updated guidelines, Llanelli is located within the Western Wales River Basin District. A summary of the updated guidelines that should be applied to the 1 in 100 (1%) annual probability event is provided in Table 3.

Table 3: Peak river flow allowances (using 1961 to 1990 baseline)

	TOTAL POTENTIAL CHANGE ANTICIPATED BY THE 2020S	TOTAL POTENTIAL CHANGE ANTICIPATED BY THE 2050S	TOTAL POTENTIAL CHANGE ANTICIPATED BY THE 2080S
Upper end estimate	25%	40%	75%
Central estimate	15%	25%	30%
Lower end estimate	5%	10%	15%

CARMARTHENSHIRE STAGE 1 STRATEGIC FLOOD CONSEQUENCES ASSESSMENT

2.1.10 The Stage 1 SFCA was produced in June 2011 to support the Carmarthenshire LDP and aims to provide an overview of flooding issues throughout Carmarthenshire. The assessment recommended the use the TAN15 DAMs as an initial filtering step at the planning application and site assessment stage. This will establish the need for a site specific FCA where further assessment of the flood hazard is required.

2.1.11 The Stage 1 SFCA states that the assessment of flood risk must guide the allocation of sites within Llanelli given that large areas of the town are at risk of fluvial and tidal flooding. The Stage 1 SFCA also recommended that a Stage 2/3 SFCA was undertaken to provide a detailed assessment of flood risk within this area.

3 SOURCES OF FLOOD RISK

3.1.1 This section of the report will assess the different sources of flood risk that are likely to impact the development of the LDO area.

3.2 DATA USED FOR ASSESSMENT

3.2.1 The following data has been used for assessment:

- NRW mapping available online i.e. Flood Zones 2 and 3, surface water outlines and areas benefiting from defences;
- TAN15 Development Advice Maps, 2015;
- Llanelli Modelling Study fluvial and tidal flood outlines (Environment Agency Wales, 2009);
- MAGIC geographical information portal;
- Ordnance Survey mapping;
- Carmarthenshire Strategic Flood Consequences Assessment, Stage 1 (2011);
- Llanelli Strategic Flood Consequences Assessment, Stage 2 (2013);
- Historic flooding records supplied by Dwr Cymru Welsh Water and Natural Resources Wales;
- LIDAR topographic data; and
- British Geological Society and Cranfield University Soilscapes geological and soil data.

3.2.2 Fluvial and tidal flood extents within Llanelli town centre have been generated using the model developed for the 2009 ESTRY-TUFLOW Llanelli Modelling Study of the Afon Lliedi, Afon Dulais, Afon Dafen and Cille Stream. Following consultation with NRW in February 2018, the hydrology of the model was updated to inform this SFCA to better represent fluvial flood risk and enable assessment of updated climate change recommendations. A 30% increase in peak flow during the 1% (1 in 100) annual probability event has been considered. This is the recommended central estimate anticipated by the 2080s for the assessment of long-term development proposals.

3.3 DEVELOPMENT ADVICE MAP

3.3.1 Review of the Development Advice Map (DAM) prepared to support TAN15 indicates that the majority of the site is located within the extent of Zone C2. This Zone indicates those areas that are identified to be at risk of flooding up to the 1 in 1000 annual probability fluvial and/or tidal event and not protected by significant flood defence infrastructure. The extent of Zone C2 as illustrated in the DAM is provided in Appendix A-2.

3.4 FLUVIAL FLOODING

3.4.1 Fluvial flooding refers to flooding from watercourses. This occurs when the watercourse exceeds the capacity of the channel and overtops its banks onto surrounding land. This typically occurs after heavy or extended periods of rainfall.

3.4.2 The LDO area is at fluvial flood risk from the River Lliedi; a main river under the jurisdiction of NRW. The watercourse flows in a south-westerly direction through Llanelli town centre and LDO area and is culverted though this entire reach. The watercourse flows into the 730m culvert upstream of the A484 Thomas Street, and re-emerges into an open channel adjacent to Old Castle Road. The watercourse continues to flow south-west to discharge to Bury Estuary at the former Carmarthenshire Dock. The alignment of the watercourse within the vicinity of the LDO area is illustrated in Figure 2.

3.4.3 There are no formal flood defences on the River Lliedi.

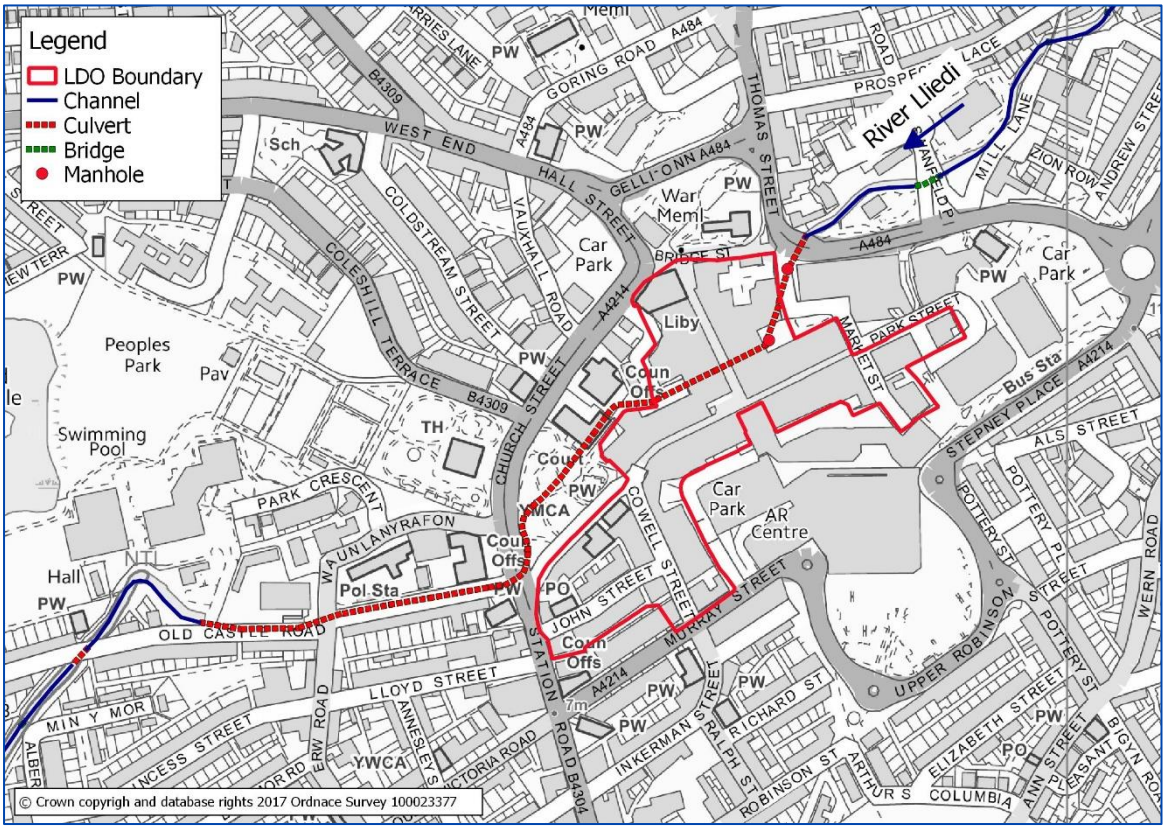

Figure 2: River Lliedi alignment

3.4.4 Review of the NRW flood map (Figure 3 and Appendix A-3) indicates that approximately a third of the site lies within Flood Zone 3, whilst the majority of the site lies within Flood Zone 2. The definition of these areas is summarised below:

- Flood Zone 3 - Land that has a 1% (1 in 100) or greater annual probability of fluvial flooding, or a 0.5% (1 in 200) or greater annual probability of tidal flooding, ignoring the presence of flood defences.

- Flood Zone 2 - Land that has between a 1% and 0.1% (between 1 in 100 and 1 in 1000) annual probability of fluvial flooding, or between a 0.5% and 0.1% (1 in 200 and 1 in 1000) annual probability of tidal flooding, ignoring the presence of flood defences.

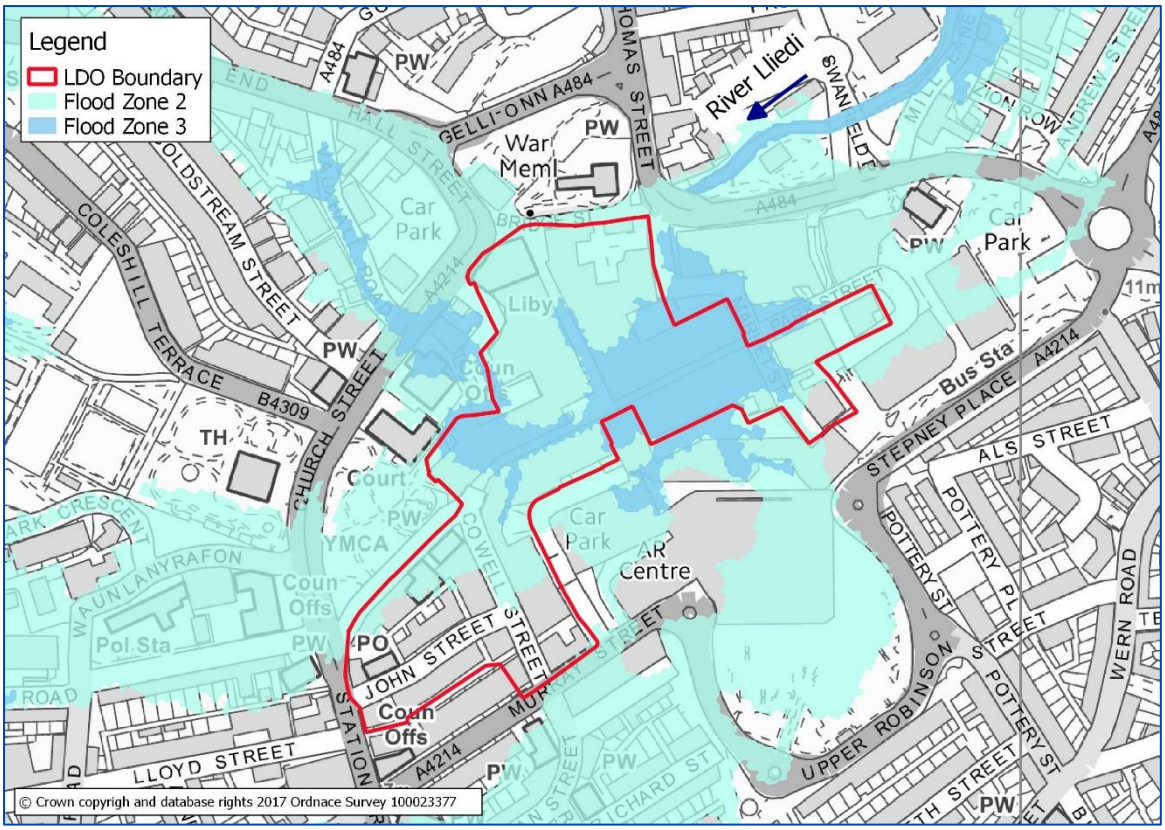

Figure 3: NRW Flood Map

3.4.5 Detailed hydraulic modelling of the River Lliedi was completed by Environment Agency Wales (now NRW) in 2009 as part of the Llanelli Modelling Study. As discussed in Section 3.2, the hydrology of the 2009 model has been updated to inform this SFCA. Maps showing the predicted flood depths and velocities for a range of events are provided in Appendix A-8.

3.4.6 The modelling indicates that initial flooding of the site is through surcharging of manholes located on Mincing Lane, adjacent to Market Street (shown on Figure 2). Flooding within the LDO area is predicted to occur during events with an annual probability of less than 1 in 25. During the 1 in 25 annual probability event the modelling indicates that the flooding would be predominantly contained to Market Street and the car park area on Mincing Lane with depths of up to 0.45m, and within the pedestrianised Stepney Street with depths up to 0.3m.

3.4.7 Flooding increases significantly during the 1 in 75 and 1 in 100 annual probability events. Water levels upstream of the A484 Thomas Street increase sufficiently to overtop the road and overland flow routes from further upstream on the River Lliedi are predicted, resulting in several overland flow paths leading towards the LDO area. Flow is shown to enter the north-east corner of the site, flow through the site in a south-westerly direction before leaving the site in both south-westerly and north-westerly directions. During the 1 in 100 annual probability event flood depths of up to 1m are predicted in the vicinity of Mincing Lane and Market Street, and flood depths of between 0.3m – 0.6m are predicted along Stepney Street and Vaughan Street. Depths greater than 1.5m are predicted at isolated locations in the Mincing Lane car park and adjacent to Stepney Street and Cowell Street, although these are considered to be anomalies and not representative of the risk. One of these locations is at Vestry Presbyterian Church which is predominantly raised above adjacent ground level but has a basement level. It is assumed that the buildings opposite (which are also shown to be at a lower level in the LIDAR topographic data) also have basements making them more susceptible to flooding. Within the LDO area the greatest flow velocities are predicted along Stepney Road and Market Street. During the 1 in 100 annual probability event flow velocities are generally predicted to be between 0.2m/s - 0.5m/s, with isolated areas experiencing velocities up to 1.0 m/s.

3.4.8 The extent of flooding within the LDO area does not increase significantly between the 1 in 100 and 1 in 1000 annual probability events. However the predicted depth of flooding increases substantially with flood depths of up to 1.5m predicted in Mincing Lane and Market Street, and flood depths of up to 1.0m predicted along Stepney Street and Vaughan Street. During the 1 in 1000 annual probability event flow velocities are also predicted to increase along Stepney Road and Market Street to up to 1.0m/s, with velocities along Vaughan Street also predicted to increase to between 0.2m/s – 0.5m/s.

3.4.9 The modelled flood extent of the 1 in 100 annual probability event generated by the Llanelli Modelling Study is significantly greater than the extent currently indicated by the NRW Flood Zone 3 (Figure 3). Within the LDO area, the modelled 1 in 100 annual probability flood extent is more comparable to the mapped Flood Zone 2 that represents the 1 in 1000 annual probability flood extents. There is little difference however between the modelled flood extent for the 1 in 1000 annual probability event and the mapped Flood Zone 2, with John Street and the southern extents of Cowell Street still indicated to be located in the low risk Flood Zone 1.

3.4.10 A 30% increase in peak flow during the 1% (1 in 100) annual probability event has been modelled. There is little difference in the extent of predicted flood risk when compared to the present-day 1 in 100 annual probability event, but flood depths increase in the centre of the LDO area with depths of up to 0.6-1.5m predicted in Mincing Lane and Market Street, and flood depths of up to 0.45m-1.0m along Stepney Street and Vaughan Street.

3.5 TIDAL FLOODING

3.5.1 Tidal flooding occurs as a result of high tides and tidal surges due to severe weather conditions, or a combination of the two.

3.5.2 Review of the Llanelli Modelling Study (2009) and Llanelli SFCA Stage 2 (2013) indicates that the LDO area is outside of the extent of the modelled 1 in 1000 annual probability extreme tidal level. The Llanelli SFCA Stage 2 (2013) also indicates that the LDO area is outside of the extent of the modelled 1 in 200 annual probability plus climate change tidal level allowing for a breach in the coastal flood defences. The risk of tidal flooding within the LDO area is therefore considered to be low.

3.6 SURFACE WATER FLOODING

3.6.1 Surface water flooding occurs when rainfall generated surface water is unable to runoff into watercourses or available local drainage systems. It is typically associated with high intensity rainfall events but may also occur at lower intensities when the ground is saturated or frozen. Rainfall collects in man-made or natural depressions in the ground and, in developed areas, can pose flood risk to properties and people.

3.6.2 Review of NRW's updated Flood Map for Surface Water suggests that the LDO area is at a high risk of surface water flooding. During the 1 in 30 annual probability event flood depths of up to 300mm are generally predicted along Stepney Street and flood depths of up to 600mm are generally predicted along Mincing Lane and Market Street. An isolated area with flooding up to 900mm is predicted in the Mincing Lane car park although this is not considered representative of the area.

3.6.3 During the 1 in 100 annual probability event the majority of the access roads through the site are predicted to flood. Flood depths of up to 600mm are generally predicted along Stepney Street and flood depths of up to 900mm are generally predicted along Mincing Lane. Flood depths continue to increase during the 1 in 1000 annual probability event, reaching 900mm within Stepney Street and 1200mm in the Mincing Lane car park.

3.6.4 The NRW surface water map in this area is produced using a national generalised computer model. As such the modelling does not include pipe drainage systems or small culverts on watercourses. Most significantly the culvert through the site is not represented in the modelling. Therefore the NRW surface water map shows that flow on the River Lliedi is backing up behind the A484 Thomas Street before spilling over the road and entering the site. It is likely therefore that the predicted flood risk is significantly over estimated as flow will be able to pass beneath the A484 Thomas Street through the River Lliedi culvert.

3.6.5 The purpose of the NRW map is to highlight those areas potentially at risk of flooding from surface water. Where flooding is shown, this should prompt further consideration to the actual risk. Maps showing the predicted flood depths and flow velocities for a range of events are provided in Appendix A-9.

3.7 GROUNDWATER FLOODING

3.7.1 Groundwater is the term given to water when it is contained within the rocks beneath our feet. Permeable rocks may contain a very large amount of water which has collected from the percolation of water through the soil and rock. The level of the water within these rocks is called the water table. Flooding can occur where the local geology is dominated by permeable rocks, there is a high water table and the land is relatively low-lying. Groundwater flooding occurs where the groundwater levels rise above the ground level.

3.7.2 Review of the BGS geological map indicates that the bedrock geology of the site comprises predominantly Hugh Member – Sandstone while the superficial geology comprises Till, Devensian-Diaicton. Soils are generally slowly permeable loamy and clayey soils.

3.7.3 Assessment of the Aquifer designation map suggests the bedrock of the site is classed as Secondary A aquifer. These are aquifers with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

3.7.4 Assessment of the Source Protection Zone (SPZ) mapping indicates that the site does not lie within the SPZ.

3.7.5 Review of historic borehole records available through the BGS geological map indicates groundwater was struck at depths between 4m and 4.9m below ground level within the LDO area. Groundwater levels within the LDO area may therefore be high. Groundwater emergence is unlikely to occur given the impermeable nature of the site. However, groundwater could pose risk to basement structures, although it is understood that no new basement structures will be proposed.

3.8 FLOODING FROM RESERVOIRS (OR OTHER WATER STORAGE FACILITIES)

3.8.1 Structures such as raised reservoirs or raised canals (i.e. structures designed to hold, or capable of holding, water above the surrounding ground levels) can pose a significant flood risk if they were to fail.

3.8.2 The NRW Risk of Flooding from Reservoirs map shows the likely extent of flooding in the event of reservoir failure. Although the likelihood of such an occurrence is low as all large reservoirs are stringently governed under the Reservoirs Act 1975, a large volume of water could escape with little or no warning if a failure were to occur. The key purpose of the map is to highlight those areas where developers and the public need to be aware of the potential risks should a breach of a reservoir occur and therefore the actions that should be taken.

3.8.3 The Upper Lliedi and Cwm Lliedi reservoirs are located approximately 5.6km and 3.2km upstream of the LDO area respectively in the upper catchment of the River Lliedi. Review of NRW's reservoir flood map indicates that should a failure at one or more of the reservoirs occur then the consequence of flooding at the site would be significant. However, given the stringent inspection and maintenance of the reservoirs the likelihood of a failure occurring is deemed to be very low and therefore the overall risk of flooding from reservoirs is considered to be low.

3.9 FLOODING FROM SEWER AND WATER SUPPLY INFRASTRUCTURE

3.9.1 Sewer flooding can occur when there is a hydraulic overload of the existing sewer network. This can result from intense rainfall or when there is a blockage in the existing network forcing the flows to back-up the pipe network and emerge out of openings such as manholes and road gullies, posing flood risk to people and properties. Infrastructure failure such as pipe burst of water mains can have a similar effect including causing internal flooding to properties.

3.9.2 Dwr Cymru Welsh Water (DCWW) service records confirms the LDO area is served by an existing combined sewer system. Further discussions with DCWW indicate that there have been a number of historic sewer flooding incidents recorded within the LDO area. Cowell Precinct, a property located to the south-west of the site on John's Street, has flooded on two occasions due to hydraulic overloading of the existing sewer network (locations shown in Appendix A-4). Records shows that on both occasions the property suffered external flooding. This has been registered on the DCWW DG5 register and is pending resolution.

3.9.3 Further assessment of the existing utilities within the Llanelli Town Centre is detailed in the Infrastructure Study report that accompanies the LDO. This report provides information on the location and capacity of the existing utilities and the utility company requirements for new connections into the existing service network, particularly with regard to sewerage discharge and water supply. It makes a recommendation in relation to the implementation of a drainage strategy to support the delivery of the LDO.

4 FLOOD CONSEQUENCES ASSESSMENT

4.1.1 Existing properties within the LDO area have been identified to be risk of flooding predominantly from the fluvial River Lliedi and surface water runoff. The area is also indicated to be largely located within the DAM Zone C2, defined as an area at (fluvial) flood risk up to the 1 in 1000 (1%) annual probability event without significant flood defence infrastructure.

4.1.2 Whilst Planning Policy Wales and TAN15 recommends new development to be steered to areas at low risk of flooding, there is the recognition that not all development can be sited in low flood risk areas. In these instances justification will be required to ensure the flood consequences are acceptable for properties sited within high risk areas.

4.1.3 The purpose of the LDO is to promote the change in use of existing buildings that will support regeneration and future investment in the LDO area; it is therefore clearly not possible to locate this redevelopment outside of this area. However, the change in use of these properties offers an opportunity to reduce flood risk by steering the most vulnerable of developments to those areas that are at the lowest risk of flooding through consideration of flood probability, flood depths and flood flow velocity; as well as reduce risk through the incorporation of appropriate mitigation. This is discussed in the sections below.

4.2 JUSTIFICATION OF LOCATION OF DEVELOPMENT

4.2.1 The LDO SFCA has identified that it is unavoidable to locate the proposed change in use within areas identified to be at fluvial flood risk. The regeneration of this area is therefore in accordance with the requirements of Planning Policy Wales and TAN15 as the proposed change in use of the buildings will form part of the Council's regeneration initiative and be important to the local economy.

4.2.2 The Local Development Order (Consultation Draft) suggests a schedule of permitted uses within the LDO area and their suitability in regard to the identified DAM Zones. This is summarised in Table 4.

Table 4: Suitability of development in Zone C2[2]

USE CLASS	WITHIN ZONE C2		OUTSIDE ZONE C2	
	Ground floor	Other floors excluding basements	Ground floor	Other floors excluding basements
A1 Shops	Yes	Yes	Yes	Yes
A2 Financial and professional services	Yes	Yes	Yes	Yes
A3 Restaurants and cafes	Yes	Yes	Yes	Yes
A3 Drinking establishments (but not night clubs)	Yes	Yes	Yes	Yes
A3 Hot food takeaways	Yes	No	Yes	No
B1 Business (offices other than those within A2)	No	Yes	No	Yes
C1 Hotels, boarding houses and guest houses	No	Yes	No	Yes

[2] Llanelli Town Centre, Local Development Order Consultation Draft, April 2017

USE CLASS	WITHIN ZONE C2		OUTSIDE ZONE C2	
	Ground floor	Other floors excluding basements	Ground floor	Other floors excluding basements
C3 Dwellings (residential incl. flats)	No	Yes	No	Yes
D1 Non-residential institution (Note – LDO excludes law courts, church halls and libraries)	No	Yes	Yes	Yes
D2 Assembly and leisure buildings (note LDO only permits gymnasiums and area for indoor sports or recreations – except for motor sports, or where firearms are used)	No	Yes	Yes	Yes
Other (specified sui) Launderettes and taxi businesses only	Yes	Yes	Yes	Yes

4.2.3 Although C1 and C3 class uses would usually be considered acceptable on a ground floor outside Zone C2 from a flood risk perspective, the Council are not promoting this as it would not assist in the promotion of a viable and vibrant street scene in Llanelli Town Centre. However, due consideration will be given should representations be received during the LDO consultation.

4.2.4 The LDO does not permit the redevelopment of existing basements and, in particular, the use of basements is not considered appropriate for any type of development located in Zone C2. The use of any basements is therefore at the occupant or landowner's risk.

4.3 ASSESSMENT OF FLOOD CONSEQUENCES

4.3.1 As discussed above, it is recommended that the location of the change in use proposals is informed by the vulnerability of the proposed use and the risk of flooding at that location. A sequential approach should be adopted that directs the most vulnerable of uses to those areas that are at the lowest risk of flooding and where the consequences of flooding are also lowest – i.e. to those areas that have the lowest flood probability and that will experience the lowest flood depths and flood flow velocities.

4.3.2 It is recommended that uses classed as highly vulnerable (i.e. residential premises (including hotels, boarding houses and guest houses)) and public buildings (i.e. assembly and leisure buildings) are located outside of Zone C2 where possible. However, given the predicted extent of Zone C2 (and modelled 1 in 1000 annual probability extents as discussed in Section 3.4) it is unlikely that all highly vulnerable development can be located outside of Zone C2. Where this is unavoidable, the Council are committed to locating this type of development on the upper floors and not on the ground floor. This approach is supported by the Local Development Order (Consultation Draft) presented in Table 4.

4.3.3 For development located within Zone C2, TAN15 provides indicative guidance on what it considers to be tolerable conditions in terms of flood depth, velocity, rate of flood level rise and speed of inundation for different types of development. This is summarised in Table 5. Typically depths over 0.15m of fast flowing floodwater can knock over an adult and 0.6m depths of water can move a car.

Table 5: Tolerances for flood depth, velocity and rate of inundation

Type of development	Maximum depth of flooding (mm)	Maximum rate of rise of floodwaters (m/hr)	Maximum speed of inundation of flood risk area (hrs)	Maximum velocity of floodwaters (m/sec)
	Property **Access**			**Property** **Access**
Residential (habitable rooms)	600 600	0.1	4	0.15 0.3
Commercial & retail	600 600	0.3	2	0.15 0.3
Industrial	1000 1000	0.3	2	0.3 0.45

4.3.4 An assessment of flood depths and velocities within the LDO area has been informed by the Llanelli Modelling Study (2009) (with updated hydrology) and NRW surface water flood mapping. The results of this assessment are discussed in detail in Section 3.4 and supported by mapping in Appendix A-8 and A-9. A summary of this analysis is presented in Tables 6 and 7 below for comparison with the TAN15 guidance. This data is extracted from the 1 in 1000 annual probability scenario.

Table 6: Summary of predicted fluvial flood depths and velocity at the high flood risk areas

Return Period (annual probability)	Maximum flood depth (mm)	Maximum flood velocity (m/s)
1 in 25	450	0.2
1 in 75	1000	1.0
1 in 100	1000	1.0
1 in 100+30%	1500	1.0
1 in 1000	1500	1.0

Table 7: Summary of predicted surface water flood depths and velocity at the high flood risk areas

RETURN PERIOD (YEAR)	MAXIMUM FLOOD DEPTH (MM)	MAXIMUM FLOOD VELOCITY (M/S)
1 in 30	600	0.50
1 in 100	900	1.0
1 in 1000	1200	1.0

4.3.5 Table 6 and Table 7 indicate that the recommended tolerances of TAN15 are exceeded during fluvial flood events greater than the 1 in 25 annual probability event and surface water events greater than the 1 in 30 annual probability event. Up to the 1 in 100 annual probability events, generally speaking the proportion of the LDO area that exceeds the recommended tolerances is relatively small, however when the potential effects of climate change and the 1 in 1000 annual probability events are considered the percentage of the LDO area that exceeds the recommended tolerances is significantly greater.

4.3.6 These predicted depths and velocities could have significant health and safety risks, particularly with the access and egress of properties during extreme events. The risk is higher where highly vulnerable use classes (i.e. residential premises (including hotels, boarding houses and guest houses)) and public buildings (i.e. assembly and leisure buildings) are sited within these areas. In these areas Carmarthenshire County Council and NRW intend to manage the consequence of flooding through mitigation measures discussed in Section 5 of this report. It should be noted that it is not proposed to locate highly vulnerable development (i.e. residential premises (including hotels, boarding houses and guest houses)) and public buildings (i.e. assembly and leisure buildings) on the ground floor if situated in Zone C2.

4.4 BLOCKAGE ANALYSIS

4.4.1 The LDO SFCA has considered residual flood risk associated with a partial blockage to flow within the River Lliedi. The analysis was undertaken for the 1% (1 in 100) annual probability fluvial event plus climate change allowance (central estimate) for the following locations and scenarios:

- 5% blockage at Andrew Street bridge upstream of the LDO area, grid reference SN 51137 00754; and
- 30% blockage at the entrance to the River Lliedi culvert immediately adjacent to the LDO area upstream of Thomas Street, grid reference SN 50762 00528.

4.4.2 Mapped outputs for flood depth and flow velocity are provided in Appendix A-8 for these scenarios.

4.4.3 Blockage at Andrew Street Bridge and at the entrance to the River Lliedi culvert is predicted to have negligible effect on the predicted fluvial flood extent, depth or velocity within the LDO area.

4.4.4 It is understood that Carmarthenshire County Council is responsible for maintaining the River Lliedi culvert, however details of that responsibility and the existence of maintenance regimes will require confirmation with the relevant department within the Council. To date there are no known records of flooding within the LDO area associated with reduced culvert capacity.

4.5 MANAGING RESIDUAL RISK

4.5.1 The decision of locating development in areas identified to be at flood risk is ultimately the decision of the local planning authority and must be informed by an assessment of the risk and the consequences of flooding, both to the development and to people and property elsewhere as a result of the development. It is therefore important to address the consequences of flooding and demonstrate that these can be adequately managed in accordance with TAN15 and the requirements of NRW and the Council.

4.5.2 TAN15 states that a site should only be considered for development if the following conditions can be satisfied:

- Flood defences must be shown by the developer to be structurally adequate particularly under extreme overtopping conditions (i.e. that flood with a probability of occurrence of 0.1%);
- The cost of future maintenance for all new/approved flood mitigation measures, including defences, must be accepted by the developer and agreed with NRW;
- The developer must ensure that future occupiers of development are aware of the flooding risks and consequences;
- Effective flood warnings are provided at the site;
- Escape/evacuation routes are shown by the developer to be operational under all conditions;
- Flood emergency plans and procedures produced by the developer must be in place;
- The development is designed by the developer to allow the occupier of the facility for rapid movement of goods/possessions to areas away from the floodwaters;
- Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood; and
- No flooding elsewhere.

4.5.3 In addition to the above, when a development located within an area identified to be at risk of flooding passes the justification test, the development should only proceed if the consequences of flooding can be managed to an acceptable level for the development and to ensure:

- Minimal risk to life;
- Minimal disruption to people living and working in the area;
- Minimal potential damage to property;
- Minimal impact of the proposed development on flood risk generally; and
- Minimal disruption to the natural environment.

4.5.4 Proposed flood management and mitigation measures are discussed in Section 5.

5 FLOOD MANAGEMENT AND MITIGATION MEASURES

5.1.1 This section of the report presents the flood management and mitigation measures that could be used to reduce and/or manage the flood consequences identified within the LDO area. It should be noted that the LDO does not permit highly vulnerable uses (TAN15) at ground floor within zone C2 and this is confirmed by the schedule of approved uses together with the conditions.

5.2 DEVELOPMENT LOCATION

5.2.1 As discussed in Section 4.2, it is unavoidable that the LDO area and proposed change in use will be located within areas identified to be at fluvial and surface water flood risk. However, as presented in Table 4 in Section 4.2, is not proposed to locate highly vulnerable development (i.e. residential premises (including hotels, boarding houses and guest houses)) and public buildings (i.e. assembly and leisure buildings) on the ground floor if situated in Zone C2.

5.2.2 Where highly vulnerable development is proposed to be located on the upper floors in Zone C2, it is recommended that a sequential approach is applied to locate development to those areas of the LDO area at least risk, i.e. where flood depths and velocities are smallest. Broadly speaking the areas of the LDO area at lowest flood risk are to the west and south-west along John Street and Cowell Street.

5.3 NATURAL RESOURCES WALES FLOOD WARNING SERVICE

5.3.1 Review of the NRW flood alert and flood warning mapping shows that the LDO area lies within the area currently receiving the NRW flood information service. This service provides warnings to communities for the possibility of flooding from nearby watercourses, giving them time to implement flood management measures such as Property Level Protection (PLP) or evacuate to a place of safety (https://naturalresources.wales/flooding). The current lead warning times for fluvial events is between 1-2 hours.

5.3.2 Communities can also access additional information such as updates on river levels, how to prepare for floods and how to get help during a flood situation. The extent of the area that receives this service is illustrated in Appendix A-6.

5.3.3 It is recommended that all occupants of properties within the Zone C2 of the LDO area register for the flood alert and flood warning services provided by NRW. Flood warnings can be received by phone, email, fax or pager.

5.4 EMERGENCY EVACUATION MEASURES

5.4.1 Appropriate emergency evacuation procedures are essential for the sustainable change in use promoted under the LDO, particularly to those areas that are identified to be at risk up to the 1 in 100 (1%) annual probability event.

5.4.2 Currently, there is no specific emergency evacuation plan for Llanelli. However, there are emergency plans developed for the wider Carmarthenshire County and by the Local Police to provide the necessary guidance to the local community on emergency response including flood events. These plans include:

- Carmarthenshire County Council Flood Response Plan - http://www.carmarthenshire.gov.wales/home/residents/your-community/emergency-planning.
- Dyfed Powys Local Resilience Forum Evacuation and Shelter Arrangements (Generic Evacuation Plan), see Appendix A-7.
- Dyfed Powys Local Resilience Forum Severe Weather Arrangements Plan.

5.4.3 It is recommended that the property owner, as part of any proposed change in use within Zone C2, provides an Emergency Response Plan applicable to the nature of risk posed to their location. Any future occupants of the buildings must be made aware of the Emergency Response Plan. Where applicable, an advice note will be appended to the Certificate of Conformity/ Commencement Notice Approval as and where appropriate. At minimum, the Emergency Response Plan should:

- Summarise the risk of flooding to the site, including the likely probability of flooding, depth of flood waters, rate of rise of flood waters, rate of inundation and velocity of flood flow.
- Set out roles and responsibilities with regards to flood management and response.
- Summarise how the risk of flooding needs to be monitored, i.e. through monitoring of the NRW Flood Information Services, and the point at which action needs to be taken.
- Useful emergency contact numbers including the flood line number and websites of where further flood information is available.
- Detail proposed evacuation routes to areas of safety, including primary and secondary evacuation routes (dry route if possible), dry refuge point and designated rest centres.
- Information on how occupants can prepare for and react to a flood event (i.e. before, during and after flood event): https://naturalresources.wales/flooding/what-to-do-during-and-after-a-flood).

5.4.4 Guidance on how to produce an emergency evacuation plan is available on the Council's website (http://www.carmarthenshire.gov.wales/home/residents/your-community/emergency-planning/community-emergency-planning).

5.4.5 Appropriate signage on doors of buildings should be erected to make occupants aware of the risk of flooding including evacuation procedures and routes to be followed during a flood event.

5.4.6 Property owners of buildings should regularly review their approach to flood management informed by any updates made to the NRW flood maps and DAMs accordingly.

5.4.7 It is important to recognise that the proposed change in use will potentially increase the number of people at risk of flooding, and therefore the number of people that may need to be evacuated during an extreme event. It is important for property owners to engage with the Emergency Services as the earliest opportunity to ensure they have adequate capacity to deal with any evacuations required.

5.5 PROPERTY RESISTANCE AND RESILIENCE MEASURES

5.5.1 Where it is unavoidable to locate development in Zone C2 (i.e. within the extent of the 1 in 1000 (0.1%) annual probability event), the use of property resistance and resilience measures may be considered.

5.5.2 Property resistance measures traditionally include measures such as flood gates and flood resilient doors and windows. These physically prevent flood waters from entering a building, but usually require occupants of the building to know when a flooding event is likely to happen and install the measures in preparation for the event. Raising internal threshold levels is another way of making a building more resilient to flooding, although as the LDO area proposes to reuse existing building structures this measure is unlikely to be appropriate.

5.5.3 The use of property resistance measures are generally considered applicable for flood depths up to 600mm. Depths greater than 600mm can apply an unacceptable amount of pressure to the structure (and to the overall building structure), and a location-specific structural stability assessment would need to be undertaken to confirm the suitability of the measures.

5.5.4 Other common measures to prevent or reduce the ingress of flood waters into a building can include replacing wooden floor boards with concrete floors to prevent the ingress of flood waters from beneath the building, and installing air brick covers or self-closing air bricks.

5.5.5 Properties at risk of flooding can also incorporate properly resilience measures within the fabric of the building to reduce recovery time in the event of internal flooding. These measures are usually bespoke to the property and may involve adapting the building and using alternative building materials. This could include the use of water-resistant plaster, using tiled floors instead of carpets, using lime plaster instead of gypsum on walls, fitting stainless steel or plastic kitchens instead of chipboard ones or have free-standing kitchen units you can move, locating heating and air conditioning equipment above the flood level, and locating all electrical sockets above the flood level.

5.5.6 All property resistance and resilience measures should, at minimum, aim to protect the property up to the 1 in 100 (1%) annual probability event and taking climate change into account. In accordance with the Welsh Government climate change recommendations, mitigation measures should be designed using the upper end estimate to ensure the long term resilience of the development.

5.5.7 It is recommended that the property owner or occupant implements the above measures where possible, however the LDO does not seek to prescribe their requirement.

5.6 MEASURES FOR FOUL WATER CONNECTIONS

5.6.1 The proposed LDO area may result in changes to occupancy levels and therefore has the potential to increase foul flows discharged into the existing sewer network. Reference should be made to the Infrastructure Study that supports the LDO and which sets out a Drainage Strategy

5.6.2 The Infrastructure Study recommends that the LDO Drainage Strategy takes the form of pre commencement conditions that may require information to be submitted from LDO applicants. Further information on the Strategy and any information required from applicants can be sourced from Section 3.1 of the Infrastructure Study

5.7 ASSESSMENT OF FLOOD RISK ELSEWHERE

5.7.1 Development proposed as part of the LDO intends to re-use existing buildings and it is understood that no changes to existing building footprints or to the topography of external areas will be required. Development within the LDO area will therefore have no impact on flood risk elsewhere.

5.7.2 As discussed above the LDO area is served by a combined sewer network. It is understood that change in use of the existing buildings will introduce no new areas of hardstanding, including that associated with building roofs, and that existing drainage connections will be maintained. Development within the LDO area will therefore have no impact on flood risk elsewhere associated with an increase in surface water runoff.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1.1 The LDO SFCA has been prepared to support the proposed change in use of the existing buildings in the LDO area in Llanelli as part of the LDO approval process. This has been informed by Planning Policy for Wales, Technical Advice Note 15 and other local planning policies relevant to flood risk. Information regarding flood risk has been obtained from multiple desk based sources including the NRW flood maps and DAMs; the 2009 ESTRY-TUFLOW Llanelli Modelling Study of the Afon Lliedi, Afon Dulais, Afon Dafen and Cille Stream; and in consultation with Carmarthenshire County Council and NRW.

6.2 SUMMARY OF FLOOD RISK

6.2.1 The LDO area has been identified to be at greatest risk of fluvial flooding from the River Lliedi and from surface water runoff. The LDO area is indicated to be largely located within the DAM Zone C2.

6.2.2 Hydraulic modelling of the River Lliedi undertaken in 2009 indicates that flooding at the site is initially through the surcharging of manholes located on Mincing Lane, adjacent to Market Street, and predicted to occur during events with an annual probability of 1 in 25.

6.2.3 Flooding during the 1 in 75 and 1 in 100 annual probability events is predicted to increase substantially. During the 1 in 100 annual probability event flood depths of up to 1m are predicted in the vicinity of Mincing Lane and Market Street, and flood depths of between 0.3m – 0.6m along Stepney Street and Vaughan Street. The greatest flow velocities are predicted along Stepney Road and Market Street with flow velocities predicted to be between 0.2m/s -0.5m/s.

6.2.4 The extent of flooding within the LDO area does not increase significantly between the 1 in 100 and 1 in 1000 annual probability events. However the predicted depth of flooding increases substantially with flood depths of up to 1.5m predicted in Mincing Lane and Market Street, and flood depths of up to 1.0m along Stepney Street and Vaughan Street. Flow velocities are also predicted to increase along Stepney Road and Market Street to up to 1.0m/s, with velocities along Vaughan Street also predicted to increase to between 0.2m/s – 0.5m/s.

6.2.5 Approximately 80% of the LDO area is predicted to be at fluvial flood risk during the 1 in 100 and 1 in 1000 annual probability event.

6.2.6 The LDO SFCA has considered residual flood risk associated with a partial blockage to flow within the River Lliedi at Andrew Street bridge upstream of the LDO area and at the entrance to the River Lliedi culvert immediately adjacent to the LDO area. The analysis was undertaken for the 1% (1 in 100) annual probability fluvial event plus climate change allowance and indicated negligible effect on the predicted fluvial flood extent, depth or velocity within the LDO area.

6.3 SUMMARY OF PLANNING CONTEXT

6.3.1 All works in the proposed LDO area comprise the change in use of existing buildings to regenerate the Llanelli town centre. It is therefore not possible to relocate the proposed change in use to areas identified to be at lower risk of flooding. The LDO area forms part of the Council's regeneration initiative and is important to the local economy.

6.3.2 Whilst Planning Policy Wales and TAN15 recommend development to be steered to areas at low risk of flooding, there is the recognition that not all development can be sited in low flood risk areas. In these instances justification will be required to ensure the flood consequences are acceptable for properties sited within high risk areas.

6.4 SUMMARY OF FLOOD CONSEQUENCES ASSESSMENT

6.4.1 To manage flood risk, it is proposed that highly vulnerable use classes such as residential properties are steered away from Zone C2 (i.e. the extent of the 1 in 1000 (0.1%) annual probability event) where possible. Where this cannot be achieved, it is proposed that highly vulnerable use classes located in Zone C2 are located on the upper floors of the property and not on the ground floor. No redevelopment of basement structures is proposed as part of the LDO.

6.4.2 Reference is made to the schedule of approved uses where no highly vulnerable development (TAN 15) is allowed on ground floors within Zone C2. Furthermore, reference is made to the LDO conditions.

6.4.3 It is anticipated that applicants will not need to submit an individual FCA to the LPA where they comply with the LDO and pertinent mitigation measures.

6.5 SUMMARY OF FLOOD MANAGEMENT AND MITIGATION MEASURES

6.5.1 The following recommended mitigation measures have been proposed to reduce and manage the identified flood risks to the LDO area:

- → It is the responsibility of all occupants of properties within Zone C2 of the LDO area to register to receive flood alert and warning services provided by NRW.
- → It is the responsibility of the property owner or landlord, as part of any proposed change in use within Zone C2, to provide an Emergency Response Plan applicable to the nature of risk posed to their building. Future occupants of the buildings must be made aware of the Plan.
- → The applicant will need to adhere to any requirements which may arise from any the recommendations set out within the LDO Infrastructure Study, most notably in relation to the proposed Drainage Strategy (and submission of any required information).

A P P E N D I X A

APPENDIX A-1 LOCATION PLAN

APPENDIX A-2 DEVELOPMENT ADVICE MAP

APPENDIX A-3 NRW FLOOD ZONES

APPENDIX A-4 HISTORICAL FLOOD RECORDS

APPENDIX A-5 CHANGE IN USE MAP

APPENDIX A-6 NRW FLOOD INFORMATION SERVICES

APPENDIX A-7 VISUAL MAP OF DYFED POWYS LOCAL RESILIENCE FORUM PLANS

APPENDIX A-8 FLUVIAL FLOOD DEPTHS AND VELOCITIES

APPENDIX A-9 SURFACE WATER FLOOD DEPTHS AND VELOCITIES