Flood Consequences Assessment
Land off Builder Street, Llandudno, LL30 1DR
Presented to Lane End Developments Construction Ltd
Issued: January 2020
Delta-Simons Project No. 19-2094.01
Flood Consequences Assessment
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Delta-Simons Project Number 19-2094.01

Report Details

<table>
<thead>
<tr>
<th>Client</th>
<th>Lane End Developments Construction Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report Title</td>
<td>Flood Consequences Assessment</td>
</tr>
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<td>Joshua Rigby (<a href="mailto:joshua.rigby@deltasimons.com">joshua.rigby@deltasimons.com</a>)</td>
</tr>
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</table>

Quality Assurance

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<thead>
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<th>Status</th>
<th>Issue Date</th>
<th>Comments</th>
<th>Author</th>
<th>Technical Review</th>
<th>Authorised</th>
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<tbody>
<tr>
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<td>Issue 2</td>
<td>23rd January 2020</td>
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<td>Josh Rigby</td>
<td>Alex Perryman</td>
<td>Alex Perryman</td>
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</tbody>
</table>

About us

Delta-Simons is a trusted, multidisciplinary environmental consultancy, focused on delivering the best possible project outcomes for customers.

Specialising in Environment, Health & Safety and Sustainability, Delta-Simons provide support and advice within the property development, asset management, corporate and industrial markets. Operating from ten locations - Lincoln, Birmingham, Bristol, Dublin, Newcastle, Leeds, London, Manchester, Norwich and Nottingham - we employ over 100 environmental professionals, bringing experience from across the private consultancy and public sector markets.

Delta-Simons is proud to be a founder member of the Inogen® Environmental Alliance, a global corporation providing multinational organisations with consistent, high quality and cost effective environmental, health, safety, energy and sustainability solutions. Inogen assists multinational clients by resolving liabilities from the past, addressing today’s requirements and delivering solutions for the future. With more than 200 offices located on every continent, more than 6,430 staff worldwide, and projects completed in more than 120 countries, Inogen provides a single point of contact for diverse markets as Automotive, Chemical, Consumer Products & Retail, Financial, Food & Beverage, Healthcare, Insurance, Manufacturing, Non-Profit Organisations, Oil & Gas, Real Estate, Services Firms, Technology and Transportation, among others.
Reference of Terms

Canal Failure
Canal failure can include a breach or overtopping of a canal system due to the effects of a high intensity rainfall event or structural failure that is not associated with a rainfall event. Such failure can be very dangerous as it can involve the rapid release of large volumes of water at high velocity, however, it is typically limited to reaches of canal that are raised above the surrounding ground level on one or both side and where watercourses or other structures pass beneath the canal. The size and nature of canals themselves can also have a hydraulic control on the mechanisms of flooding associated with a failure, resulting in a rapid peak in flow followed by a gradual reduction as the flow becomes restricted by the capacity of the canal itself to rapidly pass flow to the breach or failure point.

Fluvial Flooding
Fluvial flooding typically occurs when a river's capacity is exceeded, and the excess water overtops the river banks. It can also occur when the watercourse has a high level downstream, perhaps due to structures or blockage, thus limiting conveyance. This creates a back-up of water which can overtop the banks. Typical flooding issues occur when the natural floodplain has been urbanised and the river has been confined.

Groundwater Flooding
Groundwater flooding is caused by the emergence of water from beneath the ground at either point or diffuse locations when the natural level of the water table rises above ground level. This can result in deep and long-lasting flooding of low-lying or below-ground infrastructure such as underpasses and basements. Groundwater flooding can cause significant damage to property, especially in urban areas, and can pose further risks to the environment and ground stability.

Reservoirs Failure
Reservoir failure can be a particularly dangerous form of flooding as it results in the sudden release of large volumes of water that can travel at high velocity. This can result in deep and widespread flooding, potentially resulting in significant damage. The likelihood of reservoir flooding occurring is generally extremely low given that all large reservoirs are managed in accordance with the Reservoirs Act 1975. Under the Reservoirs Act 1975, a large raised reservoir is defined as one that holds over 25,000 cubic metres of water above the level of the surrounding land. The EA's online reservoir inundation map illustrates the maximum flood extents that could potentially occur in the event of a reservoir failure.

Sewer Flooding
Flood from sewers primarily occurs when flow entering a system exceeds available capacity or if the network capacity has been reduced through blockage or collapse. In the case of surface water sewers that discharge to watercourses, the same effect can be caused as a result of high water levels in the receiving watercourse. As a result, water can begin to surcharge the sewer network, emerging at ground level through gullies and manholes and potentially causing flooding to highways and properties. If this occurs flooding can represent a significant hazard to human health due to the potential for contaminants in flood water.

Surface Water Runoff
Surface water runoff is defined as water flowing over the ground that has not yet entered a drainage channel or similar. It usually occurs as a result of an intense period of rainfall which exceeds the infiltration capacity of the ground. Typically, runoff occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally due to the soil type or geology, or due to development which places impervious material over the ground surface (e.g. paving and roads).

Tidal Flooding
Tidal flooding is caused by high tides coinciding with a low-pressure storm system which raises sea and tidal water levels, overwhelming coastal and river defences. This may be made worse by gale force winds blowing the raised body of water up tidal river basins some distance from the coast, due to floodwater being forced up the tidal reaches of rivers and estuaries. Such flooding may become more frequent in future years due to rising sea levels.
# Executive Summary

<table>
<thead>
<tr>
<th>Project Understanding</th>
<th>The proposed development is for the redevelopment of an existing derelict / cleared Site in the centre of Llandudno town centre for residential end use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Risk Assessment Summary</td>
<td>The Site is located within Flood Zone C1 on the Welsh Government Development Advice Map – an area considered at flood risk, but served by significant infrastructure, including flood defences, with a 0.1% (1 in 1000) or greater annual probability of flooding and defended Flood Zone 3 on the NRW Flood Map for Planning. The Site is considered to be at a Low risk of flooding from all sources, assuming the initial hydraulic modelling results are representative of the final results. In order to comply with TAN15 the Site will need to flood free 1 in 200 year + 100 year Climate Change flood event.</td>
</tr>
<tr>
<td>Mitigation Measures</td>
<td>In order to comply with TAN15 the Site will need to be proven to be or raised above the 1 in 200 year + 100 year Climate Change flood level. This will ensure the building is compliant with section A1.14 of TAN15. The flood depths are within the tolerable limits permitted by A1.15 of TAN15. A Flood Warnings and Evacuation Plan should be produced in consultation with the council emergency planners.</td>
</tr>
</tbody>
</table>

This is intended as a summary only. Further detail and limitations of the assessment is provided within the main body of the Report.
Table of Contents

1.0 INTRODUCTION.........................................................................................................................1
  1.1 Appointment..........................................................................................................................1
  1.2 Project Understanding ...........................................................................................................1
  1.3 Scope of Works ......................................................................................................................1
  1.4 Sources of Information ........................................................................................................1
  1.5 Project Limitations ................................................................................................................2

2.0 SITE DESCRIPTION ....................................................................................................................3

3.0 RELEVANT PLANNING POLICY AND GUIDANCE ...............................................................5
  3.1 Introduction ..........................................................................................................................5
  3.2 Assessment of Flood Risk ....................................................................................................5
  3.3 Planning Policy Wales ..........................................................................................................5
  3.4 Local Policy ........................................................................................................................6
  3.5 Climate Change ....................................................................................................................6
  3.6 Consultation ........................................................................................................................6

4.0 ASSESSMENT OF FLOOD RISK ............................................................................................7
  4.1 Tidal Flood Risk ....................................................................................................................7
  4.2 Fluvial Flood Risk ................................................................................................................10
  4.3 Surface Water Flood Risk ....................................................................................................10
  4.4 Groundwater Flood Risk .....................................................................................................11
  4.5 Artificial Sources Flood Risk ...............................................................................................11
  4.6 Summary of Flood Risk .......................................................................................................11
  4.7 Mitigation .............................................................................................................................11
  4.8 Flood Warnings and Evacuation .........................................................................................12
  4.9 Impact on Flood Risk Elsewhere .........................................................................................12

5.0 JUSTIFICATION .......................................................................................................................13

6.0 CONCLUSIONS AND RECOMMENDATIONS ......................................................................14
  6.1 Conclusions ........................................................................................................................14
  6.2 Recommendations ..............................................................................................................14

Appendices

Appendix A Limitations
Appendix B Topographical Information
Appendix C Development Plans
1.0 Introduction

1.1 Appointment

1.1.1 Delta-Simons Environmental Consultants Limited ("Delta-Simons") was instructed by Lane End Developments Construction Ltd (the "Client") to carry out a Flood Consequences Assessment (FCA) of Land off Builder Street, Llandudno, LL30 1DR (the "Site").

1.2 Project Understanding

1.2.1 The Site is shown to be located wholly within Flood Zone C1 (an area served by significant infrastructure, including flood defences) on the Natural Resource Wales (NRW) Development Advice Map (DAM) and Defended Flood Zone 3 (High Probability) on the NRW Flood Map for Planning therefore a FCA is required to support the proposed residential development.

1.2.2 The aim of this report is to assess the potential flood risk to the Site, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified risk. This report has been prepared in accordance with the guidance contained in Planning Policy Wales (PPW) and Technical Advice Note 15 (TAN15): Development and Flood Risk.

1.2.3 This report has been prepared in consultation with NRW and Conwy County Borough Council (CCBC).

1.3 Scope of Works

1.3.1 The scope of works has been as follows for this FCA:

▲ Assess flood risk from all sources using best available information including review of NRW data and mapping, online flood mapping, topography and historical records;
▲ Assess previous relevant studies, local authority plans or strategies;
▲ Advise on flood mitigation measures and residual risks;
▲ Advise on compliance with planning policy;
▲ Assess evacuation routes;
▲ Advise on availability of flood warnings; and
▲ Prepare FCA report.

1.3.2 This report takes into account the following national and local policies:

▲ Planning Policy Wales (PPW) (2018)\(^1\);
▲ Technical Advice Note 15: development and flood risk (TAN15) (2004)\(^2\);
▲ Summary of what TAN15 requires for highly vulnerable development (houses) to be considered acceptable\(^3\);
▲ CL-03-16 Flood Consequence Assessments: Climate change allowances (August 2016).\(^4\); and
▲ CCBC Local Development and Planning Policies.

1.4 Sources of Information

1.4.1 The following sources of information have been reviewed and assessed for the purpose of this FCA:

\(^4\) https://gov.wales/climate-change-allowances-and-flood-consequence-assessments-cl-03-16
▲ NRW online flood maps⁵;
▲ British Geological Society (BGS) Interactive Map⁶;
▲ MAGIC Interactive Map⁷;
▲ HR Wallingford Conwy Tidal Flood Risk Assessment (CTFRA) – Llandudno Inundation Modelling (May 2006);
▲ HR Wallingford Conwy Tidal Flood Risk Assessment (CTFRA) – Stage 1 (May 2008);
▲ CCBC Preliminary Flood Risk Assessment (PFRA) (June 2011);
▲ West of Wales Shoreline Management Plan (SMP), (November 2011);
▲ CCBC Strategic Flood Consequences Assessment (SFCA) (August 2012);
▲ CCBC Local Flood Risk Management Strategy (LFRMS) (February 2013); and
▲ CCBC Llandudno Beach Management Plan (LBMP) (August 2017).

1.5 Project Limitations

1.5.1 The NRW Climate Change Guidance was updated in 2016, therefore it is possible that the data shown on the Development Advice Maps and the NRW Flood Map for Planning does not take into account the implications of climate change. For Sites on the periphery of defended areas and or in close proximity to Flood Zone 3, further work may be required to more accurately determine the flood risk.

1.5.2 The wider Delta-Simons limitations are contained within Appendix A.

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⁵ https://flood-map-for-planning.service.gov.uk/
⁶ http://mapapps.bgs.ac.uk/geologyofbritain/home.html
⁷ http://www.magic.gov.uk/
2.0 Site Description

2.1.1 The aim of this section of the report is to outline key environmental information associated with the baseline environment.

<table>
<thead>
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<th>Illustrative Site Layout Plan</th>
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<td><strong>Co-ordinates</strong></td>
</tr>
<tr>
<td>X</td>
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<tr>
<td>278349</td>
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</table>
Road to the north-east of the Site. Oxford Road is then shown to continue to rise to 5.21m AOD to the north of the Site.

Topographic levels to metres Above Ordnance Datum (m AOD) have also been derived from a 1m resolution NRW composite ‘Light Detecting and Ranging’ (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that it correlates well with the topographic survey, identifying that the Site and the wider area slopes form the north-east down to the south-west. Topographical information is provided as Appendix B.

Hydrology

A review of Ordnance Survey (OS) and NRW mapping indicates there are no watercourses within proximity of the Site.

The Irish Sea is located approximately 380m north-east of the Site (North Shore) and 900m south-west of the Site (South Shore) at its closest point.

Geology

Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the Site is underlain by superficial tidal flat deposits, comprising clay, silt and sand. The superficial deposits are identified as being underlain by bedrock comprising Undifferentiated Lower Palaeozoic Rocks (Mudstone) in the north-west, Moelfre Tuff Formation in the north-east and the Nant Ffrancon Subgroup (Siltstone) in the south-west.

According to the Soilscapes mapping the Site is underlain by ‘Loamy and clayey soils of coastal flats with naturally high groundwater’

Delta-Simons undertook trial pitting at the Site in November 2018. During the works nine trial pits were excavated across the Site to a maximum depth of 2.4 metres below ground level (m bgl). Made Ground was identified within all trial pit locations to a maximum depth of 1 m bgl. Tidal Flat deposits underlying the Made Ground in the central and south-western extents. Blown Sand was identified in the north-western extents within two trial pits (TP08 and TP09). No ground water was encountered during the Site investigation works.

Hydrogeology

According to the NRW’s Aquifer Designation data, obtained from MAGIC Map’s online mapping [accessed November 2019], the underlying bedrock deposits are classified as a Secondary B Aquifer. Secondary B Aquifers are ‘predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers’.

No data for superficial aquifer designations is available in Wales.

Local Drainage

Sewer Plans were not available for review at the time of reporting. It is assumed that any existing on-Site drainage was decommissioned and / or removed as part of the demolition works which have occurred. Public sewers in the vicinity of the Site will be located within the surrounding road network.

Proposed Site Conditions

The proposals are for residential development including 56No. apartments, 33No. houses and associated soft landscaping and access. A proposed development plan is included in Appendix C.
3.0 Relevant Planning Policy and Guidance

3.1 Introduction
3.1.1 The aim of this section of the report is to discuss the main aspects of the local and national planning policies that are relevant to any proposed development on the Site and relevant guidance and legislation.

3.2 Assessment of Flood Risk
3.2.1 The flood risk from fluvial (Main Rivers) and coastal flooding is assessed using the Welsh Government, TAN15, Development Advice Maps and the NRW ‘Flood Map for Planning’ (flood risk from rivers or the sea).

The Development Advice Maps define three development advice zones as follows:

▲ Zone A: Considered to be at little or no risk of fluvial or tidal/coastal flooding.
▲ Zone B: Areas known to have been flooded in the past evidenced by sedimentary deposits.
▲ Zone C: Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal) (i.e.: greater than 1 in 1,000 chance of flooding in any one year).

Zone C is divided into C1 and C2.

▲ C1 is areas of the floodplain which are developed and served by significant infrastructure, including flood defences.
▲ C2 is Areas of the floodplain without significant flood defence infrastructure.

3.2.2 The NRW ‘Flood Map for Planning’ defines three zones of different flood risk, the third of which is subdivided into two categories:

▲ Zone 1 “Low probability of flooding” – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
▲ Zone 2 “Medium probability of flooding” – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year;
▲ Zone 3a “High probability of flooding” – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (0.5%) in any year; and
▲ Zone 3b “Functional floodplain” – A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of flood. This zone is not normally included within the national Flood Map for Planning and is calculated where necessary using detailed hydraulic modelling.

3.3 Planning Policy Wales
Development Vulnerability Classification
3.3.1 The proposed residential development is considered to be ‘highly vulnerable’ development in accordance with Figure 2 of the Welsh Government’s Technical Advice Note 15 – Development and Flood Risk (TAN15).

3.3.2 TAN15 states that highly vulnerable development can be considered in Flood Zone C1 subject to the application of the TAN15 Justification Test and satisfying specific TAN15 acceptability criteria. The specific TAN15 ‘acceptability criteria’ are assessed in the following sections.

3.4 Local Policy
3.4.1 The Conwy County Local Development Plan 2007-2022, adopted October 2013, contains the following policies in relation to flood risk and drainage;
‘STRATEGIC POLICY DP/1 – SUSTAINABLE DEVELOPMENT PRINCIPLES

1. Development will only be permitted where it is demonstrated that it is consistent with the principles of sustainable development. All developments are required to: …

f) Take account of and address the risk of flooding and pollution in the form of noise, lighting, vibration, odour, emissions or dust in line with Policies DP/2 and DP/3 – ‘Promoting Design Quality and Reducing Crime’;

POLICY DP/3 – PROMOTING DESIGN QUALITY AND REDUCING CRIME

1. All new development will be of high quality, sustainable design which provides usable, safe, durable and adaptable places, and protects local character and distinctiveness of the Plan Area’s built historic and natural environment. The Council will require development to: …

f) Provide sustainable urban drainage systems to limit waste water and water pollution and reduce flood risk in line with national guidance and Policy NTE/8 – ‘Sustainable Drainage Systems’.

POLICY DP/4 – DEVELOPMENT CRITERIA

2. Planning permission will not be granted where the proposed development would have an unacceptable adverse impact: …

g) On flooding and flood risk;

POLICY NTE/6 – ENERGY EFFICIENCY AND RENEWABLE TECHNOLOGIES IN NEW DEVELOPMENT

The efficient use and conservation of natural resources are essential to the overall quality of life within the Plan Area and to support wider social and economic sustainability objectives. The Council will: …

d) Ensure that all new developments incorporate the principles of sustainable design such as:

appropriate layout, massing, orientation, use of materials, rain water harvesting, energy efficiency, sustainable drainage, and waste recycling areas/storage in line with the Development Principle policies and NTE/7 to NTE/9….

3.4.2 The Site is allocated for Employment end use within the Conwy County Local Development Plan (Site Ref.CR34).

3.5 Climate Change

3.5.1 The Welsh Government guidance note (CL-03-16) states that; ‘residential development is assumed to have a lifetime of 100 years while a lifetime of 75 years is assumed for non-residential developments. To ensure future development can provide a safe and secure living and/or working environment throughout its lifetime, national planning policy requires proposals in areas of high flood risk to be accompanied by an assessment of flooding consequences to and from the development, taking into account the impacts of climate change’.

3.6 Consultation

3.6.1 A pre-planning opinion request was submitted to NRW in November 2019 a response is awaited.
4.0 Assessment of Flood Risk

4.1 Tidal Flood Risk

4.1.1 The Irish Sea is located approximately 380m north-east of the Site (North Shore) and 900m south-west of the Site (South Shore) at its closest point. The Site is shown to be located wholly within Flood Zone 3 (High Probability) on the NRW Flood Map for Planning (Figure 1) and wholly within Flood Zone C1 (an area served by significant infrastructure, including flood defences) on the NRW DAM (Figure 2).

Figure 1: NRW Flood Map for Planning

Figure 2: Welsh Government Development Advice Map
4.1.2 The NRW ‘Historical Flood Map’ (Figure 3) indicates that the Site falls within the historical flood extent. Research online found that Llandudno has suffered a number of significant flooding events with the most notable recent example being in 1993. However, the Site is specifically assessed within the CCBC SFCA as one of the candidate development sites within the Local Development Plan (LDP), the SFCA states that; ‘It is questionable if the Site itself flooded in 1993.’

![Figure 3: NRW Historical Flood Map](image)

Defences

4.1.3 The development Site is located in an area which benefits from sea defences present along both the North and West Shores in various forms. The defences within closest proximity to the Site are detailed in Table 1 below.

4.1.4 The defence locations are illustrated on the drawings included within the CTFRA ‘Llandudno Inundation Modelling’ report. The primary, secondary and tertiary defence details (i.e. shingle beach, backed by a secondary sea wall etc.) and their effective crest levels are included within the defence description derived from (Table A2.2 within the CCBC CTFRA Stage 1).

### Table 1: Defence Details

<table>
<thead>
<tr>
<th>Defence</th>
<th>Ref</th>
<th>Existing Defence</th>
<th>Crest Level (m AOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Primary</td>
</tr>
<tr>
<td>North Shore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Llandudno Promenade (1)</td>
<td>2A</td>
<td>Beach, Vertical Wall with Sloping Apron</td>
<td>Promenade and Dwarf Wall</td>
</tr>
<tr>
<td>Llandudno Promenade (2)</td>
<td>2B</td>
<td>Beach, Stepped Sea Wall</td>
<td>Promenade and Dwarf Wall</td>
</tr>
<tr>
<td>Llandudno Promenade (3)</td>
<td>2C</td>
<td>Lower Beach, Slipway</td>
<td>Promenade and Dwarf Wall</td>
</tr>
</tbody>
</table>
4.1.5 The flood defence details indicate that the crest level of the defences on the North Shore within the vicinity of the Site range from 7.0 – 7.8m AOD whilst the crest level of the West Shore is 6.7m AOD.

**Hydraulic Modelling Works**

4.1.6 The latest available data for the area is derived from the North Wales Tidal Mapping Study (JBA Consulting, November 2011). To fully and more accurately investigate the tidal flood risk at the site utilising modern techniques, a full 2-Dimensional hydraulic modelling study, has been commissioned and is currently being undertaken. The modelling works will replicate those undertaken to support the successful application for the Nevill Hotel, Augusta Street, Llandudno LL30 1AB (Conwy Planning Ref. 0/45869) which is located immediately north of the Site.

4.1.7 As part of the works both the 0.5% and 0.1% Annual Exceedance Probability (AEP) events plus an allowance of 100 years of sea level rise are being considered. The hydraulic modelling will also consider the following to ensure the results are as robust as possible.

**Wave Overtopping**

4.1.8 Wave overtopping is also being included within the model; however, wave overtopping is assumed to be negligible (zero) when tide levels exceed defence crest levels.

**Defence Breaches**

4.1.9 A 50m wide breach along the West Shore defences is being considered. The breach is located adjacent to the West Shore Boating Lake. This location was chosen as it presents a 'worst case scenario' for the site as it is where ground levels immediately behind the defences are at their lowest (5.7m AOD). Additionally, a breach of the flood defence gates on the North Shore located near Vaughan Street (NGR 278639E 382270N) and St. George's Place (NGR 278301E 382482N) are been modelled.

**Sensitivity Testing**

4.1.10 Sensitivity tests will be undertaken to ensure the model results are as accurate as possible and allow for a margin of error. The model will investigate a +200mm variation and a +300mm variation in the tide levels during the 0.5% AEP + Climate Change (CC) and 0.1% AEP + CC tidal events respectively. This is the stated confidence interval for the 2008 extreme tide levels extracted from the EA "Coastal flood boundary conditions for UK mainland and islands" study. No breach will be simulated during these sensitivity tests.

4.1.11 It is understood that the initial results from the hydraulic model indicate that the Site and the Site access are flood free during the 0.5% AEP plus 100 years climate change however the Site is shown to be impacted during a breach of the Sea defences to the west. This FCA will be updated to reflect the results of the hydraulic modelling works when they are completed.
4.1.12 Assuming the preliminary results of the hydraulic modelling works are representative of the final results the site the Site is considered to be at a low risk of flooding during the normal conditions, however there is a residual risk of flooding from a breach of the tidal defences to the west.

4.2 Fluvial Flood Risk

4.2.1 There are no watercourses within the vicinity of the Site and therefore there is No Risk of fluvial flooding.

4.3 Surface Water Flood Risk

4.3.1 The NRW ‘Flood Risk from Surface Water’ map (Figure 4) indicates that the vast majority of the Site is at very low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding. A small isolated area within the south-western extent of the Site is identified as being at between a low (between a 1% and 0.1% annual probability of flooding) and high risk of flooding (greater than 3.3% annual probability of flooding). The area identified as being at risk of surface water flooding is an isolated, topographical low point and not associated with any flow paths leading to Site from off Site.

Figure 4: EA’s Long-Term Flood Risk Map (Flood Risk from Surface Water)

4.3.2 Map 4.4 included within the CCBC PFRA identifies areas within the county considered to be at risk of surface water / sewer flooding. Whilst an area east of the Site is considered to be at risk the Site itself and immediately surrounding area is not considered to be at risk. The CCBC PFRA also includes a list of residential properties which have recorded flooding in the area and none of the recorded flood incidents are within the vicinity of the Site.

4.3.3 The August 2012, CCBC SFCA has assessed this Site as one of the candidate development Sites within the LDP. ‘Llandudno has had historical problems with surface water drainage and extensive flooding occurred in 1993 when the drainage system was unable to cope. The Site is located at the edge of the recorded flood extent and so surface water flooding can be regarded as a potential issue at this Site. However, the Site is generally higher than Builder Street and the area to the south, so it is questionable whether the whole Site was flooded.’
4.3.4 Any potential surface water flooding arising at or near to the Site would be directed south-west, away from the Site, following the local topography.

4.3.5 It can therefore be concluded that the Site is at a **Low to Moderate** risk of surface water flooding.

4.4 **Groundwater Flood Risk**

4.4.1 BGS online mapping indicates that the Site is underlain by superficial Tidal Flat over bedrock comprising the Undifferentiated Lower Palaeozoic Rocks (Mudstone) in the north-west, Moelfre Tuff Formation in the north-east and the Nant Ffrancon Subgroup (Siltstone) in the south-west. Shallow trial pitting undertaken by Delta-Simons in November 2018 identified Made Ground over Tidal Flat Deposits in the central and south-western extents and Made ground over Blown Sand in the North-eastern extents. No groundwater was encountered.

4.4.2 The SFCA and PFRA do not include any records of groundwater flooding at or near to the Site.

4.4.3 Vulnerable areas of the Site will be predominantly hardstanding, limiting the vertical migration of groundwater. Furthermore, vulnerable areas will be raised above surrounding ground levels owing to the identified tidal flood risk, and no basement levels are identified on plans.

4.4.4 It can therefore be concluded that the risk of groundwater flooding is **Low**.

4.5 **Artificial Sources Flood Risk**

**Sewer Flooding**

4.5.1 Sewer Plans were not available for review at the time of reporting. It is assumed that any existing on-Site drainage was decommissioned and / or removed as part of the demolition works which have occurred. Public sewers in the vicinity of the Site will be located within the surrounding road network.

4.5.2 The CCBC PFRA includes sewer risk mapping and a register of historic flood incidents in the area. The Site is not within an area considered to be at risk of sewer flooding and there are no records of historic sewer flooding associated with the Site.

4.5.3 Any potential flooding arising from sewers located within the surrounding road would be retained within the roads by kerb heights and directed southward, away from the Site, following the local topography.

**Reservoir and Canal Flooding**

4.5.4 There are no canals and / or reservoirs within the vicinity of the Site. The NRW online ‘Flood Risk from Reservoirs’ map shows that the Site is not at risk of flooding from reservoirs.

4.5.5 It can therefore be concluded that there is **No Risk** of flooding from Reservoirs and Canals and a **Very Low** risk of flooding from sewers.

4.6 **Summary of Flood Risk**

4.6.1 It can be concluded that tidal flooding is the main potential source of flood risk to the Site. The associated risk has been used to inform mitigation design as discussed further in this report.

4.7 **Mitigation**

4.7.1 Table 2 includes the tolerable conditions for residential development in excess of the 1 in 200 year annual probability event (Threshold Frequency) for residential development taken from TAN15.
### Table 2: TAN15 Tolerable Conditions

<table>
<thead>
<tr>
<th></th>
<th>Maximum Depth of Flooding (mm)</th>
<th>Maximum Rate of Rise of Floodwaters (m/hr.)</th>
<th>Maximum Speed of Inundation of flood risk area (hrs.)</th>
<th>Maximum Velocity of floodwaters (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
<td>600</td>
<td>0.1</td>
<td>4</td>
<td>0.15</td>
</tr>
<tr>
<td>Access</td>
<td>600</td>
<td>0.1</td>
<td>4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

4.7.2 The actual tidal flood risk to the Site is being determined through a comprehensive hydraulic modelling exercise. The results of the hydraulic model will inform the final mitigation measures required to ensure compliance with TAN15.

### 4.8 Flood Warnings and Evacuation

4.8.1 The Site is located within a Flood Warning area. Residents and Site users should register to receive flood warnings. Flood Warnings is a free service that provides prior warning of a tidal flood event.

4.8.2 The Site owner should prepare a flood warning and evacuation plan to inform residents of the flood risk and to provide advice on what to do in the event of a flood. The flood plan should include details of a safe evacuation route to be used during a flood event / upon receipt of a flood warning. Safe evacuation should be provided via Builders Street heading north and then south-east along Conway Road, where flood depths are not shown to exceed 450mm, to an area shown outside of the extreme fluvial flood extent on NRW mapping. Where no flood warning is received it is also considered acceptable for Site users to remain within the proposed buildings. Residents should not evacuate the building into flood water unless instructed to do so otherwise by the emergency services.

### 4.9 Impact on Flood Risk Elsewhere

4.9.1 The proposed development is at not at risk of fluvial flooding during all events up to and including the 0.1% AEP event for both undefended and defended scenarios. Therefore, the development does not remove flood storage space from the floodplain and will not result in an increase in flood risk elsewhere. With regard to impounded waters behind the defences given the extent of the floodplain and its tidal nature, any displacement of floodwater is unlikely to have a significant effect on adjacent buildings or the railway station that are likely to already be experiencing the inundation of floodwaters.
5.0 Justification

5.1.1 In accordance with TAN15, highly vulnerable / less vulnerable development will be justified in Flood Zone C1 / C2 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 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 (PPW) and meets the definition of previously development land (PPW Figure 2.1); 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.

5.1.2 The Site comprises derelict land previously utilised as part of the neighbouring railway station including rail tracks and associated buildings and infrastructure. The re-development of the Site for affordable residential end use will contribute to regeneration initiatives to sustain an existing settlement. The Site meets the definition of previously developed land. The Site is also allocated within the LDP albeit for employment end use.

5.1.3 The ‘Summary of what TAN15 requires for highly vulnerable development (houses) to be considered acceptable’ note appended to TAN15 states that; ‘[The] Developer is required to demonstrate that the Site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14. Buildings should be raised above the 1 in 200 + 100 year CC flood level and therefore compliant with TAN15.

5.1.4 Assuming the initial hydraulic modelling results are representative of the final results the Site is shown to be flood free during the 1 in 200 year plus 100 years climate change event therefore the consequences of flooding are Low and Acceptable when assessed against the criteria contained in Sections 5 and 7 and Appendix 1 of TAN15.
6.0 Conclusions and Recommendations

6.1 Conclusions

6.1.1 The proposed development is for the redevelopment of an existing derelict / cleared Site in the centre of Llandudno town centre for residential end use.

6.1.2 The Site is located within Flood Zone C1 on the Welsh Government Development Advice Map – an area considered at flood risk, but served by significant infrastructure, including flood defences, with a 0.1% (1 in 1000) or greater annual probability of flooding and defended Flood Zone 3 on the NRW Flood Map for Planning.

6.1.3 The Site is considered to be at a Low risk of flooding from all sources, assuming the initial hydraulic modelling results are representative of the final results. In order to comply with TAN15 the Site will need to flood free 1 in 200 year + 100 year Climate Change flood event.

6.1.4 Safe evacuation is available via Builders Street heading north and then south-east along Conway Road, to an area shown outside of the extreme fluvial flood extent on NRW mapping. The Site is in an area which is served by flood warnings.

6.2 Recommendations

Flood Risk

▲ Update this report to reflect the findings of the ongoing hydraulic modelling works;

▲ Ensure the finished floor levels are above the 1 in 200 year + 100 year Climate Change flood level;

and

▲ Produce a Flood Warnings and Evacuation Plan in consultation with the council emergency planners.
Appendix A – Limitations
Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.
Appendix B – Topographical Information
Topographical Survey of Land at:
Builder Street
Llandudno
LL30 1DR
Sheet 2 of 2
Lane End Developments
Unit 2 Station Court
Stockport Road
Thelwall
Warrington
WA4 2GW

1:200

Scale Bar

0
2m
4m
8m
12m
16m

PLAN
GRID
NORTH
LiDAR Elevation Map
Land off Oxford Road
Llandudno

LEGEND
- Site Boundary
- Contours (0.25 m) derived from LiDAR DTM (1 m)
- LiDAR 1 m DTM (m AOD)

3
4
5
6
7

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Appendix C – Development Plans