FLOODPLAN LIMITED

Project Title: 00638AB

Product: Level 3 Flood Consequence Assessment

Date: 26 June 2026

Find us at:

Web: www.floodplanreports.co.uk

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FLOODPLAN LIMITED

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Report Revision Log

Report Reference	Date Issued	Issued To	Notes
00638AB	26/06/2026	Client	

1. INTRODUCTION

1.1. PURPOSE OF THE REPORT

FloodPlan have been commissioned on behalf of Anh Nhuyen to produce a Flood Consequence Assessment for 6 Angel Place, Neath, SA11 1RQ. This assessment has been conducted with the understanding that the document will be used to inform a property purchase by Anh Nhuyen.

1.2. LOCATION OF SUBJECT SITE

Figure 1: Site Location

1.3. SITE DESCRIPTION

The proposals include the change of use of nan existing commercial unit to that of a commercial use nail and spa salon. The proposals also include the installation of a mechanical ventilation system. The proposed change of use will retain its 'less vulnerable development' classification as per TAN15.

2. ASSESSMENT OF TAN15

2.1. INTRODUCTION TO TAN15

Technical Advice Note 15 (TAN15 - 2025) is a Welsh Government published document. This document provides guidance to local planning authorities to ensure the effective implementation of the planning policy. The policy seeks to direct development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. For these purposes: Flood risk (from river and sea) are categorised inro one of the below:

2.2. FLOOD RISK DEFINITION

Flood Zone	Flooding from rivers	Flooding from the sea	Flooding from surface water and small watercourses
Zone 1	Less than 1 in 1000 (0.1%) (plus climate change) chance of flooding in a given year		
Zone 2	Less than 1 in 100 (1%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change	Less than 1 in 200 (0.5%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change	Less than 1 in 100 (1%) but greater than 1 in 1000 (0.1%) chance of flooding in a given year, including climate change
Zone 3	A greater than 1 in 100 (1%) chance of flooding in a given year, including climate change	A greater than 1 in 200 (0.5%) chance of flooding in a given year, including climate change	A greater than 1 in 100 (1%) chance of flooding in a given year, including climate change
Tan15 Defended Zones	Areas where flood risk management infrastructure provides a minimum standard of protection against flooding from rivers of 1:100(plus climate change and freeboard)	Areas where flood risk management infrastructure provides a minimum standard of protection against flooding from the sea of 1:200(plus climate change and freeboard)	Not Applicable

2.3. FLOOD RISK VULNERABILITY CLASSIFICATION

TAN15 categorises buildings by vulnerability. A summary of categories can be seen below:

Vulnerability Category	Types
Highly vulnerable	All Residential Purposes (including hotels, Gypsy and Traveller sites, caravan parks and camping sites) Schools and childcare establishments, colleges and universities Hospitals and GP surgeries Especially vulnerable industrial development (e.g power generating and distribution elements of power stations, transformers, chemical plants, incinerators), and waste disposal sites. Buildings used to provide emergency shelter in time of flood
Less vulnerable	General industrial, employment, commercial and retail development. Transport and utilities infrastructure. Car Parks. Mineral extraction sites and associated processing facilities (excusing waste disposal sites). Public Buildings including libraries, community centres and leisure centres (excluding those identified as in Highly Vulnerable category and emergency shelters). Places of worship. Cemeteries. Equipped play areas. Renewable energy facilities (excluding hydro generation)
Water compatible development	Boatyards, marinas and essential works required at mooring basins. Development associated with canals. Flood defences and management infrastructure. Open spaces (excluding equipped play areas). Hydro renewable energy generation.

2.4. TAN15 ACCEPTABILITY OF FLOOD CONSEQUENCES

The acceptability criteria for developments are detailed within Section 11 of TAN15(2025). The following requirements must be in place for any development that is permitted to be located win flood risk areas:

In all circumstances, developers should ensure the following conditions are met:

- No increase in flooding elsewhere
- Occupiers aware of flood risk
- Escape/evacuation routes present
- Flood emergency plans and procedures agreed and in place
- Flood resistant and resilient design,
- Acceptance consequences for type of use (below)

- 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
- Minimal disruption to the sustainable management of natural resources

2.5. SUITABLE NEW DEVELOPMENT MATRIX

The below table outlines the suitable greenfield development type for the flood zone classification as per TAN15.

Flood risk vulnerability classification	Less Vulnerable	Highly Vulnerable	Water compatible Development
Zone 1			
Zone 2			
Zone 3			
TAN15 Defended Zones			

Figure 2: Suitable New Development Matrix

Key	New Development
Blue	New Development may be permitted
Red	New Development should not be permitted.
Purple	New Development may be appropriate in exceptional circumstances such as addressing national security or energy security needs, reasons of public health or to mitigate the impacts of climate change which have a clear locational need and cannot be located elsewhere.
Yellow	New development of greenfield sites is not appropriate in Defended Zones unless they are allocated in the LDP. Where new development is allocated within the LDP, adherence to Section 11 of Tan15 (2.4 within this report) is required.
Green	New development is suitable with the acceptability considerations set out in Section 11 of TAN15(2.4 within this report).
Orange	New development is suitable with the acceptability considerations set out in Section 11 of TAN15(2.4 within this report), and where the proposed development type is appropriate in accordance with the LDP.

2.6. SUITABLE REDEVELOPMENT MATRIX

The below table outlines the suitable redevelopment development type for the flood zone classification as per TAN15.

Flood risk vulnerability classification	Less Vulnerable	Highly Vulnerable	Water compatible Development
Zone 1			
Zone 2			
Zone 3			
TAN15 Defended Zones			

Figure 3: Suitable Redevelopment Matrix

Key	Redevelopment
Blue	Redevelopment may be permitted
Purple	Redevelopment should be avoided and may only be made in exceptional circumstances where it is essential to the strategy of the LDP or where it addresses national security or energy security needs, or public health or it mitigated the impacts of climate change.
Red	Redevelopment should be avoided. Redevelopment may be suitable if there is a clear commitment that flood mitigation measures will be provided to protect the site. Such measures must be set out in the LDP infrastructure plan.
Brown	Redevelopment is suitable on condition that they do not overly intensify use, neither should they reduce the area's ability to absorb flood water nor cause problems with flooding elsewhere. All applications should consider opportunities to incorporate flood resilient design.
Yellow	Redevelopment may be acceptable with adherence to Section 11 of Tan15 (2.4 within this report).
Green	Redevelopment will need to assist and be consistent with, the Development Plan strategy to regenerate an existing settlement or achieve key economic objectives.
Orange	Redevelopment will need to assist and be consistent with, the Development Plan strategy to regenerate an existing settlement or achieve key economic objectives. Where residential use is proposed at ground floor level, the development must be compatible with the tolerable conditions set out in Section 11(TAN15) and exhibit resilient flood design as described in section 12(TAN15).

3. FMfP Site Assessment

3.1. Flood Zone Classification

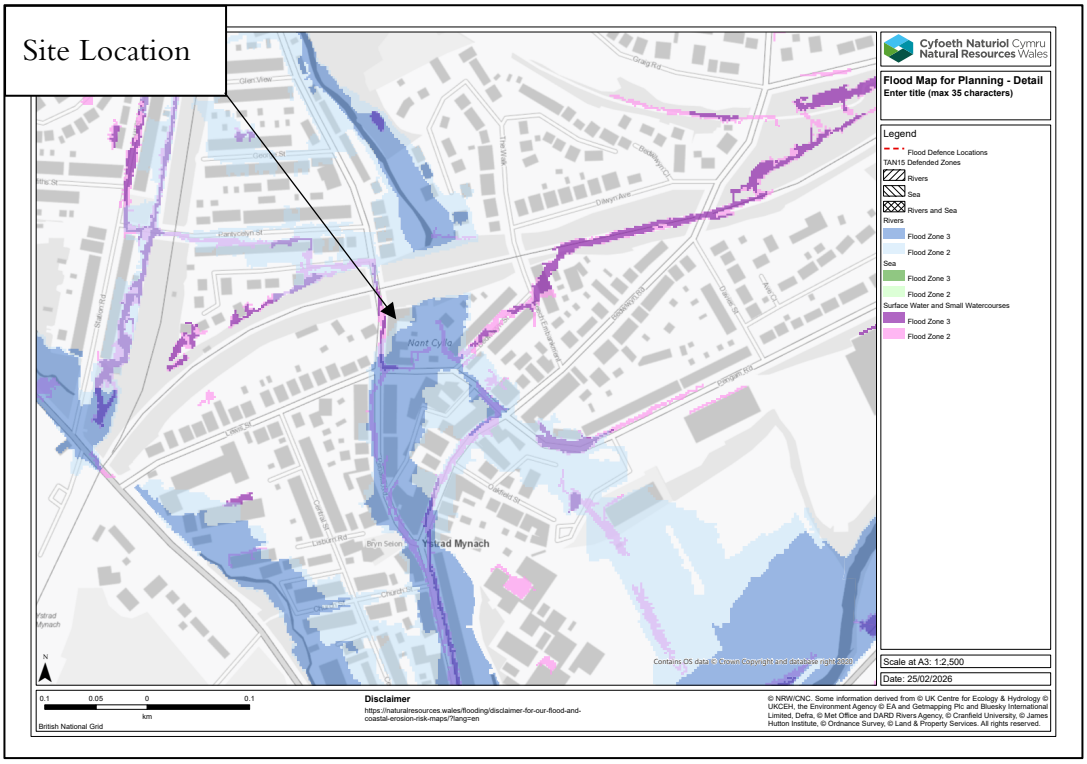


Figure 4: FMfP Flood Zone

3.2. Flood Zone Summary

Flood Source	Flood Zone 2	Flood Zone 3	TAN15 Defended Zone
Fluvial	Affected	Affected	X
Tidal	Affected	Affected	X
Surface Water	Affected	X	X

3.3. Existing Land Vulnerability Classification

The existing use of the site is used for commercial purposes and is therefore classified as 'less vulnerable development' as per TAN15.

3.4. Proposed Land Vulnerability Classification

The proposed change of use will retain its commercial use. The proposed vulnerability classification of the proposed nail and spa is 'less vulnerable development' as per TAN15

3.5. SITE SUITABILITY (TAN15)

The site is mapped to be directly affected by flood zone 3 for rivers and the sea. To a lesser extent, the site is mapped to be affected by flood zone 2 via surface water. The site is not mapped to benefit from formally maintained flood defences.

4. FLOOD MODELLING OUTPUTS

4.1. FLOOD MODELLING STUDIES

As part of this commission, FloodPlan contacted Natural Resources Wales to request flood modelling data and outputs for the site. Natural Resources Wales provided flood modelling outputs from three modelling studies:

1. Neath_5_V1-1.1_2023

4.2. NEATH 2023 STUDY

The Neath 2023 model identifies the site to remain flood free during the NEAT_DEF_TIDE_2023T0200 event.

The site is modelled to experience a maximum flood level of 7.46mOD during the NEAT_DEF_TIDE_2123T0200 event.

4.3. MITIGATION MEASURES

This report recommends the following be incorporated to lessen the potential impacts of flooding:

- Electrical fittings to be elevated to 1.2m above floor level
- Non return valves to be fitted on pipework
- A bespoke flood evacuation plan should be created and maintained

5. FURTHER SITE FLOOD RISK

5.1. THIRD PARTY FLOOD RISK DATA SUMMARY

A 'Groundsure' flood report has been acquired for advising this assessment. The full report can be found in Appendix A. The main findings are summarised below:

Type of Risk	Assessment of Risk
Overall Flood Risk	High
Rivers and the Sea	High
Surface Water	Significant
Groundwater	Moderate
Historic Flood	Not Identified
Flood Defences	No
FloodScoreTM – insurance rating	High

5.2. GROUNDWATER FLOODING

The 'Groundsure' flood report indicates that the site has a moderate risk of groundwater flooding.

5.3. RESERVOIR FLOODING

The site is not mapped to be directly affected by reservoir flooding.

5.4. CANAL AND ARTIFICIAL WATER FLOODING

The site is at not believed to be at risk of flooding from artificial water sources.

5.5. HISTORIC FLOODING

The 'Groundsure' flood report failed to identify any historic flood records.

6. FURTHER SITE ASSESSMENT

6.1. SITE ACCESS AND EGRESS ROUTES

During extreme fluvial, tidal and pluvial flood events, the site may become severed. A flood evacuation management plan is recommended to be created and maintained.

6.2. FLOOD COMPENSATION

Not required.

6.3. FLOOD WARNING AREAS

The below Figure 5, highlights the areas that are considered to benefit from Natural Resources Wales flood alerts. The site is outside of the NRW flood warnings areas.

Figure 5: NRW Flood Warning Areas

6.4. AWARENESS OF FLOOD RISK

The developer should be aware that the site is not immune from flooding. It is recommended that future occupiers take the opportunity to develop emergency and non-emergency plans.

7. FINDINGS AND RECOMMENDATIONS

7.1. FINDINGS

The proposals include the change of use of nan existing commercial unit to that of a commercial use nail and spa salon. The proposals also include the installation of a mechanical ventilation system. The proposed change of use will retain its 'less vulnerable development' classification as per TAN15

The site is modelled to experience direct flood risk during the EAT_DEF_TIDE_2123T0200 event. Whist the site is at risk during the extreme climate change output, the proposals are retaining the vulnerability classification of the site whilst not significantly increasing the concentration of use. This report finds the proposals to be commensurate with the guidance of TAN15.

7.2. RECOMMENDATIONS

This report recommends the following be considered to lower the risk and/or consequences that flooding may cause to the proposed development:

- A flood evacuation protocol be created and maintained.
- A program of flood mitigation measures should be considered.

List of Appendices

Appendix A: Development Proposals

Appendix B: Groundsure Flood Report

Appendix C: Flood Modelling Data

Appendix A: Development Proposals

Email Submission – Planning Application

To: Neath Port Talbot Council (Planning / Environmental Health)
From: wendy15122023@gmail.com
Subject: Planning Submission – DND Nails & Spa, 6 Angel Place, Neath SA11 1RQ

Dear Sir/Madam,

I would like to submit the attached documents in support of a proposed nail salon at 6 Angel Place, Neath SA11 1RQ.

The submission includes the proposed layout, ventilation system, fire safety arrangements, and an environmental statement.

The premises is located within a commercial town centre area with no nearby residential properties. The proposed use is considered appropriate for this location and is consistent with surrounding commercial activities.

A mechanical extraction ventilation system has been installed, providing approximately 600 litres per second airflow. The system discharges at high level to the rear elevation and has been designed to effectively remove fumes and prevent any odour or noise nuisance to surrounding premises.

All operations will be conducted in accordance with relevant health, safety, and environmental regulations.

Please let me know if any further information is required to assist with the assessment of this application.

Kind regards,

THI VAN ANH NGUYEN
07440347251

DND NAILS & SPA – FINAL COUNCIL SUBMISSION

6 Angel Place, Neath SA11 1RQ

Proposed Layout, Fire Safety & Ventilation Plan

Additional Clarification – Treatment Areas

The premises includes 6 manicure tables and 3 pedicure stations (P1–P3). All treatment areas are covered by the mechanical extract ventilation system. The system includes two extraction points located centrally, providing adequate air circulation and removal of fumes from both manicure and pedicure areas.

Ventilation system: Approx. 600 l/s airflow, Ø200mm ducting, with discharge at high level to rear elevation. Complies with UK Building Regulations Part F.

Additional Planning & Environmental Statement

The premises at 6 Angel Place, Neath SA11 1RQ is located within a commercial town centre area, with no nearby residential properties or sensitive receptors.

The proposed use as a nail salon is considered appropriate within this location and is consistent with surrounding commercial activities.

A mechanical extraction ventilation system has been installed to ensure adequate air circulation and the effective removal of fumes and odours generated from nail treatments. The system operates at approximately 600 litres per second and discharges at high level to the rear elevation, away from neighbouring premises.

The system has been designed to prevent any odour nuisance or adverse impact on surrounding businesses or the public realm.

Noise from the extraction system is minimal and is not expected to cause disturbance to neighbouring occupiers.

All activities will be conducted in accordance with relevant health, safety, and environmental regulations. Waste materials, including chemical products, will be handled and disposed of responsibly in line with local authority requirements.

The applicant is committed to ensuring that the operation of the premises does not give rise to any public nuisance.

Application for Advertisement Consent

1. Applicant Details

Name: THI VAN ANH NGUYEN
Phone: 07440347251
Email: wendy15122023@gmail.com

2. Location of Advertisement

Business Name: DND NAILS & SPA
Address: 6 Angel Place, Neath SA11 1RQ

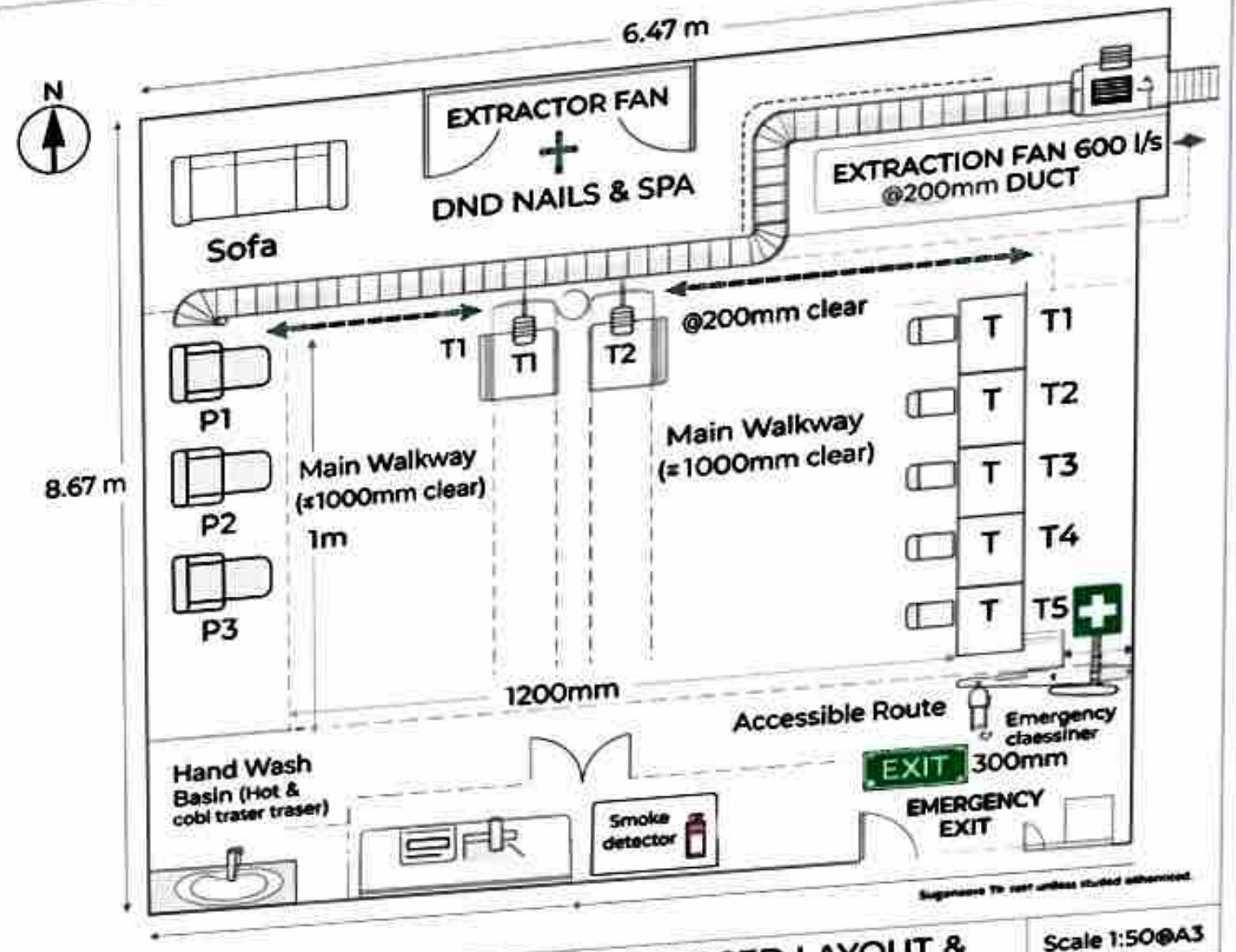
3. Advertisement Details

Type: Externally illuminated LED fascia sign
Dimensions: Width 6.47m x Height 0.84m
Externally illuminated LED fascia sign reading "DND NAILS & SPA" with address and contact details. The sign is mounted at fascia level and illuminated with warm white LED lighting. The illumination is static (non-flashing) and designed to avoid glare or distraction to pedestrians or road users. The premises is located within a commercial area and the signage will not adversely affect amenity or public safety.

4. Advertisement Period

More than 5 years (permanent signage)

5. Proposed Signage Image



DND NAILS & SPA

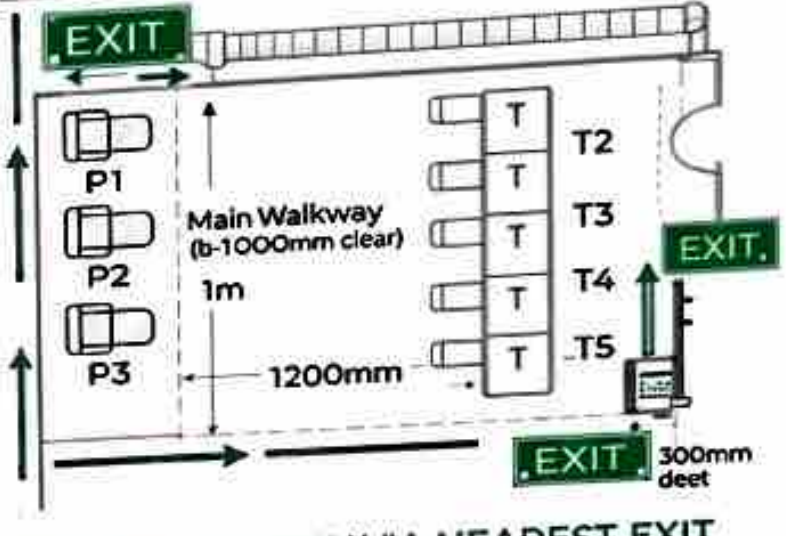
6 Angel Place, Neath SA11 1RQ

PROPOSED LAYOUT & VENTILATION PLAN

Scale 1:50@A3

Drawn by PL-01

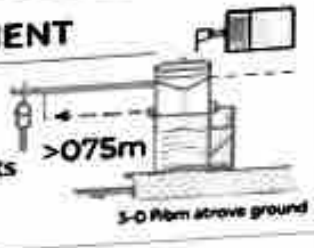
FIRE ESCAPE PLAN



EXIT IMMEDIATELY VIA NEAREST EXIT

▸ Follow signage and keep escape routes clear.

FIRE RISK ASSESSMENT



RISKS:

- Electrical equipment
- Chemicals used treatments
- Staff & customers

ACCESSIBILITY STAT:

Premiess designed with accessible route in accordance with Part M of UK Building Reg.

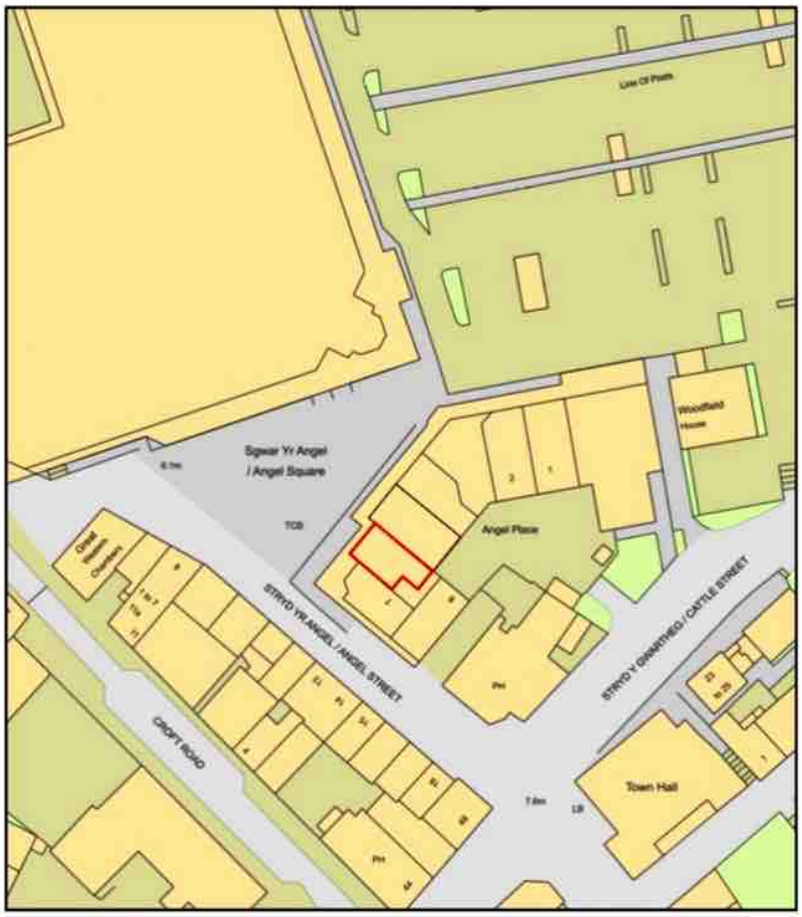
FIRE RISK ASSESSMENT

- CO2 / Foam fire extinguishers
- Clearly marked exit routes enque enevex
- Keep flammable materials in seaed
- No storage obstructs escape routes

ELECTRICAL NOTE

All electrical inscallatons to comply with Part P of UK outing Fespes.

Lease Plan - 6 Angel Place, Neath, SA11 1RQ



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ReQuestaPlan

Plan Produced for: Lawstar Limited

Date Produced: 26 Feb 2026

Plan Reference Number: TQRQM26057123025335

Scale: 1:1250 @ A4

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Appendix B: Groundsure Flood Report

Flood

R S P C A, 6 Angel Place, SA11 1RQ

Reference:
CMAPS-CM-1285196-60191-260626

Grid reference:
275221 197718

Your reference:
CMAPS-CM-1285196-60191-260626

Date:
26 June 2026

Consultant's guidance and recommendations inside.

Customer Support
info@groundsure.com

Overall flood risk

Risk to site

High Page 2 →

Groundsure Flood Report complies with relevant Law Society practice notes on flood risk in property transactions.

Building assessment

High Page 2 →

See if your home or outbuildings are at a lower flood risk than the overall site.

Search results

River and coastal	High	Page 6 →
Surface water	Significant	Page 8 →
Groundwater	Moderate	Page 10 →
Past flooding	Not identified	
Flood defences	No	
FloodScore™ insurance rating	High	Page 2 →

Your flooding search is covered!

Need answers on other potential risks to the property?

Groundsure Avista brings all our assessments together into a single, expert-led report.
Learn more about Avista

Have questions? Our experts are on hand to help you interpret the findings. Contact us

Flood

Go to front page

Flooding

High

The property and area within the site outline is at risk from one or more kinds of flooding. Property's overall risk assessment for past flooding and river, coastal, surface water and groundwater flooding is high.

Section links

Building assessment →
River & coastal →
Surface water →
Groundwater →

	Risk to site		Risk to building(s)	
River and coastal flooding	High	→	High	→
Surface water flooding	Significant	→	Significant	→
Groundwater flooding	Moderate	→	Moderate	→
Past flooding	Not identified		Not identified	
Flood storage areas	Not identified		Not identified	

FloodScore™ insurance rating
Compiled by Ambiental, a leading flood risk analysis company. Click here for details.

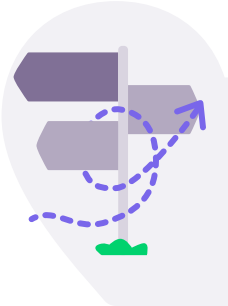
High

Next steps

Flooding

An elevated level of flood risk has been identified at the site, including areas that are currently occupied by buildings or structures.

- Ensure buildings and contents insurance covering flood risk is available and affordable. The property may be eligible for the Flood Re scheme. Whilst the property may qualify the decision to insure through Flood Re rests with your insurance provider. You may wish to enquire with them further on this;
- Make enquiries of the seller (e.g. in the TA6) and other nearby residents on any flooding that may have occurred;
- Sign up to the government's Flood Warnings and Alerts https://www.gov.uk/sign-up-for-flood-warnings;
- Create a flood plan https://www.gov.uk/prepare-for-flooding;
- A risk of groundwater flooding has been identified at the site. This will be more of an issue for properties with a basement or other section below ground. Further guidance on groundwater flooding can be found at https://knowledge.groundsure.com/factsheet-groundwater-flooding;
- Investigate the various forms of flood resistance and resilience measures that will help protect your property in the event of a flood;
- If the property has recently been constructed, the risk assessment within this report will not take into account measures put in place by the developer. This should be factored in when making any purchase decisions;
- If any buildings or structures are known to be present but not highlighted in the flood maps provided, please review the location of the flood risk data itself to infer the risk to those areas. Furthermore, if any extensions are planned at the site you can use the maps in the same way.



To save you time when assessing the report, we only provide maps and data tables of features within the search radius that we have identified to be of note. These relate to environmental risks that may have liability implications, affect insurance premiums, property values and/or a lender's willingness to lend.

You can view the fully comprehensive library of information we have searched on page 12 →

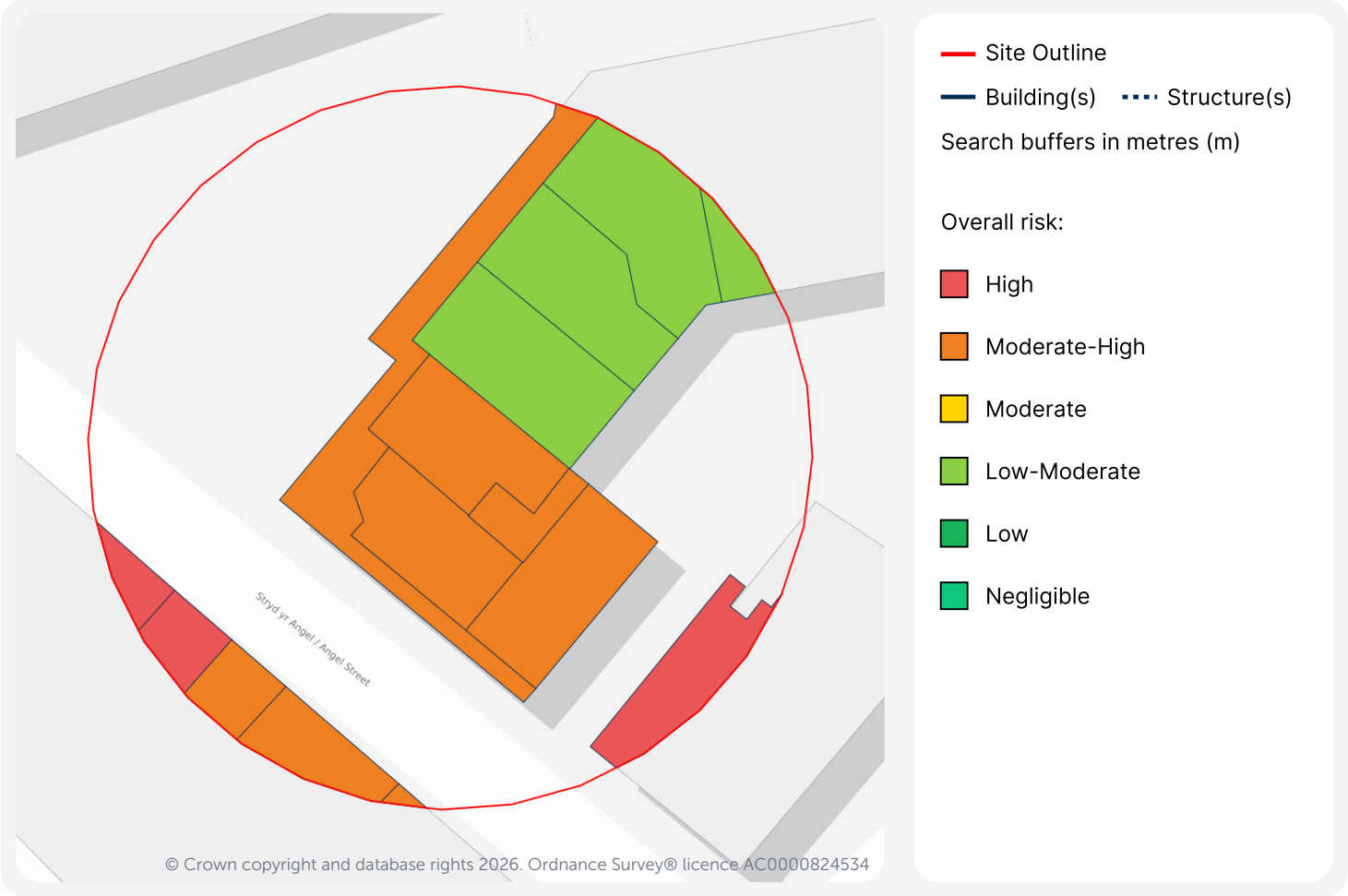
Flooding

Building assessment

This section assesses individual buildings and structures on the site for flood risk based on all main flood sources including river, coastal, surface water, and groundwater. Risk levels shown below may differ from the overall site risk, particularly where terrain or drainage affects buildings differently.

Section links Back to section summary

Building assessment → River & coastal →
Surface water → Groundwater →



Flood risk for each building (and other significant structures) at the site (those indicated on the map above) has been assessed using authoritative flood data alongside the Ordnance Survey® National Geographic Database. Further information on the limitations of this data and how it is collected can be found here https://knowledge.groundsure.com/searches-flooding.

This assessment considers data on river and coastal flooding, historical flood events, and flood defences provided by the Environment Agency / Natural Resources Wales, and surface water and groundwater flooding from Ambiental Risk Analytics. In Scotland, Ambiental Risk Analytics additionally provides the river and coastal flood models.

Description / Location	Overall risk	Rivers & coastal	Surface water	Groundwater	Historical flood (at location)	Flood defences (at location)
Commercial Building 275203, 197705	High	High	Significant	Moderate	No	No

Flood

Go to front page

Description / Location	Overall risk	Rivers & coastal	Surface water	Groundwater	Historical flood (at location)	Flood defences (at location)
Commercial Building 275200, 197710	High	High	Significant	Moderate	No	No
Mixed Use Building 275238, 197703	High	High	Significant	Moderate	No	No
Commercial Building 275213, 197698	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275223, 197719	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275207, 197702	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275219, 197694	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275221, 197712	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275230, 197709	Moderate-High	Very Low	Significant	Moderate	No	No
Unknown Building 275220, 197723	Moderate-High	Very Low	Significant	Moderate	No	No
Ancillary Building 275227, 197714	Moderate-High	Very Low	Significant	Moderate	No	No
Commercial Building 275227, 197724	Low-Moderate	Very Low	Low-Moderate	Moderate	No	No
Commercial Building 275235, 197734	Low-Moderate	Very Low	Low	Moderate	No	No
Commercial Building 275242, 197732	Low-Moderate	Very Low	Low	Moderate	No	No
Commercial Building 275231, 197730	Low-Moderate	Very Low	Low-Moderate	Moderate	No	No

Flood

Go to front page

Flooding

Risk of flooding from rivers and the sea

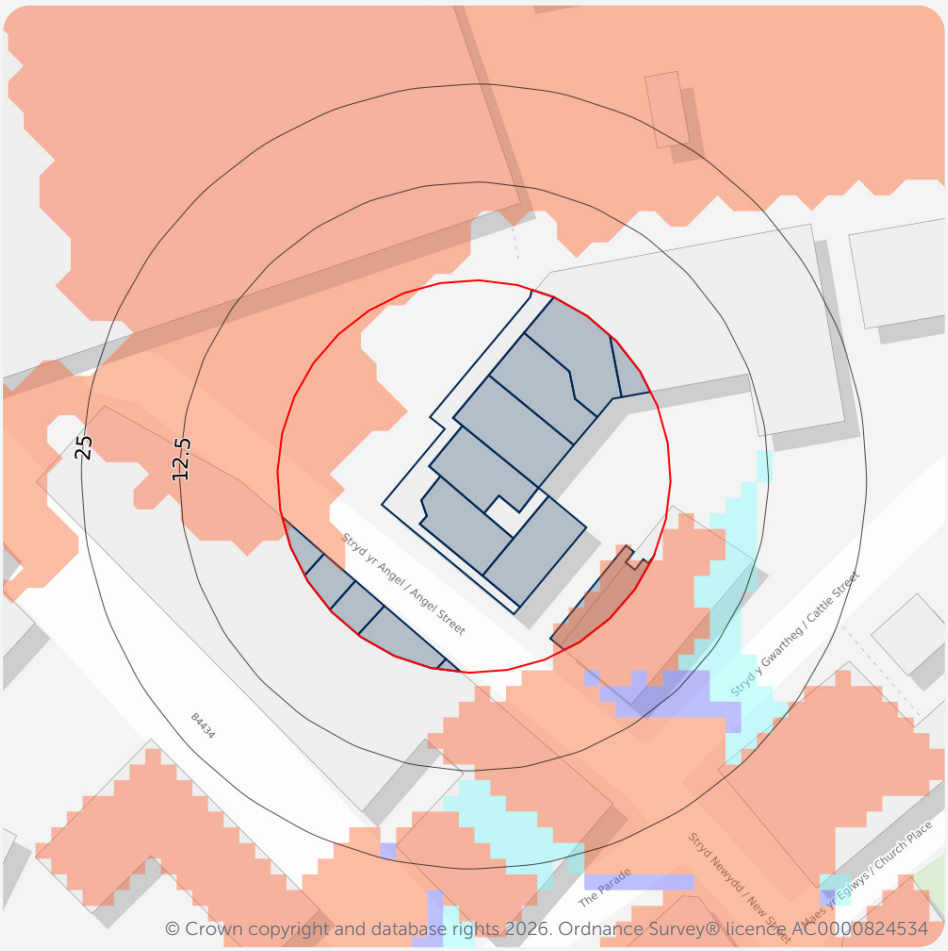
High

This section provides an indication of where there are flood risks originating from rivers and/or the sea. Rivers may break their banks following high rainfall and the sea level may rise as a result of high tides or extreme weather.

Section links

Back to section summary →

Building assessment →
River & coastal →
Surface water →
Groundwater →



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Site Outline
Main building
Other building(s)
Structure(s)

Search buffers in metres (m)

River and coastal flooding:

- High
- Medium
- Low
- Very Low
- Historical Flood Events
- Areas Used for Flood Storage
- Reduced river/sea flooding risk due to defences
- Flood Defences

Risk of river and coastal flooding to building(s)

High

A high risk of flooding from rivers or sea has been identified that could impact on the buildings or structures on-site. In the event of a flood there is a risk that flood waters could enter your home and cause damage. Please see the recommendations on page 2 → for further information of what to do next.

Risk of flooding from rivers and the sea

The property has a High chance of flooding in any given year, according to Risk of Flooding from Rivers and Sea (RoFRaS)/Flood Risk Assessment Wales (FRAW) data. This could cause problems with insuring the property against flood risk. However, if built before 2009, it may be eligible for insurance assistance from the Flood Re scheme: www.floodre.co.uk/

RoFRaS/FRAW assesses flood risk from rivers and the sea in England and Wales, using local data and expertise. It shows the chance of flooding from rivers or the sea, taking account of flood defences and the condition those defences are in. The model uses local water level and flood defence data to model flood risk. Click here for explanation of the levels of flood risk.

This data is sourced from the Environment Agency and Natural Resources Wales.

Flooding

Surface water flooding

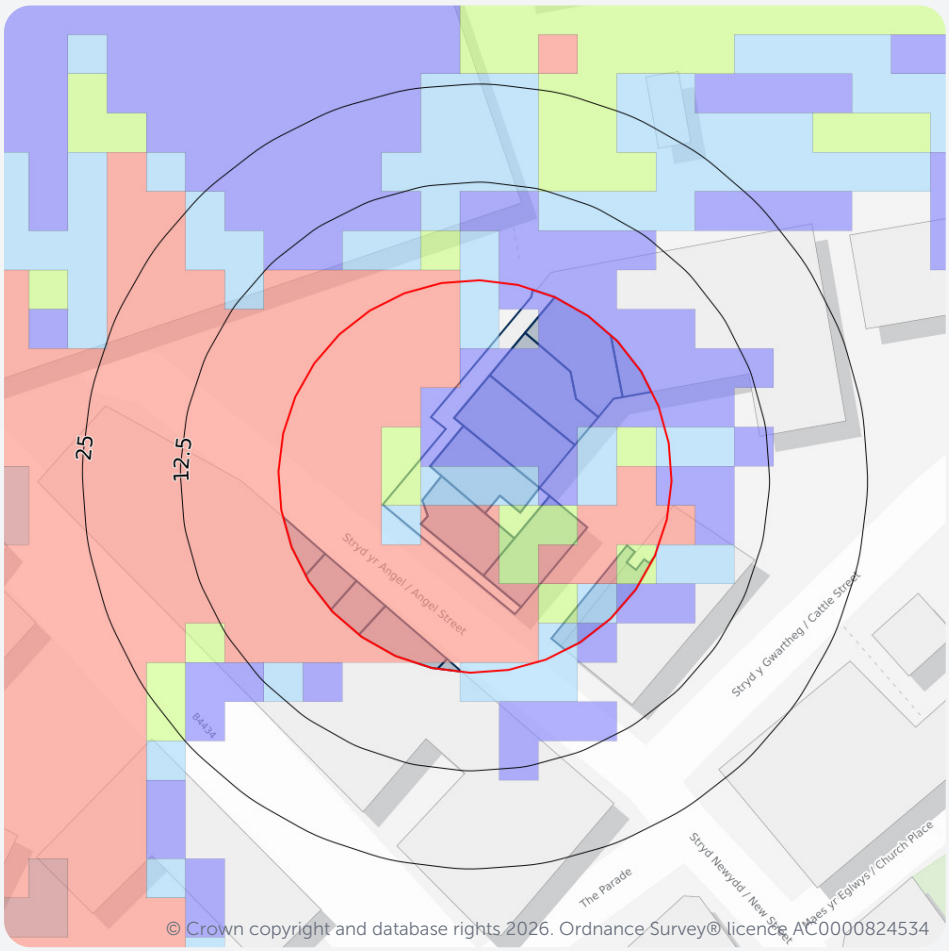
Significant

This section provides details of where there are flood risks originating from surface water. Surface water flooding can happen when heavy rain overwhelms drainage systems causing water to pool on the ground.

Section links

Back to section summary →

Building assessment →
Surface water →
River & coastal →
Groundwater →



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Site Outline
Main building
Other building(s)
Structure(s)

Search buffers in metres (m)

Surface water flood risk:

- Highly significant
- Significant
- High
- Moderate to high
- Moderate
- Low to moderate
- Low

Risk of surface water flooding to building(s)

Significant

Surface water flooding happens when heavy rainfall overwhelms drainage systems and causes flash flooding. Our assessment of this risk indicates that there is a significant risk to the buildings and structures in the event of a flood. Please see the recommendations on page 2 → for further information of what to do next.

Surface water flood risk

The property is likely to be prone to flooding following extreme rainfall, which may have an impact on insuring the property against flood risk. However, if built before 2009, it may be eligible for insurance assistance from the Flood Re scheme: www.floodre.co.uk/

The area in which the property is located has been assessed to be at a Significant risk of surface water flooding. This area is considered to have a 1 in 30 probability of surface water flooding due to rainfall in a given year to a depth of between 0.3m and 1.0m. However, as is the case with probability statistics and predictions, this information should be used as a guideline only. The area may flood several years in a row, or not at all for many years. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though some older ones may flood in a 1 in 5 year rainfall event.

These risk calculations are based on Ambiental Risk Analytics maps.

Flooding

Groundwater flooding

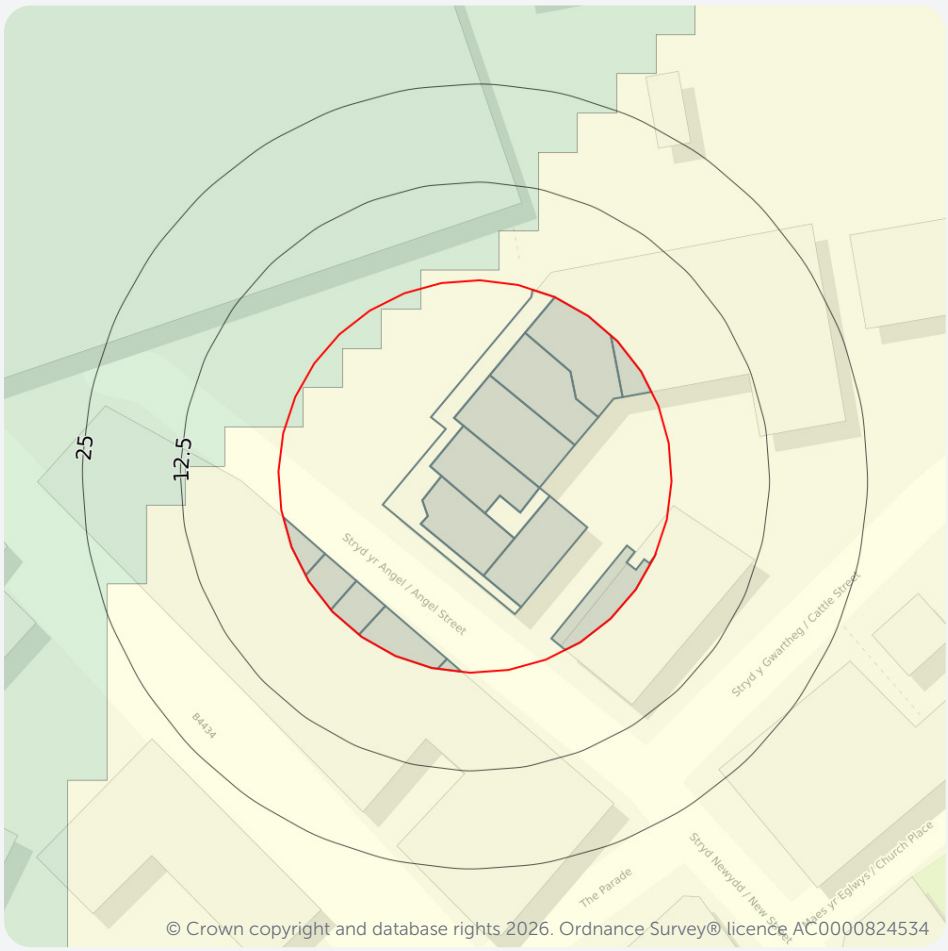
Moderate

This section provides details of where there are flood risks originating from rising groundwater. It occurs as excess water emerges at the ground surface or within underground structures such as basements.

Section links

Back to section summary →

Building assessment →
Surface water →
River & coastal →
Groundwater →



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Site Outline
Main building
Other building(s)
Structure(s)

Search buffers in metres (m)

- High
- Moderate-High
- Moderate
- Low
- Negligible

Risk of groundwater flooding to buildings(s)

Moderate

Groundwater flooding can happen when the water table beneath the ground rises to the surface after prolonged heavy rainfall. Our assessment of this risk indicates that there is a moderate risk to the buildings and structures, particularly if there are any basements present. Please see the recommendations on page 2 → for further information of what to do next.

Ambiental data indicates that the property is in an area with a moderate risk of groundwater flooding. Should a 1 in 100-year groundwater flood event occur, groundwater levels may affect basement areas. Properties without basements are not considered to be at risk from this level of groundwater flooding.

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This is a full list of the data searched in this report. If we have found results of note we will state "Identified". If no results of note are found, we will state "Not identified". Our intelligent filtering will hide "Not identified" sections to speed up your workflow.

Flooding	
Risk of flooding from rivers and the sea	Identified
Flood storage areas: part of floodplain	Not identified
Historical flood areas	Not identified
Reduction in Risk of Flooding from Rivers and Sea due to Defences	Not identified
Flood defences	Not identified
Surface water flood risk	Identified
Groundwater flooding	Identified

Methodologies and limitations

Groundsure's methodologies and limitations are available here: knowledge.groundsure.com/methodologies-and-limitations.

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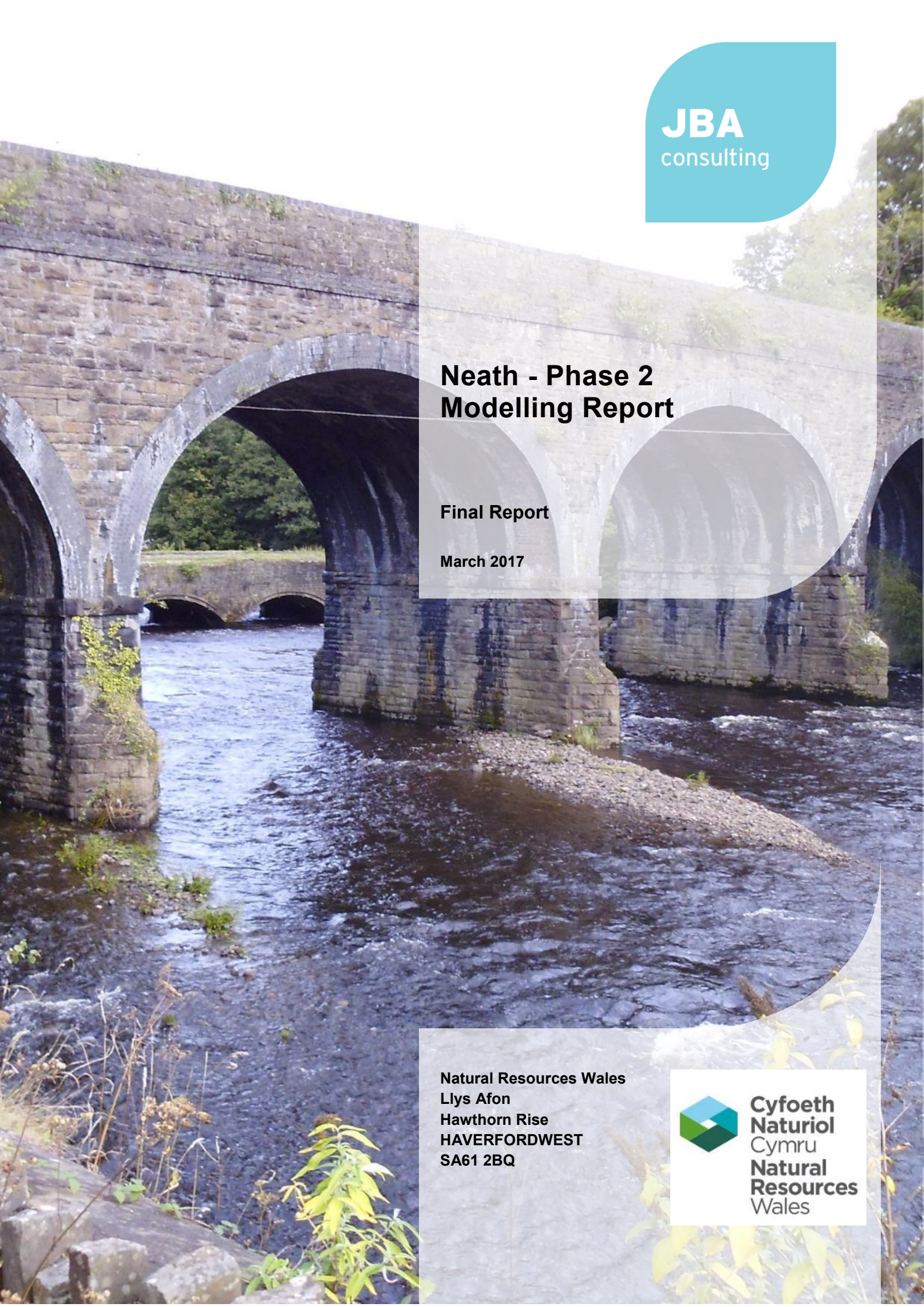

JBA consulting

Neath - Phase 2 Modelling Report

Final Report

March 2017

Natural Resources Wales
Llys Afon
Hawthorn Rise
HAVERFORDWEST
SA61 2BQ

Cyfoeth Naturiol Cymru
Natural Resources Wales

JBA Office

Bradley House
Pavilion 7
Park Five Business Centre
Harrier Way
Exeter
Devon
EX2 7HU

JBA Project Manager

Chris Smith BSc PhD CEnv MCIWEM C.WEM MCMI

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Final Report v2.0 / March 2017	Minor amendments following Draft Report review.	Filippo Scimone

Contract

This report describes work commissioned by Filippo Scimone, on behalf of Natural Resources Wales, by a letter dated 15 July 2015. Natural Resources Wales' representative for the contract was Filippo Scimone. Georgina Willis, Paul Redbourne, Adrian Kolander, and Chris Smith of JBA Consulting carried out this work.

Prepared by ..... Georgina Willis BSc
Assistant Analyst

..... Paul Redbourne BSc
Analyst

Reviewed by ..... Chris Smith BSc PhD MCIWEM C.WEM CEnv MCMI

Purpose

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Acknowledgements

JBA Consulting wishes to acknowledge the assistance and support throughout this commission of the Natural Resources Wales project manager, Filippo Scimone.

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Executive Summary

Natural Resources Wales (NRW) commissioned JBA Consulting to undertake flood risk modelling for Neath and its neighbouring settlements under the Water and Environmental Management (WEM) framework. This study is to provide a greater understanding of the flood risks and interactions between the River Neath, River Clydach, Cryddan Brook, River Dulais, Melincourt Brook and the Neath and Tennant Canals. In order to achieve this, two hydraulic models have been built, which can simulate the flood impacts arising from a variety of fluvial and tidal flood scenarios. The Melincourt Brook model has been modelled separately.

The key objectives of this study were to improve NRW's understanding of the flood mechanism and threshold of flooding to help to improve the Flood Warning service in the communities of Neath, Aberdulais, Tonna and Melincourt. This has been achieved through the development of two fit-for-purpose 1D-2D ESTRY-TUFLOW models, developed according to current best practice and guidance, which can simulate both defended and undefended scenarios. The models can be used by NRW and third parties to test and understand future scenarios and proposals.

The flood risk to Neath was assessed by the following processes:

- A hydrological analysis (carried out by NRW).
- The construction of two new-build, high-definition, hydraulic models.
- The simulation of a range of design flood events for both fluvial and tidal scenarios.
- The processing and analysis of the model results.

The hydrological analysis calculated peak flows and suitable design hydrographs for a number of flood estimation points and lateral inflow reaches within the study area.

A hydraulic model was constructed as a linked 1D-2D (ESTRY-TUFLOW) model. The 1D (ESTRY) component of the model (including bridges, weirs and culverts) was built on the basis of survey data supplied by Storm Geomatics in between February and April 2015. The Melincourt Brook 2D domain was constructed with a cell size of two metres, whereas the Main Neath model used a cell size of 4 meters. A topographic grid based on a composite LIDAR DTM, which used the latest available data across the study area) and a 2D roughness map created from OS MasterMap data.

The model results indicate that parts of Neath are at significant risk of flooding.

The key findings are:

- The model results suggest that Melincryddan is at significant risk. Flooding to a number of properties occurs during the 50% AEP modelled event, although this frequency of flooding greater than the flood history would suggest.
- Tidal design events result in flooding to a number of locations throughout the Neath study area including Melincryddan, Neath Abbey, and Aberdulais.
- The Melincourt Brook results in little flooding to Melincourt, however in the largest design events overland flow does reach Resolven impacting causing flooding to a number of businesses and residential property.

The following recommendations of future model development are given to inform flood asset management and Flood Warning.

- Investigate the impact of blockages at key structures.
- Re-asses the modelled flood extents in the vicinity of the Cryddan Brook. The frequency of flooding on this watercourse does not seem to correlate with flood history. NRW have suggested that upstream of the model extent there is a hydraulic control which restricts the flow getting downstream.
- Assess the model performance against any future flood events to ensure its reliability in replicating observed conditions.

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Abbreviations

1D	One-Dimensional (modelling)
2D	Two-Dimensional (modelling)
AEP	Annual Exceedance Probability
DSM	Digital Surface Model
DTM	Digital Terrain Model
NRW	Natural Resources Wales
FEH	Flood Estimation Handbook
JBA	Jeremy Benn Associates Limited
LIDAR	Light Detection and Ranging
OS	Ordnance Survey
QMED	Median Annual Flood (with return period 2 years)
ReFH	Revitalised Flood Hydrograph method
TUFLOW	Two-dimensional Unsteady FLOW (a hydraulic model)

1. Introduction

1.1 Purpose of the Study

Natural Resources Wales (NRW) commissioned JBA Consulting to undertake flood risk modelling for Neath and its neighbouring settlements under the Water and Environmental Management (WEM) framework. This study is to provide a greater understanding of the flood risks and interactions between the River Neath, River Clydach, Cryddan Brook, River Dulais, Melincourt Brook and the Neath and Tennant Canals. In order to achieve this, a hydraulic model of these watercourses has been built, which can simulate the flood impacts arising from a variety of fluvial and tidal flood scenarios.

1.2 Study Objectives

The key objectives of this study were to improve NRW's understanding of the flood mechanism and threshold of flooding to help to improve the Flood Warning service in the communities of Neath, Aberdulais, Tonna and Melincourt. This has been achieved through the development of a fit-for-purpose 1D-2D ESTRY-TUFLOW model for Neath, developed according to current best practice and guidance, which can simulate both defended and undefended scenarios. The model can also be used by NRW and third parties to test and understand future scenarios and proposals.

1.3 Study Extents

The Neath flood risk study area comprises of a series of watercourses that include the River Neath, River Dulais, River Clydach, Cryddan Brook, Melincourt Book and the Neath and Tennant Canals. These watercourses flow through the communities of Aberdulais, Tonna, Llantwit and Melin Court. During the model development stage it was decided to represent the Melincourt Brook at the upstream end of the study extent in a separate standalone model. This model has a separate model files, results, and model user report but the model results will be discussed within this report as it is within the same project commission.

The study extents of the watercourses are described below:

River Neath: The largest river in the study area with a typical channel width of between 30-40m, the River Neath flows from its source in the Brecon Beacons in a southerly direction through a narrow and steep sided valley, then flows in a south-westerly through a wider floodplain and through the town of Neath before it discharging into the Baglan Bay. The 1D-2D modelled extent runs from just downstream of Resolven to the upstream face of the railway embankment at Dynevor Junction, then a 1D only section extends along the Neath estuary to Witford Point at Baglan Bay.

River Dulais: The River Dulais is one of the largest tributaries of the River Neath, it has a typical channel width of 20m. Its source in the Brecon Beacons in a southerly direction through a narrow and steep sided valley, then flows in a south-westerly through a wider floodplain and through the town of Neath before it discharging into the Baglan Bay. The River Dulais rises from the south of Coelbren on the edge of the Brecon Beacons and flows through a steep valley in a south-westerly direction until it reaches the River Neath at Aberdulais. The modelled extent of the River Dulais is from ~160m upstream of the weir at the Dulais-Neath confluence.

River Clydach: The River Clydach, a tributary of the River Neath has its source in the Crynant Forest and flows from north to south for approximately 5km until it reaches the tidally influenced River Neath at Neath Abbey. It has a typical channel width of 17m. The modelled extent runs from just downstream of the railway embankment to the A465 dual carriageway bridge.

Cryddan Brook: The Cryddan brook has its source north of Gelli-gaer and flows 3.5km in a north-westerly direction before joining the River Neath at Melincryddan. The modelled extent of Cryddan Brook is from ~1km of the confluence with the River Neath.

Melincourt Brook: The Melincourt Brook rises from the north-west of Afan Forest Park and flows in a north-westerly direction for approximately 5km until it reaches the River Neath at Melincourt. The upstream modelled extent is approximately 630m from the upstream face of the A465 dual carriage way bridge at Melincourt. The downstream modelled extent is located immediately upstream of the River Neath.

Neath Canal: The Neath Canal links Gylnneath (approximately 17km north-east of Neath) to Melincryddan located in Neath. The River Neath flows parallel to the Neath Canal for much of its journey through Neath. The model extent of the Neath Canal is from the A465 underpass approximately 2.5km downstream of the Resolven gauge to Milland Rd in Melincryddan.

Tennant Canal: The Neath Canal was historical linked to the Tennant Canal at Aberdulais via an aqueduct. The Tennant Canal joins Neath to the docks at Swansea and crosses the River Clydach via an aqueduct. The model extent of the Tennant Canal is from the Neath-Dulais confluence to the Neath Abbey Business Park.

The full extent of the modelled area and watercourses is illustrated in Figure 1-1.

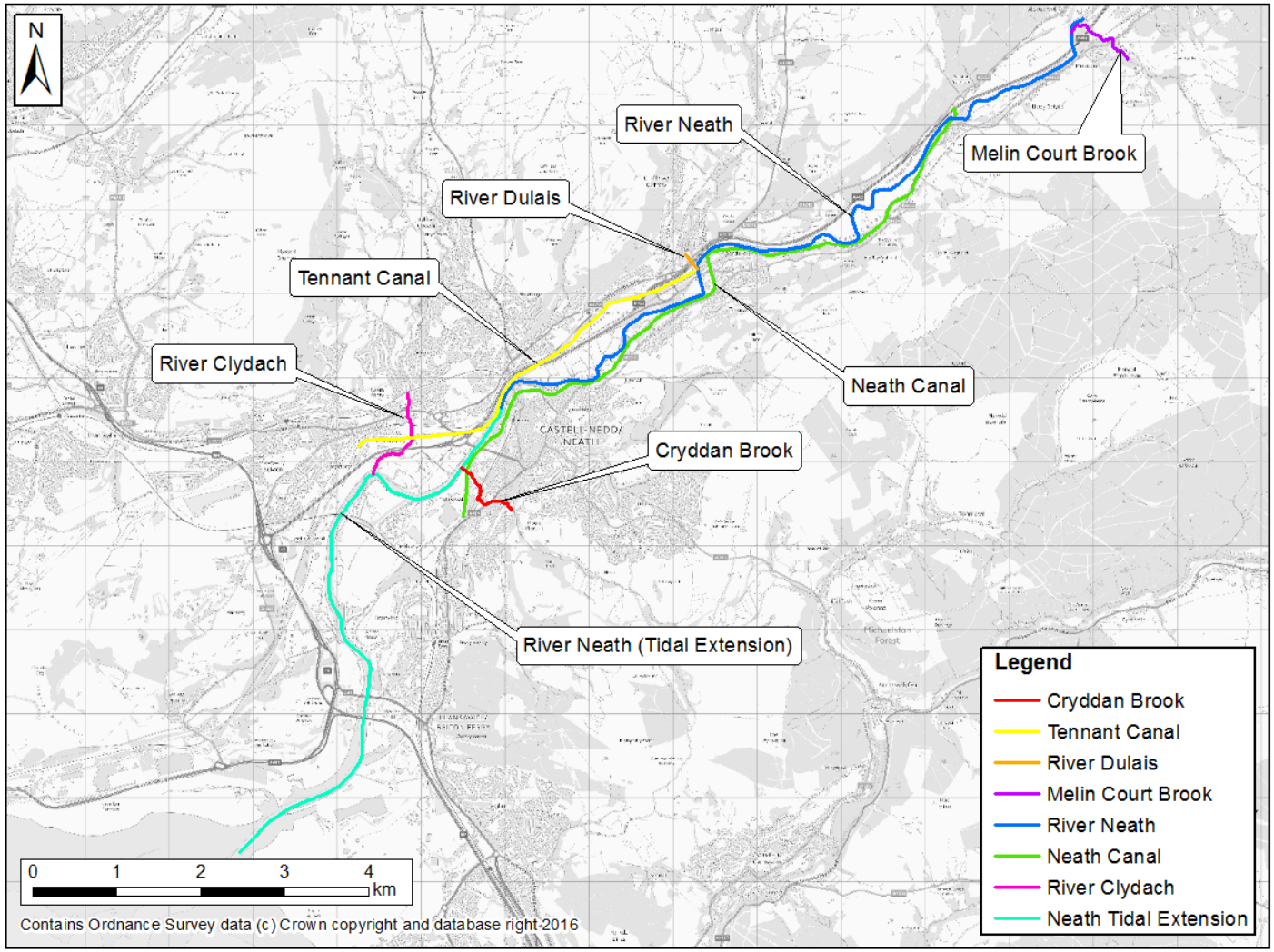


Figure 1-1: Study area showing main watercourses

1.4 Flood Zones

This commission aims to provide improved information to update the mapping used for development and flood risk decisions. Figure 1-2, Figure 1-3, and Figure 1-4 show the existing NRW flood zones for three critical areas identified within the study extent.

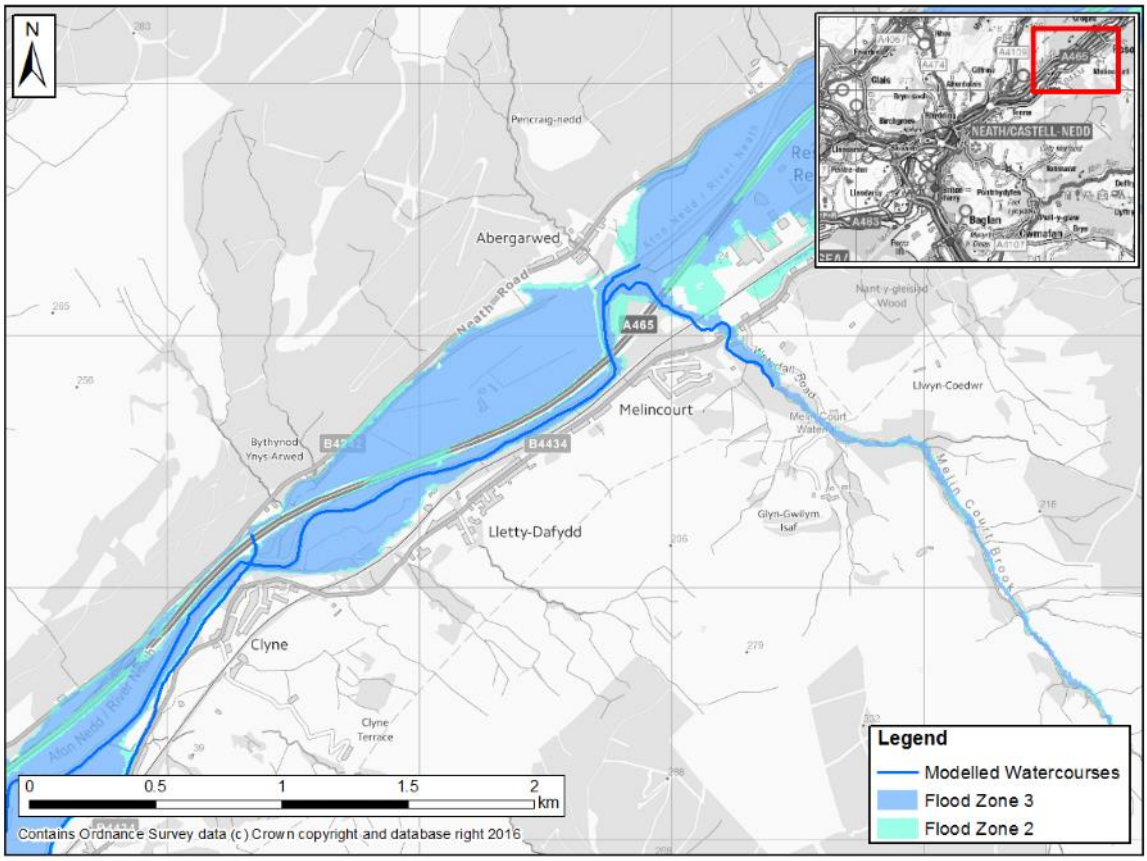


Figure 1-2: Existing NRW flood zones for the upstream model extent of the River Neath and Melincourt Brook

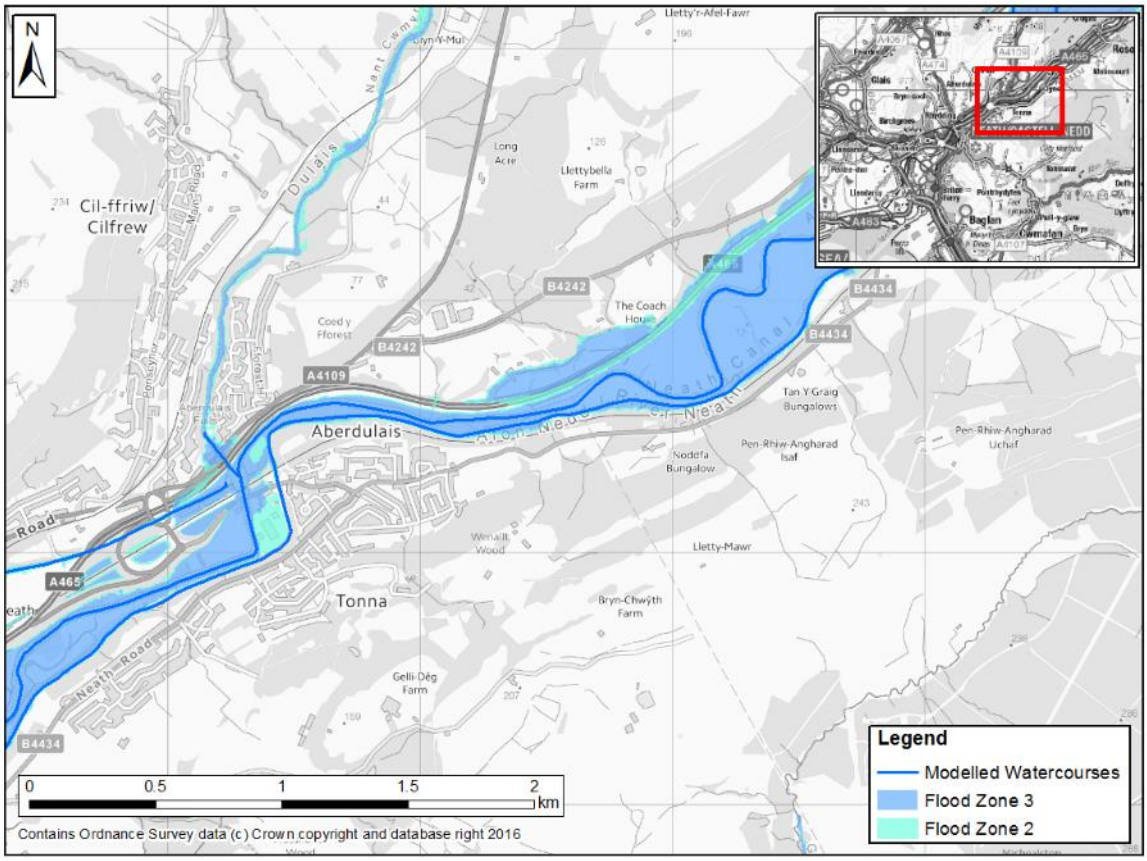


Figure 1-3: Existing NRW flood zones covering the Neath - Dulais confluence area

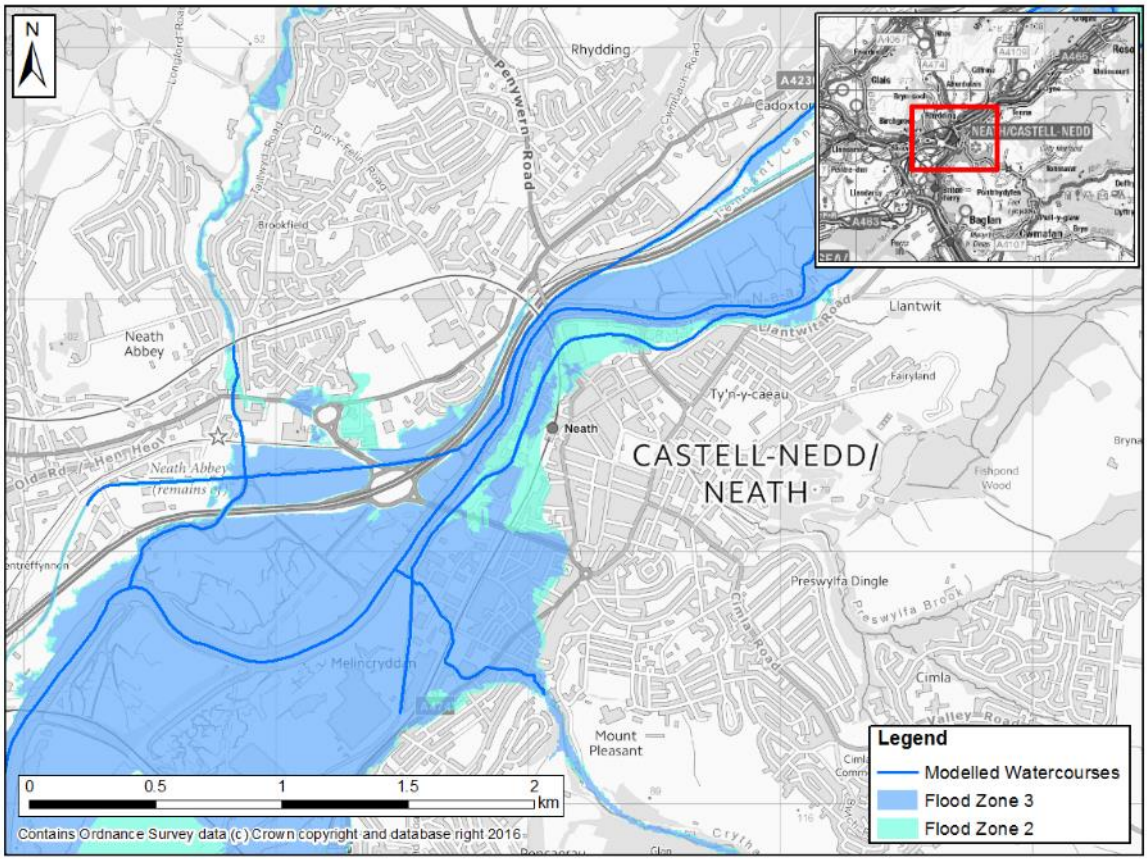


Figure 1-4: Existing NRW flood zones covering the downstream model extent

1.5 Flood History

A number of flood events have been recorded within the River Neath catchment, and most of which relate to fluvial flooding. Aberdulais is one of the key areas of concern within the study catchment with regard to property flooding. Aberdulais is located at the confluence of the River Dulais and the River Neath, and a short distance downstream of the confluence is the disused Tennant Canal aqueduct. This aqueduct presents a major obstruction to flow, and is often overtopped during medium to high flows. This obstruction coupled with the large backwater effect of the River Neath on the River Dulais is further exacerbated once the aqueduct begins to surcharge.

There are numerous key flood events in Aberdulais, namely in 1979, 1987, 1992, 1998 and 2004. A summary of flood events is detailed in Table 1-1.

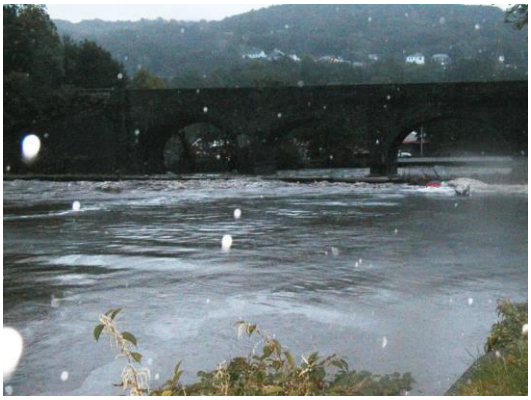
Table 1-1: Summary of flood events in Aberdulais[1]

Date	Event summary
27 December 1979	• Dulais Rock PH car park flooded as the River Dulais overtopped its right bank upstream of the A4109. • The Tennant Canal overflowed leading to flooding of properties along Canal Side. • The Railway Tavern PH, Calor Gas Depot and Riverside Cottage were also flooded.
18 October 1987	• Calor gas depot road flooded in Aberdulais.
02 December 1992	• Flooding of Railway Tavern PH and the B34434 road.
 B4434 and Railway Tavern Public House flooded in December 1992	
23 October 1998	• 25 properties flooded along Canal Side together with the Railway Tavern PH and Calor Gas depot. Flooding occurred by three mechanisms; the Tennant Canal aqueduct surcharged leading to flooding on both banks of the river upstream and downstream of the structure; the rapid inflow of water to the Tennant Canal through the river intakes, followed by a rising canal level resulted in flooding of properties along Canal Side; and the out of bank flow at the B4434 road bridge resulted in flooding of the pub, gas depot and sports ground at the B4434 road bridge.
01 February 2002	• B4434 Bridge close to surcharging.
04 October 2004	• Tennant Canal aqueduct surcharged and the water level reached the parapet level of the structure.

[1] National Resource Wales. Fluvial Flood Warning Procedures Section 12, Neath and Afan Group.

Following the 1998 flood event, flood defences were constructed along the right bank of the Neath and stop logs can be installed along the right bank just upstream of the Tennant Canal aqueduct. Since the construction of flood defences, there has been no property flooding in Aberdulais, but as shown in Table 1-2, the B4434 road bridge was close to surcharging in February 2002 and the aqueduct surcharged in October 2004.

Table 1-2: Photographs of flood events following the 1998 flood event[2]

B4434 road bridge close to surcharging in February 2002	 Tennant Canal aqueduct surcharging in October 2004

1.6 Representation of Return Period

This report quotes flood frequency in terms of Annual Exceedance Probability (AEP), which is the probability of an event occurring in any particular year. The alternative approach is to define the frequency of floods in terms of a return period, this is the inverse of AEP. Return periods are defined as the average time between years with at least one major flood.

Quoting flood frequency in terms of AEP can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval.

Table 1-3 below is provided to enable quick conversion between return periods and annual exceedance probabilities.

Table 1-3: Conversion between return periods and AEP

Return Period (years)	2	5	10	20	50	75	100	200	500	1000
AEP (%)	**50**	**20**	**10**	**5**	**2**	**1.33**	**1**	**0.5**	**0.2**	**0.1**

1.7 Reporting

This report documents all the work undertaken by JBA for the Neath – Phase 2 Commission and is intended to provide a largely non-technical overview of the various elements of the study undertaken for the commission.

Following this chapter, which sets out the objectives of the commission, the structure of the report is as follows:

- Chapter 2 - Hydraulic Modelling - details the development and key assumptions of the hydraulic model and model schematisation;
- Chapter 3 - Sensitivity Analysis and Model Proving – overview of the sensitivity analysis undertaken and details regarding the model performance and limitations;

[2] National Resource Wales. Fluvial Flood Warning Procedures Section 12, Neath and Afan Group

- Chapter 4 - Model Results - summary of model scenarios undertaken, key results and list of project deliverables; and
- Chapter 5 - Summary - a synopsis on the work undertaken and details of the project findings and recommendations.

Full technical details, results and model files are provided in the appendices, as summarised in Table 1-4 below. This only details the appendices of the main River Neath model. The Melincourt Brook was provided separately.

Table 1-4: Appendices to the main report

Deliverable	Description	Appendix
Model User Report	Model User Report providing specific details about the model construction, model performance, assumptions and limitations.	A
Hydrology	The hydrology as provided by NRW for this commission.	B
Tabulated Model Results	Tabulated 1D model results for defended and undefended fluvial model scenarios.	C
Sensitivity Analysis	Tabulated 1D results highlighting the impacts of the different sensitivity tests undertaken.	D
Animations	A total of 21 animations have been provided as based on the project scope including both defended and undefended and fluvial and tidal model scenarios.	E
Digital Data	This contains the packaged model, raw results and processed results.	F
GIS Additional Deliverables	Additional deliverables specified in the project scope including Model Nodes, and Areas Benefitting from Defence (ABD)	G
Survey	The topographic survey used for the construction of the hydraulic model.	H

2. Hydraulic Modelling

A hydraulic model to assess the fluvial and tidal flood risk and flood hazard in Neath has been developed. The schematisation and development of this model is described in this chapter. The datasets used in the model development are discussed along with the approach to model construction and testing. A Model User Report is contained within Appendix A of this report; this contains full technical details of model set-up, with a summary of the general approach adopted described herein. As mentioned the Melincourt Brook model has been delivered separately to the main Neath model however the modelling approach undertaken was consistent for both. The following section mainly focus on the work of the main River Neath but the same methods were adopted for Melincourt Brook unless stated.

2.1 Modelling Approach

An ESTRY-TUFLOW model has been developed for Neath. This approach was specified by NRW in their Statement of Requirements for the project.

The modelling approach is considered suitable for delivering on the study's aims to assess flood risk and flood hazard across the floodplain. The 2D modelling approach, such as provided by TUFLOW, is the preferred approach for generating hazard mapping particularly in urban areas where there may be complex overland flow routes. There are numerous floodplain features within the model extent which can impact on overland flow routes, including walls, roads and a railway line embankment. ESTRY is used to represent the 1D river channel and hydraulic structures within the study area.

2.2 Model Data

NRW provided a range of data to be used in the model development. This included LIDAR, Ordnance Survey (OS) mapping and hydrology data. For a detailed breakdown of the data used in the model, refer to section 2.1 of the Model User Report in Appendix A. Key datasets include:

- LIDAR with a resolution of 1m and 2m in both unfiltered (DSM) and filtered (DTM) formats were available for the entire study area. The collection date of the LIDAR tiles used was the 21/08/2015. The LIDAR was quality checked to ensure the topography was representative of the catchment. A review of the data indicated that the data are of high quality with few filtering issues identified. This data was used in the model to define key overland flow routes.
- OS Open Data, 1:10,000, 1:25,000 and 1:50,000 scale mapping was available for reporting. OS MasterMap was also provided for the study area and used to accurately locate the buildings on the floodplain and to assist in applying roughness values to the floodplain.
- A hydrological assessment of the River Neath, River Dulais, River Clydach, Cryddan Brook, and Melincourt Brook was completed by NRW. The assessment included peak flow estimates and model hydrographs (refer to Section 2.6).

2.3 Channel and topographic survey

Prior to this commission, JBA were engaged to manage the collection of survey data for the River Neath, River Dulais, River Clydach, Cryddan Brook, Melincourt Brook, and the Neath and Tennant Canals. The surveyor contractor, Storm Geomatics, undertook this survey between February and April 2015. The survey commission consisted of in-channel survey and all structures channel cross-sections, as well as approximately 2.5km of bank levels to provide a more accurate representation of the height of flood defence structures.

The extent of the survey and the number of cross-sections is shown in Table 2-1. The full survey, including survey report, can be found in Appendix F. JBA undertook checks of the survey data collected by Storm Geomatics to ensure that the required data have been collected and supplied in suitable formats and to ensure that the data were collected in line with the Environment Agency Survey Specification.

Table 2-1: Survey data collected in this commission

Watercourse	Downstream survey extent (NGR)	Upstream survey extent (NGR)	Length (km)	Number of cross-sections
River Neath	281872 202275	274952 197653	10.02km	73
River Dulais	277144 199477	277242 199353	0.16km	8
River Clydach	273830 197819	273794 197168	0.69km	14
Cryddan Brook	275060 196434	274519 196906	0.92km	24
Melincourt Brook	282400 201801	281795 202192	0.88km	21
Neath Canal	280335 201209	274490 196360	8.8km	45
Tennant Canal	277224 199279	273248 197188	4.8km	27

2.4 Model Schematisation

A linked 1D-2D approach was adopted for this commission and implemented using the software package ESTRY-TUFLOW, version 2016-03-AD-w64. This approach enables accurate representation of the river channel and structures in a 1D model domain, with flooding across the floodplain represented in a 2D model grid.

The 1D channel was constructed within the model using surveyed cross-sections to define the geometry of the river channel. The surveyed cross-sections were linked to the 2D grid at the top of the channel banks to allow for the floodplain to be represented in the 2D model domain. The bank survey was used to accurately define river walls and embankments in the study areas. All structures along the watercourse were identified and a decision on how they should be modelled was made, this is detailed in Section 2.5.

The topography of the 2D model domain was defined using the 1m LIDAR data. The filtered DTM was used as this has been processed to remove buildings and vegetation from the data.

The choice of model grid size is based on three factors, (i) adequately representing key overland flow pathways such as roads, (ii) the width of the channel cross-sections being represented in the 1D model domain, and (iii) the resolution of the topographic (LIDAR) data. The River Neath study area is large (30km) and varied, with a large river and floodplain and small, steep tributaries. In the project scope, it was suggested to use a multi-domain model at 2m-4m grid resolution. It became apparent during the model development phase that this was not practical in terms of both run times and due to the location of the Neath and Tennant Canals as the 2D2D boundary conditions that were required did not work spatially especially with the interaction of the River Clydach and the Cryddan Brook. A 4m grid resolution has been adopted for the whole model although some channel sections including parts of the Canals and the Cryddan Brook are narrower than this resolution. For the standalone Melincourt Brook model a 2m grid resolution has been used.

2.5 Structures

Throughout the study area, there are a number of structures in the river channel that may affect channel hydraulics; these include bridges, culverts and weirs. All of these structures have been included within the model to ensure that the best representation of the study area has been achieved. A description of all structures, their model representation and assumptions is provided within Section 4 of the Model User Report which can be found in the Appendix A.

In total, 57 hydraulic structures have been modelled. All structures have been modelled using a 1D approach. Depending on the nature and geometry of a structure overtopping was represented in either the 1D or 2D domain.

2.6 Hydrology

NRW undertook a hydrological assessment of the study watercourses in October 2015 and January 2016 and provided JBA with the design peak flow estimates and hydrographs to be used as input to the hydraulic model.

Storm duration testing had been undertaken by NRW. Following this, a recommended storm duration of 10.5 hours was used for all nodes on the Neath and 3.25 hour duration for the tributaries. The hydrographs for the 1% AEP flood event for the River Neath inflows are shown in Figure 2-1, the 1% AEP flood event hydrographs for the tributaries are shown in Figure 2-2. The peak flow estimates were calculated using the FEH Statistical/ReFH 'Ratio' method with Win-Fap V3 and data from HiFlows-UK V3.3.2 using Proforma V7.6.

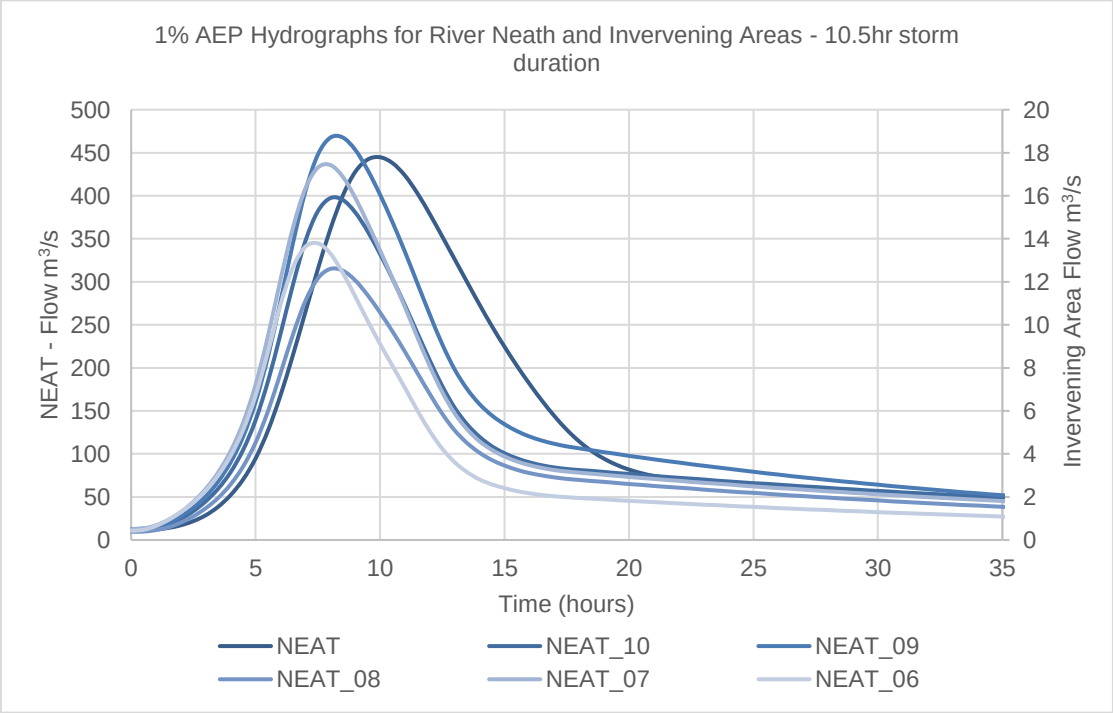


Figure 2-1: 1% AEP fluvial event hydrograph for the 10.5hr storm duration for the River Neath and intervening areas

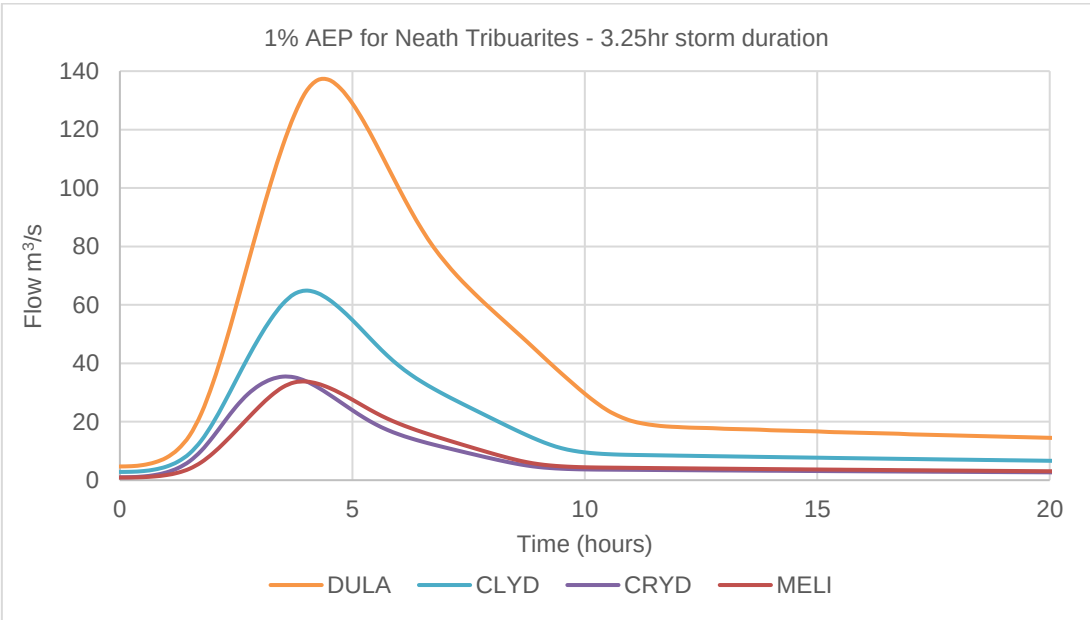


Figure 2-2: 1% AEP fluvial event hydrograph for the 3.5hr storm duration for the tributaries

2.6.1 Boundary Condition Data

A number of 1D and 2D boundaries were applied to the model to represent inflows and outflows. Locations of all boundary conditions applied in the model are shown in and described in more detail below:

- 6 1D inflow points; applied at the top of the River Neath, River Dulais, River Clydach, and the Cryddan Brook with 5 additional intermediate inflows located on the River Neath. To address some 1D model instabilities base flow inflows have been applied to the Neath Canal and Tennant Canal. All inflow points were 1D flow-time (QT) points (Figure 2-3).
- One 1D outflow point; a downstream boundary was represented as a 1D head-time (HT) boundary. This tidal boundary was generated by JBA's coastal team (Figure 2-3).

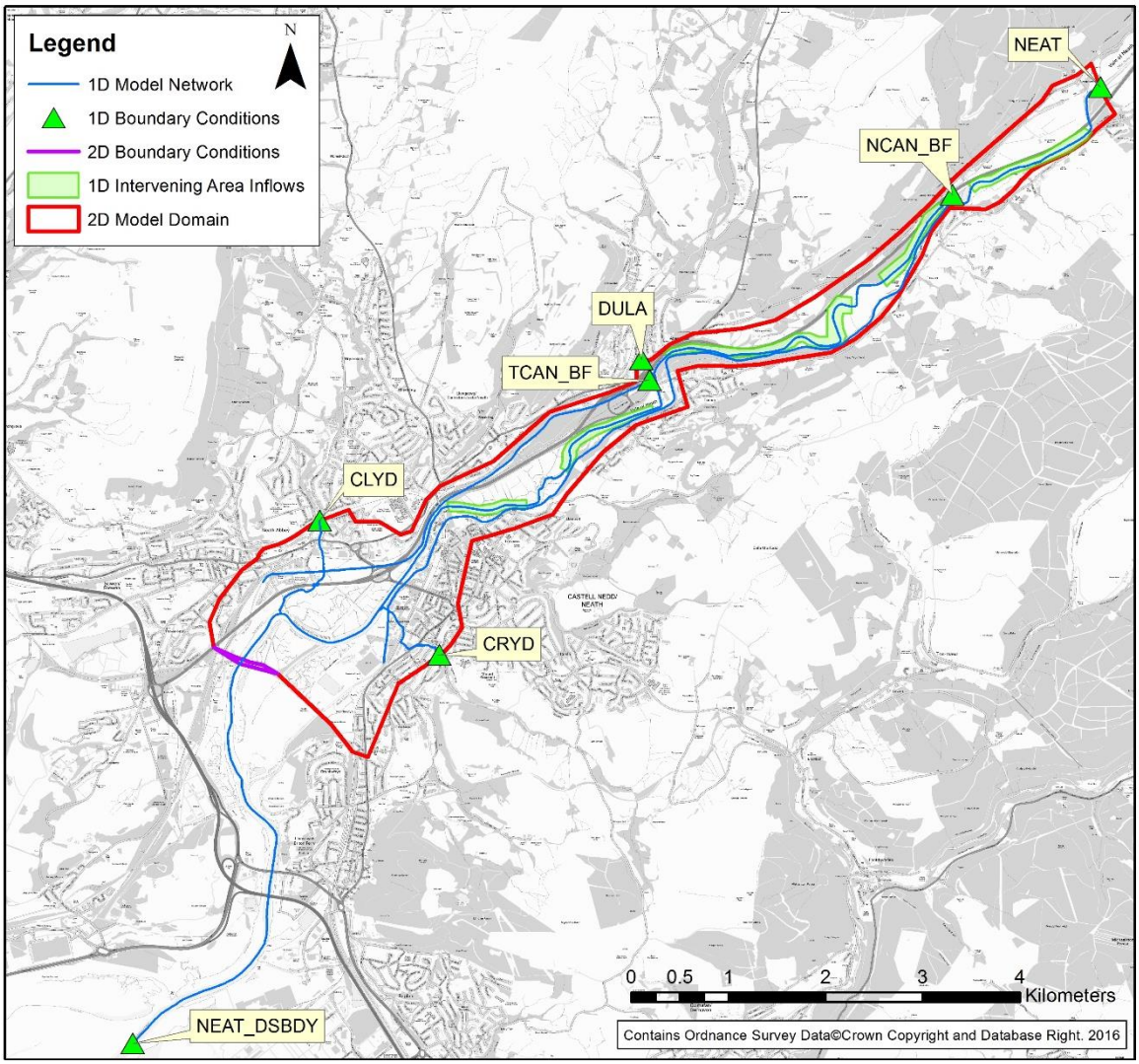


Figure 2-3: 1D and 2D Boundaries

- The Melincourt Brook model boundary conditions consist of a single 1D inflow point at the upstream extent and a 1D stage-discharge (HQ) downstream boundary as shown in Figure 2-4.

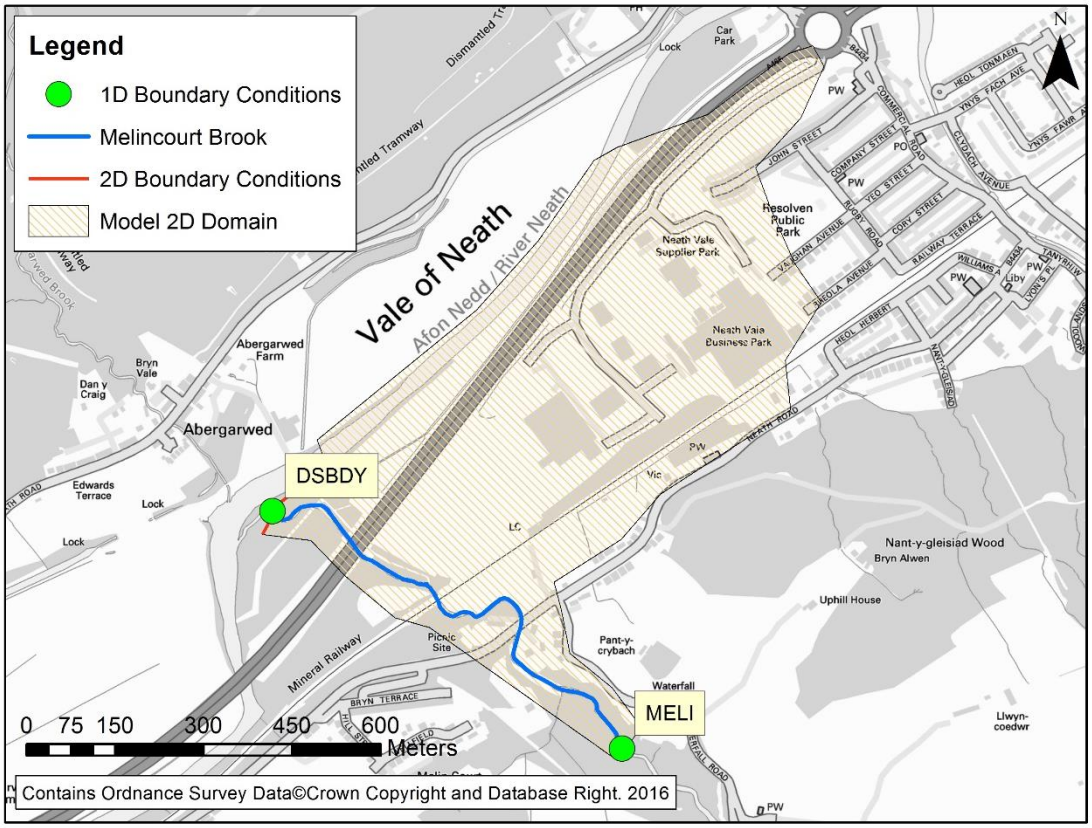


Figure 2-4: Melincourt Brook model domains

2.7 Hydraulic Roughness

Manning's n roughness coefficients are required for 1D channels and culverts, and the 2D model domain. Hydraulic roughness coefficient values for the model channels were sourced from Chow (1973)[3]. Descriptions of channel bed and bank material type provided in the text were compared to photographs collected during the site walkover and by Storm Geomatics to select the most appropriate Manning's n coefficient values. Through this method the following Manning's n coefficient values for channel roughness values were selected:

Table 2-2: 1D Manning's n coefficients used

Material Code	Manning's n	Comment / Example
101	0.025	Channel bed: Dredged stream, straight with a channel bed typified by a silt with a little vegetation (aquatic plants, grass)
102	0.030	Channel bed: Natural stream with a channel bed typified by a silt with some rocks and a little vegetation (aquatic plants, grass)
103	0.035	Channel bed: Natural stream with a channel bed typified by rocks and a little vegetation (aquatic plants, grass)
104	0.015	Channel bed: Manmade stream with a channel bed typified by smooth concrete
105	0.020	Channel banks: maintained grass
106	0.050	Channel banks: unmaintained grass with some scrub and reeds
107	0.070	Channel banks: dense shrubs and trees
108	0.035	Channel banks: Trees with bare understorey
109	0.028	Channel banks: Sheet piles
110	0.015	Channel banks: brick and concrete slab walls (pointed masonry)
111	0.040	1D Network - Vegetated bank, materials based on grass and light brush
112	0.020	Roads/Paths

[3] Chow, V.T. (1973). *Open Channel Hydraulics* McGraw-Hill Book Company.

113	0.050	Channel Banks: Rocks and boulders
114	0.040	Channel Bed: Natural Stream with a channel bed typified by cobbles and boulders
115	0.025	Channel Banks: Stone wall, rubble masonry, little vegetation

Within the 2D domain, OS MasterMap data were used to identify various land use classifications across the catchment and to assign appropriate hydraulic roughness values across the floodplain. The assessment of the data identified features that were likely to influence flow routes across the catchment. The key roughness categories were roads, railways, gardens, buildings, fields and scrub and rough grassland.

The 2D Manning's n coefficient values applied to the model are listed in Table 2-3. A general Manning's n value of 0.05 was applied to all other areas of the floodplain.

Table 2-3: 2D Hydraulic Roughness Characteristics

Material Code	Manning's n	Comment / Example
10021	0.050	Buildings and infrastructure
10053	0.050	Residential gardens
10056	0.030	Grassed areas (incl. fields)
10111	0.080	Areas of thick weeds and trees
10167	0.040	Rail
10172	0.020	Road
10089	0.040	Inland water
10183, 10119 & 10123	0.025	Roads tracks and paths
10062	0.050	Glasshouse
10193 & 10185	0.060	Structures including roadside structures
10054	0.050	General surface
10096	0.040	Manmade landform
10099	0.050	Natural landform
10093	0.045	Combined manmade / natural landforms
10203 & 10210	0.044	Tidal Water
10217	0.050	Unclassified land
1000	0.100	Stability layer

2.8 Buildings

Buildings can be represented within hydraulic models using a variety of approaches[4]. As done in previous commissions and following consultation with NRW, it was agreed that buildings should be represented as 'porous'. To apply this method, the locations of buildings have been defined using OS MasterMap data and a flow constriction has been applied at each building reducing the cell conveyance by 90%.

[4] Syme, W.J. Flooding in urban areas - 2D modelling approaches for buildings and fences, Engineers Australia, 9th National Conference on Hydraulics in Water Engineering, Darwin, Australia, 23-26/09/2008 (2008)

2.9 Defended and Undefended Model

Both defended and undefended models were developed as part of this commission to assess the impact that flood defences have upon flood risk in the area. The flood defences represented within the defended model are all located on the River Neath and the Cryddan Brook and are listed in Table 2-4. The undefended model is an amendment to the defended model, whereby flood defences (as detailed below) are excluded from the model. Topographical data, including survey and LIDAR was manipulated so existing ground levels substitute defence crest levels. As detailed in Table 2-4**,** towpaths will remain in the undefended only.

Table 2-4: Defended and Undefended Model

Watercourse	Type	Run	Figure Reference
River Neath	Embankment	Defended	Figure 2-5Figure 2-5
Neath Canal	Towpath	Defended and undefended	Figure 2-5 Figure 2-6 Figure 2-7Figure 2-5
River Neath & River Dulais confluence	Brick/concrete walls	Defended	Figure 2-6
Neath Canal	Concrete wall	Defended	Figure 2-6
Neath Canal	Concrete overspill wall	Defended	Figure 2-6
Tennant Canal	Towpath	Defended and undefended	Figure 2-7
Tennant Canal	Stone wall	Defended	Figure 2-7
Cryddan Brook	Concrete walls	Defended	Figure 2-8

In the upstream extent of the model, there is an embankment which runs along the left back of the River Neath between 279615mE 200249mN and 279286mE 199718mN for approximately 900m. To the north of the community of Tonna, there are a series towpaths which run between the left bank of the River Neath and right bank of the Neath Canal. On the right bank at the confluence between the River Neath and River Dulais there is a concrete and brick wall which prevents water spilling into the Tennant Canal. To the west of the community of Tonna there is also another towpath and concrete overspill. Just north of the community of Llantwit in Neath is a towpath between the right bank of the Neath Canal and left bank of the River Neath, and is approximately 470m long At the downstream extent of the model there is a stone wall and tow path which runs between the River Neath on the right bank and Tennant Canal on the left bank at the location of Bridge Street footbridge. Along the Cryddan Brook, there are several stone and concrete walls, one located on either side of the brook at St Catherine's Close and the other located upstream and downstream of a culverted reach adjacent to the Bingo hall car park in Melincryddan.

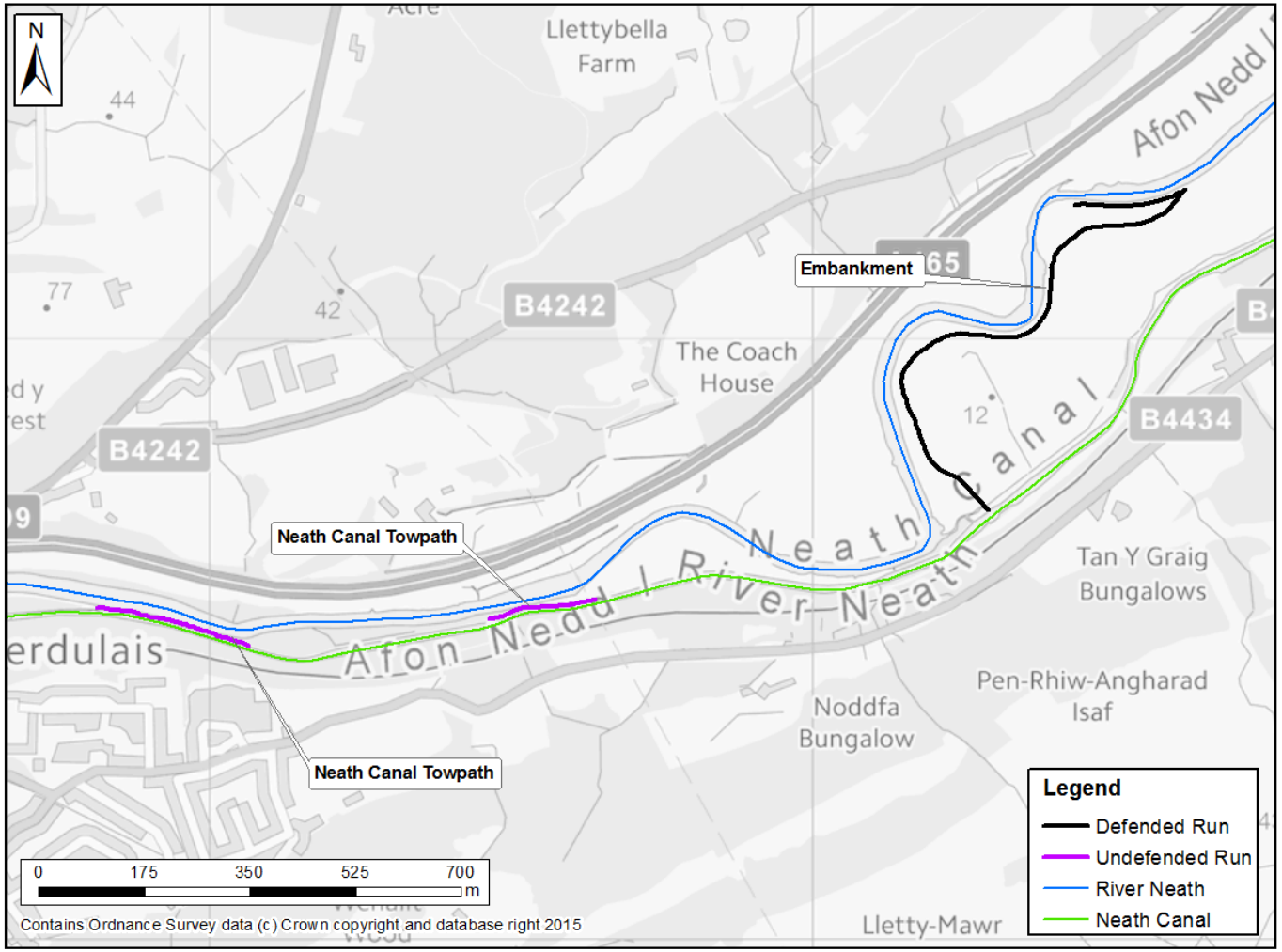


Figure 2-5: Defended and undefended runs (1)

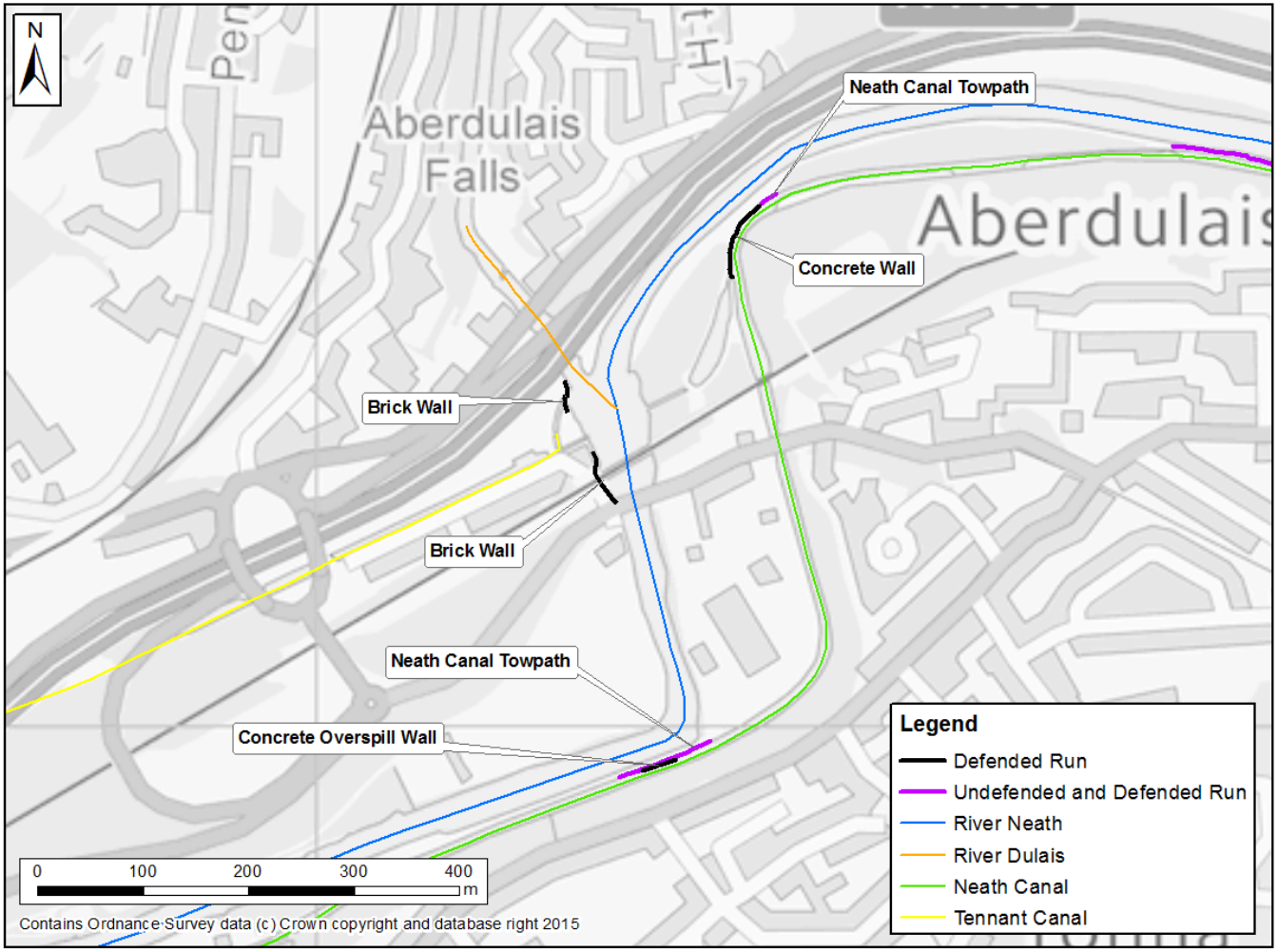


Figure 2-6: Defended and undefended runs (2)

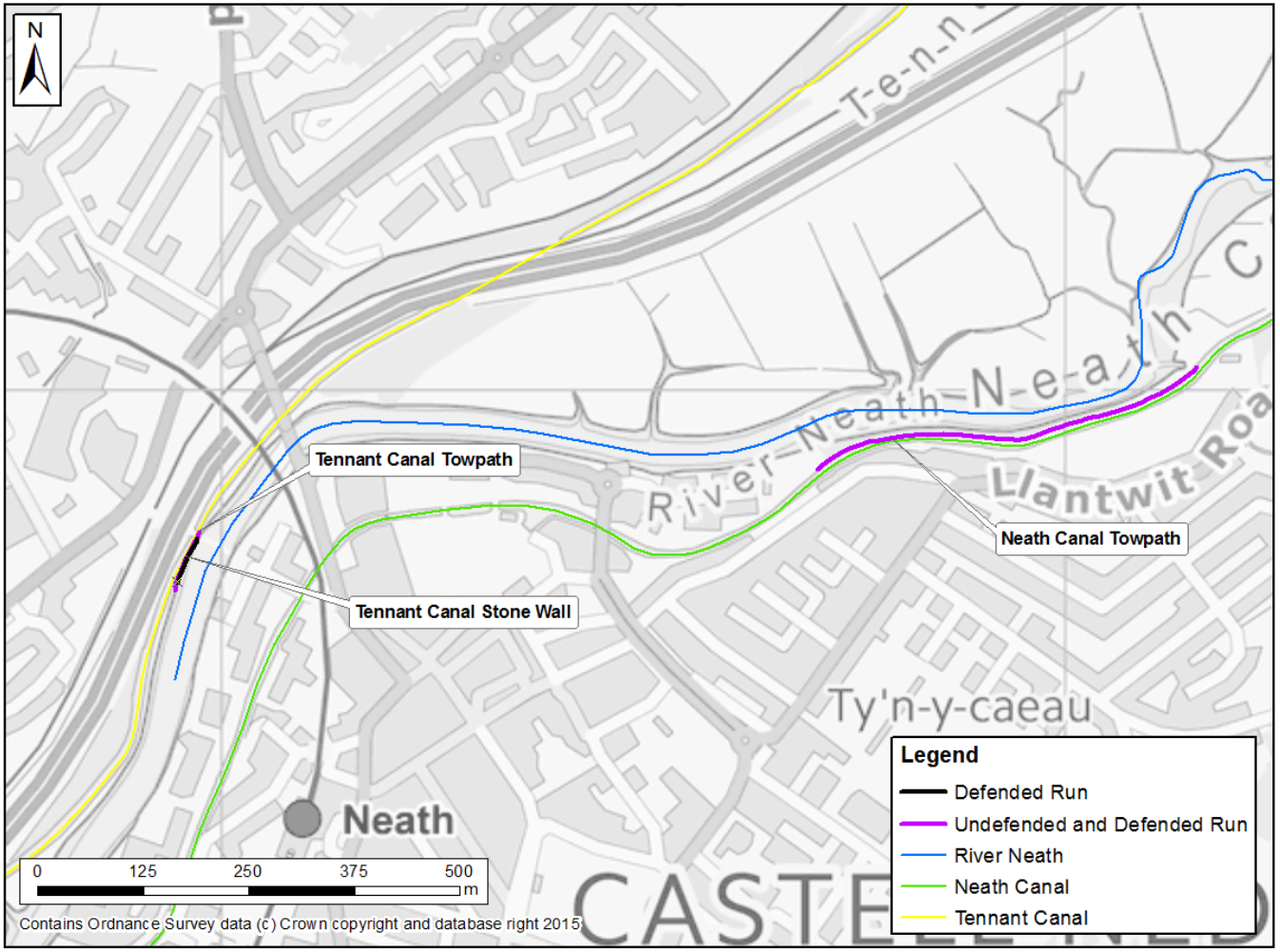


Figure 2-7: Defended and undefended runs (3)

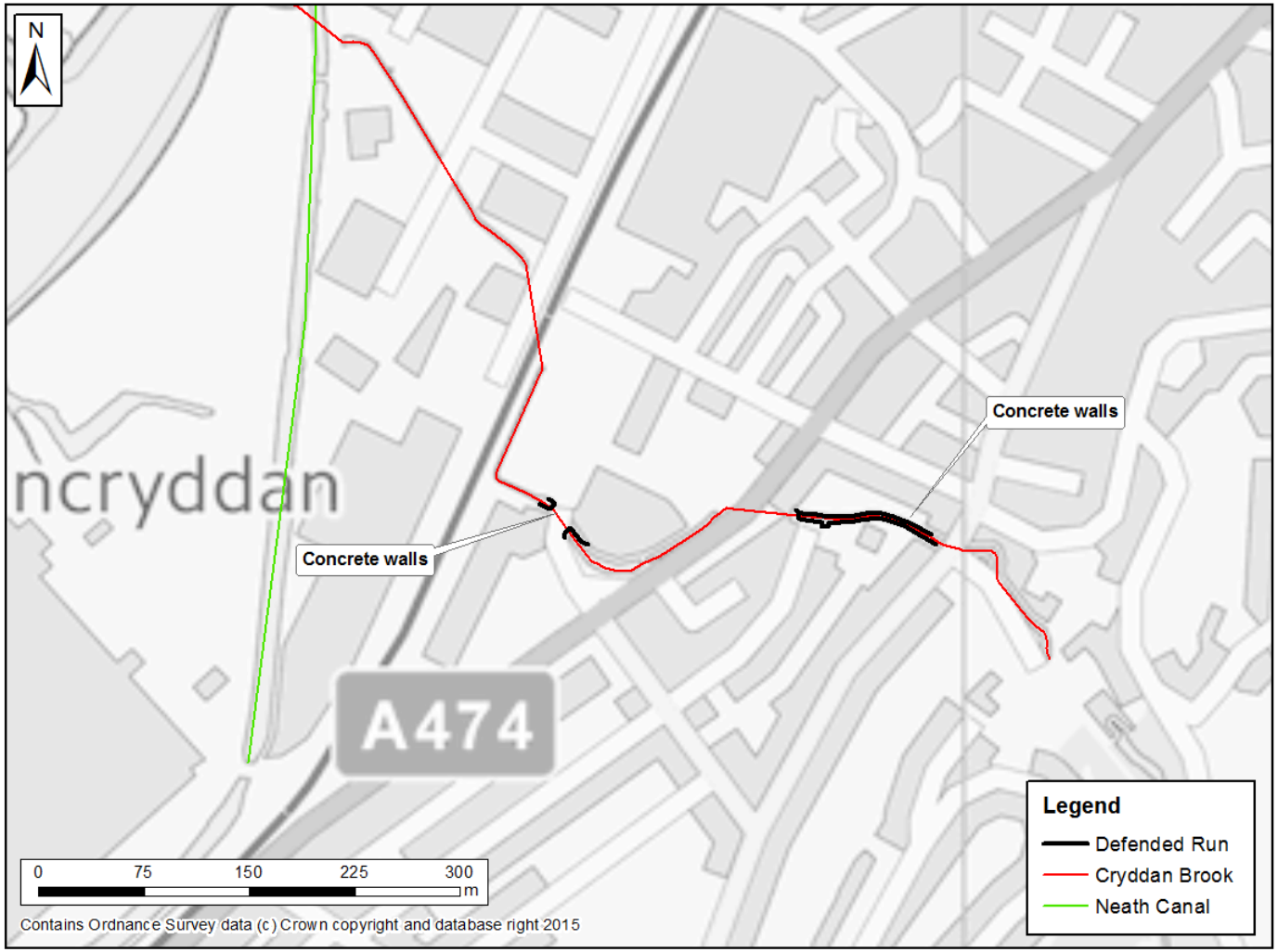


Figure 2-8: Defended and undefended runs (4)

3. Sensitivity Analysis, Model Limitations, and Calibration

An assessment of model sensitivity to design parameters has been undertaken to understand how the uncertainty associated with model parameters and variables impacts upon model results. Sensitivity testing is also a useful technique for testing the performance and robustness of a hydraulic model. Table 3-1 outlines the parameters used to assess the sensitivity of model results.

Table 3-1: Sensitivity Analysis Parameters

Parameter	Variance
Manning's n roughness coefficient	±20% change in roughness applied to 1D and 2D models
Model inflow	±20% change in all model inflows
Downstream boundary	±20% change to 1D and 2D downstream boundaries
Structure losses	±20% change in structure losses Tested the 2016 Tuflow automated structure losses
Event Timing	Coinciding of peak flows for the River Neath and tributaries

The sensitivity of the model to changes in these parameters is assessed in terms of both maximum flood extent and water level. Tabulated water levels for all sensitivity tests are included in Appendix D. In terms of changes in water level, the model results are generally considered to be sensitive when the percentage change in water depth at a node from the baseline scenario is greater than the change in the parameter assessed (±20%) or if there is a significant change in the flood extent. The baseline scenario for all sensitivity tests was the 1% AEP flood event defended model.

3.1 Key findings of the Sensitivity Analysis

- The model sensitivity tests suggest that the manning's n roughness coefficients are having very little impact on the model results with the model inflow exhibiting some localised impacts but do not have a significant impact on the overall flood risk as does the structure losses sensitivity. Due to the timing of this project it was decided to test the application of the new ESTRY-TUFLOW automated generated structure losses. This showed some localised impacts on water levels at structures but did not significantly influence the flood extent.
- Changing the downstream tidal boundary by ±1m obviously had a large influence on the flood risk to the study area. This test impacted the whole modelled study area downstream of the Neath-Dulais confluence area. It is unlikely however that the tidal curves would be out by as much of 1m.
- Tabulation of the 1D sensitivity results has highlighted the Neath and Tennant Canal are the watercourses most prone to significant changes in water levels as a result of the sensitivity testing undertaken. The water levels in the canals are predominately impacted from spilling from the River Neath and its tributaries.

Full analysis of the sensitivity testing can be found in Section 7 of the Neath Model User Report in Appendix A and Section 6 of the Melincourt Brook Model User Report.

3.2 Model limitations and assumptions

All hydraulic model results are prone to limitations and uncertainty due to factors such as uncertainty in the key model inputs (e.g. flows and model boundaries, topography) and modelling parameters (e.g. roughness), the modelling software used, model stability and the nature of the assumptions used in the modelling. Some particular limitations and assumptions of the Neath model that future users should be aware of are;

- The hydrological assessment used to derive the model inflow estimates was produced by NRW using the FEH Statistical/ReFH 'Ratio' method with Win-Fap V3 and data from

HiFlows-UK V3.4. However the flows had to be revised during the model development phase. The Cryddan Brook modelled flood outlines exhibited extensive flooding in the QMED event which did not correlate to flood history in the area. NRW revised the flows down for the final model but it is assumed the inflows for the other watercourses are appropriate.

- It has been assumed that the supplied LIDAR DTM is a suitably accurate measure of ground levels across the floodplain. The LIDAR was checked against the surveyed elevation at the extremity of each river section at an early stage in the study and this revealed no systematic bias against the survey. LIDAR has been used to form the basis for the majority of the bank elevations throughout the model extent for both the Neath and Melincourt Brook models. However the bank levels have been specified for the Neath and Tennant Canals to ensure spill levels between the River Neath and the Canals was appropriate.
- Buildings have been modelled as layered flow constrictions which restrict conveyance through buildings yet permit storage. Standalone walls (other than formal defences) have been omitted from the model. This could lead to a simplification of flow routes in urban areas.
- The 1% AEP flood extent has been shown to be relatively insensitive to certain key model parameters during the sensitivity testing so any uncertainty in these parameters would not be expected to have a very large impact on the model results. However, these parameter changes have only been tested in isolation so high uncertainties in model inflows combined with uncertainties in model parameters could lead to variations outside those presented in the sensitivity test results.
- Due to the complex nature of the flood mechanisms identified throughout the study area and the interaction between the watercourses and the canals a number of model instabilities were identified during the development phase

Full details of the model performance, limitations, assumptions and uncertainty can be found in section 8 of the Neath Model User Report and Section 7 of the Melincourt Brook Model User Report.

3.3 Model Calibration

It has not been possible to undertake any verification/calibration on the Melincourt Brook due to the lack of flood history and gauge data for the watercourse. However model calibration has been undertaken for the main River Neath model. Full details of the calibration work undertaken can be found in Section 8.3 of the Neath Model User Report. An overview of the work undertaken is detailed below:

- Calibration could only be undertaken on the River Neath watercourse due to the availability of gauged data within the model extent. There were two principal approaches to the model calibration.
- Firstly the gauged rating curve at Resolven has been compared to the modelled rating. It was not within the project scope to undertake a thorough rating review of the Resolven gauge but a number of iterations have been run altering the ESTRY weir coefficient to produce an acceptable match as can be seen in Figure 3-1.

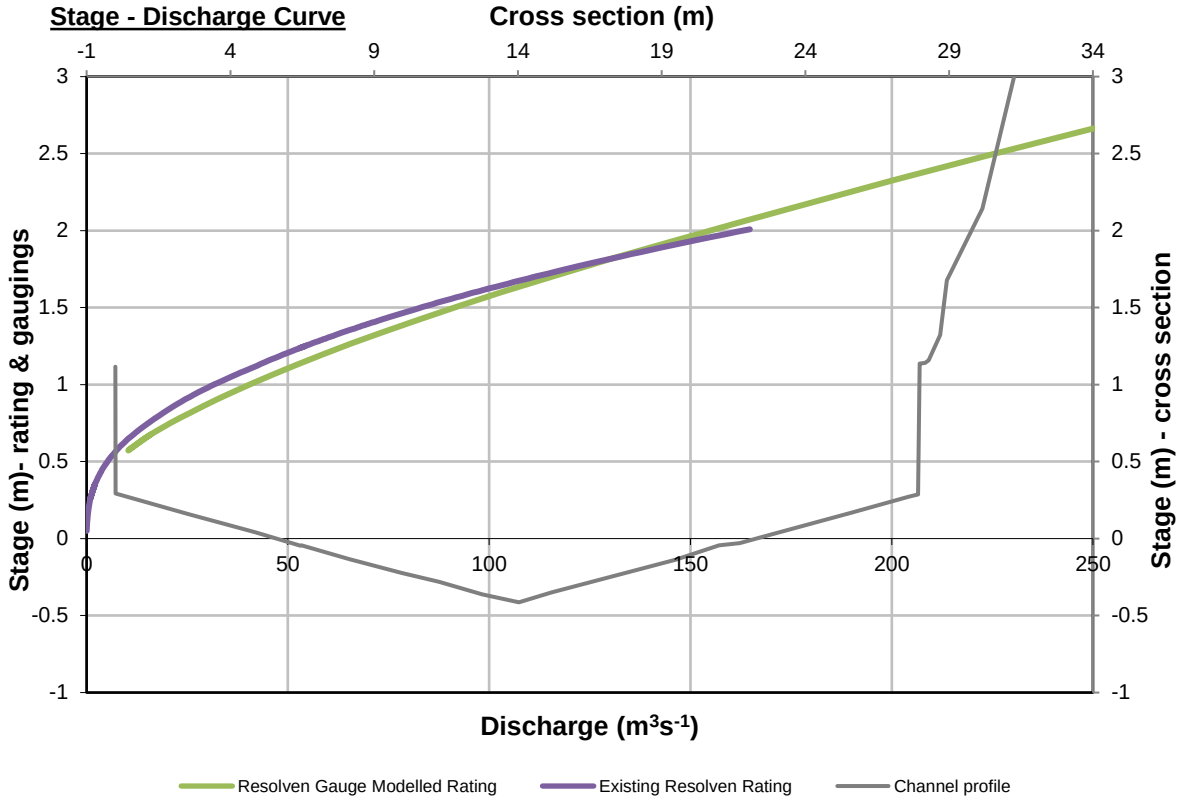


Figure 3-1: Comparison of existing Resolven gauge rating against model rating

- The second phase of the fluvial calibration looked at modelling three observed events, the water level hydrograph at both the Resolven and Dulais gauge was then compared to the model results to see how well the model was able to replicate observed conditions. Detailed analysis of how the model performed in replicating these events is detailed in Section 8.3.3 of the Neath Model User Report.
- In summary the model was able to sufficiently replicate these events in terms of event timing, hydrograph shape, and peak water level at both the Resolven and Dulais gauges. For two of the observed events (21/10/2005) & (13/12/2008) the modelled peak levels were within 34mm and 74mm respectively of the observed level however for the other event simulation (06/11/2005) peak levels were out by 240mm which is outside the typically preferred threshold of 150mm, this event was not ideal for calibration as it is twin peaked, it was therefore decided not to further amend the model parameters to calibrate this event due to the uncertainty surrounding it.
- There were two limitations with the event calibration. Firstly the Dulais gauge is located downstream of the Neath-Dulais confluence. There was no gauge located on the River Dulais within the modelled study area, therefore the inflow had to be approximated. Secondly the number of events available that covered the gauge record of both the Resolven and Dulais gauges was restricted. This lead to the inclusion of the twin peaked November 2005 event.

4. Model Results and Flood Risk

4.1 Scenarios

A series of model design runs have been undertaken to assess the flood risk and flood hazard within Neath and the surrounding area. The model scenarios that have been undertaken for this commission are:

- **Fluvial defended** scenario for 50%, 20%, 10%, 5%, 2%, 1.33% 1%, 0.5%, 0.2%, 0.1% and 1% plus climate change AEP flood events. Climate change allowance of +20% on 1% AEP flow.
- **Fluvial undefended** scenario for 1%, 0.1% and 1% plus climate change AEP flood events. Climate change allowance of +20% on 1% AEP flow.
- **Tidal defended** scenario for 1%, 0.5% and 0.1%, as well as 0.5% and 0.1% plus climate change AEP flood events. Climate change allowance using PAG3 data and tidal stage data as per Environment Agency and DEFRA (SC0600064)
- **Tidal undefended** scenario for 1%, 0.5% and 0.1%, as well as 0.5% and 0.1% plus climate change AEP flood events. Climate change allowance using PAG3 data and tidal stage data.
- Tidal **Defended** Prism Models MHWS + Q_{med}, T2.0% + Q_{med}, T1.0% + Q_{med}, T0.5% + Q_{med}, T0.1% + Q_{med}, Climate Change for T0.5% + Q_{med} and Climate Change for T0.1% + Q_{med}. 20% allowance for fluvial climate change and added using PAG3 data and tidal stage data

More detailed information on the design runs undertaken for this commission can be found in Section 9 of the Neath Model User Report and Section 8 of the Melincourt Brook Model User Report.

Section 4.3 summaries the key flood risk area and mechanisms identified as a result of this study. The digital deliverables which accompany this report should be referred to for a more detailed view of areas at risk, these are summarised below.

4.2 Supplied Results

4.2.1 Grids

Maximum floodwater depth, water level, velocity and hazard grids have also been provided in ASCII format. To create outputs from the linked 1D-2D ESTRY-TUFLOW model, the TUFLOW utility programme 'TUFLOW to GIS' was used to extract the maximum grids of the flood variables in ASCII format.

4.2.2 Flood outlines

The flood outlines are provided in MapInfo .tab and ESRI shapefile format for all modelled return period events. Flood outlines were produced by converting the flood depth grid into a simple polygon using a batch automated tool.

4.2.3 Tabulated 1D Results

The maximum water levels and flows from the 1D model have been extracted and provided in an excel spreadsheet and ESRI shapefile including in-channel model nodes.

4.2.4 Animations

21 animations were developed as part of this commission for a range of modelled scenarios and annual exceedance probabilities, and are contained in Appendix E.

- Fluvial defended 1%, 0.1% and 1.0% plus climate change AEP event,
- Fluvial undefended 1%, 0.1% and 1.0% plus climate change AEP event,
- Tidal defended 0.5%, 0.1%, 0.5% plus climate change, and 0.1% plus climate change AEP events

- Tidal undefended 0.5%, 0.1%, 0.5% plus climate change, and 0.1% plus climate change AEP events
- Tidal prism effect MHWS + Q_{med}, T2.0% + Q_{med}, T1.0% + Q_{med},T0.5% + Q_{med}, T0.1% + Q_{med}, Climate Change for T0.5% + Q_{med} and Climate Change for T0.1% + Q_{med}.

4.2.5 Areas benefitting from defences (ABD)

An ABD is an Area that benefits from a defence in a 1% (1 in 100) annual probability flood from rivers or a 0.5% (1 in 200) annual probability flood from the sea.

4.2.6 Sensitivity Analysis Tabulated Results

1D tabulated results of the different sensitivity tests undertaken. The sensitivity analysis has been undertaken on run version 067 so are therefore not directly comparable with the final design runs. The sensitivity results have been included for reference only.

4.3 Flood Risk Areas

There are several locations within the study extent where flood risk to property is shown for extreme events.

In this section the modelled flood risk to the Neath study area is summarised for the present day 10%, 1% and 0.1% AEP events by reference to a sequence of maps (starting at the upstream end of the reach and working in a downstream direction).

4.3.1 Melincourt

The flood outlines for the 10%, 1%, and 0.1% AEP events showing flooding from the Melincourt Brook can be found in Figure 4-1. The principal flood mechanisms and areas at risk at detailed in the following points. There are no formal defences located on the Melincourt Brook.

- Out of bank flooding first occurs during the 50% AEP event immediately upstream of the A465 culvert. The design event that results in flooding to property is during the 5% AEP event where floodwater gets out of bank on the left hand side upstream of the B4434 Neath Rd bridge.
- The properties located either side of the B4434 adjacent to Neath Rd Bridge are at risk during 1.33% AEP events and greater. There are no other properties in Melincourt that are risk from the Melincourt Brook.
- The principal flood mechanism is backing up upstream of the A465 road culvert and weir. Floodwater gets out of bank on the right hand side and flows in a North East direction impacting business units and residential property in Resolven. During the 0.5% AEP event and greater floodwater overtops the dual carriageway embankment and onto the A465.

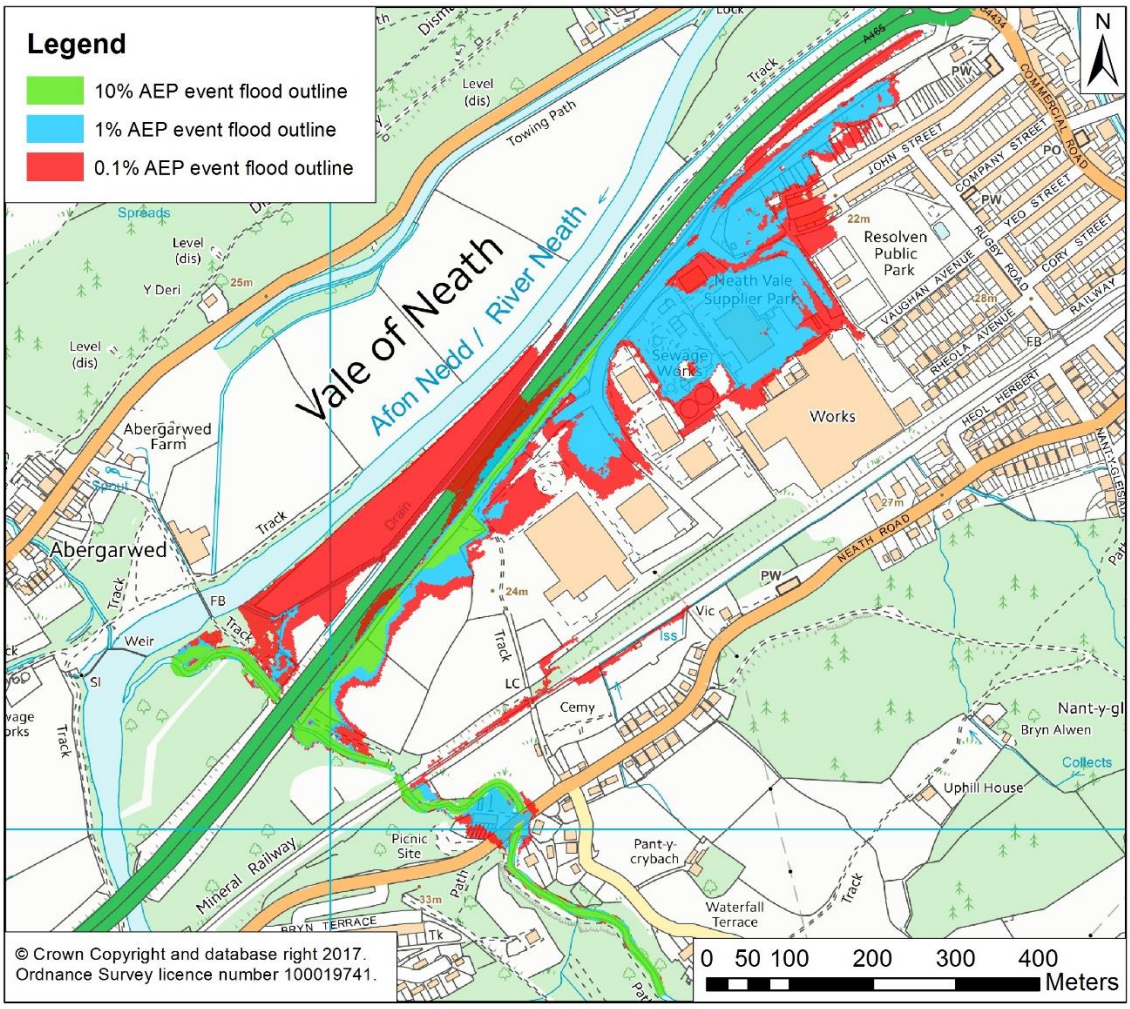


Figure 4-1: Melincourt Brook fluvial flood outlines.

4.3.2 Aberdulais

The Aberdulais area has been identified as experiencing a number of flood events in the past. This area of the modelled study extent is very complex with a high number of structures in close proximity to another and the confluence of the River Neath and River Dulais as well the Neath and Tennant Canals. This area of the model was the most difficult to schematise and involved addressing a number of model instabilities. Figure 4-2 shows the defended model flood outlines for the 10%, 1%, and 0.1% AEP events. The following points details the principal flood mechanisms and areas at risk;

- Floodwater from the River Dulais first gets out of bank on the right hand bank during the 5% AEP event upstream of the A4109 road bridge. It gets out of bank on the left hand bank during the 2% AEP event. The A4109 provides a much greater constriction compared to the A465 bridge located downstream.
- Downstream of the confluence between the River Neath and River Dulais flooding first impacts property during the 20% AEP event. Low bank heights on the right hand bank of the River Neath downstream of the B4434 Dulais Fach Rd bridge cause floodwater to impact the Aberdulais golf range.
- On the left hand bank flooding occurs to the Railway Tavern due to low bank levels of the River Neath between the Railway bridge and the B4434 Dulais Fach Rd bridge. In the 2% AEP event and greater floodwater from here combines with floodwater backing up behind the multiple arch tenant canal aqueduct and flows southerly into the Calor Gas industrial site.

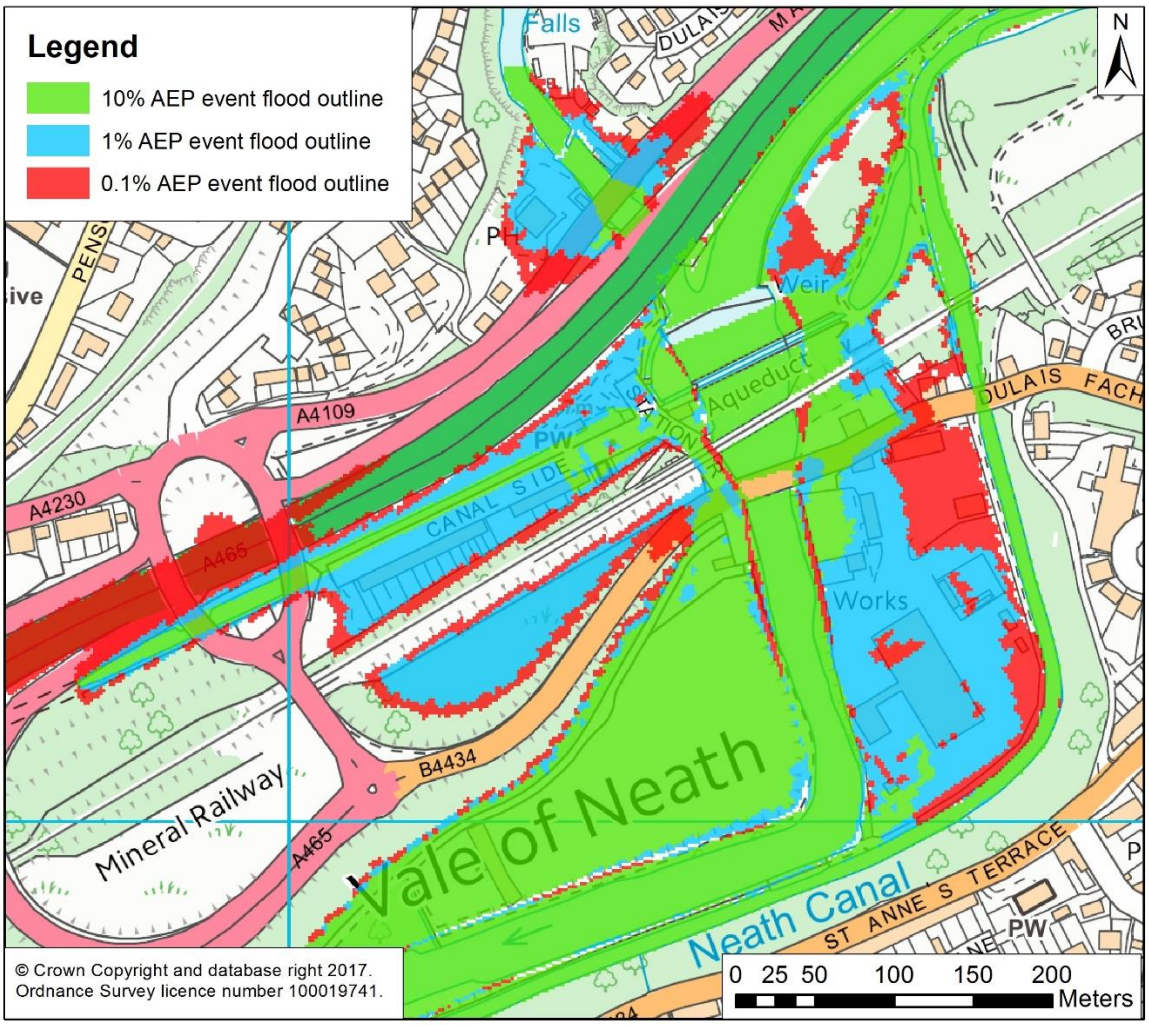


Figure 4-2: Modelled flood outlines in Aberdulais area

4.3.3 Melincryddan

As mentioned the Melincourt Brook provided some challenges during the model development phase. The original peak flows provided by NRW were found to be too high and resulted in unrealistic modelled flood extents. These flows were reviewed by NRW and revised down. The modelled flood outlines for the 10%, 1%, and 0.1% AEP event defended model scenario can be seen in Figure 4-3. The principal flood mechanisms and key areas at risk are detailed below;

- Flooding to property from the Cryddan Brook first occurs during the 50% AEP event. NRW have suggested that flooding does occur fairly regularly but the extent of flooding in the 50% AEP does not match to flood history. NRW have highlighted a potential control structure on the Cryddan Brook upstream of the model extent that could restrict the flow reaching the lower section of this watercourse. It is recommended this is assessed in order to achieve confidence in the modelled flood extents in this area.
- Flooding during the 50% AEP event originates from the right hand bank upstream of the Neath Canal culvert. Water gets out of bank and spreads across the Milland Rd industrial estate. The upstream opening dimensions for the structure could not be collected during the survey due to the accumulation of debris in front of the trash screen. The dimension used were based on the opening of the steel flap on the downstream face. This was considered the only viable approach.
- Flooding to residential property first occurs during the 20% AEP event. Two sources of flooding combine to spread floodwater to a number of properties throughout Melincryddan. Firstly floodwater backs up behind the A474 Briton Ferry Rd culvert, gets out of bank and flows in a southwest direction along the A474. Secondly floodwater gets out of bank upstream of the railway culvert and spreads along the railway line until interacts with the other overland flow route along the A474.

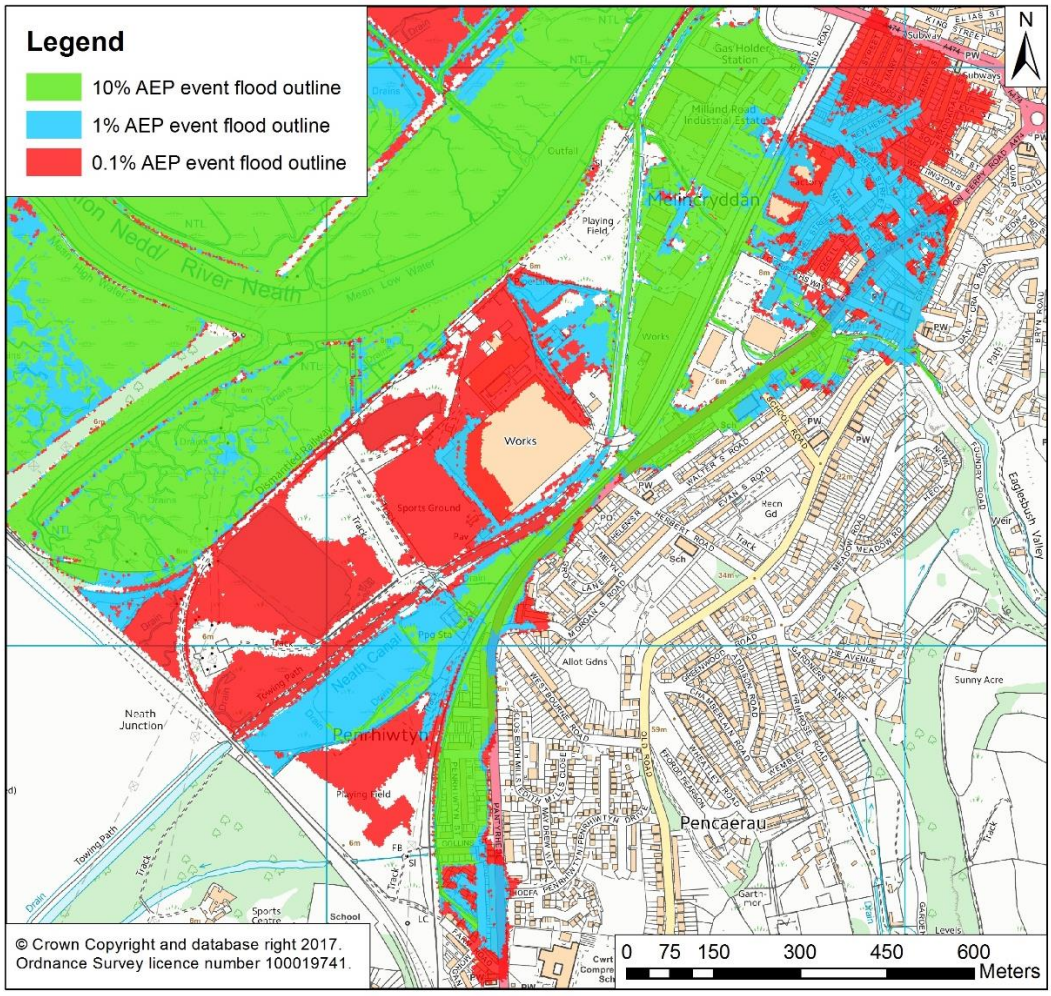


Figure 4-3: Defended model fluvial flood outlines in Melincryddan

4.3.4 Neath Abbey

The modelled flood risk affecting Neath Abbey is attributed to the River Clydach. The flood outlines for the 10%, 1%, and 0.1% AEP events showing flooding from the River Clydach can be found in Figure 4-4. The principal flood mechanisms and areas at risk at detailed in the following points. There are no formal flood defences located on the River Clydach.

- Flooding to property is first observed during the 20% AEP event. Floodwater gets out of bank near to the upstream extent of the model between the railway line and a short culvert located approximately 30m downstream. Water backs up behind the culvert, gets out of bank on the right hand bank and flows south.
- During the 10% AEP event floodwater gets onto the A4230 Neath Abbey Rd. For the 5% AEP events and larger it flows along this road in an easterly direction resulting in flooding to a number of properties within the Stratton Way housing estate.
- The floodwater on Neath Abbey Road feeds onto Monastery Rd and flows south impacting property adjacent to Neath Abbey Rd during the 2% AEP events and greater.

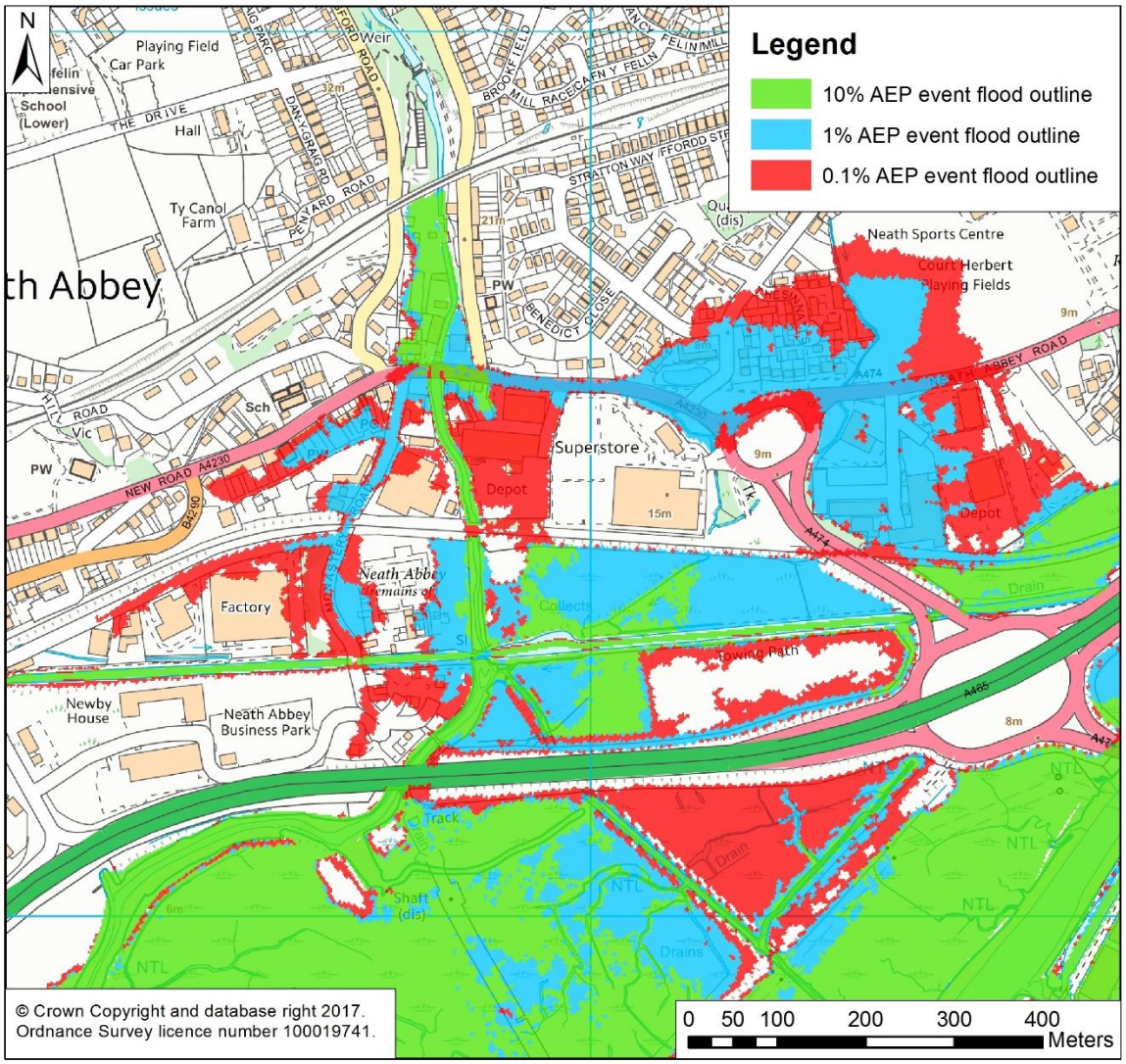


Figure 4-4: Defended model fluvial flood outlines in Neath Abbey

4.3.5 Neath – Tidal flood risk

As part of this flood mapping commission the model simulated tidal design events due to the known tidal influence of the River Neath. The 0.5% and 0.1% AEP present day event flood outlines covering Neath are shown in Figure 4-5. The impact of the tide can be seen in the model results up to the River Neath confluence with the River Dulais.

They key areas identified to be at risk from tidal flooding are detailed below;

- In Melincryddan the Melincourt Brook has a flapped outfall to restrict tidal flooding. In extreme events as can be seen in Figure 4-5 a number of properties are impacted by the 0.5% AEP event. The tide levels spill over the railway embankment and begin to spread. Due to the high tide levels the Melincourt Brook is unable to discharge into the River Neath, for the tidal simulation a baseflow was applied for the Melincourt Brook inflow but even this results in flooding to the Milland Rd industrial estate.
- The extreme tidal events cause out of bank flooding to occur from the River Clydach. Tide levels exceed bank heights upstream and downstream of the railway bridge causing flooding to some property at the southern end on Monetary Rd.
- The extreme tide levels enter into the Tennant Canal, due to its relatively flat gradient the tide levels are able to propagate up to the upstream modelled extent of the Tennant Canal at the River Neath – River Dulais confluence. This causes flooding to occur to the property located at Canal Side, Aberdulais.

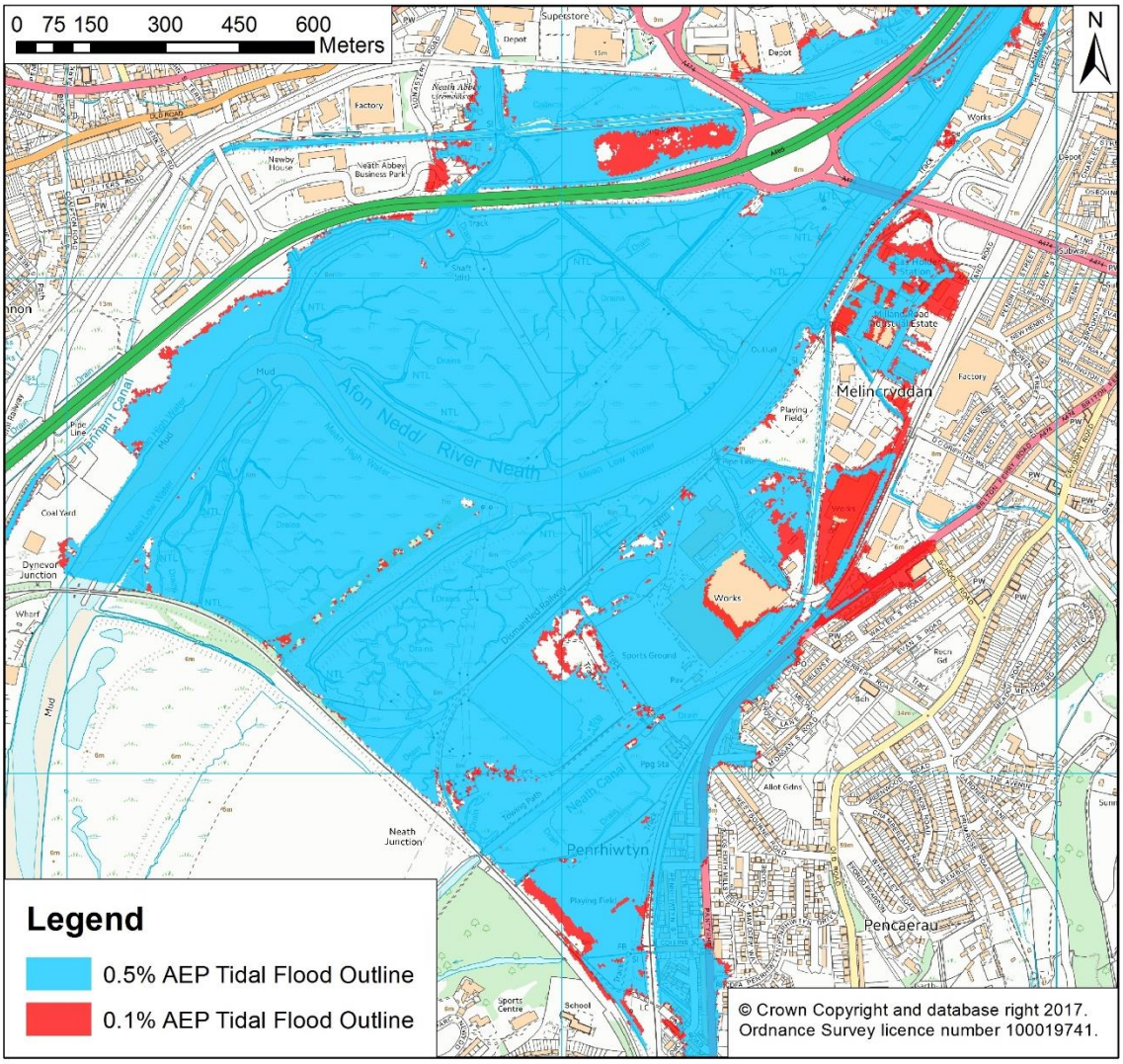


Figure 4-5: Tidal defended model scenario flood outlines

5. Conclusions

5.1 Project Objectives

The flood risk and hazard through Neath has been assessed through the development of a fit-for-purpose 1D-2D hydraulic model, for which the latest version of the TUFLOW software has been used (version 2016-03-AD-w64). Models for both the defended and undefended scenarios have been developed through the use of channel, structure and topographic survey data. GIS outputs of maximum flood extent, depth, level, hazard and velocity have been produced for the all fluvial defended and undefended scenarios and all tidal defended and undefended scenarios, summary of AEP flood events are detailed in.

Table 5-1: Summary of Scenarios

	50%	20%	10%	4%	2%	1.33%	1%	1% +CC	0.5%	0.5% +CC	0.2%	0.1%	0.1% +CC
Fluvial Defended	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Fluvial Undefended							✓	✓				✓	
Tidal Defended									✓	✓		✓	✓
Tidal Undefended									✓	✓		✓	✓
PRISM					✓		✓		✓	✓		✓	✓

5.2 Key Flood Risk Issues

The model results indicate that parts of Neath are at significant risk of flooding.

The key findings are:

- The model results suggest that Melincryddan is at significant risk. Flooding to a number of properties occurs during the 50% AEP event, the frequency of flooding is suspect in relation to flood history.
- Tidal design events results in flooding to a number of locations throughout the Neath study area including Melincryddan, Neath Abbey, and Aberdulais.
- The Melincourt Brook results in little flooding to Melincourt, however in the largest design events overland flow does reach Resolven impacting causing flooding to a number of businesses and residential property.

5.3 Recommendations

The following recommendations of future model development are given to inform flood asset management and Flood Warning.

- Investigate the impact of blockages at key structures.
- Re-asses the modelled flood extents in the vicinity of the Cryddan Brook. The frequency of flooding on this watercourse does not seem to correlate with flood history. NRW have suggested that upstream of the model extent there is a hydraulic control which restricts the flow getting downstream.
- Assess the model performance against any future flood events to ensure its reliability in replicating observed conditions.

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Appendices

A Model User Report

B Hydrological Assessment

C Tabulated Model Results

D Sensitivity Analysis

E Animations

F Digital Data

G GIS Additional Deliverables

H Survey

References

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t:+44(0)1756 799919
e:info@jbaconsulting.com

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