PARSONS BRINCKERHOFF

March 2014

LEVEL 2 STRATEGIC FLOOD RISK ASSESSMENT

CHULEY ROAD, ASHBURTON

Dartmoor National Park Authority

3512820A-SSR

Final

Level 2 Strategic Flood Risk Assessment

3512820A-SSR

Prepared for
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CONTENTS

LIST OF ABBREVIATIONS

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
DCC	Devon County Council
DHS	Devon Hydrology Study
DPD	Development Plan Document
DNPA	Dartmoor National Park Authority
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
FDGIA	Flood Defence Grant in Aid
FMfSW	Flood Map for Surface Water
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
LDF	Local Development Framework
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
NFCDD	National Food and Coastal Defence Database
NPPF	National Planning Policy Framework
PB	Parsons Brinckerhoff
PPS25	Planning Policy Statement 25: Development and Flood Risk (superseded)
PFRA	Preliminary Flood Risk Assessment
SAB	SUDS Approval Body
SFRA	Strategic Flood Risk Assessment
SUDS	Sustainable Drainage Systems
SWW	South West Water
TDC	Teignbridge District Council
TGNPPF	Technical Guidance to the National Planning Policy Framework
WaSC	Water and Sewerage Company
WFD	Water Framework Directive
WSUD	Water Sensitive Urban Design

EXECUTIVE SUMMARY

Background	Parsons Brinckerhoff was commissioned by Dartmoor National Park Authority to undertake a Level 2 Strategic Flood Risk Assessment for the Chuley Road area of Ashburton. The purpose of the report is to provide a detailed understanding of flood risk and hazard from flooding that can be used to inform future planning decisions in Ashburton. The report builds upon the findings of the 2010 Dartmoor Level 1 Strategic Flood Risk Assessment and should be reviewed alongside this document.
Existing assessment of flood risk	Existing Environment Agency indicative flood mapping showed the study area to be at high risk of fluvial flooding from the River Ashburn and the Balland Stream. Much of the Chuley Road site was shown to be in the high risk Flood Zone 3, with an annual probability of flooding of greater than 1%. The indicative assessment was based on broad-scale mapping which did not consider the impact of existing flood defences or the complex overland flow paths in urban flood events. Importantly, a flood relief culvert was constructed on the River Ashburn in the 1980s to divert peak flows away from the centre of Ashburton and reduce flood risk. The impact of this culvert and other defences was not considered in the indicative assessment. The Dartmoor Level 1 Strategic Flood Risk Assessment highlighted that further detailed assessment was required in Ashburton to improve understanding of the flood risk in Ashburton and to enable effective planning of new development.
Methodology	To improve understanding of the fluvial flood risk at the site, a1D-2D hydraulic model was created using ISIS-TUFLOW software. The two watercourses were represented in 1D using ISIS with overland flow paths represented in an interlinked 2D domain. The 1D model was represented using topographic survey data, with LiDAR data used to inform the modelling of the wider 2D domain. Hydrology for the assessment was taken from the Environment Agency Devon Hydrology Study, updated in 2013. This assessment was supported by review of records and reports of past flood events and consideration of the flood risk from other sources, such as surface water, groundwater and sewer flooding.
Results of assessment	The 1D-2D hydraulic model showed a high risk of fluvial flooding from both the River Ashburn and the Balland Stream. The extent of flooding shown was similar to the existing indicative flood map, but showed reduced likelihood of flooding in parts of the site. The modelling also provided understanding of the mechanisms of flooding across the site and the range in velocity and depth of the flooding, enabling an assessment of the hazard from flooding.
Summary of flood risk	Review of the updated hydraulic modelling and records of past flood events has identified two principal causes of flood risk in the Chuley Road site and surrounding area: 1. The Balland Stream culvert has limited capacity and is prone to blockage. Analysis has shown that the current Balland Stream culvert is liable to flooding in events with a relatively high annual probability (1 in 10 year event). Recent events have also highlighted that blockage in the Balland Stream culvert has the potential to greatly increase the likelihood and extent of flooding.

	2. There is a fluvial flood risk from the River Ashburn for areas alongside the river, with greatest risk in areas upstream of structures in the watercourse. Within the Chuley Road site, the risk is greatest at the southern end of the site and at the north of Tuckers Yard. The flood relief culvert is shown to protect central Ashburton from flooding in events up to the 1 in 50 year event. The Chuley Road site is downstream of the outlet from the flood relief culvert and does not benefit from the flood relief culvert. Review of surface water flood maps has shown a high degree of crossover between areas at risk from surface water flooding and those at risk of fluvial flooding. No significant risks were identified from groundwater flooding or sewer flooding.
Spatial planning and development guidelines	The results of the hydraulic modelling have been used to inform spatial planning guidelines to inform the future development of the Chuley Road site. These guidelines follow the 'sequential' methodology, with development guided into areas at lowest flood risk. The requirements of developers preparing Flood Risk Assessments are set out, with guidance provided on reducing flood risk and making development safe, including Sustainable Drainage Systems (SUDS) and flood mitigation measures.
Flood risk mitigation	A review has been undertaken of potential approaches to reduce the flood risk in the Chuley Road site and the surrounding area. These approaches would serve to reduce flood risk to existing properties in addition to protecting new development. The review found that the solutions with the greatest potential benefit for improving flood protection to the Chuley Road site include reprofiling the River Ashburn to increase flood storage within the channel and works to modify ground levels to control the route of overland flow from the Balland Stream. A new flood relief channel to increase below ground capacity for the Balland Stream would also reduce flood risk significantly. Advice is also provided on potential funding mechanisms for the identified flood risk reduction measures.
Summary of flood risk	Review of the updated hydraulic modelling and records of past flood events has identified two principal causes of flood risk in the Chuley Road site and surrounding area: 3. The Balland Stream culvert has limited capacity and is prone to blockage. Analysis has shown that the current Balland Stream culvert is liable to flooding in events with a relatively high annual probability (1 in 10 year event). Recent events have also highlighted that blockage in the Balland Stream culvert has the potential to greatly increase the likelihood and extent of flooding. 4. There is a fluvial flood risk from the River Ashburn for areas alongside the river, with greatest risk in areas upstream of structures in the watercourse. Within the Chuley Road site, the risk is greatest at the southern end of the site and at the north of Tuckers Yard. The flood relief culvert is shown to protect central Ashburton from flooding in events up to the 1 in 50 year event. The Chuley Road site is downstream of the outlet from the flood relief culvert and does not benefit from the flood relief culvert.

	Review of surface water flood maps has shown a high degree of crossover between areas at risk from surface water flooding and those at risk of fluvial flooding. No significant risks were identified from groundwater flooding or sewer flooding.
Spatial planning and development guidelines	The results of the hydraulic modelling have been used to inform spatial planning guidelines to inform the future development of the Chuley Road site. These guidelines follow the 'sequential' methodology, with development guided into areas at lowest flood risk. The requirements of developers preparing Flood Risk Assessments are set out, with guidance provided on reducing flood risk and making development safe, including Sustainable Drainage Systems (SUDS) and flood mitigation measures.
Flood risk mitigation	A review has been undertaken of potential approaches to reduce the flood risk in the Chuley Road site and the surrounding area. These approaches would serve to reduce flood risk to existing properties in addition to protecting new development. The review found that the solutions with the greatest potential benefit for improving flood protection to the Chuley Road site include reprofiling the River Ashburn to increase flood storage within the channel and works to modify ground levels to control the route of overland flow from the Balland Stream. A new flood relief channel to increase below ground capacity for the Balland Stream would also reduce flood risk significantly. Advice is also provided on potential funding mechanisms for the identified flood risk reduction measures.
This sheet is intended as a summary only	

SECTION 1

INTRODUCTION

1 INTRODUCTION

1.1 Project Background

1.1.1 In 2010 Dartmoor National Park Authority (DNPA) published their Level 1 Strategic Flood Risk Assessment (SFRA) covering the whole of the Dartmoor National Park. The Level 1 SFRA provides a broad scale understanding of the flood risks across this area and identifies areas where improved understanding of flood risk is required.

1.1.2 The assessment in the Level 1 SFRA is based on broad scale indicative modelling and review of historical flood events. It identified Ashburton as an area with a number of properties at risk from flooding and recommended that detailed assessment was required to improve understanding of flood risk to support future development in the town.

1.1.3 The Chuley Road area has been identified by DNPA as a site with potential for redevelopment. To support the development of this site, DNPA commissioned Parsons Brinckerhoff (PB) to prepare a Level 2 SFRA incorporating detailed 1D-2D modelling of the site to provide an improved understanding of the existing flood risk and the implications of the flood risk on future development.

1.1.4 The Level 2 SFRA has been prepared in accordance with the principles of the National Planning Policy Framework (NPPF) and is to be used to inform future development of the area.

<u>Study Area</u>

1.1.5 DNPA has identified a 3.5 hectare (ha) area of brownfield land in the south of Ashburton as having potential for mixed-use redevelopment. The area, shown in Figure 1 and in Figure A1 in Appendix A, borders Chuley Road and encompasses existing properties including the Station Yard for the former Ashburton Railway Station, the current Tuckers Country Store buildings and the Rendells Auction House. Two Main Rivers run through the development site; the River Ashburn and the smaller, culverted Balland Stream.

1.1.6 In order to understand the flood risk at the Chuley Road site, a wider study area has been identified. This wider study area, comprising approximately 19 ha, is illustrated in Figure 1 and in Figure A1 in Appendix A.

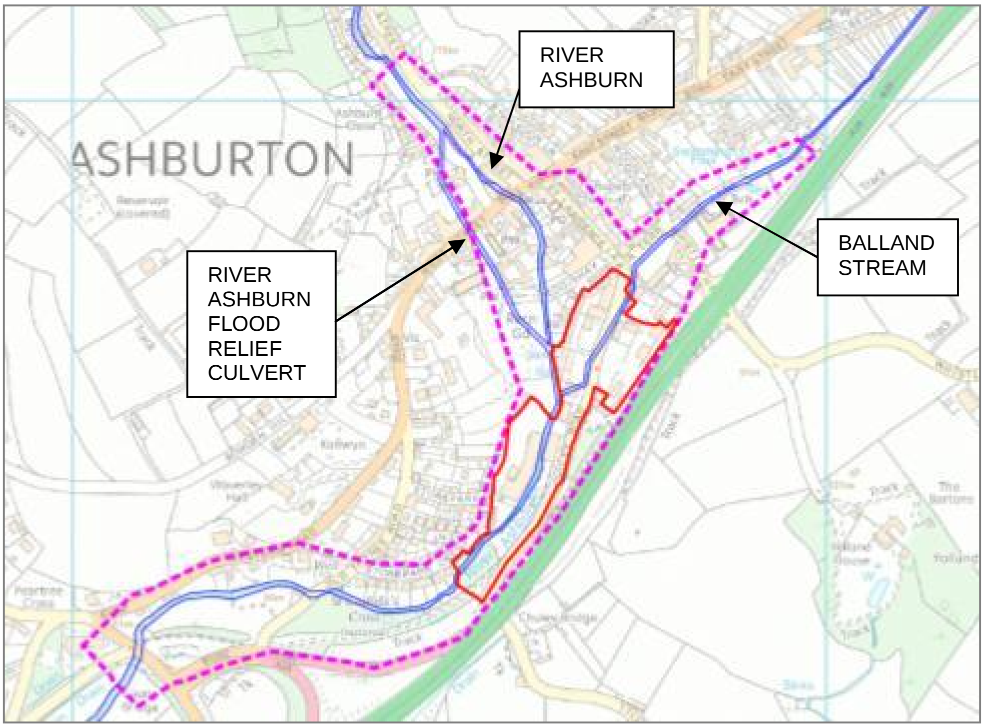

Figure 1 – Chuley Road Level 2 SFRA study area (dotted pink outline) with Chuley Road site (solid red outline).

1.2 Aims and Objectives

1.2.1 The aim of the NPPF with regard to flood risk is to ensure that flood risk is taken into account at all stages of the planning process and that new development is steered to areas with the lowest probability of flooding.

1.2.2 The purpose of this Level 2 SFRA is to provide a detailed assessment of flood risk to the Chuley Road site from all sources that can be used to provide an evidence base against which future planning applications can be processed.

1.2.3 The objectives for the Level 2 SFRA, as set out by DNPA, were:

- To develop an appropriate SFRA evidence base;
- To assess current flood risk and existing flood risk management infrastructure;
- To assess future flood risk;
- To assess the impact of flooding on the Chuley Road site and off-site and how impacts can be managed and mitigated;
- To provide guidance on the potential for spatial redevelopment of the Chuley Road site in ways that minimise flood risks, reflecting any reductions in that risk that are considered achievable and sustainable.

1.3 Sources of Flood Risk

1.3.1 This document provides an assessment of flood risk from all sources to the Chuley Road site. This includes:

- Fluvial flood risk for the River Ashburn and the Balland Stream;
- Surface water flood risk from surface water runoff from adjacent sites;
- Surface water flood risk from site generated surface water runoff;
- Sewer flooding;
- Groundwater flooding; and
- Flood risk from manmade sources such as raised canals and impounded reservoirs.

1.4 Approach

1.4.1 This document has been prepared to provide local guidance in accordance with the national approach set out in the NPPF and the Technical Guidance to the NPPF (TGNPPF). The PPS25 Practice Guide remains current and has been used alongside the TGNPPF to inform the guidance provided in the report.

1.4.2 1D-2D hydraulic modelling using ISIS-TUFLOW software has been undertaken to inform assessment of fluvial flood risk in the study area. A detailed description of the modelling approach is provided in Appendix B and summarised in Section 5.

1.4.3 Assessment of flood risk from non-fluvial sources has been made with reference to records of past flood events and existing published data including the EA indicative surface water and groundwater flood maps.

1.5 Stakeholders

1.5.1 The Level 2 SFRA was prepared in collaboration with a number of key stakeholders:

- DNPA was the lead organisation in the preparation of this document and set out the requirements for the content and delivery of the assessment.
- DNPA worked in partnership with Teignbridge District Council (TDC), who provided support in setting the requirements of the Level 2 SFRA and provided guidance on the flood history in the study area.
- The Environment Agency (EA) was a key partner in the delivery of the Level 2 SFRA, setting the requirements for the hydraulic modelling methodology, providing information on past flood events and providing information on the flood defence assets in the study area.
- As the Lead Local Flood Authority (LLFA), Devon County Council (DCC) provided input on flood risk from non-fluvial sources and provided background information on the flood history in the study area and past work on identifying flood alleviation opportunities.
- South West Water (SWW) provided information on past occurrences of sewer flooding within the site area.

1.6 Flood Risk Management Roles and Responsibilities

1.6.1 As part of the Flood and Water Management Act (FWMA) the roles and responsibilities of designated authorities has been clarified. The flood risk management responsibilities and powers for the study area are summarised in Table 1.

Table 1 – Flood Risk Management Responsibilities and Powers

Authority	Strategic Level	Operational Level
Defra	Overall national responsibility for policy on flood and coastal erosion risk management, and provides funding for flood risk management authorities through grants to the EA and local authorities.	
Environment Agency	Responsible for developing long term strategy for flood and coastal erosion risk management. Responsible for preparing Catchment Flood Management Plans.	Responsible for managing flood risk from Main Rivers. Have powers to carry out maintenance in Main Rivers. Have powers of enforcement to ensure riparian owners fulfil their maintenance obligations in Main Rivers.
Devon County Council (as LLFA)	Input to national strategy. Responsible for preparing and implementing Local Flood Risk Management Strategy. Responsible for preparing Surface Water Management Plans. Responsible for maintaining a register of structures/features which have a significant effect on flood risk in the area.	Responsible for managing flood risk from Ordinary Watercourses, groundwater and surface water. Have powers to carry out maintenance in Ordinary Watercourses. Have discretionary powers of enforcement to ensure riparian owners fulfil their maintenance obligations in Ordinary Watercourses.
Dartmoor National Park Authority	Input to Local Flood Risk Management Strategy.	Control flood risk at development scale through planning.
Teignbridge District Council	Input into Local Flood Risk Management Strategy.	Control flood risk at development scale through planning. Have powers to carry out flood risk management works in Ordinary Watercourses. Lead drainage authority.
Devon County Council as the Highways Authority	Input into Local Flood Risk Management Strategy.	Responsible for maintenance of highway drainage and riparian watercourses beneath the highway (including Balland Stream).
South West Water	Input into Local Flood Risk Management Strategy.	Responsible for maintenance of public sewer network. Responsible for managing flood risk from sewers.
Riparian owners		Responsible for maintenance of riparian owned watercourses.

1.7 Future Level 2 SFRA Updates

1.7.1 This Level 2 SFRA report is a live document and provides an assessment of the current understanding of flood risk in the study area using available information and flood modelling techniques.

1.7.2 As new information becomes available updates will be made to ensure that the latest information is used to inform new developments. Users should check with DNPA, TDC and DCC to ensure that they are using the most current version

SECTION 2

STUDY AREA AND LOCATION

2 STUDY AREA AND LOCATION

2.1 Study Area

2.1.1 Ashburton is a small town on the south-eastern edge of Dartmoor National Park in Devon. The town lies approximately 30km from both Plymouth and Exeter, linked by the A38 which runs adjacent to the south east of the town. Ashburton has a population of approximately 4700 and is the largest town in the Dartmoor National Park.

2.1.2 The Chuley Road site encompasses 3.5 ha of brownfield land in the south of Ashburton. The site is relatively linear with a predominantly north-south orientation and largely follows the alignment of the former Ashburton railway line. The River Ashburn runs through the centre of the southern half of the site and the culverted Balland Stream flows beneath the north-eastern section of the site to join the River Ashburn. Further information on the two watercourses is provided in Section 2.2 below.

2.1.3 The site is currently occupied by a range of different land uses and activities. Historical former railway buildings are located in the north-west of the site, alongside a number of small scale industrial properties. The southern and central parts of the site include more open space and are occupied by two main businesses, the Rendells Auction House and the Tuckers Country Store. A caravan / outdoor equipment salesroom, Outdoor Experience, is located in the north-west of the site on land elevated relative to the remainder of the site. The current land use of the site is shown in Figure A2 in Appendix A.

2.1.4 There are a number of historical buildings within the site which are considered to be high quality heritage assets and are to be preserved and enhanced as part of any future development proposals. These buildings which are to be retained include the Station Garage, the Station Goods Shed, the Old Umber Works and the Engine House.

2.1.5 The Chuley Road site is identified in the DNPA Development Plan Document (DPD) as Proposal ASH2 and is described as a 3.5 ha site for mixed use redevelopment including housing, commercial and employment uses and a public car park.

2.1.6 DNPA has appointed Building Design Partnership (BDP) to carry out a masterplanning exercise to help guide the further development of the proposals for the site, informed by this Level 2 SFRA.

2.2 Hydrology

2.2.1 Two watercourses run through the study area; the River Ashburn and the Balland Stream. The extents of the hydrological catchments of the two watercourses are shown in Figure A3 in Appendix A.

2.2.2 The River Ashburn is an EA Main River which rises in Dartmoor approximately 4km to the north of the site at SX752747 and flows in a southerly direction to join the River Dart at Buckfastleigh, 3km downstream of Ashburton. The catchment of the watercourse is assessed to be 9.2 km^2 at the downstream extent of the study area. The catchment is steep and predominantly rural, lying entirely within the Dartmoor National Park boundary. As shown in Figure 2 and Figure 3 the river runs in a relatively uniform, much modified channel through the study area with the river banks typically formed with stone walls.

Figure 2 – River Ashburn upstream of Chuley Road site

Figure 3 – River Ashburn in south of Chuley Road site

2.2.3 Balland Stream is a small watercourse which rises to the east of Ashburton and flows in a westerly direction to join the River Ashburn at SX756696, within the study area. The watercourse runs in a below ground culvert from the eastern end of Love Lane to the outfall to the River Ashburn, a length of approximately 400m. Balland Stream was identified as a Critical Ordinary Watercourse (COW) by the EA in 2005 and 'enmained' in 2006, reclassifying the river as a Main River. The Stream has a hydrological catchment of 3.85 km^2 at the downstream end of the watercourse.

2.2.4 The inlet to the culvert at Love Lane is shown in Figure 4.

Figure 4 – Inlet to Balland Stream culvert

2.3 Geology

2.3.1 Mapping obtained from the British Geological Survey (BGS) shows three different bedrock formations in the study area. The extent of each formation is shown in Figures A4 and A5 in Appendix A.

- The Balland Stream catchment in the north-east of the study area is underlain by limestone of the Chercombe Bridge Limestone formation. The Linhay Hill Quarry at SX768711 operated by E&JW Glendinning 1.5 km to the north-east of the study area is a commercially active limestone quarry;
- The centre of Ashburton and the area to the west of Chuley Road is underlain by igneous bedrock of the Foxley Tuff Formation;
- The area to the north of Ashburton town centre is underlain by slate of the Tavy Formation.

2.3.2 Review of superficial geology shows an area of low permeability alluvium overlying the bedrock geology in the east of the study area. In the remainder of the study area no superficial geology is shown.

2.3.3 As with much of Devon, the underlying bedrock is classified as a Secondary Aquifer. EA mapping also shows a superficial Secondary Aquifer underlying the River Ashburn. Secondary aquifers were formerly defined as 'minor aquifers' and are considered to be capable of supporting water supplies at a local rather than strategic scale.

2.3.4 The limestone in the Balland Stream catchment is categorised as a Principal Aquifer, defined as a strata with high permeability that may be capable of supporting water supply on a strategic scale.

2.4 Flood Defence Infrastructure

2.4.1 A number of flood defence infrastructure assets protect Ashburton against the fluvial flood risk from the River Ashburn and Balland Stream:

- The River Ashburn Flood Relief Culvert was constructed in 1983 to protect the centre of Ashburton against fluvial flooding from the River Ashburn. The 1.5m diameter concrete culvert runs from SX754699 to SX756696 over a total length of approximately 330m. The culvert was designed to protect against flooding up to the 1 in 50 year return period event at the time of construction;
- The Balland Stream is predominantly culverted from Love Lane to the confluence with the River Ashburn. This culvert has been extended and altered over many years and the form of construction and dimensions of the culvert vary along its length;
- Flood defence walls are located along the left and right banks of the River Ashburn through Ashburton.

2.4.2 Details of these assets are recorded in the EA National Flood and Coastal Defence Database and summarised below. The full NFCDD records for these assets are included in Appendix H and the locations of these assets are shown in Figure A7 in Appendix A.

Table 2 – NFCDD record for flood defence assets in Ashburton

NFCDD ID No	Details
40, 42	River Ashburn flood relief culvert
17-30, 41, 44-46, 100, 101	Culverted section of Balland Stream
15, 16	Culverted section of River Ashburn beneath West Street / Bull Ring.
39	Masonry flood defence wall on right bank of River Ashburn, upstream of outfall from flood relief culvert.
43	Masonry flood defence wall on right bank of River Ashburn, upstream of outfall from flood relief culvert.
97	Masonry flood defence wall on left bank of River Ashburn, downstream of confluence with Balland Stream.
99	Timber revetment on right bank of River Ashburn at southern end of recreation ground.
102	Precast concrete flood defence walls on left bank of River Ashburn, upstream of confluence with Balland Stream.
103	Masonry flood defence wall on right bank of River Ashburn, downstream of outfall from flood relief culvert.
104	Flood defence on right bank of River Ashburn, downstream of outfall from flood relief culvert.

2.4.3 The NFCDD includes an assessment of the condition of the flood defence assets, based on visual inspection. For the Chuley Road site, all assets are categorised between 1 (very good condition, cosmetic defects only) and 3 (fair, defects that could reduce performance of assets). No assets have been assessed to be in the poor or very poor condition categories.

SECTION 3

LEVEL 2 SFRA APPROACH AND METHODOLOGY

3 LEVEL 2 SFRA APPROACH AND METHODOLOGY

3.1 Overview

3.1.1 This Level 2 SFRA has been undertaken in accordance with the NPPF and its Technical Guidance.

3.1.2 Flood risk within the study area was assessed using a range of information including consultation with key stakeholders, desk study of existing information and new detailed flood modelling undertaken as part of this assessment.

3.2 Consultation

3.2.1 The following parties were consulted during the preparation of this Level 2 SFRA. A summary of key meetings and correspondence is included in Appendix C.

Environment Agency

3.2.2 The EA was consulted as a key stakeholder throughout the preparation of this assessment. The EA provided guidance on the hydraulic modelling approach and reviewed the finalised model. The EA reviewed the draft and finalised revisions of the Level 2 SFRA report document and provided input into the guidance contained in the assessment through attendance at regular stakeholder meetings.

Devon County Council

3.2.3 As the LLFA, DCC has responsibility for managing flood risk from surface water, groundwater and Ordinary Watercourses. DCC also has powers and responsibilities relating to the management of flood defence infrastructure and the recording and investigation of flood events. DCC provided input on the surface water flood risks in the study area and information on historical flood events and the flood defence infrastructure in the town.

Teignbridge District Council

3.2.4 TDC provided background information on historical flood events and details of flood defence infrastructure in the town. TDC worked alongside DNPA in instigating this report and are a key stakeholder as a result of their role in the planning process.

South West Water

3.2.5 As the Water and Sewerage Company (WaSC) for the area, SWW has responsibility for management of flood risk from public sewers. SWW provided information on historical sewer flooding issues within the study area and known areas of sewer flood risk.

3.3 Desk Based Study

3.3.1 A desk based review was undertaken to identify flood risks from non-fluvial sources and to collate records of historical flood events. The following data sources were used:

- The EA 2nd generation “Flood Map for Surface Water” (FMfSW) was used to inform assessment of the surface water flood risk in the study area;

- The EA “Areas Susceptible to Groundwater Flooding” (AStGWF) map, along with geological data from the BGS, was used to identify areas potentially at risk from groundwater flooding;
- Photographs, paper and digital flood reports, newspaper reports, previous flood studies and flood records from the EA, TDC and DNPA were used to identify historical flood risks and inform assessment of areas at risk of flooding;
- The EA indicative flood map was used as initial reference for the assessment of fluvial flood risk.

3.4 Hydraulic Modelling

3.4.1 Detailed hydraulic modelling was undertaken to inform assessment of the fluvial flood risk to the study area. The methodology used in undertaking the modelling is described in detail in Appendix B. In summary:

- An interlinked 1D-2D hydraulic model was constructed using ISIS-TUFLOW to represent the River Ashburn, the Balland Stream and overland flood flows within the study area;
- The 1D ISIS component was constructed using data obtained from a topographic river survey specifically commissioned for the purpose of this assessment;
- The 2D domain was represented using LiDAR survey data obtained from the EA in combination with OS Mastermap data;
- Mapped output showing flood depth, velocity and hazard was produced for a range of key return periods from 1 in 10 years to 1 in 1000 years.

3.4.2 The hydrology for the assessment was based on the EA Devon Hydrology Study (DHS) updated in July 2013. The DHS provides an assessment of peak flows in all EA Main Rivers throughout Devon for a range of key return periods. The results of the study are based on the best available data and are considered to be the definitive flow dataset for the assessment of flood risk in the Devon area.

Flood Hazard

3.4.3 Flood hazard has been assessed using the methodology set out in the Defra/EA document FD2321/TR1. This document provides guidance on assessing the hazard of flooding from the combination of the assessed depth and velocity of flow. Table 3 provides guidance on the four categories of flood hazard used in the assessment.

Table 3 - Definitions of hazard rations (Defra/EA document FD231/TR1)

Flood Hazard Rating	Degree of flood hazard	Description
< 0.75	Low	Caution – shallow flowing water or deep standing water.
0.75 – 1.25	Moderate	Danger for some – deep or fast flowing water that presents a hazard for some people (i.e. children, the elderly and the infirm).
1.25 – 2.0	Significant	Danger for most –deep or fast flowing water that presents a hazard for most people.
> 2.0	Extreme	Danger for all - deep or fast flowing water that presents a hazard for all people.

Potential Impact of Climate Change

3.4.4 Scientific consensus is that the global climate is changing as a result of human activity. While there remain uncertainties in how a changing climate will affect areas already vulnerable to flooding, it is expected to increase risk significantly over time. For the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall events and more frequent periods of long-duration rainfall could be expected.

3.4.5 The Department for Communities and Local Government has provided recommended national precautionary sensitivity ranges for possible peak rainfall intensities resulting from climate change for the next 100 years, shown in Table 4.

Table 4 - Recommended national precautionary sensitivity ranges for climate change

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
River flow	+10%	+20%		

3.4.6 This guidance has been implemented in the hydraulic modelling assessment, with the impact of climate change assessed with peak river flows increased by 20% in the 100 year and 1000 year events.

Exclusions and Limitations of Modelling

3.4.7 The hydraulic modelling described in this report provides an assessment of the fluvial flood risk in the Ashburton based on the best information currently available. The analysis is dependent on the accuracy of information supplied by third parties, including the topographic LiDAR data, the river survey and the EA hydrological flow assessment data.

3.5 Sequential Approach

3.5.1 A key principle of the NPPF is the sequential approach, where new development is steered to areas with the lowest probability of flooding. Where development is not possible in areas at the lowest probability of flooding, the flood risk vulnerability of land uses should be taken into account to steer the most vulnerable development types to areas at lowest probability of flooding. This approach is applied through the definition of flood zones and guidance on types of infrastructure that are appropriate for the different flood zones, based on their vulnerability to flooding.

Flood Zone Definition

3.5.1 The NPPF identifies four Flood Zones in relation to flood frequency. The zones refer to the probability of river (fluvial) and sea (tidal) flooding, whilst ignoring the presence of defences. Table 5 below summarises the relationship between Flood Zone category and the identified fluvial flood risk.

Table 5 – Flood Zones

Flood Zone	Identification	Annual Probability of Fluvial Flooding	Return Period of Fluvial Flooding
Zone 1	Low Probability	<0.1%	>1000 years
Zone 2	Medium Probability	1% – 0.1%	100 – 1000 years
Zone 3a	High Probability	>1%	Less than 100 years
Zone 3b	Functional Flood Plain*	>5%*	Less than 20 years

*Functional Flood Plain is defines in NPPF Technical Guidance as 'land where water has to be stored in times of flood." Greater than 5% annual probability is a useful guide for the identification of this area but should not be treated as the comprehensive definition.

Vulnerability Classification

3.5.2 The NPPF identifies five classifications of vulnerability to flood risk and provides recommendations on the compatibility of each vulnerability classification with the Flood Zones. These vulnerability classifications are described in Table 6 and assessment of the compatibility of these classifications with the EA Flood Zones is included in Table 7.

3.5.3 The guidance in Table 7 is to be applied in accordance with the Sequential Approach, with development to be steered to the areas at the lowest probability of flooding.

Table 6 – Flood risk vulnerability classifications

Vulnerability Classification	Examples
Essential infrastructure	Essential transport infrastructure which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons.
Highly vulnerable	Facilities required to be operational during flooding, such as police stations, ambulance stations and fire stations. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use.
More vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, Water and wastewater treatment works which do not need to remain operational during times of flood.
Water-compatible development	Flood control infrastructure. Water and wastewater transmission infrastructure and pumping stations. Water-based recreation (excluding sleeping accommodation). Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

Table 7 – Flood risk vulnerability and flood zone compatibility

EA Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b	Exception test required	✓	×	×	×

Key: × = Not acceptable. ✓= Acceptable.

3.5.4 It should be noted that car parking is not specifically designated in the NPPF within one of the vulnerability classifications. However, guidance in the PPS25 Practice Guide is as follows:

Paragraph 6.7; Site Layout	*Layout should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with more flood-compatible development (parking, open space etc.) in the highest risk areas.*
Paragraph 6.13; Site Layout	*Car parking may be appropriate in areas subject to flooding, provided flood warning is available and signs are in place. Car parks should ideally not be subject to flood depths in excess of 300mm depth since vehicles can be moved by water of this depth. Car parks located in areas that flood to greater depths should be designed to prevent vehicles floating out of the car park.*
Paragraph 6.14; Site Layout	*When considering car parking within flood risk areas, the ability of people to move their cars within the flood warning time should be considered. Long-term and residential car parking is unlikely to be acceptable in areas which regularly flood to a significant depth, due to the risk of car owners being away from the area and being unable to move their cars when a flood occurs. Like other forms of development, flood risk should be avoided if possible. If this is not feasible, the FRA should detail how the design makes the car park safe.*

3.5.5 The EA have provided the following guidance for car parking within the Chuley Road site:

- Residential car parking should be treated as per the more vulnerable classification, and should not be subject to any flood risk;
- Public car parking can be treated similarly to the less vulnerable classification, and may be permitted in Flood Zone 3a in areas of low hazard (slow moving flood water up to 300mm depth);
- Parking for commercial development can be treated similarly to public car parking;
- No parking will be permitted in Flood Zone 3b.

<u>Sequential Test and Exception Test</u>

3.5.6 The sequential approach is implemented within the NPPF through the Sequential Test and Exception Test.

3.5.7 To pass the Sequential Test, the following criteria must be met:

i It must be demonstrated that the development type is appropriate for the flood probability at the site in accordance with the compatibility guidance included in Table 7; and

ii There are no reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.

3.5.8 If the development does not meet the criteria set out in the Sequential Test, the Exception Test can be applied. For the Exception Test to be passed, two requirements must be met:

i It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and

ii A site specific FRA must demonstrate that the development will be safe, for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

3.5.9 If it cannot be demonstrated that these two requirements can be met, development is unlikely to be approved.

SECTION 4

PLANNING FRAMEWORK AND FLOOD RISK POLICY REVIEW

4 PLANNING FRAMEWORK AND FLOOD RISK POLICY REVIEW

4.1 Introduction

4.1.1 Planning policy on development and flood risk aims to direct development towards areas at lowest risk of flooding and seeks to ensure that development does not have a negative impact on flood risk to people and property elsewhere. The purpose of this section of the Level 2 SFRA is to identify policies and legislation relevant to the assessment and to highlight the changes to the planning framework and flood risk policies since the Level 1 SFRA was published in 2010.

4.2 National Planning Policy Framework

4.2.1 The NPPF was published in March 2012 with the aim of making UK planning guidance less complex and more accessible. The NPPF and the Technical Guide to the NPPF replace the previous Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs).

4.2.2 Paragraph 100 of the NPPF sets out the key guidance to local authorities on the requirements for managing flood risk for new development:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards.

Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change."

4.2.3 Technical guidance on flood risk has been published alongside the NPPF in the TGNPPF and sets out how the policy should be implemented. Further guidance on the Sequential Test and Exception Test is provided in Section 3.5.

4.3 Flood and Water Management Act 2010

4.3.1 The Flood and Water Management Act 2010 (FWMA) introduces new responsibilities for flood risk management for local authorities and sets out new requirements for the management of sustainable drainage.

4.3.2 The FWMA is being commenced into law in a gradual process which started in 2010, with the remaining Sections scheduled to be commenced by 2015. The following section provides guidance on how its implementation will impact on the management of surface water and flood risk for the proposed development.

<u>Lead Local Flood Authorities</u>

4.3.3 Under the FWMA the unitary authority or county council for an area is designated the 'Lead Local Flood Authority' (LLFA), with responsibility for managing flood risk from surface water, ground water and Ordinary Watercourses within their area. DCC is the appointed LLFA for Devon.

National SUDS Guidance

4.3.4 Schedule 3 of the FWMA introduces new National Standards for Sustainable Drainage. These standards are currently in draft and are due to be implemented in 2014. Following the implementation of the FWMA, LLFAs will become the approval body for drainage systems for new development. Approval from LLFAs for drainage proposals must be agreed prior to construction and the LLFA will have responsibility for maintenance of adopted SUDS schemes.

4.4 Flood Risk Regulations 2009

4.4.1 The Flood Risk Regulations 2009 (FRR) implement the European Flood Directive, which aims to provide a consistent approach to managing flood risk across Europe.

4.4.2 Responsibilities under the FRR are consistent with FWMA, with the EA responsible for managing flood risk from Main Rivers, the sea and reservoirs, and LLFAs responsible for managing local sources of flood risk.

4.5 Water Framework Directive 2000 / 60 / EC

4.5.1 The Water Framework Directive (WFD) is European legislation that sets requirements for water quality for inland and coastal waters in the UK and other EU Member States. It came into force in December 2000 and was transposed into UK law in 2003.

4.5.2 The WFD places statutory duties on parties such as the EA to protect and address water quality issues in lakes and rivers and requires that all inland and coastal waters within defined river basin districts must reach at least good status by 2015.

4.6 South Devon Catchment Flood Management Plan

4.6.1 The South Devon Catchment Flood Management Plan (CFMP) was published by the EA in June 2012 and sets out the EA's preferred plan for flood risk management in South Devon over the next 50 to 100 years.

4.6.2 The document divides the South Devon catchment into nine sub-areas, with one of six flood risk management policies identified for each of the sub-areas. The identified approach for Ashburton is to "take further action to reduce flood risk". The CFMP defines a number of commitments from the EA to support the implementation of this policy in Ashburton:

- *We (the EA) will take action to reduce the flood risk in Ashburton including the Balland Stream as well as the River Ashburn;*
- *We (the EA) will influence partners to improve highways drainage in Ashburton;*
- *Investigate a flood warning for the River Ashburn at Ashburton, and encourage the production of community action plans to reduce flood risk through engagement of the local community.*

4.7 Devon Preliminary Flood Risk Assessment

4.7.1 The Devon Preliminary Flood Risk Assessment (PRFA) was published by Devon County Council (DCC) in May 2011. The purpose of the PFRA is to support DCC in its role as LLFA and to provide a high level overview of flood risk from non tidal and fluvial sources, including surface water, groundwater, ordinary watercourse and canals.

4.8 Devon Local Flood Risk Management Strategy

4.8.1 As the LLFA, DCC is required to produce a Local Flood Risk Management Strategy (LFRMS) for Devon. This document will provide an assessment of the risk in the county from non fluvial and tidal flooding and will set out the DCC strategy for managing these risks. The Devon LFRMS is currently under development and is due to be published in 2014.

4.9 Dartmoor National Park Level 1 Strategic Flood Risk Assessment

4.9.1 The Dartmoor National Park Level 1 SFRA was published by DNPA in November 2010. The purpose of the Level 1 SFRA is to provide an overview of flood risk from all sources of flooding within the administrative boundary of DNPA. The document provides DNPA, developers and other interested parties with general guidance on flood risk and issues associated with flooding.

4.9.2 The Level 1 SFRA identifies Ashburton as a location where people and property are at greatest risk of flooding. The SFRA advises that further assessment in the form of a Level 2 SFRA is likely to be required within Ashburton to ensure future development is appropriately located and adequately protected against flooding.

4.10 Dartmoor National Park Local Development Framework

4.10.1 The Dartmoor National Park Local Development Framework (LDF) for 2006 – 2026 was adopted by DNPA in June 2008. The Core Strategy DPD is the principal document in the LDF and sets out the vision for development in the National Park and the strategy and policies to help meet that vision. This Level 2 SFRA will form part of the evidence base which supports the LDF.

4.10.2 The Core Strategy DPD contains 24 Core Policies which set out DNPA's position on key planning issues. Core Policies 1, 8 and 9 contain guidance related to flood risk and the relevant details are included in Table 8.

Table 8 – Dartmoor National Park LDF Core Policies relating to flood risk

Policy	Details
COR1	COR1 sets out the considerations that should be taken into account to ensure development is undertaken in a sustainable manner. It includes a requirement that the natural drainage of surface water should be taken into account and that the avoidance of new development and a reduction in the vulnerability of redevelopment should be considered within medium to high risk flood zones.
COR8	COR8 describes the DNPA policy on natural resource management. The policy specifies that development should aim to : • incorporate sustainable drainage and water conservation systems; • have no adverse effects on drainage patterns or flood storage capacity;
COR9	COR9 sets out the DNPA policy on development in areas at risk of flooding. In exceptional circumstances, development which does not satisfy the sequential test will be permitted in flood risk areas when: • there is sufficient benefit, and there are no suitable locations of lower flood risk; • it can be shown that appropriate flood protection and resistance measures can be incorporated; and • a sustainable drainage system, designed to a high standard, can be secured through conditions.

4.11 Ashburton Town Plan

4.11.1 The Ashburton Town Plan was published by Ashburton Town Council in 2005. The plan sets a vision for the future of Ashburton and identifies actions to improve Ashburton for its community. Concerns identified in the report relevant to Chuley Road include the lack of parking in the centre of Ashburton and the need for more affordable housing.

4.12 Implications of Planning Policy for Ashburton

4.12.1 The above review demonstrates the hierarchy of flood management in England, sets out how flood risk is managed within UK and local planning policy and describes how this Level 2 SFRA will be used as an evidence base to support the planning process.

4.12.2 The FWMA and the FRR define the obligations on the EA, local government and other parties to manage flood risk from all sources. These policies are in accordance with the requirements for flood management set out in EC legislation.

4.12.3 The NPPF provides the framework for the management of flood risk within the planning process and defines the 'Sequential Approach' – the key principle for the management of flood risk in England.

4.12.4 The Dartmoor LDF sets out the planning policies in Dartmoor National Park, in accordance with the parameters defined in the NPPF. A number of Core Strategies in this document directly refer to the management of flood risk, highlighting the importance of flooding in planning for sustainable development. The Level 2 SFRA will be a key document to inform the application of the Dartmoor LDF in Ashburton, providing a detailed evidence base with which DNPA can inform planning decisions.

4.12.5 The Devon LFRMS sets the strategy in Devon for the management of flood risk from local sources. Any development in the Chuley Road site should be in accordance with the objectives defined in the LFRMS. Where relevant, the results of the Level 2 SFRA will feed into this strategy.

4.12.6 The South Devon CFMP, the Devon PFRA and the Dartmoor Level 1 SFRA are regional scale assessments of flood risk and each contribute to the understanding of flood risk in Devon. The Level 2 SFRA provides a more focused assessment on a specific area and the results of this assessment will feed into these wider studies as they are updated.

SECTION 5

ASSESSMENT OF FLOOD RISK

5 ASSESSMENT OF FLOOD RISK

5.1 Introduction

5.1.1 This section identifies the probability of flooding from all potential sources, and also provides an overview of the history of flooding in the study area.

5.1.2 Fluvial flood risk has been assessed using the 1D-2D hydraulic model discussed in Section 3.4. Review of flooding from other sources has been undertaken with reference to previous reports, publicly available data and records of past flood events.

5.2 Historical Flooding

5.2.1 Ashburton has been subject to a number of incidents of flooding over the past 100 years. Records provided by DNPA and the EA are included in Appendix D. The main flood events are summarised below. These events have been used for the calibration and verification of the hydraulic modelling, as discussed in Appendix B.

22nd March 2013

5.2.2 In March 2013 heavy rainfall resulted in flooding of the Balland Stream. Large volumes of flood water flowed down Love Lane and Vealenia Terrace, through the Station Yard between the 'Grey Matter' buildings and the former railway buildings. Overland flow was unable to discharge to the River Ashburn and pooled to depths estimated at 3-4ft in the yard to the rear of the Old Umber Works buildings.

5.2.3 It is believed that a localised collapse of the Balland Stream culvert in Love Lane meant that the extent of flooding in this event was much greater than would be expected in an event of this magnitude.

Figure 5 – Extract of YouTube video showing flooding in Love Lane from adjacent to Swimming Pool entrance on 22.3.2013.

5.2.4 The EA record of the extent of the flooding (included in Figure D1 in Appendix D) highlights the following impacts of the flood event:

- Road surface damaged in Love Lane adjacent to Ashburton Primary School;
- Surcharged manhole in Love Lane adjacent to entrance to Ashburton Swimming Pool. A four foot fountain of water was reported out of this manhole;

- Two residential properties flooded at crossroads of Love Lane / Woodland Road;
- Scout hut flooded opposite Ashburton Primary School, with scouts forced to evacuate building;
- A residential property, the Station Garage and the St John's Ambulance garage flooded in north of Station Yard at the junction of Vealenia Terrace and Prigg Meadow;
- Three light industrial units in the Old Umber Works buildings at the south of the Station Yard flooded.

24th November 2012

5.2.5 Sustained rainfall from 20th- 25th November 2012 caused flooding across many areas of Devon. Over 450 residential and commercial properties suffered flooding, including five properties in Ashburton. DCC has reported that up to 250mm of rainfall was recorded in the six days up to the event, with 85mm in the last 24 hour period.

5.2.6 The EA's record of the extent of the flooding is shown in Figure D2 in Appendix D. Three residential properties were flooded in Headborough Road from surface water and two commercial properties flooded in Chuley Road from the River Ashburn. Gardens flooded from the River Ashburn at Stone Park Crescent and evidence of surface water ponding was found further downstream near the Dartmoor Motel. Gardens were also flooded in Long Park, Jordans Meadow, Hares Lane and St Lawrence Lane.

28th July 2005

5.2.7 On 28thJuly 2005 approximately 20 properties were flooded in Ashburton. A report on the flooding obtained from TDC assessed that the flooding was from exceedance of highway and private sewers following two intense storms. Surface water flowed through the centre of town, along St Lawrence Lane, Chuley Road and Station Yard before flowing into the River Ashburn. Greatest flood depths of 400mm – 500mm were recorded in parts of West Street and the Bull Ring. The TDC record of this flood event is included in Figure D3 in Appendix D.

7th February 1990

5.2.8 On 7th February 1990 flooding occurred at the southern end of the Balland Stream culvert in the former Cattle Market area. The EA record of the extent of the flooding in this event is shown in Figure D4 in Appendix D and shows this event to be attributable to the flow in the Balland Stream exceeding the capacity of the channel. Photos from the event (Figures 6 - 9) illustrate the depth and extent of flooding.

Figure 6 – Flooding adjacent to former Cattle Market in Vealenia Terrace. 7.2.1990.

Figure 7 – Flooding in Chuley Road outside of Station Garage. 7.2.1990.

Figure 8 - Flooding at south of Chuley Road site adjacent to Auction House. 7.2.1990.

Figure 9 – Flooding in Chuley Road to south of Caravan Park, 7.2.1990

<u>20th December 1989</u>

5.2.9 A TDC report from 2002 provides details of flooding from the Balland Stream on 20th December 1989, in which approximately 5 commercial and 5 residential properties were flooded.

<u>27th December 1979</u>

5.2.10 The 2002 TDC report also provides details of flooding from the Balland Stream in the east of Ashburton on 27th December 1979, in which 21 commercial and 11 residential properties were flooded. The TDC report states that the December 1979 event was an extreme flow event, with a return period of greater than 1 in 50 years.

<u>11th February 1974</u>

5.2.11 The EA has provided photographs of flooding in Ashburton in 1974. The photographs show flooding at Kings Bridge in the centre of Ashburton and in Chuley Road adjacent to the Masons Lodge. No further details are known of this flood event.

Figure 10 – Flooding in Chuley Road adjacent to Station Garage. 11.2.1974.

Figure 11 – Flooding in centre of Ashburton at Kings Bridge. 11.2.1974.

<u>2nd December 1971</u>

5.2.12 On 2nd December 1971 Ashburton suffered significant fluvial flooding from the River Ashburn. EA records of the event show properties affected through the centre of Ashburton. No flooding is shown from the Balland Stream in this event.

5.2.13 The EA record of the flooding is included in Appendix D.

<u>27th July 1971</u>

5.2.14 On 27th July 1971 flooding occurred in the centre of Ashburton. A historical record obtained from the EA suggests this flooding resulted from intense rainfall, with approximately 60mm of rainfall recorded in 2.5 hours.

5.2.15 The EA record of the flooding is included in Figure D5 in Appendix D.

5.2.16 In addition to these recorded events, it is known that there was a long history of flood issues in the centre of Ashburton prior to the construction of the River Ashburn flood relief culvert as illustrated in the historical photographs below.

Figure 12 – Flooding in the Bullring, August 1938 (source – www.oldashburton.co.uk. Accessed July 2013).

Figure 13 – Flooding at London Inn in 1939 or 1946.

Figure 14 – Flooding in central Ashburton, 1950

Summary of Historical Flooding

5.2.17 The extensive history of flooding in Ashburton highlights the high level of fluvial and surface water flood risk in the town. The River Ashburn flood defence scheme constructed in 1983 appears to have been successful, with no fluvial flooding occurring in the centre of the town since its construction.

5.2.18 The records show the Balland Stream flooding at least four times in the past 35 years, indicating a potential return period of 1 in 9 years.

Table 9 Summary of flood records for Ashburton, 1971 - 2013

Date	Source of flooding
22nd March 2013	Fluvial flooding from Balland Stream (caused by localised blockage).
24th November 2012	Surface water flooding.
28th July 2005	Surface water flooding.
7th February 1990	Fluvial flooding from Balland Stream.
20th December 1989	Fluvial flooding from Balland Stream.
27th December 1979	Fluvial flooding from Balland Stream.
11th February 1974	No details known. Photos indicate fluvial flooding from River Ashburn and Balland Stream.
2nd December 1971	Fluvial flooding from River Ashburn.
27th July 1971	Surface water flooding.

5.3 Fluvial Flooding

5.3.1 A detailed assessment of the fluvial flood risk in the study area has been undertaken using a 1D-2D ISIS TUFLOW model. Output from the model is included in Appendix E and the results are summarised in Table E1 in Appendix E.

5.3.2 In summary, the analysis shows a widespread fluvial flood risk across much of the Chuley Road site from both the River Ashburn and the Balland Stream. The areas at highest risk of flooding are (i) through the west of the Station Yard, from overland flow spilling out of the Balland Stream upstream; and (ii) at the south-east of the Chuley Road site adjacent to the Auction House, from the River Ashburn.

<u>Probability</u>

5.3.3 The model shows parts of the site to be at high probability of flooding, with flooding shown to occur in the 1 in 10 year event from both the Balland Stream and the River Ashburn downstream of the confluence with the Balland Stream.

5.3.4 In the 100 year event, flood extents are greater with flow from the River Ashburn upstream of the inlet to the Flood Relief Culvert contributing to flooding in the Chuley Road site, with overland flow running along Lawrence Lane to enter the site via Vealenia Terrace. Flood extents cover the majority of the Station Yard site, the Tuckers Yard area and the land to the east of the channel at the south of the site.

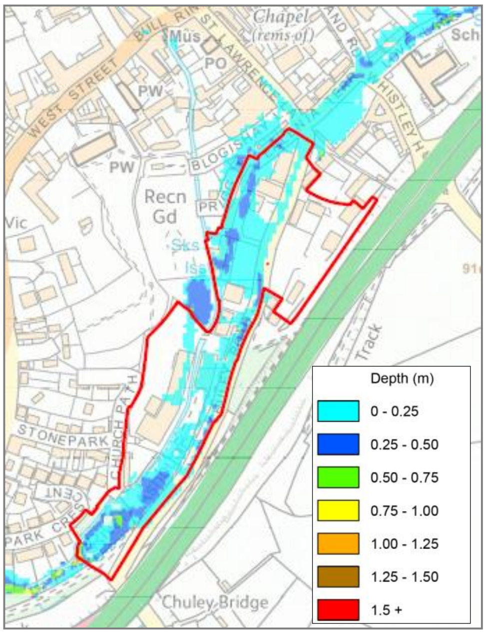

Figure 15 – 1 in 10 year flood extent

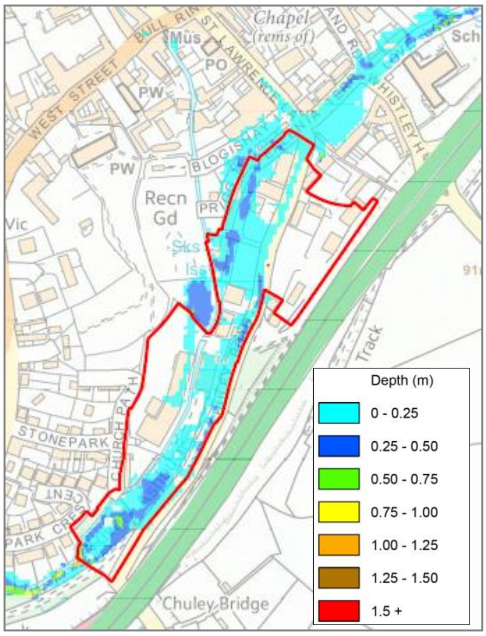

Figure 16 – 1 in 100 year flood extent

5.3.5 The 100 year event with flow increased by 20% to allow for the potential impact of climate change shows a similar extent of flooding to the current 100 year event, with increased flooding in the south of the Tuckers Yard site.

5.3.6 The 1000 year event shows fluvial flooding covering much of the site, with the only areas unaffected the raised land to the east of Chuley Road and raised land to the east of the Tuckers Yard site.

Depth

5.3.7 In the 100 year event, flooding is primarily shown to be less than 250mm deep. Deeper flooding of 250mm – 500mm is shown in the flow route through west of Station Yard, along Chuley Road and at the south of the site to the east of the River Ashburn. A pocket of deeper flooding is shown at the north of the Tuckers Yard site.

5.3.8 In the 100 year plus climate change event, flood depths are typically 100 – 200mm greater. In the 1000 year event, flood depths of greater than 500mm are shown through the west of the Station Yard sit and along Chuley Road. Peak flood depths of over 1m are shown in the north of the Tuckers Yard site.

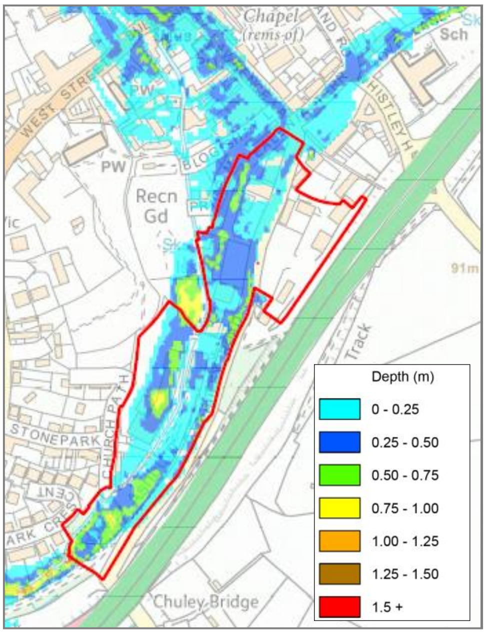

Figure 17 – 1 in 100 year +cc flood depth

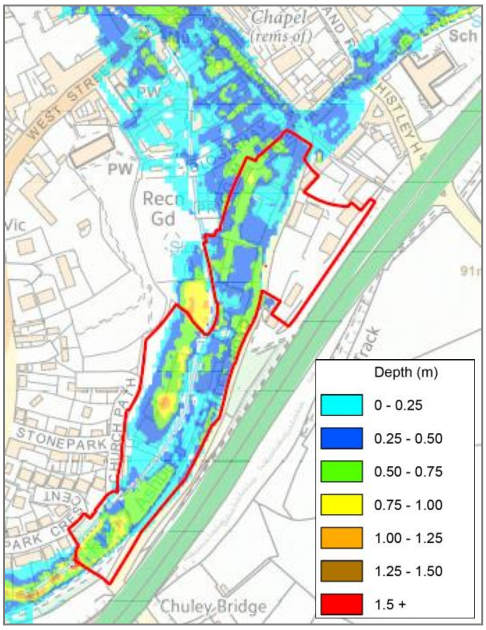

Figure 18 – 1 in 1000 year flood depth

Velocity

5.3.9 In the 10 year event, peak velocities of up 1 m/s are shown in the overland flow through the west of Station Yard and along Chuley Road. Peak velocities of up to 1.5 m/s are shown in the southern end of the site.

5.3.10 In the 100 year event, velocities of over 2 m/s are shown for the overland flow from the Balland Stream along Chuley Road.

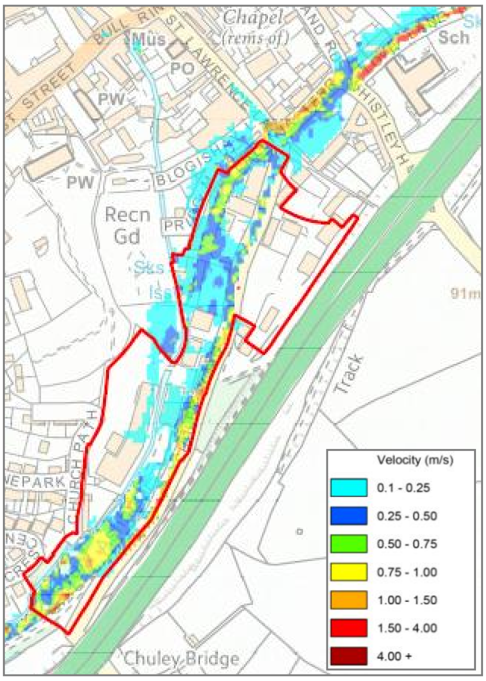

Figure 19 – 1 in 10 year flood velocity

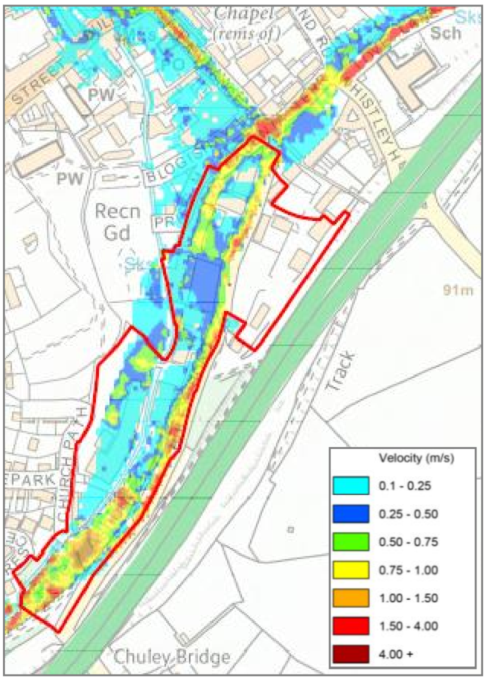

Figure 20 – 1 in 100 year flood velocity

5.3.11 In the 100 year plus climate change event and the 1000 year event, peak velocities are similar to the current 100 year event, with a peak velocity of 2.2 m/s in Chuley Road in the 1000 year event.

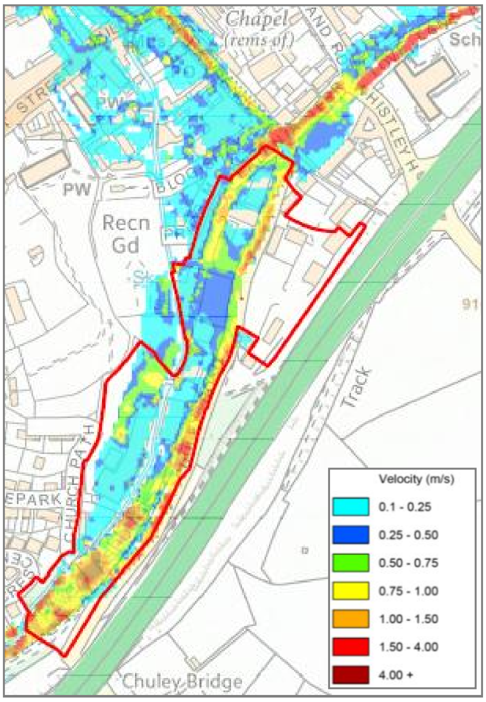

Figure 21 – 1 in 100 year +cc flood velocity

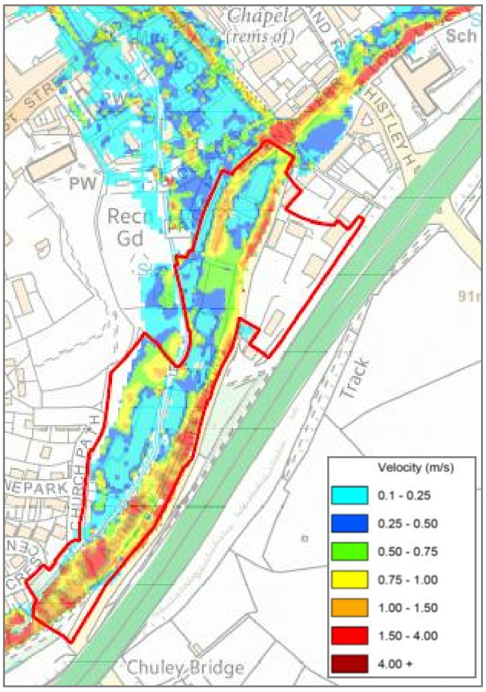

Figure 22 – 1 in 1000 year flood velocity

Hazard

5.3.12 Assessment of the hazard of flooding has been undertaken using the Defra/EA FD2320 methodology, as discussed in Section 3.4. This methodology calculates a hazard score for flooding based on a combination of the depth and velocity of flooding.

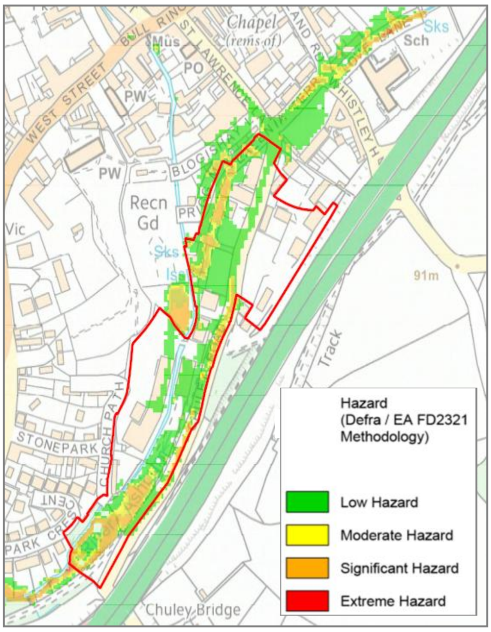

Figure 23 – 1 in 10 year flood hazard

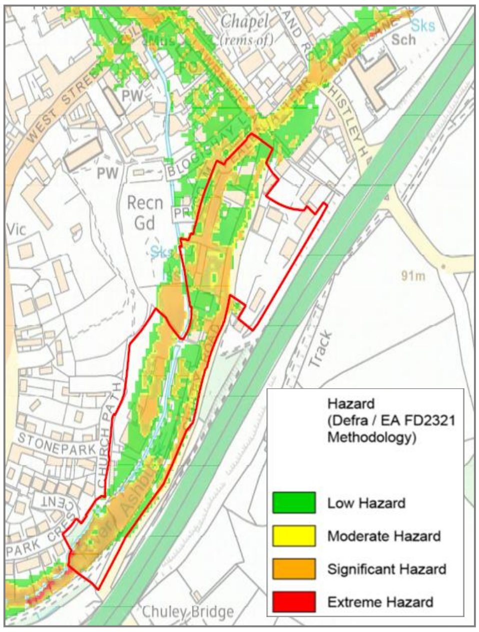

Figure 24 – 1 in 100 year flood hazard

5.3.13 In the 10 year event, significant hazard is limited to the overland flow through the west of the Station Yard site, along Chuley Road and at the southeast of the site. In the 100 year event significant hazard is shown in the overland flow route through the west of the Station Yard, along Chuley Road, at the southeast of the Chuley Road site and in the north of Tuckers Yard. The raised area of the site to the east of the Chuley Road and the raised land to the west of Tuckers Yard are shown to be at low hazard of flooding.

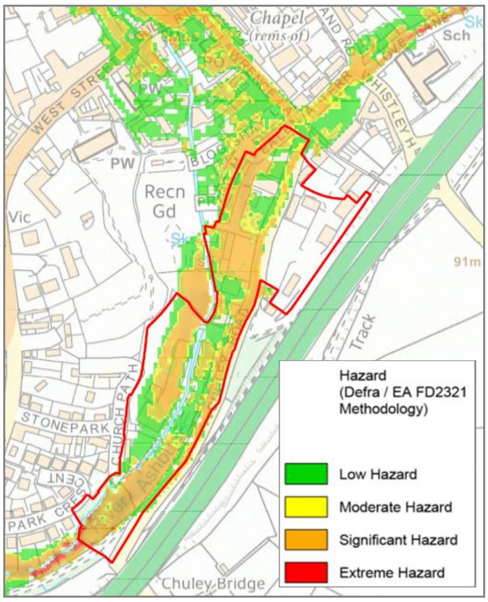

Figure 25 – 1 in 100 year +cc flood hazard

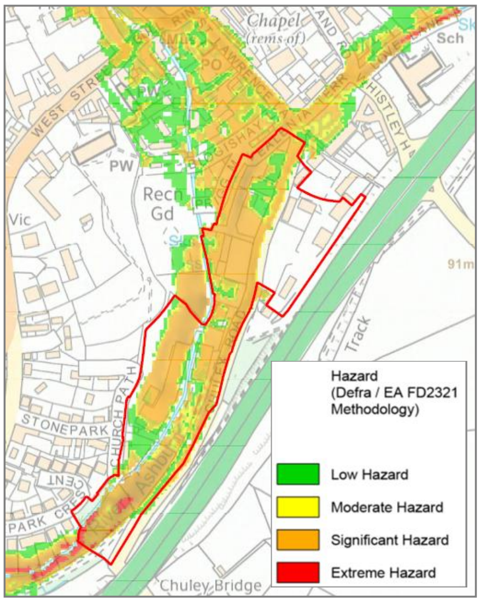

Figure 26 – 1 in 1000 year flood hazard

5.3.14 In the 100 year plus climate change event, significant hazard extends through much of the Station Yard area, Tuckers Yard and the south-east of the site. In the 1000 year event significant hazard covers the majority of the Chuley Road site, with the exception of the raised land on the east and a margin on the west of Tuckers Yard.

5.4 Updated assessment of EA Flood Zones

5.4.1 Figure 27 and Figure 28 show an updated assessment EA flood zones showing the identified extent of the functional flood plain, based on the results of the 1D-2D hydraulic model. These figures are also included as Figure F1 and Figure F6 in Appendix F. The mapping identifies the following flood zones:

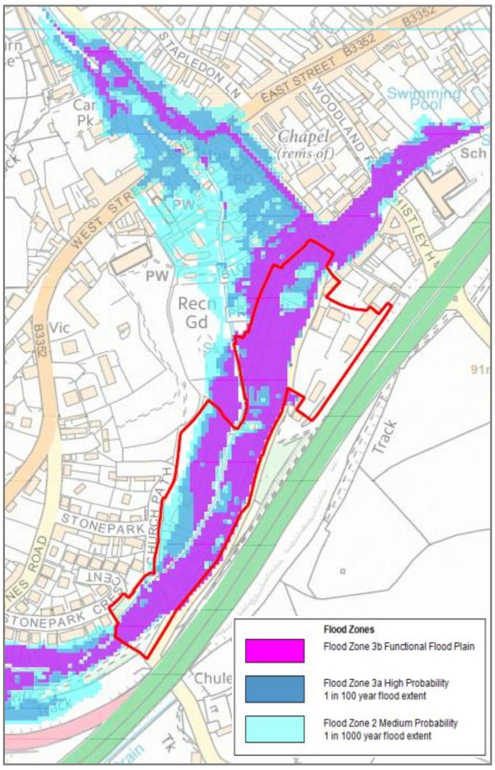

Figure 27 – Updated assessment of flood zones showing functional flood plain, based on detailed 1D-2D hydraulic model.

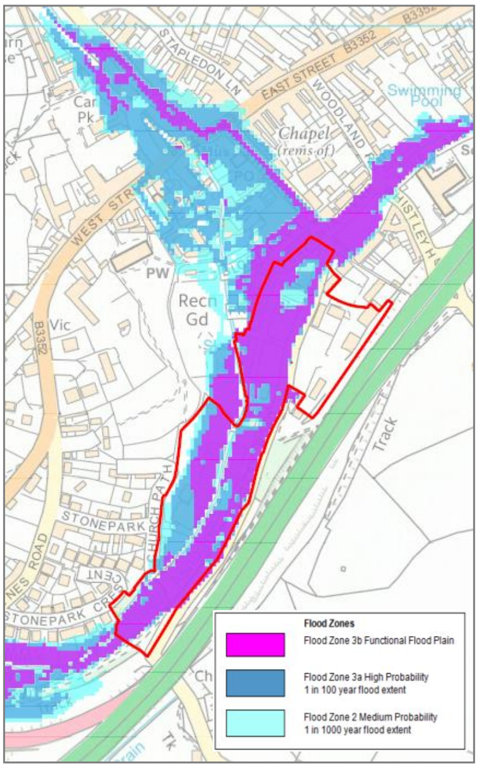

Figure 28 – Updated assessment of flood zones showing functional flood plain, based on detailed 1D-2D hydraulic model with 100 year flow increased by 20% to allow for potential climate change impact.

Flood Zone 1 – Low Probability Flood Zone

5.4.2 The raised land to the east of Chuley Road in the north of the site and a small strip of raised land to the west of Tuckers Yard is assessed as Flood Zone 1, with an annual risk of fluvial flooding of less than 0.1%.

Flood Zone 2 – Medium Probability Flood Zone

5.4.3 The 1000 year fluvial flood extent has been used to define Flood Zone 2, categorised as land with a medium probability of flooding. Within the Chuley Road site, in the non climate change assessment, the south-west of the Tuckers Yard is shown as being within this zone. With flow in the 100 year event increased by 20% to allow for potential climate change impacts, very limited land is identified as Flood Zone 2 with the 1000 year extent being largely coincident with the 100 year plus climate change extent.

Flood Zone 3a – High Probability Flood Zone

5.4.4 The 100 year plus climate change flood extent has been used to define Flood Zone 3a, the high probability flood zone. The bulk of the Tuckers Yard site to the west of the River Ashburn is categorised as Flood Zone 3a.

Flood Zone 3b – Functional Flood Plain

5.4.5 Guidance in the NPPF is that *“identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.”*

5.4.6 For this assessment, the flood extent from the 1 in 25 year return period event (4% annual probability) has been taken as an initial guide for identification of Flood Zone 3b, the functional flood plain. Design flows for the 1 in 20 year event are not provided in the DHS and therefore modelling of this event has not been undertaken.

5.4.7 The modelling shows extensive areas of the site to be classified as Flood Zone 3b, including almost the entire Station Yard area and the land to the west of the River Ashburn in the southern half of the site.

5.4.8 However, the flood risk in the northern and eastern parts of the Chuley Road site is from overland flow from the Balland Stream and the River Ashburn, rather than typical flood plain on the boundary of a watercourse. The overland flow nature of the flood risk in this area provides greater potential for measures to manage flood risk locally to reduce the area at risk of flooding, without negatively affecting flood risk downstream. Options to reduce flood risk are discussed in Section 7.

<u>Comparison against existing indicative mapping</u>

5.4.9 Figure 29 shows a revised assessment of the EA flood zones based on the updated hydraulic modelling, alongside an extract of the existing EA indicative flood map.

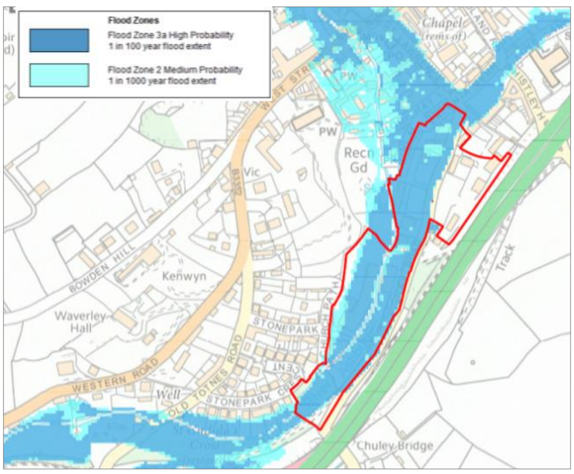

Figure 29 – Revised flood zone map based on detailed 1D-2D hydraulic model (Dark blue – 100 year flood extent, light blue – 1000 year flood extent.)

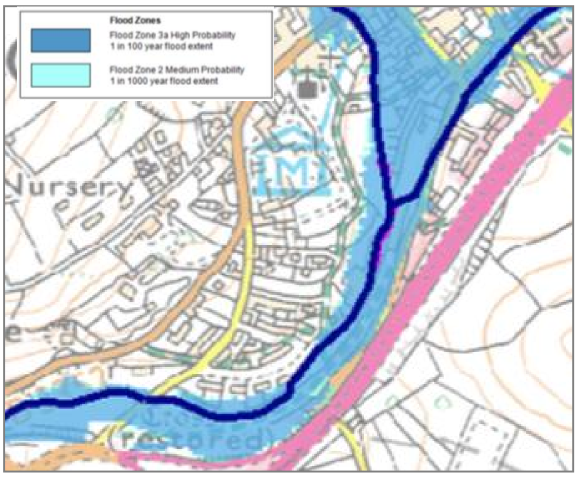

Figure 30 – Existing indicative EA flood zone map

5.4.10 The revised assessment shows a similar overall extent of flooding to the indicative flood map. The impact of the River Ashburn flood relief culvert is seen in the updated assessment, with a greater distinction between the 100 year and 1000 year flood extents, with a slight reduction in the probability of flooding in the centre of Ashburn in the 100 year event.

Blockage Risk

5.4.11 The impact on flood risk from blockage of the culverted watercourses, bridges and other structures in the channel has been assessed. Output from this assessment is included in Appendix E and can be summarised as follows:

- The Balland Stream culvert is in places undersized and is shown to flood in relatively high probability events. Even small blockages would further restrict the capacity of the channel, increasing the risk of flooding;
- At the south of the Chuley Road site, two small pedestrian bridges allow access to the informal car parking area to the east of the River Ashburn (Figure 31 and Figure 32). These structures have very limited capacity and are prone to blockage. Modelling has found that blockage of these structures does not significantly change flood risk, with flood water able to flow over or around the structures and flow back into the channel.
- The Old Totnes Road Bridge (Figure 33) is a significant constriction to flow in extreme events, with flooding shown to spill onto the road in events equal to and above the 1 in 25 year event. Modelling found that an 80% blockage of this structure resulted in increase depths of flooding immediately upstream of the bridge, but that the impact did not extend back into the Chuley Road site.
- The risk of blockage is increased by the smaller private footbridges at the rear of the properties in Stonepark Crescent (Figure 35 and Figure 36). In large events these structures could be washed out, creating a risk of blockage to the watercourse and other structures downstream.

Figure 31 – First of two bridges adjacent to Auction House at south of Chuley Road site.

Figure 32 – Second of two bridges adjacent to Auction House at south of Chuley Road site.

Figure 33 – Old Totnes Road bridge

Figure 34 - Small arch bridge 20m upstream of Castle Bridge

Figure 35 –Small privately owned footbridges at south of Stonepark Crescent

Figure 36 –Small privately owned footbridges at south of Stonepark Crescent

5.4.12 There are a number of further small structures in the River Ashburn in the centre of Ashburton. If blocked, these structures have potential to cause flooding in areas which would otherwise be protected in higher probability events by the flood relief culvert.

5.5 Surface Water Flooding

5.5.1 Surface water flooding is defined as a flooding incident that is a result of rainfall-generated overland flow before the runoff enters a watercourse or sewer.

5.5.2 Surface water flooding is usually associated with high intensity rainfall events (typically greater than 30mm/hr) resulting in overland flow and ponding in depressions in topography. Surface water flooding can also occur during lower intensity rainfall events or melting snow from areas where the ground is saturated, frozen, developed or otherwise has low permeability.

FMfSW

5.5.3 Assessment of the risk from surface water flooding has been based on review of the EA 2nd Generation Flood Map for Surface Water (FMfSW). It should be noted that the EA is currently in the process of producing a new national scale Flood Map for Surface Water and it is planned that this map will be available in 2014. The updated mapping will provide an improved understanding of the surface water risk in the study area and should be reviewed as part of any site specific Flood Risk Assessments undertaken in the study area.

5.5.4 Flood extents for the site from the FMFSW were obtained for the 30 year and 200 year rainfall events, with the mapping showing areas of shallow flooding (flood depth greater than 100mm, less than 300mm) and deeper flooding (flood depths greater than 300mm).

5.5.5 As shown in Figures A10 and A11 in Appendix A, the maps show extensive surface water flooding in the lowest lying areas of the town in both the 30 year and 200 year return periods. However, it should be noted that these maps are solely based on topography and do not include detailed assessment of surface water drainage. As such, these maps are of most use for considering extreme probability events, when the intensity of rainfall is likely to exceed the capacity of the drainage systems.

5.5.6 While the impact of climate change is not considered by the FMfSW assessment, it is predicted that rainfall intensities may increase by up to 30% in extreme events over the next 100 years. This would be likely to result in increased depth and extent of surface water flooding.

Highways Drainage

5.5.7 DCC Highways were consulted to identify any known areas of flood risk in the local highway drainage network. Two areas of known risk were identified:

- When the Balland Stream is experiencing high fluvial flows, the highway drainage discharging to the watercourse backs up, resulting in localised flooding on Love Lane;
- Due to its steep gradient and the local topography, Headborough Road in the north of Ashburton acts as an overland flow path for high volumes of surface water runoff from rural land upstream. The runoff is often heavily silted and carries a high load of vegetation and debris. This leads to blockage of surface drainage, resulting in surface water flooding. The flood risk is compounded in times of high fluvial flow in the River Ashburn, when the high river levels prevent highway drainage from discharging to the watercourse.

5.6 Sewer Flooding

5.6.1 This assessment uses the EA / OFWAT definition of sewer flooding, in which sewer flooding is defined as flooding resulting from sewerage that has escaped from below ground infrastructure. It does not include surface water flooding (discussed in Section 6.3) where flooding results from surface water that is unable to enter into the sewer network.

5.6.2 SWW was consulted as part of the scoping study for this assessment and advised that there are at no known risks of sewer flooding from the SWW public networks within the Chuley Road site. It was noted, however, that there have been two recent sewer flooding incidents in Stonepark Crescent immediately to the west of the south end of the Chuley Road site. These flooding incidents have been attributed to blockage in the sewer network.

5.7 Groundwater Flooding

5.7.1 Groundwater flooding occurs when water stored naturally below ground reaches the surface. It is commonly associated with porous underlying geology, such as chalk, limestone and gravels.

5.7.2 The geology underlying the Chuley Road site comprises igneous bedrock overlain by a layer of river alluvium. This geology suggests a low risk of groundwater flooding.

5.7.3 The Level 1 SFRA states that there are no known records of groundwater flooding in the study area. This statement remains true, and the risk of groundwater flooding is assessed to be low.

5.8 Flood Risks from Other Sources

5.8.1 No significant flood risks have been identified from other sources, such as coastal flooding or flooding from manmade sources such as impounded reservoirs or canals.

5.9 Potential Impact of Development on Existing Flood Risk

5.9.1 The impact of future development in the Chuley Road site on flooding within the site and elsewhere must also be considered. Without mitigation, increased impermeable area could result in increased surface water runoff and the potential for increased surface water flooding within the site. However, much of the site has existing development in place and as a result any future increase in surface water flows is more likely to be as a result of climate change rather than increased impermeable area.

5.9.2 Consideration must also be taken to ensure future development does not negatively alter existing overland flow paths or reduce flood storage, potentially resulting in increased flood risk elsewhere.

5.9.3 Measures to minimise the impact of development on flood risk in the study area are discussed further in Section 7.

5.10 Summary of Key Risks

5.10.1 In summary, the key flood risks identified in the Chuley Road site are:

- The site is at risk of fluvial flooding from the River Ashburn and the Balland Stream;
- The Balland Stream culvert has limited capacity and is prone to blockage. Analysis has shown that the current Balland Stream culvert is liable to flooding in relatively frequent events, with flooding shown in the 1 in 10 year event. This is supported by the frequent flood history of the watercourse. The depth and extent of flooding increases in larger events, with flood depths of up to 450mm shown in the modelled 100 year event in the Station Yard area;
- The area of the site alongside the River Ashburn is at risk of fluvial flooding from the River Ashburn, with minor flooding shown to occur in the 1 in 10 year event in the area adjacent to the Tuckers Yard buildings and in the south-east of the site

opposite the Rendells Auction House. In larger events, the depth and extent of flooding in these areas increases, with flood depths of up to 1100mm in the 1 in 100 year event;

- Downstream of the site, flooding primarily occurs upstream of the Old Totnes Road Bridge and upstream of the small stone arch bridge to the north of Castle Bridge;
- Upstream of the site, flooding from the River Ashburn is first shown to occur in the 25 year event with flow overspilling upstream of the flood relief culvert inlet and flowing through the Bull Ring and North Street and continuing south along St Lawrence Lane;
- As a result of the high velocity of the overland flow, the flooding is shown to provide significant hazard. In the 100 year event, much of the Station Yard area, Tuckers Yard and the south-east of the site are all assessed to be at significant hazard. In the 1000 year event significant hazard covers the majority of the Chuley Road site, with the exception of the raised land on the east and a margin on the west of Tuckers Yard.
- Modelling of the impact of blockage of the structures in the River Ashburn and the Balland Stream shows that a number of structures in the watercourse cause restriction to flow and blockage of these structures would lead to more extensive flooding in lower return period events;
- Indicative EA mapping and flood records show that the site is at risk of surface water flooding, with extensive surface water flooding predicted in the lowest lying areas of the town in both the 30 year and 200 year return periods. The area at risk of surface water flooding largely coincides with the area assessed to be at risk of fluvial flooding.

SECTION 6

SPATIAL PLANNING AND DEVELOPMENT GUIDELINES

6 SPATIAL PLANNING AND DEVELOPMENT GUIDELINES

6.1 Introduction

6.1.1 This section provides guidance on appropriate planning policy to steer development within the Chuley Road site to areas at appropriate risk of flooding. Guidance is provided on development scale opportunities to control flood risk locally and for the management of surface water.

6.1.2 This guidance is based on the assessment of flood risk as described in this report, alongside review of flood risk from other sources and consideration of past flood events. The guidance in this section should be reviewed if any strategic level flood works be implemented that could alter the likelihood and extent of flooding in the study area.

6.2 Spatial Planning and Development Guidelines

6.2.1 As set out in Section 3.5, a Sequential Approach is to be implemented in accordance with the NPPF, with development steered to areas with the lowest probability of flooding.

6.2.2 Figure F1 and Figure F6 in Appendix F identifies redefined flood probability zones based on the hydraulic modelling described in Section 5. This mapping has been used to inform the guidance below, alongside reference to the EA FMfSW maps and review of reports of past flood events.

<u>Flood Zone 3b – Functional Flood Plain</u>

6.2.3 It is recommended that development in this area should be limited to water compatible development, such as water based recreation and amenity open space. It is also recommended that car parking is not located in these areas due to the risk to users, the impact on overland flow and the potential of blockage to the River Ashburn.

<u>Flood Zone 3a – High Probability Flood Zone</u>

6.2.4 Only less vulnerable development types, such as commercial and industrial buildings are recommended within this area. These developments should only be permitted following the application of a Sequential Test which demonstrates that no alternative sites are available in a lower risk area. A detailed site specific FRA will be required for any development within this zone, demonstrating how the development will be protected against flood risk and how the safety of the users of the property will be ensured.

6.2.5 In accordance with the NPPF, more vulnerable development types including residential properties may be permitted in this zone following the successful application of the Exception Test. The parameters of the Exception Test are set out in Section 3 and further guidance on meeting these requirements is provided in Section 6.3.

6.2.6 Car parking serving less vulnerable development (i.e. non-residential) may be permitted in this zone, but should not be allocated in areas with flood depths of greater than 300mm in the 1 in 100 year event or in areas with raised flood hazard.

Flood Zone 2 – Medium Probability Flood Zone

6.2.7 In accordance with the NPPF, following application of the Sequential Test, all development except highly vulnerable development types is permitted in this zone.

6.2.8 As above, a detailed site specific FRA will be required for any development within this zone, demonstrating how the development will be protected against flood risk and how the safety of the users will be ensured.

Flood Zone 1 – Low Probability Flood Zone

6.2.9 All forms of development are appropriate in Flood Zone 1. A site specific FRA will only be required where the development area exceeds 1 ha and should focus on the management of flood risk from surface water.

Watercourse Easements

6.2.10 Under the Water Resources Act 1991 and associated byelaws flood defence consent is required from the EA for works in, over, under or adjacent to Main Rivers. Under these powers, the EA typically require a 7 – 9m easement on both banks of a Main River to ensure the river can be accessed for maintenance and to protect the banks of the channel.

6.2.11 EA guidance for Ashburton is that development that obstructs access for maintenance should not be permitted within 7m of the top of bank of both watercourses. Footpath, roads and green areas may all be acceptable, subjected to detailed design.

6.2.12 For the River Ashburn it is recommended that this guidance is followed, with this margin providing additional benefit through restoring fluvial flood plain and promoting riparian vegetation.

6.2.13 For the culverted Balland Stream, access for maintenance is gained via access manholes in Love Lane and Chuley Road. There would be no amenity or ecological benefit of a wide margin either side of the channel and it is therefore considered that there would be no detrimental effect of construction closer than 7m to the channel, provided that there is no obstruction to access for maintenance or risk to the structural integrity of the culvert. Any proposals to develop in this area would require consent from the EA.

6.2.14 The extent of these buffer zones is illustrated in Figure F2 in Appendix F.

6.3 Application of the Exception Test

6.3.1 If, following the application of the Sequential Test it is not possible to identify appropriate sites for development at low risk of flooding, the Exception Test can be applied. The Exception Test is used to consider the approval of more vulnerable development types in areas at raised risk of flooding, such as the construction of residential development in Flood Zone 3a.

6.3.2 In accordance with Paragraph 102 of the NPPF, for the Exception Test to be passed it must be demonstrated that the development:

- *provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*

- *will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

6.3.3 Both elements of the test have to be passed for development to be allocated or permitted.

6.3.4 Within Flood Zone 3a, the requirements of the Exception Test must be satisfied for 'more vulnerable' development types, such as housing, to be permitted. As specified in the NPPF, development will only be considered appropriate where it can be demonstrated that:

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.*

6.3.5 Flood hazard mapping has been produced in accordance with the Defra FD2321/TR1 methodology to enable a more detailed assessment of the risk of flooding within the defined flood probability zones. These maps enable the application of the Sequential Approach within flood zones, identifying areas at the lowest risk of flooding within the high probability flood zone. Further guidance on the methodology used in the preparation of this mapping is provided in Section 3.4.

6.3.6 As shown in Figure E4.3 in Appendix E, in the 100 year event significant hazard in the Chuley Road site is shown through the east and west of the Station Yard, along Chuley Road, in the Tuckers Yard area and at the south of the site adjacent to the Auction House. Areas of low hazard are shown to the south and west of Tuckers Yard, in parts of the Station Yard and the raised area to the east of Chuley Road.

6.3.7 It should be noted that the mapping produced shows the current risk of flooding. Any proposals for new development would need to undertake a detailed site specific assessment of the flood risk implications. Any proposals to provide flood mitigation or to otherwise change the flood risk within Chuley Road would need to be assessed using detailed modelling to demonstrate that the proposed works do not have a negative impact on flood risk. To gain approval it is likely that the proposed works would need to show betterment over the existing flood risk.

Safe Access and Egress

6.3.8 A key principle of the NPPF is that for all development a safe route of access and egress must be available and this must remain available during periods of flooding.

6.3.9 The assessment of flood risk has shown that Chuley Road is at high risk of flooding, with depths of up to 300 mm shown in the 1 in 10 year event. To gain approval for development it must be demonstrated that safe routes of access and egress are available at an acceptable risk of flooding.

Flood Resilience and Resistance

6.3.10 Where development is permitted in the high risk flood area, such as the construction of 'less vulnerable' development in Flood Zone 3a, the potential impact of flooding should be minimised at individual property level by raising finished floor levels, providing safe access routes and utilising flood resilient construction methods.

6.3.11 These measures will also be required for the redevelopment of any existing properties within the areas at high risk of flooding, such as the historical railway buildings in the Station Yard.

6.3.12 Finished floor levels for all new development in Flood Zone 3a should be a minimum of 300mm above the 1 in 1000 year plus climate change flood level and 150mm above the average site level or adjacent road frontage level, whichever is highest. Due to the limited warning of flooding in the catchment, temporary measures such as threshold flood barriers are not considered to be appropriate for the site.

6.3.13 Refurbishment of any existing properties located in Flood Zone 3a must be designed to be resilient to flooding, through the use of water-resistant materials for floors, walls and fixtures and the siting of electrical controls, cables and appliances at a least 1m above floor level.

6.3.14 Further guidance on suitable approaches can be found in the document *'Improving the Flood Performance of New Buildings'* (Communities and Local Government, May 2007).

Flood Warning and Evacuation

6.3.15 At present, there is not a flood warning system serving Ashburton. The catchments of the two watercourses are steeply sloped and flooding can occur with little warning. As a result, the EA has advised that creating an accurate flood warning system for Ashburton that provides sufficient warning is highly challenging and there are no immediate plans to introduce such a system for the town.

6.3.16 Developers must demonstrate that there are robust plans for evacuation or adequate safe refuge in the event of a flood event or an extreme weather warning indicating the potential for flooding.

6.4 Measures to Reduce Flood Risk

6.4.1 It may be desirable for developers to seek to alter the flood risk within the site in order increase the area available for development. Potential measures include formalising a route for overland flow through the Station Yard and localised land raising within areas shown to have shallow depths of flooding.

6.4.2 Any such measures would have to be carefully assessed to ensure there is no negative impact on flooding downstream. Further discussion of these measures and larger scale flood risk reduction approaches is included in Section 7.

6.5 Sustainable Drainage Systems (SUDS)

6.5.1 Sustainable Drainage Systems (SUDS) are management practices which encourage surface water to be drained in a way which mimics natural runoff processes prior to development. SUDS can help control surface water flood risk within a development, reduce the impact on flooding downstream and add ecological and amenity value.

6.5.2 Due to the brownfield nature of the Chuley Road site and the downstream flood risk, new development on the site will need to ensure a minimum 20% reduction in the peak rate and volume of surface water discharge from existing.

6.5.3 Figures 37 and 38 demonstrate the types of SUDs measures that may be appropriate for Chuley Road. Figure 37 shows an example of a swale (an above ground, soft landscaped drainage channel) in a residential street, and Figure 38 shows an example of a wetland area used for surface water attenuation. This approach could be adopted in the south of the Chuley Road site.

Figure 37 – Example of swale in residential street (SUSdrain, 2013)

Figure 38 - Example of wetland attenuation (SUSdrain, 2013)

6.5.4 A key principle of SUDS is that water should be managed as close to the source as possible. This means using localised ‘source control’ techniques to intercept rainfall and reduce runoff through infiltration, evapotranspiration and attenuation before water is discharged to a public sewer or downstream watercourse. Keeping water above ground also enables water to be integrated into the development, providing greater amenity and biodiversity. It also enables biological breakdown of pollutants and easier maintenance.

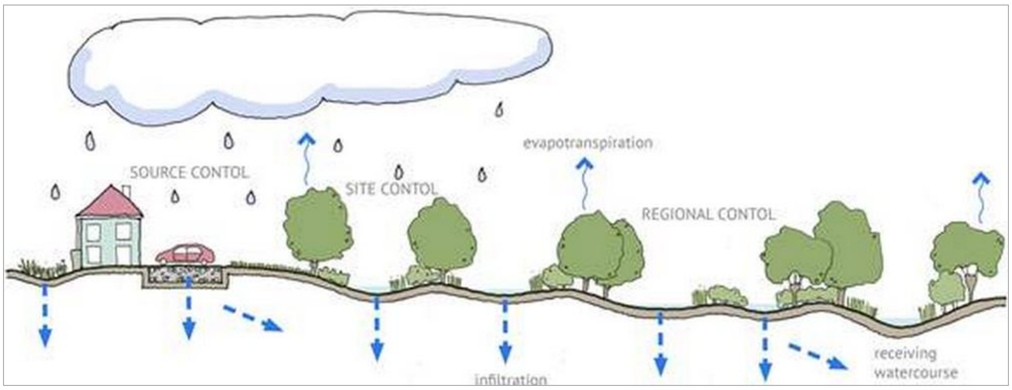

Figure 39 – SUDS management train (SUSdrain, 2013)

6.5.5 A wide range of SUDS techniques are available and the selection of a suitable method is dependent on a number of factors including topography, geology, site usage and the available land. Potential methods are listed in Table 10.

Table 10 – Potential SUDS Approaches

SUDS Type	Techniques	Flood Reduction	Pollution Prevention	Ecology / Amenity	Comments
Source Control	Green Roof	●	●	●	
	Brown Roof		●	●	
	Rainwater Harvesting		●		
	Pervious Pavements	●	●		
	Rain Gardens	●	●		
Infiltration	Soakaway	●	●		May not be appropriate in Chuley Road site due to potential contamination.
	Infiltration Trench	●	●	●	
	Infiltration Basin	●	●	●	
Detention	Pond	●	●	●	
	Wetland	●	●	●	
	Subsurface Storage	●			
	Detention Basin	●	●	●	
Filtration	Sand filter		●	●	To be used as part of 'SUDS Train' providing water quality benefits.
	Bioretention		●	●	
	Filter Strip		●	●	
	Filter Trench		●	●	
Conveyance	Swales	●	●	●	
	Urban channels / rills	●		●	

6.5.6 It is recommended that the SUDS approach for Chuley Road combines source control measures within development areas in combination with larger scale SUDS infrastructure, such as wetland areas, prior to discharge to the River Ashburn. These proposals are illustrated in Figure F3 in Appendix F.

6.5.7 Due to the past industrial activity on the site it is believed there is a high risk of contamination in the underlying soil. As a result, infiltration methods such as soakaways and infiltration basins may not appropriate. This should be assessed on a site-by-site basis following appropriate ground investigation.

6.5.8 Figure 40 shows an example of the type of source control approach that may be appropriate within development areas at the Chuley Road site. Note that for Chuley Road drainage may be required at the base of such a feature, as infiltration to ground is unlikely to be permitted.

6.5.9 Figure 41 illustrates the use of wetland to provide surface water attenuation, alongside amenity and ecological benefits. Within the Chuley Road site the existing wetland at the south of the site provides potential for adopting this approach, though the use of SUDs may not be appropriate for attenuation in areas with high fluvial flood risk.

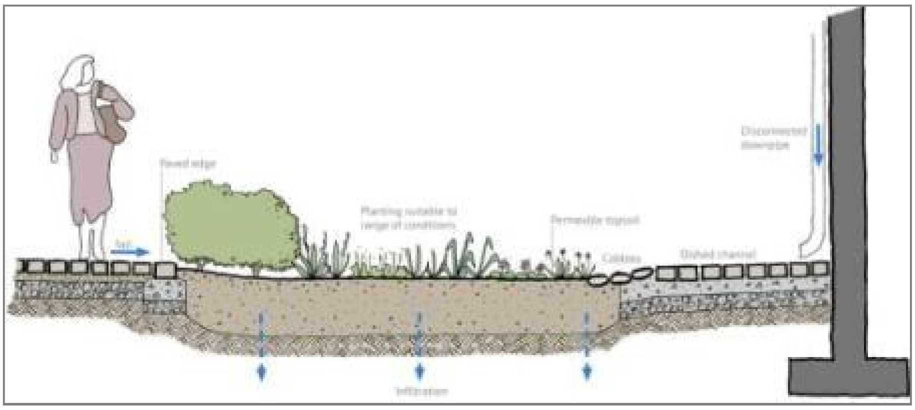

Figure 40 – Illustrative example of a SUDS rain garden (SUSdrain)

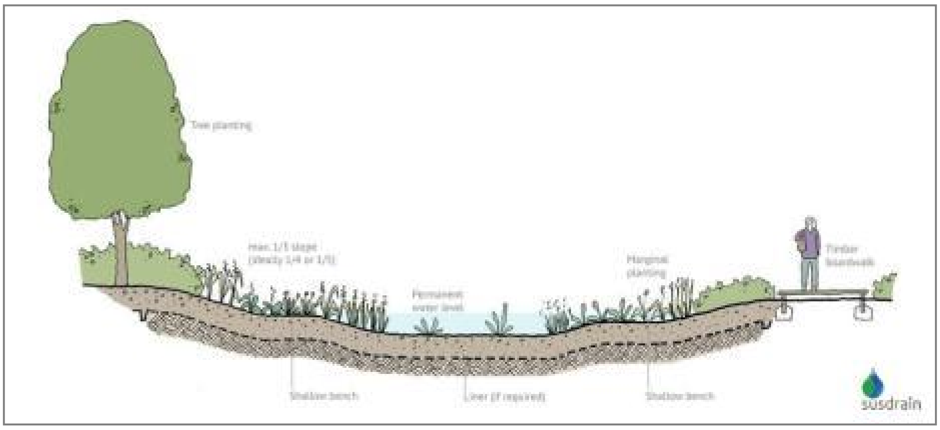

Figure 41 – Illustrative example of a SUDS wetland (SUSdrain)

Approval, Maintenance and Adoption of SUDS

6.5.10 The FWMA introduces the role of the SUDS Approval Body (SAB). This role will typically be held by the LLFA and means that the LLFA will have statutory powers to review all planning applications for developments larger than one property and ensure that an appropriate drainage system is proposed. The SAB will have powers to reject planning applications if drainage systems do not meet the new National Standards for Sustainable Drainage. Following approval, the SAB will be responsible for adopting and maintaining all approved SUDS schemes.

Health and Safety

6.5.11 Health and safety implications should be considered in the selection and design of SUDS. Potential hazards arising from the management of surface water include:

- Open water and subsequent potential risk of drowning;
- The potential for water to freeze and present risk to road users;
- The potential for stagnant water to become a breeding ground for mosquitoes;
- Requirements for maintenance of above and below ground drainage.

6.5.12 These issues should be considered early in the planning and design process and managed through appropriate design.

6.6 Water Sensitive Urban Design

6.6.1 Water Sensitive Urban Design (WSUD) is an approach to planning urban development using an integrated and sustainable approach to water management. The aim is to view water in urban areas as an opportunity which can enhance an environment, rather than a problem to be dealt with or hidden below ground.

6.6.2 WSUD encompasses a broad range of methods with the overall aim of integrating water into the urban environment to maximise the possibilities for sensitive water cycle management. Going beyond the concept of SUDS, WSUD encourages a holistic approach to water management, looking at potential benefits to water supply and wastewater as well as surface water and flood risk. WSUD also encourages the use of integrated water management to contribute to the successful design of urban areas. Through an integrated approach, WSUD can provide a cost effective solution for reducing flood risk.

6.6.3 Potential opportunities for applying the WSUD approach at Chuley Road would include:

- Deculverting the Balland Stream to maximise the ecology and amenity benefit of the watercourse and to raise awareness of the presence of the river;
- Construction of a ‘green link’ along the eastern bank of the River Ashburn from Bullivers Way to the recreation ground, providing amenity benefits and improving access to the river;
- Improvements to the wetland area on the eastern bank of the River Ashburn adjacent to Bullivers Way to enhance amenity and ecological potential;
- Use of rainwater gardens and rainwater harvesting and greywater recycling within new development to reduce surface water runoff and reduce consumption of potable water;

- Use of SUDS types measures to keep surface water on the surface, reducing surface water runoff and maximising the use of rainfall within the site.

6.7 Summary of Guidance

6.7.1 The requirements for each of the revised flood zones identified in Figures G1 in Appendix F are set out in Table 11. This guidance is to be applied following the application of the Sequential Test, with development steered to areas at lowest flood risk.

6.7.2

Table 11 – Development Guidelines

	EA Flood Zone			
	Flood Zone 3B	Flood Zone 3A	Flood Zone 2	Flood Zone 1
Annual Exceedance Probability	>5% AEP	>1% AEP	1% – 0.1% AEP	<0.1% AEP
Land use	Land use to be restricted to Water Compatible or Essential Infrastructure development.	Land use to be restricted to Water Compatible, Less Vulnerable or Essential Infrastructure development. More vulnerable development may be permitted in Low Hazard areas following successful application of Sequential and Exception Tests.	Land use to be restricted to Water Compatible, Less Vulnerable, Essential Infrastructure and More Vulnerable development types.	All land uses are appropriate.
Site specific flood risk assessment	Required for all development.			Required for developments greater than 1ha.
Flood level and flood proofing	Finished floor levels to be set 300mm above 1 in 1000 year plus climate change flood level and 150mm above surrounding ground level. .			
Safe refuge	If a safe route of access and egress to land in Flood Zone 1 is not available, safe refuge above the 1 in 1000 year flood level must be available for all users of the development.			No restrictions.

SECTION 7

APPROACHES TO REDUCE FLOOD RISK

7 APPROACHES TO REDUCE FLOOD RISK

7.1 Introduction

7.1.1 This section provides a review of potential measures to reduce flood risk in the study area.

7.1.2 An aim of the National Planning Policy Framework (NPPF) is that planning authorities should consider *'opportunities offered by new development to reduce the causes and impacts' of flooding'.* Redevelopment of the Chuley Road site may provide opportunity for developer contributions to partly or wholly fund flood risk reduction measures which could benefit both new development and existing properties.

7.1.3 The measures are divided between those affecting flood risk from the River Ashburn and those affecting flood risk from the Balland Stream.

7.2 Reducing Flood Risk from River Ashburn

7.2.1 The hydraulic modelling assessment has shown that despite the existing flood relief culvert there remains a residual flood risk from the River Ashburn, particularly in high return period events and downstream of the outfall from the culvert.

7.2.2 A detailed review of potential measures to reduce the flood risk from the River Ashburn has been undertaken, with the results provided in Appendix F. The review identified four key options with potential to provide significant improvement to the flood risk in the Chuley Road site and elsewhere in Ashburton. These options are discussed further below.

A1 Changing the profile of the River Ashburn within Chuley Road site;

A2 Increasing conveyance in the channel downstream of the Chuley Road site;

A3 Constructing permanent hard flood defences along River Ashburn;

A4 Implementing measures upstream to reduce or delay the peak flow in the River Ashburn.

7.2.3 A number of further options were assessed to be infeasible or considered unlikely to have a significant impact on flood risk. These included increasing the capacity of River Ashburn flood relief culvert, temporary flood defence solutions along the River Ashburn and works to 'daylight' the River Ashburn culvert. Further details on these measures are included in Appendix F.

<u>A1 - Change the profile of River Ashburn</u>

7.2.4 There is potential to make alterations to the profile of the River Ashburn through the Chuley Road development site in order to reduce the flood risk locally. This could increase the development potential of land located on the east and west banks of the river.

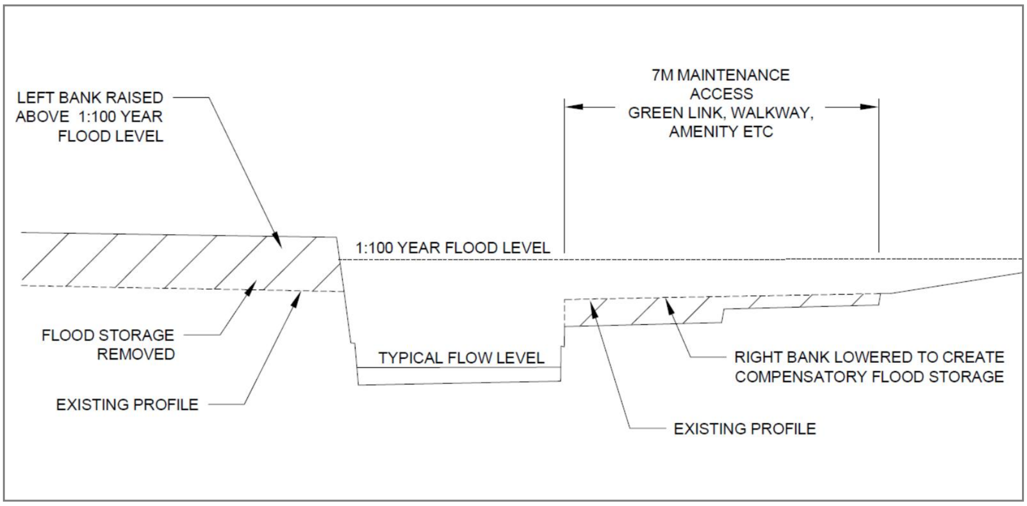

Figure 42 – Indicative sketch showing potential re-profiling options in River Ashburn

7.2.5 One potential option is to widen and lower the existing banks of the watercourse to increase flood storage within the channel, as illustrated in Figure 42. This approach could form part of works to enhance the amenity value of the watercourse and provide a green link from Bullivers Way to the recreation ground. During normal flow conditions these areas would be usable open space, but be designed to provide safe flood storage during extreme flow conditions.

7.2.6 Any works to re-profile the River Ashburn should extend as a minimum from immediately downstream of the outfall from the River Ashburn Flood Relief Culvert to downstream of the Antiques building.

7.2.7 It is considered feasible that the re-profiling of the River Ashburn could form part of the costs associated with the development of the site.

<u>A2 – Increase conveyance in downstream River Ashburn</u>

7.2.8 The hydraulic modelling undertaken to inform this SFRA has shown that the structures in the River Ashburn downstream of the Chuley Road site impact on flood levels upstream. These structures include the two bridges adjacent to the Auction House, the Old Totnes Road bridge and the weir at Castle Bridge.

7.2.9 Potential options to improve conveyance include removing or lowering the weir and altering the bridge structures to allow more flow to pass through in peak events. However, the analysis shows that the areas which currently have raised risk of flooding as a result of these structures do not contain properties and the impact of this flooding is generally low. Any changes to these structures must be carefully considered to ensure that it does not result in increased flood risk at more vulnerable areas downstream.

<u>A3 – Construct permanent hard flood defences along River Ashburn</u>

7.2.10 The traditional approach to defending the Chuley Road site from flooding from the River Ashburn would be to construct hard flood defences along the watercourse.

7.2.11 This approach is no longer considered best practice, due to the high residual flood risk should the raised defences fail. Hard flood defences also offer little amenity of biodiversity benefit and could have potential to prevent overland flow from re-entering the watercourse. In consultation, the EA and DNPA have advised that this approach is not considered a favourable solution for Ashburton.

A4 - Upstream catchment measures

7.2.12 In recent years there has been increasing attention paid to the importance of appropriate catchment management, with runoff from agricultural land shown to have significant impact on downstream flood risk and water quality. SWW has been a leader in this approach through their 'Upstream Thinking' initiative. The 'Dartmoor Mires' project led by DNPA is part of this initiative and involves the restoration of blanket bog on Dartmoor to improve water quality and potentially reduce peak runoff rates.

7.2.13 The River Ashburn catchment is largely rural and extends north of Ashburton into the Dartmoor National Park. Potential measures to reduce the peak flow in the watercourse could include:

- Creating and restoring surface water storage in ditches, ponds and wetland areas;
- Appropriate maintenance of surface water drainage channels and riparian watercourses to ensure flow capacity;
- Planting of appropriate vegetation to minimise erosion, promote evapotranspiration and reduce the rate of runoff;
- Online or offline attenuation storage to reduce and delay peak flow downstream.

7.2.14 Such measures could also provide benefits to the water quality in the River Ashburn.

7.2.15 However, it is likely that upstream works would be need to be very extensive to have a significant impact on flooding within Ashburton.

7.3 Reducing Flood Risk from Balland Stream

7.3.1 The high number of recent flood events and the hydraulic modelling assessment both indicate a high level of fluvial flood risk from the Balland Stream to the Chuley Road site.

7.3.2 Assessment of the opportunities and constraints of potential measures is included in Appendix F. The key options assessed were:

B1 Opening up the existing Balland Stream culvert;

B2 Constructing a flood relief culvert for Balland Stream;

B3 Modification of ground levels and construction of an overland conveyance route;

B4 Implementing measures upstream to reduce or delay the peak flow in the Balland Stream.

7.3.3 An option which was discounted at the review stage was increasing the capacity of the existing Balland Stream culvert. Studies completed by TDC concluded that it would be simpler and more cost effective to construct a new bifurcation flood relief culvert instead of increasing the size of the existing culvert – partly due to constraints by existing services and also the restrictions of working within the existing channel.

B1 - Open Up the Balland Stream Culvert

7.3.4 This option comprises opening up the Balland Stream culvert from within the Chuley Road site boundary and running the open watercourse adjacent to Chuley Road – either crossing the site to discharge at a similar point to the existing confluence with the River Ashburn, or continuing further south and discharging at a point near the Rendell's building. It is highly unlikely that the watercourse could be opened up between the site and top of Love Lane due to space constraints, and as a result flooding from this section of the river would be likely to be unaffected by this approach.

7.3.5 The conceptual approach of this proposal is illustrated in Figure F4 in Appendix F.

7.3.6 If appropriately designed this approach would have benefits to both fluvial flooding and surface water flooding, with the opened up channel intercepting overland flow. Additional potential benefits associated with opening up – or 'daylighting' – a culverted watercourse include

- Reduce maintenance costs by reducing blockage risk and enabling improved access;
- Improve amenity, biodiversity and water quality, as well as assist with meeting WFD objectives.
- Complements other urban regeneration initiatives and brings commercial benefits such as enhanced image for properties and up to 20% increase in land values or rents.[1]

7.3.7 However, opening of the watercourse would be complex and expensive. The land available is restricted and largely under third party ownership.

7.3.8 The amenity and regeneration opportunities are limited by the small size of the watercourse and developers may be unwilling to fund large scale works. The modelling has shown that the flood risk from the Balland Stream does not affect a large number of properties and as a result works to this watercourse would be unlikely to be eligible for significant FDGiA funding (opportunities for funding are discussed further in Section 7.4).

7.3.9 An alternative option considered was routing the opened up channel alongside the front of the 'Grey Matter' buildings in Prigg Meadow. This option was considered to pose too high a residual flood risk and would be unlikely to be favourable with owners / occupiers of the Grey Matter buildings.

B2 - Construct a flood relief culvert for Balland Stream;

7.3.10 A study was completed in 2004/05 by TDC to investigate options for reducing flood risks associated with Balland Stream. This work proposed the construction of a new bifurcation flood relief culvert, running from the junction between Chuley Road and Vealenia Terrace and passing through the Chuley Road site in front of the Grey Matter buildings, before discharging to the River Ashburn in a similar location to the existing culvert.

7.3.11 This approach would increase the capacity of the Balland Stream, reducing fluvial flood risk. With appropriate design and the inclusion of measures such as gullies and

[1] Source - Liquid Assets - Making the Most of our Urban Watercourses, Institute of Civil Engineers (1998)

slot drainage, the new culvert could also intercept overland flow and reduce flood risk from surface water and overland flow from the River Ashburn and upper reaches of the Balland Stream.

7.3.12 However, this approach would not provide amenity or biodiversity benefits and a residual risk of flooding in the event of blockage would remain. In addition, much of the flooding from the Balland Stream originates further upstream in Love Lane and the scheme considered in 2004/05 would be unlikely to have a significant impact on this flooding.

<u>B3 - Modification of ground levels and construction of an overland conveyance route</u>

7.3.13 Modifying ground levels locally to raise land above the required flood level and to reroute overland flow paths has the potential to move areas out of the high risk flood zone and increase the potential for more vulnerable development types, such as residential housing.

7.3.14 Any such works would have to be carefully considered to ensure there is no resulting detrimental effect on conveyance or flood storage adversely impacting flood risk elsewhere.

7.3.15 An area which could benefit from this approach is the Station Yard area to the east of the overland flow route in Prigg Meadow. Raising land locally, potentially in conjunction with works to formalise the overland flow route, would lower flood risk to this area and would be unlikely to increase flood risk significantly downstream.

<u>B4 - Upstream catchment measures</u>

7.3.16 The 2004/05 TDC study also investigated options for providing upstream storage in Balland Stream and subsequently reducing downstream flood risks associated with Balland Stream. These works were coupled with other improvements to the length of Balland Stream from the Glendinnings Quarry to the start of the culvert in Love Lane.

7.3.17 The most feasible option for upstream storage was identified to be within the Glendinnings Quarry where water is already stored for use by the Quarry. Additional storage here would reduce the flow of water through Balland Stream and could reduce existing flood risks – particularly those associated with the smaller, more regular flood events.

7.4 Summary of options considered

River Ashburn – Flood reduction measures				
Measure		Opportunities	Constraints	Recommendation
A1	Increase capacity and online storage in River Ashburn through site, with reprofiling, widening and or creation of a two stage channel.	Reduce fluvial flooding in southern half of Chuley Road site. Could be applied in conjunction with works to increase conveyance in Balland Stream.	Flow would have to be restricted / attenuated to prevent increased flood risk downstream. Potential high land take in river corridor, though other constraints, such as the requirements for maintenance, may also apply in this area.	Recommended, in combination with other measures. Additional analysis required.
A2	Increase conveyance in River Ashburn downstream of Chuley Road site by altering structures in watercourse.	Reduce fluvial flooding in southern half of Chuley Road site by altering structures in watercourses, such as bridges adjacent to auction house and Old Totnes Road bridge.	Flow would have to be restricted / attenuated to prevent increased flood risk downstream.	May provide some benefit. Additional analysis required.
A3	Construct permanent hard flood defences along banks of River Ashburn.	Reduce fluvial flooding in southern half of Chuley Road site	Unlikely to be approved due to high residual risk.	Unlikely to be approved by EA / DNPA
A4	Implement upstream catchment management measures.	Reduce peak flows in River Ashburn. Also potential water quality benefits.	May not provide benefit in extreme events. Difficult to quantify impact. Land take/ownership issues.	May provide some benefit. Additional investigation required.

Balland Stream – Flood reduction measures				
Measure		Opportunities	Constraints	Recommendation
B1	'Daylight' Balland Stream culvert, following western side of Chuley Road.	Increase capacity in watercourse and reduce flooding through Station Yard. Ecological, amenity and water quality benefits. Reduced maintenance, through use of natural materials and reduced risk of blockage.	Limited potential upstream of the Chuley Road area boundary. Existing utilities and services. May increase flow into River Ashburn, increasing flood risk downstream. Would require modelling to assess impact of response times and interaction of flow paths.	Likely to provide multiple benefits, though high cost. Further investigation required.
B2	Construct new flood relief culvert for Balland Stream, diverting flows from main watercourse and discharging to the River Ashburn downstream.	Studies completed by TDC identified that the route passing the Grey Matter buildings was feasible with regards to services/utilities within the site boundary. Overland flow from the River Ashburn could be directed into the flood relief culvert to further reduce flooding within the Chuley Road site.	No amenity, biodiversity or water quality benefits. Land ownership. Potentially high cost scheme. Residual risks associated with blockages.	Would be effective, but likely to need funding contributions from other sources.
B3	Land profiling within Chuley Road site to provide safe flow route for overland flow.	Relatively low cost solution. Protects against surface water flooding as well as fluvial flooding.	Overland flow route ideally to follow existing natural flow path – potential impact on development proposals. May only provide local flood protection – unlikely to reduce flood risk to existing properties	Recommended, in combination with other measures
B4	Implement upstream catchment management measures.	Reduce peak flows in watercourse by increasing upstream storage.	Difficult to quantify benefits. May not have big impact on extreme events.	May be appropriate alongside other measures.

7.5 Partnership Funding Opportunities

7.5.1 In May 2011 Defra introduced a new policy, 'Flood and Coastal Erosion Resilience Partnership Funding' which sets out how flood and coastal erosion projects are funded in England. Under the new policy, Defra has moved away from an 'all or nothing' approach to funding flood defence infrastructure and now all projects have the potential to be fully or partially funded based on the benefits that a scheme provides.

7.5.2 Funding for flood defence projects is allocated by Defra under the Flood Defence Grant in Aid (FDGiA) scheme based on an assessment of the benefits of the project over its lifetime. These benefits include the protection of households, commercial properties, public buildings, infrastructure and agricultural land, and the creation or improvement of water or tidal dependent habitat.

7.5.3 The percentage of funding available through FDGiA is calculated as follows:

Percentage of funds available through FDGiA funding	=	Household benefits + other whole life benefits + environmental outcomes	x	Fixed payment rates
		÷		
		Amount of funding required		

7.5.4 If the FDGiA funding does not cover 100% of the funding required, alternative sources of funding can be sought to make up the shortfall. Funding partners could include developers, local authorities, new or existing businesses or community groups.

7.5.5 It should be noted that allocation of FDGiA funding is based on the protection of existing properties and is not for the protection of new development.

Other potential funding sources

7.5.6 Further potential sources for flood defence infrastructure funding for the Chuley Road site include:

- The **Community Infrastructure Levy (CIL**) was introduced in 2010 and provides Local Authorities in England and Wales with an alternative source of potential funding for community infrastructure, such as a flood defence scheme. The CIL may provide a mechanism for DNPA to fund flood risk reduction measures to benefit Chuley Road and the surrounding area;
- Local authority contributions through the **South West Regional Flood and Coastal Committee Local Levy**;
- The **New Homes Bonus** is a grant paid by central government to local councils for increasing the number of homes and their use. The New Homes Bonus is based on the amount of extra Council Tax revenue raised for new-build homes, conversions and long-term empty homes brought back into use. There is also an extra payment for providing affordable homes;
- **Heart of the South West Local Enterprise Partnership** grant/loan, such as the Growing Places Fund, the Rural Growth Fund or the Capacity Fund.

SECTION 8

SUMMARY AND CONCLUSIONS

8 SUMMARY AND CONCLUSIONS

8.1 Summary

Introduction

8.1.2 This report provides a detailed assessment of flood risk at the Chuley Road site in the south of Ashburton. The assessment provides an evidence base which can be used to inform management of flood risk within the planning process in accordance with the NPPF.

Methodology

8.1.3 Fluvial flood risk at the site has been assessed using a 1D-2D hydraulic model created using ISIS TUFLOW software. The risk of flooding from other sources such as surface water and groundwater was assessed using mapping provided by the EA and review of historical flood events.

Assessment of Flood Risk

8.1.4 The assessment has found that much of the Chuley Road site is at risk of fluvial flooding from the River Ashburn and the Balland Stream and from surface water flooding. Revised flood mapping has been produced to reflect the updated assessment of fluvial flood risk.

Flood Risk Management Recommendations

8.1.5 Guidance has been provided on appropriate planning measures to control flood risk to new development and existing properties. The guidance made is in accordance with the parameters of the NPPF, with a Sequential Approach used to guide the development most vulnerable to flood risk into the areas at lowest flood risk.

8.1.6 Guidance has also been provided on the management of surface water flood risk for new development at the site, with advice provided on suitable SUDS options.

Flood Risk Alleviation Opportunities

8.1.7 Measures to reduce the flood risk within the Chuley Road site and wider area have been assessed. The opportunities and limitations of a number of approaches were considered and recommendations have been made on the most suitable approach for the Chuley Road site.

8.1.8 This Level 2 SFRA has been prepared using best currently available information and using current best practice hydraulic modelling methodology. It should be considered a living document and periodically updated when new information on flood risk is available or new planning guidance or legislation is released.

SECTION 9

BIBLIOGRAPHY

9 BIBLIOGRAPHY

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