TORBAY COUNCIL

Level 2 Strategic Flood Risk Assessment

Draft June 2026

Contents

1 Executive Summary

1.1 Scope of Level 2 Strategic Flood Risk Assessment

This Strategic Flood Risk Assessment (SFRA Part A & B) replaces the original SFRA dated December 2010. The principal purpose of the Level 2 Strategic Flood Risk Assessment is to is to provide a site focused assessment of flood risk sufficient to inform application of the sequential and exception tests, determine development suitability and establish whether development can be made safe for its lifetime without increasing flood risk elsewhere as identified in the National Planning Policy Framework (December 2024) **National Planning Policy Framework** (paragraph 170 to 182). More detailed information is required where there is deemed to be development pressure in areas that are at medium or high flood risk and there are no other suitable alternative areas for development after applying the sequential test. This more detailed study considers the detailed nature of the flood hazard, taking account of the presence of flood risk management measures such as flood defences. This will allow a sequential approach to site allocation to be adopted within a flood zone. It will also allow policies and practices required to ensure the development in such areas satisfies the requirements of the exception test, to be identified for inclusion within the Local Plan.

The findings of the SFRA also support the development of related strategies and policies, including those relating to climate change adaptation and green infrastructure, by highlighting flood-risk constraints, areas of vulnerability, and opportunities for multifunctional land use that delivers wider environmental and resilience benefits.

The scope should consider the detailed nature of the flood hazard within a flood zone including the following:

- Flood probability
- Flood depth
- Flood velocity, and
- Rate of onset of flooding

These factors can be significantly affected by the presence of flood defences or any other infrastructure which acts as a flood defence. Flooding behind such infrastructure can occur either as a result of:

- A constructional or operational failure of the defence, either in whole or in part. This is known as a breach failure.
- Water levels rising to exceed the level of the flood defence structure. This is known as overtopping.
- Overloading of the surface water drainage system, either due to its own limited capacity or being unable to discharge due to high water levels outside of the defended area.

These mechanisms can lead to rapid inundation of areas by flood water, and the consequences can be particularly catastrophic.

1.2 Outputs from Level 2 Strategic Flood Risk Assessment

The Level 2 Strategic Flood Risk Assessment builds on the source information that was included within the Torbay Level 1 Strategic Flood Risk Assessment (2026) and contains the following:

An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an appropriate allowance for climate change.

- Definition and mapping of the functional floodplain in locations where this is required.
- Maps showing the distribution of flood risk across all flood zones from all sources of flooding taking climate change into account.
- Guidance on appropriate policies for sites which could satisfy both parts of the exception test.
- Guidance on the preparation of flood risk assessments.
- For sites of varying risk across the flood zones, including information about the use of suitable drainage techniques.
- Meaningful recommendations to inform policy, development control, and technical issues.

In general, the Strategic Flood Risk Assessments provide clear guidance on the appropriate risk management measures for adoption on potential sites for all sources of flooding. In some instances, improvement works to existing defences may be required to manage residual flood risks.

1.3 Policy Recommendations

The Strategic Flood Risk Assessment includes some policy recommendations for inclusion within the Local Plan, and these should ensure that the requirements of the Environment Agency and national policy are met whilst strengthening the position of Torbay Council with regards to flood risk. The policy recommendations cover the following topics:

- Development Control
- Flood Risk reduction and resilience
- Flood Defence
- Flood Mitigation, and
- Environment

1.4 Conclusions

Flooding is an important issue, which must not be ignored. In the future, it is likely that flooding will occur more frequently and more severely due to climate change.

By using both the Level 1 and Level 2 Strategic Flood Risk Assessments, it is possible for Torbay Council to meet its flood risk obligations under the National Planning Policy Framework, applying the risk based sequential approach to all stages of the planning process, steering new developments to areas at lowest risk of flooding. This means that land for development can be allocated in a sustainable manner.

Having applied the sequential test, if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test (paragraph 177 NPPF) may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in NPPF (December 2024) Annex 3.

2 Introduction

2.1 Objective

This work has been undertaken to provide a detailed assessment of the extent and nature of the risk of flooding within Torbay together with its implications for land use planning. The Strategic Flood Risk Assessments will enable the risk based sequential approach to be applied at all stages of the planning process. It will inform the Development Plan and development control decisions.

Data used in this study has been collected on the basis of best available within the available timescale. It is inevitable that the outputs from a study of this nature will require updating as additional and more accurate data becomes available. It is proposed that this document will be reviewed and updated periodically. The report will also be updated after a significant flood and when new flood risk data becomes available. Other reasons the report may be updated include because of a change in legislation or a requirement for a revised development plan evidence base.

It is proposed that this document will be reviewed and updated on a periodic basis to ensure it remains current and fit for purpose. Updates may be required following a significant flood event or where new or revised flood risk data becomes available. The document may also be updated in response to changes in legislation or national planning policy, or where a review of the development plan requires refreshed or additional evidence to inform the spatial strategy and application of the Sequential and Exception Tests.

2.2 Overview

National Planning Policy Framework was published in March 2012 and has been updated several times, lastly in December 2024. Local Planning Authorities (LPAs) are required to undertake a Strategic Flood Risk Assessment (SFRA) as part of their evidence based for the Local Plan and use to inform strategic land use planning.

At present, the majority of Torbay is designated as a Critical Drainage Area (CDA) by the Environment Agency, with the exception of Maidencombe. The Environment Agency has indicated that the CDA designation will be extended to cover the entire local authority area in 2026, see Appendix A. This means there is a requirement for all planning applications to undertake a site specific flood risk assessment in support of planning applications.

This report presents the findings of the Level 2 SFRA. It details the methodology and results of flood risk modelling and mapping. The Level 2 mapping compliments that produced by Torbay Council's Level 1 SFRA, to provide a complete suite of flood mapping from all sources, based on available data. The Level 1 and 2 reports should be used in conjunction with each other to assist forward strategic planning and to inform ongoing development control decisions.

2.3 Aim of Level 2

The aim of this study is to provide supplementary information to the Level 1 SFRA and to provide sufficient detail on flood probability, hazard and residual risk to support planning decisions, including whether development can be safely accommodated and whether exception testing may be satisfied.
The report includes the following sources of flooding:

- Coastal - Overtopping and breach modelling have been included.
- Pluvial / Surface Water - Modelling has been undertaken to produce surface water flood risk maps.
- Fluvial - Environment Agency (EA) NaFRA2 data has been used.

- Sewer Flooding - Information on sewer flooding has been provided.

- Groundwater - Information on groundwater flooding has been provided.

Flooding from reservoirs has not been considered as there are no reservoirs over 25,000m3 within the Torbay area.

The mapping studies undertaken identify the key results, in terms of flood depth and hazard. In addition, the EA long term fluvial mapping (land having a 3.3% or greater annual probability of flooding) of the main rivers and ordinary watercourses located within Torbay have been used to identify the functional floodplains (Flood Zone 3b). The report concludes with guidance on use of the Level 2 outputs and suggested flooding based policies for Torbay Council.

2.4 Study Areas

The study area covers the towns of Torquay, Paignton, and Brixham within Torbay Local Authority area (Figure 1). Within Torbay there are 17 watercourses of which 8 have been classified as main rivers due to their significant history of flooding. Torbay also has an extensive coastline extending from the boundary with Teignbridge to the north and South Hams to the south.

Figure 1: Torbay's boundary

Much of the study area is urbanised, comprising the three main towns of Torquay, Paignton and Brixham. Historically, people have settled near watercourses and the coast, this means that there is a risk of flooding to these towns within Torbay.

The risk is mostly from watercourse flooding in the middle and lower reaches of the main catchments, from the sea in coastal areas, from surface water runoff, and from combined sewer flooding in various catchments throughout Torbay. More information on sewer capacity can be found in **An assessment of Future Sewer Capacity in Torbay" (May 2023)**. In localised areas there is a risk of flooding on low lying land and areas with susceptible geology, where ground water is becoming an increasing concern, and this risk will increase as a result of the effects of climate change.

All areas are potentially at risk from flooding or have the potential to make flood risk worse elsewhere. Some areas are at a higher risk of flooding than others; many areas are at little or no risk. It is the combination of a number of factors that contribute to making an area at risk from flooding. These are settlement location, including proximity to a watercourse or the coast, climate, geology and topography. The risk of flooding can become greater when there are extreme storms or when taking into account the predicted effects of climate change.

The coastal flood risk to these areas is due to tidal flooding as a result of the proximity to the coast and the defended nature of the coastal perimeter which, though generally maintained to a good standard, could locally fail under extreme circumstances, giving rise to residual flood risk.

2.5 Other Policies and Plans

The Water Cycle Strategy (2026) for Torbay has recently been updated and should be read in conjunction with this report along with the Level 1 Strategic Flood Risk Assessment. Other policies and plans that should be read in conjunction with this report include the following:

Drainage Wastewater Management Plan for Torbay (SWW)

National Flood and Coastal Erosion Risk Management Strategy for England

South West River Basin District Flood Risk Management Plan (EA)

Torbay Council Local Flood Risk Management Strategy

Shoreline Management Plan (South West Coastal Group)

South Devon Catchment Flood Management Plan (EA)

Torbay Water Cycle Strategy (Link to final version)

3 Flood modelling and mapping

The level 2 strategic flood risk assessment required detailed plans to show flood depths and hazards that may be experienced at the major flood risk areas within Torbay.
Heavy rainfall which may cause fluvial flooding together with breaching and overtopping of flood defences has the potential to generate significant flood hazards and damage to houses and infrastructure. The aim of all flood modelling is to simulate flood events to determine the areas at highest risk. This information can then be used to develop further strategies such as development, emergency planning, and flood prevention. This chapter presents the methodologies used in determining the maximum flood depths and extent of flooding, together with the hazard zone maps for the Torbay Level 2 SFRA.

3.1 Data

3.1.1 Model Topography & Lidar

A key component in the modelling process for the SFRA is the representation of topography throughout the flood prone regions of the study area. For this purpose, a Digital Terrain Model (DTM) was prepared for the study area to be modelled. A DTM is a three dimensional grid of elevation information upon which the model simulations are run.

The DTM is based on filtered data from a Lidar (Light Detection and Ranging) survey undertaken by the Environment Agency. The data available for this study was produced with a horizontal resolution of 1 metre and typically a vertical accuracy of +/-0.15m. Lidar records the vertical heights of an area as the eye would see it from above, and therefore includes all buildings, structures and vegetation. Algorithms which detect the presence of buildings filter the Lidar data to produce a Digital Terrain Model (DTM) where the majority of vegetation, buildings, vehicles, structures etc. are removed. This data was used in conjunction with Ordnance Survey Mastermap Building data in order to produce the 2D surface for flood and breach analysis.

3.1.2 Extreme Water Level Derivation

The coastal overtopping study was undertaken by Royal Haskoning DHV in 2017 as part of the Torbay Coastal Defences – Climate Change Adaptation study. The baseline extreme water levels at Torbay were obtained from the Environment Agency's (EA) Coastal Flood Boundary Data study (CFBD) for the UK Mainland and Islands (Environment Agency, 2011). The EA's CFBD study provides a number of output points for water levels up to a 1 in 10000 year return period. It should be noted that this report uses old CFBD and UK Climate Change Impact Projections 2009 (UKCP09) data.

For the surface water modelling the tidal influence has been taken into account within the simulations at the outfalls. A level hydrograph has been produced representing mean high water spring tides. The maximum value of this was in Brixham and was 2.01m. This level was found using the DEFRA data website (Coastal Design Sea Levels - Coastal Flood Boundary Extreme Sea Levels (2018)). This data was viewed in a GIS, and the relevant values were retrieved. This value was adjusted to the 2022 value (2.045m AOD) and modified to reflect the latest UK Climate Projections (UKCP18) allowances from the government website and based on the higher central/upper end values.

3.2 Modelling Information

3.2.1 Environment Agency - River and Sea Flood Risk Modelling

The Environment Agency Flood risk modelling data for rivers, the sea and reservoirs is available online at:

- **Environment Agency Flood map for planning**
- **Environment Agency Check long term flood risk**

The flood maps for planning do not include the defences and have recently included a layer for climate change. The long term flood risk maps include defences. EA Historic flood mapping can be found here:

- **Environment Agency Historic Flood Map**

Information on Flood alert and flood warning areas can be found here:

- **Flood Alert Areas - data.gov.uk**
- **Flood Warning Areas - data.gov.uk**

Hydraulic modelling provides an important evidence base for assessing flood risk, however, site specific local constraints, infrastructure interactions and residual risks may require further assessment beyond strategic model outputs.

3.2.2 Coastal – Overtopping / Breach Modelling

In 2017 Royal HaskoningDHV were commissioned by Torbay Council to undertake a study to assess the standard of protection afforded by the coastal defences along the Torbay frontage. The study area runs from Brixham harbour in the south to Oddicombe Beach in the north. The assessment examines current (baseline) conditions and future conditions in respect of climate change in 20 and 50 years' time based on predictions of sea level rise.

The project involved extensive modelling of the Torbay coast and frontage using a number of software packages. Firstly MIKE 21 Spectral Wave numerical modelling was used to transform offshore wave conditions to the near shore. These inshore wave conditions were then used as input to wave overtopping modelling software called AMAZON to determine wave overtopping rates for each defence. The results of this modelling were then used to determine the standard of protection afforded by each stretch of coastal defence within the project area. Finally, using the overtopping rates for each defence, the landward extent of flooding was modelled using one or two methods. A two dimensional modelling package called TuFLOW was used to model the landward flood extent from Torquay Harbour down to Brixham Harbour and a GIS technique was used to model the landward flood extent for Meadfoot, Babbacombe and Oddicombe. Flood extents were produced for the current condition at a 1 in 10, 20, 50, 75, 100, 200 and 1,000 year return period and for the same return periods (other than the 1,000 year) with predictions of sea level rise 20 years and 50 years into the future to account for climate change. It should be noted that the climate change figures used in this study were UKCP09.

Breach modelling was undertaken by Royal Haskoning DHV as part of the 2017 Torbay Coastal Defences – Climate Change Adaptation study. Breach locations were simulated for the 1 in 200 year return period. The location of each breach was provided by Torbay Council. The grid reference for the centre of each breach is provided below:

- Torre Abbey: SX290922 63557
- Preston Sands- Paignton: SX289515 61444
- Paignton Sands – Paignton: SX289365 60717
- Goodrington: SX289320 59662
- Broadsands: SX289822 57347

Breaches were undertaken in accordance with EA Operational Instruction 303_09 6. A breach was classified as a failure of a structure, either in whole or in part. The defence types of all the defences where breach was simulated can be classified as 'hard' structures and therefore breach widths were set to 50 metres. Breaches were represented by manually lowering the TuFLOW model levels to allow water to propagate through and wave overtopping was removed from the breach section. Breaches were assumed to be in place at the start of the model simulation and for the whole duration (i.e. 100 hours to provide consistency with the defended and undefended runs)

A full joint probability of offshore wave height and water level was calculated for three direction sectors (north east, south east and south) following the Defra / Environment Agency best practice guidance.

Three joint probability scenarios were modelled as part of this study and an extract of the report is presented below in Table 1. Joint probability scenario 1, 2 and 3 refers to the probability scenario with a low water level and high wave height (1), the high water level and low wave height (3) and a medium scenario (2). For the present day baseline conditions all three scenarios were modelled and the worst case in terms of wave overtopping was then taken forward for the Yr 20 and Yr 50 year runs with climate change.

Joint Probability Scenario	Return Period	Baseline Water Level (mODN)	2035 Water Level (mODN)	2065 Water Level (mODN)	NE Wave Height (m)	SE Wave Height (m)	S Wave Height (m)
1	10	2.42	2.59	2.81	4.33	4.87	6.46
2	10	2.70	2.87	3.09	3.78	4.33	5.66
3	10	2.99	3.16	3.39	2.96	3.51	4.54
1	20	2.48	2.65	2.86	4.45	4.97	6.65
2	20	2.76	2.93	3.15	3.84	4.39	5.75
3	20	3.06	3.23	3.46	3.02	3.57	4.63
1	50	2.48	2.65	2.86	4.58	5.09	6.87
2	50	2.82	2.99	3.21	3.99	4.54	5.95
3	50	3.15	3.33	3.56	3.11	3.66	4.75

Joint Probability Scenario	Return Period	Baseline Water Level (mODN)	2035 Water Level (mODN)	2065 Water Level (mODN)	NE Wave Height (m)	SE Wave Height (m)	S Wave Height (m)
1	75	2.48	2.65	2.95	4.63	5.13	6.95
2	75	2.82	2.99	3.32	4.12	4.44	6.14
3	75	3.18	3.36	3.59	3.15	3.70	4.80
1	100	2.56	2.73	2.95	4.66	5.16	7.01
2	100	2.92	3.09	3.32	3.99	4.54	5.96
3	100	3.21	3.39	3.62	3.17	3.72	4.84
1	200	2.56	2.73	2.95	4.73	5.23	7.15
2	200	2.99	3.16	3.39	4.05	4.60	6.04
3	200	3.29	3.47	3.70	3.24	3.79	4.93
1	1000	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
2	1000	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
3	1000	3.39	Not applicable	Not applicable	3.58	4.13	5.40

Table 1 - Joint Probability Water Level and Wave Height for Present Day

Table 2 below highlights the flood event scenarios that have been simulated for each of the locations considered within this report to demonstrate the predicted extent, depths and flood hazards.

Location	Flood Event Scenario Modelled
Torre Abbey, Torquay	Breach for 1 in 200 year return period
Preston Sands, Paignton	Breach for 1 in 200 year return period
Paignton Sands, Paignton	Breach for 1 in 200 year return period
Goodrington, Paignton	Breach for 1 in 200 year return period
Broadsands, Paignton	Breach for 1 in 200 year return period
Torquay to Livermead	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). Current 1 in 200 year undefended.
Preston to Goodrington	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). Current 1 in 200 year undefended.
Oddicombe Beach	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year)
Meadfoot	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year)
Broadsands	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). Current 1 in 200 year undefended.
Brixham harbour	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). Current 1 in 200 year undefended.

Location	Flood Event Scenario Modelled
Babbacombe beach	1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year)

Table 2 Flood event scenarios modelled at each major flooding location

The assumptions and limitations of the Royal Haskoning DHV study was as follows:

- It is assumed that the overtopping of the defence profiles used is consistent along the representative section. No consideration in the wave overtopping was taken into account for changing defence levels within each section.
- Small openings in the defence line, such as access steps and slipways, were assessed on a case by case basis, based on how this can be represented in a 5x5m model grid.
- The overtopping rates are based on average rates over 1000 waves.
- There is no allowance for surface water drains that may drain any overtopping water back out to sea. It has been assumed that any overtopping flow draining out is balanced by forced inflow though the defence during wave impact and high tides.
- Walls and other manmade obstructions other than coastal defences have not been included in the model. It is likely that these would have some effect on overland flows, however given the broader nature of this study it is considered impractical to include this local level of individual site detail.
- 2007 bathymetry data available from the Plymouth Coastal Observatory (CCO) was the latest available data for Torquay.
- The cill in Torquay Harbour was not included in the bathymetric data nor represented in the model.
- For those sites where a GIS technique was used for the flood extent modelling, the floodplain is contained locally and overtopped water is controlled by local topography, therefore the use of a TuFLOW model would not give reliable results nor is it suitable.

3.2.3 Surface water modelling

Surface water flood mapping has been produced for Torbay using one large hydraulic model of the bay. This modelling work was undertaken using Innovyze ICM Ultimate Version 37.0.174 (64 bit) December 2024 which includes 1d and 2d capabilities.
The latest 1m resolution lidar data was used to create a 2d mesh covering the whole of Torbay. This mesh has a finer resolution for the roads and buildings, and some modifications were made to account for flow paths (under passes, etc). Rainfall was applied to this mesh (with a reduction factor for runoff of 70%). Urban areas were identified, and a 13mm/hr infiltration rate was applied to these to account for the drainage system in line with Environment Agency guidance.

Buildings were imported from the Ordnance Survey Mastermap layer. These buildings were height adjusted based on the lidar value and following the Environment Agency's RoFSW methodology. The value used in the equation was adjusted to 0.150m based on discussions with the local Environment Agency team. This was to account for flood water entering the building when the threshold level was exceeded.

Roads were imported from the Ordnance Survey Mastermap layer. These roads were height adjusted (lowered) based on the lidar value to represent the kerb height.
Roughness values were applied to the land, buildings, and roads in line with the latest Environment Agency guidance.

FEH2022 rainfall was used with the areal reduction factor and seasonal correction factor set to 1. Return periods of 30, 100 and 1000 year were simulated for durations of 30, 60, 180 and 360 minutes.

Key inland culverts (2d culverts) and tidal culverts (1d) have been added to produce a more realistic flood representation. The mean high water spring tide level has been used and has been applied to the outfalls as a static level and modified for the various scenarios.
Present day and future scenario were simulated. The future scenarios were as follows:

- 2050's Central Allowance
- 2050's Upper Allowance
- 2070's Central Allowance
- 2070's Upper Allowance

Table 3 below shows the scenarios for the current day and with future climate change. Climate change allowances varied between 20 and 50 percent for these scenarios.

3.2.3.1 Scenario: Present Day

Return Period	Duration (mins)	Climate Change Allowance (%)
30	30	
30	60	
30	180	
30	360	
100	30	
100	60	
100	180	
100	360	
1000	30	
1000	60	
1000	180	
1000	360	

3.2.3.2 Scenario: 2050's Central Allowance (2060 MHWS)

Return Period	Duration (mins)	Climate Change Allowance (%)
30	30	20
30	60	20
30	180	20
30	360	20
100	30	25
100	60	25
100	180	25
100	360	25

3.2.3.3 Scenario: 2050's Upper Allowance (2060 MHWS)

Return Period	Duration (mins)	Climate Change Allowance (%)
30	30	35
30	60	35
30	180	35
30	360	35

Return Period	Duration (mins)	Climate Change Allowance (%)
100	30	45
100	60	45
100	180	45
100	360	45

3.2.3.4 2070's Central Allowance (2125 MHWS)

Return Period	Duration (mins)	Climate Change Allowance (%)
30	30	25
30	60	25
30	180	25
30	360	25
100	30	30
100	60	30
100	180	30
100	360	30

3.2.3.5 2070's Upper Allowance (2125 MHWS)

Return Period	Duration (mins)	Climate Change Allowance (%)
30	30	40
30	60	40
30	180	40
30	360	40
100	30	50
100	60	50
100	180	50
100	360	50

Tables 3 to 5: Surface Water Climate Change Scenarios

The surface water modelling assumptions/limitations are as follows:

- The lidar data used to set the building thresholds follows the same guidance that was used for the RoFSW maps "Updated Flood Map for Surface Water National Scale Surface Water Flood Mapping Methodology Final Report version 1.0 (May 2013). Further to a request from the Environment Agency the value was adjusted from 0.3m to 0.150m.
- Blocks of building were merged as they were formed of many polygons, and this could affect the level of joined properties i.e. terrace properties.
- A drainage rate of 13 mm/hr for urban areas. This was the figure was provided by the Environment Agency and is in line with the NaFRA2 modelling project.

- A drainage rate for rural areas of 20 mm/hr. This was the figure was provided by the Environment Agency
- A runoff value of 70% has been applied to the whole 2d zone to account for losses.
- The modelling was carried out at a catchment scale so should be not viewed at a property level.
- Only key culverts have been included to provide an interaction with the tide level and reduce unrealistic ponding.
- The tide is a static level hydrograph and does not vary with time. It is set at mean high water spring level for the various scenarios.
- No surface features i.e. walls have been added to the 2d zone.
- The flood maps include flood depths above 50mm.

Surface water flood risk should be interpreted in conjunction with fluvial, sewer and drainage mechanisms where interacting flood sources may influence site risk.

3.2.4 Groundwater

Overall ground water flooding within Torbay is not a major problem. However, it is known that it could be a problem in low lying coastal areas such as the Torquay harbour area, Paignton Town Centre, and Brixham. With predicted sea level rise this will increase ground water flooding. Groundwater can be an issue around the coastal and inland, particularly where there are basements. Groundwater re-emergence out of the landscape due to topography and geology can also occur. British Geological Survey produce Susceptibility to groundwater flooding data **Susceptibility to Groundwater Flooding | British Geological Survey (BGS)** which should be used as part of flood risk assessments.

3.2.5 Sewer

There is a risk of sewer flooding within Torbay and historically the towns have suffered flooding from the sewer system. South West Water are responsible for the sewer system and have various tanks and pumping stations that operate within the area. More information on sewer capacity can be found in **An assessment of Future Sewer Capacity in Torbay" (May 2023)**.   For more information on specific flood risk associated with their apparatus please contact South West Water.

3.3 Definition of Hazard Categories for Surface Water Flooding

Flood hazard is a function of the instantaneous flood depth and the velocity of the flood water and as a result the maximum flood hazard for a given location can be expressed at any stage of a flood event. Near the source of the flooding, where velocity is high, the highest hazards are likely to be identified at the time of peak velocity. Further away from the source the maximum hazard will depend on local factors affecting both the depth of flood waters and velocities at each location. At the very fringes of the flood event the maximum hazard occurs near the peak water depth towards the end of the simulation.

As the flood hazard is time and location dependant, a hazard calculation is performed on every output time step for all elements within the two dimensional hydraulic model. The maximum hazard value at all elements is recorded for each time step.

The flood hazard for each element is categorised as either low, medium, or high. The assigned hazard rating is determined by a relationship between flood water velocity and depth of flooding as illustrated in Figure 1 which has been reproduced from “Flood Risk Assessment Guidance for New Developments: Phase 2 FD2320 Technical Report 2, Table 13.1” published by Defra and Environment Agency in 2005.

The hazard rating expression based primarily on consideration to the direct risk of people exposed to floodwaters can be expressed as follows:

$$HR = d \times (v + n) + DF$$

Where,

HR = (flood) hazard rating

d = depth of flooding (m)

v = velocity of flooding (m/sec)

n = a constant of 0.5

DF = debris factor (for urban areas this is usually either 0 or 1 depending on the probability that debris will lead to a hazard)

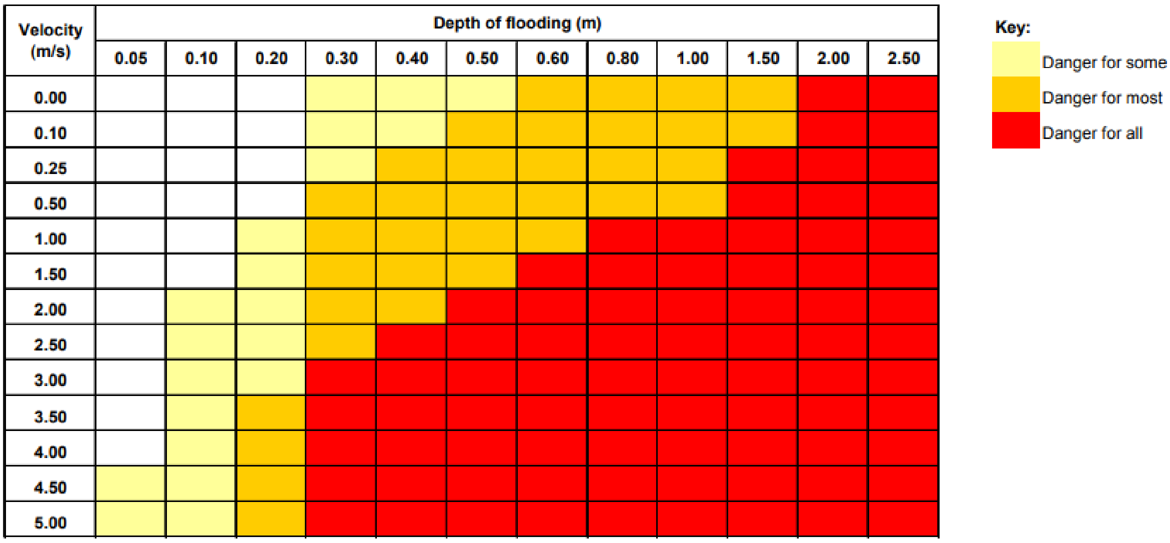

Figure 1 Hazard to People Classification using Hazard Rating (HR = d x (v + n) + DF)

The hazard maps indicate the hazard results based on depth and velocity from a particular event, be it fluvial, surface water, overtopping or a breach event. The hazard classifications do not indicate a change in flood probability.

When considering the hazard zones contained in this report for a breach analysis, it is important to remember, when using the hazard maps, that they represent the hazard arising from one or more specific breach locations. It should be noted that the hazard will vary spatially if the beach locations are in different locations.

Further issues with regards to breach failure that should be considered include the following:

- Not all possible breach locations have been considered as the modelling study had to be limited to those areas thought most likely to lead to significant flood risk.
- Breach width and depth has been based on Environment Agency guidance and therefore do not necessarily represent the actual dimensions of a breach at a given location.
- Breaches in different locations will result in different inundation extent and hence hazard zone.

3.4 Functional Floodplain (Flood Zone 3b) Modelling

The functional floodplain (Flood Zone 3b) has been produced using the EA's long term flood risk map data and using the high risk category (land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively) in conjunction with the historic flood records.

Functional floodplain performs an important role in storing and conveying floodwater and reducing flood risk elsewhere. The mapped extent of 3b should be regarded as a strategic planning tool. Whilst it provides an evidence based indication of land that may perform a floodplain function, it may not identify all areas contributing to flood storage, flood conveyance, floodplain connectivity or exceedance flow routing. Equally, the mapped extent may be refined through site-specific assessment where supported by robust evidence demonstrating that the strategic mapping does not adequately represent local flood behaviour.

The identification of functional floodplain has been informed by available flood risk evidence and hydraulic modelling. Whilst modelled flood extents form an important part of the evidence base, local flood mechanisms and hydraulic behaviour may also be relevant when considering floodplain function. These may include flood storage, flood conveyance, floodplain connectivity, ordinary watercourses, culverted systems, exceedance flow routes and the influence of flood risk management infrastructure.

The mapped extent should be regarded as a strategic planning tool and may not identify all areas contributing to floodplain function. Where supported by robust evidence proportionate to the scale and complexity of the flood risk, site-specific assessment may provide additional information regarding local flood behaviour and the role of land in storing, conveying or routing floodwater.

The functional floodplain maps for the following watercourses/rivers are included in Appendix D.

- Ilsham Valley ordinary watercourse
- Aller Brook main river
- River Fleet ordinary watercourse
- Torre Valley ordinary watercourse

- Cockington ordinary watercourse
- Hollicombe ordinary watercourse
- Occombe Valley main river
- Victoria main river
- Clennon Valley main river
- Yalberton main river
- Broadsands ordinary watercourse
- Churston main river
- Lupton ordinary watercourse
- Higher Brixham main river
- Galmpton main river
- Goodrington North watercourse

4 Results

4.1 Torquay Harbour – Coastal

The main flood risk to the area around Torquay Harbour is from tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Torquay Harbour from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Torquay Harbour area show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the Shoreline Management Plan the policy for the flood defences in this area is "Hold the Line" **Beacon Cove to Torre Abbey Sands (Torquay Harbour) 6B48 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, overtopping modelling has been carried out at Torquay inner harbour. The existing sea defence at this location consists of the harbour wall. Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth for the overtopping scenarios are presented in Appendix B. Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant. At the fringes of the flood water the maximum hazard occurs nearer the peak water depth towards the end of the storm event. Generally, there is a greater flood hazard closer to the breach location however the depth and velocity of the floodwaters around Torquay sea front have been classified as a high hazard resulting in danger for all, including the emergency services.

4.2 Torquay Town Centre – Flood Risk

The main flood risk for Torquay Town Centre is flooding (see Environment Agency flood risk maps) which emanates from the River Fleet/combined sewer system and surface water.

The River Fleet originally flowed from the Maidencombe area of Torquay through Hele, Lymington Road and through the town centre before discharging to coastal waters at Torquay harbour. As the town developed, increasing volume of sewage was discharged into the river and eventually downstream of Hele it was designated as a combined sewer which now discharges to Ilsham Valley pumping station from where flows are pumped to the sewage treatment works at Brokenbury. It should be noted that the River Fleet still discharges into the combined sewer system at Hele. During heavy rainfall events the drainage system through Torquay town centre has a history of flooding.

The Environment Agency Flood Zone applicable to the Torquay Town Centre area shows the effects of flooding from a 1 in 100 year storm event and as a result areas of the town centre are identified within Flood Zones 2 and 3.

The flood depth and hazard maps for the surface water flooding within the town centre are presented in Appendix C. As can be seen from the maps surface water flows down the road system towards the harbour. At various locations where buildings cross the path of the floodwater or ground levels rise ponding of water takes place. The most significant ponding of water takes place at the rear of the Town Hall, in Union Street outside WH Smiths and off Fleet Street. The depths of floodwater at these locations exceed 1.2m. In the remaining areas of the town centre depth of flooding is not excessive however due to the steepness of the topography velocities of floodwater are high.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Within Torquay town centre the flood hazard has been classified as either a high hazard resulting in danger for all, including the emergency services or medium hazard resulting in danger for most including the general public.

4.3 Torre Abbey – Coastal

The main flood risk to the area around Torre Abbey is from tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Torre Abbey from flood events, under normal conditions. The Environment Agency Flood Zones applicable to the Torre Abbey area of Torquay show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is “Hold the Line” **Torre Abbey Sands 6B49 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, breach modelling has been carried out at Torre Abbey. The location of the breach was chosen as coastal flooding has occurred at this location in the past. The existing sea defence at this location consists of a concrete sea defence wall and in order to provide the most conservative modelling results the breach width was set at 50m.
Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for both the breach and overtopping scenarios are presented in Appendix A. As can be seen from these maps floodwater from the breach area flows initially into Torre Abbey Meadow and Torquay Recreation Ground before flowing along the low lying roads around Torquay sea front. Due to the topography of the land, flooding from a breach at Torre Abbey or from overtopping will flow around Torquay sea front and result in flooding to properties around Torquay Harbour.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the breach or overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the breach or overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant.

Generally, there is a greater flood hazard closer to the breach location however the depth and velocity of the floodwaters around Torquay sea front have been classified as a high hazard resulting in danger for all, including the emergency services.

4.4 Preston – Coastal

The main flood risk to the area around Preston sea front is from tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Preston sea front from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Preston sea front area of Paignton show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is “Hold the Line” **Hollicombe Head to Roundham Head 6B55 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, breach modelling has been carried out at Preston sea front. The location of the breach was chosen as coastal flooding has occurred at this location in the past. The existing sea defence at this location consists of a concrete sea defence wall and in order to provide the most conservative modelling results the breach width was set at 50m.

Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for both the breach and overtopping scenarios are presented in Appendix B. As can be seen from these maps, floodwater from the breach area flows along the low lying roads surrounding the Preston sea front and promenade area of Paignton. Due to the topography of the land a breach at Preston sea front will result in flood water flowing along the Paignton sea front and eventually flooding to the low lying areas of Paignton town centre.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the breach or overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the breach or overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant.

Generally, there is a greater flood hazard closer to the breach location however the depth and velocity of the floodwaters around Preston and Paignton sea front have been classified as a high hazard resulting in danger for all, including the emergency services.
There is currently a coastal defence scheme being constructed at this location and the overtopping flood mapping will be updated once it is complete.

4.5 Occombe Valley – Flood Risk

The main flood risk for Occombe Valley area of Paignton is from fluvial flooding which emanates from the Occombe Valley main river system. The Occombe Valley main river flows from near the ring road in a south easterly direction before discharging to coastal waters at Preston sea front. Downstream of a flood storage area in Coombe Park the culverted watercourse bifurcates however the two culverts merge again under Preston Green immediately prior to discharging to coastal waters on Preston Sands. During heavy rainfall events this main river has a history of flooding.

The Environment Agency Flood Zone applicable to the Occombe Valley main river catchment area shows the effects of flooding from a 1 in 100 year storm event and as a result areas of the catchment are identified within Flood Zones 2 and 3.

The flood depth and hazard maps for the surface water flooding within the Occombe Valley catchment area are presented in Appendix C. At various locations where buildings or the railway cross the path of the floodwater or ground levels rise ponding of water takes place. The most significant ponding of water takes place upstream of where the railway embankment crosses the main river. The depth of floodwater at this location exceeds 1.2m. In the remaining areas of the catchment depth of flooding is not excessive however due to the steepness of the topography velocities of floodwater are high.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Within the Occombe Valley catchment area the flood hazard has predominantly been classified as a high hazard resulting in danger for all, including the emergency services.

4.6 Paignton Town Centre – Coastal

The main flood risk to the area around the low lying areas of Paignton town centre is as a result of tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area along the sea front at Paignton Esplanade from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Paignton town centre area of Paignton show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is "Hold the Line" **Hollicombe Head to Roundham Head 6B55 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, breach modelling has been carried out along Paignton Esplanade. The location of the breach was chosen as coastal flooding has occurred at this location in the past. The existing sea defence at this location consists of a concrete sea defence wall and in order to provide the most conservative modelling results the breach width was set at 50m. It should be noted that there is a new secondary coastal defence which is currently being constructed at

Paignton and Preston which is due be completed in 2027. The coastal flood maps do not currently include this new coastal defence.

Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for both the breach and overtopping scenarios are presented in Appendix B. As can be seen from these maps floodwater from the breach area flows across Paignton Green and enters the low lying areas of Paignton town centre via the existing road network. As the majority of this area is reclaimed land having a ground level below highest astronomical tide level, flooding will be experienced up to and beyond the main railway line which runs through the town centre. In addition to the low lying areas of Paignton town centre, as a result of the topography of the land, floodwater from the breach or overtopping of the sea defence at Paignton Esplanade will flow around the headland at Redcliffe and eventually flood the Preston Green area of Paignton.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the breach or overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the breach or overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant. At the fringes of the flood water the maximum hazard occurs nearer the peak water depth towards the end of the storm event.

Generally, there is a greater flood hazard closer to the breach location however in this location as a result of the low lying areas of Paignton town centre the depth of flooding experienced can be in excess of 1.5m. Therefore, due to the depth and velocity of the floodwaters around Paignton town centre the area has been classified as a high hazard resulting in danger for all, including the emergency services.

There is currently a coastal defence scheme being constructed at this location and the overtopping flood mapping will be updated once it is complete.

4.7 Paignton Town Centre – Flood Risk

The main flood risk for Paignton Town Centre is from fluvial flooding which emanates from the Victoria main river system. The Victoria main river lies within the low lying areas of Paignton town centre and discharges to coastal waters at two locations, namely, Paignton sands near the pier and through the wall at Paignton harbour. The majority of this river system is culverted with the only open sections being located in Victoria Park. The catchment serving this main river is totally urbanised with surface water sewers, highway drains and land drainage discharging directly to the culverted and open sections of the river system. In order to reduce the risk of flooding from this river, within Paignton town centre, a flood alleviation scheme was completed in 2007. This scheme included the construction of a pumping station under Paignton Green which allows the main river to discharge to coastal waters against all tidal conditions.

The Environment Agency Flood Zone maps applicable to the Paignton Town Centre area assume no flood defences exist (i.e. the pumping station has failed) and shows the effects of flooding from a 1 in 100 year storm event. As a result, many areas of Paignton town centre are identified within Flood Zones 2 and 3.

The flood depth and hazard maps for the surface water flooding within the town centre are presented in Appendix C. Floodwater flows through the road network and across park land towards the sea front. At various locations where buildings or the railway line cross the path of the floodwater or ground levels rise such as at Paignton Green ponding of water takes place. The most significant ponding of water takes place at the railway embankments crossing Victoria Park and Station Lane together with ponding in Queens Park and the road network around Esplanade Road due to the rise in ground levels at Paignton Green. The depths of floodwater at these locations exceed 1.0m. In the remaining areas of the town centre depth of flooding varies however, due to the relatively flat nature of the topography velocities of floodwater are low.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Within Paignton town centre the flood hazard has been classified as either a high hazard resulting in danger for all, including the emergency services or medium hazard resulting in danger for most including the general public.

4.8 Goodrington – Coastal

The main flood risk to the area around Young’s Park area of Goodrington is as a result of tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Goodrington sea front from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Goodrington and Young’s Park area of Paignton show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is “Hold the Line” **Goodrington Sands 6B56 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, breach modelling has been carried out at Young’s Park area of Goodrington. The location of the breach was chosen as coastal flooding has occurred at this location in the past. The existing sea defence at this location consists of a concrete sea defence wall faced with limestone blocks and in order to provide the most conservative modelling results the breach width was set at 50m.

Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for both the breach and overtopping scenarios are presented in Appendix B. As can be seen from these maps floodwater from the breach area flows into the low lying area of Young’s Park where initially it is contained by the railway embankment to the rear of the park which acts as a dam. However, as the water levels rise floodwater overtops the railway line and flooding is experienced in Great Western Close and Dartmouth Road. It is possible for the floodwater from a breach or overtopping during sufficiently high tidal conditions to flow along the railway line and Dartmouth Road and as a result flooding can be experienced in the low lying areas of Paignton town centre.
Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the breach or overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the breach or

overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant.

Generally, there is a greater flood hazard closer to the breach location however the depth and velocity of the floodwaters around the Young’s Park area of Goodrington have been classified as either a high hazard resulting in danger for all, including the emergency services or a medium risk resulting in a danger for most including the general public.

4.9 Clennon Valley – Flood Risk

The main flood risk for the Clennon Valley main river catchment area of Paignton is from fluvial flooding which emanates from the Clennon Valley main river system. The Clennon Valley main river rises upstream of the Great Parks area of Paignton from where it flows through Paignton Zoo and Clennon Valley before discharging to coastal waters at Goodrington sands. The initial section of the main river is rural however a new flood storage lagoon was constructed in the Great Parks area during the late 1990’s in order to receive surface water discharges from this new housing development. Downstream of Great Parks there are numerous other housing developments that have been constructed over the years that allow surface water runoff to be connected directly into the main river system. As the main river passes through Paignton Zoo and Clennon Valley nature reserve numerous ponds have been constructed along the line of the main river. The outfall for the main river comprises a culvert laid across Goodrington sands and discharging below high water spring tidal levels. As a result, the hydraulic capacity of this outfall is severely reduced during high tides. During heavy rainfall events the drainage system through the Clennon Valley main river catchment area has a history of flooding.

The Environment Agency Flood Zone applicable to the Clennon Valley main river catchment area shows the effects of flooding from a 1 in 100 year storm event and as a result areas of the catchment are identified within Flood Zones 2 and 3.

The flood depth and hazard maps for the surface water flooding within the Clennon Valley catchment area are presented in Appendix A. Floodwater flows through the road network and public open spaces including Kings Ash Road and Totnes Road, together with a number of car parks towards the sea front. At various locations where buildings, roads and the railway embankment cross the path of the floodwater or ground levels rise ponding of water takes place. The most significant ponding of water takes place at Clennon Valley playing fields and leisure centre car park, Dartmouth Road, and Quay West car park. The depths of floodwater at these locations exceed 1.2m. In the remaining areas of the Clennon Valley catchment area depth of flooding is not excessive however due to the steepness of the topography velocities of floodwater are high.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Within the Clennon Valley main river catchment area, the flood hazard has been classified as either a high hazard resulting in danger for all, including the emergency services or medium hazard resulting in danger for most including the general public.

4.10 Broadsands – Coastal

The main flood risk to the area around Broadsands sea front is from tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Broadsands sea front from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Broadsands area of Paignton show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is “Hold the Line” **Broadsands 6B58 | Shoreline Management Plans**.

In order to better understand the risk of flooding posed by the English Channel, breach modelling has been carried out at Broadsands sea front. The location of the breach was chosen as coastal flooding has occurred at this location in the past. The existing sea defence at this location consists of a concrete sea defence wall and in order to provide the most conservative modelling results the breach width was set at 50m.
Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for both the breach and overtopping scenarios are presented in Appendix B. As can be seen from these maps, floodwater from the breach area flows into the low lying areas of the Broadsands valley resulting in flooding to amenities, car parks, farmland, and a number of residential properties.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the breach or overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the breach or overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant. At the fringes of the flood water the maximum hazard occurs nearer the peak water depth towards the end of the storm event.

Generally, there is a greater flood hazard closer to the breach location however the depth and velocity of the floodwaters around Broadsands sea front have been classified as a high hazard resulting in danger for all, including the emergency services.

4.11 Brixham Town Centre – Coastal

The main flood risk to the area around Brixham town centre and harbour area is as a result of tidal flooding from the English Channel. However, this risk is residual due to the presence of flood management structures which protect the area around Brixham harbour from flood events, under normal conditions.

The Environment Agency Flood Zones applicable to the Brixham town centre and harbour areas show the effect of extreme tidal flooding should there be no flood defences in place. However, it is noted that within the South Devon and Dorset Shoreline Management Plan the policy for the flood defences in this area is “Hold the Line” **Churston Cove (East) to Shoalstone Point 6B60 | Shoreline Management Plans**.

Overtopping of the sea defences was modelled for the 1 in 10, 20, 50, 75, 100, 200, 1000 return periods for current conditions and with predictions of sea level rise for 20 and 50 years in the future (other than 1000 year). The undefended 1 in 200 year scenario was also modelled.

The flood depth and hazard maps for the overtopping scenario is presented in Appendix B. As can be seen from these maps, floodwater from the overtopping locations flows into the low lying area of Brixham town centre up to and beyond the Town Hall at Bolton Cross and to the low lying areas of land surrounding the harbour walls. In addition, as a result of the topography of Brixham floodwater from overtopping of the harbour wall, will flow around the headland near Brixham fish quay and flooding will be experienced in the low lying areas of Oxen Cove and Freshwater car parks.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Near the overtopping location where velocities are high the highest hazard is likely to occur at the time of peak velocity. Further from the overtopping location the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant. At the fringes of the flood water the maximum hazard occurs nearer the peak water depth towards the end of the storm event.

Generally, there is a greater flood hazard closer to the overtopping location however the depth and velocity of the floodwaters around Brixham town centre and harbour area have been classified as a high hazard resulting in danger for all, including the emergency services.

4.12 Brixham Town Centre – Flood Risk

The main flood risk for Brixham Town Centre is from fluvial flooding which emanates from the Higher Brixham main river and Lupton watercourse systems. The Higher Brixham main river originates near Kennels Road at Hillhead and flows through Higher Brixham to Bolton Cross and then through the low lying areas of Brixham town centre before discharging to coastal waters under the Brixham fish quay. The upstream section of this river is rural and fed by surface water run-off from farm fields however, downstream of Rowan Way the catchment becomes urbanised and is fed by surface water run-off from housing developments. In the downstream section approximately 60% of the river length is culverted.

The Lupton watercourse also originates near Kennels Road and flows alongside New Road then through the low lying areas of Brixham town centre before discharging to coastal waters at Brixham inner harbour near the Prince of Orange statue. As with the Higher Brixham main river the initial length of this watercourse is rural, being fed by surface water run-off from fields and then downstream of Monksbridge the watercourse becomes urbanised, being fed by surface water sewers and highway drains. Both of these systems have a history of flooding during heavy rainfall events.

The Environment Agency Flood Zone applicable to the Brixham Town Centre area shows the effects of flooding from a 1 in 100 year storm event and as a result areas of the town centre are identified within Flood Zones 2 and 3.

The flood depth and hazard maps for the surface water flooding within Brixham town centre are presented in Appendix C. The floodwater flows along the road network towards the harbour. At various locations where buildings cross the path of the floodwater or ground levels rise ponding of water takes place. The most significant ponding of water takes place within the low lying area of Brixham town centre surface car park, where flood depths exceed 1.2m. In the remaining areas of the town centre depth of flooding is not excessive however due to the steepness of the topography velocities of floodwater are high.

Flood hazard can be expressed as a combination of flood depth and velocity. Therefore, the maximum flood hazard for a given location could be experienced at any stage of the flooding event. Further from the source of the flooding the maximum hazard will depend on local factors affecting both the depth of floodwaters and velocities at each instant. At the fringes of the flood water the maximum hazard occurs nearer the peak water depth towards the end of the storm event.

Within Brixham town centre the flood hazard has been classified as either a high hazard resulting in danger for all, including the emergency services or medium hazard resulting in danger for most including the general public.

5 Risk based approach to flood risk assessment

Where developments are proposed in flood risk areas the developers must employ a risk based approach as outlined in the National Planning Policy Framework in order to show that the risk of flooding has been carefully considered and where necessary mitigation has been proposed. The risk based approach is outlined below:

a. Direct development to the lowest flood risk areas

The NPPF requires a sequential approach, meaning development should be steered to areas with the lowest probability of flooding first. This includes all sources: rivers, sea, surface water, groundwater, drainage, reservoirs, and artificial sources.

b. Use of Sequential and Exception Tests

Sequential Test: Ensures reasonable alternative sites in lower-risk areas are considered before allowing development in higher-risk zones.

Exception Test: Applied only when development in higher-risk areas is necessary and must demonstrate:

1. wider sustainability benefits, and
2. development can be made safe for its lifetime without increasing flood risk elsewhere.

c. All sources of flooding must be assessed equally

All flooding sources are equally important.

d. Climate change assessed

Developers and authorities must assess future as well as present flood risk, incorporating climate change allowances.

Under the NPPF, plan-makers are expected to take a risk-based approach to flood risk. This includes assessing all sources of flood risk and applying the Sequential and, where necessary, Exception Tests when allocating land. Plans should take account of climate change, be informed by Strategic Flood Risk Assessments and advice from relevant authorities, and include policies to ensure that development is safe for its lifetime without increasing flood risk elsewhere.

5.1 Site Specific Flood Risk Assessment Guidance

The Torbay Council SFRA Level 1 and 2 together provide a comprehensive collation of existing flood risk information within the Borough. The Level 2 derives new information on the potential risks and hazards from tidal sources. However, the scope of these documents is strategic in nature and so it is imperative that site specific flood risk assessments are produced by those proposing development.

It is possible that flood risks exist within the Borough that have not been highlighted in either the Level 1 or 2 SFRAs either because the information has not existed or due to other development factors. As a result, site specific flood risk assessments are required to assess the flood risk posed to proposed developments and to ensure that where necessary and appropriate suitable mitigation measures are included in the development. They should, however, use information from the SFRA, where this is helpful or strengthens the assessment.

Torbay Council require a flood risk assessment to inform both local sequential testing and site specific exception tests, rather than relying solely on the information presented within the Level 1 and 2 SFRAs.

This section presents the recommendations for site specific risk assessments prepared for submission with planning applications in the Torbay Council administrative area.
Site specific flood risk assessments should assess all relevant flood mechanisms, including residual flood risk, culvert blockage, drainage exceedance, flood hazard, rapid inundation, access and egress, interactions between multiple sources of flooding, impacts on flood storage and conveyance and climate change resilience where relevant to the proposed development.

Further details for producing a site specific flood risk assessment and what to include can be found on the government website **Flood risk assessments: applying for planning permission - GOV.UK** and Torbay Councils website **https://www.torbay.gov.uk/planning-and-building-control/apply-for-planning-permission/make-your-plans-and-documents/flood-risk-assessments/**
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5.2 Requirement for a Flood Risk Assessment

As Torbay has been classified as a critical drainage area all developments must include a site specific flood risk assessment in support of their planning application. The complexity of the site specific flood risk assessment will depend on the level of flood risk from all sources and the vulnerability of the development or receptors.

5.3 Cumulative impact

Cumulative impact should be considered in Torbay. Flooding from all the sources of flooding considered in this report (fluvial, pluvial, surface water, groundwater, coastal overtopping and breach) have been included so this can be investigated within site specific flood risk assessments.

Each development site in the local plan should be assessed for cumulative impacts. Developers should work with Torbay Council's Lead Local Flood Authority, the Environment Agency and LPA to deliver flood risk improvements at an early stage of the development.

Within the site specific flood risk assessment for developments, cumulative effects of peak flow rates and runoff volumes should be assessed. This should include how impacts may influence overall peak flows, flood duration, and the timing of flood peaks. Torbay suffers from urban creep and the loss of permeable surfaces, particularly with the creation/extensions of driveways and small household extensions under permitted development. To reduce the cumulative impact of development, the Suds National Standards **National Standards For Sustainable Drainage Systems** and the **Torbay Council Suds Design Guide** should be strictly followed.

The Critical Drainage Area is established to mitigate downstream flooding by managing the cumulative effects of surface water runoff from multiple development sites within sensitive catchment areas.

Cumulative assessment should consider the potential for development to contribute to incremental reductions in flood storage, obstruction of flood conveyance routes, increases in runoff, pressure on drainage infrastructure or worsening of residual flood risk. Where relevant, applicants should demonstrate that cumulative impacts on flood risk have been appropriately considered.

5.4 Natural Flood Risk Management

Natural Flood Risk Management (NFM) – also called nature-based solutions or working with natural processes – reduces flood and coastal erosion risk by restoring natural features of rivers, floodplains, and coasts. These approaches slow and store water in the landscape, helping to lower peak flows and give communities more time to respond during flood events.

The Environment Agency's *Working With Natural Processes* directory highlights techniques such as woodland planting, land management changes, leaky dams, and peatland restoration.

Examples of NFM include:

- Planting trees and hedgerows
- Increasing vegetation and soil cover
- Creating water storage areas
- Installing leaky barriers
- Restoring wetlands, salt marshes and peat bogs

NFM should be considered as part of an integrated catchment-based approach to managing flood risk. Where NFM measures are proposed, applicants should have regard to the latest evidence and guidance.

Whilst NFM can provide flood risk reduction and wider environmental benefits, the effectiveness of measures depends upon their type, location, scale, deliverability and long-term maintenance. Benefits should not be assumed without appropriate evidence.

Where NFM is relied upon to support a development proposal, applicants should demonstrate the anticipated flood risk benefits, the catchment area influenced, the deliverability of the measures, arrangements for long-term management and maintenance, and how the benefits will be secured for the lifetime of the development.
NFM should not generally be relied upon as the sole measure to offset floodplain storage loss, justify changes to functional floodplain designation, or demonstrate that development will be safe for its lifetime unless supported by robust evidence and assessment.

5.5 Development affecting Functional Floodplain (Flood zone 3b)

Where development proposals involve the alteration, diversion or reconfiguration of flood flow routes, flood storage areas, exceedance pathways, conveyance corridors or other areas contributing to floodplain function, applicants should demonstrate through appropriate assessment that floodplain function will be maintained or enhanced and that the proposals will not:

- Increase flood risk elsewhere
- Increase flood hazard

- Transfer flood risk to neighbouring land
- Reduce flood storage capacity
- Obstruct flood conveyance routes
- Adversely affect exceedance flow pathways
- Adversely affect the operation of the wider drainage or flood risk management system

Development proposals should be considered in accordance with national planning policy and the applicable flood risk vulnerability classification.

5.6 Residual Risk & Safe Access

As part of the site specific flood risk assessment for development sites the developer must consider the following:

- Ensure developments remain safe if defences fail or are overtopped
- Ensure developments remain safe if drainage systems become blocked or fail
- Engage emergency planners early
- Provide "places of safety", adhere to floor level requirements, and provide suitable escape routes

Residual flood risk may arise from mechanisms that are not fully represented within strategic flood mapping, including infrastructure blockage, structural failure, culvert surcharge, exceedance flow routes, overtopping, defence failure and interactions between multiple sources of flooding. Where relevant, site-specific flood risk assessments should consider the potential consequences of these mechanisms and demonstrate that development will remain safe for its lifetime without increasing flood risk elsewhere.

6 Policy Recommendations

National and local policies have been reviewed against the local flood risk issues.

The South Devon Catchment Flood Management Plan (CFMP) provides a summary of the flood risk management policies that have been set out by the Environment Agency. The strategies suggested below comply with these aspirations and if integrated will aid to strengthen the position of Torbay Council.

From these policies the following recommendations are made around which Torbay Council may wish to form specific policies within their Development Plan. Integration of these suggested policy considerations into the Development Plan should ensure that the objectives and aspirations of the Environment Agency and national policy are met whilst strengthening the position of Torbay Council with regard to Flood Risk.

6.1 Development Control

- If development is to be constructed with less vulnerable uses on the ground level, agreements need to be in place to prevent future alteration of these areas to more vulnerable uses without further study into flood risk.
- Single storey residential developments should not be considered in flood risk areas as they offer no opportunity for safe refuge areas on upper floors.
- Where a development is applying for a change of use, flood evacuation plans should be developed through liaison with the emergency services. This accounts for changes from lower to higher vulnerability classes and should be delivered as part of the site specific flood risk assessment.
- Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.
- For surface water drainage the developer must comply with the requirements of **Torbay Council Suds Design Guide** and **National Standards For Sustainable Drainage Systems**
- The Council ensures that proposed developments can be accommodated by the existing drainage infrastructure provision. Where a development cannot be met by current resources, ensure that the phasing of the development is in tandem with infrastructure investment.
- Where uncertainty exists regarding flood behaviour, hazard or residual mechanisms, a precautionary approach should be adopted when considering development suitability
- All development must comply with the policies included in the Local Plan.

6.2 Flood Defence

- The SFRA process has highlighted the importance of flood defences throughout the Torbay Council area. Future policy should seek to address how these defences are to be maintained to ensure that they are maintained to the current high level of protection. The presence of flood defences should not be assumed to remove flood risk. Residual risks associated with overtopping, exceedance, breach or infrastructure failure should remain material to development decisions.

- Review the condition of the existing local defences, the dependence of additional local development on them for flood mitigation and where necessary the Council should seek to maintain and or improve defences if necessary.

- Where necessary and achievable, and through liaison with the Environment Agency, adopt a policy for routine maintenance of all main rivers and watercourses ensuring that they are clear of debris that could affect flood flow conveyance.

6.3 Flood Mitigation

- Avoidance of flood risk through appropriate site selection and layout should remain the preferred approach, with engineered mitigation considered only where development suitability has first been established.

- Where possible, mitigate flood risk from developments through development of flood storage schemes which will also provide amenity benefit.

- Within flood risk assessments, groundwater flooding should be investigated in detail, and the Council should ensure that new developments in known groundwater flood risk areas undertake a site investigation to determine the risks from groundwater flooding and incorporate mitigation measures into the design of any buildings to prevent flood damage from this source.

- Within flood risk assessments surface water flooding should be investigated in detail, and comprehensive surface water run-off calculations undertaken.

- Require all flood risk assessments and sustainable drainage design to consider the impacts of climate change for the lifetime of the development at the site and downstream.

- Opportunities to use Natural Flood Risk Management and Working with Natural Processes should be considered when considering any development.

6.4 Environment

- Consider the potential benefits an appropriately designed sustainable drainage system could have on the biodiversity, amenity value, water quality and resource value of a development and/or surrounding area in line with the National Suds Standards.

- Consider the vulnerability and importance of local ecological resources when determining the suitability of drainage strategies/sustainable drainage systems.

- Opportunities to use Natural Flood Risk Management and Working with Natural Processes should be considered when considering any development.

- Development can affect water quality as changes upstream can influence conditions downstream. New proposals must assess the quality of water discharged from sites and its potential impact on receiving waterbodies. Future development should ensure no deterioration in water quality. Where impacts are identified, they must be considered against WFD status requirements, and opportunities to enhance watercourse condition should be taken.

- Protection and restoration of open watercourses, natural flood storage areas and flood conveyance corridors should be supported as part of long term flood resilience and sustainable place making.