
Tendring District Council

Harwich Strategic Flood Risk Assessment

Final Level 2 Report
August 2008



Prepared for



Tendring
District Council

Revision Schedule

Harwich Level 2 Strategic Flood Risk Assessment Final Report

Rev	Date	Details	Prepared by	Reviewed by	Approved by
1	18 th Aug 2008	Final	Tom Edwards Flood Risk Consultant	Jon Robinson Associate Director	Jon Robinson Associate Director
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1 Introduction

1.1 Overview

Scott Wilson Ltd was commissioned to undertake the Harwich Strategic Flood Risk Assessment (SFRA) for Tendring District Council (TDC). This Level 2 SFRA forms part of the evidence base for the Local Development Framework in line with the requirements of Planning Policy Statement 25: Development and Flood Risk (PPS25).

The Harwich Level 1 SFRA was completed in April 2008 and provides a strategic overview of the potential sources of flooding throughout Harwich. The information presented within the Level 1 report forms the evidence base for undertaking the Sequential Test within the Harwich area. It is understood that TDC are currently commissioning a study to consider the flood risks throughout their administrative area, which will be used in conjunction with the Jaywick Flood Study and the Harwich SFRA to complete a district wide Sequential Test.

This Level 2 SFRA therefore considers potential development areas, some of which have been allocated in the current Tendring Local Plan, which was adopted in December 2007. One of the specific areas is the Peninsula, which lies within Harwich 'Old Town' which has been designated as an urban regeneration area within the current Tendring Local Plan. A Master Plan has been developed identifying certain areas and sites for redevelopment. The area has been identified as a growth node and significant government funding has been allocated to support development in the area.

This study presents the results of an extensive tidal and fluvial modelling and mapping exercise, which has considered the residual flood risk from both breach and overtopping of existing defences from tidal flooding and failure of the Ramsey River pumping station. The modelling methodology and flood mapping showing the residual risk from tidal and fluvial sources are described in the Level 1 SFRA.

1.2 Study Area

The potential development areas which have been identified for further investigation by TDC are listed below and illustrated within Figure A1.

- Refinery
- A120 Corridor
- Peninsula
- Dovercourt
- Low Road

1.3 Aim of Level 2 SFRA

The aim of this study is to provide supplementary information to the Level 1 SFRA. To inform on specific tidal and fluvial flood risk issues and the suitability for development of potential sites with known flooding problems, as identified in the Level 1 SFRA.

This report discusses the key results from the modelled residual flood risk at the potential development sites in terms of flood depth, hazard and safe access and egress, for a range of scenarios, these are:

Fluvial

- Ramsey River pumping station failure scenario during the current 1 in 100 year fluvial event;
- Ramsey River pumping station failure scenario during the future 1 in 100 year fluvial event accounting for climate change (+CC).

Tidal

- Breach scenario for the 1 in 200 year tidal event;
- Breach and overtopping scenario for the 1 in 200 year tidal event accounting for climate change (+CC);
- Breach scenario for the 1 in 1000 year tidal event;
- Breach and overtopping scenario for the 1 in 1000 year tidal event accounting for climate change (+CC).

This report concludes with a short summary of each site providing an overview of the residual flood risk experienced from each modelled scenario.

1.4 Level 2 SFRA Objectives

The aims of this Level 2 SFRA will be achieved through the following objectives;

- Identify the depth of flooding in each development area;
- Indicate the flood hazard based on depth and velocity in each development area;
- Advise on appropriate development vulnerability based on the Sequential Test;
- Consider whether application of the Exception Test is likely to be required;
- Advise on potential safe access and egress routes from each development area;
- Consider the safety of people and property.

2 Flood Sources

A full description of potential flood sources throughout the study area is provided in the Level 1 SFRA report, however a brief summary of the key details is set out below.

2.1 Tidal – North Sea / Tidal Stour Estuary

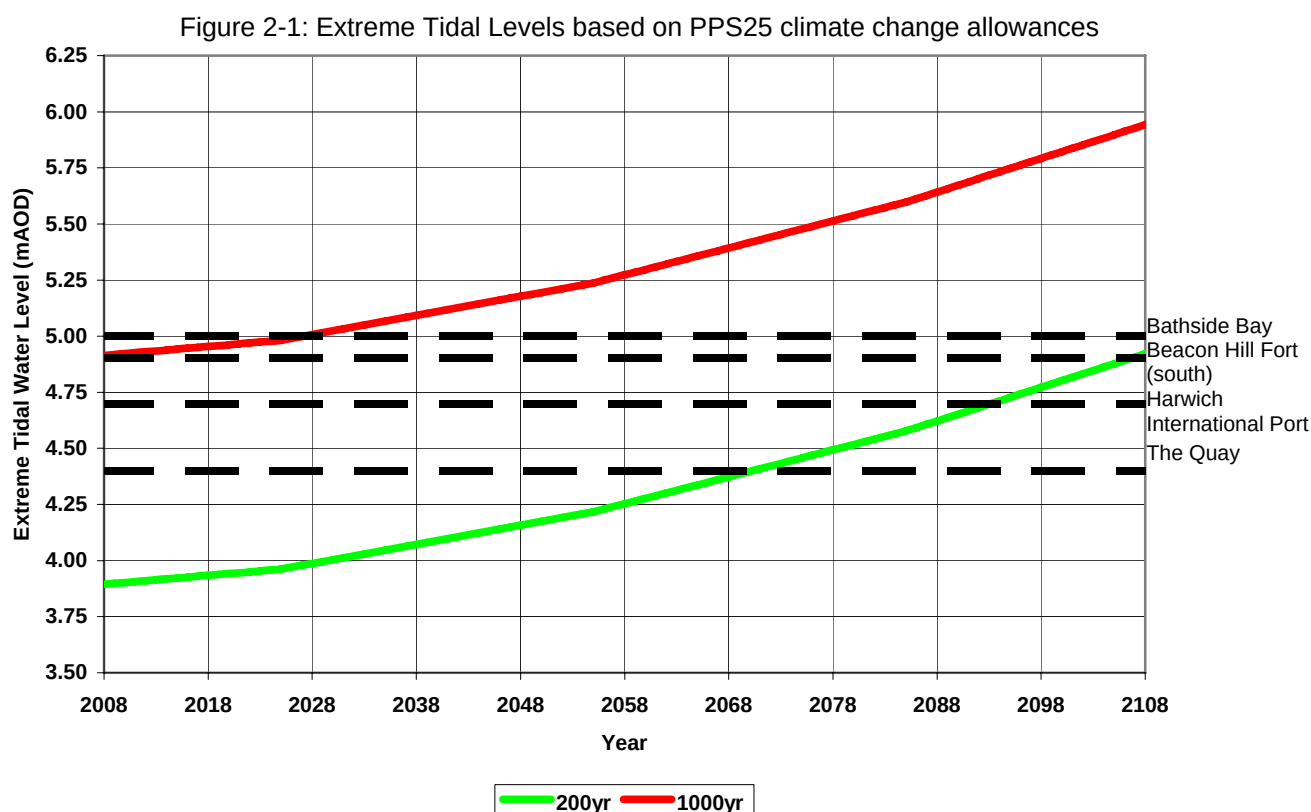
Harwich is protected by tidal flood defences situated along the coastline as shown within Figure 5, Level 1 SFRA. The defences typically consist of raised concrete or masonry walls, often fronted or topped by stepped revetments or curved wave return walls. A former refuse tip is located on the seaward side of the Environment Agency flood embankment at the southern extent of the Dovercourt frontage which is protected by a “clay embankment overlaid with open stone asphalt” (TDC Sea Defence Survey, October 2006).

Flood Defences

Standard of Protection

The existing defences provide protection from a 1 in 200 year tidal flood event, therefore the standard of protection is currently 1 in 200 years. Figure 2-1 below shows the predicted change in extreme tidal levels based on PPS25 allowances, alongside the crest levels of existing defences.

Figure 2-1 confirms that the defences currently provide a 1 in 200 year standard of protection with approximately 0.5m freeboard between the lowest defence crests along The Quay and the present day 1 in 200 year tidal level. However as sea levels are predicted to rise due to climate change and isostatic rebound this freeboard will continue to reduce over time.



Based on PPS25 climate change allowances the existing defences along The Quay will be overtopped by a 1 in 200 year tidal event in the year 2070. The 1 in 1000 year event in 2070 would overtop these defences by approximately 1m depth of water. Additional flood risk management measures will therefore be required at some time in the future in order to maintain the existing standard of protection.

Defence Condition

The tidal flood defences throughout Harwich are owned and maintained by several bodies including the Environment Agency, Tendring District Council and private tenants. The Environment Agency and/or the private tenants have not provided any information regarding the existing condition of the defences. However it is understood that the Environment Agency carry out bi-annual walkover inspections to assess condition and identify maintenance requirements.

Tendring District Council also inspects the defences and records the results in a defences database, which was last updated in October 2006. The database includes a description of the flood defence structures and a condition summary to inform prioritisation of maintenance activities.

The October 2006 survey identified that the defences within the study area were typically in 'Fair' to 'Good' condition, with the exception of the Beacon Hill Fort area where the condition is identified as 'Poor' in some areas. The main problems in this area appear to be poor condition of masonry walls, toe protection exposure, concrete damage and lack of joint sealant.

It should be noted that high ground is located to the rear of the coastline in the vicinity of Beacon Hill, which is classified as Flood Zone 1 (low risk) due to its elevated nature. However should the existing defences be allowed to degrade significantly this could allow erosion of the high ground situated behind the defences.

Likely Future Policy

Harwich lies within the 'Harwich to Canvey Island Shoreline Management Plan (SMP) Subcell 3d' and it is understood that the current plan was prepared during the 'first round' of SMPs and is awaiting review. It is also understood that the recommended policy in the current SMP is to hold the existing line of flood defence.

The Environment Agency has confirmed that the revised SMP will encompass appropriate estuary elements of the coast and as such will incorporate the Stour & Orwell Essex Estuarine Strategies (EES). The revised Essex Shoreline Management Plan is programmed to commence in summer 2008 and is likely to take in excess of one year to complete.

Tendring District Council's current Coast Protection Strategy was formulated based on the policies set out within the current SMP. The strategy confirms that the preferred coastal defence policy within the study area is to hold the existing line of defence. The strategy outlines that the Coastal Defence Action Plan for the next five years throughout the study area includes:

- Monitor and maintain the existing defences;
- Consider the need for refurbishment of defences and prioritise within the forward work programme of special maintenance works.

The current policies set out within the SMP and the Coastal Protection Strategy are to hold the existing defence line through monitoring and maintenance procedures. Given the current population that is served by the defences in Harwich it could be anticipated that policies will be maintained to protect the existing population.

The SMP is currently being revised and it is anticipated that it will be finalised in 2010. The future policies formulated in the revised SMP should be reviewed to determine the potential impacts on the conclusions on both the Level 1 and this Level 2 SFRA.

Tidal Defence Breach

Flood defence breaches can potentially occur where raised defences have been formed, with crest levels raised above adjacent land levels. A breach of the defence can occur due to failure of this raised structure. The probability of a breach occurring is greater during high water level events in particular during storm surge events when high tides and large waves combine.

Hydrodynamic modelling was carried out for the Level 1 SFRA to provide additional information regarding the consequences throughout the study area should a breach in the defences occur at the same time as an extreme tidal flood event. Three independent flood cells were identified based on potential breaches at the following locations:

- HAR01 – Harwich International Port;
- HAR02 – Harwich Peninsula; and,
- HAR03 – Dovercourt.

The modelling simulates the potential inundation that would occur during a breach and a 1 in 200 and 1 in 1000 year tidal flood event. Full details of the modelling methodology are contained within Appendix D, Level 1 SFRA. The tidal flood levels were based on present day levels, therefore no overtopping of flood defences occurred, therefore water can only enter and leave the flood cell through the breach location.

Tidal Defence Overtopping

The three breach models have also been used to simulate the potential inundation based on tidal levels including PPS25 climate change allowances. The modelling considered a climate change horizon of 100 years which gives a 1.02m increase in sea level for 2108, based on PPS25 allowances for the East of England.

The existing flood defence levels have not been modified within the hydrodynamic models therefore the climate change model runs simulate overtopping of the defences in addition to a breach at each specific location. The climate change modelling therefore includes significant inundation behind the defences as water is able to enter the flood cell via overtopping of significant defence lengths in addition to entering via the breach location.

The increased head of water assumed due to sea level rise has the affect of significantly increasing the inflow of water through the breach location. When this is combined with overtopping of the defences the result is widespread inundation of the land behind the defences, often resulting in deep fast flowing water with a significant flood hazard.

Although the current policy is to hold the line of the existing defences there can be no guarantee that this will be carried forward into the future therefore this has not been considered in the modelling. However should the existing defences be raised to prevent future overtopping, the flooded area will be less extensive than the climate change modelling predicts.

2.2 Ramsey River – Fluvial

The Ramsey River meanders north east through the north of the study area, its wide low lying floodplain contained by the railway line and the A120 road. The Ramsey is a pumped catchment; since construction of the railway line a pumping station has discharged the river over the embankment into the tidal Stour Estuary / North Sea.

A broad-scale hydraulic model has been constructed to simulate failure of the pumping station and determine whether the floodplain storage volume is sufficient to avoid flooding of homes and properties. Model simulations were carried out to determine Flood Zone 3b (functional floodplain), Flood Zone 3a (100 year flood event), with and without climate change. The modelled flood outlines therefore define residual flood risk areas during a pumping failure scenario.

Due to its location in the north of the study area the Ramsey River is only a potential flood source for the Refinery and the A120 corridor.

2.3 Surface Water / Overland Flow

Areas of steep ground can generate significant volumes of run-off during rainfall events which when combined with impermeable steep topography can lead to overland flow. This flood source can be exacerbated when drainage systems become blocked or overwhelmed when the flow of water will follow the topography and pond in low lying area.

A digital terrain model (DTM) of the study area has been created to highlight low areas of topography. The DTM has also been analysed to highlight areas of steep ground, which can be viewed in conjunction to determine likely flow paths for overland flow.

3 The Sequential Test

3.1 Background

The Level 1 SFRA provides details of how to undertake the PPS25 Sequential Test within section 7. The Sequential Test is a means of applying a precautionary principle to strategic land allocations, with the aim of locating development in areas with the lowest possible risk of flooding.

As this study only covers the Harwich area and not the entire district, Tendring District Council has not currently undertaken a Sequential Test. It is understood that a district-wide SFRA is currently being progressed which will incorporate the Jaywick and Harwich SFRA work, and allow Tendring DC to complete a district wide Sequential Test.

The Sequential Test considers the vulnerability of the type of development, which is set out in PPS25 Table D2, reproduced as Table 3-1 below.

Table 3-1: Flood Risk Vulnerability Classification (from PPS25, Appendix D, Table D2)

ESSENTIAL INFRASTRUCTURE	Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
HIGHLY VULNERABLE	- Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use. - Installations requiring hazardous substances consent.
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	- Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. - Land and buildings used for agriculture and forestry. - Waste treatment (except landfill and hazardous waste facilities). - Minerals working and processing (except for sand and gravel working). - Water treatment plants. - Sewage treatment plants (if adequate pollution control measures are in place).

WATER-COMPATIBLE DEVELOPMENT	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.
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PPS25 also stipulates the flood zones in which the different development vulnerabilities are appropriate, in relation to flood risk. This is presented in Table D.3 of PPS25, which is reproduced below.

Table 3-2: PPS25 Flood Risk Vulnerability and Flood Zone 'Compatibility' (from PPS25, Appendix D, Table D3)

FLOOD RISK VULNERABILITY CLASSIFICATION		ESSENTIAL INFRASTRUCTURE	WATER COMPATIBLE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE
FLOOD ZONE	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3A	Exception Test Required	✓	✗	Exception Test Required	✓
	3B	Exception Test Required	✓	✗	✗	✗



– Development is appropriate



– Development should not be permitted

3.2 Development Area Assessments

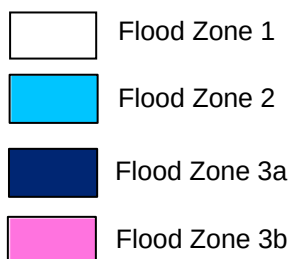
The flood zone mapping and breach modelling outputs have been examined for the five development areas identified by Tendring DC. A summary table has been produced for each area to summarise the main flood risks present and the impacts on potential development, presented as Table 3-3 to 3-7 overleaf.

Key to Tables 3-3 to 3-7

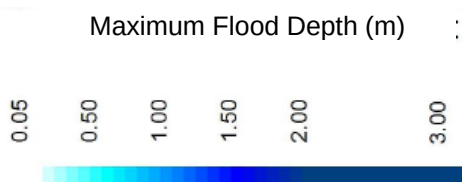
Notes:

1. The mapping presented within the tables has been extracted from the Harwich Level 1 SFRA report and shows the Flood Zones, plus flood depth and hazard mapping from the breach modelling work undertaken.
2. The year and event considered in the breach modelling is shown in the top left hand corner of the mapping extracts. The 2008 outputs have considered the present day flood levels, whilst the 2108 mapping considers 100 years of climate change in line with PPS25 sea level rise allowances. Full details are provided within the Level 1 SFRA.
3. The key for the mapping extracts is as follows.

Flood Zones



Flood Depth



Flood Hazard

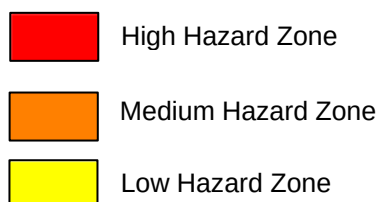


Table 3-3: Refinery Area Summary

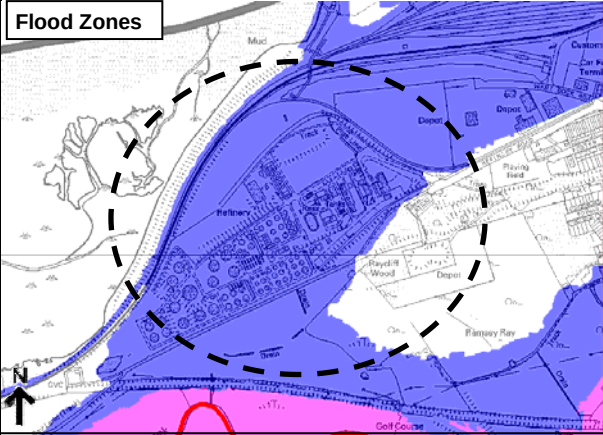
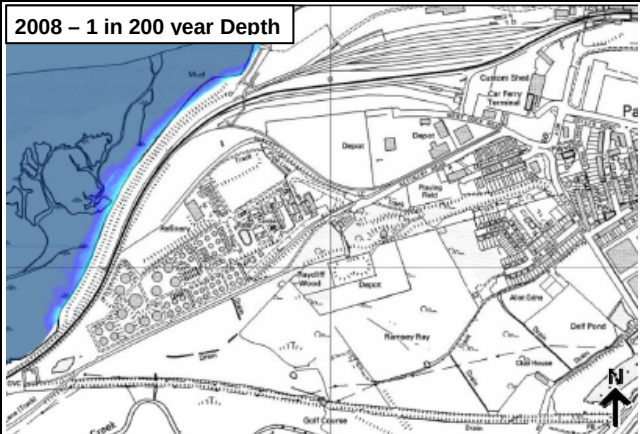
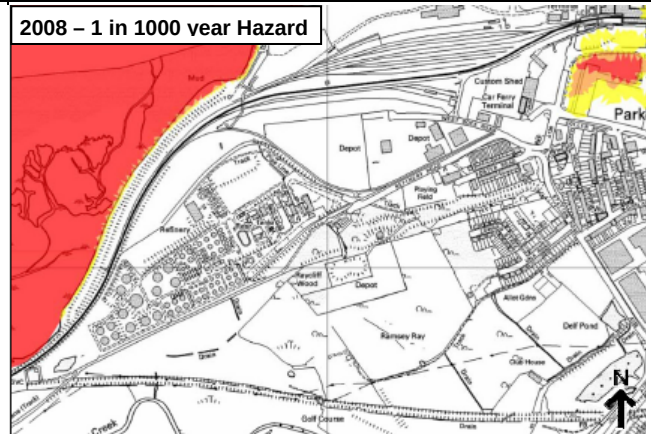
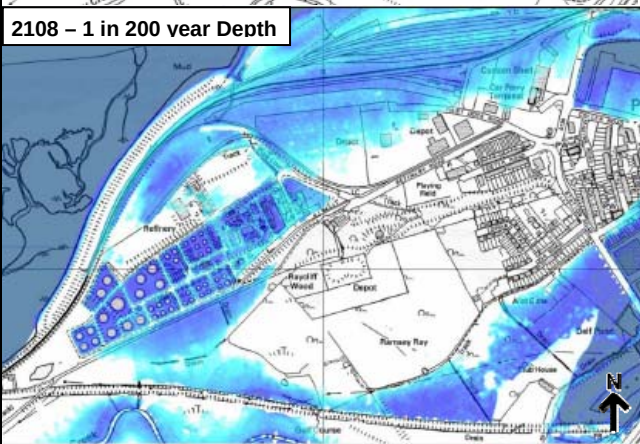
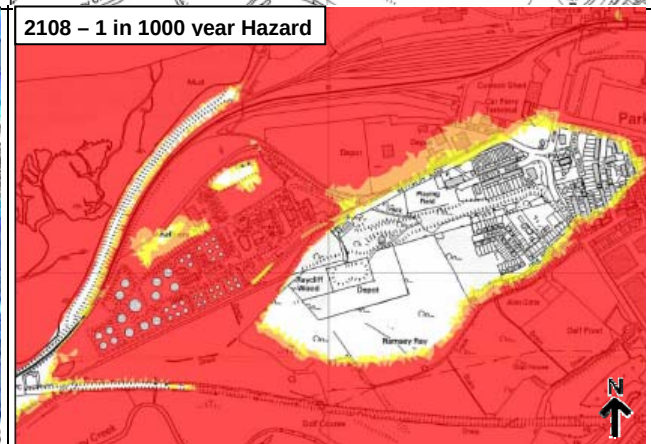
Flood Zones 	Flood Defences Currently defended to 1 in 200 year standard; but overtopping of railway embankment predicted with climate change during 1 in 1000 year event in 2075. However embankment crest is 0.5m above 1 in 200 year level in 2108, therefore defended horizon for new development currently in excess of 100 years. Potentially at risk from breach of railway embankment adjacent to area, which has not currently been modelled. Flood Depth and Hazard No inundation from port breach scenario during present day conditions, but significant flood depths up to 1m for 2108. Widespread high hazard zones preventing access and egress. Development Potential Industrially dominated area; further industrial/commercial development considered appropriate subject to specific warning and evacuation plan on site specific basis. Exception Test Requirements See section 4 for discussion of 'safe development' for part (c) of PPS25 Exception Test.
Sequential Test Flood Zone 3a: Less vulnerable (commercial, industrial) uses appropriate. Exception test required for more vulnerable use (residential) or essential infrastructure	
2008 – 1 in 200 year Depth 	2008 – 1 in 1000 year Hazard 
2108 – 1 in 200 year Depth 	2108 – 1 in 1000 year Hazard 
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Table 3-4: A120 Corridor Area Summary

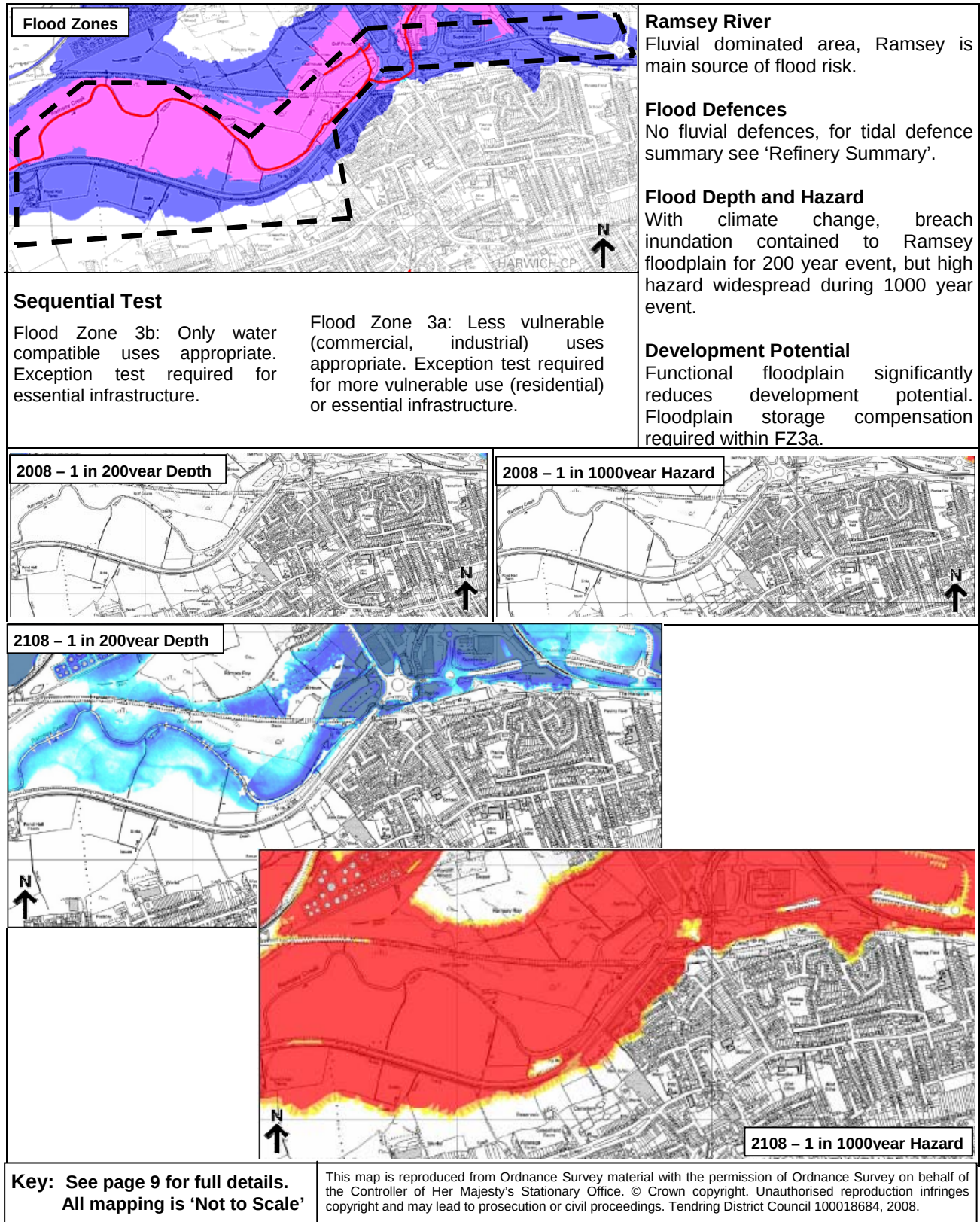


Table 3-5: Peninsula Area Summary

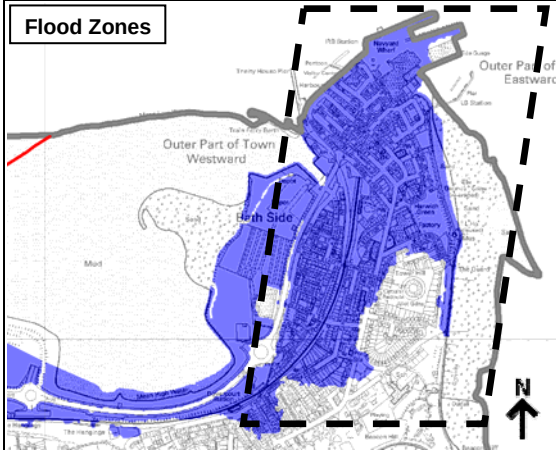
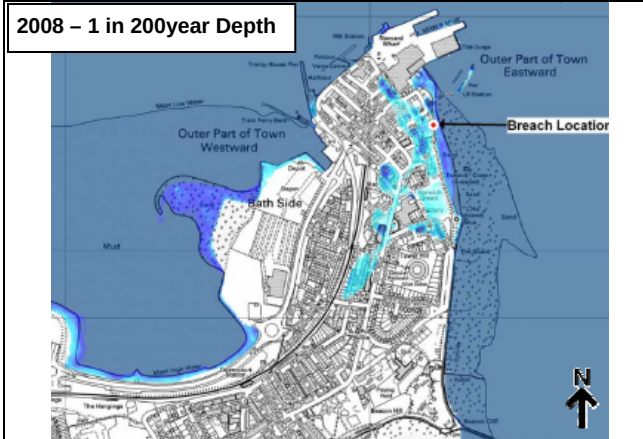
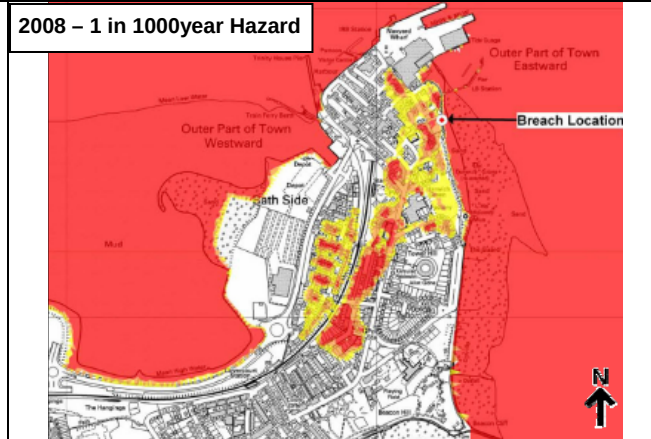
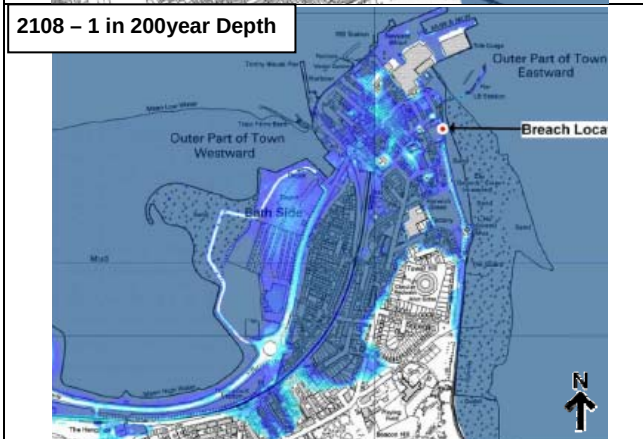
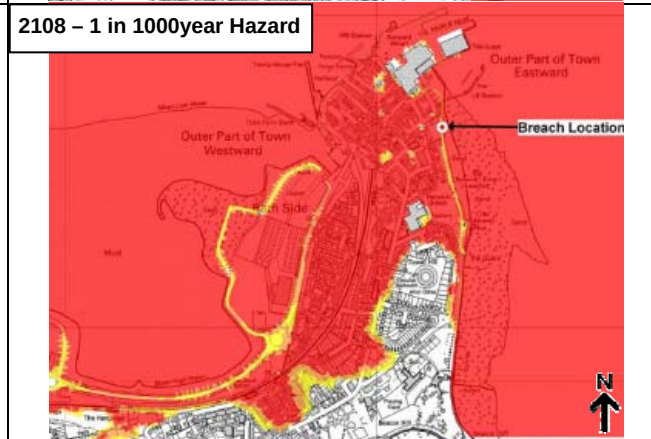
Flood Zones 	Flood Defences Currently defended to 1 in 200 year standard; but predicted to overtop with climate change by 1 in 200 yr event in 2070, i.e. maximum defended horizon for new development is 62 years from 2008, reducing year on year. Flood Depth and Hazard Limited inundation during present day conditions with typical flood depths between 0.5m and 1m. However with climate change, increased flood depths in excess of 2m and widespread high hazard zones are present along access routes. Development Potential Mixed residential and commercial area; further mixed development proposed under Harwich masterplan. Provision of safe access and egress route likely to be challenging when considering climate change. Exception Test Requirements See section 4 for discussion of 'safe development' for part (c) of PPS25 Exception Test.
2008 – 1 in 200year Depth 	2008 – 1 in 1000year Hazard 
2108 – 1 in 200year Depth 	2108 – 1 in 1000year Hazard 
Key: See page 9 for full details. All mapping is 'Not to Scale'	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office. © Crown copyright. Unauthorised reproduction infringes copyright and may lead to prosecution or civil proceedings. Tendring District Council 100018684, 2008.

Table 3-6: Dovercourt Area Summary

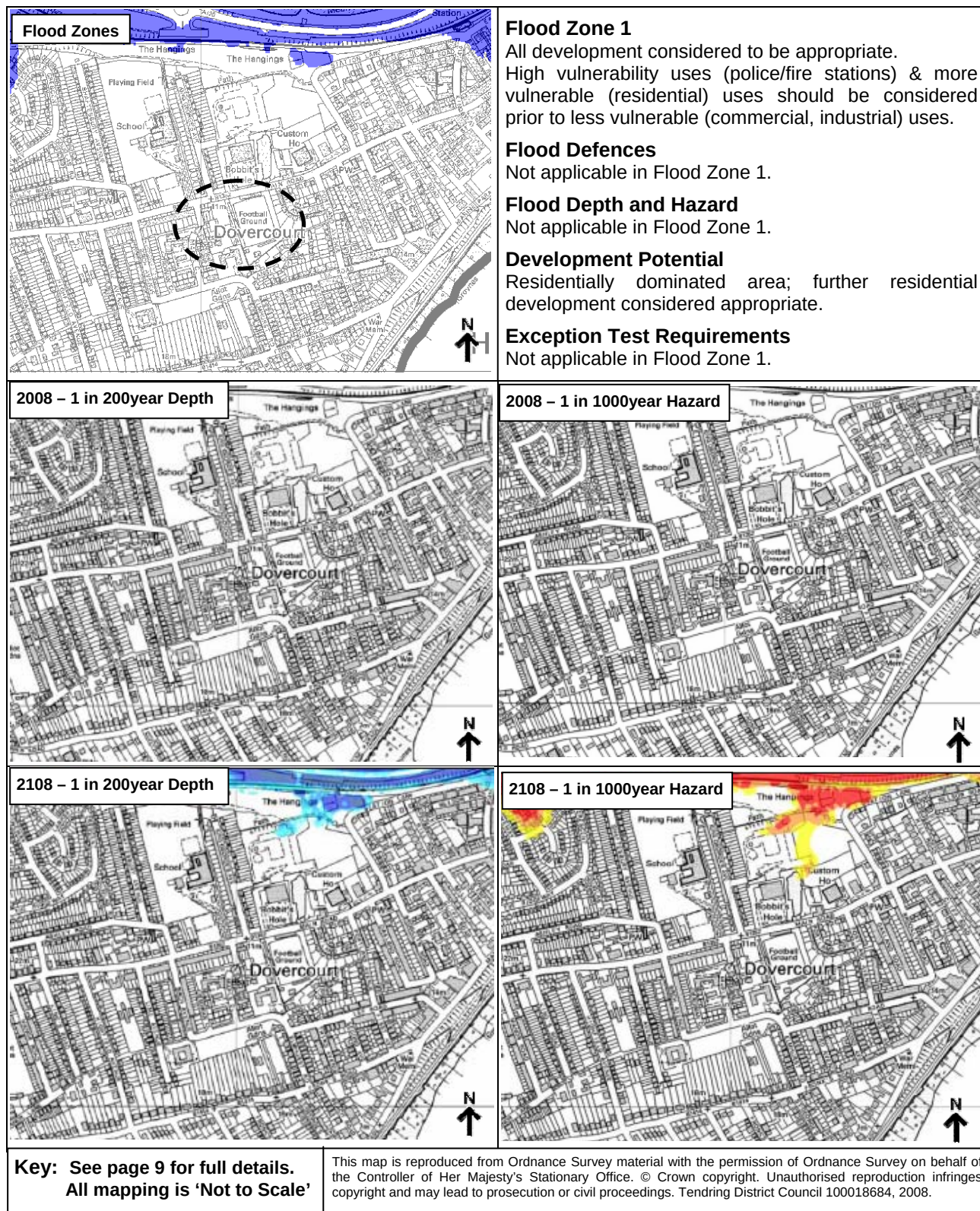
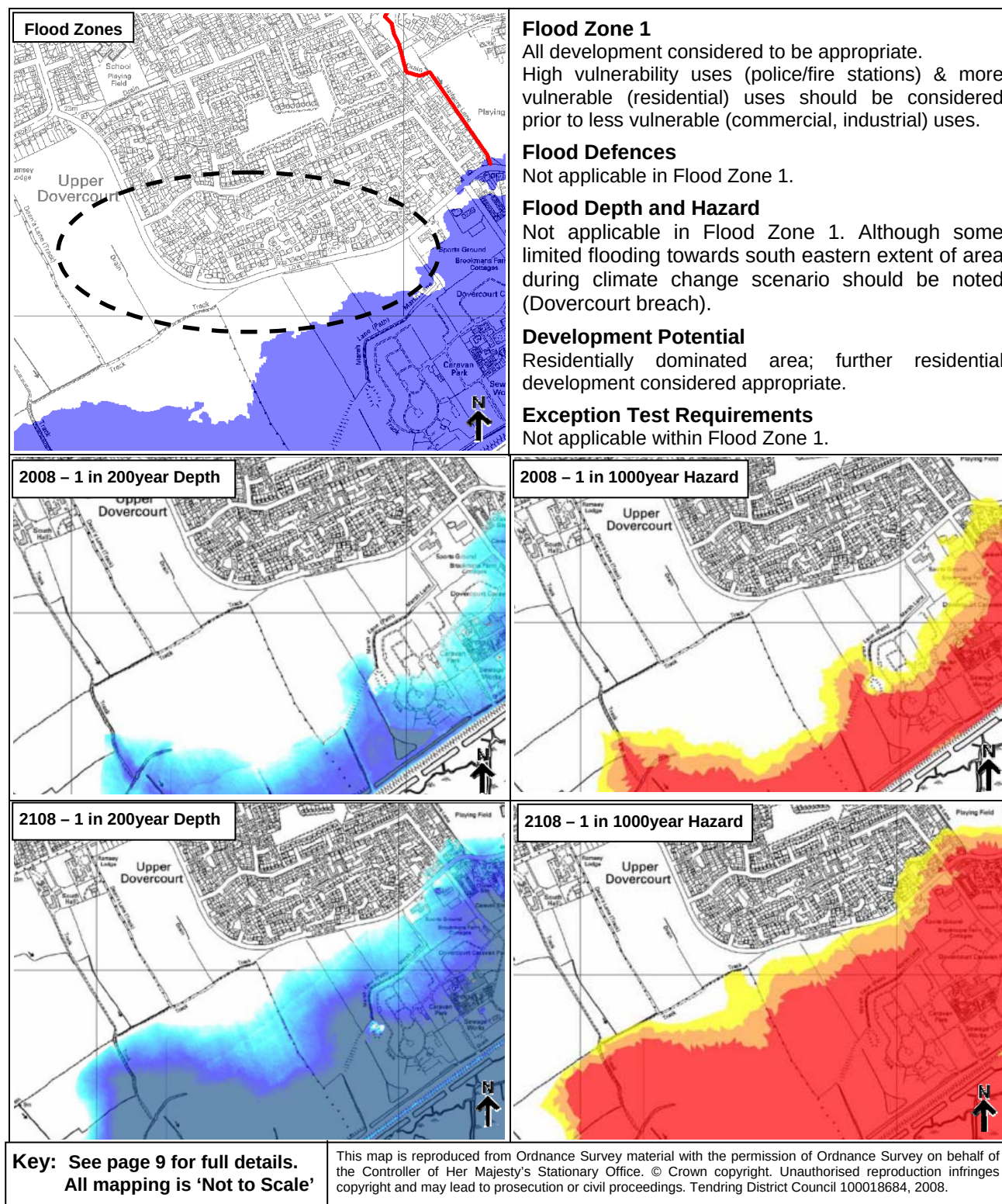


Table 3-7: Low Road Area Summary



3.3 Summary

Tables 3-3 to 3-7 present the flood risks for each area and confirm which development vulnerabilities are considered to be appropriate under the Sequential Test. As shown in Table 3-2 'more vulnerable' development, such as residential use is not considered appropriate within Flood Zone 3a under the Sequential Test and requires application of the Exception Test.

This study has identified that the Peninsula, A120 Corridor and Refinery areas are all dominated by Flood Zone 3a therefore more vulnerable development types are only appropriate subject to the Exception Test. The A120 corridor also contains significant areas of functional floodplain, which is only considered to be appropriate for water compatible development under PPS25.

Background information on the Exception Test is provided within the Level 1 SFRA report (section 8). Further details relating to relevant development areas are presented in section 4 of this report.

4 The Exception Test

Following completion of the Sequential Test, if it is not possible to locate development within a lower flood zone, it may be possible to apply the Exception Test. At this stage it is possible to consider whether the additional wider benefits resulting from development outweigh the flood risks.

The assessments of specific development areas included within section 3.2 confirm that the Dovercourt area and Low Road area lie within Flood Zone 1. As this Flood Zone is classified as 'low risk' any type of development is considered appropriate (in flood risk terms) and application of the Exception Test is not necessary.

However the Refinery and Peninsula areas are classified as Flood Zone 3a, which requires application of the Exception Test to justify 'more vulnerable' and 'essential infrastructure' development. The A120 Corridor contains areas of Flood Zone 3a therefore the same Exception Test requirements will apply. However it also includes significant areas of Flood Zone 3b, where only 'essential infrastructure' development is considered appropriate subject to application of the Exception Test.

The Test consists of three individual parts, all of which must be satisfied for development to be considered appropriate:

Part A – Wider Sustainability to the Community

It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared. If the DPD has reached the 'submission' stage (Figure 4 of PPS12; Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal.

- The site should be scored against the sustainability criteria of the Sustainability Appraisal (SA).
- Where a development fails to score positively against the SA, Tendring District Council could consider planning conditions or Section 106 Agreements.

Part B – Redevelopment of Previously Developed Land

The development must be on developable previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously developed land.

Planning Policy Statement 3: Housing defines previously developed land as:

'Previously-developed land is that which is or was occupied by a permanent structure, including the curtilage of the developed land and any associated fixed surface infrastructure.'

The definition includes defence buildings, but excludes:

- Land that is or has been occupied by agricultural or forestry buildings.
- Land that has been developed for minerals extraction or waste disposal by landfill purposes where provision for restoration has been made through development control procedures.
- Land in built-up areas such as parks, recreation grounds and allotments, which, although it may feature paths, pavilions and other buildings, has not been previously developed.

- Land that was previously-developed but where the remains of the permanent structure or fixed surface structure have blended into the landscape in the process of time (to the extent that it can reasonably be considered as part of the natural surroundings).

There is no presumption that land that is previously-developed is necessarily suitable for housing development nor that the whole of the curtilage should be developed.

Part C – Safe from Flood Risk

A Flood Risk Assessment (FRA) must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall. The FRA must consider the risks throughout the design life of the development, and the PPS25 Practice Guide recommends that for residential development a minimum of 100 years is specified, unless there is specific justification for considering a shorter period.

The PPS25 Practice Guide provides details on the definition of 'safe' in Chapter 5 – Risk Management by Design, and Chapter 6 – Residual Risk.

As shown in Tables 3-3 to 3-7 application of the Exception Test is only applicable in the Refinery, Peninsula and A120 areas, if completion of the Sequential Test demonstrates that there are no other reasonably available sites in lower flood risk areas.

PPS25 requires consideration of the following issues when preparing site specific FRAs for sites subject to the Exception Test, in order to demonstrate safety:

- Actual flood risk throughout development lifetime i.e. defence overtopping
- Residual flood risk throughout development lifetime i.e. defence/pumping station failure
- Access and egress routes
- Flood warning and evacuation procedures

A discussion of each of these issues and the likelihood of demonstrating safety for part (c) of the Exception Test is contained below.

Actual Flood Risk – Defence Overtopping

As shown in Figure 2-1 the existing defences are predicted to be overtopped in the future, based on PPS25 climate change allowances for sea level rise. Current guidance suggests that defences running along The Quay on the Peninsula will be overtopped by the 1 in 200 year tidal level in the year 2070 (approximately). The defences at Harwich International Port and Bathside Bay are predicted to be overtopped by the same event in years 2095 and 2010 respectively (approximately).

It is potentially possible that the existing defences could be raised in the future to protect Harwich against rising sea levels due to climate change. Although it should be noted that no consideration of the costs, technical feasibility, environmental impact, etc has been undertaken at this time. It would not seem an unrealistic task to raise defence levels throughout Harwich, which would be required to protect the existing community to the current defence standard, in addition to permit new development.

Any future flood risk management measures such as raised defences, should be considered for the whole area on a strategic basis. It is likely that a Project Appraisal Report would be required to ensure a full cost benefit analysis is undertaken to demonstrate that any scheme is cost effective and sustainable.

Residual Flood Risk – Pumping Station Failure / Defence Breach

Flood risk management measures can be put in place to protect areas from flooding, however there is always a residual risk that the measures will fail to operate correctly during a flood event, when they are most needed.

The Ramsey River modelling carried out for the Level 1 SFRA considered failure of the pumping station during the 1 in 100 year event with climate change. As the capacity of the pumping station is very limited (only 1m³/s), then the impact of failure of the pump is minimal. The residual risk from the Ramsey River is therefore considered to be low.

However the breach modelling demonstrates that the residual risk associated with a tidal defence breach during an extreme tidal flood event is high. The climate change modelling simulates both overtopping and a breach occurring simultaneously and therefore represents a worst case scenario than a breach alone. Despite this it is anticipated that the flood depths and hazards resulting from a breach with an additional 1.02m head of water (due to climate change) flowing through the breach onto the land behind, will result in extensive areas of significant flood depths and high hazard zones.

The residual risk in the event of a defence breach will therefore continue to increase throughout time. Increasing the crest levels of the existing defences to prevent overtopping due to rising sea levels will not reduce or remove the residual risk. In fact it is not possible to remove the residual risk as it can never be guaranteed that flood risk management measures will perform as intended. The increase in sea levels due to climate change will mean that a greater head of water is retained on the seaward side of defences, which itself increases the residual risk.

The only true way to reduce the residual risk is to carry out ground raising measures to reduce the difference in level between peak tidal levels and ground levels throughout the area. However this is clearly not feasible in Harwich due to existing development and infrastructure.

The tidal residual flood risk in Harwich will therefore increase with rising sea levels in the future and there is little that can be done to reduce this.

Access and Egress Routes

The ability for occupants and users of a development to gain safe access and egress to higher ground outside the floodplain during a flood event is of primary concern. It is also important to consider whether emergency services will be able to access the development to provide assistance during a flood event.

The existing standard of protection in Harwich is the 1 in 200 year tidal flood event, however PPS25 also requires access and egress routes to be considered during the 1 in 1000 year tidal flood level, to assess the consequences of events exceeding the defence design standard. Designated routes should preferably remain dry during flood events particularly during the 1 in 200 year event, however areas of low flood hazard are typically considered to be acceptable where this is not possible. Access and egress routes need to be considered in relation to both actual flood risk and residual flood risk.

The breach modelling that has been undertaken demonstrates that when considering the 1 in 200 and 1 in 1000 year tidal flood events with climate change, it will be very challenging to provide safe access and egress routes from the Harwich area. The A120 road was constructed relatively recently and has therefore been raised above the surrounding area as it runs parallel to the coast before entering Old Harwich. Despite the road being raised in this area the climate change modelling still shows that the road is inundated to a typical depth of approximately 1m adjacent to Dovercourt station.

It should be noted that the modelling simulates overtopping in addition to a breach in the defences. As discussed previously, although it is considered possible to raise defences in the future to prevent overtopping significant inundation of the area is still anticipated due to the increased head of water flowing through the breach.

As the A120 enters into Old Harwich, the road level reduces significantly and the climate change modelling shows flood depths of up to 2m in the vicinity of the junction with George Street. When the hazard category for a designated access and egress route is classified as low or medium, then it is possible that vehicles may be able to drive through floodwaters to gain access. However due to the significant depth of water and corresponding areas of high flood hazard, it is unlikely that safe access will be available. The problem is simply that ground levels are generally very low and are significantly below peak flood levels. The A120 could potentially provide an access route, however the difficulty would be in getting from individual properties, which are typically situated at a lower level than the A120, onto the elevated road in order to gain access and egress.

The lack of safe access and egress during flood events with climate change is considered to be a major problem for the Harwich area. The area most affected by this is the Peninsula, as the area is surrounded by water and the only main road in close proximity is the A120. It is considered that it will not be possible to demonstrate safe access and egress for residual risk breach and/or future overtopping scenarios, therefore other options for this area should be investigated. One potential option would be to ensure that residents/occupants retreat to the upper floors of the building, above the breach flood level to seek refuge for the duration of the flood event. This would require a significant amount of education of residents/occupants to ensure that users of the development understand the flood risks in the area and the correct course of action to take should a defence breach occur.

Flood Warning and Evacuation

The main source of flood risk in Harwich, both in terms of actual and residual risk is a tidal storm surge event. The National Storm Tide Forecasting Service (NSTFS) monitor tidal levels and weather conditions throughout the North Sea and along the east coast and can predict tidal levels with good accuracy. Although the movement of weather systems can also be unpredictable, the systems of the North Sea have been extensively studied and are generally well understood, and it is understood that flood warnings for tidal areas are typically issued 11 hours in advance as a minimum.

Given the advance warning provided by NSTFS it seems feasible that Tendring District Council could formulate and implement a Flood Plan. It is recommended that this should be centred around the flood warning system, which all residents and businesses should be encouraged to register with. The warning service would provide anticipated tidal levels and the Plan should set out specific actions based on trigger water levels, e.g. when the predicted tidal level exceeds 4m AOD certain high risk areas should be evacuated, etc.

The Flood Plan should be prepared in consultation with the Environment Agency and Essex County Council emergency planners. The Plan should also be reviewed at regular intervals to ensure it is based on the most up to date information and still recommends the most appropriate actions.

Summary

The existing defences are predicted to be overtopped by extreme tidal levels in the future due to rising sea levels. The raising of defences and replacement of flood gates is extremely costly however it appears technically possible that the defences could be raised in the future to prevent overtopping during the design event. However the residual risk in the event of a breach in the defences will remain, and will in

fact continue to increase alongside rising sea levels, due to the increased difference in levels between ground levels and peak tidal levels.

Safe access and egress from Harwich is unlikely to be possible when considering the impacts of climate change and the residual risks of flood defence breaches. It is therefore recommended that alternative options are considered such as retreating to refuge areas located on upper floors during breach events. Further consultation will be required with the Environment Agency to determine appropriate procedures for the area.

The most significant source of flood risk is the North Sea extreme tidal surge events, which can be predicted with reasonable accuracy in advance of occurrence (a minimum 11 hour warning time is provided). It therefore appears feasible that TDC could formulate and implement a Flood Plan for Harwich which will utilise flood warnings to trigger evacuation if necessary or other appropriate measures.

5 Environment Agency Consultation

The Harwich Strategic Flood Risk Assessment has been completed in consultation with the Environment Agency. This has recently included a meeting to discuss the finalisation of the Level 2 report, following production of an initial 'incomplete draft' version.

As discussed within section 4 of this report, the modelling work undertaken demonstrates that safe access and egress is unlikely to be available from the Peninsula area when considering climate change tidal flooding scenarios. This is because the existing flood defences are predicted to be overtopped, which results in significant inundation of the Peninsula area and widespread areas of high hazard.

Should the existing defences be raised in the future to prevent overtopping during extreme events, a residual risk will still remain which would require a defence breach in order to be realised. The residual flood risks for the Harwich Peninsula will continue to increase if sea levels rise in the future as currently anticipated. This is due to the increased tidal water level that would drive a greater volume of water through any potential breach in the defences. The most effective method to reduce residual risk for the area would be to undertake large scale ground raising works throughout the Peninsula, however this is clearly not feasible given the extent of existing development, infrastructure and services.

During the recent meeting with the Environment Agency, Scott Wilson presented a summary of the existing defence crests, future predicted tidal levels based on PPS25 allowances and a summary of the key issues as outlined above.

Tendring District Council explained that Harwich has been designated as a regional growth node by the Government with significant funding allocated for re-development of the area. A master plan has been prepared for the Peninsula area which includes significant development proposals for the old Trinity House site and the Navyyard Wharf site in particular.

The Environment Agency has confirmed that the conclusions of the SFRA modelling considered in light of the requirements of PPS25 appear to form a significant barrier to redevelopment of the area. The Environment Agency has agreed that based on the requirements of PPS25 the potential 'safety' of new development regarding access and egress is the key issue.

The Environment Agency has commented that:

"Ideally access and egress routes from the site would be dry, and if this is not practical then minimum depths and velocities of water may be acceptable. Please refer to Table 13.1... for information on acceptable levels of flooding."

The flood depths and velocities experienced throughout the Peninsula area result in widespread high hazard zones, which are the equivalent to the 'Danger for all' category contained within Table 13.1 referred to by the Environment Agency.

Scott Wilson has therefore suggested that the following measures could be implemented throughout redevelopment of the Peninsula area as mitigation against the residual flood risks which are currently present:

- Finished floor levels should be set above the 1 in 200 year with climate change breach flood level for 'more vulnerable' uses;
- Safe* access and egress routes for 'more vulnerable' uses should be provided above the 1 in 200 year with climate change breach flood level and lead to high ground outside the floodplain where possible;

- Where safe access and egress routes are not possible, refuge areas should be provided on the upper floors of the development above peak flood levels. These should be freely accessible via internal staircases from all areas which are below the 1 in 200 year with climate change breach flood level on the site;
- A flood warning and emergency response plan should be prepared and agreed in consultation with the Local Planning Authority and Emergency Planners.

*' Low Hazard/Hazard for some' as classified FD2320/TR2 –Flood Risks Assessment Guidance for New Development

However the Environment Agency has confirmed that they consider it is unlikely that the measures listed above will be sufficient to permit 'more vulnerable' development types on the Peninsula, due to the lack of a safe access and egress route as this would not meet the requirements of PPS25.

The measures listed above provide potential mitigation options against residual flood risks and additional flood risk management measures will be required in the future should sea levels rise as currently anticipated. Tendring District Council has an obligation to protect the existing population and infrastructure of Harwich, and based on PPS25 allowances the existing defences are not estimated to be overtopped by the 1 in 200 year event until approximately 2070.

Significant funding and long term planning is required for large scale capital works such as flood alleviation schemes. However the existing defences are estimated to maintain the current standard of protection until 2070. In considering defence upgrade with respect to climate change predictions, investment of significant funds at this point in time, based on climate change estimations, may prove unnecessary as the risks faced in the future may be different to those currently envisaged.

Despite this the PPS25 Practice Guide requires consideration of a development lifetime of 100 years, against which timescale defence upgrade would appear the only solution capable of offering sufficient protection to new development.

The requirements of PPS25 and the interpretation of the Environment Agency are therefore currently preventing Tendring District Council and the Haven Gateway Partnership from implementing the Government's development plans for the Harwich area.

However it should be remembered that the Environment Agency are a statutory consultee in the planning process and that the decision to allow development or not ultimately lies with the Local Planning Authority.

The Environment Agency has recommended that guidance is sought from the local branch of Communities and Local Government (CLG) to confirm the best way forward. At present it would appear that the requirements of PPS25 conflict with the Growth Point status of Harwich. Guidance is therefore required from CLG as to how Tendring District Council and the Haven Gateway Partnership should proceed.

6 Conclusions

Scott Wilson was commissioned to undertake the Harwich Strategic Flood Risk Assessment for Tendring District Council. The Level 1 study was completed in April 2008, however TDC has not completed a district-wide SFRA and is therefore not in a position to undertake the PPS25 Sequential Test to identify allocation sites which may require application of the Exception Test.

Tendring District Council therefore requested that Scott Wilson carry out the Level 2 study based on five potential development areas as examples across the SFRA study area.

This Level 2 SFRA considers the flood risks associated with the Refinery, A120 Corridor, Peninsula, Dovercourt and Low Road. The Peninsula area is a key development area for Tendring District Council which has been designated as a regional growth node and significant investment has been provided for regeneration.

Flood zone, depth and hazard mapping has been presented for each area alongside a summary of the potential for future development, highlighting the likely requirements for satisfaction of the Exception Test, where applicable.

The assessment highlights that the existing defences will be overtopped when considering future sea levels including climate change allowances, which presents a significant challenge in providing safe access and egress routes, especially from the Peninsula area.

The use of lower vulnerability ground floor uses, provision of refuge areas and flood warning and emergency response plans have been suggested as potential mitigation measures for the Peninsula area. However the Environment Agency has confirmed that these are not considered to be acceptable based on the requirements of PPS25 and the accompanying Practice Guide.

Current flood risk planning policy is therefore presenting a significant barrier to redevelopment of the Peninsula area, and realisation of the benefits associated with the Government's regional growth node investment. Further guidance is required from Communities and Local Government as to how the regeneration plans for the area can be implemented in light of the current and potential future flood risks.

7 References

- Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk, TSO: London
- Communities and Local Government (2008) PPS25 Development and Flood Risk: Practice Guide, Department for Communities and Local Government: London
- Tendring District Council (2008) Harwich Strategic Flood Risk Assessment – Level 1
- Tendring District Local Plan (2007). Tendring District Council, December 2007
- Sea Defence Survey, October (2006). Tendring District Council, October 2006
- Tendring Coast Protection Strategy (2002 to 2007). Tendring District Council, 2002

Appendices

Appendix A - Figures

