Basildon Borough Council

Level 1 Strategic Flood Risk Assessment

Level 1 Final Report

June 2011

Prepared for

Basildon Council

BASILDON • BILLERICAY • WICKFORD

Revision Schedule

Basildon Borough Council Strategic Flood Risk Assessment – Level 1
June 2011

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	November 2010	Draft Report for Client Comment	**Sarah Littlewood** Assistant Hydrologist	**Elizabeth Gent** Principal Consultant	**Jon Robinson** Technical Director
02	February 2011	Draft Report for EA Comment	**Sarah Littlewood** Assistant Hydrologist	**Emily Craven** Senior Flood Risk Consultant	
03	June 2011	Final Report	**Sarah Littlewood** Assistant Hydrologist	**Emily Craven** Senior Flood Risk Consultant	**Jon Robinson** Technical Director

Scott Wilson
6-8 Greencoat Place
London
SW1P 1PL

Tel +44 (0)20 7798 5000
Fax +44 (0)20 7798 5001

www.scottwilson.com

Non Technical Summary

Basildon Borough Council, in partnership with Rochford District Council and Castle Point Borough Council, has commissioned Scott Wilson to produce a Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS25): *Development and Flood Risk*[1] and its accompanying Practice Guide[2]. This SFRA provides a revision to the Thames Gateway South Essex SFRA which was published in November 2006 and prepared under previous policy Planning Policy Guidance (PPG25) Development and Flood Risk.

The following report constitutes a Level 1 SFRA for Basildon Borough Council which will contribute to the evidence base for the plan-making process of the Local Development Framework (LDF), in particular the Core Strategy. The purpose of the Level 1 SFRA is to collate existing data and information with respect to flood risk, sufficient to enable the application of the Sequential Test by the Council, i.e. to steer development towards areas of lowest flood risk. It is the role of the Council to undertake the application of the Sequential Test within their administrative area; and guidance to assist in this process is included in Chapter 6.

The findings from this Level 1 SFRA confirm that the primary mechanism of flooding in the Borough is pluvial flooding in the urban centres of Billericay, Wickford and Basildon, which often coincide with fluvial flooding associated with the River Crouch and its tributaries. The Basildon New Town washland system, created as an integral part of the Basildon New Town, performs a valuable surface water management function for the urban area of Basildon. The washlands help to mitigate the impacts of historic development in Basildon against increasing fluvial risks to existing developments in other towns such as Wickford through which the receiving watercourses flow. A series of storage areas and reservoirs connected via drainage networks enables attenuation of storm water during heavy rainfall events, prior to its release into watercourses and the local drainage network.

Historical records of surface water flooding incidents have been mapped in Figure A-8 and used to verify the Environment Agency 'Areas Susceptible to Surface Water Flooding' dataset which highlights those parts of the Borough that are particularly susceptible to surface water flooding. It is recommended that this information is used to inform Emergency Planning procedures in the Borough and to determine locations for future efforts in surface water management through maintenance regimes.

The most significant fluvial flood events tend to occur when high rainfall events in the upper catchment of the River Crouch coincide with high tidal water levels to produce high volume fluvial flows and elevated water levels in the River Crouch and its tributaries. Flood Zones delineating the variation in probability of fluvial flooding from these watercourses have been mapped in Appendix B of this report and should be used to inform the location of future development through the application of the Sequential Test by Basildon Borough Council.

The southern part of the Borough is located next to the Vange Creek and the East Haven Creek which are tidal estuaries on the northern edge of the River Thames estuary. Flood defences along the southern edge of the Borough as well as two flood barriers provide a high standard of protection to this area from tidal flooding; the Fobbing Horse flood barrier, located to the south of the marshes, on the Vange Creek, and the Benfleet barrier, located to the south east of the marshes, on the Benfleet Creek. The risk of flooding from tidal sources is therefore a residual risk. Further assessment of the residual risk of tidal flooding in

[1] CLG (December 2006, revised March 2010) Planning Policy Statement 25: Development and Flood Risk
[2] CLG (June 2008, revised December 2009) Planning Policy Statement 25: Development and Flood Risk

Basildon, in the event of failure of these flood barriers, will be undertaken as part of a Level 2 Strategic Flood Risk Assessment.

Where development has to be located in areas at risk of fluvial flooding (following application of the Sequential Test), development control recommendations provided in Chapter 7 of this report should be used to determine the safety of the proposed development (in consultation with the council's emergency planners) and to ensure that the proposed development does not increase flood risk to surrounding areas or impact upon the ability of Basildon Borough Council and the emergency services to safeguard the current population.

In addition, for all future development in the Borough, particular attention should be paid to the risk of surface water flooding, and in particular the need to ensure that the proposed development does not increase flood risk to surrounding areas or impact of the ability of the washland system to perform its function as designed. Developers need to discuss preliminary drainage proposals with the Lead Local Flood Authority (Essex County Council) and the Environment Agency at the early stages of site master planning to ensure that drainage designs have a good chance of gaining approval through the future SuDs Approval Board. Specific guidance relating to the use and maintenance of Sustainable Drainage Systems (SuDS) is provided in Chapter 8.

It is noted that additional surface water flood risk information has recently been made available by the Environment Agency. It is proposed to use this mapping to inform the Level 2 SFRA. Results from the hydrodynamic tidal breach modelling, up to date surface water flood risk information, as well as the fluvial information within this Level 1 SFRA will be used to provide a review of broad development areas and urban sites identified by Basildon Borough Council throughout their LDF process.

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Glossary of Terms

Climate change - a change in average weather or a change in the distribution of weather events around an average over a period of time e.g. greater or fewer extreme weather events.

Core Strategy - The Development Plan Document which sets the long-term spatial planning vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.

Development Plan Documents (DPDs) - Spatial planning documents within the Council's Local Development Framework which set out policies for development and the use of land. Together with the Regional Strategy they form the development plan for the area. They are subject to independent examination. They are required to include a core strategy and a site allocations document, and may include area action plans if required; other DPDs may also be included, e.g. development control policies.

Defra - Department for Environment, Food & Rural Affairs.

Drift Geology - Sediments deposited by the action of ice and glacial processes.

Emergency Planning – Planning for and response to emergencies such as flooding, including consideration of the resilience of emergency infrastructure that will need to operate during flooding.

Environment Agency Flood Zones - Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.

Flood Risk Assessment (FRA) – A site specific investigation carried out by site developers to be submitted as part of their planning applications. It assesses both current flood risk to the site and ensures development does not increase flood risk to the site or surrounding areas.

Flood Risk Vulnerability - PPS25 provides a vulnerability classification to assess which uses of land may be appropriate in each flood risk zone.

Flood Zone 1 - Low Probability - Flood Zone comprising land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any one year (<0.1%)

Flood Zone 2 - Medium Probability – Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Flood Zone 3a - High Probability – Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year

Flood Zone 3b - Functional Floodplain - Land where water has to be stored or flow in times of flood

Formal Flood Defence - A structure built and maintained specifically for flood defence purposes.

Greenfield Runoff - The surface water runoff regime from a site before development. This is normally taken to mean the site in its natural state (i.e. no man-made developments on site).

LiDAR – 'Light Detection and Ranging' is an airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground. It therefore provides accurate topographical/contour mapping.

Local Development Framework (LDF) - The name for the portfolio of Local Development Documents. It consists of the Local Development Scheme, a Statement of Community Involvement, Development Plan Documents, Supplementary Planning Documents, and the Annual Monitoring Report.

Local Lead Flood Authority (LLFA) – Unitary or County Council Authority for an area, responsible for implementing the requirements of the Flood and Water Management Act, which gained Royal Assent in April 2010. In this case, Essex County Council is the LLFA.

Mitigation – where flood risk cannot be avoided or controlled, mitigation measures should be applied to further reduce the risk of flooding and/or minimise the danger and damage caused by flooding to acceptable levels. This could include options such as non-habitable ground floors, resistant and resilient design, flood warning and evacuation plans.

Previously Developed (Brownfield) Land - Land which is or was occupied by a building (excluding those used for agriculture, open space and forestry). Land used for mineral working and not subject to restoration proposals can also be regarded as brownfield land.

Residual Risk - The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.

Return Period – Return Period is a statistical measure of how often, on average, an event could occur. It is the inverse of Annual Exceedence Probability (AEP), where AEP is the probability of a storm event of given magnitude or greater occurring in any given year. It should be noted that both return period and AEP are probability measures, so for example an event which has a 5 year return period (or 20% AEP) has a 1 in 5 chance of occurring in any given year, and is expected to occur once every 5 years on average. The, on average, term is important - just because it has happened one year does not mean it will not occur again for the next 4 years; there is still a 1 in 5 chance each year of the storm, or a larger storm, occurring, but over a long period of time it is expected that a fifth of the years will have had a storm of that magnitude or larger.

Risk Management Authority – organisations or bodies responsible for functions pertaining to flood risk management as set out in the Water Resources Act 1991, Land Drainage Act 1991, Highways Act 1980 and Flood & Water Management Act 2010. Risk Management Authorities include the Environment Agency, Lead Local Flood Authority, a District or Borough Council for an area for which there is no unitary authority, such as Basildon Borough Council, an internal drainage board, water company and highway authority.

Storm surge - An offshore rise of water level associated with a low pressure weather system. Water levels rise primarily due to the action of high winds upon the oceans surface.

Sustainable Development – "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).

SuDS Approval Body - The Flood & Water Management Act 2010 places a duty on Lead Local Flood Authorities to approve, adopt and maintain Sustainable Drainage Systems. The LLFA is required to establish a SUDS Approval Board to approve all developments that have drainage implications. If the drainage is sustainable, serves more than one property and is approved, the SUDS Approval Board must adopt it. The approval process will run parallel with any planning application that may also be required for the development and development may not commence without drainage approval from the SUDS Approval Board.

The Exception Test - If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed, the Exception Test may apply. PPS25 sets out strict requirements for the application of the Test.

The Sequential Test - Informed by a Strategic Flood Risk Assessment, a local planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

1 in 200 year event - Event that on average will occur once every 200 years. Also expressed as an event that has a 0.5% probability of occurring in any one year.

1 in 200 year design standard - Flood defence that is designed for an event, which has an annual probability of 0.5%. In events more severe than this the defence would be expected to fail or to allow flooding.

1 in 1000 year event - Event that on average will occur once every 1000 years. Also expressed as an event that has a 0.1% probability of occurring in any one year.

1 Introduction

1.1 Background

1.1.1 URS Scott Wilson Ltd has been commissioned by Basildon Borough Council, in partnership with Rochford District and Castle Point Borough Councils, to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS25): Development and Flood Risk[3] and its accompanying Practice Guide[4].

1.1.2 This SFRA provides a revision to the Thames Gateway South Essex SFRA which was published in November 2006 under previous policy Planning Policy Guidance (PPG25) Development and Flood Risk. The TGSE SFRA was prepared by Scott Wilson Ltd to aid the South Essex Strategic Planning Authorities of Essex County Council, Southend-on-Sea and Thurrock Borough Council and the Local Planning Authorities of Rochford District, Castle Point Borough and Basildon Borough Council in their planning and development control processes.

1.1.3 Due to differing timescales for the publication of their Local Development Framework, Thurrock Council and Southend-on-Sea Borough Council have commissioned separate SFRAs for their administrative areas. It is envisaged however that all the SFRAs are able to be interpreted as a suite of SFRAs for South Essex upon completion in 2011.

1.2 SFRA Structure

1.2.1 PPS25 defines a two staged approach to the completion of a SFRA as follows:

Level 1 – A strategic overview of all potential sources of flooding which is sufficiently detailed to enable the application of the Sequential Test i.e. to steer future development towards areas of Low flood risk.

Level 2 – An 'increased scope' SFRA to provide more detail of flood risk where there is development pressure in areas that are at Medium and High risk and to facilitate the application of the Exception Test where necessary.

1.2.2 This report comprises a Level 1 Strategic Flood Risk Assessment for Basildon Borough Council. It is proposed to prepare a Level 2 assessment that will consider the residual risk of flooding from tidal sources as well as updated information regarding surface water flood risk.

1.3 Objectives

1.3.1 The objectives of the **Level 1** SFRA are as follows:

- Collate and review all available existing information on flood risk within the Basildon Borough Council study area from relevant stakeholders including the Environment Agency, Water Utility (Anglian Water), Highway Authority (Essex County Council) and the Local Authority;

[3] CLG (December 2006, revised March 2010) Planning Policy Statement 25: Development and Flood Risk
[4] CLG (June 2008, revised December 2009) Planning Policy Statement 25: Development and Flood Risk

- Map the tidal and fluvial Flood Zones based on the most up to date information at the time of writing provided by the Environment Agency, including the functional floodplain (fluvial outlines only) and an allowance for climate change;
- Map areas liable to suffer from surface water flooding through the use of the Environment Agency dataset 'Areas Susceptible to Surface Water Flooding' and local flooding records;
- Provide an assessment of groundwater flooding including mapping based on British Geological Survey data;
- Refer to Anglian water data to provide an assessment of flood risk from sewer flooding using DG5 data and local historical records where available;
- Provide guidance on the preparation of site specific Flood Risk Assessments (FRAs);
- Provide meaningful recommendations to inform policy and development control issues;
- Provide guidance on the likely applicability of sustainable drainage techniques for managing surface water.

1.4 Consultation

Anglian water

1.4.1 Anglian Water have been consulted in capacity as sewerage undertakers as part of this assessment. They are responsible for surface water drainage from development areas via adopted sewers and in some cases are responsible for the maintenance of SuDS systems. Anglian water maintain trunk sewers, however, they are not responsible for the gullies or local drainage connections to trunk sewers.

Essex County Council

1.4.2 Essex County Council is the Highways Authority and is responsible for maintaining an effective highway drainage system including kerbs, road gullies and the pipes which connect the gullies to the trunk sewers and soakaways. The Highways Authority has been contacted and has provided information to this study with regard to highway flooding hot spots.

1.4.3 Essex County council as Lead Local Flood Authority (LLFA) in accordance with the Flood and Water Management Act *'must develop, maintain, apply and monitor a strategy for flood risk management in its area'* including flood risk from surface runoff, groundwater and ordinary watercourses.

The Environment Agency

1.4.4 The Environment Agency is the principal flood defence operating authority in England with permissive powers for the management of flood risk arising from designated Main Rivers and the sea. The Environment Agency is also responsible for flood forecasting, flood warning and general supervision over matters relating to flood defence. The Environment Agency have been consulted and have provided Flood Zone outlines, information on flood history, flood defences and have reviewed the document prior to publication.

Basildon Borough Council

1.4.5 Basildon Borough Council has permissive powers to undertake flood defence works on ordinary watercourses which have not been designated Main River and has provided information regarding

localised surface water flooding in the Borough. It is noted that in accordance with the Flood and Water Management Act, which gained Royal Assent in April 2010, Basildon Borough Council is a Risk Management Authority (RMA). As such it is responsible for analysing, assessing and reducing risks associated with flooding in the local area. Basildon Borough Council is also responsible for working with and supporting the Lead Local Flood Authority, (LLFA) Essex County Council, as it seeks to implement the requirements of the Flood and Water Management Act, including the delivery of the local flood risk management strategy for the county.

2 Study Area Overview

2.1 Basildon Borough Study Area

2.1.1 Basildon Borough is located within the southern part of Essex County. It is bordered to the west by Brentwood, to the south by Thurrock, to the north by Chelmsford, and to the east by Rochford and Castle Point. The Borough covers an area of approximately 11,000 hectares and has a resident population of approximately 172,600[5]. It has three predominant urban centres including Wickford, Billericay and the Basildon New Town, which comprises a continual urban area created from the three original settlements of Laindon, Basildon and Pitsea as well as other minor settlements.

2.1.2 These urban centres occupy approximately half of the Borough area, with the remainder largely designated as Green Belt and including several sites of special scientific interest (SSSI) including Basildon Meadows, Norsey Wood, Mill Meadows, Pitsea Marsh, Vange and Fobbing Marshes, Holehaven Creek. In addition there are a number of Special Areas of Conservation (SAC) and Special Protection Areas (SPA) within close proximity to the Borough including the Roach and Crouch Estuaries, Blackwater Estuary, Abberton Reservoir and Dengie Peninsular. These areas form the Natura 2000 network and are protected under the EU Habitats Directive.

2.2 Geology & Soils

2.2.1 The type of geology and soils in a particular region influence how surface water is conveyed and absorbed and therefore directly affects the likelihood and characteristics of flooding. The presence of impermeable rocks will lead to rapid and greater volumes of runoff, thereby increasing the risk of flooding downstream.

2.2.2 The predominant solid geology underlying the study area is Thames Group Clay. This is impermeable and therefore rapid runoff can be expected. In the north of the study area around the urban area of Billericay, Bagshot Beds are present. These comprise sand and clays and are frequently present in the Borough capping the hills of London clay[6].

2.2.3 The majority of the study area does not have any drift geology overlying the Thames Group Clay. There are minimal deposits of sand and gravel along the valley of the upper Crouch and overlying the Bagshot geology around Billericay.

2.2.4 Soil characteristics have a significant affect on how the catchment responds to rainfall. The South Essex CFMP identifies the presence of seasonally wet, deep clay soils across the Basildon study area. These soils are relatively impermeable and therefore contribute to rapid runoff of surface water runoff, resulting in a greater risk of surface water flooding and causing watercourses to respond rapidly to rainfall. The presence of such geology and soils reduce the risk of flooding from groundwater sources.

2.2.5 When considering surface water runoff in urban areas, soil type and geology are of little importance given the presence of largely impermeable surfaces such as roads and pavements which contribute to rapid runoff of rainfall.

[5] S1KS01 Usual resident population: Census 2001, Key Statistics of Urban Areas
[6] Environment Agency (August 2008) South Essex Catchment Flood Management Plan

2.3 Topography

2.3.1 The topography within the Basildon Borough study area is shown in Figure 2-1. The majority of the district is located on a raised plateau with the exception of the lower lying marshes that form the Basildon New Town Washlands adjacent to Castle Point and the low lying land around Wickford close to the Crouch Estuary. Higher slopes such as the Langdon Hills surround the south west side of Basildon as well as Billericay in the north west of the district.

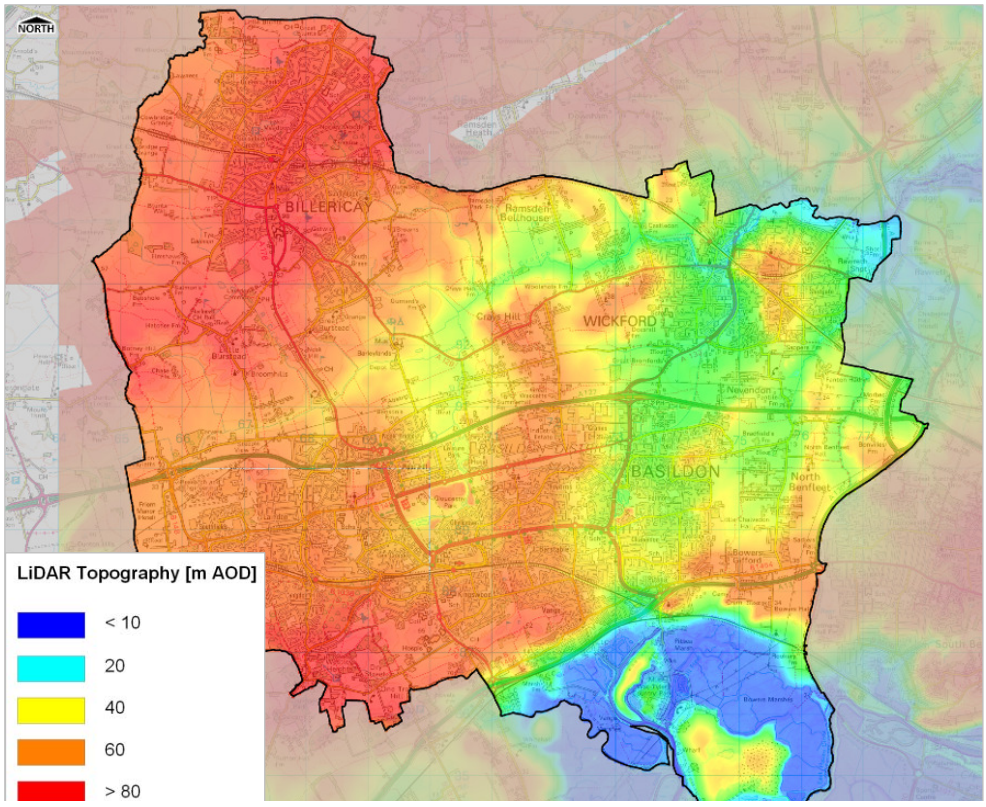


Figure 2-1 LiDAR Topographic Data in the Basildon Study Area

2.4 Hydrology

2.4.1 Main Rivers are defined as large or locally significant watercourses in England and Wales designated by Defra or the Welsh Assembly Government. A map of the Main Rivers within the Basildon Borough area is shown in Figure A-5.

2.4.2 The principal fluvial system in the Borough is the rivers and tributaries associated with the upper region of the River Crouch. The source of the Crouch, The Wilderness, is located in Little Burstead to the south of Billericay, and the watercourse flows eastwards through Wickford and out of the Borough into the neighbouring Borough of Chelmsford. Just outside the study area, in Battlesbridge, the Crouch becomes tidal and forms part of the Crouch and Roach estuary. A number of small tributaries adjoin the River Crouch within the Basildon Borough area and these are shown in Figure A-5.

2.4.3 In the south of the Borough are the Bowers Marshes, comprising a network of channels and rivers. These drain into the Vange Creek and Holehaven Creek which flows south to the River Thames Estuary approximately 4km to the south.

2.4.4 A further river begins west of Billericay and follows the Borough boundary northwards around the urban area of Billericay and out of the Borough. This watercourse is a tributary of the River Wid which adjoins the River Chelmer and subsequently the Blackwater, before meeting the North Sea at Maldon.

2.4.5 The south western part of the Borough drains into the eastern Mardyke system which flows through the Borough of Thurrock and enters the Thames Estuary at Purfleet.

3 Level 1 Assessment – Flood Risk Review

3.1 Overview

3.1.1 Strategic Flood Risk Assessments are required to consider all sources of flooding as set out in Annex C of PPS25 'Forms of Flooding'. This Chapter provides an overview of the different sources of flooding in the Basildon study area along with details regarding how each source is mapped.

3.2 Fluvial Flooding

Sources

3.2.1 Fluvial flooding results from large rainfall in the upper reaches of the catchment causing flows in excess of the carrying capacity of the channel. Where land is protected by fluvial flood defences, flooding can occur as a result of overtopping of the defences when the flood event is greater than that which the defences are designed for.

3.2.2 The main source of fluvial flooding in the district is from the River Crouch and its tributaries. The River Crouch extends from its source in Little Burstead to the east of Battlesbridge, in the neighbouring Borough of Chelmsford, where it becomes tidal and forms part of the Crouch Estuary. The River Crouch has a catchment size of approximately 110km^2 and a main river length of approximately 16km.

3.2.3 The courses of the tributaries of the River Crouch are shown in Figure A-5 (Appendix A) and Figure 3-1 below.

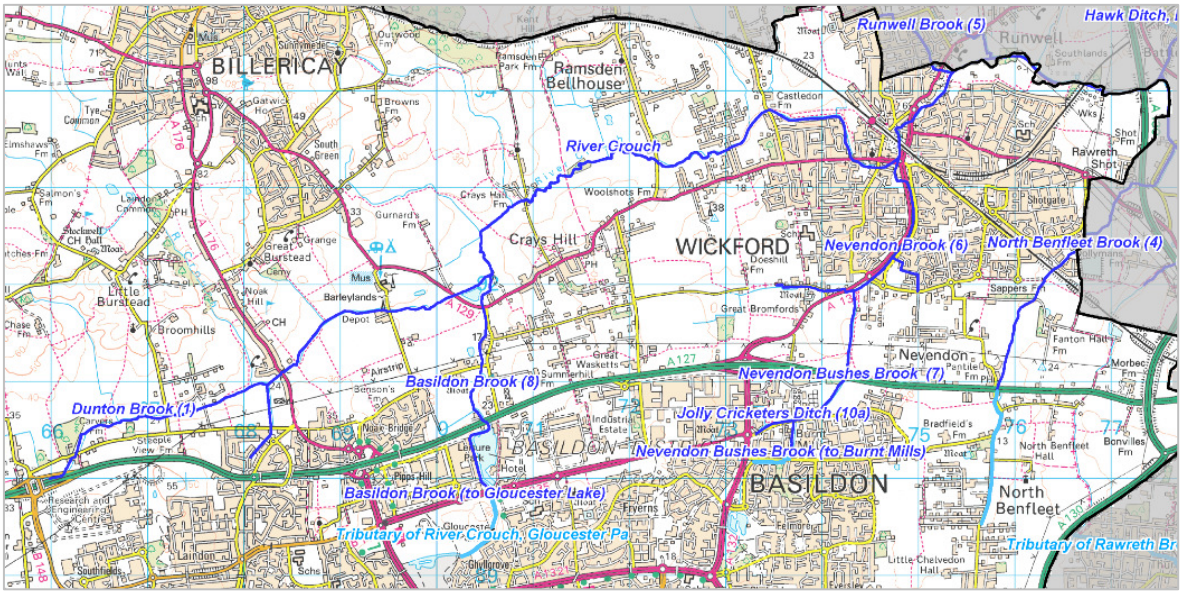


Figure 3-1 Tributaries of River Crouch

3.2.4 The Dunton Brook flows east from the western part of the Borough north of the A127 towards Wickford. The Basildon Brook drains the central part of the Borough and flows north to join the River Crouch. A collection of watercourses including the Nevendon Bushes Brook and the Jolly Cricketers Ditch drain Basildon Town and flow north to join the River Crouch in Wickford.

3.2.5 The Benfleet Brook drains the area surrounding North Benfleet and passes out of the Borough before joining the River Crouch at Battlesbridge.

3.2.6 In the north west of the Borough, the Mountnessing Brook and Haveringsgrove Brook flow northwards to the west of Billericay, as shown in Figure 3-2. These watercourses are tributaries of the River Wid which flows northwards towards Chelmsford.

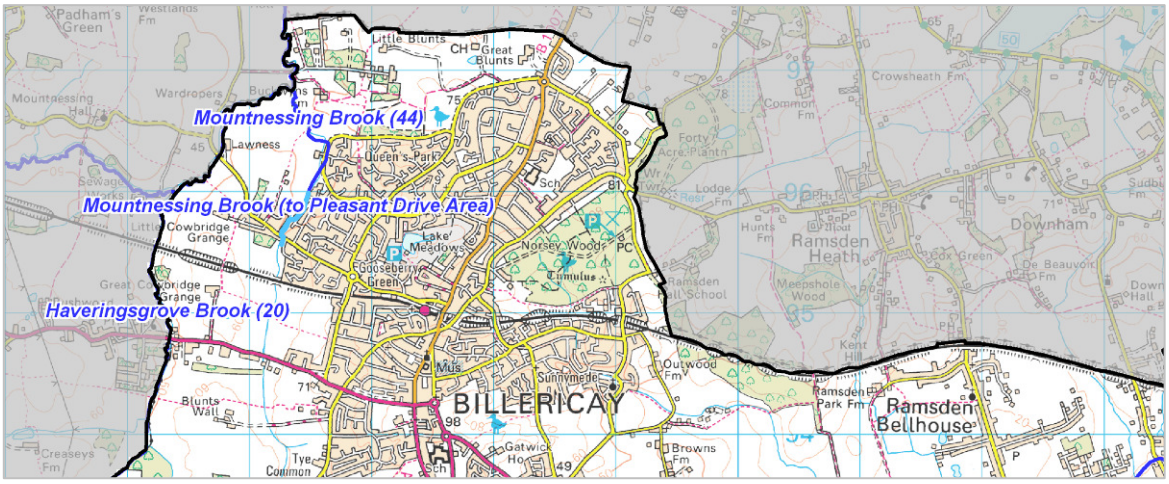


Figure 3-2 Tributaries of the River Wid

3.2.7 The most significant fluvial flood events tend to occur when high rainfall events in the River Crouch catchment coincide with high tidal water levels to produce high volume fluvial flows and elevated water levels in the River Crouch.

3.2.8 Floodwater is conveyed away from the channel banks across areas of flat land adjacent to the channel and via small creeks and drains, depressions in the ground, roads and walkways.

Historical Flooding

3.2.9 In September 1958, 76mm of rainfall fell in two hours, leading to major flooding in the Crouch catchment, notably in Wickford and Runwell. Exactly ten years later Basildon and Wickford were again affected by fluvial flooding from the River Crouch. More than 50 houses and some roads between Nevendon and Wickford were affected by floodwaters and 8 houses were flooded by 0.5m floodwater in Rawreth. Water also came out of bank from the North Benfleet Brook resulting in flooding of 54 properties in Bowers Gifford and the surrounding area.

3.2.10 In 2003, minor flooding from the River Crouch led to flooding of properties in Runwell and Rawreth.

3.2.11 In addition, regular flooding is recorded on the Mountnessing Brook at the Buttsbury Wash, which results in people being rescued from submerged cars on a yearly basis.

Flood Zones

3.2.12 Flood Zones are based on the probability of flooding occurring and are defined in accordance with the definitions in PPS25, which are shown in Table 3-1.

Table 3-1 PPS25 Fluvial Flood Zones (Table D.2 of PPS25, CLG 2010)

Flood Zone	Fluvial Flood Zone Definition	Probability of Flooding
Flood Zone 1	Land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (less than 0.1%).	**Low**
Flood Zone 2	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding in any year (between 1.0% and 0.1%)	**Medium**
Flood Zone 3a	Land assessed as having a 1 in 100 or greater annual probability of river flooding in any year (greater than 1.0%)	**High**
Flood Zone 3b	The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions between the Local Planning Authority and the Environment Agency.	**Functional Floodplain**

Flood Zone 3b – Functional Floodplain

3.2.13 The Functional Floodplains have the highest probability of flooding of all the Flood Zones defined within PPS25. A functional floodplain is defined as an area of land where water has to flow or be stored at times of flood and has an annual probability of flooding of 5% (i.e. from a 1 in 20 year return period event).

3.2.14 The functional floodplain has been mapped for tributaries of the River Crouch. However modelling of the 1 in 20 year flood outline has not been undertaken for the North Benfleet Brook or the Mountnessing and Haveringsgrove Brooks as part of the Environment Agency's Strategic Flood Risk Mapping (SFRM) process. As a result Flood Zone 3b is not available for these watercourses within this SFRA.

3.2.15 Flood storage areas associated with the washland system are also designated Flood Zone 3b. Further information regarding this designation is provided in Section 4.3.

Flood Zone 3a with Climate Change

3.2.16 To ensure delivery of development that is sustainable now and in the future, PPS25 requires that the effects of climate change are taken into account and that Flood Zones with allowances for climate change should be presented.

3.2.17 PPS25 suggests that when completing an SFRA, planning bodies will need to agree how to factor climate change and over what time frame. The standard approach adopted by the Environment Agency in their Strategic Flood Risk Mapping for fluvial risk is to include a net increase of 20% over and above peak flows, which is added to the 1 in 100 year flood event to account for climate change.

3.2.18 Flood Zone 3a including an allowance for climate change has been mapped for tributaries of the River Crouch. However modelling of this flood outline has not been undertaken for the North

Benfleet Brook or the Mountnessing and Haveringsgrove Brooks as part of the Environment Agency's Strategic Flood Risk Mapping (SFRM) process. As a result Flood Zone 3a including allowance for climate change is not available for these watercourses within this SFRA.

3.2.19 In these areas where climate change has not been modelled or mapped, Flood Zone 2 should be used as a surrogate for Flood Zone 3 plus climate change until such time that more detailed information is available, such as an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific FRA.

Mapping

3.2.20 Flood Zone outlines have been provided by the Environment Agency for the fluvial River Crouch and its tributaries and are mapped in Figure A-6. High resolution mapping of the Flood Zones has also been provided in Appendix B; this more detailed mapping should be used for the application of the Sequential Test throughout the Borough.

3.2.21 The Flood Zones for the River Crouch extend from the east of Wickford, upstream to Carvers Farm off Dunton Road. Between Carvers Farm and Barleylands Road the maximum extent of the floodplain is approximately 200m. The floodplain through this area shows inundation of predominantly rural areas, with the exception of approximately 20 properties in the south of Noak Hill near St Agnes Road. The inundation area also extends south of Noak Hill, towards the Steeple View neighbourhood, along the line of a drain discharging from the Laindon area of Basildon New Town. To the east of Barleylands Road, the flood inundation area increases resulting in a substantial area of flooding around Whites Bridge Farm, Crays Hill. This is likely to be the result of contributions from Basildon Brook, which converges with the River Crouch at this point.

3.2.22 The floodplain associated with the Basildon Brook extends from the south of Gloucester Park and the west of the Ghyllgrove area of Basildon, through Gloucester Park, north across the Cranes Farm Road to the Pipps Hill Lake. Flood inundation maps indicate Pipps Hill Lake is of a sufficient capacity to attenuate the 1 in 100 year flood flow. Downstream of Pipps Hill Lake, Basildon Brook breaks its banks again resulting in flooding of properties around Laindon Ponds and Portsea House Farm, in Wash Road, Noak Bridge, Whites Bridge Farm, Crays Hill and surrounding areas, up to and including Crays Hall Cottages in Church Lane, Crays Hill.

3.2.23 Between Crays Hall Cottages and east Wickford, the extent of the floodplain associated with the River Crouch is relatively narrow, extending a maximum of 100m from either bank. Anecdotal evidence suggests flooding in this area affects the New House Farm Plotland area and Sugden Avenue, Wickford. There are approximately 20 properties affected by flooding in this area.

3.2.24 In the centre of Wickford, the floodplain of the River Crouch is again relatively narrow, but does affect properties near the town centre including properties on:

- Riverside Walk
- Reeds Way
- London Road between Victoria Avenue and Irvon Hill Road
- The north of Azalea Avenue
- Wick Drive, and
- The junction of London Road A129 and the A132 – Nevendon Avenue

3.2.25 The floodplain also extends south along Nevendon Brook affecting properties on Douglas Drive.

3.2.26 South of Wickford and north of Basildon, the floodplain of the Nevendon Brook is shown to be extensive, however, relatively few properties are affected. Within Basildon the floodplain of the Nevendon Brook affects the Basildon Sewage Works, the Burnt Mills industrial areas and properties around Nevendon Bushes.

Fluvial Flood Defences

3.2.27 Data from the National Flood and Coastal Defence Database (NFCDD) has been provided by the Environment Agency for the study area. Information regarding the standard of protection afforded by the fluvial and tidal flood defences is mapped in Figure A-7. Flood defences along the fluvial watercourses are predominantly in the form of maintained channels.

3.2.28 In the 1960s and 1970s a flood defence programme was implemented through much of the Borough to protect parts of Basildon New Town, Billericay and Wickford from fluvial flooding.

3.2.29 In Wickford this entailed major river improvement works on the Nevendon Brook and the River Crouch. In Basildon New Town the flood defence programme involved the creation of a network of storage areas to effectively attenuate flood flows and storm water from the town.

3.2.30 The indicative standard of defence for these structures is 75 years. Following extensive flooding in 1998, the Standard of Protection was reassessed in 2000 by Halcrow following concerns regarding the adequacy of the defences. Techniques in the Flood Estimation Handbook (FEH) were used to reassess the flow rates for watercourses and remotely sensed ground mapping data supplemented by site inspections was used to determine the topography of channels and floodplains. Table 3-2 summarises the findings of the assessments for defences within the Borough.

Table 3-2 Indicative Fluvial Flood Defence Standard in Basildon Borough

Fluvial Flood Source	Catchment Area (km^2)	Defended	Existing[1] Standard of Protection (2000)	Indicative[2] Standard of Protection (2000)
Upper Crouch (Wickford)	49	Yes	100	100
River Crouch (Wickford)	80	Yes	100	100
Nevendon Brook (Wickford)	15	Yes	100	100
Pippshill Lake (Basildon)	11	Yes	50	75
Burnt Mills (Basildon)	4.25	Yes	90	100
Nevendon Bushes (Pitsea)	1.45	Yes	100	100
Steeple View (Laindon)	3.66	No	65	75

[1] Current standard of defence offered by defence structures

[2] Standard of defence offered by defence structures at time of construction

3.3 Tidal Flooding

Sources

3.3.1 The Thames Estuary is the only potential source of tidal flooding to impact the Basildon Borough and given that the majority of the Borough is located on a plateau, only relatively small areas in the south are at risk of flooding from tidal sources.

3.3.2 Tidal flooding may occur during storm surge conditions characterised by wind driven waves and low atmospheric pressure coupled with high spring tides. In areas protected from flooding by sea defences, tidal flooding can occur as a result of a breach in the defences, failure of a mechanical barrier or overtopping of defences.

3.3.3 In the event of a breach in the sea defences outside the Borough, the low-lying marshland and drainage channels in the south of the Borough provide pathways for floodwater. This part of the Borough does not have well defined flooding pathways, so floodwater will tend to pool at low-lying areas adjacent to a flood defence breach.

Historical Flooding

3.3.4 The South Essex area has suffered two major tidal flood events during in the 20th century; in 1928 and 1953. In January 1953 a major storm surge coincided with a high spring tide and resulted in widespread flooding affecting eastern England. 307 people lost their lives, a further 30,000 were evacuated and 24,000 properties were destroyed. The overall cost of the disaster is estimated at over £5 billion in the current economic state.

3.3.5 In response to the major flood events, the UK Government initiated the construction of an improved flood defence scheme. Flood defence measures include barriers at Purfleet, Grays, Tilbury, Tilbury Fort, Shell Refinery, Canvey Island and the Holehaven and Benfleet barriers, as well as many kilometres of raised walls in both the upper and lower reaches of the estuary. The loss of life during the 1953 floods could have been avoided through a more comprehensive forecasting and warning system. Therefore, in addition to the hard-engineered structural defences, the local authorities also aimed to improve the warning systems in the area (Thamesweb, 2003).

Mapping

3.3.6 Tidal flood risk is mapped in a similar manner to fluvial flood risk. The definition of Flood Zone 3a is based on the 1 in 200 year flood event (0.5% AEP), rather than the 1 in 100 year event (1% AEP) used to map fluvial Flood Zones.

Table 3-3 Tidal Flood Zones (Table D.2 of PPS25, CLG 2010)

Flood Zone	Tidal Flood Zone Definition	Probability of Flooding
Flood Zone 1	Land assessed as having a less than 1 in 1000 annual probability of sea flooding in any year (less than 0.1%).	**Low**
Flood Zone 2	Land assessed as having between a 1 in 200 and 1 in 1000 annual probability of sea flooding in any year (between 0.5% and 0.1%)	**Medium**
Flood Zone 3a	Land assessed as having a 1 in 200 or greater annual probability of sea flooding in any year (greater than 0.5%)	**High**
Flood Zone 3b	Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event (0.1% AEP). The 1 in 20 year annual probability floodplain is the starting point for consideration but local circumstances should be considered and an alternative probability can be agreed between the Local Planning Authority and Environment Agency	**Functional Floodplain**

3.3.7 Flood Zones 2 and 3a with respect to tidal flood risk have been mapped on Figure A-6 along with the fluvial Flood Zones. The definition of flood zones does not take into account the presence of flood defences.

Tidal Flood Defences

3.3.8 Large sections of South Essex benefit from a high degree of protection from tidal flooding by embankments, hard defences and movable barriers. The southern part of the Basildon Borough at risk from tidal flooding currently benefits from a high degree of defence.

3.3.9 There are two flood barriers that provide protection to the area during high tide events; the Fobbing Horse flood barrier, located to the south of the marshes, on the Holehaven Creek, and the Benfleet barrier, located to the south east of the marshes, on the Benfleet Creek. These are shown in Figure 3-3.

Figure 3-3 Fobbing Horse & Benfleet Barriers

3.3.10 Data from the National Flood and Coastal Defence Database (NFCDD) has been provided by the Environment Agency for the study area. Information regarding the standard of protection afforded by the tidal flood defences is mapped in Figure A-7. This figure shows that the southern portion of the Borough is protected to a design standard of 1 in 1000 year.

3.3.11 Further assessment of the residual risk of tidal flooding in Basildon, in the event of failure of these flood barriers, will be undertaken as part of a Level 2 Strategic Flood Risk Assessment.

3.4 Surface Water Flooding

3.4.1 Surface water flooding typically arises when intense rainfall, often of short duration, is unable to soak into the ground and/or enter drainage systems. It can run quickly off land, resulting in localised flooding. The Pitt Review (2008) revealed that two-thirds of the flooding in summer 2007 was a result of surface runoff in urban areas, as rainwater runs over the surface of the ground or ponds in low lying areas, and there is a growing likelihood of similar flooding in the future.

Historical Records

3.4.2 Urban areas within the study area, including Basildon town, Billericay and Wickford have historically suffered from this form of flooding. In December 2002 and January 2003, the urban areas of Basildon, Billericay and Crays Hill were affected by surface water flooding following heavy rainfall and at least 14 properties are known to have experienced flooding. More generally, pluvial

flooding is known to occur in the urban centres which often coincide with fluvial flooding associated with the River Crouch and its tributaries.

3.4.3 Table 3-4 provides a summary of locations that have been affected by surface water flooding in the Borough during the last 10 years, and these records are presented in Figure A-8.

Table 3-4 Surface Water Flooding Records

Location	Area
Castledon Road	Wickford
A129 Southend Road	Wickford
A176 Noak Hill Road	Billericay
A176 Upper Mayne	Basildon
Brentwood Road	Dunton
Clay Hill Road	Basildon
Cranes Farm Road	Basildon
Curling Tye	Basildon
Hardings Elm Road	Billericay
Mountnessing Road	Billericay
Perry Street	Billericay
Pound Lane	North Benfleet
Botney Hill Road	Little Burstead
Golden Jubilee Way	Wickford
Crays Hill	Wickford
A13 London Road Pitsea Bypass	Basildon
Runwell Road	Wickford

National Level Pluvial Modelling

3.4.4 Following extensive surface water flooding across England in July 2007, the Environment Agency has undertaken a broad scale national mapping exercise of 'areas susceptible to surface water flooding'. This dataset has been mapped for the Basildon study area in Figure A-8. When using this dataset, the following limitations should be considered:

- The map has been produced using a simplified method that excludes urban sewerage and drainage systems, excludes buildings, and uses a single rainfall event;
- The mapping does not show the interface between the surface water network, the sewer systems and the watercourses;
- It does not show the susceptibility of individual properties to surface water flooding;
- The mapping has significant limitations for use in flat catchments.

3.4.5 This mapping is intended for use by the Local Resilience Forums solely to inform emergency planning and should not be used for spatial planning decisions, whether allocating individual sites or determining individual planning applications. In addition, the Environment Agency strongly recommend that local knowledge is applied to assess the suitability of the mapping as an indicator of surface water flooding before emergency planners make decisions based upon it.

3.4.6 In line with these recommendations, local flooding records supplied by Basildon Borough Council, Anglian Water (from their DG5 register), and the Environment Agency have been overlaid onto Figure A-8 to verify this data.

3.4.7 The Areas Susceptible to Surface Water Mapping highlights that the surface water flow paths follow the general topography of the area, as shown in Figure A-2. As to be expected, the predominant flow paths shown in the modelling correlate with the natural topographic depressions and the tributaries of the River Crouch.

3.4.8 The mapping and the information in Table 3-4 highlights that a significant number of properties may be at risk of surface water flooding across the district. The modelled surface water flow paths typically follow the topography and therefore the pathways mimic that of the fluvial systems in the Borough. However other flowpaths are also visible from the mapping, including land surrounding Ramsden Bellhouse, the slopes between Billericay and Crays Hill, western Laindon and North Benfleet.

3.4.9 It is noted that the Environment Agency have commissioned a second edition of the Areas Susceptible to Surface Water Flooding dataset with greater accuracy. In addition, further pluvial modelling is currently being undertaken as part of the Surface Water Management Plan undertaken by Basildon Borough Council (also in partnership with Rochford District Council and Castle Point Borough Council). Both of these datasets should be used to continue to develop and improve the understanding of surface water flood risk posed to the study area and the potential options for mitigation and management of surface water flood risk.

3.4.10 When mapped against the national property database Defra reports that approximately 7,900 properties within Basildon Borough are estimated to be susceptible to surface water flooding. The following table provides a summary of the number of properties that may be susceptible to surface water flooding in each of the key settlement areas in Basildon Borough.

Table 3-5 Number of properties susceptible to pluvial flooding in Basildon BC (Defra 09)

Rank	Settlement	Properties
84	Basildon	3800
98	Wickford	3400
511	Billericay	560
1411	North Benfleet	100
2161	Ramsden Bellhouse	30
2896	Little Burstead	10
	TOTAL	**7900**

3.4.11 The effective management of surface water is a growing concern across the Borough. With the rapid increase in urban development across the Borough over the last 60 years, measures have been taken to manage surface water runoff from the growing urban areas through the creation of the washlands throughout Basildon New Town, Wickford and Billericay. This system is discussed in Chapter 4.

3.5 Sewer Flooding

3.5.1 Sewer flooding is defined as flooding which occurs when the capacity of the underground network system is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters, or as a result of excessive wet weather or tidal conditions.

3.5.2 As part of this study, Anglian Water has provided an extract from their DG5 register which is a record of sewer flooding incidents in the Borough over the last 10 years. The approximate locations of these incidents are summarised in Table 3-6 and in Figure A-8.

Table 3-6 Sewer Flooding Records

Location	Area
Noak Hill Road	Billericay
Clay Hill Road	Basildon
Greenway	Billericay
Graham Close	Billericay
Perry Street	Billericay
Tye Common Road	Billericay
West Park Avenue	Billericay
Elm Road	Pitsea
Cranfield Park	Wickford
Ivy Gate Close	Wickford
Mount Road	Wickford
New House Avenue	Wickford

3.5.3 It is thought that these incidents are the result of heavy rainfall generating significant quantities of surface water that overwhelm the local drainage network. Lack of adequate maintenance prior to large storm events may lead to blockages in the gullies which then prevent surface water entering the drainage system.

3.6 Drainage Ditches & Closed Watercourses

Source

3.6.1 Where information is available, SFRAs should also consider the risk of flooding from small open channels, drainage ditches and culverted watercourses in the study area. These channels and watercourses receive the majority of their flow from inside the urban area and perform an urban drainage function.

3.6.2 There are a number of ditches and closed watercourses within the Borough that pose a source of flood risk due to insufficient capacity or inadequate maintenance of the channels.

3.6.3 It is noted that Basildon Borough Council are the responsible organisation for ensuring that open water courses and piped ditches are kept clear by the responsible organisations and riparian owners. At the current time, few of these watercourses are known and little information is available regarding their ownership. In cases where an owner cannot be found, it passes to the council to carry out any works required, and recharge the responsible person, if identified, at a later date.

3.6.4 A summary of known mechanisms of flooding from drainage ditches, as well as the areas impacted is provided below.

Open Ditch – Tye Common Road junction to Wiggins Lane (Nth)

3.6.5 This privately owned ditch is overgrown and silted up to such an extent that the invert level is now above the outfall pipes to the Essex County Council and Anglian Water drainage systems. Water

therefore discharges over a large section of the road and floods private domestic properties in Wiggins Lane.

Open Ditch – Rear of 2 to 32 The Meadow Way Billericay

3.6.6 This ditch is privately owned. The ditch is blocked as a result of development that has been permitted either side of the ditch, and blockages in the ditch and screens in the section where it becomes piped. Enforcement of clearance and maintenance of the ditch is required to ensure that the profile of the ditch is restored.

Frithwood Ditch

3.6.7 Blockages along the Frithwood ditch are recorded to have resulted in flooding along Second Avenue in Billericay.

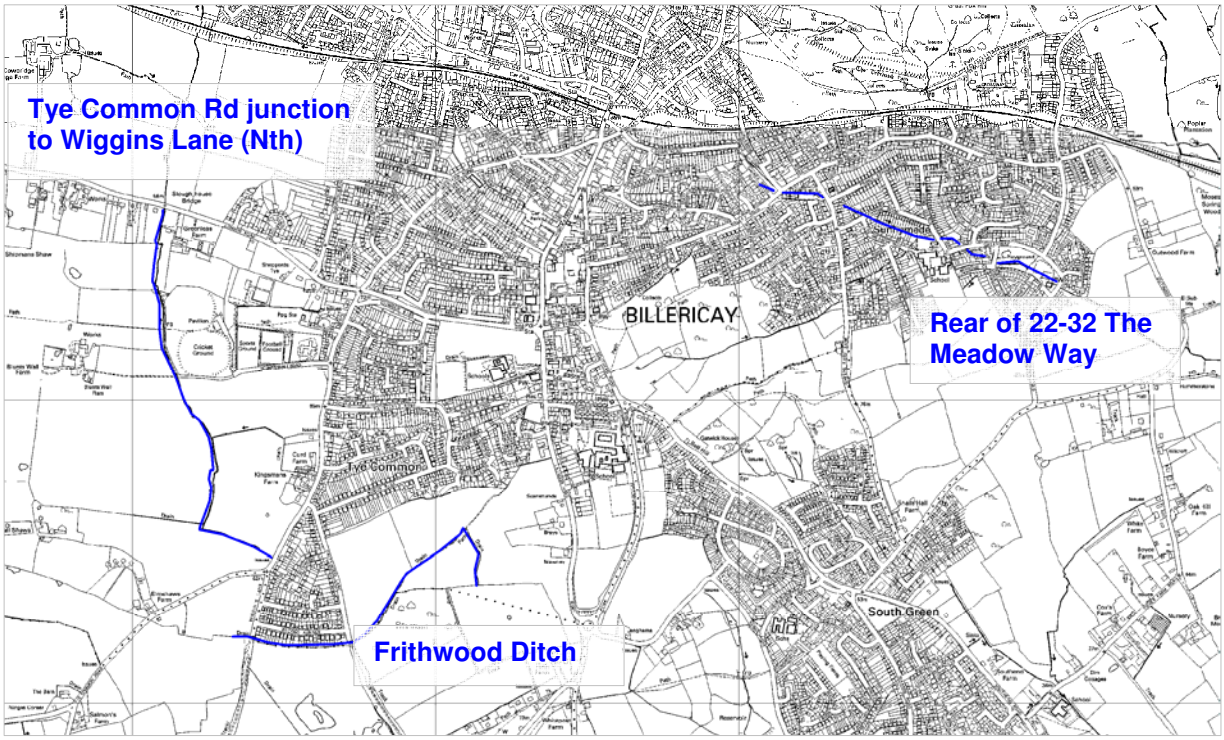


Figure 3-4 Drainage Ditches in the Billericay Area

Open Ditch – Potash Road

3.6.8 At this location to the north of Billericay, there is an open ditch located in a topographic depression. Due to the topography surrounding this ditch, it also serves a surface water attenuation function during times of heavy rainfall.

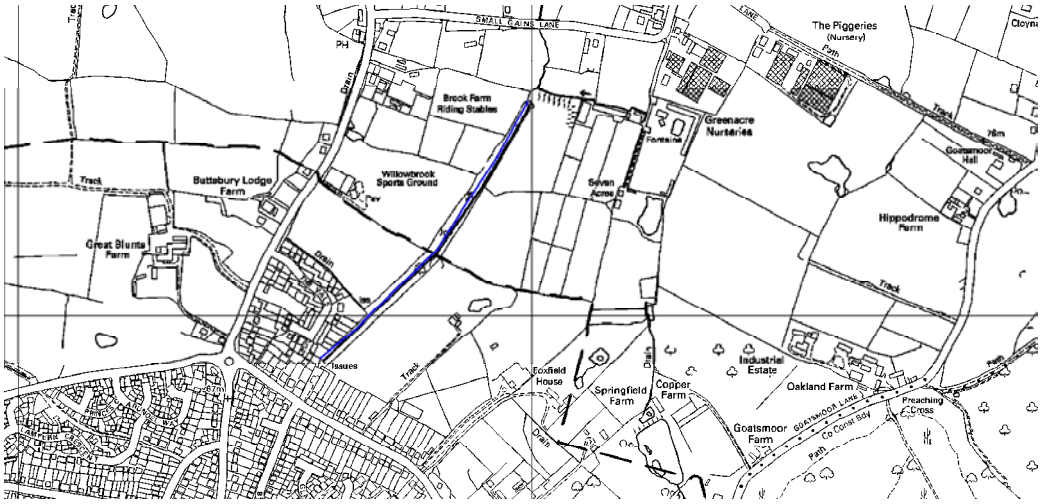


Figure 3-5 Potash Road Drainage Ditch

Open Ditch – Tye Common Road to St Agnes Road, Burstead

3.6.9 This drainage channel is severely overgrown and silted up. Access to the ditch is difficult which makes ongoing maintenance difficult. As a result of the blocked ditch, flooding causes severe damage to numerous domestic properties in St Agnes Road.

Open Ditch – Tye Common Road nr Broomhills Chase

3.6.10 This ditch is also privately owned and has become severely overgrown and filled with silt. An Essex County Council culvert is partially blocked but not accessible due to the condition of the ditch.

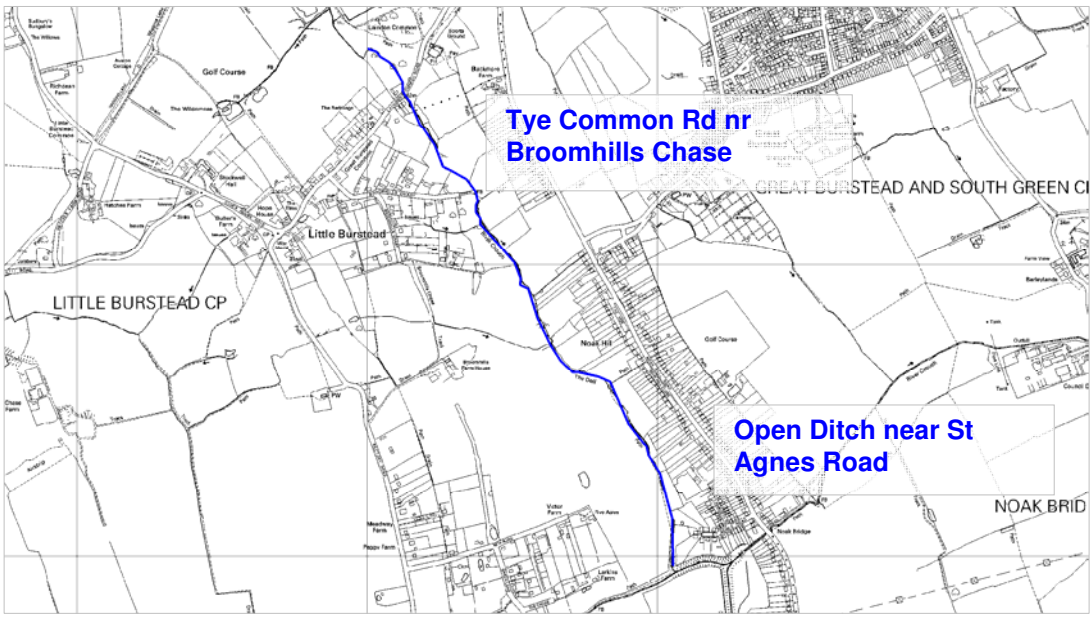


Figure 3-6 Ditches in the Burstead Area

Open Ditch – Lincewood Park Drive to Berry Lane

3.6.11 This ditch is owned and maintained by Basildon Borough Council. It is located within a wooded area also owned by Basildon Borough Council, which is difficult to access from either Lincewood Park Drive or Berry Lane. As a result, this drainage channel is severely overgrown, there is evidence of siltation, damming of the channel banks and breaches in the banks in several locations. Whilst there is little at risk within the wooded area, there is a potential risk of flooding where the ditch becomes piped at the Berry Lane end.

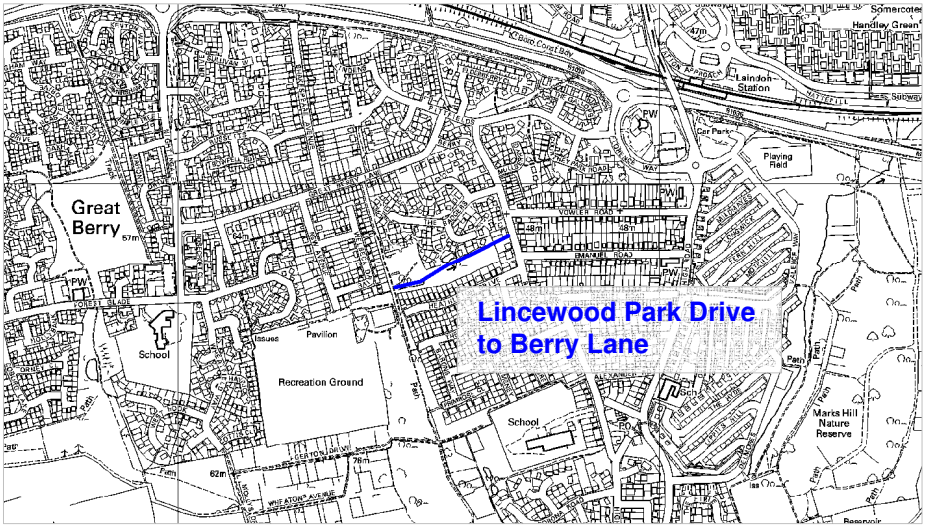


Figure 3-7 Lincewood Park Drive to Berry Lane Ditch

Open Ditch – Gardiners Lane South to East Mayne

3.6.12 The ditch along this section is located within a wooded area maintained by Basildon Borough Counciland has become severely overgrown. There is limited access to the site thereby preventing the use of a large machine. The ditch is silted and dammed in several locations causing a potential flood risk especially where the ditch becomes culverted under East Mayne. This culverted section is maintained by Essex County Council.

Open Ditch – Courtauld Road to Southend Arterial Road A127

3.6.13 This ditch is silted up and severely overgrown to the extent that the exact course of the ditch is unknown. The ditch is dammed in several locations causing a potential risk of flooding to private property. This ditch takes most of the flow from the East Mayne and Waitrose areas.

Open Ditch – Cricketers Way to Courtauld Road

3.6.14 This open ditch is located within a private housing estate and is owned and maintained by Basildon Borough Council. The ditch is silted up and dammed in several locations causing a potential risk of flooding to private property. There is limited access to the open ditch via private car parks at both ends and domestic rear gardens along its length.

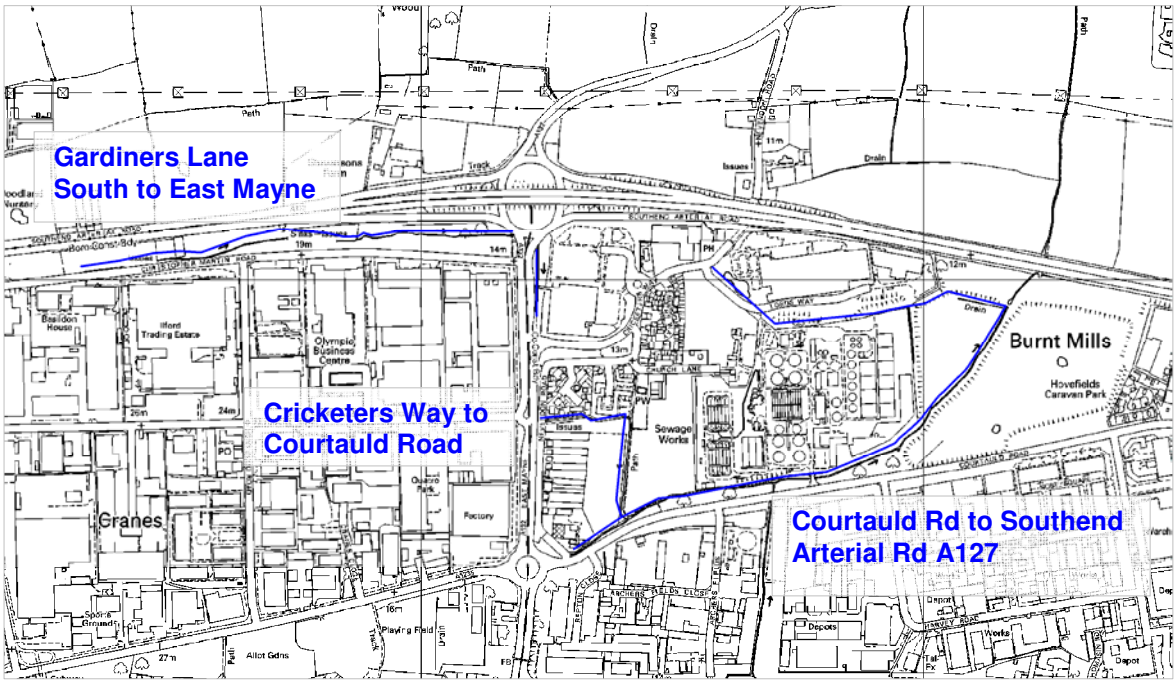


Figure 3-8 Watercourses around the A127

Open Ditch – Pound Lane, North Benfleet just north of Harrow Road to A127

3.6.15 The ditch in this location takes most of the surface water from Bowers Gifford and the highway drainage from Pound Lane until it passes under the A127 in an Essex County Council maintained box culvert. The ditch is overgrown which significantly restricts the flow, and as a result the surrounding area is subject to frequent flooding.

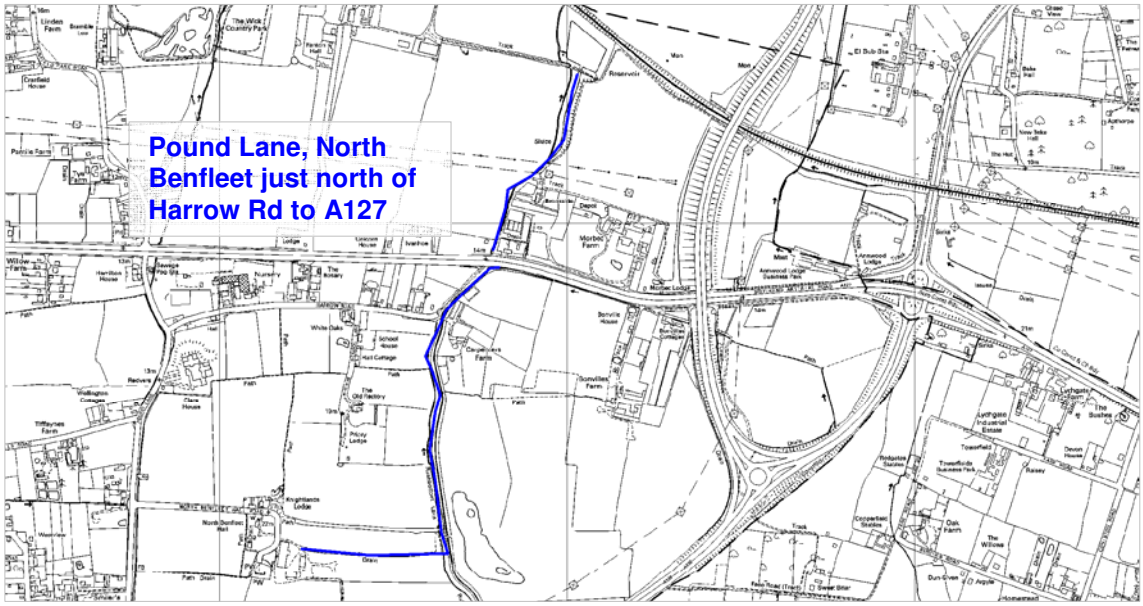


Figure 3-9 Watercourses in North Benfleet

3.7 Groundwater Flooding

3.7.1 Groundwater flooding occurs when water levels in the ground rise above surface elevations. Groundwater flooding may take weeks or months to dissipate, as groundwater flow is much slower than surface water flow therefore water levels take much longer to recede. In addition, the ability for groundwater levels to recede is dependant upon additional inputs from precipitation.

3.7.2 An assessment of the risk of groundwater flooding needs to be carried out; however, a quantified assessment of risk from groundwater flooding is difficult to undertake, especially on a strategic scale. This is due to lack of groundwater level records and the lack of predictive tools (such as modelling) that can assess the risk of groundwater flow and flooding following significant precipitation.

Geology

3.7.3 Data from the British Geological Survey showing the solid and drift geology underlying the study area has been mapped in Figures A-2 and A-3. The predominant solid geology underlying the study area is Thames Group which comprises clay, silt, sand and gravel.

3.7.4 The predominance of clay and deep loam to clay soils lead to a relatively impermeable surface where rapid runoff of surface water can be expected. This results in a greater risk of surface water flooding and causes local watercourses to respond rapidly to rainfall. However, the presence of such geology and soils also create an impermeable barrier to prevent groundwater rising to the surface and therefore reduces the risk of flooding from groundwater.

Aquifer Designation

3.7.5 The risk of groundwater flooding is considered to be greatest where areas are underlain by permeable rocks that form major aquifers.

3.7.6 Figure A-12 shows that the geologies underlying the Basildon Borough study area are either designated a Minor Aquifer or a Non Aquifer. A Minor Aquifer can be defined as strata of variable permeability where groundwater may be used as a local source but seldom produces sufficient water for large abstractions. A Non Aquifer is defined as strata that are generally regarded as containing insufficient quantities of groundwater; however groundwater may flow through the structure.

3.7.7 These conditions suggest that the risk of groundwater flooding in the Basildon Borough study area is low. In addition, the Environment Agency has been contacted and has confirmed that they have no records of groundwater flooding in the Basildon Borough study area.

3.7.8 Further detail with regard to groundwater flood risk across the Borough will be provided as part of the Surface Water Management Plan for Basildon Borough Council which is anticipated in 2011.

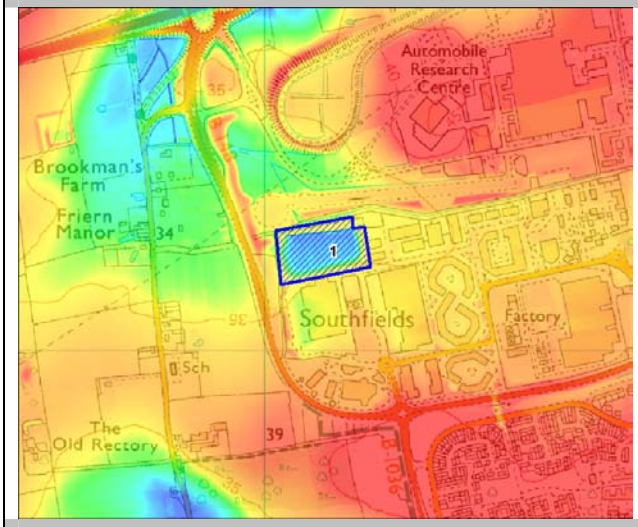
4 Surface Water Management

4.1 Basildon Borough Washland System

4.1.1 As part of the development of Basildon New Town between the 1950s and 1980s, as well as the urban expansion of Wickford and Billericay, several drainage reservoirs and storage areas were created, largely by the Basildon Development Corporation & water authorities, to manage surface runoff from the urban areas. The majority of these washlands remain in use today, under mixed ownership, and continue to form a surface water management function across the highly urbanised area. The washlands operate as a system for each of the local catchment areas, with attenuated flows passed from one storage area to the next via engineered channels and regulated by structures at the outfalls of major storage areas. Figure A-9 shows the storage area locations and their probable extent based on OS Landline data. Table 4-1 below provides an overview of their location, approximate area and condition.

Table 4-1 Basildon Washlands Storage Areas

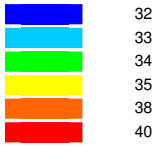
1 Southfields Washland, Southfields, Laindon



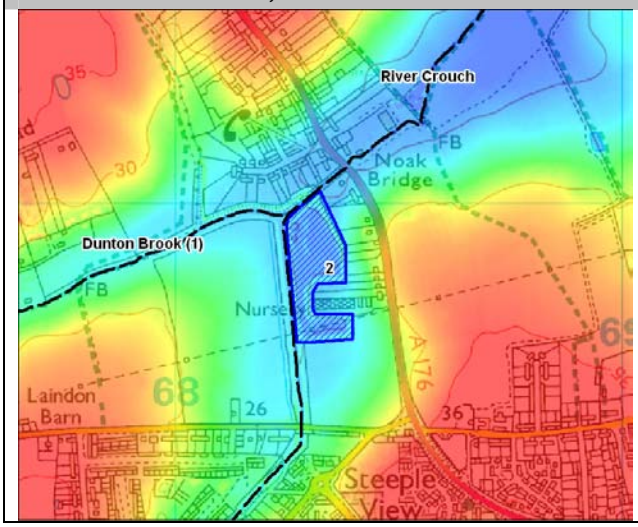
Approximate Area: 3.2 hectares
Approximate Storage Capacity: 59,500m^3

Southfields washland comprises a noticeable depression suitable for the impoundment of flood flows.
The washland is overgrown with semi mature vegetation and tall grasses.
Anecdotal evidence suggests that the effectiveness of this storage area may be limited by waterlogging in the Winter/Spring.

Topography [mAOD]



2 Noak Hill Washland, Laindon

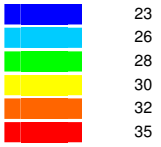


Approximate Area: 3.2 hectares
Approximate Storage Capacity: 56,400m^3

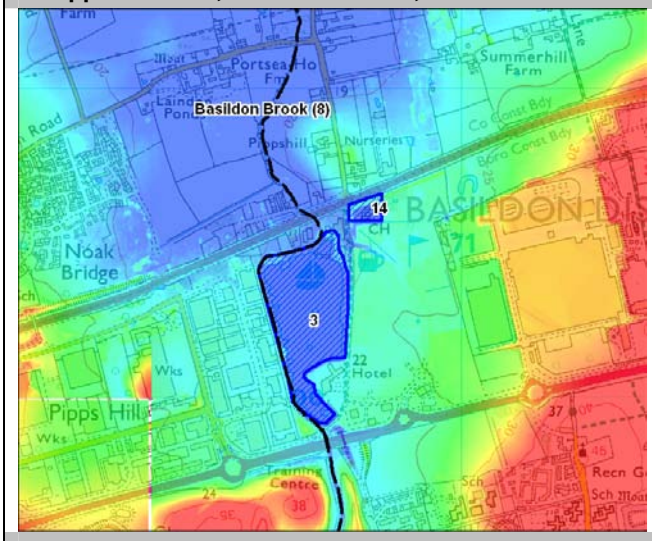
There is a clearly identifiable washland to the south west of Noak Hill. Flood flows would be contained by the bunded bank around the perimeter of the washland. The area is vegetated with tall grasses and light scrub.

Owned by the Environment Agency.

Topography [mAOD]



3 Pipps Hill Lake, Waterfront Walk, Basildon



Approximate Area: 10.8 hectares
Approximate Storage Capacity: 164,400m^3

The Pipps Hill Lake is in good condition. Where the Basildon Brook meets the Lake, a bank acts as a natural weir for the overflow of flood water from Basildon Brook.
Outfall from the northern end of the Lake is maintained by a control structure, however the condition of this structure is considered to be poor. Pipps Hill Lake is owned by a Private Fishing Company.

Topography [mAOD]

	20
	22
	26
	30
	32
	35

4 Courtauld Road Washland, Basildon

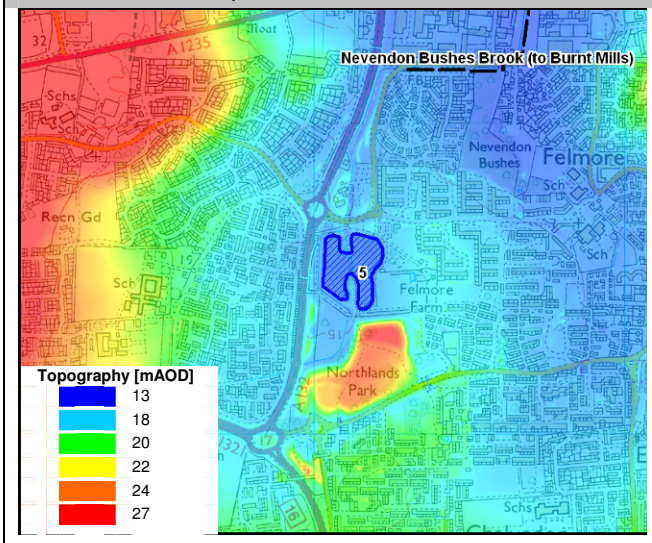
*Approximate Area: 2*2.8 hectares

This washland has been relocated to enable the development of the area to the south of the A127 as a waste management facility. The Nevendon Brook has been diverted to enable this development. The new washland is to be managed as a privately owned nature reserve.

Topography [mAOD]

	10
	12
	16
	18
	20
	25

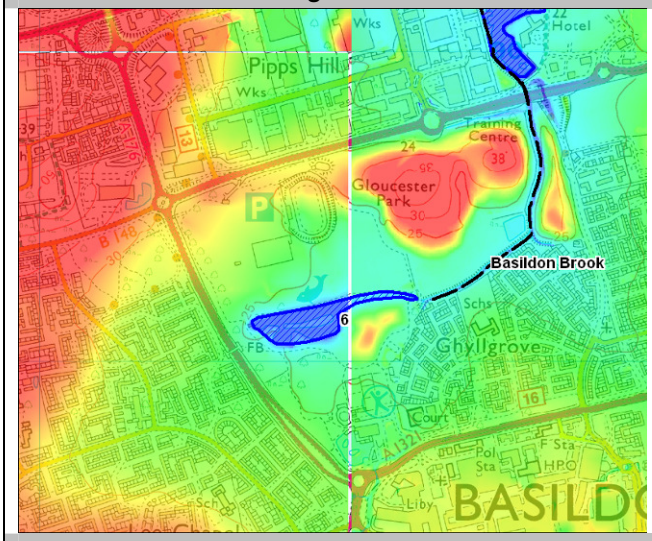
5 Northlands Park, Pitsea



Approximate Area: 3.0 hectares
Approximate Storage Capacity: 57,900m^3

Northlands Park is used extensively for amenity purposes and is therefore in good condition.
A large open culvert runs around the south, west and northern boundaries of the lake. Many of these drains are overgrown. On the northern boundary the culvert runs underground through a flow restrictor before flowing out of the site along an open culvert. The culverts are fed from the storm water drains for a large amount of the local urban drainage.
At times of heavy rain, the flow restrictor operates to back up the flow in the culvert, forcing it over a purpose built overflow section in the lake bank and into the lake. After the storm event, excess water in the lake flows back into the culverts and away.
This storage area is maintained by Basildon Borough Council.

6 Gloucester Park Fishing Lake

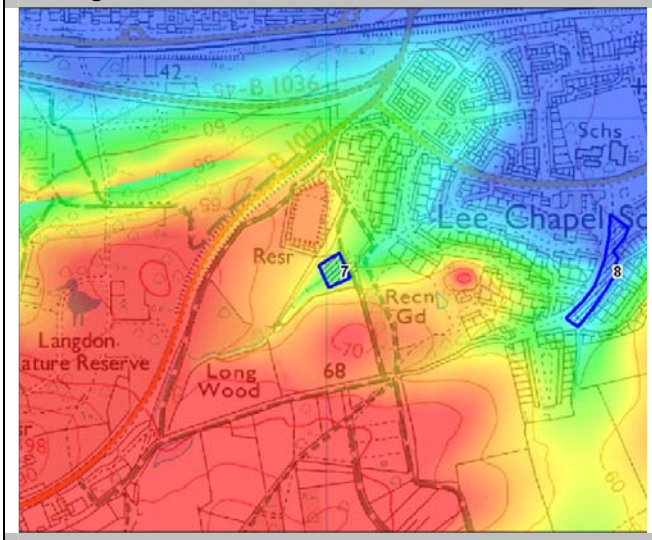


Approximate Area: 3.1 hectares

Gloucester Park is a large man-made lake, which is essentially a widening of a large storm water overflow drain. The storm water drain enters on the west end of the lake and exits at the east end. It does not flow under normal circumstances.
The lake is suffering from a build up of silt particularly in the long arm on the east end near the outfall (Blue Roof Report).

Topography [mAOD]

7 Long Wood Washland



Approximate Area: 0.3 hectares

Approximate Storage Capacity: 9,500m^3

The washland at Long Wood is heavily overgrown by mature tress and scrub.

Topography [mAOD]

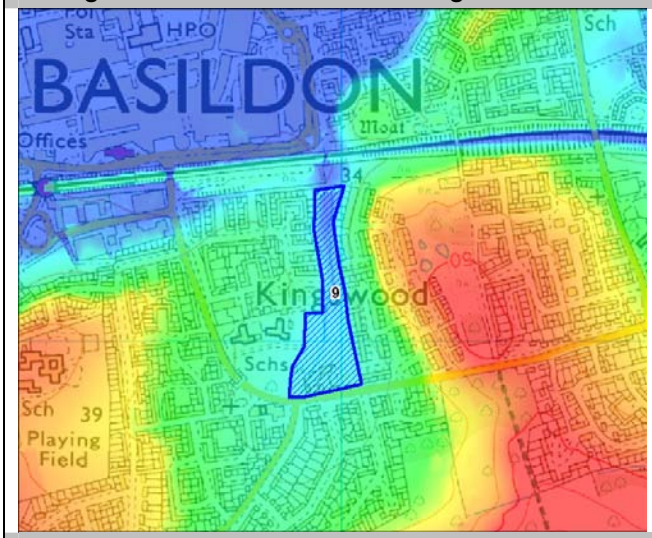
8 Lee Chapel South Flood Relief Works

Approximate Area: 0.7 hectares
Approximate Storage Capacity: 6,500m^3

The Lee Chapel South Flood Relief Works comprises an open ditch feature with throttle points along its length to encourage retention of flow. During site visits, all throttle points were noted to be silted up. The final outfall from the system was completely blocked. The potential for the system to be used to its capacity is dependent upon ongoing maintenance of these outfalls and throttle points as well as regular clearance of the ditch.

Topography [mAOD]

9 Kingswood Surface Water Balancing Area



Approximate Area: 3.3 hectares
Approximate Storage Capacity: 53,500m^3

This area is a local amenity area with a swale and an embanked footpath that serve to provide contained storage of flood water during heavy rainfall events.
During site visits, the swale was noted to be overgrown; however this is unlikely to significantly affect the performance of the balancing area. The remainder of the storage area is considered to be in a good condition.

Topography [mAOD]

30
32
38
40
45
50

10 Dry Street Washland, Basildon

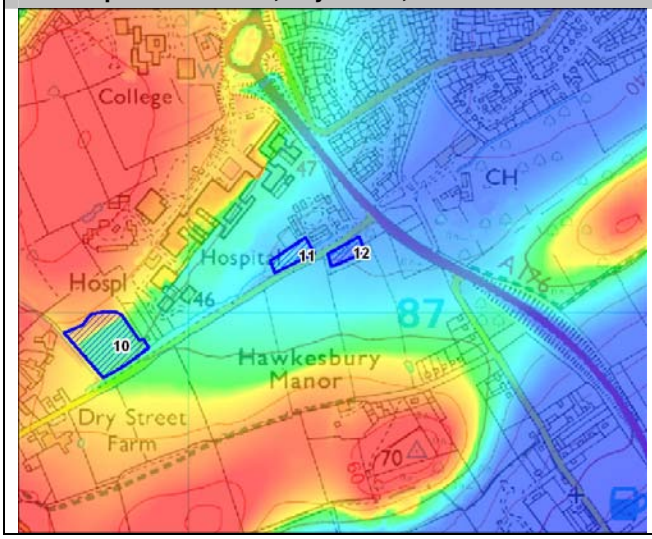
Approximate Area: 1.4 hectares
Approximate Storage Capacity: 4,300m^3

The washland at Dry Street is approximately 1.4 hectares. There is a drainage ditch that links this washland to the Hospital Washland directly to the east.
This washland is heavily overgrown with mature trees and scrub which may limit its capacity to store surface water flows.

Topography [mAOD]

48
50
51
52
56
60

11 Hospital Washland, Dry Street, Basildon



Approximate Area: 0.3 hectares

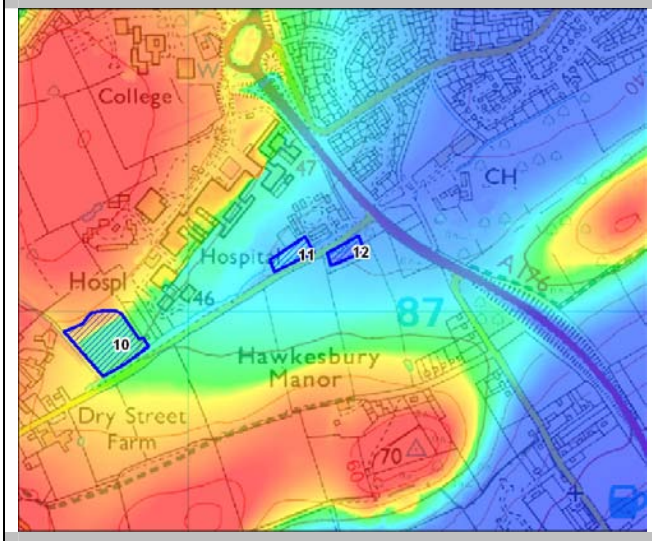
Approximate Storage Capacity: 31,900m^3

This washland has been retained as a balancing pond within the Hospital site.

Topography [mAOD]

48
50
51
52
56
60

12 Wootens Washland



Approximate Area: 0.2 hectares

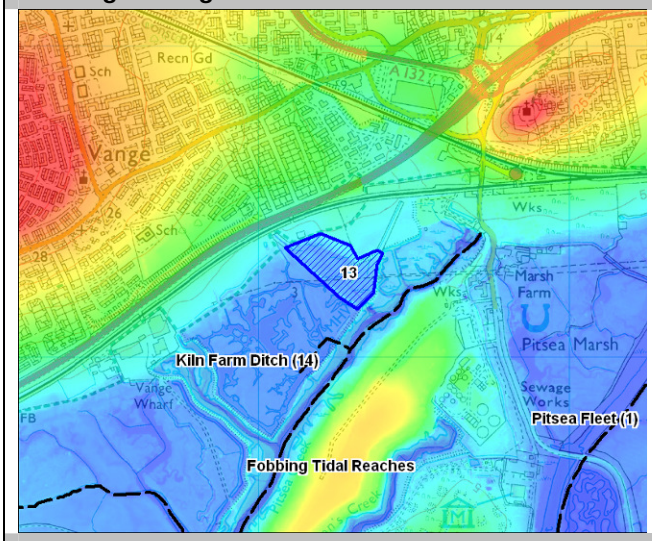
Approximate Storage Capacity: 4,170m^3

Site visits identified that this small washland is heavily overgrown with mature trees and scrub which are likely to impact on its ability to store and attenuate surface floodwater.

Topography [mAOD]

	48
	50
	51
	52
	56
	60

13 Vange Storage Basin



Approximate Area: 3.8 hectares

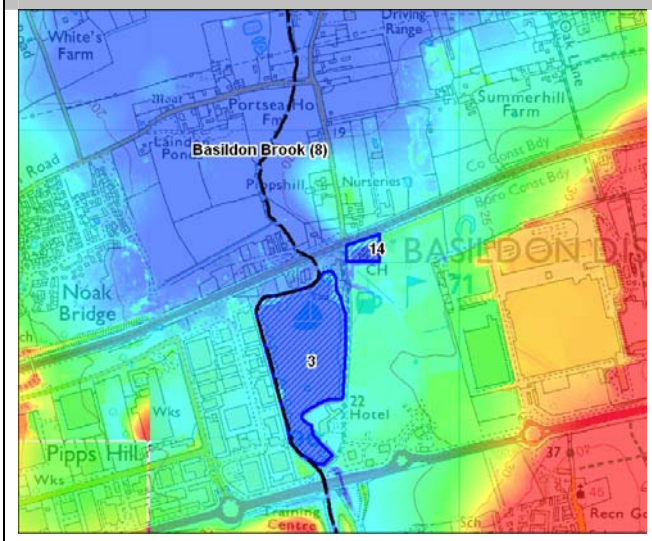
Approximate Storage Capacity: 89,900m^3

This storage basin is not accessible; however, a review of aerial photography indicates large area of open ground available for the retention of floodwater without impacting on sensitive receptors.

Topography [mAOD]

	2
	4
	10
	18
	30
	35

14 Turners Chase Washland

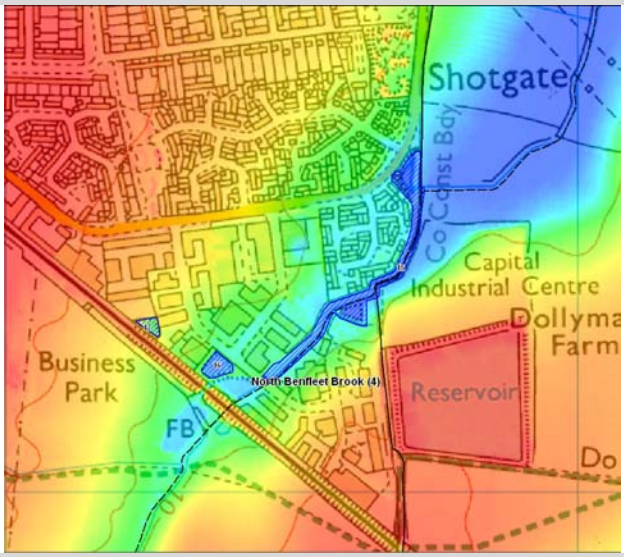


Approximate Area: 0.8 hectares

Topography [mAOD]

	20
	22
	26
	30
	32
	35

15 Wethersfield Way Washland, Wickford



Approximate Area: 1.2 hectares

Topography [mAOD]

7
9
10
12
15
18

16 Hurricane Way and 17 Blenheim Court, Wickford

Hurricane Way Approximate Area: 0.15 Ha
Blenheim Court Approximate Area: 0.07 Ha

Topography [mAOD]

7
9
10
12
15
18

18 Albany Road, Wickford

Approximate Area: 0.23 Ha

Topography [mAOD]

7
9
10
12
15
18

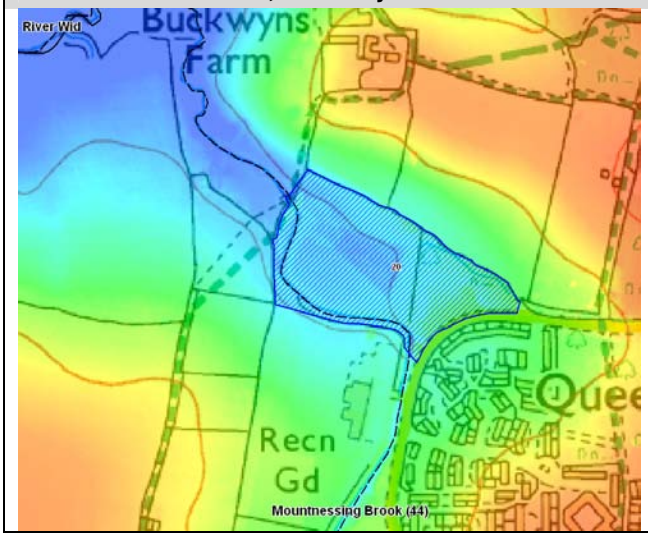
19 Pleasant Drive, Billericay

Approximate Area: 0.21 Ha

Topography [mAOD]

50
52
54
56
58
60

20 Hannikins Meadow, Billericay



Approximate Area: 4.1 Ha

Topography [mAOD]

44
46
48
50
52
60

4.2 Storage Area Adequacy

4.2.1 As part of the 2006 SFRA, an assessment was undertaken to provide an indication of the effectiveness of the washlands storage area in managing flood flows. This assessment concluded that when the storage system is properly maintained there is adequate storage within the existing washland basins to mitigate flood risk from rainstorms with a return period up to 200 years (0.5% AEP). However the condition of some of the storage areas and associated control structures was noted to be poor, which may significantly affect both the storage capacity available during flood events and the routing of flood waters and lead to localised flooding, that might otherwise be preventable.

4.2.2 Table 4-2 presents the volumes for known storage areas compared to the runoff volumes that can potentially be generated by their contributing catchments for a range of storm events.

4.2.3 Estimates of storage area volume were determined from querying available landline and LiDAR data and verified by field observations. These do not take into account the current condition of the system in terms of vegetation cover.

4.2.4 Estimates of the volumes of runoff generated by contributing catchments for a range of storm return periods were calculated using the 'Rational Method'. This empirical formula enables peak flow to be calculated for catchments based on limited information regarding catchment area, rainfall intensity and a dimensionless coefficient of impermeability. For the Basildon New Town washland catchments a coefficient of 0.95 was used to represent impervious urban areas.

4.2.5 This peak flow was applied to a stylised unit hydrograph for the catchment to estimate the volume of runoff generated by the catchment. The results indicate that all washlands have sufficient capacity to attenuate the volume of runoff generated by a range of storm events up to and including the 200 year storm.

4.2.6 The positive condition of the washlands was however noted to be linked to amenity value. In cases where storage areas were also used for local amenity, fishing lakes, manicured parks etc (Northlands Park, Pipps Hill Lake) the washlands were generally in a good condition. In areas with little amenity requirement the sites of washlands appear to have been left to nature, raising concerns regarding their storage and routing potential during extreme events.

4.2.7 It was recommended in 2006 that a programme of routine washland maintenance was developed to ensure the full capacity offered by these flood storage areas and connecting channels was available in the event of a flood. In the first instance remedial works have involved clearance of vegetation, and ensuring any incoming and out-going pipework and structures operated freely. It may also be beneficial to undertake a comprehensive survey of any connecting channels and pipework to ensure they are free of blockages. Whilst channels were inspected and noted to be in the main heavily overgrown, connecting pipework was not inspected as part of this assessment. Such a programme has yet to be put in place by Basildon Borough Council or other responsible bodies.

4.2.8 Undertaking these remedial works will enable clearer identification of washland areas, any specific remedial works that may be necessary and also enable more detailed information to be obtained should hydraulic modelling be desired. Such hydraulic modelling would be necessary to identify the contribution each storage area and connecting channel has to managing flood risk in an area and throughout Basildon Borough. This would require detailed knowledge of the system including contributing catchments, dimensions of connections between storage basins and hydraulic modelling of the system before the contribution that a part of the washland system has in managing flood risk for an area and Basildon Borough as a whole.

Table 4-2 Storage Area & Runoff Volumes

Washland Name	Runoff Volume (m^3) for Storm Event Return Period (years)							Washland Area Indicative Storage Capacity (m^3)
	2	5	10	25	50	100	200	
Southfields Washland	209.68	280.76	394.49	543.75	687.69	870.72	1,101.72	**59,496.22**
Noak Hill Washland	997.42	1,438.31	1,821.37	2,464.64	3,086.22	3,859.58	8,528.66	**56,409.85**
Pipps Hill Lake	3,937.13	5,567.15	6,996.55	9,353.81	11,610.76	14,394.34	17,804.84	**164,361.84**
Courtauld Road Washland	2,017.00	2,883.36	4,995.12	4,913.90	6,132.23	7,634.82	9,502.92	**441,624.62**
Northlands Storage Basin	916.92	1,322.07	1,691.68	2,310.06	2,907.12	3,646.34	4,577.48	**57,856.98**
Long Wood Washland	349.92	506.98	647.50	884.45	1,113.14	1,396.94	1,755.13	**9,492.78**
Lee Chapel South Flood Relief Works	141.28	204.97	262.87	360.15	455.10	574.38	722.61	**6,424.00**
Kingswood Surface Water Balancing Area	672.25	972.18	1,241.08	1,685.81	2,115.01	2,652.82	3,325.07	**53,560.05**
Dry Street Washland	316.00	462.05	592.17	809.92	1,022.36	1,290.56	1,625.15	**4,293.00**
Hospital Washland	161.19	234.20	301.71	413.30	523.51	659.89	832.10	**31,870.65**
Wootens Washland	316.00	462.05	592.17	809.92	1,022.36	1,290.56	1,625.15	**4,165.20**
Vange Storage Basin	333.03	488.45	624.44	857.56	1,082.35	1,365.43	1,722.89	**89,943.05**

4.3 PPS25 Designation of Washland Areas

4.3.1 PPS25 states that local planning authorities should identify within their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. Flood Zone 3b comprises land where water has to flow or be stored in times of flood. PPS25 states that the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

4.3.2 In accordance with PPS25 and following correspondence with the Environment Agency, the washland areas that have been identified by Basildon Borough Council have been designated as Flood Zone 3b Functional Floodplain for the purposes of informing spatial planning across the Borough.

4.4 Surface Water Management Plan

4.4.1 Basildon Borough Council has recently commissioned a Surface Water Management Plan in partnership with Castle Point Borough Council and Rochford District Council. As part of this work a 2D hydraulic direct rainfall model will be built for the area and an assessment made of the capacity of the existing washland system to store rainfall during extreme rainfall events.

4.4.2 It is recommended that as part of this work an assessment is made of the potential to redesign components of the existing washland system to increase the volume of storage available and/or free up possible development land.

4.4.3 In the light of this proposed work no further assessment has been carried out with respect to the capacity of the washland system as part of this SFRA.

5 Flood Risk Management & Warning Systems

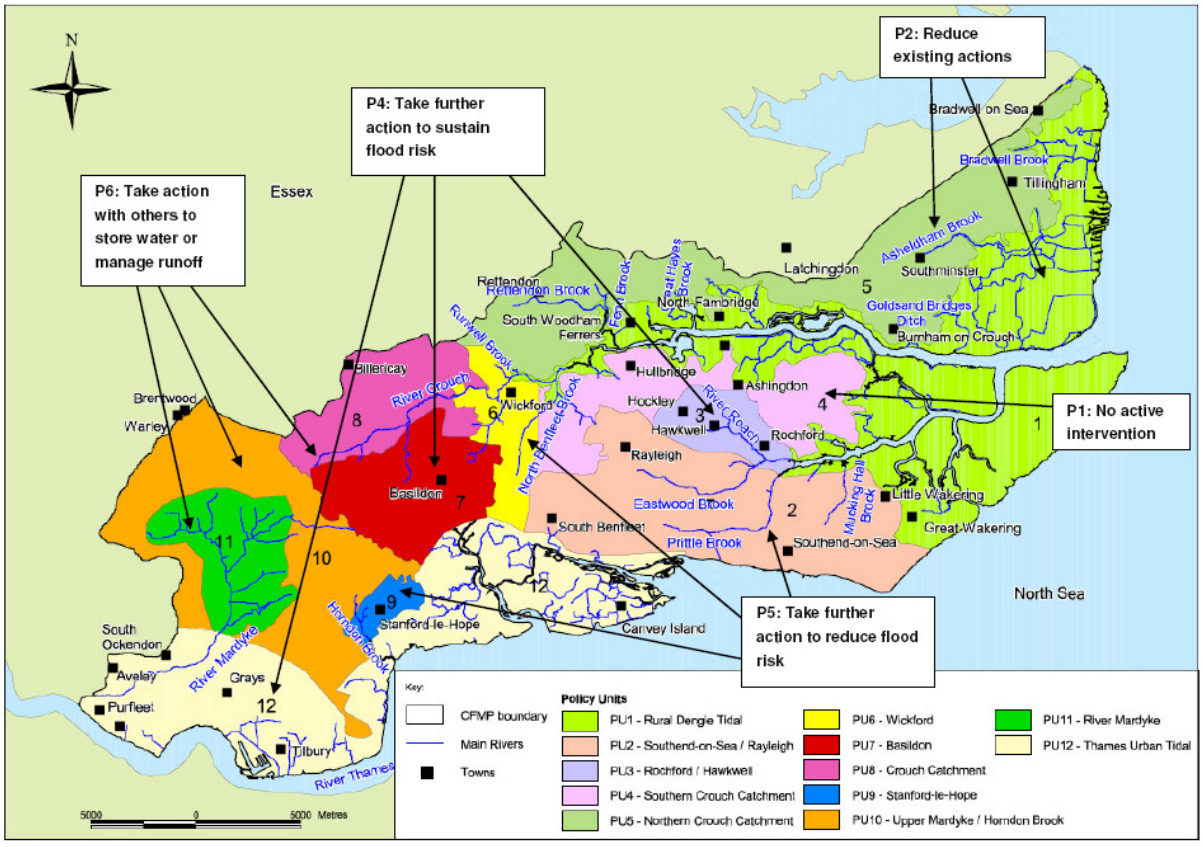
5.1 Introduction

5.1.1 SFRA reports are part of a wider collection of documents relating to flood risk management and warning. It is emphasised that SFRA reports are living document which should be updated when Environment Agency datasets and other documents such as Catchment Flood Management Plans, Strategic Warning Systems and Shoreline Management Plans are updated and revised. This helps to contribute to a joined-up approach to flood risk management as a whole.

5.2 Catchment Flood Management Plans

5.2.1 The Catchment Flood Management Plans for South Essex and North Essex were prepared by the Environment Agency and published in August 2008 and December 2008 respectively. The purpose of these CFMPs is to develop policies for the long-term management of flood risk within the catchment, taking into account the likely effects of changes in climate, land use and land use management, and urban development. The policy approaches are defined for particular areas in the catchment and entail accepting, maintaining, reducing or transferring the flood risk. The policies for areas within Basildon Borough are shown in Figure 5-1 and described below.

Figure 5-1 South Essex CFMP Policy Areas (extracted from South Essex CFMP, 2008)



Preferred Policies

Policy Unit 6: Wickford (South Essex CFMP)

5.2.2 This unit covers the extended area of Wickford and its surrounding areas, including the River Crouch, Nevendon Brook and North Benfleet Brook. The selected policy for this area is Policy 5, to take further action to reduce flood risk, both now and into the future.

Policy Unit 7: Basildon (South Essex CFMP)

5.2.3 Policy Unit 7 includes the urban area of Basildon located in the upper Crouch, upstream of Wickford. Within this policy unit, it is proposed to take further action to sustain the current level of flood risk into the future, responding to the potential increase in risk from urban development, land use change and climate change.

Policy Unit 8: Crouch Catchment (including the majority of Billericay) (South Essex CFMP)

5.2.4 This unit is defined by the upper relatively rural River Crouch sub catchment, and excludes Basildon and Wickford. The main urban area in the unit is Billericay. The selected policy for this area is to take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

Policy Unit 12: Thames Urban Tidal (South Essex CFMP)

5.2.5 The area covered by this policy unit is predominantly tidal but is protected by sea defences up to the 1 in 1000 year standard of protection. Current flood risk management is primarily through flood warnings. The selected policy for the area is Policy 6; to take further action to sustain the current level of flood risk into the future, responding to the potential increases in risk from urban development, land use change and climate change.

Blackwater & Chelmer Policy Unit (North Essex CFMP)

5.2.6 This area is predominantly located in Chelmsford Borough; however the north west part of the Basildon Borough within the catchment of the River Wid is covered by this policy unit. Current flood risk management includes flood warning on the main rivers, channel maintenance, obstruction clearance, asset management and planning liaison. The adopted policy for this area is to reduce existing flood risk management actions, accepting that flood risk will increase over time.

5.3 Thames Estuary 2100

5.3.1 The Thames Estuary 2100 Project (consultation April 2009) was led by the Environment Agency with the aim of developing a long-term tidal flood risk management plan for London and the Thames Estuary. This is in response to the changing climate and ageing flood defence system. The report includes a detailed assessment and appraisal of options available to manage flood risk, their economic benefits and environmental impacts in the short term (next 25 years), medium term (the following 40 years) and long term (to the end of the century).

5.3.2 The southern part of the Borough including Bowers Marshes and the northern most part of the Fobbing Marshes is covered by the Thames Estuary 2100 Project.

Bowers Marshes

5.3.3 The Bowers Marshes is an open area of freshwater grazing marshes. The area at risk of flooding includes the railway line, the main A130 road, the Wat Tyler Country Park, an electricity generation plant and a sewage works. The flood risk management policy for this area is Policy 4; to take

further action to sustain the current level of flood risk into the future, responding to potential increases in risk from urban development, land use change and climate change.

Fobbing Marshes

5.3.4 The Fobbing Marshes extend northwards just inside the Basildon Borough Council administrative boundary. This area comprises freshwater marshes, some of which are designated SSSIs. Much of the defence system of the marshes consists of embankments on Vange Creek, upstream of the Fobbing Horse Barrier.

5.3.5 The flood risk management policy for this area is Policy 3, to continue with existing or alternative actions to manage flood risk at the current level, accepting that flood risk will increase over time from this baseline. This approach is to be supplemented with local secondary defences to protect key sites where necessary.

5.4 Flood Warning Systems

5.4.1 The Civil Contingencies Act (2004) requires that the Environment Agency *'maintain arrangements to warn the public of emergencies'* including flood risk. The existing warning service provided by the Environment Agency applies only to flooding from rivers and the sea. There is no obligation on Water Companies to provide warnings of flooding from sewers or drains.

5.4.2 The Environment Agency are responsible for issuing flood warnings to the public based on meteorological reports and forecasts, including the use of radar to track storms and rainfall intensity, and data from the national tide gauge network. If flooding is forecast, warnings are issued using a set of four codes via the Environment Agency website, through TV and radio, SMS, fax, direct to your home via an automatic voice message and in some areas via public address systems.

5.4.3 All existing development is included in the service under the 'opt out' policy; however any new development in the area will need to 'opt in' in order to benefit from the service. Figure A-10 shows the extent of Flood Warnings across the Borough.

5.4.4 The Environment Agency Flood Warning service consists of three warning messages as follows:

- **Flood Alert** - flooding is possible and that you need to be prepared.
- **Flood Warning** - flooding is expected and that you should take immediate action. You should take action when a flood warning is issued and not wait for a severe flood warning.
- **Severe Flood Warning** - there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

5.4.5 It should be noted that while it is a significant challenge to provide warning of a possible flood defence failure (breach) the likelihood of a failure is significantly increased during an extreme tide event. In this scenario, warnings of a high tide will have been issued to the local community who should be on alert.

5.4.6 The degree of advance warning that can be provided is critical to the amount of action that can be taken to prevent damage. It is anticipated that the Environment Agency will be able to provide at least 12 hours of warning time of extreme tides (i.e. 200 year event or greater (0.5% annual probability)).

5.4.7 Lead times for flood warnings from the Environment Agency with respect to fluvial systems are generally much shorter. For example, a lead time of 2 hours is expected for flooding from the River Crouch in Wickford and the surrounding area. Warning lead time availability is compounded by the rapid rate of water level rise in these watercourses in response to intense rainfall, the closeness of urban settlement to the Environment Agency's river level monitoring stations and the relatively short pathway from the sources of the watercourses to their respective points of outfall to estuary.

5.5 Basildon Borough Council Emergency Plan

5.5.1 The Civil Contingencies Act 2004 delivers a single framework for civil protection. Basildon Borough Council are designated as a Category 1 responder and have a legal duty to assess local risks and use this information to inform emergency planning, put in place emergency plans and put in place arrangements to warn, inform and advise the public in the event of an emergency.

5.5.2 The Civil Contingencies Act (2004) defines an emergency as:

- *An event or situation which threatens serious damage to human welfare (e.g. loss of life, injury, damage to property).*
- *An event or situation which threatens serious damage to the environment (e.g. contamination).*

5.5.3 Flood Warning and Emergency Procedures tend to form part of a higher level emergency management plans for the wider area including information such as repair procedures, evacuation routes, refuge areas, flood warning dissemination and responsibilities.

5.5.4 Evacuation is where flood warnings provided by the Environment Agency can enable timely evacuation of residents to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred and prior evacuation has not been possible.

5.5.5 Basildon Borough Council has prepared an Emergency Plan (December 2009) which sets out the framework for integrated management of emergencies within the Borough, including flooding incidents. Rest centres have been allocated across the Borough within the Emergency Plan.

5.5.6 It is recommended that the findings of this report and the Level 2 SFRA are used to amend and update the Emergency Plan with respect to flood risk considerations.

5.6 Basildon Borough Council Flooding & Severe Weather Plan

5.6.1 Basildon Borough Council have also prepared a Flooding and Severe Weather Plan (June 2010), the aim of which is to set out the Council's management arrangements and response to a flood and severe weather related warnings and incidents.

5.6.2 The Plan considers incidents including tidal surges, breaches in defences, fluvial flooding and surface water flooding as well as severe weather incidents. The Plan also describes historic events and the warnings, alerts and notification systems that are in place.

5.6.3 Basildon Borough Council has four levels of response as shown in Figure 5-2; Level 4 is the opening of a rest centre upon request from the emergency services, and Level 0 is the stand down procedure.

Figure 5-2 Levels of Response, Basildon BC Flooding & Severe Weather Plan (June 2010)

8.1 Prompt Table

Response Level	Action Summary	Internal liaison	External liaison
Level 1	Vigilant approach, take note and familiarise with the potentially effected area	No	No
Level 2	Remain vigilant; CONSIDER notification to BC Plan owners. BC plan owners to refer to individual BCP's to assess potential risks to services	**Consider** BC Plan Owner Notification	No
Level 3	Notify Heads of Service and BC plan owners. Refer to Rest Centre Plan and put arrangements on standby.	Heads of Service. BC Plan Owners.	Essex County Council.
Level 4	Evacuation required refers to Emergency Plan and Rest Centre Plan.		
Level 0	Stand Down; inform those previously notified at previous levels.		

5.6.4 It is recommended that the findings of this report and the Level 2 SFRA are used to support future revisions of the Basildon Borough Council Flooding and Severe Weather Plan.

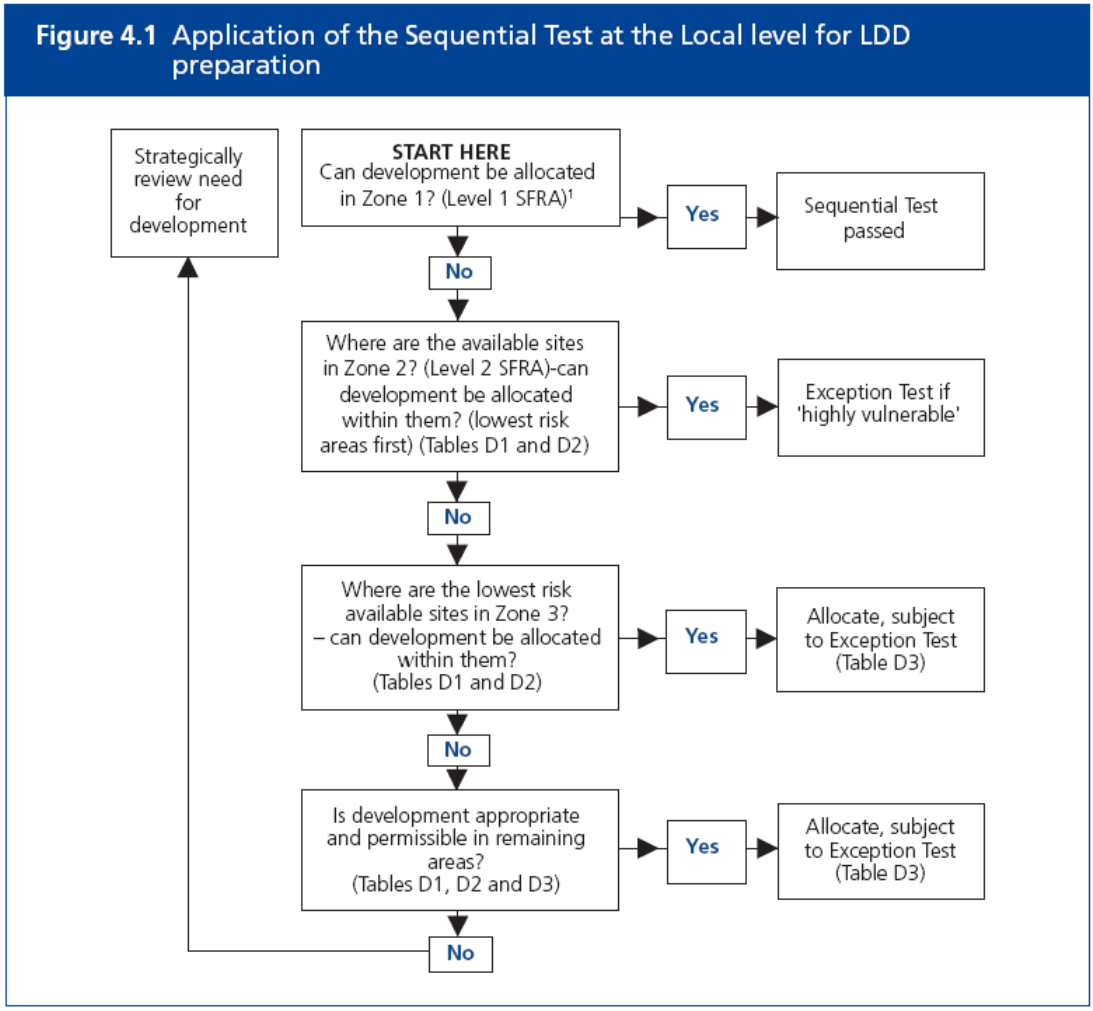
6 Sequential Test & Site Selection Guidance

6.1 Application of the Sequential Test

6.1.1 The sequential approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. It should be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except water-compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

6.1.2 The Sequential Test refers to the application of the sequential approach by Local Planning Authorities (LPA). This allows the determination of site allocations based on flood risk and vulnerability. Development should be directed to Flood Zone 1 wherever possible, and then sequentially to Flood Zones 2 and 3. In addition, development should be directed to areas of least flood risk within Flood Zone 2 and then Flood Zone 3, as identified within this SFRA. A flow diagram, extracted from the Practice Guide to PPS25, illustrating the application of the Sequential Test is provided in Figure 6-1.

Figure 6-1 Application of the Sequential Test, PPS25 Practice Guide CLG 2009



Note

1 Other sources of flooding need to be considered in Flood Zone 1

Table 6-1 PPS25 Table D.2 Flood Risk Vulnerability Classification (CLG 2010)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, • Essential utility infrastructure which has to be located in a flood risk area for critical operational reasons, including electricity generating power stations and grid and primary substations; water treatment plants; and sewage treatment plants if adequate measures to control pollution and manage sewage during flooding events are in place. • Wind turbines.
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.7 (Where there is demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan.**
Less Vulnerable	• Police, ambulance and fire stations which are ***not*** required to be operational during flooding • Buildings used for: shops; financial, professional and other services; 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 which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events 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.**

[7] DETR Circular 04/00, paragraph 18: *Planning controls for hazardous substances.* See www.communities.gov.uk/index.asp?id=1144377

6.1.3 PPS25 classifies developments according to their vulnerability and stipulates where the differing types of vulnerability are considered appropriate based on flood risk. The vulnerability classifications are shown in Table 6-1 and the compatibility matrix is shown in Table 6-2.

Table 6-2 PPS25 Table D.3 Flood Risk Vulnerability & Flood Zone Compatibility (CLG 2010)

Flood Risk Vulnerability Classification (Table D.2 PPS25)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test required	✓	✓
	3A	Exception Test required	✓	X	Exception Test required	✓
	3B	Exception Test required	✓	X	X	X

✓ – Development is appropriate (subject to the Sequential Test) ✗ – Development should not be permitted

6.1.4 The application of the sequential approach aims to manage the risk from flooding by avoidance. This will help avoid the promotion of sites that are inappropriate on flood risk grounds. The application of the Exception Test will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers.

6.1.5 Basildon Borough Council must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test, and where necessary, the Exception Test (see Appendix D of PPS25), in the site allocation process. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development, based on past trends.

6.2 Using the Level 1 SFRA to Apply the Sequential Test

6.2.1 The Sequential Test should be undertaken by Basildon Borough Council and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test should be carried out on potential development sites, seeking to balance the flood probability and development vulnerability of sites throughout the Local Planning Authority area.

6.2.2 The recommended steps required to undertaking the Sequential Test are detailed below. This is based on the Flood Zone and Flood Risk Vulnerability.

Recommended stages for LPA application of the Sequential Test

6.2.3 The information required to address many of these steps is provided in the accompanying GIS layers and maps included in this Level 1 SFRA Report.

1. Assign potential developments with a vulnerability classification (Table 6-1). Where development is mixed, the classification should be determined by the element of greatest vulnerability.
2. The location and identification of potential development should be recorded.

3. The Flood Zone classification of potential development sites should be determined based on a review of the Environment Agency Flood Zone maps for fluvial and tidal sources and upon the Flood Zones presented in this SFRA. Where these span more than one Flood Zone, all zones should be noted.
4. The design life of the development should be considered with respect to climate change:
    - 75 years – up to 2085 for commercial / industrial developments; and
    - 100 years – up to 2110 for residential developments
5. Identify existing flood defences serving the potential development sites. However, it should be noted that for the purposes of the Sequential Test, flood zones ignoring defences should be used.
6. Highly vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area. Highly vulnerable development within Flood Zone 2 must pass the Exception Test. Highly vulnerable development is not appropriate within Flood Zones 3a and 3b.
7. Once all highly vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as more vulnerable. In the first instance more vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate more vulnerable development, sites in Flood Zone 3a can be considered. More vulnerable developments in Flood Zone 3a will require application of the Exception Test. More vulnerable developments are not appropriate within Flood Zone 3b.
8. Once all more vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as less vulnerable. In the first instance less vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
9. Essential infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is fulfilled.
10. Water compatible development has the least locational constraints with respect to flood risk and it is considered appropriate to allocate these sites last.

6.2.4 Where the development type is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further and the sequential test applied in line with paragraphs 4.8 to 4.12 of the PPS25 Practice Guide.

Windfall Sites

6.2.5 Windfall Sites are sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

6.2.6 Should a site become available that has not been allocated as part of the LDF process, the Sequential Test should be applied on an individual site basis and the developer will need to provide evidence to the LPA that they have adequately considered other reasonably available sites across

the Borough. This will involve considering windfall sites against other sites allocated as suitable for housing plans.

6.2.7 The following steps should be followed for windfall sites:

1. Identify if the Sequential Test is required; Paragraph D.15 of PPS25 states that if the application is minor development or for a change of use, the Sequential and Exception Tests are not required. However, the application will still need to meet the requirements for FRAs and flood risk reduction as set out in Table D.1 of PPS25.

2. If the Sequential Test is required, identify which Flood Zone the site is located within using the Environment Agency flood maps and the Flood Zones presented in this SFRA.

3. Agree scope and considerations for the site-specific Sequential Test and, where necessary, Exception Test with the LPA and Environment Agency.

6.3 Advice for Site Selection & Masterplanning

6.3.1 A review of the Flood Zones in Figure A-6 and Figures B1 – B10, demonstrates that a large part of the Borough of Basildon is located in 'Flood Zone 1 – Low Probability' of flooding from tidal or fluvial sources. It is therefore likely that the majority of sites that come forward during the site selection process will pass the Sequential Test.

6.3.2 However there are a number of other issues with respect to flood risk that should be considered during the site selection process to ensure that the principals of PPS25 are adhered to and any constraints regarding future development on the basis of flood risk are understood from an early stage in the site selection and subsequent Masterplanning phases. These are summarised in the remainder of this section.

Other Sources of Flood Risk

6.3.3 PPS25 acknowledges that some areas will (also) be at risk of flooding from flood sources other than fluvial or tidal systems. All sources of flooding must be considered when looking to locate new development. The other sources of flooding requiring consideration when situating new development allocations include:

- Surface Water;
- Groundwater;
- Sewers; and
- Artificial Sources including Reservoirs.

6.3.4 These sources (as sources of flooding) are typically less understood than tidal and fluvial sources. Data primarily exists as point source data or through interpretation of local conditions. In addition, there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year standard. Any storm event in excess of the 30 year return period storm would be expected to cause flooding. If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

Sequential Approach within Sites

6.3.5 Paragraph D8 of PPS25 states that developers should apply the sequential approach to the allocation of land uses *within* the development site. This process should ensure that elements of the redevelopment that are of greater vulnerability are located in parts of the site at lowest risk.

6.3.6 Where sites come forward that fall within a range of flood zones, it should therefore not be assumed that all of the site will be available for a particular type of development, nor should it be considered that the site must be wholly discounted as suitable for development if only part of it is covered by a flood zone.

Set Back Distances

6.3.7 Where development is located adjacent to a watercourse, it will be necessary to set back development from flood defences. This is required to enable the Environment Agency to gain access to the defences for maintenance and upgrades. This should also be taken into consideration when allocating sites for future development.

Existing Developed Areas in Flood Zone 3b

6.3.8 PPS25 defines Flood Zone 3b Functional Floodplain as *'land where water has to flow or be stored in times of flood'*. The definition remains open to interpretation and agreement between the Environment Agency and the Local Planning Authority, however, areas which would naturally flood with an annual exceedence probability of 1 in 20 (5%) or greater are often used as a starting point for delineation of Functional Floodplain and have been used to map Flood Zone 3b in this SFRA.

6.3.9 Paragraph 4.91 of the PPS25 Practice Guide states that existing developed areas are not generally defined as part of the Functional Floodplain. In these cases, PPS25 advocates an approach whereby the high level of flood risk is acknowledged and recognised without applying the strict policy restrictions associated with Functional Floodplain.

6.3.10 Existing developed areas lying within Flood Zone 3b, whilst scarce and predominantly affecting rural properties, are present within the Borough. The classification of whether or not a site within these areas lies within the Functional Floodplain should be identified on a site by site basis as part of a site specific Flood Risk Assessment.

6.3.11 Where it can be demonstrated that the existing buildings exclude floodwater, for example due to raised floor levels and appropriate flood resistant building measures (see Section 7.5.7), these buildings are not considered to be part of the Functional Floodplain. Where the existing buildings do not exclude floodwaters, the site is Functional Floodplain and further redevelopment of the site is only permitted for Water Compatible land uses or Essential Infrastructure subject to the satisfaction of the Exception Test, in accordance with PPS25.

6.3.12 Where a site is not considered to be located within Functional Floodplain, any future redevelopment should be restricted to less vulnerable land uses. More vulnerable land uses should be actively discouraged and should only be considered within sites of an equivalent existing land use.

6.3.13 Any future redevelopment within this area must result in a reduction in the flood risk to and from the proposed development, and opportunities should be sought to create areas for the storage and conveyance of floodwaters. Further information and guidance for potential developers is included in Chapter 7.

Development in Flood Zone 3b Washland Areas

6.3.14 PPS25 states that local planning authorities should identify within their SFRAs areas of functional floodplain, in agreement with the Environment Agency.

6.3.15 Flood Zone 3b comprises land where water has to flow or be stored in times of flood and therefore Basildon Borough Council has identified all the washland areas within the Borough as Flood Zone 3b for the purposes of informing spatial planning across the Borough. Any application to develop within a washland area will receive a holding objection from the Environment Agency and Basildon Borough Council would treat such an application with extra caution.

6.3.16 However, it is recognised that in some cases, it will be necessary to safeguard the future development potential of these areas. When considering the potential for future development within a washland area, the following principles must be considered:

Sequential Test

6.3.17 The status of the washland prior to its designation as Flood Zone 3b within this SFRA will be a consideration. For example if the washland was in Flood Zone 3a prior to its designation as Flood Zone 3b, there should be a presumption against development. Other sites in areas of lower flood risk throughout the Borough should be considered prior to the consideration of a washland site in Flood Zone 3a, in accordance with the principles of the sequential test within PPS25. Only where it can be demonstrated that there are no other sites in areas of lower risk could the site be considered for development.

6.3.18 For washlands that are located within areas of Flood Zone 1 and it is only the washland that has been designated Flood Zone 3b within this SFRA, this in itself would be material to determining whether a redevelopment scheme could be deemed acceptable.

Betterment

6.3.19 Where development of a washland site is appropriate in accordance with the Sequential Test, it will be necessary to prove that full or partial development of the site would not increase the flood risk to the site or the surrounding area. Where this is the case, the requirements of PPS25 would be satisfied and the Environment Agency and Basildon Borough Council would uphold this.

6.3.20 Wherever possible, additional capacity on site or off site should be created to ensure that additional benefit can be brought to the area, for example in the form of added gain of flood protection or biodiversity.

Site Configuration & Sustainable Drainage Systems

6.3.21 Flooding arising from surface water runoff and the insufficient capacity of the local drainage network is a significant source of flooding in Basildon Borough. There is therefore a particular need to ensure that future development incorporates sustainable drainage systems (SuDS) to adequately manage surface water runoff and does not reduce the ability of the existing drainage network and washlands system to perform its function.

6.3.22 Some SuDS techniques may require a notable area of a development site to perform their function and this should be factored into the site selection and site planning phases when considering the density of development that could be accommodated by a particular site together with scheme viability.

7 Site Specific FRA Guidance

7.1 Overview

7.1.1 This Level 1 SFRA provides a review of existing flood risk information in the area which will be further developed as part of the Level 2 SFRA. However the scope of both these documents is strategic and therefore it is vital that site specific Flood Risk Assessments are produced by those proposing development.

7.1.2 It is probable that flood risk exists within an area that has not been highlighted in the SFRAs either because the information has not existed or due to other factors, for example the location of breach assessments relative to development areas. Therefore, site specific FRAs 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 use information from the SFRA, where this is helpful or strengthens the assessment.

7.1.3 This section presents recommendations and guidance for site-specific FRAs prepared for submission with planning applications in the Basildon Borough.

7.2 When is a Flood Risk Assessment required?

7.2.1 The Environment Agency provides flood risk standing advice for applicants and agents on their website http://www.environment-agency.gov.uk/research/planning/82587.aspx. This includes information on when a Flood Risk Assessment is required and advice on the contents of FRAs for various development types in Flood Zones 1, 2 and 3.

7.2.2 In the following situations a Flood Risk Assessment should always be provided with a planning application:

1. The development site is located in Flood Zones 2 or 3;
2. The area of the proposed development site area is 1 hectare or greater in Flood Zone 1. This is to ensure surface water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property. Surface water management will also need to be considered as part of the Flood Risk Assessment for sites of 1 hectare or greater in Flood Zone 2 and 3; and
3. The development site is located in an area known to have experienced flooding problems from any flood source.

7.3 What does a Flood Risk Assessment include?

7.3.1 The PPS25 Practice Guide (CLG 2010) sets out a staged approach to site specific Flood Risk Assessments, with the findings from each stage informing both the next level and the site Masterplan throughout the development process. Table 7-1 provides a summary of the three levels.

7.3.2 FRAs should always be proportionate to the degree of flood risk in each case and appropriate to the scale, nature and location of the proposed development as well as its vulnerability.

Table 7-1 Levels of Site Specific FRA, PPS25 (CLG 2010)

FRA Level	Description of Report Content
Level 1 **Screening Study**	The Level 1 Flood Risk Assessment is intended to identify any flooding or surface water management issues related to the development site that may require further investigation. The study should be based on readily available existing information, including: • SFRA, • Environment Agency Flood Maps, • Standing Advice The Level 1 Flood Risk Assessment will determine the need for a Level 2 or 3 FRA.
Level 2 **Scoping Study**	Where the Level 1 Flood Risk Assessment indicates that the site may lie in an area at risk of flooding, or may increase flood risk elsewhere due to runoff, a Level 2 Flood Risk Assessment should be carried out. This report will confirm sources of flooding which may affect the site and should include the following; • Appraisal of available and adequacy of existing information; • Qualitative appraisal of the flood risk posed to the site, the potential impact of the development on flood risk on and off the site; • An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. This Level may identify that sufficient quantitative information is already available to complete a Flood Risk Assessment appropriate to the scale and nature of the development.
Level 3 **Detailed Study**	Undertaken if the Level 2 Flood Risk Assessment concludes that further quantitative analysis is required in order to assess flood risk issues related to the development site. This Level should include: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of development on the site under investigation on flood risk on and off the site; • Quantitative demonstration of the effectiveness of any proposed mitigation measures.

7.3.3 Annex E of PPS25 presents the minimum requirements for a Flood Risk Assessment as follows:

- Consider the risk of flooding off-site arising from the development in addition to the risk of flooding on-site to the development;
- Identify and quantify the vulnerability of the development to flooding from different sources and identify potential flood risk reduction measures;
- Assess the remaining 'residual' risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development;
- Consider the vulnerability of those that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification, including arrangements for safe access as prescribed by Planning Policy Statement 25 (PPS25) and associated guidance;
- Consider the ability of the soil to receive surface water runoff generated on site, and how it would be stored and managed, along with how the proposed layout of development may affect drainage systems; and
- All calculations must fully account for current climate change scenarios and their effect on flood zoning and risk.

7.3.4 At all stages, Basildon Borough Council and where necessary the Environment Agency and Anglian Water should be consulted to ensure the Flood Risk Assessment provides the necessary information to fulfil the requirements for Planning Applications.

7.4 Risks of Developing in Flood Risk Areas

7.4.1 Developing in flood risk areas can result in significant risk to a development and site users. It is possible to reduce the risk through the incorporation of mitigation measures; however, these do not remove the flood risk altogether and developments situated in the floodplain will always be at risk from flooding. This creates Health and Safety considerations, possible additional costs and potential displacement of future residents during flood events, which could result in homes and businesses being uninhabitable for substantial periods of time.

7.4.2 The guidance in this chapter should identify the requirements of a FRA and the main flood risks posed to the site; additional issues to consider include the following:

- Failure to consider wider plans prepared by the Environment Agency or other operating authorities may result in a proposed scheme being objected to;
- Failure to identify flood risk issues early in a development project could necessitate redesign of the site to mitigate flood risk;
- Failure to adequately assess all flood risk sources and construct a development that is safe over its lifetime could increase the number of people at risk from flooding and/or increase the risk to existing populations;
- Failure to mitigate the risk arising from development may lead to claims against the developer if an adverse effect can be demonstrated (i.e. flooding didn't occur prior to development) by neighbouring properties/residents;
- Properties may be un-insurable and therefore un-mortgageable if flood risk management is not adequately provided for the lifetime of the development;
- By installing SuDS without arranging for their adoption or maintenance, there is a risk that they will eventually cease to operate as designed and could therefore present a flood risk to the development and/or neighbouring property;
- The restoration of river corridors and natural floodplains can significantly enhance the quality of the built environment whilst reducing flood risk. Such an approach can significantly reduce the developable area of sites or lead to fragmented developments, however positive planning and integration throughout the master planning process should resolve these potential issues.

7.5 Development Control Recommendations

Sequential Approach

7.5.1 Where the development includes development types of varying vulnerability in accordance with the definitions in PPS25, Paragraph D8 of PPS25 states that developers should apply the sequential approach to the allocation of land uses *within* the development site. This process should ensure that elements of the redevelopment that are of greater vulnerability are located in parts of the site at lowest risk.

Access and Egress

7.5.2 PPS25 requires that safe access and egress is provided to enable the evacuation of people from the development at or above the 1 in 100 year (1%) fluvial flood event up to the 1 in 1000 year (0.1%) flood event, in order to provide emergency services with access during a flood event and enable flood defence authorities to carry out their duties during periods of flood.

Finished Floor Levels

7.5.3 Where development in flood risk areas is unavoidable, the most common method of mitigating flood risk to people is to ensure habitable floor levels are raised above the maximum flood water level with an allowance of 300mm freeboard. This can substantially reduce the damage to property and risk of injury and fatalities.

7.5.4 Where minimal depths of floodwater are experienced, raising finished floor levels may be included into building design. This may be possible in areas of fluvial and/or surface water flood risk. Where floodwater depths are more substantial the practice of raising finished floor levels may not be possible.

7.5.5 In some cases it may be considered appropriate for ground floor uses to be restricted to Less Vulnerable uses, such as commercial use, garage, utility areas and public space, with habitable areas above. Any hazardous substances held in commercial properties should be stored above the flood level to reduce the risk of contamination during a flood event.

7.5.6 It is considered prudent to set the minimum finished floor levels 300mm above street/pavement level for all new development to act as a safeguard against internal flooding from surcharging drainage systems which is likely to be a more frequent phenomenon in the future.

Flood Resilient / Resistant Design

7.5.7 The Association of British Insurers in cooperation with the National Flood Forum has published guidance on how homeowners can improve the food resilience of their properties (ABI, 2004). These measures not only reduce flood risk to properties, by reducing residual risk, but can also improve the insurability of homes in flood risk areas. The guidance identifies the key flood resistant measures for different construction methods, further details can be found in the CLG's 2008 report, Improving the Flood Resilience of New Buildings and the ODPM's 2003 report, 'Preparing for Floods' (ODPM, 2003b).

7.5.8 In the document '*Improving the Flood Performance of New Buildings, Flood Resilient Construction'*, a number of design strategies are detailed including the Water Exclusion Strategy and Water Entry Strategy. Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, for example depths of less than 0.3m.

7.5.9 For significant flood depths, for example in excess of 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, i.e. the Water Entry Strategy. (It is noted that for depths between 0.3 – 0.6m, attempts should be made to exclude water in part or in full, depending on structural assessment. However if structural concerns exist, the Water Entry Strategy should be adopted).

7.5.10 The principle behind the Water Entry Strategy is not only to allow water through the property to avoid the risk of structural damage, but also to implement careful design in order to minimise damage and allow rapid re-occupancy of the building. PPS25 considers these measures to be appropriate for both changes of use and for less vulnerable uses where temporary disruption is acceptable and suitable flood warning is received.

7.5.11 Materials will be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

7.5.12 Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction' (CLG, 2007).

Flow Paths and Floodplain Compensation

7.5.13 Where development plans result in a reduction of the ***fluvial*** floodplain it is essential that new floodplain storage capacity is provided to compensate for any lost storage. The Environment Agency requires this to be provided on a 'Level for Level, Volume for Volume Basis'. *N.B. Any encroachment into tidal floodplains does not normally require compensation storage.*

7.5.14 Potential overland flow paths should be determined and appropriate solutions proposed to mitigate the impact of the development, for example through the configuration of road and building layouts to preserve existing flow paths and improve flood routing whilst ensuring that flows are not diverted towards other properties. In addition, any raising of the land as part of the development, for example, to achieve safe access, will need to be carefully considered as part of the FRA to ensure that no obstruction is made to flood flow routes.

Land Raising

7.5.15 Land raising can have mixed results when used as a secondary flood alleviation measure. It can be an effective method of reducing flood inundation on certain areas or developments by raising the finished ground levels above the predicted flood level. However, it can result in the reduction in flood storage volume within the flood cell. As a result, floodwater levels within the remainder of the cell can be increased and flooding can be exacerbated elsewhere. Level for level compensatory storage should be provided where any loss of fluvial floodplain storage has occurred as a result of land raising or developing within the undefended floodplain.

7.5.16 Partial land raising can be considered in larger, particularly low lying, areas such as marshlands. It may be possible to build up the land in areas adjacent to flood defences in order to provide secondary defences. However, again the developer should pay due regard to the cumulative effects of flooding such as increasing flood risk elsewhere.

7.5.17 It should also be remembered that although land raising may allow for development above the flood level, it may also create a 'dry island' which may still not overcome the issue of a safe access/egress route from the site. This must be considered where land raising is suggested as mitigation for developing in an area liable to flooding.

Recreation, Amenity and Ecology

7.5.18 Recreation, amenity and ecological improvements can be used to mitigate the residual risk of flooding either by substituting less vulnerable land uses or by attenuating flows or both. Examples include the development of parks and open spaces through to river restoration schemes. The aim of these techniques is to increase flood storage and the storage and conveyance of rainwater. Typical schemes include arrangements of pools, ponds and ditches, although these are best suited to larger sites and masterplan areas.

Sewer Flooding

7.5.19 In areas at risk of sewer flooding, a site specific FRA should assess the level of risk to the site. Anglian Water should be approached to obtain any information regarding sewer flooding records in the area and any recent capital improvement works undertaken, which should be reviewed in relation to local topography and potential flow paths to determine the actual risk to the site. This will allow appropriate mitigation measures to be incorporated where necessary.

Groundwater Flooding

7.5.20 Due to the scarcity of information with respect to groundwater flood risk in the Borough and the limitations in using historic data to define current flood risk, it is recommended that a site specific investigation of geology and groundwater levels is undertaken in proportion to the nature and scale of the proposed development. Local groundwater monitoring should be identified and where possible analysed to assess ground water levels as part of a FRA, in addition to detailed geology mapping which identifies potential spring lines.

7.5.21 In addition, consideration should be made for the impact of excavation works prior to construction on the risk of groundwater flooding to the site.

Surface Water Flooding

7.5.22 Development typically increases the coverage of impermeable areas and therefore contributes to increased overland flows. As part of a site specific FRA for new developments, an assessment of surface water runoff and temporary flood storage on the site should be undertaken. Development should seek to reduce surface water runoff rates through the appropriate application of Sustainable Drainage Systems (SuDS).

7.5.23 Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere. When designing a drainage system for new development it is important to consider whether surface water surcharging from other systems/areas in extreme circumstances is likely to affect the site via overland pathways. This could compromise the efficient working of SuDs devices designed to control volumes of water that arise only from hardstanding and surfaces within the development site in isolation.

7.5.24 Under the Flood and Water Management Act (2010), all new development must demonstrate that all measures have been taken to manage runoff on site before connection to the sewer is permitted. Due to the prevalence of surface water flooding and the highly urbanised nature of parts of the Basildon Borough, source control options will be an important method of surface water management. Rainwater harvesting, green roofs, attenuation features and landscaped public realm areas, will therefore be essential elements of new developments to facilitate the minimisation of runoff.

7.5.25 It is essential that the design of SuDS is considered early in the design process for a development area to ensure that a coordinated and integrated system can be implemented. Under the Flood and Water Management Act (2010), it will become the responsibility of Essex County Council to adopt and maintain these drainage systems into the future and therefore an integrated approach to surface water management across new development areas will need to be established.

8 Guidance for the Application of SuDS

8.1 Introduction

8.1.1 It has been established that one of the predominant forms of flood risk facing the Basildon Borough study area is from surface water flooding as a result of the increased occurrence of extreme rainfall events and the impact of underlying clay soils. This risk is likely to increase over time as a result of climate change and changes in the local environment such as paving of gardens.

8.1.2 The risk from surface water flooding can be mitigated through the use of Sustainable Drainage Systems (SuDS). SuDS seek to manage surface water as close to its source as possible, mimicking surface water flows arising from the site, prior to the proposed development. Typically this approach involves a move away from piped systems to softer engineering solutions inspired by natural drainage processes. PPS25 indicates that Regional Planning Bodies and Local Authorities should promote the use of SuDS for the management of surface water runoff generated by development.

8.1.3 SuDS should be designed to take into account the surface run-off quantity, rates and also water quality ensuring their effective operation up to and including the 1 in 100 year design standard flood including an increase in peak rainfall up to 30% to account for climate change.

8.1.4 Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below with the favoured system contributing significantly to each objective:

1. Reduce flood risk (to the site and neighbouring areas),
2. Reduce pollution, and,
3. Provide landscape and wildlife benefits.

8.1.5 These goals can be achieved by utilising a management plan incorporating a chain of techniques, (as outlined in Interim Code of Practice for Sustainable Drainage Systems 2004), where each component adds to the performance of the whole system:

Prevention	good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping)
Source Control	runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements)
Site Control	water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site)
Regional Control	Integrate runoff management systems from a number of sites (e.g. into a detention pond)

8.1.6 This chapter presents a summary of the SuDS techniques currently available and a review of the soils and geology of the study area, enabling Basildon Borough Council to identify where SuDS techniques could be employed in development schemes.

8.1.7 The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each

development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

8.1.8 It is important that developers liaise with Development Management Engineers at Essex County Council, Anglian Water Services Limited and the Environment Agency in the early stages of site master-planning to agree outline design concepts for developing a site SuDs drainage system. This will help to increase the chance of a SuDs system gaining Approval through the SAB. It can also help to avoid the need for costly redesign of a scheme if there are fundamental difficulties with the acceptability of a design from a flood management and future adoption & maintenance perspective that only come to light once the drainage application has been made to the SuDs Approval Board.

8.2 Regulatory Position

8.2.1 Until 2010 there were no legally binding obligations relating to the provision and maintenance of SuDS. In April 2010, the Flood and Water Management Act gained Royal Assent and with it came a number of responsibilities for Upper Tier Local Authorities, defined as Lead Local Flood Authorities (LLFAs), which in this study area's case is Essex County Council. In relation to Basildon Borough Council, Essex County Council are required to:

- Investigate and record flooding incidents;
- Produce an asset register of all flood risk related assets;
- Develop a preliminary flood risk assessment;
- Adopt and maintain SuDS.

8.2.2 In their document, 'Flood and Water Management Act 2010 – What the Flood and Water Management Act means for property developers', Defra set out details regarding the process of SuDS approval by the relevant Local Lead Flood Authority as follows:

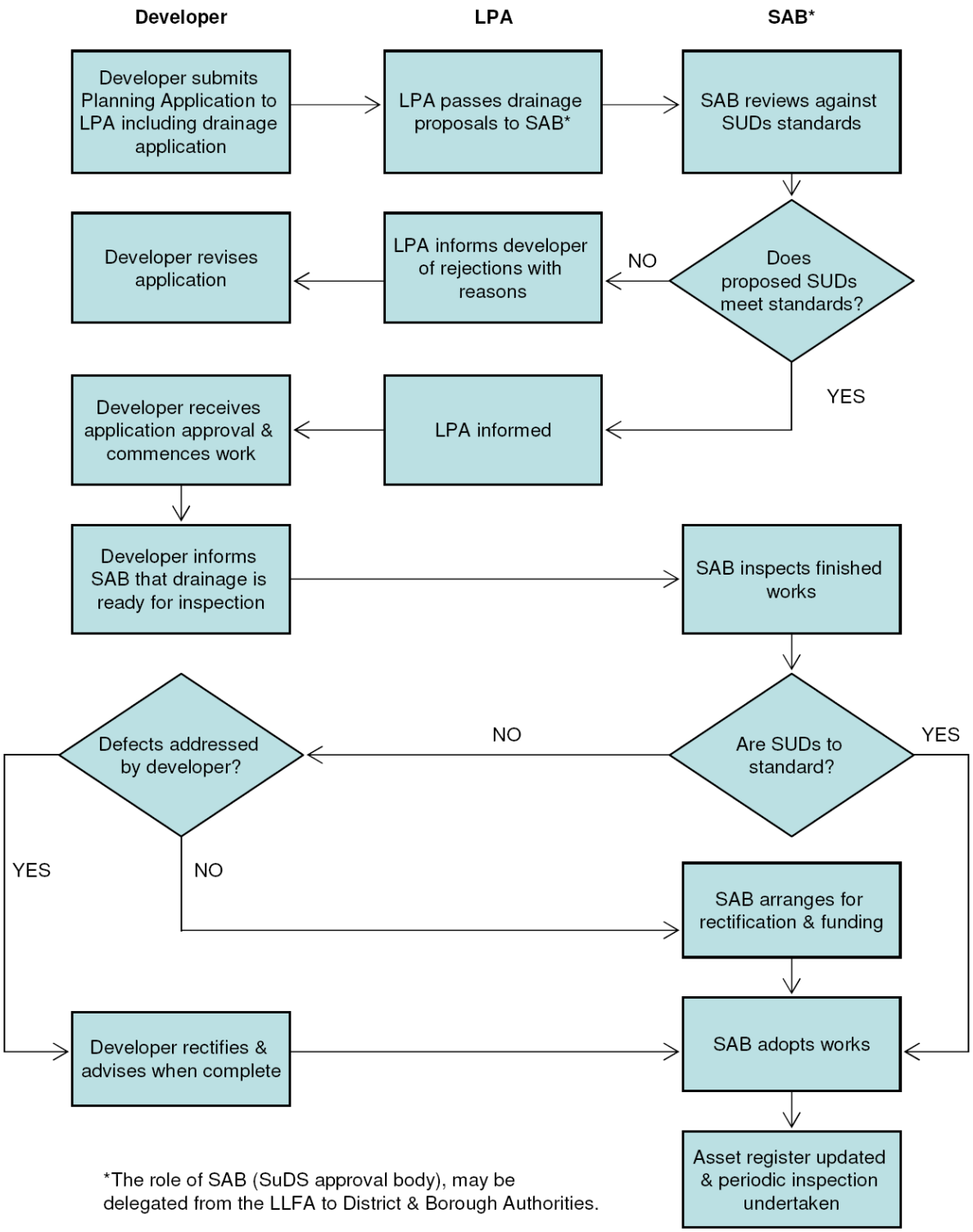
8.2.3 Plans for a proposed drainage system will need to be approved prior to construction, by the SuDS Approving Body (SAB) which will be the unitary or county council for the area, in this case Essex County Council. This applies to both permitted developments and those that require planning permission. This will ensure that SuDS are also included in construction that may cover large surface areas, but does not require planning permission.

8.2.4 Where both planning permission and SuDS approval are required, it is anticipated that the processes will run together. Applications for the drainage system and for planning permission will be submitted together to reduce burdens for the applicant. The planning authority will notify the developer of the outcome of both the planning permission and drainage approval at the same time, including any conditions of approval. Regulations will set out a timeframe for the approval of drainage application by the SAB, so the planning process is not delayed.

8.2.5 At the time of writing, the organisational arrangements for SuDS approval and adoption at Essex County Council are still to be clarified. Figure 11-1 provides a suggestion of a potential overview process that could be used when a planning application is submitted. It is noted that it is also possible for the role of SuDS Approving Body to be delegated by the Lead Local Flood Authority to Local Planning Authorities.

8.2.6 In addition, Anglian Water, the local waste water provider has set out adoption standard for SuDS. Essex County Council currently expects all new SuDS systems to meet the adoption standards outlined by Anglian Water to ensure their long term maintenance.

Figure 11-1 Potential SuDS Approval Process (Scott Wilson 2011)



8.3 SuDS Techniques

8.3.1 SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available and operate on two main principles:

- Infiltration
- Attenuation

8.3.2 All systems generally fall into one of these two categories, or a combination of the two.

8.3.3 The design of SuDS measures should be undertaken as part of the drainage strategy and design for a development site. A ground investigation will be required to access the suitability of using infiltration measures, with this information being used to assess the required volume of on-site storage. Hydrological analysis should be undertaken using industry approved procedures, to ensure a robust design storage volume is obtained.

8.3.4 During the design process, liaison should take place with the Local Planning Authority, the LLFA, the Environment Agency, and if necessary, the Water Undertaker to establish a satisfactory design methodology and permitted rate of discharge from the site.

8.3.5 Reference should be made to the SuDS Manual CIRIA C697 for best practice on the planning, design, construction, operation and maintenance of SuDS.

8.4 Infiltration SuDS

8.4.1 This type of Sustainable Drainage System relies on discharges to ground, where suitable ground conditions are suitable. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

8.4.2 Development pressures and maximisation of the developable area may reduce the area available for infiltration systems. This can be overcome through the use of a combined approach with both attenuation and infiltration techniques e.g. attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

Permeable Surfaces

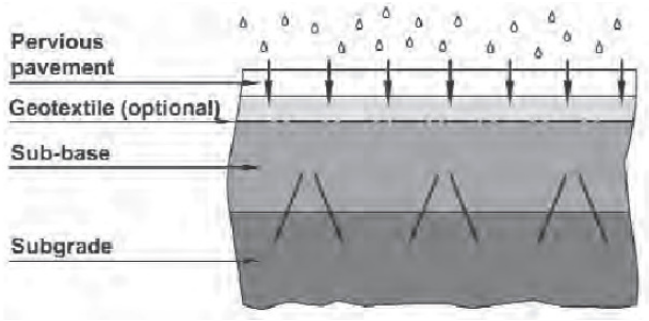
8.4.3 Permeable surfaces are designed to intercept rainfall and allow water to drain through to a sub-base. The use of a permeable sub-base can be used to temporarily store infiltrated run-off underneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate. These two scenarios are depicted in Figure 8-1.

8.4.4 Permeable paving prevents runoff during low intensity rainfall, however, during intense rainfall events some runoff may nevertheless occur from these surfaces.

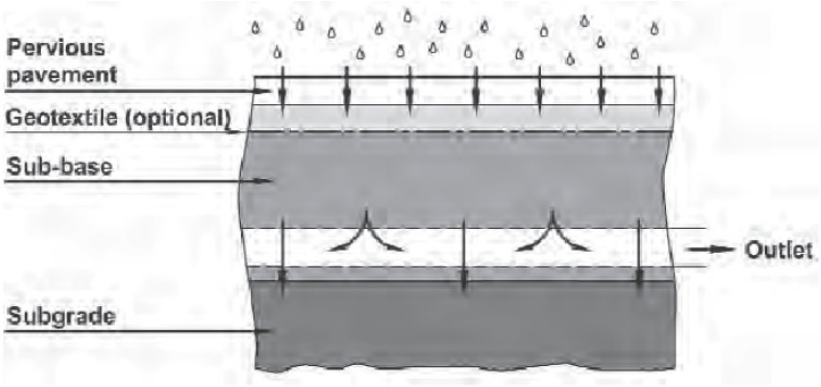
8.4.5 Programmes should be implemented by the adoption authority to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

Figure 8-1 Pervious Pavement (C697 CIRIA SuDS Manual)

a) Total Infiltration



b) Partial Infiltration



8.4.6 Types of permeable surfaces include:

- Grass/landscaped areas
- Gravel
- Solid Paving with Void Spaces
- Permeable Pavements

Sub-surface Infiltration

8.4.7 Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate the generated run-off into the ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage. These systems are constructed below ground and therefore may be advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5m of buildings, beneath roads or in soil that may dissolve or erode.

8.4.8 Various methods for providing infiltration below the ground include:

- Geocellular Systems
- Filter Drain

- Soakaway (Chamber)
- Soakaway (Trench)
- Soakaway (Granular Soakaway)

Table 8-1 Suitability of Infiltration Methods towards with respect to the wider aims of SuDS

Infiltration Method	Reduce Flood Risk (Y/N)	Reduce Pollution (Y/N)	Landscape and Wildlife Benefits (Y/N)
Permeable Surface	Y	Y	N
Sub-surface Infiltration	Y	Y	N

8.5 Attenuation SuDS

8.5.1 If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. This technique attenuates discharge from a site to reduce flood risk both within and to the surrounding area. It is important to assess the volume of water required to be stored prior to discharge to ensure adequate provision is made for storage. The amount of storage required should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

8.5.2 The rate of discharge from the site should be agreed with the Local Planning Authority, the Local Lead Flood Authority (LLFA), and the Environment Agency. If surface water cannot be discharged to a local watercourse then liaison with the Sewer Undertaker should be undertaken to agree rates of discharge and the adoption of the SuDS system.

8.5.3 Large volumes of water may be required to be stored on site. Storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

Basins

8.5.4 Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of run-off from a developed site. Basins are designed to drain free of water and remain waterless in dry weather. These may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Native species of vegetation should be used wherever possible and should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual clearance of aquatic vegetation and silt removal as required.

Ponds

8.5.5 Ponds are designed to hold the additional surface water run-off generated by the site during rainfall events. The ponds are designed to control discharge rates by storing the collected run-off and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitats, water features to enhance the urban landscape and, where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands

into public areas to create new community ponds. Ponds and wetlands trap silt that may need to be removed periodically. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. In situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond in order to trap and subsequently remove the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).

8.5.6 Various types of ponds are available for utilising as SuDS measures - examples of which are present throughout the Borough in the Washland System (Section 5). These include:

- Balancing/Attenuating Ponds
- Flood Storage Reservoirs
- Lagoons
- Retention Ponds
- Wetlands, see Figure 8-2

Figure 8-2 Schematic Plan of Shallow Wetland (C697 CIRIA SuDS Manual)

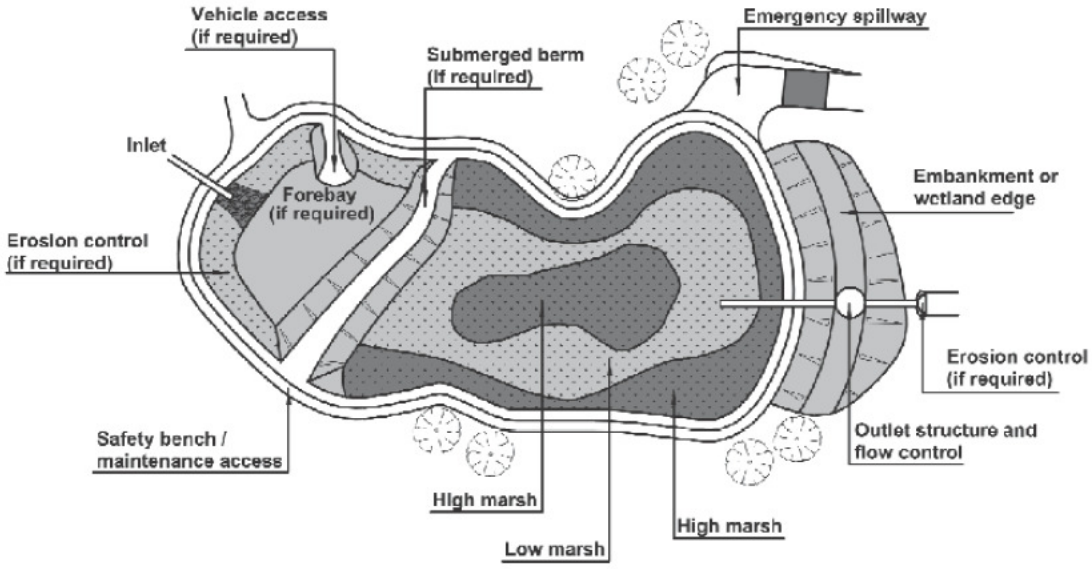


Table 8-2 Suitability of Attenuation Methods towards the 3 Goals of SuDS

Infiltration Method	Reduce Flood Risk (Y/N)	Reduce Pollution (Y/N)	Landscape and Wildlife Benefits (Y/N)
Basins	Y	Y	Y
Ponds	Y	Y	Y

8.6 Alternative Forms of Attenuation

8.6.1 Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the

provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods in the previous section cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

8.6.2 Methods for providing alternative attenuation include:

- Deep Shafts
- Geocellular Systems
- Oversized Pipes
- Rainwater Harvesting
- Tanks
- Green Roofs

8.6.3 In some situations it may be preferable to combine infiltration and attenuation systems to maximise the management of surface water runoff, developable area and green open space.

8.7 SuDS in Basildon Borough

Geology & Soils

8.7.1 As described in Section 2.3, the predominant geology underlying Basildon is Thames Group Clay. This is impermeable and therefore conducive to large amounts of surface water runoff. In the north of the study area around the urban area of Billericay Bagshot Beds are present. These comprise sand and clays and are frequently present capping the hills of London clay[8].

8.7.2 The majority of the study area does not have any drift geology overlying the Thames Group Clay. There are minimal deposits of sand and gravel along the valley of the upper Crouch and overlying the Bagshot geology around Billericay.

8.7.3 The South Essex CFMP identifies the presence of seasonally wet, deep clay soils across the study area. These soils are relatively impermeable and therefore contribute to rapid runoff of surface water runoff, resulting in a greater risk of surface water flooding and causing watercourses to respond rapidly to rainfall, as they fill up rapidly and therefore channel water away. The presence of such geology and soils reduce the risk of flooding from groundwater sources.

SuDS Suitability

8.7.4 As a result of the underlying soils and geology, **the use of infiltration systems is largely not appropriate for use in the Basildon Borough.**

8.7.5 Developers are expected to collect subsoil information derived from trial pit information at their sites as this will form the basis for discussions with the LLFA, Anglian Water Services Ltd and the EA over the SuDs techniques that most appropriate to the site.

8.7.6 It is strongly recommended that options for the use of attenuation measures described in Sections 8.5 and 8.6 are explored for use in development sites across the Borough.

8.7.7 These measures will require a portion of the development site and should therefore be considered from an early stage in the Masterplanning process for future development sites.

[8] Environment Agency (August 2008) South Essex Catchment Flood Management Plan

8.7.8 It is important that developers liaise with Development Management Engineers at Essex County Council, Anglian Water Services Limited and the Environment Agency in the early stages of site master-planning to agree outline design concepts for developing a site SuDs drainage system. This will help to increase the chance of a SuDs system gaining Approval through the SAB.

9 Conclusions & Recommendations

9.1 Conclusions

9.1.1 The findings from this Level 1 SFRA confirm that the primary mechanism of flooding in the Borough is pluvial flooding in the urban centres of Billericay, Wickford and Basildon, which often coincides with fluvial flooding associated with the River Crouch and its tributaries. The Washland System, created as part of the development of the Basildon New Town and the urban expansion of Wickford and Billericay, performs a surface water management function for the urban area and helps to reduce fluvial flood risk from receiving watercourses to other areas downstream of the Washlands i.e. the functioning of Basildon Washlands helps to prevent an increase in flood risk from the River Crouch at Wickford. However, the capacity of this system to continue to perform its function is highly dependent upon continued clearance and maintenance of the storage areas as well as the associated channels, ditches and supporting infrastructure.

9.1.2 Fluvial flooding tends to occur when high rainfall events in the upper catchment of the River Crouch coincide with high tidal water levels to produce high volume fluvial flows and elevated water levels in the River Crouch and its tributaries. Figures of the fluvial Flood Zones in Appendix B show the extent of flooding along the corridor of the River Crouch; a notable extent of the floodplain is located in rural areas, however parts of Wickford and the north of Basildon Town are shown to be affected by fluvial flooding.

9.1.3 The southern part of the Borough is located next to the Vange Creek and the East Haven Creek which are tidal estuaries on the northern edge of the River Thames estuary. Flood defences along the southern edge of the Borough as well as two flood barriers protect this area from tidal flooding; the Fobbing Horse flood barrier, located to the south of the marshes, on the Vange Creek, and the Benfleet barrier, located to the south east of the marshes, on the Benfleet Creek. The risk of flooding from tidal sources is therefore a residual risk in the event of failure of one of these barriers or a breach in the flood defence wall.

9.2 Recommendations

Emergency Planning

9.2.1 It is recommended that the historical records of surface water flooding as well as the Areas Susceptible to Surface Water Flooding mapping is used by Basildon Council to inform Emergency Planning procedures in the Borough and to determine locations for future efforts in surface water management through maintenance regimes.

Sequential Test

9.2.2 Flood Zones delineating the variation in probability of fluvial flooding from these watercourses have been mapped in Appendix B of this report and should be used to inform the location of future development through the application of the Sequential Test by Basildon Borough Council. In addition, information regarding the risk of surface water flooding should also be used when considering site allocation and a sequential approach should be adopted for site selection based on surface water flooding.

9.2.3 Given that surface water flood risks are identified in this SFRA as being the most significant flood risk within the Borough, Basildon Borough Council have designated the Basildon Washlands as

Flood Zone 3b Functional Floodplain. Annex B of PPS25 identifies that peak rainfall intensities are likely to increase in future as a function of climate change and this underlines the importance of the protection of washlands and their ability to function both now and into the future.

Development Control

9.2.4 Where development has to be located in areas at risk of fluvial flooding (following application of the Sequential Test), development control recommendations provided in Chapter 7 of this report should be used to determine the safety of the proposed development (in consultation with the Council's Emergency Planning Team) and to ensure that the proposed development does not increase flood risk to surrounding areas or impact upon the ability of Basildon Borough Council and their emergency services to safeguard the current population.

9.2.5 In addition, for all future development in the Borough, particular attention should be paid to the risk of surface water flooding, and in particular the need to ensure that the proposed development does not increase flood risk to surrounding areas or impact of the ability of the washland system to perform its function as designed. Specific guidance relating to the use of Sustainable Drainage Systems (SuDS) is provided in Chapter 8.

Level 2 Assessment

9.2.6 Further assessment of the residual risk of tidal flooding in the Borough, in the event of failure of the Benfleet or Fobbing Horse Barriers should be undertaken as part of a Level 2 Strategic Flood Risk Assessment.

9.2.7 It is noted that intermediate level pluvial modelling will be undertaken as part of the Surface Water Management Plan undertaken by Basildon Borough Council (also in partnership with Rochford DC , Castle Point Borough Council and Essex County Council). It is recommended that the results from this modelling are used to inform the Level 2 SFRA. Results from the modelling should be used to continue to develop and improve understanding of surface water flood risk posed to the study area as well as potential options for mitigation and management of surface water flood risk throughout the strategic planning process.

9.3 Living Document – SFRA Maintenance & Updates

9.3.1 For an SFRA to serve as a practical planning tool now and in the future, it will be necessary to undertake a periodic update and maintenance exercise. The Environment Agency flood zone outlines are updated every quarter to include the latest modelled outlines. Flood zone outlines should be compared with the outlines used in this report to determine whether any updates have been undertaken in the Basildon Borough area and whether they would impact upon strategic planning in the area. This section clarifies what specific actions are recommended to ensure correct maintenance and updating of the SFRA.

GIS Layers

9.3.2 GIS layers used in this SFRA have been created from a number of different sources, using the best and most suitable information available at the time of publishing. Should new Flood Zone information become available, the data should be digitised and geo-referenced within a GIS system. A copy of the current dataset should be created and backed up and the new data should then be merged or combined with the current data set.

9.3.3 For example, should updated modelled outlines delineating Flood Zone 3b on the River Crouch become available as a result of future modelling by the Environment Agency as part of the Strategic Flood Risk Mapping (SFRM) process, the current FZ3b outline should be edited to ensure that the newest data is displayed and that the old data is overwritten.

9.3.4 For other GIS layers such as the historical flood outlines or the sewer flooding information, it is likely that data will be added rather than be replaced. For example, where a new sewer flooding incident is reported in the catchment, a point should be added to the sewer flooding GIS layer rather than creating a new layer. It is recommended that these datasets are kept up to date by Basildon Borough Council.

9.3.5 All GIS layers used in the SFRA have meta-data attached to them. When updating the GIS information, it is important that the meta-data is updated in the process. Meta-data is additional information that lies behind the GIS polygons, lines and points. For example, the information behind the SFRA Flood Zone Maps describes where the information came from, what the intended use was together with a level of confidence.

OS Background Mapping

9.3.6 The SFRA has made use of the OS 1:25000 and 1:50000 digital raster maps. Periodically these maps are updated. Under the Basildon Borough Council OS License, it is likely that these maps will be updated. Updated maps are unlikely however to alter the findings of the SFRA.

Data Licensing Issues

9.3.7 Prior to any data being updated within the SFRA, it is important that the licensing information is also updated to ensure that the data used is not in breach of copyright. The principal licensing bodies relevant to the SFRA at the time of publishing were the Environment Agency (Thames Region), British Geological Survey, Ordnance Survey and Anglian Water. Updated or new data may be based on datasets from other licensing authorities and may require additional licenses.

Flooding Policy and PPS25 Practise Guidance Updates

9.3.8 This SFRA was updated inline with policy and guidance that was current in September 2010, principally PPS25 (DCLG March 2010) and the accompanying Practice Guide (December 2009). Furthermore, guidance and recommendations issued in the Pitt Review (Pitt 2008) and the subsequent Floods and Water Management Act (2010) have been incorporated into this updated revision. Should new flooding policy be adopted nationally, regionally or locally, the SFRA should be checked to ensure it is still relevant and updates made if necessary.

Stakeholder Consultation and Notification

9.3.9 The key stakeholders consulted in the SFRA were Basildon Borough Council, Anglian Water and the Environment Agency. It is recommended that a periodic consultation exercise is carried out with the key stakeholders to check for updates to their datasets and any relevant additional or updated information they may hold. If the SFRA is updated, it is recommended that the Environment Agency and the Emergency Planning Team are notified of the changes and instructed to refer to the new version of the SFRA for future reference.

Frequency of Updates and Maintenance

9.3.10 It is recommended that the key information to affect the validity of this SFRA would be any major alterations to flood risk planning policy or the flood zone outlines. As a result, in the event of any changes to either of these, it is recommended that the SFRA is updated and re-issued.

References

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Basildon District Council Flooding & Severe Weather Plan, Draft June 2010.

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Pitt, M. (2008) Pitt Review - Learning Lessons from the 2007 Floods.

Limitations

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Appendix A: General Figures

Appendix B: Detailed Flood Zone Mapping

Appendix C: Data Register