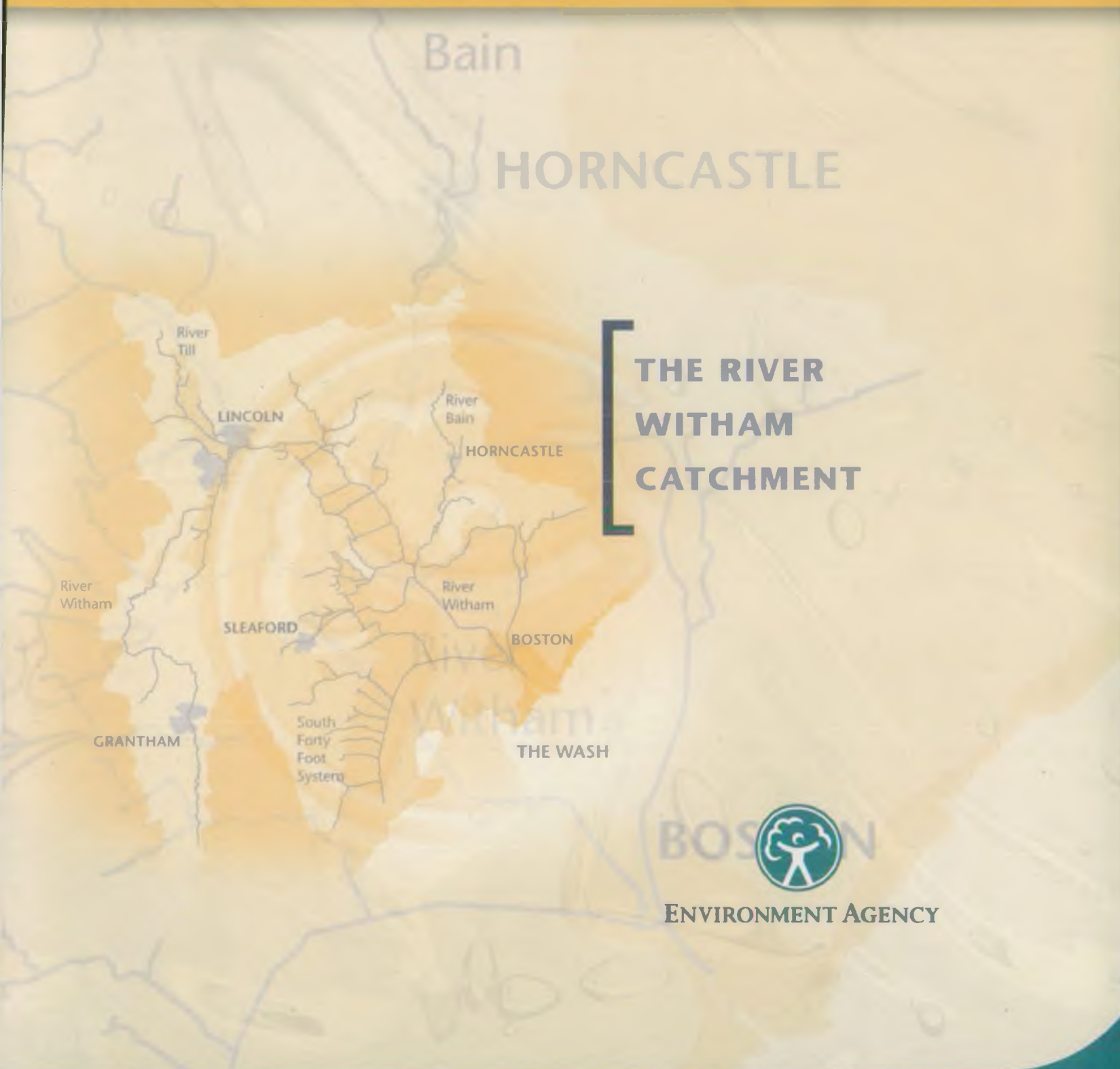


STRATEGIC REVIEW OF DEVELOPMENT AND FLOOD RISK





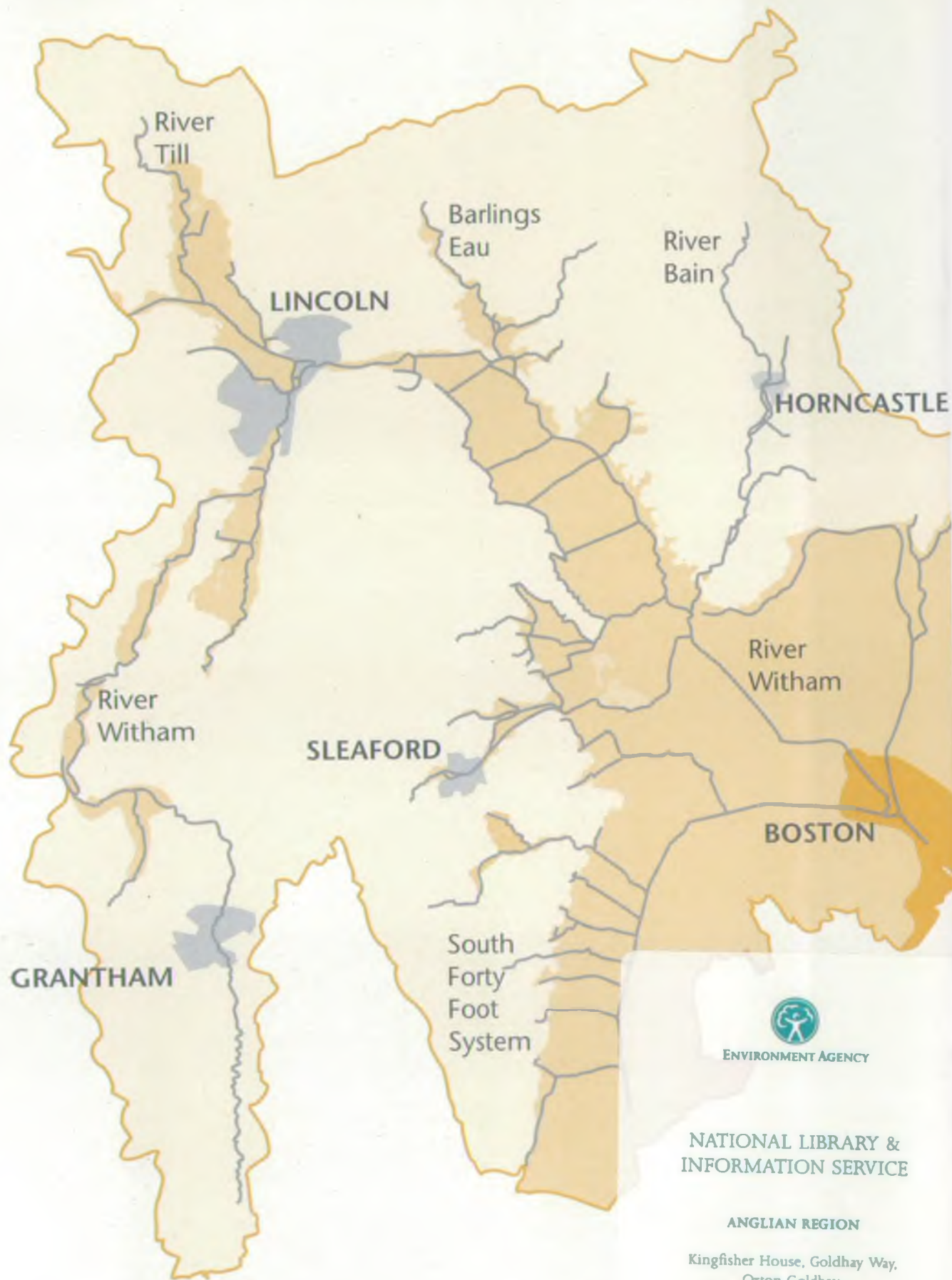
STRATEGIC REVIEW OF DEVELOPMENT AND FLOOD RISK



THE RIVER WITHAM CATCHMENT



ENVIRONMENT AGENCY



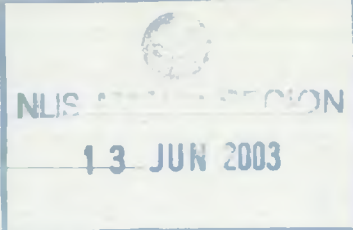
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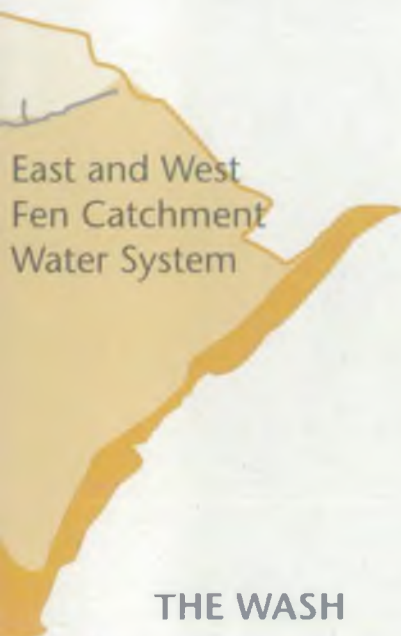
Kingfisher House, Goldhay Way,
Orton Goldhay,
Peterborough PE2 5ZR

The Environment Agency



LEGEND

-  Main River
-  Catchment Boundary
-  Tidal Floodplain
-  Fluvial Floodplain



The Environment Agency came into being on 1 April 1996 as a result of the Environment Act 1995. The flood defence powers, duties, and responsibilities of the now abolished National Rivers Authority transferred to the Agency.

In addition to flood defence, the responsibilities of the Agency include: the regulation of water quality and resources; fisheries, conservation, recreation and navigation issues; regulation of potentially polluting industrial processes; regulation of premises which use, store, or dispose of radioactive material; and the prevention of pollution by licensing and controlling waste management sites, waste carriers and brokers.

The Environment Agency's vision is of a better environment in England and Wales for present and future generations. The Agency will protect and improve the environment as a whole by effective regulation, by direct actions and by working with and influencing others.

THE WASH

THE RIVER WITHAM CATCHMENT



ENVIRONMENT AGENCY



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Introduction

1.1 PURPOSE OF DOCUMENT

This document sets out the Agency's approach to Development and Flood Risk in the River Witham Catchment.

The Agency considers that development should help in the reduction of flood risk rather than increasing it. The purpose of this document is to set-out the principles, practice and technical reasoning which the Agency wish to see adopted in the Town and Country planning consent process as a contribution to sustainable development.

The document is aimed at:

- ▶ Local Authority planners and others concerned with understanding and implementing strategic and detailed planning issues;
- ▶ providing developers and their advisors with information and guidance in preparing acceptable forms of development;
- ▶ informing public to raise awareness of development and flood risk issues; and
- ▶ providing guidance for Agency regulation officers in specifying requirements from developers.

1.2 SCOPE OF DOCUMENT

In order to provide a framework and technical basis for future management of flood risk the Agency has reviewed:

- ▶ current responsibilities and liaison with developers;
- ▶ sustainable urban drainage systems;
- ▶ the response of the catchments to severe rainfall events and tidal conditions;
- ▶ the impact of current and future development;
- ▶ criteria for Developers to consider when appraising new developments affecting flood risk.

The principle focus of this document is the consideration of development and flood risk affecting towns and villages. The principles contained herein are likely to be applicable across other catchments in order to protect people and property better from increased flooding.

Some concern has been expressed about the terminology used by practitioners in discussing flood risk and the public perception of this. Therefore in addition to containing a glossary, the opportunity has been taken where relevant to express the risk of flooding throughout the document as a percentage probability. For example the flood event with a return period of once in every hundred years (1:100years) is given the description of 1.0% probability.

1.3 BACKGROUND

In 1993 MAFF (now DEFRA) published a Strategy for Flood and Coastal Defence in England and Wales.

The aim of the Strategy is:

"To reduce the risk to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defence measures."

The objectives of the Strategy are:

- To encourage the provision of adequate and cost effective flood warning systems.
- To encourage the provision of adequate, economically, technically and environmentally sound and sustainable flood and coastal defence measures.
- To discourage inappropriate development in areas at risk from flooding and coastal erosion.

In consequence, the Agency, in liaison with others, has been developing proposals in these three principal areas recognising that they are linked and that flood defence improvements must progress in conjunction with appropriate planning and development control and an effective flood warning system.

With regard to planning and development control, the Agency wishes to see the following seven key principles adopted by Planning Authorities:

1. Since any development outside the floodplain will ultimately drain to it, all new development shall be considered against the 1% (1:100 year) for rivers, or 0.5% (1:200 year) for tidal, return probability flood for both the design of mitigation measures and flood level.
2. Development will be directed away from greenfield sites in the floodplain to prevent any further erosion of flood flow and storage capacity which would increase flood risk. The indicative floodplain is defined on the Agency's Circular 30/92 Flood Envelope maps as issued in September 2000 and any subsequent revisions thereof.
3. Any redevelopment of brownfield sites within the floodplain will only be permitted if the development maintains or improves the flood defence standard as given in 1 above and any works to prevent the future erosion of that standard are carried out where this is relevant to the site.
4. Wherever possible a contribution will be sought to a tangible reduction in flood risk in the floodplain. This may be achieved by extra mitigation measures or by contributing to increased floodplain flow and / or storage to achieve a progressive reduction in flood risk.
5. Development should be precluded or time limited in areas where managed re-alignment of defences is most likely.

6. All development should be precluded within a 9m strip of land from top of bank or landward toe of any embankment, to allow for future access to defences for inspection purposes and repairs and improvements. This strip is subject to control through Byelaws made under Section 34 of the Land Drainage Act 1976 and enforceable by provisions in the Water Resources Act 1991.
7. Development, especially single story development, should be precluded immediately behind raised defences where breaches could lead to rapid inundation by fast flowing floodwater.
8. In seeking to promote a reduction in flood risk, a strategic rather than a piecemeal approach will be promoted.

The principles outlined above are being promoted in consultations on both County Structure and Local Plans. Proposed developments already in the system will be guided into line with these principles so far as is possible within the legal and regulating framework governing the planning process.

The principles will be promoted in association with the guidance in PPG25.

1.4 AGENCY CONTACTS

The Area Customer Services Manager is responsible for dealing with all aspects of planning and development control for the Agency's Northern Area.

The main liaison with Local Planning Authorities is via the Planning Liaison Team who are responsible for the co-ordination of internal functional responses to planning applications, thereby ensuring that the Agency's views are adequately represented.

This team is based in the Northern Area office at

**Waterside House,
Waterside North
Lincoln
LN2 5HA
Tel. 01522 513100
Fax. 01522 512927**

Detailed consideration of the Flood Defence aspects of development proposals in the Witham catchment is the responsibility of the Development Control Team. This team would undertake technical liaison with developers regarding specific proposals and is based at the Lincolnshire Catchment office at:

**Guy Gibson Hall
Manby Park
Louth
LN11 8UR
Tel. 01507 328102
Fax. 01507 328737**

Power and Responsibility

Both the Agency and Local Planning Authorities have obligations as detailed in:

- Policy and Practice for the Protection of Floodplains (Environment Agency); and
- Planning Policy Guidance Note 25 (PPG25) - (successor to Circular 30/92 – Development and Flood Risk (Department of Transport, Local Government and the Regions))

2.1 DIRECT POWERS AND RESPONSIBILITIES OF THE ENVIRONMENT AGENCY

Although the Agency operates within an extensive regulatory framework, it must be recognised that Agency controls in respect of development are limited. The Agency is therefore dependent upon effective planning legislation to ensure the protection of the environment and to prevent future problems arising as a result of development.

The Agency has limited direct powers to control activities that impact on the functions of floodplains through:

- The Environment Act 1995
- The Water Resources Act 1991
- The Land Drainage Act 1991
- Environment Agency Byelaws

Generally these powers relate specifically to river channels and flood defences rather than floodplains themselves. Control of the latter largely rests with the planning authorities. The Agency's consents and Byelaw powers will be used to protect the Agency's interests.

In order to assist with meeting its responsibilities the Agency produces Local Environment Agency Plans (LEAP's) which provide a position statement on the current state of the environment and describe a wide range of issues which influence the environment, economy and social well being of the area. The LEAP document also considers the issue of flood risk and development, and establishes a basis for future review of these aspects.

2.2 LOCAL AUTHORITIES AND DEVELOPMENT

The protection of floodplains and existing property from the physical threats posed by inappropriate development is dependent on the powers exercised by local planning authorities. The planning authorities and not the Environment Agency are responsible for protecting the flood defence interests of people whose property may be affected by development proposals. However, the Agency is a statutory consultee on development plans and many aspects of development control. One of the Agency's roles is to advise planning authorities on the implications of development proposals on flood risk issues and the environment. The floodplain policies referred to in this document can be applied to the Agency's response to both development plan and individual development control consultations.

Section 54a of the Town and Country Planning Act 1990 (inserted by the Planning and Compensation Act 1991) stresses the importance of development plans. The planning authority must have regard to the development plan and determination must be made in accordance with the plan, unless material considerations indicate otherwise.

The definition of development is given in Section 55 of the 1990 Town & Country Planning Act as:

"Development means the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of any material change in use of any buildings or other land".

2.3 INTERNAL DRAINAGE BOARDS

Internal Drainage Boards (IDB's) are corporate bodies established in areas where there is a special need for drainage works. Where they exist their views on the impact of development are a crucial consideration.

2.4 PRINCIPAL GUIDANCE DOCUMENTS

The principal guidance documents are:

Planning Policy Guidance Note 25 (PPG25)	DTLR
Strategic Assessment of Flood Risk Guidance for Local Planning Authorities *	Environment Agency
Guidance note for Developers *	Environment Agency
Policy and Practice for the Protection of Floodplains *	Environment Agency
Culverting Policy *	Environment Agency
Design of Flood Storage Reservoirs	CIRIA
Local Environment Agency Plan (LEAP) *	Environment Agency
Sustainable Urban Drainage Systems (Design Manual for England & Wales)	EA / CIRIA

* These guidance documents are subject to periodic review and the Agency will make revisions available in due course.

Flood protection standards and flood risk maps

3.1 OVERVIEW OF THE CATCHMENT AND FLOOD RISKS

The specific areas covered by this document is the River Witham Catchment, which include the main river systems of the River Witham, the River Till and Fossdyke Canal, the Barlings Eau, the River Bain, the River Sleas, the East and West Fen Catchwater drains, and the South Forty Foot Drain system. The various sub-catchments vary significantly in terms of size, geology, and subsequent response to rainfall events.

The downstream reaches of the River Witham, the South Forty Foot Drain and East and West Fen Catchwater drain systems are also heavily influenced by tidal conditions, and have parts that lie within tidal flood risk areas.

With regard to this document these areas as a whole are referred to as The Catchment, and the area covered is illustrated on the inside cover of this document.

The catchment, which is managed by the Agency's office at Manby, Louth, spans across all or parts of the following Local Planning Authorities:

- ▶ Boston Borough Council
- ▶ South Holland District Council
- ▶ North Kesteven District Council
- ▶ South Kesteven District Council
- ▶ Lincoln City Council
- ▶ West Lindsey District Council
- ▶ East Lindsey District Council
- ▶ Newark and Sherwood District Council

In addition Internal Drainage Boards also serve parts of the catchment, namely:

- ▶ Upper Witham IDB
- ▶ Witham 1st IDB
- ▶ Witham 3rd IDB
- ▶ Witham 4th IDB
- ▶ Black Sluice IDB

Predominantly rural catchments are normally able to absorb rainfall, however in extreme situations when the land becomes saturated after long periods of excessive rain, surface water run-off cannot be accommodated by the normal river channels. Consequently natural floodplains are brought into use and the risk of breaches in embanked watercourses and out of bank flow is increased.

When flooding of this magnitude occurs the consequences may include loss of life, injury, property damage and significant cost to emergency services. In extreme events it is reasonable to assume that there may also be associated problems with blockages to the river, power failures and the sewerage systems.

Several urban areas within the catchment have associated flood risks, including Grantham, Lincoln, Horncastle, Sleaford, and Boston. There is also a history of flooding affecting smaller rural communities such as Harlham, Kirkby on Bain, Swaton, Minting, Hagnaby, Langworth and Billingborough.

The majority of locations within the catchment have benefited, or will benefit, from flood defence improvement schemes to help reduce the risk of flooding from main rivers and / or tidal waters.

Grantham

The standard of flood defence in Grantham currently ranges from 5% (20 years) to 1% (100 years) by means of flood walls, although some localised improvement works are planned through the town to provide a general standard of protection against the 1% (100 year) flood event. Parts of the town also suffer from surface water flooding, especially during very intense rainfall.

The floodplain through Grantham is relatively narrow, however there are large numbers of residential and commercial properties at risk.

Lincoln

Lincoln is protected against the 1% (100 year) flood event by means of a combination of flood walls and large upstream flood storage areas. These flood storage areas were designed in the early 1980's and made allowance for development in place at that time. The impact of development in the last 20 years on the standard of protection provided by the flood storage areas is currently being assessed.

As it approaches Lincoln the Witham floodplain is relatively narrow, only little more than 100m wide, however as it enters the city the Witham is joined by the Boultham Catchwater Drain and the Fosdyke Canal, with the resulting floodplain covering large parts of central Lincoln. Over 3500 residential and commercial properties are located within the floodplain in Lincoln, including major industrial sites, shopping complexes and the University of Lincoln complex.

Horncastle

There is a long history of flooding in Horncastle, and the villages immediately downstream, with flood events in 1960, 1981, and 1993 causing widespread damage. Parts of the town also suffer from surface water flooding, especially during very intense rainfall.

At present Horncastle is protected against a 10% (10 year) flood event, although the Agency has improvement works programmed that would raise this standard to the 1% (100 year) flood event. These works are likely to take the form of upstream flood storage reservoirs.

Boston

Boston is protected against the 10% (10 year) fluvial flood event, with almost all of the town being within the floodplain of either the River Witham, the Maud Foster Drain, or the South Forty Foot Drain. Large parts of Boston are also within the tidal floodplain, and have a standard of protection of between 1% (100 years) and 0.6% (150 years) against tidal flooding.

Tidal Frontage

The Wash Shoreline Management Plan (SMP), which covers the Witham Haven and the Wash frontage of the Witham catchment, is currently under review. At present the plan recommends holding the current defence line, although an area for managed re-alignment has been identified along the Freiston to Butterwick frontage. Works are currently ongoing at this site and are due for completion in 2002.

Further areas may be identified in future reviews of the SMP, and as such potential for managed re-alignment must be taken into account for all proposed development sites adjacent to the Wash frontage. Further information can be obtained from the Agency.

General

Other parts of the catchment have varying standards of protection, ranging from 20% (5 years) to 2% (50 years). Works are currently ongoing in several parts of the catchment, in particular along the Lower Witham and River Bain, to improve flood defence standards. This will be in accordance with DEFRA guidelines outlined above, and consequently are unlikely to provide 1% (100 year) standards of protection.

Large areas of the catchment are within Internal Drainage Board areas, and as such are often protected from flooding by large raised embankments.

3.2 FLOOD PROTECTION STANDARDS

Climate change is considered by many to be affecting weather patterns. The impact on predictions for flood frequency and intensity is under review by the Department for Environment, Food and Rural Affairs (DEFRA).

DEFRA publish indicative standards of protection against flooding based upon land use bands, as tabled below. They do not represent any entitlement to protection or minimum level of standard to be achieved. The actual level provided at a particular location will be determined by economic analysis, in accordance with DEFRA guidelines.

Land Use Type	Indicative Standards of Protection (annual risk / return period)	
	River	Tidal
High density urban containing significant amount of both residential and non residential property.	2% - 0.5% 50 - 200yrs	1% - 0.3% 100 - 300yrs
Medium density urban – lower than above, may include some high-grade agricultural land.	4% - 1% 25 - 100yrs	2% - 1% 50 - 100yrs
Large areas of high-grade agricultural land, with some properties at risk, including caravans.	20% - 2% 5 - 50yrs	10% - 1% 10 - 100yrs
Generally arable farming with occasional properties at risk	80% - 10% 1.25 - 10yrs	40% - 5% 2.5 - 20yrs
Low-grade agricultural land, with isolated properties at risk.	<40% <2.5yrs	<20% <5yrs

However Agency policy is to consider development proposals relative to the 1% probability (1:100 year) for rivers, or 0.5% probability (1:200 year) for tidal, flood event for all new development. The Agency considered that mitigation to these standards is the minimum required, however it is important to recognise that a residual risk remains from events with higher return periods.

3.3 FLOOD RISK MAPS

The Agency has prepared, as required under DoE Circular 30/92, a set of flood risk maps that have been issued to Local Authorities in the form of a CD-ROM (The Circular 30/92 maps).

The flood envelope shown is the greater of either the 1% probability (1:100 year) for rivers, or 0.5% probability (1:200 year) for tidal, flood envelope or the highest known recorded flood.

It is important to recognise that the information shown on these maps represents the best available knowledge at the time of their publication and the extent of *flooding shown is indicative only* of the area at risk.

As new information becomes available either as a result of actual flood events, re-survey or in-depth model analysis of certain areas, the maps will be amended and formally re-issued on an annual basis. However, Agency Planning Liaison officers will be made aware of any such alterations as and when they are made in order that they can make the appropriate comments with regard to development proposals received.

The limit of flooding shown on the floodplain maps may represent:

- ▶ The extent of one or more actual recorded flood events, or
- ▶ A prediction derived from one or more modelling techniques, either a strategic model using limited survey information for both channel and floodplain, or a more detailed model used for scheme design, or a combination of both, or
- ▶ Engineering assessment in conjunction with scheme design records, where they exist.

In some locations the extent of flooding shown will be an actual recorded event whilst in others it will be representative of a model prediction which may or may not have been modified through the exercise of engineering judgement.

There is no indication on the maps as to the origin of the flood limit and it is possible that on any single map tile the limit of flooding may be a combination of any or all of the above.

It is important to note that where the floodplain extents have been derived by means other than actual recorded floods that they ignore the presence of any defences which may exist.

In many parts of Eastern England, including the Fens and parts of the East Coast, the topography means that areas at risk of flooding are very extensive. In practice, the areas at greatest risk are those within a few hundred metres of raised river banks or sea walls, and other defences, where the impacts of overtopping and defence breaches will be greatest. These breach / overtopping risk areas need to be fully referenced in relation to current and future development proposals.

Those areas of floodplain which are defended to the indicative standard (1% for rivers or 0.5% for tidal) are identified by cross-hatching. However the nature, location and actual standard of any defence is not shown. Many areas are defended, but to standards lower than above. Typically defence standards may vary between 10 and 75 years. This information is not shown on the maps, although the Agency would be able to provide further information for specific sites.

The extent of fluvial flooding shown is generally that which is, or would be, attributable from designated main rivers. Although the Agency may be aware that flooding occurs from ordinary watercourses, this may not be indicated on the maps. Therefore it should be recognised that there may be a risk of flooding from any watercourse even where no floodplain is shown.

Some areas may be at risk from both fluvial and coastal (tidal) sources, although the Circular 30/92 only indicates one or the other. In these cases the predominant risk has been shown, be it fluvial or tidal.

There is no indication of the depth of flooding within the flood envelope shown on the maps.

The Agency is currently reviewing the information shown on its floodplain maps in light of the publication of PPG25.

3.4 CATCHMENT MODELS AND AVAILABLE DATA

The Agency has a range of information available within the catchment, including hydraulic models of river systems, daily rainfall and flow records. This information will usually be made available to Developers and Local Authorities in preparation of Flood Risk Impact Assessments, either at the Strategic or Site level. A charge may be made for the information provided, in accordance with the Agency's charging policy, a copy of which is available upon request.

The hydrology underpinning some of the models will require reviewing in light of the latest techniques described in the Flood Estimation Handbook (FEH).

River Witham

The existing main hydraulic model of the Lower Witham extends from Stamp End in Lincoln down to the tidal outfall at Grand Sluice, Boston. The downstream reaches of a number of tributaries have been partially included in the Lower Witham model, to a point where levels in the Witham do not influence levels in the tributaries.

The main tributaries that have been included in this way are the Barlings Eau, the River Bain, and the Kyme Eau. The model also includes "The Delphs" and Carr Dyke.

The model has been constructed using the ISIS software, and is in the process of being re-calibrated for the floods of Winter 2000, at the same time the hydrological inputs to the model are being re-evaluated in line with FEH methodology.

The model is currently being used in the development of, and assessment of works for, the Lower Witham Flood Defence Strategy.

Boultham Catchwater

A hydraulic model of the Boultham Catchwater drain is currently under construction using the ISIS software, extending from its confluence with the River Witham to its end of main river, upstream of Skellingthorpe village.

Fosdyke Canal

A hydraulic model of the Fosdyke Canal is currently under development, and is expected to feed into the proposed Upper Witham model.

Heighington Beck

A hydraulic model of Heighington Beck, including Sandhill Beck, has been constructed using the ISIS software, extending from its confluence with the River Witham to a point upstream of Heighington village.

Barlings Eau

The downstream reaches of the Barlings Eau are also included in the Lower Witham model, whilst a separate hydraulic model exists for the reaches from Coldstead Farm upstream to Cold Hanworth village. This model is in the ISIS software.

River Bain

A hydraulic model exists for the River Bain from Coningsby Lock, the extent of influence of the River Witham, to upstream of Horncastle.

The model has been constructed using the ISIS software, and is in the process of being re-calibrated for the floods of Winter 2000, at the same time the hydrological inputs to the model are being re-evaluated in line with FEH methodology.

River Slea

A hydraulic model of the River Slea drain is currently under construction using the ISIS software, extending from Cobblers Lock to a point upstream of Sleaford.

South Forty Foot Drain

A detailed hydraulic model of the South Forty Foot Drain has been constructed using the ISIS software, for the Black Sluice Catchment Strategy Study. The model extends from the tidal limit at Black Sluice Pumping Station, Boston, to the end of main river on the South Forty Foot Drain. Inflows from tributaries and IDB pumping stations along its length are included, with the lower reaches of some tributaries being included in the model, only to the limit of influence on water levels from the South Forty Foot Drain.

Billingborough Ouse Mere Lode

A hydraulic model exists of the Billingborough Ouse Mere Lode through the village of Billingborough. The model was constructed using the ISIS software, however it requires extending downstream, such that it links in with the main South Forty Foot Drain model.

Real-Time Forecasting and Strategic Planning Models

In addition to the above design models the Agency is developing a high level real-time flow forecasting model of the entire Witham. In due course all of the above design models will be tied into this forecasting model to provide further refinement. This forecasting model does not include the South Forty Foot Drain system nor the East and West Fen Catchwater systems.

It is also planned to have a Strategic Development model for the Witham catchment, specifically for use in determining the impacts of developments and which will be made available to developers to assist them in assessing the impacts of their particular proposals.

4 Reducing Flood Risk

4.1 AGENCY OBJECTIVES AND MODEL POLICIES

The Agency's aim is to adopt a strategic approach to reducing the risk of flooding and thereby protecting public safety and property. This will be achieved by establishing a flood warning system, improving the flood defences where this can be economically justified and influencing the development planning system.

In addition the Agency considers that local planning authorities should exercise development controls that clearly meet the objectives to:

- ▶ restrict development in floodplain;
- ▶ restrict additional run-off that would arise from changes in surfacing, drainage etc;
- ▶ promote the use of Sustainable Urban Drainage Systems (SUDS) where appropriate; and
- ▶ provide a strategic approach to development and flood risk.

In all cases developers will be required to identify, implement and cover the costs of any necessary measures, including the costs of flood risk impact assessments.

All required flood risk reduction measures should be completed and operationally effective prior to development commencing.

4.2 DEVELOPMENT IMPACTS

In general, the effects of increasing development are:

- ▶ An increase in the volume of surface water run-off due to less rainfall soaking into the ground.
- ▶ An increase in this rate of run-off due to the rainfall being shed by smooth hard surfaces and piped drainage systems.
- ▶ An increase in the magnitude of peak flow due to the combination of increased volume and rate of run-off, together with increased storage requirements at the downstream limits of river systems due to tide-lock at the point of discharge.
- ▶ A change in the catchment hydrographs as a result.

At the strategic level a number of issues will need to be considered including:

- ▶ Records of past flood events, identification of factors affecting the risk of flooding including land use change.
- ▶ The hydrology and drainage of the plan area.
- ▶ Identification of the area at risk of flooding and the frequency of flood risk.
- ▶ The impact of development on flood risk both within the plan area and downstream.

At the local level, peak flows discharging to a watercourse may be attenuated. Flow peaks at this scale are sensitive to intense storms of short duration. The volume of flood storage necessary to achieve attenuation is related to the volume of the design storm of the critical duration.

However on a catchment wide scale, there is generally more natural storage available so the design storm duration that is critical for flood peaks tends to be longer. Local flood storage may have an effect on flood flows within the catchment but its influence diminishes with distance from the affected area.

4.3 STRATEGIC FLOOD RISK IMPACT ASSESSMENT

The Agency has produced guidance for local planning authorities on the preparation of Strategic Flood Risk Impact Assessments at Local Plan scale.

The purpose of a Strategic Flood Risk Impact Assessment is to identify areas which are at risk of flooding, to identify and detail those factors which are relevant to current and future flood risks and measures which can be applied to such areas to minimise and manage the risk.

The assessment should be undertaken in discussion with the Environment Agency and have regard to the sequential tests identified in paragraph 30 of PPG25.

By assisting in this process so far as possible the Agency will be acting in accordance with its duty to exercise an overall supervisory role in all matters relating to flood defence.

The Circular 30/92 maps published by the Agency will provide a starting point for a strategic flood risk impact assessment. In due course the Agency is seeking to develop a Strategic Planning Model for all areas, specifically for use in determining the impacts of developments and which will be made available to developers to assist them in assessing the impacts of their particular proposals. A charge may be made for this service.

4.4 SITE SPECIFIC FLOOD RISK IMPACT ASSESSMENT

Whilst a considerable amount of information is now available this may not be sufficient to enable the Agency to fully assess the impact of new development. Where this is the case developers will be required to undertake a site specific flood risk impact assessment and provide relevant additional information as required by the Agency. This information may include detailed survey and modelling of reaches of river and other watercourses.

The Agency will undertake appropriate technical assessment of the details submitted and judge whether an independent assessment of the developers proposals is required.

The process that prospective developers will be expected to follow is detailed in Section 5.

4.5 PROPOSED DEVELOPMENT WHICH MAY AFFECT FLOOD PLAIN

The overall aim of the Agency's flood defence floodplain policies is to secure and, where necessary, restore the effectiveness of floodplains for flood defence and environmental purposes.

The Environment Agency will, in accordance with PPG25 seek to persuade planning authorities, initially through the Development Plan Process, and then via Development Control, to guide development away from areas that are at risk from flooding.

The Agency believes that built development in floodplain areas should be avoided. Where, however, overriding justification for development occurs, adequate mitigation and compensation measures must be clearly identified, agreed by the planning authority in conjunction with the Environment Agency, and implemented by the developer prior to development commencing.

The Agency considers that a contribution should be sought to a tangible reduction in flood risk in the floodplain. This may be achieved by extra mitigation measures or by contributing to increased floodplain flow and/or floodplain storage to achieve a progressive reduction in flood risk.

The Agency considers that the appropriate standard for flood defences for all new developments is the 1% probability (1:100 year) for rivers, or 0.5% probability (1:200 year) for tidal, flood event regardless of the DEFRA indicative standards referenced in section 3.2. It will be necessary for the developer to be required to protect new development to this standard, as a minimum, as part of his proposal without increasing flood risk to others.

Particular risks exist with regard to Coastal and Tidal flood risk areas, and some Fenland areas, which are protected by large raised defences. Areas close to these defences are at particularly high flooding risk when the severity of the flood exceeds the standard of the defence. Breaches of the defence and rapid severe flooding to a significant depth is possible in such circumstances. Such areas are likely to be identified as part of any Strategic Flood Risk Impact Assessment.

Further general guidance is set out in the publication "Policy and Practice for the Protection of Floodplains" which is available on request from the Environment Agency.

4.6 PROPOSED DEVELOPMENT WHICH MAY INCREASE SURFACE WATER RUN-OFF

Some existing methods of determination only consider the need to reduce peak flow rate. However unless adequate source control methods are employed, new developments may increase the total volume of run-off.

All new development proposals should incorporate the following source control and regulation measures as necessary and wherever technically possible:

- Sustainable Urban Drainage practices i.e. swales, reed beds, storage in porous media;
- source control techniques;
- minimisation of diffuse pollution;
- on sewer flow balancing; and
- open water space flow balancing i.e. attenuation/detention channels and lagoons either site specific or at strategic locations.

The Agency seeks that developers incorporate source control, regulation and sustainable drainage systems within their proposals. Details of such methods and an assessment of their impact should be provided for consideration by the Agency. The latest information on this topic is available on a research web site at :

<http://www.sepa.or.uk/guidance/scontrol/ciria/ciria.htm>.

If mitigation and flood risk reduction options are proposed that depend upon long term maintenance, then due account should be taken of any reduction in performance throughout their working life.

Sustainable Urban Drainage Systems (SUDS) is a fundamental requirement of the strategic approach towards new development in the catchment and there is a real need to establish the long-term legal responsibility for maintenance of any features and infrastructure proposed. This should be undertaken at the planning stage because if not, there is a risk of a gradual deterioration in flood mitigation and no regulatory means of addressing this issue later on.

A commuted sum sufficient to ensure adequate maintenance of surface water drainage facilities for 40 years, following completion of the development will be required by whichever agency is to be responsible for carrying out this maintenance.

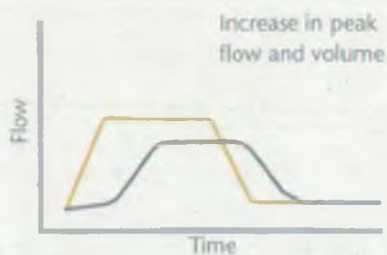
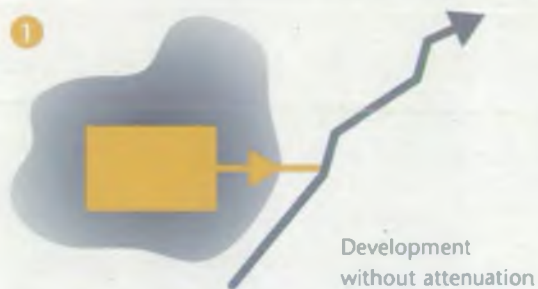
4.7 SUSTAINABLE URBAN DRAINAGE SYSTEMS

Many existing urban drainage systems are damaging the environment and are not, therefore, sustainable in the long term. Techniques to reduce these effects have been developed and are collectively referred to as Sustainable Urban Drainage Systems (SUDS).

Sustainable urban drainage is a concept that focuses decisions about drainage design, construction and maintenance on the quality of the receiving environment and people. SUDS are physical structures built to receive surface water run-off. They typically include ponds, wetland swales and porous surfaces. These structures should be located as close as possible to where the rainwater falls, providing regulation for the run-off. They may also provide treatment for water prior to discharge, using the natural processes of sedimentation, filtration, absorption and biological degradation.

There are a range of design options available enabling SUDS to be designed to "fit" into almost all urban settings, from hard surfaced areas to soft landscaped features.

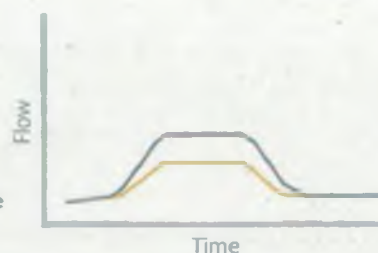
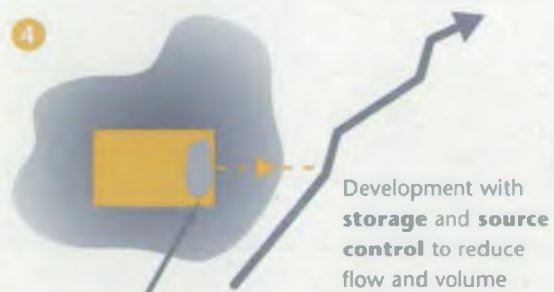
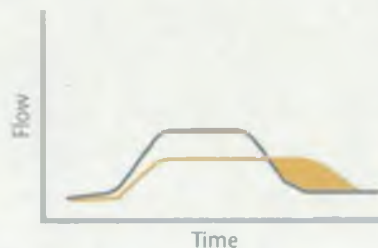
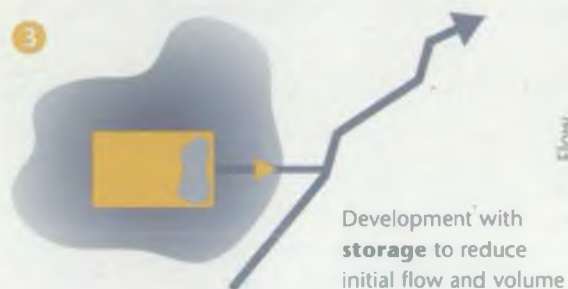
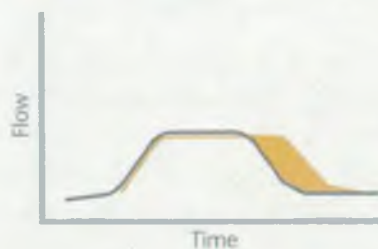
The variety of options allows designers to consider local land use and the needs of local people when undertaking the drainage design, as well as considering the traditional engineering components of the design, such as peak flow and capacity in the system.



Key

Before Development
After Development

These 'Hydrographs' show the profile of flow in cubic metres per second over the duration of a typical flood event.



Volume reduction based on increased natural storage only e.g. swales

Arrangement 1 is not considered acceptable by the Agency

Arrangement 2 is not normally considered acceptable by the Agency

Arrangement 3 may not be acceptable at certain locations

Arrangement 4 is a sustainable solution, it REDUCES FLOOD RISK and is acceptable to the Agency

Figure 1 illustrates a range of attenuation measures for new developments

SUDS can be designed to improve amenity and biodiversity in urban areas. For instance, ponds can be designed as a local feature for recreational purposes and to provide valuable wildlife habitat in an urban setting whilst providing regulation of surface water flows.

It is important to note that the use of SUDS in some circumstances may not be the most sustainable solution, in particular in parts of Internal Drainage Boards (IDB) areas. In some circumstances it may be beneficial to allow direct discharge into an IDB system, where the future maintenance requirements could be better managed. It is essential that where appropriate the IDB be fully consulted with regard to the most sustainable solution to increased run-off.

4.7.1 Source Control Techniques

These techniques are designed to counter increased discharge from developed sites, as close to the source as possible and to minimise the quantity of water discharged directly to a watercourse. This can have benefits in reducing flood risk, improving water quality through a reduction in the amount of polluting matter flushed into a watercourse, enhancing the recharge of underground water resources and helping to maintain flows during dry weather.

These systems work best when dealing with small quantities of water, and are most effective when distributed throughout a catchment at the point where run-off arises. For example, uncontaminated water from roofs can, subject to percolation tests to the approval of the local authority, be fed directly into soakaways and infiltration trenches where soil conditions and groundwater protection policies permit.

However, in some circumstances, for example on contaminated land, close to water supply boreholes or in vulnerable aquifer areas, infiltration may not be appropriate, so consultation with the Agency and the Internal Drainage Board for the site area, if any, is advisable.

4.7.2 Minimisation of Diffuse Pollution

Swales, reed beds, storage in porous media etc should be employed wherever possible and designed to enhance the quality of run-off. The first flush of water is generally the most polluted and so systems should be designed to retain the first 10mm of rainfall for 24 hours and then release it over the following 24 hours having removed as much pollution as possible. The design should not allow accumulated pollutants to be flushed into the watercourse at a later stage. These measures will also attenuate storm run-off.

4.7.3 On Sewer Flow Balancing

As an alternative to or in conjunction with the provision of SUDS, consideration should be given to a well designed on-sewer flow balancing system, subject to agreement with the sewerage undertaker.

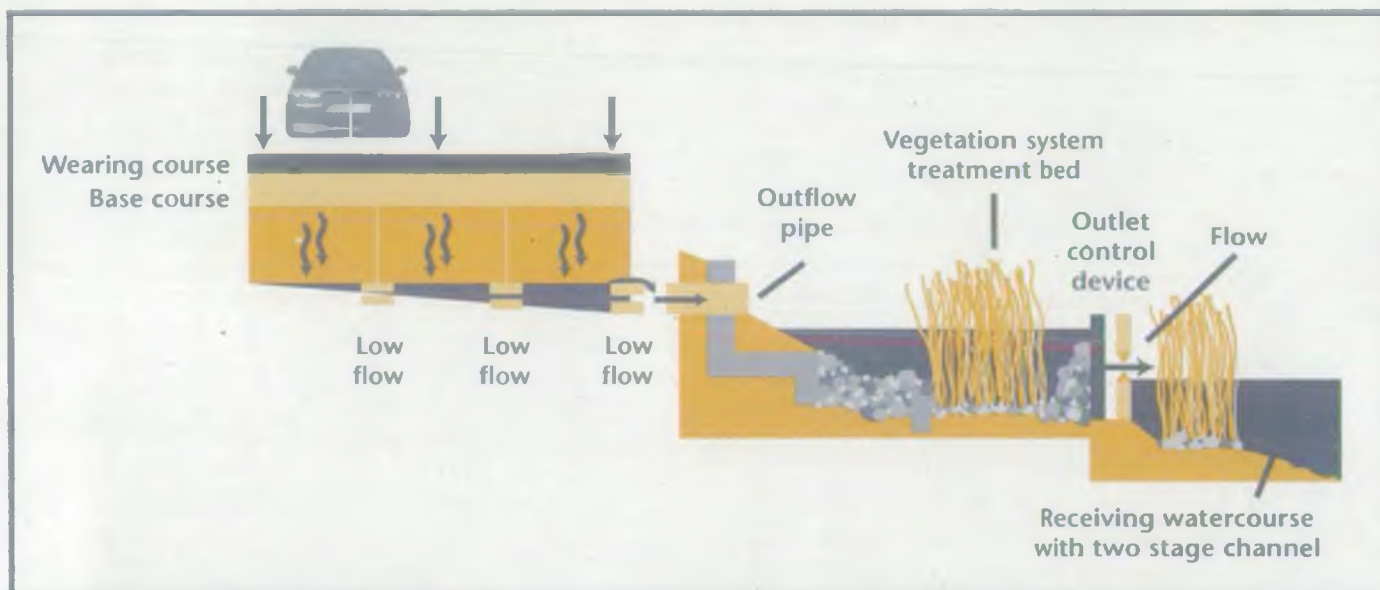


Figure 2 Typical Example of Source Control Techniques

4.7.4 Open Water Space Flow Balancing

These solutions can be either site specific or strategically located. In the past, water drainage matters have tended to be tackled on a site-specific basis, which has led to a proliferation of individual regulation facilities where subsequent maintenance has been neglected. Increasingly, the Agency is looking to promote strategic and comprehensive solutions based on whole catchment considerations to avoid this situation.

Where appropriate, and subject to detailed investigation and modelling to ensure that flood risk is not increased, surface water balancing may be introduced. Where it is known that further development is likely in the future then such balancing facilities should be designed so as to be capable of enlargement in due course.

In some instances, an appropriate alternative may be for the conveyance capacity of the receiving watercourse to be improved to the required standard. This will be acceptable providing that it can be achieved in an environmentally appropriate way, that flood risk is not increased elsewhere and that landowner consent can be obtained.

All surface water regulation facilities should be operational and effective prior to the construction of development leading to an increase in surface water run-off.

If surface water discharge relies upon a pumping system then that system should be adequately protected to remain effective to at least a 1 in 100 year flood event.

If the proposals incorporate site specific regulation such as storage ponds the following notes should be taken into consideration.

1. Surface water run-off from the development should be determined for the 1 in 10, 1 in 50, 1 in 100 and 1 in 200 year flood return period events using a method approved by the Agency and rainfall rates derived using the techniques described in the Flood Estimation Handbook.
2. The development should be designed and programmed to ensure that all additional run-off is routed to the completed regulation facility.
3. The maximum volume to be regulated should satisfy the following:
 - ▶ adequate detention of any residual additional volume of run-off arising from increased impermeability etc; and
 - ▶ required storage volume to be provided above the flood level in the receiving system unless it is a pumped discharge; and
 - ▶ assessment of rainfall duration to give maximum storage volume required to comply with point 1 above; and
 - ▶ within 24 hours of top water level being attained in a 1 in 100 year flood return period event the regulation facility must be capable of storing 80% of the additional run-off arising from a 1 in 10 year flood return period event; and

- ▶ the time lag between peak inflow and outflow introduced by the regulation facility should be sufficient to avoid increasing the overall catchment peak in critical storm durations. This requirement will depend upon location of the development and the Agency may, or request the developer to, undertake appropriate hydraulic model runs to determine the impact.
4. The facility must be designed to cater for a range of water flood levels up to 1 in 100 year flood level in the receiving watercourse/system.
 5. The regulation facility is to be physically separated from any existing watercourses.
 6. The maximum depth of water in a regulation facility above ground should normally be no greater than 1.5 metres at the top design water level.
 7. The use of on-site flow balancing may not be, in some circumstances, the most sustainable solution, in particular in IDB areas. Full consultation with the IDB is essential.
 8. It is essential that future maintenance of any regulation facilities, including source control measures, are clearly resolved. If it is not adopted by the local authority or a public body / Agency, then it will be necessary to enter into a section 30 Agreement (Anglian Water Authority Act 1977) between the Environment Agency and the landowner.

9. The allowable flow from any regulatory facility is based on the impermeable area but may take into account additional areas that contribute overland flows. Under no circumstances should the allowable discharge be exceeded in up to and including 1 in 100 year flood return period event.
10. For previously developed "brownfield" site the allowable discharge from the regulation facility must not exceed the historical flow to the sewer or watercourse from the site.
11. For "Infill" sites within fully sewered development areas the allowable discharge from the regulation facility must not exceed the design flow for the sewer from the site.

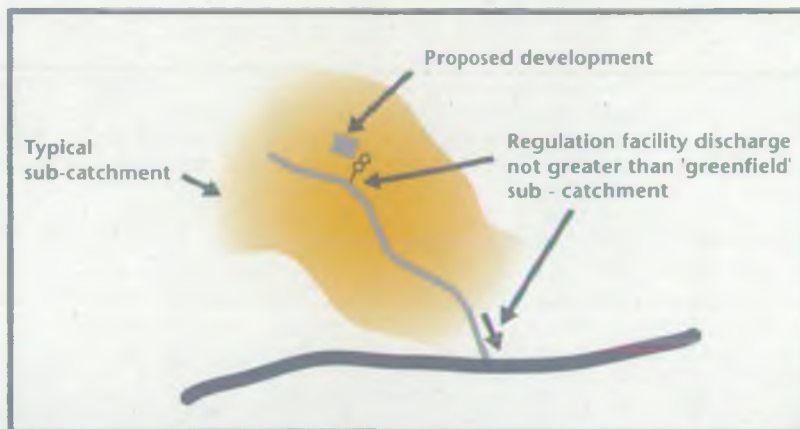


Figure 3 Control of Surface Water Discharge

4.8 PRE AND POST DEVELOPMENT MONITORING OF RUN-OFF

For major proposals, developers may be required to incorporate and maintain suitable gauging facilities in order to monitor the impact on surface water run-off. The Agency will advise of this requirement at an early stage in the process.

Agency Requirements of Developers

5.1 DEVELOPMENT PLANNING

Local planning authorities should accept and adopt the policies and principles set out in Section 6 of this document and incorporate them in future production of structure and local plans and any issue of Supplementary Planning Guidance.

5.2 DEVELOPMENT CONTROL

The Agency wishes to see a reduction in flood risk to people and property brought about by development and not merely the maintenance of the status quo in this regard.

In order to achieve this aim the Agency considers that local planning authorities and developers should support the following "stepped" procedure:

STEP 1

Developer completes Pre-planning Enquiry / Response Form as per sample in Appendix 5 and submits to the Agency Development Control Team.

STEP 2

The Agency will give initial response indicating (without prejudice) their principal concerns in relation to flood risk. These will include preliminary consideration of:

- ◆ impact on flood plain and risk to people and property;
- ◆ impact on surface water run-off; and
- ◆ interference with existing or proposed flood defence measures.

The Agency response will specify the additional information required for the development proposal to be incorporated in a Flood Risk Impact Assessment. Appendix 6 lists the various points which may need to be addressed, depending upon the scale, nature and location of the development proposed. In certain cases an assessment of existing flood defence standards and condition may also be required.

The impact on the floodplain may be able to be determined by reference to existing plans and survey. However the information may not be sufficient to determine for example, whether any loss of flood plain would occur as a result of the development. The Agency response would be to request an appropriate level of survey information to be provided by the applicant/developer at a later stage.

Impact on surface water run-off will also require an appropriate level of assessment. At enquiry stage the Agency will be able to confirm the peak outflow constraints in the affected respective locations.

However, it is important to note that this may not be sufficient to meet all of the requirements set down in Section 4.5. There may be a need for the applicant/developer to investigate more fully the areas downstream including the existing standard of any drainage system channels, floodplain and existing defences.

In order to comply with discharge requirements in any receiving watercourses it may be necessary to calculate, with the use of models if necessary, accurate return period/level relationships.

In order to determine overall input and future applications by others the Agency will require full and free use of any information submitted including survey information and models.

STEP 3

The developer should then submit an appropriate Flood Risk Impact Assessment incorporating the issues above, together with drawings, calculations etc to support proposals for mitigation. This will be required at the Outline Planning application stage.

All hydrological calculations made to determine the effect of development proposals will be expected to be carried out in accordance with the latest methods as detailed in the Flood Estimation Handbook (FEH).

STEP 4

On receipt of the flood risk impact assessment the Agency will, as part of the consultative process, undertake appropriate technical assessment of the details submitted and judge whether an independent assessment of the developers proposals is required.

The Agency will then, as part of the consultative process provide the local planning authority with a letter confirming its advice in respect of the proposed mitigation and flood risk reduction measures.

STEP 5

The local authority should exercise its powers having regard to the contents of this document, PPG25, SEPA/AGENCY recommendations on Sustainable Urban Drainage and the Agency's specific advice in relation to the proposed development by incorporating suitable conditions within its response to developers applications.

There may be circumstances, particularly where large scale developments are proposed with several developers involved, in which it might be possible to promote developer consortia to deliver a strategic solution to flood risk impact.

Conclusions of the Review

The conclusions drawn from this Strategic Review can be categorised as follows:

- Policies
- Principles
- Technical
- Future Actions

6.1 POLICIES

The Agency believes that built development in floodplain areas in the Witham Catchment should be avoided.

Local Planning Authorities should incorporate the following policy statements in their development plans and any Supplementary Planning Guidance issued.

1. Development will not be permitted if it would either alone, or in conjunction with other developments, be likely to:
 - Be itself at risk from flooding;
 - inhibit the capacity of the floodplain to store water;
 - impede the flow of flood water; or
 - otherwise increase the flood risk.

2. Proposals which do increase flood risk, either alone or in conjunction with other development, will be resisted unless appropriate mitigation measures, including suitable maintenance arrangements are provided that comply with the requirements of these policies and principles as part of the overall development.
3. Development proposals must incorporate source control techniques and Sustainable Urban Drainage Systems wherever technically feasible.
4. Development proposals that would result in the restoration and/ or enhancement of the floodplain or contribute to a reduction in surface water run-off will be encouraged.
5. Development proposals must bring about an overall reduction in flood risk and not merely seek to maintain the status quo in this respect.

6.2 PRINCIPLES

In order to reduce flood risk Local Planning Authorities should adopt the following principles in their development plans and in respect to any current and future planning proposals:

1. Development will be directed away from greenfield sites in the floodplain to prevent any further erosion of its flood flow and flood storage capacity, which would increase flood risk.
2. Any permitted development outside the floodplain will need to include mitigating action against its effects up to at least the 1 in 100 year storm event.
3. Redevelopment of brownfield sites within the floodplain will only be permitted if:
 - ▀ there is no increase in flood risk to people and property;
 - ▀ the development maintains or improves river flood defences to at least the 1 in 100 year standard;
 - ▀ any works required to prevent any future erosion of that standard are carried out where this is relevant to the site.
4. New development must contribute towards a reduction in flood risk. This may be achieved by extra mitigation measures or by contributing to improved floodplain flow or floodplain storage to achieve a progressive reduction in flood risk.
5. Appropriate long-term maintenance agreements in respect of all flood risk reduction infrastructure including flood defences, attenuation lagoons, structures and facilities etc. must be completed prior to construction, in order that the long-term effectiveness of these facilities is ensured.
6. Flood Risk Impact Assessment of the potential impacts of any proposed development, detailing flood risk reduction measures to be incorporated, will be required, prior to development taking place.
7. All flood risk reduction measures should be completed and operationally effective prior to development commencing.
8. In seeking to promote a reduction in flood risk, a strategic approach should be promoted which will both reduce flood risks and provide opportunities for environmental enhancements.

6.3 TECHNICAL

1. Communities are at risk of flooding when the rural catchment landscape is saturated and rainfall intensity approaches 25mm in 24 hours.
2. Changes in the catchment areas such as urbanisation, agricultural practices, climate change and flood defence schemes have an impact on the risk of flooding.
3. Computer based mathematical models of the catchment are being developed which will be able to be used as a basis for assessing the impact of rainfall events and changes in the catchment.
4. Individual sub-catchment flows that should not be exceeded as a result of development, will be available in due course.
5. Flood risk assessment can be undertaken by developers with the aid of Environment Agency models, where available. This may be a complex, interactive procedure undertaken in parallel with the overall design of the development site.
6. The extent of mitigation and flood risk reduction measures are best established as early as possible in the planning process in order to examine available options.
7. If mitigation and flood risk reduction options are dependent on long term maintenance then due account should be taken of any reduction in performance throughout their working life.
8. The viability of applications according with current land allocations in local plans cannot be determined without sufficient flood risk assessments being carried out.
9. Installation of appropriate devices for measurement of surface water run-off pre and post development would enable impacts to be monitored and regulated with greater certainty.

6.4 FUTURE ACTIONS

1. In order to reduce flood risk to people and property, current local plan land allocations and planning application approvals should be reviewed to ensure that adequate provision of flood risk reduction measures can be accommodated within these allocations.
2. The Agency will make future representations on structure and local plan reviews in accordance with the principles and conclusions of the Strategic Review and other relevant documents to promote flood risk reduction.
3. Proposed developments already in the planning system will be guided into line with policies and principles in this Strategic review in so far as is possible within the legal and regulation framework governing planning processes.
4. This document should be reviewed in the light of its use following a period of twelve months and subjects for review may include:
 - ▀ success of SUDS
 - ▀ the development of models with further detail to provide related flood levels and development limits.
 - ▀ revisions and improvements to the "step process" for planning enquiries.
 - ▀ contents, format and application of Pre-planning Enquiry Response Form.
5. The conclusions set out above are drawn from the consultation and technical work undertaken to date. Research and development is continuing and this may lead to revisions and additions in the interests of continuous improvement.
6. A commuted sum sufficient to ensure adequate maintenance of surface water drainage facilities for 40 years, following completion of the development will be required.
7. Further liaison with ADAS should be undertaken to determine the changing nature of the rural sub-catchments drainage systems.
8. Further consideration should be given to the effects of climate change and global warming on the contents of this review document.

Appendix - 1 Glossary

CATCHMENT

A river catchment is the whole area that drains either naturally or with artificial assistance to a river. It includes the drainage channels, tributaries, floodplains and washlands associated with a river and an estuary where one is present.

DEVELOPMENT

In accordance with the definition given in Section 55 of the Town and Country Planning Act 1990, with certain exceptions development means the carrying out of building, engineering, mining or other operations, in on over or under land or the making of any material change in use of any buildings or other land.

PERMITTED DEVELOPMENT

The Town and Country Planning (General Permitted Development) Order 1995 grants planning permission for certain types of development without any requirement for an application under the Town and Country Planning Act 1990. Such "permitted development" may nevertheless require the consent of the Environment Agency under Water Resources/Land Drainage legislation.

DRAINAGE (LAND DRAINAGE)

The Water Resources Act 1991 (as amended by the Environment Act 1995) defines drainage as including:

- a) defence against water, including sea water;
- b) irrigation other than spray irrigation;
- c) warping;
- d) the carrying on, for any purpose, of any other practice which involves management of the level of water in a watercourse.

FLOOD DEFENCE

Flood defence means the drainage of land (as defined above), and the provision of flood warning systems.

FLOODING

Inundation of land from a river or by sea water, whether caused by inadequate or slow drainage, or by breaches or overtopping of banks or defences.

FLOODPLAIN (RIVER AND COASTAL)

The following definitions of floodplain have been adopted in accordance with PPG25 (Planning Policy Guidance 25) :-

"All land adjacent to a watercourse over which water flows in times of flood or would flow but for the presence of flood defences where they exist. The limits of floodplain are defined by the peak water level of an appropriate return period event on the watercourse or at the coast. On rivers this will normally be the greater of the 1 in 100 year return period flood or the highest known water level. In coastal areas the 1 in 200 year return period flood or the highest known flood will be used. In both instances, where a flood defence exists which protects to a greater standard than those defined, then the floodplain is the area defended to the design water level".

MAIN RIVER

Main river means all watercourses shown as such on the statutory main river maps held by the Environment Agency and DEFRA, and can include any structure or appliance for controlling or regulating the flow of water into, in or out of the channel.

PROPERTY

In this context, property may be anything that is owned by a person or an organisation. It may be a building, farmland, conservation area, flood defence, railway, road, culvert, fishery etc.

RETURN PERIOD/RISK

The risk of flooding to floodplain areas and property is often described in terms of a return period.

Statistical return periods relate to the long-term average time interval between events of a particular magnitude. The 1 in 100 year return period flood has a one percent chance of occurring in any one year i.e.. The odds of it happening are one hundred to one.

It must be emphasised that return periods are averages. It should not be assumed that it will be exactly 100 years for example before a 1 in 100 year event re-occurs. It is statistically possible for such events to occur in successive years or even more than once in one year. Equally, such events may be several hundred years apart. It should also be emphasised the return period of an event refers to the return period of the FLOW at the point of interest. The return period of the rainfall required to generate this flow is usually different.

RUN-OFF

That part of rainfall which finds its way into streams, rivers etc and flows eventually to the sea.

SUSTAINABLE DEVELOPMENT

Sustainable development is defined in the 1987 Report of the World Commission on Environment and Development (the Brundtland Report) as "Development that meets the need of the present without compromising the ability of future generations to meet their own needs".

WATERCOURSE

The term watercourse includes all rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewers) and passages through which water flows.

Appendix 2 - Schedule of Permitted Discharges

As part of a continuous effort to reduce flood risk it is the Agency's intention to move towards lower allowable rates of discharge from future development sites.

The Agency considers that in order to provide a positive contribution to flood risk reduction it is usually not sufficient to attenuate surface water run-off from new developments to an estimated "greenfield" rate of discharge.

Lower discharge rates may also be necessary as a result of site location, stored volume and extended detention time requirements. This may be achieved by the increased application of Sustainable Urban Drainage Systems, where appropriate, which can reduce flows to below 1 litre/sec/hectare.

The Agency would expect that greenfield discharge rates for sub-catchments be calculated as part of the Strategic Flood Risk Impact Assessment undertaken by Local Authorities and verified through site specific Flood Risk Impact Assessments.

Where they exist the views of Internal Drainage Boards should be sought on run-off rates for sites discharging into an IDB system.

Developers should contact the Agency's Development Control team at Manby for further information on allowable rates of run-off for specific sites.

Appendix 3 - Rainfall / Return Period Tables

The following Depth / Duration / Frequency (DDF) Tables have been calculated for sample points within the catchment using FEH. All rainfall amounts shown are in millimetres

Catchment : River Witham

Location : Grantham

NGR : SK 92348 38061

		RETURN PERIOD (YEARS)									
Duration	1	2	5	10	20	50	100	200	500	1000	10000
30 min	6.6	8.2	10.6	13.5	17.0	22.9	30.0	35.8	48.0	59.9	125.0
60 min	9.2	11.4	14.6	36.3	22.9	30.4	37.6	46.5	61.5	76.0	153.3
120 min	12.6	15.4	19.5	24.2	29.9	39.2	48.0	58.7	76.6	93.7	183.0
4 hrs	16.9	20.4	25.5	31.4	38.3	49.6	60.1	72.8	93.8	113.6	214.4
6 hrs	19.9	24.0	29.7	36.3	44.1	56.5	68.1	82.1	104.9	126.2	233.7
12 hrs	26.2	31.2	38.3	46.3	55.5	70.2	83.8	99.9	126.0	150.1	268.8
24 hrs	33.5	39.5	47.9	57.2	67.9	84.8	100.2	118.2	147.1	173.6	300.5
48 hrs	42.6	49.7	59.5	70.4	82.7	101.9	119.1	139.2	170.9	199.6	334.2
72 hrs	47.2	54.8	65.2	76.6	89.5	109.4	127.0	147.6	179.8	208.8	342.7
120 hrs	53.7	61.9	73.0	85.1	98.6	119.3	137.0	158.7	191.4	220.6	353.5
7 days	58.5	67.0	78.6	91.2	105.1	126.3	145.0	166.3	199.3	228.6	360.1
10 days	63.9	72.9	84.9	98.0	112.3	134.0	153.0	174.7	207.9	237.2	367.3
14 days	69.4	78.8	91.3	104.8	119.5	141.7	161.0	182.8	216.3	245.5	374.0
21 days	76.7	86.6	99.6	113.6	128.8	151.5	171.1	193.1	220.6	255.6	328.1
28 days	82.3	92.5	106.0	120.2	135.7	158.7	178.5	200.7	234.2	263.2	387.8

Rainfall amounts shown in millimetres

Rainfall amounts shown in millimetres

Catchment : River Witham

Location : Lincoln

NGR : SK 99544 70982

Duration	RETURN PERIOD (YEARS)										
	1	2	5	10	20	50	100	200	500	1000	10000
30 min	5.4	6.8	8.7	11.1	14.0	18.8	23.5	29.3	39.3	49.0	102.0
60 min	8.0	9.9	1.7	15.9	19.8	26.3	32.5	40.1	53.1	65.5	131.9
120 min	11.2	13.8	17.3	21.5	26.4	34.6	42.4	51.8	67.6	82.6	160.9
4 hrs	15.1	18.2	22.7	27.9	34.1	44.0	53.3	64.5	93.1	100.5	189.3
6 hrs	17.7	21.3	26.4	32.2	39.1	50.1	60.3	72.6	92.7	111.5	205.9
12 hrs	23.1	27.5	33.6	40.6	48.7	61.6	73.4	87.5	110.3	131.3	234.5
24 hrs	29.8	35.1	42.5	50.8	60.2	75.1	88.7	104.6	130.0	153.3	264.8
48 hrs	38.1	44.5	53.2	62.9	73.8	90.8	106.1	123.9	152.0	177.4	296.3
72 hrs	42.3	49.0	58.3	68.4	79.8	97.5	113.2	131.4	159.9	185.6	303.9
120 hrs	48.0	55.3	65.2	75.9	87.9	106.3	122.5	141.1	170.1	195.8	312.9
7 days	52.2	59.3	70.1	81.2	93.5	112.5	128.8	147.7	176.9	202.7	318.6
10 days	56.9	64.9	75.6	87.1	99.8	119.0	135.8	154.9	184.2	210.0	324.4
14 days	61.8	70.1	81.1	93.0	106.0	125.6	142.6	161.8	191.2	216.9	329.7
21 days	68.1	76.8	88.3	100.5	113.9	133.9	151.1	170.4	199.8	225.4	335.9
28 days	72.9	81.9	93.7	106.2	119.8	140.0	157.4	176.8	206.1	231.5	340.3

Rainfall amounts shown in millimetres

Rainfall amounts shown in millimetres

Catchment : River Bain

Location : Horncastle

NGR : TF 25499 68761

Duration	RETURN PERIOD (YEARS)										
	1	2	5	10	20	50	100	200	500	1000	10000
30 min	6.3	7.9	10.3	13.0	16.4	22.1	27.7	34.6	46.5	58.0	121.4
60 min	9.1	11.2	14.3	18.0	22.5	29.9	37.0	45.8	60.6	75.0	151.7
120 min	12.6	15.4	19.5	24.2	29.9	39.2	48.0	58.8	76.9	94.1	184.1
4 hrs	17.1	20.7	25.9	31.9	39.0	50.4	61.2	74.2	95.6	115.9	219.2
6 hrs	20.4	24.5	30.5	37.3	45.2	58.1	70.0	84.4	108.0	130.0	241.3
12 hrs	27.2	32.5	39.8	48.2	57.8	73.3	87.5	104.4	131.8	157.1	281.9
24 hrs	34.1	40.3	48.8	58.4	69.4	86.7	102.5	121.1	150.8	178.0	308.9
48 hrs	42.5	49.6	59.5	70.4	82.8	102.1	119.4	139.7	171.6	200.6	336.6
72 hrs	47.1	54.7	65.1	76.6	89.4	109.4	127.2	147.9	180.3	209.5	344.7
120 hrs	53.5	61.6	72.7	84.9	98.4	119.2	137.5	158.7	191.6	221.0	354.7
7 days	58.1	66.6	78.2	90.8	104.7	126.0	144.7	166.1	199.2	228.6	361.1
10 days	63.4	72.3	84.4	97.4	111.7	133.5	152.5	174.2	207.6	236.9	367.8
14 days	68.8	78.1	90.6	104.0	118.8	141.0	160.3	182.1	215.6	244.9	374.0
21 days	75.9	85.7	98.7	112.6	127.8	150.4	170.0	192.1	225.6	254.8	381.5
28 days	81.3	91.5	104.9	119.1	134.5	157.5	177.2	199.4	232.9	261.9	386.8

Rainfall amounts shown in millimetres

Rainfall amounts shown in millimetres

Catchment : River Slea

Location : Sleaford

NGR : TF 08112 46648

Duration	RETURN PERIOD (YEARS)										
	1	2	5	10	20	50	100	200	500	1000	10000
30 min	7.8	9.6	12.4	15.7	19.6	26.3	32.7	40.6	54.1	67.2	137.9
60 min	10.3	12.7	16.1	20.2	25.1	33.2	40.9	50.4	66.4	81.8	163.2
120 min	13.4	16.4	20.7	25.7	31.6	41.2	50.4	61.6	80.2	97.9	189.8
4 hrs	17.3	21.0	26.2	32.2	39.2	50.6	61.4	74.3	95.6	115.7	218.1
6 hrs	20.0	24.1	29.9	36.5	44.3	56.9	68.6	82.6	105.6	127.2	235.6
12 hrs	25.5	30.4	37.4	45.3	54.4	69.0	82.4	98.5	124.5	148.6	267.5
24 hrs	33.1	39.2	47.7	57.2	68.2	85.5	101.3	119.9	149.8	177.3	310.2
48 hrs	43.0	50.4	60.7	72.1	85.1	105.5	123.9	145.5	179.7	210.8	358.3
72 hrs	46.8	54.6	64.5	77.3	90.7	111.7	130.5	152.4	187.0	218.3	364.8
120 hrs	52.0	60.3	71.7	84.1	98.1	119.8	139.1	161.4	196.4	227.7	372.7
7 days	55.7	64.4	76.1	89.0	103.3	125.4	144.9	167.5	202.7	234.1	377.7
10 days	60.0	68.9	81.3	94.3	109.0	131.5	151.4	174.1	209.5	240.9	383.0
14 days	64.2	73.5	86.1	99.6	114.7	137.6	157.7	180.6	216.1	247.4	387.9
21 days	69.7	79.4	92.4	106.4	121.8	145.2	165.5	188.7	224.2	255.4	393.8
28 days	73.9	83.9	97.2	111.5	127.2	150.8	171.3	194.5	230.1	261.2	397.9

Rainfall amounts shown in millimetres

Rainfall amounts shown in millimetres

Catchment : River Witham

Location : Boston

NGR : TF 32449 44511

Duration	RETURN PERIOD (YEARS)										
	1	2	5	10	20	50	100	200	500	1000	10000
30 min	9.4	11.8	15.4	19.8	25.1	34.1	43.0	54.0	73.2	92.0	196.6
60 min	11.9	14.8	19.0	24.1	30.2	40.5	50.4	62.7	83.7	104.1	214.4
120 min	15.0	18.5	23.5	29.4	36.4	48.1	59.2	72.8	95.7	117.7	233.9
4 hrs	19.0	23.1	29.0	35.8	43.9	57.1	69.5	84.5	109.5	133.2	255.1
6 hrs	21.8	26.3	32.8	40.2	48.9	63.1	76.3	92.2	118.5	143.2	268.4
12 hrs	27.5	32.8	40.4	49.0	58.9	74.9	89.6	107.1	135.6	162.0	292.7
24 hrs	33.3	39.4	47.9	57.3	68.2	84.5	101.0	119.4	149.0	176.1	306.6
48 hrs	40.5	47.3	56.7	67.1	78.9	97.3	113.9	133.2	163.7	191.3	321.2
72 hrs	44.6	51.7	61.6	72.4	84.5	103.3	120.1	139.6	170.1	197.6	324.7
120 hrs	50.3	58.0	68.3	79.6	92.2	111.5	128.5	148.1	178.6	203.7	329.0
7 days	54.5	62.4	73.2	84.8	97.6	117.2	134.4	154.0	184.4	211.3	331.9
10 days	59.3	67.6	78.7	90.6	103.7	123.5	140.9	160.5	190.8	217.3	335.0
14 days	64.3	72.8	84.2	96.4	109.8	129.9	147.3	166.9	197.0	223.2	338.0
21 days	70.8	79.7	91.5	104.0	117.6	137.9	155.4	175.0	204.7	230.5	341.6
28 days	75.8	85.0	97.0	109.7	123.5	143.9	161.4	180.9	210.4	235.8	344.2

Rainfall amounts shown in millimetres

Catchment : South Forty Foot Drain / Maud Foster Drain

Location : Boston

NGR : TF 32638 42716

Duration	RETURN PERIOD (YEARS)										
	1	2	5	10	20	50	100	200	500	1000	10000
30 min	5.8	7.2	9.3	11.9	14.9	20.0	25.0	31.2	41.8	52.0	108.3
60 min	8.4	10.4	13.3	16.7	20.7	27.5	34.1	42.1	55.6	68.7	138.3
120 min	11.6	14.2	17.9	22.2	27.4	35.9	44.0	53.8	70.2	85.9	167.5
4 hrs	15.4	18.7	23.3	28.7	35.0	45.3	55.0	66.6	85.9	104.0	196.5
6 hrs	18.1	21.8	27.0	33.0	40.1	51.4	62.0	74.7	95.6	115.1	213.5
12 hrs	23.4	27.9	34.2	41.4	49.7	63.0	75.3	89.8	113.4	135.3	243.0
24 hrs	30.5	36.0	43.7	52.4	62.3	77.9	92.1	108.9	135.8	160.5	279.2
48 hrs	39.5	46.2	55.4	65.7	77.3	95.5	111.9	131.0	161.2	188.7	318.0
72 hrs	43.3	50.3	60.0	70.7	82.8	101.5	118.2	137.6	168.2	195.7	323.6
120 hrs	48.5	56.0	66.3	77.5	90.0	109.3	126.4	146.1	179.9	204.3	330.1
7 days	52.5	60.0	70.6	82.2	95.0	114.6	131.9	151.8	182.6	210.0	334.0
10 days	56.4	64.5	75.5	82.3	100.5	120.4	137.9	157.9	188.7	216.0	337.9
14 days	60.6	69.0	80.3	92.5	105.8	126.1	143.7	163.8	194.5	221.6	341.4
21 days	66.1	74.8	86.5	99.0	112.6	133.1	150.9	171.0	201.6	228.4	345.3
28 days	70.2	79.2	91.1	103.8	117.7	138.3	156.2	176.2	206.7	233.2	348.0

Rainfall amounts shown in millimetres

Appendix 4 - Guidance Note For Developers

A4.1 GENERAL

This Guidance Note provides further guidance on the process outlined in Section 5, and has been produced to enable all developments to contribute to future flood risk reduction.

Development may:

- ▶ **increase the amount of impermeable land in river catchments which increases the amount and rate of surface water run-off, which if unmanaged increases river flows and the risk of flooding;**
- ▶ **be itself at risk from flooding if located in the floodplain. The indicative extent of floodplains are shown on the Circular 30/92 Flood Envelope Maps produced by the Agency. These maps are held by the Environment Agency and Local Planning Authorities;**
- ▶ **obstruct flood flows if located in the floodplain. This may increase flood levels and increase upstream flood risks;**
- ▶ **reduce the amount of land available for flood water storage. This may reduce flood attenuation and increase downstream flood levels and flood risks.**

The Environment Agency will promote eight key objectives for all developments:

1. All new development, whether inside the floodplain or not, shall be considered against the 1% (1:100 year) for rivers, or 0.5% (1:200 year) for tidal, return probability flood for both the design of mitigation measures and flood level.
2. Development will be directed away from greenfield sites in the floodplain to prevent any further erosion of flood flow and storage capacity which would increase flood risk. The indicative floodplain is defined on the Agency's Circular 30/92 Flood Envelope maps as issued in September 2000, and any subsequent revisions thereof.
3. Any redevelopment of brownfield sites within the floodplain will only be permitted if the development maintains or improves the flood defence standard as given in 1 above and any works to prevent the future erosion of that standard are carried out where this is relevant to the site.
4. Wherever possible a contribution will be sought to a tangible reduction in flood risk in the floodplain. This may be achieved by extra mitigation measures or by contributing to increased floodplain flow and / or storage to achieve a progressive reduction in flood risk.
5. Development should be precluded or time limited in areas where managed re-alignment of defences is most likely.

6. All development should be precluded within a 9m strip of land from top of bank or landward toe of any embankment, to allow for future access to defences for inspection purposes and repairs and improvements. This strip is subject to control through Byelaws made under Section 34 of the Land Drainage Act 1976 and enforceable by provision in the Water Resources Act 1991.
7. Development, especially single storey development, should be precluded immediately behind raised defences where breaches could lead to rapid inundation by fast flowing floodwater
8. In seeking to promote a reduction in flood risk, a strategic rather than a piecemeal approach will be promoted.

A4.2 RESPONSIBILITIES

The Environment Agency

- ▀ The Agency will review developer proposals in the context of the Strategic Review and make comments to the Local Planning Authority on this basis.
- ▀ The Agency will make available to Developers, any current models that may assist in assessing the impact and acceptability of their development proposals. A charge may be made for this service.
- ▀ The Agency will continue its normal role for issuing statutory consents where this is appropriate.

- ▀ The Agency will, under its general supervisory powers, continue to assist the Local Authorities to ensure that flood risk reduction measures identified through the planning process are implemented and effectively maintained.

Developers

- ▀ Developers will be expected to comply fully with the requirements of the Strategic Review, including the steps identified in Section 5, from the initial planning process through to implementation and future maintenance of flood risk reduction measures.
- ▀ Developers will be responsible for ensuring the strategic acceptability of their proposals by using existing models or developing new models, including assessments of cumulative flood risk impact and residual flood risk impact.
- ▀ Developers will be requested to provide appropriate information to the Agency for updating the models. This information will be used by the Agency solely for the purpose of continual improvement of the Strategic Model for future use by the Agency, the Local Planning Authority and Developers to secure a reduction in flood risk.
- ▀ Developers will only submit detailed proposals to the Agency once they have met the criteria set out in the Strategic Review.

A4.3 PRE PLANNING ENQUIRY / RESPONSE (FRAPPER)

In the first instance, the Pre-Planning Enquiry / Response form, (Appendix 5), should be completed by the developer and forwarded to the Agency.

A4.4 FLOOD RISK IMPACT ASSESSMENT (FRIA)

In accordance with PPG25 developers will be required to submit a flood risk impact assessment of their proposal for consideration.

The FRIA will be a formal document submitted as part of the planning approval process. It will be retained in the Local Planning Authority files and will be open to inspection. It will be passed to the Environment Agency for its review and assessment. The FRIA will form part of the basis of the Agency's response on developer proposals to the Local Planning Authority.

An assessment is required at the outline as well as full planning stage. Any development proposed within the indicative floodplain should be referred in writing to the Agency prior to the submission of a planning application.

A Flood Risk Impact Assessment Check List has also been established to assist the Agency in assessing FRIA's (Appendix 6). Developers may wish to refer to this checklist when preparing a FRIA.

The FRIA must present all details relevant to the existing site, including its position in relation to the floodplain.

Development proposals must be clearly presented and a thorough assessment of the impact of the proposals must be undertaken for flood events up to the prescribed design standard. Alongside this assessment the developer must state what mitigation is proposed, what its impact will be, and what if any, residual flood impact will remain.

The developer must take full account of the impact of the proposed development (with any mitigation) in the context of the downstream catchment (cumulative impacts). The Agency will make available whatever mathematical models exist for the developer's use in assessing this and any other local impacts.

The Agency and the Local Planning Authority accept that there will potentially be flood risk impacts for flood events above the design standard. The Agency will require some information on this potential flood risk.

In completing the Flood Risk Impact Assessment the developer must have regard to the Strategic Review document, the principles and standards contained therein, in accordance with which the Agency will review any FRIA's submitted.

A4.5 SMALL DEVELOPMENTS

Small developments are defined as small planning applications (property extensions through to small residential developments of up to 20 properties) which would increase surface water run-off (e.g. paved areas, increased roof areas) or which are located in the floodplain and would reduce floodplain storage or floodplain flow area.

The Agency will expect small developments to incorporate the following considerations:

1. Small developments in the floodplain include work necessary to mitigate the effects of reduced floodplain flow and floodplain storage. Any development proposal within the indicative floodplain should be referred in writing to the Agency prior to the submission of a planning application. The Agency will advise against the development being permitted in cases where there has been no prior consultation, or where mitigation is inappropriate or not considered.
2. All small developments, whether in the floodplain or not, have works to reduce surface water run-off incorporated into the development, for example:
 - ▶ Soakaways and water butts for small developments
 - ▶ Porous paving
 - ▶ Permeable drain systems

▶ Open water space flow balancing i.e. attenuation/ detention channels and lagoons (Contact the Environment Agency for a copy of "Sustainable Urban Drainage, an Introduction" which gives more details on these measures)

3. that surface water discharges are connected to a surface water sewer incorporating on-sewer flow balancing, where practicable (contact the local sewerage undertaker for details).
4. that culverting of watercourses is avoided unless there is no practicable alternative (refer to the Environment Agency Culverting Policy for details).
5. that satisfactory arrangement for long term maintenance and future renewal of the drainage system are established.

A4.6 TECHNICAL GUIDANCE NOTES

The Agency has developed Technical Guidance Notes for the following:

- ▶ Reprofilng / Recontouring of Floodplains
- ▶ Estimating River Flood Flows
- ▶ Surface Water Run-off and Balancing
- ▶ River Corridors
- ▶ Culverting of Rivers

These Technical Guidance Notes are available from the Agency.

Appendix 5 - Flood Risk Assessment

PRE PLANNING ENQUIRY/RESPONSE

FRAPPER/99/102

For initial advice developers should submit this form to the Environment Agency addressed to:
Team Leader Development Control, Environment Agency, Guy Gibson Hall, Manby, Louth, Lincs. LN11 8UR.

A DEVELOPERS SUBMISSION

Address:

Site Details:

Please enclose 1 : 2500 scale plan showing site boundary/levels and locations of existing surface water system and discharge point(s).

Local Planning Authority:

Type of Development:

(Industrial / Commercial / Residential / Mixed)

Existing Site Use:

(Greenfield / Brownfield / Infill / Mixed)

Site Area:

Means of surface water drainage (attach details including; SUDS, Source, Regulation)

Other Relevant Information eg: Previous Agreements: (References / Correspondence)

Submitted By: Name

Address

Date

Tel No.

B

AGENCY RESPONSE: THE AGENCY MAY/WILL RECOMMEND CONDITIONS/OBJECTION TO THIS DEVELOPMENT TO THE LPA DUE TO THE IMPACT OF THE DEVELOPMENT PROPOSED ON FLOOD RISK TO PEOPLE AND PROPERTY:

- 1) Part of the proposed development area is in undefended/defended floodplain.
- 2) Surface water run-off peak flows.

You are advised:

A full assessment of flood risk and mitigation / attenuation / compensation measures will be required in accordance with the Agency's current Strategic Review of Development and Flood Risk, Policy and Practice for the Protection of Floodplains, and Sustainable Urban Drainage Systems publications.

Signed:

Date:

Appendix 6 - Environment Agency Check List

ENVIRONMENT AGENCY FLOOD RISK IMPACT ASSESSMENT CHECK LIST

Development Name:

File Ref:

Report Title:

Document Ref:

Document Title:

Revision :

Documents Assessed:

A Summary Information

- 1 Site location plan (1:1250) showing the extent of the development area and position of discharge
- 2 Description of the site
- 3 Description of the existing land use
- 4 Description of the proposed development
- 5 The lowest floor levels for the development
- 6 Is the development in the floodplain?
- 7 Has the 1 in 100 year flood level been established for the receiving watercourse with sufficient accuracy
- 8 Précis of the impact of the 1 in 100 year return flood in the watercourse on the development
- 9 Précis of the impact of the 1 in 200 year return flood in the watercourse on the development
- 10 State if the detailed design of flood risk mitigation is available in the report
- 11 State what sustainable urban drainage systems have been employed
- 12 State what source control measures/ flood risk mitigation measures have been employed
- 13 State if the planned mitigation is to be operational prior to the construction of the development
- 14 Has gradual deterioration of the performance of the flood risk mitigation measures been incorporated into the design?
- 15 State if the long term maintenance of the mitigation measures and legal responsibilities have been established
- 16 State the general impact of the development on the overall flood risk. To include appropriate consideration of any insurance related effects on others.
- 17 State the impact and mitigation of overland flows from areas around the development
- 18 Has a risk assessment been undertaken in relation to the proposed development incorporating the ability of any future occupier to insure against flood risk?

B Scope of Regulation Facility

- 1 Site specific
- 2 Strategic
- 3 Planned further development incorporated in solution
- 4 Receiving watercourse improvements compliant with EA practices and environmental best practice

C Classification of Sustainable Urban Drainage Practices Utilised (% of total attenuation volume)

- 1 Swales
- 2 Reed beds
- 3 Porous pavements
- 4 Infiltration trenches
- 5 Soakaways
- 6 Infiltration basins
- 7 Filter (French) drains
- 8 Filter strips
- 9 Other (state)

D Classification of Source Control Measures Utilised (% of total attenuation volume)

- 1 On sewer flow balancing
- 2 Dry attenuation ponds
- 3 Wet attenuation ponds
- 4 Wetlands
- 5 Detention
- 6 Other (state)

E Method employed to Minimise Diffuse Pollution

1	Reed beds
2	Extended detention
3	Shallow marsh
4	Porous pavements
5	Reed beds
6	Infiltration trenches
7	Infiltration basins
8	Filter strips
9	Wet pond
10	Other (state)

F Design Criteria for the Flood Risk Mitigation Measures

1	Have approved impermeability coefficients been used?
2	References need to be given for alternative impermeability coefficients and technical reasons for use
3	The historic flow from a Brownfield site should be established and verified
4	A letter of verification from the drainage authority should be appended for the outflow from a Brownfield site
5	The allowable outflow to the existing sewer from the infill site should be established and verified
6	A letter of verification from the drainage authority should be appended for the outflow from the infill site
7	Maximum outflow from the regulation facility should not exceed the figure for allowable run-off
8	The approved method should be used to establish allowable run-off
9	The regulation facility should be offline from the receiving watercourse
10	Is required surface water run-off storage (not pumped) above the flood level (1 in 100 year) in the receiving system
11	Surface water run-off from the development should be calculated for 1 in 10, 1 in 50, and 1 in 200.
12	Has the approved method been used to calculate surface water run-off?

13	The regulation facility should accommodate the run-off that causes the 1 in 100 year flood event in the receiving watercourse
14	The regulation facility should accommodate 80% of the additional runoff arising from the 1 in 10 year flood event in the receiving watercourse in addition to the 1 in 100 year flood event.
15	Outflow from the regulation facility should not exceed the allowable discharge prior to overtopping
16	Maximum outflow from the regulation facility should not exceed the verified historic flow figure (watercourse or sewer) for the existing Brownfield site prior to overtopping
17	Maximum outflow from the regulation facility should not exceed the design flow for the sewer from the infill site prior to overtopping
18	Regulation facility should retain the first 10mm of rainfall for 24 hours and release it over the following 24 hours
19	Is all additional surface water run-off routed through the completed regulation facility?
20	Maximum depth of regulation facility should not exceed 1.5 metres at top design level
21	On sewer flow balancing should be compliant with the requirements of the sewerage undertaker
22	Is a letter of acceptance for the on sewer flow balancing design from sewerage undertaker appended?
23	The pumped mitigation measure should be effective to the 1 in 100 year flood event level (minimum requirement)
24	Letter of acceptance for the pumped mitigation design from sewerage undertaker should be appended
25	Have risks of gradual deterioration of the performance of the flood risk mitigation measures been addressed and incorporated in the design?
26	Catchment peak for critical storm durations established (EA activity)
27	The Time lag between inflow into attenuation system and outflow should not exacerbate catchment peak flows (EA activity)

G River Model of the Receiving Watercourse

1	Has Agency standard software (ISIS / MIKE 11 / HEC-RAS) been used to model the receiving watercourse?
2	Assumptions made in model satisfactory?
3	Have accepted calibration events used?
4	If accepted calibration events have not been used, has a sensitivity analysis been undertaken in deriving the flood level?
5	Has the effect of increasing Manning's value (to no maintenance equivalent) been established?
6	Has the 1 in 100 year flood level been established for the receiving system with sufficient accuracy?

H Development Control Criteria

- 1 Is the development at risk from flooding (i.e. below the 1 in 100 year flood level of the receiving watercourse)?
- 2 Does the development reduce/ enhance the flood storage capacity of the floodplain?
- 3 Does the development impede the flow of water during the 100 year flood event in the receiving watercourse?
- 4 Does the development increase flood risk elsewhere?
- 5 Does the development contribute to the reduction of surface water run-off?
- 6 Does the development reduce flood risk overall (EA modelling response)?
- 7 Have flow-monitoring facilities been provided?
- 8 Is flow monitoring effective up to the 1 in 100 year flood level of the receiving watercourse?

I Legal Requirements

- 1 Are flood risk mitigation measures dependent on long-term maintenance?
- 2 Have the long term legal responsibility of mitigation measure(s) been established?
- 3 Has a letter from the drainage authority been appended accepting the long term maintenance of the flood risk mitigation measures?
- 4 Is the control of the regulation facility going to be passed to the EA via a Section 30 Agreement (Anglian Water Authority Act 1977)?
- 5 Has a commuted maintenance sum for (40 years post development) the mitigation measures been calculated?
- 6 Has a completed Section 30 Agreement been appended for the proposed flood risk mitigation?
- 7 Has a risk assessment been undertaken in relation to the proposed development incorporating the ability of any future occupier to insure against flood risk?
- 8 State the general impact of the development on the overall flood risk. To include appropriate consideration of any insurance related effects on others.

References/Supporting Documents

▀ Sustainable Urban Drainage	SEPA/Environment Agency
▀ Policy and Practice for the Protection of Floodplains	Environment Agency
▀ Design of Flood Storage Reservoirs	CIRIA
▀ Easter 1998 Floods	Bye/Horner
▀ Urban Storm Drainage	P R Helliwell
▀ Flood Defence Regulation Manual	Environment Agency
▀ Sustainable Urban Drainage	SEPA/Environment Agency
▀ Local Environment Agency Plan	Environment Agency
▀ Wash Shoreline Management Plan	Environment Agency
▀ Flood Estimation Handbook	CEH
▀ Planning Policy Guidance Note 25 (PPG25)	DTLR

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD

Tel: 01454 624 400 Fax: 01454 624 409

Internet World Wide Web www.environment-agency.gov.uk
www.environment-agency.wales.gov.uk

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN

Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

SOUTHERN

Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000
Fax: 01903 821 832

MIDLANDS

Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324
Fax: 0121 711 5824

SOUTH WEST

Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000
Fax: 01392 444 238

NORTH EAST

Rivers House
21 Park Square South
Leeds LS1 2QG
Tel: 0113 244 0191
Fax: 0113 246 1889

THAMES

Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: 0118 953 5000
Fax: 0118 950 0388

NORTH WEST

Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

WALES

Rivers House/Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 0LT
Tel: 01222 770 088
Fax: 01222 798 555



For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY GENERAL ENQUIRY LINE

0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE

0800 80 70 60



**ENVIRONMENT
AGENCY**

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE

0845 933 3111

ENVIRONMENT AGENCY
FLOOD LINE

0845 988 1188

ENVIRONMENT AGENCY
EMERGENCY HOTLINE

0800 80 70 60

REGIONAL OFFICE

Environment Agency
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

NORTHERN AREA OFFICE

Waterside House,
Waterside North
Lincoln
LN2 5HA
Tel. 01522 513100
Fax. 01522 512927

LINCOLNSHIRE CATCHMENT OFFICE

Guy Gibson Hall
Manby Park
Louth
LN11 8UR
Tel. 01507 328102
Fax. 01507 328737



ENVIRONMENT AGENCY

LINCOLN

River
Witham

SLEAFORD

