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Flood and Water Management Bill

Impact Assessment - Local Flood Risk Management and the increased use of Sustainable Drainage systems

Last updated: 02 October 2009

defra
Department for Environment Food and Rural Affairs

Summary: Intervention & Options

Department /Agency:	Title:	
DEFRA	Impact Assessment of Local Flooding Management and the increased use of Sustainable Drain	
Stage: Draft for Bill	**Version:** 35	**Date:** 2 October 2009
Related Publications: Draft Floods and Water Bill		

Available to view or download at:

http://www.

Contact for enquiries: **Telephone:**

What is the problem under consideration? Why is government intervention necessary?

The cost of damages in England associated with local flooding are estimated to be between £1.3 billion and £2.2 billion per year and are predicted to rise due to climate change and continuing building development. Existing arrangements for the management of local flooding are complex and could be improved. Measures to tackle flood risk may be applied by several organisations without a lead co-ordinator. Government intervention is required to identify which organisations should take a lead role, and to underpin that role with legislation to improve the management of local flooding.

What are the policy objectives and the intended effects?

The policy objectives are to bring about an improvement in the management of flooding and flood risk and to increase the use of sustainable drainage systems. The intended effects are a significant reduction in the social, economic and environmental impact of local flooding, reduction of flood risk due to surface water flooding and protection and improvement of surface water quality in England.

What policy options have been considered? Please justify any preferred option.

The Pitt Review on floods made detailed recommendations for improvements for managing surface water. Defra consulted on proposals for new options regarding which organisations should take the lead responsibility. The preferred option (option 2) in this impact assessment is supported by the majority of respondents to the Future Water consultation and is consistent with the Pitt review recommedations. This option gives Upper Tier Authorities the lead responsibility for coordinating local flood risk management and includes new duties and powers for the assessment of local flood risk.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

Work is underway to establish the evidential base needed to review the impact of the new arrangements, which will be undertaken within 10 years.

Ministerial Sign-off For final proposal/implementation stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

.....Date:

Summary: Analysis & Evidence

Policy Option: 2	Description: **Legislative measures for the management of local flood risk including the adoption and maintenance of SUDS**

COSTS

ANNUAL COSTS	
One-off (Transition)	**Yrs**
£	50
Average Annual Cost (excluding one-off)	
£ 50 to £62m	

Description and scale of **key monetised costs** by 'main affected groups' Surface Water management plans (SWMP): Production £18 - 56m PV, capital investment following recommendations of SWMPs £337m PV, staff costs to carry out proposals £23 - £105m PV. Total: £378 – £498m PV. Local Authorities and Developers Sustainable Drainage Systems (SUDS) £643 - £874m PV

Total Cost (PV) **£ 1,021 to £1,372m**

Other **key non-monetised costs** by 'main affected groups'

BENEFITS

ANNUAL BENEFITS	
One-off	**Yrs**
£	50
Average Annual Benefit (excluding one-off)	
£ 78 to £392 m	

Description and scale of **key monetised benefits** by 'main affected groups' Local authorities, public and insurance companies. Benefits from £540 to £877m PV. Benefits are reduction of damage from flooding & efficiency savings in co-ordination of activities. SUDS benefits would be £970m & £6,251m PV in the form of a reduction in damages due to surface water flooding.

Total Benefit (PV) **£ 1,510-£7,128m**

Other **key non-monetised benefits** by 'main affected groups' SWMPs may generate benefits by creating the opportunity for more efficient strategic planning & investment of resources. Non-monetised SUDS benefits include amenity, recreation, value to ecosystems & can also include an increase property value. There are also likely to be health and stress reduction benefits.

Key Assumptions/Sensitivities/Risks Assumptions (See Appendix 5 for details). Damages due to surface water flooding, flood damage due to urbanisation equal to climate change, staff numbers necessary, percentage uptake of SUDS, new build rates, SWMPs applied to high risk areas, only measures with benefit cost ratio > 1 taken forward.

Price Base Year 2008	Time Period Years 50	**Net Benefit Range** (NPV) **£ 138 to £6,107 million**	**NET BENEFIT** (NPV Best estimate) **£ 138 to £6,107 million**

What is the geographic coverage of the policy/option?			England	
On what date will the policy be implemented?			2011	
Which organisation(s) will enforce the policy?			LG	
What is the total annual cost of enforcement for these organisations?			£ N/A	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ N/A	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro **N/A**	Small **N/A**	Medium **N/A**	Large **N/A**
Are any of these organisations exempt?	Yes/No	Yes/No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 14,000 Decrease of £ **Net Impact** **£** 14,000

Key: **Annual costs and benefits: Constant Prices** **(Net) Present Value**

Evidence Base (for summary sh

[Use this space (with a recommended maximum of 30 pages) to set out the evidence, analysis and detailed narrative from which you have generated your policy options or proposal. Ensure that the information is organised in such a way as to explain clearly the summary information on the preceding pages of this form.]

Full Impact Assessment for Local Flooding Including the Implementation of Sustainable Drainage Systems

1. What is the Problem?

1.1 Overview

1) Flooding has caused substantial damage in England over the past few years. A significant proportion of flooding is due to local problems from sources such as surface water runoff, small watercourses or groundwater rather than main-river or coastal flooding[1]. In this impact assessment we have called this type of flooding, local flooding. This Impact Assessment covers England but Wales is included in appendix 8.

2) Damage caused by local flooding is significant and includes: loss of life, damage to domestic and business premises, loss of livestock and damage to agriculture, infrastructural damage and loss of revenue. A high level assessment in the Foresight Report (2004) on flood damages for the UK estimated this to be around £270 million annually[2]. A report[3] commissioned by Defra estimated current damages (2008) due to local flooding in England to be much higher, between £1,304 million and £2,237 million per year. The key difference was a change in the assumption of the role of piped drainage.

3) Depending on what the damage is and where it is, damages are paid for by one or a combination of - insurance companies, householders, owners of commercial properties and local authorities.

4) The 2007 flooding revealed issues which could be improved upon in the organisation of flood management and with infrastructure in place to deal with it. The environment agency stated “These floods were different in scale and type from recent severe floods. In particular, a much higher proportion of the flooding than normal came from surface water rather than rivers” ... “Two-thirds of the properties ... were affected because drains and sewers were overwhelmed”. [4]

5) The Association of British Insurers[5] regarded the 2007 floods as an extremely serious event. “The floods of summer 2007 were the most severe weather-related event that the UK has experienced in decades. In total, around £3bn of this loss was covered by insurance with insurers receiving around 165,000 claims. This is eight times the combined cost of the floods in Carlisle in 2005 and in Boscastle in 2004 and makes it the most costly insured weather event in the UK”. They were also concerned about the likely increase in flooding due to climate change and emphasised the needs to ensure the dangers of surface water flooding were recognised was taken into account.

6) Flooding due to surface water drainage can lead to overfilling of surface water sewers and combined sewers and can lead to flooding of properties with foul water and more frequent discharges of raw sewage from combined sewer over flows.

[1] Flooding types are described in Appendix 1.
[2] Foresight (April 2004) Future Flooding DTI
[3] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009
[4] available from http://www.environment-agency.gov.uk/research/library/publications/33891.aspx.
[5] Summer Floods 2007: Learning the Lessons Association of British Insurers November 2007.

7) Many of the Water and Sewerage Companies' (WaSC) existing surface water drainage assets are close to or at capacity. As new developments feed into them and rainfall increases in intensity due to climate change, they will flood with increasing frequency unless further capacity is provided.

8) Surface water runoff can also cause pollution, mainly from sediment and pollutants in the sediment. Pollution of surface water drainage can be due to:
   - flooding surface water mixing with foul sewage
   - normal drainage of waters direct from roads and contaminated surfaces
   - a sudden increase in water flow during storms which can carry more sediments and other pollutants.

9) An increase in hard standing can cause exacerbation of drought due to a reduction in deep infiltration of water into the soil.

10) There is a reduction in the number of valuable habitat areas in urban areas particularly wetlands.

1.2 Current Management and responsibility

11) Currently the Environment Agency assesses flood risk from main rivers and the sea on a national scale. This helps inform future policy direction, long term investment programmes and shorter term priorities. There is no equivalent national assessment of flood risk from other sources of flooding.

12) No organisation has clear responsibility for managing flooding from surface run-off or groundwater sources. Nor is there clear responsibility for co-ordinating the inter-related responsibilities of others when their drainage infrastructure does not have the capacity to deal with this water.

13) A number of authorities have responsibility for managing various parts of the drainage infrastructure. The drainage infrastructure includes watercourses and culverts, which come under the responsibility of the Environment Agency for main rivers. The District, Unitary or Lower Tier Authorities are responsible for smaller water courses, with local highway authorities responsible for local highway drains. Water Companies are responsible for surface water sewers and drains.

14) Existing arrangements for surface water drainage[6] provide these authorities with limited incentives for managing surface water flooding effectively. Where there are clear responsibilities, each stakeholder tends to tackle their small part of the surface water drainage system, often passing the problem downstream. It is very rare, except following a serious flooding incident, for one organisation to take the lead in managing an integrated solution to flooding from combined sources or for an organisation to prioritise action according to a risk- based approach.

15) No organisation currently has a duty or sufficient incentive to plan for management of flooding caused by multiple sources. There is little incentive for organisations to co-operate with or provide information to authorities who might wish to lead an integrated approach when the organisations have other priorities and no duty to share information.

16) The management of water by a multiplicity of organisations before it reaches a major watercourse leads to a number of management problems:
   - No clear accountability of which organisation should take the lead to resolve problems or how different organisations should work together.
   - Limited understanding of the level of flood risk particularly the risk from a combination of sources.
   - Transferring and increasing flooding problems to down-stream locations rather than dealing with them at source.

[6] Surface water drainage in this Impact Assessment means methods for removing water from areas that would otherwise be prone to flooding from rainfall and the resulting surface run-off. Surface water management covers this but also includes the strategic planning process that determines where surface water drainage measures are best applied and prioritised, and also taking into account effects from other sources of flooding.

1.3 Current Use of Sustainable Drainage Systems

17) A method of improving the management of surface water is to use Sustainable Drainage Systems (SUDS). This approach mimics natural drainage that would occur on a greenfield site and typically includes infiltration systems swales[7], ponds and wetlands. The SUDS approach reduces the impacts of flooding compared to conventional systems by slowing the flow and reducing the volume of water draining from a site.

18) SUDS manage more water above-ground than conventional drainage systems, keeping water out of sewers. Conventional systems are designed to move water downstream as quickly as possible. SUDS store surface water and allow it to infiltrate into the ground or gradually release it downstream, where possible, to the natural drainage system. SUDS also reduce pollution through the reduction of runoff and purification of water flowing through the SUDS[8].

19) Annex F of PPS25[9] sets out planning policy strategy on the management of surface water and states that *"Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account."*

20) This continues to be Government guidance. However the take up of SUDS has not increased sufficiently to see the flood benefits that were anticipated. There are two main reasons for this:

- There is no organisation which has a duty to adopt and maintain SUDS. In practice some are adopted by the local authority, some by the water company, some by a private management company and some by a combination. A number fall through the system entirely and are not maintained.
- Currently developers have an automatic right to connect surface water (Section 106 and Section 115 of the Water Industry Act 1991) to public surface water sewers, so have no need to change to using new drainage methods.

2. Why does it need Government intervention?

21) Good management of surface water, ground water and sewerage is a public good with large health, economic and environmental benefits.

22) Government intervention is required to establish effective mechanisms underpinned by legislation for consistently improving the management of local flood risk that address the following shortfalls:

- Informational problems: Local flood risk management (LFRM) is poorly understood. Drainage systems are complex and there may be weak understanding of the location and performance of drainage assets, and the interactions between them. Available information is not pooled across stakeholders; drainage expertise is weak, particularly in LAs; there is uncertainty concerning alternatives to traditional approaches to drainage; planning and financing horizons of stakeholders may be short-term.
- Drainage stakeholders operate within a legislative framework that does not promote a co-ordinated and consistent approach to surface water management.[10]
- The ownership and state of current drainage assets is often unclear, leading to sub-optimal decisions about maintenance and improvements.

[7] Swales are open, green drains that slow down surface water movement, allowing all or a part of the water to infiltrate into the soil and suspended particles to settle out.
[8] Soil particles and vegetation in SUDS filter pollutants out of the water; microbes in the soil can increase this cleaning effect.
[9] PPS 25 – Planning Policy Statement 25 Development and Flood Risk 2006
[10] Further discussion in Vivid Economics (2007) *Funding and Charging Arrangements for Sustainable Urban Drainage Systems*, Report for Defra, http://www.defra.gov.uk/environment/water/quality/diffuse/non-agri/research/documents/SUDS-report.pdf

- Incentives problems: No organisation has overall responsibility for local flood risk. There are a large number of stakeholders and none have sufficient incentive to fully account for flood and related risks.
    - Each organisation has a different set of incentives and accountabilities for managing surface water, and plans its investments to different standards of protection and over different time horizons.
    - Local authorities have no formal responsibility for taking actions to mitigate risk in relation to existing urban development. LAs may be reluctant to adopt SUDS because of difficulties establishing a robust funding mechanism for maintenance.
    - Water and sewerage companies are the principle providers of drainage but face limited incentives to mitigate flood risk. They are obliged to provide drainage only to a standard of 1 in 30. The regulatory regime governing water charging discourages investment that cannot be represented as capital expenditure, such as rainwater harvesting or water efficiency measures.
    - Environment Agency has significant relevant expertise but no responsibility for sources of flood risk other than 'fluvial'.
    - Local Highway Authorities have a right to connect to public sewers by agreement with the water utility but at zero cost. This provides no incentive to manage water flows at source, creating increased risk downstream.
    - Property-owners face weak incentives to manage surface water at source. Water charges do not discriminate by surface water volume. Rebate for disconnection of surface water is small. The consequences of creating hard surfaces such as paving gardens are limited.

- Funding issues. Mains drainage is financed by a charging mechanism that is publically regulated. Any additional investment in drainage would currently be financed by increasing sewer charges or by some alternative mechanism, such as Council Tax, local authority (LAs) grants or developer commuted sums.
- This lack of alignment between Local Authorities (LAs), Water and Sewerage companies (WaSCs), the Environment Agency (EA) and private individuals means that measures to tackle flood risk and improve day-to-day drainage are applied in a piecemeal way without any lead to organise or co-ordinate others in an integrated management strategy that prioritises action to manage flood risk according to risk.

23) These factors are compounded by the land use planning and building control process which, due to a lack of detailed evidence, may give insufficient weight to surface water management issues and does not take into account the cumulative impact of new developments on flood risk.

24) If we do not improve current flood risk management we will not have a full understanding of flood risk or a co-ordinated approach to managing flood risk. This could lead to an increase in incidents of serious flooding as a result of new developments and climate change, an increase in water quality problems and difficulty in achieving development goals.

25) Table 7 in appendix 2 sets out the recommended policies for LFRM and the expected consequences of the proposed policy.

3. Background to proposals

26) Options for change have been developed since the government's Making Space for Water (MSW) strategy for flooding (2005) promoted 15 pilots for integrated urban drainage and to develop guidance for the preparation of surface water management plans. Future Water, the government's water strategy for England (Feb 2008), set out and consulted on proposals for improving surface water management which took account of early recommendations made by Sir Michael Pitt in his December 2007 review of the summer flooding in 2007.

27) These reports all identified that improvements could be made in the arrangements for managing flood risk from surface runoff and ground water[11].The balance of responses[12] to the Future Water consultation supported the proposals including the need for legislation as opposed to voluntary action. Making Space for Water and the Pitt Review also identified the need to understand and manage flood risk from all sources at both a national level and a local level.

28) The Government's response to Sir Michael Pitt's Review accepted the package of recommendations relating to surface water management and committed to take them forward as legislative proposals – these are presented as option 2 in section 5. Option 1 is the baseline option assuming that existing policies and practices remain and no legislative change is made.

4. Purpose and Intended Effects of Proposals

29) The proposals apply to England.

30) The proposals are to bring about:

- An improvement in the management of local flooding.
- An improvement in the understanding of local flood risk.
- An increase in the use of sustainable drainage systems
- Improved assessment of the interaction of local flood risks with any other cause of flood risk such as main rivers or the sea.
- Clarity on roles and responsibilities for local flood risk management.

31) The intended effects of the proposals include:

- A significant reduction in the social, economic and environmental impact of local flooding, relative to the projected increase with climate change. Surface water would be more effectively managed and directed away from property, and the onset of flooding delayed, allowing more warning where flood water flow was slowed down in SUDS.
- Protection and improvement of surface water quality particularly, as there would be less surface water runoff, from new developments, contaminated with diffuse urban pollution, particularly from roads, entering sewer systems or water courses. There would be fewer incidences of sewage being discharged from combined sewer overflows.
- Reduced duplication of effort across organisations involved in flood management.
- Reduced gaps in responsibilities and an increase in motivations for flood management for surface runoff and groundwater.
- Development of the most cost-beneficial investment strategies for flood management, for example by undertaking flood risk assessments and prioritising and implementing phased solutions that produce greater reductions in flood risk for every pound spent.
- Allocation of land during the planning process, for uses that minimise surface water impacts on new and existing development (all other considerations being equal).
- Use of sustainable drainage systems (SUDS) in most new developments.
- A substantial reduction in the amount of water draining to surface water sewers or combined sewer pipes.
- Increase in wetlands habitats and amenity value in new developments. SUDS can provide attractive, ecosystems within an urban setting (see appendix 4).
- Reduction of drought through increased infiltration of water.

5. Policy Options

Options

32) Two options were evaluated:

- **Option 1- the baseline**. No changes to current methods for managing floods or assessing flood risk.

[11] See appendix 1 for further explanation of these terms.
[12] Summary of Responses to the Improving Surface Water Drainage Consultation (Sep 2008)

- **Option 2 – redefining roles and responsibilities for flood management** and the assessment of flood risk including compulsory consideration of SUDS for new developments.

5.1 Option 1 Baseline – current local flood risk management.

33) This option is the baseline and assumes current policies and legislation are retained. For the baseline we assumed that the following changes will occur:

- Climate change – an increase in winter rainfall, an increase in the intensity of rainfall events throughout the year and therefore an increased frequency and consequence of flooding.
- Continued urbanisation - development of greenfield sites and redevelopment of brownfield sites.
- Requirements for improvement to water quality through European legislation, particularly the Water Framework Directive.

Climate Change

34) Information from reports[13] on climate change was used to predict damage from surface water flooding over a 50 year period. This is discussed further in section (6.4) on SUDS benefits. We have assumed that by 2060 there will be a 20%-40% increase in rainfall which will produce a 30% to 110% increase in flood damages to surface water flooding.

Continued Urbanisation

35) On advice from CLG we have assumed a growth figure of 240,000 new domestic properties per year and a figure of 20,000 for commercial properties (non-domestic). The Halcrow report of 2009[14] assessed information on housing growth and map information to estimate areas of new developments. We used their assumption that 60% of new build would be in brownfield sites. We have also used their assumption suggested by other sources that urbanisation will cause the same magnitude of increase in flood damage due to surface water that climate change does. So this effect will produce an additional 30% to 110% over current surface water flooding damages. This is discussed in more detail below and in the Halcrow report (2009).

Water Quality Improvements.

36) We have not tried to quantify the effect of the proposals on water quality but are confident that the proposals will make a contribution towards improvements in water quality.

37) Under PPS25, Strategic Flood Risk Assessments (SFRAs) are required, and it is likely that these will continue to be developed, and will include information about surface water flood risks. However unless there is a clear responsibility for local flood management these SFRAs alone may not secure effective local flood risk management. It is assumed that local authorities will develop Surface Water Management Plans in some areas on a voluntary basis and whilst there will be costs to this, difficulties may arise in development if other organisations do not co-operate with information for the plans. Implementing actions will also rely on availability of existing resources.

38) PPS25 already requires developers to mimic natural drainage conditions as far as possible. Individual planning decisions will start to take PPS25 and Strategic Flood Risk Assessments into account as a material consideration, but new development and investment decisions will continue to be informed by patchy and fragmented evidence on surface water flood risk. Moreover, without a duty to adopt and maintain SUDS, the number of sites using the SUDS approach will remain low and there is a risk that un-adopted SUDS will grow in number.

[13] Flood and Coastal Defence Project Appraisal Guidance FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities - Appraisal of Human Related Intangible Impacts of Flooding (Defra (2004)); Foresight (2004); IUD Pilot Studies for Hogsmill, River Aire and West Garforth.

[14] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

39) At present adoption of SUDS by a local authority is often dependent on negotiation of a commuted sum[15] with the developer, traditionally as part of negotiating planning conditions under Section 106 of the Town and Country Planning Act. In the current economic climate it is to be expected that these sums will become harder to negotiate and subsequently the number of SUDS adopted will fall.

40) A limited number of SUDS have been adopted by water companies but they are concerned about whether these can be treated as part of their asset base for charging purposes. Expansion of this route to adoption is unlikely. The net result is that the risk of surface water flooding and the costs when local flooding does occur under a 'do nothing' baseline scenario will continue to grow.

Present and future flood risks.

41) The Foresight report on flooding (2004)[16] is considered to be the most developed source of information currently available. Foresight looks at a variety of economic and climate change scenarios and the effect that the interaction between the two has on damage due to flooding.

42) The future occurrence of floods is uncertain and impacts from it are dependent on socio-economic factors as well as the effects of climate change impacts. The scenarios have different factors for future growth with consequential increasing value of assets at risk. They predict a growing cost to society from surface water flood risk.

43) Climate change is predicted to increase both the frequency and severity of flooding events. This will drive up the cost of responding to events and will put a greater value of assets at risk. The impact of climate change has been considered in the evidence supporting this impact assessment.

44) The cost of damage to property would be borne by householders and businesses, and shared amongst the insured or borne directly by those without insurance. To date losses to human life have been limited. However, under the baseline scenario loss of life would increase. Risk to live-stock will also increase.[17]

45) If no action is taken, the flood damages could rise dramatically and require the retro-fitting of flood management measures at inflated cost.

46) Under the baseline option no additional flood risk management is undertaken, and knowledge and information on increasing risks from surface water flooding would be limited to theoretical studies. The real risks would not be assessed or planned for at a strategic national level as no organisation would have responsibility for doing so. A lack of co-ordination in disseminating good practice for managing local flood risk would lead to disparate and inconsistent approaches being applied in different areas making information transfer inefficient and potentially costly.

47) Water and Sewerage Companies would come under increasing pressure to provide additional water storage in underground tanks and to treat the additional foul water contained in combined sewerage. Where this is not cost-effective or not carried out the frequency of discharges from Combined Sewerage Overflows will increase.

48) Option 1 is the baseline for the analysis of costs and benefits for option 2. Option 1 is the hypothetical situation where there are no improvements to the current situation and but local flooding continues to increase due to climate change and continued urbanisation.

[15] A commuted sum is a calculated sum of money necessary to compensate for the transfer of a maintenance liability from one organisation to another. In this case the liability is the maintenance of the SUDS.
[16] Foresight Future Flooding2004
[17] Approximately 1000 sheep were drowned in the 2008 September floods. Impact of 2007 summer floods on agriculture, ADAS (FINAL) 2007

5.2 Option 2 - Redefining roles and responsibilities for Local Flood Management

49) This option analyses the impact of our proposals to re-organise the management and assessment of local flood risk in order to mitigate damage.

50) Proposals for new legislation have been developed from the Future Water Consultation on Improving Surface Water Drainage (Feb 2008) and recommendations from Sir Michael Pitts Review – Lessons Learned from the floods in the summer of 2007.

51) The proposal for new policies cover:

- Giving new responsibilities to local authorities for local flood risk management, to improve understanding and management of flood risks.
- Making arrangements to ensure the adoption and maintenance of Sustainable Drainage systems (SUDS) in new developments.

5.3 New Responsibilities for Local Authorities

52) The proposals include enhancing upper tier (County Council and Unitary authorities) current local flood management responsibilities by placing new duties on them to lead and co-ordinate a strategy for the management of *local flood risk* from all sources of flooding at the local level including :

- Maintaining a register of the main drainage and flood risk management assets, including existing and new sustainable drainage systems (SUDS).
- Powers to manage flood risk from surface runoff and groundwater so as to reduce the impact of flooding where this is justified and cost effective.
- Investigating local flooding incidents, identifying ownership and legal responsibility.
- Powers to develop local flood risk assessments and action plans, agreed with the Environment Agency (EA), for investment programmes with others. Upper tier local authorities will have a duty to do this to comply with the EU Directive on the Assessment and management of floods. This activity will grow, commencing with assessment and plans for locations at higher risk, and then in due course, to locations at lower risk, up to the point where it will not be viable to justify the costs of developing the plans. Chapter 2 of Halcrow (2009)[18] presents a model for assessing the impacts of this, using results from a national surface water mapping exercise by the EA. The plans' objectives will include sustainable management and where feasible they will aim to mitigate local flood risk using the information gained to inform local authority planning decisions and emergency plans.
- Giving local authorities power in relation to granting consents to works that may affect the flow of ordinary watercourses (which currently lie with the EA).

53) In addition all relevant organisations would have a duty to co-operate and share information with local authorities and the Environment Agency to facilitate the management of flood risk. There will also be additional powers for district councils, internal drainage boards, water and sewerage companies and highways bodies to undertake work on surface runoff and groundwater to facilitate delegation arrangements from upper tier authorities. Making district councils, internal drainage boards work on ordinary watercourses subject to compliance with any strategy established by a county or unitary authority.

54) Evidence shows that there are benefits from local flood risk management but they may take significant time to realise.

- Surface Water Management Plans (SWMPs) can identify 'quick fixes'. For example, West Garforth Integrated Urban Drainage plan (IUD) identified and facilitated removal of obstructions in a culverted water course (Halcrow 2008, IUD pilot summary report).
- There is evidence that permeable paving is no more costly on a whole life basis than impermeable paving, and it is considered a key SUDS component for existing urban developments. SUDS components that 'take-land' such as ponds and swales are more difficult to justify[19].

[18] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009
[19] *Cost-benefit of SUDS retrofit in urban areas. Science report – SC060024 Environment Agency (2007)*

- Few IUD pilots and no SWMPs have quantified impacts of proposed plans. Some broad conclusions may be drawn, informed by IUD pilots in Lewes, Torbay, West Garforth and Hogsmill and surface water management plans in Kingston and Richmond and Ravensbourne. A relatively large number of small-scale and local interventions may be identified that impact on flood risk. Typically, these involve maintenance only, or a modest capital investment plus maintenance. There is great variability in the benefit cost ratios. We have therefore analysed a range of benefit cost ratios covering certain measures tested in the Integrated Urban Drainage pilots. For some pilots, a handful of measures were exhibiting BCRs below 1, and would not be selected in practice. Hence the range of low and high BCRs excludes those measures. An important driver is the number of properties protected and as a result a reduction in stress to members of the public in areas subject to flooding[20].
- *The integrated Urban Drainage Pilot Summary Report*[21] stated that 'Surface water flood risk problems are endemic to urban areas and may only be resolvable through the redevelopment of town centres and housing so that space can be made for water. The benefits of Integrated Urban Drainage Management may therefore take many years to be realised'.
- Local Flood Risk Management (LFRM) involves significant fixed and overhead costs, largely a consequence of the poor evidence base and the requirement to invest in a capability.

5.4New responsibilities for Local Authorities for SUDS

55) The provisions on SUDS within the draft Bill aim to increase the uptake of SUDS and define responsibilities for their maintenance. The key proposals are as follows:

- An approval system for the surface water drainage systems of the majority of new developments, wherever these will affect the drainage of other properties. This will include roads.
- A requirement on unitary and county local authorities to adopt and maintain new SUDS which serve two or more properties.
- A requirement on developers to demonstrate that they have met National Standards for application of SUDS techniques before they can connect any residual surface water drainage from a new development to a public sewer (amending section 106 of the Water Industry Act 1991).
- National Standards for SUDS which govern the way in which surface water drainage systems must be constructed, and operated. These will reflect the need to mitigate flooding, improve water quality, protect the environment, protect health and safety, and ensure the stability and durability of the drainage systems.

56) Though the main legislative changes would be made through the Floods and Water Management Bill, to align legislation there are changes that would need to be made in the Building Regulations. We will reflect these new responsibilities in guidance and amendments to the Building Regulation part H when they are next amended in 2013. However we will ensure that interim legislation will bridge the period between implementation of the Flood and Water Management Bill and changes in the Building Regulations so that the proposals for SUDS will not be delayed.

57) The SUDS approval and adoption process will take the place of the existing process for agreeing the adoption of new surface water drains and sewers with the WASC.

58) The right to connect to sewer would be conditional on obtaining approval for SUDS plans.

59) The new duties for Local Authorities fit well with their community responsibilities, as well as their duties as highway authorities, planning and building control authorities, and the largest land managers of the public realm.

[20] Flood and Coastal Defence Project Appraisal Guidance FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities - Appraisal of Human Related Intangible Impacts of Flooding (Defra (2004))
[21] Making Space for Water Urban flood risk & integrated drainage (HA2) IUD pilot summary report, Defra, June 2008

6. Benefits and Costs

6.1 Introduction

60) There are a number of costs and benefits, quantified and un-quantified, in moving from the current policy landscape (option 1) to implementing our proposals (option 2). The methodology and assumptions for calculating each of these is set out in the following subsections, concluding with a summary of costs and benefits. The costs and benefits considered are summarised in the following table. These costs and benefits refer to England only.

Table 1 Summary of Costs and Benefits Considered

	Option 1	**Option 2**
Costs	**Baseline - no change to current policy**	**Introduce SWMPs and increase SUDS use**
Quantified	No additional policy costs (limited use of SUDS is part of current policy) Growing flood damage costs	SUDS – additional to option 1 • Processing applications to build SUDS • Maintenance of SUDS
		SWMP costs – fully additional to option 1 • Production of SWMPs • Capital Investment following plans • Staff costs to produce and service SWMPs
Benefits		
Quantified	None additional to those for current policies	Increase in SUDS over option 1 • benefit is flood damage cost avoided
		SWMP – fully additional to option 1 • benefit is flood damage cost avoided
Not quantified	None	SUDS increase over option 1 • Amenity • Recreation • Ecosystem value • Possible increase in property values • Benefit to health through stress reduction
		SWMP – fully additional to option 1 • more efficient planning generating savings

6.2 Methods

61) The analysis separates Surface Water Management Plans and SUDS. The proposals for SUDS will affect new developments and the properties downstream of them. SWMPs mainly apply to existing developments but will have to address new developments in the future.

62) The proposals for SUDS are to ensure high uptake in new developments. To assess the impact of SUDS in new developments, we have assumed a current level of damage. The cost of SUDS construction was assumed to be similar to conventional drainage but the costs of maintenance were assumed to be higher. Costs included annual maintenance and staff costs for assessing applications to build SUDS.

63) To calculate the benefit we assumed damage due to surface water flooding would increase by 60%-220%. This increase includes two components – climate change and urbanisation. We made assumptions (described below and in appendix 6) about the uptake of SUDS and how much damage would be mitigated by SUDS. The reduction in damages is the benefit.

64) To calculate SWMP costs, assumptions were made about cost of the plans and staffing time required to resource making plans and following their recommendations. A range for the number of plans which would be required was then estimated[22] and this number used to calculate costs for SWMPs.

65) The benefit from SWMPs was then estimated by determining a reasonable benefit to cost ratio range using a number of projects carried out to mitigate flooding. This range was used to give a range of possible benefit to cost ratios for the SWMP proposals.

66) We consider fifty years to be a reasonable time period over which to assess the cost benefit for the types of assets involved in flood protection though there will be a wide variety of SUDS components involved with a range of lifetimes.

6.3 Sustainable Drainage Systems

67) For new development the policies are aimed at ensuring that where cost beneficial sustainable drainage systems are used to reduce the damage due to surface water flooding; both in the new development and downstream of the new development.

68) To estimate the costs and benefits we used information from case studies, estimates and assumptions detailed in a report produced by Halcrow for Defra providing evidence for this impact assessment[23].

6.4 SUDS Benefits

69) The benefits calculations include only flood benefits of SUDS. Non-flood benefits include – amenity, recreation, value to ecosystems, and can also include an increase property value[24] where SUDS including open water features are used. The use of SUDS will also reduce the flow of water to sewerage systems many of which have already reached capacity. This would result in decrease discharges from sewer overflows and a decrease in the amount of water flowing to sewage works from that expected from conventional drainage. There was insufficient evidence available to quantify these benefits.

70) The methodology we used first estimated the damages caused by surface water flooding, then calculated the reduction of these damages possible due to use of SUDS and applied that reduction over a 50 year period to give a figure for the possible benefits. To manage uncertainties arising from a limited number of case studies, a sensitivity analysis was included to give a range for the probable value of benefits.

Current Flood Damage.

71) The primary assumption for the benefits is for damages due to surface water flooding. A range for current damages due to surface water flooding was taken from the Halcrow report (2009).

- The Halcrow report estimated current damages based on a damage per property approach. Low and high values of damages per property were used. These were £23,290 and £29,430 respectively. These values were informed by several studies[25].

[22] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

[23] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

[24] CIRIA – SR622 An Assessment of the Social Impacts of SUDS in the UK "Well designed and managed SUDS appear to have a positive effect on house saleability and on house prices". From public perception survey.

[25] Lewes IUD (2008), Foresight (2004),, Ravensbourne delivery plan(2007), Richmond and Kingston 1st edition SWMP (2009)

- Halcrow estimated that 2% of the homes at risk of flooding from surface water would flood each year. This estimate was made using data from the Kingston and Richmond SWMP and the Ravensbourne Delivery Plan.
- Using a range of 2.8 million to 3.8[26] million homes susceptible to flooding, 2% gives 56,000 to 76,000 properties expected to flood in one year.
- Using the range of damages from above, we arrived at a range of **£1,304 million to £2,237 million current annual damages due to surface water flooding**.

Future Flood Damage.

72) Future annual flood damage was estimated using the increase of damage due to climate change. Both the Foresight report and the River Aire Integrated Urban Drainage (IUD) report (2008) stated that urbanisation would lead to a similar increase in damage from surface water flooding as climate change. There is no causal link suggested but the predicted magnitude of the damage was found to be similar[27]. The Foresight report considered the two sources of flood damage to be additive. We have added the effect of urbanisation to the climate change effect in calculating the future flood damages for this assessment.

Rainfall Increase

73) There is no standardised methodology for determining the impact of climate change on surface water flood risk. As a result it was necessary to provide a range of likely increases in flood risk owing to increases in precipitation. The current Defra guidance, based on UK Climate Impact Programme 2002 (UKCIP02) findings, recommends that to account for climate change impacts on rainfall an increase in peak rainfall intensity in the range of 10-30% should be adopted. The Defra guidance indicates that for the period 2055-2085 peak rainfall intensity is predicted to increase by 20%. Understanding of potential increases in precipitation has progressed since the UKCIP02, with the release of a new suite of climate projections, UK Climate Projection 2009 (UKCP09). With regards to precipitation changes, UKCP09 provide probabilistic predictions for mean rainfall and the wettest day. Surface water flooding is usually the result of high intensity rainfall, and thus the analysis of precipitation on the wettest day provides a better surrogate to assess surface water flooding than mean precipitation. UKCP09 indicates that precipitation on the wettest day could increase by up to 40% across large parts of England in the winter, and up to 30% in summer under the high emissions scenario by the 2050s. These outputs suggest that increases in precipitation could be greater than those currently predicted in the Defra guidance. These findings are also reflected in the update to the Foresight Report undertaken as part of the Pitt Review (see Table 9, page 95). Overall, the evidence suggests a range of 20-40% to represent precipitation increases**.**

Flooding Damages Increases.

74) A range of studies show the relationship between increased rainfall and scale of flood damage as this is not a one-for-one relationship (i.e. for a given percent increase in rainfall, there is a bigger increase in flood damage). Therefore, the estimated increase in rainfall due to climate change would result in 30-110% increase in flood damage over a 50 year period[28]. If we accept that due to increased climate change impacts surface water flooding damage will be similar to increases in damage due to urbanisation, then we can use the same range of increases in surface water flooding damage for urbanisation. This would make the total increase in damages due to surface water flooding 60-220%. There is large uncertainty in these figures, as for any prediction involving growth and climate change. So the range of values above has been used to calculate the benefits. We have estimated benefits for a minimum predicted climate change and urbanisation which would give a 60% increase in damages over 50 years and for the high estimate we have assumed climate change and urbanisation effects are at the maximum predicted – producing an increase of 220% in flood damage over 50 years.

[26] Environment Agency figures Investing for the Future Flood and Coastal Risk Management A Long Term Strategy 2009

[27] Foresight 2004 "*changes in risk of flooding in the intra-urban area owing to urbanisation might be of a similar magnitude to that from the increases from precipitation" Chapter 5 page 142*

[28] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

75) The method therefore does not use predictions of house numbers to estimate future damages. The results are higher but in the same order as estimates of future damage using Foresight (2004) predictions in the previous partial impact assessment (£450 million to £4,420 million).

76) Using the 60%-220% increases the Halcrow report predicted that in 2060 flood damage due to surface water flooding would be between £2 billion and £7 billion for England alone.

77) We have made the assumption that, damages due to flooding increase linearly between now and 2060 giving a steady increase in damage. We cannot predict when major flooding events will occur so it is a reasonable proxy assumption that damages are evenly spread over the 50 year period.

Reduction in damages due to SUDS.

78) Table 2 below shows the results of calculations of damages in the year 2060 which is mitigated by options 1 & 2. Option 1 – the baseline - includes the use of existing policies to mitigate damage. Rows (1) to (5) show the results of the baseline case. Row 6 shows the additional damage addressed by the new proposals of option 2. For example for the low case benefits, the estimate for damages in 2011 was £1,304 million. The 2060 damage was estimated at 60% more than this giving £2,087 million.

79) **Table 2 Example Calculation of Benefits of SUDS for one year (2060) for England[29]**

Option	Option 1	Option 1	Option 2	Option 2	
Parameter	Low Case £ millions	High Case £ millions	Low Case £ millions	High Case £ millions	Comments
1) Current annual damages due to surface water flooding.	£1,304	£2,237	£1,304	£2,237	For England in 2011
2) Damage in the year 2060 due to surface water flooding with an increase in urbanisation.	£2,087 (60% increase)	£7,157 (220% increase)	£2,087 (60% increase)	£7,157 (220% increase)	Assumes no policies for flood damage reduction
3) Increase in damage due to surface water flooding in the year 2060 over damages in 2011. Extra damages.	£783	£4,921	£783	£4,921	Row 1 minus row 2
4) Extra damages (3) assumed to be managed with existing policies in the year 2060.	£424 (54.2% of extra damages)	£2,611 (53.1% of extra damages)	£424 (54.2% of extra damages)	£2,611 (53.1% of extra damages)	Assume 60% of major development and 40% of minor development managed.
5) Increase in flood damage in the year 2060 not dealt with by existing policies (baseline - option 1)	£358	£2,310	£358	£2,310	Row 3 minus Row 4.
6) Additional damage avoided in 2060 through improved development control with option 2 proposals	n/a	n/a	£108	£693	Assume 75% uptake of SUDS, and they reduce damage by 40% where implemented

[29] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

80) The next step was an estimate of the reduction in damages if the policies proposed for SUDS were applied.
    - Option 1. Assessing the damages as if no SUDS policy were in place (set out above), we made assumptions about the effectiveness of current policies on new developments. The Halcrow report (2009) estimates that flood damage would be mitigated by 54% (low scenario estimate) and 53% (high scenario estimate). We applied this mitigation to the potential increase in damage due to new developments. So for example for the low costs, of the £738 million potential damages £424 million will be mitigated by present policies.
    - Option 2 - We have assumed SUDS would only be effective in 75% of new developments. There is no evidence on which to base this assumption, we considered 75% a reasonable number for uptake of SUDS. We have also assumed that SUDS would reduce damage by 40%. These points are discussed further in appendix 6. This means we would expect to reduce the remaining damage after current policies have been accounted for by 40% of 75%.

6.5 **SUDS Benefits Assumptions**

81) We have counted a reduction in damages due to SUDS as a benefit.

82) The method assumes 75% uptake of SUDS policies in new developments from year 1 to year 50. The same assumption of linear behaviour is made for the costs for SUDS. In reality there will be gradual uptake of SUDS which will produce a gradual increase of costs and benefits over the first few years of the implementation of the policy.

83) In calculating the cumulative benefit we assumed that surface water risks due to urbanisation and climate change continue throughout the 50 year period and that mitigation measures also last for this time period.

84) The differences between the low case and the high case are:
    - Low estimates on amount of flooding.
    - Low estimate of damage caused by flooding.
    - Number of properties susceptible to flooding

85) For SUDS option 2, taking the low and high estimates in row 6 in table 2 and discounting them using Green Book methodology, this gives a range of benefits of £970 million to £6.251 billion by 2060 over the baseline option 1.

6.6 SUDS Costs

Costs of traditional drainage versus SUDS

86) Considerable research has been carried out to determine the costs of alternative approaches to drainage (*HR Wallingford 2003 a, b, 2004a, b, 2005 and 2006, Scott Wilson 2006, The Solution Organisation 2005, Atkins 2004).*

87) The conclusions were;
    - Costs of SUDS fall under three categories, approval and adoption, capital[30] and maintenance[31]
    - Costs of SUDS schemes are highly variable depending on factors such as drainage features, location, geology and expectations of residents, and are more variable than a traditional approach

[30] Construction costs of SUDS schemes include the cost of erosion and sediment control, material costs, labour and equipment costs and planting and landscaping costs. Total cost is inherently variable and more variable than traditional drainage systems, influenced by variation in location, soil, slope, design criteria and features, access and space requirements.

[31] Operation and maintenance: Operation and maintenance costs of SUDS include costs of inspection and monitoring, regular maintenance (such as grass-cutting, collecting trash), irregular maintenance (disposing of waste, responding to damage, pollution incidents) and remedial maintenance (eg mid-life refurbishment). Maintenance costs vary depending on the level of service expected by local residents; i.e., whether a manicured appearance or a more natural vegetation is acceptable.

- Some SUDS features, such as rainwater harvesting, are very expensive, and the additional costs associated with these must be compared with any additional benefits.
- For a standard SUDS approach, excluding some more expensive components, it is reasonable to represent capital costs of SUDS as broadly equivalent to costs of traditional drainage.
- Effectiveness of some SUDS schemes may be compromised by poor design or maintenance. Excepting these, SUDS deliver greater benefit than a traditional scheme, though the extent of these benefits remains unquantified.
- A traditional approach to drainage in brownfield sites is likely to be significantly more expensive than traditional drainage in greenfield land because the public sewers were developed for a different urban environment and are likely to need significant modification, involving digging up pipework, etc
- For many developments, a SUDS approach will be of similar cost to a traditional approach but deliver additional benefits. In some cases, cost of SUDS will be lower than costs of traditional systems, particularly in brownfield sites.

88) We have assumed that SUDS capital costs are the same as conventional drainage that would be used in option 1. We have assumed that maintenance costs of SUDS are £6 greater than the estimated £40 per property per annum accepted for conventional drainage. We have assumed land costs will be similar to those for conventional drainage following advice from CIRIA. So costs to consider to calculate costs over those of current policies (Option 1) are:
    - Costs of approval and adoption of SUDS
    - Costs of maintenance of SUDS

89) The costs for SUDS can be broken down into cost of employees to approve SUDS, and maintenance of SUDS. The maintenance was estimated to be £6/property per year additional to the cost of conventional drainage. The costs of maintenance of SUDS is uncertain but we consider the addition of £6 maintenance to be a conservative assumption since SUDS may well cost less than conventional drainage depending on the design and size of project. Appendix 5 has more detail on this assumption.

90) According to CIRIA report 2008[32] for an equivalent level of flood service, the costs of a SUDS option is significantly less than traditional drainage even accounting for land-take. For the purposes of this report we have taken a conservative assumption in assuming SUDS construction costs are the same as those for conventional drainage. Conventional drainage is not normally built to handle the same level of flood event as SUDS so direct comparisons are difficult to achieve.

91) The numbers of staff required is not easy to predict. There are crossovers with other tasks and the skills required can be quite specific. Local authorities may share expertise for some of the SUDS approval work. We believe that 0.5 to 1.5 gives a large enough range to cover the requirements of SUDS approval (Table 3).

[32] *Collating the Urban Drainage Evidence Base CIRIA (2008)*

Table 3 Costs associated with new SUDS responsibilities

Parameter	Low	High	Comments
No. of additional employees per local authority	0.5	1.5	FTE dedicated to SUDS
Annual cost of employees	£5.027 millions	£15.081millions	Cost is based on £68.4k[33] per employee, and 147 unitary local authorities
Number of New Properties Per Year	260,000	260,000	These figures are calculated in the Halcrow report
Maintenance of SUDS cost per year	£1.170 millions	£1.170 millions	Assume £6/property/year on 75% of these
Year 1 total costs of new SUDS	£6.197 millions	£16.251 millions	Sum of employee and maintenance of SUDS
Year 2 total costs of new SUDS	£5.027+£1.170 + £1.170 = £7.367 millions	£15.081+£1.170 +£1.170 =£17.421 millions	SUDS maintenance is cumulative and will increase by the same amount each year.
Year 50 total costs of new SUDS	£5.027+(50*£1.170) = £63.527 million	£15.081+(50*£1.170) = £73.581 million	Total costs year 50
Cumulative cost of all years, year 1 to year 50 not discounted	£1,743 million	£2,246 million	Not Discounted
Cumulative cost of all years, year 1 to year 50 Discounted	**£643 million**	**£874 million**	**Discounted**

6.7Costs Assumptions

92) In Option 2 we have assumed that numbers of SUDS for new developments approved each year stays the same throughout the 50 year period. In option 1 we assume there are no significant numbers of SUDS for new developments.

93) Maintenance of SUDS is assumed to increase by the same amount each year and accumulate since there will be more SUDS each year.

94) The possibility of water companies maintaining SUDS was considered but rejected as an option because this type of maintenance is already carried out by LAs who have responsibility for open public spaces and highways. It would be inefficient to split responsibility for care of open spaces and could lead to confusion of responsibility. Also not all SUDS will discharge to a sewer so would not be classed as directly impacting on water company assets.

6.8 SUDS in New Developments Net Benefit

95) A summary of the benefits, discounted over 50 years is given in table 4.

[33] This has been derived using a Pitt Review estimate of £55,000 for a qualified engineer, 20% overheads and corrected to 2008 as base year giving £68,395.

Table 4 Summary of Option 2 Discounted Costs and Benefits Compared to Baseline option 1 for SUDS up to 2060

SUDS Costs and Benefits	Millions
Low Cost Estimate	£643
High Cost Estimate	£874
Low Benefit Estimate	£970
High Benefit Estimate	£6,251
Net Benefit Low (lowest benefit minus highest cost)	**£96**
Net Benefit High(Highest benefit minus lowest cost)	**£5,608**

6.9 Costs and Benefits for Surface Water Management Plans

96) To determine the costs and benefits of Surface Water Management Plans (SWMPs), case studies were used to determine a typical benefits costs ratio achieved through the application of local flood risk management. Estimates were then made of the costs of implementing the use of SWMPs in England. A range of benefits was then calculated using the benefit cost ratios gained from the case studies.

97) The model incorporates costs and benefits associated with a range of activities. These include 'process-type' activities involved in developing asset registers establishing partnerships, collecting data, and developing plans, as set out in Appendix 2, table 7. Costs and benefits of non-structural interventions must also be accounted for, such as any changes to emergency procedures or early flood warnings that may result from SWMPs.

98) The benefit cost analysis was done for England over a 50 year discounting period, and for locations where Surface Water Management Plans would be developed, which would be typically for locations facing higher vulnerability to surface water flooding.

99) For assessing the costs and benefits associated with local flood risk management, evidence is set out below, largely informed by isolated case studies and evidence from the report *Impact Assessment of Local Flood Risk Management – Supplementary Evidence Base (Halcrow 2009).* This evidence base was commissioned by Defra to reinforce the earlier evidence presented by the Impact Assessment that accompanied the Flood and Water Management Bill Consultation. The key findings of the Halcrow report are presented in these next sections.

6.10 Costs of SWMP

100) Under Option 1 (current policy) there are no SWMPs. Therefore, the following costs identified for SWMPs occur under Option 2 only. All are related to the process of managing Local flood risk management and largely fall on LAs:

- Cost of developing SWMPs.
- Capital investment leading from SWMPs recommendations.
- Asset register - development scrutiny and review.
- Development of partnerships.
- Flood incident activity.

101) We have assumed that local flood risk management proposals will require 0.5 to 1.5 extra staff for local authorities. Part of this resource will be used to deal with each of the above tasks. We have not estimated staff resource specifically for strategic flood management because there was no evidence available, additional staff resources to that estimated above may be required.

102) **Developing SWMPs.** The costs of developing and maintaining SWMPs in England were estimated. There are 147 county or unitary local authorities in England and within counties there are numerous candidates for SWMPs. The analysis undertaken for Defra by Halcrow assessed the number of properties susceptible to surface water flooding (at intermediate and high risk) for every settlement in England (Chapter 3 of Halcrow 2009). Using the Environment Agency's national mapping that

identified locations at low, intermediate and high susceptibility to surface water flooding. Halcrow (2009) calculated the total number of properties in urban settlements that were in the intermediate and high susceptibility categories. Susceptibility was used as a relative measure of surface water flood risk vulnerability. This information was used to prioritise settlements most in need of SWMPs, which would focus investment where flood risk is highest. The list of settlements was divided into quartiles on the basis of 'risk exposure' - low, medium, high and very high. Halcrow (2009) then assumed that there would be no SWMPs in low risk exposure settlements, 0% to 10% of medium risk settlements would undertake SWMPs; 50% to 80% of high risk settlements would undertake SWMPs; 70% to 100% of very high risk settlements would undertake SWMPs. Based on this analysis between 97 and 186 SWMPs may be needed.

103) Costs of developing SWMPs consist of employment of specialist contractors, input from local authorities, water companies and Environment Agency staff.

104) Costs of each SWMP will vary depending on size and delivery mechanism and will be principally associated with the employment of specialist contractors to undertake the work. Halcrow 2009 estimated costs for SWMP initial production to be in the range of £75k to £150k per plan.

105) It has been assumed that there will be input from local authorities, water companies and environment agency staff at a cost of £15k per plan for each organisation. This figure is an estimate based on expert judgement (Halcrow 2009).

106) We have also assumed that the SWMPs will be completed at a uniform rate and costs will be spread evenly over a five year period. So as in table 5 annual costs for SWMP production are £120k to £195k. For the lower estimate we applied this to 97 SWMPs which gives £11.6 million. Spread over the 5 initial years this would be £2.3 million per year. Similarly for the higher estimate and using the high estimate for plans required of 186 we have £36.3 million for the 5 years and so £7.3 million per year for the first 5 years.

107) In addition to the cost of undertaking the plan, there will be costs to update the SWMP. It is assumed that this is a third of the cost of undertaking the original plan and that an update will take place every five years, at an estimated annual cost per plan of between £40,000 and £65,000. This is an estimate based on experience of report production costs by Halcrow.

Table 5 Summary of Surface Water Management Plan costs

Cost of an individual SWMP		
	Low Estimate	High Estimate
	£	£
Cost of SWMP	75,000	150,000
LA staff cost	15,000	15,000
EA cost	15,000	15,000
Water company cost	15,000	15,000
Total cost	**120,000**	**195,000**
Annual cost of developing and maintaining SWMPs for England		
Years	Low Estimate	High Estimate
	£m	£m
1-5	2.3	7.3
6-50	0.4	1.3

108) The total annual cost for developing the SWMPs over the first five years in England falls within a range of £2.3million to £7.3million. The total annual cost of maintenance is then between £431,000 and £1.3 million for the following forty-five years.

109) Discounted over fifty years the NPV of these costs will be £18million - £56million.

110) **Capital investment** has been assumed to be £100,000 per local authority per year. For 147 local authorities, this is £14.7 million per year.

111) For the other activities we have assumed (after SWMP resource requirements) a resources split of:

- 70% for on asset register development, scrutiny and review
- 15% for partnership working
- 15% on flood incident activity

112) The 15% values were based on work done on information on shoreline management planning where partnership was 0.15 of a post in the NNDC[34].

113) Following the assumption of 0.5 to 1.5 full time equivalents (FTE) for these LFRM proposals. We have taken £68,000 per year as the cost of 1 FTE. £15,000 per year is the amount we estimate will be required for SWMPs (table 5). We split the remainder between the other tasks according to the percentages given above.

Table 6 Other Annual Costs for first year of SWMPs for 147 LAs in England

Annual Costs	Low Estimate £ millions per annum	High Estimate £ millions per annum
Capital Investment	14.7	14.7
Asset registers	1.98	9.01
Partnerships	0.42	1.93
Flood Incident management	0.42	1.93
Total	17.5	27.6

114) Adding up the items from tables 5 and 6, **total costs discounted over 50 years range from £378 million to £498 million.**

115) It should be noted that some powers that currently lie with the EA need to be transferred to the local authorities if they are to have the lead role. For example granting consents to works that may impact on the flow of ordinary watercourses and cause flooding. This would mean an additional cost to local authorities as a whole of approximately £250,000 in England and Wales. These costs have not been added to our total costs as they are a transfer of costs from one body to another and are minimal in comparison with other costs.

6.11 Benefits of SWMPs

116) The benefits were estimated to be a proportion of the costs. This is based on work done by Halcrow in comparing cost benefit ratios for work done for IUD projects. Using data from IUDs a benefit to costs ratio range of 1.6 to 2.6 was estimated. The comparison of benefit-cost ratios is detailed in Appendix 3.

117) Excluding fluvial schemes, the Lewes IUD pilot included 21 projects. The average BCR of the Lewes projects is 3.3 however excluding the outlier of 25.76 (High Down Road) gives an average BCR of 1.6. In 13 of these projects benefits exceed costs (BCR>1). We have assumed no projects with a BCR of less than one are carried out, since they would not normally be justified. Excluding those less than 1, the average BCR is 2.6. We have therefore taken the range of SWMP BCR to be

[34] Based on discussion with NNDC officer working on Shoreline Management Planning.

1.6 to 2.6. Halcrow (2009) addressed this in Section 5.2 of their evidence. This has been taken account of in the calculations above.

118) Data from other studies was examined to check the validity of the assumptions for the Lewes BCR figures. Data from Torbay and West Garforth IUDs gave average BCRs of similar magnitude.

119) In addition to the direct benefits of the capital investment there will be some efficiency benefits from the development of the plans themselves. The Halcrow (2009) report concluded that a percentage reduction in current damages could be achieved through SWMP this would be between 0.23% and 2.11%, of the overall damages avoided from surface water management investment as set out in table 6 of their report. This percentage reduction is achieved through the better planning and prioritisation of investment that SWMPs would bring compared to not developing and using an SWMP.

120) Assuming that the benefit cost ratio is between 1.6 and 2.6 times and assuming a fifty year time horizon for discounting, using HMT Green Book guidance, the Net present Value of the benefits for the local flood risk management proposals would be £540million to £877million.

Table6b Summary of Option 2 Costs and Benefit Local Flooding

Local Flood Management Proposals Costs and Benefits	£ Millions
Low Cost Estimate	£378
High Cost Estimate	£498
Low Benefit Estimate	£540
High Benefit Estimate	£877
Net Benefit Low (lowest benefit minus highest cost)	**£42**
Net Benefit High(Highest benefit minus lowest cost)	**£499**

7 Specific impact tests

121) Impact assessments require consideration of a number of potential impacts on businesses, people and the environment. The impacts on the specific test criteria required are summarised below:

- Competition – the introduction of the proposals for improvements to local flood management and increased use of SUDS will not have any significant impact on competition, since the proposals will affect all new developments all business involved will be equally affected.

- Small firms – small building firms will have to take into account the implementation of SUDS. They will need to ensure that they have staff trained to construct SUDS to meet the National standards for SUDS. However the proposals will also open new opportunities for small firms who specialise in SUDS materials such as porous paving.

- Legal aid – the policy measures do not introduce any new criminal sanctions, civil penalties or appeals so no impact is expected on Legal aid.

- Sustainable development – the introduction better flood management and particularly increase use of SUDS will contribute substantially to sustainable development and should provide significant positive benefits.

- Carbon assessment – the proposals will not have a significant impact on emissions of greenhouse gases, but are likely to contribute to an overall reduction through increasing effectiveness of flood risk management and resulting reduction in flood damage.

- Other environment – The proposals will contribute significantly to the environment particularly through the use of SUDS which will provide new habitat and habitat corridors in urban areas where such habitat is generally in short supply.

- Health impact – no significant impacts are expected, although more effective flood risk management is likely to have beneficial impacts on health and particularly stress for communities in areas at risk. There is also evidence that well constructed and maintained SUDS water features through enhancing amenity and recreation will benefit health. Good design and maintenance of SUDS should ensure that nuisance aquatic insects are not a concern.

- Race, disability, gender equality and human rights – no impact is anticipated from the introduction the proposals discussed in this IA.

- Rural proofing – Local flooding and introduction of SUDS are focussed mainly on urban areas however they both aim to control flooding at source (where the rain falls), rather than moving the problem downstream as conventional drainage tends to. So there should be less impact on rural areas downstream of urban land. Also where building developments occur in rural areas the aim is to ensure that discharge from such a site does not change in volume due to the development.

8 Conclusion

122) Based on the evidence, option 2 is the favoured option. The proposals are very likely to produce high benefits compared to costs.

123) Subject to data and methodology limitations, the conclusion of the analysis is that the proposed policies are cost-beneficial. Discounting over 50 years, an estimate of net benefits is between **£138 million and £6,107 million**. The sensitivity analysis in Appendix 7 shows that the results are most sensitive to the estimates for surface water flood damage, the number of properties at risk and the percentage increase in damages over the next 50 years.

Table 6c Summary Table of Net Benefits

	Low Estimate	High Estimate
Net Benefits SUDS	£96 million	£5,608 million
Net Benefits Local Flooding Management	£42 million	£499 million
Total Net Benefit Option 2	£138 million	£6,107 million

124) The key arguments for the proposals are:

- A strong economic argument may be made for policies that promote SUDS in new developments. Subject to significant variation, it is not unreasonable to represent the costs of SUDS in new development as no more than the costs of a traditional conveyance-based drainage system. SUDS will deliver greater benefit in terms of flood risk, water quality and other benefits. Uncertainty remains as to the extent of these benefits and they will depend on the rate of SUDS uptake. Significant barriers may remain, particularly relating to establishing a maintenance funding mechanism.

- The proposals include the condition that it should be shown that SUDS are cost beneficial before they are implemented. So despite the broad assumptions we have had to make for SUDS we are confident that the SUDS proposals must have a favourable benefit to cost ratio. Similarly any capital works recommended by SWMPs should also be cost beneficial.

- The proposed policies are likely to lead to a range of interventions in existing development, and these will be cost-beneficial. However, we would still have concerns on local flood risk management and the impact of the proposed policies.

    - Better management of LFRM involves significant upfront investment in establishing and maintaining an evidence database, in systems, processes and people. Impacts on the ground will only be seen through time. It is important that these costs are controlled by, for example, targeting areas of high risk and pooling drainage expertise across appropriate boundaries.
    - In some urban areas, surface water management problems are acute and only resolvable through radical intervention.
    - Many interventions are not cost-beneficial and LAs should be dissuaded from pursuing these.
    - Net benefits are only realisable where funding is available, and this remains an issue in respect of existing and new development.

9 Further work and Review

125) The review of the effectiveness of these proposals for local flood management and SUDS will have to be done in the long term. The implementation of flood management initiatives is a proposal that needs to be done over decades. The assessment of the effects they have on flood damages in a changing climate with changes in urbanisation will also be long term.

126) Further work should be put in train to monitor the effects and assess the effectiveness of these measures on flooding damages as well as water quality.

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	*Results in Evidence Base?*	*Results annexed?*
Competition Assessment	Yes	No
Small Firms Impact Test	Yes	No
Legal Aid	Yes	No
Sustainable Development	Yes	No
Carbon Assessment	Yes	No
Other Environment	Yes	No
Health Impact Assessment	Yes	No
Race Equality	Yes	No
Disability Equality	Yes	No
Gender Equality	Yes	No
Human Rights	Yes	No
Rural Proofing	Yes	No

Annexes

Appendix 1
Further Explanation of the Current Problems and Issues Related to Local Flood Management.

1. Flooding definitions

1) Natural drainage systems such as streams or man-made ones such as piped drains or sewers have a finite capacity that accommodates flows that are likely to occur frequently. Surface water flooding occurs wherever rainfall events exceed the drainage capacity in an area. In this context the term surface water has been used to describe a combination of different sources of flood water (or often used as a general term) including:

- Surface runoff flooding - water from precipitation flowing over the ground surface or ponding in low areas before it reaches a watercourse or other drainage system.
- Groundwater - water which has infiltrated into the subsoil or underlying deposits. Groundwater flooding occurs when this water re-emerges on the surface or rises into basements due to heavy rain exceeding the storage capacity underground.
- Flooding from minor watercourses such as ditches and streams.
- Flooding from sewers or drains due to heavy precipitation.

2) Flooding from rivers or the sea can sometimes occur in combination with surface water flooding or separately.

2. Damages from Floods

3) In areas where surface water flows and collects and flood waters are not directed away from houses and other properties, serious flooding of property and possessions can occur. The Foresight Future Flooding report estimated that currently 80,000 properties are at very significant risk from surface water flooding (10% annual probability or greater), causing on average £270 million of damage each year.[35]

4) These problems were exemplified during the floods of June 2007, when extreme rainfall over the Midlands and the north of England led to large-scale flooding, much of which was from surface water runoff overloading drainage systems. Currently there is no organisation with responsibility for managing flooding from surface runoff or groundwater or to co-ordinate action with other organisations when there are multiple sources of flooding combined as is often the case in urban areas.

5) Future pressures are set to exacerbate these surface water drainage problems. With climate change, winter rainfall is predicted to increase by 10 - 30% by the 2080s, while rainfall intensity could increase by up to 20%. The rising risks of flooding and diffuse pollution from a drainage system ill equipped to cope with more intense rainfall have been underplayed in the adaptation debate to date. With more properties, built at higher densities, the amount of hard standing in urban areas is increasing. When these pressures are combined, the impacts and costs of rainfall events could rise sharply. The Foresight report estimated that the number of properties at very significant risk from surface water flooding, around 80,000 per year, could more than double by the 2050s, leading to a prediction of £0.46-2.1 billion in damages each year.[36]

[35] Foresight (2004) *Future flooding*, (UK costs) http://www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence; at least half of these costs are borne through insurance.
[36] Foresight (2004) *Future flooding*, http://www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence.

6) It is not always appropriate to solve flooding problems by simply increasing the capacity of existing drainage systems. Rivers naturally extend onto floodplains during floods and then recede. This approach can also be used more to manage surface water flooding on the surface by creating safe flood routes through urban areas or holding it in temporary storage ponds. Greater use of SUDS for managing normal drainage can facilitate the design of arrangements for dealing with flooding in an area.

3. Water Quality

7) Water quality is under pressure in many areas of England. Pollution from surface runoff can cause sudden changes in the temperature and quality of water which can pose a risk to animal and plant life, as well as making water unsuitable for amenity uses. Where physical modifications have to be made to water courses to facilitate conventional drainage they can damage or prevent access to the habitats of aquatic animals and plants.

8) Improving water quality is a key part of Defra's role and forms an integral part of the upcoming Water Strategy. The Water Framework Directive (2000/60/EC) (WFD), which came into force on 22 December 2000, provides an additional driver and framework through which improvements can be achieved. The WFD seeks to address issues relating to the water environment including impacts from excessive nutrients and hazardous chemicals.

9) UK TAG (the UK Technical Advisory Group) has developed standards or water bodies, guided by the WFD requirements. Meeting these standards is a requirement for meeting the status objectives, but assessments have shown that 75% to 99% of surface water bodies in England and Wales are not currently in good status.

10) Well designed SUDS reduce the polluting load in surface water runoff. They help reduce variations in temperature and dissolved oxygen resulting from runoff. They offer the opportunity for pollutant reduction in areas particularly at risk. Introducing SUDS to new developments fits well within the UK's overarching approach to the WFD of introducing adaptive, cost-effective and proportionate measures in order to meet WFD objectives.

11) There are four main diffuse pollution impacts resulting from conventional management of surface water run-off.

i) Sediments, hydrocarbons and metals are flushed into streams and groundwaters from impermeable surfaces such as roads and roofs.
ii) Conventional drainage also leads to sudden increases in flow of water into water-courses disturbing sediments and releasing pollutants from the stream bed.
iii) Conventional drainage of surface water run-off prevents rainwater from infiltrating into the ground, reducing groundwater stored and prolonging the times when rivers flows are low and pollutants more concentrated.
iv) Where runoff is carried in Combined Sewers, exceedances in the drainage capacity often result in direct overflows of raw sewage which contains pathogens and other pollutants into water bodies.

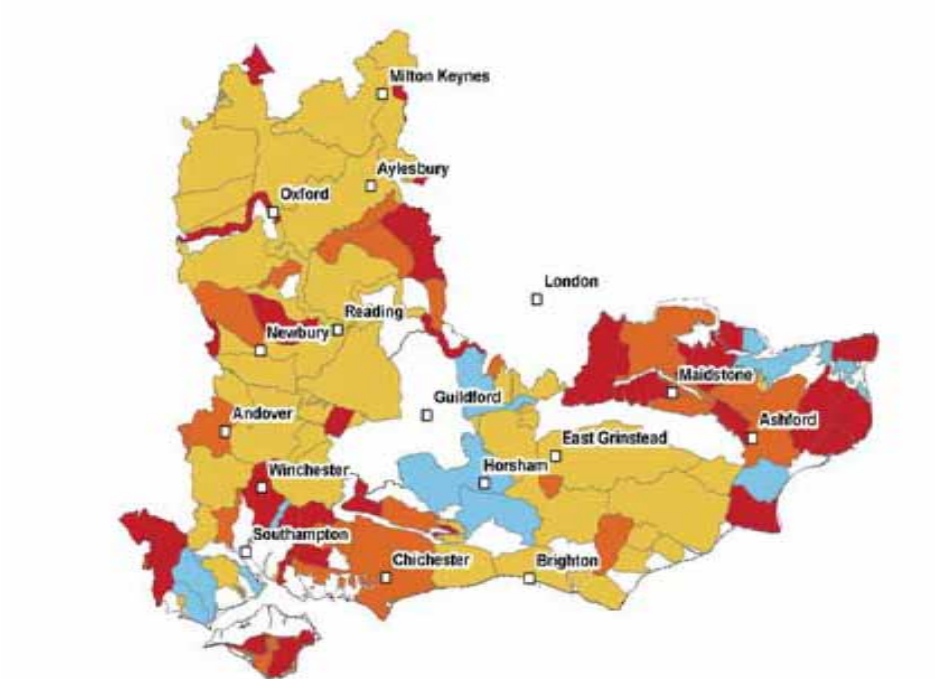
12) The resultant water pollution effects society at large and is not costed. There is evidence to suggest that at least half of the pollutant load from runoff would be avoided by well designed SUDS.

13) The ICF report on 'The potential costs of climate change adaptation for the water industry' found that the water industry has begun to target investments to reduce nitrogen including ammonia loads from wastewater treatment works. It concluded that cost estimates to reduce ammonia at this stage are extremely uncertain, but could be in the order of £billions.

14) One major source of ammonia is from storm overflows. The number and volume can be reduced by building underground storage, but the SUDS approach, preventing runoff from entering the sewers in the first place is often more cost effective and sustainable.

4. Drought

15) In addition sustainable management of surface water and ground water can help contribute to water resources. The fate of surface water on a greenfield site depends on many variables. However, typically about 25% infiltrates deeply, replenishing the water-table. This percentage is decreased to less than 5% in heavily urbanised areas. The use of sustainable drainage systems can increase infiltration in urban areas closer to natural levels.



16) The diagram above shows in red the areas of the South East where over-abstraction is a problem. In such areas, the use of conventional drainage exacerbates potential drought problems.

17) The UK Climate Impact Programme has predicted that summers in the South East will get hotter and drier. Use of SUDS can help prevent the 'urban heat island' effect as well, by increasing the amount of green cover[37]

5. Habitat conservation and creation

18) Around 10% of the land area of the United Kingdom is notified as Sites of Special Scientific Interest (SSSI) or Areas of Special Scientific Interest (ASSI). Many are also Special Areas of Conservation under the EC Habitats Directive, Special Protection Areas under the EC Birds Directive or Ramsar sites. Many of these sites are close to developed areas, or served by watercourses and rivers that run through them.

19) Development has a range of impacts on biodiversity in these special areas, including increased culverting of watercourses and abstraction of water for drinking, and increasing variations in water quantity, quality and temperature, due to conventional drainage. It can also present particular problems for some migratory bird species that are unable to rest and feed in large urban areas.

[37] Newcastle University, *Building knowledge for a changing climate*, Newcastle University, 2007

20) Many SUDS techniques will help mitigate these impacts by creating areas of wet land and open water, including swales, ponds, and wetlands. These are often rich in biodiversity and provide a valuable source of food and drink for migratory species within an urban area. In addition the use of the SUDS approach will help mitigate the impact of development on existing watercourses and rivers.

6. European requirements

21) While action on surface water management is required under both the Water Framework Directive[38] and more recently the Floods Directive,[39] the primary driver for intervention is the need to reduce the damages, disruption and distress caused by flooding.

22) A separate Impact Assessment considers the wider implementation of the floods directive although the costs and benefits of flood risk management plans for surface water flooding under the directive are contained within the provisions of this impact assessment.

[38] Under the Water Framework Directive, Member States must prevent deterioration and aim to achieve 'good status' in most inland and coastal waters by 2015 (this constitutes both 'good ecological status' and 'good chemical status'). By promoting more sustainable approaches to drainage, effective management of surface water will improve water quality and contribute to the objectives of the Water Framework Directive.

[39] The Floods Directive requires Member States to prepare Floods Directive requires member states to prepare the following assessments for the European Commission: (i) preliminary flood risk assessments to identify areas that are at potentially significant flood risk, by 20 December 2011; (ii) flood hazard maps (showing the likelihood and flow of the potential flooding) and flood risk maps (showing the impact), by 20 December 2013; (iii) flood risk management plans (showing measures to decrease the likelihood or impact of flooding). These risk assessments and plans should cover all forms of flooding, except those arising specifically from sewers. Surface Water Management Plans should play a significant role.

Appendix 2
Intervention Logic

1) This appendix sets out the intervention logic associated with the Draft Bill. This is shown in table 7. It looks into the intervention through legislation and regulation, as well as funding. It then summarises the first and second order effects of this along with the intended outcome.

2) Column 1 of Figure 1 sets out the recommended policies for LFRM. Columns 2 to 5 set out the expected consequences of the proposed policy in loose chronology.

3) **COLUMN 1:** The proposed Floods and Water Bill assigns responsibility for Local Flood Risk Management (LFRM) to local authorities (LAs) with a requirement to establish Surface Water Management Plans (SWMPs) and undertake some other duties, including establishing a 'register' of drainage assets. It assigns a role to the Environment Agency to support the development of surface water management plans, and a requirement on all relevant organisations to share information, such as water companies. In addition, the Bill will remove the automatic right to connect to public sewers, establish a regulatory regime to govern standards of drainage, and require local authorities to 'adopt' SUDS. No new funding streams are available for LFRM. The proposal is that water companies will adopt 'private sewers' releasing savings to LAs to undertake LFRM.

4) **COLUMN 2**: Integrated Urban Drainage pilots demonstrate the importance of establishing a process for management of local flood risk (Urban flood risk and integrated drainage. IUD pilot summary report, 2008). And, characteristically, the key challenges are establishing a partnership of local organisations and an evidence base for LFRM. There are a number of organisations with a stake in LFRM including water companies, local authorities and the Environment Agency. In comparison to other sources of flooding, evidence is partial, of varying quality and not fully accessible.

5) **COLUMNS 3 and 4:** A key purpose of partnerships is to develop a 'surface water management plan' that sets out the local flood risk and proposes actions in mitigation, in parallel, supporting the development of 'spatial' and 'emergency' plans. These may recommend a variety of actions that include:

- Improved maintenance of existing drainage infrastructure
- Development of new drainage infrastructure, including Sustainable Drainage Systems (SUDS), either in new development of 'retrofitted' into existing development. CIRIA (2008) describe SUDS as a 'total solution to rainwater management. The aim is to mimic the natural drainage system by managing and treating water as close to source as possible. This is compared to the 'traditional' approach to drainage' that emphasises 'conveyance' of water away from source.[40]
- Management of exceedence. Various techniques can be employed including use of raised kerbs, and car and public parks for flood water storage. SWMPs can improve emergency planning, reducing risk to life and maintaining traffic flows in the event of flooding.
- Improved flood warning.
- Characteristics of new developments including their location, spacing and build impact on flood risk. The aim of Planning Policy Statement (PPS 25, 2006) is to ensure that flood risk is taken into account at all stages of the planning process. SWMPs will support this goal.

6) The removal of the right to connect to sewers, the requirement of LAs to adopt SUDS and revised drainage regulations are primarily focussed on promotion of SUDS largely in the context of new development.

[40] Table 3.5 of CIRIA (2008) identify 12 SUDS components; rain water harvesting (water butts), filter strips, infiltration trenches and soakaways, green roofs, oil and sediment separation systems, swales, filter trenches, pervious payments, underground storage systems, infiltration basins, wetlands, and ponds.

7) COLUMN 5: The primary outcome of the proposed policy is reduced flood risk. Water quality benefits may arise as a consequence, where, for example, flooding is associated with diffuse urban pollution or combined sewer overflow. Some SUDS components provide an alternative water treatment and may deliver natural environment-type benefits. An alternative scenario is that the policy delivers a given outcome at a lower cost. Examples include elimination of waste or exploitation, efficiencies in shared data procurement, delivery of a water quality requirement at lower cost.

Table 7 Intervention logic

New Policy	Intended effects, first-order	Effects, second-order	Effects, third-order	Outcomes

LEGISLATION AND REGULATION
Assignment of 'responsibility' for 'management and co-ordination' of LFRM to upper-tier LAs, with duties, incl. to,
• develop surface water management plans in areas of 'high-risk'
• maintain a register of drainage assets,
and powers to take appropriate actions
	Establishing of a **PROCESS** and **EVIDENCE BASE** for LFRM. Outputs include,
	• 'Partnerships' for LFRM, including asignment of leadership role
	• Identification, quali**t**y-assurance and sharing of data on LFRM
	• Tools to measure and map LFRM
	• Estimation of LFRM by LA and identification of LAs by level of risk
	• A register of drainage assets
		Development of **ACTION PLANS** at level of LA. These include
		• Development of a Surface Water Management Plan (initially in 50 LAs at highest risk)
		• Development of spatial plans that better account for LFR (in all LAs?)
		• Development of emergency plans that better account for LFR
			DELIVERY of plans 'on the ground;
			• Various in relation to existing flood risk. Includes 'disconnection' of surface water drainage and, where appropriate, **'retrofit'** of SUDS-type drainage, such as permeable paving and green roofs. **Resilienc**e (eg., of public infrastructure, such as hospitals)
			• Various in relation to **new development.** Include changes to location, spacing, and build of developments (controlling for impact of other policy, such as PPS). Where appropriate, build and maintenance of SUDS-type drainage such as ponds and basins.
			• Provision of improved **flood warning** and better **management of 'exceedence'**, Measures include water storage through, for example, use of raised kerbs and car parks, and improved provision of emergency services in event of flood.
				Primary outcome is
				• **REDUCED FLOOD RISK.** Comprises
				  • Reduction in flood risk in relation to existing development against a rising baseline (on account of climate change and growth in value of assets at risk of flood)
				  • Complete or partial mitigation of flood risk that would arise from new development
				Other outcomes include
				• **Increase in water quality.**. May be presented as reduction in costs of attaining water quality requirements of the Floods Directive in comparison to an alternative approach
				• Potential **benefits relating to natural environmen**t gains (arising e.g., from creation of pond)
				• Potential **savings, e**.g., identifying waste/duplication, data procurement, cheaper drainage.

Assignment of responsibility to EA for 'strategic overview' of all flood risk, incl. LFRM, with duties, incl to • develop and provide guidance on methodologies and tools for estimating LFRM • identify LAs by level of risk				
Requirement of all 'relevant' organisations to co-operate and share information in relation to LFRM				
Requirement of other relevant organisations to comply with a LFRM strategy, and powers to take actions (e.g., Internal Drainage Boards)				
Removal of 'automatic right to connect' to public sewer				
Regulation of drainage standards, identifying conditions for connection to sewer .				
Requirement of LAs to adopt and maintain some drainage assets (SUDS)				
FUNDING Expectation that resources are released to LAs through transfer of responsibilities to water companies in relation to private sewers to be financed with expectation of increased customer sewerage charges				

Appendix 3

Benefit Cost Ratio Ranges from IUD Case Studies

1) Data from 3 IUDs was used to estimate a reasonable benefit to cost ratio for the implementation of local flood risk management. The main data set from Lewes was used to give a range which was then check against further, similar data from two other projects.
2) Local evidence on benefit-cost ratios (BCR) for surface water mitigation measures is available from the IUD pilot studies. Evidence available from the IUD pilots indicate there is likely to be a broad range of BCR for mitigation measures; for examples the BCR in Lewes IUD pilot ranged from 0.11 to 25.76.
3) To scale this up to estimate a national BCR it was necessary to define a representative range of BCR to use. The Lewes IUD pilot study undertook economic analysis for over 20 proposed mitigation measures and included a range of measures which would typically be expected to mitigate surface water flooding including improved maintenance of gulleys and watercourses, increased gully capacity, increase combined sewer capacity and improved highway drainage. The average BCR of all schemes was 3.3, but two of the schemes had BCR which are not considered to be representative, High Down Road and The Course (combined). When these two measures are removed from the analysis the average BCR is 1.6. If the proposed measures which have a BCR of <1 are also removed from the analysis the BCR is 2.6.

Table 8 BCRs of measures from Lewes IUD pilot study

Location	BCR
High Down Road	25.76
Waterloo Place	2.36
Mildmap/Prince Edwards Rd	0.22
Talbot & Toronto Terrace	2.41
Pelham Terrace	0.76
Friars Walk Jct w/ School Hill	2.33
Friars Walk	0.72
Wheatsheaf Gardens	1.45
Orchard Rd/Spences Lane	1.9
Neville Crescent	1.03
Winterbourne Hollow/Bell Lane	0.67
Jct Landport & Offham Rd	1.17
Grange Rd	2.95
Southover Rd	4.67
Fisher St	0.69

Station St	0.61
The Course	1.81
Cliffe High St	4.84
The Course (combined)	11.57
Paddock Rd (combined)	0.52
Winterbourne Lane (combined)	0.11
Average BCR (all)	3.3
Average BCR (if BCR>10 removed)	1.6
Average BCR (if BCR>10 and BCR<1 removed)	2.6

4) Further evidence is available from Torbay and West Garforth IUD pilot studies. In Torbay four mitigation measures were proposed, which had a BCR in the range of 0.22 to 2.68. The average BCR was 1.7 if all measures were included, and 2.2 if measures with a BCR<1 are excluded from the analysis. In West Garforth four of the five proposed mitigation measures had a BCR of <1, and the average of all proposed measures was 1.3.

Table 9 BCR options from Torbay IUD pilot study

Location	**BCR**
New River Fleet Culvert	1.06
Overflow from Upton & Ellacombe Tanks	2.68
Town Centre overflows	2.82
Reprofile Fleet Street	0.22
Average BCR (all)	1.7
Average BCR (if BCR>1)	2.2

Table 10 BCR of measures from West Garforth IUD pilot study

Location	**BCR**
Lowther Road	0.41
Oak Drive	0.42
Barleyhill Rec. Ground	0.7
Ninelands Lane	4.27
Richmond Rd/Glebelands	0.8

Average BCR (all)	1.3
Average BCR (if BCR>1)	4.27

Appendix 4

Case Studies Evidence

SUDS in New Development: Case Studies

In the UK, SUDS is a relatively new phenomenon and some of the best evidence on SUDS use is in the form of case studies. Case studies for several SUDS projects have been described below to give a comparison to figures developed for this impact assessment.

Case study evidence: Lamb Drove, Cambourne.

1) Lamb Drove, Cambourne is a residential development of 35 homes that is drained by a SUDS design to a 1 in 100 standard , incorporating water butts, permeable paving, green roofs, swales and detention basins.
2) Capital costs – Detailed costing figures from the project show that SUDS has the potential to be cheaper than more traditional forms of drainage. At Lamb Drove SUDS was £314 cheaper per house. This includes a commuted sum of £17,400 for maintenance of the permeable paving.
3) Maintenance Costs – The project has found that the maintenance for the natural SUDS measures (e.g. swales, detention basins) can be incorporated into the landscape maintenance. This means that there is minimal extra cost for maintaining these measures. In addition, the visible and understandable nature of these measures means that maintenance is relatively easy.[41]

Case study evidence: Elvetham Heath, Hampshire

4) Elvetham Heath is a large residential development with integrated SUDS system comprising soakaways, detention basins, swales and ponds to a 1 in 30 return period standard for the Minor System. Comparison of a variety of indicators was made against a traditional approach and a 'full' SUDS scheme including permeable paving and rain water harvesting. The broad conclusions are that the whole life costs of the SUDS scheme as built is very similar to a traditional approach, but delivers more benefits. Costs of full SUDS are significantly greater and there is no quantification of benefits. Whole life costs are detailed in table 12.

[41] http://www.cambridgeshire.gov.uk/NR/rdonlyres/A7708AFE-FA15-41D8-B4AF-9563B4347CE2/0/AdditionalInformationSUDS.pdf

Table 12 Elvetham Heath SUDS whole life costs

	Traditional drainage /£	SUDS, as built /£	SUDS extra /£
Capital			
Excl land costs	2.24 million	1.11 million	2.03 million
Incl land costs	2.24 million	2.14 million	3.06 million
Operation and maintenance			
Excl waste management	0.56 million	0.69 million	1.63 million
Incl waste management	0.56 million	0.89 million	1.83 million
Whole life costs			
Excl land costs			
Excl waste management	**2.80 million**	**1.80 million**	**3.67 million**
Incl waste management	**2.80 million**	**2.00 million**	**3.87 million**
Incl land costs			
Excl waste management	**2.80 million**	**2.82 million**	**4.70 million**
Incl waste management	**2.80 million**	**3.01 million**	**4.90 million**

National Scale up Based on Case Studies.

5) Table 13 reproduces table 11.1, of the CIRIA report 2008[42]. According to this analysis, for an equivalent level of flood service, the costs of a SUDS option is significantly less than traditional drainage even accounting for land-take.

6) This is primarily because the costs of storing water in basins and ponds is significantly less than costs of equivalent storage underground. Brownfield and Greenfield, and residential and commercial development are treated identically. A level of service of 1 in 100 is assumed across all options.

Table 13 National costs of draining new development: Traditional drainage vs SUDS

Costs and benefits	Traditional drainage / £	SUDS / £	SUDS extra £
Total whole life costs, excl land costs	846 million	264 million	1042 million

[42] *Collating the Urban Drainage Evidence Base CIRIA (2008)*

Total whole life cost, incl land costs	846 million	485 million	1148 million
Hydraulic benefits	Same level of service against flooding , 1 in 100	Same level of service against flooding , 1 in 100 Increased infiltration and support of river base flows	Same level of service against flooding , 1 in 100 Increased infiltration and support of river base flows
Water quality benefits	None	Small reduction in spill frequency and volume if connected to a combined sewer Treatment of surface water for discharge to rivers	Significant reduction in spill frequency and volume if connected to a combined sewer Treatment of surface water for discharge to rivers

Case Study Evidence:Hogsmill IUD, Nonsuch Park and Rosebery Park.

7) The Hogsmill IUD pilot study identified surface water flooding as a key risk in the Hogsmill catchment. Studies were undertaken to consider construction of two small storage facilities in Non-Such and Rosebery Parks.[43].

8) The method considered the costs and benefits of three options; the proposed schemes, do-minimum (maintenance of existing drainage infrastructure) and do-nothing (total cessation of maintenance, or abandonment of existing drainage infrastructure). The estimated Present Value Costs and benefits of the two schemes are shown below in table 14.

Table 14 PVC, PVB and BCR for Hogsmill IUD Case Study

	PV Costs	**PV benefits**	**BCR**
Nonsuch Park (capital)	£249k	£488k	1.91
Nonsuch Park (maintenance only)	£161k	£ as above	3.03
Rosebery Park (capital)	£902k	£322k	0.36

9) The maintainance option for Nonsuch Park was the better option and the Rosebery Park option was not worth pursuing.

Case study evidence: Lewes IUD.

10) The Lewes Integrated Urban drainage pilot study was one of 15 studies funded by Defra with the aim of developing and testing best practice for the management of urban flood risk and

1) [43] *Rosebery Park Flood Attenuation Area. Pre-feasability study; Non-Such Park FAA. Pre-feasability study (Environment Agency (2009).*

integrated drainage. Broad objectives included development of understanding of the nature and scale of the risk, and identification of actions to mitigate it[44].

11) As part of the study, a Lewes Action Plan identified 28 locations at risk and proposed actions at each of these. For seven, the primary source of flood risk is fluvial, affecting the large majority of properties at risk of flooding in Lewes (approx 450 properties). For four of the seven proposed schemes in Lewes, the capital cost is close to or in excess of £2million, with annual operating costs of £20-35,000.

12) Table 15 below identifies the other locations at risk, with details of the proposed mitigation, and its costs and benefits. The sources of risk include highway drains, combined sewer, groundwater, springs and culverts. The problems are of a smaller scale than the fluvial flooding.

13) In total, 21 sources of risk affect 73 properties, primarily residential. Two broad interventions can be identified.

14) *Capital.* Actions may include capital investments of a varying but modest size. For example, these include establishing an overflow connection or increasing size of existing connection pipes, creating new soakaways or increasing the capacity of existing ones, diversion of flows into new storage tanks or a localised combined sewer upgrade. Costs range from £10,000 to £150,000 but typically are of the order of £20,000 to £30,000.

15) *Maintenance*. The second intervention type is maintenance. For four of the locations of risk, improved maintenance is the only recommended action. Typically, costs are from £200-500 per annum.

16) The plan has identified a number of actions that are worth pursuing and some that are not, on cost-benefit grounds. Of the 21 'schemes':

- 11 schemes have cost-benefit ratios, significantly in excess of 1 of which 4 schemes are in excess of a ratio of 4.
- 2 schemes are marginal and
- 8 schemes have benefit cost ratios less than 1.

17) It is not clear what all the determinants of the Benefit Cost Ratio are but they will include numbers of properties at risk, and the probability of flooding. The maintenance only option is not necessarily cost-beneficial, where relatively few properties are at risk.

18) Costs and benefits were evaluated over a 100 year time horizon. Benefits are exclusively flood risk benefits and the assessment also accounted for climate change. There is little evidence that the IUD pilot has a significant impact on the character of emergency plans and flood warning systems.

Table 15 Case study Lewes Integrated Urban Drainage Pilot

Risk location	Proposed actions	Unit costs	PV costs	PV benefit	B/C	Prop. nos.
High Down Road	Maintain overland flow paths and encourage farmer to contour plough or leave unploughed strip adjacent to development. Possible change use to pasture land. Increased maintenance of existing soakaways. Determine soak-away capacity and increase size/add new soakaways as appropriate	£1000/yr £10000	38,813	999,856	25.76	2

[44] *Lewes Integrated Urban Drainage Pilot Study. Final Report – Volume 2; Defra (2008)*

Waterloo Place	High pressure water jet existing system plus CCTV survey to determine any problems and ascertain system capacity; Increase size of connection pipes as required; Possible overflow connection to Southern Water holding tank within Waitrose car park.	£1000 £15000 £40000	56,000	131,925	2.36	5
Mildmay Rd/ Prince Edwards Rd	Increase soak-away capacity and maintenance. Potential pump arrangement to transfer surface water to combined system.	£8000 £50000	58,000	12,498	0.22	1
Talbot and Toronto Terrace	Increased gully maintenance	£200/yr	5,763	13,887	2.41	10
Pelham Terrace	Increased gully maintenance	£200/yr	5,763	4,374	0.76	3
Friars Walk junction with School Hill	Increased gully maintenance plus enhanced traffic management in town centre. Jetting of existing system plus CCTV survey to determine any probs and ascertain system capacity. Increase size of connection pipes as required.	£2000/yr £5000	62,625	145,778	2.33	4
Friars Walk	Increased gully maintenance plus enhanced traffic management in town centre. Jetting of existing system plus CCTV survey to determine any problems and ascertain system capacity. Increase size of connection pipes as required.	£1000/yr £5000 min	33,813	24,317	0.72	1
Wheatsheaf Gardens	Maintain overland flow paths. Increased gully maintenance	£200/yr	5,763	8,332	1.45	6
Paddock Road	Localised combined sewer upgrade	£30000	30,000	15,623	0.52	1
Orchard Road / Spences Lane	Maintain overland flow paths between houses. Maintain drainage culverts in fields behind residential properties. Increase number of gullies.	£200/yr £3000	8,763	16,664	1.9	12
Winterbourne Lane	Localised combined sewer upgrade. Maintenance of the Winterbourne Stream.	£500/yr	30,000	3,224	0.11	1
Neville Crescent	Diversion of high level flows into new storage tank in recreation ground. Increase size or number of existing soakaways.	£150000 £5000	155,000	160,247	1.03	2
Winterbourne Hollow/Bell Lane	Maintenance of the Winterbourne Stream	£500/yr	14,406	9,599	0.67	0
Junction of Landport Rd and Offham Rd	Investigation of existing system including CCTV survey to determine cause of problems. Reconnect and repair drainage system as required.	£10000	10,000	11,698	1.17	0
Grange Road	Connection pipe size to be increased to increase capacity of connection. More frequent gully maintenance including seasonal targeting. Additional gullies on steep contributing adjacent streets or at low point for collection of overland flow.	£20000 £200/yr £10000	35,763	105,540	2.95	4
Southover Road	Revised connection into surface water system (current connection into foul system). More frequent gully	£12000	27,763	129,708	4.67	3

	maintenance including seasonal targeting. Additional gullies on steep contributing adjacent streets or at low point for collection of overland flow.	£200/yr £10000				
Fisher Street	Increased gully maintenance.	£200/yr	5,763	3,997	0.69	0
Station Street	Remove swan neck gullies to improve performance and facilitate maintenance.	£7000	7,000	4,240	0.61	0
The Course (external)	Jetting of existing system plus CCTV survey to determine any problems and ascertain system capacity Increase capacity of system (soak aways, connection to combined system, direct connection to Winterbourne Stream).	£5000 £20000	25,000	45,132	1.81	13
The Course (internal)	Remove connection between foul and surface water systems, surface water connection to Winterbourne Stream.	£20000	20,000	231,448	11.57	2
Cliffe High St	Investigate the function of the Cliffe Culverts and their condition and review whether they need to be replaced, refurbished or abandoned. Agree which organisation will be responsible for future maintenance of replaced or refurbished system.	£20000 £500/yr	34,406	166,643	4.84	3
ALL			670,404	2244,730	3.35	
ALL, where BC>1			485,659	2166,858	4.46	
ALL, where BC>1, excl High Down Road			446,846	1167,002	2.62	

Note: Locations with 0 properties at risk are locations at risk of highway flooding with consequences for road-use, etc

Appendix 5

Key assumptions

1.	Effectiveness of policy in combating surface water flooding. - Where does the 40% saving for SUDS proposals come from?
	In order to estimate the benefits of the proposed measures to combat surface water flooding the benefits model assumes that flood risk management will reduce a percentage of the estimated overall national damages attributed to surface water flooding. Foresight Report 2004 The Foresight work was based on all risk and types of interventions estimated effectiveness depending on the socio-economic scenario. It indicated that measures could be 40-70% effective in reducing (increasing) risks up to the 2080s. It would be reasonable to assume that there will be considerable variation in effectiveness of measures as they are applied to different areas with different problems and different solutions. **40% was considered to be a reasonable and conservative estimate.**
2.	SUDS maintenance costs £6/property/year
	This assumption will and can vary depending on local circumstances and the extent of maintenance desired. Some maintenance costs are not critical (e.g. litter picking). We have used a mid-point from the data available, taken from CIRIA research on Collation of Evidence on SUDS[45]. In practice, where a SUDS solution tends towards the upper end of the costs it may not be implemented on cost grounds, unless the local flood risk justifies it, so the average cost may be lower than the range would suggest. Furthermore, as budgets are tight, and as experience increases, some savings would be expected. The Lamb Drove case study report suggested that maintenance costs were no higher than for traditional drainage. We therefore considered that £6/property per year is a reasonable estimate which allows for variation in maintenance costs.
3.	75% take-up rate for SUDS
	A blanket take up rate has been assumed for SUDS even though the aim would be to implement SUDS in all locations even if only partially reducing direct flows to watercourses or surface water sewers. In practice it is likely that the take up and effectiveness of the SUDS will be tailored to the particular location. This will depend critically on the construction and performance standards developed for SUDS, the local flooding situation and also on the funding package for LAs. This is likely to depress the take up rate in early years, but also make take up more cost-effective.
4	SWMP work done when Benefit Cost Ratio >1
	We have assumed that work recommended by the SWMPs will be done when the

[45] *Collating the Urban Drainage Evidence Base CIRIA (2008)*

	benefit cost ratio is greater than one. There may be other drivers for mitigation of flooding problems that outweigh cost issues particularly if benefits are difficult to calculate. However this is a logical assumption to make.
5	Linear changes over 50 years
	In calculation of the increases in costs or benefits over the 50 year period we have assumed a linear growth – the same increase in each year. We know this is unlikely to occur. The use of SUDS for instance may increase gradually not achieving a peak rate until say the 5th year. The rate of development is also likely to be variable; the numbers of new houses built each year will be dependent on the economy and markets. We cannot predict what this variability will be so we used the simplest growth behaviour rather than complicate the assessment with speculation on growth patterns.

Appendix 6

Costs and Benefits

1) This appendix lists the costs and benefits of the proposals and describes what their provenance is.

SUDS Benefits

Item	Quantified	Comment
Reduction in Flood Damage due to surface water	Yes	This is the major constituent of the SUDS benefits. It is an estimate of the reduction of flood damage based on a range given in the Foresight (2004) report.
Amenity	No	There is insufficient information available and this is a difficult factor to quantify in monetary terms. It is however an important factor and is a key factor in the sustainability of proposals.
Recreation	No	Recreation is linked to amenity but includes activities such as fishing, models boats, picnicking, bird watching – any water related activities that ponds and basins can promote. So a benefit but insufficient information to quantify.
Ecosystems	No	A key factor in promoting SUDS particularly with the pressures put on ecology by climate change and the aims of the water framework directive to protect aquatic ecosystems. So a benefit but insufficient information to quantify.
Property Values	No	There is some evidence from SUDS work that property prices might rise if they are close to high amenity, well constructed SUDS. The survey (CIRIA) was based on public perception not actual sales figures. So a benefit but insufficient information to quantify.
Reduction in flows to sewerage systems	No	This could be significant but the action of this aspect of SUDS is very variable and no data was available at the time of preparing this IA.

SUDS Costs

Item	Quantified	Comment
Staff costs for SUDS	Yes	This figure is based on opinion there is no data to support this figure.
Annual cost of employees	Yes	£68,395 based on the grade that would be expected to be required for this type of work.
Maintenance	Yes	£6 an estimate – see (2) appendix 5
Number of properties protected by SUDS per year	Yes	Based on number of developments including domestic and non domestic developments. The numbers were derived by Halcrow in their 2009 report.

Local Flood Management Issues Benefits

Item	Quantified	Comment
Local Flood Risk Management	Yes	The benefits of the local flood risk management proposals were assumed to be a proportion of the costs based on case study data.
Efficiency benefits	No	A reduction in costs of flood risk management should be gained through better organisation of bodies involved in flood management.

Local Flooding Risk Management Costs

Item	Quantified	Comment
Development of SWMPs	Yes	Estimated using number of settlements and number of high risk flooding areas. Inclusion of different flood risks gave a range of predicted numbers of SWMPs.
Asset Registers	Yes	Estimates made on cost of asset registers based on experience of similar IT projects.
Development of partnerships	Yes	Estimated from comparison to similar work on shoreline management
Flood Incident Activity	Yes	Estimate based on experience of flood work
Capital Investment following SWMP recommendations	Yes	No real basis for this figure. Investment is dependent on funds available and the number of projects which are cost beneficial

Appendix 7

Sensitivity Testing

1) The tables below shows changes in the Net Benefit (PV) range when changes are made to key figures in the calculations. For each line only one figure is reduced by 10% from the initial calculation on line 1. This shows the sensitivity of the calculations to the various assumptions made.
2) Each table, for England and Wales, shows that there are three major groups of figures
   - Those in the SWMP calculations where changes due to decreases in estimates are fairly minor. Benefits for SWMPs are linked to costs so a reduction in costs (7) for SWMPs gives a reduction in benefits.
   - Then there are SUDS costs where maintenance costs and numbers of properties are multiplied so (4) and (5) give the same changes.
   - Finally there are SUDS benefits where assumptions can have a marked effect on the results. However the lower estimate is already small so any change tends be a large percentage.
3) The results of the IA are most sensitive to:
   a. Number of properties at risk from surface water flooding
   b. The damage per property from surface water flooding
   c. The increase in damages over the next 50 years due to surface water flooding

Sensitivity of Results to 10% reductions in key figures (England)

	Item changed	Net Benefit (PV) £ millions		Percentage change in Net Benefit	
		Low	High	Low	High
1	No change for comparison	138	6107	0%	0%
2	Damage per property £23290 to £29430	41	5482	-70%	-10%
3	Percentage Increase in Flood Damages 60% to 220%	41	5482	-70%	-10%
4	SUDS additional maintenance cost £6	191	6160	38%	0.9%
5	Numbers of new properties built annually 260,000	191	6160	38%	0.9%

6	Staff Costs £68,395	173	6118	25%	0.2%
7	Costs of Capital Investment £100,000 per LA	118	6053	-15%	-0.9%

Sensitivity of Results to 10% reductions in key figures (Wales)

	Item changed	Net Benefit (PV) £ millions		Percentage change in Net Benefit	
		Low	High	Low	High
1	No change for comparison	-8	418	0%	0%
2	Damage per property £23290 to £29430	-12	380	63%	-9%
3	Percentage Increase in Flood Damages 60% to 220%	-12	380	63%	-9%
4	SUDS additional maintenance cost £6	-5	420	-27%	0.5%
5	Numbers of new properties built annually 10,000	-5	420	-27%	0.5%
6	Staff Costs £59,504	-3	419	-60%	0.4%
7	Costs of Capital Investment £100,000 per UA	-11	410	40%	-1.9%

Appendix 8

Management of local flood risk including the adoption and maintenance of SUDS in Wales

Summary: Analysis & Evidence

Policy Option: 2	Description: Legislative measures for the management of local flood risk including the adoption and maintenance of SUDS in Wales

COSTS

ANNUAL COSTS

One-off (Transition) **Yrs**
£ 50

Average Annual Cost 43 Years* (excluding one-off)
£ 4.1 to £5.6m

Description and scale of **key monetised costs** by 'main affected groups' Surface Water management plans (SWMP): Production £4.1 - 6.6m PV, capital investment following recommendations of SWMPs £50m PV, staff costs to carry out proposals £2.6 - £13.3million PV. Total: £57 – £70m PV. Local Authorities and Developers Sustainable Drainage Systems (SUDS) £35 - £65m PVauthorities.

Total Cost (PV) **£ 92-£ 136m**

Other **key non-monetised costs**:

BENEFITS

ANNUAL BENEFITS

One-off **Yrs**
£ N/A

Average Annual Benefit (excluding one-off)
£ million

Description and scale of **key monetised benefits** by 'main affected groups'
Local authorities, public and insurance companies. Benefits from £81 to £131m PV. Benefits are reduction of damage from flooding & efficiency savings in co-ordination of activities. SUDS benefits would be £47m & £379m PV in the form of a reduction in damages due to surface water flooding.

Total Benefit (PV) **£ 128-£510m**

Other **key non-monetised benefits** by 'main affected groups' SWMPs may generate benefits by creating the opportunity for more efficient strategic planning & investment of resources. Non-monetised SUDS benefits include amenity, recreation, value to ecosystems & can also include an increase property value. There are also likely to be health and stress reduction benefits.

Key Assumptions/Sensitivities and Risks Assumptions (See Appendix 5 for details). Damages due to surface water flooding, flood damage due to urbanisation equal to climate change, staff number necessary, percentage uptake of SUDS, new build rates, SWMPs applied to high risk areas, only measures with benefit cost ratio > 1 taken forward.

Price Base Year **2008**	Time Period **50 years**	**Net Benefit Range** (NPV) **£ -7.5 to £418 million**	**NET BENEFIT** (NPV Best estimate) **£ -7.5 to £418 million**

What is the geographic coverage of the policy/option?			Wales	
On what date will the policy be implemented?			2011	
Which organisation(s) will enforce the policy?			LG	
What is the total annual cost of enforcement for these organisations?			£ N/A	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ N/A	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro N/A	Small N/A	Medium N/A	Large N/A

Are any of these organisations exempt?	Yes/No	Yes/No	N/A	N/A
Impact of Admin Burdens Baseline (2005 Prices)			(Increase-decrease)	
Increase of £14,000	Decrease of £		**Net Impact**	£14,000

Evidence Base For Wales

What is the Problem?

Overview

1. As in England, flooding has caused substantial damage in Wales over the past few years. Drawing on figures in their 2008 National Flood Risk Assessment, the Environment Agency estimates that:

"220,000 properties at risk of flooding from rivers and the sea in Wales. Our preliminary assessment of surface water flood risk also suggests that 97,000 of these are also susceptible to surface water flooding with a further 137,000 properties susceptible to surface water flooding alone.

In all, around 357,000 properties in Wales, or one in six properties, are at risk of flooding. The expected annual damages to residential and non-residential properties in Wales at risk of flooding from rivers and the sea is estimated at about £200 million."[46].

2. The floods experienced in recent times have highlighted this increasing threat and, while Wales has been fortunate to have escaped the worst of the severe weather, we are just as vulnerable to such events. The risks and consequences are similar to those outlined in Section 1.1 to this document.

Current Management and Responsibility

3. The current arrangements for the assessment and management of flood risks in Wales are very similar to those in England. The Environment Agency assesses flood risk from main rivers and the sea on a national basis, but there is no equivalent assessment for other sources of flood risk.

4. A number of authorities are responsible for different aspects of these risks. For example, at present no single operating authority in Wales has overall responsibility for surface water, with the Environment Agency, local authorities, Internal Drainage Boards, water companies and others all having roles in respect of different aspects of surface water management and flooding. This results in confusion over who should be doing what and leads to gaps in coverage.

5. The problems this causes are similar to those in relation to England described in Section 1.2 of this document.

Current use of Sustainable Drainage Systems (SUDS)

6. The situation regarding the use of sustainable drainage in Wales is similar to that in England, with the same barriers to progress. The use of SUDS is encouraged in Planning Policy Wales Development and Flood Risk (TAN 15), Section 8: "SUDS can perform an important role in managing run-off from a site and should be implemented, wherever they will be effective, in all new development proposals, irrespective of the zone in which they are located."

7. As for England, the use of SUDS has not increased because of a lack of clarity over adoption and the automatic right of connection.

Why does it need Government intervention

8. As has been acknowledged, there are overlaps and gaps in the coverage of the current arrangements. For some flood risks there are several operating authorities that have responsibilities for assessment

[46] Flooding in Wales: a national assessment of flood risk, 2009

and management. For others there are none.

9. There is clearly a need for greater clarity on the roles and responsibilities of those involved and Government intervention is required to both the clarity and the underpinning framework and mechanisms. The shortfalls in Wales are the same as those identified in Section 2.3 of this document.

Background to the Proposals

10. The Welsh Assembly Government consulted on proposals for change to the flood and coastal erosion risk management system in Wales, including the management of local flood risks, within the consultation on the draft Flood and Water Management Bill. The proposals were contained in Annex A to the consultation paper: *'The Policy Position in Wales'*.

11. Our proposals took account of the evidence emerging from the four studies into various forms of flood risk management taking place across Wales. These all consider different flood risks and are being led on by different operating authorities, with different reporting timescales.

12. The evidence of the increasing risks from both flooding and coastal erosion is underpinned by a series of reports produced in the last few years including the 'Foresight: Future Flooding Study' (2004), the Stern Review on the Economics of Climate Change (2006) and most recently Sir Michael Pitt's Review into the Summer 2007 Floods (2008).

13. The Welsh Assembly Government has committed to learn the lessons of these reports and in December 2008 we undertook to mainstream the recommendations of Sir Michael Pitt's Review into our policies on flood and coastal erosion risk management.

14. Details of the proposals are at the end of this appendix. The purpose and intended effects of the proposals for Wales are the same as those set out for England in Section 4 of this document.

Policy Options

Options

15. Two options were evaluated:

- **Option 1- the baseline**. No changes to current methods for managing floods or assessing flood risk; and
- **Option 2 – redefining roles and responsibilities for flood management** and the assessment of flood risk including compulsory consideration of SUDS for new developments.

Option 1 Baseline – current local flood risk management.

16. This option is the baseline and assumes current policies and legislation are retained. For the baseline we assumed that the following changes will occur in line with those for England outlined in Section 5 to this document:

- Climate change – an increase in winter rainfall, an increase in the intensity of rainfall events throughout the year and therefore an increased frequency and consequence of flooding;
- Continued urbanisation - development of greenfield sites and redevelopment of brownfield sites; and
- Requirements for improvement to water quality through European legislation, particularly the Water Framework Directive.

Option 2 - Redefining roles and responsibilities for Local Flood Management

17. This option analyses the impact of our proposals to re-organise the management and assessment of local flood risk in order to mitigate damage.

18. Proposals for new legislation have been developed from the consultation contained in Annex A to the consultation on the draft Flood and Water Management Bill and recommendations from Sir Michael Pitts Review – Lessons Learned from the floods in the summer of 2007

19. The proposal for new policies cover:

- Giving new responsibilities to local authorities for local flood risk management, to improve understanding and management of flood risks; and
- Making arrangements to ensure the adoption and maintenance of Sustainable Drainage systems (SUDS) in new developments.

New Responsibilities for Local Authorities

20. The proposals include enhancing local authorities current local flood management responsibilities by placing new duties on them to lead and co-ordinate a strategy for the management of *local flood risk* from all sources of flooding at the local level including:

- Maintaining a register of the main drainage and flood risk management assets, including existing and new sustainable drainage systems (SUDS);
- Powers to manage flood risk from surface runoff and groundwater so as to reduce the impact of flooding where this is justified and cost effective;
- Investigating local flooding incidents, identifying ownership and legal responsibility;
- Powers to develop local flood risk assessments and action plans, agreed with the Environment Agency, for investment programmes with others. Local authorities will have a duty to do this to comply with the EU Directive on the Assessment and management of floods. The plans' objectives will include sustainable management and where feasible they will aim to mitigate local flood risk using the information gained to inform local authority planning decisions and emergency plans; and
- Giving local authorities power in relation to granting consents to works that may affect the flow of ordinary watercourses (which currently lie with the Environment Agency).

21. In addition all relevant organisations would have a duty to co-operate and share information with local authorities and the Environment Agency to facilitate the management of flood risk. There will also be additional powers for local authorities, internal drainage boards, water and sewerage companies and highways bodies to undertake work on surface runoff and groundwater to facilitate delegation arrangements from upper tier authorities.

22. Evidence shows that there are benefits from local flood risk management but they may take significant time to realise. These are outlined in Section 5 of this document.

New responsibilities for Local Authorities for SUDS

23. The provisions on SUDS within the draft Bill aim to increase the uptake of SUDS and define responsibilities for their maintenance. The key proposals are outlined in Section 5.4 of this document and relate to an approval process for new surface water drainage systems and adoption of public SUDS.

Benefits and Costs

24. There are a number of costs and benefits, quantified and un-quantified, in moving from the current policy landscape (option 1) to implementing our proposals (option 2).

25. The methodology and assumptions for calculating each of these is the same as that for England and set out in the relevant subsections of Section 6 to this document.

26. Adding up the items in table 6, **total costs for Local Authorities in Wales discounted over 50 years range from £2.5 million to £12.3 million.**

Table 1 Calculation of Benefits of SUDS in 2060 for Wales[47]

Option	Option 1	Option 1	Option 2	Option 2	
Parameter	**Low Case £ millions**	**High Case £ millions**	**Low Case £ millions**	**High Case £ millions**	**Comments**
7) Current annual damages due to surface water flooding.	£63.8	£136	£63.8	£136	For Wales in 2011
8) Future (2060) annual damage due to surface water flooding with an increase in urbanisation.	£102 (60% increase)	£434 (220% increase)	£102 (60% increase)	£434 (220% increase)	Assumes no policies for flood damage reduction
9) Increase in damage due to surface water flooding by 2060 over damages in 2011.	£38.3	£298	£38.3	£298	
10) Extra annual damages (3) assumed to be managed with existing policies in 2060. (Proportion from England applied for Wales % of new development not managed by existing policies)	£20.8 (54.2% of extra damages)	£158 (53.1% of extra damages)	£20.8 (54.2% of extra damages)	£158 (53.1% of extra damages)	Assume 80% of major development and 20% of minor development managed.
11) Increase in annual flood damage in 2060 not dealt with by existing policies (baseline - option 1)	£17.5	£140	£17.5	£140	Row 3 minus Row 4.
12) Additional damage avoided in 2060 through improved development control with option 2 proposals	n/a	n/a	£5.3	£42	Assume 75% uptake of SUDS and they reduce costs by 40%

[47] **Halcrow Group Limited** Impact Assessment of Local Flood Risk Management Supplementary Evidence Base August 2009

Table 2 Costs associated with new SUDS responsibilities

Parameter	Low	High	Comments
No. of additional employees per local authority	0.5	1.5	FTE dedicated to SUDS
Annual cost of employees	£655 k	£1,963 k	Cost is based on £59.5k[48] per employee, and 22 unitary local authorities
Number of New Properties Per Year	10,000	10,000	These figures are calculated in the Halcrow report
Maintenance of SUDS cost per year	£45k	£45k	Assume £6/property/year on 75% of these
Year 1 total costs of new SUDS	**£700k**	**£2,008k**	Sum of employee and maintenance of SUDS
Year 2 total costs of new SUDS	**£655k+£45k + £45k = £745k**	**£1,963k +£45k+£45 =£2,053k**	SUDS maintenance is cumulative and will increase by the same amount each year.

Table 3 Summary of Option 2 Discounted Costs and Benefits

Compared to Baseline option 1 for SUDS up to 2060

SUDS Costs and Benefits	Millions
Low Cost Estimate	£35.3
High Cost Estimate	£65.4
Low Benefit Estimate	£47.5
High Benefit Estimate	£379
Net Benefit Low (lowest benefit minus highest cost)	**-£18**
Net Benefit High(Highest benefit minus lowest cost)	**£344**

Table 4 Summary of Surface Water Management Plan costs

Cost of an individual SWMP

[48] This has been derived using a Pitt Review estimate of £55,000 for a qualified engineer (adjusted to 87% for Wales), 20% overheads and corrected to 2008 as base year giving £59,503.

	Low Estimate	High Estimate
	£	£
Cost of SWMP	75,000	150,000
LA staff cost	15,000	15,000
EA cost	15,000	15,000
Water company cost	15,000	15,000
Total cost	**120,000**	**195,000**
Annual cost of developing and maintaining SWMPs for Wales		
Years	Low Estimate	High Estimate
	£	£
1-5	528,000	858,000
6-50	98,000	158,000

Table 5 Other Costs of SWMPs in first year for 22 LAs in Wales

Annual Costs	Low Estimate £ k per annum	High Estimate £ k per annum
Capital Investment	2,200	2,200
Asset registers	227	1,144
Partnerships	49	245
Flood Incident management	49	245
Total	2,525	3,834

Specific Impact Tests

27. Impact assessments require consideration of a number of potential impacts on businesses, people and the environment. The impacts on the specific test criteria required are summarised below:

- Competition – the introduction of the proposals for improvements to local flood management and increased use of SUDS will not have any significant impact on competition, since the proposals will affect all new developments all business involved will be equally affected.

- Small firms – small building firms will have to take into account the implementation of SUDS. They will need to ensure that they have staff trained to construct SUDS to meet the National standards for SUDS. However the proposals will also open new opportunities for small firms who specialise in SUDS materials such as porous paving.

- Legal aid – the policy measures do not introduce any new criminal sanctions, civil penalties or appeals so no impact is expected on legal aid.

- Sustainable development – the introduction better flood management and particularly increase use of SUDS will contribute substantially to sustainable development and should provide significant positive benefits.

- Carbon assessment – the proposals will not have a significant impact on emissions of greenhouse gases, but are likely to contribute to an overall reduction through increasing effectiveness of flood risk management and resulting reduction in flood damage.

- Other environment – The proposals will contribute significantly to the environment particularly through the use of SUDS which will provide new habitat and habitat corridors in urban areas where such habitat is generally in short supply.

- Health impact **–** no significant impacts are expected, although more effective flood risk management is likely to have beneficial impacts on health and particularly stress for communities in areas at risk. There is also evidence that well constructed and maintained SUDS water features through enhancing amenity and recreation will benefit health. Good design and maintenance of SUDS should ensure that nuisance aquatic insects are not a concern.

- Race, disability, gender equality and human rights – no impact is anticipated from the introduction the proposals discussed in this IA.

- Rural proofing – Local flooding and introduction of SUDS are focussed mainly on urban areas however they both aim to control flooding at source (where the rain falls), rather than moving the problem downstream as conventional drainage tends to. So there should be less impact on rural areas downstream of urban land. Also where building developments occur in rural areas the aim is to ensure that discharge from such a site does not change in volume due to the development.

Conclusion

28. Based on the evidence, option 2 is the favoured option. The proposals are very likely to produce high benefits compared to costs.

29. Subject to data and methodology limitations, the conclusion of the analysis is that the proposed policies are very likely to be cost-beneficial. Discounting over 50 years, an estimate of net benefits is between minus **£7.5 million and plus £418 million**.

Table 6b Summary of Option 2 Costs and Benefit Local Flooding

Local Flood Management Proposals Costs and Benefits	£ Millions
Low Cost Estimate	£57
High Cost Estimate	£70
Low Benefit Estimate	£81
High Benefit Estimate	£131
Net Benefit Low (lowest benefit minus highest cost)	**£10**
Net Benefit High(Highest benefit minus lowest cost)	**£74**

Table 6c Summary Table of Net Benefits for Wales

	Low Estimate	High Estimate
Net Benefits SUDS	-£18 million	£344 million
Net Benefits Local Flooding Management	£10 million	£74 million
Total Net Benefit Option 2	-£7.5 million	£418 million

30. The key arguments for the proposals are as set out in Section 8 of this document.

Further work and Review

31. The review of the effectiveness of these proposals for local flood management and SUDS will have to be done in the long term. The implementation of flood management initiatives is a proposal that needs to be done over decades. The assessment of the effects they have on flood damages in a changing climate with changes in urbanisation will also be long term.

32. Further work should be put in train to monitor the effects and assess the effectiveness of these measures on flooding damages as well as water quality.