Effective Floodplain Development Policy

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1. Scope of Paper

1.1 I explain the history of development in fluvial floodplains and briefly describe the main technical issues associated with such development. I then consider both current and emerging planning policy together with the constraints that it imposes and the potential opportunities that remain. As the Environment Agency plays an important advisory role in the planning process in relation to floodplain development, I explain this role and further explain how the development industry can work within both the Government's national planning policy and the Agency's internal policies to create appropriate and sustainable developments. I then outline the potential impact of climate change and the minimum requirements of the insurance industry. All the various elements are then pulled together in the form of a planning tool kit.

2. Introduction

2.1 Our forefathers selected locations for settlement close to rivers based on the need for drinking water, foul drainage, transport, commerce and fishing. Such settlements were often located at appropriate bridging or fording points of rivers where restrictive conditions of width or depth made the location suitable for such crossings; however, such conditions also restricted flood flows. With the development of navigation and water power for milling, there was increased need for settlements to encroach into the adjacent floodplain. The subsequent loss of both conveyance (flow routes) and storage gave rise to locally increased flood levels.

2.2 The last century has seen society expecting much more from flood defences, as what was historically tolerated in terms of frequency of flooding is no longer considered acceptable. In addition, there is some evidence that more efficient drainage of our agricultural and urban areas has led to increased peak flood flows. This has often been mitigated by improvements to rivers and their control structures, but this has not halted the increasing awareness of the role of floodplains and the need to protect property from flooding, particularly since the great floods of Winter 1947.

.3 However, pressure for development within existing towns has continued and it has been considered necessary in some circumstances to encroach further into floodplains. This can be appropriate provided that such development is not at risk of flooding and does not increase the risk of flooding elsewhere. The development can be raised out of the floodplain to afford the necessary protection; alternatively raised defences, such as flood banks, may be appropriate around the development, although there is always an inherent risk of breach or overtopping with this latter option.

2.4 The raising of land or provision of raised defences in a floodplain has the effect of removing a volume of floodwater storage. However, this volume can often be readily provided elsewhere by lowering land adjacent to the floodplain to extend the floodplain and provide replacement storage. In recent years it has been expedient to provide more storage than that which is lost, thereby providing an element of betterment by reducing flood levels at downstream properties. While hydrology and hydraulics are complex, no two sites are the same. However, experienced river engineers within the Environment Agency and its predecessors have been able to make prudent and pragmatic decisions on whether to support or object to each planning application on its particular merits.

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2.5 Undoubtedly some mistakes have been made and there has been some inappropriate development in floodplains that has either been at risk of flooding or given rise to increased flooding elsewhere. While such mistakes are unfortunate, they should not detract from the much larger number of appropriate developments that have often not only mitigated their own impacts but also created benefit by reducing flood risk to others.

3. The role of fluvial floodplains

.1 In order to explain the role of fluvial floodplains we should start with an understanding of what causes flooding. It is not too outlandish to assume that flooding is caused by excessive rainfall. However, while it is true that rainfall is the major contributor to flooding, there are other factors which significantly influence the extent and nature of flooding. Fluvial flooding (flooding from overflowing rivers) is caused by a combination of hydrological, hydraulic and groundwater-related conditions.

3.2 First, hydrological conditions determine the actual flow in a river through a number of factors. The intensity and duration of the rainfall, the permeability of the geology and soils which underlie the catchment, the soil moisture deficit (dryness) of the soils, the amount of snow lying on the ground, the degree to which the ground is frozen and the actual ''land use'' all make a difference.

3.3 Secondly, the hydraulic conditions determine how the river system will respond to the input of the flow and thereby to what levels the floodwater will rise. These hydraulic conditions are dependant on the physical dimensions (gradient, cross sectional area) of the river and floodplain, the hydraulic efficiency (roughness), the degree of obstruction or blockage and the correct maintenance and operation of flow-control structures such as weirs and sluices.

3.4 Thirdly, the groundwater conditions affect how much rainfall can be absorbed into the ground and how much flow is already in the river at the time at which it has to accept the inflow from the run-off of the rainfall and sometimes snowmelt event.

3.5 Floodplains are areas of relatively flat land adjacent to more mature rivers, which have naturally developed over thousands of years through a process of erosion and accumulation of silt. These floodplains act as a ''safety-valve'' for rivers in that once the flow in a river channel exceeds the capacity of the channel, then it can spill into the floodplain where it is both stored and conveyed. The storage of floodwaters within a floodplain has the effect of reducing peak flood levels downstream; such stored floodwaters naturally return to the river once the levels have subsided. The conveyance (flow) of floodwater along the floodplain has the effect of reducing peak flood levels upstream. Both storage and conveyance are important roles within floodplain management, which should be maintained and protected in perpetuity. The two roles are intrinsically linked as increased conveyance can reduce upstream storage and thus increase flood levels downstream.

4. PPG25—the current planning policy guidance

4.1 Planning Policy Guidance (''PPG'') Note 25: Development and Flood Risk was issued in July 2001 and contained valuable guidance in the text, bringing a more consistent approach to development control in floodplains. However, much of this guidance was overshadowed by the only prescriptive guidance which was that enshrined in Table 1, para.30. It was never intended that this table should be rigidly applied, since it is only guidance, but the practitioners have pored over each word and punctuation mark within this table to seek an interpretation that supports their particular cause. During this process, the spirit and intent of the guidance is sometimes lost, but at least it is lost consistently!

4.2 The authors of PPG25 attempted to classify different floodplains according to the frequency of flooding and the land use. The frequency of flooding was addressed by setting a series of three Flood Zones where Zone 1 was out of the 1:1000 year floodplain, Zone 2 was between the 1:100 year (1:200 year for tidal flooding) and the 1:1000 year floodplains, and finally Zone 3 was the 1:100 year (1:200 year for tidal flooding) floodplain. These Flood Zones were based on ignoring any existing flood defences. The land use was then addressed by subdividing Zone 3 into (a) developed area; (b) undeveloped or sparsely developed area; and (c) functional floodplain. While the Flood Zones 1—3 were quite sensible the sub-divisions in Zone 3 were confusing as (a) and (b) were clearly based on land use, and (c) was more linked to functionality of flooding. An area of land could be in either (a) or (b) and also be in (c) at the same time, such that there would be a contradiction in the relevant ''appropriate planning responses'' given in Table 1 of para.30, the most important guidance in the whole document. The functional floodplain classification was actually introduced at the request of English Nature in order to protect natural floodplains with high environmental value from development.

4.3 These ''appropriate planning responses'' were given as being ''appropriate'' irrespective of the existence of flood defences. This meant that a site that was once in the 100 year floodplain but was now protected to a 1:1000 year standard attracted the same ''appropriate planning response'' as a similar site that was in the existing 1:100 year floodplain and was frequently inundated with floodwater. To put this situation into context it should be remembered that much of the City of London is in Flood Zone 3 even though it is defended by the Thames embankments, the Thames Barrier and other such well maintained substantial defences providing a 1:1000 year protection.

Table 1. Planning response to sequential characterisation of flood risk

Flood zone (see Note a)	**Appropriate planning response**
1. **Little or no risk** Annual probability of flooding: River, tidal & coastal <0.1%	No constraints due to river, tidal or coastal flooding. Low to medium risk
2 **Low to medium risk** Annual probability of flooding: River 0.1–1.0% Tidal & coastal 0.1–0.5%	Suitable for most development. For this and higher-risk zones, flood risk assessment appropriate to the scale and nature of the development and the risk should be provided with applications or at time of local plan allocation. Flood-resistant construction and suitable warning/evacuation procedures may be required depending on the flood risk assessment. Subject to operational requirements in terms of response times, these and the higher-risk zones below are generally not suitable for essential civil infrastructure, such as hospitals, fire stations, emergency depots etc. Where such infrastructure has to be, or is already, located in these areas, access must be guaranteed and they must be capable of remaining operational in times of emergency due to extreme flooding
3 **High risk (see note b)** Annual probability of flooding, with defences where they exist: River 1.0% or greater	**a) Developed areas** These areas may be suitable for residential, commercial and industrial development provided the appropriate minimum standard of flood defence (including suitable

Table 1. *continued*

Flood zone (see Note a)	Appropriate planning response
Tidal & coastal 0.5% or greater	warning and evacuation procedures) can be maintained for the lifetime of the develpment (see paragraph 31 below), with preference being given to those areas already defended to that standard. In allocating or permitting sites for development, authorities should seek to avoid areas that will be needed, or have significant potential, for coastal managed realignment or washland creation as part of the overall flood defence strategy for coastal cells and river catchments. **b) Undeveloped & sparsely developed areas** These areas are generally not suitable for residential, commercial and industrial development unless a particular location is essential, eg for navigation and water-based recreation uses, agriculture and essential transport and utilities infrastructure, and an alternative lower-risk location is not available. General-purpose housing or other development comprising residential or institutional accommodation should not normally be permitted. Residential uses should be limited to job-related accommodation (eg caretakers and operational staff). Caravan and camping sites should generally not be located in these areas. Where, exceptionally, development is permitted, it should be provided with the appropriate minimum standard of flood defence and should not impede flood flows or result in a net loss of flood-plain storage. **c) Functional flood plains** These areas may be suitable for some recreation, sport, amenity and conservation uses (provided adequate warning and evacuation procedures are in place). Built development should be wholly exceptional and limited to essential transport and utilities infrastructure that has to be there. Such infrastructure should be designed and constructed so as to remain operational even at times of flood, to result in no net loss of flood-plain storage, not to impede water flows and not to increase flood risk elsewhere. There should be a presumption against the provision of camping and caravan sites.

Notes:

(a) All risks relate to the time at which a land allocation decision is made or an application submitted. The Environment Agency will publish maps of these flood zones. Flood zones should be identified from Agency flood data ignoring the presence of flood defences. Local planning authorities should, with the Agency, identify those areas currently protected by defences and the standard of protection provided by those defences.

(b) Development should not be permitted where existing sea or river defences, properly maintained, would not provide an acceptable standard of safety over the lifetime of the development, as such land would be extremely vulnerable should a flood defence embankment or sea wall be breached, in particular because of the speed of flooding in such circumstances (see paragraph 69 below).

4.4 The main thrust of a floodplain planning policy is to prevent ''inappropriate'' development in floodplains and not frustrate ''appropriate'' development in floodplains. In this respect PPG25 generally achieves the former but fails to achieve the latter, not so much in the intent of the text but more in the potential for misinterpretation.

4.5 Following publication of PPG25, the work carried out by Professor George Fleming and the Institution of Civil Engineers, resulting in the publication of ''Learning to Live with Rivers'', and Defra in preparing its strategy consultation document ''Making Space for Water'' has concentrated on the need for management of flood risk. Under the policies contained in PPG25 and ''Making Space for Water'', there are many opportunities for sustainable development in floodplain areas where an appropriate standard of flood defence can be achieved and at the same time significant improvements can be provided for the reduction in flood risk elsewhere. Often such improvements would not otherwise ever be brought to fruition as the public purse is already spread thinly and indeed the cost/benefit criteria quite rightly means that the most needed improvements are funded first. Unfortunately such opportunities are sometimes lost through rigid application and often misinterpretation of such policies.

5. PPS25—the future planning policy statement

Programme

5.1 The deadline for responses to the consultation on the draft PPS25 was the end of February 2006. The ODPM (and the successor department) are now considering all such responses and plan to issue the new PPS25, which will supersede PPG25, in the Winter of 2006/2007. All further commentary on and references to PPS25 are in relation to the consultation draft as issued in December 2005.

5.2 PPS25 is still not without its failings but it builds on the guidance in PPG25, clarifies some of the areas that were open to misinterpretation and introduces a more appropriate system of controlling development in floodplains on the basis of flood risk and vulnerability to such risk. This is effectively adopting the ''source, pathway, receptor'' method of analysis and assessment to the issue of flood risk.

Flood zones

5.3 The three Flood Zones previously introduced in PPG25 are retained; as in 1, low; 2, medium; and 3, high probability. However, where PPG25 has three sub-categories in Flood Risk Zone 3 based on a combination of existing land use and flooding functionality, the draft PPS25 has only two sub-categories which are based purely on flooding functionality. Sub-category 3a is general 1:100 year floodplain; while 3b is land within the 1:100 year floodplain where ''water has to flow or be stored in times of flood''. Both the 3b description and the 3b name of ''The Functional Floodplain'' concentrate on this issue of functionality and it is clearly referring to strategic flood flow routes or storage elements that cannot be readily relocated through engineering measures. Therefore, these floodplain functions have to be located on these particular areas. Quite rightly any development in such Functional Floodplain is strictly controlled and is limited to ''water compatible uses'' and ''essential infrastructure'' (subject to passing an ''Exception Test'') where such development is further defined in the Flood Risk Vulnerability Classifications.

Table D.1. Flood Risk Zones

Zone 1 Low Probability

This zone comprises land assessed as having a less than 1 in 1000 chance of river and sea flooding in any year (<0.1%).

All the uses of land listed in Table D.2 are appropriate in this zone. However, all development proposals should still be considered in relation to:

a) their vulnerability to flooding from other sources as well as from river and sea flooding; and
b) their potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off.

For development proposals on sites comprising one hectare or above, these considerations should be incorporated in a FRA. This need only be brief unless the factors at a) and b) above or other local considerations require particular attention.

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development; and
ii. mitigate the potential to increase flood risk elsewhere through the appropriate application of sustainable drainage techniques.

Zone 2 Medium Probability

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 chance of river flooding (1% – 0.1%) and between a 1 in 200 and 1 in 1000 chance of sea flooding (0.5% – 0.1%) in any year.

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone.

The highly vulnerable uses in Table D.2 are **only** appropriate in this zone if the Exception Test (see para. D10) is passed.

All development proposals in this zone should be accompanied by a FRA, which should include:

a) their vulnerability to flooding from other sources as well as from river and sea flooding;
b) their vulnerability to flooding over the lifetime of the development;
c) their potential to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water run-off, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property; and
d) a demonstration that residual risks of flooding after existing and proposed flood management and mitigation measures are taken into account, including flood defences, flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning, are acceptable.

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development; and
ii. mitigate the potential to increase flood risk elsewhere through the appropriate application of sustainable drainage techniques.

Zone 3a High Probability

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development;
ii. mitigate the potential to increase flood risk elsewhere through the appropriate application of sustainable drainage techniques; and
iii. relocate existing development to land in lower flood zones.

Table D.1. *continued*

Zone 3b The Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flood.

Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. Essential infrastructure in this zone should pass the Exception Test and be designed and constructed to:

—remain operational in times of flood;

—result in no net loss of floodplain storage;

—not impede water flows; and

—not increase flood risk elsewhere.

The less vulnerable, more vulnerable and highly vulnerable uses in Table D.2 should not be permitted in this zone.

All development proposals in this zone should be accompanied by a FRA, which should include:

a) their vulnerability to flooding from other sources as well as from river and sea flooding;

b) their vulnerability to flooding over the lifetime of the development;

c) their potential to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water run-off, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property; and

d) a demonstration that residual risks of flooding after existing and proposed flood management and mitigation measures are taken into account, including flood defences, flood resilient and resistant design, escape/evacuation, effective flood warning and emergency planning, are acceptable.

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development;

ii. mitigate the potential to increase flood risk elsewhere through the appropriate application of sustainable drainage techniques; and

iii.relocate existing development to land in lower flood zones.

Note: These Flood Zones refer to the probability of river and sea flooding ignoring the presence of defences.

Vulnerability classifications

5.4 The permitted land uses within each Flood Zone are based on the vulnerability of each such land use to flooding of the relevant frequency range for that zone. The potential land uses are allocated a Flood Risk Vulnerability Classification in accordance with Table D.2.

5.5 These Vulnerability Classifications range from Essential Infrastructure, through Highly, More and Less Vulnerable to Water Compatible Development at the least vulnerable end of the scale. Within Flood Zone 3a the Highly Vulnerable land uses, such as police stations, hospitals and housing for the elderly are not permitted; More Vulnerable land uses such as residential, public houses and hotels are permitted subject to passing an Exception Test. It is important to note that no Highly Vulnerable land uses are permitted within any Flood Zone 3, irrespective of the technical merits and ability to pass the Exception Test.

The Exception Test

5.6 The Exception Test puts the issue of flood risk into context with other sustainability criteria and allows some tolerance to flood risk on the basis that the Test is passed. The Exception Test is that:

(a) the development makes a positive contribution to sustainable communities;

(b) the development is on brownfield land unless there are no alternative brownfield sites;
(c) a Flood Risk Assessment demonstrates that any residual risk is acceptable; and
(d) the development makes a positive contribution to reducing or managing flood risk.

5.7 These requirements for the Exception Test are all quite reasonable and tie in with other sound Government objectives. Requirement (d) provides the challenge to engineers and other practitioners to design schemes providing real benefit to local communities in a robust and sustainable manner.

The Sequential Test

5.8 As in PPG25, the draft PPS25 promotes the Sequential Test of allocating land for development in Lower Flood Risk Zones before considering Higher Flood Risk Zones which is very sensible but should only be considered in conjunction with other sustainability criteria. Important as flood risk is to the planning process, it should not be treated in isolation—there are other issues of similar importance in respect of sustainability to which the same robust technical solutions that are available for flood risk, are often not available.

The Practice Guide

5.9 In parallel with PPS25, a Practice Guide is being drafted which is intended to assist with the implementation of the PPS. To do this, it is intended to provide practical advice illustrated by case studies to ''show how implementing flood risk management strategies can achieve multiple social, economic and environmental benefits''. The Practice Guide will cover the following aspects:

- The Planning Process and Flood Risk
- Flood Risk Assessments
- The Sequential Test and Exception Test
- Opportunities for Reducing Flood Risk
- Managing Surface Water
- Managing Residual Risk
- Relevant Plans.

It is planned to publish the Practice Guide at the same time as the PPS25, however, it is to be subject to finalisation following a fixed period where it is open to feedback and comment.

6. Flood risk assessment

Requirement

6.1 PPG25 requires that a Flood Risk Assessment (''FRA'') be carried out that is ''appropriate'' to the scale and nature of the proposed development and the risks involved. Guidance on the FRA is provided in Appendix F of PPG25. The Environment Agency produced some standing advice to Local Authorities in July 2004, subsequently updated in October 2005, which can be accessed on their website; this provides further guidance on what a FRA should include. PPS25 Annex E also sets out the general principles of FRAs and highlights the need ''to demonstrate how flood risk to the development itself and flood risk to others will be managed both now and over the expected lifetime of the development''.

6.2 The range of FRAs is increasing; as well as being required for all development proposals in Flood Zones 2 and 3, FRAs are now required for all major developments in Flood Zone 1 (i.e. they are out of the 1000 year fluvial or tidal floodplain). This is so that other forms of flooding and the impacts of surface water drainage are addressed.

6.3 The table following shows the requirement for a FRA for the given general development categories and the PPG25 flood risk zones. Liaison with the Environment Agency (indicated on the table as FRA/Environment Agency) and in some cases directly with the local planning authority (indicated LPA/FRA), is recommended at the outset to agree the scope of the FRA. In some situations a FRA (indicated Check with LPA) may not be required.

Table D.2. Flood Risk Vulnerability Classification

Essential Infrastructure	—Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure.
Highly Vulnerable	—Police stations, Ambulance stations and Fire stations and Command Centres required to be operational during flooding. —Electricity-generating power stations and sub-stations. —Hospitals. —Emergency dispersal points. —Residential institutions such as residential care homes, childrens' homes, social services homes and student Halls of Residence and hostels. —Gypsy and traveller sites using caravans or mobile homes. —Mobile or park homes for permanent residential use. —Dwelling houses designed, constructed or adapted for the elderly or other people with impaired mobility.
More Vulnerable	—Buildings used for: dwelling houses (except for those in the highly vulnerable classification); drinking establishments; nightclubs; and hotels. —Non-residential institutions such as health services, nurseries and educational establishments, but excluding hospitals. —Landfill and hazardous waste facilities.
Less Vulnerable	—Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions; and assembly and leisure. —Land and buildings used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan. —Land and buildings used for agriculture and forestry. —Waste treatment (except landfill and hazardous waste).

Table D.2. *continued*

Water-compatible Development	—Minerals working and processing. —Transport infrastructure. —Flood control infrastructure. —Water treatment plants and pumping stations. —Sewage treatment plants and pumping stations. —Docks, marinas and wharves. —Navigation facilities. —Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. —Water-based recreation and tourism (excluding sleeping accommodation). —Lifeguard and coastguard stations. —Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms. —Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Note:

1) This classification is based on advice from the Environment Agency on the flood risks to people and the need of some uses to keep functioning during flooding.

2) Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

Content

6.4 A FRA needs to address all types of flooding: river, sea, land drainage, groundwater and sewers including non-natural and artificial sources such as reservoirs, canals and lakes.

6.5 The initial stage of preparing a FRA is to obtain the appropriate data and information such as any hydrologically and hydraulically modelled flood levels, any records of flooding, the Ordnance Datum GPS survey, the drainage details, the underlying soils, any flood defences and any other structures which may have an influence on the flood risk to the development proposals.

6.6 The assessment part of the FRA then looks at the impact of the flood risk in terms of ensuring the safety of those who could occupy the proposed development and what steps can be taken to minimise possible damage to the fabric and contents of buildings. The effects of a range of magnitudes of flooding including the extreme events and the possibility that climate change may increase the likelihood of flooding, needs to be considered with the appropriate risk reduction measures being identified and incorporated.

6.7 The assessment is about ensuring that the flood risk can be managed and that the building and its occupants are able to remain safe throughout the planned lifetime of the development. The assessment also needs to demonstrate that there is no resultant increase in flood risk to third parties and that a satisfactory route for egress in times of flood is available.

Development category	Within Flood Zone 3	Within Flood Zone 2	Within Flood Zone 1
Domestic extensions	LPA/FRA	LPA/FRA	Check with LPA
Industrial/ Commercial extensions less than 250m^2	LPA/FRA	LPA/FRA	Check with LPA
Development less than 1ha	FRA/ ENVIRONMENT AGENCY	LPA/FRA	Check with LPA
Development between 1ha and 5ha	FRA/ ENVIRONMENT AGENCY	FRA/ ENVIRONMENT AGENCY	LPA/FRA
Development greater than 5ha	FRA/ ENVIRONMENT AGENCY	FRA/ ENVIRONMENT AGENCY	FRA/ ENVIRONMENT AGENCY

6.8 The level of detail required for a FRA is dependant on the particular stage in the planning process; FRAs range from what is in effect a preliminary or scoping study to a full assessment.

The FRA in the planning process

6.9 Ideally the FRA, together with a ''letter of compliance'' from the Environment Agency confirming that they are satisfied with the FRA, is submitted with the planning application. If the FRA involves complex technical issues, the 'letter of compliance' procedure allows the proper consideration of such issues and their resolution outside of the statutory time constraints for determination of planning applications.

7. The Plan Led system

7.1 In order to address flood risk management in a holistic, catchment-wide manner PPS25 reinforces the system of FRAs at different levels as introduced in PPG25. This is so that an individual site development or redevelopment within the floodplain can fit within a bigger strategy which in turn fits within a more regional based focus. To this end, the hierarchy of Flood Risk Assessment is as follows:

1. Regional Flood Risk Assessment
2. Strategic Flood Risk Assessment
3. Site Flood Risk Assessment

7.2 The Regional Flood Risk Assessment can be very general and lay down some ''common sense'' based guidelines which would depend firstly on the degree, extent and type of flood risk, secondly the potential impact of climate change and thirdly the local social and economic planning requirements.

It is important that such a Regional FRA does not provide undue constraint to the more specific Strategic Flood Risk Assessment.

7.3 The Strategic Flood Risk Assessment provides the opportunity to achieve appropriate sustainable floodplain development which will not only be fully protected from flooding but will also address current flood risk to existing property and the potential future increase in flood risk due to climate change.

7.4 The difficulty with a Strategic FRA is that for it to be credible and to realise the full potential for both sustainable development and planning gain, a detailed analysis is required. With the inherent uncertainties in hydrology and hydraulic modelling it would be necessary to carry out detailed survey, modelling and calibration in order to facilitate the design and proving of a strategy that provides for the realisation of the opportunities. Without such design tools being available, the necessary application of the precautionary principle could rule out good opportunities at an early stage.

7.5 The Strategic Flood Risk Assessment provides the opportunity to implement strategic flood relief to existing development at risk through a series of smaller development proposals contributing to a strategic scheme. This could be in the same way that strategic transport systems within an urban area are sometimes funded by apportionment of the costs to local development proposals through s.106 agreements.

7.6 The Site Flood Risk Assessment is then a simple application of the strategy and would only have to address points of detail as the principle is already enshrined within the Strategic FRA.

8. Constraints and opportunities

8.1 The prescriptive structures in Table 1 of PPG25 and more generally in Annex D of PPS25 are based on ignoring flood defences, be they either existing or proposed as part of the scheme for which planning permission is sought. It is to be recognised that the siting of development behind raised flood defences is not ideal, however, development or re-development behind existing defences should be permitted where there is surety that the defences will be maintained for the lifetime of the development. Such defences should also be to an appropriate standard and 1:1000 years should be the target standard together with the proposed development being designed to accommodate breach scenarios.

8.2 Potential climate change impacts on increased flood levels are more readily accommodated in fluvial situations than in tidal situations (where rising sea levels have a more significant impact). The proposed Thames Gateway Development area is behind existing raised tidal defences. While commitment to the future maintenance of these defences is a given, the development will have to also be designed to accommodate breach scenarios.

8.3 The best solution to protect a floodplain area from flooding is to raise the site 'wholesale' so that it is above the 1:1000 year flood level and therefore in the lowest risk Flood Zone 1 where there is no limitation on the type of development that is appropriate (from a flooding perspective). However, as both PPG25 and the draft PPS25 are predicated on there always being residual risk, the type of development permitted is based on the pre-development risk. This is clearly not sensible and will hopefully be addressed in the final version of PPS25.

8.4 The best opportunity for avoiding an initial objection from the Environment Agency to a proposed floodplain development is for the proposal to be in accordance with a Strategic Flood Risk Assessment. The Strategic FRA, therefore, becomes an important document and the cost of

producing it to the level of robustness required for it to be credible is often not likely to be within the budget of the local planning authority. A consortium of interested landowners and/or developers could be formed to fund the Strategic FRA which would be undertaken in liaison and with the support of the local planning authority.

8.5 Local planning authority administrative boundaries pay no heed to river catchment boundaries so it will often be the case that a Strategic FRA has to cross more than one boundary and involve more than one planning authority which is clearly a potential source of difficulty. Local planning authorities within a common river catchment are well advised to work together on a Strategic FRA. It should also be checked whether a Catchment Flood Management Plan is available so that the Strategic FRA can be produced in accordance with any appropriate recommendations therein.

8.6 In order to ensure that a ''functional floodplain'' objection from the Environment Agency is avoided, it is necessary to plot the 1:10 year and 1:20 year floodplain extents as the Environment Agency's internal definition of ''functional floodplain'' is within the 1:10 year to 1:20 year range. The draft PPS25 defines ''functional floodplain'' as the area ''where water has to flow or be stored in times of flood''. As all floodplains involve the flow or storage of water in times of flood, the only descriptor which separates ''functional floodplain'' from other floodplain is the term ''has to'', the implication being that such roles of ''flow'' or ''storage'' cannot be readily re-located elsewhere. This is not an unreasonable definition, if accepted by the Environment Agency, which allows for technical solutions involving the relocation of flood storage or flood flow routes to permit development, where practicable.

8.7 While the relocation of flood flow routes is generally straightforward through the re-profiling of the floodplain and constructing of flow training works, the relocation of storage is more problematical. Flood storage compensation has to provide relocated flood storage on a ''level for level'' basis so that the relocated storage has the same effect on attenuating flood flows as had the storage lost to development. This usually requires the lowering of land which is outside of, but adjacent to, the existing floodplain. It is not possible to simply lower existing floodplain areas as this would not provide for the higher level storage in the ''level for level'' requirement.

8.8 Relocated flood storage can also be provided through other technical solutions involving storage reservoirs or flood gradient optimisation. Such schemes do not provide strict ''level for level'' storage but with a substantial 'over provision' of storage it can be demonstrated, with the use of computer modelling, that there is no increase in flood risk at the full range of flood return periods. To do this generally results in a very robust scheme which can bring a significant reduction in flood levels downstream to the benefit of any existing properties currently at risk of flooding either by reducing such existing risk or providing protection from the potential future impacts of climate change.

9. The role of the Environment Agency

9.1 Contrary to popular belief, the Environment Agency was not actually a statutory consultee in the planning process in respect of applications for floodplain development, however, within the consultation process for PPS25 there was a proposal for the Agency to become a statutory consultee. In parallel to the PPS25 consultation process there is also a proposal to give the Agency ''power of direction'' by which means the planning authority must refer to the Secretary of State any planning application that they are minded to approve contrary to sustained Environment Agency advice.

9.2 The Environment Agency does have a general supervising role in respect of flooding issues and is responsible for both provision of new flood defences and maintenance of existing defences

where appropriate. The Environment Agency has certain Acts of Parliament in the form of the Water Resources and Land Drainage Acts, including the By Laws made under such legislation, which empower it and give it duties. The Environment Agency also has its own internal policies and guidelines which it uses to apply the regulatory function in a consistent manner across the different regions.

9.3 As is often the case with a regulatory authority, the Environment Agency is resistant to change because with any change there is potential risk of adverse impacts. Generally the Environment Agency will start from a position of objection to any development proposal and will maintain such objection until all its concerns are addressed to its satisfaction. This is not an unreasonable approach on the basis that it is much easier to move from a position of ''objection'' to a position of ''non objection'' than the reverse.

9.4 In any pre-application discussions with the Environment Agency it is important to firstly establish the baseline floodplain against which impacts are to be assessed and the criteria against which the development can be planned and designed. In order to work towards a position of ''non objection'' from the Environment Agency it is often prudent to separate the technical issues from the policy issues. The technical issues can then be addressed and the Environment Agency's concerns satisfied irrespective of any policy concern, such policy issues are often a matter of interpretation. It is then a relatively simple matter for the planning officer to weight such objection in relation to other policy criteria. However, if there are outstanding technical objections, then the planning officer will be less confident in making a balanced judgement as he/she is unlikely to have sufficient technical knowledge to be able to weight the objection appropriately and so will take a precautionary approach.

10. Climate change

10.1 While it is acknowledged that the average global temperature is rising, the more detailed local impacts are less certain. In terms of sea levels, the melting ice caps and the thermal expansion of sea water is causing average sea levels to rise globally thereby significantly increasing flood risk to coastal development. However, in terms of fluvial (river) flood levels the impact is less certain but the most likely scenario is that generally there will be a reduction in annual rainfall allied to a more extreme range of weather between summer and winter. In this scenario the summers will become hotter and drier while the winters will become more prone to storms with high intensity rainfall.

10.2 The impact on flood flows and flood levels that will result from the changes in rainfall are dependent on the geology of the river catchment, the actual catchment area and other catchment characteristics that contribute to a complex range of possible scenarios. In the absence of a reliable prediction of impacts, it is appropriate to apply the precautionary principle where the impact of such potential increased flood levels is significant. It is generally the case that the impact is significant on flood defence levels and minimum floor levels but not significant on the issue of baseline floodplain used for assessment of effects of lost storage or conveyance. Therefore, the potential impact of climate change should be accommodated in the setting of crest levels for raised defences and the setting of minimum floor levels in buildings. It should not be required that the potential impact of climate change be accommodated in the baseline 1:100 year floodplain used for assessment of the proposed development impacts on floodplain storage or conveyance. This baseline leads to the design of mitigation, however, it would be prudent to model the proposed development with a climate change scenario to check that impacts are not significant.

10.3 When PPG25 was issued in July 2001 it was appreciated that confidence in respect of predictions on the potential impacts of climate change would increase over the following years and commitment

was made to review PPG25 in the light of such increases after three years. The review was carried out and the results were part of the reason for the decision to issue PPS25 to supersede PPG25. No surprise, therefore, that PPS25 does update the climate change impact predication. While the previous allowance of 20 per cent increase in flood flows to 2050 is retained, a higher allowance of 30 per cent increase is given for a second horizon of 2110.

10.4 Although not in accordance with PPG25, the Environment Agency has on some recent projects requested that the potential climate-changed floodplain be adopted as the baseline for assessment of impacts of the proposed development. Such a baseline will be the flooding extent of the 1:100 year plus 20 per cent flood, which results in a higher flood level and a greater extent than for the current 1:100 year flood. This can mean that potential development sites currently out of but adjacent to the floodplain could become either undevelopable or at least significantly constrained for development. Owners of such sites should be advised of the risks to the value and development potential that will exist as a result of adopting a climate-changed floodplain as a baseline. Such risk will only move to increase following issue of PPS25.

11. Property insurance

11.1 The current position of the insurance industry, as represented by the Association of British Insurers (''ABI''), is that a standard of protection in respect of flooding of 1:75 year is the minimum requirement for normal terms of insurance on existing buildings. Over time, as the impact of climate change takes more effect the number of properties below this standard will increase unless flood protection measures are put in place. In respect of new development the minimum requirement of the Environment Agency is 1:100 year protection in fluvial floodplains and 1:200 year in coastal (salt water) floodplains. The minimum standard required by the ABI for new developments is 1:200 year plus an allowance for climate change to 2050. These are, however, minimum standards and it is recommended that 1:1000 year standard is adopted for residential development with an allowance for the potential impact of climate change. Such a standard would effectively bring the site into the lowest of the flood risk zones (zone 1) where there is no restriction on land use in respect of vulnerability to flooding.

12. The planning application tool kit

12.1 In the planning of any proposal for development or re-development of a site, the first stage is to establish the current risk of flooding. An initial indication of flood risk can be obtained from the Environment Agency website where there are flood maps of the whole country but it should be noted that the accuracy of the mapping is variable and depends on the degree of investment in river modelling and mapping that has been made in the area.

12.2 Written application should then be made to the Environment Agency for any more recent or more specific floodplain information. There is usually a £50 charge for such information. Similar applications should be made of the local council, the sewerage undertaker, the landowner and any other relevant body or person that may hold records of flooding. Potential sources of flooding would be tidal, fluvial, surface water (pluvial) or groundwater.

12.3 Flood records are often inaccurate and in the absence of reliable information a conservative approach has to be taken which inherently means that higher flood levels and more extensive floodplains are assumed. This can result in excessive constraint of the planned development and in some cases can further result in the site being undevelopable. More reliable flood levels and floodplain

extents can be achieved through further more detailed analysis generally using sophisticated computer modelling techniques.

12.4 A detailed topographic survey of the site is a precursor to the assessment of flooding so that the recorded or predicted flood levels can be compared with the actual ground levels. Such survey must be referenced to the Ordnance Survey GPS datum as the old system of fixed benchmarks is no longer maintained and is not accepted by the Environment Agency. The survey should also be in a digital three-dimensional format so that the production of contours and cut/fill volumes, using appropriate software, can be achieved without extensive post survey conversion work.

12.5 If it is necessary to carry out local river modelling this could involve a survey of land outside the control of the developer. Firstly a check with the Environment Agency would determine whether they have a programme for river modelling in the area. However, such programmes have a tendency to slip as internal resources are managed to prioritise modelling on the basis of changing need. If modelling is planned by the Environment Agency then it may be that the survey data has already been obtained either under agreement for access or under the Environment Agency's powers. In the absence of such topographic survey there are other options available of more coarse level information in the form of Light Direction and Ranging (''LiDAR'') data which can be suitable in certain circumstances. The actual profile of the river channel below water level does, however, still require conventional survey involving access to the area.

12.6 If the Environment Agency has already modelled a river and mapped the floodplain it is likely to have been a mapping project over a wide area to produce a general planning and development control tool. In this case it is often possible to request and receive a copy of the model which can then be reviewed and refined locally to be more accurate by addition of more detail to the model. It is generally the case that the more detailed and accurate the model the lower the flood levels as certain requirements for conservative assumptions are replaced with recorded or measured data.

12.7 Once the flood level and the floodplain extents are agreed with the Environment Agency then the constraints on the planning of the development can be set. If the whole site is in the 1:100 year floodplain then it is difficult to develop as the necessary protection of the proposed development will result in lost storage and/or conveyance which can only be replaced on land currently outside of but adjacent to the floodplain. Such flood storage compensation would, therefore, have to be provided on land outside of the site.

12.8 If part of the site is in the floodplain then this area can be retained without development or the site can be reconfigured through flood storage compensation to ensure that the area most suitable for development is raised above the flood level and the same volume of storage on a ''level for level'' basis is available on the residual part of the site. This residual floodplain area should also be continuous with the main floodplain area outside of the site. As a general guide, the plan area of floodplain post-development should be at least that which existed pre-development. Any flood storage compensation should also result in improved streamlining of the floodplain or at least no obstruction of flood flow routes.

12.9 If the proposal is for redevelopment, then in any assessment of existing floodplain storage the volumes of storage are only measured outside of existing habitable buildings or other buildings which would reasonably be protected in times of flood. Garages, sheds and stables are assumed to flood and the volumes within need to count in the measurement.

12.10 In the design of the proposed development, the site should be ideally raised above the 1:1000 year flood level with minimum floor levels set at a higher level to allow for the potential impact of

climate change. If the proposed development involves building behind raised defences then the long term viability and maintenance liability of such defences would have to be investigated. The impact of a breach scenario in the raised bank would also have to be modelled to determine minimum floor levels and also to set a buffer zone behind the flood defences where flooding could be tolerated.

12.11 A further consideration in the design is that a dry access should be available in a 1:100 year flood event for at least pedestrians and preferably vehicles. In recent years, the Environment Agency policy in respect of access has evolved such that the previous policy of allowing some flooding of the access, with allowable depth being a function of the speed of flow up to a maximum of 300mm, has been superseded by a policy of dry access. However, in matters of emergency access, the Environment Agency generally makes it clear that it is not the competent authority but does have policies in this regard which are used to provide advice in the absence of any advice from the emergency services.

12.12 It is also necessary to produce at least a preliminary design of the surface water drainage system from the site. Such system should follow the principles of Sustainable Drainage (''SUDS'') whereby the regime for drainage strives to follow the pre-development regime. Such drainage systems mainly concentrate on a regime of infiltration and soakaway areas, but where soils are not suitable for such a regime then a balancing pond may be necessary. In any case it is necessary to ensure that there is not an increase in the rate of run-off over the pre-development situation.

12.13 While the technical requirements of a Flood Risk Assessment are laid out in Appendix F of PPG25, and Appendix E of PPS25 they do not include the requirement to address the pure policy related issues. However, these policy issues do need to be addressed irrespective of the technical merits of a scheme. If the site is in Flood Zone 3 and classified by the Environment Agency as Functional Floodplain (3b, PPS25) then any development proposal other than for essential infrastructure is likely to be subject to an objection from the Environment Agency. However, as the PPS25 definition of functional floodplain is land ''where water has to flow or be stored in times of flood'', if through floodplain management mitigation works there is a technical solution to relocate the storage and conveyance elsewhere, then clearly the site cannot be functional floodplain. It is likely that the Environment Agency will not accept this interpretation as it does not accord with their internal policy definition that the functional floodplain is between the 1:10 year and 1:20 year floodplain which is certainly a more extensive area.

12.14 On the basis that the site is not in the functional floodplain then it would have to comply with the requirements of the Flood Risk Vulnerability Classifications (Table D2, PPS25) permitted in the relevant Flood Risk Zone (Table D1, PPS25). This will also probably lead on to the requirement to satisfy the Exception Test. It should also be ascertained as to whether the site is covered by a Strategic Flood Risk Assessment which is already approved by the planning authority and the Environment Agency. The development proposals should be designed to comply with this and any other local planning documents which have been adopted.

12.15 The Sequential Test is gaining increasing importance and profile such that the Environment Agency will generally require it to be demonstrated that a Sequential Test has been carried out in respect of flooding and indeed that the test has been passed. This can often be a significant hurdle to leap and the degree to which the test is carried out in isolation of other spatial planning criteria (such as transport, housing, economic growth and land availability etc.) is a potential area of debate.

13. Conclusions

13.1 Flood risk is a real issue today and is likely to be more of an issue in the future as the impacts of climate change are felt with rising sea levels and potentially rising flood levels in our rivers. Some existing development in areas at risk of flooding could experience an increase in such risk and this will need to be addressed through engineered flood defence solutions in most cases and ''managed retreat'' in some coastal areas. While the increased risk is most acute in coastal areas (so that some hard decisions will have to be made in both the short and long term future), the potential for increased risk in fluvial floodplains should not result in a knee jerk reaction of prohibiting floodplain development.

13.2 Development in fluvial floodplains can be effectively protected from flooding and can be so designed as to not only avoid increased flood risk to other property but to actually reduce such risk. Effective floodplain development policy is required which enables planning authorities to prevent inappropriate floodplain development and support appropriate floodplain development.

13.3 While PPG25: Development and Flood Risk provided a good basis for effective floodplain development policy, it was open to misinterpretation especially in the main area of prescriptive guidance in Table 1 where appropriate planning responses are given for different development risk scenarios. PPG25 is based on risk management rather than risk avoidance and promotes the sound principle of linking flood risk to development vulnerability. PPG25 will be replaced with PPS25 in Winter 2006/2007. PPS25 was issued in draft in December 2005 and builds on the principles laid down by PPG25 while clarifying some of the previous areas of guidance that were open to misinterpretation. The guidance in both documents is predicated on there being residual risk after development so that permitted types of development are dictated by the flood risk zone within which the site lies prior to the development. Once the site is developed to include appropriate flood protection measures then the flood risk will change. If the whole site is raised above the 1000 year flood level then the flood risk zone will change from Zone 2/3 to Zone 1 yet with development behind raised defences the zone will not change. In either case the type of development permitted should be based on the flood risk during the lifetime of the development rather than the risk that existed prior to development, which would have then become an historical irrelevance.

13.4 The planning authorities and Environment Agency should not be concerned over floodplain development which is technically robust and contributes to overall sustainability aims even though it may not accord with their interpretation of elements of PPS25 or other internal policies. As floodplain development can actually bring local reductions in flood risk by contributing to strategic flood relief schemes, such development should be seen as positive and can help bridge the gap in Government funding for flood relief in areas currently at risk.

13.5 In some cases floodplain development can be seen as part of the solution to addressing the potential impacts of climate change rather than being part of the problem.