

# *Flood Risk Action Groups*

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## Mechanisms of Flooding Report

An Independent Report on the Cause of Flooding Along the River Thames  
Between Hurley and Teddington in January 2003

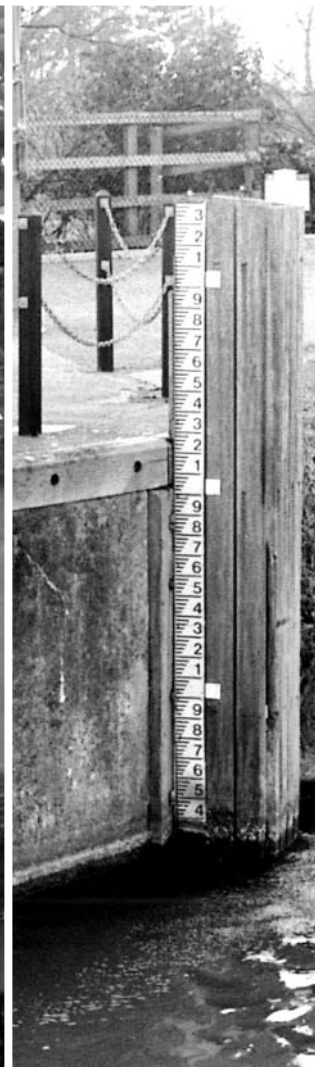
**By the Mechanisms of Flooding Subgroup on behalf of the FRAGs**

Independent Chairman: Clive Onions

INTRODUCTION

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# *Flood Risk Action Groups*

## **CLIVE ONIONS, BSc, CEng, MICE, MStructE, MCIWEM, MIHT FRAG Independent Chairman**

Clive Onions is an Associate Director with consulting engineers Arup, with whom he has worked since Graduating in 1975. He has been involved in Civil Engineering for over 29 years generally advising Developers on site appraisals, masterplanning their development and advising on detailed design and contract administration of projects. In recent years he has devoted more time to water engineering and has been involved in many Flood Risk Assessments and Sustainable Drainage design, involving innovative drainage solutions to minimise the impact on the environment.

Clive has been active in the Institution of Civil Engineers (ICE); he has been Programme Secretary for the South-Western Association for 14 years, Chairman of the South-Western Association, a Member of the ICE National Council, Member of ICE Benevolent Fund Committee and is currently a Member of the ICE Water Board Committee. He is also currently active on the ICE Local Branch Committee for Avon. He is a Member of the Construction Industry Research and Information Association (CIRIA) Project Steering Group which is producing a national guide for sustainable drainage techniques. As a diversion, Clive is also Chairman of the Board of Trustees for a small film editing company in Bristol, which is a publicly funded charity to assist people who wish to develop a career in film.

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Risk  
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**INTRODUCTION, CONCLUSIONS & RECOMMENDATIONS**

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## 1. LIST OF MECHANISMS OF FLOODING SUBGROUP MEMBERS

<u>Name</u>	<u>Representing</u>
Clive Onions	Independent Chairman
Simon Lavin	Royal Borough of Windsor & Maidenhead
Cllr Jesse Grey	Royal Borough of Windsor & Maidenhead
Ian Thompson	ThamesAwash
Bill Markham	ThamesAwash
Colin Candish	Environment Agency
Bill Ellison	Environment Agency
Michael Morgan	The Upstream Group (TUG)
Geoffrey Payne	Rivers Thames Society
Paul Holmes	Water Resource Associates (TUG)
Keith Ward	Elmbridge Borough Council
John Godden	Runnymede Borough Council
Cllr Mrs Vivienne Leighton	Spelthorne Borough Council
Richard Reading	Spelthorne Borough Council
Peter Taylor	Thames Water
<i>In Attendance:</i>	
Graham Barton	Environment Agency
Ian Tomes	Environment Agency

## 2. LIST OF FLOOD RISK ACTION GROUP MEMBERS

### FRAG 1 Hurley to Wraysbury FRAG Members

Clive Onions	Independent Chairman
Craig Woolhouse	Environment Agency
Colin Candish	Environment Agency
David Lunn	Royal Borough of Windsor & Maidenhead
Cllr Donald Gregory	Royal Borough of Windsor & Maidenhead
Cllr Eric Wiles	Royal Borough of Windsor & Maidenhead
Cllr John Iles	Royal Borough of Windsor & Maidenhead
Cllr David Ricardo	Royal Borough of Windsor & Maidenhead
Cllr Mrs Cubley	Royal Borough of Windsor & Maidenhead
Cllr Jesse Grey	Royal Borough of Windsor & Maidenhead
Cllr Nick Binns	S. Bucks District Council
Richard Powell	Wycombe District Council
Cllr Bill Jennings	Wycombe District Council
Cllr Bob Woollard	Bucks County Council
Jim Stevens	Bucks County Council
Dai Brogden	Bucks County Council
PCLlr Mike Smith	Chairman Community Support Group (South)
Red Gallagher	Chairman Community Support Group (North)
Cllr Chris Bertram	ThamesAwash
Simon Miller	The Upstream Group
Michael Morgan	The Upstream Group
Val Mason	River Thames Society
Peter Taylor	Thames Water
<i>Support</i>	
Abigail Brooks	Environment Agency
Graham Barton	Environment Agency
Cathryn Bullimore	FRAG Public Relations Advisor
Ian Hunt	Royal Borough of Windsor & Maidenhead

### FRAG 2 Wraysbury to Teddington FRAG Members

Clive Onions	Independent Chairman
Craig Woolhouse	Environment Agency
Colin Candish	Environment Agency
Cllr Gordon Chubb	Elmbridge Borough Council
Keith Ward	Elmbridge Borough Council
Geoffrey Payne	River Thames Society
Cllr Geoffrey Woodger	Runnymede Borough Council
Cllr Relph	Runnymede Borough Council
John Godden	Runnymede Borough Council
Karen Satterford	Spelthorne Borough Council
Cllr Frank Davies	Spelthorne Borough Council
Cllr Vivienne Leighton	Spelthorne Borough Council
Nigel Lynn	Spelthorne Borough Council
Richard Reading	Spelthorne Borough Council
Bob Moodie	Surrey County Council
Councillor Jim Maxwell	Surrey County Council
John Pollen	Runnymede Community Liaison Group Chairman
	/ThamesAwash
Andrew De Bell	Thames Water
<i>Support:</i>	
Abigail Brooks	Environment Agency
Graham Barton	Environment Agency
Cathryn Bullimore	FRAG Public Relations Advisor

**FRAG 3**

**Chertsey Bourne FRAG Members**

Clive Onions	Independent Chairman
Ian Tomes	Environment Agency
Colin Candish	Environment Agency
Cllr Chris Norman	Runnymede Borough Council
Cllr Mrs Sarah Jacobs	Runnymede Borough Council
John Godden	Runnymede Borough Council
Bob Moodie	Surrey County Council
Cllr Ray Lowther	Surrey County Council
Peter Taylor	Thames Water
Malcolm Loveday	ThamesAwash /Chertsey Society
Rob Nason	Thames Water
Derek Cotty	CLG Chairman
Jerry Marsh	Surrey County Council
<i>Support:</i>	
Abigail Brooks	Environment Agency
Graham Barton	Environment Agency
Cathryn Bullimore	FRAG Public Relations Advisor

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## **VOLUME 1      MAIN REPORT**

### **Chapter 1 - Introduction and Scope**

#### **1.1      Setting the Scene**

For many many years land and property near the River Thames has suffered from serious flooding. In response to this problem the river authorities of the time have developed various plans for flood defence schemes. In 1992 the National Rivers Authority (NRA) promoted the latest major scheme, the Maidenhead, Windsor and Eton Flood Alleviation Scheme (MWEFAS) through a Public Inquiry. The Secretary of State for the Environment subsequently granted approval and acknowledged that there would be a detriment downstream, the effect of which was predicted to raise flood levels by up to 40mm above their natural peak level in the Old Windsor area, diminishing with distance downstream. A substantial part of the scheme is the Jubilee River, an 11.6km flood relief channel to the north-east of the natural River Thames, with a design capacity of 215m<sup>3</sup>/s. The Jubilee River was officially opened in June 2002.

During the very wet autumn of 2002 flows were satisfactorily diverted into the Jubilee River amounting to some 15% of its capacity.

During the period 28<sup>th</sup> December 2002 to 1<sup>st</sup> January 2003 heavy rain occurred on a saturated catchment with already swollen rivers. As a consequence the River Thames' flows increased to the trigger level set for the operation of the Jubilee River. The approximate maximum flow diverted into the Jubilee River was 144m<sup>3</sup>/s during the peak of the event on 5<sup>th</sup> January 2003. The scheme successfully protected the Maidenhead, Windsor and Eton areas, subject to minor basement flooding, and the Environment Agency estimates that at least 1,000 properties were saved from flooding by the MWEFAS scheme. However, there was serious flooding downstream of the Jubilee River, with approximately 128 properties suffering internal flooding, many of which were in the Ham Island and Wraysbury areas, but other riverside areas were also affected. Approximately 500 properties were flooded by the River Thames and its tributaries between Oxford and Teddington. This figure also includes properties flooded from the Chertsey Bourne, the cause of which is outside the scope of this report. The flooding caused widespread disruption to traffic, electricity supplies and day-to-day activities and businesses.

The flooding occurred over the New Year period, when some residents were away on holiday. Temperatures also fell rapidly after the rain, causing some freezing of the floodwater, adding to the practical difficulties to be overcome by people. There is no record of anyone being seriously injured or killed as a result of the flooding, but it has caused extreme hardship to many people, some of whom have still not returned to their homes 15 months after the event.

It is widely recognised that this was an extreme event and that flooding was inevitable. Records confirm that River Thames water levels were the highest since 1947. However, since the time of the Public Inquiry, people have suspected that the MWEFAS scheme, in protecting Maidenhead, Windsor and Eton, would exacerbate flooding downstream.

The Environment Agency, held public surgeries soon after the event, to consult with residents and inform them of the role of the Jubilee River, in an attempt to prove to people that the MWEFAS did not significantly affect the extent of flooding. The strong feeling caused by the flooding resulted in calls for a Public Inquiry, but the Minister determined that there were no grounds for such an Inquiry.

However, the Local Authorities and the Environment Agency agreed to set up the Flood Risk Action Groups (FRAGs) as a response to the public demand for independent scrutiny. The purpose of the Inquiry was to investigate the causes of flooding, and to seek to establish the truth with regard to whether the Maidenhead, Windsor and Eton flood alleviation scheme made flooding worse.

This report follows the Independent Inquiry into the event, and results from a wide consultation process involving many people from the community and their representatives. I return to the benefits of the Independent Inquiry process in the final Chapter, 'Conclusions and Recommendations'.

## **1.2 Independent Chairman**

I was appointed Independent Chairman in May 2003. My first activity was to visit some of the areas affected by flooding in January 2003, and I met many people whose homes had flooded. Many of the houses were easy to identify because they still had skips in the front gardens where restoration works were continuing. The conversations I had helped to focus my mind on the emotions and hardships people had gone through and were still going through as a result of their homes being flooded.

Since this time I have met many more residents, particularly in the Datchet, Ham Island and Wraysbury areas, and listened to their concerns so that I could try and address these in my report. All the people I have met have been polite and courteous, despite the obvious stress they are under, and their justifiable concern about the risk of flooding in the future.

I am not from the Lower Thames area and so I have had to familiarise myself with the geography, the river and the communities, as well as to understand the roles of the Stakeholder Groups such as ThamesAwash, The Upstream Group (TUG) and the River Thames Society. I have devoted considerable time to engaging with these organisations.

## **1.3 Flood Risk Action Groups (FRAGs)**

I set up the membership of the FRAGs, with assistance from the Environment Agency and Local Authorities, to include representatives of the Environment Agency, Local Authorities, Thames Water and Stakeholder Groups. I was anxious to ensure a wide representation, but also concerned to limit the size of the groups to ensure the business could be managed effectively. I decided not to make the meetings public, so that people could speak freely and agree a structured release of information.

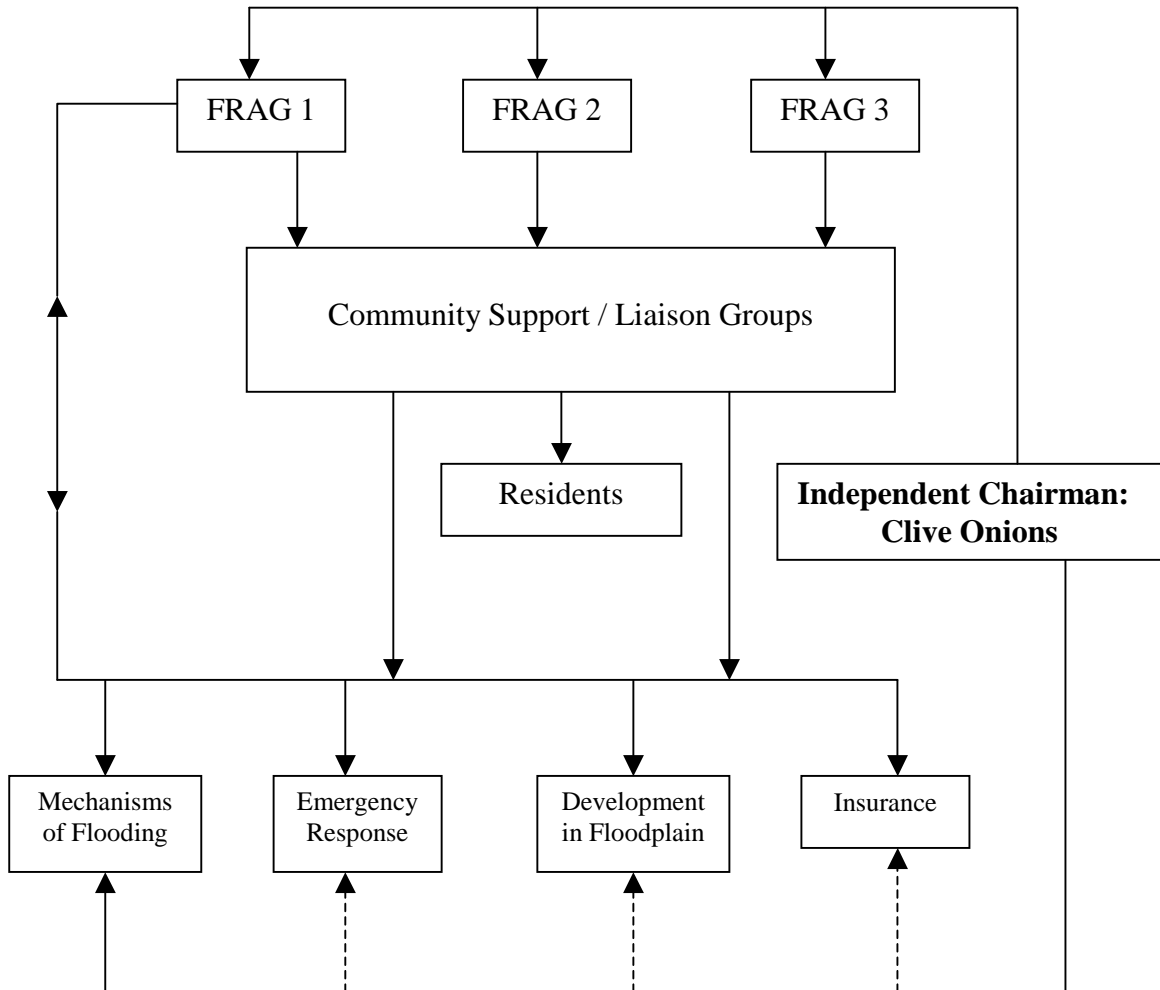
There are three FRAGs; two groups cover the River Thames (Hurley to Wraysbury, and Wraysbury to Teddington), and the third group deals with the area of the Chertsey Bourne, a tributary of the Thames.

All three groups are independently chaired by myself.

The FRAGs were created to establish the cause of flooding during the January 2003 floods, to learn any lessons, to ensure that the authorities work together more effectively in the future and to deliver an action plan to minimise future flood risk in the FRAG areas. The Terms of Reference for the Hurley to Teddington FRAGs can be found in Appendix 1.

The FRAGs also set up Community Support and Liaison Groups (CSGs/CLGs) made up of representatives from the riverside communities. The role of the CSGs is to gather local information for the FRAGs, and to disseminate information to the communities. (See FRAG Organisation Chart). The FRAGs also have a Public Relations advisor, who prepares Press Releases on behalf of the FRAGs and encourages wide dissemination of the information.

### FRAG Organisation Chart



At their early meetings the FRAGs agreed that the main areas of concern fell under the following four headings:

- i. The Cause of Flooding;
- ii. Development in the Floodplain;
- iii. Emergency Response; and
- iv. Property Insurance.

Four Subgroups were set-up to progress each of these issues. This report deals with the cause of flooding. It is planned to issue a separate summary of the activities of the other Subgroups in due course.

Through the FRAG meetings I have encouraged contributions from members, and many wide ranging issues have been discussed and many actions have been achieved. These resulted in many useful technical and information papers being prepared by the Environment Agency, Local Authorities, County Councils and Thames Water. These can be viewed on the FRAG website ([www.frag.org.uk](http://www.frag.org.uk)).

#### **1.4 Background to Mechanisms of Flooding (MoF) Subgroup**

The two FRAGs which cover the River Thames decided that their terms of reference were to understand and agree the cause of flooding, especially in relation to the role of the Jubilee River.

The FRAG Members agreed that I should form a 'Mechanisms of Flooding' Subgroup and produce a report on the January 2003 floods. I invited a representative cross-section of the organisations in the area covered by the Thames FRAGs to join the Subgroup, and I selected technical and non-technical members.

I asked the members of the Mechanisms of Flooding Subgroup to gather questions from their communities and organisations to make the report comprehensive. The data and evidence has been scrutinised, maps updated, and the members of the Subgroup have contributed significantly to the production of this report. Many staff from the Environment Agency have been involved in assembling the factual information. I have also met with residents in the area to learn first-hand about their experiences and concerns to supplement the technical information, and I have travelled the river between Bell Weir and Windsor Weir.

#### **1.5 Purpose of the Report**

The Subgroup agreed that the report should:

- Describe the river catchment conditions and rainfall as background to the 2003 floods.
- Compare the 2003 (post-Jubilee River) events with the 2000 (pre-Jubilee River) events in terms of the amount and distribution of rainfall.
- Describe where and how flooding occurred on the Thames during the 2003 event.
- Analyse flood levels in the River Thames during the January 2003 floods and compare them with key historical flood events on the Thames, particularly, the 2000 event.
- Scrutinise the influence of the Jubilee River on the January 2003 event.
- Address other key issues such as groundwater and dredging.
- Provide an independent assessment of the cause of flooding, with conclusions and recommendations.

It was always intended that this report would look back at the January 2003 floods to explain what happened and why, even though some remedies may have been identified at a local level during the course of this work. However, I am keen to set the tone for the future whilst concluding investigations into that flood event. To this end I have drawn out recommendations from the conclusions of each chapter in order to indicate where progress might be made. Although all these issues are not findings from the report, they demonstrate the next steps towards reducing and better managing flood risk in the FRAG area.

There have been suggestions that the Chapters could be re-ordered, and that information could be moved about within the report. There is also some repetition, which reflects the range of contributors to the report, and to a certain extent, trying to explain the technical level of some aspects. I give no apology for this; there has been pressure from many people to urge the release of the report, and pressure from others to ensure it is delayed to ensure it is comprehensive. I made the decision on the completion date, and I am satisfied that it's scope and conclusions meet the objectives set.

## **1.6 Summary of Report Chapters**

### **Chapter 2 – Overview of 2003 Flooding**

This Chapter describes the extent of the 2003 flood, mainly by reference to the Flood Envelope Maps which are contained in Volume 4 of this Report. It also includes a schedule of short reports on discrete incidents of local flooding which are contained in Volume 3 of this Report. The Chapter notes that revisions of the mapping details may continue to occur, and includes a brief description of the quality assurance criteria that have been applied in the compilation of the 2003 Flood Envelope Maps.

### **Chapter 3 – Sources of Data**

The Environment Agency gathered information about the 2003 flood from a wide range of sources, including reports from members of the public, Local Authorities and its own staff during the event, as well as aerial photography, permanent river gauges, lockkeepers' records, rainfall gauges, etc. This Chapter describes these sources and how the information is gathered. It also refers to Soil Moisture Deficit, a measure of the level of saturation of the soil which affects the way in which rivers respond to rainfall.

### **Chapter 4 – Antecedent Weather and Catchment Conditions**

The impact of rainfall on flows in the River Thames depends on how much rain has fallen, how wet the soil was beforehand, the flow in the river etc. This Chapter first identifies the extent of the catchment area upstream of the worst affected locations on the River Thames. It then examines the autumn rainfall amounts and soil moisture levels prior to the 2003 flooding, and compares them with the conditions preceding the December 2000 event. It investigates the difference between the two events in the light of the perception that the overall rainfall was greater in autumn 2000, although the impact was significantly worse in January 2003. This Chapter also emphasises that the day-by-day rainfall pattern is more significant in this respect than monthly or quarterly rainfall accumulations.

### **Chapter 5 – Thames Flood Levels in Historical Perspective – Charts**

This Chapter puts the 2003 flood into historical perspective by comparing January 2003 peak levels with levels reached in other floods that have occurred since 1890. This comparison is undertaken for a representative sample of about one third of all the locks on the River Thames, and shows how the severity of the 2003 flood varied in different locations along the river.

## **Chapter 6 - Thames Flood Levels in Historical Perspective – Regression Analysis**

This Chapter describes how the statistical technique of Regression Analysis can be used to analyse the Environment Agency's historical records of flood level data. The analysis establishes a simple and reasonably reliable mathematical relationship between peak flood levels at two different locations, one upstream of the Jubilee River and one downstream. This Chapter then investigates how closely the actual 2003 peak level matches the level predicted by this relationship, and repeats the process for three other locations downstream of the Jubilee River. This analysis can be expected to reveal any anomalies in the 2003 flood levels that might have arisen as a result of the operation of the Jubilee River. A discussion of the technique is included in an associated Appendix.

## **Chapter 7 – Distribution of 2003 Peak Levels Along the River Thames**

This Chapter brings together level information taken at the locks, and compares the differences between the 2000 and 2003 peak levels for all the Thames locks between Lechlade in Gloucestershire and Molesey in Surrey. The comparison shows that 2003 levels exceeded 2000 levels in nearly all locations on the River Thames. However, the size of the difference in level varies along the river, and the reasons for this are discussed in the context of flood level data from other historical floods..

## **Chapter 8 – Time Line Chart, September/October 2002 to January 2003**

This Chapter uses charts to provide visual illustrations of the way in which the 2003 flood developed over time, with reference to rainfall, catchment conditions, river flows and levels, and the river control measures used by the Environment Agency; comparative charts relating to the 2000 flood are also included. Further charts show how the timing of the issue of flood warnings in December 2002 and January 2003 related to the onset of flooding in different Thames-side locations.

## **Chapter 9 – Influence of MWEFAS / Jubilee River**

This is the largest Chapter in this Report, and contains five separate sections. The first is a factual description of the main features of the Maidenhead, Windsor & Eton Flood Alleviation Scheme (MWEFAS), with particular reference to the Jubilee River. This is followed by a section describing the Scheme operating procedures that have been developed by the Environment Agency, with particular reference to Taplow Weir gates. This section also describes how the Scheme was actually operated during the 2003 flood, and how the operating procedures have subsequently been reviewed and revised.

The third section has been contributed by Jacobs, the Environment Agency's Consultants who have carried out much of the recent mathematical modelling work on the River Thames. This section describes mathematical modelling in general and its application to the MWEFAS in particular, and includes the results of comparing the modelled simulation of the 2003 flood with the imaginary situation of the same flood occurring but without the MWEFAS in operation. It also compares the modelled increase in water levels resulting from the 2003 flood with the predictions presented to the 1992 Public Inquiry.

The fourth section provides an overview of the hydraulic principles applying to storage of floodwater in the floodplain, and discusses how the reduction in floodplain storage as a result of the MWEFAS affects the flow in the river. The final section is a discussion of the general use of different types of models – physical, mathematical and others.

## **Chapter 10 – Groundwater**

This short Chapter notes that, because of the complexity of interaction between groundwater, surface water and river water, it is very difficult to quantify the extent of groundwater flooding. It also notes that the current legislative framework does not identify clear roles and responsibilities with regard to groundwater flooding, and that this situation is currently being reviewed by Defra.

## **Chapter 11 – Dredging**

This Chapter describes the background and history of dredging of the Lower River Thames, and contains extensive details of the current legislative situation as it affects dredging practice. Several problems and uncertainties are identified, including issues such as the accuracy of survey techniques, the practicality and cost of the disposal of dredged material, the environmental impacts of dredging, and the need for extensive research in order to establish whether future large-scale dredging would be economically justifiable. This Chapter ends by noting that the Environment Agency is continuing to work towards resolution of these issues.

## **Chapter 12 - Frequently Asked Questions (FAQs)**

This Chapter is in two sections: Section 12(a) refers to elaboration of questions related to matters raised in the report. Section 12(b) refers to other questions that have been received by myself or the EA that are about topics not covered in the report.

## **5. CONCLUSIONS & RECOMMENDATIONS**

The individual chapters of the report contain detailed conclusions. Here I have brought together the key strategic Conclusions with my Recommendations on matters of public interest.

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## 1. Public Inquiry versus Independent Chairman

I know that after the flooding event of January 2003, there were many calls for a Public Inquiry and there are still calls for a Public Inquiry. I have considered this carefully because I think it is important that people are as reassured as they can be that this process has been conducted professionally and that it gives people the reasons for the flooding, as well as guidance on future steps. I recognise that for many people the realisation that they live in a flood sensitive area has affected the cost of their insurance and saleability of their houses. Although many people enjoy the spectacular views and changing scenery of the river, those living on streets away from the river bank have also suffered and were not in a position to observe the river rising and have good visual warning of the arriving flood.

The Minister ruled out a Public Inquiry into the January 2003 floods, but agreed to independent scrutiny led by an Independent Chairman to respond to the public on the activities of the Environment Agency, Local Authorities, Thames Water, etc.

I have made some enquiries into the difference between a Public Inquiry and Independent Inquiry, and I am all too aware of some recent Public Inquiries that have not lived up to public expectations.

I therefore contacted the Council on Tribunals, which is the organisation that advises 'the Lord Chancellor on procedural issues arising in the conduct of Public Inquiries set up by Ministers'. Following the report into his enquiry into 'Exports of Defence Equipment to Iraq' published on the 15<sup>th</sup> February 1996, Sir Richard Scott gave a report to the Lord Chancellor on the procedures and observations to be taken into account when major Public Inquiries are set in future.

I quote from 'Terms of Reference':

### *Clause 5.19*

*As indicated in paragraph 5.3 above, the Inquiry's terms and references will require careful consideration from the outset. Notwithstanding that there may be some pressure, healthy in a democratic society, for a full Public Inquiry, care should be taken to ensure that the terms go no wider than is necessary to fulfil this specific need which the Minister has in mind when setting up the inquiry. If the terms of reference are too wide, this may result in unnecessary cost and delay, and may introduce questions which merely confuse the essential issues.*

### *Clause 5.20*

*Consideration could be given to incorporating within the terms of reference any specific requirement that the Minister wishes to see fulfilled, for example, the making of recommendations, the provision of a summary of conclusions, or a target date for completion. Even if these matters are not incorporated in the terms of reference, they should be addressed at the outset in discussion with the inquiry chairman, and should be the subject matter of an announcement.*

At the early FRAG meetings I invited all FRAG Members to advise me what the important issues were to the communities they represented, and the four headline issues mentioned in the introduction were raised:

- i. The Cause of Flooding;
- ii. Development in the Floodplain;
- iii. Emergency Response; and
- iv. Property Insurance.

At each FRAG meeting I allowed Members to raise any issues they had concerning those they represented, and they were addressed or are still being addressed by the organisations responsible, e.g. Environment Agency, Thames Water, Local Authorities and importantly the local community. The FRAG process has brought a great deal of local knowledge to the forefront and has resulted in short term improvement works and co-operation between the Local Authorities and the Environment Agency in clearing watercourses. It has also allowed discussion and a wider understanding of riparian responsibilities, enforcement issues and flood wardens, which are part of the wider picture, but are nevertheless very important aspects in the management of flooding.

Opinion:

In my opinion the FRAG process has engaged a large number of local people resulting in this comprehensive report. At the same time, the Flood Risk Action Groups have been able to address pressing 'on the ground' matters, such as improvement works and emergency response planning, without waiting for formal recommendations from a Public Inquiry. Their work has also raised wider awareness and understanding of flooding issues and responsibilities.

I believe that this combination of local engagement, 'on the ground' works and the completion of an independent investigation has been of greater benefit overall than the narrower remit of a Public Inquiry. I am confident that most importantly the true cause of the flooding has been established.

This report deals with the cause of flooding. It is planned to report separately on the other three headline issues in due course.

## **2. Sources of Data**

History tells us that after most major floods there is a review of some kind to investigate the causes and identify any lessons learned so that appropriate action can be taken (e.g. Easter 1998, Autumn 2000, Lewes). As part of my review I have investigated the adequacy and reliability of measuring equipment on the River Thames. I am informed that the River Thames is one of the most 'measured' rivers in the country, with a large concentration of flow gauging stations, and water level measuring equipment at every lock. In January 2003 some key measuring instruments failed to give continuity of reliable information through the critical stage of the flood peak. The Jubilee River is operated in relation to flows, so when these gauges are seen to have problems, the public's suspicions are aroused, as they are in this case. The report details the reasons for the measuring equipment failures and I understand that the Environment Agency has remedied these faults and has taken steps to minimise the risk of future failures.

Opinion:

The FRAG process has demonstrated the public desire and need to understand exactly what happened and why, so that lessons can be learned and changes made either to the infrastructure or the management processes. I believe it is difficult for large organisations to empathise with this feeling. Missing information is usually interpreted by the public as 'hidden information', and treated with deep suspicion.

Although the public may perceive that the organisations involved have been slow and unwilling to provide information, I am satisfied that the Environment Agency and other organisations have striven to deal with all requests in a timely manner. I am also satisfied that there have been no attempts to withhold information that has been requested through the appropriate channels. The vast majority of this information has been accurate. However, there has been an instance where erroneous information has been issued which is described in Conclusion 9a. In addition it is difficult for people to know what information is available, and therefore what to request.

I am satisfied that there are sufficient gauges on the River Thames to enable the Environment Agency to adequately manage the infrastructure provided that the equipment works effectively at all times.

Recommendations:

- i. All measuring equipment to be checked regularly, to verify its calibration, operational range, general functionality and reliability, particularly in an extreme event;
- ii. The Environment Agency to make available its policy on maintenance;
- iii. Information issued by all organisations must be checked and accurate and sent through the appropriate channels; and
- iv. All information requests should be addressed directly to the relevant area offices (e.g. not from Lock and Weir Keepers).

### **3. Antecedent Weather Conditions**

There have been many comments to the effect that there was more rainfall in Autumn 2000 than there was in 2003, so why was the flooding worse? The response of a river to rainfall is very complex. It is a function of how much, when, the ground and river conditions, direction of the wind, distribution of rain throughout the catchment, etc.

Opinion:

I am satisfied that the conditions as described above, prior to the 2003 event, were significantly different from those in 2000 for the River Thames. This resulted in greater flows and the subsequent flooding. In addition, I am confident that the conclusions of the report are not invalidated in any way as the rainfall figures are based upon records for 92% of the catchment.

Recommendation:

- i. The Environment Agency should ensure that all rainfall information is collated and archived in a timely manner.

### **4. The 2003 Event in an Historical Perspective**

Based on comparison with levels recorded over the last 110 years there is absolutely no doubt that this was a significant event – in Reading it was only exceeded by the 1947 and 1894 events. In the Marlow – Bell Weir area it ranked in the region of eighth - eleventh worst since 1890. I am therefore satisfied that this was an extreme natural event and flooding was inevitable.

### **5. Regression Analysis**

Regression analysis is a recognised statistical approach using factual information. In this analysis I have been able to draw upon approximately 120 years' records of actual flood levels at Thames locks to demonstrate the relationships between flood levels at different sites.

Opinion:

The results confirm that there is no evidence that the Jubilee River made a significant difference to levels either upstream or downstream. This analysis also confirms that this was a serious event. It demonstrates that levels were significantly reduced along the length of the River Thames protected by the Jubilee River.

## **6. Management of the River Thames Weirs (excluding Taplow)**

The Environment Agency uses the dedication, skills and knowledge of the lock and weir keepers to manage river levels. All River Thames weirs were fully drawn by 1<sup>st</sup> January 2003 compared with the time of the peak of the flood occurring on 5<sup>th</sup> January. Concern has been expressed about the late operation of Romney weir in particular, and I have frequently been asked why the River Thames levels cannot be lowered in advance of a flood through early operation of the weirs. In addition, people have expressed concern about the rapid rise and fall in water levels.

### Opinion:

I am satisfied that the operation of the weirs had no adverse effect on the peak of the flood, nor could they have been used to influence the peak. In response to questions I have been posed:

- (a) The weirs could not have been used to pre-lower the water level and reduce the effect of the peak.
- (b) The rapid rise in water levels resulted from rapidly increasing flows which themselves were due to the rainfall intensity and distribution.
- (c) Although Romney weir was the last to be fully opened this had no effect on the peak flows or levels of the flood.

### Recommendation:

- i. The Environment Agency should consider methods of improving communication with external parties regarding the operation of the River Thames weirs, particularly in times of high flows.

## **7. Flood Forecasting**

The Environment Agency uses many sources of information including Met. Office forecasts, rainfall radar, telemetered rain gauges, Soil Moisture Deficit, river flows and river levels to inform flood forecasting. This information is assimilated at the Environment Agency's Flood Forecasting Centre in Reading, and using various forecasting methods, predictions of river flows and levels are made. These are communicated to the Area Office at Frimley and are used to assess the need to issue Flood Warnings. The Environment Agency is preparing a sophisticated model of the River Thames to improve forecasting.

### Opinion:

It is my opinion that, given the level of flood risk in the Lower Thames area, the current Flood Forecasting capability is inadequate. However, forecasting River Thames flooding is a very complex issue requiring a high level of technical sophistication.

### Recommendations:

- (a) The Environment Agency to expedite preparation of River Thames flood forecast model.
- (b) The Environment Agency to ensure that flood forecasting is effectively linked to warnings.

- (c) I am conscious of the difficulty of conveying the severity of a flood event. The normal international convention is to use return period, e.g. 1 in 20 years (or 5%), which is a difficult concept to grasp – it serves more as a record for statistics. The Environment Agency could consider research into an alternative method to be used in predictions, such as the Beaufort scale is for winds.

## **8. Flood Warnings**

The Environment Agency has nationally set guidelines for issuing warnings under the headings: Flood Watch; Flood Warning; Severe Flood Warning; and All Clear, (see Appendix 12). The Environment Agency has a commitment to provide a minimum of two hours warning, prior to flooding affecting property. During the 2003 flooding the Environment Agency's website failed and I am told by some people that they did not receive any warning. It is clear that those people who are at risk of flooding need the maximum possible warning, to make all the arrangements to minimise impact, such as moving cars, clearing garages and moving furniture and other belongings, organising pumps, etc. The flood warning system is not set up to convey information on the likely extent of flooding. I understand that some of those who were flooded have now registered with the Environment Agency's Automatic Voice Messaging (AVM) system to receive warnings of future floods.

### Opinion:

Although it is a matter of record that the Environment Agency met its target standard for issuing flood warnings by some margin, including the AVM system, many people did not receive warnings. The Environment Agency devotes considerable funds towards improving flood warning and holds annual awareness campaigns. Of the 20,000 people at risk of flooding in the FRAG area, only 3,000 are registered. The fact that many people who were flooded in 2003 have subsequently registered with the AVM system illustrates its value to people. It should be noted that although properties within the Indicative Floodplain Map areas are alerted to the AVM system, properties immediately outside this area may not be immune from flooding in very extreme events.

### Recommendations:

- (a) The Environment Agency encourages people to receive Flood Warnings via the AVM system. This effort should continue in order to maximise the number of people benefiting from the service.
- (b) The Environment Agency to expedite the release of their new multi-media warning system.
- (c) Flood Warnings should be issued as early as possible and include as much information as possible on the likely extent and severity of flooding.
- (d) Community organisations to encourage residents to register with the AVM.

## **9a. Jubilee River - Operation and Impacts**

There is no doubt that the Jubilee River and the Maidenhead Windsor and Eton Flood Alleviation Scheme (MWEFAS) prevented many properties from flooding in these locations.

I have devoted a considerable amount of time to learning about the concerns people have about the behaviour of the flood, obtaining the factual information from the Environment Agency's records and assessing the modelling. My key objective has been to determine if more flooding occurred due to the operation of the Jubilee River, than would have occurred if it had not been used. The key area I have investigated is that between Romney and Bell Weirs, i.e. the areas affecting Datchet, Ham Island and Wraysbury. Conclusions drawn from the impacts of the Jubilee River on flooding in these areas can be applied downstream.

I have obtained the lock and weir keepers signed records for the operation of Taplow Weir, inspected the actual and modelled level records along the River Thames and the Jubilee River and inspected the hydrographs at Taplow Sluice and Maidenhead Bridge.

In February 2003, the Environment Agency issued a table of weir gate movements and estimated flows for Taplow weir to assist in the understanding of the flood event. Subsequently this information was circulated and has been the basis of much debate. I have obtained the original tackle sheets for Taplow weir to compare with the information sent out in February 2003. This demonstrates that the information circulated and still being issued in February 2004 was incorrect. The erroneous table of February 2003 stated that 32m<sup>3</sup>/s was diverted at 23.45 on 4<sup>th</sup> January 2003, whereas in reality approximately 10m<sup>3</sup>/s was diverted into the Jubilee River at this time. The table is also misleading by indicating that when the Taplow weir opens it diverts a specific flow. The flow varies with the head of water, and because of dynamic effects, takes time (e.g. approximately 30 minutes) to reach a stable flow. This has been observed during a recent demonstration to myself and several members of the MoF Group, Local Councillors and FRAG members.

#### Opinion:

After considering all this information in minute detail, satisfying myself that the latest records are reliable, and studying the modelled and actual levels, I conclude that the operation of the Jubilee River did not increase levels by more than 2-3 mm at or below the confluence. The effects of the last movement of the Taplow Weir reached Old Windsor in the early hours of 5<sup>th</sup> January. The peak of the flood in this area occurred some 12 hours later during the evening of 5<sup>th</sup> January. For further details see the relevant chapter in the main report.

Many people have reported seeing 'waves' or rapid changes in the water level. I was not there to personally observe the effect nor have I seen any photographs to illustrate this effect. I therefore have to rely on factual information. The level graphs all look as they should; I cannot see any abnormal peaks. It may be that local waves occurred naturally due to overland flows or possibly actions by people/emergency services releasing areas of flooding or removing blockages. However, there is no evidence of anything abnormal occurring, or that the Maidenhead, Windsor and Eton Flood Alleviation Scheme played a role in producing this effect.

#### Recommendations

- (a) Environment Agency to ensure that clear, precise records are maintained of all operations of Taplow Weir. These should be kept in an appropriate location with other lockkeepers' records for easy reference.
- (b) Taplow Weir gate operation to be based on information from the Maidenhead flow gauge.
- (c) My review of the information has highlighted the importance of managing the Taplow weir carefully. Environment Agency to review and amend operating instructions to ensure that diversion of flows into the Jubilee River are small and frequent rather than in big steps, and avoided near the peak if possible.

- (d) Environment Agency to consider installing CCTV or to obtain professional video records at Taplow and particularly at the confluence (which was apparently inaccessible during the floods), to record the effects in future floods. The locations to be agreed with community representatives.

### **9b. Jubilee River - Floodplain Issues**

Many people have drawn the conclusion that the protection of the floodplain around Maidenhead must have transferred more floodwater downstream and exacerbated flooding accordingly. It is the Environment Agency's policy to rigorously protect the floodplain, in accordance with Planning Policy Guidance (PPG 25). The Environment Agency has explained that by diverting flows down the Jubilee River, water that would have been stored in the floodplain is discharged before the natural flood peak, and hence does not exacerbate flooding downstream.

#### Opinion:

I have investigated this carefully and I am satisfied that there is no evidence that the peak of the 2003 flood was any more than 2 - 3mm higher, and there are good reasons to explain that this is the case.

### **9c. Jubilee River - Condition**

During the course of the FRAGs there has been considerable concern expressed about the Jubilee River's performance during January 2003. Since then:

- £1.9M has been spent on repairs during 2003 to remedy serious erosion
- Doubts have been expressed about its flow capacity
- Most recently, doubts were expressed about the design and construction of the banks, particularly at Datchet.

#### Opinion:

I have treated this as a separate issue, but this report would not be complete without recording these concerns. Doubts about the integrity of the left bank at Datchet have been a particular cause for concern to the residents of Datchet, who fear it may fail. I am satisfied that the Environment Agency has taken sufficient steps to ensure that these are rebuilt in summer 2004 and that they have adequate interim measures in place until then.

#### Recommendations:

- (a) The Environment Agency to continue their technical studies into the problems and undertake remedial works expeditiously.
- (b) The Environment Agency to develop an effective form of communication with the residents to restore confidence in the integrity of the banks, especially at Datchet, and operation of the Jubilee River.
- (c) The result of the capacity analysis should be used to inform decisions regarding any further remedial works.

## **10. Communications**

Following the January 2003 floods, many organisations have been criticised about their communication with the public. In setting up the FRAGs, the member organisations have recognised the need to improve their mechanisms for providing information. They also wanted to understand more about public expectation to make their communications more effective and efficient. The Community Support / Liaison Groups have provided invaluable information to the FRAG members in this area.

### Opinion:

I believe that Local Authorities, the Environment Agency and Thames Water can improve the way that they communicate with the public. Although the FRAG process has focused resources in this field, I have a number of recommendations, which I am confident will help these organisations meet public expectations. The FRAG network can provide a vehicle for this communication.

### Recommendations:

- (a) All organisations to ensure that their information gathering and filing systems are well organised and allow easy retrieval of accurate information.
- (b) All organisations to consult widely to reach an understanding on what information the public want, and what is reasonably available.
- (c) All organisations to consider establishing a library or terminal for public access to flooding-related information.
- (d) Environment Agency to engage the community during all stages of future flood alleviation schemes.

## **11a. Dredging – River Thames**

This is a very emotive issue, especially since it is common knowledge that large scale dredging took place from 1947 until the mid-1990s. Public perception is that dredging makes a difference and many people who know the river and its creeks, etc. affirm that the bed has silted up significantly in recent years. The Environment Agency has an established surveying programme. However, changes in the technology it has used over the years does not allow adequate comparisons to be made. The Environment Agency's judgement has been that there were generally only small variations to the riverbed over time and on balance the bed was neither eroding nor silting. Recent work has cast doubt on this and further study is required. The chapter on dredging in this report points to the tightening in legislation and escalation of costs, and therefore questions the value of dredging in the light of other flood risk management options.

### Opinion:

The Environment Agency undertakes a considerable amount of survey work on the River Thames. However, there does not appear to be a transparent programme for this. Also, as the survey techniques have changed over the years no method has been devised to compare these surveys. Hence, it is difficult for anyone to draw firm conclusions on the effect of dredging, and how long the benefits last. The latest technique (swathe bathymetry) needs proving before it is used further.

Changes to legislation mean that disposal of dredged material is becoming more difficult and costly. This is a significant problem affecting all those involved in dredging, (including Local Authorities and Port Authorities).

Dredging of the River Thames must theoretically make a difference. The question is how much, and can the large amounts of money involved be justified from the public purse. At present I do not believe the Environment Agency has the information to answer these questions.

Recommendations:

- (a) The Environment Agency to continue the practice of dredging shoals, in response to its own Inspectors and following investigation of requests from others.
- (b) The Environment Agency to determine an appropriate method for surveying the bed that will be done on a regular cycle and which will allow comparisons with previous surveys to confirm any trends.
- (c) The Environment Agency to undertake further work to research the effect of dredging on flood risk. It must also do further work to assess the benefits of dredging to justify dredging in the context of other methods of flood risk management.
- (d) At a national level the Environment Agency, other drainage authorities and Defra need to resolve the legislative framework for dredging disposal and provide guidance to operating authorities.
- (e) The Environment Agency needs to secure, as a matter of urgency, new arrangements for the disposal of dredged materials.
- (f) The Environment Agency to liaise with the community to share their findings and communicate priorities.

**11b. Dredging – non River Thames**

The work of the FRAGs has highlighted the need for dredging on a number of watercourses other than the River Thames. The Local Authorities and the Environment Agency have both responded by carrying out a significant amount of work over the past year.

Opinion:

The 2003 floods highlighted the need for a regime of inspection and maintenance of watercourses in the area. Whilst dredging will not necessarily prevent flooding from the scale of the 2003 event, on some watercourses it will help to mitigate the effects.

Recommendations:

- (a) The Local Authorities and the Environment Agency to undertake routine and regular inspections.
- (b) Appropriate maintenance regimes should be established.
- (c) Better communication of these activities should be undertaken.

## **12. Groundwater**

Relating to the January 2003 floods, many people reported water rising from the ground, as the nearby river level rose, and this then led to overland flooding. Groundwater is often the first observed sign that flooding may be imminent. No authority has responsibility for groundwater flooding, (only for groundwater as a resource and for protecting groundwater quality).

### Opinion:

Little is known and understood about the mechanism of groundwater flooding, but I believe it is significant enough to warrant further investigation. The consequences of this type of flooding need to be taken into account in development control and flood risk management.

### Recommendations:

- (a) All parties to urge Defra to conclude it's work to establish clear responsibilities for groundwater flooding, and to put into place any new arrangements as soon as possible.
- (b) Planning Authorities to treat groundwater flooding as a material consideration, and ensure that Developers consider the possibility of groundwater effects and produce an appropriate assessment for the planning consultation process. This should be treated with the same level of regard as fluvial flooding.
- (c) Once new responsibilities are established, those authorities should be given resources to investigate and report on groundwater issues.

## **13. General Items**

### **13.1 Watercourse Clearance**

The FRAG process has revealed to members the complex responsibilities for watercourses and culverts, which is a nationally recognised problem. Permissive powers lie with the following:

- Environment Agency – Main River
- Local Authority – Ordinary Watercourses
- Highway Authority – Roadside ditches and culverts
- Landowner.

The FRAG process has resulted in significant improvements to many watercourses in the area, and this will continue in accordance with the FRAG work plan. It has also highlighted the responsibilities of riparian owners, i.e. those who own the bed and banks. Riparian owners should take an interest in 'their' watercourse and observe the Bye-Laws, which prevent any alterations within 8m of the bank without consent. The FRAGs have heard of riparian owners encroaching into 'their' river with walls and fences, thus reducing the channel capacity, which potentially increases the risk of flooding on their property and that of their neighbours.

### Recommendations:

- (a) The Environment Agency and Local Authorities to make available their policies on watercourse maintenance.

- (b) Communities to ensure that their watercourses are respected. This involves raising awareness of the importance of keeping channels clear of obstructions.
- (c) The Environment Agency and Local Authorities to use their powers of enforcement against those who seriously encroach into the watercourse.
- (d) The Environment Agency and Local Authorities to review the legislation concerning enforcement, and seek changes to improve its effectiveness.
- (e) Highway Authorities to establish a database of their highway drains and ditches, and introduce a routine for inspection and clearance.
- (f) Communities to consider long-term plans to improve the quality of their watercourses and associated leisure opportunities, in conjunction with planning strategies. This would create a greater awareness of the watercourses and their condition, and allow easier reporting of problems.

### **13.2 Sewer Flooding**

Sewer flooding caused significant nuisance during the January 2003 floods. During this event Thames Water provided portable toilets that are reported to have assisted in many areas.

It is clear that once overland flooding occurs, the sewerage system becomes overwhelmed and cannot work effectively in some areas. However, Thames Water is investigating many areas where localised flooding occurred and plans improvements to reduce or eliminate these problems.

#### Recommendation:

- (a) Thames Water to expedite their implementation programme for eliminating localised sewer flooding problems.

### **13.3 Utilities**

During the floods some communities lost their electricity and telephone services, despite not being flooded.

#### Recommendations

- (a) Utilities to ensure that their equipment has improved protection against flooding.
- (b) Utilities to ensure that any new infrastructure is protected against flooding.

## **14. Long Term Plans**

### **14.1 Lower Thames Study**

The Environment Agency has completed phase one of a study into flood risk management options extending from Datchet to Walton on Thames. Phase two of this work will extend the study area to Teddington and is due to commence shortly.

This is a very welcome step, but any solution will need to go through all the financial stages and planning processes, which will take many years to complete.

Recommendations:

- (a) The Environment Agency, Planning Authorities etc. to liaise with the community to help develop a successful scheme.
- (b) The Government to provide increased funding towards flood risk management to increase the number of schemes being built.

#### **14.2 Catchment Flood Management Plans**

The Environment Agency is embarking on a national study to develop strategies for all the main river catchments in England and Wales. These consider land use, ecology, flood management, siltation, agricultural practices, etc.

Recommendation:

- (a) The Environment Agency to expedite these studies and inform the public of progress.
- (b) Planning Authorities and other organisations to use the results to influence development in the catchment.

#### **14.3 Flooding Expectation**

Flooding is a natural event and people need to find out whether their homes are in flood risk areas, understand what steps they can take to reduce the risk and prepare in advance to cope with the situation. There is an expectation that areas such as Maidenhead, Windsor and Eton, which are to some extent protected by the MWEFAS scheme, will still flood in a large scale event.

The Environment Agency provides detailed information on its website regarding flood risk areas for England and Wales, together with useful information on how to receive flood warnings and preventative measures that can be taken.

### **15. The Future of the FRAGs**

With the publication of this report, the format of the Flood Risk Action Groups must change in line with the end of the 'Independent Inquiry', which has been the focus of my work. Through the work of the FRAGs, partners have developed much closer relationships and progress has been made in areas such as emergency planning and response. Subgroups considering development in the floodplain and property insurance are longer term issues. Plans for the future of this work must support these relationships and build on their achievements, whilst making the best use of the resources available.

Recommendations:

- (a) I will consider the future of the FRAGs with all FRAG and Subgroup members. Consideration should include the chairmanship, administration, frequency of meetings, membership etc. This review must examine a format for future liaison that will build on the successes of the FRAGs.
- (b) The authorities responsible for flooding issues must continue to undertake the actions detailed within the agreed FRAG work plans.

## **16. Community Engagement**

The FRAG process has developed relationships between the authorities and local communities.

### Recommendations:

- (a) The review of the FRAGs must take account of the continuing need to communicate with local communities.
- (b) I strongly advise that local communities move forward and develop a support process in preparation for future flooding. This includes supporting a good active network of Environment Agency flood wardens.
- (c) The names and contact details of flood wardens should be published locally, so that residents in the area know who to contact.
- (d) Wraybury Parish Council and Royal Borough of Windsor and Maidenhead to investigate the function of the Wraybury bank and consider if it should be reinstated.

## **17. Environment Agency Responsibilities - Permissive Powers**

It is important that everyone in the community understands that the Environment Agency only has 'permissive powers' – it has no obligations to protect property against flooding. This is enshrined in Government legislation. It is important to appreciate that there must be funds and an economically viable scheme, before works can be done. A viable scheme is one that has satisfied all the criteria set down by Defra and has a satisfactory 'priority score' when compared with other competing schemes.

## **18. The Next Step**

I have asked all FRAG partners to confirm acceptance and adoption of my recommendations by the end of July 2004, with programme information where appropriate. I will then forward these responses to the FRAG members, who can decide how to proceed. I plan to issue a separate summary of the 'Activities of the Development in the Floodplain', 'Emergency Response' and 'Property Insurance Subgroups' in due course.

## **6. ACKNOWLEDGEMENTS**

I want to thank all the Flood Risk Action Group partners, individual members and particularly the Mechanisms of Flooding Subgroup members for all their hard work, commitment and the personal time they have devoted to the work we have undertaken. I would like to acknowledge the assistance of the Environment Agency, whose staff have responded to requests for detailed information and have provided explanations and efficient administrative support. Local Authorities, Thames Water, Jacobs Consultants and Stakeholder Groups have also given me a great deal of support and answered my questions.

My special thanks are reserved for the victims of the floods and their families. I have met many people and have received many letters and reports. I am also grateful for the time these people spent with me explaining their concerns, which motivated me to research and explain comprehensively what happened during the January 2003 floods. Everyone I have met has been polite and courteous, which has made my task easier during what has been a very busy period. The dreadful experiences of local residents should illustrate the real lessons for all those that direct or deliver flood risk management services.

I must apologise to those people who have written to me but have not received a reply. Please do not presume that an unanswered letter was of no value. I have read all the information I have received, which has been invaluable in helping me to understand the issues that needed to be addressed in my report.