

Box 5

Environment Agency Thames Region

Autumn 2000 Floods Review Regional Report



ENVIRONMENT
AGENCY

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This report covers events for the period 28th October 2000 to 20th November 2000
Review of events and response highlighting key issues and recommendations.

It was only with the usual high level of effort that the region's commendable response to the challenge were both possible. Special thanks are due to the Regional Operations Officer for his leadership and the Regional Operations Officer for his assistance in which this report is compiled.

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Cautionary note

This report has been produced with the best information and data available at the time of preparation. Surveys and information searches are continuing and as a result some details may be superseded.

Postscript:

Subsequent flood events in December 2000 are not referred to in this report. That event was effectively continuous with the floods, which are the subject of this report and occurred in part as a result of the remnants of the October/November flood and a completely saturated catchment, which reacted, immediately to further rainfall.

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Environment Agency Thames Region – The Floods Report October/November 2000

GLOSSARY OF TERMS

ABC	Area Base Controller
AIR	Area Incident Room
AMT	Area Management Team
AVM	Automatic Voice Messaging
AOTL	Area Operations Team Leader
CEH	Centre for Ecology and Hydrology
CNFDR	Changing Needs for Flood Defence Review
EWf	Emergency Work Force
FD	Flood Defence
FDER	Flood Defence Emergency Response
FDRO	Flood Data Recording Officer
FDRSO	Flood Data Recording Standby Officer
FDWR	Flood Defence and Water Resources
FWA	Flood Warning Area
HLT	High Level Targets
HSO	Hydrometry Standby Officer
MAFF	Ministry of Agriculture Fisheries and Food
MFDO	Monitoring and Forecasting Duty Officer
RBC	Regional Base Controller
RCC	Regional Communications Centre
RFFC	Regional Flood Forecasting Centre
RMS	Recorded Message Service
SITREPS	Situation Reports
SuDS	Sustainable Drainage Systems

EXECUTIVE SUMMARY

1. Weather and Catchment Conditions

September and October 2000 were unusually wet and proved the prelude to the flooding which commenced on the 28th October, by which time the catchment was saturated. The combined rainfall totals for September and October made the period the wettest for 40 years and the second wettest since records began in 1882. In the extreme west and south of the region, rainfall accumulations of close to 200mm were recorded in the period 26th October to 12th November, as illustrated on Map 1. The flooding in Thames region in October and November was extensive. A few locations were badly affected, but the impact was felt across the entire region.

2. Flood Warnings

During the period 28th October to 12th November, flood warning activity resulted in:

Severe Flood Warnings	9
Flood Warnings	110
Flood Watches	248

Broadcast warnings were provided for all rivers affected by Flood Warnings and Severe Flood Warnings and direct warnings were provided where AVM or warden arrangements are in place. Levels of flood warnings are shown on Map 3.

3. River Levels

The highest levels and flows since 1947 were recorded on the Lower River Roding and the highest flows since 1968 on many reaches of the River Mole. Flows on the River Wey, Kennet, Stort, Ash (Herts.) Lower Lee and Blackwater exceeded or came close to exceeding the previous highest on record.

4. Performance of Defences

Existing defences on the Rivers Lee, Stort, Thame, Mole, Wey, and South London rivers and in several other locations successfully prevented flooding to somewhere between 50,000 and 100,000 properties. Defences on the River Roding at Wanstead in NE London were overtopped by flows that exceeded the design standard as a result of which over 200 properties were flooded. The incident damaged the embankment, necessitating temporary repairs. Elsewhere, the River Roding defences prevented flooding to several hundred properties.

5. Major Incidents

The most severe flooding occurred on the River Roding at Wanstead, as described above and at Weybridge on the River Wey where about 50 properties were flooded. Also on the River Wey at Byfleet some 30 properties were flooded. In both incidents the flooded property is situated in previously recorded floodplain. At Woking the Hoe Stream, a tributary of the River Wey, flooded over 140 properties.

Locations of property flooding are shown on Map 2.

In addition there were a number of closures of major roads, the most disruptive being that at the Winnersh roundabout in Reading for 5 days and all roads into Guildford for 2 days.

6. Regional Issues

The demands of the flood fully stretched flood defence manpower resources. With vacancy levels generally at 25%, experienced staff in particular were put under considerable pressure. The assistance provided by other teams and the wholehearted commitment of staff generally enabled a commendable performance to be achieved.

The value of the sandbagging machines in the region was demonstrated by the filling and placing of 28,800 sandbags and the supply of a further 11,200 to Southern region. The experience and response of the Emergency Work Force (EWF) prevented flooding at a number of locations by removing obstructions, providing temporary defences or pumping.

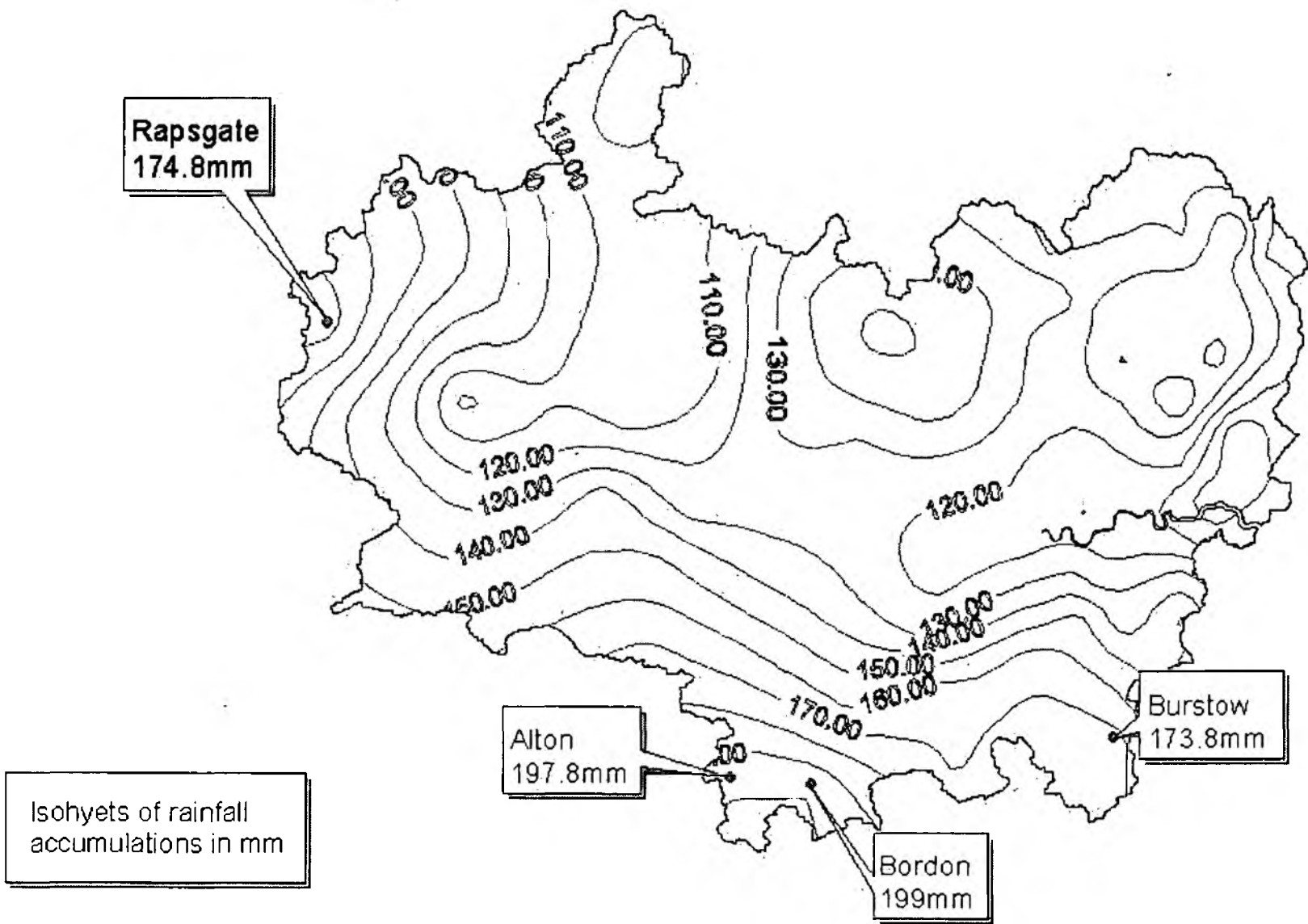
7. Recommendations for Action

The competent response by the Agency nevertheless revealed several issues that need to be addressed as well as wider concerns for debate nationally.

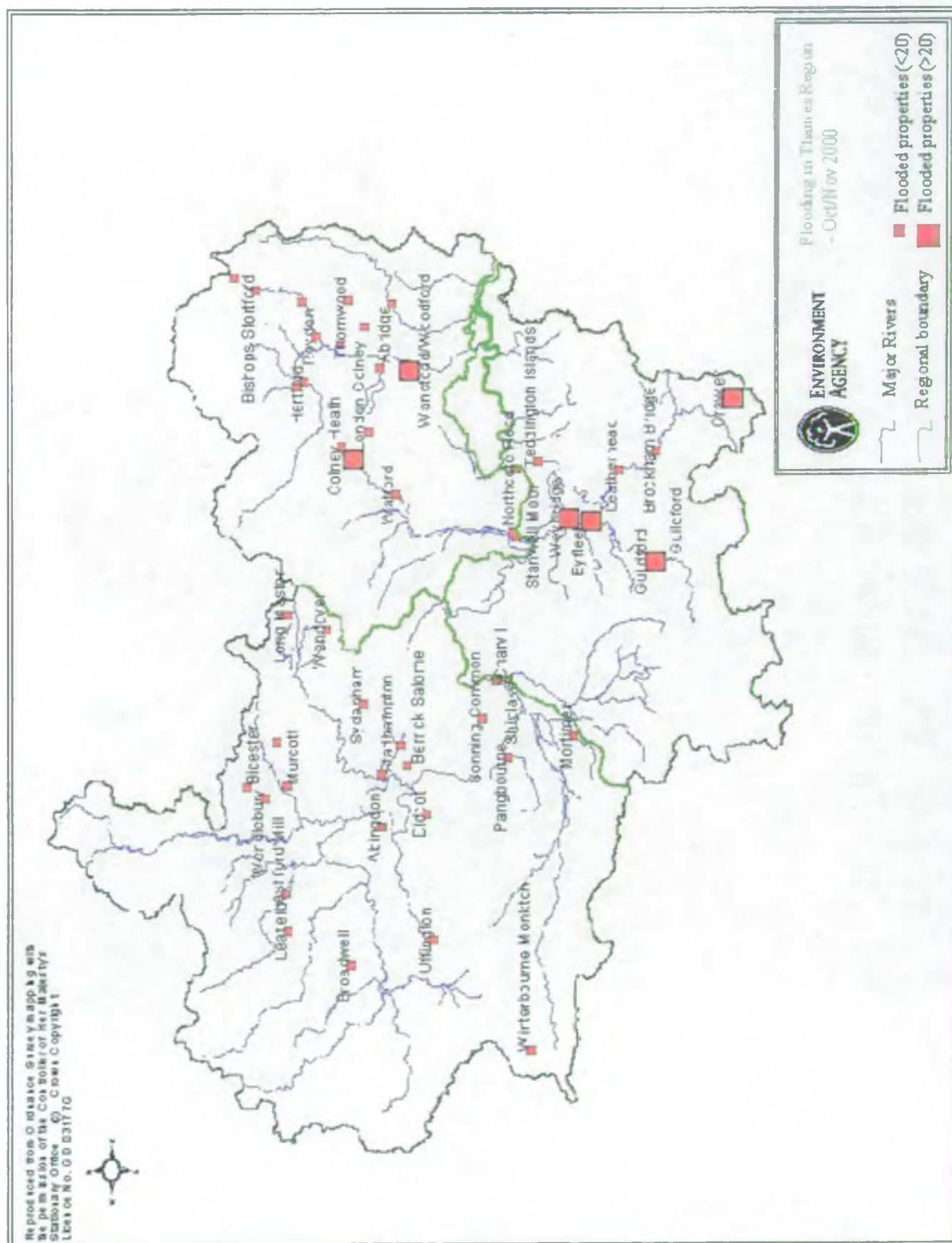
- Both flood defence client and EWF numbers and competencies need review on the basis of planning for incident response.
- Health, Safety and Welfare arrangements related to flood response should be reviewed to ensure good practice is shared.
- Incident management procedures need to accommodate line management arrangements.
- A review of flood warning codes definitions should be undertaken in the light of experiences gained during the event.
- A review of the Floodline service and communications with the public should be undertaken in the light of experiences gained during the event.
- Arrangements for 24-hour support for data gathering and processing equipment need review.
- More attention is needed by all organisations involved to the development of major incident plans.

- Co-ordination of the presently fragmented responsibilities for drainage is needed, not least to reduce public confusion.
- As well as promoting Sustainable Drainage Systems (SuDS) and no development in the flood plain, sustainable agricultural land use practices need attention.
- If developments are permitted in flood risk areas they should provide for that risk either through Building Regulations measures or arrangements for their defence.
- Further work is needed on the social impact of flooding, including health impacts so that they can be taken into account during scheme justification.
- Work is needed with the insurance industry to avoid any moves to restrict flood insurance availability, which may lead to greater pressure to provide or improve defences.

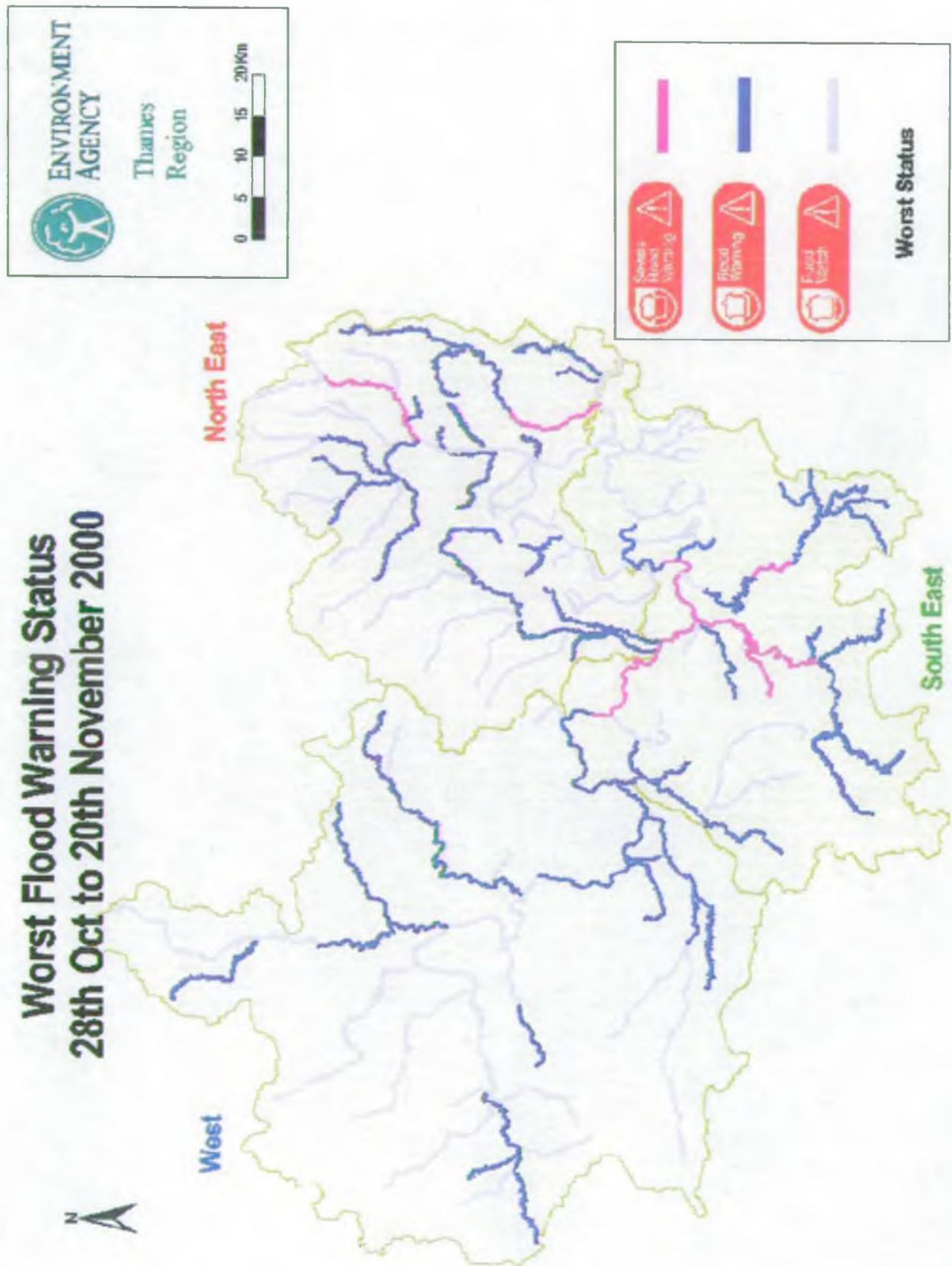
Map 1.



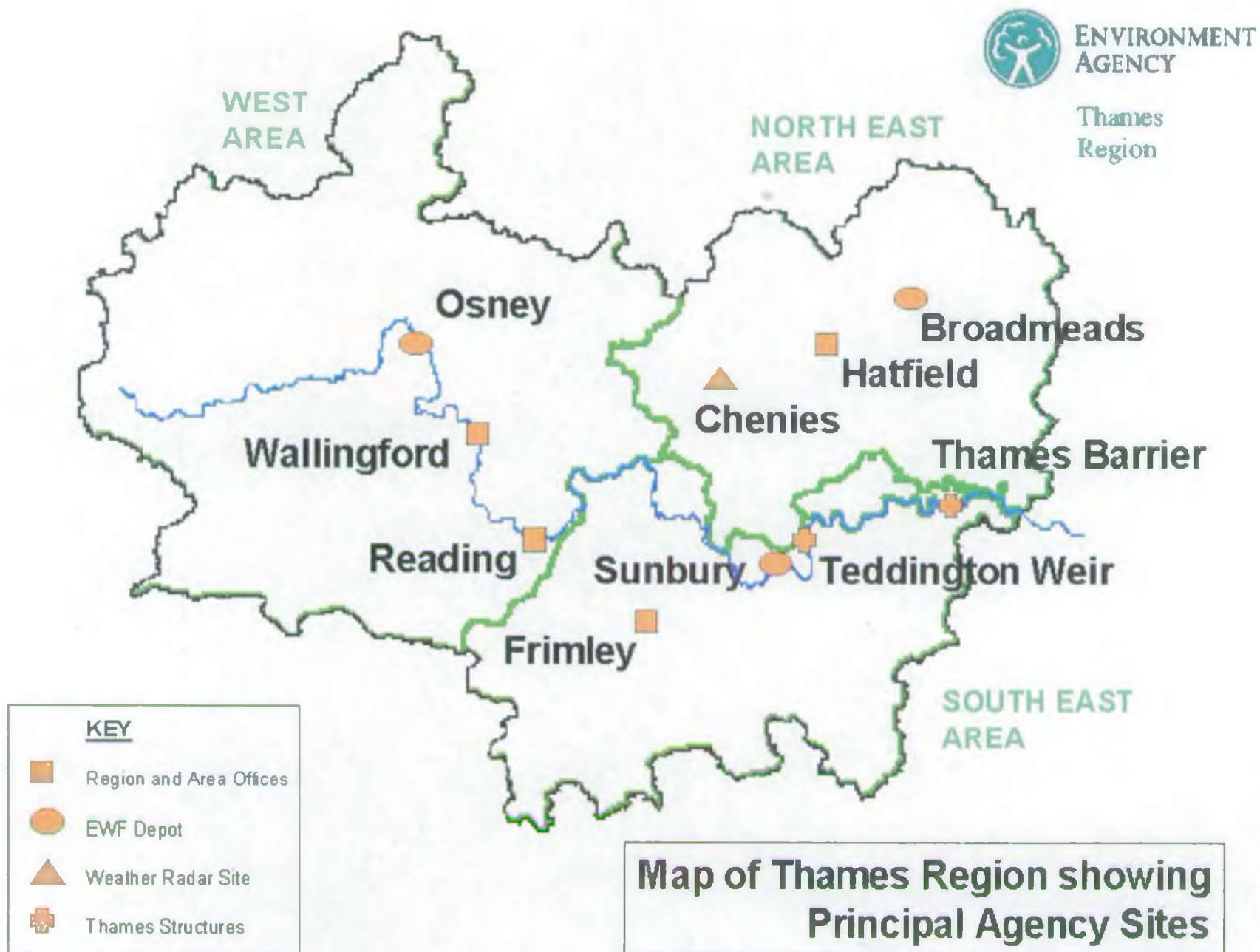
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Map 3.



Map 4.



CHAPTER 1 : INTRODUCTION

1.1 General Scene Setting

The floods were the first major test of the new operational arrangements established under the Agency's "Changing Needs in Flood Defence Review" (CNFDR) initiatives. Despite the fact that the various teams were relatively new and, in some cases inexperienced, they acquitted themselves well delivering service levels that generally met public requirements. This was despite very high vacancy levels –25% or more in some teams, and it is worth recording the assistance provided by other functional groups and the commitment of all involved, without which performance levels would not have been achieved.

Nationally, the flooding was the most extensive since 1947, but in Thames region the impact was less severe than in that year. Nevertheless, over 1100 houses and other properties were flooded with the attendant misery and financial loss that inevitably accompanies such events.

1.2 Weather Conditions

- 1.2.2 September and October 2000 were unusually wet and proved the prelude to the flooding which commenced at the end of October. Rainfall in September was almost 170% of the long-term average and in October some 250% of the long term average. The combined totals made the period the wettest for 40 years and the second wettest since records began in 1882.
- 1.2.3 From the 28th October, a series of weather fronts associated with low-pressure areas brought further heavy rain to the region. The build up of unsettled wet weather began on Saturday 28th October when 15-25 mm of rain fell across the Region. Sunday 29th October and Monday 30th October saw a particularly severe low-pressure centre track across the south of Britain. Heavy rain over the 24-hour period from midday on Sunday to midday on Monday brought widespread rainfall totals of 25-50mm in West Area and generally 40-65mm across both SE and NE Areas.
- 1.2.4 A two day window of more settled weather was experienced on Tuesday 31st October and Wednesday 1st November before another band of rain brought 12-25mm of rain on Thursday morning. A further band of rain pushed across the Region on the afternoon of Sunday 5th November into the early hours of Monday morning. Rainfall totals of 15-20mm were seen across West Area, 20-25mm across NE Area and 25-50mm across SE Area in the 24 hours between midday on Sunday and midday on Monday. A further 20mm affected southern parts of SE Area in heavy showers during daylight hours on Monday 6th November.

- 1.2.5 The weather became more settled between Tuesday 7th November and Friday 10th November. However, a further band of rain affected the Region on Saturday, bringing rainfall accumulations of 10-20mm, with Southeast Area bearing the brunt of the rainfall once again. Total accumulations for the period 28th October to 12th November are shown on Map 1.

1.3 Where Flooding Occurred

All Main River in the catchment other than the River Ash in SW Middlesex was subject to either a Flood Watch, Flood Warning or Severe Flood Warning. Levels of Flood Warning are shown on Map 3. Except where there were flood defences, all rivers occupied their flood plains to a greater or lesser extent. The impact on agricultural land was most significant in the catchments of the Rivers Mole, Wey, Loddon, Kennet, Thame, Cherwell, Windrush and Upper Thames. Property flooding occurred at over 70 locations across the region. The distribution of property flooding across the region is illustrated in Map 2. The most significant sites are listed below: -

Number of properties flooded

R. Wey Catchment	311
R. Mole Catchment	74
R. Loddon Catchment	33
The Bournes (Surrey)	13
Western tributaries	21
R. Pang catchment	10
R. Colne catchment	83
R. Stort catchment	47
R. Lee catchment	236
(exc. R Stort)	
R. Roding Catchment	230
R. Thames floodplain	48
Total	1106

1.4 Impact of Severe Flooding

- 1.4.1 Defences on the River Roding at Wanstead in NE London were overtopped by flows that exceeded the design standard as a result of which over 200 properties were flooded. The incident damaged the embankment, necessitating temporary repairs. Elsewhere, occupation of the floodplain resulted in 50 properties flooded at Weybridge, another 30 nearby in Byfleet and 140 in Woking.

1.5 Event Impact

- 1.5.1 The highest levels and flows since 1947 were recorded on the Lower Roding and the highest flows since 1968 were recorded at some stations on the Mole. However, observed levels further downstream were apparently higher than in 1968. The flows and levels on the Loddon and Blackwater were high, but not the highest recorded. Flows on the River Wey were high, which resulted in numerous flooded properties, and the records at Tilford show this to have been the highest flow since 1968. Data from old gauging station records indicate

that higher events occurred in 1954 and 1960, but this was not a very reliable station.

1.6 Causes of Flooding

- 1.6.1 In most cases, property flooding was a result of river flows exceeding the capacity of the channel, causing overtopping into the flood plain and affecting those properties built in at risk areas. The exceptions to this were found at: -

Wanstead, River Roding – The defence, a raised embankment, was overtopped and damaged by scour.

Briars Close, Pangbourne, River Pang – A combination of overland flows and river water affected several properties.

- 1.6.2 In some locations, high river levels prevented the discharge of surface water sewers and drains, which surcharged and caused flooding, or added to flooding from Main River or ordinary watercourses. It is almost impossible to separate these instances from those solely attributable to flooding directly from Main River.

1.7 Effectiveness of Response to Flooding

- 1.7.1 The entire flood was characterised by improved communications and relations with the emergency services and local authorities than was the case previously. This was due undoubtedly to proactive measures taken to strengthen the integration of the response to floods by the various organisations involved.
- 1.7.2 The region received an unprecedented number of telephone calls from members of the public, placing great demands on staff in the Regional Communications Centre, the regional switchboard and Area Incident Rooms. Enhanced staffing levels, using personnel from outside flood defence as well as flood defence staff ensured that public needs were met, other than in a few cases.
- 1.7.3 The new Flood Warning Codes appeared to help the public but resulted in greater activity for flood forecasting and flood warning staff than was the case using the previous system. The extended nature of the event fatigued those staff on duty rosters.
- 1.7.4 There were very few instances of property flooding without the prior issue of a warning. Where this occurred, the reason can be attributed mostly either to a blockage or the effects of surface water. Not all warnings were in the form of individual contacts with property owners and good use was made of local radio.
- 1.7.5 The Emergency Work Force (EWF), also known in Thames Region as Regional Works Contractor, provided invaluable operational support. Their activities in clearing obstructions, pumping and filling and placing sandbags

helped save a number of properties from the flooding that would otherwise have occurred. A total of 28,800 sandbags were used in Thames Region.

- 1.7.6 Arrangements for inter-regional assistance, though not heavily called upon, were established and managed on a sounder basis than previously. Assistance was provided to Southern region in the form of 11,200 sandbags.
- 1.7.7 Extension and improved resilience of the river level telemetry network allowed improved monitoring on several Thames tributaries, leading to more reliable flood forecasts and warnings.
- 1.7.8 Additional staff recruited to flood warning enabled a better warning service to be provided both to those at risk and the professional partners.
- 1.7.9 Closer liaison with the Met. Office facilitated greater mutual confidence in rainfall forecasts.
- 1.7.10 The availability of Indicative Flood Risk Maps allowed warnings to be targeted more accurately.
- 1.7.11 Local Flood Warning Plans enhanced an integrated response by the Agency and the professional partners.
- 1.7.12 The revised flood warning codes and the associated preparatory meetings with the professional partners ensured a more integrated response to the floods.
- 1.7.13 The Flood Action Week 2000 and attendant publicity made for a more informed public better able to react to the warnings.

1.8 Performance of Defences

- 1.8.1 Existing defences on the Rivers Lee, Stort, Thame, Mole, Wey and South London rivers and in several other locations successfully prevented flooding to somewhere between 50,000 and 100,000 properties.
- 1.8.2 Other than where the defences on the River Roding were overtopped by flows that exceeded the design standard, they prevented flooding to several hundred properties.

1.9 Recommendations

- 1.9.1 Management of and response to the flooding highlighted a number of issues requiring further attention. A summary of the more significant recommendations appears in Chapter 9.

1.10 Professional Partners

- 1.10.1 The Agency's Supervisory Duty effectively involves a need to assess the performance of other organisations involved in the planning for and response to floods. Overall, the performance of our professional partners was considered to be very good, but it is recognised that differences in local arrangements and resource limitations result in variations in performance.

This inconsistency presents a challenge to the Agency, and can result in staff in a flood event being drawn into a mediating role between the public and local authorities in particular. This needs to be seen in the context of the fragmented responsibilities of different aspects of drainage and the uncertainty or confusion this creates with the public.

CHAPTER 2 : EVENT MANAGEMENT

2.1 Procedures

- 2.1.1 The scale, extent and duration of the flooding and risk of flooding provided a severe test of the various procedures established within the region. These include: -

- Area Incident Room (AIR) procedures
- Flood Warning Dissemination Plans
- Regional Incident Procedures
- Emergency Work Force procedures.

These are supported by rostered arrangements for: -

- Flood forecasting, at regional level
- Regional Communications Centre (RCC) operation, at regional level
- Regional Base Controller, as circumstances necessitate
- Public and Media Relations, at regional level
- Flood Warning, at Area level
- Flood Defence Operations, at Area level
- Emergency Work Force gangs
- Flood Recording
- Telephone cover at Area level

- 2.1.2 These were supplemented by ad hoc rostered support, particularly at Area level, from staff manning AIR's and flood recording. These were drawn, voluntarily, from Flood Defence staff at both Region and Area and staff from other functions. Without that extra assistance, service levels could not have been maintained due to the duration of the event and the unprecedented number of calls from the public. Additional staff were drafted in also to the Regional Communications Centre (RCC).

2.2 Area Incident Rooms

- 2.2.1 Area Incident Rooms were opened as follows: -

NE Area	29/10 - 1/11 (24 hours from the 29/10 to 31/11)
SE Area	30/10 - 4/11, 6/11 - 9/11, 11-12/11 (all 24 hours)
West Area	30/10 - 11/11 (24 hours on 5/11)
Regional	30/10 - 3/11, 5/11 - 10/11 (24 hours on 5,7/11)

- 2.2.2 As the scale of the event escalated, an informal Regional Base Controller (RBC) roster came into operation from 30/11 to 11/11 (formal RBC rosters operated from the 11/11 through to 7/1/01). Situation Reports (SITREPS) and HELP reports were produced for the duration of the event from 30/10 to 13/11.

- 2.2.3 Calls received by the AIRs' during the period 28th October to 12th November were distributed as shown below:

NE Area	1500+
SE Area	2000+
West Area	500+
RCC.	6000+

2.3 Liaison

- 2.3.1 Liaison externally was established with those local authorities most affected by the flooding and with LB Redbridge and Epping Forest District Council Gold Control, and Surrey CC Silver Control. Although no staff were able to be present, these contacts worked well to the benefit both of the Agency and the local authorities and emergency services, where they were also involved.
- 2.3.2 Internal liaison arrangements generally worked well. This was the first serious test of the new, post CNFDR, especially the relationship between the Regional flood forecasting team and Area flood warning teams. There was debate on some occasions about the need to issue warnings, especially Severe Flood Warnings. The 'political' implications of such decisions resulted in senior management involvement outside of procedures and is an issue to be revisited. As the event developed, procedures and liaison arrangements, previously untested in such demanding conditions, were modified as some lessons learnt were identified and incorporated.

2.4 Communications

- 2.4.1 Switchboard extensions, direct lines and mobile phones enabled communications links to be maintained throughout the event with relatively few difficulties. Mobile phones, as expected, proved particularly effective for the deployment of staff and EWF gangs on site. The sheer volume of calls strained communications at times and consideration is to be given to more direct lines to reduce delays or missed calls in respect of key links.
- 2.4.2 The Regional Communications Centre managed to respond to most calls but the pressure on a few occasions meant that some callers hung up before it was possible to answer them.
- 2.4.3 Floodline proved both a benefit and a problem. An enormous number of calls were handled which might otherwise have come to the region. However, having established a public expectation and demand, limited Floodline operational hours resulted in many general calls being directed to the region outside those hours, adding to the pressures on operating staff. There were a few instances of misdirected calls and misleading or incorrect information being given by Floodline operators.
- 2.4.4 The benefit of e-mail communication with and between AIR's was not exploited and internal e-mails to individual user accounts were not accessed in a timely way because of the pressure of events and duties away from the usual work station.

2.5 Manpower

2.5.1 The shortage of experienced flood defence staff in the region was exposed by this event. This placed a heavy demand on a few staff with long service to act as Area or Regional Base Controllers. Paradoxically, the event (and its sequel in December) has provided a large number of staff with first hand experience of responding to a flood and this will stand the region in good stead, if those staff are retained and their skills and experience developed and extended. However, there is scope to improve training for staff likely to be involved in AIR duties.

2.5.2 AIR's were manned by between 8 and 10 staff at any given time, deployed typically as: -

- Base Controller (and media response)
- Flood Warning Duty Officer
- Flood Recording Duty Officer
- Flood Defence Operations Liaison
- Emergency Work Force Liaison
- Water Level Information Officer
- Telephone Response (3 officers)

10 or more staff were involved at any one time on site flood recording and providing data and information to the AIR or the Regional Flood Forecasting Centre (RFFC)

2.5.3 At regional level, RFFC roles included: -

- Monitoring and Forecasting Duty Officer
- Assistant Monitoring and Forecasting Duty Officer
- River Control Duty Officer
- Media and public relations liaison
- Systems support for regional CASCADE system

In addition, when the Centre was closed, duty staff monitored the situation from home with hand over arrangements working smoothly.

2.5.4 The extended hours worked and the need to avoid excessive hours for individual staff members on rosters necessitated the involvement of many staff. Over 200 staff were involved in responding to the event, with the inevitable impact on the day job. Although an extensive and extended event, the flood levels were not particularly severe other than in a few locations. A larger event, with the attendant transport and communications disruption, could result in fewer staff available to respond.

2.5.5 The Emergency Work Force was fully deployed responding to operational needs including clearing obstructions, checking known trouble spots, information gathering, responding to calls for assistance from local authorities and members of the public and filling and placing sandbags. In total some 40,000 sandbags were deployed including 11,200 provided to Southern

Region. Round the clock working was maintained over several days and resources were fully stretched, despite the scale of the event being less than that on which the Region's EWF Noble number was based.

Table 2.1 Key statistics for the event

	Regional Office	North East Area	South East Area	West Area
Dates Agency Incident Rooms Opened	30 Oct - 3 Nov 5 Nov - 10 Nov	29 Oct - 1 Nov	30 Oct - 4 Nov 6 Oct - 12 Nov	30 Oct - 11 Nov
Staff Number Worked	29	79	70	36
Staff time worked	266 days plus 1150 hours overtime	380 days plus 1350 hours overtime	310 days plus 1300 hours overtime	250 days plus 1500 hours overtime
Number of Calls taken in incident rooms directly	6,000+	1,500+	2,000+	500+
Number of Calls to Floodline *	467,239 (only figures for Wales and England available)			

2.6 CIS

2.6.1 Some support was required from CIS and this exposed several issues needing attention, namely: -

- Out-of-hours contact during an event
- Extended server access out of hours
- The need for remote fault diagnosis
- Establish an AIR GroupWise account
- Out of hours cover for ARGUS based workstations

2.6.2 A freeze on infrastructure work was instituted on the 7th November but it was not clear initially what this covered, although this was clarified fairly quickly.

2.7 Health and Safety

2.7.1 Although staff welfare arrangements proved adequate, standards need to be formalised including accountability for ensuring that standards are met and working hours are not excessive. There was some concern that a few experienced staff, through their own commitment, were prepared (or even determined) to work very long hours and their safety when driving home became paramount.

2.7.2 Lone working arrangements applied when and where appropriate. Working on site at night exposed individuals to a number of potential hazards, not least because they may have been in areas unfamiliar to them. There were no problems, but there is a widespread view that the training already provided for such situations, needs review.

2.7.3 The Emergency Work Force deployed gangs at night and it is recognised that improved lighting is needed in such circumstances.

CHAPTER 3 : FLOOD FORECASTING

3.1 Weather Input to Flood Forecasting

3.1.1 Background

The region makes use of a range of Met Office services to support flood-forecasting activities, in line with the national agreement. Extensive use is made of weather radar and the region receives the following Met Office products: -

- Single site data at both 5 km and 2km resolution from the Chenies radar in the Chilterns.
- National rainfall display for England and Wales and the United Kingdom.
- Nimrod quality control and rainfall forecasting system.
- COST 78 European Composite Rainfall Radar Picture.
- GANDOLF on regional trial (not materially relevant to the autumn floods).

In addition, the regional local rainfall forecasting system is based on the Chenies single site data.

3.1.2 Accuracy of the five day Daily forecast

The first 36 hours of the 5 day daily forecast produced by London Weather Centre has been verified to be acceptable albeit on a subjective basis on 79-89% of occasions between the 25th October and 12th November. From the acceptable forecasts, 50-63% were considered 'good' forecasts with an accuracy of the forecasts of within +/- 30% of the actual rainfall recorded in 22 raingauges across Thames Region. The forecasts were issued at 10.30 hours, which meant that the latest information could not be included in the daily SITREPS.

3.1.3 The majority of these 'good' forecasts issued between 25th October and 12th November coincided with the periods of heavy rainfall. The poorer forecasts occurred on those days that were showery in nature, were forecast rainfall accumulations being greater than the actual rainfall recorded in the raingauges. (see Fig. 3.1)

3.1.4 The accuracy of the forecasts produced by London Weather Centre deteriorated with increasing lead-time from the date of issue of the forecast. The percentage of acceptability fell from 79-89% on the first 36 hours to 55-65% on the next 36-108 hours of the daily forecasts. (see Table 2.1)

3.1.5 Assessment of the five-day forecasts showed that forecast accumulations given for a particular day often varied greatly on subsequent issues of the forecast. For example, on the 29th October the forecast issued 5 days previously, underestimated the rainfall accumulations by 20mm; the forecast produced 4 days previously, underestimated the rainfall by 13mm, while the forecast, issued on the day of the heavy rainfall, estimated it accurately to be

within 4mm of that recorded. Therefore, no flood warning procedures would have been implemented based on the forecast made on the 25th October or the 26th October due to the inaccuracy of the weather forecasts issued on those days. In practice, the experience of the flood forecasting was used to good effect and the early forecast treated with caution. (see Fig. 3.2)

- 3.1.6 It was also noted that on a few occasions the forecast rainfall accumulations given were not consistent on subsequent forecasts for a particular day. The rainfall amounts oscillated on daily bases making it difficult to forecast river levels and plan resource needs greater than 24 hours in advance.

Table 3.1 Weather forecast accuracy for the first 24 hours of the daily 5-day forecast

Date 24 hrs starting 12:00 on:	NE Area		SE Area		W Area		Daily success rate
	Forecast	Actual	Forecast	Actual	Forecast	Actual	
28/10/00	10	5-13	12	6-15	13	8-15	100%
29/10/00	35	33-50	48	45-56	36	15-54	100%
30/10/00	7	0-2	16	0-5	13	0-3	0%
31/10/00	14	0-3	24	0-1	19	0-4	0%
01/11/00	13	11-18	20	14-23	23	7-14	67%
02/11/00	12	0-2	6	0-2	7	0-13	33%
03/11/00	0	0-0.2	1	0-0.2	0	0-0.2	100%
04/11/00	0	0-1	0	0-2	0	0-1	100%
05/11/00	34	18-28	43	23-50	47	14-31	67%
06/11/00	28	4-9	29	5-22	17	2-8	33%
07/11/00	28	1-4	23	0-3	29	0-3	0%
Area success rate	55%		64%		45%		

Key: 10 Under Forecast
10 Over Forecast

3.1.7 Accuracy of the Evening Update Forecast

The evening update forecasts issued by the London Weather Centre for overnight rainfall were considered, on the whole, to give good guidance in the overnight period between the 25th October to 12th November. 82% of forecasts were thought to be accurate, with 64% of the forecasts verified to be within +/- 30% of the values recorded in a selection of 22 raingauges across the Region.

3.1.8 Accuracy of Heavy Rainfall Warnings

Five heavy rainfall warnings were issued during the period from the 25th October to the 8th November. Three of the most crucial warnings, which coincided with the periods of heavy rainfall, were considered to be accurate. The warnings were issued with a lead-time of between 6 and 14 hours before the onset of rainfall, and the predicted rainfall accumulations agreed in the most part with those actually recorded.

- 3.1.9 One Heavy Rainfall Warning that was considered to be inaccurate was issued several hours into the rainfall event on the 29th/30th October. It was issued when a previous warning was already in force. It is felt that this warning did not add any value to the original warning that was still in force. The rainfall accumulations given in the second warning were excessive and were thought

to be alarmist as the extra amount of rainfall did not materialise and would have caused serious flooding region-wide if had done so. The Monitoring and Forecasting Duty Officer was not aware that this second warning had been issued due to no back-up call from London Weather Centre, contrary to agreed procedures.

- 3.1.10 Another inaccurate Heavy Rainfall Warning was issued for all Areas across Thames region on Monday 6th November. The actual rainfall accumulations recorded in the raingauges did not meet warning criteria in NE and West Areas. It is also felt that even though the actual rainfall accumulations met warning criteria in SE Area, the warning was issued too late to be any value, as the majority of the rainfall had already fallen.

3.2 Impact of Inaccurate Forecasts

- 3.2.1 Forecasts and warnings were considered accurate over the periods of heavy rainfall between 25th October and 12th November. Therefore, there were relatively few adverse impacts from the forecasts issued by London Weather Centre. The poorer forecasts tended to occur on days of showery weather, when rainfall predictions were often over-predicted. The impacts of this were that the river levels did not rise as much as one would have anticipated given the forecast rainfall accumulations, and some may have been spared flooding.
- 3.2.2 The oscillation of predicted rainfall accumulations on subsequent days forecasts meant that forecasting river levels on subsequent days was made difficult, with low confidence being attributed to any forecasts greater than 24 hours. The oscillation also made it difficult to assess what resources were available on a particular day, i.e. when personnel should be rested, and whether personnel could be lent to other regions if inter-regional aid had been requested.

3.3 Agency Telemetry and Outstation Robustness and Availability

- 3.3.1 The testing nature of the flood in terms of its widespread geographical extent and the duration of the event highlighted a number of issues with regard to the telemetry system. These issues can be subdivided into those which related to the telemetry outstations (raingauges and level/flow gauges) and those related to the operation of the data gathering and archiving software and hardware, controlled by the Flood Warning VAX computer system.

3.3.2 Telemetered Outstations

From the period of 28th October to 2nd November, 82 level/flow outstations out of a total of 302 (27%) used for flood warning purposes experienced some problems with data quality, or were out of service and in the process of being fixed. These data quality problems ranged from gaps in the data record to spurious values being recorded. Of the 302 flow/level gauges used by flood warning 10 outstations were not operational at the start of the flood event, 34 outstations had gaps in the stored data record and 40 outstations displayed spurious data or strange readings.

- 3.3.3 A number of the flow/level gauges displayed trends/levels that did not correspond to observations received from staff on site. Certain of these gauges are thought to have suspect calibrations and have been re-calibrated. Other sites exhibited jumps in level/flow which are unusual for those sites and require further investigation as to the causes. A few sites within the telemetry network displayed signs of exceeding their operating range, whereby the peak levels were truncated. These sites require their operational range extending.
- 3.3.4 On the 31st October a power failure was experienced at one of the ARGUS computer based radio telemetry link sites at Guildford. Due to the network configuration, data from a number of key sites was therefore unavailable until the power supply was restored (No data from Lower Thames and some River Mole sites). Although the radio telemetry outstations were functioning the data from key sites was not made available due to this power failure. The configuration of the radio telemetry network needs to be reviewed to build in an inherent robustness, which is not available at present. In addition to the gaps in data from the radio telemetry sites due to the power failure, a number of the Thames Lock level gauges were reading incorrect levels, a more frequent maintenance check on those sites is necessary as they are at present visited on a six monthly basis.
- 3.3.5 The maintenance, data quality and fault fixing of telemetered flood warning flow and level gauges is an important issue and one which requires dedicated resources, rather than rely on personnel with wider responsibilities. To enable an improvement in the flood warning telemetry network the Area hydrometric teams need to be fully resourced, a situation, which was apparent during the flood event. Attention is needed to fill outstanding vacancies and to the adequacy of the existing posts.
- 3.3.6 Telemetry System (Hardware and Software)
The VAX based telemetry system was tested to full capacity during the flood event over an extended time period, which highlighted several systems issues:-

There was a noticeable effect on the performance on the VAX due to the large numbers of users, which were logging onto the system through the LAN. The system slowed as the processing power was shared between the users. The extra load of increased frequency of telemetry polling also compounded the issue. The VAX requires increased capacity to allow for these extra users logging on and for more frequent polling, specifically an increase in memory capacity.

The numbers of telemetered flood warning outstations polled by the VAX has significantly increased over the last year. The numbers of hardware units associated with the data gathering and alarm handling from Dynamic Logic data gatherers (Master Stations) has not increased, which caused a capacity problem during the flood event. To allow for the extra numbers of outstations being added to the telemetry network, the number of Master Stations needs to be increased to handle the extra numbers of alarms generated and extra data gathering capacity required.

The software for polling the Dynamic Logic equipment crashed several times throughout the flood event. The software crashes appear to have been caused by the Master Stations being left in a hung or unusable state. Software changes have been implemented to ensure that the system is able to detect these error conditions and handle them correctly without crashing.

Duplication of polling of the outstations by both Region and Area flood warning staff caused temporary overloading of the system. The system has been modified to allow polling to be performed only by Regional flood monitoring and forecasting staff.

- 3.3.7 Other issues include the requirement for an automatic polling program for the DTS level/flow gauges, similar to that which is available for the Dynamic Logic gauges and the modification of telemetry displays on the VAX to conform to the current structure of the Flood Warning function.

3.3.8 Other Related Issues

Monitoring of the River Thames levels was made more complex by the fact that Navigation work in Imperial units whilst Flood Warning work in Metric units. This situation is not ideal and may lead to errors in conversion.

- 3.3.9 A general review of alarm levels is required for the telemetered outstations especially the new flood warning sites where the alarm levels may need "bedding in". Reports of property flooding at various locations and other related information from Flood Recording/Monitoring reports can be used to verify the outstation alarm levels.

3.4 Ability of Agency to Predict the Actual Flood Levels Using Their Current Models

3.4.1 Background and Techniques Available:

Following the independent report from Peter Bye into the flooding experienced in the Region in 1998, the Region undertook to implement a forecasting system. Over the past 12 months the Region has been working on implementing the River Flow Forecasting System (RFFS) produced by the Centre for Ecology and Hydrology (CEH) and used in North East Region.

- 3.4.2 At the time of these floods, RFFS was running experimentally in real time, and forecasts were available in real time for 21 sites across the Region. All of these sites are located on tributaries of the River Thames. On the Thames itself, some level-to-level correlation techniques were employed during this event to predict downstream levels. Similarly on several tributaries (notably the Cherwell, Loddon, Wey and Mole) information on past flood events was used to provide guidance on estimating the peak flood level and timing of the flood peak.

3.4.3 Results During Event

Good results (defined as predicting the peak flow/level to within +/-20% at a particular site) were obtained during the recent event from 8 of the 21 sites.

These were:

Redbridge	River Roding
Kinnersley Manor	River Mole
Denham	River Colne
Uxbridge	River Pinn
Tilford	River Wey
Esher	River Mole
Wimbledon Common	Beverley Brook
Colindeep Lane	Silk Stream

3.4.4 These are the sites for which calibration had been carried out by CEH as part of an earlier study for the Agency. The RFFS system was generally run once per day through the event (since it is operating in an experimental form). In the best case, the model predicted the peak flow at Tilford to within 5%, and gave a lead-time of 8 hours. This clearly demonstrates the value of a well-calibrated forecasting system. In general terms, the accuracy of the forecasts increased the closer the forecast run was to the time of the actual peak, as would be expected.

3.4.5 Poor results were obtained from the remaining 13 sites. The reasons behind this can generally be attributed to lack of calibration of these models and the infrequency of model runs.

3.4.6 On the Thames, the level-to-level correlations were used to predict the level at Maidenhead, where the prediction (once the upstream peak at Shiplake was known) under-predicted the actual peak level by 25mm. Level-to-level correlations were also used for other selected sites on the Thames and, whilst the accuracy of the prediction was not as good as that seen at Maidenhead, this technique was found to be useful as an indicator of peak flood levels. Overall, it is considered that RFFS should be implemented fully in the Region.

Figure 3.1: Raingauge recorded rainfall against Day 1 forecast accumulations

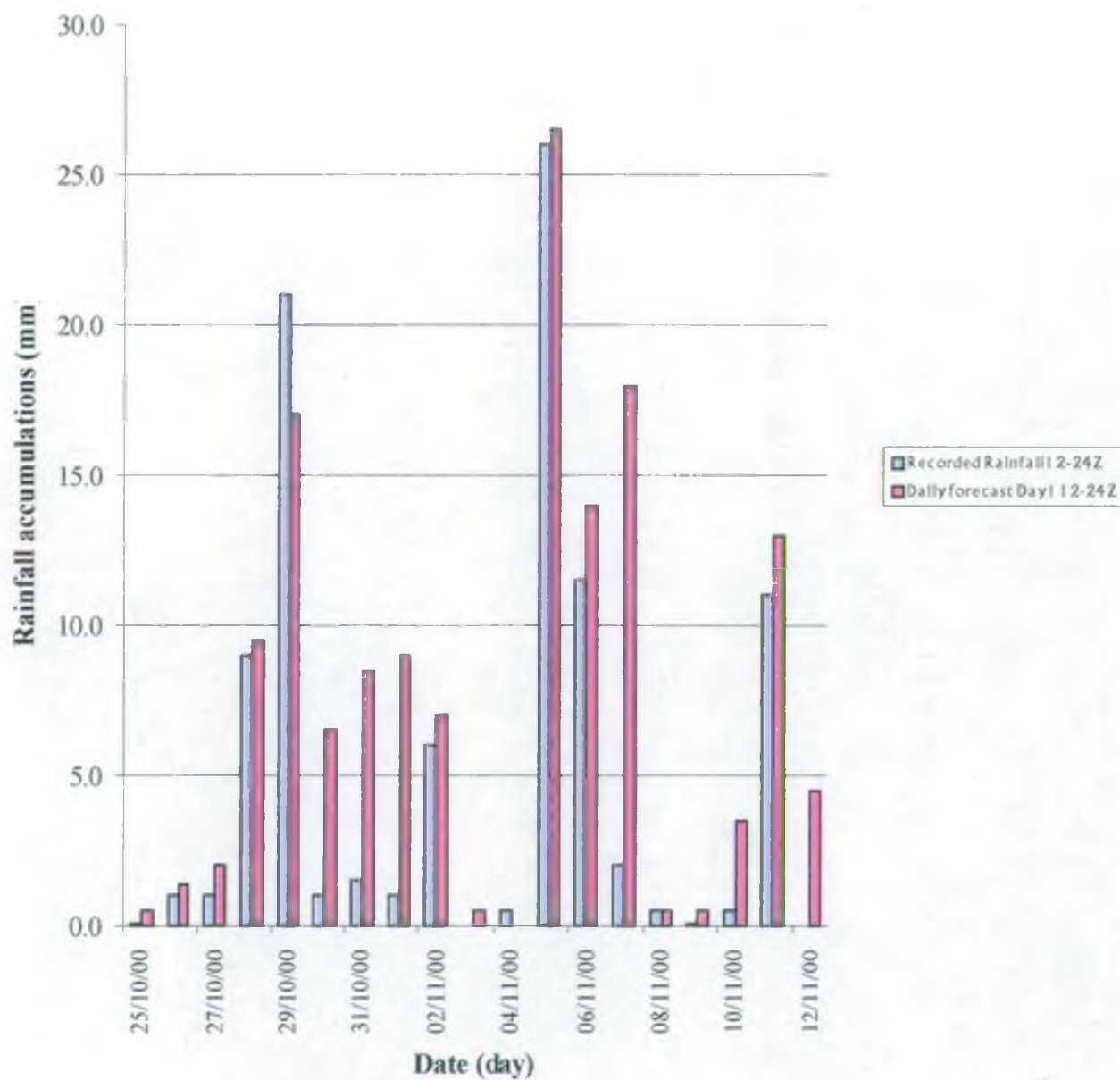
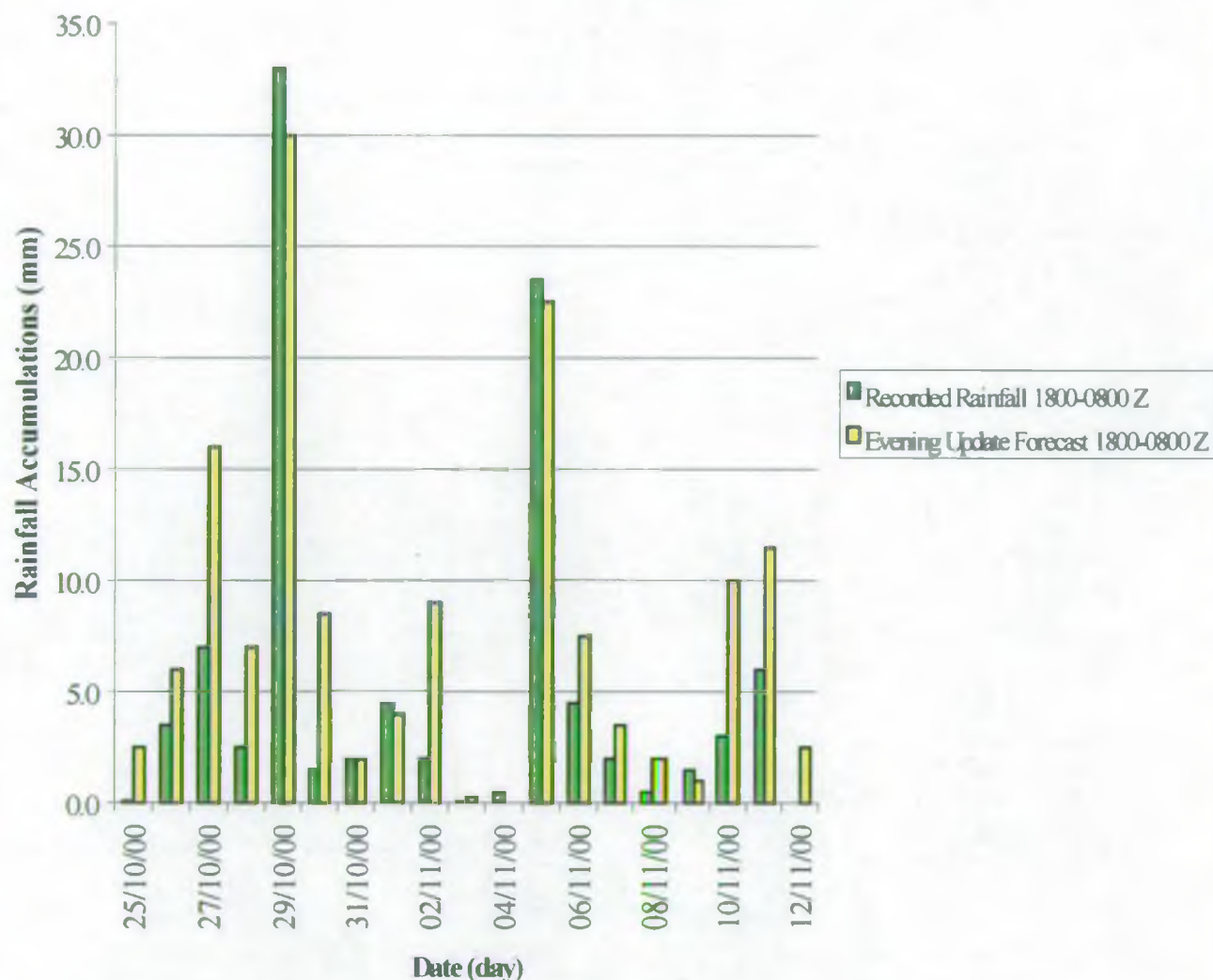


Figure 3.2 Comparison between average recorded rainfall and average forecast rainfall



CHAPTER 4 : FLOOD WARNING

4.0 Background

On the 12th September 2000, Regional fluvial Flood Forecasting and Warning arrangements changed to comply with CNFDR. Catchment monitoring and forecasting is undertaken from the Regional Flood Forecasting Centre and flood warning dissemination from the Area offices. Tidal flood forecasting and warning, which covers the Thames seaward from Teddington Weir is undertaken from the Thames Barrier.

4.1 Trigger / Threshold Levels for Warnings Issued

- 4.1.1 There are several factors involved in the flood warning decision besides the actual river level antecedent conditions – amount of rainfall, rate of rise, latest weather forecasts, reports from the ground all have to be taken into account. For this reason Thames Region do not normally set trigger levels for the issue of Flood Watches, Flood Warnings and Severe Flood Warnings.
- 4.1.2 Instead pre-set alarm levels have been programmed in to every river level gauge to indicate whether the river is within banks, into the floodplain or up to the lowest property threshold level. These are used, in conjunction with the factors outlined above to enable Flood Warning Duty Officers to make a decision regarding warning status.
- 4.1.3 Alarm levels are being constantly reviewed and some will need to be revisited in the light of the data gathered during this event.
- 4.1.4 As the flooding became more serious, it became apparent that some specific guidance is needed on upgrading to a Severe Flood Warning, in order to achieve consistency.

4.2 Warnings Issued. Target Times v Actual Times

- 4.2.1 To measure precise lead times is very difficult at this point without detailed data regarding exact times that individual properties were flooded. Where currently no telemetry is available on certain rivers there is reliance on reports from staff on the ground and in many cases this leads to uncertain lead times.

The four Tables below detail the warnings issued in Thames Regions' three Areas and the Thames Barrier, including timings.

Table 4.2.1 – Warnings Issued between 29/10/00 and 13/11/00 – SE Area

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
29/10/00	17.20	Loddon	Issue	Flood Watch
29/10/00	18.00	Wey	Issue	Flood Watch
29/10/00	18.00	The Bournes	Issue	Flood Watch
29/10/00	18.30	Mole	Issue	Flood Watch
30/10/00	05.20	Mole 32/7	Issue	Flood Warning

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Date	Time	Catchment & Ref.	Issue / Downgrade	Status
30/10/00	05.20	Mole 32/8	Issue	Flood Warning
30/10/00	05.55	Hogsmill	Issue	Flood Watch
30/10/00	06.10	Loddon 24/6	Issue	Flood Warning
30/10/00	07.05	Mole 32/1	Issue	Flood Warning
30/10/00	07.05	Mole 32/2	Issue	Flood Warning
30/10/00	07.05	Mole 32/6	Issue	Flood Warning
30/10/00	07.55	Beverley Brook	Issue	Flood Watch
30/10/00	07.55	Wandle	Issue	Flood Watch
30/10/00	07.55	Ravensbourne	Issue	Flood Watch
30/10/00	08.15	The Bournes 29/1	Issue	Flood Warning
30/10/00	08.25	Thames 23/7	Issue	Flood Watch
30/10/00	09.50	Hogsmill	Issue	Flood Warning
30/10/00	10.30	Wey 30/1	Issue	Flood Warning
30/10/00	10.30	Wey 30/2	Issue	Flood Warning
30/10/00	10.50	Wey 30/6	Issue	Flood Warning
30/10/00	10.50	Wey 30/7	Issue	Flood Warning
30/10/00	11.05	Mole 32/3	Issue	Flood Warning
30/10/00	13.25	Wey 30/5	Issue	Flood Warning
30/10/00	15.40	Loddon 24/2	Issue	Flood Warning
30/10/00	15.40	Loddon 24/3	Issue	Flood Warning
30/10/00	19.15	Mole 32/3	Issue	Severe Flood Warning
30/10/00	21.00	Wey 30/3	Issue	Flood Warning
30/10/00	21.00	Wey 30/4	Issue	Flood Warning
30/10/00	23.10	Mole 32/4	Issue	Flood Warning
30/10/00	23.30	Thames 23/5	Issue	Flood Watch
30/10/00	23.30	Thames 23/6	Issue	Flood Watch
31/10/00	07.45	Mole 32/3	Downgrade	Flood Warning
31/10/00	11.15	Thames 23/7	Issue	Flood Warning
31/10/00	15.00	Thames 23/7 Teddington to Molesey only	Issue	Severe Flood Warning
31/10/00	20.00	Thames 23/6	Issue	Flood Warning
31/10/00	20.30	Thames 23/7 Teddington to Molesey only	Downgrade	Flood Warning
31/10/00	21.15	Hogsmill	Downgrade	Flood Watch
1/11/00	10.00	Thames 23/5	Issue	Flood Warning
1/11/00	11.40	Mole 32/1	Downgrade	Flood Watch
1/11/00	11.40	Mole 32/2	Downgrade	Flood Watch
1/11/00	11.40	Mole 32/3	Downgrade	Flood Watch
1/11/00	11.40	Mole 32/6	Downgrade	Flood Watch
1/11/00	11.40	Mole 32/7	Downgrade	Flood Watch
1/11/00	11.40	Mole 32/8	Downgrade	Flood Watch
1/11/00	12.45	Loddon 24/1	Downgrade	Flood Watch
1/11/00	12.45	Loddon 24/4	Downgrade	Flood Watch
1/11/00	12.45	Loddon 24/5	Downgrade	Flood Watch
1/11/00	12.45	Loddon 24/6	Downgrade	Flood Watch
1/11/00	13.30	Wey 30/1	Downgrade	Flood Watch
1/11/00	13.30	Wey 30/2	Downgrade	Flood Watch
1/11/00	13.30	Wey 30/6	Downgrade	Flood Watch
1/11/00	13.30	Wey 30/7	Downgrade	Flood Watch
1/11/00	16.00	Mole 32/4	Downgrade	Flood Watch
1/11/00	16.00	The Bournes 29/1	Downgrade	Flood Watch
1/11/00	16.00	Wey 30/3	Downgrade	Flood Watch
1/11/00	16.00	Wey 30/4	Downgrade	Flood Watch
1/11/00	16.00	Loddon 24/2	Downgrade	Flood Watch

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Date	Time	Catchment & Ref.	Issue / Downgrade	Status
2/11/00	11.30	Mole 32/6	Issue	Flood Warning
2/11/00	11.30	Mole 32/7	Issue	Flood Warning
2/11/00	11.30	Mole 32/8	Issue	Flood Warning
2/11/00	11.30	Mole 32/1	Issue	Flood Warning
2/11/00	12.00	Wey 30/1	Issue	Flood Warning
2/11/00	12.00	Wey 30/2	Issue	Flood Warning
2/11/00	12.00	Wey 30/6	Issue	Flood Warning
2/11/00	15.30	Mole 32/2	Issue	Flood Warning
2/11/00	21.15	Mole 32/3	Issue	Flood Warning
3/11/00	09.45	Wey 30/1	Downgrade	Flood Watch
3/11/00	09.45	Wey 30/2	Downgrade	Flood Watch
3/11/00	09.45	Wey 30/6	Downgrade	Flood Watch
3/11/00	10.30	Mole 32/6	Downgrade	Flood Watch
3/11/00	10.30	Mole 32/7	Downgrade	Flood Watch
3/11/00	10.30	Mole 32/8	Downgrade	Flood Watch
3/11/00	10.30	Mole 32/1	Downgrade	Flood Watch
3/11/00	10.45	Loddon 24/1	Downgrade	Flood Watch
3/11/00	16.30	Mole 32/2	Downgrade	Flood Watch
3/11/00	16.30	Mole 32/3	Downgrade	Flood Watch
3/11/00	17.00	Wey 30/5	Downgrade	Flood Watch
4/11/00	10.15	Thames 23/7	Downgrade	Flood Watch
4/11/00	17.00	Mole 32/1	Issue	Flood Warning
4/11/00	17.00	Mole 32/6	Issue	Flood Warning
4/11/00	17.10	Mole 32/7	Issue	Flood Warning
4/11/00	17.10	Mole 32/8	Issue	Flood Warning
4/11/00	17.20	Wey 30/6	Issue	Flood Warning
4/11/00	22.10	Wey 30/1	Issue	Flood Warning
4/11/00	22.10	Wey 30/2	Issue	Flood Warning
4/11/00	22.10	Wey 30/3	Issue	Flood Warning
5/11/00	23.15	Loddon 24/1	Issue	Flood Warning
5/11/00	23.15	Loddon 24/2	Issue	Flood Warning
5/11/00	23.15	Loddon 24/3	Issue	Flood Warning
5/11/00	23.30	Loddon 24/6	Issue	Flood Warning
5/11/00	23.40	Wey 30/5	Issue	Flood Warning
6/11/00	02.15	Wey 30/7	Issue	Flood Warning
6/11/00	03.10	Mole 32/2	Issue	Flood Warning
6/11/00	06.00	Mole 32/3	Issue	Flood Warning
6/11/00	06.50	Thames 23/7	Issue	Flood Warning
6/11/00	07.15	Wey 30/4	Issue	Flood Warning
6/11/00	10.10	Mole 32/4	Issue	Flood Warning
7/11/00	08.50	Wey 30/4	Issue	Severe Flood Warning
7/11/00	09.00	The Bournes 29/1	Issue	Flood Warning
7/11/00	12.00	Wey 30/5	Issue	Severe Flood Warning
7/11/00	15.30	Thames 23/7	Issue	Severe Flood Warning
7/11/00	00.30	Thames 23/6 Maidenhead Only	Issue	Severe Flood Warning
8/11/00	08.45	Loddon 24/1	Downgrade	Flood Watch
8/11/00	08.45	Loddon 24/2	Downgrade	Flood Watch
8/11/00	08.45	Wey 30/1	Downgrade	Flood Watch
8/11/00	08.45	Wey 30/2	Downgrade	Flood Watch
8/11/00	08.45	Wey 30/6	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/6	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/7	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/8	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/1	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/2	Downgrade	Flood Watch

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
8/11/00	08.45	Mole 32/3	Downgrade	Flood Watch
8/11/00	08.45	Mole 32/4	Downgrade	Flood Watch
8/11/00	12.25	Wey 30/3	Downgrade	Flood Watch
8/11/00	12.25	Wey 30/7	Downgrade	Flood Watch
8/11/00	12.25	Wey 30/4	Downgrade	Flood Watch
8/11/00	15.10	The Bournes 29/1	Downgrade	Flood Watch
8/11/00	15.10	Loddon 24/6	Downgrade	Flood Watch
8/11/00	18.45	Wey 30/5	Downgrade	Flood Watch
9/11/00	06.30	Thames 23/7	Downgrade	Flood Warning
9/11/00	21.30	Thames 23/6	Downgrade	Flood Warning
10/11/00	09.00	Loddon 24/3	Downgrade	Flood Watch
10/11/00	11.00	Thames 23/5	Downgrade	Flood Watch
10/11/00	11.00	Thames 23/6	Downgrade	Flood Watch
10/11/00	11.00	Thames 23/7	Downgrade	Flood Watch
13/11/00	12.30	South London	Downgrade	All Clear
13/11/00	13.30	Wey	Downgrade	All Clear
13/11/00	13.30	The Bournes	Downgrade	All Clear
13/11/00	14.00	Loddon	Downgrade	All Clear
13/11/00	14.00	Cut	Downgrade	All Clear
13/11/00	14.20	Mole	Downgrade	All Clear
13/11/00	14.40	Thames 23/5	Downgrade	All Clear
13/11/00	14.40	Thames 23/6	Downgrade	All Clear
13/11/00	16.00	Thames 23/7	Downgrade	All Clear

Table 4.2.2 – Warnings Issued between 29/10/00 and 16/11/00 – West Area

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
28/11/00	19.15	Thame	Issue	Watch
29/10/00	18.00	South Cotswolds	Issue	Watch
29/10/00	18.10	Cherwell	Issue	Watch
29/10/00	18.20	Ray (Oxon.)	Issue	Watch
29/10/00	18.40	Evenlode	Issue	Watch
29/10/00	18.50	Windrush	Issue	Watch
29/10/00	18.55	Ock	Issue	Watch
29/10/00	19.10	Pang /Sulham	Issue	Watch
30/10/00	04.50	Kennet	Issue	Watch
30/10/00	08.30	Ray (Oxon.) 14/R	Issue	Warning
30/10/00	08.30	Ock 17/1	Issue	Warning
30/10/00	08.55	Ray (Wilts)	Issue	Watch
30/10/00	09.15	Wye	Issue	Watch
30/10/00	09.15	Cole	Issue	Watch
30/10/00	10.00	Inborn 22/4	Issue	Warning
30/10/00	11.05	Thames 23 / 1 & 2	Issue	Watch
30/10/00	14.40	Pang 21/1	Issue	Warning
30/10/00	15.00	Thames 23 / 3 & 4	Issue	Watch
30/10/00	16.30	Thame 19/1	Issue	Warning
30/10/00	19.45	Sulham Brook 21/2	Issue	Warning
30/10/00	22.38	Sor & Bloxham Brook	Issue	Warning
31/10/00	09.30	Leach	Downgrade	All Clear
31/10/00	09.30	Ray (Wilts)	Downgrade	All Clear
31/10/00	09.30	Enborne	Downgrade	All Clear
31/10/00	13.30	Sor & Bloxham Brook	Downgrade	Watch
31/10/00	14.00	Cherwell 14/2	Issue	Warning
31/10/00	16.00	Thame 19/2	Issue	Warning
31/10/00	18.30	Kennet 22/2	Issue	Warning

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
31/10/00	19.27	Thames 23/4 (part of the FWA)	Issue	Warning
01/11/00	08.00	Thames 23/4 (complete FWA)	Issue	Warning
01/11/00	08.00	Ock 17/1	Downgrade	Watch
01/11/00	08.00	Pang 21/1	Downgrade	Watch
01/11/00	08.00	Sulham Brook	Downgrade	Watch
02/11/00	12.00	Leach	Issue	Watch
02/11/00	14.00	Enborne	Issue	Watch
03/11/00	08.00	Ampney Brook 04/1	Issue	Warning
03/11/00	08.00	Ray (Wilts)	Issue	Watch
03/11/00	10.25	Thames 19 / 1 & 2	Downgrade	Watch
03/11/00	10.45	Cherwell 14/2	Downgrade	Watch
03/11/00	14.00	Ray (Oxon.) 14/R	Downgrade	Watch
03/11/00	11.45	Kenet 22/2	Downgrade	Watch
03/11/00	13.45	Thames 23/1	Issue	Warning
04/11/00	10.30	Ampney Brook 04/1	Downgrade	Watch
04/11/00	10.30	Thames 23/1	Downgrade	Watch
13/11/00	14.00	Churn	Downgrade	All Clear
13/11/00	12.00	Ray (Wilts)	Downgrade	All Clear
13/11/00	12.50	Cole	Downgrade	All Clear
13/11/00	13.15	Evenlode	Downgrade	All Clear
13/11/00	13.20	Ock	Downgrade	All Clear
13/11/00	14.00	Kenet	Downgrade	All Clear
13/11/00	14.25	Wye	Downgrade	All Clear
13/11/00	13.45	Pang & Sulham Brook	Downgrade	All Clear
13/11/00	14.40	Thames	Downgrade	All Clear
13/11/00	14.40	Thames	Downgrade	All Clear
14/11/00	10.45	Leach	Downgrade	All Clear
14/11/00	10.45	Cherwell	Downgrade	All Clear
15/11/00	13.00	Thame	Downgrade	All Clear
15/11/00	13.30	Ampney Brook	Downgrade	All Clear
15/11/00	13.15	Ray (Oxon.)	Downgrade	All Clear
16/11/00	16.00	Thame	Issue	Watch

Table 4.2.3 – Warnings Issued between 29/10/00 and 31/10/00 – NE Area

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
29/10/00	19.43	Pinn 28/7	Issue	Watch
29/10/00	19.43	Colne 28/1	Issue	Watch
29/10/00	19.43	Colne 28/2	Issue	Watch
29/10/00	19.43	Mimmshall Brook 28/9	Issue	Watch
29/10/00	19.43	County Ditch 28/8	Issue	Watch
29/10/00	20.16	Stort 51/3	Issue	Watch
29/10/00	20.16	Stort 51/2	Issue	Watch
29/10/00	19.54	Cobbins Brook B1	Issue	Watch
29/10/00	19.54	Nazeing Brook N1	Issue	Watch
29/10/00	19.54	Salmons Brook S1	Issue	Watch
29/10/00	19.54	Turkey Brook T1	Issue	Watch
29/10/00	20.06	Roding 54/3	Issue	Watch
29/10/00	20.06	Cripsey Brook	Issue	Watch
29/10/00	20.06	Roding 54/1	Issue	Watch
29/10/00	20.06	Roding 54/2	Issue	Watch
30/10/00	00.53	Nazeing Brook N1	Issue	Warning
30/10/00	01.02	Mimmshall Brook	Issue	Warning

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
30/10/00	02.13	Stort 51/3	Issue	Warning
30/10/00	02.13	Stort 51/2	Issue	Warning
30/10/00	02.21	Cripsey Brook	Issue	Warning
30/10/00	02.29	Cobbins Brook B1	Issue	Warning
30/10/00	04.31	Turkey Brook T1	Issue	Warning
30/10/00	06.10	Roding 54/1	Issue	Warning
30/10/00	06.16	Roding 54/2	Issue	Warning
30/10/00	10.13	Pinn 28/7	Issue	Warning
30/10/00	10.50	Roding 54/3	Issue	Warning
30/10/00	12.05	Colne 28/1	Issue	Warning
30/10/00	14.12	Stort 51/3	Issue	Severe FW
30/10/00	14.12	Stort 51/2	Issue	Severe FW
30/10/00	17.41	Colne 28/2	Issue	Warning
30/10/00	18.07	Roding 54/3	Issue	Severe FW
31/10/00	17.46	County Ditch	Issue	Warning

Table 4.2.4 – Warnings Issued between 31/10/00 and 14/11/00 – Thames Barrier

Date	Time	Catchment & Ref.	Issue / Downgrade	Status
31/10/00	14.00	Thames 23/8	Issue	Watch
31/10/00	14.40	Thames 23/8	Issue	Warning
31/10/00	15.05	Thames 23/9	Issue	Watch
31/10/00	18.20	Thames 23/8 & 9	Downgrade	All Clear
12/11/00	12.47	Thames 23/8	Issue	Watch
12/11/00	19.38	Thames 23/8	Downgrade	All Clear
12/11/00	21.42	Thames 23/8	Issue	Watch
13/11/00	01.36	Thames 23/9	Issue	Watch
13/11/00	02.45	Thames 23/8	Issue	Warning
13/11/00	05.49	Thames 23/8	Downgrade	Watch
13/11/00	11.26	Thames 23/8	Issue	Warning
13/11/00	20.18	Thames 23/8	Downgrade	Watch
13/11/00	20.34	Thames 23/10	Issue	Watch
14/11/00	05.38	Thames 23/10	Downgrade	All Clear
14/11/00	08.47	Thames 23/8	Issue	Warning
14/11/00	10.18	Thames 23/9	Issue	Watch
14/11/00	18.31	Thames 23/9	Downgrade	All Clear
14/11/00	19.33	Thames 23/8	Downgrade	All Clear

Table 4.2.5 Flood Warning: Summary of Performance (See Notes (i) - (iii))

	NE Area	SE Area	West Area	Total
No. of properties flooded following Flood Warning	290	22	39	351
No. of properties flooded without Flood Warning	76	366	3	445
No. of properties not flooded but received Flood Warning	n/a	n/a	1142	
No. of properties flooded following Severe Flood Warning	264	23	(ii)	287
No. of properties flooded without Severe Flood Warning	n/a	101	(ii)	
No. of properties not flooded but received Severe Flood Warning	n/a	n/a	(ii)	

- (i) Broadcast warnings were issued for all rivers affected by Flood Watches & Warnings: direct warnings were issued either via AVM or a warden scheme.
- (ii) West Area there were no Severe Flood Warnings issued.
- (iii) For a fuller explanation see Paragraphs 4.3 to 4.8.

Note: For the following sections 4.3 to 4.8 the figures refer to those properties that received a **direct warning** only whether via AVM or a warden scheme.

4.3 No of Properties Flooded Following a Direct Warning (do not include properties that also received a Severe Flood Warning)

- NE Area – estimated at 290 (following the issue of a flood warning)
- SE Area – estimated at 22 and figures for some Flood Warning Areas not available (following the issue of a flood warning)
- West Area – 39 properties flooded following warnings issued by AVM

4.4 No of Properties Flooded without a Direct Warning

- NE Area – number of properties flooded whilst on a flood watch, that should have received a flood warning is 76. Flooding to these properties is thought to have been caused by a blockage upstream of the telemetry station.
- SE Area – number of properties flooded whilst on a flood warning but did not receive a direct warning is estimated at 366
- West Area – 3 properties flooded

4.5 No of Properties not Flooded but Warned Directly (not Severe Flood Warning)

- NE Area – estimate of figures not available
- SE East Area – estimate of figures not available
- West Area – 1142 properties warned by AVM and not flooded. These properties were on the River Cherwell and covered by a single schedule. Only a few of the properties were at risk during this event.

4.6 No of Properties flooded Following Severe Flood Warning (do not include properties that also received warning)

- NE Area – number of properties flooded following Severe Flood Warning is estimated at 264. (the initially received estimate for properties flooded on the River Roding were between 200 and 400. The figure included is 230 on the River Roding thought to be the most realistic). It should be noted that the part played by surface water in this event is under investigation.
- SE Area – estimate of 22; however figures unavailable for Flood Warning Area (FWA) Windsor to Teddington.
- West Area – no Severe Flood Warnings were issued.

4.7 No of Properties Flooded without Severe Flood Warning (do not include properties that also received a warning)

- NE Area – estimate of figures is currently not available.
- SE Area – these properties did not receive a *direct* warning however a severe flood warning was issued, estimate of figures is 101, (excluding FWA Thames 23/7 where figures are not available)
- West Area – no severe flood warnings were issued

4.8 No of Properties not Flooded but Received Severe Flood Warning

- NE Area – estimate of figures is not available
- SE Area – estimate of figures is not available
- West Area – no severe flood warnings were issued

4.9 Public Awareness

The public awareness campaign of the last two years has heightened the general awareness of flood risk and the role of the Environment Agency in this area. This enabled widespread use of our messages and resulted in an increase of calls via the Floodline call centre into the Area Incident Rooms. The majority of callers were either asking practical questions or seeking additional information about the flood risk or future weather prospects.

4.10 Flood Risk Mapping

The exercise to produce the flood risk maps has been very valuable and provides the basis for targeting resources. The maps were used when dealing with enquiries from the public and were found to be generally useful, if only to determine whether a property was in the indicative floodplain or not. There is a need to show both fluvial and tidal risks where these both exist at the same location.

4.11 Codes

4.11.1 The code system has worked well and has generally been well received; two issues did arise as a result of such prolonged flood event:-

4.11.2 The general principle is that we do not issue a Flood Watch direct to the public (professional partners, media and flood wardens only). This presents a problem when we have issued a Flood Warning or a Severe Flood Warning to a specific flood warning area (FWA) and subsequently downgrade to a Flood Watch, because we must then issue Flood Watch information to the public direct.

4.11.2 This is also the case when downgrading to All Clear. It is unclear whether we should issue a direct All Clear message to those areas that have received direct warnings and especially those that have flooded. (Some members of the public have stated they wish to receive the all clear message).

4.12 Floodline

4.12.1 The combination of Flood Action Week only a month earlier and the widespread nature of the event meant that the Floodline number was heavily publicised and received a record breaking number of calls exceeding previous years figures.

4.12.2 The reporting arrangements for statistics that are being developed by the National Flood Warning Centre will allow AIR's and region to monitor the number of calls being transferred during a flood event.

- 4.12.3 Procedures have recently been issued clarifying the role of the Floodline helpdesk and BT Call Centre and these have been welcomed and are invaluable in furthering understanding of the importance of Floodline.
- 4.12.4 The recorded message service (RMS) was updated every twelve hours as a minimum and as warnings were issued. Public feedback has been good and they appear to like the message content, with the Quickdial boxes providing targeted information.
- 4.12.5 The 51 Quickdial boxes cover all 132 fluvial flood warning areas and three Quickdial boxes cover the three tidal warning areas. Thames region Quickdial boxes use the master and slave system extensively both within the region and inter region.
- 4.12.6 For the period between and including the 29th October to 12th November the number of **master** Quickdial boxes containing flood watches, flood warnings and severe flood warnings are as follows: -

NE Area (8 master boxes and 10 slaves)

Flood Watches	8
Flood Warnings	8
Severe Flood Warnings	2

SE Area (9 master boxes and 4 slaves)

Flood Watches	8
Flood Warnings	6
Severe Flood Warnings	4

West Area, (10 master boxes and 10 slave)

Flood Watches	10
Flood Warnings	9
Severe Flood Warnings	0

Number of times the master Quickdial boxes were updated: -

NE Area	242
SE Area	305
West Area	284

- 4.12.7 Thames used the master and slave option extensively when setting up the new RMS structure and this has proved beneficial in larger events as it has at least halved the amount of time spent recording messages whilst providing an improved local information service to the public.
- 4.12.8 At 03.00hrs on 30/10/00 a duty officer was unable to record a message in one of the London catchments – Quickdial box 0112123. The fault was reported to the helpdesk but unfortunately BT engineers do not work a 24-hour shift and the fault was not fixed until the next morning. During this downtime properties did flood and Thames Region were unable to record a Flood Warning message onto RMS Floodline. This raises the important issue that it is vital that BT engineers are rostered 24 hours to support RMS and Floodline.

4.13 Automatic Voice Messaging (AVM)

- 4.13.1 Over 5,000 properties in the region are able to receive AVM. The AVM was used extensively for the first time since the new staffing structures were in place for Thames region. There are four AVM machines within Thames and these can be accessed remotely from a duty officer's PC. Contingency plans are also in place should any one AVM fail completely, its data can still be accessed from one of the remaining three sites.
- 4.13.2 There were occasions when the AVM's at all sites had to be rebooted which resulted in some delays, but not sufficient to require access to alternative machines.
- 4.13.3 Some form of warning, update or summary was issued to the professional partners and the media everyday throughout the course of the event.

4.14 Loudhailers

- 4.14.1 Loudhailers are available for use throughout Thames region and staff have been trained should they be needed. There are four sets of loudhailer equipment at the three Area offices.
- 4.14.2 Loudhailers were used at London Colney, after it was established that of the flooded properties on the 30th October only a few had received a direct warning. When levels rose again on the 6th November, loudhailers were deployed. Concerns were raised by the public about the use of loudhailers as they unnecessarily alarm people not likely to be affected, especially in a small village location; also that they are difficult for the hard of hearing to understand. A review of loudhailer practices will be conducted to establish preferred situations for use.

4.15 Media / Press

The issues are more extensively covered in Chapter 7.

4.16 Wardens

- 4.16.1 On receiving a flood warning from the Environment Agency, the local Flood Warden will walk round the area at risk, knocking on doors and relay the message to the residents. There may be several Wardens in the area depending on the number of properties at risk. A single Warden may pass the flood warning on to as many as twenty other residents. The Warden will ensure that any elderly or infirm residents are taken care of by helping move belongings upstairs, switching off the electricity and if necessary evacuating them to a safe place. Wardens also play an important role in assisting the Environment Agency with establishing the potential flood risk. Those that were contacted provided good information as to the situation in their area.
- 4.16.2 The Flood Wardens schemes within NE Area were very active during the event. In Nazeing where a number of properties were flooded, liaison with the wardens provided valuable feedback of on-site conditions and the areas being affected. This was mirrored at several locations such as Warrengate Road where the wardens fed back the flood situation and details of actions the

property owners were taking including self evacuation for some elderly residents. Feedback from Wardens who were not affected by flooding also proved useful. Areas where rising water levels were considered to be presenting a risk, but where on site observations reported no problems, assisted in the deployment of resources. Where calls from flood wardens identified blockages or potential problem areas, their local knowledge helped pinpoint and prioritise the problem and target stretched resources.

4.16.3 During the flood event the number of wardens contacted is as follows:

- SE Area – 26 Wardens contacted for Flood Watch; they contacted a further 50 people when a flood warning was issued. If further rivers had been issued with a flood warning another 200 people would have been alerted by a flood warden scheme. In addition the Royal Borough of Windsor and Maidenhead run a warden scheme including 12 wardens and supported by the Agency.
- West Area – 39 wardens were contacted with the potential to contact a further 532 properties within flood warden schemes.
- NE Area – 30 wardens contacted 325 properties through the warning scheme as the rivers were issued with a flood warning.

4.17 Health and Safety

No issues to report

CHAPTER 5 : EVENT IMPACT

5.1 Rainfall and Flooding

5.1.1 This flood event was remarkable for the extent of the area affected, not only in the Thames Region but also for the whole of England and Wales. The severity of the event in various Thames Region catchments can be judged from the sample plots of rainfall, flows and levels from selected stations shown in Fig 5.1. These all show a 20-day period starting on 28th October. The data are taken from the telemetry system and in many cases alarm levels are shown which are used by flood forecasting officers as guidance when advising on the issuing of flood warnings. Reference to the property flooding alarm level gives an indication of the duration of the event.

5.1.2 As shown in Map 1 between 100 and 200mm of rain was recorded over the Thames catchment in the 20 days following 28th October 2000. The rain fell in 5 major events: 28th/29th October 1st/2nd, 5th/6th, 10th/11th and 15th/16th November. The first three of these caused flooding problems. On the Roding and other watercourses in the Region's NE Area the first event caused extensive flooding with no great problems subsequently, while on the Mole and the Wey, the first and third events were of similar magnitude. On the Thames, high levels were maintained throughout the event, with the peak on 9/10th November. Subsequent rainfall was only sufficient to slow the recession and leave this catchment vulnerable to renewed flooding in the event of further heavy or persistent rainfall.

5.1.3 Magnitude of Flows and Levels

Flows and levels in the Region's West Area, London catchments, and the Thames itself, although high were generally not very remarkable. Chalk catchments, as would be expected, had very little immediate response to the rainfall. However in SE and NE Areas, many sites subsequently recorded some of the highest flows and levels in decades.

5.1.4 Although tempting to make a quick assessment of return periods, this can be misleading for the following reasons:

- In extreme floods, gauging stations were submerged, bypassed or both, and time consuming careful work will be required to estimate reasonably accurate flow figures
- Flood Estimation Handbook analysis makes use of data from similar catchments throughout the country. It would be sensible to allow time for data from this event to be collected and processed throughout the country, since many very high flows are likely to have been recorded, which may have a marked effect on return period estimates
- Previous high flow figures at a station may have been estimated differently and maybe not compatible – research in the archives may be required
- Rainfall return periods can easily be assessed but generally have little relationship to flood severity because of the importance of catchment wetness, the duration of the rainfall and the characteristics of the catchment.

- 5.1.5 In West Area there were no very exceptional flows or levels recorded; the worst property flooding in terms of numbers of properties was at Pangbourne, where overland flows from the River Pang flooded Briars Close. Flooding was probably more related to overland surface water flow and the very low level of the properties. This indicates the need for new developments with any risk of flooding to be designed to minimise damage as a result of flooding. However, in West Area it was the duration of the event that was the greatest problem.
- 5.1.6 Some flooded properties lay outside the flood risk areas indicated by the indicative flood maps. The individual circumstances need to be investigated and the maps amended as may be shown to be necessary.
- 5.1.7 The following table gives some indication of the severity of the event by giving the rank of the peak flow or level and the number of years of record. The highest levels and flows since 1947 were recorded on the lower Roding and the highest flows since 1968 were recorded on some stations on the Mole. The flows and levels on the Loddon and Blackwater were high, but not the highest recorded. However, observed levels further downstream were apparently higher than in 1968. Flows on the River Wey were high with numerous flooded properties, and the records at Tilford show this to have been the highest flow since 1968. Data from the old gauging station indicate higher events occurred in 1954 and 1960, but this was not a very reliable station.

Table 5.1 Indication of the severity of the event

Catchment	Site	Level (m)	Flow (m ³ s ⁻¹)	Indication of flood rarity Rank/years of record *see Note 2	
North East				Rank	Years of record
Colne	Berrygrove (Watford)	1.685	See note 1		
Crane	Marsh Farm	0.915	11.9	6	24
Brent	Colindeep Lane	2.012	13.6	5	22
Upper Lee	Luton Hoo	0.551	3.9	10	41
Lower Lee	Low Hall	2.199	See note 1	1	21
Cobbins Brook	Sewardstone Road	2.520	See note 1	1	30
Turkey Brook	Albany Park	1.394	See note 1	2	28
Mimram	Panshanger	0.899	2.4	16	48
Beane	Bragbury Park	0.776	3.8	5	27
Ash	Mardock	1.340	13.6	1	22
Rib	Wadesmill	1.606	18.4	5	21
Stort	Sheering Hall	1.711	See note 1	1	27
Roding	Redbridge	2.300	See note 1	1	49
South East					
Mole	Gatwick Airport	1.626	16.1	2	40
Mole	Horley	2.583	48.5	2	40
Mole	Kinnersley Manor	3.376	74.9	1	28
North Wey	Farnham	1.270	28.1	1	24
Wey	Tilford	1.986	38.9	4?	47
Wey	Weybridge	1.934	83.4?	1	23
Loddon	Sheepbridge	1.120	22.425	4	36

Blackwater	Swallowfield	1.443	35 severe bypassing	2	49
West					
Cherwell	Banbury	1.42		6	34
Kenet	Theale	1.534	63.5	2	40

Note 1: No flows are currently available for these sites since the extreme levels reached are outside the modular measurement range of these sites. Manual calculation of flows is on-going. Many gauging weirs were drowned and/or bypassed, and so precise flow estimates must be treated with caution.

Note 2: For example the River Brent recorded its 5th highest flow in 22 years.

Table 5.2 Summary of river levels (above station datum) in NE Area

Gauging station	River	Maximum level recorded during event (m)	Time elapsed since river last exceeded this level	Date of highest recorded level
Berrygrove (Watford)	Colne	1.685	Highest recorded	n/a
Marsh Farm	Crane	0.915	21 years	28/12/79
Colindeep Lane	Brent	2.012	16 years	5/10/84
Luton Hoo	Upper Lee	0.551	16 years	17/06/84
Low Hall	Lower Lee	2.199	Highest recorded	n/a
Sewardstone Road	Cobbins Brook	2.520	Highest recorded	n/a
Albany Park	Turkey Brook	1.394	21 years	30/05/79
Panshanger	Mimram	0.899	4 years	23/07/96
Bragbury Park	Beane	0.776	7 years	13/10/93
Mardock	Ash	1.340	Highest recorded	n/a
Wadesmill	Rib	1.606	7 years	13/10/93
Sheering Hall	Stort	1.711	Highest recorded	n/a
Redbridge	Roding	2.300	Highest recorded	n/a

Table 5.3 Summary of river levels (above station datum) in SE Area

Gauging station	River	Maximum level recorded during event (m)	Time elapsed since river last exceeded this level	Date of highest recorded level
Gatwick Airport	Mole	1.626	32 years	15/09/1968
Horley	Mole	2.583	32 years	15/09/1968
Kinnersley Manor	Mole	3.376	>28 years	6/11/200
Farnham	North Wey	1.270	>24 years	30/10/2000
Tilford	Wey	1.986	32 years	16/09/1968
Weybridge	Wey	1.934	>23 years	7/11/2000
Sheepbridge	Loddon	1.120	26 years	22/11/1974
Swallowfield	Blackwater	1.443	32 years	16/09/1968

Table 5.4 Summary of river levels (above station datum) in West Area

Gauging station	River	Maximum level recorded during event (m)	Time elapsed since river last exceeded this level	Date of highest recorded level
Cerne Wick	Churn	0.619	5 years	31/01/71
Water Eaton	Ray (Wilts)	2.500	1 year	27/09/74
Bibury	Coln	0.394	1 year	11/02/90

Inglesham	Cole	1.366	21 years	28/12/79
Worsham	Windrush	1.707	1 year	28/12/79
Cassington	Evenlode	0.848	1 year	28/12/79
Banbury	Cherwell	1.428	2 years	09/04/98
Grendon Underwood	Ray (Oxon)	1.666	7 months	10/07/68
Abingdon	Ock	0.982	6 years	16/03/82
Wheatley	Thame	5.806	10 years	04/02/90
Pangbourne	Pang	0.650	26 years	22/11/74
Theale	Kennet	1.563	29 years	11/06/71

5.2 Source of Flooding, Main River, Ordinary Watercourses, Surface Water

Source of flooding across the Region varied, and is summarised below in Table 5.5

Table 5.5 Source of flooding

LOCATION	No of Props	WATERCOURSE	LOCAL AUTHORITY	CAUSE A - Main River B - Ordinary W'cse C - Blockage D - Surface Water E - Sewer
NE Area				
Woodford, Essex		River Roding	LB Redbridge	A, B
Ilford, Essex		River Roding	LB Redbridge	A,B,D
Redbridge total for above	230	River Roding	LB Redbridge	A,B,D
Waltham Abbey, Essex	130	Cobbins Brook	Epping Forest DC	A,B,D
Nazeing, Essex	20	Nazeing Brook	Epping Forest DC	A,B
Edmonton	75	Salmons Brook	LB Enfield	A,C,D,E
London Colney, Herts.	40	River Colne	St Albans DC	A,C,D,E
Colney Heath, Herts	5	River Colne	St Albans DC	A
Colnebrook, Slough	8	County Ditch	Slough BC	A,D
South Mimms, Herts	11	Mimmshall Brook	Welwyn Hatfield DC	A
Stanwell Moor Village	30	River Colne	Spelthorne BC	A,B,D
Bishops Stortford	10	River Stort	Bishops Stortford TC	A,C,D
Stansted Mountfitchet	37	Ugley Brook	East Stortford DC	A,C,D
SE Area				
Woking	142	River Wey	Woking DC	A,E
Godalming	32	River Wey	Waverley DC	A
Guildford	36	River Wey	Guildford BC	A
Shalford	5	River Wey	Guildford BC	A
Byfleet	26	River Wey	Woking DC	A,E
Weybridge	48	River Wey	Elmbridge BC	A,E
Ockham	3	River Wey	Guildford BC	A
Various	19	River Wey	Various	A
Dorking	20	River Mole	Mole Valley DC	A
Leatherhead	4	River Mole	Mole Valley DC	A
Horley	2	River Mole	Reigate & Banstead DC	A
Ifield	7	River Mole	Crawley DC	A
Crawley	40	River Mole	Crawley DC	A,E
Various	1	River Mole	Various	A
Emm Brook	14	River Loddon	Wokingham DC	A,E
Winnersh	5	River Loddon	Wokingham DC	A

Charvil	6	River Loddon	Wokingham DC	A
Various	7	River Loddon	Various	A
Maidenhead	4	River Thames	Windsor & Maidenhead	A
Teddington	15	River Thames	LB Richmond	A
Walton on Thames	5	River Thames	Elmbridge BC	A
Various	7	River Thames	Various	A
Hale Bourne	13	The Bournes	Surrey Heath DC	A,E
Various	5	London Rivers	Various	A
West Area				
Winterbourne Monkton	3	Upper Kennet	Kennet DC	A,C
Stadhampton	1	Chalgrove Brook	South Oxfordshire DC	A
Pangbourne	10	River Pang	West Berkshire DC	A
Mortimer	3	Foudry Brook	West Berkshire DC	A
Faringdon	1	Uffington Brook	Vale of White Horse DC	A
Abingdon	2	Radley Park ditch	Vale of White Horse DC	C
Long Marston	1	Upper Thame	Aylesbury Vale	A
Banbury	1	River Cherwell	Cherwell DC	A
Witney	1	Lower Evenlode	West Oxfordshire DC	A
Shiplake	5	River Thames	South Oxfordshire DC	A
Goring	1	River Thames	South Oxfordshire DC	A
Wargrave	1	River Thames	Wokingham DC	A
Henley	4	River Thames	South Oxfordshire DC	A
Hannington Wick	8	Thames/Shire Ditch	Thamesdown BC	A,B
Cotswold Caravan Park	?	Cerney Wick Brook	Cotswold DC	A
Total	1106			

5.3 No. Properties not Flooded due to Agency Defences

5.3.1 The number of properties estimated not to have flooded due to Agency flood defences are listed below. These figures are the best estimates available at the time of producing the report.

Roding Catchment	600
Lower Lee / Cobbins Brook	300
Lower Lee / Salmons Brook	600
Lower Lee/Nazeing Brook	15
Colnebrook	37
Stanwell Moor / Bedfont Court	10
River Stort / Ugley Brook	700
Somerford Keynes	70
Aylesbury	122
Hannington Wick	8
Cove Brook	150
River Wey, Farnham	150
Total	2,760

In addition, Flood Alleviation Schemes on the River Lee, Lower Mole and South London Rivers prevented flooding to between 50,000 to 100,000 properties. Detailed analysis is needed to be more precise.

5.3.2 Routine preventative maintenance and emergency work by the EWF prevented flooding at number of locations, but it is not possible to provide a realistic estimate of the number of properties not flooded.

5.4 No. Properties not Flooded due to Third Party Defences

The number of properties not flooded due to third party defences is largely unknown at the time of compiling the report. It is estimated that the following did not flood.

River Stort and Ugley Brook	200
River Windrush, Standlake	20+
Bloxham Brook, Bloxham	10

5.5 No. Properties Flooded due to Failure (not exceedence) of Agency Defences

No properties were flooded due to failure of Agency defences, however, it is possible that one golf course on the Roding catchment flooded due to the failure of Agency defences.

5.6 No. Properties Flooded due to Failure (not exceedence) of Third Party Defences

It is not known whether any properties were flooded due to the failure of third party defences.

5.7 No Properties Flooded due to Exceedence of Agency Defence Standards

The best estimate at the time of compiling the report of the number of properties flooded due to the exceedence of Agency defence standards are as follows:

Roding Catchment	230
Lower Lee / Cobbins Brook	131
Lower Lee / Salmons Brook	76
Lower Lee/Nazeing Brook	21
River Colne / London Colney	38
Colney Heath	5
Colnebrook	6
Mimmshall Brook	11
Stanwell Moor / Bedfont Brook	29
River Stort / Ugley Brook	47 (Inc 37 commercial)
Hatch Mill, Farnham	1

Total 600

5.8 List of Towns affected without Adequate Defences, Viability (cost benefit) of Scheme

Roding Catchment	No viable schemes; current defence standard meets guidelines.
Lower Lee / Cobbins Brook	No viable scheme, previous b/c = 0.1.
Lower Lee / Salmons Brook	Lower Edmonton/Tottenham Cemetery; current defence standard meets guidelines.
Lower Lee/Nazeing Brook	No viable scheme, previous b/c = 0.7.

River Colne / London Colney To be reviewed.

Colney Heath To be reviewed.

Mimmshall Brook No viable scheme, present b/c = 0.9.

Stanwell Moor / Bedfont Court Stanwell Moor village, scheme currently being programmed for 1/100 design standard, but will be reviewed as a result of the flooding.

River Stort / Ugley Brook Bishops Stortford town centre, Stanstead Mountfitchet.

River Wey, Goldalming Scheme unlikely, low b/c.

River Wey, Guildford Many schemes previously considered, but b/c only 0.4.

River Wey, Byfleet Scheme unlikely, high cost, order of £10m.

Emm Brook Possible local scheme.

The Cut Possible local scheme.

Upper Mole, Ifield Green Promoting improvements.

5.9 Major Infrastructure Affected

Major infrastructure affected in Thames Region were primarily main roads including the following:

NE Area

Slip road to M11 at A406 junction roundabout.

A121, A113, A406, A1250, A414 (Epping Rd and Coppers Hill).

B194, B137, B5378, B1531, B1051.

SE Area

A245 (Cobham several days).

All roads into Guildford for 2 days.

Southbound A3 at Boulder Mere.

Winnersh Roundabout, Reading, 5 days.

West Area

None in this event, however, in December 2000 the main railway line between Didcot and Oxford was flooded and closed.

5.10 Incidence of Repeat Flooding

5.10.1 In Thames Region the incidence of property being flooded more than once during the event occurred at Lower Nazeing Village on the 30th October and 2nd November. On both occasions a Flood Warning was issued with sufficient lead in time. There were also at least 4 properties, which experienced repeat flooding at Old Woking, Goldalming, Leatherhead, and Hamm Court Farm.

5.11 Near Misses

A number of near misses occurred due to Agency defences close to being overtopped; those that are known are as follows:

	Properties
Kennedy Drive, Pangbourne	30
Nazeing Brook	50 – 100
London Colney	43
Colney Heath	4
Mimmshall Brook	1

5.12 Design Standards Adequate

Roding catchment	Generally 1/70, therefore, adequate.
Lower Lee/Cobbins Brook	1/30, therefore below indicative MAFF standards.
Lower Lee/Salmons Brook	1/70.
Lower Lee/Nazeing Brook	No, 1/35, but continues to flood frequently.
River Colne/London Colney	No
Colney Heath	No, 1/5 or less
Mimmshall Brook	No.
River Stort	No
Ugley Brook	Yes
Lower Mole	1/200 adequate.
Farnham (2 stage channel)	Believed to be 1/70, needs further investigation, may have exceeded 1968 flood.
The Cut, Binfield	Needs further investigation.
River Blackwater, at Ash	Needs further investigation.

5.13 Need for Schemes

River Pinn	Review required.
River Roding	Needs review of current standards and maintenance practices of all areas flooded.
Lower Lee/Cobbins Brook	Yes, however, unlikely to be justified.
Lower Lee/Salmons Brook	No, however, minor investigation required to identify why flooding occurred (possible blockage)

River Colne/London Colney	Yes
River Beam	Review underway.
River Crane	Review required.
Lower Lee/Nazeing Brook	Recently reviewed, potential need for further studies.
Colney Heath	Yes – but is well below indicative standard, b/c = 0.92, but rejected by residents.
Mimmshall Brook	Scheme currently programmed without MAFF Grant Aid due to low priority score.
River Stort/Ugley Brook	Yes, currently being worked on.
River Churn/South Cerney	Yes, flood embankment, and other options being investigated.
Stratfield Mortimer	Yes, options being considered.
The Cut, Binfield	Pre-feasibility studies being prepared.
Emm Brook	Pre-feasibility studies being prepared.
River Wey, Goldalming	Pre-feasibility studies being prepared.
River Wey, Weybridge	Pre-feasibility studies being prepared.
Upper Mole, Ifield	Pre-feasibility studies being prepared.
Gatwick Stream, Crawley	Pre-feasibility studies being prepared.

5.14 Need Identified but no Scheme

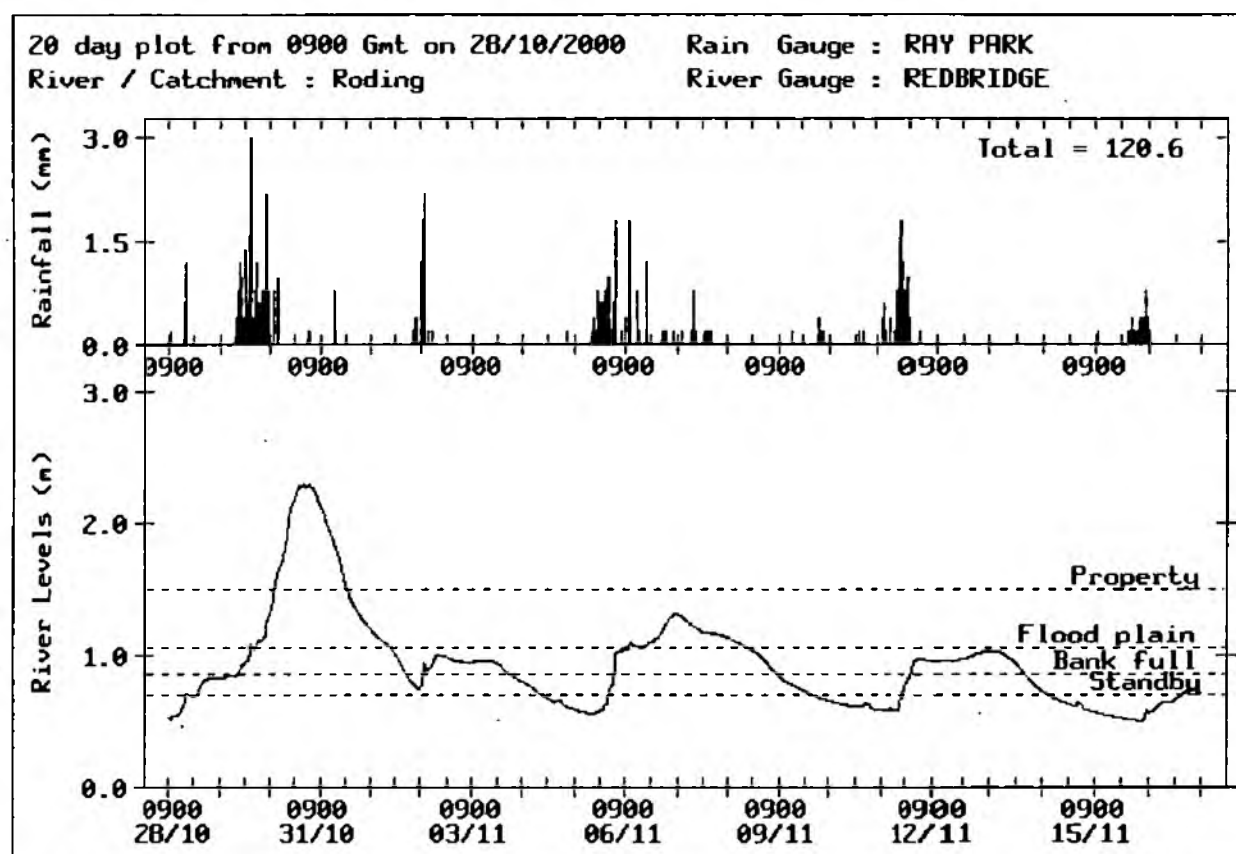
River Pinn	Review required
Roding catchment	Statement of need required.
Lower Lee/Cobbins Brook	Statement of need required, to review previous study.
Lower Lee/Salmons Brook	Statement of need required.
River Colne, Bedfont Estate	Review required
Stanwell Moor Ditch Stanwell Moor Village	Review required
River Colne Stanwell Moor Village	Review required

Silk Stream, Edgware	Review required - under investigation.
River Colne/London Colney	Statement of need required, to re-evaluate need for small flood alleviation scheme.
River Stort/Ugley Brook	Currently being investigated.
River Pang/Sulham Brook Pangbourne	Feasibility study due shortly.
River Cherwell/Banbury	Feasibility complete.
Guildford Town	Guildford town has been identified in the past, but since the b/c ratio is in the order of 0.4 no scheme has been forthcoming. Discussions have previously taken place with Guildford BC but they did not show any interest in contributing funds.

5.15 Contributory Factors

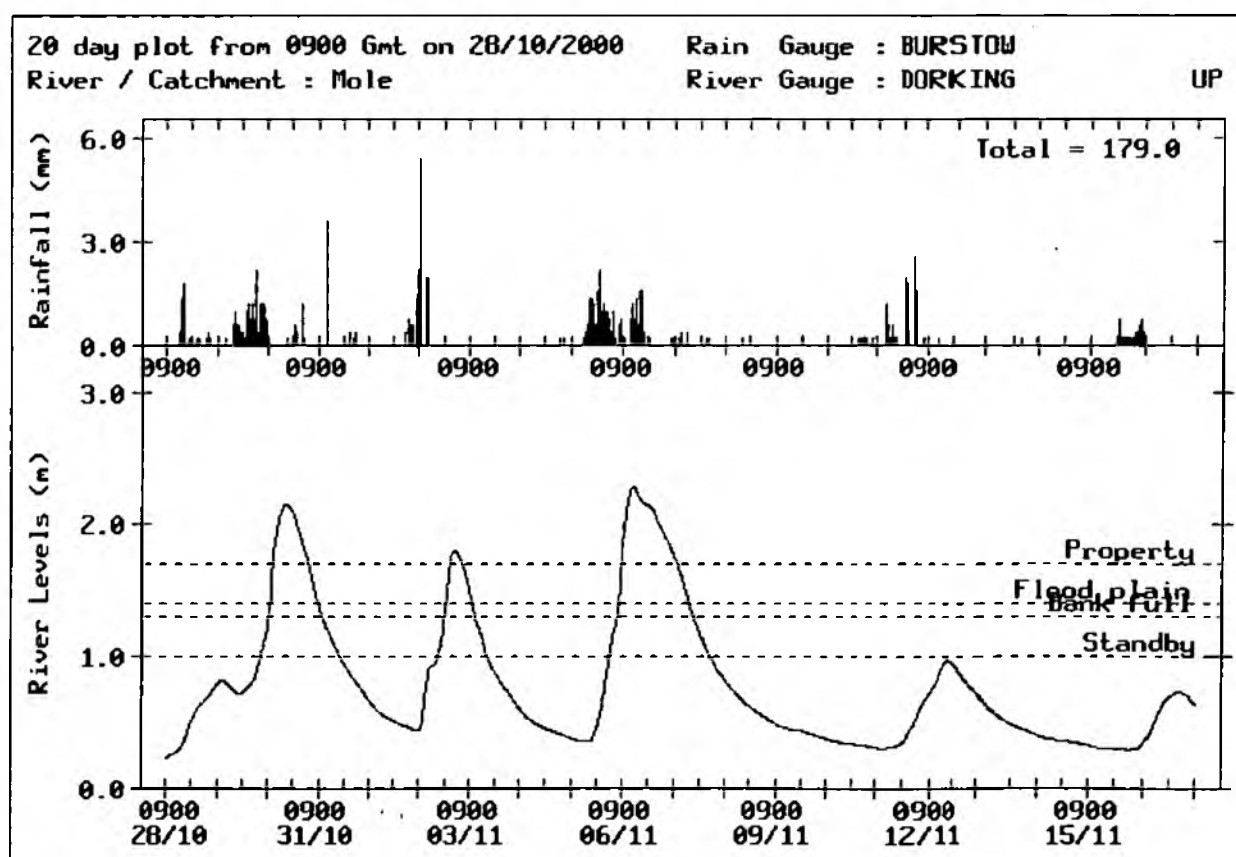
It has not been possible to determine whether unconsented structures, for example, contributed to, or aggravated any flooding.

Figure 5.1 Example Hydrographs: Rivers Roding, Mole, Wey and Thames



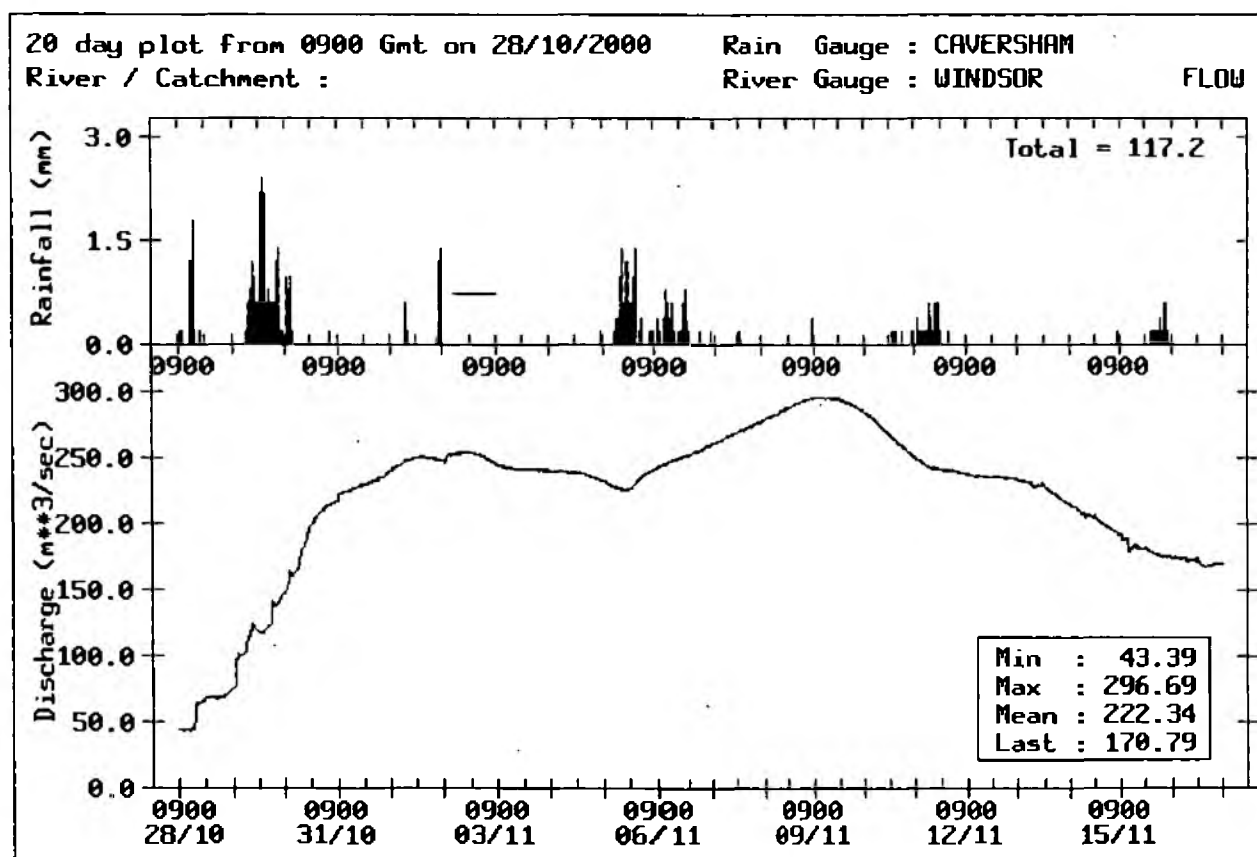
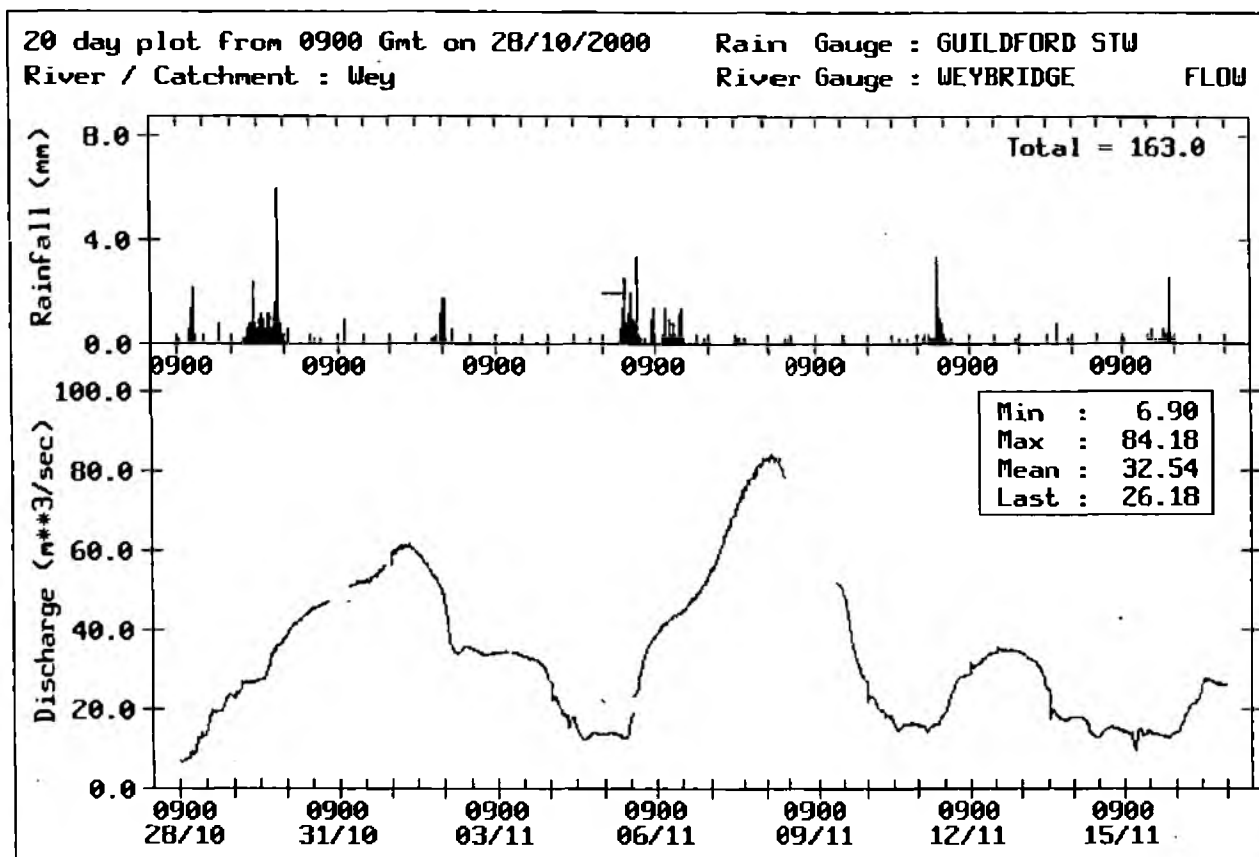
Hydro-Hetogram of Telemetred Data

(c) EA (Thames) 2000



Hydro-Hetogram of Telemetred Data

(c) EA (Thames) 2000



CHAPTER 6 : EMERGENCY RESPONSE

6.1 Major Incident Plans Activated

- 6.1.1 A number of requests were received for Agency staff to attend Gold or Silver control from the Region's NE and SE Areas. Only three of these requests were met on an intermittent basis, Gold at LB Redbridge and Epping Forest District Council, and Silver at Surrey CC. Due to the widespread nature and duration of the event it meant that those requesting elsewhere Agency staff were unavailable to attend. However, the other Local Authorities requesting attendance were made aware that specific Agency officers were available to input to these controls via the telephone if required. This was understood and accepted.
- 6.1.2 Many other local authorities activated their major incident procedures and opened emergency centres, with some opening rest centres for the public.

6.2 Adequacy of Agency Resources

- 6.2.1 There is no benchmark standard against which to judge the performance of the flood defence client in any particular event. This is in contrast to each Region's EWF, where such a standard has been set (as part of the process to establish the "Noble Numbers"). This concept for the client needs to be addressed at national level.
- 6.2.2 There were no major problems with the availability of existing members of FD staff, and no shortage of volunteers from the other Area functions, who were willing to help out in any way they could.
- 6.2.3 There is, however, a general shortage of staff within FDWR (especially appropriately experienced staff) who can populate rostered duties and provide other general support, especially in longer-term events such as this. For example during the event SE Area's Flood Defence and Water Resources was operating with 35% vacancies.
- 6.2.4 Such shortages are particularly, but not exclusively, acute in the following roles:
- Area Base Controller
This will require training, clarification of the role and regular updates. A standby roster will be implemented to ensure general availability and preparedness of individuals.
 - Assistant Flood Warning Duty Officer
This will be addressed through additional training of staff, but any long-term event such as that recently experienced will test our resources when lengthy shift patterns are required.
- 6.2.5 With current vacancy levels a similar event occurring over a holiday period such as bank holiday or Christmas, would present even greater difficulty in maintaining a suitable shift pattern.

- 6.2.6 Agency staff were deployed as the circumstances dictated. A total of 50 flood recording staff were feeding information into the AIRs and closely liaising with the local authorities and the Fire and Rescue Services on the ground. Ten hydrometric staff were gauging flows on the various watercourses as they were reaching their peak. A total of 263 EWF staff were involved during the event.

6.3 Emergency Services, Local Authorities, other Response Organisations

- 6.3.1 At peak times, liaison with the emergency services and local authorities was mainly carried out through a specific liaison officer, in order to help consistency and ease of communication amongst the parties. Specific subjects were current overview status reports of particular catchments & locations, plus exchange of detail information on locations flooded.
- 6.3.2 The Agency had good contact and liaison when necessary with the emergency services. For example at Pangbourne the Berkshire Fire Service were on the scene where Agency pumps were pumping water from one watercourse to another watercourse, and four fire pump tenders pumping water from properties.
- 6.3.4 There are a large number of tasks that fall to local authorities in flood emergencies. These include response to flooding on Ordinary Watercourses and where applicable, giving help to the community such as providing sandbags evacuation and temporary shelter, and re-housing.
- 6.3.5 The Agency's Supervisory Duties include leading the involvement of other organisations in planning for and responding to floods. Overall, the performance of our professional partners was very good, but it is recognised that differences in arrangements and resource limitations result in variations in performance. This inconsistency presents a challenge to the Agency, and can result in staff in a flood event being drawn into a mediating role between the public and local authorities in particular. Seen in the context of the fragmented responsibilities of different aspects of drainage, the uncertainty or confusion this creates with the public is perhaps not surprising.
- 6.3.6 During the flooding, liaison with local authorities was generally very good, both on the ground and with control centres. There were variations between the standards of readiness and response, however, which need to be explored further in some instances.

6.4 Properties Evacuated

Properties are reported to have been evacuated in the following areas:

River Roding, Woodford Green	15
River Roding, Wanstead, London	15
Mimmshall Brook, Warrengate Road, North Mymms	*
Nazeing Brook, Lower Nazeing Village	*
Spout Lane Ditch, Spout Lane East, Stanwell Moor	*
River Colne, London Colney	*

Cobbins Brook, Waltham Abbey	*
Crawley, Sussex,	40
River Thames, Wheatleys Ait, Thames Ditton Island, and Trowlock Island	60+
Rivermead Rehabilitation Centre, Oxford	20+

* Self evacuation, actual nos. not available

In addition across the Region a number of individual properties, pubs, hotels, restaurants and offices were evacuated.

6.5 Views of Flood Victims

- 6.5.1 Views of flooding victims was mixed, dependent on whether they had previously been flooded and their understanding in terms of operating the river system, for example the control of sluice gates etc. Many of those affected are now expressing their views including praise and criticism at public meetings and in correspondence.
- 6.5.2 At the time of compilation of this report, NE Area have received, 70 letters from the residents affected, their MP or Councillors. These cover the Upper Colne, River Stort, Lower Lee, River Roding, River Crane and River Pinn.
- 6.5.3 As is the experience of previous flood events, the majority are expressing their concerns about recent flooding. Many are seeking a commitment from the Agency that action will be taken to prevent flooding in the future. A number are of the opinion that development permitted (sic) by the Agency has resulted in their properties now flooding. Some are surprised to find that their property was in the flood plain.
- 6.5.4 In addition to above points, some of the letters also allege that they did not receive a flood warning or received a late warning.
- 6.5.5 Several letters thank the Agency and its staff for their work during the flood event. Many more commendations have been received verbally, either in person by field staff, or via the telephone both during and after the event.
- 6.5.6 It became clear that many flood victims, or potential victims needed guidance or information on measures they could take to protect their property and belongings, and to reduce flood damage.

6.6 Views of External Partners

- 6.6.1 On the whole the Agency has received good feedback from its partners, but in particular from those involved in the River Roding flooding. Communication with our partners was good throughout and they have recorded their appreciation of the time and effort Agency staff were able to provide to them. Encouraging and positive comments have been received on the partnership, which was evident both on the ground and between officers in the Incident Centres.

- 6.6.2 Following a letter sent out to all the local authorities thanking them for their support and requesting information on the flood event, comments are being received from many of them. The majority are investigating their own incidents on surface water/foul/river flooding and considering if work is needed in the future. A sample of views appears in Appendix F.

6.7 Flood Recording

- 6.7.1 The Region operates a Flood Data Recording System managed by four Flood Data Recording Standby Officers (FDRSO) in each Area. The FDRSO can call Flood Data Recording Officers (FDRO) from both the Area and regional offices during an event to record flood levels, flows, extent, and take photographs.

6.7.2 Manpower

At the height of the event, FDRO's also supported operational staff in identifying where flooding was either happening or was likely. This is needed mainly due to a lack of river gauges at some sites. The numbers of staff available for immediate call-out at these times was insufficient. However, once the scale and locations of the actual flooding were identified, it became more feasible to resource the flood data-recording task required.

- 6.7.3 Factors relevant to staffing availability are summarised below:-

- Widespread nature and length of the event
- Resources previously available for flood data recording now have substantive operational posts following CNFDR
- There are 47 vacancies across the region in Flood Defence, despite a number of attempts to recruit staff.

6.7.4 System Management

There were no difficulties in filling the shadow roster on this occasion, as all four FRDSO's from the normal roster were available. During this event, the above shadow roster was set up after 3 days which was not soon enough putting unnecessary pressure on the original FDRSO working over this prolonged period. It was felt that the FDRSO would benefit from a dedicated assistant at such times.

- 6.7.5 The gathering of flood information by the local authorities is being pursued by letter drops to affected residents requesting more detailed information. The Agency has collated all the logs of the monitoring staff together with photos and video footage and plotted the flood envelope, and where necessary arranged additional survey work. Further work is needed to develop data recording arrangements, which were initiated, following the Easter 1998 floods.

6.8 Emergency Work Force (EWF)

6.8.1 General Performance

The nature of this particular event was such that whilst significant flooding did occur, it happened very quickly on the tributaries, which reduced the demands on the EWF to carry out preventative operations.

6.8.2 The EWF were fully deployed clearing obstructions to flow where possible, delivering sandbags, and assisting our professional partners. Two sandbag-filling machines were in constant use at the Agency's Sunbury depot. In all, some 40,000 sandbags were filled and deployed, including 11,200 provided to Southern Region.

6.8.3 There was a very favourable public reaction to the activities of the EWF who were praised for their quick response to reported problems and their professionalism. The value of in-house resources with local knowledge and relevant experience was demonstrated.

6.8.4 However, the region has many urban catchments and had these been affected an immediate many-fold increase in demand for site attendance would have resulted.

6.8.5 Impact on Normal Work Programme

During the five-week period very little flood defence maintenance work was undertaken. Normally flood running (clearing debris from trash screens, structures, pinch points etc.) would be expected to account for 20% of their time. Effectively, four weeks of watercourse maintenance have been delayed.

6.8.6 The floods have also delayed construction of capital works, which will require work to be carried over to next year.

6.8.7 Transport, Plant and Equipment

Experience during the event, highlighted several issues:

- The need for additional resources was identified, notably a long reach grab lorry and a compressor, and these should be available in the next financial year.
- At Osney Depot sandbags are filled by hand. Although West Area were not short of sandbags, with a sandbagging machine the region could have provided more sandbags to other Regions if requested and reduced the cost of providing sandbags, as well as releasing labour for use elsewhere. Consideration should be given to the purchase of a sandbagging machine in each Area.

6.8.8 Materials

The only materials used were sand and sandbags. West Area had an ample supply of bags but need to set up arrangements with local sand suppliers to have 24-hour contact and delivery.

- 6.8.9 The limited stock of sandbags are primarily held for the purpose of protecting our own assets and securing our own defences. In a more severe event they would very quickly have been used up for these purposes. The Agency would also have come under a great deal of pressure to use these for the benefit of the public.
- 6.8.10 There is still a very important need to get a properly published, consistent policy for the issuing of sandbags to the public by the Agency.
- 6.8.11 Procedures
Key tasks to be undertaken by the EWF were clear.
- 6.8.12 In West Area an EWF officer is in the AIR when it is opened and is an advantage. However, staff need to be reminded that requests for the EWF's services of the EWF go to this EWF representative in the AIR.
- 6.8.13 Some minor tasks were added to those of the key EWF roles, but with the exception of those for the Area Operations Team Leader (AOTL) these additions were minor. The AOTL role evolved to focus on visiting sites where engineering solutions were required to a short time scale. The senior Duty Co-ordinator's role was carried out by other members of the team during this time and the overall result was seen to be successful. With the limited EWF staff resources available, realistically this was probably the most productive way to manage this event.
- 6.8.14 The main debate in the Region's NE Area was, and will be, whether or not to have an EWF representative in the AIR. In this event it was not felt beneficial to have a senior duty co-ordinator based in the AIR. The use of the FD Inspectors to review the work issued to the EWF was particularly effective. If the Inspectors' priorities had not allowed this, EWF Supervisors could have carried out this role in the AIR, although their expertise, and that of their assistants (HCO's) could be better used out on site.
- 6.8.15 Communications
Communications have shown vast improvement over previous events as all gangs now have a mobile telephone.
- 6.8.16 Manpower
The EWF maintained their standard roster throughout the event, with the addition of an upper tier co-ordinator and additional standby gangs. This avoided potential confusion of responsibilities and contacts, and implementing revised rosters for the gangs.
- 6.8.17 The manpower and resources available were adequate for this event although very little night work occurred. Where the gangs worked nights and when individuals lost any sleep they were stood down for at least eight hours.
- 6.8.18 This event provides the data to review the Noble number and this work should be carried out to a nationally agreed approach.

6.8.19 Liaison

Reporting lines generally were clearly understood internally. The EWF understanding of the operation of the AIR and the roles of the individuals manning the AIR was generally poor. A familiarisation session or a joint training exercise will be necessary.

6.8.20 EWF Flooding Costs

The total costs for the EWF between 29 October and 30 November is £626,325.00, broken down as follows:

Labour	£593,637
Material/Expenditure	£ 20,762
Plant Charges	£ 7,437

Total £626,325

Table 6.1 Summary of EWF personnel involved in the event

Emergency Works Unit	
Number of people involved	245 manuals and 24 staff
Number of shifts involved	13 x 24hr shifts (17 manuals involved)
Number of hours worked	21,500

6.9 Hydrometry

6.9.1 Manpower / Rosters

The Hydrometry Team provides a service to the Area and to Regional Flood Monitoring and Forecasting. During the event the hydrometry teams were asked to provide:

- Procurement, installation and commissioning of three temporary flood warning stations (all completed and operational within 60 hours from decision).
- Repair and calibration of permanent hydrometric network sites
- Current meter gauging to establish extreme discharge to stage relationships at one flow gauging station and one flood warning station

6.9.2 In addition to the Hydrometry Standby Officer (HSO), extra officers were deployed outside normal hours, the remainder of the team being fully utilised during each normal working day.

6.9.3 FDROs could be trained to assist hydrometry staff with current meter gauging, thus allowing the deployment of more teams. This would also leave the HSO available to deal with more technical emergency responses, generate more

instantaneous flow data during an event and allow more gauging station calibration to take place throughout their full range.

- 6.9.4 This, along with an emergency roster, would ensure that staff could rest during a protracted event where Hydrometric Officers are often expected to work long hours in extreme weather conditions.
- 6.9.5 The normal HSO roster remained in force throughout, which proved effective for this event. However, a shadow roster should have been put in place and this is considered essential for more protracted events.
- 6.9.6 The Hydrometry Teams were operating with 7 vacancies during this event.
- 6.9.7 Reporting lines
During normal office hours, contact is to either the Team Leader Hydrometry, or either of the Hydrometry Officers. The response is then the senior officer's responsibility unless this has been delegated to the HSO.
- 6.9.8 Outside normal office hours the HSO reports and is accountable to the Regional Monitoring and Forecasting Duty Officer (MFDO) but also liaises directly with the Area Flood Warning Duty Officer (FWDO). During a significant event the HSO will establish contact with the Team Leader Hydrometry who will, if necessary, assume a hydrometric co-ordination role.
- 6.9.9 A clear reporting line for the HSO is needed to avoid the potential conflict between:
- MFDO for telemetry response
 - FWDO for local observation and calibration of outstations
 - FD Telemetry Officer who may require emergency support for telemetry instrumentation at structures
 - Project Managers who require extreme flow gauging to be undertaken for calibrating models and as background information for FD schemes.

6.10 Health & Safety

- 6.10.1 The main Health & Safety issue related to the hour's people worked. Some staff had to be firmly told to "stand down". Others worked 12-hour shifts for several days in a row. The risk this poses needs to be recognised in the procedures and uppermost in the mind of all managers in future events.
- 6.10.2 Flood recording officers were expected to cover catchment areas with which they were unfamiliar. This will be addressed either by training or enhanced risk assessments.
- 6.10.3 Risk assessment procedures were not immediately available to flood data recording personnel.
- 6.10.4 The use of grab lorries for screen and blockage clearance, and the use of one tonne bulk bags more than once, has been questioned and is being investigated.

- 6.10.5 In the SE Area some 'flood running' was not undertaken during the hours of darkness since this was considered to be unsafe due to out-of-bank conditions. Although this was not highlighted in NE Area, the need for emergency lighting in the gang vehicles has been acknowledged. Risk assessments for working at night are required.
- 6.10.6 Some structures that were inspected/operated during the floods need work on them which has been picked up through Risk Assessments.
- 6.10.7 One or two operatives developed strains whilst filling sandbags using the machine at Sunbury. Working practices will be changed to overcome this.
- 6.10.8 The ABC role includes ensuring that AIR-based staff do not work unnecessarily long hours in an event. Accountability for ensuring the same for field officers needs to be defined.

CHAPTER 7 : PUBLIC RELATIONS

7.1 Introduction

- 7.1.1 The regional public relations team co-ordinated media activity associated with the flooding event. This rostered service was provided on a 24 hours a day, seven days a week basis with media officers maintaining close contact with staff in flood warning teams at both regional and area level. The majority of interviews given were by Area or regional flood defence staff. The enormous demand for information from both external and internal sources and the sheer quantity of information circulating, threatened to overwhelm the team at times. Activity outside office hours was hampered by insufficient equipment.

7.2 Links to the Media

- 7.2.1 The time spent preparing the media for the Public Awareness Campaign this year proved to be very worthwhile. The new flood codes and the Agency's role in flood warning were explained to many of our key media outlets from June to August. This has resulted in more consistent reporting of flood warnings and the Agency's role in flooding scenarios. It also helped in educating media staff, leading to more productive interviews for the benefit both of the public at risk and the Agency's reputation.
- 7.2.2 A dedicated team of Regional Flood Warning staff was identified in advance, and it was these individuals who performed the majority of the media interviews. This placed a heavy demand on a few individuals. The Flood Warning Information Officer acted as the main point of contact with Public Relations, and establishing a similar post may be beneficial to other Regions.

7.3 Media coverage

- 7.3.1 The Public Relations team received well in excess of 600 calls from the media (local and national newspapers, radio stations and TV) between October 30th and November 15th. 24 press releases about flooding were issued between 30 October and 13th November giving regular updates on the situation.
- 7.3.2 Area staff provided regular flooding information to Regional Flood Warning and Public Relations. This enabled the majority of interviews to be performed by Regional staff, leaving Area staff free to deal with the flooding incidents. This system worked well and should be adopted again in the future.
- 7.3.3 Over 150 interviews were given, mainly to local radio stations, and also local TV stations. With the initial interview requests coming direct to PR, the flood warning information officer allocated staff to interviews and co-ordinated interview responses to journalists. This system worked very well, as journalists prefer interviewing technical experts rather than PR officers. Well over 350 press cuttings from local newspapers have reached the press office from our press cutting service, and around the same number from national newspapers, with more still on their way. The new media database greatly facilitated management of enquiries.

7.3.4 Interviews were distributed as follows:

TV	5
Radio	147
National Press	4
Local Press	2

7.3.5 Overall, media coverage was balanced and showed the Agency's work in a positive light, issuing warnings, responding to flooding and working with the emergency services. The Agency came across as being much more pro-active in its approach than during the Easter Floods of 1998. Even in areas where we were potentially open to criticism, such as Maidenhead, where the flood alleviation scheme is not yet completed and some homes were flooded, reporting was balanced.

7.3.6 The main issues of interest to the media were:

- General update on flooding situation
- Nos. of properties flooding and their location
- Weather forecast/rain fall expected
- Timing of warnings
- Specific local features/human interests e.g. celebrities homes flooded
- Unusual angles for stories e.g. vandalism of water pumps

7.3.7 The main messages communicated by the Agency included:

- Flood warnings in place and locations they cover
- What flood warning codes mean
- Role of the Agency and what staff are doing on the ground etc.
- Self help/vigilance messages to the public
- Risks to property in the flood plain
- The possible consequences of climate change

CHAPTER 8 : INCIDENT SPECIFIC

8.1 Introduction

- 8.1.1 There were no major incidents in Thames Region, however, as an example outlined below is a description of what was probably the most significant incident in the Region.

8.2 River Roding Defence Overtopping

- 8.2.1 In the Regions NE Area large areas of the floodplain of the River Roding were inundated. In the majority of locations property was not unduly affected, but two were of particular note, Woodford, Essex and at a few kilometres downstream at Wanstead in NE London. There is a flood defence scheme in place on the lower River Roding, involving significant lengths of earth bunding. The contributing sources of the flooding were surface water, Ordinary Watercourse, and Main River.
- 8.2.2 Wide-scale flooding at these locations appears to have commenced from surface water and Ordinary Watercourse flow. This was additionally constrained from joining the Main River due to its high level. In a couple of places, the Roding's Main River defence bunds were eventually overtopped and then breached, although the currently available data suggests that this augmented, rather than directly caused, the surface water flooding. However, survey and other investigations are continuing, in order to obtain better data on this.
- 8.2.3 The approximate number of properties affected is given elsewhere in this report. Also affected were large areas of the surrounding urban infrastructure. The emergency services were heavily involved in the response, as were the local authorities' community support services. Communications between the professional partners were generally good throughout this period. One exception however was the unauthorised removal of part of the Agency's Main River earth bund defence, to allow adjacent surface water to escape from the highway to the river. This went unreported until discovered by Agency staff. This could have been extremely serious had the River Roding level risen again. An immediate repair was carried out by the Emergency Work Force.
- 8.2.4 In addition to ongoing attention from Area Agency officers throughout, Sir John Harman and MAFF Minister Elliot Morley also visited these two locations, shortly after the peak of the event. The scale of the flooding in the Roding Valley has been captured by the police's aerial video footage, which the Agency has received a copy of.
- 8.2.5 Emergency repairs to the remaining damaged Main River defences plus the demolition of an adjacent, now unsafe, access bridge have already commenced at the time of writing.

- 8.2.6 In the recent visual survey of assets, the condition of the damaged embankments was recorded as good on the basis that crest level and embankment condition showed no signs of deterioration. The scour revealed that the fill material was unsuitable. This suggests that many defences may need intrusive investigation as part of the full structural surveys that are to be undertaken. The resource and time implications of this will need to be assessed.

8.3 Brooklands Motor Museum

- 8.3.1 As an example of the amount damage that can occur to one property, loss adjusters have estimated the damages from flooding by the River Wey to the Brooklands Motor Museum at Weybridge, Surrey, at £2,000,000.

CHAPTER 9 : TABLE OF MAJOR ISSUES

Issues & Recommendations

Chapter 9: Major Issues

Focus for action:

A © = Common to all Thames Areas

R = Region

• = National

Serial No.	Text Ref:	Issue	Recommendation	A ©	R	N
T01	2.3.2	Relationship between incident related management roles and line management roles ambiguous in some circumstances.	Senior management accountabilities and roles need to be recognised and accommodated in procedures	A ©	R	
T02	2.2.4	Limited data readily available to assist event comparison, event prediction, and operational response planning.	Produce "Historic Event" database related to impacts.	A ©		
T03	2.2.15	Confusion over when the AIR is "open" or "closed". The terms "open" and "closed" were misleading on occasions.	Ensure there are more easily understood criteria for when the AIR is open and closed. The terms "operating" and "monitoring" may be more self-explanatory.	A ©	R	
T04	2.4.4	Important messages sent by e-mail may be overlooked.	Email needs to be used with caution and a back-up telephone call to confirm messages received.	A ©	R	*
T05	2.5.1	Difficulties ensuring the continuity of practices as fresh staff were rostered into the AIR.	Produce a training plan to include an AIR training video	A ©		
T06	2.5.1	The deployment of the FDWR Manager in particular, and other experienced managers in active incident management has both advantages and disadvantages.	Needs debate at AMT and Function level, possibly Thames Operations Meeting		R	
T07	2.5.1	Reliance on too few experienced staff, putting the key players under a great deal of stress	Manpower and event planning need debate at AMT and Function level		R	
T08	2.6.1	Mid-event fault with Hatfield server but no CIS out of hours support. Major risk to functionality.	Investigate options for out of hour's systems support complemented by nationally agreed service standards.		R	*
T09	2.7.1	The provision of food and refreshments for AIR staff and arrangements for rest breaks etc.	Allocate accountability to an individual as welfare officer	A ©	R	
T10	2.7.2	Access to some sites difficult by road for those not intimately aware	Produce appropriate travel-route plans for flooded catchments.	A ©		

		of each catchments road networks, given the disruption caused to key transport routes.			
T11	3.1.2	Timing of daily forecast was out of step with requirements for SITREPS, etc. internally.	Negotiate earlier delivery of forecast from the London Weather Centre: 07.00hrs rather than 10.30hrs.		R
T12	3.1.9	London Weather Centre were not always making backup telephone calls when heavy rain warnings were issued	Raise with the London Weather Centre direct and secure agreement to revised procedures.		R
T13	3.4.5	Operational rainfall/runoff modelling should be fully implemented across the region.	Funding should be secured for software development and operational implementation of RFFS.		R
T14	3.4.5	The calibration of forecasting models for existing and new sites should be advanced.	Assistance from CEH Wallingford to obtain the necessary packages for model calibration. Staff training will also be required.		R
T15	4.1.3	Alarm levels were in some cases found to be inappropriate.	Continue the process of reviewing accuracy of alarm levels.	A ©	R
T16	4.1.4	Better definition of the triggers for Severe Flood Warning.	Nationally consistent definition needed, via Code Change Review Group		R *
T17	4.10	Where flooding from both fluvial and tidal rivers is possible, this is not highlighted on indicative maps	Amend maps and reissue externally and internally. Ensure those unfamiliar with indicative and FWA maps are aware of these factors		R
T18	4.11.2	Not issuing Flood Watch to public causes problems when downgrading from Warnings. Same for All Clear	Review and investigate options, refer to Code Change Review Group.	A ©	R *
T19	4.12.1	Heavy demand staff time used in giving out info on sandbags, weather and travel info.	Investigate better use of technology to reduce the demands on staff and implement as appropriate.		R *
T20	4.12.7	RMS not given priority in the dissemination process, led to delays in getting information out after the AVM	Floodline is a valuable public information service and needs to given equal priority to other flood warning systems, Further training required of both Floodline and RMS to Area staff in the AIR and FD.	A ©	R
T21	4.12.8	RMS fault occurred at 03.00hrs, no BT engineers on 24-hour shift to repair fault, during downtime some properties flooded.	Vital that BT engineers need to be on 24hr shifts to support RMS and Floodline, investigate options.		R *

T22	4.13.2	The AVM failed on a couple of occasions in all 3 Areas, requiring rebooting in 2 cases and an engine replaced in West Area.	Investigate further with Kingston Communications to ensure robust systems.	A ©	R	
T23	4.13.3	An Update voice message needed when warnings have been out for a few days	Explore possibility	A ©	R	*
T24	4.16.1	Consider the content of the voice message especially for Flood Watches which goes to flood wardens	Needs to be reviewed along with content of other AVM messages	A ©	R	*
T25	4.14.2	Loudhailers proved ineffective as used.	Carry out review of usage and experience in other Regions.	A ©	R	*
T26	5.1.4	A quick assessment of flow return period can be misleading due to possible inaccuracy of measurements; poor access to historic event data.	Investigate empirical methods based on historical data e.g. ranking against highest flow by the number of years of record will give some indication of severity.		R	
T27	5.1.6	Some flooded properties outside limits on Indicative Flood Risk Maps.	Review circumstances and amend maps as appropriate.	A ©	R	
T28	5.13	Current strategies for capital investment and operational improvement based on pre-flood needs.	Review existing plans for adequacy in the light of this report.	A ©	R	
T29	5.14	A number of locations have been recognised as subject to risk and having scheme potential, but staff knowledge has been lost in successive reorganisations	Establish interim programme to identify potential risks and priorities pending Catchment Flood Management Plans.	A ©	R	
T30	6.2.1	Client side staffing needs in a major flood event neither clearly identified in terms of numbers and competencies nor related to a benchmark flood.	Consider the “Noble number” concept for the Client side, and relate to ‘event duration’ as well as ‘flood return period’.			*
T31	6.3.1	Inconsistency in readiness and response of Local Authorities (LA).	Seek to influence LAs’ via MAFF HLT dialogue and other liaison, specifically with respect to FDER.	A ©	R	*
T32	6.3.5	Diverse responsibilities for different aspects of drainage confuse the public.	Co-ordinated approach by the various organisations needs to be initiated at national level.			*
T33	6.6.2	Some delays in deciding how best to seek LAs’ views of response to the event.	Develop standard protocols across Agency.			*
T34	6.7.9	Alignment of data collection and management during a flood with the diversity and detail required for post	Develop EFAPA1:28 to produce a standard format of data collection and train flood	A ©	R	

		event analysis.	recording staff.			
T35	6.8.2	Dependence on sandbagging machine at Sunbury	Review needs for sandbags and bagging machines.			
T36	6.8.10	External demand for sandbags exceeded available capacity.	Review and publicise the policy for external issue of sandbags.	A ©	R	*
T37	6.8.18	Event provided evidence that EWF Noble number should be revisited.	Review Noble Numbers for EWF.	A ©		*
T38	6.9.5	Hydrometry manpower resources could be enhanced during an event.	Review hydrometry resource and use of flood data recording staff and others.	A ©		
T39	6.10.7	Strain experienced by operatives whilst filling sandbags using sand bagging machine at Sunbury.	Working practices need to be reviewed.		R	
T40	6.10.7	Many detailed H&S lessons learned from the event.	Share best practice nationally.			*
T41	7.1.1	Huge demand for flooding info from media, surpassing previous demands.	Procedure for twice daily News Releases faxed to Thames media partners to be established.		R	
T42	7.1.1	Large amounts of paper generated, Fax updates on warnings, HELP reports etc.	Investigate potential for database system between AIRs, functions, RCC and PR to enable updated info to be more easily shared.	A ©	R	*
T43	7.1.1	HO media required regular updating.	System for sending through press release updates established.		R	*
T44	7.3.3	Unprecedented interest from the media initiated large number of interview requests and information both during and outside office hours.	Formalise procedure for Regional Handling of media to avoid over commitment of lead interviewees. More flood warning and flood defence staff may need media training. FW have already identified a duty role for a media co-ordinator and will continue the close liaison with PR for all future flood events.	A ©	R	
T45	7.1.1	Images of flooding requested by media; currently no system exists to provide images quickly.	PR to investigate how images can be sent to press quickly.		R	
T46	7.3.3	New media database speeded up media call logging and enabled evaluation of enquiries to be performed more quickly.	Database template to be shared with other Regions for adoption.			*
T47	7.1.1	Insufficient equipment for out of hours work at home. There is a need to issue press releases etc. from home.	Review present procedures and identify resource needs and implement.		R	

APPENDIX A

DEVELOPMENT IN THE FLOODPLAIN

Note: Figures are for numbers of properties flooded in this event.

A1 Properties built in the floodplain

Properties built in last 5 years	20
" 6 - 10 years	76
" 11 - 20 years	144
" 20+years	900+

A2 Properties built against Agency's advice

Spiceball Leisure Centre, Banbury, Oxon.

A3 Comparison of flooding with S105 information

Information currently not available.

A4 Land allocated for development that flooded, or had Severe Flood Warning issued

Horley SE Sector flooded, otherwise awaiting information.

A5 Objection History

In West Area the Spiceball Leisure Centre, Banbury, was the only property flooded where the Agency or predecessors had previously objected.

In SE Area there have been 5 flooding objections to development in Weybridge, namely:

- 2 no replacement dwellings @ Wey Meadows
- Residential on land at rear of 23-59 Brooklands Rd (now Parnell Gardens)
- Residential on land of Wellington Way
- Office re-development @ 1 Brooklands Rd

There have been several objections over the years to office & residential development at Catteshall Rd, Godalming.

For NE Area, information currently not available.

A6 Enforcement issues

Collapsed redundant canal bridge near Cricklade on the River Key in West Area, investigations continuing.

The Road Bridge in Maidenbower, Crawley on the Upper Mole was found to be unconsented and of inadequate cross-sectional area. Since this was the direct result of flooding to property it has subsequently been removed with agreement of the owner, West Sussex CC.

APPENDIX B

PUBLIC RESPONSE

B1 Public responses/actions

- The most popular request from the public was for sandbags. An emotive issue for many who could not obtain them.
- Some individuals arrived at Sunbury Depot demanding them and the gates had to be closed as a result.
- In one instance at Byfleet Agency asked for a police presence to ensure fair distribution.
- Evidence of self-help and requests (by phone) for updates on the FWLs.
- Now receiving a large number of letters from individuals post-flood asking for action.
- Public meetings have been held at Maidenbower and Crawley on the Upper Mole. The cause of flooding at Maidenbower was a bridge culvert which was clearly unconsented and therefore has subsequently been removed. The cost is being born by West Sussex CC who effectively own the bridge.

B2 Proportion of properties who took effective action

- Unknown, many instances where sandbags and or plastic bags filled with earth were effective.
- Also aware of mastic being used around the doors and even windows to keep out flood water and there is at least one company attempting to promote this idea.

B3 Public awareness

- Public awareness appeared to be high. However, as one would expect, those that had experienced flooding previously were better organised and accepted the situation more readily.

B4 Commendations

- At least one letter was received praising the efforts of our workforce clearing trees and debris which resulted in lowered floods although the property still flooded.
- NE Area has received 4 commendation letters for its actions in this event, plus many verbal ones received via telephone whilst discussing post-event issues with the public.
- One letter particularly thanked our officers for the “measured and responsible” way in which they responded to questions from an aggrieved riverside community at one of the many post-flood public meetings that have been attended by staff from in NE Area.

- Two 'thank you' letters received in West Area, one from Chalgrove Parish Council for keeping a watch on the flood levels, and one from a householder at Greenhills Park, Bloxham for promptly removing a tree from the brook.

APPENDIX C

ORGANISATIONAL ISSUES

C1 Impact of CNFDR on ability of Agency to respond to the event

South East Area

- Having Flood Warning in the Area, following this implementation of CNFDR was definitely an improvement in terms of working with the Operations function. However, the links to Flood Forecasting (at Region) need to be more robust. Following the re-organisation, Flood Defence and Water Resources has been left vulnerable in this and possible future events due to both recruitment and turn-over of staff (currently 35% vacancies). In addition there were issues of insufficient staff with knowledge and experience.

West Area

- A new AIR and the provision of Area Flood Warning Delivery contributed to a successful outcome of the events.
- Since July, the new Flood Warning team had devoted some time to sourcing and training staff to attain 'standby' cover and these individuals were able to be rostered to provide 24 hour cover.
- However, there was a 'blurring' of CNFDR Roles and Responsibilities as staff from other Flood Defence Sections were drafted in, owing to a lack of local knowledge, technical know-how and experience in Operations.
- The consequences of this are raised in the Issues and Recommendations tables, and include health issues.
- Another effect of this is that core business in Flood Defence as a whole has suffered – delays of up to 4 weeks in revenue projects, the 'parking' of strategic planning initiatives are two examples.

Regional Flood Warning

- Regional forecasting had more time to focus on forecasting - not dealing with public calls – away from the pressures of frontline response.
- Liaison arrangements did not follow the procedures set out in CNFDR – e.g. regional forecasting officer could not always liaise directly with the Area Flood Warning Duty Officer. FW Officers in the Areas appeared not to be fully empowered to make decisions on flood warning matters.
- Media co-ordination at region worked very well - this procedure evolved as the event progressed. This should be put through to CNFDR as best practice during flood events.

C2 Can existing Agency structure cope with change i.e. may be short return periods but longer duration events

- Resource implications have been mentioned in several sections.
- The Areas would not be able to cope in any event if the only source of staff for the AIR, is from the Operations and Flood Warning teams. The complications arise

from having too few senior people with the local knowledge, technical know-how and experience in Operations.

- However, supplementing operations staff with experienced people from other teams – while having serious effects on core work and with health and safety issues – has been proven to produce a successful outcome.
- It seems clear that the Areas would struggle to cope with *long duration* events. Shorter duration events at discreet locations are relatively easier to manage and staff are able to recover more quickly.
- Support to FD from other functions was vital to manage this event. Given the significant level of vacancies that currently exists in Thames Region, without other function's assistance a number of roles would not have been performed. If another long duration event should occur, a decision would need to be taken on whether to sacrifice other functions' workloads to assist Flood Defence.
- It should also be recognised that the experienced Flood Defence staff that remain in the Areas are now more thinly distributed across the Flood Defence teams. This has resulted in a dilution of suitable staff available for specific roles, for flood warning and flood recording activities in particular.
- Other more detailed notes on the Areas' general resource constraints appear in Chapter 2 and Chapter 6.
- Flood Defence was reliant on support from other functions, as the event grew longer. This was the result of too few experienced staff, 35% vacancies in Flood Defence and Water Resources and 24-hour roster requirements.

General

A more severe event that significantly disrupted transportation and communications could interfere with the availability and movement of the Agency personnel, leading to a more limited and less satisfactory response to the flooding.

C3 Global Warming

- Interest in global warming was a feature of several media interviews. Although this was a significant event, examination of the regional record over the past 25 years suggests that it could be within the range of what might be expected from normal climatic variations. However, the possible influence of global warming should not be dismissed, as associated climatic changes may not be readily discernible from variations otherwise regarded as normal. The changes in rainfall patterns that climate change models currently predict, suggest that floods of the scale described in this report will become significantly more frequent over the next 20 years.

C4 Impact of Easter 1998 Floods Actions

- Extension and improved resilience of the river level telemetry network allowed improved monitoring on several Thames tributaries, leading to more reliable flood forecasts and warnings.
- Additional staff recruited to flood warning enabled a better warning service to be provided to those at risk and the professional partners

- Closer liaison with the Met Office facilitated greater mutual confidence in rainfall forecasts.
- The availability of Indicative Flood Risk Maps allowed warnings to be targeted more accurately.
- Local Flood Warning Plans enhanced an integrated response by the Agency and the professional partners
- The revised flood warning codes and the associated preparatory meetings with the professional partners ensured a more integrated response to the floods.
- The Flood Action Week 2000 and attendant publicity made for a more informed public better able to react to the warnings.
- Events demonstrated that visual surveys of assets provide an indication only of asset condition. More rigorous surveys will be needed where design and/or construction information is not available.
- Restructuring of flood defence had only a marginal impact overall on the response to the floods. The benefit of more staff and better-focused teams was offset by their relative inexperience.

APPENDIX D

ECONOMIC IMPACTS

D1 Cost of Emergency Response (£000s)

	<u>Staff</u>	<u>RWC</u>	
NE Area	62	111	
SE Area (inc Barrier)	250	268	
W Area	127	248	
Region	23		
Totals	462	627	1089

D2 Cost of Emergency Repairs (£000s)

NE Area	190
SE Area	125
Barrier	130
W Area	-
Total	445

D3 Extra Flood Defence Schemes Identified

These are listed as numbers of problem areas identified where pre-feasibility studies will be carried out which may result in flood defence schemes

NE Area	7
SE Area	6
W Area	2
Total	15

D4 Overall Economic Costs, Insurance Claim Level and Distribution

Overall impact unknown.

Known Impacts:

- Brooklands Museum, Weybridge, River Wey, £2m damages.

D5 Impacts on Employment

Impacts unknown

Supplementary Information (£000s)**D2 Cost of Emergency Repairs****NE Area**

Diving inspections	30
Ilford GC embankment breaches	25
“ “ bridge repairs	10
Chigwell Rd ft'bidge embankments	5
Hendon Lane Weir repairs	30
Pymmes Brook, collapsed wing wall	2
Ugley Brook, removal of silt deposition	15
Colne Bedfont Ct, embankment repairs	6
Nazeing Brook, shoal removal	2
County Ditch, Poyle	10
Salvon Brook	5
Hartham Weir, Hertford, scour repairs	10
Bounds Green Brook, piling collapse	15
Associated consultancy costs	25
Total	190

SE Area

Teddington Roller Sluices	25
R Wey, gates at Millmead, Broad Oak,	60
Hamm Oil Mills	
Kidd Brook, collapsed wall	25
Ravensbourne South, culvert repair	15
Total	125

Barrier (as managers of assets damaged due to fluvial floods)

Barking, collapsed piling defence	90
Dartford Creek, collapsed defence	40
Total	130

Grand Total 445**D3 Extra Flood Defences Identified****NE Area (7)**

River Pinn
River Roding
Lower Lee
Upper Colne
River Beam
Upper Lee

River Crane

SE Area (6)

R Wey, Weybridge

Emm Brook, Wokingham

R Wey, Godalming

Gatwick Stream, Crawley

R Mole, Ifield Green

The Cut, Binfield

W Area (2)

R Churn, South Cerney

Foudry Brook, Stratfield Mortimer

APPENDIX E**HISTORY OF FLOODING**

Previous history of flooding in Thames Region since april 1998, estimate of properties flooded, and action taken subsequently:

DATE	RIVER	LOCATION	PROPERT IES	SUBSEQUENT ACTION
Easter'98	Cherwell	Banbury Kidlington Various villages	168 78 50	Scheme feasibility completed. Scheme starts in 3/01. Pre feasibility undertaken .
April'98 Jan'99 Dec'99 Apr'00	Pang	Pangbourne	Garages	Feasibility study expected shortly
Jan'99	Crane	Twickenham	1	
Jan'99 Jul'00	Non main river, trib Cranleigh Waters	Cranleigh Town Centre	26 16	Waverley BC have stepped up trash screen clearance, Feasability Studies undertaken with help from Thames Region.
Jun'99	Pinn	Ruislip	5	Review required.
Jun'99	Yeading	Hillingdon	4	
Dcc'99	Evenlode	Witney	1	
Jul'00	Non main river, trib Hogsmill	Surbiton	13	Kingston BC going out to tender to Consultants. Brief prepared by Thames Region.
Oct'00	Brickenden	Hertford	1	

APPENDIX F**VIEW OF PROFESSIONAL PARTNERS**

In Thames Regions North East Area 22 questionnaires were sent to Local Authorities, Police, Fire and Rescue Services, 14 have so far been returned with the following results:

QUESTION No.	ANSWER				
	YES	NO	N/A	DON'T KNOW	NONE
Q1 Do you feel the new codes provide sufficient information for your organisation to respond to a risk of flooding?	11	2	0	0	9
Q2 Do you feel the warning stages are clear and unambiguous and that the timing of warnings is suitable? If not, what would you like to see changed?	8	5	0	0	9
Q3 Do you find the warning fax layout and content easy to use and informative? If not, what changes would you like to see?	11	2	0	0	9
Q4 Do you feel the Local Flood Warning plans are adequate? What changes would you like to see in future revisions?	7	5	0	1	9
Q5 Did you feel there was sufficient liaison during the recent flooding to ensure an effective and co-ordinated emergency response?	6	6	1	0	9
Q6 Were the Agency able to assist you in responding to the flooding? If so, in which particular matters were the Agency able to assist?	5	4	4	0	9
Q8 Were there any additional areas where you felt the Agency could have assisted?	4	6	0	0	12
Q9A Do you feel there is a need to run joint exercises, annually?	9	3	0	0	10
Q9B Do you feel there is a need to run joint exercises, as part of training sessions for your staff?	9	3	0	0	10

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