Environment Agency Southern Region

Autumn 2000 Floods Review Regional Report

ENVIRONMENT AGENCY

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Cover: Firemen in rescue dinghy, Uckfield, Oct/Nov 2000

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FOREWORD

To ensure we deliver the best service to our customers it is essential that we continually review our performance and identify opportunities for improvement. This report has been produced to ensure an accurate and clear understanding of the events that occurred during the Autumn Floods and the role and response of the Environment Agency. Some issues have already been identified from a review of the events and recommendations are proposed. In the light of this report, and further flooding problems seen during the winter and into 2001, an Action Plan will be produced to address issues and opportunities. The Action Plan will contain a detailed time-scale for introducing improvements from both this Review and the National Review also being undertaken. We expect to produce this Action Plan for July 2001. Additional detailed reports for each of the Agency's three Areas within Southern Region – Hampshire and Isle of Wight, Sussex and Kent are also being prepared. In the meantime, much work is being done to secure damaged flood defences, increase the number of people who wish to receive direct flood warnings from us, and maintain and improve our readiness to respond to further flooding.

Copies of this review are being circulated to interested groups including Local Authorities, Emergency Services, local MPs and members of the public on request. If you are aware of any issues or further information in relation to the flooding events detailed in this report, we would welcome your written comments at the address below.

For convenience a foldout glossary of terminology used is provided at the back of this report.

David Jordan
Regional Director

February 2001

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ENVIRONMENT AGENCY

EXECUTIVE SUMMARY

Autumn 2000 was the wettest in England and Wales since records began in 1766. Between 15th September and 15th November 2000 a series of storms with heavy rain repeatedly swept across Hampshire, the Isle of Wight, Sussex and Kent with up to three times the average monthly rainfall, three months in succession. Four serious flood events resulted from the deluge, causing widespread disruption and devastation to around 2,500 properties and businesses with thousands of people directly and indirectly affected by the flooding. The problems then continued beyond the 15th November as rainfall led to extremely high groundwater levels across the chalk catchments resulting in continued flooding into 2001.

The impact of the flooding on the thousands of families and individuals affected during the autumn cannot be underestimated. Many have seen their homes flooded more than once during this period and some even up to nine times in the last two years. Many families have yet to return to their homes months after rivers levels have dropped. The polluted and contaminated nature of flood waters makes worse the impact on people and their property, and will contribute to the length of time it will take for many to recover. The Agency will continue to support local communities affected by the flooding through public meetings, advising on recovery plans and prospects and by dealing with the hundreds of letters from individuals affected and reducing future risk where possible.

This report has been produced by staff across Southern Region of the Environment Agency as a record of the events between 15th September and 15th November 2000. Issues and recommendations are identified in order to pursue continuous improvement of the Agency's flood forecasting and warning systems, the emergency response service and management of flood risk in the Region.

The Agency's flood forecasting and flood warning systems were key factors in the response. Agency staff forecasted where river flooding was likely to occur and issued warnings to those at highest risk, thus giving people and organisations the opportunity to respond. Across the Region nearly 200,000 calls were made by the Agency's Automated Voice Messaging (AVM) system to issue the 742 flood warnings direct to individual homes and businesses. The National Public Awareness Campaign, launched on 11th September, which included direct mailings and television advertising, had raised the profile of flood risk and provided information to the public on self help during flooding. The Agency's Floodline service received over 500,000 calls nationally during the period, many from elderly and vulnerable members of society. The Floodline operators were able to give advice on what warnings were in force, what help was available and what individuals could do to help themselves.

As lifeboats were launched on the streets of the South and many people suffered the trauma of flooding in their homes, the Agency's operational staff and emergency workforce battled with the unrelenting river flows. The Agency supported the response to the floods throughout the South, working with the police, the fire brigade, local authorities and many other organisations to provide information, and help limit the worst consequences of a truly extraordinary series of events. Pollution and potential sources of pollution were identified and dealt with by environment protection officers. Fisheries and conservation officers similarly helped to offset some

of the worst consequences for wildlife. Navigation staff in Kent demonstrated remarkable skill as they managed the navigation channels and dealt with vessels breaking free from moorings.

Despite the scale of the event there was no major structural failure of an Agency-managed flood defence and mercifully no loss of life occurred across the Region. There were instances where third party defences failed; however the major cause of flooding was due to over topping.

This report identifies a series of issues and makes recommendations for improvements both within and external to the Agency which are summarised below.

a) Although the response of the Agency was seen to have been successful in many respects the recommendations show that there is still room for improvement. Many of these improvements will require increased financial and staffing resources. Adequate funding of flood defence is crucial as lives and livelihoods are seriously at risk and the impact of flooding on those affected cannot be underestimated. Despite the scale of the events and the potential for them to continue and repeat themselves, the Agency has experienced considerable difficulties in some areas in raising necessary funding for flood defence work through the levies. A national review of the way the Agency's flood defence activities are funded is underway led by MAFF. Local authority members of flood defence committees carry heavy responsibilities and it is important that their nominating authorities and national government support them.

b) To a householder any flooding is devastating but the existing arrangements for flood risk management are not clear for the general public. In an extreme and prolonged event an individual family can suffer flooding from several sources: overwhelmed urban drainage, surface runoff, overtopped riverbanks, overwhelmed sewerage system and groundwater. No single body is managing these combined risks. Help and guidance is needed to help the public know who to ask for advice in such traumatic and devastating circumstances.

c) More robust guidance is needed on development in the floodplain. Flood risk must be a high priority planning consideration. Planning guidance needs to be precautionary and built on a presumption of safety during extreme events. The Agency's influence in respect of development in flood risk areas must be strengthened. The Agency has been encouraging house buyers and their conveyancers to research flood risk and, although still very small, the number of searches we receive is slowly increasing. There are huge development pressures in the Southeast. Flood risks must not be allowed to escalate as a consequence.

d) The likely far reaching consequences of climate change need to be taken into account by all involved in flood risk management. People deserve to know why in some specific cases they have been flooded up to nine times within the past two years and what plans can be put in place to alleviate flooding problems. We need to determine the causes of the flooding and the likely consequences of climate change. We can then decide if mitigation and adaptation measures can be applied to offset an escalation in flood risk, in addition to the work we are already undertaking.

e) There is a need to apply the strategic approach currently used for coastlines to rivers so that flood risk is managed in whole catchments to ensure appropriate defence standards are in place. Such a strategic approach must be comprehensive and include, where possible, the wider issues such as flooding from non-main rivers, groundwater, sewerage and drainage systems, urban and rural land use planning and climate change. We must provide sustainable solutions that do not create other problems elsewhere either now or in the future.

f) Whilst the scale of the event led to the overtopping of some river defences, the extent of the flooding was reduced wherever possible. Flood storage areas managed by the Agency reduced the extent of the flooding at Milford-on-Sea, Tonbridge, Ashford, Bexley and Crayford. There were instances where defences were overtopped by the sheer scale of the events and these are being investigated. These investigations will determine if the chance of a recurrence can be reduced through future investments in defences.

g) The organisational and staffing changes implemented by the Agency after the Easter 1998 Floods ensured that roles and responsibilities were clear and well delivered. However, the pressure of a prolonged event on filling the roles was significant. The new flood warning codes implemented on 12th September 2000 were well received by the public. This reflects the success of the National Public Awareness Campaign in September and ongoing liaison with emergency services and local authorities. It is important that this success is built upon to improve the integrated response.

h) 582 staff from all of the Environment Agency functions (approximately 70% of all Agency staff in Southern Region) assisted in managing the floods, collecting data and operating flood defences. Staff from neighbouring Regions were also called on to help manage the event. The emergency response on the ground involved Flood Defence, Environment Protection, Conservation, Fisheries, Navigation, Water Resources and support staff responding as one organisation in a co-ordinated manner to the impact of the floods. In addition, the value of the Agency being the navigation authority for the River Medway was demonstrated by the successful and co-ordinated management of the navigation and flood defence river structures, including dealing with vessels which broke free from moorings and threatened to block bridges, sluices or the river itself.

i) On many occasions people suffered from flooding of their properties and the trauma of evacuation even though the rivers and flood defences were not overwhelmed. This suggests much of the drainage infrastructure including sewerage, urban and highway drainage systems are being managed to lesser standards than the major flood defence schemes. As a consequence, flooding which has caused some of the worst devastation for homeowners has come from sewerage systems, such as that experienced in Portsmouth. The few regulatory powers that exist in respect of this kind of flooding are weak and ineffective. It is essential to influence developers and operators as to the importance of designing Sustainable Urban Drainage Systems (SUDS).

j) The expansion and development of new technology for flood detection, forecasting and warning systems supported the effective forecasting of flooding and the warning of those at risk. Over 35,000 people living or working in flood risk areas

are currently registered on the Southern Region warning system. This system was used to issue 742 flood warnings over the period (of which 50 were Severe Flood Warnings). Our existing systems were stretched to and occasionally beyond their limits by the scale and duration of these floods. The issues identified will be used to improve their robustness. The Agency needs continually to improve both the technological capability and coverage of these systems. Since 1996 the majority of people offered the chance to enrol in the direct flood warning service have declined to be involved.

k) Close liaison with the media throughout the period enabled the Agency to regularly update the general public and partner organisations during the events. The Agency received over 4,500 calls from national and local media and Southern Region staff gave over 1,000 radio interviews and over 400 television interviews which stretched resources. The media provided an invaluable public service during the floods, and became an integral part of the flood warning process.

l) Prompt and comprehensive data collection has enabled a record of the floods to be compiled. This will assist future management of the flood risk. These data have already enabled improvements to be made to the flood risk maps provided by the Agency to local authorities (in Sussex and Hampshire and soon in Kent) and recently published on the Agency's Internet site. Detailed data collection regarding specific properties flooded and evacuated is not always easy to determine accurately.

m) The floods of Autumn 2000 did not happen in isolation but appear as part of a series of disturbed weather. On Christmas Eve 1999 the storm of the century came very close to hitting the South coast. A last minute change of direction took this storm to France where it killed over 90 people and brought down 350 million trees. This event overshadowed the 'hurricane' of 1987 which is well remembered by those in the Southeast. Had the Christmas Eve storm hit the South coast the loss of life and devastation could have been enormous. The greatest threat to life and property from flooding in Southern Region is from the sea. This must not be forgotten in the response to improve fluvial flood risk management.

This review is part of an ongoing process of review and improvement in the Agency. Each of the Agency's eight Regions affected by the flooding are producing reports to identify key issues. Additional detailed reports for each of the Agency's three Areas within Southern Region – Hampshire and Isle of Wight, Sussex and Kent are also being prepared. A national report is also being produced. It is expected that an action plan will be produced by July 2001 which clearly identifies the time-scales for implementing the actions identified here and in the national report.

CONTENTS

1 INTRODUCTION

Autumn 2000 saw the most widespread flooding across England and Wales in over 50 years. Southern Region in particular suffered several prolonged periods of extreme weather causing extensive and severe flooding between 15th September and 15th November 2000. The problems have continued long after 15th November and into 2001 as rainfall has continued to hit saturated catchments causing more flooding from rivers across the Region.

This report seeks to describe these flood events from the initial forecasting through to the emergency response and present the lessons learnt at this stage. Many aspects of the events were well managed and show that the Agency and its professional partners have learnt from the floods of Easter 1998 and have made significant improvements to the process of flood management. There are however still many areas where improvements are needed and although the flooding is still continuing across the Region this report draws together some of the issues and makes preliminary recommendations for actions.

Four main periods of flooding have been identified between the 15th September and 15th November, the period covered by this report:

- 15th September
- 9th October – 19th October
- 20th October – 4th November
- 5th November – 15th November

Current estimates of properties and businesses flooded between the 15th October and 15th November now stand at around 2,500; surveys continue and additional reports are still being received. This compares with early estimates made during the event of 1,100 properties affected. Properties were flooded by main rivers (i.e. those where the Agency is the lead drainage authority), non-main rivers, surface water, groundwater sources and sewerage systems. These figures are our best estimate of properties which suffered damage through internal flooding. A much larger number of property owners suffered the worry and disruption of being surrounded, often trapped, by flood water, often polluted, together with the stress and fear that the situation may escalate. In Portsmouth, for example, some 3,000 properties were affected in this way whilst we are only aware of some 200 being flooded internally. Together with inland flooding some problems were experienced along the coast at Pett and Medmerry with 53 Flood Warnings issued for coastal areas. The polluted and contaminated nature of flood waters seriously exacerbates the impact on people and their property, and will contribute to the length of time it will take for many to recover. Locations affected during the events are shown on the Map 1.1.

A total of 742 flood warnings were issued across the Region, including 50 Severe Flood Warnings. Almost 200,000 calls were made to the public at risk and professional partners during the event via the Agency's Automatic Voice Messaging (AVM) system.

This review has been undertaken as part of a national programme of assessing the Agency's performance during the floods and to identify issues and make recommendations for improvements. Continuous improvement of our performance is a key activity for the Agency as we continue to develop a seamless and integrated flood forecasting, warning and response service. Additional detailed reports for each of the Agency's three Areas within Southern Region – Hampshire and Isle of Wight, Sussex and Kent are also being prepared.

This review focuses on seven main topics: event management, flood forecasting, flood warning, event impact, emergency response, public relations, and specific incident issues.

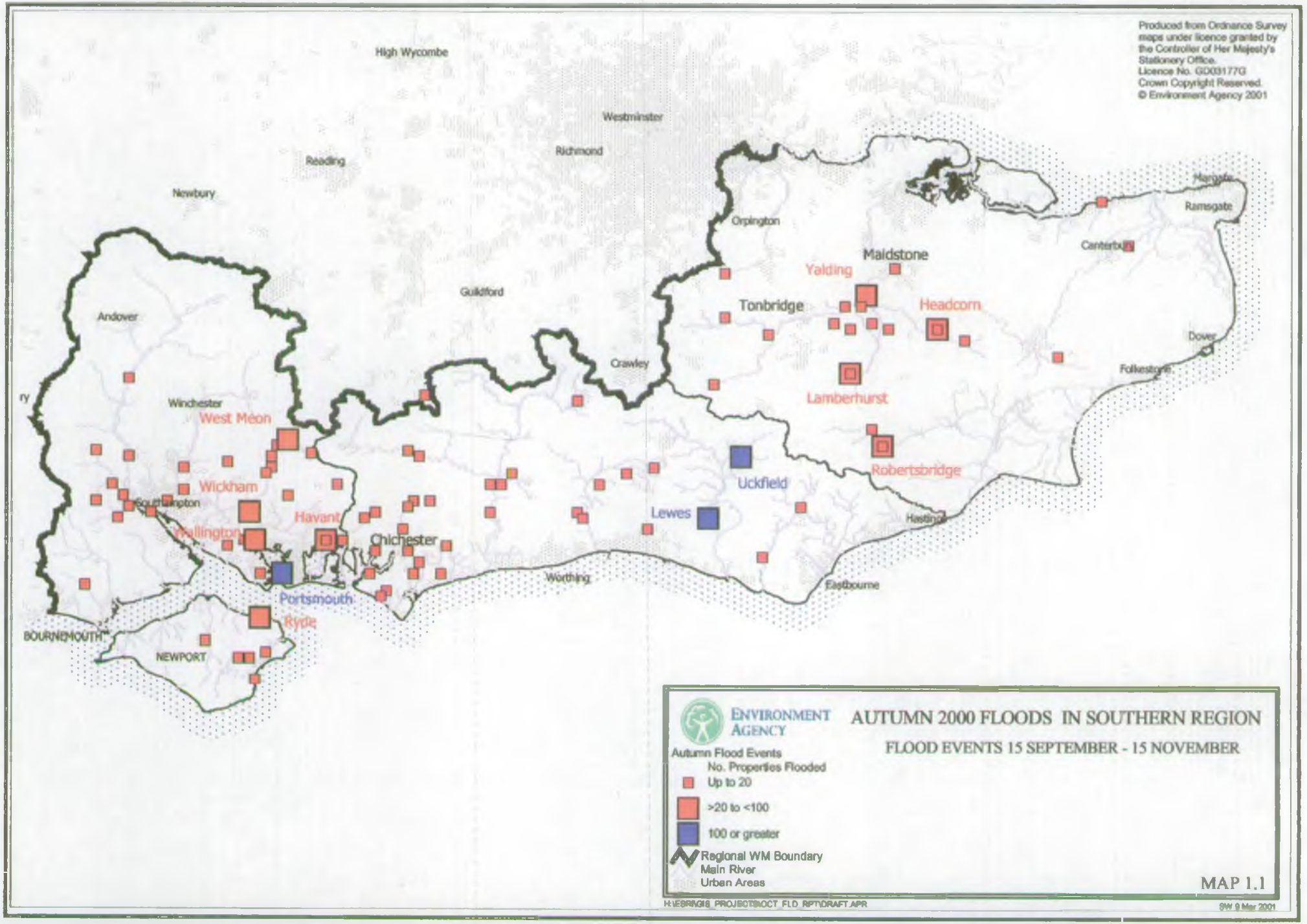
1.1 EVENT MANAGEMENT

Internal improvements introduced over the last two years have delivered significant benefits to the successful handling of the Autumn Floods. These include consistent staff structures, improved procedures for incident management, clarified roles and responsibilities and improved communications throughout the event both within the Agency and with professional partners. Altogether some 582 Agency staff were directly involved in the event across the Region many others were indirectly affected as they filled in for staff involved in the flooding. There was planned widespread support from other operational functions; event management could not have been sustained by the Flood Defence function alone. Call handling has been progressively improved since previous events and the support of the Floodline call centre, during its extended opening hours, markedly helped to manage calls.

Externally, the Agency was fully involved in ensuring that the event was well managed by supporting Strategic (Gold Control) and Tactical (Silver Control) Command Centres established at Chichester, Lewes and Maidstone as well as Operational (Bronze Control) Command Centres across the Region. Details of these command structures can be found in the Home Office document, *Dealing with Disaster (3rd ed.)*.

1.2 FLOOD FORECASTING

Despite certain weaknesses in the timeliness and accuracy of Met Office weather forecasts the Agency arrangements worked well. The newly established Monitoring Duty Officer and Forecasting Duty Officer roles introduced in September 2000 brought significant improvements over previous arrangements. Flood forecasting must be underpinned by accurate weather forecasts, which during the events were on occasion lacking in timeliness and accuracy. The under estimation of rainfall on the evening of the 11th October, where the Met Office Heavy Rainfall Warning forecast 15 to 20mm rainfall, was perhaps the least aligned with actual rainfall. Accumulations of up to 140mm in 24 hours were recorded causing the worst of the flooding in Uckfield, Lewes, Robertsbridge, Yalding and Lamberhurst. Had an accurate weather forecast been received on the evening of 11th October the Agency would have had the opportunity to issue Severe Flood Warnings several hours earlier, rather than in the early hours of the morning when it became clear how much rainfall was falling. A screen shot of the Hydrological Weather Radar Image (HYRAD) from the 11th October shows the intense rain that fell over the period in a band of rain arriving from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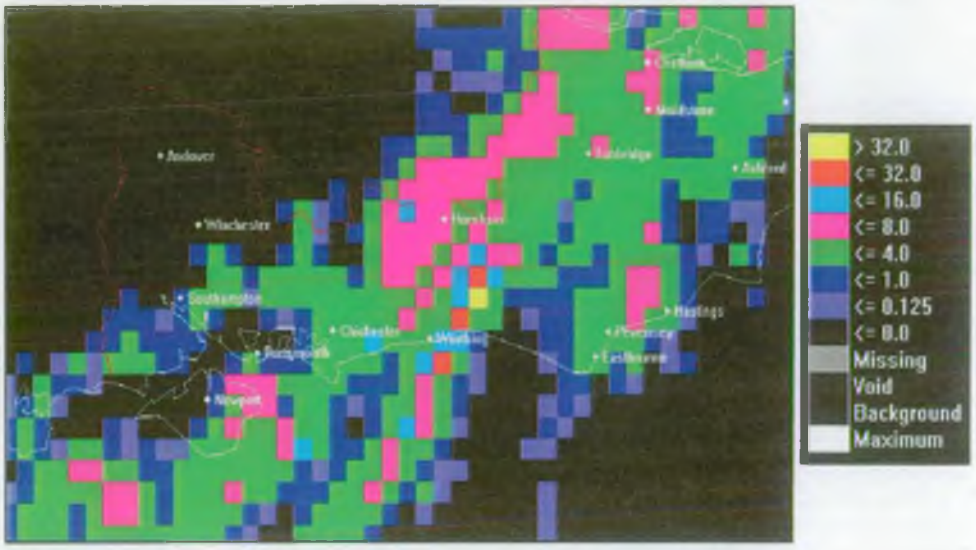
High Wycombe
Westminster
Richmond
Reading
Newbury
Guildford
Crawley
Andover
Winchester
West Meon
Wickham
Havant
Wallington
Chichester
Portsmouth
Ryde
BOURNEMOUTH
NEWPORT
Worthing
Eastbourne
Hastings
Uckfield
Lewes
Lamberhurst
Robertsbridge
Tonbridge
Yalding
Maidstone
Headcorn
Orpington
Canterbury
Ramsgate
Dover
Folkestone
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
FLOOD EVENTS 15 SEPTEMBER - 15 NOVEMBER
Autumn Flood Events
No. Properties Flooded
Up to 20
>20 to <100
100 or greater
Regional WM Boundary
Main River
Urban Areas
MAP 1.1
H:\ESRIGIS_PROJECTS\OCT_FLD_RPT\DRAFT.APR
SW 9 Mar 2001

the Channel stretching from Sussex into Kent (see Figure 1.1, brighter colours show more intense rainfall).

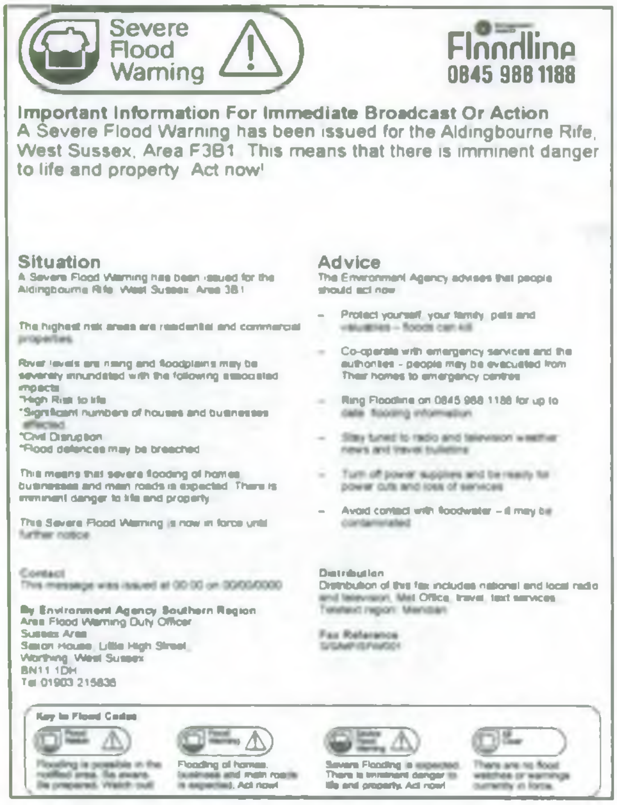
Figure 1.1: Hydrological Weather Radar (HYRAD) display, 21:00 on 11th October 2000



The Regional Telemetry System (RTS) is a network of rain gauges, river level and flow recorders that provide vital information on catchment conditions to Environment Agency officers through the Agency's computer system. Overall the Regional Telemetry System performed very well with nearly 80% of faults rectified within 24 hours and back up sites used where possible. Some sites which, were overwhelmed by the scale of the event, could not be replaced due to prolonged high flows and alternatives had to be used. Weather radar coverage was shown to be very poor across the Region and no quantitative use of data was possible for flood forecasting purposes. During the event rainfall runoff models were in place for 14 out of the Region's 79 fluvial Flood Warning Areas, 12 more than were in place during the Easter Floods of 1998. In areas not covered by these models a mixture of methods including reviewing historical events, Flood Estimation Handbook techniques and interpolating data were used. Overall these worked well for estimating peak levels and timings but it was not possible to forecast flood extents accurately. This was an important issue in helping Strategic Commands identifying areas for possible evacuation.

1.3 FLOOD WARNING

The Agency is responsible for issuing flood warnings and has a four stage warning code system: Flood Watch, Flood Warning, Severe Flood Warning and All Clear. Recent organisational improvements together with the introduction of the new Flood Warning Codes on the 12th September and the National Flood Warning Awareness Campaign could not have been more timely. The Automatic Voice Messaging System was strengthened with greater capacity and back up facilities when additional dissemination systems were introduced during the year 2000 and Area staff were trained to issue warnings. 742 warnings were issued including new catchment wide Flood Watch messages which in some places gave an additional three days warning of



Severe Flood Warning

Floodline
0845 988 1188

Important Information For Immediate Broadcast Or Action
A Severe Flood Warning has been issued for the Aldingbourne Rife, West Sussex, Area F3B1. This means that there is imminent danger to life and property. Act now!

Situation
A Severe Flood Warning has been issued for the Aldingbourne Rife, West Sussex, Area 3B1

The highest risk areas are residential and commercial properties.

River levels are rising and floodplains may be severely innundated with the following associated impacts
*High Risk to life
*Significant numbers of houses and businesses affected
*Civil Disruption
*Flood defences may be breached

This means that severe flooding of homes businesses and main roads is expected. There is imminent danger to life and property.

This Severe Flood Warning is now in force until further notice

Advice
The Environment Agency advises that people should act now

- Protect yourself, your family, pets and valuables – floods can kill
- Co-operate with emergency services and the authorities - people may be evacuated from their homes to emergency centres
- Ring Floodline on 0845 988 1188 for up to date flooding information
- Stay tuned to radio and television weather news and travel bulletins
- Turn off power supplies and be ready for power cuts and loss of services
- Avoid contact with floodwater – it may be contaminated

Contact
This message was issued at 00:00 on 00/00/0000

By Environment Agency Southern Region
Area Flood Warning Duty Officer
Sussex Area
Saxon House, Little High Street,
Worthing, West Sussex
BN11 1DH
Tel 01903 215836

Distribution
Distribution of this fax includes national and local radio and television, Met Office, travel, text services
Teletext region: Meridian

Fax Reference

Key to Flood Codes

Flooding is possible in the notified area. Be aware. Be prepared. Watch out!

Flooding of homes, business and main roads is expected. Act now!

Severe Flooding is expected. There is imminent danger to life and property. Act now!

There are no flood watches or warnings currently in force.

events developing. Significantly, the previous confusion over the meaning of warnings appeared to feature far less during this event. Warnings are issued when predetermined actual or forecast trigger points are exceeded on rivers and at rain gauges. Site observation and weather forecasts are used where required. Altogether 50 Severe Flood Warnings were issued during the period; all Severe Flood Warnings were preceded by a Flood Warnings and earlier Flood Watches. The full extent to which these warnings were successful will be determined by Public Opinion Surveys during early 2001.

An example of a Severe Flood Warning issued by fax is shown here.

1.4 EVENT IMPACT

People in cities, towns, villages and individual properties across the region have experienced horrendous flooding from rivers, streams, groundwater, drains and overwhelmed sewerage systems. Portsmouth, Ryde, Uckfield, Lewes, Tonbridge, Yalding, and Robertsbridge have been particularly badly affected. Chichester and Maidstone have both been at serious risk of property flooding during the period.

With current estimates of around 2,500 properties flooded from rivers, urban drainage, surface water and groundwater, Southern Region has experienced extensive and severe flooding. Rainfall statistics demonstrate how extreme the weather throughout the autumn has been, which when taken as a whole, presents the wettest autumn on record:

- September 2000 was the wettest since 1981, with an average total rainfall of 124mm in Hampshire, 191mm in Sussex and 90mm in Kent (some rain gauges in North West Kent recorded over 127mm) compared to a long-term average of around 75mm for the region.
- October 2000 was the wettest since 1903, with an average total rainfall of 175mm in Hampshire, 261mm in Sussex and 204mm in Kent compared to a long-term average of around 80mm for the region.
- November 2000 was the wettest since 1970, with an average total rainfall of 185mm in Hampshire, 213mm in Sussex and 160mm in Kent compared to a long-term average of around 84mm for the Region.

The Agency has been involved in 33 public meetings since the flooding including Robertsbridge, Yalding, Collier Street, East Peckham, Five Oak Green, Uckfield, Lewes, Chichester, Barcombe, Ryde and Exton. Many of these meetings have been held with MPs, parish councils, residents associations and traders groups.

Table 1.1: Summary of properties flooded by Area[1]

	Main River	Non Main River	Total
Sussex	945	229	1,174
Hampshire and Isle of Wight	164	396	560
Kent	320	429	749
Total for Southern Region	1,429	1,054	2,483

[1] *The information in the above table represents current best estimates and it will not include all property flooding. For example it has not been possible to collect full information on the extent of groundwater flooding.*

Photographs and details of some of the worst affected locations in Southern Region follow. These are representative of the flooding around the Region. Typical river flows and levels were well above the long-term averages for this time of year. For example, flows into the Aldington Storage Reservoir peaked at 16m^3/s, the long-term average is 1.4m^3/s. The reservoir reduced the flow by 74% and prevented extensive property flooding along the East Stour through Ashford.

1.4.1 Portsmouth

Following very heavy rainfall on the 15th September many parts of Portsmouth were flooded when the Southern Water Services Eastney Pumping Station was itself flooded. This caused sewage and surface water flooding to around 200 houses across parts of the city centre although there are approximately 3,000 properties in the areas affected by flooding. Portsmouth City Council opened a Tactical Command Centre and evacuated members of the public. Investigations into the flooding continue.

1.4.2 Ryde

Heavy rainfall, greater than 50mm over a 24 hour period, was recorded throughout the Isle of Wight on 15th September 2000. Surface water entering the combined sewer system exceeded its capacity and was unable to discharge into the Monkton Mead Brook through the combined sewer overflow (CSO) due to raised water levels caused by high river flows, and high tide. 20 properties which are at the lowest point in the sewer system were flooded internally from the sewers as a consequence.

On 9th – 10th October rainfall recorded on parts of the Isle of Wight exceeded 90mm. Seventy properties were flooded due to a combination of surface water, combined sewers and fluvial flooding exacerbated by high tide.

The causes of flooding at Ryde are complex. The Agency is due to start work this year which will help reduce the likelihood of flooding from the river in the lower reaches. The wider risks from the drainage systems will still remain although Southern Water will be increasing the capacity when new pumps are installed in the Appley Sewage Works.

1.4.3 Chichester

Flows of nearly $8m^3/s$ on the River Lavant through Chichester compared to a long-term average of $0.48m^3/s$ were a serious cause for concern during October and November. Notwithstanding these exceptionally high flows a major inter-agency response averted extensive flooding to the city centre as had occurred in 1994. Since the 1994 flood event improved understanding of the mechanisms that cause flooding in and around Chichester has led to improved flood prediction and subsequent early warning. This enabled a set of procedures to be agreed by the appropriate authorities which ensured that the impacts of the flood event were managed to best effect.

During early October 2000 monitoring of groundwater data also indicated that there was a significant risk of river flooding to the City of Chichester. Two groups were established to co-ordinate preparations:

- Strategic Command Group – Comprising staff at Chief Executive/Chief Officer Level from Chichester District Council, West Sussex County Council, the emergency services and the Agency.

- Tactical and Operational Group – Comprising representatives from the same organisations as for Strategic Command Group but at a lower hierarchical level.

The group has co-ordinated a major pumping and diversion of flood waters around the City which is still ongoing. The Agency has been fully involved in providing an emergency flood relief scheme along the line of the proposed permanent flood alleviation scheme for the City. The full benefits of these emergency investments will be realised when the permanent scheme is introduced.

1.4.4 Uckfield

The intense rainfall that fell across East Sussex on the 11th October caused the River Uck to respond very rapidly prompting the issue of a Severe Flood Warning at 02:37 on the 12th October. Reports of properties flooding were received from 05:00 with the centre of Uckfield and hundreds of residents severely affected by deep and fast flowing flood water. Boats were the only available form of transport as the road and rail networks were flooded to depths of a metre or more. One man swept from outside of his shop was fortunately rescued. 100 properties and businesses were flooded during the event.

Figure 1.2: The Fire Brigade at Uckfield

Photograph courtesy of John Connor Press Associates, Lewes

1.4.5 Lewes

The scale of the flooding in Lewes was some of the most extensive and severe seen during the event across England and Wales. The previous highest level recorded in Lewes was 4.9mAOD in 1960. In October 2000 it was 6.0mAOD (both measured on the upstream side of Cliffe High Street bridge). The intense rainfall caused exceptionally high river flows along the Ouse; the mean average winter flow at Barcombe upstream of Lewes is 55.6m^3/s, in October flows peaked at an estimated 192m^3/2. The high flow coincided with high spring tides which exacerbated the situation; current estimates indicate that 817 properties and businesses were flooded on the 12th and 13th October and needed to be evacuated.

Figure 1.3: The impact of flooding at Lewes

Photograph courtesy of John Connor Press Associates, Lewes

1.4.6 Tonbridge

Intense rainfall over the upper Medway catchment resulted in the flood storage area behind the Leigh Barrier filling in 5 hours. On average, past events have taken 2 days to fill the storage area. Operation of the barrier reduced the peak flows through Tonbridge where flooding had not been seen since the 1960s. The effect of the barrier was that, despite the greater volume of water, the river level peaked at 22.05mAOD, 86.5cm lower than during the flooding in 1968. This resulted in flooding being narrowly avoided upstream of the High Street, however further downstream in the commercial part of the town flooding did occur.

Figure 1.4: Flooding at Tonbridge was reduced due to the Leigh Flood Barrier

Photograph supplied by Agency Flood Defence staff

1.4.7 Yalding

With the swollen rivers Medway, Teise and Beult converging at Yalding this became the centre of national and local media attention. The normal winter river levels at Yalding are between 8.5mAOD as 9mAOD; in the autumn levels exceeded the average by more than two metres resulting in extensive flooding which caused damage to approximately 40 properties, a mobile home park and a number of boats. The village was flooded threee times between 15th September and 15th November. This is in addition to flooding twice in the previous year.

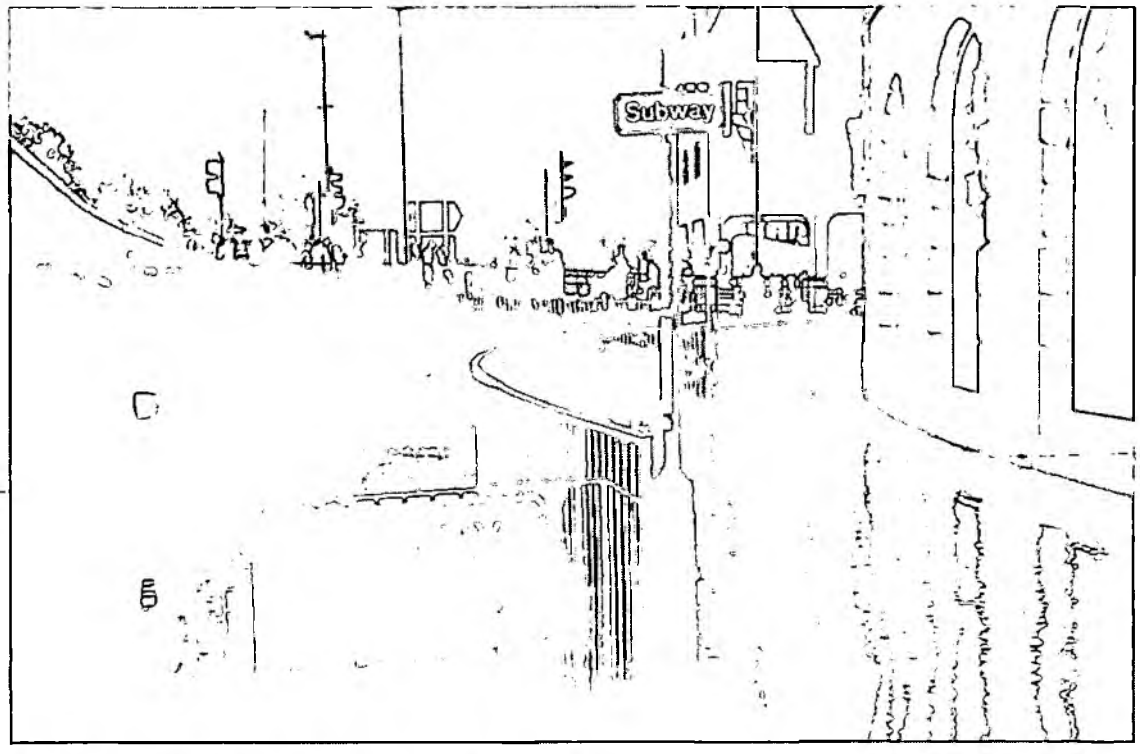
Figure 1.5: Flooding at Yalding

Photograph supplied by Agency Flood Defence staff

1.4.8 Maidstone

River flows upstream of Maidstone at East Farleigh peaked at 275m^3/s, nearly five times higher than the long-term average. This, combined with the high tides, resulted in localised flooding from the Medway to riverside properties, subways and car parks. Boats were torn from their moorings resulting in damage to Allington Lock and a risk of blocking bridges or the river itself. If the main river channel had become blocked the impact of the flooding would have been much worse, as the peak flows were experienced during the night. Flooding was generally constrained to subways and roads but came very close to flooding many commercial properties in the town.

Figure 1.6: Flooding at Maidstone

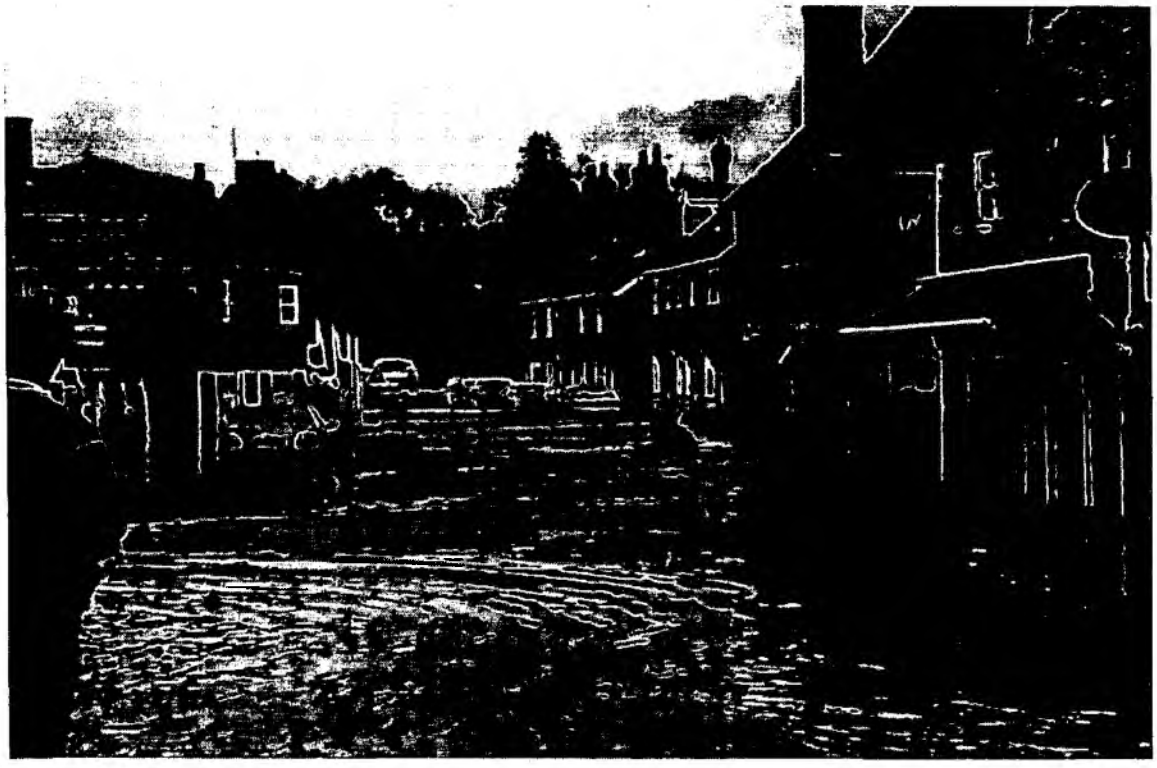


Photograph supplied by Agency Flood Defence staff

1.4.9 Robertsbridge

Intense rainfall over the Rother catchment resulted in severe flooding to parts of Robertsbridge, the scale of which was not even seen in the 1960s. River flows at Udiam, downstream of Robertsbridge, peaked in excess of $80m^3/s$; more than six times the long-term average for this time of year. Approximately 74 properties were affected; some of which have now been flooded 9 times in the last two years.

Figure 1.7: Flooding at Robertsbridge



Photograph supplied by Agency Flood Defence Staff

1.4.10 Recurring Floods

Many towns and villages were affected by flooding more than once. Ryde, Havant, parts of Ashford, and Canterbury flooded twice during the autumn; Robertsbridge, Yalding, Lamberhurst, Five Oak Green, Barcombe Mills and East Peckham flooded three or more times during October and November. With flooding in December 1999 and May 2000 some sites – Ryde, Yalding, Lamberhurst, Robertsbridge, Hellingly and Alfriston - have flooded up to nine times.

A full programme of flood event data collection has been undertaken during and following the flooding across the region. This has included aerial photography and ground surveys of most of the affected catchments.

1.4.11 Who is responsible and what organisations have powers to act?

The flooding of homes and businesses due to surcharging of groundwater aquifiers brought misery to many across the Region. This type of flooding is very difficult to forecast and equally difficult to manage or control. Brighton and Hove Council is one

example of a unitary authority which found itself having to help numerous residents whose properties were affected by such flooding. In these circumstances the Agency provides technical support on request but the powers to intervene lie with the authorities concerned backed by Southern Water Services who manage the combined sewer system.

Flood defence and land drainage law is complex but in general terms the following applies:

- Individual landowners ("riparian owners") are responsible for drainage of their own land and accepting and dealing with the natural flows from adjoining land. Thus the basic common law and statutory responsibilities rest with the riparian owner, irrespective of whether other organisations have permissive powers on the same stretch. The Environment Agency publishes the Riverside Owner's Guide which explains responsibility.

- The Local Authority has permissive powers (ie they may do flood defence work but do not have a statutory duty to do so) on what are known as 'ordinary' watercourses. These are the minor streams. It can serve notice on riparian owners on ordinary or IDB watercourses to require remedial action if flow is being impeded. It normally takes the lead on ordinary watercourses.

- In particularly low lying areas where land drainage and flood defence are important, Internal Drainage Boards have existed for many years. The Boards comprise elected agricultural ratepayers and nominated Local Authority appointees. In its District the IDB serves the land drainage needs of agricultural land but the Local Authority may still exercise its permissive powers to provide flood protection. Both can serve notice on riparian owners. The Robertsbridge Petty Sewer, Darwell Stream, Darwell Petty Sewer and Glottenham Stream are IDB watercourses though Rother IDB utilises engineering and operational services from the Environment Agency.

- The Environment Agency has permissive powers to do works on what are known as 'main rivers' These are the major arterial watercourses designated on official MAFF maps, eg the Rother, Robertsbridge Mill Stream and Bugshill Mill Stream. The Environment Agency provides a flood warning service for all natural watercourses and also has a general supervisory duty for land drainage matters and can serve notice on riparian owners on main rivers and ordinary watercourses which are not IDB watercourses if the Local Authority has not taken the lead.

1.5 EMERGENCY RESPONSE

The scale of the flood event across the Region prompted the opening of some Strategic (Gold Control) and Tactical (Silver Control) Command Centres. Portsmouth City Council opened a Tactical Command Centre to manage the Southern Water Services Eastney foulwater pumping station failure on the 15th September. In Sussex Strategic Command Centres were established at Lewes and Chichester with Tactical Commands Centres at Lewes, Uckfield, Bognor Regis and Chichester. In Kent Strategic and Tactical Command Centres were established at Maidstone and Tonbridge. Both Kent and Sussex police forces have praised Agency representation at these co-ordinating centres.

In addition to staff involved in Regional and Area Incident Rooms, the Agency's Emergency Workforce worked exceptionally hard during the event maintaining essential flood defence operations including pumping station maintenance, sandbagging, sluice operation and obstruction clearance including removing boats that came adrift on the Lower Medway. The huge efforts invested by the Agency's Emergency Workforce helped ensure that there were no major structural failures of Agency-managed flood defences even though many were overtopped by huge flood flows. Additional Emergency Workforce staff were also brought in from Anglian and Thames Regions to assist with the operations.

Police and Local Authorities offered residents the chance to evacuate properties during the peak of the floods. Rest centres were established in Yalding, Lewes and Uckfield. Rest centres for Canterbury and Ashford were established during November but not required. There are examples where members of the public were reluctant to leave properties at risk or where they left and returned. Such behaviour is known to be influenced by a number of factors including security of property and a disbelief in the scale of risk to life.

1.6 PUBLIC RELATIONS

Since the Agency's second Flood Awareness Week launched on the 11th September the Agency has established and maintained a very high and positive media profile throughout the Autumn Floods.

Within the Region, between 9th October and 15th November, some 65 flood related press releases were issued. Over 4,500 media calls have been handled and over 1,000 radio interviews and 400 television interviews have been undertaken. Over two thousand press clippings have been collated from the Autumn Floods.

Taken as a whole the media coverage has been overwhelmingly positive allowing the Agency to promote issues of national and local importance including flood defence funding, climate change and restricting development in flood risk areas. The media has played a full role in public service broadcasting of flood warnings and flooding information.

1.7 INCIDENT SPECIFIC ISSUES

In addition to the widespread property flooding there are numerous reports of road closures and disruption to railway lines during the event. The Isle of Wight railway was closed between the 9th – 11th October. The most significant infrastructure failure was at Southern Water Services Eastney pumping station (serving Portsmouth) where the pumping station was itself flooded and caused sewage flooding of an estimated 200 houses across the city on the 15th September. The Zeneca Agrochemical plant at Yalding was at risk of flooding in October with private flood defences at risk of overtopping and flooding storage and production facilities. Direct warnings and discussions with local Agency staff helped prepare the site and reduce the potential risk. The widespread flooding of farmland led to many instances of livestock being drowned by flood water.

Professional partners have been sent questionnaires inviting comments on the Agency's performance, a repeat of work undertaken following the May 2000 floods.

Responses to date indicate that the Agency has developed its level of service since May 2000.

2 EVENT MANAGEMENT

This event proved the most testing for the Agency (and its predecessor organisations) in 40 years. It was timely that the Agency had just introduced and exercised both a new flood warning code system and a new set of incident management procedures for Flood Defence in September 2000 as a result of the Easter 1998 Floods Project.

All functions within the Region were mobilised to deal with the event, proving that the Agency is greater than the sum of its parts. This flexibility has proven to be one of its core strengths.

Liaison with professional partners across the Region was excellent and survey results show that customers' views of the Agency are significantly higher now than after the flooding in May 2000. Detailed results are in Appendix F. Consultants, who conducted a survey of professional partner views, comment:

> *"Overall, most professional partners seem to feel that the Agency is providing a better service now than in May 2000."*

2.1 PROCEDURES

New procedures had been put in place at Regional and Area level over the summer for Flood Warning, Flood Defence Operations, Flood Forecasting and Monitoring and for the opening and operation of Area Incident Rooms (AIRs). Areas had been issued with the enhanced Regional Incident Procedures (RIPs) as early as May 2000, and Area Incident Procedures were issued in September 2000 and a further Regional Incident Procedures update in October 2000. Thus all Areas started the events with the most up to date procedures. These were produced as a collaborative effort between Area and Regional staff, led by the staff who would be using them. This ensured good ownership of the procedures.

New procedures were adhered to, with their greater emphasis on pro-active response to forecasts of heavy rainfall and severe weather.

Business Continuity Planning carried out for the transition to the new millennium showed its worth as generators that were purchased then were used at various times by all three Areas to keep their AIRs running through power disruptions brought on by severe weather. New Area Incident Plans enabled staff to be quickly and smoothly mobilised out-of-hours to open AIRs in response to rainfall much heavier than that forecasted.

2.2 LIAISON (INTERNAL/EXTERNAL)

Internal liaison worked well. Decisions about whether to open or close Regional and Area Incident Rooms were influenced by proactive assessments of forecast weather and likely impact of prolonged periods of operation.

External liaison worked well. This was due to the efforts made to hold exercises and liaise over the previous year. Agency Area Incident Room communications systems had been reviewed and improved during the summer. Agency liaison officers from a range of functions were posted to Strategic (Gold Control) and Tactical (Silver

Control) Command Centres established by police forces in Sussex and Kent. Many very positive comments were made about Agency attendance at Strategic and Tactical Command Centres, typically:

From Sussex police:

> *"There is a very good relationship between police and the Agency especially between those 'on the ground'. The Agency has a clear understanding of the needs of police and this is reflected in regular meetings and working parties. This is important to the police service because of the regular changes of roles that is indicative of the service today. Regular updating is important and this is achieved very well. During the recent flooding, an officer of the Agency was posted at (Gold Control) and this was very appreciated. The member of staff worked very long hours and had a very clear knowledge of the requirements.*
>
> *The new warning system has been well received and it was felt the system had been properly explained."*

From Kent County Council:

> *"The establishment of the Strategic Co-ordinating Group at police HQ is a standard arrangement implemented when incidents are sufficiently large. The main advantage of having an Agency representative there was to get in many cases, instant answers to questions and to be able to discuss these face to face."*

Details of command structures can be found in the Home Office document, *Dealing with Disaster (3rd ed.)*.

The Agency has a key role in Strategic Command Centres in forecasting flood extents and advising on areas at risk of flooding. Improvements can be made in the provision of detailed maps for these purposes beyond those currently in Local Flood Warning Plans used during the events.

2.3 COMMUNICATIONS

Internal communications worked well. This was a key success due to a number of factors reducing the clogging of internal communications:

- Floodline stayed open later and re-directed calls to Area Incident Rooms thus avoiding bottlenecking. The Regional Communications Centre (RCC) and Regional Incident Room (RIR) handled simple calls and also re-directed those that required more local knowledge to Area Incident Rooms. A system to re-route misdirected calls to other Regions would improve call handling.

- Extra Agency call handlers were in place in Incident Rooms and the Regional Communications Centre manning public information lines using 'Automatic Call Distribution (ACD)' and 'Hunt Groups'; systems which facilitate call queuing.

- The more robust Floodline Recorded Message Service system satisfied the needs of 90% of callers for Flood Warning information and the system proved resilient under heavy loading.

The new division of roles which provided dedicated Operational Duty Officers, Flood Warning Duty Officers and Emergency Duty Officers worked well with all present in AIRs.

There were occasional internal communication difficulties. At times it proved difficult to put public callers through to AIRs as lines became jammed and Areas experienced similar problems with the RCC and RIR. Capturing these calls in queues, monitoring call progress and lost calls would enable these problems to be detected and managed in real-time. This could be achieved by the deployment of more telephone operators. Additionally, coverage problems made contact with field staff difficult.

Forwarding calls from members of the public to emergency services, professional partners and other parties was very difficult. This is extremely important, particularly to assist the needy.

Communications with external bodies generally worked well as contact numbers are now actively updated quarterly. Clearer communications of times at which authorities open and close incident rooms would further improve liaison.

2.4 NUMBERS OF STAFF DEPLOYED

Very few, if any, Agency staff have not been impacted by the floods in some way, whether working in the field shoring up defences or providing refreshments to those in the incident rooms.

Table 2.1: Estimated numbers of staff deployed

	Incident Room	Field	Emergency Workforce
Region	100	0	239
Hampshire and Isle of Wight	25	10	
Sussex	55	33	
Kent	100	20	
Sub-totals	280	63	239
Grand Total	**582**		

Monitoring Duty Officers handling telemetry alarms ensured the RCC did not become a major communications bottleneck. AIRs also benefited from having pre-trained multi-functional staff e.g. Environmental Protection staff trained as Assistant Flood Warning Duty Officers (AFWDO), call handlers etc. Many staff new to the Agency,

recruited during the summer were plunged into shift working for weeks through these major incidents.

2.5 RANGE OF FUNCTIONS AND INTER-REGIONAL CO-OPERATION

All functions supported the Flood Defence function in many ways, especially through call handling. Managers from all functions acted as Area Base Controllers in all three Areas. At Region the Regional Duty Officer role was shared by Flood Defence, Water Resources, Environmental Protection, Support and Legal functions. Floodplain surveys were carried out by a range of functions. Significant amounts of high-flow gaugings were completed by the Water Resources function.

2.5.1 Inter-Regional co-operation (including Military Aid to the Civil Community (MAC))

Numerous requests were made for inter-Regional aid and many offers of help were received from across the Agency and from external organisations. A dedicated Regional Liaison Officer role was introduced to co-ordinate requests for assistance internally and externally. This ensured that requests were clear and clarified where necessary. A list of requests made is shown in Table 2.2 below. Whether requests for Military assistance should be directed through Strategic Command Centres or through Agency channels is an area where improvements in liaison can be made.

Table 2.2: Details of inter-Regional co-operation

Date/Area	Request
12th Oct Sussex	AIR – 13 men from Anglian Region Emergency Workforce c/w 4WD vehicles
29th Oct Kent	MAC – Sandbag filling machine, bags, sand and operatives to secure leaking defence in Tonbridge.
1st Nov Kent	MAC – requested to secure barge at risk of drifting. Requested via Kent CC.
2nd Nov Sussex	Pumps requested from MPCU (Marine Pollution Control Unit) First request for Midlands 24" pump to be on standby if needed.
6th Nov Sussex	Delivery of 4000 sandbags 24" pump from Midlands Region with pump fitters
7th Nov Sussex	7400 sandbags – 5000 from Thames and 2400 from Anglian EA Wales on standby to support with pumps

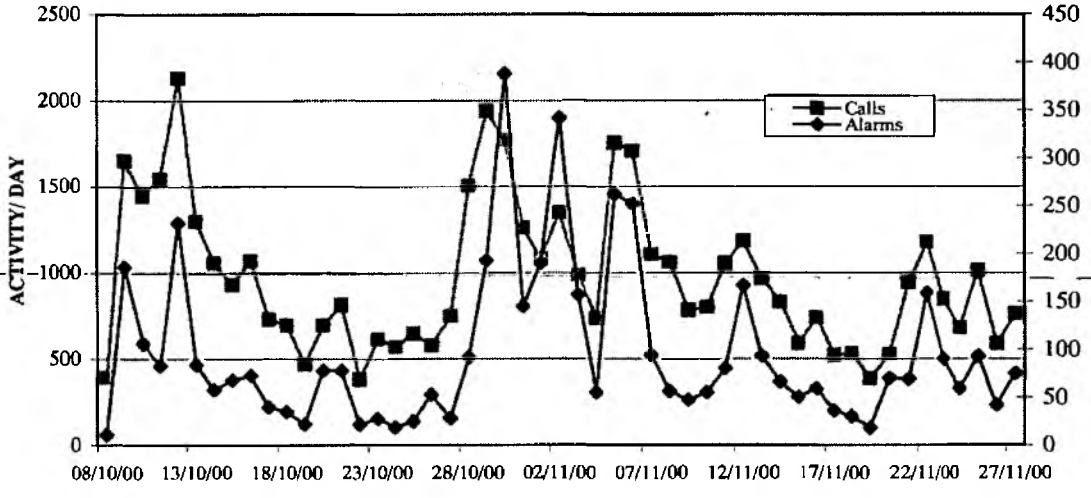
In addition to the above requests Military aid was considered for Lewes by the Strategic Command Centre but not called in. At Chichester support from the Military was on standby but not called into use.

2.6 SCALE OF CALLS RECEIVED

The number of calls we received from the public surpassed both the Christmas 1999 and May 2000 flood events. These are the most recent events against which useful comparisons can be made since the Floodline service was introduced.

Figure 2.1 shows the scale of the calls received by the Regional Communications Centre (RCC) during October and November as well as the alarms that were received and passed on via the RCC. However, improvements to the call monitoring systems are required to manage and record call handling numbers better during events of this scale.

Figure 2.1: Activity in the Regional Communications Centre (RCC)



Axes represent alarms (right hand side scale) and calls (left hand side) coming in

2.7 ISSUES ARISING AND RECOMMENDATIONS

Based on the findings to date, a number of issues and recommendations have been identified. It should be noted, however that the flooding in Southern Region is continuing and further issues may arise which will be fed in to an action plan later this year.

SO\EM\1	Telephone call handling and monitoring
Issue	Our call handling systems have not kept pace with current requirements. Effective monitoring of the number of calls is not currently possible and call distribution from office to office can be improved, particularly when Incident rooms open and close.
Recommendation	Review requirements and introduce improved call handling and monitoring system.

SO\EM\2	Communications with field staff
Issue	The Agency's emergency response is heavily dependent upon good communications between the incident rooms and the multi-functional field staff and the emergency workforce. Currently Private Mobile Radio (PMR) and mobile phones are used. The efficiency of this mix of systems can be improved.
Recommendation	Review and develop the national strategy for communication with field staff and emergency workforce operatives during flood events.

SO\EM\3	Liaison with Military
Issue	Better liaison links with the Military are required to fully understand the role of Military Aid to the Civil Community (MAC) and the services that can be provided There is a need to inform and educate the Military of Agency responsibilities.
Recommendation	Establish requirements and arrange joint meetings and exercises with local Military contacts.

SO\EM\4	Flood Defence Emergency Response
Issue	Area liaison with Professional Partners is good and can be improved. The recent recommendations of the Flood Defence Emergency Response report (FDER) need to be fully implemented.
Recommendation	Influence professional partners to implement FDER recommendations in each County.

SO\EM\5	Flood Risk Maps
Issue	During the event the provision of accurate 'At Risk' maps was essential for efficient and appropriate evacuation of areas by the Strategic Command Centres. Combinations of Local Flood Warning Plan maps and indicitive floodplain maps were used to advise across the Region.
Recommendation	Review needs of Strategic Command Centres for evacuation purposes and assist in provision of flood risk information.

SO\EM\6	Liaison with professional partners
Issue	Communications improve where clear notification and contact details are distributed during the early stages of an event.
Recommendation	Review and encourage consistency for all Agency and Local Authorities when opening and closing incident rooms.

3 FLOOD FORECASTING

The Agency has its flood forecasting expertise based in the Regional office in Worthing. Monitoring Duty Officers (MDO) and Forecasting Duty Officers (FDO) are supported 24 hours a day by a team in the Regional Communications Centre (RCC). These members of staff monitor the weather, rivers and tides all day, every day throughout the year using data from the Met Office, the Storm Tide Forecasting Service and the Agency's own network of rain, river level and flow gauges. The FDOs use these data with tools such as the recently developed river models and their experience of how the catchments behave to provide detailed fluvial (river) and coastal flood forecasts which in turn inform the flood warning decision making process.

Following an August with below average rainfall, September 2000 started as mostly dry with occasional light rain and drizzle. On the 15th September a cold front from the West brought heavy thundery rain and prolonged showers giving very high rainfall totals across the Region (see Map 3.1), particularly in Hampshire where at Havant 60mm of rain fell in 12 hours, equivalent to a 1 in 100 year return period. 56mm fell within a 4 hour period at this location. Combined with the failure of Southern Water Services Eastney pumping station this caused widespread flooding in Portsmouth and Havant. There was also flooding on the Isle of Wight at Ryde due to the combined effect of heavy rain and high tides. At the end of September, several fronts moving East across the country brought heavy rain and showers across the Region for a couple of days, but mainly this period was dry. The soil moisture deficit (SMD), which is a measure of the ability of the soil to absorb rainfall, fell throughout September. By the end of the month it was on average half that calculated at the beginning. River levels remained high in impacted areas and did not return to those observed prior to the flooding. September 2000 was the wettest for 19 years, with an average total rainfall of 124mm in Hampshire, 191mm in Sussex and 90mm in Kent (some rain gauges in North West Kent recorded over 127mm) compared to a long term average of around 75mm for the Region.

The beginning of October was mainly dry with the occasional periods of thundery showers giving moderate rainfall totals. River levels dropped towards the end of October to levels approximate to those recorded at the beginning of September. A complex low pressure area lingered over northern parts of the Region on the 9th–10th October and a series of fronts moving easterly across the country brought heavy rain, showers and gales across the Region. On the evening of 11th October a slow moving band of continuous rain streaming up from France into Sussex and Kent brought very high rainfall totals across the Region, particularly in East Sussex where over 130mm fell in 15 hours at Plumpton, equivalent to a 1 in 300 year return period. Widespread flooding resulted on 12th and 13th October across the Region, notably in Uckfield, Lewes, Ryde and on the Medway and in the Rother Valley. The 13th–26th October remained unsettled, but mainly dry with some rain and showers allowing river levels to fall slightly. Catchments remained completely saturated in Sussex and Kent although a soil moisture deficit (SMD) remained in Hampshire. Rivers responded very rapidly to additional rainfall.

On 27th October another very wet period arrived as a series of fronts moved in from the West. This culminated in a severe storm with heavy rain and gale force winds

during 29th and 30th October as a deep depression crossed northern parts. There was flooding in Kent at Yalding on the Medway and at Robertsbridge on the Rother. Romney Marsh was completely saturated with local flooding. The flood retention reservoirs at Ashford were storing large amounts of flood water. Flooding continued throughout Sussex, and high groundwater levels in, around and to the north of Chichester caused flooding of houses and roads requiring emergency pumps to ease water levels on the River Lavant. By the end of October all catchments throughout the Region were completely saturated. October 2000 was the wettest since 1903, with an average total rainfall of 175mm in Hampshire, 261mm in Sussex and 204mm in Kent compared to a long term average of around 80mm for the Region.

Maps 3.2 and 3.3 show rainfall totals across the Region during 9th–19th October and 20–26th October respectively.

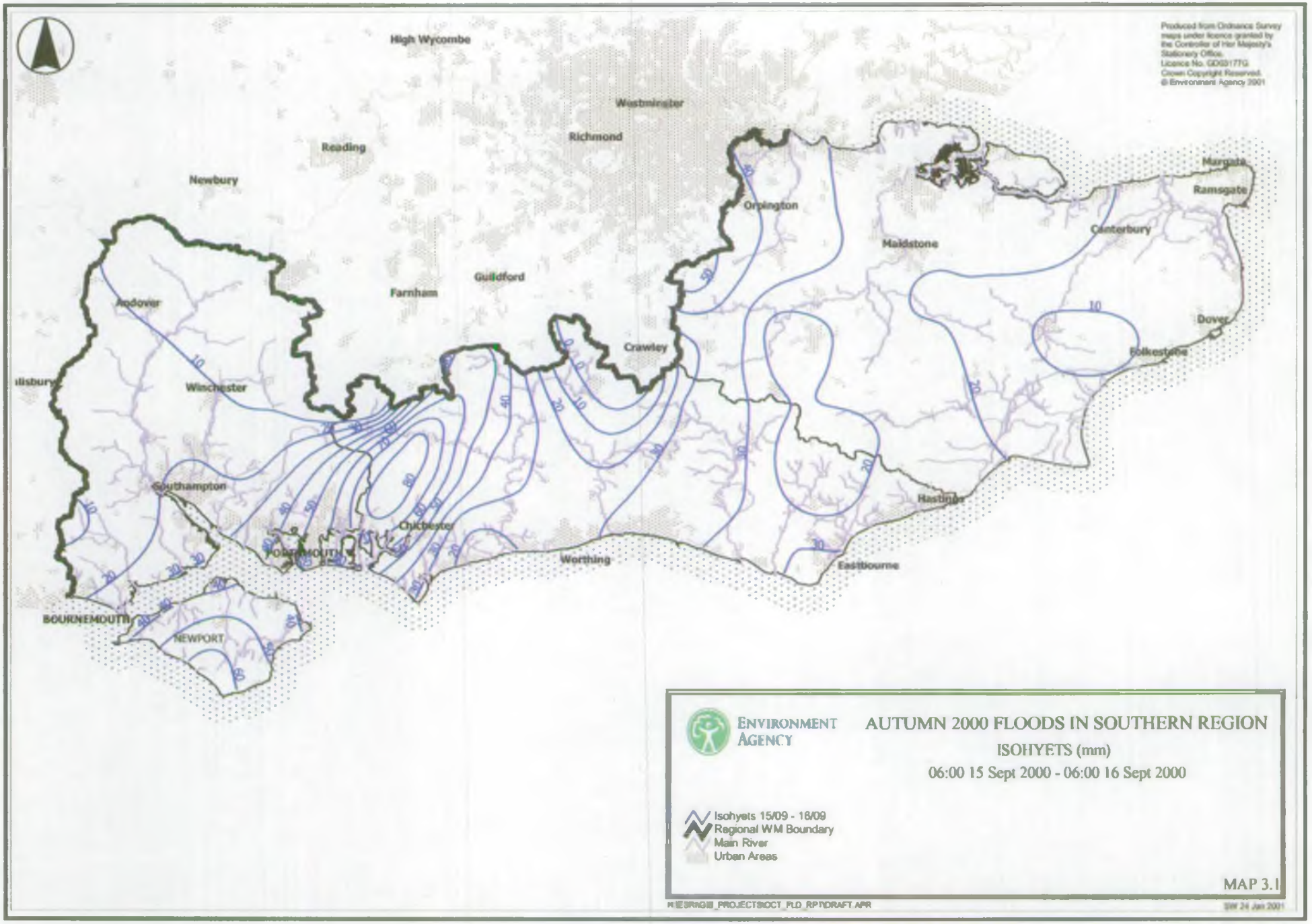
The wet weather continued at the beginning of November with bands of rain and showers affecting the whole Region. On the 5th and 6th November several fronts crossed the Region bringing heavy thundery rain and showers accompanied by strong winds. Up to 60mm of rain was recorded in Sussex over this period. Following this there was further heavy rain between 10th–13th November when a slow moving cold front crossed the Region. Flooding continued in the areas previously affected although not to the same scale as before. As river levels gradually dropped, groundwater continued to rise causing further flooding in West Sussex, particularly to the north and west of Chichester in the Lavant and Ems valleys. Following this a period of rain and showers brought moderate rainfall totals across the Region allowing river levels to drop, but groundwater levels continued to be high. This was the wettest November since 1970, with an average total rainfall of 185mm in Hampshire, 213mm in Sussex and 160mm in Kent compared to a long term average of around 84mm for the Region (see Map 3.4).

Rainfall accumulations across the period across the Region are shown in Map 3.5.

During the flooding period the Monitoring Duty Officers (MDOs) and Forecasting Duty Officers (FDOs) used many tools at their disposal including the Met Office forecasts, the Storm Tide Forecasting Service (STFS), the Regional Telemetry System (RTS), Flood Forecasting Platform (FFP) forecasting models, the Flood Estimation Handbook (FEH) and archived hydrometric data. The forecasts were made based on best available data and tools in a highly dynamic situation thus enabling the Area flood warning teams to take the most appropriate action based on the best available information.

3.1 ACCURACY AND TIMELINESS OF THE MET OFFICE SHORT AND MEDIUM TERM FORECASTS

The accuracy and timeliness of Met Office forecasts is crucial. When under forecasting occurs it proves extremely difficult to provide timely advice and flood warnings. Where over forecasting occurs significant preparations can be put in place leading to a loss of confidence in those providing warnings. The vital role of the Met Office cannot therefore be overstated. Ongoing liaison as an event unfolds is crucial to ensuring the most accurate information is used. This requires good co-operation between the Met Office and Agency staff which needs to be developed.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ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
ISOHYETS (mm)
06:00 15 Sept 2000 - 06:00 16 Sept 2000
Isohyets 15/09 - 16/09
Regional WM Boundary
Main River
Urban Areas
MAP 3.1
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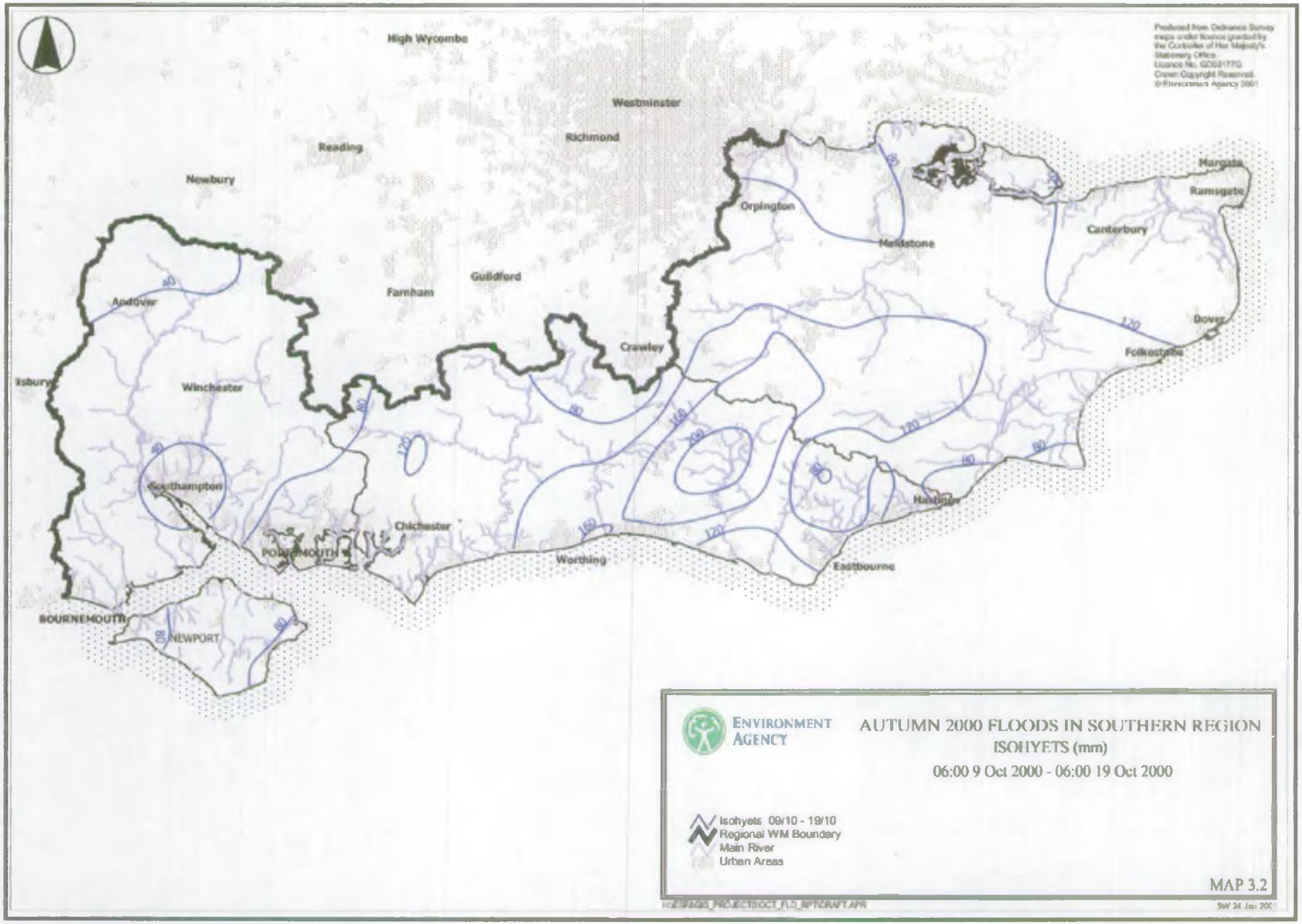
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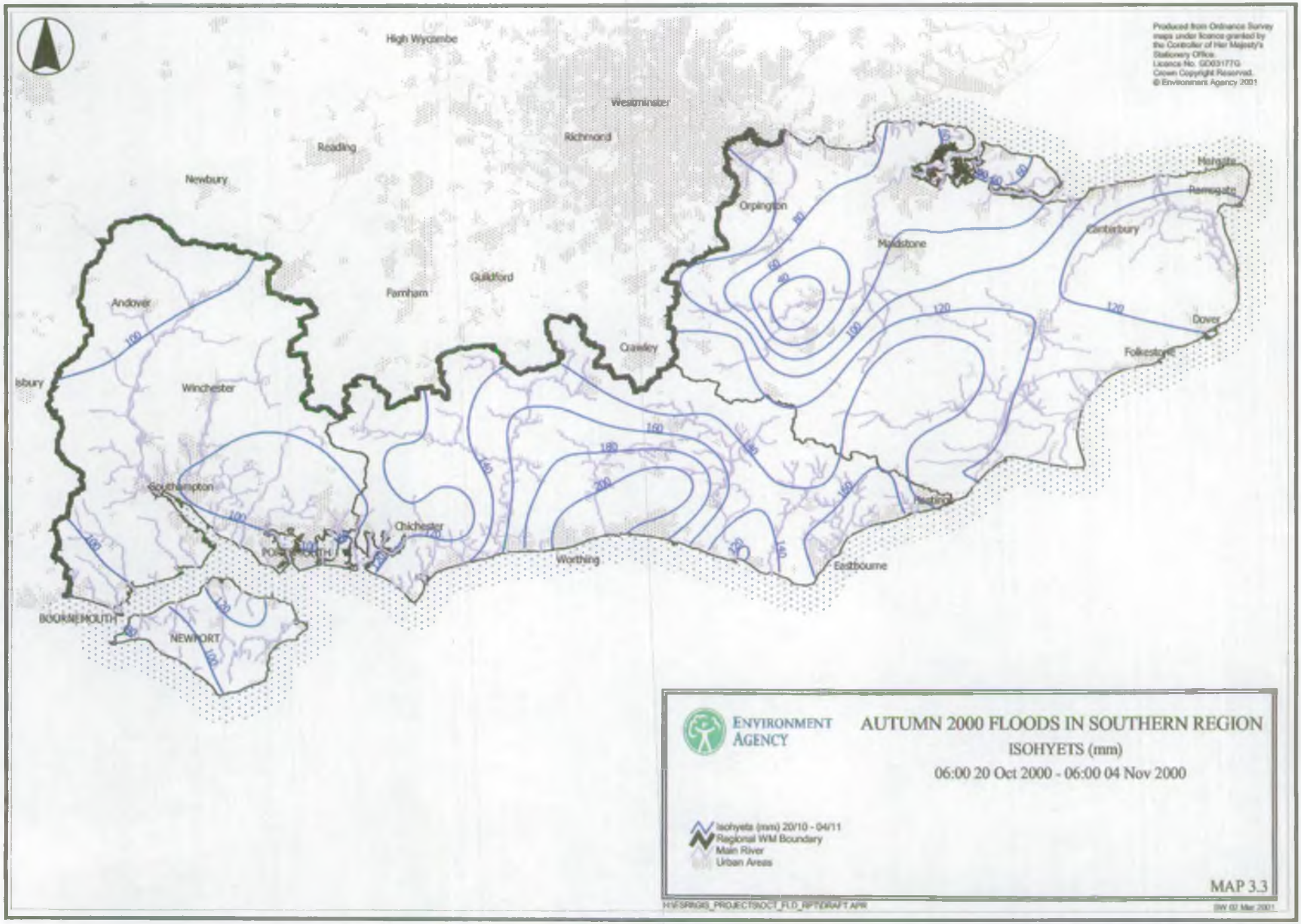
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
ISOHYETS (mm)
06:00 9 Oct 2000 - 06:00 19 Oct 2000
Isohyets 09/10 - 19/10
Regional WM Boundary
Main River
Urban Areas
MAP 3.2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ISOHYETS (mm)
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Main River
Urban Areas
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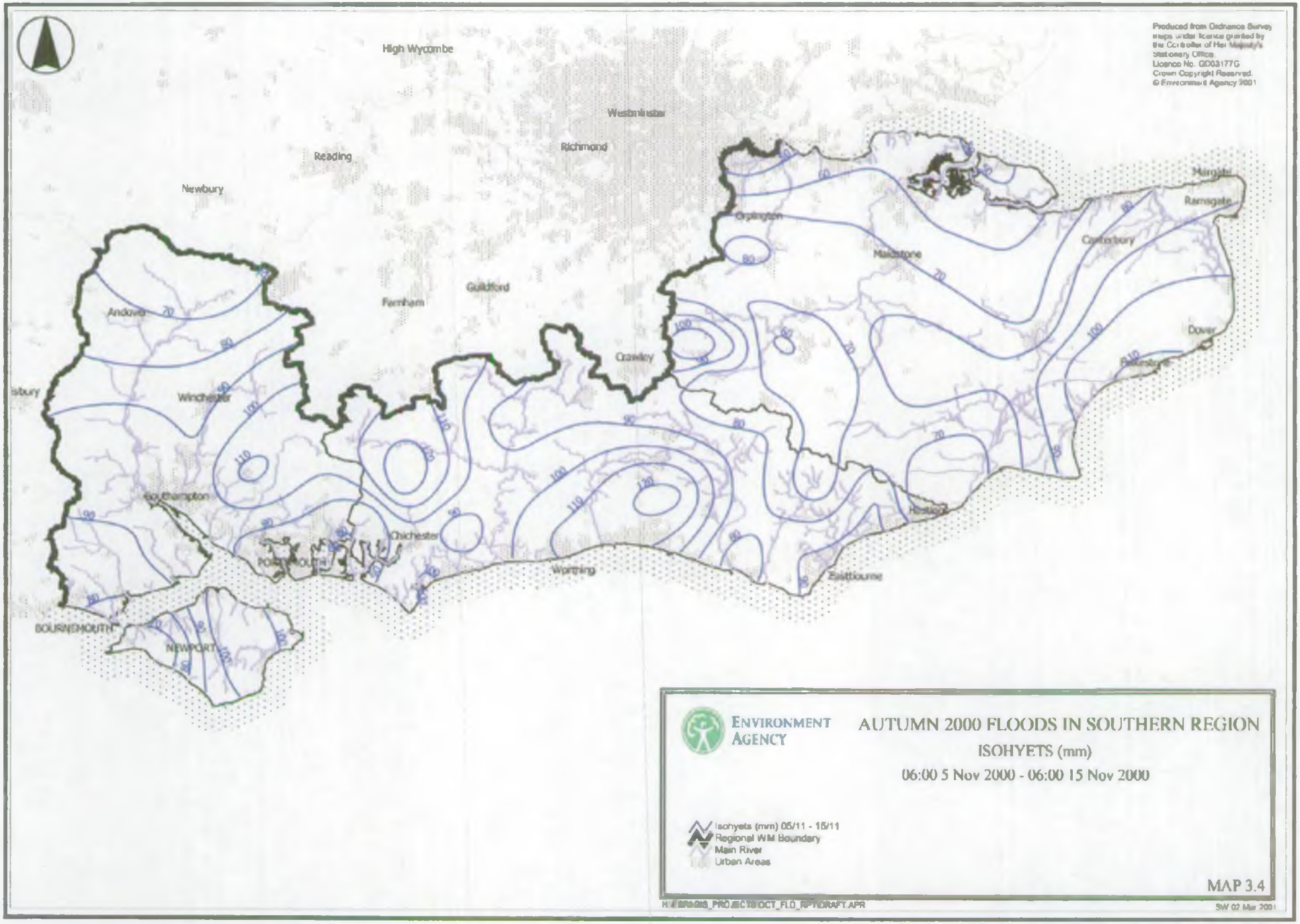
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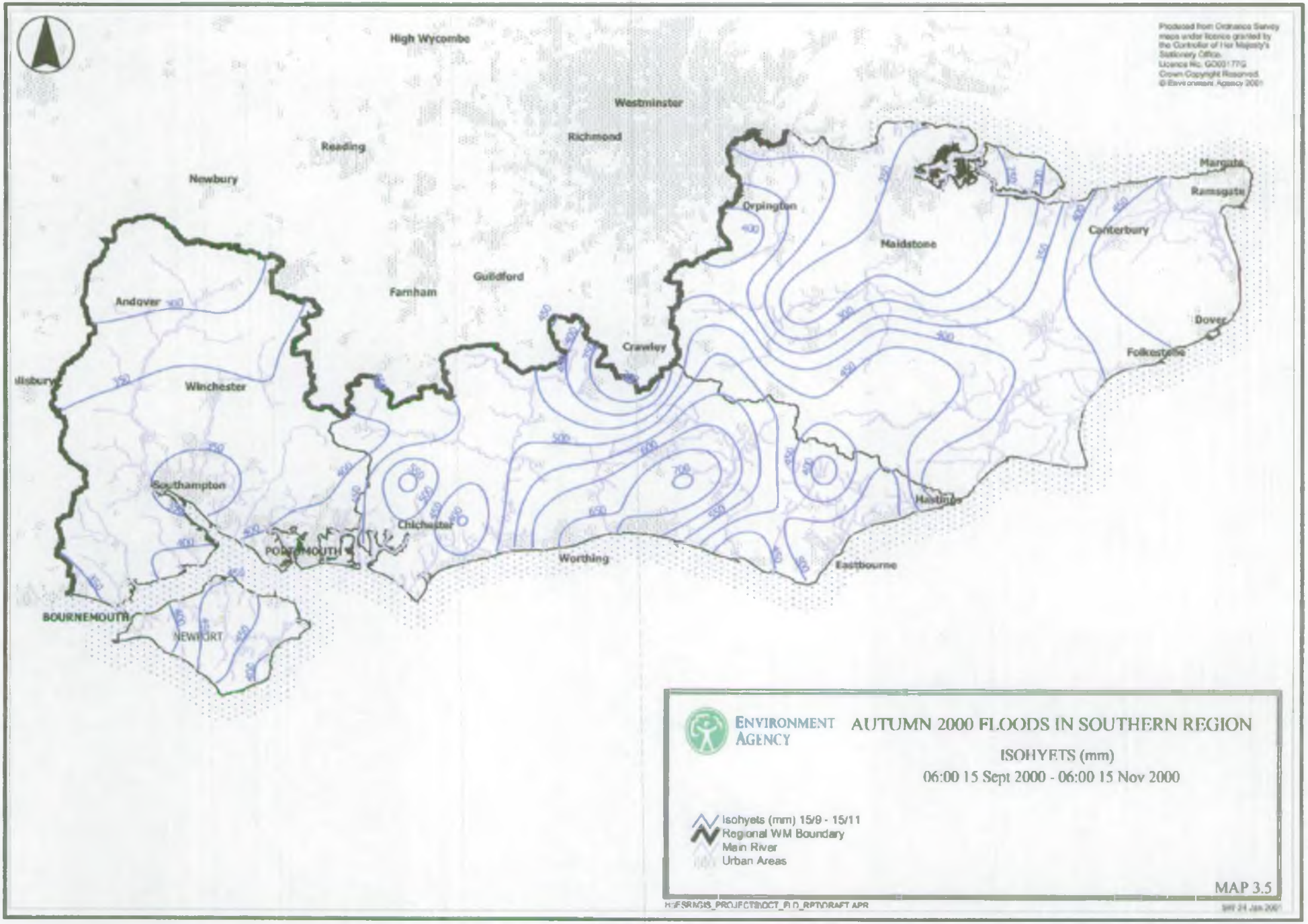
Regional WM Boundary
Main River
Urban Areas
MAP 3.4
SW 02 Mar 2001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ENVIRONMENT AGENCY
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ISOHYETS (mm)
06:00 15 Sept 2000 - 06:00 15 Nov 2000
Isohyets (mm) 15/9 - 15/11
Regional WM Boundary
Main River
Urban Areas
MAP 3.5

The Met Office provides weather forecast information through numerous channels including:

- Met Office, Bracknell – operate National Severe Weather Warning Service
- Met Office, London Weather Centre – provide local forecast for Southern, Thames and Anglian Regions including daily weather forecasts, Heavy Rainfall Warnings, gale warnings and consultancy services
- Met Office Storm Tide Forecasting Srvice, Bracknell – provide coastal water level information and wind forecasts.
- BBC Weather Centre, London – provide routine information following news broadcasts

3.1.1 Accuracy and Timeliness of Heavy Rainfall Warnings

14th–15th September

A Heavy Rainfall Warning received on the 14th September advised that heavy rain was expected during the latter part of the day and evening. Accumulations of 20–30mm were anticipated, although totals as high as 40–45mm were expected in a few areas. Examining totals for the 24 hour period starting at 06:00 on the 14th September showed that 1 to 4mm fell across the whole Region. Calls to the Met Office through the day confirmed that the front was moving slower than had been anticipated, and was not due to arrive in Hampshire until Friday morning.

The main cause for concern was the lack of information/warning received on the morning of Friday 15th September, where problems started occurring in Hampshire and Sussex before midday. By the time Flash Warning of Severe Weather and Heavy Rainfall Warnings had been received (12:30 and 12:50), parts of East Hampshire and West Sussex had seen rainfall accumulations of 20–25mm and 16–30mm respectively. An Early Warning of Severe Weather was issued at 09:45 advising that a band of showers would move across the Region in the afternoon, giving about 3hrs rainfall with totals of around 15mm, but with no mention of the rain in the morning. No Heavy Rainfall Warnings had been supplied during the morning. At 12:30 a Flash Warning of Severe Weather advised that outbreaks of heavy rain were occurring across parts of the Southeast making conditions difficult. This was received after the above mentioned rain had occurred.

The Heavy Rainfall Warning issued at 19:40 forecast that accumulations of 20mm+ would be observed over all catchments in Hampshire, Sussex and Kent during a 14 hour period from 08:00 to 22:00. However, this warning was received when only two hours were left in the time period it covered. By this time, all areas had received in excess of 20mm: the warning presented no additional information. In the 24hr period starting 06:00 on the 15th September, 50–60mm fell on the Isle of Wight, 35–60mm in East Hampshire, and 6–22mm in West and North Hampshire.

9th–12th October

Deep depressions, bringing heavy rain and high winds, tracked over the Region from the 9th–12th October triggering the issue of a number of Heavy Rainfall Warnings and Severe Weather Warnings. Problems occurred when Heavy Rainfall Warnings under or overestimated the amount of rain that was forecast in a certain time period. For example, the warning received at 09:52 on the 9th October predicted that accumulations of 20mm+ would be found throughout the whole Region (all catchments) in a six/seven hour period. This in itself is rather unspecific, however the text that accompanied the warning advised that Areas would see between 20–30mm, locally up to 35mm. In this example, the forecast greatly underestimated the amount of rainfall that was received throughout the Region. Sites in Hampshire and the Isle of Wight collected, in places, up to 60mm, Sussex 40–50mm and Kent 30–40mm. Although the information on the Heavy Rainfall Warning was applicable to parts of the Region, many sites received in excess of the figures presented (see Figure 3.1 for an a comparison of daily weather forecasts, Heavy Rainfall Warnings and actual rainfall received for the 9th-19th October in Sussex).

The warning issued on the 10th October was accurate, correctly advising that between 15–20mm could be expected across the Region.

On 11th October a Heavy Rainfall Warning received at 14:35 advised totals could reach 15mm at most. Consultation with the Met Office confirmed 10–15mm could be expected during the rest of the evening. A warning was then issued at 17:00 increasing the forecast accumulations to 15–20mm with highest totals in East Sussex and Kent (the Met Office confirmed that these totals should not be widespread). As the evening progressed, heavy showers began developing and bands of continuous rain streamed up from France into Sussex and Kent. In parts of East Sussex, accumulations of up to and over 140mm were recorded, whilst other parts of Sussex received from 15–40mm. Kent was also badly hit with totals of between 20–80mm. Accumulations in Hampshire were within the boundaries of the warning, although some sites in East Hampshire and the Isle of Wight collected up to 25mm.

15th–18th October

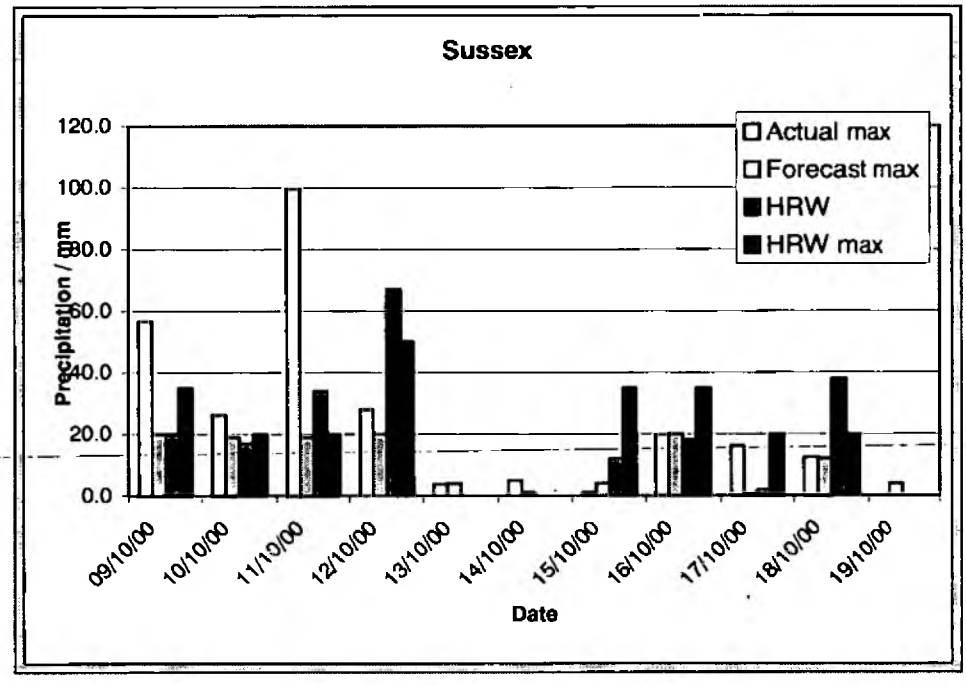
Between the 15th and the 18th October three Heavy Rainfall Warnings were issued: all forecast greater accumulations than those seen. On the evening of the 15th October, a Heavy Rainfall Warning advised that between 5–12mm of precipitation would fall in Hampshire, up to 30mm in Sussex, and 20–30mm in Kent (up until mid-afternoon on the 16th October). Accumulations were expected to be heavy in Sussex and Kent, with some of the eastern parts of the Region collecting 35mm, whilst the extreme West of Hampshire was expected to escape with even smaller accumulations. The rain that arrived was significantly lower than that forecast: Hampshire received between 0.2–2.4mm, West Sussex 1–5mm, East Sussex 10–20mm, and Kent 15mm maximum.

On the 17th October a Heavy Rainfall Warning was issued forecasting that 20mm+ was expected across the Region as a whole. The text accompanying the warning advised that overall amounts would generally reach 8–15mm, with a few places obtaining totals of 20mm. The RTS showed that the greatest rain recorded was in Sussex (where no place received more than 16mm), Hampshire got between 5–12mm, and Kent 1–5mm. The text explanation of the warning was accurate for Hampshire

and Sussex, however the table specifying how much would be received per catchment (in this case 20mm+) was an overestimate. Accumulations in Kent were overestimated up to 15mm both in the text explanation and in the individual catchment table.

The afternoon of the 18th October brought another Heavy Rainfall Warning, advising accumulation totals of 20mm+ would be seen across Sussex and Kent catchments, although totals were generally predicted to reach 10–15mm. In this case, the totals were inaccurate: Sussex only received 0–2mm, and Kent 1–4mm.

Figure 3.1: Comparison of daily weather forecasts, Heavy Rainfall Warnings and actual rainfall received for a period from the 9th October to the 19th October in Sussex



5th November

During the afternoon and evening of the 5th November, heavy and persistent rain crossed the Region prompting a Heavy Rainfall Warning. Overall amounts were expected to be between 15–25mm perhaps even as much as 35mm in places. Unfortunately no catchment differentiation had been made: a figure of 20mm+ was quoted for all Areas. Actual precipitation exceeded the amounts quoted on the Heavy Rainfall Warning. Hampshire received up to 48mm in places, and Sussex values ranged from 25–58mm. Totals in Kent were as forecast, between 20–35mm.

3.1.2 Other Weather Warnings

As well as Heavy Rainfall Warnings, a variety of other weather warnings were issued by the Met Office during the autumn flood period including Early Warnings of Severe Weather, Flash Warnings of Severe Weather, and Weather Watches. Although these are less specific to the Southern Region than Heavy Rainfall Warnings, they provide an early warning of any weather systems that may cause problems in the next 12–48hrs. A number of Early Warnings of Severe Weather and Update Warnings were

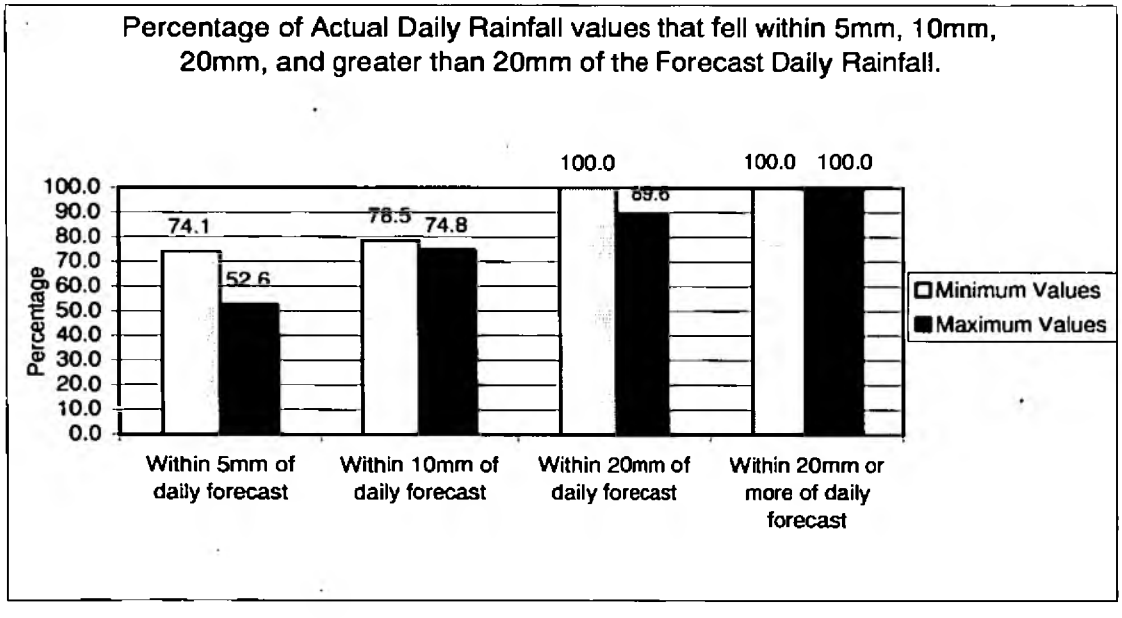
issued for the 9th–12th October flood event. Although they gave a good indication of the severity of the system and approximate timings, they were generalised and not very specific to the Southern Region. The same problems occurred with Flash Warnings, which often arrived after the worst of the weather had been received, or after Heavy Rainfall Warnings had been issued.

A large number of gale warnings were issued which were important for assessing surges and coastal defences. However the warnings generally were specific to open water rather than inshore and a call to the Met Office was necessary to clarify matters.

3.1.3 Met Office Daily Weather Forecasts

The daily weather forecast gave a good indication of whether it was going to rain on that day or not, but in some cases the rainfall totals were not accurate. Looking at the maximum and minimum values quoted on the daily weather forecast over the flood period the forecasts were generally more accurate for the minimum values. 74% of actual rainfall was within 5mm of the forecast values, whereas 53% of maximum values were within 5mm (see Figure 3.2). 75% of maximum values and 79% of minimum values were within 10mm of the forecast values. Generally the forecasts were more accurate for those periods where lower amounts of rainfall were expected, for example those days between the 21st October to the 26th October. However on many occasions areas that were forecast between 10 and 20mm only received 1 to 5mm. Heavy Rainfall Warnings were issued when greater than 20mm was expected during the day, which overruled a number of daily weather forecasts.

Figure 3.2: Comparison of actual accumulations to daily forecast accumulations



Being able to speak to a Met Office Duty Forecaster was extremely useful, however over the period 10th – 12th October the quality of verbal forecasts was poor. On the evening of the 11th, Met Office forecasters maintained the opinion that low quantities of rainfall were expected across the Region. Accumulations were actually much greater than forecast which led to problems throughout the Region. When Forecasting Duty Officers requested forecasts the quality of the information seemed to be

dependent on the Met Office Duty Forecaster available at that time. Individual interpretation of model results often varied from one forecaster to the other, giving inconsistent forecasts.

3.1.4 Accuracy of Weather Radar

There is a need for reliable, timely and accurate predictions of precipitation from the weather radar system. Unfortunately during the autumn floods the data, in most circumstances over predicted rainfall rates. The Nimrod forecasts were of particular concern, often being quantitatively unusable. However forecasters used the real-time data qualitatively, predicting the direction in which systems were moving and how quickly they were moving.

The Nimrod radar forecast is poor at convective development which explains why, in most cases, the Nimrod forecasts were so inaccurate. Cells were often shown to decay over the six-hour forecast when in reality the system was itself developing, bringing more precipitation than forecast.

Comparison between the real time radar rainfall accumulations and ground truth data showed that the radar overestimated, sometimes by 300%, compared to rain gauges. Nearly every rain gauge returned a figure lower than the radar, the discrepancy increasing the greater the precipitation.

Despite recent improvements, weather radar coverage continues to be a major problem for the Region. There is a large radar network coverage 'gap' in the Southeast of England and the South coast as shown on Map 3.6. This shows the limit of 2km grid square data currently available for the Region. This 2km coverage has recently improved with the installation of new processor equipment at the Chenies and Wardon Hill radar sites. This increases coverage from 75km to 100km from the radar site but this still does not give coverage to the whole of Southern Region. 5km grid square coverage is available for the whole of the Region but this is too coarse for accurate flood forecasting. 1km grid square information is now available for six of the eight weather radars around the country but only within 50km of the radar sites.

Historically efforts on improving radar coverage and quality have focussed on the Chenies radar site due to its importance for London. Discussions with the Met Office in the early 1990s on the installation of a new radar site for the Southeast did not progress because of the cost/benefit calculations at the time. As a result the Region ensured best use of its rain gauge network by purchasing the Hyrad Weather Radar display system. This allows radar rainfall estimates calculated by the Met Office to be graphically displayed.

Weather radar is used to provide real time quality controlled rainfall estimates and forecast rainfall estimates up to six hours ahead using the Nimrod system at the Met Office. Unfortunately during the autumn floods Nimrod often over predicted rainfall rates and was quantitatively unusable. However Agency forecasters used the Nimrod forecast data qualitatively to predict the direction and speed of weather systems. The Nimrod forecast is poor at convective storm development which explains why, in most cases, the Nimrod forecasts were so inaccurate – cells were often shown to decay over the six-hour forecast when in reality the system was itself developing, bringing more precipitation than forecast.

Comparison between Nimrod quality controlled radar rainfall accumulation estimates and ground truth data showed that the radar overestimated, sometimes by 300%, compared to Agency rain gauges. Nearly every rain gauge returned a figure lower than the radar, especially with higher precipitation amounts.

Ensuring complete weather radar coverage is a priority for the Region to permit accurate flood forecasting. Further work to locate new radar sites and improve Nimrod forecast data is urgently required.

3.2 IMPACT OF ANY INACCURATE METEOROLOGICAL FORECAST

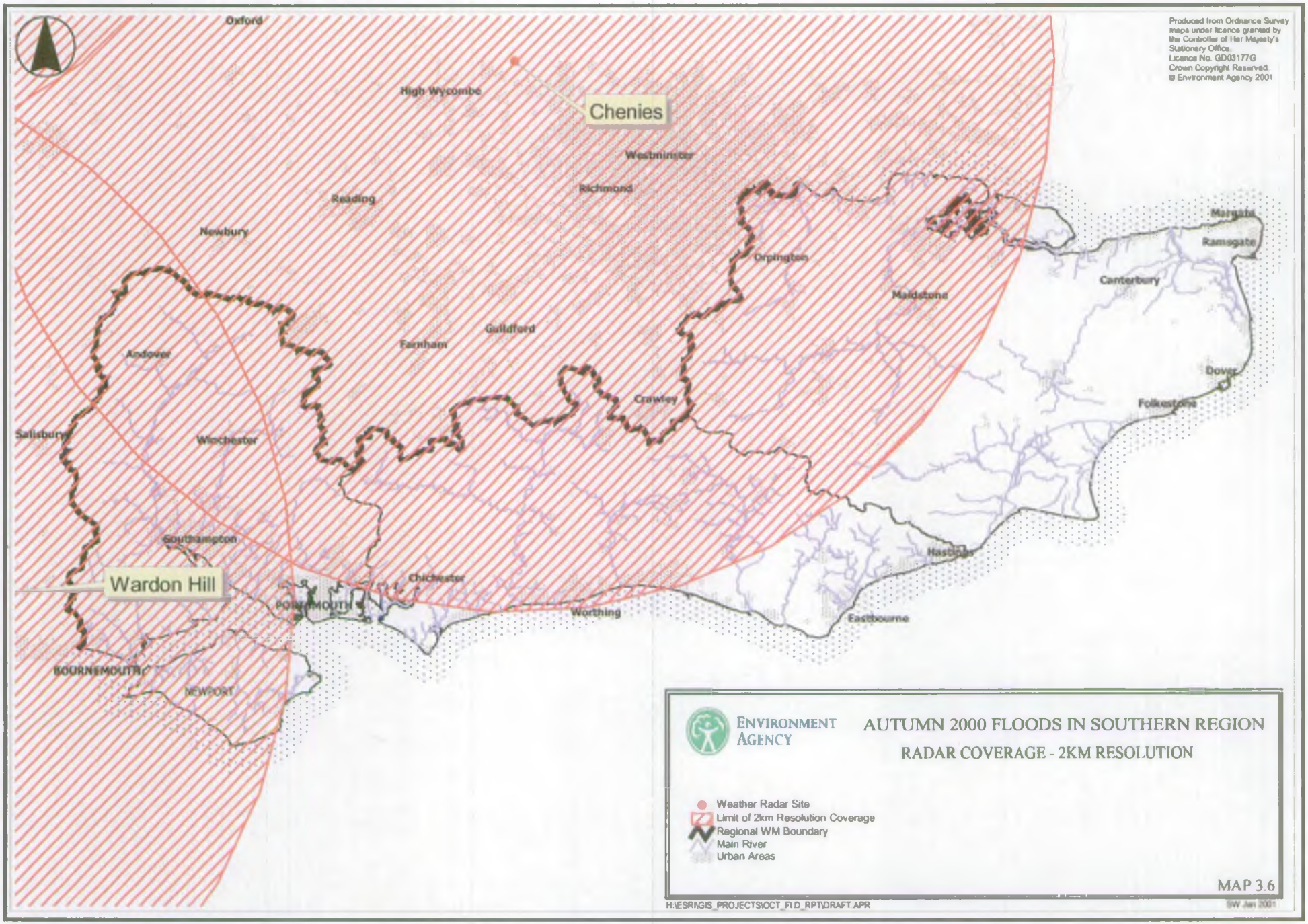
The quantity and suddenness of the precipitation received in the morning of Friday 15th September led to a number of flooding events through the Region. Thunderstorms developed very quickly off the coast of Hampshire and streamed across Hampshire, the Isle of Wight and Sussex during the morning. No Heavy Rainfall Warnings were received from the Met Office for this event. Flooding occurred in Portsmouth, as well as at Ryde on the Isle of Wight.

One of the main problems during 9th–19th October event was the underestimation of rainfall on the 11th October. Having received a Heavy Rainfall Warning advising that at most 15–20mm would be seen across the whole Region, and with further consultation with the Met Office Forecaster, the decision was taken to stand down the FDO and MDO 24 hour shift roster and return to standby arrangements. As night drew on, bands of rain continued developing and moving over the South coast. The MDO was relocated to the RCC to handle alarms and the FDO to the forecasting room It was realised that the MDO and FDO would need to return to 24 hour monitoring and forecasting. That evening, as mentioned previously, an exceptional amount of rain was received in the Region. Some places saw 4 to 5 times more rainfall than the Heavy Rainfall Warning had predicted. Provisional rosters had already been drawn up for the staff for that evening and the next day. Had these not been in place it would have been extremely difficult to staff the Forecasting and Incident Rooms at such late notice. With the amount of rain that fell, more staff were called into offices to issue warnings and handle calls. A rapid and accelerated response to this situation was required from the Area offices.

Heavy Rainfall Warnings issued between the 15th and 18th October tended to overestimate the amount of rain due. Significant resources were expended in staffing up incident and forecasting rooms, making sure that phones could be manned, and that enough support operators were present in the RCC. Staff who had been working on rosters could have been rested and stood down, instead had to continue on overnight shifts.

Individual catchment summaries were often inadequate for the needs of the Areas i.e. those that quoted a figure of 20mm+ across all catchments in the Region. The idea of splitting the Heavy Rainfall Warning into different catchments was to give staff as much detail as possible in order to issue flood warnings for those different catchments. Unfortunately, most of the Heavy Rainfall Warnings that were issued had not been broken down into individual catchments.

As mentioned above, a large proportion of the warnings significantly under or overestimated forecast accumulations. However there were occasions when the Heavy


Oxford
High Wycombe
Chenies
Westminster
Richmond
Reading
Newbury
Orpington
Margate
Ramsgate
Canterbury
Maidstone
Guildford
Farnham
Andover
Crawley
Dover
Folkestone
Salisbury
Winchester
Southampton
Wardon Hill
Chichester
PORTSMOUTH
Worthing
Hastings
Eastbourne
BOURNEMOUTH
NEWPORT
Produced from Ordnance Survey maps under licence granted by the Controller of Her Majesty's Stationery Office. Licence No. GD03177G Crown Copyright Reserved. © Environment Agency 2001
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
RADAR COVERAGE - 2KM RESOLUTION
Weather Radar Site
Limit of 2km Resolution Coverage
Regional WM Boundary
Main River
Urban Areas
MAP 3.6
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SW Jan 2001

Rainfall Warnings were accurate. The period around the 28th to the 30th October is a good example where timings and precipitation accumulations were relatively good. It was also positive to see a Heavy Rainfall Warning being cancelled (7th November) when it was realised that the system would not bring any additional rain.

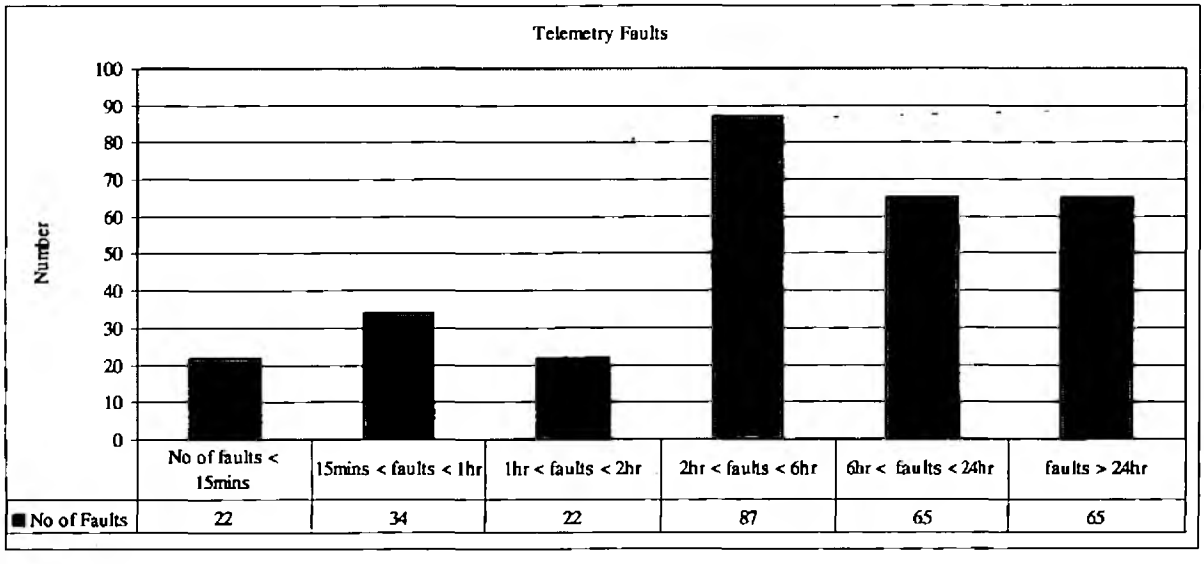
3.3 AGENCY TELEMETRY AND OUTSTATION ROBUSTNESS AND AVAILABILITY

Since taking on the role of flood warning dissemination in 1996 Southern Region has invested heavily in new technology to support its new role. The Regional Telemetry System (RTS), introduced in 1999 at a cost of £3m, has replaced outdated equipment and allowed further expansion in terms of the number of sites from which information is available and the quality of the information presented. Information on rainfall, river levels and river flows and the operation of flood defences is available on dedicated PCs the Agency's standard PC desktop and via remote access. Overall the RTS system performed very well throughout the event. Problems that occurred can be largely attributed to the severity of the event (one outstation was washed away), communications problems and outstation battery failures – primarily due to the prolonged nature of the event. These are discussed below.

3.3.1 Robustness of telemetry system

The number and duration of faults reported has been taken directly off the Regional Telemetry System. Those stations that are applicable to flood forecasting (i.e. all rain, flow and level gauges) have been filtered out and the reported faults have been further analysed. Figure 3.3details a breakdown of all the reported faults.

Figure 3.3: Number of communications faults reported during the period 15th September 2000 to 15th November 2000



The duration of the faults has been assumed to be the time difference between the first instance of a fault being reported on the RTS to the time at which the fault is reported as having been cleared. Due to the nature of the telemetry system this method of calculating the duration of faults can overestimate the actual downtime of the stations. Faults will be reported as alarms as they happen; faults will continue to be reported

each time the station is polled unless the fault has been rectified, in which case a 'NORMAL' alarm will be reported. A single missed scan of a station can therefore result in an apparent downtime of several hours - the time until the station is next polled. As the stations are polled every 24 hours, faults cannot be considered to be significant for periods shorter than this. Longer duration faults have occurred for differing reasons. In terms of data availability for flood forecasting each station can be scanned on request at any time to retrieve information that may have been missed due to a temporary communications link failure.

Table 3.1 details the number of faults that were reported that were greater than 24 hrs in duration. For each type of gauge between 10 and 20% of the network experienced a failure lasting in excess of 24 hrs. The loss of gauges for this length of time is only an issue if there are no other gauges within the respective Flood Warning Areas that can be used to adequately forecast flood flow.

Table 3.1: Failures greater than 24 hours in duration by station type

Station type	No of stations in Region	No of Stations with failures > 24 hrs	Total no. of failures >24 hrs
River Flow	64	10	14
River Level	159	16	28
Rain Guage	59	11	15
Tide Level	10	1	1
Groundwater Level	11	1	2

Of the faults that are reported in the table above a few sample sites have been investigated for the cause. These are summarised in the table below.

Table 3.2: Sample causes of reported outstation downtime

Station Name	Time of fault	Duration	Cause
Houghton Bridge	29-Sept-00	5 Days	Battery Failure
Wye Great Stour	05-Sept-00	5 Days	Battery Failure
Cowbeech Rain guage	10-Oct-00	5 Hrs	Temporary communications link failure
Buxted	12-Oct-00	6 Days	BT line flooded
Uckfield	12-Oct-00	>3 Months	Outstation washed away
Robertsbridge	4-Nov-00	3 Mins	Temporary communications link failure

3.4 ABILITY OF AGENCY TO PREDICT ACTUAL FLOOD LEVELS

3.4.1 Overview of Forecasting Procedures

Forecasting procedures currently fall into one of two main categories:

1) locations modelled by the Flood Forecasting Platform (FFP) (using transfer functions) and,

2) locations not included in the FFP (forecasts use a range of methodologies).

The Met Office rainfall forecasts are an integral part of the forecasting procedures.

Flood Forecasting Platform

There are currently 79 fluvial Flood Warning Areas with 14 covered by the FFP as shown in Table 3.3.

Table 3.3: Flood Warning Areas covered by the FFP

Flood Warning Area	Code
Hampshire Area	
Lower Test – Tadburn Lake	F1A2
Tanners Brook – Millbrook	F1A4
Lavant Stream – Leigh Park	F1C3
Sussex Area	
River Ems	F3A1
River Lavant	F3B3
River Arun from Pulborough to Arundel	F3C3
River Arun from Arundel to Littlehampton	F3C4
River Uck	F4A2
River Ouse from Lindfield to Isfield	F4A3
River Ouse from Isfield to Barcombe	F4A4
Cuckmere River from Hellingly to Shermans Bridge	F4B2
Kent Area	
River Great Stour from Lenham to Ashford	F6A3
River Medway form Penshurst to the Tonbridge Bypass	F8A3
River Beult from Pluckley and Bethersden to Yalding	F8A9

Observed data is extracted from the RTS up to the point at which the calculation is being made. The FDO then forecasts the flow and/or level at the site, based on weather predictions and the FFP transfer functions.

Forecasts are initially made to predict if water levels are expected to exceed the trigger levels. Further to this the forecasts are used to predict at what time the exceedence is likely to occur and finally they then may be used to predict a peak level or flow at the respective sites.

The primary function of the forecasts using the FFP is to give warnings of possible exceedence of the trigger levels. There are two locations within the Region where the main priority is to predict the peak flow: at Chichester where the flow is critical to the degree of flooding of the city, and at the Leigh Barrier where the flow downstream of the Barrier has to be regulated to minimise flooding potential. This supports the advance rainfall and river level information on the RTS which informs the Leigh Barrier operating procedures.

The FFP models have been derived and validated over the past 18 months from observed data. The Agency intends to develop and verify the models and determine their accuracy and performance based on the flood events of the winter of 2000/2001.

The primary objective of the FFP models is to support rain gauge and upstream river level information to more accurately predict if and when water levels will rise above the trigger levels. As a result the FFP models have been calibrated to mimic the rise of the hydrograph as accurately as possible at the expense of the accuracy of the falling hydrograph and the peak.

Other methods

There are a number of other forecasting methods employed at sites not included in the FFP. These include:

- RTS forecasting models
- FEH techniques
- Interpolating data
- Review of historic events

The River Cray and the River Shuttle have warnings that are based on rainfall trigger levels as the catchments respond quickly. Two models are stand-alone and are incorporated into the RTS system. These are for the Leigh Barrier and the River Lavant.

Interrogation of the RTS data and the weather forecasts (whether from the Met Office or from HYRAD etc) require a detailed knowledge of how the catchments respond to rainfall. Forecasts can then be made as to whether Warnings Levels are likely to be exceeded, based on comparison with prior events with similar antecedent conditions.

RTS forecasting models include the Medway model, which is a combination of several transfer function models combined with reservoir routing. The major focus of the forecasting is on forecasting the correct trigger level exceedences, rather than on accurate forecasting of the peak flow time and magnitude. The few occasions where peak flows were the focus included the incident at Maidstone on the 14th October and at Lewes on the 12th October.

3.4.2 Review of forecasts for the Autumn 2000 events

Introduction

The Forecasting Duty Officer (FDO) issues the forecasts at the relevant times preceding an event, updating forecasts whenever possible. Due to the nature of the Autumn 2000 floods and the peak workloads, predictions to support information from the Regional Telemetry System were verbally transmitted to the Area Incident Rooms.

Review of forecasts

Table 3.4 lists many of the weather and flood forecasts transmitted from the Regional office to the Area offices to support Regional Telemetry System information between 15th September and 15th November 2000. Flood forecasts have been compared against resulting events where possible.

Table 3.4: Flood forecasts issued and outcomes

Date of issue	Recipient	Site	Prediction	Prediction technique	Outcome
10/10/00 17:10	Hampshire		Rainfall forecasts, level information		
10/10/00 19:30	Sussex FWDO		Modelling information		
10/10/00 23:15	Kent A.I.R.	Newbridge and Hamstreet	RTS interpretation		
11/10/00 20:25	Sussex FWDO		RTS interpretation		
12/10/00 12:50	Area incident rooms	Region	Rainfall forecasts, Flow forecasting predictions. Medway model predicting massive inflows of 350m^3/s with a five hour lead time. Estimated peak is 140m^3/s at 5 hr lead time.		
13/10/00 02:01	Kent FWDO	Yalding, Maidstone	Weather and flow update. Peak at Yalding at 09:00 to 10:00 of 220m^3/s		Peak at Yalding at 13/10/00 19:30 (u/s), and13/10/00 15:21 (d/s)
28/10/00 08:30		Cowbeech	Rise next 2 hours.	FFP	Rose till 28/10/00 12:15 before receeding.
28/10/00 08:30		Herran, Great Stour	Levels continue to rise next 6 hours though levelling after 4 hours.	FFP	
28/10/00 08:30		Isfield	Forecast to rise for next 4 hours then begin to fall	FFP	Peaked about 28/10/00 22:30 (rating table exceeded)
28/10/00 08:30		Raner	Forecast to continue to fall next 6 hours	FFP	
28/10/00 08:30		Stile Bridge, Beult	Continue to rise next 6 hours	FFP	Peak of 15.007mAOD at 31/10/00 04:45.
29/10/00 00:20		Skuebridge, Beult	40m^3/s next 6 hours		40m^3/s at 30/10/00 15:45, Peak at 31/10/00 04:45 of 60.4m^3/s.
29/10/00 04:45		Lymington	Level rising above H1 at T +6hrs	Based on rainfall forecast and current levels	H1=1.50. Peak was 1.199 on 29/10/00 11:30
29/10/00 10:55		Medway	Medway model predicting 110-120m^3/s T+9	RTS Medway model	

Date of issue	Recipient	Site	Prediction	Prediction technique	Outcome
29/10/00 13:12		Isfield (Uck)	Peak of 70m^{3}s^{-1} at 2100	FFP based on 12mm in 3hrs	Rating table exceeded at 11.447m^3/s
29/10/00 21:34		Iping ()	Flow of 19m^3/s at 0200 (still rising)	FFP	
30/10/00 11:00		Leigh Barrier Res Lvl, River Medway	Peak of 110-120m^3/s at T + 9	RTS Medway model	
30/10/00 18:18		Cuckmere	Peaking at 0.9mALD at 22:00		
30/10/00 18:32		Medway	Forecast of 50m^3/s (using 10mm of rain in 3hrs)	RTS Medway model	
30/10/00 20:01		Lewes (Ouse)	Peak of H4, 00:00-02:00	Estimation based on travel time from Barcombe	Peak of 4.134 at 31/10/00 01:45. H4=4.5, H3=4.2, H2=3.9.
30/10/00 20:40		Leigh Barrier Res Lvl, River Medway	Peak of 27.9m, 06:00.	RTS Medway Model	
31/10/00 06:30	Kent FWDO	Yalding	Level to rise to 11.4 m	Based on previous events	Peak on 31.10/00 20:00 of 10.777mAOD (u/s)
31/10/00 07:30		Cowbeech (Cuckmere)	Peak 1.3mALD at 2100	FFP based on 12mm in 3hrs	Level decreased from issue of forecast.
31/10/00 07:30		Isfield (Uck)	Flow of 92m^3/s at 0200 (still rising)	FFP	
31/10/00 07:30		Medway	Medway model predicted level to reach 28.05 in next 4-6 hours. 80m^3/s outflow.	RTS Medway model	
31/10/00 07:30		Regionwide	Through H3 and H4 within 24 hrs	Based on rainfall forecast and current levels	
31/10/00 07:30		Upper and Lower Rother	Trigger level exceeeded within next 4 hrs	Based on rainfall forecast and current levels	
31/10/00 22:48	Kent A.I.R.	Allington	Level will be 0.4 m lower than 14/10		
01/11/00 07:30		Isfield	Probably 'clip' H3 then level and fall.		
01/11/00 07:30		Uckfield u/s	Probably H2 then falling.		

Date of issue	Recipient	Site	Prediction	Prediction technique	Outcome
02/11/00 10:10		Cowbeech	Likely to exceed H3.		Rose to 30.866mAOD at 02/11/00 13:00. H3=30.5
02/11/00 10:30		Cowbeech, U. Cuckmere	May reach H4 just.		Rose to 30.866mAOD at 02/11/00 13:00. H4=30.9
02/11/00 10:30		Goldbridge, Ouse	May reach H2.		Peak of 13.296 on 03/11/00 00:30. H2=13.2. Reached 13.2 on 2/11/00 20:00.
02/11/00 10:30		Isfield, Uck	May reach H3.		
02/11/00 11:45		Beult	High H2 20.8-21.2		
02/11/00 11:45		Colliers Land Bridge	Probably H2.		Peak of 32.722 on 02/11/00 23:00.
02/11/00 11:45		Eden	Definitely H2 next 6 hours.		Peak of 39.973 on 03/11/00 00:15. H3=39.60, H4=40.7.
02/11/00 11:45		Lamberhurst, Teise	Probably H2 next 6 hours.		Peak of 39.432 at 02/11/00 18:00. H2=38.00, H3=38.5, H4=39.75.
02/11/00 11:45		Summerford, U. Medway	Probably 41.4-41.8 next 6 hours.		
02/11/00 20:07		Lamberhurst (Teise)	Peak just below H3 by 22:00	Based on current rate of rise.	Level decreased from issue of forecast.
02/11/00 20:07		Smarden (Beult)	Peak just below H3 at 23:00	FFP	
02/11/00 20:07		Stile Bridge (Beult)	Peak of 14.3m at 14:00 (on 4/11/00)	FFP	Peak 14.230 03/11/00 18:30.
02/11/00 20:07		Stonebridge (Teise)	Peak just below H2, 02:00	Based on current rate of rise.	Peak of 26.093mAOD at 02/11/00 15:45.
02/11/00 20:07		Udiam	Through H3 in 12 hours.		Peak of 4.731 at 03/11/00 13:15.

Date of issue	Recipient	Site	Prediction	Prediction technique	Outcome
02/11/00 20:07		Yalding	Peak of 10.6-10.7m, 18:00-19:00 (3/11/00)		Peak of 9.929 on 03/11/00 01:15 (u/s)
03/11/00 09:00		Horton, Great Stour	Rising next 6 hours (from 07:00)		Peaked at 03/11/00 15:34
03/11/00 09:00		Rother, Udiam	Still rising but levelling next 2 hours (from 07:00)		
05/11/00 07:30		Uck	Advised peak flows should be between high tides.	Catchment knowledge/lag times	
05/11/00 15:15	FWDO's/ AIR's	Botley rd.	17.7mAOD at 2200 - 2300	FFP	
05/11/00 15:15	FWDO's/ AIR's	Buxted	At least 26.76mAOD by 2300 - 0000	FFP	
05/11/00 15:15	FWDO's/ AIR's	Cowbeech (Cuckmere)	Rise of at least 0.7mAOD by 2100. Could well reach 30.85mAOD again and could possibly exceed H4	Model	Reached 30.74 at 21:00. Was 29.91 at 15:15. Reached recorded peak of 31.446 at 5/11/00 23:45, but appears to have reached limit of recorder. H4 is 30.9mAOD.
05/11/00 15:15	FWDO's/ AIR's	Hempstead Mill	At least 22.80mAOD (above H4)	FFP	
05/11/00 15:15	FWDO's/ AIR's	Sherman's Bridge (Cuckmere)	Likely to reach 5.41mAOD (H3) and could go further	FFP	
05/11/00 15:15	FWDO's/ AIR's	Uckfield	22.43mAOD maybe higher (above H3)FFP		
05/11/00 17:23	FWDO	Aldington Flood Storage	2-3 hours max to peak from end of rainfall. 10 mm should stay in, 15-20 mm will cause levels to overtop around 0600 - 1000	Based on rainfall forecast and current levels	Peak of 48.974 on 07/11/00 11:15 (u/s)
06/11/00 15:46	FWDO Sussex	Lavant	Rise by 4.9m^3/s by 0600 on 09/11 or by 1200 on 08/11 with an extra 10mm	Model	
06/11/00 15:46	FWDO Sussex	Lewes (Ouse)	1.67mAOD for next high tide. Level will remain between H2 and H3, may briefly touch H3		
06/11/00 22:27	Kent FWDO	Yalding	Peak at 10.8-10.9mAOD on 07/11 1000-1100		Peak of 10.769 on 07/11/00 13:30 (u/s)
07/11/00 02:00	Kent AIR	Yalding	Peak levels at 0700 +/- 1 hr		Peak of 10.769 on 07/11/00 13:30 (u/s)

Date of issue	Recipient	Site	Prediction	Prediction technique	Outcome
07/11/00 03:00	Kent AIR	Horton, Great Stour	26-28m^3/s RTS	Medway Model	Peak of 29.50m^3/s on 07/11/00 09:45, followed by a peak of 31.30m^3/s on 07/11/00 11:49.
07/11/00 06:45	Kent AIR	Horton, Great Stour	Peak flows rising for next 6 hrs to 28-29m^3/s		Peak of 29.50m^3/s on 07/11/00 09:45, followed by a peak of 31.30m^3/s on 07/11/00 11:49.
07/11/00 07:35	Sussex AIR	Lavant	Flows to decrease unless showers become stationary	Model	
07/11/00 14:18	Kent AIR	Sheerness	Specific values for next two high tides: 7/11 2200 -0.08m, 8/11 1000 -0.22m		
07/11/00 21:18	FWDO	Allington Lock	Peak of 4.3-4.4mAOD		
08/11/00 09:25	Sussex AIR	Lavant	Rise by 5 cm +/- 1 cm during next 16 hrs, 21.53mAOD	Extrapolation of base flow increase	
08/11/00 15:40	Sussex AIR	Lavant	6.8m^3/s, 21.55mAOD 0900 9/11; 7.15m^3/s, 21.58mAOD 0900 10/11; 7.35m^3/s, 21.6mAOD 0900 11/11	Extrapolation of the hydrograph	
10/11/00 11:19	FWDO	Lavant	Forcast 6.00m^3/s by 1200 Sat, 6.5m^3/s by 2359 Sat, 6.5-7.0m^3/s by 0600 Sun remaining at this level all day, lowering to 6.2-6.5 by Mon into Tue	Model	
10/11/00 19:51		Lower Arun	Levels still high and could reach those of the 5/11 and 6/11		
10/11/00 19:51		Monkton Mead	Could again exceed H3 (key will be timing of tide)		
12/11/00 11:25	FWDO	Aldington Flood Storage	2-3 hours max to peak from end of rainfall. 10 mm over next 4 hours and could come close to overtopping	Based on rainfall forecast and current levels	Peak of 45.946 on 12/11/00 21:17 (d/s).

3.5 ISSUES ARISING AND RECOMMENDATIONS

SO\FF\1	Improved weather forecasting
Issue	The timeliness and accuracy of daily weather forecasts, heavy rainfall warnings and verbal updates from the London Weather Centre and Bracknell needs urgent review. Forecast information received during the flood event was frequently late and under and over predicted actual rainfall..
Recommendation	Accurate rainfall forecasting is essential to allow timely and effective flood forecasting and warning. The Met Office are urged to review their procedures and systems for forecasting extreme rainfall events as seen during the Autumn.

SO\FF\2	Weather Radar Coverage and Accuracy
Issue	The Southeast of England suffers from very poor weather radar coverage. This causes differences in forecast and actual rainfall intensities. Additionally the six hour Nimrod radar forecast cannot be used to input accurate rainfall forecasts into flood forecasting systems.
Recommendation	i) Investigate and identify possible new radar sites in the Southeast and develop a buisness case for the installation of a new radar site. Introduce the new site in partnership with the Met Office. ii) In addition to the current rainfall collaboration project between the Agency and the Met Office further work is required by the Met Office on improving the accuracy of the six hour Nimrod forecast.

SO\FF\3	Telemetry System Operation and Usage
Issue	During the Autumn Floods the telemetry outstation network and the newly introduded Regional Telemetry System provided essential information. Several issues have been identified to improve flood forecasting and monitoring as follows.i) Outstation coverage, siting, power supply and the robustness of communications all need reviewing within the current Improvement Project instigated in 1998. ii) the current system of manually handling alarms generated by the outstations is becoming too onerous as the number of telemtry sites increases. iii) Key sites need improved high flow data to allow more accurate flood forecasting and flood monitoring.
Recommendation	i) Within the current four year Regional Telemetry Network Improvements Project, review the need for additional sites and the siting of sites above the 1:100 year flood level. Additionally services to sites need to be above the 1:100 year flood level where possible and all services and communications need to be robust enough to withstand extreme conditions. ii) Review and introduce an automatic alarm handling and dissemination system. iii) Prioritise key sites where high flow gauging is required within the Regional Telemetry Network Improvements Project.

SO\FF\4	Modelling and System Development
Issue	Currently 14 flow forecasting models are available on the Regional Flood Forecasting Platform, FFP. Many catchments do not have models available and in these cases forecasts of level and flows were estimated using extrapolation of observations, FEH analysis of flows and comparison with previous events.
Recommendation	Southern Region implemented a Regional Flood Forecasting Project in 1999 which will deliver a real-time forecasting capability to all at risk areas; fluvial, tidal and coastal. The project has two foci: Forecasting system development and model development. Model development is ongoing and key catchments have been identified. The prioritisation of model development has been established on a risk basis in consultation with Area Flood Warning and Flood Defence staff. The scope of this work needs reviewing in light of this event.

SO\FF\5	Forecasting Toolkit
Issue	Forecasting Duty Officers indicated the need for additional forecasting tools to speed up their analysis and to improve the quality of information they can supply to aid the flood warning decision making process.
Recommendation	Due to the time needed for the Regional Flood Forecasting Project to deliver full model capability to the Region, a forecasting tool-kit is being developed. This will provide FDOs with the tools they need to provide the best estimate of levels and flows in the absence of real-time forecasting models. This work is already underway and is due to be completed by the end of the financial year 2001/2002.

4 FLOOD WARNING

The Agency has recently introduced a four-stage flood warning service across England and Wales. The warning codes are Flood Watch, Flood Warning, Severe Flood Warning and All Clear and either refer to whole rivers or discrete sections of the coast and river network. Southern Region is divided into 22 catchments as shown on Map 4.1. Within these there are 79 fluvial and 25 coastal areas where flood warnings are issued and these are shown on Map 4.2. Flood Watches issued for the 22 catchments provide an early warning service of events developing as requested by professional partners following the Easter Floods of 1998. They also provide the only warning for area known to be at risk of flooding, i.e. within the indicative floodplain, but not yet covered by the four-stage service.

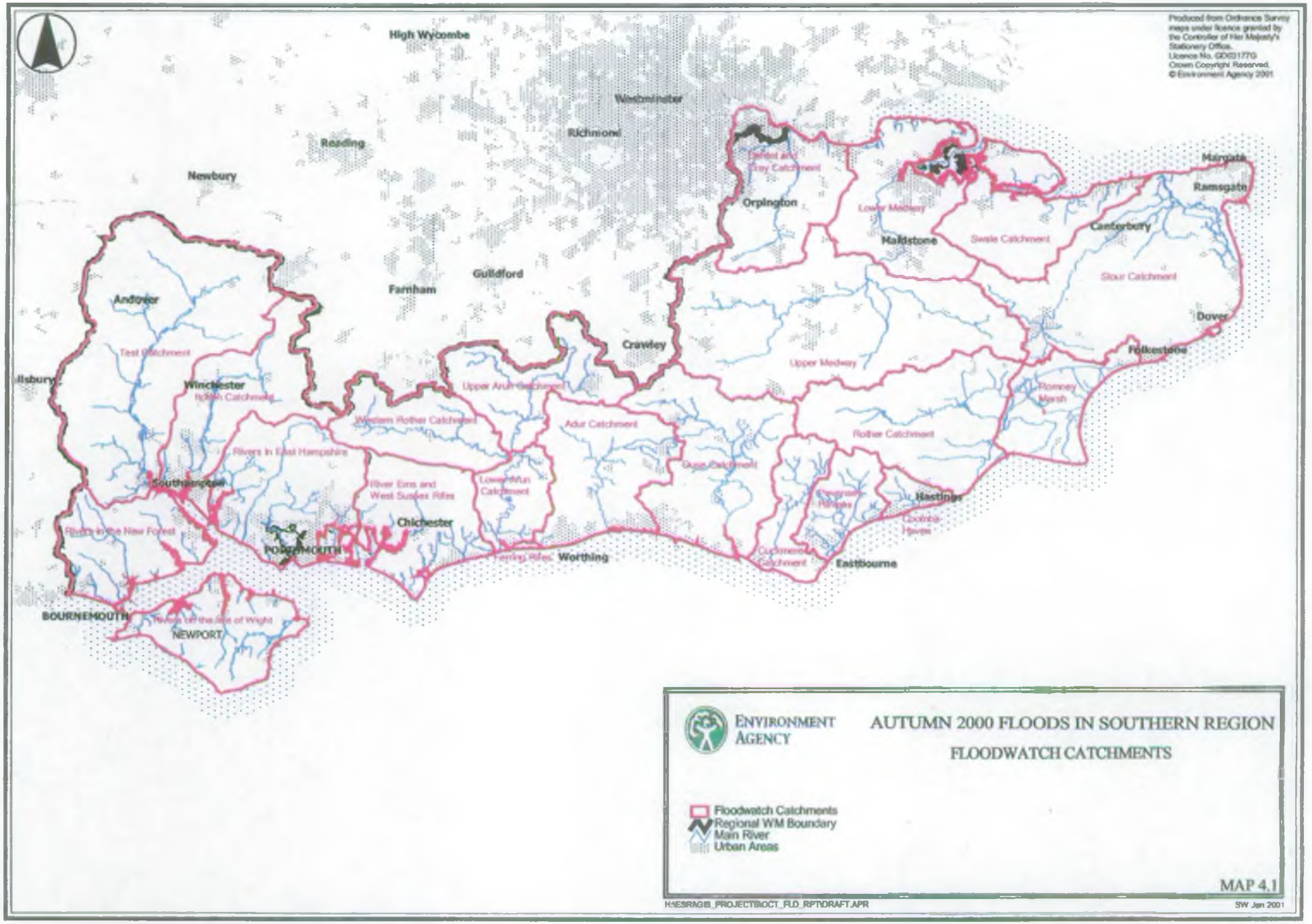
Arrangements for flood warning dissemination across the Region are described in four Local Flood Warning Plans, for Kent, Sussex, Hampshire and the Isle of Wight. These plans have been written in consultation with the local authorities and emergency services and are based on their boundaries. The Agency has strong links with the local authorities and emergency services and meets them on a regular basis to discuss flood warning issues.

4.1 TRIGGER/THRESHOLD LEVELS FOR WARNINGS AND LEAD TIMES FOR SEVERE FLOOD WARNINGS

Catchment Flood Watch messages are based on a combination of forecast information including Severe Weather Warnings, Heavy Rainfall Warnings and weather radar observation together with an assessment of the catchments saturation level. The majority of fluvial flood warnings are based on actual or forecast trigger point exceedence for river flow and level. These trigger points are referred to as H1, H2, H3 and H4 as levels increase. For the more responsive urban rivers, rain gauge alarms are also used. Site observations are also sought prior to the issue of Severe Flood Warnings.

The Agency aims to issue warnings at least two hours before the onset of property flooding from a 'main river'; this period is called the 'lead time'. However, since flooding can occur from a number of different sources the calculation of lead times is a difficult process. Table 4.1 summarises trigger levels, times of warnings issued and the Agency's best estimates of lead times for Severe Flood Warnings issued. A total of 50 Severe Flood Warnings were issued for the period, including 2 updates for the River Medway between Yalding and Allington which covers the Maidstone area.

Map 4.3 indicates the frequency of the risk of flooding across Southern Region during the autumn. For one Flood Warning Area (F8A5 The River Medway between Yalding and Allington) a Severe Flood Warning was issued four times during the period 9th October to 15th November.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Andover
Crawley
Dover
Folkestone
Ilsbury
Winchester
Southampton
Chichester
PORTSMOUTH
Worthing
Eastbourne
Hastings
BOURNEMOUTH
NEWPORT
Test Catchment
Upper Medway
Romney Marsh
Adur Catchment
Rother Catchment
Ouse Catchment
Stour Catchment
Swale Catchment
Lower Medway
Rivers in East Hampshire
Rivers in the New Forest
Rivers of the Isle of Wight
River Ems and West Sussex Rifes
Lower Arun Catchment
Western Rother Catchment
Upper Arun Catchment
Cuckmere Catchment
Combe Haven
Darent and Ray Catchment
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
FLOODWATCH CATCHMENTS
Floodwatch Catchments
Regional WM Boundary
Main River
Urban Areas
MAP 4.1
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SW Jan 2001


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High Wycombe
Westminster
Richmond
Reading
Newbury
Orpington
Margate
Ramsgate
Canterbury
Maidstone
Guildford
Farnham
Andover
Dover
Crawley
Folkestone
Winchester
Chichester
Hastings
Worthing
Eastbourne
BOURNEMOUTH
NEWPORT
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
FLOOD WARNING AREAS
Fluvial Flood Warning Areas
Regional WM Boundary
Main River
Coastal Flood Warning Area
Urban Areas
MAP 4.2
H:\EBRIGIS_PROJECTS\OCT_FLD_RPT\DRAFT.APR
SW Jan 2001

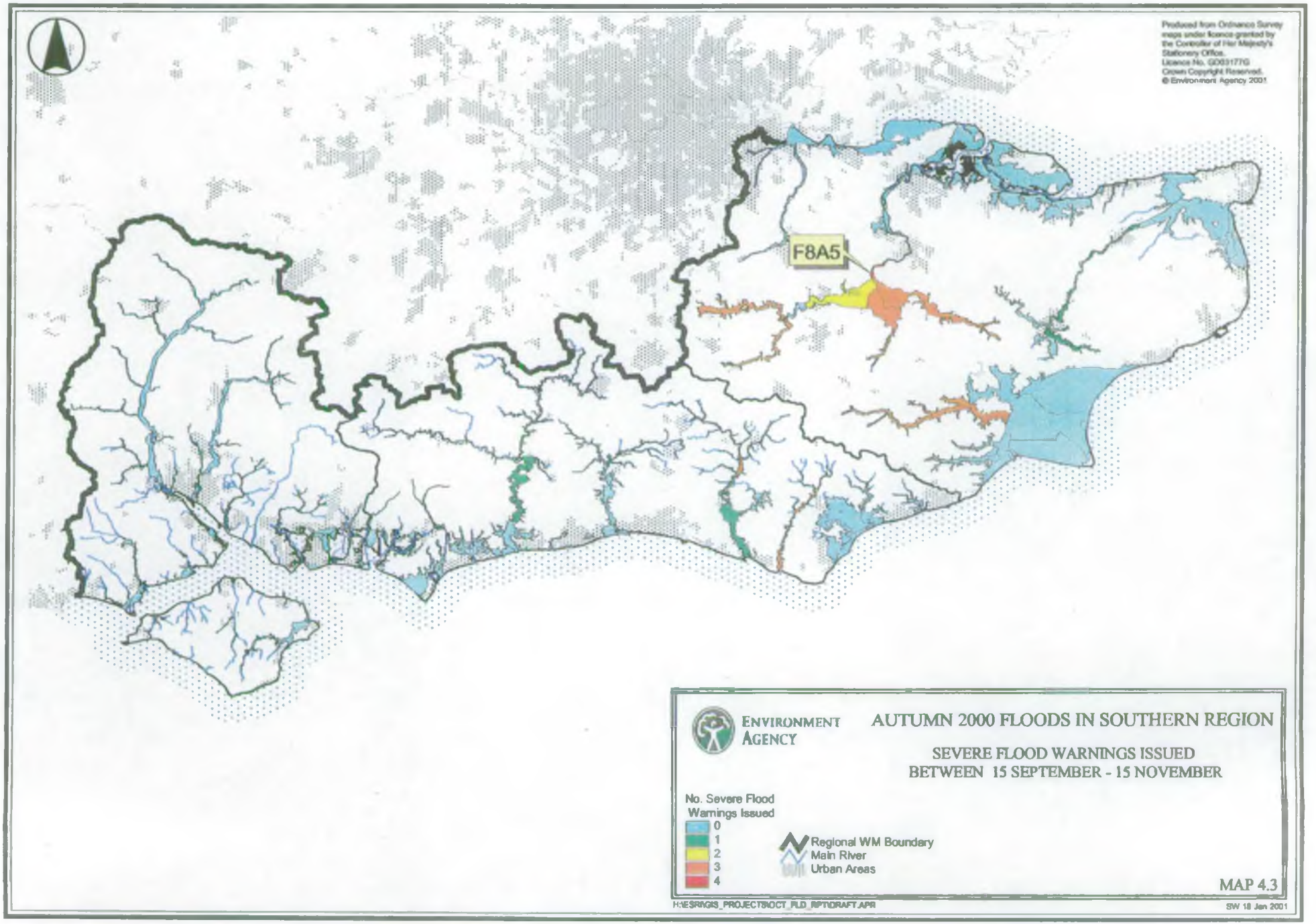
Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
12/10/00	F4B1	Cuckmere River at Hellingly	Cowbeech RL	12/10/00 02:00 30.51mAOD	12/10/00 03:05	03:34	12/10/00 03:45 30.91mAOD	12/10/00 15:15	15:46	20:30	12/10/00 10:15 31.44mAOD	17 hours	43	80
12/10/00	F4B2	Cuckmere River from Hellingly to Shermans Bridge	Shermans Bridge	12/10/00 09:15 5.4mAOD	12/10/00 06:15	06:58	12/10/00 12:00 5.70mAOD	12/10/00 15:15	15:46	13/12/00 00:30	12/10/00 16:30 6.65mAOD	74 hours	49	83
12/10/00	F4B3	Cuckmere River from Alfriston to Exceat Bridge	Shermans Bridge	12/10/00 09:15 5.4mAOD	12/10/00 09:00	15:20	12/10/00 12:00 5.70mAOD	12/10/00 15:15	15:46	21:00	12/10/00 16:30 6.65mAOD	5 hours 40 mins	49	83
13/10/00	F8A5	The River Medway between Yalding and Allington	Yalding RL D/S	N/A – Update	N/A – Update	-	N/A – Update	13/10/00 06:40	07:20	Update		Update	116	81
13/10/00	F8A5	The River Medway between Yalding and Allington	Yalding RL D/S	N/A – Update	N/A – Update	-	N/A – Update	13/10/00 21:00	21:58	Update		Update	114	80

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
12/10/00	F9A2	The West Brook	West Brook RL	-	12/10/00 09:45	10:02	-	12/10/00 12:00	13:04	Not yet confirmed	12/10/00 08:00 4.43mAOD	-	110	83
12/10/00	F9A3	The Swalecliffe Brook	Swalecliffe RL	-	12/10/00 08:45	10:11	-	12/10/00 12:00	12:49	Not yet confirmed	12/10/00 14:00 2.63mAOD	-	132	89
12/10/00	F4A4	River Ouse from Isfield to Barcombe	Barcombe U/S	09/10/00 20:15 5.62mAOD	09/12/00 22:10	22:54	No H4	12/10/00 13:20	13:39	13/10/00 00:00	Out of range	94 hours	52	79
12/10/00	F8A4	The River Medway between the Tonbridge Bypass and Yalding	Yalding RL U/S	12/10/00 15:10 21:49mAOD	12/10/00 07:40	08:37	12/10/00 20:42 21.80mAOD	12/10/00 13:35	15:19	-	13/10/00 05:10 22.05mAOD	-	923	83
12/10/00	F8A5	The River Medway between Yalding and Allington	Yalding RL D/S outstation lost 13:30 last reading 11.22mAOD 13/10/00	13/10/00 00:48 10.52mAOD H2 12/10/00 15:34 10.01mAOD	12/10/00 07:40	08:37	-	12/10/00 13:45	15:19	12/10/00 17:00	13/10/00 12:48 11.22mAOD	8 hours 23 mins	118	83

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
12/10/00	F5A1	The River Rother between Mayfield and Newenden	Udiam RL	12/10/00 06:00 4.75mAOD	11/10/00 00:45	01:28	12/10/00 11:12 5.32mAOD	12/10/00 10:40	11:59	Not yet confirmed	12/10/00 14:00 5.41mAOD	-	122	76
12/10/00	F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	Edenbridge RL	-	10/10/00 00:35	01:15	-	12/10/00 10:50	11:58	Not yet confirmed	12/10/00 13:17 40.13mAOD	-	278	84
12/10/00	F8A2	The River Medway between Forest Row and Penshurst	Colliers Land Bridge	-	12/10/00 03:15	04:05	-	12/10/00 11:00	11:58	Not yet confirmed	12/10/00 12:24 33.31mAOD	-	145	87
12/10/00	F4A5	River Ouse from Barcombe to Lewes	Lewes	12/10/00 11:15 4.20mAOD	12/10/00 10:00	11:03	12/10/00 12:45 4.50mAOD	12/10/00 11:10	12:35	13:30	12/10/00 14:45 4.94mAOD	2 hours 27 mins	226	86
12/10/00	F4A6	River Ouse from Lewes to Newhaven	Lewes	12/10/00 11:15 4.20mAOD	12/10/00 10:00	10:56	12/10/00 12:45 4.50mAOD	12/10/00 11:10	12:59	12:30	12/10/00 14:45 4.94mAOD	1 hour 34 mins	131	72

Table 4.1: Details of Severe Flood Warnings issued

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
12/10/00	F4A2	River Uck	Buxted RL (Uckfield U/S RL outstation overwhelmed = 05:21 12/10/00)	09/10/00 22:24 26.61mAOD	09/10/00 23:40	10/10/00 00:10	12/10/00 02:45 27.2mAOD	12/10/00 02:37	03:13	05:00	12/10/00 07:00 28.21mAOD	29 hours	75	86
12/10/00	F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	Lamberhurst RL	13/10/00 00:48 10.52mAOD	10/10/00 02:20	10/10/00 03:02	N/A – Only 3 levels	12/10/00 08:00	09:11	05:00	12/10/00 14:00 41.mAOD	50 hours	314	97
12/10/00	F8A9	The River Beult from Pluckley and Bethersden to Yalding	Smarden Beult RL	12/10/00 08:48 21.71mAOD	10/10/00 03:15	04:10	N/A – Only 3 levels	12/10/00 08:30	09:29	07:00	12/10/00 15:36 22.10mAOD	51 hours	208	87
12/10/00	F8A7	The River Bourne between Hadlow and East Peckham	R. Hadlow	-	10/10/00 06:30	07:18	-	12/10/00 08:30	09:37	Not yet confirmed	12/10/00 20:00 23.81mAOD	-	131	89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F8A5
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
SEVERE FLOOD WARNINGS ISSUED
BETWEEN 15 SEPTEMBER - 15 NOVEMBER
No. Severe Flood Warnings Issued
0
1
2
3
4
Regional WM Boundary
Main River
Urban Areas
MAP 4.3
H:\ESRIGIS_PROJECTS\OCT_FLD_RPT\DRAFT.APR
SW 18 Jan 2001

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
29/10/00	F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	Lamberhurst RL	30/10/00 06:10 39.75mAOD	29/10/00 15:30	16:58	-	29/10/00 19:30	22:21	30/10/00 08:00	30/10/00 08:54 40.09mAOD	15 hours	322	85
29/10/00	F5A1	The River Rother between Mayfield and Newenden	Udiam RL	29/10/00 20:42 21.8mAOD (level used for SFW)	29/10/00 11:35	17:13	no H4	29/10/00 21:30	22:40	- Not yet confirmed	30/10/00 05:00 22.43mAOD	-	119	74
30/10/00	F4B1	Cuckmere River at Hellingly	Cowbeech RL	29/10/00 21:34 30.51mAOD	29/10/00 21:00	21:54	30/10/00 00:22 30.91mAOD	30/10/00 00:25	01:17	07:45	30/10/00 11:17 31.30mAOD	9 hours 45 mins	42	78
30/10/00	F4A2	River Uck	Buxted RL	30/10/00 02:30 26.60mAOD	29/10/20 21:45	22:27	-	30/10/00 05:15	05:42	05:25	30/10/00 07:06 27.06mAOD	7 hours	71	82
30/10/00	F8A9	The River Beult from Pluckley and Bethersden to Yalding	Smarden Beult RL	30/10/2000 09:30:00 20.19mAOD	29/10/00 13:30	17:01	-	30./10/00 06:10:00	07:02	06:00	30/10/00 14:00 21.95mAOD	13 hours	193	80

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
30/10/00	F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	Edenbridge RL	Did not go through H3 (but went through H2 30/10/00 05:13)	29/10/00 11:55	16:58	-	30/10/00 07:50	08:51	Not yet confirmed	30/10/00 14:12 40.36mAOD	-	269	82
30/10/00	F8A2	The River Medway between Forest Row and Penshurst	Colliers Land Bridge	Did not go through H3 (but went through H2 30/10/00 03:44)	29/10/00 11:55	16:58	-	30/10/00 07:50	09:25	18:00	30/10/00 13:44 33.18mAOD	25 hours	140	86
30/10/00	F4A4	River Ouse from Isfield to Barcombe	Barcombe U/S	30/10/00 08:15 5.75mAOD	29/10/00 21:10	22:00	No H4	30/10/00 09:25	10:47	Not yet confirmed	30/10/00 15:45 6.25mAOD	-	48	73
30/10/00	F4B2	Cuckmere River from Hellingly to Shermans Bridge	Shermans Bridge	30/10/00 07:40 5.40mAOD	30/10/00 06:10	06:58	30/10/00 09:15 5.20mAOD	30/10/00 12:05	14:28	19:00	30/10/00 15:10 6.30mAOD	12 hours	46	78
30/10/00	F4B3	Cuckmere River from Alfriston to Exceat Bridge	Shermans Bridge	30/10/00 07:40 5.40mAOD	30/10/00 07:35	08:17	30/10/00 09:15 5.20mAOD	30/10/00 12:25	14:30	12:00	30/10/00 15:10 6.30mAOD	3 hours 43 mins	48	81

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
31/10/00	F8A5	The River Medway between Yalding and Allington	Yalding RL D/S	30/10/00 11:00 10mAOD	30/10/00 10:45	11:33	31/10/00 00:45 10.5mAOD	31/10/00 01:00	01:38	Not yet confirmed	31/10/00 18:30 10.92mAOD	-	111	79
06/11/00	F4A2	River Uck	Buxted RL	05/11/00 21:18 26.60mAOD	05/11/00 21:25	22:05	05/11/00 23:13 27.20mAOD	06/11/00 00:30	01:09	15:30	06/11/00 01:17 27.79mAOD	17 hours 25 mins	71	82
06/11/00	F5A1	The river Rother between mayfield and Newenden	Crowhurst Bridge	05/11/00 21:10 21.53mAOD	01/11/00 07:25	-	05/11/00 23:03 21.80mAOD	06/111/00 01:15:00	05:35	Not yet confirmed	06/11/00 01:41 22.47mAOD	-	121	78
06/11/00	F3D1	Western River Rother from Liss to Midhurst	Princes Marsh	05/11/00 21:03 57.80mAOD	05/11/00 22:05	23:54	05/11/00 23:37 58.10mAOD	06/11/00 03:10	05:48	08:45	06/11/00 01:58 58.19mAOD	8 hours 49 mins	95	78
06/11/00	F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	Lamberhurst RL	06/11/00 02:12 39.77mAOD	05/11/00 22:30	06/11/00 23:30	-	06/11/2000 00:38:00 AVM system crashed, re-issued at 03:50	05:40	07:55	06/11/00 03:00 40.08mAOD	2 hours 15 mins	288	76

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
06/11/00	F8A9	The River Beult from Pluckley and Bethersden to Yalding	Smarden Beult RL	-	06/11/00 01:20	06/11/00 04:08*	-	06/11/00 04:20	05:40	08:20	06/11/00 06:22 21.66mAOD	2 hour 20 mins	181	76
06/11/00	F4B3	Cuckmere River from Alfriston to Exceat Bridge	Shermans Bridge	06/11/00 02:12 5.40mAOD	31/10/00 18:20	31/10/00 19:13	06/11/00 05:37 5.70mAOD	06/11/00 06:10	06:48	12:00	06/11/00 09:30 6.37mAOD	134 hours	48	81
06/11/00	F4B2	Cuckmere River from Hellingly to Shermans Bridge	Shermans Bridge	06/11/00 02:12 5.40mAOD	31/10/00 18:20	31/10/00 19:13	06/11/00 05:37 5.70mAOD	06/11/00 07:40	08:14	11:00	06/11/00 09:30 6.37mAOD	94 hours	45	76
06/11/00	F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	Edenbridge RL	Did not go through H3, (but H2 06/11/00 03:30 39.60mAOD)	05/11/00 22:50	05/11/00 23:59	-	06/11/00 07:50	09:51	Not yet confirmed	06/11/00 12:46 40.21mAOD	-	276	83

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
06/11/00	F8A2	The River Medway between Forest Row and Penshurst	Colliers Land Bridge	Did not go through H3 (but H2 06/11/00/01:27 32.50mAOD)	05/11/00 22:50	05/11/00 23:48	-	06/11/00 07:50	09:03	Not yet confirmed	06/11/00 07:27 33.29mAOD	-	145	88
06/11/00	F3F2	River Adur from Burgess Hill to Henfield	Sakeham	05/11/00 22:45	05/11/00 23:35	06/11/00 00:16	06/11/00 00:00	06/11/00 08:50	09:52	11:30	06/11/00 05:15	11 hours 14 mins	53	85
06/11/00	F4A3	River Ouse from Lindfield to Isfield	Goldbridge	06/11/00 02:30 13.40mAOD	06/11/00 00:45	06/11/00 01:30	06/11/00 04:30 13.6mAOD	06/11/00 09:00	09:55	07/11/00 00:30	06/11/00 07:20 13.79mAOD	23 hours	58	87
06/11/00	F4A4	River Ouse from Isfield to Barcombe	Barcombe U/Ss	05/11/00 23:41 5.75mAOD	05/11/00 23:20	06/11/00 00:03	No H4	06/11/00 09:10	10:06	07/11/00 00:30	06/11/00 09:00 6.528mAOD	24 hours 30 mins	53	80
06/11/00	F3C2	River Arun below Billingshurst to Pulborough	Newbridge	06/11/00 08:00	06/11/00 08:05	06/11/000 08:35	06/11/00 08:15	06/11/00 13:15	13:58	07/11/00 02:30	Out of range	18 hours 25 mins	95	86

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
06/11/00	F8A4	The River Medway between the Tonbridge Bypass and Yalding	Town Lock	06/11/00 16:22 21.50mAOD	06/11/00 01:40	06/11/00 09:46	did not reach H4	06/11/00 16:17	17:08	Not yet confirmed	-	07/11/00 17:48 21.70mAOD	-	85
06/11/00	F8A7	The River Bourne between Hadlow and East Peckham	R. Hadlow	Did not go through H2 or H3	05/11/00 23:10	06/11/00 01:20	-	06/11/00 16:24	17:29	Not yet confirmed	06/11/00 05:58 23.08mAOD	-	130	88
06/11/00	F6A5	The River East Stour between Sellindge and Ashford	Aldington u/s	Did not go through H3	02/11/00 13:00	02/11/00 14:35	-	06/11/00 20:50	21:51	Not yet confirmed	06/11/00 23:51 48.97mAOD	-	121	92
06/11/00	F6A4	The River Great Stour between Ashford and Fordwich	Hothfield u/s	30/10/00 17:36 46.39mAOD	29/10/00 19:25	29/10/00 21:13	-	06/11/00 23:30	23:59	-	08/11/00 07:12 47.93mAOD	-	399	78
07/11/00	F3C3	River Arun from Pulborough to Arunde	Pulborough	06/11/00 09:37 4.2mAOD	06/11/00 09:25	06/11/00 09:56	06/11/00 13:10 4.60mAOD	07/11/00 17:05	17:35	23:00	Out of range	33 hours 30 mins	198	86

Date Severe Flood Warning Issued	Flood Warning Area No.	Flood Warning Area	Measuring Station	H3	Time Flood Warning Issued	Last AVM system Call Time for Flood Warning	H4	Time Severe Flood Warning Issued	Last AVM system Call Time for Severe Flood Warning	First Property Flooding	Time and Level of Peak	Lead Time (Taken from Last AVM system Call for Flood Warning)	Number of People Warned	Recipients contacted, as a percentage
08/11/00	F3B3	River Lavant	Graylingwell	05/11/00 21:12 21.92mAOD	05/11/00 22:25	05/11/00 23:54	06/11/00 00:00 21.35mAOD	08/11/00 07:10	08:24	09/11/00 02:30	08/11/00 20:48 21.52mAOD	74 hours 30 mins	605	85

* Dissemination of this Flood Warning took almost three hours. This is because two Severe Warnings had already been issued and were being disseminated. Severe Flood Warnings are programmed to take priority over Flood Warnings.

4.2 WARNINGS ISSUED

During the four events a total of 742 warnings were issued of which 691 were for rivers and 51 for the coast. 50 Severe Flood Warnings were issued for rivers across Sussex and Kent. Full details for the full period and individual events are shown in tables Table 4.2 to Table 4.6 below.

Table 4.2: Summary of Flood Warnings issued during the four events

Fluvial				
	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	22	28	50
Flood Warning	35	103	101	239
Flood Watch	50	107	162	319
Catchment Flood Watch	35	29	19	83
Fluvial Total	120	261	310	691
Coastal				
	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	0	0	0
Flood Warning	0	2	4	6
Flood Watch	1	36	8	45
Coastal Total	1	38	12	51
Total	121	299	322	742

Table 4.3: Summary of Flood Warnings issued: 15th September 2000

Warning Code	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	0	0	0
Flood Warning	6	0	1	7
Flood Watch	4	0	5	9
Catchment Flood Watch	10	4	4	18
Total	20	4	10	34

Table 4.4: Summary of Flood Warnings issued: 9th October 2000 – 19th October 2000

Warning Code	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	7	12	19
Flood Warning	4	30	23	57
Flood Watch	12	29	45	86
Catchment Flood Watch	10	14	7	31
Total	26	80	87	193

Table 4.5: Summary of Flood Warnings issued: 20th October 2000 – 4th November 2000

Warning Code	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	5	6	11
Flood Warning	11	41	51	103
Flood Watch	15	82	74	171
Catchment Flood Watch	5	11	8	24
Total	31	139	139	309

Table 4.6: Summary of Flood Warnings issued: 5th November 2000 – 15th November 2000

Warning Code	Hampshire	Sussex	Kent	Total
Severe Flood Warning	0	10	10	31
Flood Warning	14	34	30	78
Flood Watch	20	32	46	100
Catchment Flood Watch	10	0	0	10
Total	44	77	87	208

Measuring the success of flood warnings is measured by national surveys which the Agency has carried out since 1996. These provide independent assessment of how effective flood warnings are and the actions people have taken to protect themselves and their properties. Initial estimates of properties flooded and the warnings issued are described below.

4.3 NO. PROPERTIES FLOODED FOLLOWING WARNING

Of the 2,500 properties flooded during the period, around 1,500 were flooded by main river. It is estimated that the vast majority of these would have been covered by warnings being received directly and via the media.

4.4 NO. PROPERTIES FLOODED WITHOUT WARNING

The most significant location where property flooding occurred without a Flood Warning was in Portsmouth following the failure of the Southern Water Services Eastney Pumping Station. Current estimates are that 200 properties in Portsmouth suffered internal flooding with some 3000 properties affected by flood water externally. The Agency's flood warning service does not cover such events being unrelated to river or coastal flooding. The Agency has provided information and support to Southern Water Services and Portsmouth City Council and helped provide information to the public where requested.

4.5 NO. PROPERTIES NOT FLOODED BUT WARNED (NOT SEVERE WARNING)

The number of properties that received a Flood Warning for the period is approximately 13,500. Of these some 1,500 flooded giving a figure of approximately 12,000 properties warned but not flooded.

4.6 NO. PROPERTIES FLOODED FOLLOWING SEVERE WARNING

Some 50 Severe Flood Warnings were issued over the period requiring some 7,800 calls to properties at risk of flooding. Of the 1,500 properties flooded from main rivers the vast majority were covered by Severe Flood Warnings prior to the onset of

flooding. For example at Uckfield and Lewes around 900 properties are now known to have flooded following the issue of the Severe Flood Warnings.

4.7 NO. PROPERTIES FLOODED WITHOUT SEVERE WARNING

The majority of those properties flooded from non main river sources would not have received Severe Flood Warnings, as described in Section 4.4 above.

4.8 NO. PROPERTIES NOT FLOODED BUT RECEIVED SEVERE WARNING

The number of properties that received a Severe Flood Warning for the period is approximately 7,800. Of these some 1,500 flooded giving a figure of approximately 6,300 properties warned but not flooded.

4.9 AVAILABILITY, RELIABILITY, USE AND EFFECTIVENESS OF DISSEMINATION SYSTEMS

4.9.1 Automatic Voice Messaging System

General description of Automated Voice Messaging System operation

Southern Region has four Automatic Voice Messaging (AVM) systems situated in the Kent Area Office, the Sussex Area Office, the Hampshire and Isle of Wight Area Office and the Regional Office. To ensure robustness each system holds the same recipient contact details and warning messages. This allows warnings for any Area to be issued from any of the four systems should faults occur.

The AVM systems can issue warnings via telephone, fax and pagers. They are capable of making 1,200 voice calls per hour with current voice message lengths. All warning messages have been set up in advance as templates. The only editing that is done in real-time is that the time and date is added to the faxes and any locally specific information e.g. forecast information and localities which may be affected.

In addition to the robust backup arrangements for the AVM additional safeguards are in place. Fax messages can be issued via the SureFax system and loudhailers are held in each Area at strategic locations. None of these secondary backup systems were required during the Autumn Floods.

Tables 4.7 to 4.11 show how the AVM performed during the period from 15th September to 15th November.

Table 4.7: AVM system calls: 15th September – 15th November

	Voice messages	Fax messages	Pager messages	Total calls
Total number of recipients	**78,393**	**50,466**	**4,870**	**133,729**
Aborted calls	15,409	4,305	1,525	21,239
Answered calls	**62,984**	**46,161**	**3,345**	**112,490**
Unsuccessful calls due to recipient[1]	45,571	12,788	735	59,094
Unsuccessful calls due to unobtainable number[2]	9,272	0	0	9,272
Unsuccessful calls due to system failure[3]	5,634	6,920	4,276	16,830
Attempted calls	**123,461**	**65,869**	**8,356**	**197,686**

[1] *Includes calls that failed because the call was not answered or because the line was engaged.*

[2] *Unobtainable fax and pager numbers are recorded as 'Call Errors' and are consequently included here as a system failures.*

[3] *Includes failure of pager bureaux, etc. as well as AVM system failures.*

Table 4.8: AVM system performance: 15th September 2000

	Voice messages	Fax messages	Pager messages	Total calls
Total number of recipients	**452**	**995**	**55**	**1,502**
Aborted calls	143	63	29	235
Answered calls	**309**	**932**	**26**	**1,267**
Unsuccessful calls due to recipient[1]	240	223	6	469
Unsuccessful calls due to unobtainable number[2]	135	0	0	135
Unsuccessful calls due to system failure[3]	227	119	82	428
Attempted calls	**1,054**	**1,337**	**143**	**2,534**

[1] *Includes calls that failed because the call was not answered or because the line was engaged.*

[2] *Unobtainable fax and pager numbers are recorded as 'Call Errors' and are consequently included here as a system failures.*

[3] *Includes failure of pager bureaux, etc. as well as AVM system failures.*

Table 4.9: AVM system performance: 9th October 2000 – 19th October 2000

	Voice messages	Fax messages	Pager messages	Total calls
Total number of recipients	**16,601**	**13,343**	**1,287**	**31,231**
Aborted calls	3,418	1,049	418	4,885
Answered calls	**13,183**	**12,294**	**869**	**26,346**
Unsuccessful calls due to recipient[1]	10,297	2,876	192	13,365
Unsuccessful calls due to unobtainable number[2]	1,733	0	0	1,733
Unsuccessful calls due to system failure[3]	790	1,980	1,224	3,994
Attempted calls	**26,003**	**17,150**	**2,285**	**45,438**

[1] *Includes calls that failed because the call was not answered or because the line was engaged.*

[2] *Unobtainable fax and pager numbers are recorded as 'Call Errors' and are consequently included here as a system failures.*

[3] *Includes failure of pager bureaux, etc. as well as AVM system failures.*

Table 4.10: AVM system performance: 20th October 2000 – 4th November 2000

	Voice messages	Fax messages	Pager messages	Total calls
Total number of recipients	**32,740**	**18,460**	**1958**	**53,158**
Aborted calls	6,332	1,666	569	**8,567**
Answered calls	**26,408**	**16,794**	**1,389**	**44,591**
Unsuccessful calls due to recipient[1]	18,517	4,805	300	**23,622**
Unsuccessful calls due to unobtainable number[2]	4,052	0	0	**4,052**
Unsuccessful calls due to system failure[3]	2,622	2,633	1,834	**7,089**
Attempted calls	**51,599**	**24,232**	**3,523**	**79,354**

[1] *Includes calls that failed because the call was not answered or because the line was engaged.*

[2] *Unobtainable fax and pager numbers are recorded as 'Call Errors' and are consequently included here as a system failures.*

[3] *Includes failure of pager bureaux, etc. as well as AVM system failures.*

Table 4.11: AVM system performance: 5th November 2000 – 15th November 2000

	Voice messages	Fax messages	Pager messages	Total calls
Total number of recipients	**23,424**	**13,898**	**1,296**	**38,618**
Aborted calls	4,490	1,368	422	**6,280**
Answered calls	**18,934**	**12,530**	**874**	**32,338**
Unsuccessful calls due to recipient[1]	14,140	4,283	194	**18,617**
Unsuccessful calls due to unobtainable number[2]	2,269	0	0	**2,269**
Unsuccessful calls due to system failure[3]	1,346	1,921	1,376	**4,643**
Attempted calls	**36,689**	**18,734**	**2,444**	**57,867**

[1] *Includes calls that failed because the call was not answered or because the line was engaged.*

[2] *Unobtainable fax and pager numbers are recorded as 'Call Errors' and are consequently included here as a system failures.*

[3] Includes failure of pager bureaux, etc. as well as AVM system failures.

Considerable efforts at improving the number of direct contacts through the AVM system have been made since 1996 as shown on Maps 4.4 and 4.5 and in Table 4.12. These show that when the Agency took on the role of flood warning dissemination in 1996 there were some 600 direct contacts. There are now some 35,000 contacts. This is a great improvement but still some way short of 158,000 properties at risk of flooding across the Region. Most of the people offered the opportunity to enrol within the flood warning service decline the offer.

Table 4.12: Summary of AVM system recipients at each periodical data update

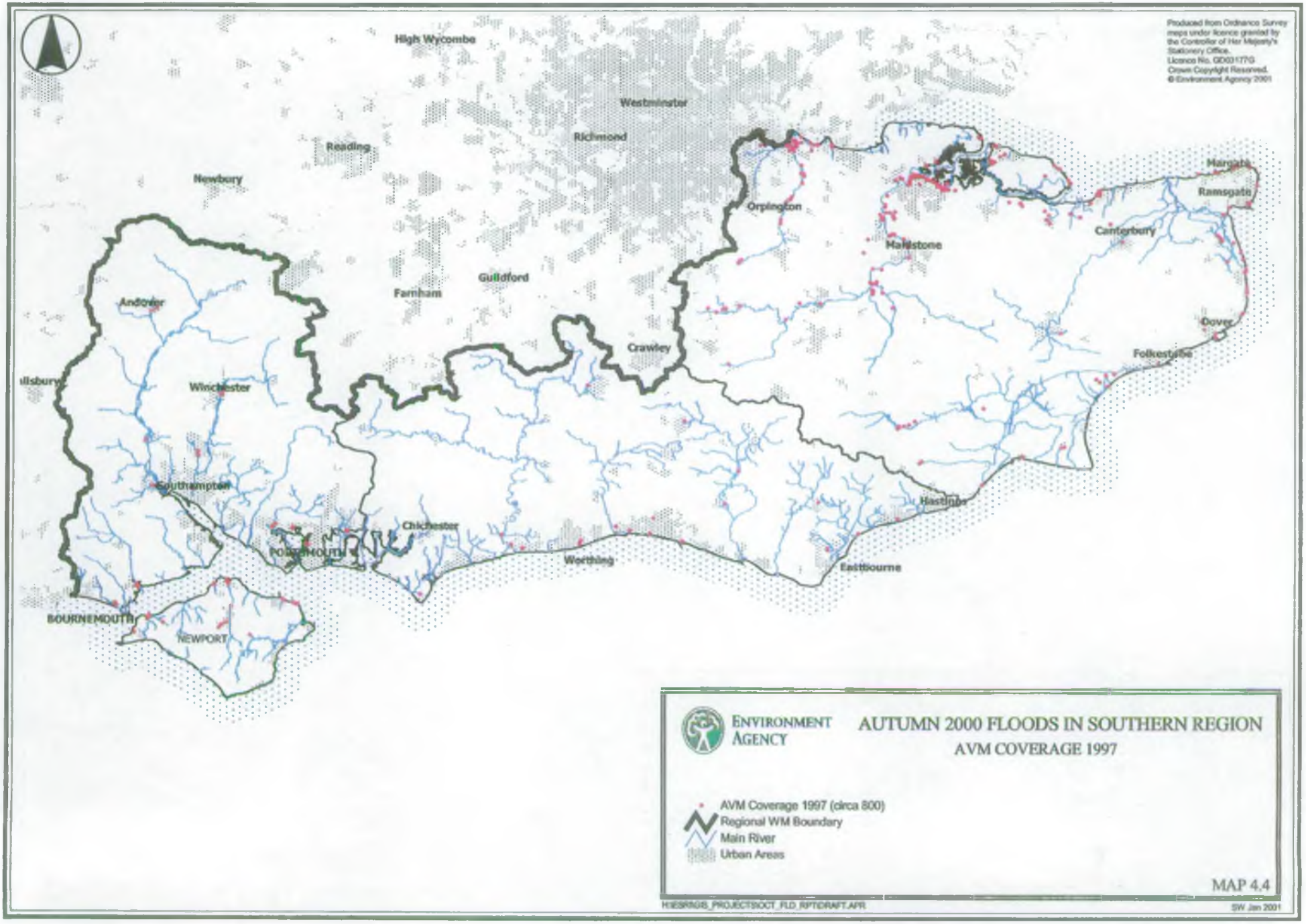
		30/04/97	30/04/98	30/06/99	24/08/00	05/10/00	07/11/00	20/12/00
Direct Flood Warning Recipients	Hampshire	90	635	3,784	4,700	4,700	4,738	4,779
	Sussex	5	1,666	8,396	10,054	10,137	10,209	10,307
	Kent	537	1,249	9,777	12,337	12,370	12,442	12,432
	Organisations	103	166	169	210	241	238	244
	Agency Contacts	12	25	173	193	192	192	192
Flood Wardens	Hampshire	0	0	492	416	416	416	416
	Sussex	0	0	1,018	948	947	948	950
	Kent	0	0	1,293	1,210	1,209	1,209	1,206
Flood Warden Contacts	Hampshire	0	0	899	842	842	840	840
	Sussex	0	0	1,811	1,726	1,725	1,726	1,728
	Kent	0	0	2,187	2,120	2,118	2,118	2,111
Total		747	3.741	29,999	34,756	34,897	35,076	35,205

AVM System Availability and Reliability

With four duplicate systems in place the current AVM systems provide a robust system for flood warning dissemination. The number of AVM systems within the Region has been doubled since the Christmas 1999 Floods as the demand for flood warnings has increased doubling our call making capacity from 2,400 voice calls per hour to 4,800 voice calls per hour.

There are instances when individual machines experienced problems during the event which required backup arrangements to be used and these are listed below.

- 9th October, the Kent AVM system failed halfway through flood watch for River Cray. Subsequent warnings were issued from the Regional AVM system until the system was restarted.
- 10th October, the Hampshire AVM system played the incorrect acknowledgement message. This fault was fixed by the system supplier.
- 10th October, both the Hampshire and Regional AVM systems had problems creating the fax messages. This fault was fixed by the system supplier.
- 10th October, the Sussex AVM system failed. Subsequent warnings were issued from the Regional AVM system until the system was restarted.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Crawley
Winchester
Hastings
Chichester
Worthing
Eastbourne
BOURNEMOUTH
NEWPORT
AUTUMN 2000 FLOODS IN SOUTHERN REGION
AVM COVERAGE 1997
ENVIRONMENT AGENCY
AVM Coverage 1997 (circa 800)
Regional WM Boundary
Main River
Urban Areas
MAP 4.4
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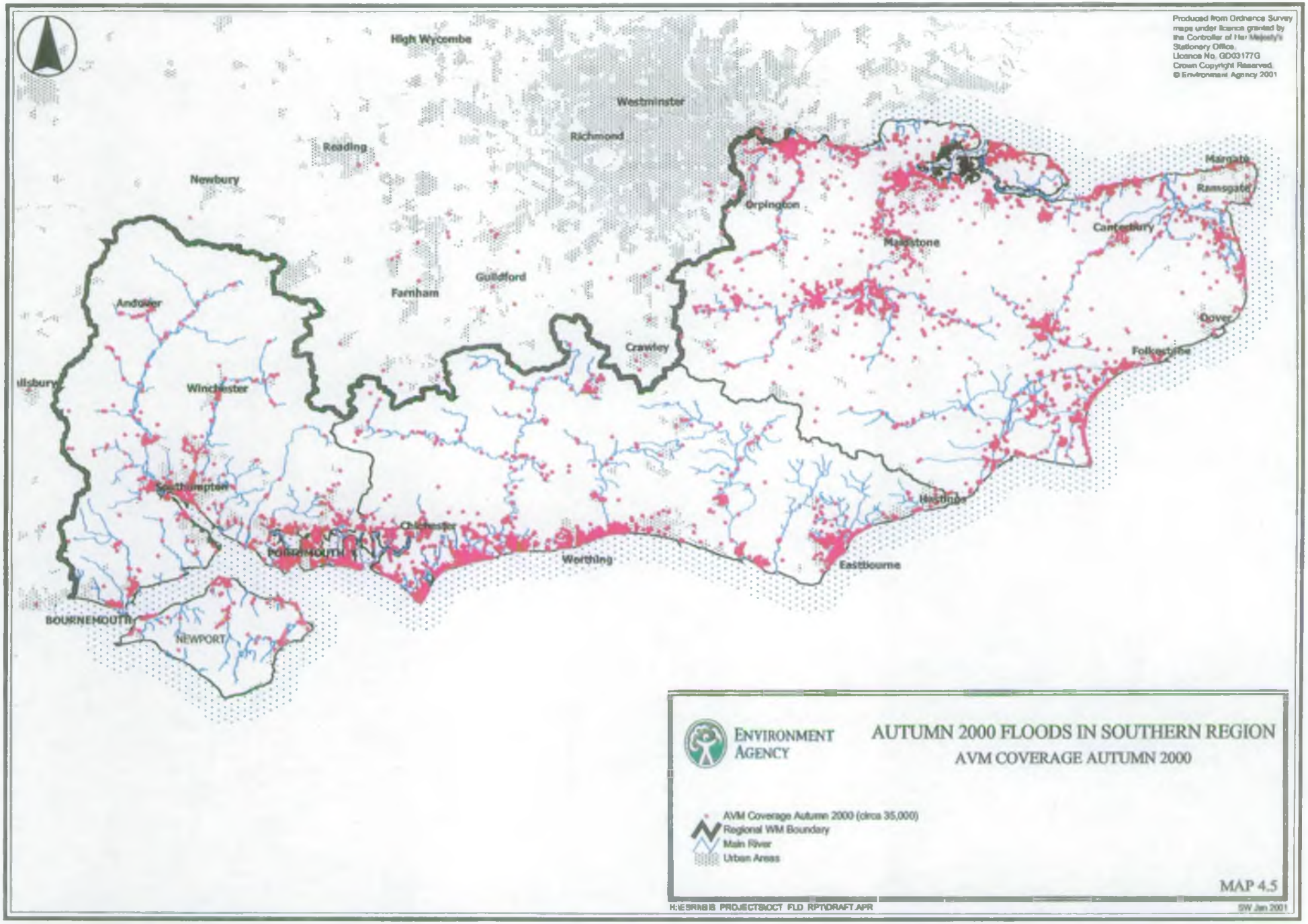
SW Jan 2001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Westminster
Richmond
Reading
Newbury
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Margate
Ramsgate
Canterbury
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Crawley
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ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
AVM COVERAGE AUTUMN 2000
AVM Coverage Autumn 2000 (circa 35,000)
Regional WM Boundary
Main River
Urban Areas
MAP 4.5
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SW Jan 2001

- 12th October, the Kent and Sussex AVM systems failed. Subsequent warnings were issued from the Regional AVM system until the system was restarted.
- 13th October, the Hampshire AVM system failed and could not issue warnings. This fault was fixed by the system supplier.
- 2nd November, the Hampshire AVM system failed. The system was restarted by the supplier.
- 6th November, the Kent AVM system was very slow to issue warnings. The 'warnings issued' log was exported by Flood Warning staff.
- 6th November, the Hampshire and Regional AVM systems failed. These faults were fixed by the system supplier.
- 9th November Kent AVM system failed. The system was restarted by the supplier.

4.9.2 Floodline

The Agency provides a 'Dial and Listen', local-rate national telephone service known as Floodline on 0845 988 1188 for advice and information about flooding.

When a caller dials Floodline they have an option to hear recorded information for flooding in their area. It should be updated or re-timed every twelve hours or whenever a warning changes. Callers can quickly obtain information for their area by using a Quickdial code, published in Flood Warning Directories which are produced for Isle of Wight, Hampshire, West Sussex, East Sussex and Kent.

Table 4.13: No. of calls received 15th September 2000

Option 1: RMS (Recorded Message Service)	Option 2: To report flooding (diverted to RCCs)	Option 3: To Order a Floodpack	Option 4: To speak to call centre staff	Aggregate calls to Floodline
3001	363	190	568	4122

Figure 4.1: National Floodline activity: 9th October-15th November 2000

4.9.3 Call Handling

Many calls from the public were received via Floodline; either directly into the RCC, into Area Incident Rooms or passed from the Floodline call centre staff. Callers who chose 'Option 2' to report flooding were automatically routed through to the RCC. As many phones as required can be linked into the Floodline call queue to answer calls, so the number of operators can be increased or decreased according to the volume of calls. In previous events, such as the Christmas 1999 Floods, the RCC had been inundated with calls from Floodline which had operational consequences. During this event staff from other functions were brought into the Incident Rooms to handle calls. This was essential as all available Flood Defence staff were dealing with the flooding.

Many staff called in to deal with calls were supervised by the Operational Duty Officers and since the event have made useful suggestions on how a comprehensive training package can be developed and standard scripts introduced.

4.9.4 Local Media

Southern Region has strong links with local and national media contacts and warnings were disseminated to the following contacts via the AVM systems:

Table 4.14: Flood warning dissemination media contacts

Organisation Name	Location
106 CTFM	Canterbury
107.6 Kestrel FM	Basingstoke
2CR FM	Bournemouth
AA Roadwatch	Stanmore
BBC Radio Kent	Chatham
BBC Radio Solent	Southampton
BBC South	Southampton
BBC Southern Counties Radio	Guildford
BBC Weather Centre	London
Cable Radio	Portslade
Greater London Radio	London
Independent Weather Productions	London
Invicta FM Newscentre	Whitstable
Isle Of Wight Radio	Newport
Medway FM	Rochester
Metronetworks Southeast Region	London
Ocean FM South Coast FM Power FM	Fareham
Radio Mercury Ltd	Crawley
Radio Victory 107.4	Portsmouth
South City FM	Southampton
Southern FM	Brighton
Sovereign Radio	Hailsham
Spirit FM	Chichester
Surf 107	Brighton
Teletext	Glasgow
Thanet Local Radio	Margate
Wave 105 2 FM	Fareham

4.9.5 Sirens and Public Address

A number of loudhailer systems are held in various locations in each Area but were not required during this event. They are usually reserved for major AVM system failures and Severe Flood Warnings for the coast.

4.10 ISSUES ARISING AND RECOMMENDATIONS

SO\FW\1	Current AVM system operation and performance
Issue	Introduced in 1996 the current AVM system was pushed to its limits during the Autumn Floods. A new system is currently being specified but several short term issues require resolving to improve system performance. i) Current hardware needs upgrading to cope with the expanding number of recipients and messages. ii) Current system reporting can reduce performance over prolonged periods. iii) Updating the four systems is currently to0 time consuming when new contacts are added.
Recommendation	i) Review and introduce improved system hardware. ii) Undertake additional staff training to manage AVMs during events and when updates are required.

SO\FW\2	Replacement flood warning dissemination system
Issue	A replacement for the AVM systems is now urgently needed and steps are required to upgrade the existing systems before the introduction of their replacement. Lessons learnt from the operation of the AVM systems during the Autumn Floods need to be included in the new system specification. In particular the process of preparing a warning needs to be less complicated and less time consuming. Additionally the reporting facilities should not hinder the operation of the dissemination system.
Recommendation	Ensure that the system specification fully reflects needs flood warning dissemination during extreme events when huge numbers of warnings and calls are required during a short period of time.

SO\FW\3	Floodline
Issue	The Floodline recorded message System provided information to thousands of members of the public during the floods. Additional message boxes are required to improve both the ease of updating and information to the public which was time consuming with the current structure. Two faults experienced during the event highlighted the need for the service provider to have 24 hour cover for this critical system.
Recommendation	Review and introduce additional message boxes for Floodline recorded message System. Raise issue of 24 hour cover with service provider and include in revised contract arrangements.

SO\FW\4	Warning trigger levels
Issue	Some trigger levels for Severe Flood Warnings appear inconsistent across the Region in terms of areas and properties affected.
Recommendation	Review and map trigger levels within Flood Warning Areas, and amend procedures where required.

SO\FW\5	Content of warning messages
Issue	Following the introduction of the new flood warning codes, voice messages (sent via the AVM system) are very 'hard hitting'. This has led to an over-response in some locations by the public.
Recommendation	Review wording of warning code scripts.

SO\FW\6	Providing information to the public and media
Issue	Staff were brought into the Incident Rooms to handle calls from the public. Many staff received little training on how to deal with these calls and would consequently benefit from increased training and standard event scripts so consistent messages are passed to the public and media (see issue SO\EM\1).
Recommendation	(i) Run training courses in each Area and at the Regional office to train staff in call handling. (ii) Develop standard scripts and make them available to call handlers across all Incident Rooms. (iii) Introduce a GIS-based system to help locate callers and provide more site specific information.

SO\FW\7	Enrolling the public on the flood warning system
Issue	Major effforts are still required to recruit more members of the public onto the AVM system. Despite the regular mailing to 'at-risk' properties since 1996 the majority of people decline the offer of the service.
Recommendation	Continue to raise public awareness of the flood warning service and the benefits of direct warnings.

5 EVENT IMPACT

5.1 RAINFALL

This chapter seeks to describe the impact of the rainfall and river flow on the catchments and the numbers of properties flooded. The intensity of the rainfall on saturated catchments meant that there was a great deal of surface water flooding and many properties were flooded by a combination of river water, surface water and sewage as the drainage systems failed to cope.

Agency staff worked around the clock to clear obstructions from watercourses and operate pumping stations, flood gates and defences to minimise the impact of the event. In general the Agency's defences performed well and some in excess of their design standard. Many areas however saw the defences overtopped as the event exceeded design standards. There were some instances where third party defences failed, but in most cases where flooding occurred this was also due to overtopping.

The Agency will investigate the cause and impact of the flooding to determine where works can be undertaken to improve the situation.

5.1.1 Hampshire and Isle of Wight Area

During the first event on 15th September, rainfall totals were greatest in Eastern Hampshire and the Isle of Wight, the highest total being 59.4mm in Havant. Four additional automatic rain gauges recorded rainfalls greater than 50mm. In all other areas rain gauges recorded less than 20mm rainfall.

Rainfall totals during the second event from 9th-16th October varied throughout the Area, the highest totals being in Eastern Hampshire and on the Isle of Wight. The highest total was recorded in Carisbrooke on the Isle of Wight (93.6mm). Two additional gauges on the Isle of Wight recorded over 90mm during the event. Over 90mm of rainfall was also recorded at Cowplain, East Hampshire while a further two in the Area recorded 70mm or above. Both rain gauges in the New Forest recorded rainfall totals above 55mm. In other areas rain gauges recorded totals between 33.6mm and 51.4mm. A majority of the rainfall during this event was recorded on 9th October and 11th October, with totals on other days being significantly less and often below 1mm.

For the third event from 29th-31st October, rainfall totals were generally much lower than totals recorded during the previous event (9th-16th October 2000). Highest rainfall totals were recorded on the Isle of Wight, the highest being at Cowes (65.8mm). One other rain gauge recorded greater than 50mm on the Island. In the Itchen Valley three rain gauges recorded greater than 50mm of rainfall. In other areas rainfall totals were generally between 40 and 45mm. Throughout the Area the majority of rainfall fell on the 29th October 2000. In Hampshire rainfall on other days was insignificant, however on the Isle of Wight rainfall totals on other days varied between 2mm and 11.2mm.

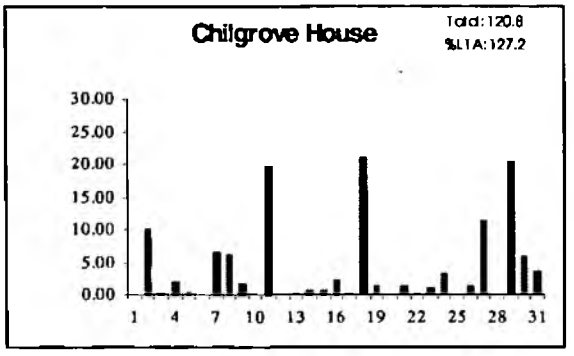
During the last event, from 5th-8th November, the highest rainfall totals were recorded in East Hampshire, the maximum being 72.2mm in Cowplain. One other rain gauge

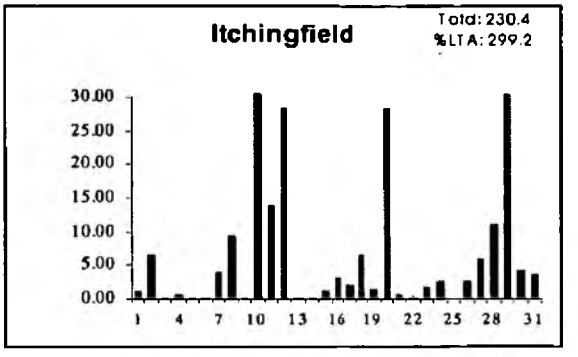
recorded more than 70mm during the event. Rain gauges in all other areas recorded less than 70mm during the event. Generally rainfall totals were between 55mm and 65mm.

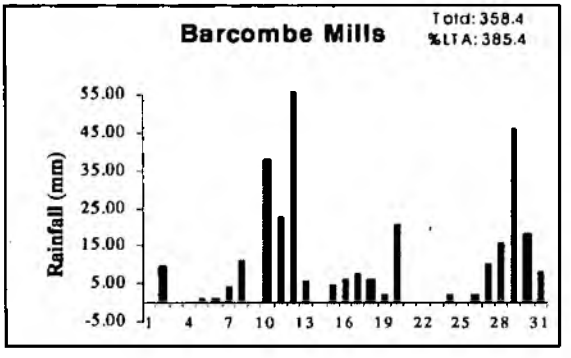
5.1.2 Sussex Area

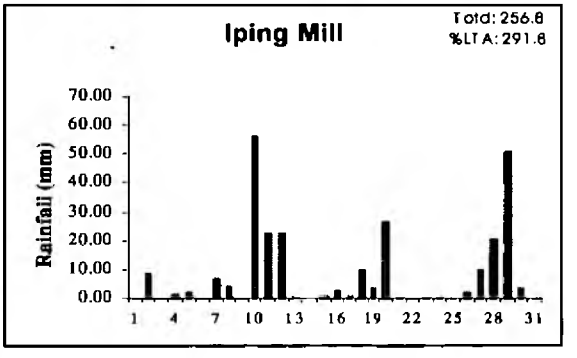
During October and November Sussex was subjected to a series of particularly extreme rainfall events. Rainfall for individual storms exceeded previous records with cumulative rainfall figures exceeding the long term monthly average by nearly 400% at Barcombe Mills in October and over 300% at Plumpton in November. A preliminary estimate of the return period for the rainfall on Plumpton gauge on 12th October is 1 in 300 to 350 years. The October and November rainfall figures are displayed in graphical format below.

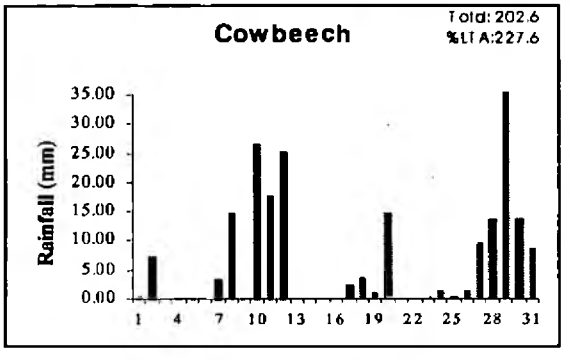
Table 5.1: Hydrometric Tables October 2000

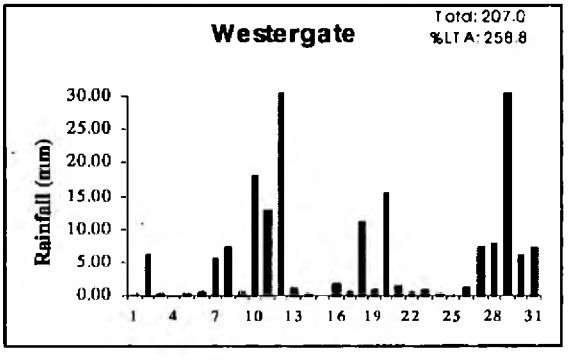


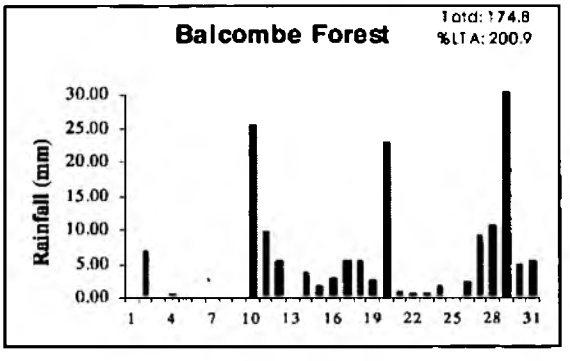












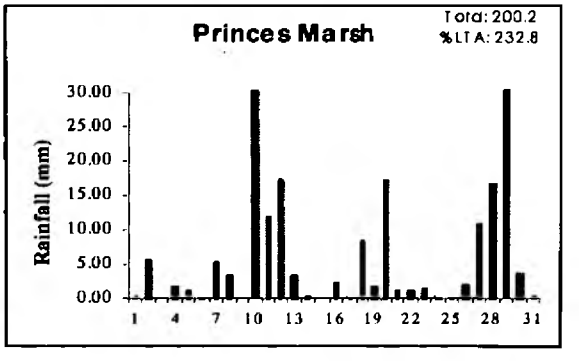
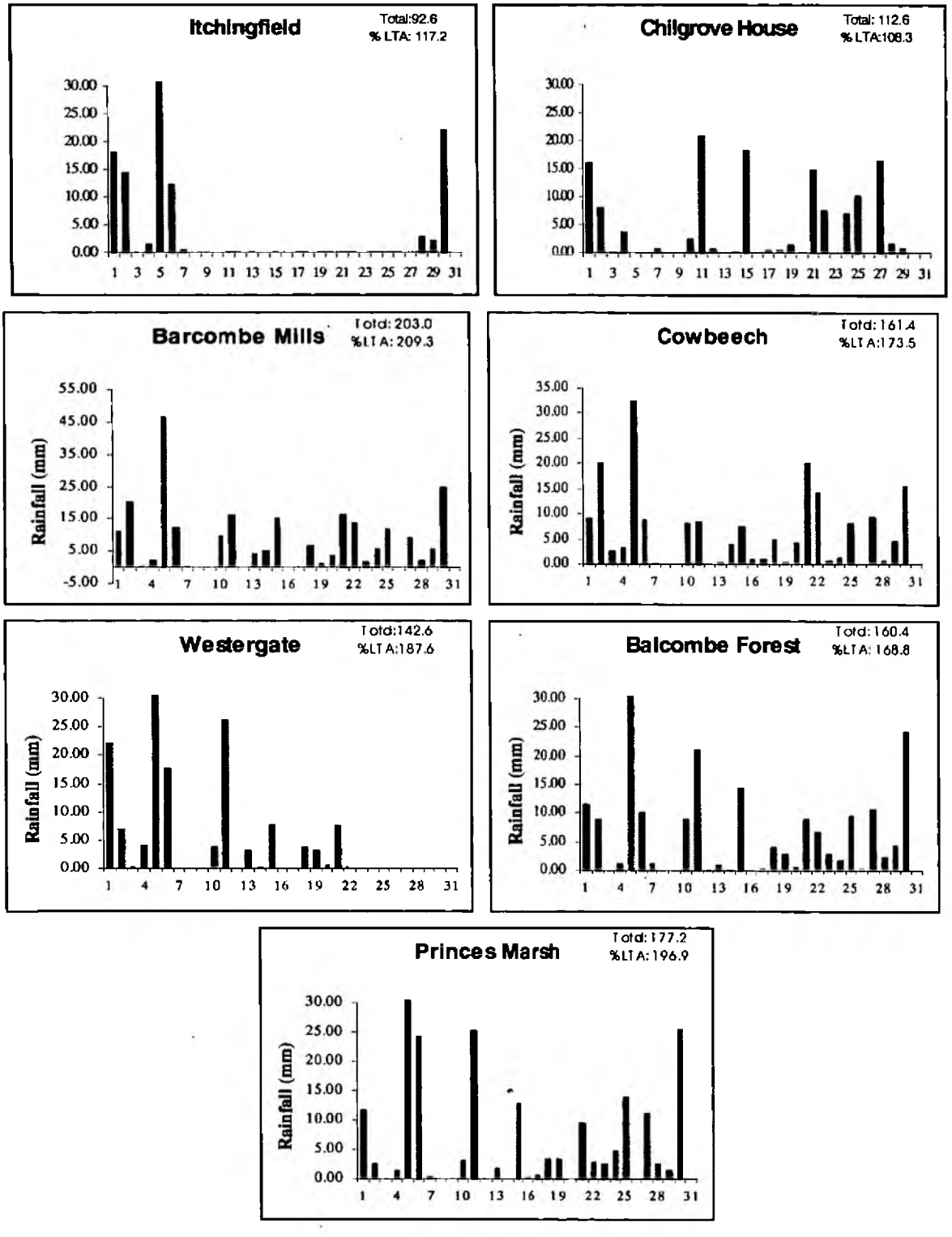


Table 5.2: Hydrometric Tables November 2000



5.1.3 Kent Area

The weather in the Southeast of England during the summer months was cool and changeable with more than the average rainfall for that time of year. September was

generally warm but with outbreaks of rain, heavy at times. Consequently, by mid September, the soil moisture deficits (SMD) across the Kent Area were relatively low.

October also began changeable with frequent showers. However, by the second week of the month an area of high pressure on the continent blocked a deep depression travelling west across southern England and this resulted in heavy and prolonged rainfall over central and southern parts of Kent and Sussex.

There was a brief lull in the wet weather during the second half of October, but at the end of the month a series of depressions travelling in from the Atlantic combined to give stormy conditions across much of the country. Heavy rain, accompanied by high winds, fell over the Southeastern counties between 30th October and 2nd November.

After an all too brief lull in the wet weather at the beginning of November, another depression came in from the west and brought yet more heavy rainfall onto the already flooded catchments in the Southeast between 5th and 8th November.

The most intense rainfall was experienced with the first of the three storms in mid October with up to 50mm of rainfall being recorded over a large area of East Sussex and West Kent during a 24hr period ending Thursday 12th October. At Herstmonceux in East Sussex, 103.4mm of rain fell in the three day period of 9th–11th October, a return period of nominally 1 in 50 years. The second storm at the end of October was less intense, although more widespread, with 63.6mm of rainfall being recorded at Enfield in North London over a 24hr period ending 09:00 Monday 30th October. The third storm in the first week of November was also less severe than the first. The first storm on its own was a rare enough event, but what was particularly unusual was that it was followed by two other intense storms soon afterwards that did not allow the catchments affected to recover. The combined probability of the three storms together is not easily determined. For the country as a whole, autumn 2000 was the wettest since meteorological records began in 1766. September 2000 was the wettest September month since 1981; October 2000 was the wettest October month since 1903 and November 2000 was the wettest November month since 1970. During Autumn 2000, (September to November), an average of 492mm of rain fell over England and Wales, which was 191% of the 1961 – 90 average.

5.2 RIVER FLOW

5.2.1 Hampshire and Isle of Wight Area

Prior to the 15th September river flows throughout Hampshire and the Isle of Wight were about average for the time of year. However, due to intense rainfall on 15th September river flows throughout the Isle of Wight and East Hampshire increased significantly. River flows in the New Forest, Itchen Valley and Test Valley remained average for the time of year.

The underlying geology throughout the catchments of the Test and Itchen is chalk and therefore the rivers react slowly to rainfall events. However by the 9th October levels had generally increased from those recorded on 15th September. Flows peaked on 9th October and then fell only slightly. Therefore river levels on 16th October were significantly higher then they had been on 15th September.

In East Hampshire river flows peaked on 9th October following heavy rainfall and within one week generally fell to levels below those recorded on 15th September. In the New Forest again levels peaked on 9th October and fell slightly in the following week, giving similar levels to those recorded in mid-September.

On the Isle of Wight rivers flows rapidly increased with their flows peaking on 9th October then rapidly decreasing to average flows for the time of year.

Throughout the Test and Itchen Valley, river flows on 29th October were significantly higher then those recorded on 16th October due to groundwater reaching the river. River flows peaked on 30th October due to heavy rain. After this some river flows decreased while others increased. This inconsistency is due to the varying effect of groundwater.

In East Hampshire, river flows increased significantly since the 16th October and again peaked on 30th October. River flows began to decrease on 31st October. Similar trends were noted in the New Forest.

Rivers on the Isle of Wight had slightly higher flows then those recorded on 16th October, due to much rainfall. However between 29th and 31st October flows peaked and returned to levels similar to those on the 16th.

From the 5th-8th November river flows throughout the Itchen and Test had continued to rise significantly due to the effects of groundwater.

Rivers on the Isle of Wight peaked on 5th November and then rapidly decreased. However tides and surges at Ryde on the Monkton Mead were a contributor to flooding.

5.2.2 Sussex Area

The flooding that occurred during October and November was driven by excessive rainfall events falling onto already saturated catchments. Throughout the event the groundwater levels in Sussex remained extremely high and to the point of saturation. Many boreholes became artesian and previously unidentified springs started to flow at points throughout the Area.

With the exception of the large scale flooding that took place in Lewes (on the tidal stretch of the Ouse) coastal influences such as tides, surge and waves had very little impact on the flooding in Sussex in proportion to the volumes of water generated by fluvial influences.

Flow gauging was undertaken throughout the event and results will be available for three river sections:

- The River Lavant at Graylingwell
- The Ouse at Goldbridge
- The Cuckmere River

Other sections have been flow gauged but the quality of output is likely to be poor due to the lack of resources available to undertake the initial surveys. It also proved to be very difficult to undertake the surveying in a number of locations because entire catchments/floodplains were inaccessible.

Due to the unprecedented volumes of water flowing through the river catchments, a significant number of telemetry sites were overwhelmed. There is currently a schedule of works to be undertaken with a view to reinstating those telemetry sites that have been affected.

Some of the sites have been a source of contention with local land/property owners for some time now. This is an issue that needs to be addressed with a view to giving the Agency the power to locate equipment as and where required with the necessary access rights. Legal issues need to be satisfactorily established.

5.2.3 Kent Area

The first flood event on 15th September did not greatly affect Kent and only one Flood Warning was issued. However, the second event from 9th-19th October, affected much of the Kent Area but was particularly severe over West and Mid Kent and East Sussex. The rain fell onto already wet soils, many of which are clay based, with the consequence that run-off into streams and rivers was relatively rapid. The worst affected rivers were the Medway with its headwaters in West Kent and East Sussex, the Beult and the Teise, which are tributaries of the Medway and the Rother with its headwaters in East Sussex.

Rivers overflowed their banks in many areas with extensive inundation of floodplains, some of which stayed under water for several days. Many towns and villages within or on the edges of the floodplains were severely affected by flood water, often to depths greater than experienced previously by local residents. The smaller, upland catchments were the first to react to the heavy rainfall with villages such as Lamberhurst on the Teise, Robertsbridge on the Rother and Headcorn on the Beult suffering badly. Edenbridge on the River Eden, an upper tributary of the Medway in West Kent, came within centimetres of major flooding with water lapping at the crest of the floodwalls for several hours. A similar situation occurred at Smarden on the River Beult.

Throughout the autumn the effective operation of the Leigh Barrier by Agency Staff greatly reduced the extent of flooding along the route of the Medway, especially in Tonbridge. The Barrier performed well in excess of its design capabilities largely due to the skilful operation by Agency staff. Existing operating procedures used during the event are based on historical records. These procedures will be updated in light of the data collected during this event.

The previous recorded event in any way comparable in scale to the flooding experienced in October and November, was in 1968 when flows at Leigh peaked at 226m^3/s. In the autumn 2000 the flow into the Barrier was as great as 260m^3/s. Clearly the 2000 event was exceptional especially when compared to the long-term average for this time of year which is just 10m^3/s.

Notwithstanding the greater volumes of water the level of the Medway at Tonbridge Town Lock was more than 90cm lower in 2000 than in 1968. The peak level in Tonbridge was 22.05mAOD recorded on 13th October, and was extremely close to overtopping defences there. By impounding water at the Leigh Barrier and controlling its discharge Agency staff were able to reduce the river flow through Tonbridge by 42% thus preventing large scale flooding there. Due to the scale of the event large volumes of water had to be discharged in anticipation of more rain yet to come. This was managed very carefully to prevent the defences in Tonbridge being overtopped. In the event the only flooding that occurred on the High Street was due to the drains surcharging and causing localised flooding around the drains themselves.

The positive effect of the Barrier's operation has also been recorded downstream of Tonbridge at East Farleigh where peak river levels in October were recorded at 8.75mAOD compared to 9.41mAOD in 1968. Similarly at Allington downstream of Maidstone the river levels peaked at 5.18mAOD, 18cm lower than in 1968.

Also some distance downstream of Tonbridge the village of Yalding, adjacent to the confluence of the Beult and the Teise with the Medway, was particularly badly affected by flood water for two or three days. Many other villages in the floodplains of these rivers were also badly affected. Below Yalding, those parts of Wateringbury and East Farleigh closest to the river suffered flooding as did Maidstone, which is just upstream of the tidal limit of the Medway at Allington Lock. The possibility of more severe flooding in Maidstone due to backing up of flood water over several high tide periods was of major concern to the Agency particularly on Friday 13th and Saturday 14th October.

The subsequent storms resulted in more widespread flooding across the Kent Area. Significantly for the later events the rain fell on already saturated land with rapid run-off into already swollen streams and rivers. So, whilst less rain fell during the storms at the end of October and the beginning of November, the severity of the flooding was only marginally less than that for the flooding of the 9th–19th October.

The third event of 29th–31st October was of shorter duration than the flooding of the second event, which is illustrated by the fact that the Leigh Barrier above Tonbridge was impounding water for a period of just three days between Monday 30th October and Wednesday 1st November. Despite this, repeat flooding was experienced by the residents of numerous villages including Robertsbridge, Lamberhurst, and Yalding with new flooding on rivers further East in the county. The on-line flood storage reservoirs at Aldington on the East Stour and at Hothfield on the Great Stour began impounding during this period thereby preventing flooding in Ashford and Wye.

The fourth event, 5th–8th November, was also of shorter duration than the second earlier in October but, as with the third, caused relatively severe flooding in the Kent Area. The flooding was again relatively widespread with flooding to numerous properties for the third time in five weeks or so. Yalding, Robertsbridge and Lamberhurst were once again badly affected and the Leigh Barrier was brought into action, this time for a period of four days. Fortunately, however, the reservoir had been emptied after the previous event before new impounding began. This, regrettably, was not the case on the East Stour and the Great Stour where fixed mechanical devices (hydrobrakes) control the discharge from the flood storage reservoir at a constant rate to ensure it stays within the river banks downstream. New

flood water entered the partly emptied reservoirs at Aldington and Hothfield. Consequently, despite the return period of the fourth event being less than the design standard of the reservoirs, Aldington Reservoir overspilled and four times the design flow of $4m^3/s$ was discharged into the watercourse below. The reservoir at Hothfield came within centimetres of overspilling. The village of Mersham immediately downstream of Aldington was protected from the serious flooding experienced before the construction of the reservoir, however three properties did suffer flooding. Severe flooding through Ashford and Wye was also avoided. Downstream of Canterbury at the tidal limit of the Great Stour, river flows were tidally affected which caused backing up of river flows and hence flooding in the village of Fordwich.

November 5^{th} – 6^{th} saw high winds and storm conditions in The English Channel resulting in the issuing of Coastal Flood Warnings for the South Kent coastline. The Pett beach frontage suffered severe erosion and significant quantities of beach were lost. An emergency recharge was required in order to return the defence to the existing standard.

The profile of the shingle beach had been adversely affected by delays in securing planning permission for the annual recycling operation. This delay resulted from the deliberations of the Local Authority over the undertaking of the appropriate assessment under the Habitats Regulations (1994). As a result a more intensive emergency operation was required.

The amount of rain that had fallen in the Kent Area over the autumn period also had the effect of raising groundwater levels to the extent that chalk streams in the East of the county flowed full and in some places overspilled. On the Nailbourne Stream, a tributary at the head of the Little Stour in East Kent, properties in the villages of Patrixbourne and Littlebourne suffered from internal flooding, due to excessively high groundwater conditions. Problems associated with high groundwater levels in the chalk stream areas are still a cause for concern some two months after the last main flood event.

The severity and duration of the rainfall over the Kent Area, particularly during the storm of 9^{th}–14^{th} October was such as to cause flash flooding on smaller catchments and longer term flooding on larger catchments. An example of the former would be at Lamberhurst on the River Teise, which suffered severe flooding on three separate occasions, each of relatively short duration of 6 to 9 hours. However, Yalding suffered from flooding for 24 to 48hrs duration, again on three separate occasions, due to the much more enduring peaks of flood water at the confluence of the Teise and the Beult with the Medway.

The table below gives initial estimates of peak flows for key locations in the Kent Area for the Autumn 2000 floods. (Please note that due to the relatively few 'high flow' gauging stations across the Kent Area and the scale and closeness in time of the three events some of the data could not be obtained in the time available for the preparation of this report. Where this is the case then N/A has been used in the table to denote that the information is not yet available).

Table 5.3: Kent Area peak flows in m^3/s

Location	River	Second Event 9th – 16th October Peak Flow	Third Event 29th – 31st October Peak Flow	Fourth Event 5th – 8th November Peak Flow
Leigh[1]	Medway	260	190	200
Tonbridge[1]	Medway	150	110	105
East Farleigh	Medway	275	218	214
Lamberhurst[2]	Teise	42	42	40
Headcorn[3]	Beult	67	60	57
Hadlow[4]	Bourne	N/A	N/A	14
Robertsbridge[5]	Rother	N/A	N/A	65
Wye[6]	Great Stour	N/A	24	N/A
Canterbury[7]	Great Stour	26	23	32

[1] *Flows for Leigh and Tonbridge in the table above have been obtained by reference to the records of operation and the Operating Manual procedures for the Leigh Barrier.*

[2] *The results for Lamberhurst have been obtained principally by use of data from Stonebridge GS.*

[3] *The results for Headcorn have been obtained principally by the use of data from Stilebridge GS.*

[4] *The results for Hadlow have been obtained principally by the use of data from Hadlow GS.*

[5] *The results for the second event at Robertsbridge are being obtained by reference to a report by the Babtie Group. The results for the fourth event are being obtained principally by use of data from Udiam GS*

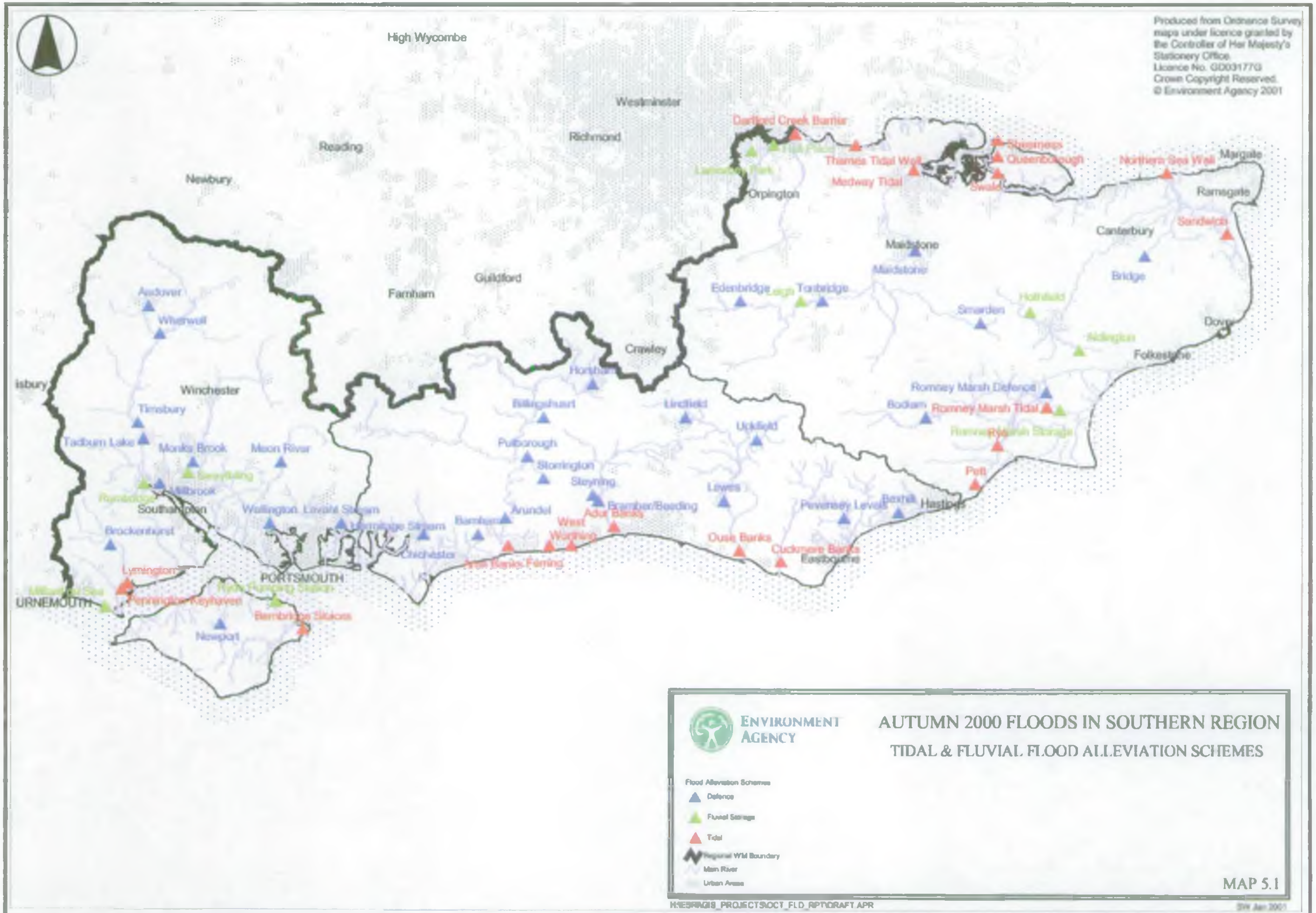
[6] *The results for Wye have been obtained principally on data from Wye GS.*

[7] *The results for Canterbury were obtained principally by use of data from Horton GS.*

The combined severity of the Autumn 2000 floods in the Kent Area is well illustrated by consideration of the flows in the River Medway upstream of Tonbridge at the Leigh Barrier. The second event resulted in a peak inflow to the flood reservoir of nominally $260m^3/s$. The third event had a peak inflow at Leigh of nominally $190m^3/s$, whilst the fourth event resulted in a peak inflow of nominally $200m^3/s$. A flood of the magnitude of the lesser of these three events had not been experienced since the opening of the Leigh Barrier scheme in 1981. The highest inflow to the Leigh Barrier prior to this autumn's floods was $144m^3/s$, in December 1982.

5.3 SOURCE OF FLOODING

Map 5.1 shows locations of key Agency tidal and fluvial Flood Alleviation Schemes in the Southern Region.



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High Wycombe
Westminster
Richmond
Reading
Newbury
Dartford Creek Barrier
Thames Tidal Wall
Medway Tidal
Sheerness
Queenborough
Swale
Northern Sea Wall
Margate
Ramsgate
Orpington
Canterbury
Sandwich
Maidstone
Bridge
Guildford
Farnham
Edenbridge
Leigh
Tonbridge
Andover
Wherwell
Hothfield
Smarden
Aldington
Dover
Folkestone
Crawley
Horsham
Winchester
Romney Marsh Defence
Romney Marsh Tidal
Bodiam
Billingshurst
Lindfield
Uckfield
Timsbury
Tadburn Lake
Monks Brook
Meon River
Pulborough
Storrington
Pett
Millbrook
Southampton
Steyning
Lewes
Bramber/Beeding
Pevensey Levels
Bexhill
Hastings
Wallington
Arundel
Adur Banks
West Worthing
Brockenhurst
Ouse Banks
Cuckmere Banks
Eastbourne
Chichester
Lymington
PORTSMOUTH
Bembridge Sluices
Newport
URNEMOUTH
Pennington Keyhaven
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
TIDAL & FLUVIAL FLOOD ALLEVIATION SCHEMES
Flood Alleviation Schemes
Defence
Fluvial Storage
Tidal
Regional WM Boundary
Main River
Urban Areas
MAP 5.1
H:\ESRI\GIS_PROJECTS\OCT_FLD_RPT\DRAFT.APR
Jan 2001

5.3.1 Hampshire and Isle of Wight Area

The number of properties recorded here as being flooded is estimated from site visits, local authority data and questionnaire data. It is likely that as information becomes available further properties will be identified as having been affected.

On 15th September an estimated 200 properties were flooded on Portsea Island due to failure of Southern Water Services Eastney Pumping Station. The only flooding influenced by 'main river' occurred at Ryde, however 'main river' was not the only source of flooding at Ryde.

Between 9th October and 16th October 120 properties (113 internally, 7 externally) were affected by flooding. 'Main river' flooding affected 10 properties (3 internally, 7 externally). In addition to direct 'main river' flooding 70 properties were flooded internally at Ryde due to a number of factors including high water levels in the main river. Failure or exceedence of defences, both Agency and third party, did not cause any flooding during this event. The 70 properties at Ryde were flooded from the Monkton Mead Brook. Heavy rainfall caused surface water to enter the combined sewer system and exceed its capacity. It was unable to discharge into the Monkton Mead Brook through the combined sewer overflow (CSO) due to raised water levels caused by high river flows, and high tide. 20 properties which are at the lowest point in the sewer system were flooded internally from the sewers as a consequence.

125 properties (95 properties internally and 30 externally) were affected by flooding between 29th and 31st October. One property was flooded from 'main river', while the remainder were due to a combination of surface water and inadequate drainage.

The number of properties flooded is estimated from site visits, local authority data and questionnaire data. No other data collection methods were used for this report, therefore it is likely that further properties were affected.

Between 5th and 8th November 300 properties (133 internally, 167 externally) were affected by flooding. 'Main river' flooding affected 183 properties (90 internally, 93 externally).

In Wallington overtopping due to Agency defences being exceeded resulted in flooding to 62 properties. In addition, failure of third party defences caused flooding to 5 properties.

Table 5.4: Hampshire and Isle of Wight Area property flooding by catchment

Period	Catchment	Location	Description
15-Sep	Itchen	Eastleigh	1 property is known to have flooded internally. It is likely that flooding was caused due to surface water or blocked drains (Data source: telephone conversation)
	East Hampshire	Havant	Internal flooding was reported to 38 properties due to heavy rainfall and inadequate drainage. High river levels exacerbated the situation so water was unable to flow into the local watercourses. A limited number of properties were flooded from West Brook (ordinary watercourse). Further problems were experienced as the Bellmouth automatic sluice on the River Hermitage operated erratically. (Data source: Havant Borough Council)
		Fareham	1 property is known to have flooded internally. The property is located adjacent to the tidal section of the Wallington River (Data source: telephone conversation). A further one property is known to have had sewage flooding
		Portsea Island	The Agency sent approximately 900 questionnaires to properties in Portsea Island, of which 276 questionnaires were returned. 105 of these properties reported internal flooding and it is therefore estimated that up to 200 properties were flooded internally as Southern Water Services Eastney Pumping Station failed due to heavy rainfall. Widespread surface water and combined effluent flooding was reported in the city. Portsmouth City Council has indicated areas on Portsea Island which were affected by flooding. The number of properties in these areas is 2797. However other areas are believed to have been affected but not recorded by Portsmouth City Council. It is therefore estimated that up to 3000 further properties were affected by external flooding
		Gosport	Six properties are known to have flooded internally due to surface water. (Data source: telephone conversation)
		Rowlands Castle	Three properties are known to have flooded internally due to surface water and blocked highway drains. (Data source: Agency Questionnaire)
	Isle of Wight	Shanklin	Five properties were flooded internally and required water to be pumped out by the Fire Brigade. Some road flooding also occurred in the area. (Data source: Isle of Wight Fire Brigade)
		Ryde	The Fire Brigade was involved in pumping water out of 20 properties when surface water from roads and roofs entered the combined sewer system and was unable to discharge into the Brook as levels were high. No additional flooding is believed to have occurred. (Data source: Isle of Wight Fire Brigade)

Period	Catchment	Location	Description
		Seaview	One property is known to have flooded internally and required water to be pumped out from the house by the Fire Brigade (Data source: Isle of Wight Fire Brigade)
		Wooton	One property is known to have flooded internally and required water to be pumped out from the house by the Fire Brigade (Data source: Isle of Wight Fire Brigade)
9/10/00 to 16/10/00	East Hampshire	Waterlooville	Eight properties were flooded due to a surcharging Southern Water Sewer. (Data source: Havant Borough Council)
		Wallington	1 property is known to have flooded due to surface water being unable to enter drains due to blockages. Some road flooding also occurred in the area. (Data source: telephone conversation)
	Isle of Wight	Newchurch	4 properties were affected by flooding (2 internally and 2 externally) as the Eastern Yar overtopped its banks. In addition two caravan parks were also affected. (Data source: Agency Questionnaire and Agency report)
		Alverstone	4 properties were affected by flooding (1 internally and 3 externally) as the Eastern Yar overtopped its banks. (Data source: Agency Questionnaire)
		Sandford	1 property was flooded internally. (Data source: Agency Questionnaire)
		Ryde	The Fire Brigade was involved in pumping water out of 39 flooded properties. It is estimated that the flooding at this time was similar to the flooding of December 1999 and therefore it is thought that approximately 70 properties were flooded internally. 19 properties were affected directly from fluvial flooding while the remainder flooded due to a combination of surface water, combined sewers and fluvial flooding. (Data source: Agency report and Isle of Wight Fire Brigade)
29/10/00 to 31/10/00	Test Valley	Romsey	1 property is known to have flooded internally (Data source: Agency Questionnaire)
	Itchen Valley	Southampton	1 property is known to have flooded internally due to the River Itchen overtopping it banks. (Data source: Agency Questionnaire)
	New Forest	Hounsdown	5 properties were affected (3 internally, 2 externally) due to the overtopping of an ordinary watercourse. The peak time of flooding was 07:00 on 30th October. (Data source: Agency Questionnaire)
		Bartley	4 properties were flooded internally as Bartley Water overtopped its banks. (Data source: New Forest District Council)

Period	Catchment	Location	Description
	East Hampshire	Havant	Flooding was reported to 19 properties due to heavy rainfall and inadequate drainage. The drainage systems did not work effectively because the high river levels restricted the flow from these drainage systems. (Data source: Havant Borough Council)
		Hayling Island	Flooding was reported to 16 properties due to 'ordinary watercourses' overtopping their banks. (Data source: Havant Borough Council)
		Waterlooville	15 properties were affected by flooding due to heavy rainfall and inadequate drainage. (Data source: Havant Borough Council)
		Emsworth	5 properties were affected by flooding due to heavy rainfall and inadequate drainage. (Data source: Havant Borough Council)
		Purbrook	6 properties were affected by flooding due to heavy rainfall and inadequate drainage. (Data source: Havant Borough Council)
5/11/00 to 8/11/00	Test Valley	Romsey	1 property is known to have flooded internally due to the 'main river' exceeding its banks and 1 property due to an overflowing sewer. 2 properties are known to have flooded externally as the 'main river' exceeded its banks. (Data source: Agency Questionnaire, telephone conversations)
		Sherfield English	1 property is known to have been affected by flooding due to surface water. (Data source: telephone conversation)
		Stockbridge	2 properties are known to have flooded internally due to rising groundwater (Data source: telephone conversation)
	Itchen Valley	Eastleigh	2 properties are known to have been flooded internally with sewage due to Chickehall Sewage Treatment Works (STW) overflowing its tanks. (Data source: telephone conversation)
	East Hampshire	Wallington	67 properties were affected by flooding (47 internally, 13 externally and 7 additional properties had garages only flooded). This occurred because the Wallington River's defences through Wallington village were exceeded. The situation was exacerbated by water backing up against the footbridge over the river where the river defences were lower.
		Upham	1 property is known to have been affected by internal flooding due to surface run-off. (Data source: telephone conversation)

Period	Catchment	Location	Description
		Hambledon	1 property is known to have been affected by internal flooding due to an inadequate culvert. (Data source: telephone conversation)
		Denmead	2 properties are know to have been affected by flooding due to surface water and blocked highway drains (Data source: telephone conversation)
		Corhampton	7 properties are known to have been affected by flooding (externally, cellar flooding or garage flooding). This occurred due to a combination of surface water, blocked drainage and high river levels. (Data source: Agency Questionnaire, site visit and telephone conversation)
		Exton	15 properties are known to have been affected by flooding (6 internally and 9 externally). This occurred due to a combination of surface water, blocked drainage and high river flows, out of banks. (Data source: Agency Questionnaire and site visit)
		Frogmore	11 properties are known to have been affected by flooding (6 internally and 5 externally). Flooding occurred due to the 'main river' overtopping its banks. (Data source: Agency Questionnaire and site visit)
		Meonstoke	4 properties are known to have been affected by flooding (3 internally and 1 externally). This occurred due the 'main river' overtopping its banks. Some flooding was caused due to poor drainage systems. (Data source: Agency Questionnaire, site visit and telephone conversations)
		Titchfield	12 properties are known to have been affected by flooding (2 internally and 10 externally)
		Warnford	8 properties are known to have been affected by flooding (3 internally and 5 externally). Flooding occurred due to groundwater and poor drainage. The 'main river' did not go out of bank through this village. (Data source: Agency Questionnaire and site visit)
		West Meon	31 properties are known to have been affected by flooding (12 internally, 16 externally and an additional 3 properties experience cellar flooding). This occurred due to a combination of the water levels in the 'main river' being high, blocked drainage and surface water. Additionally septic tanks overflowed causing sewage flooding within the village. (Data source: Agency Questionnaires and site visit)
		Wickham	24 properties are known to have been affected by flooding (6 internally and 18 externally). This occurred due to a combination of the 'main river' overtopping its banks and poor drainage. (Data sources: Agency Questionnaire and site visit)

Period	Catchment	Location	Description
		Droxford	1 property is known to have been affected internally due to 'main river' overtopping its banks. (Data source: telephone conversation)
	Isle of Wight	Cowes	A mobile home park was flooded due to a blocked surface water drain. (Data source: telephone conversation)
		Newport	3 properties were flooded internally due to surface water run-off. (Data source: telephone conversation)
		Brading	Three properties were affected (2 externally and 1 internally) due to the overtopping of an ordinary watercourse (Data source: Agency Questionnaire)

5.3.2 Sussex Area

The cumulative result of the weather and ground conditions has produced some of the worst flooding ever witnessed in Sussex, with all of the river catchments experiencing flood conditions. Due to the extreme high river levels flooding has also occurred away from 'main rivers', where 'ordinary watercourses', surface water and highway drainage systems have become overwhelmed. A number of discharge points were themselves underwater and thus hindered the escape of the flood water.

Groundwater flooding has also caused many problems with the highest groundwater levels since records began being recorded across Sussex. The Chilgrove borehole that feeds the River Lavant became artesian earlier in the year than had been previously recorded, since records began in 1836. This resulted in the highest river flow through Chichester since records began.

The only sea flooding that occurred during this event was overtopping of the sea defence shingle banks at Medmerry. This resulted in the flooding of a number of caravans in a site on the front, just behind the defences.

Table 5.5 gives a summary of the flooding in Sussex.

Table 5.5: Sussex Area property flooding by catchment

Catchment	Date of Flooding	Location (Town, Village etc.)	Description (Main River, Surface Water etc.)
Arun	12/10/2000	Stedham	2 properties flooded by 'main river' and surface water
	12/10/2000	Chiddingfold	10–15 properties flooded by surface water
	12/10/2000	Pulborough	5 properties flooded by 'main river'
	12/10/2000	Greatham	2 properties flooded by 'main river'
	12/10/2000	Houghton	3 properties flooded by 'main river'
	6-7/11/2000	Chiddingfold	5 properties flooded by surface water
	6-7/11/2000	Pulborough	3 properties flooded by 'main river' and surface water
	6-7/11/2000	Houghton	2 properties flooded by 'main river' and surface water
	6-7/11/2000	Midhurst	2–5 properties flooded by 'main river' and surface water
Adur	12/10/2000	Grove House, Burgess Hill	Main river flooding from East branch of Adur
	12/10/2000	Gambrook Kennels, Burgess Hill	Main river flooding from Pookebourne Stream
	12/10/2000	Cobbs Mill, Sayers Common	Main river flooding from Herrings Stream
	12/10/2000	The White Cottage, Sayers Common	Main river flooding from Herrings Stream
	12/10/2000	The Thatch Cottage, Sayers Common	Main river flooding from Herrings Stream
	12/10/2000	Mock Bridge House, Henfield	Main river flooding from East Branch of Adur
	12/10/2000	Malt House, Henfield	Main river flooding from East Branch of Adur
	12/10/2000	Cedar Cottage, Ashurst	Flooding from IDB watercourse, Blakes Sewer
	12/10/2000	Rye Farm House, Henfield	Flooding from IDB watercourse, Pocca Lea Sewer and River Adur
Adur	12/10/2000	Little Barn, Henfield	Flooding from IDB watercourse, Pocca Lea Sewer and River Adur

Catchment	Date of Flooding	Location (Town, Village etc.)	Description (Main River, Surface Water etc.)
	06/11/2000	Flooding to all properties as above	
	06/11/2000	Steyning	2 properties flooded form 'main river', Tanyard Stream
	06/11/2000	Bramber	14 properties flooded from 'main river', Adur
Chichester, Ems and West Sussex Rifes	Various dates throughout October and November	Stoughton	12–15 properties flooded by ground and surface water
		Walderton	2–10 properties flooded by ground and surface water
		Emsworth	17–20 properties flooded by ground and surface water
		Bosham	10–20 properties flooded by ground and surface water
		East Dean	5–10 properties flooded by ground and surface water
		Charlton	10–15 properties flooded by ground and surface water
		Singleton	10–15 properties flooded by ground and surface water
		Lavant	5 properties flooded by ground and surface water
		Chichester	5 properties flooded by ground and surface water
		Itchenor	5–10 properties flooded by ground and surface water
		Almodington	5–10 properties flooded by ground and surface water
		Earnley	5–10 properties flooded by ground and surface water
		Nyton	10–15 properties flooded by ground and surface water
		North Bersted	5 properties flooded by ground and surface water
Chichester	Various dates throughout October and	South Bersted	50 Caravans flooded from Aldingbourne Rife and surface water

Catchment	Date of Flooding	Location (Town, Village etc.)	Description (Main River, Surface Water etc.)
	November	Runcton	5–10 properties flooded by ground and surface water
		South Mundam	5–10 properties flooded by ground and surface water
		Fisher	1–5 properties flooded by ground and surface water
Ouse	The exact number of properties flooded in this catchment is far too numerous to list individually. Lewes suffered flooding to 817 domestic and business properties. Uckfield suffered flooding to approximately 100 domestic and business properties. Many of the out lying villages e.g. Barcombe, Isfield, Buxted, suffered flooding. This number may increase or decrease upon analysis of the questionnaires which are currently being received from the residents of Lewes and Uckfield. A questionnaire to all residents within a modified floodplain was sent out at the end of January 2001.		
Cuckmere	Various dates throughout October and November	Horham	1 property flooded from 'main river'
		Hellingly	5 properties flooded from 'main river'
		Alfriston	1 property flooded from 'main river'
		West Dean	1 property flooded from 'main river'
		Flooding has also occurred in isolated areas within Eastbourne, Pevensey Bay and Westham.	

5.3.3 Kent Area

The principal source of flooding in the Kent Area was the sheer volume of rain that fell over relatively short periods onto already wet or saturated catchments. As a consequence this led to rapid run-off from the land into streams and rivers that, for the last two flood events at least, were already swollen as a result of earlier flooding. The watercourses affected overflowed their banks causing inundation of the floodplains with obvious damage to land and property alike. Whilst the most extensive and severest flooding of this sort was undoubtedly associated with 'main rivers', there were numerous incidents of flooding as a result of minor watercourses overtopping their banks.

The severity of the rainfall and run-off not surprisingly resulted in problems being encountered due to other direct and indirect causes, including:

- Backing up of water behind culverts and bridges and blockages caused by waterborne debris
- Backing up of water from road drains

- Reduced storage of flood storage reservoirs due to repeat events
- Development within the floodplains
- Changes of land use
- Rising groundwater causing direct flooding and high base flows
- Backing up of flood water due to tidal effects
- Road traffic wash
- Sewage

At Robertsbridge, for example, the possible impact of the flood culverts through the embankment carrying the recently diverted A21 London to Hastings road across the floodplain of the Rother is being investigated. A similar issue may exist at Lamberhurst, where the River Teise passes beneath the A21. In North Kent, the size of culverts on the Swalecliffe Brook and the Westbrook is thought to have contributed to the major disruption to traffic by flooding on the A299 Thanet Way. At Maidstone, a major problem was only just averted on the evening of Friday 13th October when a large passenger boat threatened to break away from its moorings upstream of the old A26 road bridge across the Medway in the centre of the town; if it had done so it would have almost certainly blocked one of the three arches of the bridge. In another incident, at Headcorn on the River Beult, an oil tank was picked up by the flood water and ended up partially blocking the culvert under the A274 causing more extensive flood damage than would otherwise have been the case. There were numerous other examples of this type of problem across the county.

Backing up of drains was thought to be a factor in many locations. For example, at Tonbridge on the River Medway, localised flooding was caused during the second event, probably by backing up of road drains, even though the flood wall protecting the town remained intact. At Smarden on the River Beult it was reported that localised flooding occurred because of flows finding a conduit beneath the flood defences, although, again, the flood defences for the village remained largely intact. Also, at Snoll Hatch near East Peckham, localised flooding was thought to have occurred on more than one occasion due to backing up from road drains. As is often the case in such situations, flood water contaminated with sewage was a major hazard in many parts of the Area.

As previously reported, flooding occurred at Mersham on the East Stour upstream of Ashford during the fourth event when the Agency's flood storage reservoir at Aldington overspilled using the designed spillway. The reservoir had only partially emptied following the third event.

A questionnaire survey carried out on behalf of the Agency subsequent to the Autumn 2000 floods revealed recent residential developments in the floodplain at most of the villages visited.

Rising groundwater levels were also a significant factor with regard to flooding in various locations in the Kent Area. This was especially the case with respect to

flooding of villages close to the chalk streams in the East of the county, such as the Nailbourne Stream

Backing up of flood waters due to tidal effects exacerbated flooding in a number of places in the Kent Area, such as Maidstone and Fordwich as described previously.

During the house-to-house questionnaire survey in the Kent Area, a number of members of the public complained that the main cause of flooding within their properties was waves caused by vehicles travelling too fast along flooded roads.

The successful operation of the Leigh Barrier prevented what would otherwise have been extensive and deep flooding of the town of Tonbridge. The knowledge gained from these events will be built into the operating procedures for the barrier. These procedures need to be computerised and the gauging stations upstream and downstream need to be reviewed and extended. Out of bank rating curves will then be further developed so that they provide improved data during such large flood events in the future.

The house-to-house questionnaire survey also revealed that members of the public often held strong views about the cause of flooding to their property or village, some of which are listed below:

- Several residents of Robertsbridge were of the opinion that the flooding was tidally influenced, even though the village is nominally 25km upstream of the tidal outfall of the Rother near Rye. Furthermore, the tidal limit without the effects of Scots Float Sluice at Rye would be at Bodiam, still nominally 5km downstream of Robertsbridge.

- Other residents at Robertsbridge reported a surge of water through the village around the time of the peak of the second event. Some suggested this may be linked to the operation of a sluice gate by the Agency further upstream, although none exists.

- Several residents in Yalding, at the confluence of the Beult and Teise with the Medway which was badly affected on all three events, felt that the control exerted by the Leigh Barrier upstream of Tonbridge was in some way to blame for the severity of the flooding in their village. They were unaware that without the Leigh Barrier, the flooding through Tonbridge and many villages downstream, including Yalding, would have been very much worse.

- A number of people living in the Medway Valley revealed that they believed flows in the river to be tidally influenced as far upstream as Yalding and Tonbridge, whereas the tidal limit is downstream at Maidstone.

It is evident from the above that there is still some confusion regarding flood defences and their operation

5.4 NUMBER OF PROPERTIES NOT FLOODED DUE TO AGENCY DEFENCES

Although analysis is ongoing, current best estimates indicate that at least 16,000 additional properties would have flooded were it not for Agency managed defences. Details of some of these follow.

5.4.1 Hampshire and Isle of Wight Area

Within the Hampshire and Isle of Wight Area there are a number of flood defences and flood alleviation schemes which reduced or prevented flooding in certain areas during the Autumn 2000 event.

Test Valley

Wherwell – A flood bank was constructed in 1996, which reduces the risk of flooding. No flooding was recorded in this area.

Romsey – New bankworks have been constructed at Fishlake in order to control flow. No flooding was recorded in this area.

Tadburn lake – Channel improvements and floodwall at Halterworth. No flooding was reported in the area

Itchen Valley

Swaythling – The Agency maintains a flood wall at Swaythling and a flood bank at the Fleming Arms. These defences were designed for a 1 in 50 year event. No flooding was recorded in this area.

Millbrook – Defence walls along the Tanners Brook prevented the centre of Millbrook flooding.

Chandlers Ford – Monks Brook Channel improvements prevented a majority of flooding in the area. Only some road flooding occurred.

New Forest Rivers

Brockenhurst – The flood alleviation scheme constructed in 1994 on the Weirs prevented the centre of Brockenhurst being flooded twice during the Autumn 2000 event.

Milford-on-Sea – The Milford Dam flood alleviation scheme has been designed to store water during high flows. The gate operation is automatic and if there is a power loss air pressure will close the gate to the fail-safe condition. It will open on resumption of power but the gas cylinder will need changing. This defence prevented Milford village from flooding 4 times during the Autumn 2000 event.

Rumbridge – There is a river defence system above and below Rumbridge. Above Rumbridge the defence takes the form of a wall, and below Rumbridge it takes the form of an earth bank. No flooding was recorded in this area.

East Hampshire

Wallington – The Agency maintains a floodwall through the village of Wallington and at Broadcut. The defence through Wallington village was exceeded by flood waters. However the defence wall on the other side of the channel was not overtopped and no flooding occurred to the adjacent industrial units. The Agency maintains a bank surrounding Riverdale Cottages, Wallington. This bank prevented these properties being flooded internally.

Havant – In the 1960s extensive channel improvements were made to the Hermitage Stream and the Lavant. Environmental improvements have recently been made to parts of the Hermitage system and both new and old arrangements prevented flooding of extensive housing areas. A board can be installed at Crosslands Drive, Havant to divert flow from the Lavant Stream to the Hermitage Stream via a pipe link, designed for a 1 in 50 year event. This pipe link was operational and was partially successful during the Autumn 2000 flood event.

River Hamble – A balancing system North of the M27 near Bursledon prevented flooding downstream.

Hedge End – A balancing system, including a bypass channel and dams, behind the Botleigh Grange Hotel, limited flooding downstream.

East Meon – The River Meon has been placed in a concrete channel through the centre of East Meon which enlarges its capacity. This prevented properties being flooded during the Autumn 2000 event.

Wickham – The flood alleviation scheme allows water from the River Meon to surge bridges and then flood the recreation area. This system reduced the risk to a number of properties downstream from being flooded.

Isle of Wight

Ryde – There is a pumping station on the Monkton Mead Brook at Ryde which reduces the risk of flooding from the lower catchment.

Bembridge – Tidal sluices protect the Eastern Yar from inundation by the tide. These are designed to protect Sandown and other properties in the floodplain.

5.4.2 Sussex Area

But for Agency defences in place across the Area, widespread flooding to properties in Storrington, Horsham, Billingshurst, Newhaven, Arundel, Eastbourne, Bexhill and Bognor, to name but a few locations, would have occured. A significantly large area in the centre of Chichester has been saved from flooding by the works that have been undertaken since 1993.

Since the end of the events the Agency has been working in conjunction with various external bodies in an attempt to develop an accurate model of the floods as they happened. Data collection activities being employed are:

- A questionnaire has been circulated around the Ouse and Uck catchments in order to gain residents' views.

- Lewes District Council has provided the Agency with an initial estimate of the Lewes floodplain.

- Binnie, Black and Veatch are undertaking a detailed study into the flooding of the Ouse and Uck catchments.

- Halcrow have undertaken a survey of the extent, level and depths of the flooding in the Ouse and Uck catchments.

5.4.3 Kent Area

Within the parts of the Kent Area affected by the Autumn 2000 floods, the Agency has flood defences in the following locations:

- Edenbridge – River Eden, 150 properties protected. This town in West Kent is protected from flooding from the River Eden, a tributary of the Medway, by flood banks and walls that separate the town from the floodplain. The flood alleviation scheme, which was built in 1978 with a design standard of 1 in 30 years, just managed to withstand the second event and coped adequately with the subsequent floods.

- Tonbridge – River Medway, 690 properties protected. The Leigh Barrier which was commissioned in 1981 and low flood walls on the upstream side of the High Street combine to give flood protection to Tonbridge to a theoretical standard of 1 in 100 years. Serious flood damage upstream of the High Street was only narrowly avoided during the second event. In all three flood events, however, the commercial part of the town below the High Street was flooded, seemingly from water backing up from the downstream channel. It is, as yet, unclear whether the capacity and condition of the sluice and weir at Eldridges Lock was influential in this flooding.

- Smarden – River Beult, 12 properties protected. This village on the upper reaches of the River Beult had a flood alleviation scheme built by the Agency c.1997. The scheme consists principally of low flood walls and embankments and a pumping station belonging to Southern Water Services to evacuate excess surface water in the village. The design standard was 1 in 50 years. The defences in general performed well during the three events without being overtopped and hence prevented widespread flood damage. However, failure of the pumping station during the second event and previously unidentified drainage pipes beneath the defences resulted in localised flood damage to a number of properties.

- Ashford – Great Stour, 300 properties protected. The town of Ashford is protected from frequent flooding from the Great Stour by means of on-line flood storage reservoirs at Aldington and Hothfield. Excess flood water is retained in the reservoirs by Hydro-brakes which automatically restrict the discharges to $4m^3/s$. The standard of protection achieved by this means is 1 in 100 years. For the second event and the third event the reservoirs performed their tasks satisfactorily and as explained previously, the reservoir at Aldington was overtopped during the

last event with an estimated additional $12m^3/s$ being discharged over the emergency spillway.

- Bridge – River Nailbourne, 50 properties in the town of Bridge are protected by a scheme that was built in 1996. In the past heavy rainfall has caused flooding to residential properties in the town, most notably in the 1940s to 1960s and 1988. Works have included improvements to High Street culverts, works to a ford and a 12.5m embankment.

5.5 NUMBER OF PROPERTIES NOT FLOODED DUE TO THIRD PARTY DEFENCES

Again, with analysis ongoing accurate data is unavailable but best estimates suggest that, for the Autumn 2000 flood events, in excess of 20,000 properties were protected from flooding.

5.5.1 Hampshire and Isle of Wight Area

The number of properties not flooded due to third party defences is in the order of approximately 5,000. A significant number of these protected properties are due to small third party defences. They often only protect a few properties.

However there are some bigger schemes throughout the area:

- There are a number of balancing ponds within the Hampshire Area which are owned by third parties. Operation of these balancing ponds stopped flooding to a significant number of properties, for example, New Milton (Danes Stream)
- Warren Dam in Havant protected large parts of Havant town centre
- Defences at Beaulieu on the tidal part of the Beaulieu River protected the village centre
- Alresford Pond protected areas of Alresford
- ABP Pumping Stations in Southampton Docks prevented extensive surface water flooding in parts of Southampton City
- Portsmouth City Council Pumping Station in Portsmouth Docks prevented extensive surface water flooding in parts of Portsmouth City

5.5.2 Sussex Area

The only third party defences about which we have received any detail to date are Mock Bridge House, Malt House and Shermanbury on the River Adur; these were overtopped, but we have no information as to whether this caused property flooding.

5.5.3 Kent

Most recent development includes some form of attenuation that will have helped to protect many properties. Some residents in the Kent Area have also constructed their own flood defences, many of these are now coming to light as retrospective planning

applications where they are being checked to ensure that downstream impacts are minimal. Several councils in the Area maintain their own defences. It is unclear how well they performed. Road and rail embankments may also double as flood defences. In Wateringbury the railway embankment is known to have carried out this function.

It is therefore difficult to estimate the number of properties that were defended by third party defences.

5.6 NUMBER OF PROPERTIES FLOODED DUE TO FAILURE (NOT EXCEEDENCE) OF AGENCY DEFENCES

None reported to date.

5.7 NUMBER OF PROPERTIES FLOODED DUE TO FAILURE (NOT EXCEEDENCE) OF THIRD PARTY DEFENCES

5.7.1 Hampshire and Isle of Wight Area

Five properties are known to have flooded at Wallington (one internally) due to failure of a third party defence.

5.7.2 Sussex Area

Despite the failure of the three sections of flood defence wall in Lewes during the event of 12th–13th October, virtually all flooding in Sussex can be attributed to a combination of 'exceedence of defence' and surface water flooding. This is true for both third party and Agency owned defences. The failure of the walls in Lewes did not have a major impact on the extent or level of flooding in the town because peak flood levels were generally in the region of 1m higher than the defences throughout the town.

5.7.3 Kent Area

Three properties are known to have flooded at Smarden due to failure of a Southern Water Services pumping station during the second event and water seeping below the Agency's defences through previously unidentified drainage pipes.

5.8 NUMBER OF PROPERTIES FLOODED DUE TO EXCEEDENCE OF AGENCY DEFENCE STANDARDS

5.8.1 Hampshire and Isle of Wight Area

Sixty-seven properties at Wallington were flooded (47 internally) when the Agency defences were exceeded. Seventy properties were flooded at Ryde. Heavy rainfall caused surface water to enter the combined sewer system and exceed its capacity. It was unable to discharge into the Monkton Mead Brook through the combined sewer overflow (CSO) due to raised water levels caused by high river flows, and high tide. 20 properties that are at the lowest point in the sewer system were flooded internally from the sewers as a consequence.

5.8.2 Sussex Area

The flooding at Lewes, Uckfield, Hellingly and Alfriston occurred due to exceedence of Agency defence standards. Around 920 properties flooded at these locations.

5.8.3 Kent Area

Three properties were flooded at Mersham, a village downstream of Aldington Reservoir but upstream of Ashford.

Additionally the 50 properties below Tonbridge High Street were flooded apparently due to backing up from the downstream river channel. However, the Agency's defences that are generally upstream of the High Street were not overtopped

5.9 LIST OF TOWNS AFFECTED WITHOUT ADEQUATE DEFENCES

5.9.1 Hampshire and Isle of Wight Area

Towns affected by flooding include:

- Ryde – Flooding occurred twice in the centre of Ryde during the Autumn 2000 flood event, due to a combination of factors including 'main river', surface water, highway drainage, tide locking and the sewer system. A scheme to address the 'main river' flooding has been proposed for this area and currently is in the process of approval by MAFF.

- Havant – The majority of flooding that occurred in Havant was due to inadequate surface drainage. A limited number of properties were affected due to overtopping of an ordinary watercourse.

5.9.2 Sussex Area

Property flooding has caused major upset across Sussex with many properties, not previously flooded, being inundated with water. At present it is believed that in excess of 1,000 domestic and business properties flooded to varying degrees from minimal flooding to that in excess of 3m. To date reports, letters and questionnaires are still arriving at the Agency's offices.

5.9.3 Kent Area

The table below lists the towns and villages that were worst affected in the Kent Area by the Autumn 2000 flood events. It also lists the current standard of protection provided, if any, and the indicative standards of protection as taken from "Flood and Coastal Defence Project Appraisal Guidance - Economic Appraisal (PAG3)" as published by the Ministry of Agriculture, Fisheries and Food.

Table 5.6: Kent Area locations affected with defence standards

Town or Village	River	Current Standard	Indicative Standard
Tonbridge	Medway	1 in 100 years	50 – 200 years
Yalding	Medway etc.	-	25 – 100 years
Maidstone	Medway	-	50 – 200 years
Headcorn	Beult	-	25 – 100 years
East Peckham	Bourne	-	25 – 100 years
Lamberhurst	Teise	-	25 – 100 years
Collier Street	Teise	-	25 – 100 years
Laddingford	Teise	-	25 – 100 years
Etchingham	Rother	-	25 – 100 years
Robertsbridge	Rother	-	25 – 100 years
Fordwich	Great Stour	-	25 – 100 years

On the basis of the above and the initial findings of the causes of flooding in the Kent Area, it is strongly recommended that investigations are carried out to assess the viability of flood alleviation schemes or upsteam attenuation for Yalding, Lamberhurst, Robertsbridge and other hard hit areas. In addition, consideration should be given to investigations to assess the viability of flood alleviation works at the other locations. Furthermore, it is recommended that reviews of the adequacy of the existing defence standards are carried out for Tonbridge and Edenbridge.

5.10 MAJOR INFRASTRUCTURE AFFECTED

5.10.1 Hampshire and Isle of Wight Area

Some parts of the railway network were closed due to flooding and/or landslips. Between 9th and 11th October 2000 the Isle of Wight railway was closed due to track flooding and severe erosion.

Table 5.7: Hampshire and Isle of Wight Area roads affected

Road	Report confirmed by	Date Closed	Date Re-opened (if known)
Woolston Rd Netley	Eastleigh BC	30/10	08/12
Allbrook Hill	Eastleigh BC	30/10	21/12
Shop Lane Netley	Eastleigh BC	30/10	03/11
Grange Rd Netley	Eastleigh BC	30/10	08/12
Ashford Hill	Area Surveyor North	30/10	
Hocombe Rd/Ladwell Hill Junction	Area Surveyor East	30/10	
Stoneham Lane	Eastleigh BC	30/10	
Stoneham Link	Eastleigh BC	30/10	
A325 Sleaford	Area Surveyor East	30/10	
A30 Hook	Area Surveyor North	30/10	
Worthy Rd	Winchester CC	30/10	
Water Lane	Winchester CC	30/10	
A33 Chineham	Area Surveyor North	05/11	06/11
A340	Area Surveyor North	05/11	06/11
A336 Lyndhurst	Area Surveyor West	06/11	
A35 Ringwood	Area Surveyor West	06/11	
Wallington Shore Rd	Fareham BC	06/11	Noted as closed on the 12/12
Bridge St Titchfield	Fareham BC	06/11	Noted as closed on the 12/12
River Lane Funtley	Fareham BC	06/11	
A272 Westmark Fm	Area Surveyor East	06/11	
Hatch Rd, Old Basing	Area Surveyor North	07/11	
Belmore Lane Lymington	New Forest DC	06/11	07/11

5.10.2 Sussex Area

The extent of the flooding across Sussex resulted in major disturbance to the Area's infrastructure with many roads being impassable and the railway station at Lewes being completely awash.

Table 5.8: Sussex Area infrastructure flooding by catchment

Catchment	Date of Flooding	Location (Road No. Town etc.)	Description (Main River, Surface Water etc.)
Arun	12/10/2000	A272, Midhurst	Surface water flooding
	12/10/2000	B2138, Fittleworth	Main river flooding
	12/10/2000	A29 Pulborough	Main river flooding
	12/10/2000	B2139 Houghton	Main river flooding
	12/10/2000	Railway, Arundel to Billingshurst line.	Main river flooding causing restricted travel/timetable
	12/10/2000	Chiddingfold, Petworth road	Surface water flooding
	12/10/2000	A272 Newbridge	Main river flooding
	6-7/11/2000	Chiddingfold, Petworth road	Surface water flooding
	6-7/11/2000	A29 Pulborough	Main river flooding
	6-7/11/2000	A272 Midhurst	Surface water flooding
	6-7/11/2000	Railway, Arundel to London line	Main river flooding causing restricted travel/timetable
	6-7/11/2000	A272 Newbridge	Main river flooding
Adur	12/10/2000	A2037, Smalldole	Main river flooding form Mill Stream
	12/10/2000	Kings Barn Lane, Steyning	Main river flooding form Tanyards Stream
	12/10/2000	B2135, Ashurst	Flooding from IDB watercourse, Blakes Stream
	12/10/2000	B2135, Bines Bridge	Main river flooding, Adur West branch
	12/10/2000	A281, Mock Bridge	Main river flooding, Adur East branch
	12/10/2000	Stairbridge, Hickstead	Main river flooding, Adur East branch

Catchment	Date of Flooding	Location (Road No. Town etc.)	Description (Main River, Surface Water etc.)
	12/10/2000	Wortleford Bridge, Goddards Green	Main river flooding, Adur East branch
	12/10/2000	Leigh Mill Bridge, Goddards Green	Main river flooding, Adur East branch
	12/10/2000	Fairplace RoadBridge, Burgess Hill	Main river flooding, Adur East branch
Adur	12/10/2000	Jaynes Lane Bridge, Burgess Hill	Main river flooding, Adur East branch
	12/10/2000	Mill Lane Bridge. Sayers Common	Main river flooding, Herrings Stream
	12/10/2000	Tenchford Bridge, Shipley	Main river flooding, Adur West branch
	12/10/2000	Capps Bridge, Shipley	Main river flooding, Adur West branch
	12/10/2000	Ashbrook Bridge, Shipley	Main river flooding, Adur West branch
	12/10/2000	Malt House Lane Bridge, Burgess Hill	Main river flooding, Pookbourne Stream
	12/10/2000	Danworth Lane Bridge, Burgess Hill	Main river flooding, Pookbourne stream and Herrings stream.
	6/11/2000	All the above sites suffered repeat flooding on this date.	
	6/11/2000	Wineham Lane Bridge, Wineham	Main river flooding, Adur West branch
	6/11/2000	Herrings Road, Twineham	Main river flooding, Herrings Stream
Chichester	Various dates throughout October and November	Stockbridge	Surface water flooding to road
		Apuldram	Surface water flooding to road
		Hunston	Surface water flooding to road
		Pagham	Surface water flooding to road
		Tangmere, A27	Surface and groundwater flooding
		Barnham	Barnham rife and surface water flooding to road

Catchment	Date of Flooding	Location (Road No. Town etc.)	Description (Main River, Surface Water etc.)
Ouse	Various dates throughout October and November. Principally 12/10/2000	Many of the roads in the Ouse catchment suffered from flooding. The towns of Lewes and Uckfield were completely cut off, with major flooding to all the main routes in and out of the towns. Lewes Railway station was closed due to flooding.	
Cuckmere	Various dates throughout October and November. Principally 12/10/2000	Within the Cuckmere catchment the A22, A27, A259, A267 and A271 were all closed to flooding at varying times during October and November.	

5.10.3 Kent Area

The roads closed or badly disrupted by flooding, either localised or general, in the Kent Area during the Autumn 2000 events are too numerous to identify individually in this report. However, listed below are several of the more significant closures:

- A299 – Thanet Way between Whitstable and Herne Bay in North Kent
- A21 – Tonbridge to Hastings road at Lamberhurst; (Teise)
- A274 – Biddenden Road at Headcorn; (Beult)
- A262 – Station Road at Hope Mill near Goudhurst; (Teise)
- A28 at Wye near Canterbury; (Great Stour)
- A26 – Maidstone Road at Hadlow; (Bourne)
- B2162 – Lees Road at Yalding and Laddingford; (Medway, Beult and Teise)
- B2010 – Teston to Yalding road at Teston Bridge; (Medway)
- B2188 – Penshurst to Fordcombe road at Colliers Land; (Medway)
- B2178 at Penshurst; (Medway)

Several railway lines were closed or disrupted by the flooding including the mainline between Tonbridge and Ashford; the mainline between Tunbridge Wells and Hastings at Etchingham and the branch line between Paddock Wood and Maidstone. The mainline Ashford to Canterbury railway was closed due to groundwater inundation.

5.11 INCIDENCE OF REPEAT FLOODING

5.11.1 Hampshire and Isle of Wight Area

Goundwater

The prolonged rainfall throughout the autumn started groundwater flooding throughout the county that has resulted in house flooding and disruption of roads by sandbagging for several weeks in some cases.

Ryde

Flooding occurred in Ryde both on 15th September and 9th October. Flooding occurred as surface water discharge through combined sewer overflow into the Brook. Ryde flooded in December 1999 as well as December 1993 and June 1999.

Havant

Flooding occurred in parts of the Havant Borough Council area 3 times (15th September, 9th October, 29th October). Flooding was due to inadequate drainage and surface water.

5.11.2 Sussex Area

Many of the river catchments in Sussex were in a state of flood from early October, with the most severe floods occurring on the 12th October 2000. Since then the rivers have remained in varying states of flood and continue to give cause for concern following each belt of rain. Repeat flooding has been experienced in Hellingly, Barcombe Mills and Alfriston.

5.11.3 Kent Area

In Kent it is known that Yalding, Lamberhurst and Robertsbridge were subjected to significant flooding during each of the three major flood events under consideration, whilst the others such as Five Oak Green, East Peckham, Ashford and Canterbury were affected more than once during the Autumn 2000 floods. Extreme examples of repeat flooding are low lying properties in Lamberhurst and Robertsbridge which, according to the owners, have been flooded internally six times already this autumn and winter.

Other areas in Southern Region including Lamberhurst have flooded up to five times within the last year. Yalding and Robertsbridge, for example, have flooded in December 1999 and May 2000. The Autumn 2000 floods affected these areas twice in October and once again in November.

5.12 ISSUES ARISING AND RECOMMENDATIONS

SO\EI\1	Adequacy of drainage systems
Issue	Many properties were flooded totally or partly due to blocked and inadequate drainage systems. Many ordinary water courses and highway drainage gullies were blocked and therefore caused the water to remain in fields, gardens or on the highway.
Recommendation	The Environment Agency does not maintain surface water gullies, although it does have a supervisory duty in relation to drainage issues. A regularly maintained surface water drainage system would reduce the areas flooded and hence the number of properties flooded. However, the reduction in storage on flooded roads together with more rapid concentration of flow may increase flood levels downstream. At present highway drainage systems are designed for a 1 in 1 or 1 in 2 year return period, therefore the drains were unable to cope with a majority of the rain. It is recommended that (i) the Agency advises local authorities to maintain and regularly clean surface gullies. (ii) The local authorities could collect data from flood events so that persistent problems can be brought to the attention of the Agency. (ii) Influence planners developers and operators to ensure drainage designs are reviewed in the light of the whole drainage system and are sustainable.

SO\EI\2	Flood proofing 'At-Risk' properties
Issue	Many of the properties affected by flooding are low lying properties and therefore water is easily able to enter the property. Some properties in the flooded areas had the floor level significantly above the ground level and hence were only externally flooded.
Recommendation	If a minimum difference between the ground level and floor level was legally required a number of properties would have been prevented from such extensive flooding. Additional flood proofing measures should also be investigated.

SO\EI\3	Flood event data collection
Issue	Much of the data quoted above have been collated from telephone calls, Agency questionnaires and local authorities. However the reliability of this data is uncertain and it is therefore recommended that each site affected by flooding is visited during the flood event where practical so as to assess the exact extent of the flooding.
Recommendation	Agency staff to confirm the extent of flooding after flood events. Liaison with Parish Councils throughout the event would be helpful and may lead to further details being known about the event itself.

SO\EI\4	Review flood defences at affected sites
Issue	Following the Autumn Floods reviews of flood defences are required in the following Catchments: Upper Medway, Ouse, Wallington, Monkton Mead and the Nailbourne Stream. Specific sites that require investigation include Wallington, Ryde, Lewes, Uckfield, Tonbridge, Smarden, Yalding, lamberhurst, Robertsbridge, Swalecliffe, Westbrook and Edenbridge. Any areas that flooded during the Autumn, and any others at risk, require Catchment flood management plans to be in place.
Recommendation	The Agency has an agreed programme of flood defence improvements in place which includes some of the areas flooded during the Autumn. This programme is being reviewed in light of the flooding and further works are being identified. Areas flooded but not previously considered require initial investigations to establish the viability of any proposed scheme and inclusion in the programme..

SO\EI\5	Catchment Flood Risk Management Plans
Issue	The impact of the flooding across the Region has been far reaching and in some cases devastating for the people affected. It has highlighted the need for in depth catchment studies, where detailed consideration can be given to the cost benefit of schemes, adequacy of existing defences and overall river management.
Recommendation	Ensure the early completion of Catchment Flood Risk Management Plans, to address all of the issues such as flooding from 'main river', ordinary water courses, groundwater, sewerage na dother drainage systems as well as urban and rural land use planning and climate change. This will enable the Agency and other bodies to better understand the catchment and review how the flood risk is best managed including how warnings could be issued.

SO\EI\6	Review Leigh Barrier operations
Issue	The experience of this event needs to be included into the operating procedures for the Leigh Barrier on the River Medway above Tonbridge. There is a need for additional telemetry.
Recommendation	Review all aspects of the operating procedures for the Leigh Barrier scheme in order to ascertain the benefits of any amendments to operating procedures.

SO\EI\7	Improve public awareness of flood defence operations
Issue	During the flooding it was clear that the public could be helped in their understanding of rivers and the operation of flood defences.
Recommendation	Raise public awareness into the work of the Agency, the causes of flooding and how the defences are operated.

SO\EI\8	Development in flood risk areas
Issue	During the event many recently built properties were affected with many more at serious risk of flooding.
Recommendation	(i) Seek to increase the Agency's influence on planning issues. (ii) Continue to raise political awareness of the detrimental effects of floodplain development and the risk to life it causes both to Local Planning Authorities and individual house buyers.

SO\EI\9	Vehicle wash in flooded areas
Issue	Localised problems of flooding due to vehicle wash. Vehicles driving through flooded areas exacerbated problems by increasing water levels in houses.
Recommendation	(i) Undertake liaison with local authorities and the police with respect to control of vehicle movements along flooded roads. (ii) Include issue in public awareness material.

6 EMERGENCY RESPONSE

6.1 MAJOR INCIDENT PLANS ACTIVATED

In addition to the forecasting and warning staff the Environment Agency has operations staff and its own contractor / emergency workforce who work very closely with the local authorities and emergency services to respond to flood events. During a flood event the Agency opens Area and Regional Incident Rooms which provide the focus for all management decisions during the event to co-ordinate the emergency response. The Area Incident Rooms disseminate the warnings, control flood defence operations through the emergency workforce and organise extra resources as required. The police also open control centres to co-ordinate the emergency services and the Agency usually seeks to provide staff to attend the control centres to increase the level of liaison.

The Environment Agency's procedures, including new flood warning and operation plans, worked very well. A dedicated phone line was provided for the Agency's professional partners and was used to notify them of the first Flood Watches. Emergency response from professional partners, generally using generic plans for major incidents, also worked well. Without these plans in place and the Agency's presence in emergency response control centres, it would not have been possible to manage the event as effectively. However where site specific plans are in place, for example in Chichester, the response to flooding is felt to be improved.

6.1.1 Hampshire and Isle of Wight Area

No Severe Flood Warnings were put in place during the Autumn 2000 flood events, and therefore no major incident plans were activated.

6.1.2 Sussex Area

Activation of the Major Incident Plans in Sussex was progressive. As the flood warnings became more severe, more elements of the plans were activated. The major plans were principally put into operation on 12th and 29th October with a Strategic Command Centre as a key element of this. Parts of plans were also activated on 6th November (Uckfield) and 13th December (Lewes).

6.1.3 Kent Area

The response to a major flooding incident involves a number of organisations working at the local level. Included within this group are the police, Fire Service, Local Authorities, and public utility companies.

At periods throughout the autumn the Kent police were responsible for establishing Strategic (Gold Control), Tactical (Silver Control) and Operational (Bronze Control) Command Centres to ensure a fully co-ordinated inter-organisational response in Kent. The Control Centres, once established, were the focus for the emergency services and their co-ordination.

The Strategic Command Centre has, during a flood event, overall responsibility for strategic control with countywide responsibilities. In the Kent Area this was

established on four occasions throughout the autumn. The Tactical Command Centre is the second level of the control hierarchy. It follows guidance from the Strategic Command Centre and liaises with operatives on the ground to ensure emergency works are carried out. The third level of the control hierarchy is known as the operational level. This level is established when a localised response is required and consists of operational workforces who receive instructions from the Tactical Command Centre to respond to events on the ground. Further details of these command structures can be found in the Home Office document, *Dealing with Disaster (3rd ed.)*.

Maidstone Borough Council and Tonbridge and Malling Borough Council instigated Emergency Incident Plans relating to the evacuation of properties. Evacuation of residents was co-ordinated through the three Control centres with assistance from the organisations present. The smooth running of evacuations is an objective of the control structure, which allows a multi-functional response.

Canterbury City Council and Ashford Borough Council had their incident procedures in place if evacuations were deemed to be required. River levels, however, did not reach levels where a large-scale evacuation of residents was required.

6.2 STRATEGIC (GOLD CONTROL) AND TACTICAL (SILVER CONTROL) COMMAND CENTRES OPENED

6.2.1 Hampshire and Isle of Wight Area

No Strategic or Tactical Command Centres were opened in Hampshire or on the Isle of Wight during the Autumn 2000 Floods.

6.2.2 Sussex Area

Table 6.1: Sussex Area Command Centre opening times

Control Description	Opened		Closed	
	Date	Time	Date	Time
Strategic Command Centre	12/10/2000	09:30	13/10/2000	20:00
Tactical Command Centre (Lewes and Uckfield)	12/10/2000	10:00	20/10/2000	10:00
Strategic Command Centre	29/10/2000	15:00	30/10/2000	16:30
Tactical Command Centre (Selsey)	29/10/2000	16:00	30/10/2000	16:45
Tactical Command Centre (Chichester)	8/11/2000		Christmas	

In Sussex a major incident was declared at 08:00 by the Fire Brigade on the 12th October. A Joint Strategic Command Centre was established at Sussex police HQ Lewes from 08:30 on 12th October to 20:00 on 13th October, then again from 14:00 on 29th October to 16:30 on 30th October.

Joint Tactical Command Centres were established at Lewes and Uckfield on 12th and 13th October at 10:00 on 12th October, and again on 29th–30th October. The joint Tactical Command Centre in Lewes remained in operation from 12th–20th October (police chair 12th–15th, Lewes District Council chair 16th–20th). The group then reformed and still meets regularly as the Lewes Flood Recovery Co-ordinating Group.

Following gales (tornadoes) at Selsey and Bognor, West Sussex Fire Brigade opened a Silver Control (major incident room) at Bognor Regis at 16:00 on 29th October.

On 29th October at 15:00, a multi-agency meeting was held, a Strategic Command Centre was opened with immediate effect at Sussex police HQ. Situation meetings continued at 2 hour intervals from 19:30.

On the 8th November, in response to the deteriorating situation in Chichester, the Strategic Co-ordinating Group (SCG) of West Sussex County Council met at County Hall Chichester. As a result a Tactical Command Centre (Silver Control) was set up for the Public Information and Evacuation Group. The major incident in Chichester remains with SCG continuing to meet on a weekly basis.

6.2.3 Kent Area

The table below shows the periods of time that the two Control Centres were open in the Kent Area.

Table 6.2: Kent Area Command Centre opening times

Control Description	Opened		Closed	
	Date	Time	Date	Time
Strategic Command Centre	12/10/2000	12:00	15/10/2000	08:00
Tactical Command Centre	13/10/2000	08:00	16/10/2000	18:00
Strategic Command Centre	29/10/2000	21:00	1/11/2000	08:30
Tactical Command Centre	30/10/2000	06:00	2/11/2000	13:00
Strategic Command Centre	2/11/2000	06:00	3/11/2000	16:00
Strategic Command Centre	5/11/2000	20:00	8/11/2000	12:00
Tactical Command Centre	6/11/2000	06:00	7/11/2000	10:00

A police command unit was sent by the Strategic Command Centre to Robertsbridge and co-ordination took place with Kent Area Incident Room.

6.3 STRATEGIC (GOLD CONTROL) AND TACTICAL (SILVER CONTROL) COMMAND CENTRES WITH AGENCY ATTENDANCE

6.3.1 Hampshire and Isle of Wight Area

No Strategic or Tactical Command Centres were opened in Hampshire or on the Isle of Wight during the Autumn 2000 Floods.

6.3.2 Sussex Area

Where possible, Sussex Environment Agency staff had been in attendance at the various incidents both at Strategic and Tactical Command Centres, being on hand to offer assistance and advice were necessary. This involvement has been beneficial in providing good lines of communication between the Command Centres and the Sussex Area Incident Room.

In addition to Agency staff attending Strategic Command Centres, an open invitation was offered to the emergency services, enabling them to have representatives at the Environment Agency's Area Incident Room, which was accepted on a number of occasions.

6.3.3 Kent Area

At all times when the Command Centres were open the Environment Agency staff maintained a 24hr presence. Environment Agency Staff in the Strategic Command Centres were usually team leaders or members of higher management.

Startegic Control comprised of officers from the following organisations, each of which had their own major incident plans and procedures:

- Environment Agency
- Kent police force
- Kent Fire Brigade
- Kent Ambulance Service
- Kent County Council
- Social Services
- The Army
- The Coastguard

The Strategic Command Centre is part of the Kent Police Emergency Incident Plan. Within the emergency plan it is a requirement that the Command Centre be established at the Kent police HQ, Sutton Road, Maidstone, Kent.

6.4 AGENCY RESOURCES

6.4.1 Hampshire and Isle of Wight Area

Throughout the event, a large number of staff were utilised from all functions, including Flood Defence, Water Resources, Environmental Protection, Fisheries, Business Services and Customer Services.

Flood Defence staff, being the lead function, were involved in the management of the event. Work undertaken included monitoring rainfall and flow levels, issuing flood warnings, organising responses and answering telephone calls from huge numbers of people.

The Emerg4ency Workforce was co-ordinated by an Emergency Duty Officer to ensure all emergency work was undertaken as quickly and efficiently as possible.

Water Resources staff were also involved in the management of the event and spent much of their time collecting field data. Also as groundwater levels began to rise Water Resources staff began to monitor the increase in levels.

Other functions involved were Fisheries staff and Environmental Protection staff who were mainly involved in the collection of data. Business Services and Customer Services staff were call handlers throughout the event.

Environmental Protection Officers were also on hand during flooding events that were to have an adverse effect on the environment, the main example being the failure of Southern Water Services Eastney Pumping Station.

Adequate equipment and plant was available throughout the event, with the Emergency Workforce being able to use it at all times.

6.4.2 Sussex Area

For much of the months of October and November the Sussex Incident Room was open and fully staffed 24hrs a day. The events showed the Area staff to be resourceful and multifunctional in the management of the events as they developed.

Flood Defence staff have been involved in the management of the Incident Room, with staff also attending issues on the ground. All 19 Area staff were fully utilised throughout.

Environment Protection staff played a big part in the control of pollution and the aftermath clear up. This involved the removal of dead livestock in Lewes with up to 25 staff being deployed.

Water Resources staff have been deployed all over the Area to retrieve on the ground data, with 10 permanent staff and 2 external Agency staff being deployed throughout.

Fisheries staff have been involved primarily for their boat handling skills. They have also been involved with a fish rescue at Malling Brook, Lewes.

A total of 100 Area staff were utilised in the manning of the Sussex Area Incident Room.

6.4.3 Kent Area

Over the autumn period a number of Severe Weather Warnings were received. In response to these warnings 24hr emergency response rosters were put in place. Included in these rosters are the following roles as identified in the procedures for the staffing of the Area Incident Room:

Table 6.3: Area Incident Room staffing roles

Role	Description of Role
Area Base Controller (ABC)	Strategic Management of event
Flood Warning Duty Officers (FWDO)	Monitor levels, decide on which warnings to issue
Assistant Flood Warning Duty Officers (AFWDO)	Issue warnings via the AVM system, update Floodline and assist the FWDO
Operational Duty Officers (ODOs): One for North Kent One for South Kent	Receive alarms, monitor levels, operate control structures, liaise with EDOs
Emergency Duty Officers EDOs North Kent South Kent	Manage the Emergency Workforce on the ground in liaison with ODOs
Strategic Command Centre (Gold Control) Liaison	Liaise with ABC and professional partners
Tactical Command Centre (Silver Control) Liaison	Liaise with the Strategic Command Centre (Gold Control)
Floodline operators	Answer telephone calls from the public

To resource these roles, 33 members of staff are identified in the emergency rosters for the Area Incident Room. This does not include a large number of staff who volunteered their services as Floodline operators.

An important item of equipment within the AIR is the Automatic Voice Message system, which during the autumn delivered thousands of calls. This proved a very powerful system for communicating directly to a mass audience. The system is, however, 'old technology' carrying an enormous number of contacts and at times is very temperamental and extremely difficult/stressful to use. It is urgent that the existing system be upgraded otherwise it will soon restrict our ability to provide the flood warning service to a larger proportion of the 'at risk' population.

Data collection was also carried out during all of the recorded events throughout the autumn. There was a total of 10 data collectors used, as well as 10 dedicated drivers. Data collection staff were equipped with a data collection pack including 1:10,000 scale maps for recording levels and road marking crayons so that peak levels could be 'levelled in' after the event. Data collection and analysis is still continuing using aerial stereoscopic photography and other sources of captured information.

6.4.4 Regional Emergency Workforce

The Regional Emergency Workforce operates as a Regional service and throughout the event it supported the Region with almost the full complement of 204 operatives and 35 staff with additional assistance from Anglian, Thames, Wales and Southwest Regions' Emergency Workforce units.

Equipment and plant were hired to supplement the Agency's own. Additional staff from contract agencies were provided to assist with the operation and the distribution of 35,000 sandbags. Specialist contractors were arranged for tree-felling and removal.

Communication across the Emergency Workforce benefited from close links with the Area Incident Rooms and the roles of Emergency Duty Officer and Operational Duty Officer. Both were very effective. Close liaison took place with the Strategic and, in particular, Tactical Command Centres. Liaison between the Emergency Workforce and professional partners was also good.

In many instances the Emergency Workforce was the first point of contact with the public as they dealt with numerous enquiries in the field.

The Emergency Workforce had at its disposal a considerable amount of plant and equipment. South Kent alone had access to the following plant for emergency response.

- 14 excavators
- 1 low loader
- 8 lorries
- 2 bulldozers
- 6 tractors
- 4 x 12" pumps
- 3 x 6" pumps

The Emergency Workforce in Kent were required to recharge the shingle beach of the Pett levels as storms ravaged the South Kent coastline. The shingle recharging was required in order to maintain the integrity of the coastal defence. This work was in addition to the work conducted in response to fluvial events.

6.5 ADEQUACY OF AGENCY RESOURCES

6.5.1 Hampshire and Isle of Wight Area

During an emergency response a large number of staff could be utilised and therefore resources could always be improved.

During the Autumn 2000 flood event Agency flood defence experts were stretched with people working long hours and therefore becoming tired. Within the Hampshire

Area flooding occurred intermittently during the Autumn 2000 events giving staff a few days to recover. They were therefore able to work longer hours during the emergency response period.

6.5.2 Sussex Area

Throughout the event the staffing resources available in Sussex to mange the event were adequate, with many personnel from other functions willing to assist when a designated member of Flood Defence was unavailable. This flexible approach from the staff ensured that the Agency had representation at all the strategic locations including the Strategic and Tactical Commands Centres as and when required.

6.5.3 Kent Area

The number of staff manning the Kent Area Incident Room during the months of October and November totalled over 100. Officers from all the Environment Agency functions assisted to fill the roles required for the effective management of flood events.

The number of staff trained in Regional Incident Procedures within Flood Defence allowed 24hr coverage of all roles. However the longevity and severity of the second event which was closely followed by two further severe events in late October and early November did inhibit the running of the normal office role on a daily basis.

In terms of plant, Operations reported that there was sufficient plant and equipment available to respond to the incident.

Although problems were experienced with the Automatic Voice Messaging (AVM) dissemination system, back-up resource was available in other Areas. In times of need, a spare AVM system was always available to disseminate the required warnings. At no time was a warning not sent for a Kent Flood Warning Area due to software problems on the AVM system.

6.6 NUMBERS OF STAFF DEPLOYED

6.6.1 Hampshire and Isle of Wight Area

In the Hampshire Area the Operations Team and Emergency Workforce were available to respond to incidents on the ground. The number of staff deployed varied significantly throughout the event. Fourteen members of the Emergency Workforce were available throughout the event. Staff were rostered to enable essential rest and were therefore not available at all times. All eleven members of the Flood Defence team were available to respond to the flooding event during this period. In addition 25 multi-functional staff were involved in data collection and call handling during the event.

However, on the night of 5th November many staff were deployed both to Exton and Wallington. Eight staff were at Exton, helping with sandbagging across the road to stop the water flowing down the road into Exton village. A further three staff were at Wallington attending the flood event.

On the Isle of Wight staff on the Agency's contract arrangement were available throughout the event. In addition four Flood Defence/multi-functional staff were available to monitor the flooding on the ground.

6.6.2 Sussex Area

The total number of staff deployed during the event in Sussex were:

- Sussex Area staff: 130
- Emergency Workforce: 69
- External Agencies: 11 staff from Anglian Region, 1 assisting Water Resources with river gauging

6.6.3 Kent Area

During the course of the autumn flood events over 100 staff made themselves available for covering the Kent Area Incident room. A further ten members of staff became available to directly assist the Strategic and Tactical Command Centres.

Operationally in South Kent 66 members of the Emergency Workforce staff were available to respond to incidents on the ground whilst in North Kent there were 50 members of the Emergency Workforce were available for emergency response.

Tasks undertaken included the operation and maintenance of pumping stations and critical flood defence structures, monitoring of water levels during periods where telemetry systems were inundated, weed raking and blockage clearance, assisting emergency services with rescues, filling and issuing of sandbags.

The Emergency Workforce were also active carrying out emergency repairs to pumping stations. During the second event the Emergency Workforce in Southeast Kent were required to repair a pumping station that became surrounded by flood water. The Emergency Workforce involved rowed out to the pumping station and replaced a gearbox.

On the 14th October the Emergency Workforce Mechanical and Electrical section assisted navigation staff with the clearance of two boats that crashed into Allington lock and became stuck. Mechanical and Electrical staff then re-hung the lock gate and made the site safe.

Telemetry staff were also very busy in making emergency repairs to telemetry sites which had been damaged due to the severe conditions experienced.

Table 6.4 below is a summary of the number of staff involved in the response from the Kent Area.

Table 6.4: Number of staff involved in the response from the Kent Area

Function	Number of trained staff
Area Incident Room (Including the various roles, Floodline and Gold/Silver Control)	100
South Kent Operations	66
North Kent Operations	50
Data collectors and drivers	20
Total	236

6.7 RANGE OF FUNCTIONS AND INTER-REGIONAL CO-OPERATION

Staff from all functions pulled together to ensure the successful management of the flooding. Staff were utilised from the following functions:

- Flood Defence
- Water Resources
- Business Services
- Environmental Protection and Planning
- Fisheries and Conservation
- Planning Liaison
- Emergency Workforce including staff from Anglian Region

The Regional Communications Centre proved to be a valuable source of information, providing Forecasting Duty Officers, dissemination of river alarm levels, rainfall alarm levels and alarms relating to the operation of Environment Agency structures.

6.8 PROFESSIONAL PARTNERS

6.8.1 Hampshire and Isle of Wight

Response by Emergency Services

Monday 9th October – Monday 16th October 2000 Event

The Isle of Wight Fire Brigade were at Ryde and tenders remained in attendance throughout the night of 9th – 10th October. The Isle of Wight Fire Brigade was also in attendance at Alverstone on 10th October.

The Isle of Wight Council distributed sandbags to residents in Ryde and opened an incident room throughout 9th October which closed at 00:30 on 10th October. The Isle of Wight Council attended the flooding event at Alverstone.

Sunday 5th November to Wednesday 8th November 2000 Event

Fire Brigade, police and Fareham Borough Council staff were in attendance at Wallington.

The Hampshire Fire Brigade have a record of all telephone calls received during the event. The extent of involvement cannot be related at this stage.

Response by Local Authorities

Evacuation was considered in some areas throughout the Autumn 2000 event.

Fareham Borough Council offered evacuation to the residents of Wallington following the overtopping of defences on the Wallington River. However none of the residents wanted to be evacuated.

Response by Professional Partners

Portsmouth City Council declared a Major Incident. The pumping station in Eastney was flooded causing the storm overflow pumps to cut out. The resulting flood waters also short circuited the long sea outfall electric pumps. Surface water and sewer flows backed up in the sewer system and flooded extensive low lying areas in parts of Portsmouth and Southsea. Agency Environmental Protection staff were in attendance both at the Eastney site and at the Tactical Co-ordination Centre. The Emergency Workforce assisted in the pumping operation on Saturday and continued to remain on standby on site.

Contact was maintained with Portsmouth City Council Emergency Planning Team to advise of the latest situation and to pass flood information.

There was regular exchange of information with Isle of Wight Council Emergency Planning and Highways Teams, Isle of Wight Fire Control and Southern Water throughout the event. The Isle of Wight Council manned an incident room through to 00:30 on 10th October.

Exchange of information was also carried out with Ryde Residents' Association.

6.8.2 Sussex Area

Across Sussex the following organisations have been involved in the management of the events, co-ordinating local responses and the general aftermath tidy up, public meetings etc.:

Environment Agency, East Sussex County Council, East Sussex Fire Brigade, Sussex police, Lewes District Council, Ambulance Service, Southern Water, Highways Agency, Chamber of Commerce, Royal National Lifeboat Institute, West Sussex County Council, West Sussex Fire Brigade, Chichester District Council, Arun District Council, Military and numerous voluntary groups.

6.8.3 Kent Area

In Kent liaison occurred during events with the Local Authorities and Emergency Services either by telephone or through contact at the Strategic and Tactical Command Centres.

The Emergency Services reported that procedures worked well with good liaison at the Strategic Command Centre and that the benefit of the Command Centre was that it enabled them to build a countywide picture of what was happening on the ground. This overview allowed Emergency Services to accurately assess resource deployment and augmentation of staff.

Local Authorities instigated their emergency plans. Activities undertaken by Local Authorities during the autumn flood events include: providing sandbags to local residents, providing advice to customers, assisting with evacuations and providing support to local residents.

Parish Councils have, since the autumn flooding, organised local meetings to discuss concerns of local residents. Environment Agency Officers from the Kent Area have provided staff to respond to questions posed. Meetings have taken place in Robertsbridge, Colliers Street, East Peckham and Lamberhurst and briefing has been provided to the Yalding Flood Committee. Local residents in some areas have, in response to these meetings, arranged recovery groups and action groups; the earliest example was the Rother Recovery Group.

6.9 PROPERTY EVACUATED AND TYPE

6.9.1 Hampshire and Isle of Wight Area

Portsmouth City Council offered evacuation to residents in the following roads: Taswell Road, Napier Road, Duncan Road, St Vincents Road, Exmouth Road, Marmion Road, Fontwell Road, Chester Place, Malvern Road, Hamilton Road, Brandon Road, Freestone Road, Worthing Road, St Simons Road, Onslow Road, St Catherine's Road and Airport Service Road. Five evacuations took place.

No other evacuations were reported during the Autumn 2000 flood event.

6.9.2 Sussex Area

As a result of the severity of the flooding in certain areas of Sussex, it became necessary to evacuate people from their homes and businesses. This occurred on a very large scale in Lewes with rest centres being set up in the town and a total in the region of 600 domestic and 200 business properties being evacuated.

6.9.3 Kent Area

In Kent, the number of people and properties evacuated has not been fully collated. Initial figures obtained from households and questionnaires indicate that approximately 140 properties were evacuated some of which more than once. It is noticeable in modern society that people turn to friends and relatives more readily than to the emergency centres.

Maidstone Borough Council provided a rest centre predominantly for the residents of Yalding on the 12th October. This gave temporary shelter for residents who were evacuated at that time. The rest centre was established at the Cornwallis School in Maidstone, transport and food was provided by Maidstone Borough Council. The rest centre was closed on the evening of Sunday 15th October. During this three day period estimates of between 150 and 200 people utilised this facility though no formal register was kept.

One area badly affected by the second event was the Hampstead Lane Caravan Park at Yalding, which housed permanent residents against the advice of the Environment Agency. Maidstone Borough Council rehoused residents unable to return to their properties. Some 46 family groups were affected. Of these families 27 have since returned to their properties as their insurance companies have managed to carry out repairs. This still leaves 19 families who have been housed by Maidstone Borough Council, most of which are elderly people who did not have adequate insurance.

Tonbridge and Malling Borough Council established two rest centres, initially on Thursday 13th October. They were located at the Judd School in Tonbridge and the East Peckham Sports Centre. During the course of 13th October 60 individuals from Tonbridge were evacuated to the Judd school all of whom were residents of Tonbridge. The East Peckham Sports Centre was also used, catering for three families that were evacuated from East Peckham. However evacuees from East Peckham, Collier Street and Laddingford travelled to the Cornwallis School in Maidstone.

Approximately 15 commercial properties in Tonbridge High Street were evacuated. Rother District Council reported that 72 properties were flooded in Robertsbridge during the course of the 10th–16th October flood event. The residents of these properties where supplied with a temporary rest centre though none of the evacuated residents required overnight accommodation from the council. Although 72 properties where flooded the number of individuals evacuated by the council was significantly lower due to many people evacuating before they were aware of Local Authority arrangements.

Both Maidstone Borough Council and Tonbridge and Malling Borough Council reported that their Major Incident Plans ran smoothly throughout the autumn and reported no major problems.

Both Canterbury and Ashford experienced high flows on the Great Stour during the period of 3rd November through to the 8th November. This was the period during the autumn when the Great Stour was at its highest level. Canterbury City Council and Ashford Borough Council both had their emergency evacuation plans in place ready with sites for rest centres earmarked. However, the levels never reached a point where evacuation of properties was necessary.

It has been estimated that during the autumn over 320 properties were flooded in Kent by 'main river'. The number of properties flooded due to surface water and groundwater intrusion is still being investigated though it is predicted that this figure will eclipse that of 'main river' flooding.

Table 6.5: Summary of the approximate number of people evacuated

Event Date	Location	Number of evacuees
10–16th October	Yalding	40 Families
	Tonbridge, Collier Street, Laddingford	60 Individuals
	Robertsbridge	60 Individuals
	Maidstone	70 Individuals
	Total	190 Individuals + 40 Families
30th October	Yalding	30 Families
	Robertsbridge	60 Individuals
	Total	60 Individuals 30 Families

6.10 ISSUES ARISING AND RECOMMENDATIONS

SO\ER\1	Joint flood response plans
Issue	In order to ensure an effective response to flooding, site specific response plans offer advantages over generic plans, e.g. accurately locating rest centres outside of flood risk areas. Local authorities should be encouraged to develop these based on Agency flood risk maps.
Recommendation	Identify all flood risk areas to local authorities and co-ordinate development of joint response plans.

SO\ER\2	Long term event management
Issue	Generally across the functions and from outside organisations it is agreed that all Agency staff involved coped remarkably well under the circumstances, with many staff members working well above their normal duty hours to ensure the successful management of the events. However, if these events had continued for much longer or indeed any future event was to be more prolonged, the Region may encounter staffing issues as personnel become increasingly exhausted.
Recommendation	Review Emergency Response Roles and Responsibilities to ensure (i) Enough staff are on standby. (ii) More trained staff are available from the Agency as a whole.

SO\ER\3	Identification of obstructions and blockages
Issue	Obstructions and blockages identified during the event were sometimes visited more than once as it was unclear if an inspection had taken place.
Recommendation	Obstructions and blockages should be marked (e.g. with luminescent tape) so that it is clear that the item has been investigated.

SO\ER\4	Identification of flooded properties and evacuated areas
Issue	Broad information on the extent of the flooding is relatively easy to obtain, however, specific data regarding numbers of individual properties flooded and evacuated are very difficult to obtain during and after flood events.
Recommendation	(i) Early data collection to include an accurate number of properties flooded. (ii) Better liaison and reporting of evacuated properties by Local Authorities. (iii) Improve links with insurance companies to improve exchange of flood information.

SO\ER\5	Staffing levels at the Strategic and Tactical Command Centres
Issue	New emergency roles and responsibilities need to be expanded to consider staffing requirements for the Strategic and Tactical Command Centres.
Recommendation	The provision of liaison officers to Strategic and Tactical Command Centres will need to be reviewed. We must provide expertise at the right level in order to successfully manage the event.

7 PUBLIC RELATIONS

Pubic relations are taking an increasingly major role in flood events, not only to help disseminate the warnings but also to provide information to the public through news broadcasts and the printed media. Through television and radio the Agency can reach many more people with its warnings than the AVM direct warning service which can be vital for visitors to the area and those on the move.

The Agency has a proactive approach to public relations, issuing press releases to fill in more details than given with the warnings and arranging interviews / photo shoots. This has established a positive relationship with the press which the Agency seeks to maintain.

7.1 LINKS TO THE MEDIA AND COVERAGE BY THE MEDIA

The Agency launched its second national Flood Awareness Week on Monday 11th September with two key themes: the launch of the new flood warning codes and advice under the heading 'Flooding – you can't prevent it; you can prepare for it'. The week included numerous events to promote these themes and included a mailing to all of the properties within known Flood Risk Areas across the Region – some 159,000 properties.

On Friday 15th September 2000 Southern Water Services Eastney pumping station failed, flooding c.200 homes in the Southsea area of Portsmouth with raw sewage. Calls were received from local media the day before the incident in response to Agency publicity predicting heavy rainfall, which turned out to be over 60mm in a short period of time.

The incident attracted a huge amount of media attention due to the human interest angle as an infant school was flooded with up to 30cm of sewage and the children had to be evacuated. Other stories included homes being demolished, the risk of electrocution and sewage related illness. On the evening of the event, the Agency was the only organisation willing to be interviewed with the Hampshire Area Manager appearing live on the BBC.

From a Public Relations point of view the incident was difficult to handle as the media were looking to the Agency as regulators to control and punish Southern Water for the pollution.

A news release was issued on Monday 18th September entitled, 'Environment Agency investigates Portsmouth and Southsea incident', which mentioned that a preliminary report would be available from the Agency by the 20th September. By this stage the local newspaper, The Portsmouth News (circulation 73,000 per day) was running updates on the story on the front page every morning.

Pressure was put on the Agency when it was obliged to give the water company emergency permission to pump the sewage into Eastney Lake on the banks of the wildlife haven of Langstone Harbour. The Portsmouth News had front page headlines such as 'Tide of Filth' and although the dilution factor meant that there was no long term threat to the lake, public perception was of irreversible damage.

The interim report was issued and the Hampshire Area Manager and Environment Protection Manager attended a public meeting on the incident on Monday 2nd October. Film crews from the local TV stations were there along with a number of reporters. In media terms the incident is ongoing as the official report is soon to be published.

Between the first Flood Watches issued in Hampshire on Friday 15th September 2000 and Wednesday 15th November, 65 flood related news releases were issued by the Agency's Southern Region Press Office to regional and national media.

As the worst of the situation was building in Sussex and Kent on Thursday 12th October, the Public Relations Manager was doing a constant stream of interviews for stations from the local FM's through to BBC Radio 5 Live and BBC Radio Four.

Radio Kent featured half hourly updates as the event threatened Maidstone and regular interviews were carried out by Regional Duty Officers and Base Controllers. Issues from floodplain development to pollution prevention were aired on Sky News, ITN and the BBC.

The incidents in Sussex and Kent did not receive any identified negative publicity initially and the PR department monitored press cuttings and sent out further news releases in order to keep the public informed. In the following four weeks false accusations were rebutted that opening the gates at Barcombe Mills had led to Lewes being flooded and that the release of flood water from the Leigh Barrier had made the situation worse at Yalding. Early reaction to the Sussex rumour by way of a news release and verbal denial in radio interviews prevented negative media coverage, but the accusations by the traumatised Kent residents are still wrongly being treated as fact by a small section of the print media.

The Press Office needed support staff as human resources became stretched and help was gratefully received from National Flood Warning Centre, London Press Office and Anglian Region.

At the beginning of November groundwater was starting to rise to unprecedented levels as the chalk in the North and South Downs became saturated and the first sign of the problems to come were put into the public domain when the trigger levels on the River Lavant were reached. As the rains continued the flow rates on the river were faster than the ones recorded during the Chichester floods of 1993/94 and both regional and national media sent cameras to record the rising river. Probing questions about why the full scheme has not been built during the six years since the last flood were successfully addressed by the Sussex Area Manager and Flood Defence Manager.

Villages in Hampshire that suffered from flooding from groundwater in 1994 and 1995 started having water in their cellars once again and 7,000 properties in the Test and Itchen Valleys have been identified as potentially 'at risk' before the end of spring 2001. In Kent the Romney Marsh remained sodden and reliant on pumped drainage which was complicated by the high tides. The Nailbourne Stream that flows on average every seven years started to threaten properties. The limited role of the Agency in groundwater flooding makes the problem difficult in PR terms as the media struggle to understand where the powers and responsibilities of the Agency lie.

Regular liaison with the relevant print and broadcast media in the coming months will be imperative if coverage is to remain accurate and positive.

7.2 NUMBER OF INTERVIEWS BY MEDIA TYPE

The current tally for media calls handled during the period between 15th September and 15th November is: Total Media calls handled during the incident – 4,500, total radio interviews set up – 1,000 and total TV interviews set up – 400. It is worth pointing out that these are our best estimates from the logs left by relief staff. It is possible that some calls are unaccounted for. The figures will also not take into account mentions on TV or radio when no spokesperson was requested or repeats of parts of interviews used on subsequent broadcasts.

Press cuttings were collated and consisted of over two thousand clippings from national and regional media.

7.3 ISSUES ARISING AND RECOMMEDATIONS

SO\PR\1	Communication of Responsibilities
Issue	Flooding occurred from fluvial, surface, sewage and groundwater sources and there is no single body that manages these combined risks. The impact of any type of flooding is devastating for the households affected. It is not clear to the public who is the relevant body to turn to.
Recommendation	Review public awareness campaign messages to clarify the Agency's role and the role of other organisations, e.g. water companies, Local Authorites, etc. during flood events.

SO\PR\2	Number of PR Staff Able to Assist During Events
Issue	The extended nature of the flood event required additional trained staff from other Regions and our National office as well as significant work for senior staff to ensure close liaison with the media was maintained throughout the event.
Recommendation	Review staffing levels and training requirements.

8 INCIDENT SPECIFIC

8.1 MAJOR INDUSTRY/INFRASTRUCTURE

This chapter looks at specific issues arising from the event that are not covered elsewhere.

8.1.1 Environmental Pollution

Flooding had a major impact on the Environment Protection functions of the Agency with many officers involved in work to prevent and clean up pollution. Hundreds of industrial sites were visited and staff provided pollution prevention advice and assessed the impact of flood water on the environment and business activities. There were large numbers of reports of oil pollution and many sewerage systems became surcharged, some were unable to cope which resulted in the premature operation of storm overflows and the discharge of sewage via manholes. Several main foul sewage pumping stations were out of action and in some cases the Agency assisted sewerage undertakers by providing large pumps to move sewage. There were many reports of dead animals in rivers but small numbers of carcasses were found and in some cases these were difficult to access. Record groundwater levels during November resulted in the emergence of springs which had been dormant for many years and this caused problems by disturbing underground fuel tanks and flooding sewerage systems, septic tanks and cesspools. Water Supply Companies were given early warning of any potential pollution problems that could affect their sources of supply.

Incident Types and Impact

There were 163 reported incidents attributed to flooding or abnormal weather conditions during the reporting period. 82 of these were found to have no environmental impact whilst 81 had an environmental impact category of 1, 2 or 3 on water, land or air (category 1 is most significant). All 81 of these had a Water Impact and 16 had an additional Land or Air Impact as presented in Table 8.1.

Table 8.1: Environmental pollution incidents by impact category

Impact Category	Water Impact	Land Impact	Air Impact
1	1	0	0
2	0	1	0
3	80	12	3

The source of the incident with the Water Impact category 1 was the Wholesale and Retail Trade – Garages and Vehicle Sales. There was a massive release of waste oil following the devastating flooding in Lewes. In excess of 70,000 litres of waste oil/heating oil was recovered. There was extreme damage to over 50 industrial units with total loss of all stocks, products and machines.

The rupture of an oil tank caused the incident with a land impact category 2. This resulted in the spillage of 2000 litres of fuel oil from a private domestic dwelling.

General and Biodegradable; Sewage and Sewerage Material was the pollutant type found in 77.8% of the incidents with an impact category of 1,2 or 3. Out of the total number of sewage incidents 45 were attributed to crude sewage and 12 to Storm Sewage overflows.

Following Sewage and Sewerage Material, Organic Chemicals; Mineral and Synthetic Oils were found to be the pollutant type in 8.6% of incidents.

The source of the pollution incidents or premises type from which the pollution arose was Sewage, Sewerage or Supply in 59 or 73% of incidents with the impact categories of 1,2 or 3. Three of these were private Sewage; Sewerage or Supply systems and the remaining 56 was Water Company's. Out of the 56 incidents arising from Water Company systems or installations 25% arose from foul sewers and 21% from pumping stations.

During an event each Incident Room produces regular Situation Reports (SITREPS) which are disseminated to other Incident Rooms, Tactical and Strategic Command Centres, etc. These not only constitute an effective, systematic means of communication and liaison but also provide a factual record of the event for reference later.

Incident Details from Situation Reports

4 types of incidents were most common during the period under review:

1. Pumping stations failures due to electricity disruptions, pump breakdown.
2. Overflows and surcharges leading to discharges of untreated sewage direct to watercourses, including the use of the consented emergency overflow in Brighton (near Brighton palace Pier).
3. Fuel spillage from storage tanks.
4. Dead animals.

2nd October 2000

The diesel operated storm pumps at Eastney pumping station were either out of operation or had been taken off line for emergency repair. This meant that they would be unable to deal with any storm water except by the use of their emergency pumps.

11th-17th October 2000

Reports were received of sewage contamination, diesel/petrol spillage and leaks from a waste oil bank at the Tesco site, Malling Brook , Lewes. Reports of sewage and oil contamination in Lewes included oil emerging from surface water drains due to a petrol station interceptor being flooded. Minor incidents of oil were also reported. The Lewes to Newhaven sewage pumping station

and its subsidiary had both failed. Industrial estates on the East Side of the Ouse released potential unknown contaminants and 3-400 gallons of oil were recovered from Lewes Industrial Estate. Contaminated water was tankered away, rubbish was cleared and a clean up at a of fuel station tool place.

Dead animals were found: 4 carcasses in Lewes and 13 dead animals removed from Barns in the Ouse catchment.

Numerous oil pollution were reported but the most serious issue was the loss of chemicals from flooded sites in the Medway catchment. At Wateringbury: a barge sank under the bridge.

2nd-9th November 2000

A number of incidents relating to sewage contamination were under investigation across the Region. In Sussex there were major concerns about surface water entering sewerage systems and consideration was given to allowing emergency discharges of untreated sewage direct to watercourses (low environmental impact due to high river flows).

All abstractors of river water (and groundwater where appropriate) had been warned of the possibility of significant contamination.

11th-15th November 2000

By the 11th the Brighton combined sewerage system was at full capacity and the consented emergency overflow near the Palace Pier was in use to relieve the system and prevent localised surface water flooding. On the 12th, the Black Rock overflow was opened as a precautionary measure with a potential impact on coastal waters (dilute crude sewage in the vicinity of Black Rock) but in the event this did not come into operation.

At the Patcham Garage (Q8) there were concerns over the possible ingress of groundwater into underground storage tanks. In the end there were no outward spills of petrol but monitoring continued and emergency equipment was placed nearby as a precaution.

Other Issues

- Several Wastewater Treatment Works and Pumping Stations were severely affected by flood waters most notably Aylesford and Motney Hill STWs in Kent.

- Significant number of oil and sewage related incidents were investigated. Stocks of absorbents were transferred from Canterbury to Addington/Tonbridge depots. No major incidents occurred.

- Up to 100 potentially polluting sites were inspected by Tonbridge Office staff to 15th October.

- Sampling runs continue to assess chemical and bacteriological quality of the Nailbourne and Little Stour following an ingress of ground water into sewerage systems and peoples' homes. Although surface water lakes and areas of water

outside the riverbanks have diminished, fine sewage solids have been left stranded in fields in particular at Ottinge Court. These have been collected up where possible by tanker. Recent rain has caused further problems mainly due to infiltration in the Littlebourne area. Six temporary discharges are still operating, although the Agency has not given consent to those discharging the operators responsible are within their rights under the 1991 Water Resources Act Section 89 (1).

- Sussex Area Environmental Protection staff provided a 24hr response from Saturday 14th–19th October. The situation was then closely monitored until Christmas.

8.1.2 Southern Water Services Eastney Pumping Station, Portsmouth

Failure of Eastney Pumping Station, Portsmouth of 15th September 2000 caused flooding to some 750 properties and has been confirmed through questionnaires that 200 were flooded internally. Since the event the Pumping Station has been repaired and is now operational.

The Agency is preparing an investigation of the flooding of Portsmouth and is keen to gain a full understanding of the reason for this event.

8.1.3 Zeneca Agrochemical Plant

Detailed information relating to the operation of industries in affected locations is ongoing. Of most concern during the second event was the Zeneca Agrochemical plant at Yalding which was given a direct warning two days in advance of the mid-October Flood. Zeneca, which has private flood defences in place and procedures to follow, reported disturbance to normal operations. Further investigations relating to cost incursions are being carried out.

8.1.4 Disruption to Public Highways

During the course of the autumn, many roads crossing or running parallel to affected rivers have at one point or another been closed to traffic due to flooding.

Examples of road closures flooded from 'main river' are given in 5.10.3:

8.1.5 Disruption to Railways

During the event, significant disruption was caused by the closure of the Isle of Wight railway between 9th and 11th October 2000 and the failure of Southern Water Services Eastney Pumping Station, Portsmouth.

Railway services were also disrupted during the second event. Mainline services were cancelled on the following services: Tonbridge to Ashford, Hastings to Etchingham and the branch line between Paddock Wood and Maidstone.

The Ashford to Canterbury mainline was also closed due to flooding on 10th November. Although not affected by the Great Stour, the embankment became undermined by the infiltration of groundwater.

8.1.6 Waterway Navigation

The Environment Agency is also the Navigation Authority for the River Medway between Leigh (upstream from Tonbridge) and the tidal limits at Allington (Maidstone) which enabled a seamless and integrated response during the recent floods. Navigation staff form part of the Emergency Workforce and are on the standby and emergency rosters. Many boatyards and boat owners had elected to receive the Auto Voice Messaging service for flood warnings and Agency Navigation staff also visited boatyards and moorings to warn users.

During the flood, vessels which had broken free, or were threatening to break free, were a major concern in view of the potential to block or damage bridge arches and sluices. Several were dealt with by Navigation staff in extremely difficult circumstances.

The Navigation comprises 31Km (19miles) of 'live' river. There are ten locks with associated sluices. The impact of the flood water passing under the open sluices has been to deposit silt in the less turbulent water below the lock gates. This has resulted in nine locks being rendered impassable.

Significant localised dredging is in progress to endeavour to re-open the Navigation by Easter. A number of sunken vessels, caravans and other obstructions have been located and identified for removal but five vessels remain unaccounted for. Side scan radar will be used together with lowering of water levels, where possible, to locate and mark, or remove, obstructions.

8.2 LEGAL RECOMMENDATIONS

Many defences are the responsibility of a third party or riparian owner. This issue is quite clear in Lewes where much of the town's defences are third party owned and many of which are reaching the end of their useful life.

8.3 RETROSPECTIVE VIEW BY PROFESSIONAL PARTNERS

Stirling Reid, external Emergency Management consultants, carried out a short customer survey following the Autumn 2000 flood event. A number of multiple choice questions and individual questions were sent to a number of professional partners. Follow up telephone interviews were then carried out with selected professional partners. Interviewees were selected on the basis of their written responses and generally those who had given either very high or very low scores on the multiple-choice questions were selected. A summary of the responses is included in Appendix F.

8.4 ISSUES ARISING AND RECOMMENDATIONS

SO\IS\1	Benefit of routine flood exercises
Issue	Flood event exercises and introductions to the new flood warnings codes were held over in July and Auguist 1999. Many professional partners commented that these were useful and should be run on an annual basis. During the Autumn Floods communications were improved where staff had attended these exercises.
Recommendation	Carry out regular exercises involving all parties concerned to forge good working relationships.

SO\IS\2	Contact directories
Issue	Clear updated lines of communication are essential to the management of an incident. The roles of all the professional partners need to be concisely defined and disseminated.
Recommendation	Communications could be improved between professional partners and the Agency, most notably outside of the control centres. Directories of professional partner and Agency telephone numbers should be disseminated to professional partners and to ourselves.

APPENDIX A: DEVELOPMENT IN THE FLOODPLAIN

A.1 REGIONAL ISSUES

Development in Flood Risk Areas is a major issue in the Southeast. The recently published revised Draft Regional Planning Guidance for the Southeast sets a figure for 39,000 new dwellings per annum to 2006. Between 40 and 45% will be within the Agency's Southern Region i.e. 15,600 to 17,550 new dwellings per annum. These figures are based on the current rate of completions and are due to be reviewed in the next five years. In the longer term to 2016 it is envisaged that this figure will increase to 43,000 new dwellings per annum for the Southeast i.e. some 17,200 to 19,350 dwellings per annum within Southern Region. The guidance also advocates higher housing development levels (between 30 and 50 dwellings per hectare) to make more efficient use of land.

Based on these projections there is a risk that the number of properties within Flood Risk Areas will rise significantly between 2001 and 2016. With even 5% or 10% of new dwellings built in Flood Risk Areas the current number of at risk properties (159,000 in 2000) could increase by between 14,060 and 31,635 to 2016. See Table A.1.

Ashford in Kent has been identified as one of the potential growth areas because it is relatively unconstrained on its southern side by high quality and other landscape designations and the area is well located for sub – Regional, national and international communications. No indication is given within the Regional Planning Guidance of the extent of expansion envisaged.

A.1.1 Preliminary estimates of ages of properties flooded:

Age of property	Approximate number of properties flooded
Up to 5 years	30
6-10 years	30
11-20 years	50
Greater than 20 years	1,900

It would appear that approximately thirty properties that flooded were built against Agency advice. There is an example in Tonbridge where a new development being built against Agency advice was isolated by flood water.

Comparison of the extent of flooding with information provided under Section 105 of the Environment Act, including the number of properties flooded from 'main river' which are not shown 'at risk' on Section 105 maps, is ongoing.

Land allocated for development that flooded or had Severe Flood Warnings issued is the subject of ongoing data analysis and research.

Table A.1: Projected increase in development within the floodplain in Southern Region

Year	Completions in Southeast	40% Completions in Southern Region	45% Completions in Southern Region	40% Increase in Southern Region				45% Increase in Southern Region			
				Assuming 5% in Flood Risk Areas		Assuming 10% in Flood Risk Areas		Assuming 5% in Flood Risk Areas		Assuming 10% in Flood Risk Areas	
1999	0%	0%	0%	5%	159,000	10%	159000	5%	159000	10%	159,000
2000	39,000	15,600	17,550	780	159,780	1,560	160,560	878	159,878	1,755	160,755
2001	39,000	15,600	17,550	780	160,560	1,560	162,120	878	160,756	1,755	162,510
2002	39,000	15,600	17,550	780	161,340	1,560	163,680	878	161,634	1,755	164,265
2003	39,000	15,600	17,550	780	162,120	1,560	165,240	878	162,512	1,755	166,020
2004	39,000	15,600	17,550	780	162,900	1,560	166,800	878	163,390	1,755	167,775
2005	39,000	15,600	17,550	780	163,680	1,560	168,360	878	164,268	1,755	169,530
2006	39,000	15,600	17,550	780	164,460	1,560	169,920	878	165,146	1,755	171,285
2007	43,000	17,200	19,350	860	165,320	1,720	171,640	967	166,113	1,935	173,220
2008	43,000	17,200	19,350	860	166,180	1,720	173,360	967	167,080	1,935	175,155
2009	43,000	17,200	19,350	860	167,040	1,720	175,080	967	168,047	1,935	177,090
2010	43,000	17,200	19,350	860	167,900	1,720	176,800	967	169,014	1,935	179,025
2011	43,000	17,200	19,350	860	168,760	1,720	178,520	967	169,981	1,935	180,960

Year	Completions in Southeast	40% Completions in Southern Region	45% Completions in Southern Region	40% Increase in Southern Region				45% Increase in Southern Region			
				Assuming 5% in Flood Risk Areas		Assuming 10% in Flood Risk Areas		Assuming 5% in Flood Risk Areas		Assuming 10% in Flood Risk Areas	
2012	43,000	17,200	19,350	860	169,620	1,720	180,240	967	170,948	1,935	182,895
2013	43,000	17,200	19,350	860	170,480	1,720	181,960	967	171,915	1,935	184,830
2014	43,000	17,200	19,350	860	171,340	1,720	183,680	967	172,882	1,935	186,765
2015	43,000	17,200	19,350	860	172,200	1,720	185,400	967	173,849	1,935	188,700
2016	43,000	17,200	19,350	860	173,060	1,720	187,120	967	174,816	1,935	190,635
Increase in At Risk Properties				14,060		28,120		15,816		31,635	

A.2 FLOODPLAIN POLICY AND ITS APPLICATION

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

By virtue of its general supervisory duty over all matters related to flood defence, the Agency is charged by the Government to advise planning authorities on development and flood risk matters. DoE Circular 30/92, "Development and Flood Risk", gives guidance to planning authorities on development and flood risk. Circular 30/92 emphasises the importance of flood defence considerations in relation to the development planning process when it states:

> *"The Government therefore looks to local authorities to use their planning powers to guide development away from areas that may be affected by flooding, and to restrict development that would increase the risk of flooding or would interfere in the ability of the NRA (now the Agency) or other bodies to carry out flood control works and maintenance."*

Further, Circular 30/92 defines floodplains as:

> *"All land adjacent to a watercourse over which water flows or would flow but for the presence of flood defences where they exist. The limits of floodplain are defined by the peak water level of an appropriate return period event on the watercourse or on the coast. On rivers, this will normally be the greater of the 1 in 100 year return period flood or the highest known water level."*

The Agency has adopted the definition of floodplain from the DoE Circular 30/92. In March 1997 the Agency published its "Policy and Practice for the Protection of Floodplains" which sets out the flood defence policies of the Agency in relation to river and coastal floodplains, and explains the reasoning behind them. The overall aims of the Agency's floodplain policies are to secure and, where possible, restore the effectiveness of floodplains for flood defence and environmental purposes. The objectives of the Agency's floodplain policy are to ensure that:

- development should not take place which has an unacceptable risk of flooding leading to danger to life, damage to property and wasteful expenditure on remedial works
- development should not create or exacerbate flooding elsewhere
- development should not take place which prejudices possible works to reduce flood risk
- development should not cause unacceptable detriment to the environment
- natural floodplain areas are retained and, where practicable, restored in order to fulfil their natural functions

The Easter Floods in the Midlands in 1998 caused an estimated £350 million worth of damage to property and, more importantly, directly or indirectly, led to the deaths of five people. The subsequent independent report by Peter Bye into the lessons to be learnt from these events highlighted the importance of restricting development in areas at risk to flooding. In his overview to the Easter Floods, Peter Bye has stated:

> *"Imprudent developments in the floodplains exacerbated the impact of the floods and increased the damage and costs. The Environment Agency's position as a statutory consultee on planning applications should be exercised more assertively with a presumption against further development in and around the floodplains."*

The Agency has taken on board the recommendations resulting from the Easter Floods Report and is taking a more robust response to planning applications in locations considered at risk to flooding. Flood risk is clearly capable of amounting to a material planning consideration. In November 1999 a report, entitled "Rising to the Challenge", assessing the vulnerability of the Southeast to climate change was published. This states prophetically:

> *"The Southeast avoided the famous floods in 1998 but this is no reason for complacency. Climate change will mean more winter rainfall, wetter soils in winter and a greater risk of extreme flooding."*

The consultation draft Planning Policy Guidance Note 25 "Development and Flood Risk" advises that the susceptibility of land to flooding is a material planning consideration and encourages Local Planning Authorities to apply the precautionary principle to the issue of flood risk, avoiding such risk where possible and managing it elsewhere. PPG 25 also recognises that the Environment Agency has the lead role in providing strategic advice on flood issues. The significant flood events during the autumn 2000 have highlighted the importance of ensuring floodplains are retained to perform their natural function.

The Environment, Transport and Regional Affairs Committee has recommended that the draft PPG 25 should be significantly strengthened and also suggests that:

> *"Only very exceptional development should be allowed in the functional floodplain"*

The Agency's records do not include a comprehensive list of properties flooded; it is from reports through Floodline, post-event questionnaires, submissions from local authorities and eye-witness accounts that we receive this information. Figures for properties flooded should be treated with caution and it is likely that many properties were affected without Agency knowledge, particularly in remote, rural locations. Therefore, our estimates of properties that flooded need to be treated with caution.

It is the areas of land that remain at risk to flooding under the 1 in 100 year event that should be stressed to Local Planning Authorities (LPAs) rather than an estimated number of properties affected by a lesser event. If the numbers do not appear significant then there is a risk that LPAs will continue to permit development in the floodplain against Agency advice. The Agency should take these recent flood events as a warning. Providing the number of developments that have taken place against our

advice does not truly reflect the number of developments the Agency would object to in principle.

Until recently, (c.1998), the Agency would usually state if a potential development site was at risk to flooding and rely on the LPA to follow the recommendations in Circular 30/92 to 'guide development away' from such areas. However, subsequent to the issue of the Bye Report, the Agency has adopted a more positive approach by formally objecting to inappropriate development. Even now the Agency considers it has been responding to applications in a culture where it is accepted that development will proceed irrespective of our comments. Therefore the Agency will make recommendations to best mitigate the effects of flooding, even in situations where the Agency has lodged a formal objection. These recommendations are often adopted by the LPA who are minded to grant permission but they by no means make the proposal acceptable, they just potentially reduce the damage caused and lessen the possibility of death or serious injury.

Placing a veto on development in the floodplain is unrealistic, particularly where other policies such as the development of 'brown-field' sites are applicable, and LPAs have been unwilling to proceed to appeal on a lack of evidence or on flood information over 30 years old.

Since the Bye Report the Agency has been issuing stronger advice to the planning authorities but there are however, many sites which have existing permissions and in these cases the Agency will not object but look for betterment. It is also difficult to object to sites that have been allocated for development in adopted local plans.

The recent flood events have highlighted that residential accommodation should not be introduced into the floodplain as it creates an unnecessary risk to life and puts added strain on the emergency services in the event of flooding. The Agency is opposed to such development in the floodplain, it is unsustainable and leads to damage to property and wasteful expenditure on remedial works.

Development within the floodplain of rivers progressively removes available flood storage. This loss may not seem significant in isolation but the cumulative effects on the floodplain can only lead to an increase in flood risk elsewhere. In line with Agency Policy FD-P1 and FD-P2, the Agency must advise the LPA to use its powers to guide development away from areas at risk to flooding and to ensure that the floodplain can fulfil its principal function. The recent flooding highlighted the extent of flood damage that can be caused to non-residential development. For example, the swimming pool in Tonbridge, built contrary to Agency advice, flooded and remedial works are believed to be of the order of £0.5million. This figure excludes loss of revenue. Further work has been proposed to defend the property in the future which will have to be assessed in the context of impact on the floodplain.

Table A.2 lists examples of developments where the Agency has opposed development in relation to flood risk in the last two years (1998 to 2000) for various LPAs. The list is not comprehensive and the developments shown would not necessarily have flooded during the recent events. Indeed, some of the developments are not themselves at risk but may increase risk to others elsewhere. The decisions for applications on some of the developments are not known and for others, works may be possible to overcome the objection. During the period there was, therefore, the

potential for over 1000 dwellings to receive approval against the Agency's advice on flood risk.

Table A.2: Examples of areas that have been developed contrary to Agency opposition in relation to flood risk (1998 to 2000)

Local Planning Authority	Number of units
Ashford	Equivalent to 178
Canterbury	34
Dartford	8
Dover	9
Maidstone	51
Medway Council	245
Medway Council	20
Rother	5
Sevenoaks	36
Shepway	107
Swale	1
Tandridge	16
Thanet	1
Tonbridge and Malling	>294
Tunbridge Wells	2

APPENDIX B: PUBLIC RESPONSE

B.1 PUBLIC RESPONSE AND ACTIONS

The aim of flood warnings is to ensure a response from the public to allow them to take effective action to protect life and property. The introduction of the new flood warning codes has undoubtedly helped improve the public's ability to respond by delivering clear advice in what steps to take.

As part of a national programme, quantitative assessments of the public's actions are being assessed at key sites across the Region i.e. where significant numbers of properties have been flooded which allows a representative sample of those affected to be analysed.

Sites put forward for surveys include:

- Wallington
- Ryde
- Yalding
- Robertsbridge

B.2 PROPORTION OF OWNERS OF FLOODED PROPERTIES WHO TOOK EFFECTIVE ACTION

Quantitative assessments of actions taken in the above locations should be available in the spring 2001 as part of national programme of public opinion surveys.

B.3 PUBLIC AWARENESS

In Southern Region there are approximately 159,000 properties at risk of fluvial or coastal flooding. Of these 150,000 are covered by the four stage flood warning service and 9,000 by the flood watch only service.

The Region has produced 5 local Flood Warning Directories describing the flood warning service in place and highlighting the Flood Warning Areas covered. A newsletter called 'Flood Watch' has also been produced annually. It is mailed to the properties listed on the Automatic Voice Messaging (AVM) system and sent to local authorities and emergency services for information, and has been very well received.

The Agency has used digital maps of known and possible flood risk areas to identify properties at risk of flooding and to build up an 'At Risk' database since 1996. This enables the direct mailing of flood warning information to places of high risk.

In 1996, leaflets and letters were sent out explaining the changes in flood warning dissemination. A help-line was set up, but no written response was required from the public.

In 1997, letters and pre-paid response cards were sent to those at risk. This mailing produced 11,000 responses (8%). From this exercise the number of AVM system recipients increased from 600 to 4,000.

The sole aim of the 1998 mailing was to increase the number of people on the AVM system. AVM system forms were mailed to 146,000 properties. The response was positive with 21,000 (14%) of the forms returned; taking the number of properties recorded on the AVM system to 30,000 in June 1999

The Region currently holds 35,500 properties on the AVM system in contrast to the 600 which were inherited from the police in 1996. This is an increase of over 5750% in four years and represents 22% of the Region's 159,000 at risk properties.

Table B.1: New Flood Warning Code mailings

Date	Contents of Letter	No. of properties mailed	Enclosures
July 2000	Letter to businesses/households informing them of the forthcoming changes in the flood warning codes	159,000	Form to fill to request copy of one of 5 Flood Warning Directories (one for each Area), available from end of September 2000.
Early September 2000	Letter advising occupier that they are in a Flood Risk Area, notification of New Warning System, floodplan checklist	159,000	Red plastic card with: Guide to Flood Warning Codes Advice on what to do for each Warning code
Dec 2000	Letter advising of Imminent Flood, inviting people to come onto AVM system service and fact sheet for: Test Valley	3,363	
	Itchen Valley	1,586	

APPENDIX C: ORGANISATIONAL ISSUES

C.1 IMPACT OF THE CHANGING NEEDS IN FLOOD DEFENCE REVIEW

Southern Region introduced the recommendations of an internal review of incident management known as the 'Changing Needs in Flood Defence Review' on Monday 11th September 2000. Changes to reflect the 'day job' activities within Flood Defence, i.e. Strategic Planning, Regulation, Operations, Flood Warning and Improvements were also introduced during the period from June to September 2000. Table C.1 shows the rosters in place prior to, and after, the Changing Needs in Flood Defence Review.

Table C.1: 'Changing Needs in Flood Defence Review' duty roster roles

Activity	Before the 'Changing Needs in Flood Defence Review'	After the 'Changing Needs in Flood Defence Review'
Detection	RCC Officer	RCC Officer
	Regional Duty Hydrologist	Monitoring Duty Officer
Forecasting	Regional Duty Hydrologist	Forecasting Duty Officer
	Flood Defence Duty Officer	No area forecasters
Warning Dissemination	Flood Defence Duty Officer	Flood Warning Duty Officer
	Flood Warning Duty Manager	No Regional role; subsumed into RBC role
	Flood Information Duty Officer	Assistant Flood Warning Duty Officer
Emergency Response	Flood Defence Duty Officer	Operations Duty Officer
	Direct Works Officer	Emergency Duty Officer.
Public Awareness	PR Duty Officer	PR Duty Officer
		Call Handlers
Incident Management	Regional Duty Officer	Regional Duty Officer
	Regional Base Controller,	Regional Base Controller
	RCC Supervisor	RCC Supervisor
	Area Flood Defence Duty Co-ordinator	Area Base Controller

The move to the new roles and responsibilities has had several significant effects in how the Region and Area teams are structured with the following significant impacts:

The introduction of the Monitoring Duty Officer role and RCC Officer role has strengthened the RCC and clarified roles and responsibilities within this key area. The RCC supervisor role, which is not rostered but was used during the event, is required to manage the numerous staff working in the RCC.

The introduction of the Forecasting Duty Officer role within the Regional office has expanded that of the previous Duty Hydrologist role to cover coastal and fluvial flooding. Additional modelling tools have been introduced and the roster is staffed by Regional Flood Warning and Water Resources staff. The previous roster had eight Regional and Area staff; the Forecasting Duty Officer roster has four staff. Overall the creation of the Forecasting Duty Officer role has improved the reliability and accuracy of flood forecasting in terms of timing and peak water level forecasts but much remains to be done on flood extent forecasting.

Establishment of the Flood Warning Duty Officer role has not significantly changed from that of the previous Flood Defence Duty Officer with the exception of the closer responsibility for warning dissemination. However, the move of this role from a district basis to an Area basis has significantly changed the workload in terms of the number of rivers and length of coast that require attention.

The Region has moved from Regional warning dissemination using two Automatic Voice Messaging Systems to Area warning dissemination using four. The number of rosters that can operate the AVM system has also increased from two to four. Overall the move to Area dissemination has improved the delivery of warnings to the public by spreading the workload across the three Areas and improved liaison with professional partners who receive a more consistent service.

Establishment of the Operations and Emergency Duty Officer roles has improved links with The Emergency Workforce but does require more internal liaison than the previous Flood Defence Duty Officer role which covered Operations and Flood Warning.

Arrangements for Public Relations have improved since the introduction of new the roles as rosters have specific responsibilities to assist with handling media enquiries. The requests from the media could not be managed from the Region alone and additional staff were brought in from the National Flood Warning Centre and Anglian Region during the peak in October.

The move to rostered Regional and Area Base Controllers has significantly improved event management. In September, Hampshire had not rostered this role but a roster has been in place since November.

C.2 STRUCTURE OF GOVERNMENT

Within Southern Region funding for flood defence is raised through three Local Flood Defence Committees, corresponding to the three Area boundaries for Kent, Sussex and Hampshire and the Isle of Wight, and overseen by a Regional Committee.

During the preparation of this report the Minister for Fisheries and the Countryside, Elliot Morley Esq MP, announced £11.6m additional funding for flood defence in

light of the severity of the floods. The implications of this additional funding are being assessed.

C.2.1 Hampshire and Isle of Wight Local Flood Defence Committee

The Hampshire and Isle of Wight LFDC supported the Agency's recommended levy increase of 30% but there was some dissension due to pressure on budgets. There is clearly concern regarding the receipt of government grant support for land drainage being received a year in arrears. The budget increase will enable the area to meet most of the needs based programme over the coming years. However, recently identified problem areas will need to be subject to river strategy investigations before schemes are put into place.

Coastal flooding, however, remains a risk along the Hampshire and Isle of Wight coasts that should not be overshadowed by recent events.

C.2.2 Sussex Local Flood Defence Committee

The flooding has clearly demonstrated the effects of general under-investment in flood defence infrastructure. A desk study to identify the immediate investment needs was undertaken in the Sussex Area towards the end of October, however, problems are still occurring to date (February 2001) and could be expected to continue, subject to rainfall, well into March. In terms of work required on the ground, to bring defences up to an adequate standard, works in excess of £55million in value were identified. This figure is expected to increase as the full extent of damage to flood defences and other infrastructure is evaluated. However it is recognised that works would be prioritised in accordance with the LFDC and be recognised as part of a wider catchment strategy. Subject to funding and human resource issues it is recognised that the £55M capital investment would be over a 7 to 10 year period.

This appraisal of flood defence requirements was refined to produce a "needs based" programme for recommendation to the Sussex Local Flood Defence Committee for the 2001/02 financial year. The Agency presented a 'needs based' recommendation for an increase of 15% in the levy for the 2001/2 financial year to the Sussex LFDC on 6th December 2001.

After considerable debate the Sussex LFDC approved a 10% increase in levy, resulting in a shortfall of some £450k, under-funding the Agency for the 5th year running. The Sussex LFDC agreed Policy Statement of priorities was used as the basis of delays to the Flood Defence programme and the Programme of Grant Aided capital projects has been revised to delay works to the River Lavant Flood Alleviation Scheme. The programme has yet to be agreed as the meeting on the 29th January was re-scheduled in light of the MAFF announcement of an additional £11.6m. The revised date is set for 12th March 2001.

Despite the recent events coastal flooding along the Sussex coast represents a far greater risk to life and property than that seen in the autumn floods.

C.2.3 Kent Local Flood Defence Committee

As in the Sussex Area, a desk study to identify the immediate investment needs was undertaken in the Kent Area before the flood water had fully receded. In a report to the Regional Flood Defence Manager works in excess of £25million in value were identified. This figure is likely to increase as the full extent of damage to flood defences and other infrastructure is evaluated.

The initial appraisal of flood defence requirements was refined to produce a "needs based" programme for recommendation to the Kent Local Flood Defence Committee. Officers of the Agency presented a 'needs based' recommendation for an increase of 22% in the levy for the 2001/2 financial year to the Kent LFDC Finance Sub Group on the 16th November and the full Kent LFDC meeting on the 7th December 2000.

The Kent LFDC approved a 12% increase on the basis of affordability. The Programme of Grant Aided capital projects was revised in accordance with the priorities identified in the Policy Statement and subsequently agreed at a 'Special' Kent LFDC meeting on the 10th January 2001. This has led to delays to important capital investments.

Despite the recent events coastal flooding is considered to represent a far greater risk to life and property in Kent. Over 70% of the total number of properties at risk of flooding are within coastal Flood Warning Areas. The Kent Area has coastlines on three flanks and over 50,000 hectares of land below sea level.

APPENDIX D: ECONOMIC IMPACTS

D.1 COSTS OF EMERGENCY RESPONSE

The costs of emergency response include additional staff time and expenses, overtime, hire of plant, costs of materials, costs of Floodline, aerial photography and analysis, and other data collection arising from the flooding events.

Costs reported to date are estimated by the Area Flood Defence Managers and have been previously passed to the Agency's Head Office to inform the Minister of Agriculture.

Table D.1: Estimated cost of the emergency response of the Autumn 2000 Floods

Local Flood Defence Committee	Agency Costs (£K)	Floodline (£K)	Other Operating Authorities (£K)	Total Response (£K)
Hampshire and Isle of Wight	110	-	2,254	2,364
Kent	500	-	1,449	1,949
Sussex	600[1]	-	4,082	4,682
Southern Total	1,210	28	7,785	9,023

[1] *Excludes £750,000 for River Lavant emergency works which are currently being funded by West Sussex County Council*

D.2 COSTS OF EMERGENCY REPAIRS

These costs relate to undertaking repair works to bring the flood defence asset back to a condition in which it can fulfil its intended function. In many instances either the full extent of the necessary repairs have not yet been identified or the repairs identified cannot be implemented. This is due to continuing high water levels in many of the rivers and the absence of satisfactory means of access for heavy plant to carry out repairs to earth banks etc.

Table D.2, Table D.3 and Table D.4 have been prepared through the period of the event but are not yet considered to be final. Property flooding has continued through December and January and will continue further. The costings and timings of the work must be considered tentative at this stage and are subject to revision in the light of better information when it becomes available.

Table D.2: Emergency repairs – Hampshire and Isle of Wight

Location	River	Approx age	Defences		Damage Analysis	Emergency Repairs				
						Costs (£k)		Time Scale		Nature of Repairs
			Length	Type		Construction Fees	Salaries	2000/01	2001/02	
Wickham	Meon		10m	Bank	Emergency repair	15	1.5	Nov/Dec		Reinstate Banks
Exton	Meon				Overtopping	5	0.5	Nov/Dec		Raise Crest
Meonstoke	Meon			Channel	Restrictions	5	0.5		Apr/May	Dredging
Wallington Village	Wallington			Wall	Emergency repair	10	1			
Ryde, Isle of Wight	Monkton Mead Brook				Exceedence of capacity	80	8	October/ March		Temporary pumping pending capital project
Wickham	Meon		20m	Bank	Overtopping	5	0.5			Emergency bank Bridge Street
Keyhaven	Lymington			Flap		1	0.5			Repair flap
Total						121	12.5			

Table D.3: Emergency repairs – Sussex

Location	River	Approx age	Defences		Damage Analysis	Emergency Repairs				
						Costs (£k)		Time Scale		Nature of Repairs
			Length	Type		Construction Fees	Salaries	2000/01	2001/02	
Westbourne	Ems	30yrs	250m.	Clay	Visual seepage poss flooding at school	1		Nov		Holes closed by reshaping
Amberley	Arun	30yrs	200m.	Clay	Overtopping and Breaching	25	2		spring/summer	Reconstruct, raise and strengthen banks
Greatham										
Bury										
Houghton										
Mock Bridge	Adur	30yrs	300m.	Clay	Overtopped	30	3		spring/summer	raise and repair banks
Bramber										
Uckfield	Uck	10yrs.	40m.	Piling	Blown in parts – damage behind	25	4		spring/summer	structural assessment plus repairs
Malling	Ouse	20yrs.								
Offham		30yrs								
Stoneham		30yrs								

Location	River	Approx age	Defences		Damage Analysis	Emergency Repairs				
						Costs (£k)		Time Scale		Nature of Repairs
			Length	Type		Construction Fees	Salaries	2000/01	2001/02	
Barcombe Mills		30yrs		Pumping Stations	Pumps and switchgear drowned out	40	5	ongoing		rewind motors new control panels
Lewes Town	Ouse	30yrs	60m.	River Walls	Cracks and small breaches	32	4	complete		temporary repairs by reinforcing existing walls
Cliffe, Lewes		35yrs.	33m.	River Walls	Major collapses	57	3	ongoing		long term temporary repairs
Cliffe, Lewes		35yrs	10m.	River Walls	Cracked and unsafe	10	1	a.s.a.p		temporary repair to strengthen and secure
Cliffe Lewes		35yrs	20m.	River Walls	Cracking/unsafe – listed building at risk of collapse if wall fails	200	25		asap	needs complete rebuild
Alfriston	Cuckmere	30yrs	100m.	Flood Banks	Overtopped	10	2		spring/summer	Raise and strengthen banks
Total						430	49			

Table D.4: Emergency repairs – Kent

Location	River	Approx age	Defences		Emergency Repairs				
					Costs (£k)		Time Scale		Damage Analysis/Nature of Repairs
			Length	Type	Construction Fees	Salaries	2000/01	2001/02	
Tonbridge Town Wall	Medway	1957	200m	Brick Wall	10	2	Dec-00		Repointing and sealing brick wall.
Edenbridge Town Wall	Eden	1981/8	200m	Bank Crest	47.5	2.5		Spring	Retop and shape earth banks
Leigh Barrier Stilling Basin	Medway	1979/82	1000sqm	Stilling Basin	208	12		Spring	Replacement of 1 000sqm of Gabion Cages
Allington Sluices	Medway	1937	-	Sluice	0.5	1.5	Jan-01		Repair damage to sluice gate
Marden Mill Auto Sluice	Lesser Teise	1979	-	Auto Sluice	0.6	0.4	Nov-00		Gate control panel flooded
Dimsdale Pumping Station	Dimsdale Petty Sewer	1978	-	Pumping Station	5	1.5	Nov-00		Both pump motors burnt out
Dimsdale Pumping Station	Dimsdale Petty Sewer	1978	-	Pumping Station	1.5	0.2	Nov-00		Mains electricity failure hire of temporary generators
Hacklinge Pumping Station	North Stream	1994	-	Pumping Station	1.7	0.2	Nov-00		Mains electricity failure hire of temporary generators
Black Sluice Pumping Station	North Stream	1992	-	Pumping Station	1.7	0.2	Nov-00		Mains electricity failure hire of temporary generators
Ash Level Pumping Station	Richmond Stream	1957	-	Pumping Station	1.7	0.2	Nov-00		Mains electricity failure hire of temporary generators

Location	River	Approx age	Defences		Emergency Repairs				
					Costs (£k)		Time Scale		Damage Analysis/Nature of Repairs
			Length	Type	Construction Fees	Salaries	2000/01	2001/02	
River Rother Banks	Rother	1960	Total 300m	Bank Crests	250	12	Nov-Jan 01		Repairs to clay banks in various locations along river
Court Lodge Pumping Station	Court Lodge Petty Sewer	1971	-	Pumping Station	1	0.2	Oct-00		Repairs to gearbox
Appledore Pumping Station	Engine Sewer	1950	-	Pumping Station	1.5	0.5	Nov-00		Emergency repairs
Greatstone Pumping Station	New Romney Sewage Arm	1962	-	Pumping Station	1.8	0.2	Oct-Jan-01		Provide an emergency pump to assist existing pumps.
River Stour Bank	Stour	-	50m	River Bank	1	0.2	Oct-00		Temporary sheet piling to bank
River Little Stour	Little Stour	-	50m	River Bank	4	1	Feb-01		Repairs to clay bank
Hothfield Flood Storage Reservoir	Great Stour	1991	-	Culvert	0.5	0.5	Feb-01		Repair damage to hydro brake
Total					540.5	39.8			

The approximate costs incurred in response to the flooding events have been collected and are reported below. Again, at this stage the figures provided are not final, much of the work has not yet been invoiced to the Authority. The figures should therefore be considered tentative at this stage.

Table D.5: Cost of the Autumn 2000 Floods incurred by local authorities

Authority	Response Total (£K)
Sussex	
Adur DC	0
Arun DC	68
Brighton and Hove BC	500
Chichester BC	30
Crawley BC	12
East Sussex CC	1500
Eastbourne BC	0
Hastings BC	2
Horsham BC	12
Lewes BC	300[1]
Mid Sussex DC	65
West Sussex CC	1587[2]
Worthing BC	6
Total	4082[2]
Hampshire/Isle of Wight	
East Hampshire DC	15
Eastleigh BC	14
Fareham BC	15
Gosport BC	0
Hampshire CC	1850[2]
Havant BC	20
Isle of Wight CC	55[2]
New Forest DC	150[2]

Authority	Response Total (£K)
Portsmouth City Council	30[1]
Southampton City Council	0
Test Valley DC	5
Winchester City Council	100
Total	2254[2]
Kent	
Ashford BC	17
Canterbury City C	62
Dartford BC	0
Dover DC	10
Gravesham BC	0
Kent CC	800[2]
Maidstone BC	250
Medway Council	10
Sevenoaks DC	28
Shepway DC	10
Swale BC	60
Tonbridge and Malling BC	119
Tunbridge Wells BC	53
Romney Marsh IDB	[3]
River Stour (Kent) IDB	[3]
Upper and Lower Medway IDB	30
Total	1449

[1] *Excludes damage to council property etc subject of insurance claims*

[2] *Includes works to highways*

[3] *Figures not available separately included in Agency LFDC total*

D.3 EXTRA FLOOD DEFENCE SCHEME NEEDS IDENTIFIED

As a result of the flooding, Area Flood Defence Managers have reviewed the flood defence needs and the requirement for additional capital investment. An initial assessment of the likely costs of such additional works for the Region was £61 million, however in many cases the viability of schemes is dependent upon economic justification and meeting MAFF priority scores. These can only be finally determined following completion of strategy plans for the rivers. A programme of strategies is being implemented through National Capital Programme Management with those considered most urgent having been brought forward to start during the current financial year (2000/01). Other strategies will start during 2001/02 with the intention of completing the programme in 2002/03.

In response to a request by MAFF, those projects that could commence within the period 2000 to 2004 have been identified and proposed revisions to the Medium Term Plan have been made. The following table indicates the adjustment to the Medium Term Plan identified at that time.

Table D.6: Cost of extra flood defence schemes identified to date

LFDC	2000/01 (£K)	2001/02 (£K)	2002/03 (£K)	2003/04 (£K)
Hampshire/Isle of Wight	-10	+343	+1312	+1507
Sussex	+15	+315	+1958	+3947
Kent	+10	+771	+3164	+2134
Total	+15	+1429	+6434	+7588

Final figures for additional investment will only be available following completion of the various strategy plans.

D.4 OVERALL ECONOMIC COSTS, INSURANCE CLAIM LEVEL AND DISTRIBUTION

No figures for this element have been obtained other than a figure from Association of British Insurers who quote a total value of claims of £500 million nationally for claims resulting from the flooding events.

D.5 IMPACTS ON EMPLOYMENT

No figures for this heading have been obtained.

APPENDIX E: HISTORY OF FLOODING

E.1 JUNE 1999

At Freshwater on the Isle of Wight, heavy overnight rainfall on 1st and 2nd June 1999 caused water levels to rise in the Western Yar. Nineteen properties were flooded from a combination of river levels and surface water. A rainfall observer recorded 55.7mm of rain in 24hrs with 44.6mm overnight.

E.2 JULY 1999

On the 5th July 1999 heavy rain associated with thunder occurred in the Andover area of Hampshire from late morning onwards. 73mm of rain fell in 24hrs, as recorded at the Andover rain gauge. The Agency recorded 50mm fell in one hour (1 in 650 chance occurrence).

It was established that the River Anton through Andover remained in bank but appeared to have restricted the drainage from Bridge Street. This caused about 20 commercial properties to be flooded to a depth of about 200mm. There were also a number of isolated places suffering from storm water flooding, one notable one being the Safeway supermarket.

The River Anton at Rooksbury Mill did overtop its banks and affected a fish farm. Also hatches under the mill were washed away when a tree trunk hit them. Free passage for the river remained. The Anton returned within its bank before the confluence of Phill Hill Brook.

Phill Hill Brook was affected by the rain but also remained in bank and appeared to peak about 17:00 hours. The Bourne Rivulet at Hurstbourne Priors was checked but had not overtopped. Roads in the valley were affected by surface run-off. At Whitchurch storm water had blocked the road to over 300mm by the Silk Mill. Again it was confirmed that the River Test remained in bank at all times. The mill had been affected plus a couple of adjacent properties.

E.3 DECEMBER 1999

The Met. Office issued a forecast predicting strong gale force winds, positive storm surges and a possibility of up to an inch of rain for Christmas Eve coinciding with high tides over the Christmas period. Heavy rain throughout the morning of the 24th December 1999 caused river levels to rise across the Region. In response to rising levels incident rooms were opened in each Area to manage the incident and respond to calls from the public, which came through Floodline and via the Agency switchboard.

A number of flood warnings were issued along the Sussex and South Kent coastline. Throughout the Christmas period tides remained high with gale force winds not relenting until the 27th December, although overtopping of sea defences was experienced, no flooding of properties was reported. Rainfall continued throughout the Christmas period.

Many areas in Hampshire and the Isle of Wight were flooded, with 97 properties flooded internally and many more experiencing external flooding. The majority of flooding was due to high rainfall swelling the rivers which then became tide locked as they flowed into the sea. The only flooding in Hampshire related to high rainfall alone was in Romsey. During the 23rd and 24th December 1999 between 40 and 60mm of rain fell across the Area, and a further 14 to 20mm, of rain was recorded on 26th December 1999.

In Romsey, four properties were flooded internally and a further 19 experienced external flooding. The majority of internal flooding affected properties on Seaward Rise and Jenner Way. Fishlake Stream flowed out of bank and affected 8 properties internally. Wellow Mill on River Blackwater was also flooded.

At Beaulieu five properties were flooded due to problems with the sluice gates at the downstream end of Beaulieu Mill Pond.

In Lymington, the river overtopped its banks upstream of the Toll Bridge on the Lymington side and flooded the railway line. Flooding also occurred in Bridge Street and Waterloo Road, with approximately 13 properties having internal flooding and a further 5 experiencing external flooding.

At Totton, a highway culvert on the Calmore Canal became blocked by a fridge/freezer that had been dumped on the 24th December. This caused severe flooding to a number of roads, and caused 1 house to be flooded internally. An additional 67 properties were externally flooded.

At Marchwood, the exceptionally high tides and high rainfall caused flooding to properties in Magazine Lane, Marchwood.

On the Isle of Wight at Newport, the extreme weather conditions resulted in approximately 4 properties being flooded from the Lukely Brook, and 1 property being flooded from an ordinary watercourse. In addition, at Ryde the severe weather resulted in flooding at The Strand, Simeon Street and Westhill Road. Approximately 27 properties were damaged from surface and foul water and the Brook overtopping. The Gurnard Luck spilled out to flood approximately 5 properties in Marsh Road.

In Sussex, isolated properties were flooded in several towns and villages, as follows:

- Stedham – Properties flooded adjacent to Stedham bridge.
- Houghton – One property flooded
- Arundel – One property flooded from surface water (Arundel River Road) being unable to discharge into river.
- Buxted – Two properties
- Uckfield – One property
- Barcombe Mills – One to five properties

- Hellingly – One property flooded
- Alfriston – One property flooded
- Eastbourne – Six domestic and two business properties flooded

In Kent Area, flooding occurred in several locations. On the 25th December the River Rother spilled out over the Wet Levels and the Royal Military Canal rose to bank full. Six houses were flooded from a private watercourse and one property was flooded due to surface run-off from surrounding agricultural fields. A caravan site was inundated at Swalecliffe from the Swalecliffe Brook. During the course of the 25th December further reports of flooding were received from the River Tiese at Lamberhurst. The Leigh Barrier on the River Medway was utilised to capture the peak flow of the flood and reached 78% of capacity (4,827 million litres). Flooding of properties from 'main river' was reported in:

- Yalding – Riverside properties and Hampstead Lane caravan park
- Wateringbury – Riverside restaurant
- Blindley Heath – One property
- Robertsbridge

Flooding of properties from Internal Drainage Board watercourses:

- Lamberhurst – 10 properties
- Five Oak Green – Village Centre 25 properties
- Norton Way – Near Railway Line approximately 100 Properties
- Paddock Wood – Approximately 50 properties

River levels in the upland catchments began to recede in the early hours of the 26th December. Although two more periods of heavy rainfall during the day caused river levels to rise again, the levels experienced on the 25th December were not surpassed.

The Leigh Barrier emptied on the 29th December following the release of impounded flood water. The duration of impounding lasted a total of four days.

E.4 MAY 2000

In Hampshire flooding occurred at Whiteley between 17:00 and 19:00 on Monday 8th May 2000. The flooding was caused by a combination of high volumes of surface run-off due to heavy rain on saturated soil and high water levels in the adjacent ditches and streams. Surface water from Gull Coppice to the West of the Whiteley development flowed into the stream at the southern end of Hyssop Close. This stream joints the stream that runs adjacent to the rear of the entire development. As this stream was so full it caused the smaller stream to back up and overflow into the properties on Hyssop Close. In addition the surface run-off flowed directly into the

properties on the other side of Hyssop Close. The remainder of the surface run-off flowed over and under (via a culvert) Marjoram Way. From this point the water flowed through the development in the direction of the lower ground. The culvert under Sorrel Drive blocked, causing additional flooding at the northern end of the development. The blockage was due to a log and a large amount of suspended solids in the water collected as the water passed through Gull Coppice.

In Sussex, heavy rainfall resulted in several isolated properties flooding as follows:

- Pulborough 2 properties
- Billingshurst 1 property
- Buxted 2–6 properties flooded
- Uckfield 10–20 properties flooded
- Barcombe Mills 3 properties flooded
- Hellingly 5 properties flooded
- Alfriston 1 property flooded.

In Kent, heavy rain in April affected the Stour catchment causing both Aldington and Hothfield storage reservoirs to impound. High levels resulted on the Stour necessitating the operation of Stonar Cut. Throughout the catchment there were numerous reports of flooding caused by road drainage and ordinary/private watercourses.

Heavy rain also fell in the Rother and Teise catchments during May causing flooding to approximately 8 properties in Robertsbridge and 6 in Lamberhurst as the Rother came out of bank.

APPENDIX F: VIEWS OF PROFESSIONAL PARTNERS

In order to record the view of professional partners we have undertaken a questionnaire survey, a repeat of work carried out following the May 2000 floods. This has allowed us to consistently assess our performance and identify areas of improvement. We have used external consultants for this work as we believe it promotes more open responses. A summary of the survey results is presented below.

Overall, most professional partners feel that the Agency is providing a progressively better service. The new warning system is still causing some confusion to some recipients. In many cases the problem is that the recipient does not want all the warnings they are getting, or they want something which the Agency cannot give.

There are conflicting views on whether the Agency does enough training and exercising with its professional partners, or too much!

Key issues and common themes are:

- Flood warning faxes did not have Flood Warning Area codes clearly marked. This has been rectified.
- Many customers had asked for several flood warnings as they were uncertain of which were relevant to them. We could rationalise these requests by explaining more clearly the geographic coverage of each warning.
- Professional partners would prefer summary flood warning faxes to individual ones. Ideally the Agency would have a secure internet site that professional partners could access at any time to see the complete picture.
- Information about 'actual flooding' is needed but not disseminated and indeed the Agency relies on external reports of property flooding.
- Sandbags. The Agency does not issue sandbags to private property owners and neither do most Local Authorities, but refer requests for sandbags to each other.

There is much additional work and correspondence not recorded in this report, particularly that carried out in Areas. For example in Kent 22 MPs queries have been resolved (more information on this is listed at the end of this appendix) and there has been extensive liaison with Local Authorities.

F.1 SUMMARY OF MULTIPLE CHOICE RESPONSES

This questionnaire and analysis exercise was conducted to an extremely tight deadline which means that there are fewer results than one might normally expect.

Against this, more questionnaires were sent out, so there are three times the number of replies available than in May 2000. A table summarising the results is below. 40 responses were received in time to be analysed from 110 surveys sent out.

2001 results show an improvement on the May 2000 questionnaire in all average scores except the question 'Did you feel that the Agency had a clear understanding of your role in this incident?', which is slightly lower.

Most dramatic improvements over May 2000 in average scores are in:

- Did you feel that you clearly understood the Agency's role in this incident?
- Did you feel that the Agency acted appropriately and promptly?

There were also significant improvements for the following questions:

- Did you feel the Agency gave you enough information about events and/or its own activities?
- Did you feel that the Agency acted appropriately and promptly?

Higher deviations are probably due to the larger number of responses. However, where standard deviations are lower, it may suggest that the Agency is being more successful in communicating its message to others. Certainly the number of respondents choosing the lowest option in each multiple choice question (i.e. a 'very poor' response) is less despite the much larger number of responses.

There were 'very poor' responses to only three questions in 2001. These were:

Do you feel that you have a good understanding of the Agency's incident response procedures and objectives, as they were used in this incident? (2 'very poor')

Did you feel that you clearly understood the Agency's role in this incident? (1 'very poor')

Did you feel that the Agency had a clear understanding of your role in this incident? (2 'very poor')

F.2 RESPONSES TO INDIVIDUAL QUESTIONS

Where mathematical scores exist (i.e. for multiple choice questions) we have given a figure for 'average scores': this figure (e.g. 0.7) is the mathematical average. There were five, or occasionally three, options, with +2 being the best possible score and -2 the worst possible. In general, average scores below 0 are poor; above 1 are excellent.

Table F.1: Summary of survey scores

	Autumn 2000 Floods *(40 recipients)*			May 2000 Floods *(11 recipients)*		
Questions	Average	Deviation	Number of Very Bad	Average	Deviation	Number of Very Bad
Do you feel that you have a good understanding of the Agency's incident response procedures and objectives, as they were used in this incident?	0.9	0.9	2	0.7	0.6	0
Did you feel that you clearly understood the Agency's role in this incident?	1.2	0.8	1	0.7	0.7	0
Did you feel that the Agency had a clear understanding of your role in this incident?	0.8	1.1	2	0.9	0.7	0
Did you feel the Agency gave you enough information about events and/or its own activities?	1.0	0.7	0	0.6	1.3	1
Did you find the revised Flood Warning system more helpful than the old one?	0.7	0.7	0	N/A	N/A	N/A
Which aspects of Flood Warnings are the most and least useful to you?- Information about severity of flooding?	0.6	0.5	N/A	N/A	N/A	N/A
Which aspects of Flood Warnings are the most and least useful to you?- Information about timing of flooding?	0.7	0.4	N/A	N/A	N/A	N/A
Which aspects of Flood Warnings are the most and least useful to you?- Information about duration of flooding?	0.6	0.5	N/A	N/A	N/A	N/A
Did you feel that the Agency acted appropriately and promptly?	1.2	0.5	0	0.8	1.2	1

11 responses were received on the May event and 40 to the Autumn 2000 event survey.

F.3 RESPONSES TO TELEPHONE FOLLOW-UP

Interviewees were selected on the basis of their written response and we chose those who had given either very high or very low scores on multiple choice questions.

F.3.1 Has the Agency improved?

All questioned said there has been considerable improvement since May 2000 and some went further and reflected further back to 1999 and even 1994. The main areas being communication and briefing methods together with good quality practical help. This and the warning system is commented on below. There was a general opinion that improvements had been spurred by poor publicity after the initial incidents.

F.3.2 New flood warning system

There were mixed opinions on this. On one hand "there can never be too much information" but this was countered by: "we get far too much." It all depends on the organisation concerned. One Fire Service prefers the old system's 'amber and red' and is perfectly happy with that; electricity boards just want to know if the road is blocked on the way to a repair but others want more detail. In an ideal world each agency would receive exactly what they ask for. However, overall the new system is an improvement although it was suggested it was intended more for the public than emergency services. Some respondents had difficulty remembering the 'old' system.

F.3.4 The Agency explaining itself and its systems

Some respondents had a strong view that there were too many briefings, meetings, explanatory leaflets and so on. There were also those who thought it all very good. There was an underlying theme in the interviews that the Agency tended to use public relations in order to protect itself and did not contact other agencies before releasing information to the press, etc. It was suggested that even if contact with other agencies was made beforehand, it was usually too late!

As far as co-operation is concerned, there was lots of positive feedback. Many referred to Agency staff by first names and clearly there is a very good professional relationship between them.

F.4 AREA ACTIVITY SUMMARY

F.4.1 Hampshire and Isle of Wight Area

MP Involvement

- Sandra Gidley MP: Flooding at Romsey
- Mark Oaten Esq MP: Flooding at Bramdean, Cheriton, Hambledon and Winchester
- Peter Brand MP: Flooding at Ryde and Eastern Yar
- Rt Hon Charles Kennedy MP: Flooding at Romsey, climate change and funding

Council Involvement

- All councils were involved in detailed liaison, briefings and site meetings with officers and councillors.

Public Meetings

- Ryde
- Exton

F.4.2 Sussex Area

MP Involvement

- Rt Hon Sir Geoffrey Johnson-Smith DL MP: Six letters. Cuckmere Valley flooding, Flooding in Uckfield, riparian owner responsibilities at Isfield, constituent ideas on flood defences.
- Norman Baker MP: Thirteen letters. Flooding in Lewes, Dredging, constituent ideas on flood defences, sea defences at Seaford, Flooding at Alfriston and Cliffe High Street.
- Andrew Tyrie Esq MP: One letter. Use of Waste in Sea Defences, Lavant Flood Alleviation Scheme.
- M Foster Esq DL MP: One letter. Coombe Haven, development within floodplains.
- Hon Nicholas Soames MP: Four letters. Flooding at Hickmans Lane, Lindfield.
- Rt Hon Virginia Bottomley MP: One letter. Flooding at Chiddingfold.
- David Lepper Esq MP: Two letters. Groundwater flooding at Patcham
- Nigel Waterson Esq MP: One letter. Flooding, Princes Park
- Rt Hon Dr Mo Mowlam MP: One letter. Dredging, Lewes

Public Meetings

- Chilgrove Valley meeting
- Singleton Valley meeting
- Westhampnett meeting
- 2 x Chichester Traders meetings
- 3 x Pagham Parish Council meetings
- 1 x Oving Parish meetings
- Barcombe Parish Council/Residents
- 2 x Lewes Traders meetings

- Lewes meeting
- Uckfield meeting
- Malling Brooks meeting
- Cliffe Residents Association
- Winterbourne Residents
- Cuckmere Valley residents
- Emsworth meeting
- Chiddingfold meeting
- Horsham District Council
- Pevensey Bay Stakeholders
- Wealden
- Chichester
- 2 x West Sussex

Table F.1: MP involvement in Sussex Area

Number of MPs letters	31
Number of MP briefings	26
Number of parliamentary questions	7

F.4.3 Kent Area

MP Involvement

MPs generally wanted to get an understanding of who does what and how the Agency is funded. There is a general perception of under-funding.

- Damian Green Esq MP: General Briefing
- Rt Hon Anne Widdecombe MP: Flooding at Wateringbury, Yalding, Collier Street, Marden, hardship funds
- Archie Norman Esq MP: Development in floodplains, flooding in Lamberhurst, levies

- Julian Brazier Esq TD MP: Flooding of Swalecliffe Brook, Nailbourne, Stodmarsh
- Rt Hon Michael Howard QC MP: Flooding in Ford Valley, Romney Marsh, levies
- Charles Wardle Esq MP: Flooding in Robertsbridge and Mountfield
- Rt Hon Sir John Stanley MP: River Wall, Tonbridge; Flooding in Edenbridge, East Peckham
- Derek Wyatt MP: Flooding at Lower Halstow and hardship funds
- Dr Ladyman MP: Flooding – Stour and East Stourmouth

Table F.2: MP involvement in Kent Area

Number of MP queries	22	All resolved
Number requiring follow up letters	3	
Number of proactive and briefing letter to MPs	23	
Number of Parliamentary Questions (Kent)	2	
Number of Adjournment Debates	2	

Council Involvement

- Maidstone Borough Council
- Tonbridge and Malling Borough Council
- Tunbridge Wells District Council
- Rother District Council
- Kent County Council Scrutiny Committee

Public Meetings

- Robertsbridge
- Collier Street
- Yalding
- East Peckham

- Five Oak Green

Voluntary organisation involvement

- National Farmers Union

LPA	-	Local Planning Authority
MAC	-	Military Aid to the Civil Community
MAFF	-	Ministry of Agriculture, Fisheries and Food
mALD	-	Metres Above Local Datum: Height above local reference point.
mAOD	-	Metres Above Ordnance Datum: Height above mean sea level at Newllyn (Cornwall).
MDO	-	Monitoring Duty Officer: Responsible for the detection of conditions likely to lead to potential flooding incidents within the Region.
NIMROD	-	A six-hourly forecast at hourly intervals of rain rates across Southern Region
ODO	-	Operations Duty Officer: Responsible for planning and managing effective emergency response on the ground in conjunction with the EDO, and following liaison with the FWDO.
PR	-	Public Relations: Ensure media coverage and support is provided for all appropriate incidents.
RBC	-	Regional Base Controller: Co-ordinates and manages the Regions response to an incident.
RCC	-	Regional Communications Centre: Continuously manned facility whose primary role is to act as a focal point for regional communications.
RDO	-	Regional Duty Officer: Designated Manager who is available to manage/co-ordinate the strategic issues of a major incident and support/advise RBC/ABC as appropriate.
Return Period	-	A statistical analysis of the probability of an event occurring over a period.
RIPs	-	Regional Incident Procedures: Provides information and procedures relevant to all staff involved in environmental incidents.
RIR	-	Regional Incident Room: A designated and appropriately equipped room which, in an incident, can be staffed to provide support to Areas.
RMS	-	Recorded Message Service: Provides recorded information on the latest flooding situation in England and Wales.
RTS	-	Regional Telemetry System: Display system that collates rainfall and river information from around the Region.
SMD	-	A measurement of the amount of rainfall required to bring the ground up to field capacity, i.e. saturation.
STFS	-	Storm Tide Forecasting Service: provides forecasting service based on estimates of surge tides at a series of key points on the East, South and West Coasts.

GLOSSARY

ABC	-	Area Base Controller: Responsible for providing tactical support duringan incident. Directs activities in the Area Incident Room including communication/liasing with all other Agency staff and external organisations off site.
AFWDO	-	Assistant Flood Warning Duty O fficer: Assists in the issuing and dissemination of flood warnings.
AIR	-	Area Incident Room: designated and appropriately equipped room which can be staffed in an incident.
AVM	-	Automatic Voice Messaging: Agency Flood Warning Dissemination System.
BC	-	Borough Council.
CC	-	County Council.
DC	-	District Council
DETR	-	Department of the Environment, Transport and the Regions (formerly DoE).
EDO	-	Emergency Duty Officer: Ensures emergency response works are sufficiently resourced and are undertaken on the ground as requested by the ODO.
EP	-	Environmental Protection
FEH	-	Flood Estimation Handbook: Flood Frequency Estimation Procedures produced by the Centre of Hydrology and Ecology.
FFP	-	Flood Forecasting Platform: Agency modelling system used to produce forecast river flows.
FDO	-	Forecasting Duty Officer: Provides a fluvial and tidal forecasting service within the Region.
FWDO	-	Flood Warning Duty Officer: Responsible for issuing and disseminating flood warnings and liasing with the ODO regarding the need for pre-determined operational works to be carried out.
H3/H4	-	Regional Telemetry System Trigger Levels
HYRAD	-	Hydrological Weather Radar Display: System displaying forecast and actual rain rates.
LFDC	-	Local Flood Defence Committee
LA	-	Local Authority

LPA	-	Local Planning Authority
MAC	-	Military Aid to the Civil Community
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H3/H4	-	Regional Telemetry System Trigger Levels
HYRAD	-	Hydrological Weather Radar Display: System displaying forecast and actual rain rates.
LFDC	-	Local Flood Defence Committee
LA	-	Local Authority

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