Environment Agency
Kent Area

Autumn 2000 Floods Review
Area Report

Southern Region

ENVIRONMENT AGENCY

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FOREWORD

The dramatic events experienced last winter have deeply affected all those involved. The extent of the flooding and speculation regarding climate change have devastated the confidence of those living in flood risk areas, the effects of which will be felt long after the physical damage has been repaired. We must now work together to face up to the challenge of managing the risk of flooding.

To ensure that the Environment Agency delivers the best possible service to our customers, it is essential that we continually review our performance to identify any areas for improvement. This report has been produced to provide an accurate and clear understanding of the events that occurred during the Autumn floods in the Kent Area.

Throughout the report issues are raised and recommendations have been made. From the list of recommendations an Action Plan will be produced in order to address the recommendations proposed. The Action Plan will include a detailed programme for introducing the improvements. We expect to produce the Action Plan by August 2001. In the meantime, much is being done to repair the defences damaged over the Autumn and Winter period and to increase the number of people who receive warnings directly from ourselves.

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 would like further information relating to content of this review, we would welcome your written comments at the address below.

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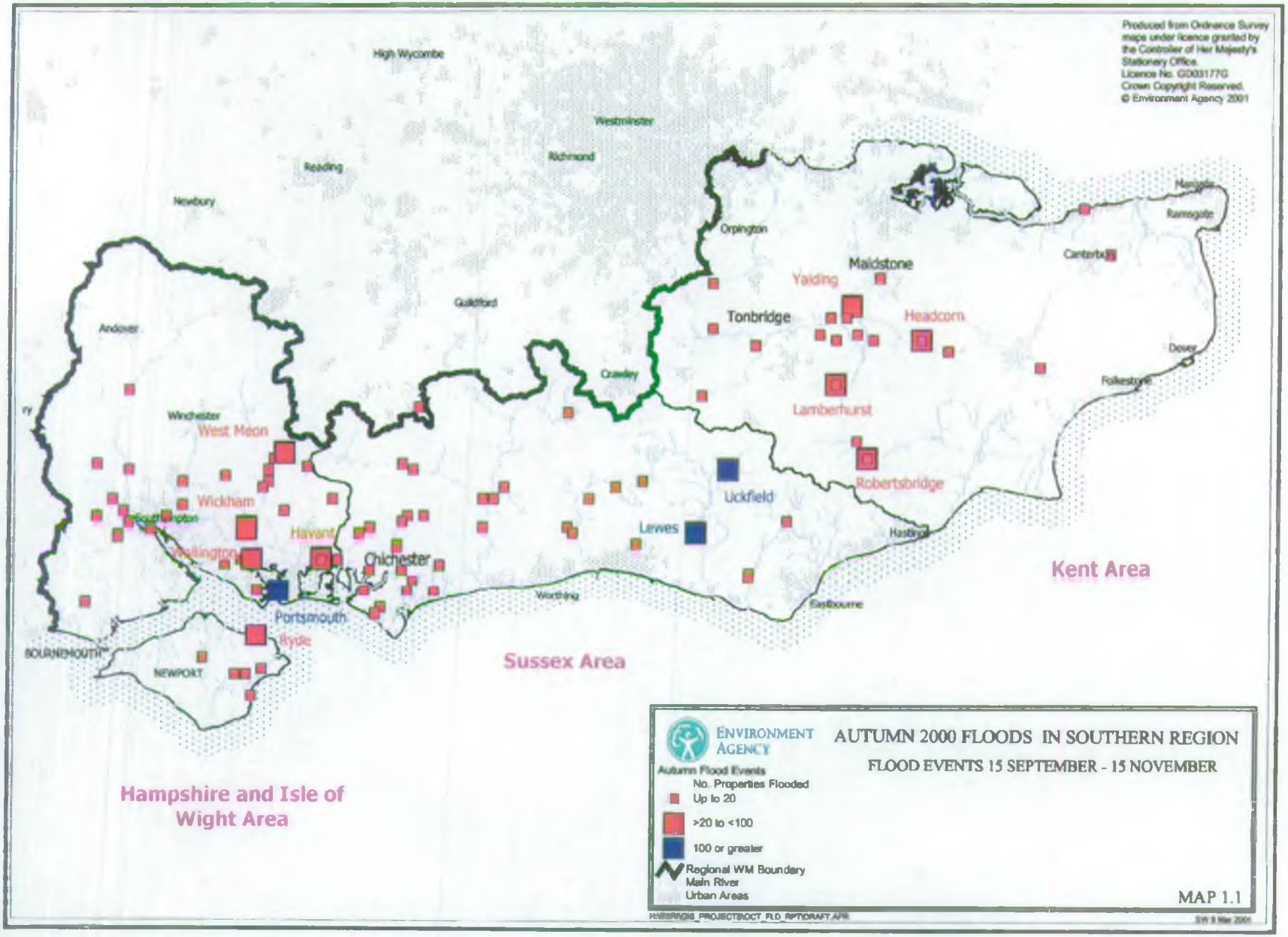
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NEWPORT
Kent Area
Sussex Area
Hampshire and Isle of Wight Area
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
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>20 to <100
100 or greater
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1 EXECUTIVE SUMMARY

This report has been compiled by the Kent Area office of the Environment Agency in response to an unprecedented Autumn of severe and widespread flooding. The report covers the period of 15th September to the 15th November, encompassing three major flood events affecting all catchments within the Kent area:

- Event No.1 ("Great Flood") - 9th to 14th October
- Event No.2 ("Halloween Flood") - 29th to 31st October
- Event No.3 ("Bonfire Night Flood") - 5th to 8th November

Individually the mid-October storm was a rare event, that it was followed by two other intense storms soon afterwards was particularly unusual. This did not allow time for the catchments to recover. Where possible, return periods have been calculated for affected areas, but the combined probability of the three events cannot easily be determined

During the compilation of this report, flooding has continued throughout the winter in many locations, most notably Lamberhurst, Robertsbridge and Yalding. Further flooding has been experienced in locations hitherto unaffected during the autumn period. Littlebourne, Patrixbourne and Bridge have experienced groundwater-fed flood flows from the Nail Bourne and the Little Stour. In north Kent Herne Bay and Swalecliffe have also been severely affected by floods over the winter. These events are detailed in Chapter 6 'Subsequent Events of Importance'.

It is important to note, that, for the country as a whole, Autumn 2000 was the wettest since meteorological records began in 1766.

Specifically for the Kent Area:

- September 2000 was the wettest since 1981.
- October 2000 was the wettest since 1903.
- November 2000 was the wettest since 1970.

The exceptional rainfall made inundation of natural floodplains inevitable. However, Agency owned defences proved effective in minimising flooding. Flood storage reservoirs reduced the impact of flooding in the commercial centres of Tonbridge and Ashford.

Organisational and staffing changes implemented by the Agency after the Easter 1998 floods in the Midlands ensured that roles and responsibilities were clear and well delivered. This reorganisation ensured that despite intense pressure, personnel were efficiently deployed.

In October 1999 the Agency initiated a successful National Public Flood Awareness Campaign. New flood warning codes were implemented on the 12th September 2000 and were generally well received by the public and professional partners.

216 Agency staff from across all functions in the Kent Area assisted during the flood events. Such tasks as dissemination of warnings, manning of the Area Incident Room, operation of defence structures, reinforcement of defences and data collection were carried out. The response was carried out in a unified and co-ordinated manner.

The report identifies issues and makes recommendations for improvements to the response provided by the Agency and other bodies. These are summarised below:

1) The response of the Agency was successful in many ways, however there is room for improvement. Such progress will require increased funding if the Agency is to continue to provide an effective Flood Defence and Flood Warning Service. The Department for Environment Food, and Rural Affairs (DEFRA) is conducting a national review of the way that the Environment Agency's Flood Defences are funded.

2) Properties in the Kent Area were flooded from numerous sources: overwhelmed urban drainage and sewerage systems, surface run-off, overspilled riverbanks and groundwater. No single body manages these combined risks, existing arrangements for flood risk management are often not clear to members of the public. The public requires help and guidance of whom to contact in different flooding situations. The value of the Agency as Navigation Authority for the River Medway was illustrated in the integrated management of the navigation and flood defence structures. This was demonstrated when the Agency dealt with vessels that had broken free from their moorings and threatened to block bridges or sluices.

3) A strategic approach to river catchment management is necessary to ensure that defences of an appropriate standard are in place. The strategic approach should consider the wider issues of flooding from groundwater; non Main River; sewerage and drainage systems and address urban and rural land use planning and climate change. Solutions should be sustainable, neither creating nor exacerbating problems elsewhere now, or in the future.

4) The expansion and development of new technology enabled more accurate flood forecasting, detection and public information systems. The Automated Voice Messaging system was used to disseminate over 300 flood warnings of which 28 were Severe Flood Warnings. These systems and their operators were at times stretched to their limits. The issues identified will help justify further improvements in the robustness of these systems.

5) Accurate flood warnings are reliant upon a number of systems including weather forecasts from the Meteorological Office, weather radar and data from the Regional Telemetry System (RTS - a flood detection system). The weather forecasts provided by the Meteorological Office often proved unreliable. Weather radar coverage in the South East is inadequate. Both factors could inhibit the Agency's effectiveness in forecasting flood events. One element, that performed well and enabled accurate predictions, was the Agency's RTS. This allowed staff to monitor events using real time data in terms of water levels and rainfall accumulations.

6) The media provided an invaluable service during the floods. They became an integral part of the Flood Warning Service enabling the Agency to keep the public informed. However, in conducting nearly 500 media interviews in the Kent Area, resources were stretched.

7) Prompt data collection has enabled an accurate record of events to be recorded that will assist in the future management of flood risk. Data compiled will be incorporated into improved versions of the flood risk maps. Detailed data regarding specific individual properties flooded is often not accurately determined nor in some circumstances is the source of flooding.

8) More robust guidance is required with regard to development in the floodplain. Flood risk must be given a higher priority during planning consultations. The Agency's influence in respect of development in floodplains needs to be strengthened.

It is evident that the "Great Flood" on its own was possibly the worst in the Kent Area since 1927. The combination of all three serious flood events in autumn 2000 can rightly be identified as an extremely rare sequence of events. The fact that flooding has occurred since the autumn and throughout the winter has led to an extremely traumatic time for those people who have been flooded, some of whom may have been flooded in excess six times.

The response from the Agency was seen to have been successful in many ways. New procedures introduced after the Changing Needs in Flood Defence Review have led to improvements in the service provided by the Agency in terms of flood incident management. Flood warnings were disseminated on time and liaison with external partners was excellent. The recommendations however show that in some areas there is still scope to improve the service provided.

2 FLOOD FORECASTING AND HYRDOLOGICAL RESPONSE

2.1 FORECASTING

Flood Forecasting requires interpretation of measured and forecast rainfall, river and tidal levels and the use of real time hydrological and hydrodynamic models to forecast future conditions. This process requires reliable monitoring systems and accurate forecasts of rainfall.

Table 2.1: Summary of rainfall events for the period.

August	Below average rainfall
Early September	Mainly dry, some light rain and drizzle
Sept 15th	Cold front, heavy thundery rain and prolonged showers
Late September	Mainly dry, heavy rain and showers over 2 days
The soil moisture deficit across Kent fell throughout September. River levels remained high. September 2000 was the wettest for 19 years, with an average total rainfall of 90mm in Kent compared to a long-term average of around 70mm.	
Early October	Mainly dry, occasional thundery showers
Oct 9th/10th	Complex low resulted in series of fronts bringing heavy rain, showers and gales.
Oct 11th	Slow moving band of continuous rain from France brought very high rainfall totals up to 136mm during the night.
Oct 13th - 26th	Unsettled, mainly dry
Oct 27th	Series of fronts moving from west
Oct 29th - 30th	Severe storm with heavy rainfall and gale force winds
All catchments remained saturated. This was the wettest October since 1903, with an area average rainfall of 204mm compared to the long-term average of 80mm.	
Early November	Bands of rain and showers
Nov 5th/6th	Several fronts bringing heavy thundery rain and showers with strong winds.
Nov 10th – 13th	Slow moving cold front bringing heavy rain
Late November	Moderate rainfall
Wettest November since 1970, with area average of 160mm rainfall compared to a long-term average of 84mm. River levels dropped towards end of month, but groundwater levels remain high.	

During this period the Monitoring Duty Officers and Forecasting Duty Officers based in the regional office had a number of tools at their disposal:

- Met Office weather forecasts
- Storm Tide Forecasting Service

- Regional Telemetry System
- Flood Forecasting Platform forecasting models
- Flood Estimation Handbook
- archived hydrometric data

Issues regarding the quality of meteorological information arose, which led to difficult fluvial and tidal forecasts.

2.1.1 Accuracy and Timeliness of the Met Office Short and Medium Term Forecasts (forecast v actual precipitation)

The accuracy and reliability of weather forecasts are an essential component in the provision of flood warnings. Inaccurate forecasts result in either late action or unnecessary expenditure of time and resource both by the Agency and its Professional Partners.

Table 2.2: Accuracy and Timeliness of Heavy Rainfall Warnings

Sept 14th	Heavy Rainfall Warning: 20-30mm, 40-45mm locally over 24hrsAn average 1 – 4mm of rain actually fell. Front moving slower than expected.
Sept 15th	Heavy Rainfall Warnings: 19:30. Cold front, heavy ,thundery rain and prolonged showers
Late September	Mainly dry, heavy rain and showers over 2 days
The soil moisture deficit across the Kent Area fell throughout September. River levels remained high in impacted areas. September 2000 was the wettest for 19 years, with an average total rainfall of 90mm across the Kent Area compared to a long-term average of around 70mm.	
9th October	Heavy Rainfall Warning received at 0952 predicting accumulations of 20mm across all catchments in the Area for a six/seven hour period. Accompanying text advised that 35mm might be experienced in some locations. 35-45 mm widespread across the Kent. Area Heavy Rainfall Warning from the Met Office underestimated rainfall totals
10th October	Heavy Rainfall Warning predicted 15-20mmActual Rainfall experienced 15 – 20mmForecast very accurate.
11th October	Heavy Rainfall Warning received at 14:35 predicted a maximum of 15mm. This was subsequently increased to 15 – 20 mm concentrated in West Kent. Rainfall accumulations varied between 20 & 136mm, bands of continuous rain streamed up from France into Sussex and Kent. Gross underestimation of rainfall accumulations in Met Office forecast.
15th October	Heavy Rainfall Warning issued advising between 20 & 30mm.Actual rainfall didn't exceed 15mm in any location, many raingauges recorded less than 10mm. Rainfall overestimated in the Met Office Forecast.
17th October	Heavy Rainfall Warning issued advising that 20mm + expected throughout the Kent Area. Actual rainfall experienced only in the region of 1-5 mm. Rainfall overestimated in the Met Office Forecast.
18th October	Heavy Rainfall Warning advising of accumulations of 20mm +. Actual Rainfall across the Kent Area was in the range of 1-5mm. Rainfall totals exaggerated in the Met Office Forecast.
5thNovember	Heavy rainfall prompted a Heavy Rainfall Warning, no catchment differentiation had been made, a general forecast of 20mm+ was quoted. Actual rainfall accumulations in the Kent Area were forecast as 20-35 mm. Certain amount of underestimation of forecast rainfall in some catchments.

2.1.2 Other Weather Warnings

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

A number of Early Warnings of Severe Weather and Update Warnings were issued for the 9th-14th 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 Kent Area. The same problems occurred with Flash Warnings, which often arrived after the worst of the weather had been received, or after Heavy Rainfall Warning 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.

2.1.3 Met Office Daily Weather Forecasts

The Daily Weather Forecast gave a good indication as to whether it was going to rain on that day or not, but often rainfall totals were not accurate.

On a number of days the daily forecast overestimated accumulations. Often catchments due to receive between 10 and 20mm only received 1-5mm. Heavy Rainfall Warnings were usually issued in the event of the daily weather forecast underestimating accumulations when greater than 20mm was expected.

2.1.4 Accuracy of Weather Radar

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

Comparison between the real time radar rainfall accumulations and ground truth data showed that the radar overestimated, sometimes by 300%, compared to raingauges. Nearly every raingauge retumed a figure lower than the radar, especially the greater the precipitation.

Radar coverage has continued to be a problem, with a large network 'gap' in the south east of England and the south coast.

2.1.5 Impact of Any Inaccurate Meteorological Forecast

One of the main elements during 9th-12th October event was the underestimation from the Met Office of rainfall on the 11th October. Having received a Heavy Rain Warning advising that at most 15-20mm would be seen across the Kent Area the decision was taken to maintain a monitoring presence in the Area Incident Room.

As the night drew on, bands of rain continued developing and moving over the south coast. In the early hours of the morning it was necessary to extend the monitoring presence to a full scale Area Incident Room. Fortunately this had been anticipated and provisional rosters were drawn up for the Area Incident Room for that evening and the next day. Had these not been in place it would have been extremely difficult to arrange staffing of the Area Incident Room at such late notice. A rapid and accelerated response succeeded in meeting the unanticipated situation.

Following the "Great Flood", subsequent Heavy Rainfall Warnings issued by the Met Office between the 15th and 18th October tended to overestimate the amount of rain expected. Significant resources were expended in staffing the Area Incident Room, making sure that phones could be manned. Staff that had been working on rosters could have been rested and stood down, but instead had to continue on overnight shifts as further rainfall was expected.

Individual catchment forecasts from the Met Office were often inadequate for the needs of the Area i.e. those that quoted a figure of 20mm+ across all catchments in the Area. The idea of splitting the warning into different catchments was to give the Area as much detail as possible in order to issue flood warnings for those different catchments.

2.1.6 Agency Telemetry and Outstation Robustness and Availability

Since taking on the lead role of flood warning dissemination in 1996 the Southern Region and the Kent Area has invested heavily in new technology to support the role. The Regional Telemetry System (RTS) was introduced in 1999 at a cost of £2.5m and has replaced outdated equipment. This has allowed an expansion of the number of sites, allowing improvements in the speed and quality of information presented and sites are designed to be more resilient to high flows.

Overall the Regional Telemetry System performed very well and proved an invaluable tool for flood forecasting. The problems that did occur where few and can be attributed to the severity of the event, communication problems and battery failures due to the longevity of events was experienced. In cases where telemetry faults occurred data could be gleaned from either back up sites or by Emergency Workforce operatives on the ground taking manual levels.

2.2 RAINFALL

The weather in the south east of England during the summer months was cool and changeable with more than the average rainfall for the time of year. September was generally warm but with outbreaks of rain, heavy at times. Consequently, by the end of September the soil moisture deficits 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 resulting in heavy and prolonged rainfall over 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, this time accompanied by high winds, again fell over the south eastern counties between 30th October and 2nd November rainfall is shown for this period in the form of isohyets these appear in Appendix K.

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

The most intense rainfall was experienced with the first of the three storms in mid October over the Western-most catchments of the Kent Area, highlighted by the rainfall isohyets shown in Appendix K.

Up to 50mm of rainfall was recorded in several places during a 24hr period ending Thursday 12th October and at Argos Hill near Crowborough 136mm of rain fell over the night of the 11th - 12th 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 Argos Hill, 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 mid October 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 affected catchments to recover. The combined probability of the three storms together is not easily determined. It is of interest to note, that, 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
- November 2000 was the wettest November month since 1970
- During the autumn, (September to November 2000), an average of 492mm of rain fell over England and Wales, which was 191% of the 1961 – 90 average.

November 5th – 6th also 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 shingle were lost. An emergency recharge was required in order to return the defence to the required standard.

The amount of rain that fell 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 principally to excessively high groundwater conditions. As a result of the heavy rainfall in autumn 2000 and ongoing wet weather between November and February 2001, problems associated with high groundwater levels in the chalk stream areas are still a cause for concern to the Agency and of course local residents.

Figure 2.1: An Aerial view of Penshurst on Friday 13th October 2000 at the confluence between the River Eden with the River Medway.

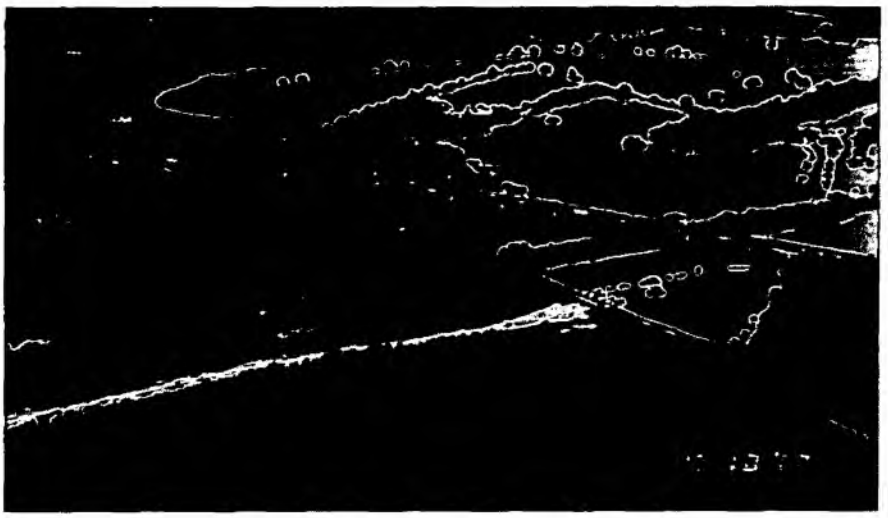
2.3 RIVER FLOWS

The heavy rain in mid October fell onto already wet soils, many of which in the West Kent Area are clay based, with the consequence that run-off into streams and rivers was relatively rapid. The worst affected rivers in the Kent Area were the River Rother, the Upper Medway and the Teise with their headwaters in south west Kent and south east Sussex and the River Beult on wealden clays. As a consequence of the high flows in its southern tributaries, the River Medway downstream of Penshurst was also badly affected by flooding.

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 the flood water, often to depths greater than previously experienced by local residents. The smaller, upland catchments were the first to react to the heavy rainfall with villages such as Lamberhurst on the Teise and Robertsbridge on the Rother suffering. 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.

The Leigh Barrier across the floodplain of the Medway was manned from early on Monday 9th October, with excess flood water being impounded from October 12th, flooding the valley thereby reducing the volume of water passing through Tonbridge. The Barrier was continuously manned by Agency staff for six days until the evening of Saturday 14th October. The severity of flooding at Tonbridge and the villages downstream was significantly reduced by the operation of the Barrier. Otherwise the damage would have been more devastating than the 1968 floods.

Figure 2.2: An aerial view of the Leigh Barrier in operation on the afternoon of the 12th October 2000



Beyond the protection of the Leigh Barrier, some distance downstream of Tonbridge, the village of Yalding adjacent to the confluence of the Beult, the Teise and 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 the villages of Wateringbury and East Farleigh closest to the river suffered flooding as did Maidstone, 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 further widespread flooding across the Kent Area. Significantly the rain fell on already saturated land with rapid run-off into already swollen streams and rivers. Hence whilst less rain fell during the storms at the end of October and the beginning of November, the severity of the flooding in many places was only marginally less than that for the flooding of the 9th–19th October.

Figure 2.3: View across the floodplain of the River Medway with the Hop Farm at Stilstead in the distance.

The second event of 29th–31st October was of shorter duration than the flooding in mid October, 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, 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, preventing flooding in Ashford and Wye.

The third event from 5th–8th November was also of shorter duration than that in mid October but, as with the second event, caused relatively severe flooding in the Kent Area. The flooding was again widespread with numerous properties being inundated for the third time in five weeks. Yalding, Robertsbridge and Lamberhurst were once again badly affected and the Leigh Barrier again was brought into action, this time for a period of four days. Fortunately, the reservoir had been emptied after the previous event before new impounding began. This, was not the case on the East Stour and the Great Stour, where fixed mechanical devices (hydrobrakes) control the discharges from flood storage reservoirs at a constant rate to ensure that flow downstream stays within bank. New floodwater entered the partially emptied reservoirs at Aldington and Hothfield. Despite the return period of the third event being less than the design standard of the reservoirs, Aldington Reservoir overspilled via the designed spillway and three times the design flow of $4m^3/s$ was discharged into the watercourse below. The village of Mersham immediately downstream of Aldington avoided the worst effects of flooding, although three properties were affected. 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.

The severity and duration of the rainfall over the Kent Area, particularly during the storm of 9th–14th 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. However, Yalding suffered from flooding for 24 to 48hrs duration, again on three occasions, due to the longer time of flood water concentration at the confluence of the Teise and the Beult with the Medway.

Table 2.3 gives estimates of peak flows and return periods at various locations in the Kent Area for the autumn 2000 floods. The flows have either been identified by reference to the Agency's gauged records and/or estimated by use of the Flood Studies Report, (FSR), methodology which makes use of catchment characteristics and rainfall records. The return periods have generally been obtained by use of Flood Estimation Handbook, (FEH), methodology that makes use of catchment characteristics and historical flow gauge records. At a few locations, however, estimates of return period have also been obtained by reference to previously published work by other consultants on behalf of the Agency. Where no results have been given, this is either due to insufficient time to carry out detailed analyses or the lack of adequate data.

The results to the initial study of return periods have been examined, where there is concern regarding the accuracy of the return periods further investigations have proven to be necessary. For the individual locations descriptions have been given

relating to how the return period has been calculated. Further investigations into the validity of the return periods had to be carried out, the final recommended return periods and flows appear in Table 2.4.

Table 2.3: Estimates of peak flows and return periods for Kent Area Autumn 2000 Floods

Location	River	9th - 14th Oct		29th - 31st Oct		5th - 8th Nov	
		Peak Flow	Return Period	Peak Flow	Return Period	Peak Flow	Return Period
Medway							
Edenbridge	Eden	46	1 in 17				
Penshurst (1)	Eden	56	1 in 18				
Penshurst (2)	Upper Medway	172	>1 in 500				
Leigh Barrier (1)	Medway	260	1 in 85	190	1 in 28	200	1 in 35
Leigh Barrier (2)	Medway	260	>1 in 200	190	1 in 100	200	1 in 120
Leigh Barrier (3)	Medway	216	1 in 130				
Tonbridge	Medway	150	1 in 65	110	1 in 33	105	1 in 30
Hadlow (1)	Bourne					14	1 in 15
Hadlow (2)	Bourne	9	1 in 3				
Lamberhurst.(1)	Teise	52	>1 in 500				
Lamberhurst.(2)	Teise	52	>1 in 200				
Stone Bridge (1)	Teise	42	1 in 30	42	1 in 30	40	1 in 25
Stone Bridge (2)	Teise	110	>1 in 500				
Headcorn	Beult	106	1 in 70				
Stile Bridge	Beult	67	1 in 14	60	1 in 9	57	1 in 7
East Farleigh	Medway	275	1 in 40	218	1 in 11	214	1 in 12
Darent							
Eynsford	Darent	16	>1 in 500				
Rother							
Robertsbridge (1)	Rother	151	>1 in 200				
Robertsbridge (2)	Rother	115	1 in 75			65	1 in 10
Great Stour							
Aldington	East Stour	11	1 in 9				
Hothfield	Great Stour	23	>1 in 500				
Wye	Great Stour	26	1 in 25	24	1 in 15	26	1 in 25
Canterbury	Great Stour	26	1 in 13	23	1 in 7	32	1 in 50

The following points should be noted with respect to the data within the above table:

Edenbridge - The flow estimate was obtained by the FSR methodology for ungauged catchments, whilst the return period was obtained by the FEH methodology.

Penshurst (1) - These results are for the River Eden catchment only at Penshurst. The flow estimate was obtained by the FSR methodology for ungauged catchments, and compares very well with the gauged flow at Vexour Gauging Station, nominally 3 kms upstream, which peaked at 51 cumecs. The return period was obtained by the FEH methodology.

Penshurst (2) - These results are for the Upper Medway catchment only at Penshurst. The flow estimate was obtained by the FSR methodology for ungauged catchments, but does not compare well with the recorded flow at Colliers Land Gauging Station which peaked at just 83 cumecs. There are good reasons, however, to doubt the validity of the gauged record at Colliers Land. The return period was obtained by the FEH methodology.

Leigh Barrier (1) - The incoming peak flows to the Leigh Barrier reservoir were obtained by reference to the continuous records kept during impounding, whilst the return period estimates were obtained by reference to the "return period/inflow" chart within the operating manual for the Leigh Barrier. The manual was prepared nominally 20 years ago.

Leigh Barrier (2) - The incoming peak flows to the Leigh Barrier reservoir were obtained by reference to the continuous records kept during impounding, whilst the return period estimates were obtained by use of the FEH methodology. Again, it should be noted that there are doubts regarding the accuracy of the "stage/discharge" relationship for the sluice gates at the Leigh Barrier as taken from the Operating Manual, which then leads to similar concerns regarding the accuracy of the calculated inflow to the reservoir.

Leigh Barrier (3) - The peak flow was obtained, for comparison purposes, by the FSR methodology, whilst the return periods were obtained by the FEH methodology.

Tonbridge - The discharges from the Leigh Barrier through Tonbridge were obtained by reference to the continuous records kept during impounding, whilst the return period estimates were obtained by reference to the "return period/outflow" chart within the operating manual for the Leigh Barrier. The manual was prepared nominally 20 years ago. Again, it should be noted that there are some doubts regarding the accuracy of the "stage/discharge" relationship for the sluice gates at the Leigh Barrier, as taken from the Operating Manual.

Hadlow (1) - The peak flow from the Agency gauging station at Hadlow was only available for the third event and the return period was obtained by means of the FEH methodology.

Hadlow (2) - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology

Lamberhurst (1) - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology.

Lamberhurst (2) - The peak flow has been obtained by means of the FSR methodology and the return period by reference to the "return period/flow" relationship from "River Teise, Lamberhurst - Preliminary Investigation into River Flooding on 30th December 1993" by Babtie Shaw and Morton dated January 1995.

Stone Bridge (1) - The peak flows were obtained from the Agency's flow records for Stone Bridge Gauging Station, which is nominally 7 kms downstream of Lamberhurst, whilst the return periods were obtained by the FEH methodology. However, there are fears that the station was malfunctioning during the autumn floods due to the fact that the peak flows for all three events were all but identical.

Stone Bridge (2) - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology. It should be noted, however, that the effects of the Bewl Water reservoir would be to reduce the flows at Stone Bridge when compared to a purely natural catchment as assumed by the FSR methodology.

Headcorn - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology.

Stile Bridge - The peak flow was obtained by reference to the Agency's records for the gauging station at Stile Bridge, which is nominally 10 kms downstream of Headcorn, whilst the return period was obtained by the FEH methodology. The flow and return period obtained by this method, however, appear to be relatively low when compared to the results obtained for Headcorn and for other, nearby, catchments.

East Farleigh - The peak flow was obtained by reference to the Agency's records for the gauging station at East Farleigh, whilst the return period was obtained by the FEH methodology

Eynsford - The peak flow has been obtained by means of the FSR methodology and

the return period by means of the FEH methodology. However, there is concern about the validity of the results for Eynsford given the fact that at Hawley Gauging Station the maximum recorded flow was just 3.4 cumecs. Whilst this discrepancy could be explained by the various lakes on the Darent near Sevenoaks which would be expected to attenuate flood flows but might not be modelled adequately by FSR, uncertainties also exist with regard to the integrity of the gauged records from Hawley.

Robertsbridge (1) - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology.

Robertsbridge (2) - The peak flow and return period was obtained by applying the level records for the mid October event to "return period/flow/level" relationship for Robertsbridge contained in "Flooding at Robertsbridge, East Sussex - Engineer's Report" by the Babtie Group dated May 1996.

Aldington - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology. The FSR methodology was used to determine the river flow above the flood storage reservoir at Aldington. Below Aldington the flow was restricted to 4 cumecs.

Hothfield - The peak flow has been obtained by means of the FSR methodology and the return period by means of the FEH methodology, the results for upstream of Hothfield can not be trusted and have therefore not been included in Table 2.4. Further work will be required in order to ascertain a reliable set of data.

Wye - The peak flow was obtained by reference to the Agency's records for the gauging station at Wye, whilst the return period was obtained by the FEH methodology. (Please note that there appears to be a discrepancy between the gauged flows at Wye and the gauged flows at Horton for the three events. This is particularly so for the third event when the reservoir at Aldington overspilled discharging significantly more flow into the watercourses downstream than it would ordinarily have done).

Canterbury - The peak flow was obtained by reference to the Agency's records for the gauging station at Horton, whilst the return period was obtained by the FEH methodology. (Please note that there appears to be a discrepancy between the gauged flows at Wye and the gauged flows at Horton for the three events. This is particularly so for the third event when the reservoir at Aldington overspilled discharging significantly more flow into the watercourses downstream than it would ordinarily have done).

Table 2.3 contains the final recommended flows and return periods for various locations within the Kent Area after taking account of the details contained in the points above i.e. they are the refined version of the figures that appear in Table 2.4.

Table 2.4: Recommended flows and return periods for Kent Area

Location	River	9th - 14th Oct		29th - 31st Oct		5th - 8th Nov	
		Peak Flow	Return Period	Peak Flow	Return Period	Peak Flow	Return Period
Medway							
Edenbridge	Eden	46	1 in 17	NB. Subsequent events may be of a higher magnitude.			
Penshurst	Eden	56	1 in 18				
Penshurst	Upper Medway	172	>1 in 200	Research ongoing.			
Leigh Barrier	Medway	260	>1 in 100	190	1 in 30	200	1 in 40
Tonbridge	Medway	150	1 in 65	110	1 in 33	105	1 in 30
Hadlow	Bourne	9	1 in 3			14	1 in 15
Lamberhurst	Teise	52	>1 in 100	Research ongoing.			
Headcorn	Beult	106	1 in 70	Research ongoing.			
East Farleigh	Medway	275	1 in 40	218	1 in 11	214	1 in 12
Rother							
Robertsbridge	Rother	151	>1 in 100	Research ongoing.			
Great Stour							
Upstream of Aldington	East Stour	11	1 in 9	Research ongoing.			
Upstream of Hothfield[1]	Great Stour	Research ongoing.					
Wye	Great Stour	26	1 in 25	24	1 in 15	26	>1 in 25
Canterbury	Great Stour	26	1 in 13	23	1 in 7	32	1 in 50

[1] *Flows and return periods upstream of Hothfield have been omitted from Table 2.4 due to the peak flow being predicted using the FSR methodology which proves to be somewhat untrustworthy, meaning that there is still work to be undertaken.*

Flows and return periods have not been included for Eynsford due to concern over the accuracy of the figures obtained using the FSR methodology.

It is recommended, however, that the flow and return period results from either of the two tables are used only with caution. It is important to note also that return periods may vary throughout the catchment covered. A number of problems associated with the hydrological analyses carried out means that the confidence in the accuracy with respect to the individual results is variable. The difficulties encountered can be summarised as follows:

a) **FEH Methodology** - Whilst this is considered to be the most reliable method of predicting return periods when reliable flow data are available for the site or an adjacent site and the peak flow during the event is known, it should be noted that the FEH procedure appears to be relatively unstable when used to assess return

periods in excess of 1 in 100 years. Under such conditions, iterations involving initially assumed target return periods and calculated return periods do not necessarily converge. For this reason a maximum target return period of 1 in 100 years has been adopted

b) **FSR Methodology** - This method of estimating peak flows by the use of rainfall records is only adopted when a gauged peak flow for the flood event and location under consideration is not available. It should be noted, however, that this method is not considered to be especially reliable.

c) **Gauged Records** - The analysis was complicated by the thin coverage of reliable high-flow gauging stations across the Kent Area and uncertainties with those that do exist. These led to the need to carry out numerous FSR analyses to estimate the peak flows for the rainfall events on the catchments. The situation was further compounded by the fact that the gauged records on the FEH database, which ended generally in 1995, were often not compatible with the Agency data for the same gauging stations. The above problems have resulted in doubts about the validity of the available flow data from the Agency's gauging stations at Colliers Land on the Upper Medway, Udiam on the Rother, Stone Bridge on the Teise, Stile Bridge on the Beult, Hawley on the Darent, and Wye and Horton on the Stour.

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 first event resulted in a peak inflow to the flood reservoir of nominally 260m^3/s. Whilst the second event had a peak inflow at Leigh of nominally 190m^3/s and the third event had 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 commissioning of the Leigh Barrier scheme in 1981. The highest inflow to the Leigh Barrier prior to the autumn 2000 floods was 144m^3/s in December 1982.

2.4 ISSUES AND RECOMMENDATIONS

SO/K/FF/1 Accuracy and timeliness of Heavy Rainfall Warnings	
Issue	The timeliness and accuracy of all weather warnings from the Met Office needs urgent review. Forecast information received during the event was frequently late and often unreliable.
Recommendations	Accurate and timely forecast information is essential to effective flood forecasting and warning. The Met Office is urged to review its procedures and systems for forecasting extreme rainfall events as seen during the autumn.

SO/K/FF/2 Accuracy of Weather Radar	
Issue	The south east of England suffers from very poor weather radar coverage causing differences in forecast and actual rainfall intensities. The rainfall figures cannot be used to input accurate rainfall forecasts into flood forecast systems.
Recommendations	Instigate and identify possible new radar sites in the south east and develop a business case for its installation. Ensure further work is carried out by the Met Office to improve the accuracy of the six hour Nimrod forecast.

SO/K/FF/3 Agency Telemetry and outstation Robustness	
Issue	The telemetry outstation network and the newly introduced Regional Telemetry System provided essential information. Coverage for some locations is better than others.
Recommendations	Within the current four year Regional Telemetry Network Improvements Project, the Agency will review the need for additional sites and the siting of sites above the 1:100 year floodplain. Where possible these sites need to be robust enough to withstand extreme conditions. Prioritise key sites where high flow gauging is required within the Regional Telemetry Networks Improvements Project.

SO/K/FF/4 River Flows	
Issue	The lack of reliable gauging stations for high river flows across the county and the inconsistency, in some cases between the Agency's records and those on the Flood Estimation Handbook database.
Recommendations	A review is carried out with respect to the number and reliability of high flow gauging stations in the Kent Area. A detailed review is carried out to identify the reasons for discrepancies between Agency records of gauged flows and those held on the Flood Estimation Handbook database.

3 FLOOD WARNING

The Environment Agency is the lead authority for the dissemination of flood warnings to members of the public, the media and other operating authorities. The flood warning service comprises two key components:

- The Automated Voice Messaging (AVM) system, enabling the direct transmission of warnings to service recipients.
- The 'Floodline' public information service, enables people at risk to:
  - Obtain regular updates with regard to weather conditions and water levels.
  - Report flooding incidents.
  - Order an advice pack.
  - Speak to a BT operator for further advice, or to be transferred to the Local Environment Agency office.

The Agency can provide a flood warning service in defined Flood Warning Areas. Beyond these areas, a general, catchment 'Flood Watch' message may be issued in advance of forecast rainfall, to provide an early warning of general flooding problems across a wider area. There are currently 28 Fluvial and 11 Coastal Flood Warning Areas and 7 catchment Flood Watch messages in the Kent Area. Arrangements for flood warning dissemination are detailed in the *Local Flood Warning Plan for Kent*.

The flood warning service uses the following codes:

- Flood Watch — Flooding is possible. Be aware, be prepared.
- Flood Warning — Flooding is expected. Act now.
- Severe Flood Warning — Serious flooding is expected. Imminent danger.
- All Clear — There are no Flood Watches or warnings in force.

3.1 TRIGGER/THRESHOLD LEVELS FOR 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 catchment saturation level. The majority of fluvial Flood Warnings are based on actual or forecast trigger level exceedence for river flow and river level, with those for 'flashier' urban rivers based upon rain gauge alarms. Site observations are also sought prior to the issue of Severe Flood Warnings. These are achieved by the Emergency Workforce liaising with the Operations Duty Officer and the Flood Warning Duty Officer in the Area Incident Room.

3.2 TRIGGER LEVELS FOR SPECIFIC SITES

Please see Appendix G that tabulates trigger levels for Kent Area telemetry sites at some of the worst affected locations.

3.3 WARNINGS ISSUED

During period covered in this report, a total of 323 warnings were issued for Kent Area as follows.

Table 3.1: Summary of warnings issued 15th September - 15th November

Warning code	No. of Warnings
Fluvial	
Severe Flood Warning	28
Flood Warning	101
Flood Watch	163
Catchment Flood Watch	19
Fluvial Total	**311**
Coastal	
Severe Flood Warning	0
Flood Warning	4
Flood Watch	8
Coastal Total	**12**
Grand Total	**323**

Table 3.2: Summary of fluvial Warnings Issued: 9th October 2000 to 19th October 2000

Warning Code	No. of Warnings
Severe Flood Warning	12
Flood Warning	23
Flood Watch	45
Catchment Flood Watch	7
Total	**87**

Table 3.3: Summary of fluvial warnings issued 29th October 2000 to 2nd November 2000

Warning Code	No. of Warnings
Severe Flood Warning	6
Flood Warning	41
Flood Watch	17
Catchment Flood Watch	8
Total	**69**

Table 3.4: Summary of fluvial Warnings Issued: 5th November 2000 to 13thNovember 2000

Warning Code	No. of Warnings
Severe Flood Warning	9
Flood Warning	25
Flood Watch	15
Catchment Flood Watch	7
Total	**56**

3.4 AUTOMATED VOICE MESSAGING (AVM) USE AND EFFECTIVENESS

The Kent Area Incident Room has its own Automated Voice Messaging (AVM) system and since the introduction of the Changing Needs in Flood Defence Review (on 12th September 2000) the Kent Area is responsible for the dissemination of its own Flood Warnings. Warnings are authorised by the Flood Warning Duty Officer (FWDO) and issued by the Assistant Flood Warning Duty Officer (AFWFDO), who is also responsible for keeping the "Floodline" service updated.

There is one AVM in each Area office in the Southern Region and a back-up machine in the Regional Office at Worthing. The four AVMs in Southern Region utilise the same database. If a fault occurs in one of the Areas' AVMs, another system can be used as a backup to ensure that warnings are issued.

The AVM can issue warnings via telephone, fax and pagers. The system is capable of making 1,600 calls per hour but experience indicates that a rate of 1,200 should be taken as a working average. All warning messages have been set up as templates in advance, with the application of date, time and specific information on fax templates being the only real-time preparation required. This ensures that flood warnings are issued efficiently and Assistant Flood Warning Duty Officers can prepare a warning

in five minutes. Each of the Automated Voice Messaging systems can be accessed remotely from other Automated Voice Messaging systems.

The Automated Voice Messaging system and its associated database is administered by the Regional Office and one member of staff is devoted full time to data entry, adding new recipients and changing records. Managing the data from the Regional Office is an effective way of ensuring all four Automated Voice Messaging systems contain the same information. It would be impractical to conduct database administration from the Areas, with four teams making changes.

In the event of a system failure, fax messages can be issued to professional partners and the immediate community via the 'Surefax' system, and loudhailers, which may be used to broadcast warning messages in critical areas. During some of the more severe events, Kent County Constabulary assisted the Agency in the dissemination of Severe Flood Warnings by informing residents on the ground by calling on 'at-risk' homes.

3.5 AVM AVAILABILITY AND RELIABILITY

Prior to 12th September 2000, the issuing of Flood Warnings was a responsibility held by the Regional Office. The AVM in the Regional Communications Centre was primarily employed, with the AVM in Hampshire, acting as back up. This could be accessed remotely from the Regional Communications Centre and warnings issued simultaneously if required, or if the Regional Communications Centre AVM had failed. However, issuing warnings remotely is slow. With the installation of two further AVMs under the Changing Needs in Floods Defence Review, capacity has effectively been doubled from 2,400 voice calls per hour to 4,800 voice calls per hour. Fortunately the events experienced during the autumn period were mainly fluvial, had these been compounded by the need to issue Coastal Flood Warnings, AVM capacity and performance could have been challenged. The Environment Agency will review the possibility of increasing the capacity of the current system.

3.5.1 Specific times when an AVM back up was utilised:

Evening of 9th October 2000 the Kent Assistant Flood Warning Duty Officer issued a Flood Watch for the River Cray via the Guildbourne House AVM, which was accessed remotely from the Kent AVM.

3.6 'FLOODLINE'

The Agency provides a 'Dial and Listen', local-rate, national telephone service Floodline – 0845 9 88 11 88 for advice and information about flooding.

The Floodline Recorded Message Service was continually updated to provide current information for the General Public.

When a caller dials Floodline they have an option to hear recorded information for flooding in their area. Callers can quickly obtain information for their area by using a Quickdial code (as published in Flood Warning Directories).

Floodline messages were recorded in parallel with the Automated Voice Messaging system. Floodline failed only once to record a message: on the 14th October at 23:00

for the River Medway at Maidstone. This proved serious as the message recorded was for a Severe Flood Warning. To record a new message on the Floodline Recorded Message Service, the old message must first be deleted and then the new message recorded. In this instance the system would not allow a new message be recorded.

It is important to note that other media also disseminated flood warnings to the public, radio and television proved valuable in ensuring that large sections of the community received valuable flood warning information.

3.7 ISSUES ARISING AND RECOMMENDATIONS

SO/K/FW/1 Automated Voice Messaging – Log Files	
Issue	The current AVM system records every call made in a log file. When warnings are disseminated the log file increases. If the log file becomes too large then the process of dissemination is slowed. The logs have to be deleted on a regular basis to ensure that the AVM is operating at its optimum.
Recommendations	Train all AFWDOs on how to delete log files. Investigate whether the system can be adapted to an auto archive system. Improve voice engine hardware, review and upgrade when required.

SO/K/FW/2 AVM Availability and Reliability	
Issue	The AVM system could be more user friendly, the Agency could reduce the steps in message preparation and Warning dissemination.
Recommendations	The next version of the AVM needs to be more user friendly and easier to operate.

SO/K/FW/3 AVM Availability and Reliability	
Issue	When a large quantity of warnings are queued it can stress the system. The problems are associated with the current hardware.
Recommendations	Improve voice engine hardware, review and upgrade when required.

SO/K/FW/4 AVM Availability and Reliability	
Issue	As the autumn progressed there was a large demand from the public to be placed on the AVM system. This causes problems because they cannot be put on the system instantly. The AVM has to be taken 'off line' in order for the amendments to be made. The updating takes 6 –8 hours and therefore can only be done when there is a clear weather forecast.
Recommendations	Train all AFWDOs on how to update AVMs and ensure that the next version of the AVM is easier to update.

SO/K/FW/5 'Floodline'	
Issue	'Floodline' failed to accept a message on one occasion for a Kent flood warning area, leaving a blank message in the quickdial box. The problem occurred overnight, the service provider did not provide 24 hour service so the problem could not be rectified until the following morning.
Recommendations	The 'Floodline' service provider should have 24 hour service so that faults can be rectified at the time.

SO/K/FW/6 Floodline	
Issue	It was found during times of intense activity that it was onerous for AFWDOs to keep message boxes updated and disseminate the relevant flood warnings. The problem is compounded by the fact that for some flood warning areas notably the River Medway has within it 8 separate flood warning areas, all of which require updating when only one needs changing.
Recommendations	New message boxes have now been added so that there is one message per flood warning area

SO/K/FW/7 Floodline Call Handlers	
Issue	During the worst of the flooding the quantity of 'Floodline' calls was immense, leading to staff being pulled from functions other than Flood Defence to answer the phones. Some staff involved had little training on how to deal with calls from the public or a flood defence background.
Recommendations	For staff identified as Floodline call handlers to receive training on how to deal with calls from the public relating to flood defence.

4 EMERGENCY RESPONSE/STANDARDS OF DEFENCE

4.1 MAJOR INCIDENT PLANS ACTIVATED

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 the establishment of the Gold, Silver and Bronze Control centres to ensure a fully inter-organisational response in Kent. The Control centres once established, were the focus for the emergency services and their co-ordination.

Gold Control, has during a flood event, overall responsibility for strategic control with countywide responsibilities. This was established on four occasions throughout the autumn period. Silver Control is the second level of the Control hierarchy, also known as the tactical level. Silver Control follows guidance from Gold Control and liaises with operatives on the ground to ensure emergency works are carried out. The third level of the Control hierarchy is known as Bronze Control. Bronze Control is established when a localised response is required and consists of operational workforces who receive instructions from Silver Control to respond to events on the ground.

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 can be directly attributed to the Control structure, which allows a seamless inter organisational response.

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

The Environment Agency's procedures, including new flood warning and operation plans worked very well. Emergency response from professional partners, generally using generic plans for major incidents, also worked well. Without these plans in place and an Agency presence, who was familiar with Agency capabilities in emergency response control centres it would not have been possible to manage the event as effectively.

4.2 GOLD AND SILVER CONTROLS WITH AGENCY ATTENDANCE

Gold and Silver Control centres were established at various points throughout the autumn. At all times when the Control centres were open the Environment Agency staff maintained a 24-hour presence. Environment Agency Staff in Gold Control were usually team leaders or higher management. During the "Bonfire night" flood event the Agency recommended the opening a Gold Control Centre. The following table shows when Gold and Silver Control centres were operational:

Table 4.1: Opening and Closing of Gold and Silver Controls

Control Description	Opened	Closed
Gold Control	12/10/2000	15/10/2000
Gold Control	29/10/2000	01/11/2000
Gold Control	02/11/2000	03/11/2000
Gold Control	05/11/2000	08/11/2000
Silver Control	13/10/2000	16/10/2000
Silver Control	30/10/2000	03/11/2000
Silver Control	06/11/2000	07/11/2000

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

- Environment Agency
- Kent Police
- Kent Fire Brigade
- Kent Ambulance Service
- Kent County Council
- Social Services
- The Army
- HM Coastguard

Gold Control, is part of the Kent Police Emergency Incident Plan. Within the emergency plan it is a requirement that the Gold Control centre be established at the, Kent Police HQ, Sutton Road, Maidstone, Kent.

4.3 AGENCY (STAFFING, EQUIPMENT AND PLANT)

Over the autumn period a number of severe weather warnings were received. In response to these warnings 24 hour emergency response rosters were initiated. These rosters include the following roles identified in the procedures for the staffing of the Area Incident Room:

Table 4.2: Incident room staffing roles

Role	Description of Role
Area Base Controller (ABC)	Strategic Management of event
Flood Warning Duty Officers (FWDO)	Receive alarms, monitor levels and decide on which warnings to issue.
Assistant Flood Warning Duty Officers (AFWDO)	Issue warnings via the AVM, update 'Floodline' and assist the FWDO.
Operational Duty Officers (ODOs)	Receive alarms, monitor levels and operation of control structures, and liaise with EDO's.
Emergency Duty Officers (EDOs)	Manage Direct Workforce on the ground in liaison with ODOs
Gold Control	Liaise with ABC and professional partners.
Silver Control	Liaise with 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 Area Incident Room 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 can be temperamental and difficult/stressful to use. Investigations are being carried out with respect to a replacement system that will be able to disseminate warnings at a faster rate.

Throughout the autumn data collection was carried out during all of the recorded events. 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 which includes road marking crayons and a series of 1-10 000 scale maps for recording levels.

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

- 14 excavators
- low loader
- lorries
- bulldozers
- tractors
- 12 inch pumps

- 6 inch pumps

Environmental Protection officers managed their own incident desk during the autumn to receive reports of pollution arising from high water levels and to manage the response.

4.4 ADEQUACY OF AGENCY RESOURCES

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 effective management of the threat.

The number of Regional Incident Procedures trained staff within Flood Defence allowed 24-hour coverage of all roles. However, the longevity and severity of the "Great Flood" closely followed by two further severe events in early November did inhibit the running of the office on a daily basis.

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

Although minor problems were experienced with the Automated Voice Messaging (AVM) dissemination system, the resource was available in other areas. In times of need, a spare AVM 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.

4.5 NUMBERS OF STAFF DEPLOYED

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 Gold and Silver Control centres.

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

Tasks undertaken by the Emergency Workforce 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 "Great Flood" Emergency Workforce staff in South East Kent were required to repair a pumping station that became surrounded by floodwater. The Emergency Workforce operatives involved rowed out to the pumping station and replaced a gearbox.

On the 14th October Direct works Mechanical and Electrical section assisted navigation staff with the clearance of two boats that crashed into Allington sluices and became stuck. Mechanical and Electrical engineers then re-hung the sluice 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.

Below is a summary table showing the number of staff involved in the response by the Kent Area:

Table 4.3: Number of staff in Kent area involved in Emergency Response

Function	Number of staff
Area Incident Room (Including the various roles, 'Floodline' and Gold/Silver Control)	100
South Kent Area Operations	66
North Kent Area Operations	50
Data collectors and drivers	20
Total	**216**

4.6 RANGE OF FUNCTIONS AND INTER REGIONAL CO-OPERATION

Region proved to be a valuable source of information via the Regional Communications Centre and the Regional Flood Forecasting Service, which provided Forecasting Duty Officers and dissemination of river alarm levels, rainfall alarm levels and alarms relating to the operation of Environment Agency structures.

Such liaison proved vital, allowing responses from the Kent Area Incident Room to be of a proactive nature to the forecast threat.

4.7 EMERGENCY SERVICES, LOCAL AUTHORITY, OTHER RESPONSE ORGANISATIONS

Liaison occurred during events with the Local Authorities and Emergency Services either by telephone conversations or through contact at Gold and Silver Control.

The Emergency Services reported that procedures worked well with good liaison at Gold Control and that the benefit of Gold Control 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 own emergency plans. Activities undertaken by Local Authorities during the autumn flood events included, providing sandbags to local residents, providing advice to customers, assisting with evacuations and providing support to local residents.

Since the autumn flooding, Parish Councils have 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 and Lamberhurst. Local residents in some areas have in

response to these meetings arranged recovery groups and action groups the earliest examples being the Rother Recovery Group, East Peckham Recovery Group and the Little Stour and Nail Bourne River Management Group.

4.8 PROPERTY EVACUATED (NO. OF PEOPLE) AND TYPE

The number of people and properties evacuated was not accurately recorded, initial figures obtained from Local Authority estimates, indicate that approximately 140 properties were evacuated some of which more than once.

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. 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 "Great Flood" 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 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 which were residents of Tonbridge. The East Peckham Sports Centre was also established, catering for three families that were evacuated from East Peckham, although this is not representative of the total evacuees because most from East Peckham, Collier Street and Laddingford travelled to the Cornwallis School in Maidstone.

Rother District Council reported that over 80 properties were flooded in Robertsbridge during the course of the 10th – 16th October flood event. The residents of these properties were supplied with a temporary rest centre though none of the evacuated residents required overnight accommodation from the council. Many affected residents chose to evacuate to friends or family rather than council run rest centres.

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.

Canterbury and Ashford experienced high flows on the Great Stour, which occurred 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. The levels however never reached a point where evacuation of properties was necessary.

It has been estimated that during the autumn over 489 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 exceed that of Main River Flooding.

Table 4.4: Number of people evacuated 10-16th and 30th October

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**

Figures supplied by local authorities

Table 4.5: Predicted number of businesses affected by Autumn 2000 Floods

Flooded Village	Estimated Number of Businesses flooded	Cost to Businesses
East Peckham	21	£5 484 000
Etchingham	6	£54 000
Headcorn	6	£93 000
Lamberhurst	21	£360 000
Robertsbridge	17	£1 268 000
Yalding	25	£1 000 000

4.9 ISSUES AND RECOMMENDATIONS

SO/K/ER/1 Agency Staffing Equipment and Plant	
Issue	Flood Defence staff coped very well with the events, though due to the number of trained staff many officers had to work well above their normal working hours. The deficit of experienced staff to undertake Regional Incident Procedures roles was also a problem as predicted. This was most evident in North Kent where officers were required to manage the Leigh barrier. If the autumn events had been of a longer duration then the Area may have encountered problems with staff becoming increasingly exhausted.
Recommendations	Review Emergency Response Roles and Responsibilities to ensure that enough staff are on standby rotas and that more staff from across Agency functions are trained in Regional Incident Procedures roles.

SO/K/ER/2 Agency Staffing Equipment and Plant	
Issue	Obstructions and blockages identified during the event were sometimes visited more than once by the Emergency Workforce as it was unclear if an inspection had taken place.
Recommendations	Obstructions and blockages should be marked (e.g. with luminescent tape) so that it is clear that the issue has been investigated.

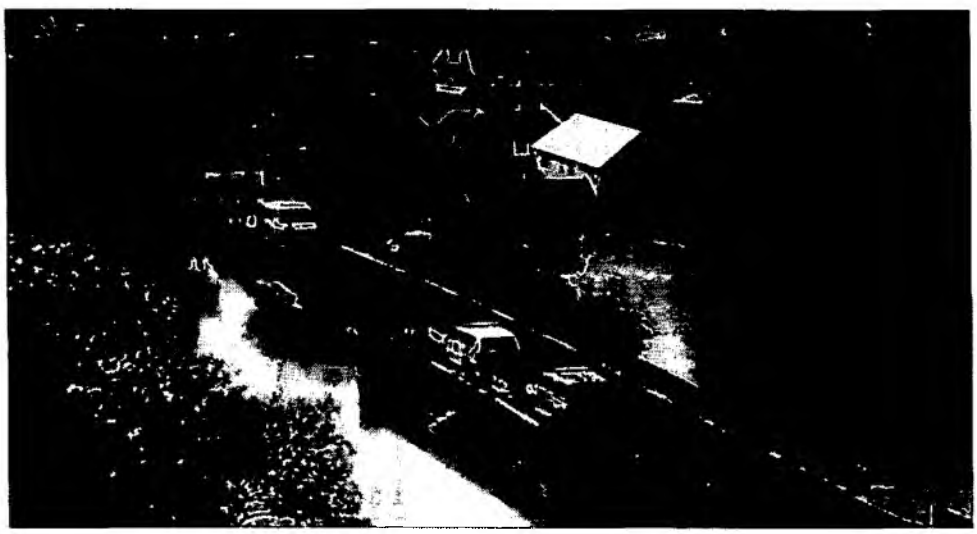
SO/K/ER/3 Property Evacuated	
Issue	Local Authorities did not keep formal registers of the people who were evacuated during the autumn floods and the people who attended rest centres, this is highlighted by the disparity between the figures gained from our questionnaire surveys.
Recommendations	The Local Authority should produce a formal register of people evacuated, including names and addresses.

5 EVENT IMPACT AND DATA COLLECTION

This chapter describes the extent and impact of the rainfall and river flow on the catchments in the Kent Area and the number of properties affected by the floods. The duration and intensity of the rainfall during autumn 2000 on already saturated catchments resulted in severe flooding throughout the Kent Area, with many properties being flooded by surface water, river water or groundwater, often contaminated by sewage as drainage systems failed to cope with the volume of water.

Agency staff worked around the clock to manage the flood events and to minimise the effects of flooding to the public. Staff worked in difficult circumstances, to clear obstructions from watercourses, to operate floodgates and pumping stations and to monitor and, in some cases, strengthen flood defences. It is important to note that the Agency's defences performed very well.

Figure 5.1: The High Street bridge in Yalding with the River Beult in flood.



After the mid October event, the Kent Area of the Agency was quick to recognise the need for the early collection and collation of flood data from the affected towns and villages. A team was set up at the Area Office at Addington to organise this data collection exercise and outside consultants were appointed to assist with the process. Survey work was carried out and a questionnaire survey was organised for residents and businesses in the worst affected towns and villages. Local consultants were employed to assist with the data collection and collation exercise, carry out hydrological analyses and to assist with the preparation of flood reports.

5.1 SOURCES OF FLOODING

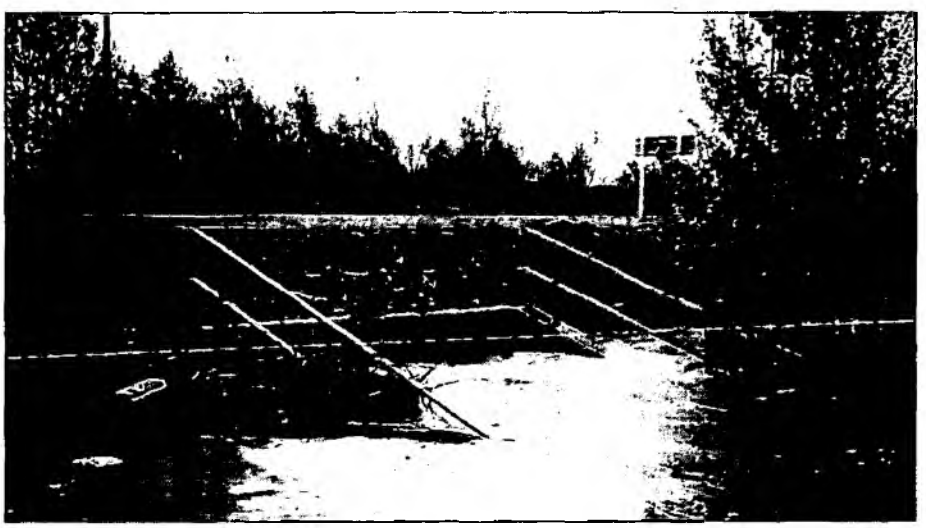
The principal source of flooding in the Kent Area was the sheer volume of rain that fell over relatively short periods onto already wet or saturated catchments. This led to rapid run-off from the land into streams and rivers that, for the last two flood events at least, were already swollen as a result 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 severe flooding of this sort was undoubtedly associated with 'main rivers', there were numerous incidents of flooding as a result of minor watercourses overspilling 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 behind culverts and bridges and blockages caused by waterborne debris.
- Backing up from road drains and surcharging of combined sewerage systems.
- Reduced storage in flood reservoirs due to repeat events.
- Little or no storage capacity in on-line water supply reservoirs.
- Recent building 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.

Figure 5.2: One of the culverts taking the River Rother flood flows beneath the A21 bypass embankment downstream of Robertsbridge



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 flood water and ended up partly 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 Kent Area.

Backing up of drains was thought to be a factor at many locations. For example, at Tonbridge on the River Medway, localised flooding was caused during the first 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 seepage route 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, during the third event, flooding occurred at Mersham on the East Stour upstream of Ashford when the Agency's flood storage reservoir at Aldington overspilled using the designed spillway. The reservoir had only partially emptied following the previous event.

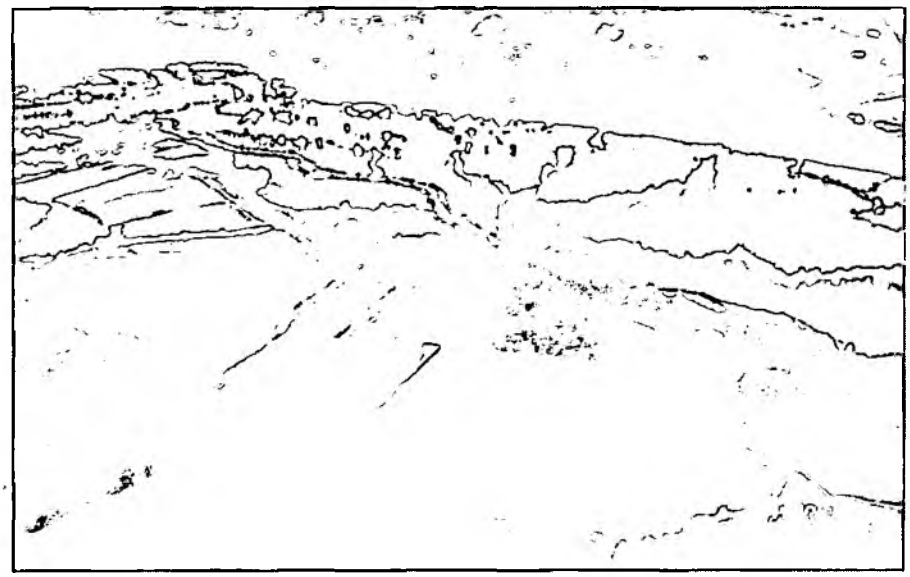
A questionnaire survey carried out on behalf of the Agency subsequent to the autumn 2000 floods revealed recent residential developments in the floodplain at most of the villages visited.

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 Nail Bourne and Little Stour.

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.

In one instance flooding may also have been affected by the capacity Eldridges Lock, immediately downstream of Tonbridge, situated on private land which may not have the same flow capacity as the adjacent river channels. The poor condition and lack of capacity of the ageing sluice and weir might have been partly responsible for backing up of floodwater.

Figure 5.3: Aerial view of the River Medway floodplain downstream of Tonbridge 13th October 2000



Other factors which have to be considered on the River Medway are the Agency's current operating regime for the Leigh Barrier upstream of Tonbridge. This major flood control structure uses manual procedures that were originally established 20 years ago. Furthermore, the procedures are still based on the use of original theoretical hydro-graphs of incoming flows into the reservoir and have not been sufficiently developed to take account of 20 years of operating experience because since the commissioning of the barrier a large flood had not previously been experienced. The quality of the flow gauging stations upstream from the barrier could be improved. They are used to give warning of the size of the hydro-graph approaching Tonbridge. It was reported that, during the autumn flood events, the gauging stations were not gauging the total flow leading to difficulties in the management of the barrier. It would seem that, under such circumstances, the staff operating the Leigh Barrier, particularly during the "Great Flood" in mid October, did exceptionally well to control the flood water through Tonbridge whilst managing to avoid major flooding to the town.

Figure 5.4: Aerial view of Colliers Land bridge on the Upper Medway, the gauging station is a key element of the Leigh Barrier operating system.

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 were waves caused by vehicles travelling too fast along flooded roads.

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

- A significant number of residents in Yalding, Collier Street and Headcorn near to the confluence of the Beult and Teise with the Medway felt that the operation of the Leigh Barrier upstream of Tonbridge was in some way to blame for the severity of the flooding in their village. However without the Leigh Barrier, the flooding through Tonbridge and villages downstream would have been very much worse.

Figure 5.5: General view of Yalding. The River Beult is in the foreground.

- Many residents, particularly in the villages in the low lying areas between the Beult, the Lesser Teise and the Teise, considered that lack of dredging of river channels over recent years and failure to clear field drains and culverts to be contributory factors to the flooding. It is important to note that the Agency has in place a rolling maintenance programme identifying future works.

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

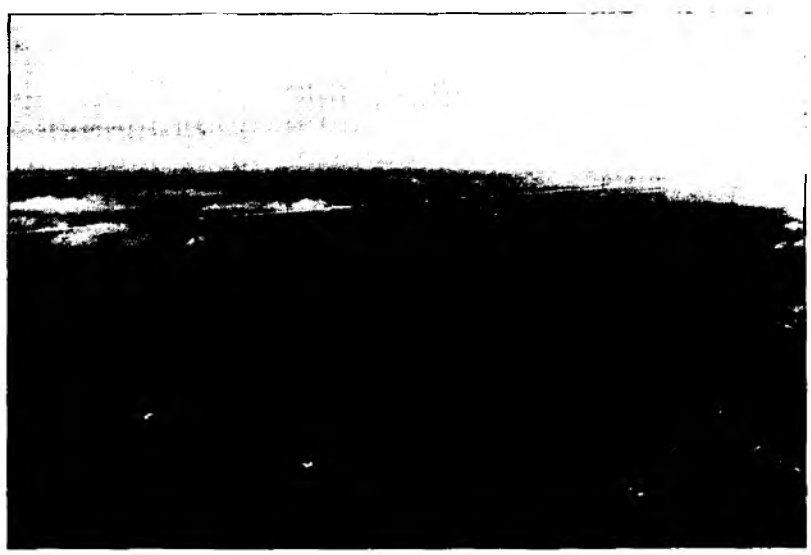
- Residents of Robertsbridge felt that the A21 bypass contributed to the extreme flooding in the village.

- A few residents of Robertsbridge were of the opinion that the flooding was tidally influenced, even though the village is approximately 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 approximately 5km downstream of Robertsbridge.

- Some residents in Robertsbridge reported a surge of water through the village around the time of the peak of the mid October event. Some suggested this may have been linked to the operation of a sluice gate by the Agency further upstream, although no such structure exists.

- Several residents in Collier Street and Marden reported that a "bore wave" travelled through the villages on the aftemoon of Thursday 12th October leaving severe damage in its wake. This phenomenon seems to have been confirmed by a motorist who reported that his car in which he was travelling was swept by a "wave" into a roadside ditch near Headcorn.

Figure 5.6:Aerial view of the River Teise and the Lesser Teise on Friday 13th October, showing Colliers Street and Laddingford.



- Several residents in Collier Street thought that the raised banks along the Lesser Teise were formal flood defences managed by the Agency, whereas in practice they are probably the result of silt disposal from earlier dredging operations.

- At least one resident, believed that the radial sluice gate structure at Cheveney on the River Beult was used by the Agency to retain flood water behind with controlled discharges downstream. In practice the sluice is designed to automatically retain water levels upstream during periods of low and normal flows, and to open automatically in response to higher flows in order to minimise flooding upstream.

5.2 NUMBER OF PROPERTIES NOT FLOODED DUE TO AGENCY DEFENCES

Best estimates indicate that approximately 1,200 additional properties in the Kent Area would have been flooded were it not for Agency-managed flood defences. in the following locations:

- **Edenbridge** – Approximately 150 properties in Edenbridge on the River Eden are protected from flooding 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, seemingly just managed to withstand the mid October event and coped adequately with the subsequent floods.

- **Tonbridge** – 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 approximately 700 properties in Tonbridge to a theoretical standard of 1 in 100 years. Serious flood damage upstream of the High Street was avoided during the mid October event. In all three flood events, however, the commercial part of the town below the High Street was flooded, 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.

Figure 5.7: Botany in Tonbridge inaccessible due to flooding.

- **Smarden** – This village on the upper reaches of the River Beult has a flood alleviation scheme that was built in 1997 which provides protection to 15 or so properties to a design standard of 1 in 50 years. The scheme consists principally of low flood walls and embankments and a pumping station belonging to Southern Water Services which evacuates excess surface water in the village. In general the defences 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** – Around 300 properties in Ashford are protected from flooding from the Great Stour by means of on-line flood storage reservoirs at Aldington and Hothfield. Excess floodwater 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 first two flood events in October the reservoirs performed their tasks satisfactorily. However, as explained previously, the reservoir at Aldington overspilled during the "Bonfire Night" event with an estimated additional $12m^3/s$ being discharged over the designed spillway.

- **Robertsbridge** - Up to 40 properties on the upstream side of the High Street in Robertsbridge are reported to be protected from flooding from the River Darwell by means of low flood embankments on the right bank of the river between Station Road and the High Street. During the mid October event, this embankment was thought to have been overtopped.

Figure 5.8: Aerial view of the flooded Rother on 13th October 2000.

- **Bridge** – Nominally 50 properties in the town of Bridge are protected from flooding from the Nail Bourne by a scheme that was constructed in 1996. The scheme included improvements to High Street culverts, works to a ford and a short flood embankment. The defences operated satisfactorily through all three autumn flood events.

5.3 NUMBER OF PROPERTIES NOT FLOODED DUE TO THIRD PARTY DEFENCES

Most recent development within floodplains in the Kent Area will have included some form of attenuation works that will have helped to protect many properties from flooding. Furthermore, some residents have constructed flood defences around their

own properties, many of which are now coming to light as retrospective planning applications. Construction of bunds to protect properties should be given consent from the Agency prior to construction in order to ascertain whether the defence will exacerbate flooding to others. Also, several councils in the Area maintain their own defences. In some places, such as at Wateringbury on the River Medway, railway embankments through or alongside floodplains coincidentally double as flood defences. The same is also applicable to a number of road embankments in the Kent Area.

It is not known, however, how well these third party defences did perform and it is therefore not possible to estimate the number of properties that were successfully defended by third party defences.

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

There have been none reported.

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

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

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

Three properties were flooded at Mersham, a village downstream of the Aldington flood storage Reservoir and upstream of Ashford.

There were up to 40 properties that may have been flooded due to overtopping of a low flood embankment in Robertsbridge on the River Rother during the mid October event. These properties would probably, however, have been flooded anyway due to backing up of floodwater from the floodplain downstream of the High Street.

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

5.7 LIST OF TOWNS AFFECTED WITHOUT ADEQUATE DEFENCES

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. Also included, where available, are best estimates of the maximum return period of the autumn 2000 flood events.

Table 5.1: Towns affected without adequate Defences

Town or Village	River	Current Standard	Autumn Return Period	Indicative Standard
Yalding	Medway etc.	-	1 in 50	25 – 100 years
Maidstone	Medway	-	1 in 40	50 – 200 years
Headcorn	Beult	-	1 in 70	25 – 100 years
Lamberhurst	Teise	-	>1 in 200	25 – 100 years
Collier Street	Teise	-	>1 in 200	25 – 100 years
Laddingford	Teise	-	>1 in 200	25 – 100 years
Etchingham	Rother	-	>1 in 200	25 – 100 years
Robertsbridge	Rother	Unknown	>1 in 200	25 – 100 years
Fordwich	Great Stour	-	1 in 50	25 – 100 years

On the basis of the above and the initial findings of the causes of flooding in the Kent Area, it has been identified that investigations need to be carried out to assess the viability of stand alone flood alleviation schemes at Yalding and Robertsbridge. In addition, consideration will be given to investigations to assess the viability of flood alleviation works at the other locations within the scope of river strategy studies.

5.8 MAJOR INFRASTRUCTURE AFFECTED

The roads closed or badly disrupted by flooding, whether 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 - 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 - Penshurst; (Medway)

Figure 5.9: The B2162 Benover Road in Yalding village

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 between Ashford and Canterbury was closed due to groundwater inundation.

5.9 INCIDENCE OF REPEAT FLOODING

Many villages and towns in the Kent Area were subjected to repeat flooding during the autumn 2000 flood events. Yalding, Collier Street, Lamberhurst and Robertsbridge, however, were particularly badly affected by all of the three events whilst Five Oak Green, East Peckham, Ashford and Canterbury were affected more than once. Extreme examples of repeat flooding are low lying properties in Yalding, Lamberhurst and Robertsbridge which, according to the owners, have been flooded internally at least six times during the autumn and winter storms.

Figure 5.10: Rutley close Robertsbridge. Friday 13th October.

5.10 ISSUES AND RECOMMENDATIONS

The more important issues arising out of the autumn 2000 floods in the Kent Area with respect to event impacts and data collection are as follows: -

SO/K/EIDC/1 Sources of Flooding	
Issue	The capacity of the existing sluices on the River Medway, particularly the capacity and condition of the sluice and weir structures at Eldridges Lock downstream of Tonbridge.
Recommendations	A review is carried out with respect to the adequacy of the capacities of the existing sluice and weir structures at Oak Weir Lock, Eldridges Lock, East Lock and Porters Lock on the River Medway.

SO/K/EIDC/2 Sources of Flooding	
Issue	Ongoing maintenance of river channels, ditches, drains and culverts.
Recommendations	Carry out a review, as necessary, of the Agency's current maintenance programme for "main river" channels, especially with respect to the River Beult, the Teise and the Lesser Teise. Also carry out a review of the adequacy of the flow control structure at the bifurcation of the Teise with the Lesser Teise. Remind landowners and local authorities of their duties to maintain and regularly clear "non-main river" channels, ditches, surface gullies, drains and culverts. Encourage local authorities to collect data from flood events so that persistent problems can be brought to the attention of the Agency. Influence planners, developers and operators to ensure designs are carried out to take account of the whole drainage system and so that the systems are sustainable.

SO/K/EIDC/3 Sources of Flooding	
Issue	Building development within the floodplain
Recommendations	Seek to increase the Agency's influence on planning issues. and continue to raise political awareness of the detrimental effects of floodplain development

SO/K/EIDC/5 Sources of Flooding	
Issue	The adequacy of the size of the flood culverts beneath the A299 Thanet Way.
Recommendations	An assessment is carried of the adequacy of the flood culverts under the A299 Thanet Way at the Swalecliffe Brook and Westbrook.

SO/K/EIDC/6 Sources of Flooding	
Issue	Localised problems of flooding due to vehicle wash.
Recommendations	Undertake liaison with local authorities and the police with respect to control of vehicle movements along flooded roads.

SO/K/EIDC/7 Sources of Flooding	
Issue	Public misconceptions regarding the causes of the flooding.
Recommendations	An assessment is carried out into ways of raising public awareness into the work of the Agency, the causes of flooding and how flood defence systems are operated.

SO/K/EIDC/8 Number of Properties Not Flooded Due to Agency Defences	
Issue	The adequacy of the existing flood defences at Tonbridge
Recommendations	A structural and hydraulic analysis is carried out regarding the low flood defences on the south bank of the River Medway as they pass through Tonbridge, followed by structural repairs or replacement as appropriate

SO/K/EIDC/9 River Flows	
Issue	The causes and severity of flooding at Yalding and Robertsbridge.
Recommendations	Feasibility studies are to be carried out into the viability of new flood alleviation schemes at Yalding and Robertsbridge. An assessment is made into the adequacy of the flood culverts beneath the A21 bypass embankment at Robertsbridge.

SO/K/EIDC/10 River Flows	
Issue	Post flood event data collection.
Recommendations	A review is required into the Agency's data collection and collation procedures after significant flood events, to accurately establish the number of properties flooded.

SO/K/EIDC/11 River Flows	
Issue	Enhanced understanding of river catchment dynamics and inter-dependencies.
Recommendations	Ensure the early completion of Catchment Flood Risk Management Plans in the Kent Area to address all relevant issues such as flooding, land-use planning and the likely effects of climate change.

6 SUBSEQUENT EVENTS OF IMPORTANCE

The scope for the Autumn 2000 Floods Review Area Report, was to cover the period of the 15th September through to 15th November, and therefore did not include the serious flood events that occurred later in the winter. The most significant events of the winter impacted on some of those catchments that escaped the worst of the flooding that occurred in the autumn period. National media were present to record the events that were experienced in February on the lesser known rivers such as the Swalecliffe Brook, West Brook, Plenty Brook, the Nail Bourne and the Little Stour while further flooding was also experienced over the rest of Kent.

6.1 DECEMBER 2000

7th – 15th December: Heavy rainfall throughout the Kent Area prompted the opening of the Kent Area Incident room. Flood storage reservoirs at Leigh, Aldington and Hothfield captured the peak flows. The following wamings were issued:

- 2 Severe Flood Warnings, for the River Teise and Beult.
- 24 Flood Warnings.

Flooding of properties occurred at Lamberhurst (3 in number), Yalding (6 in number) and Littlebourne, Patrixbourne, Wickhambreaux. 20 properties remained flooded due to the Nail Bourne and the Little Stour.

6.2 JANUARY 2001

6th January: Further rainfall in early January again led to the Kent Area Incident room being opened. Repeat flooding was experienced at Yalding, Robertsbridge and on the River Stour.

- 9 Flood Warnings were issued, along with
- 26 Flood Watches

Flood storage reservoirs at Leigh, Aldington and Hothfield captured the peak flows. Although no property was reported to have flooded from 'Main River' large areas of agricultural land was inundated.

6.3 FEBRUARY 2001

7th – 10th February The evening of the 8th February saw intense rainfall concentrated mainly in the East of the County, with raingauges recording up to 60 mm in a 24 hour period. The combination of saturated catchments and already high flows in rivers led to the following warnings being issued:

- 76 Flood Watches
- 50 Flood Warnings
- 8 Severe Flood Warnings

During this period 30 properties were flooded at Chick Hill on the Pett Levels, local Police initiated evacuations of the affected homes.

The rainfall again caused problems on the Nail Bourne and the Little Stour resulting in up to 50 properties being flooded in the villages of Bridge, Patrixbourne, Littlebourne and Wickhambreaux. Roads running adjacent to the river or crossing it were closed during most of the winter period.

Again Rutley Close, in Robertsbridge was affected with four properties reporting internal flooding. These houses have been empty since November due to the ongoing flooding problems encountered over the past year.

6.4 RIVERS AFFECTED

The following paragraphs detail the flooding experienced after the 15th November on rivers that were not adversely affected during the autumn.

6.4.1 Elham Valley

Little Stour and Nail Bourne

The Little Stour flows from perennial springs at Well Chapel near Garrington, north of Littlebourne, to the confluence of the Little Stour and the Great Stour at Plucks Gutter. The Little Stour is in effect the continuation of the Nail Bourne as they both merge at Garrington. The Little Stour is the reach of river that flows all year round and is the historic reason why two different named rivers exist in one valley.

Historically the Little Stour between Littlebourne Bridge and Wickhambreaux Mill has been diverted from its original course to power numerous water mills. During high groundwater conditions water emerges as springs and flows to the lowest part of the valley; following the original course of the Little Stour, rather than being intercepted by the present channel. Correspondingly surface runoff and surface drainage do not discharge into the canalised reach.

Flows in the Little Stour are affected by inputs from the Nail Bourne. As stated previously flows can be expected to be 'flashy' in response to rainfall events when groundwater levels are high.

Extensive flooding was experienced in both the Grove and Preston Marshes, with floodwater overspilling from the Great Stour. The four pumps at Stourmouth Pumping station were operating at full capacity but it was necessary for the Emergency Workforce to install two 12inch pumps and three 6inch pumps in order to cope with the increased volume of water.

Flooding was reported from the canalised section of the Little Stour upstream of Ickham mill. Surface water flooding affected Nargate Street, Littlebourne, due to high river levels restricting surface water drainage from discharging. Groundwater flooding impacted on the low-lying areas between the Wickhambreaux and Ickham. Land drainage features such as ditches, including one section of the Blackhole Dyke, exist in this area. The high river levels in the Little Stour impeded the drainage of the area. The combined effects of groundwater and surface water continued to cause flooding throughout the winter and into the spring.

The Nail Bourne flows from Lyminge near Folkestone to Littlebourne near Canterbury a distance of approximately 25km. The Nail Bourne rarely flows its full length due to it being a groundwater fed river, it is therefore reliant on high groundwater levels to promote flow. Previously it has flowed in fragmented sections if at all. Historical evidence suggests that the earliest the Nail Bourne rises is during January, with the normal time being later in spring, when groundwater is at its highest following winter recharge. The build up to the winter flood event can be traced back to the winter of 1999-2000, where high quantities of rainfall resulted in recharge of the chalk aquifer. The summer of 2000 was cool and damp, compounding the high groundwater levels due to low evapotranspiration. The autumn period of 2000 was the wettest since records began in 1766, with the autumn deluge starting in early September. October and November rainfall figures were well above average resulting in the highest groundwater levels at Bekesbourne Hill Farm since observations began in 1967. In response to the chalk aquifer recharge, groundwater levels rose resulting in emergent springs and flow in the Nail Bourne. Flow in the complete length of the Nail Bourne was recorded in mid November.

It is possible to deduce that the Nail Bourne will continue to flow through the spring and into the summer due to high groundwater levels supporting baseflow. The effects of evaporation and evapotranspiration will bring an end to further recharge in the spring; correspondingly flows will then recede, reducing the risk of fluvial flooding. If however the summer is cool with low levels of evaporation the groundwater levels are unlikely to fall to levels whereby flow completely ceases in the Nail Bourne.

Figure 6.1: Nail Bourne upstream of Bridge

The first people who experienced flooding, were those flooded from emergent springs, with groundwater coming through their floorboards and into the houses. Properties flooded were those situated at the lowest point of the valley or within the original river channel itself, the course of the original bourne had been changed to power the numerous mills that are situated in the valley.

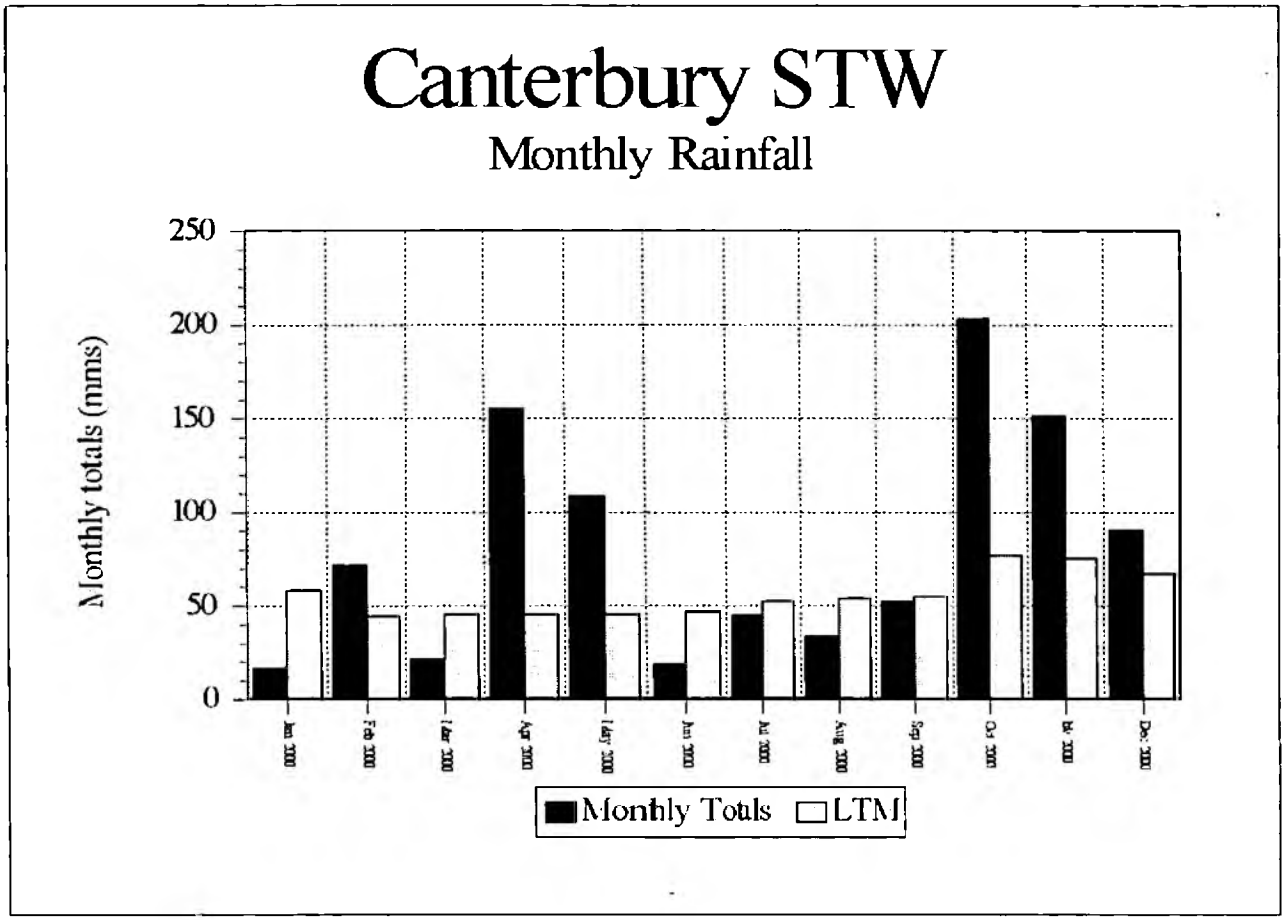
Fluvial flooding affected the Nail Bourne valley in early December. Although December was no wetter than any of the previous three months, catchment saturation meant that run off was extremely rapid into Nail Bourne. Channel capacities were exceeded and localised flooding resulted in the villages through which the Nail Bourne flows, namely; Bridge, Barham, Patrixbourne and Wickhambreaux.

Groundwater derived flooding continued throughout the winter and into the spring affecting numerous properties in the Nail Bourne catchment. The Nail Bourne, due to high levels, has also caused surface water flooding. Surface water flooding has affected a number of properties and roads throughout the valley. An assessment of why the Nail Bourne has flooded would indicate that flooding is in the main confined to points where flow is restricted by structures such as bridges or culverts.

Along the Nail Bourne and Little Stour there are 15 sites where Southern Water Services pumped sewage directly into the watercourses. Section 8 of the Water Resources Act 1991 states that is "not an offence to allow entry of any matter into any water if the discharge is made in an emergency in order to avoid danger to life and health". During the winter, sewage treatment systems throughout the Elham Valley where inoperable. To minimise the impacts, solid filters were placed on the end of the pumps and Southern Water Services tankered away quantities of sewage to alleviate pressures on the system. Environment Agency Environmental Protection staff monitored both rivers. The available dilution ensured that the average River Ecosystem Rating remained Class 1 throughout the winter.

Rainfall and in particular the intensity of events witnessed since September have resulted in flooding being observed in other bourne catchments in the Kent Area, such as the, Alkham Valley and Chartham Valley (Petham Bourne). The bar chart in Fig 1 depicts monthly rainfall recorded in 2000, at a representative rainfall gauging station for the area. The monthly average totals are shown in relation to the long term average monthly rainfall totals, providing evidence of the extreme 'nature' of recent events.

Figure 6.2: Canterbury Rainfall: Monthly Totals and Long Term Mean



6.4.2 Chartham Valley

Petham Bourne

The Petham valley is a rural area to the south west of Canterbury and the area is predominantly agricultural, the Petham Bourne flows very rarely. Previous records show that the last time the Petham Bourne flowed was 69 years ago. Fluvial flooding was restricted to properties in Shalmsford Street where it joins the Great Stour. Approximately 5 properties where flooded from the bourne itself, though due to the rural nature of the bourne it is possible that further properties may have been flooded and not reported.

The Petham Bourne also caused flooding of the Canterbury to Ashford railway, resulting in the closure of the line on a number of occasions, Railtrack installed a number of pumps in order to keep the line open.

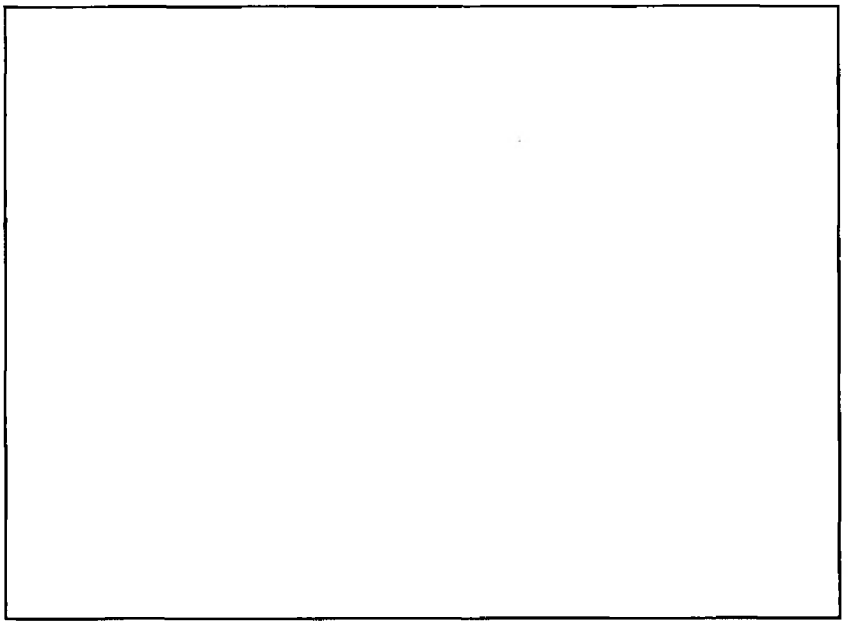
6.4.3 Herne Bay and Whitstable Area

Swalecliffe Brook

The Swalecliffe valley is narrow and steep sided and as a result shows a flashy response to rainfall. During periods of intense rainfall several properties at the lower end of the valley are at risk from fluvial flooding.

The Swalecliffe Brook runs through the village of Chestfield and through to its outfall at Swalecliffe. Throughout the winter flooding has been experienced in the village of Chestfield and within Swalecliffe itself.

Figure 6.3: Chestfield Cricket Club under a foot of flood water from the Swalecliffe Brook on 8th February 2001



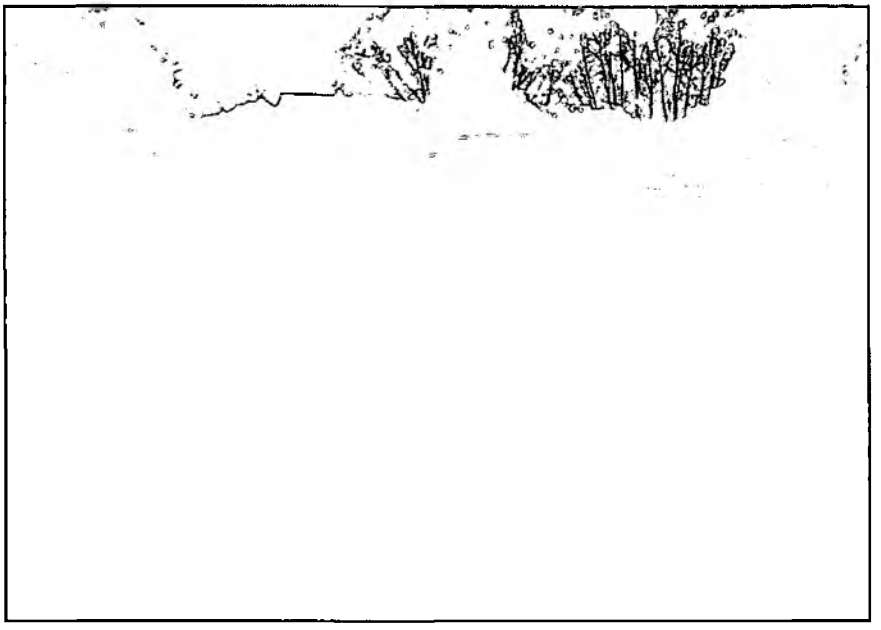
A Flood Warning was issued for the Swalecliffe Brook on the morning of the 8th February at approximately 6am, this was followed by a Severe Flood Warning at 8am.

During the course of the 8th February the Swalecliffe Brook flooded properties in Chestfield, some of these properties have now flooded nine times in a 14-month period. The flooding during February was the worst recorded in the village since the 1950s. Such was the severity of the event that at times the village was completely cut off.

The Swalecliffe Brook also causes flooding to the A299 Thanet Way, culverts take the brook below the road but it would appear that the culverts are less than adequate for dealing with the excessive high flows experienced throughout the winter. Flooding has caused the A299 to be closed on two occasions over the winter.

Problems here are compounded by tide locking, this is when the flood flows from the brook are held back the high tide in the North Sea. Canterbury City Council operates an automatic gate that closes when the tide reaches a certain height. Without the gates at the outfall coastal flooding would occur.

Figure 6.4: Swalecliffe Brook causing flooding to a caravan park in Swalecliffe



West Brook

The West Brook is designated 'Main River' from Frogs Island Farm to the south of Green Hill, Herne Bay until its outfall at Hampton. An automatic gate controls the outfall at Hampton, which is open during low tide to allow the brook to discharge, the gate is maintained by Canterbury City Council. The gate closes when the level of the tide registers on a sensor or when a coastal flood warning is in place. Upstream of the automatic gate the river flows through a residential area called Studd Hill. Flooding of properties occurred in the Studd Hill area. Flood events were recorded on the 12th October 2000 and on the 8th February 2001. As with both the Plenty Brook and the Swalecliffe Brook problems are exacerbated during tide locking, when floodwaters are held back behind the sea wall.

As with the Swalecliffe Brook culverts take the West Brook below the A299, again the culverts appear to be inadequate in handling the extreme flood flows experienced.

Flooding of properties has been recorded at Aldridge Close and Fife Road on the Green Hill estate and industrial units located on Sea Street. The flooding can be attributed to a tributary of the West Brook which is a Surface water drain (therefore maintained by Southern Water). On the 8th February 2001 the surface water drain became overloaded and caused flooding to 12 houses in Aldridge Close. Floodwater was up to 1m in depth in some properties and the junction of Fife Road and Aldridge Close was impassable.

Plenty Brook

The Plenty Brook is a designated Critical Ordinary Watercourse that passes through urban areas in Herne Bay. The Plenty Brook has numerous culverted sections including a crossing the new A299 Thanet Way. It has a history of flooding over the past few years, the most significant events in recent history include 4th April 2000 and 12/13th October 2000.

The Environment Agency does not currently provide a flood warning service on the Plenty Brook. A flood warning service is provided on most 'Main Rivers', estuaries and coasts.

The rainfall experienced on the 8th February resulted in the most severe flooding from the Plenty Brook with approximately 48 properties in Herne Bay flooding internally. It is too simplistic to blame the flooding on the 8th February solely on the intense rainfall experienced during the night of the 7th – 8th February when raingauges in the area recorded up to 60 mm. The raingauge at Manston Airport recorded 36mm between midnight and 6am. The monthly average is 40mm.

On the morning of the 8th February the first properties to experience flooding were those on Cherry Gardens to the north of the railway. The properties here are situated at a low point and are the most vulnerable to flooding. South of the railway line properties started to flood at approximately 10am. The sluice at the seaward end of the culverted section of the Brook was not closed until 10:30 am when it became completely submerged by the incoming tide. Soldiers were drafted in to help evacuate dozens of people from their homes. A team of 40 men from the Royal Irish Regiment, based in Canterbury, evacuated homes in Cherry Gardens, which were waist-deep in water. The troops used inflatable dinghies to get access to the flooded areas while Canterbury City Council set up three emergency rest centres and issued 2,000 sandbags to residents.

The rain that fell did so on already saturated soils resulting in rapid run off from the fields into the drainage system. Obviously the heavy rain and the saturated soil is a major contributory factor, but there are other influences that cannot be ignored.

The outfall into the North Sea is located in Herne Bay at the end of the culverted section through the town. Canterbury City Council controls the automatic gates and during the course of the 8th February the gates were closed due to the fact that a coastal flood warning was in place because of a predicted North Sea surge. The gate automatically closes when it becomes submerged by the rising seawater. This 'tide locking' influence is a contributory factor to the flooding especially if the highest flows in the Plenty Brook coincide with a high tide in the North Sea.

Recent developments have impacted on the Plenty Brook catchment including the construction of the A299 Thanet Way and housing developments south of the railway line. It was necessary during the construction of both new developments to include drainage systems that do not allow more water into the catchment than the previously undeveloped land.

Surface water originating from the A299 Thanet way is thought to be a contributory factor to the flooding experienced on the 8th February, it is believed that some of the balancing lagoons adjacent to the A299 overflowed, discharging water into the Plenty Brook. The drainage system designed into the new housing developments is thought to have coped with the intense rainfall experienced.

The flooding that occurred on the 4th April 2000 was exacerbated by a blocked weedscreen prior to the culverted section, during the 8th February 2001 observations confirmed that the refurbished weedscreen did not contribute to the flooding problems.

A number of Agencies are involved with issues on the Plenty Brook. The watercourse is designated an 'Critical Ordinary Watercourse'. Canterbury City Council is therefore the lead Authority and as the coastal protection Authority also manages the floodgate at the tidal outfall. Southern Water is responsible for all adopted foul and surface water drainage on the Plenty Brook, this relates to the culverted section from its inlet south of the railway line through to the outfall. It is also responsible for the weedscreen at the inlet and the overflow at the south of the old A2990 Thanet Way. Kent County Council designed and constructed the new A299 Thanet Way and its surface water drainage that includes lagoons that drain into the Plenty Brook. The Environment Agency has a general supervisory duty with respect to all matters relating to flood defence.

Because of the number of organisations involved an Inter Agency Working Group has been established to look at issues and identify possible actions. The group consists of officers from the Environment Agency, Canterbury City Council, Kent County Council and Southern Water Services.

Kite Farm ditch

Kite Farm ditch is located near Swalecliffe, it is designated a surface water sewer. The intense rainfall on the 7th and 8th February led to flooding of properties in Colewood Road. The ditch is maintained by Southem Water, a problem that was identified by council engineers was that the weedscreen at the outfall was blocked with debris, which could have caused the ditch to back up.

6.5 OPERATIONAL RESPONSE

Most of the severe flooding after 15th November occurred in the east of the county in areas administered by Canterbury City Council who also had there own incident procedures in place. During the 8th February Canterbury City Council received 1300 calls from the public. Canterbury City Council provided support for those residents affected by the flooding. Operational response included clearing of blockages in ordinary watercourses and the issuing of sandbags to at risk properties.

The most severe event in this district was on the 8th February 2000 especially in the north and east of the county. Evacuation of approximately 50 properties was required in the Herne Bay area alone. Although the situation was serious, no formal Police control centre was established. The emergency services however supplied liaison officers to Canterbury City Council's emergency incident room to allow an inter-organisational response.

Canterbury City Council provided emergency rest centres for residents affected by flooding from the Plenty Brook, West Brook, Swalecliffe Brook and the Nail Bourne.

The Environment Agency's Emergency Workforce were heavily involved in ensuring the effects of the flooding on the Nail Bourne where minimised activities included sandbagging operations to maintain the integrity of defences and the installation of 12 inch pumps.

Sandbagging operations where undertaken by Canterbury City Council in locations affected by the Plenty Brook, Green Hill sewer, Kite Farm Ditch and throughout the Stour valley providing over 2000 sandbags where necessary.

Environmental Protection staff inspected many potentially polluting sites around the county including Treatment Works and Pumping Stations affected by the floodwater.

6.6 ISSUES AND RECOMMENDATIONS

SO/K/SEI/1 Flooding in the Elham Valley.	
Issue	Ongoing high flow conditions on the Nail Bourne Stream.
Recommendations	An assessment is carried out into the problems of localised flooding on the Nail Bourne due to excessively high groundwater levels.

SO/K/SEI/2 Flooding in the Elham Valley	
Issue	Public misconceptions regarding the causes of the flooding especially in the Elham Valley where there is a number of causes, i.e. Groundwater, Surface water and Fluvial Flooding.
Recommendations	An assessment is carried out into ways of raising public awareness into the work of the Agency, the causes of flooding.

SO/K/SEI/3 flooding in the Herne Bay and Whitstable area.	
Issue	Flooding of the A299 Thanet Way.
Recommendations	Assess the adequacy of the flood culverts under the A299 Thanet Way at the Swalecliffe Brook, Plenty Brook and Westbrook.

SO/K/SEI/4 Improvements to Flood Warning Service	
Issue	The inability to issue timely, accurate and targeted flood warnings to flood risk areas outside the current Flood Warning Areas.
Recommendations	To look at the effectiveness of issuing warnings to key areas outside the current Flood Warning areas such as on the Plenty Brook and Nail Bourne in the Canterbury Area.

SO/K/SEI/5 Development of Catchment Flood Management Plans	
Issue	Flooding was experienced from numerous sources over the winter and was exacerbated by, limitations of urban drainage systems, recent developments, and tidal influences.
Recommendations	Development of Catchment Flood Management Plans to identify the issues specific to each catchment to allow informed decisions to be made relating to the holistic management of flood risk.

APPENDIX A: DEVELOPMENT IN THE FLOODPLAIN

Development in flood risk areas is a major issue in the South East. The recently published revised Regional Planning Guidance for the South East (RPG 9) 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 South East i.e. some 17,200 to 19,350 dwellings per annum within Southern Region. The guidance also advocates higher housing development level (between 30 and 50 dwellings per hectare) to make more efficient use of land. Kent has been earmarked for 5,700 dwellings which takes into account the need to regenerate the Thames Gateway. The only other county with a higher housing allocation being Hampshire.

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. Although Government has not taken a view on the appropriate scale or pace of growth in Ashford it does require the local Authorities to initiate an early study, in conjunction with the Regional Planning body and other Key Stakeholders including the Environment Agency. Current estimates suggest some 2,400 properties were flooded by main river, non main river, surface water, groundwater and urban drainage systems during the autumn Floods (between 15th September – 15th November).

1) Approximately 1.5% (1.62%) of properties flooded were built in the last 5 years

2) Approximately 1.5% (1.52%) of properties flooded were built in the last 6-10 years

3) Less than 3% (2.88%) of properties flooded were built in the last 11-20 years

4) Approximately 94% (93.98%) of properties flooded were built 20+ years ago

5) It would appear that less than ten properties that flooded were built against Agency advice. There is one property in Tonbridge that was built against Agency advice and was isolated by floodwater.

6) Comparison of flooding extent with S105 flood plain information, including the number of properties flooded not shown at risk on S105 maps will require more detailed analysis

7) Land allocated for development that flooded or had severe flood warnings issued will also require further data analysis and research.

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Table A.1: Predictions for development in the Flood Plain

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
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**	

Table A.2: Developments in the Flood Plains – Summary

Age of Flooded Building (Yrs)	Flood 1				Flood 2				Flood 3			
	<5	5-10	11-20	>20	<5	5-10	11-20	>20	<5	5-10	11-20	>20
Collier Street	0	0	5	71	0	0	0	46	0	0	0	27
East Peckham	2	0	7	28	2	0	0	11	2	0	0	4
Etchingham	5	3	3	5	0	0	0	0	0	0	0	0
Fordwich	0	0	0	0	0	0	0	0	3	0	0	24
Headcorn	2	0	0	41	0	0	0	8	0	0	0	4
Laddingford	0	0	0	9	0	0	0	6	0	0	0	6
Lamberhurst	0	0	0	45	0	0	0	28	0	0	0	31
Robertsbridge	8	0	4	78	4	0	2	25	0	0	2	29
Smarden	2	0	0	21	2	0	0	9	2	0	0	5
Yalding	17	14	7	119	7	14	3	27	3	14	3	27
TOTALS	**36**	**17**	**26**	**417**	**15**	**14**	**5**	**160**	**10**	**14**	**5**	**157**

NB: All figures are factored

APPENDIX B: PUBLIC RESPONSE

On 6th December 2000, the Environment Agency issued town and village plans to Lewin Fryer and Partners. These plans identified those areas it required to be surveyed by questionnaire.

B.1 PUBLIC RESPONSE – EAST PECKHAM

B.1.1 Questionnaire Survey

On the 4th and 5th December 2000, Lewin, Fryer and Partners surveyed the town of East Peckham. 37 residents were interviewed. 91 questionnaire forms were posted of which 22 were returned, completed, by 22nd February 2001. This represents a 46% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, approximately 1/0.46 = 2.17 in the case of East Peckham, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report.

B.1.2 Dates of Flooding

On the basis of the information from the questionnaire, it can be confirmed that, within the October to November 2000 period of interest, East Peckham suffered three flood events. The first was on the Friday 13th October, the second on Monday 30th October and the third on Tuesday 7th November 2000. It is clear from the responses that the first flood was the most severe and most damaging and, unlike all other towns and villages in the survey, more commercial premises than homes were flooded. The estimated cost of flood damage to commercial premises in East Peckham was very high and, by far, the largest reported within the surveyed area.

The quality of data recorded by the public was at its best for the first, and worst, flood event, but generally poor for the subsequent events. Flooding occurred in two main areas and these were within the business parks and around Old Road near Pinkhams Lane. People were less able to recall details of events with less general impact. The detail and timings for the second and third events is poor and not very reliable.

B1.3 Basic Factored Flood Statistics for East Peckham

12th October 2000, estimated total number of properties flooded = 37

30th October 2000, estimated total number of properties flooded = 13

6th November 2000, estimated total number of properties flooded = 6

Estimated total cost of flood damage is £5,445,615

B.1.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Respondents reported that the floodwater came from various directions and not obviously from the river itself. 9 respondents, 15%
- Residents of Old Road complained generally about traffic moving at speed through the flooded water, and specifically about a bus which caused flooding and wall damage. 7 residents, 12%
- The respondents believed that operation of the Leigh Barrier was in some way responsible for the severity of the flooding. 6 residents and premises, 10%
- A number of residents of Old Road reported that the floodwater initially came from the road drains. 5 residents, 9%
- The respondents expressed concern over inadequate maintenance of drains and ditches. 4 residents, 8%
- For flood event no.1, the respondents reported that the water velocity was very fast/ a raging torrent or a strong current. 5 respondents, 9%
- Some were dissatisfied with the EA warning system(s). 2 residents, 4%

B1.5 Other comments by residents

- Some people from a home for the elderly were evacuated to Maidstone Hospital
- Councillors were directing Police to the wrong, less critical areas
- There was a petrol or diesel smell in the air
- Only 2 sandbags were eventually delivered by the Local Authority to one residence
- Sandbags did not go to those who really needed them
- When the second flood came, the resident decided it was time to buy wellingtons
- Generally power was reported as lost in the first flood but not the others

B.2 PUBLIC RESPONSE – LADDINGFORD

B.2.1 Questionnaire Survey

On the 9th January 2000, Lewin, Fryer and Partners surveyed the village of Laddingford. 6 residents were interviewed. 43 questionnaire forms were posted of which 17 were returned, completed, by 22nd February 2001. This represents a 47%

success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, approximately 1/0.47 = 2.13 in the case of Laddingford, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report

B.2.2 Dates of Flooding

On the basis of the information from the questionnaire, it appears that, within October to November 2000, Laddingford suffered three flood events. There is some uncertainty over the dates and times but it is most likely that the first was during the night of 12th/13th October (Thursday/Friday), the second late on Tuesday 31st October and the third on the evening of Monday 6th November 2000. It also appears from the responses that the first flood was only just the most severe and most damaging. There were no reports of flooding or damage to commercial premises for any of the events.

The quality of data recorded is generally poor for all three events. The timings are few, and often conflicting, so cannot be relied upon.

B.2.3 Basic Factored Flood Statistics for Laddingford

12th October 2000, estimated total number of properties flooded = 8

30th October 2000, estimated total number of properties flooded = 6

6th November 2000, estimated total number of properties flooded = 6

Estimated total cost of flood damage is £128,465

B.2.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Residents are unhappy about the level of ditch and drain maintenance. 4 residents, 17%
- Vehicles driving through the floodwater caused damage. 3 residents, 13%
- The floodwater flowed from different directions each time/ from Lesser Teise. 2 residents, 9%
- Belief that the operation of the Leigh Barrier contributed to the flooding problems. 2 residents, 9%
- Sandbags were either not available or were delivered too late. 2 residents, 9%

B.3 PUBLIC RESPONSE - LAMBERHURST

B.3.1 Questionnaire Survey

On the 18th December 2000, Lewin, Fryer and Partners surveyed the village of Lamberhurst. 4 residents were interviewed. 65 questionnaire forms were posted of which 16 were returned, completed, by 22nd February 2001. This represents a 29% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, approximately 1/0.29 = 3.45 in the case of Lamberhurst, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report. However, in the case of Lamberhurst, it is likely that the general low level of response, with a very high proportion of returns from flooded properties, has distorted the estimated figures from the survey. The Lamberhurst estimated totals are therefore not reliable.

B.3.2 Dates of Flooding

On the basis of the information from the questionnaire, it appears that, within the October to November 2000 period of interest, Lamberhurst suffered three flood events. There is some uncertainty over the dates and times but it is most likely that the first was on the morning of Thursday 12th October, the second late on Monday 30th October and the third on Monday 6th November 2000. It also appears from the responses that the first flood was the most severe and most damaging. However the quality of data recorded is generally poor for all three events. The timings are few, and often conflicting, so cannot be relied upon.

B.3.3 Basic Factored Flood Statistics for Lamberhurst

12th October 2000, estimated total number of properties flooded = 48

30th October 2000, estimated total number of properties flooded = 30

6th November 2000, estimated total number of properties flooded = 34

Estimated total cost of flood damage is £498,525

B.3.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Respondents expressed concern that they were flooded not by the river but by surface run off from a recent development, to the rear of the High Street. 4 respondents, 17%

- Respondents are unhappy about the level of ditch and drain maintenance. 2 residents, 9%

- The floodwater flowed from different directions each time/ from Lesser Teise. 2 respondents, 9%

B.3.5 Other comments by residents

- Belief that closing the sluice gate on the Teise caused flooding

- There has been new building in Lamberhurst which lacks the necessary infrastructure, like drainage

- The water came up quickly

- I don't like living near a river (!)

B.4 PUBLIC RESPONSE – SMARDEN

B.4.1 Questionnaire Survey

On the 2nd and 3rd December 2000, Lewin, Fryer and Partners surveyed the town of Smarden. 20 residents were interviewed. 35 questionnaire forms were posted of which 18 were returned, completed, by 22nd February 2001. This represents a 59% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, approximately 1/0.59 = 1.711 in the case of Smarden, to model a 100% success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report.

B.4.2 Dates of Flooding

On the basis of the information from the questionnaire, it can be confirmed that, within the October to November 2000 period of interest, Smarden suffered three flood events. The first was on the Thursday 12th October, the second on Monday 30th October and the third on Monday 6th November 2000. It is clear from the responses that the first flood was the most severe and most damaging. There were no reports of flooding or damage to commercial premises for any of the events.

The quality of data recorded by the public was at its best for the first, and worst, flood event, but generally poor for the subsequent events. Most flooding occurred in two main areas. One was in the Water Lane area following a Southern Water pump station failure and the other was the Cage Lane area. People were less able to recall details of the following events with less general impact. The detail for the second and third events is very scant. The timings are based on two reports only for the second flood, and on three for the third, so cannot be relied upon.

B4.3 Basic Factored Flood Statistics for Smarden

12th October 2000, estimated total number of properties flooded = 22

30th October 2000, estimated total number of properties flooded = 10

6th November 2000, estimated total number of properties flooded = 7

Estimated total cost of flood damage is £438,000

B.4.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Residents reported that the flooding around Water Lane was caused by failure of the Southern Water pump station in Water Lane. 10 residents, 26%
- Residents are unhappy about the level of ditch and drain maintenance. 4 residents, 11%
- Some were dissatisfied with the EA warning system(s). 2 residents, 6%

B.4.5 Other comments by residents

- Two residents recommend the construction of floodwater storage reservoirs near Smarden.
- The EA allegedly built a floodwall for one property but it was overwhelmed.
- One resident is building a new floodwall at a personal cost of £65,000 since the existing one failed during the floods.
- Sandbags did not go to those who really needed them.
- When the second flood came, the resident decided it was time to buy wellingtons.
- Generally power was reported as lost in the first flood but not the others

B.5 PUBLIC RESPONSE - FORDWICH

B.5.1 Questionnaire Survey

On the 22nd, 24th and 31st January 2001, Lewin, Fryer and Partners surveyed the town of Fordwich. 21 residents were interviewed. 174 questionnaire forms were posted of which 36 were returned, completed, by 22nd February 2001. This represents a 29% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, approximately 1/0.29 = 3.421 in the case of Fordwich, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report.

B.5.2 Dates of Flooding

On the basis of the information from the questionnaire, it appears that, within the October to November 2000 period of interest, Fordwich suffered only one flood event with flood damage. This event was on Tuesday 7th November 2000.

B.5.3 Basic Factored Flood Statistics for Fordwich

7th November 2000, estimated total number of properties flooded = 20

Estimated total cost of flood damage is £462,000

B.5.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Respondents expressed dissatisfaction with the local sewerage system, which either fails to pump, or is overwhelmed whenever it rains. Also some think that the drainage infrastructure is not designed to accommodate new developments (Water Meadows, for example). 19 respondents, 33%

- Residents are unhappy about the level of ditch and drain maintenance. 7 residents, 12%

- Tankers were reported to be pumping out of sewer manholes in Brooklands. 6 residents, 11%

- There were not enough sandbags to go about. 4 residents, 7%

- There were rumours about the opening of Ashford reservoir. This was either to 'save the channel tunnel' or 'caused a 'flood surge'. 2 respondents, 4%

B.6 PUBLIC RESPONSE – ROBERTSBRIDGE

B6.1 Questionnaire Survey

On the 12th, 13th and 14th December, Lewin, Fryer and Partners surveyed the town of Robertsbridge. 37 residents were interviewed. 89 questionnaire forms were posted of which 29 were returned, completed, by 22nd February 2001. This represents a 52% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, 1/0.52 = 1.909 in the case of Robertsbridge, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report

B6.2 Dates of Flooding

On the basis of the information from the questionnaire, it can be confirmed that, within the October to November 2000 period of interest, Robertsbridge suffered three flood events. The first was on the Thursday 12th October, the second on Monday 30th October and the third on Monday 6th November 2000. It is clear from the responses that the first flood was the most severe and most damaging.

The quality of data recorded by the public was at its best for the first, and worst, flood event, but generally poor for the subsequent events. Many flooded properties had been left empty, awaiting repairs. The residents of properties prone to flooding were not in attendance during the later events and were thus unable to provide the specific details and times that were sought. In addition, people were less able to recall details of events which had less general impact. For the lesser events, there was a greater reliance on reports from those not flooded out and these reports often lacked detail.

B.6.3 Basic Factored Flood Statistics for Robertsbridge

12th October 2000, estimated total number of properties flooded = 88

30th October 2000, estimated total number of properties flooded = 31

6th November 2000, estimated total number of properties flooded = 33

Estimated total cost of flood damage is £2, 487,427

B6.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- The residents were concerned over, or unhappy about, or doubtful about the merits of, the planning of, the design and/or construction of the A21 Robertsbridge bypass. 11 residents, 9%

- The residents expressed dissatisfaction with, or concern over, or reported that, maintenance of the rivers, sewers, ditches and the millstream was poor and inadequate. 8 residents, 6%

- For flood event no.1, the residents expressed surprise or alarm at the speed with which the water flowed or the speed at which the flood water flowed or saw a surge. 11 residents, 9%

- The residents expressed dissatisfaction with the EA warning system(s). 3 residents, 2%

- The residents suggested that the operation/or emptying of Darwell reservoir in some way contributed to the scale of the first flooding event. 4 residents, 3%

- The resident was frustrated/dissatisfied by some officials' contributions given at an open public meeting, after the first flood event, between Robertsbridge residents, and representatives of the Environment Agency, the local authority, and the Highway Agency. 3 residents, 2%

- The resident drew attention to new developments within the flood plain and suggested this may contribute to flooding problems. 2 residents, 2%

B6.5 Other comments by residents

- One reported that Robertsbridge was not mentioned specifically in EA recorded messages

- One resident was annoyed by motorists driving through the floodwater, creating waves

- One resident built a flood wall but it was insufficient for the 4 ft of flood water

- One resident believes that the River Rother has not been dredged for 20 years

- Generally power was reported as lost in the first flood but not the others

- The EA visited the Favor Parker factory the day before the big one but this was an enquiry about sheep.

B7 PUBLIC RESPONSE AT YALDING

B7.1 Questionnaire Survey

On the 9th, 10th and 11th January 2001, Lewin, Fryer and Partners surveyed the town of Yalding. 25 residents were interviewed. 278 questionnaire forms were posted of which 64 were returned, completed, by 22nd February 2001. This represents a 29% success rate for the survey area. This information is tabulated at the end of this appendix, along with the other surveyed towns and villages.

The raw statistics originating from the survey have each been multiplied by a simple factor, 1/0.29 = 3.405 in the case of Yalding, to model a 100 % success rate. These factored statistics provide estimated totals for the whole town or village. It is these factored, estimated totals that have been used elsewhere in this report

B7.2 Dates of Flooding

On the basis of the information from the questionnaire, it can be confirmed that, within the October to November 2000 period of interest, Yalding suffered three flood events. The first began early on Friday 13th October, the second on Monday 30th October and the third reported as either Monday 6th or Tuesday 7th November 2000 with the latter date more frequently reported. It is clear from the responses that the first flood was the most severe and most damaging.

The quality of data recorded by the public was at its best for the first, and worst, flood event, but generally poor for the subsequent events. A great, many flooded properties had been left empty, awaiting repairs. The residents of properties prone to flooding

were not in attendance during the later events and were thus unable to provide the specific details and times that were sought. In addition, people were less able to recall details of events which had less general impact. For the lesser events, there was a greater reliance on reports from those not flooded out and these reports often lacked detail as the inconclusive date for the third flood demonstrates.

B7.3 Basic Factored Flood Statistics for Yalding

13th October 2000, estimated total number of properties flooded = 157

30th October 2000, estimated total number of properties flooded = 52

6th November 2000, estimated total number of properties flooded = 47

Estimated total cost of flood damage is £7,666,017

B7.4 Issues raised by local residents and recorded within questionnaires

Residents were encouraged to add comments on each flood event. The issues they raised are summarised below and suffixed with a number and percentage. The number reflects the actual number of times the issue was raised. The percentage corresponds to the proportion of respondents raising this issue.

- Many people commented on the Police evacuation of October 12th. Comments ranged widely, for example; it was started far too early ('8' hours before flood arrived, which caused preventable damage), people could not return to homes (where young and older people were stranded without their help), it started in the wrong place, homes were selected which would never flood, people were given only minutes to join evacuation buses. 14 residents, 16%

- Residents expressed dissatisfaction with, or concern over, or reported that, maintenance of the rivers, sewers, and ditches was poor and inadequate. 11 residents, 12%

- The residents suspect that the Leigh barrier was not operated correctly. 10 residents, 11%

- Residents expressed dissatisfaction with the EA warning system(s). 10 residents, 11%

- For flood event no.1, residents expressed surprise at the speed with which the flood water rose and, in some cases, receded. 9 residents, 10%

- Residents were not happy with the performance of the Police during the evacuation. Comments are, for example; that the police were unhelpful, that residents were angry that Police were not local, that the Police went to wrong areas, that Police behaviour was disgraceful, that confusing information was given out by the Police, that the Police caused panic among residents, that the Police were following the wrong evacuation plan, and lastly that Police notices left in the roads were misleading. 8 residents, 9%

- Residents were not happy about the availability of sandbags from the Local Authority. 6 residents, 7%

- Residents were concerned about developments within the flood plain. Specific mention was made several times of a proposed Doctor's surgery along Benover Road. 5 residents, 6%

- Residents were worried that flooding around the Zeneca plant may have led to chemical contamination. 3 residents, 3%

- Residents complained about damage resulting from vehicles driving through the flood water.

B7.5 Other comments by residents

- Insurance premiums have increased by 1/3.

- Belief that Yalding was sacrificed for the benefit of Maidstone.

- The lorry delivering sandbags was prevented from driving through the Police cordon.

- It was one resident's belief that a man in charge of one of the Leigh Barrier gates had been on the job for only two weeks, and was left on his own.

- Yalding should have its own, dedicated 'Floodline' number.

- One resident advises that Hogweed grows on the river banks and does not help (flooding) matters.

- One resident suspects that a pump station (which supplies the Bewl Reservoir?) failed to operate at Yalding and exacerbated the rise in flood level.

- One resident suspects that the Bewl Reservoir overflowed.

- One caravan park resident lost his mobile home only to lose his replacement touring caravan in the next flood.

- One resident left his home by boat mainly for the welfare of his dogs.

- One resident believes that the EA (after these floods) has now learnt how to operate the Leigh barrier correctly.

B8 TABLES

Table B.1: Summary of Questionnaire Activity to 22/02/01

Village Name	No. of Questionnaires filled in at interview	No. of Questionnaires Posted	Total Questionnaires coverage in village	No. of Questionnaires returned by post to date	Total No. of Questionnaires completed.	Percentage of posted Questionnaires Returned %	Percentage of total Questionnaires completed %	Survey Factor
Collier Street	14	139	153	53	67	38%	44%	2.2836
East Peckham	37	91	128	22	59	24%	46%	2.17
Etchingham	3	16	19	4	7	25%	37%	2.714
Fordwich	21	174	195	36	57	21%	29%	3.421
Headcorn	47	100	147	31	78	31%	53%	1.885
Laddingford	6	43	49	17	23	40%	47%	2.13
Lamberhurst	4	65	69	16	20	25%	29%	3.45
Robertsbridge	37	89	126	29	66	33%	52%	1.909
Smarden	20	35	55	18	38	51%	59%	1.711
Yalding	25	278	303	64	89	23%	29%	3.405
Total	**214**	**1030**	**1244**	**290**	**504**	**31% (Average)**	**43% (Average)**	

Table B.2: Kent Floods Losses

	Reported Losses			Factored Losses	
	Residential	Commercial	Factor	Residential	Commercial
Collier Street	£1,740,200	£2,000	2.2836	£3,973,921	£4,567
East Peckham	£154,000	£2,355,500	2.17	£334,180	£5,111,435
Etchingham	£102,000	£120,000	2.714	£276,828	£325,680
Fordwich	£135,000	0	3.421	£462,000	0
Headcorn	£419,500	£45,500	1.885	£790,758	£85,768
Laddingford	£60,300	0	2.13	£128,465	0
Lamberhurst	£67,000	£77,500	3.45	£231,150	£267,375
Robertsbridge	£870,000	£433,000	1.909	£1,660,830	£826,597
Smarden	£256,000	0	1.711	£438,000	0
Yalding	£1,444,400	£807,000	3.405	£4,918,182	£2,747,835
Totals				**£13,214,314**	**£9,369,257**

Table B.3: Number of Evacuees Prior to Flood Start

	Flood 1	Flood 2	Flood 3	Factor	Factored Up		
					Flood 1	Flood 2	Flood 3
Collier Street	0	0	0	2.2836	0	0	0
East Peckham	0	0	0	2.17	0	0	0
Etchingham	0	0	0	2.714	0	0	0
Fordwich	0	0	0	3.42	0	0	0
Headcorn	2	0	0	1.885	4	0	0
Laddingford	2	0	0	2.13	4	0	0
Lamberhurst	0	0	0	3.45	0	0	0
Robertsbridge	0	0	0	1.909	0	0	0
Smarden	0	0	0		0	0	0
Yalding	8	1	0	3.405	27	3	0
Totals					**35**	**3**	**0**

Table B.4: Age of Flooded Buildings

Age of Flooded Building (Yrs)	Flood 1				Flood 2				Flood 3			
	<5	6-10	11-20	>20	<5	6-10	11-20	>20	<5	6-10	11-20	>20
Collier Street	0	0	5	71	0	0	0	46	0	0	0	27
East Peckham	2	0	7	28	2	0	0	11	2	0	0	4
Etchingham	5	3	3	5	0	0	0	0	0	0	0	0
Fordwich	0	0	0	0	0	0	0	0	3	0	0	24
Headcorn	2	0	0	41	0	0	0	8	0	0	0	4
Laddingford	0	0	0	9	0	0	0	6	0	0	0	6
Lamberhurst	0	0	0	45	0	0	0	28	0	0	0	31
Robertsbridge	8	0	4	78	4	0	2	25	0	0	2	29
Smarden	2	0	0	21	2	0	0	9	2	0	0	5
Yalding	17	14	7	119	7	14	3	27	3	14	3	27
Totals	**36**	**17**	**26**	**417**	**15**	**14**	**5**	**160**	**10**	**14**	**5**	**157**

Table B.5: "The Great Flood" Flood Warning Performance to 22/02/01 ***(Figures extrapolated to model 100% questionnaire response)***

Village Name	No. of Properties flooded following level 1 or 2 Warnings		No. of Properties flooded following Severe Warning		No. of Properties flooded without Warning		No. of Properties NOT Flooded following Severe Warning	
	Residential	Commercial	Residential	Commercial	Residential	Commercial	Residential	Commercial
Collier Street	36	0	11	0	37	0	7	0
East Peckham	14	8	11	4	0	15	46	2
Etchingham	0	0	0	0	8	5	0	0
Fordwich	0	0	0	0	0	0	7	0
Headcorn	17	0	6	0	18	8	2	0
Laddingford	6	0	2	0	2	0	17	0
Lamberhurst	0	3	0	3	28	17	0	0
Robertsbridge	17	2	2	0	52	17	2	0
Smarden	10	0	7	0	12	0	2	0
Yalding	89	17	75	14	48	3	89	0
Sub-totals	**189**	**30**	**114**	**21**	**205**	**65**	**172**	**2**
Category Totals	**219**		**135**		**270**		**174**	

NB Total estimated number of flooded properties = 489

NB Properties flooded without warning, warnings were issued for the locations included however not all homeowners or business owners have accepted an invitation to receive messages from the Agency's Automated Voice Messaging System.

Table B.6: "Halloween" Flood Warning Performance to 22/02/01 *(Figures extrapolated to model 100% questionnaire response)*

Village Name	No. of Properties flooded following level 1 or 2 Warnings		No. of Properties flooded following Severe Warning		No. of Properties flooded without Warning		No. of Properties NOT Flooded following Severe Warning	
	Residential	Commercial	Residential	Commercial	Residential	Commercial	Residential	Commercial
Collier Street	25	0	9	0	21	0	7	0
East Peckham	0	2	0	0	7	4	2	0
Etchingham	0	0	0	0	0	0	0	0
Fordwich	0	0	0	0	0	0	7	0
Headcorn	4	0	2	0	4	0	0	0
Laddingford	4	0	2	0	2	0	0	0
Lamberhurst	3	3	0	3	7	17	0	0
Robertsbridge	8	0	2	0	19	4	6	0
Smarden	5	0	3	0	5	0	0	0
Yalding	21	0	14	0	24	7	54	7
Sub-totals	70	5	32	3	89	32	76	7
Category Totals	75		35		121		83	

NB Total estimated number of flooded properties = 196

NB Properties flooded without warning, warnings were issued for the locations included however not all homeowners or business owners have accepted an invitation to receive messages from the Agency's Automated Voice Messaging System.

Table B.7: "Bonfire Night" Flood Warning Performance to 22/02/01*(Figures extrapolated to model 100% questionnaire response)*

Village Name	No. of Properties flooded following level 1 or 2 Warnings		No. of Properties flooded following Severe Warning		No. of Properties flooded without Warning		No. of Properties NOT Flooded following Severe Warning	
	Residential	Commercial	Residential	Commercial	Residential	Commercial	Residential	Commercial
Collier Street	12	0	7	0	16	0	9	0
East Peckham	2	0	2	0	4	0	4	0
Etchingham	0	0	0	0	0	0	0	0
Fordwich	13	0	10	0	4	3	34	0
Headcorn	2	0	0	0	2	0	0	0
Laddingford	4	0	2	0	2	0	0	0
Lamberhurst	0	3	0	3	14	17	0	0
Robertsbridge	8	0	2	0	19	6	0	0
Smarden	4	0	2	0	3	0	0	0
Yalding	20	0	10	0	20	7	20	0
Sub-totals	65	3	35	3	84	33	67	0
Category Totals	68		38		117		67	

NB Total estimated number of flooded properties = 185

NB Properties flooded without warning, warnings were issued for the locations included however not all homeowners or business owners have accepted an invitation to receive messages from the Agency's Automated Voice Messaging System.

Table B.8: Number of properties flooded during the "Great Flood"

Category	Collier Street	East Peckham	Etchingham	Fordwich	Headcorn	Laddingford	Lamberhurst	Robertsbridge	Smarden	Yalding	Totals
No Flooded following warning(Not Severe) (4.3)	25	7	0	0	11	4	0	17	3	17	Total properties flooded Flood 1
No Flooded without warning (4.4)	37	15	14	0	26	2	45	69	12	51	
No NOT Flooded but warned (Not Severe) (4.5)	18	24	1	7	32	0	0	0	0	7	
No Flooded following Severe Warning (4.6)	11	15	0	0	6	2	3	2	7	88	
No Flooded without Severe Warning (4.7)	62	22	14	0	37	6	45	86	15	68	
No NOT Flooded but rec'd Severe Warning (4.8)	7	48	0	7	2	17	0	2	2	88	
Total No. flooded	**43**	**37**	**14**	**0**	**43**	**8**	**48**	**88**	**22**	**156**	**489**
Factor	2.2836	2.17	2.714	3.421	1.885	2.13	3.45	1.909	1.711	3.405	

NB Figures are factored up (Residential and commercial properties are combined)

Table B.9: Number of Properties flooded during the "Halloween Flood"

Category	Collier Street	East Peckham	Etchingham	Fordwich	Headcorn	Laddingford	Lamberhurst	Robertsbridge	Smarden	Yalding	Totals
No Flooded following warning(Not Severe) (4.3)	16	2	0	0	2	2	3	6	2	7	Total properties flooded Flood 2
No Flooded without warning (4.4)	21	11	0	0	4	2	24	23	5	31	
No NOT Flooded but warned (Not Severe) (4.5)	11	17	1	14	13	6	0	2	0	17	
No Flooded following Severe Warning (4.6)	9	0	0	0	2	2	3	2	3	14	
No Flooded without Severe Warning (4.7)	37	13	0	0	6	4	27	29	7	38	
No NOT Flooded but rec'd Severe Warning (4.8)	7	2	0	7	0	0	0	6	0	61	
Total No. flooded	**46**	**13**	**0**	**0**	**8**	**6**	**30**	**31**	**10**	**52**	**196**
Factor	2.2836	2.17	2.714	3.421	1.885	2.13	3.45	1.909	1.711	3.405	

NB Figures are factored up (Residential and commercial properties are combined)

Table B.10: Number of properties flooded during the "Bonfire Night Flood"

Category	Collier Street	East Peckham	Etchingham	Fordwich	Headcorn	Laddingford	Lamberhurst	Robertsbridge	Smarden	Yalding	Totals
No Flooded following warning(Not Severe) (4.3)	5	0	0	3	2	2	0	6	2	10	Total properties flooded Flood 3
No Flooded without warning (4.4)	16	4	0	7	2	2	31	25	3	27	
No NOT Flooded but warned (Not Severe) (4.5)	7	15	1	27	15	6	0	2	0	20	
No Flooded following Severe Warning (4.6)	7	2	0	10	0	2	3	2	2	10	
No Flooded without Severe Warning (4.7)	21	4	0	10	4	4	31	31	5	37	
No NOT Flooded but rec'd Severe Warning (4.8)	9	4	0	34	0	0	0	0	0	20	
Total No. flooded	**28**	**6**	**0**	**20**	**4**	**6**	**34**	**33**	**7**	**47**	**185**
Factor	2.2836	2.17	2.714	3.421	1.885	2.13	3.45	1.909	1.711	3.405	

NB Figures are factored up (Residential and commercial properties are combined)

APPENDIX C: HISTORY OF FLOODING

C1 RIVER MEDWAY

The Kent Area of the Environment Agency has been subject to many flood events prior to the autumn 2000 floods. Long term records are available for the River Medway, from a report for the Kent River Authority by Sir. M. MacDonald and Partners dated September 1969 entitled "River Medway and Tributaries - Flood Relief Investigations - Feasibility Report", and as the Medway is the largest river in the Kent Area it considered appropriate to focus on this river with respect to history of flooding for the Area. The data from the MacDonald report can be augmented by other records of flooding on the Medway since the commissioning of the Leigh Barrier Scheme upstream of Tonbridge in 1981 and Agency flow records from the gauging station at East Farleigh, to give a relatively coherent long term record. Table C.1 shows, the major flood events recorded at Maidstone between 1814 and 1963, major flood events at East Farleigh and Tonbridge between 1947 and 1968, and major incoming floods to the Leigh Barrier since 1981. Whilst considering the data in the table, it should be noted that the throttling effects of the Leigh Barrier since its construction in 1981 will be noticeable with respect to the flows recorded downstream at East Farleigh.

The table only records major events on the Medway with a threshold for Leigh being set at 75 cumecs which relates to a return period of nominally 1 in 2 years according to the operating manual for the Leigh Barrier.

Please note that there have been other high flow events on the Medway, especially in the earlier years, for which flow data are not available. Furthermore, there would have been occasions when rivers in the Kent Area smaller than the Medway were in flood when the Medway, due to rainfall patterns, was not.

By inspection of the tabulated data, the worst flooding on the Medway in living memory was in September 1968 when the greater part of Tonbridge, at that stage without the protection of the Leigh Barrier, was inundated. It was this event that was the catalyst to the design and construction of the Barrier.

The MacDonald report contains a brief description of the 1968 event as follows:

> *"These were large scale floods, occurring not only in the Medway, but over South East England. The floods were caused by severe high intensity rainfall under thunderstorm conditions.*
>
> *In the Upper Medway Catchment the storm was most severe along the northern boundary.....the rainfall was greatest along a line drawn between Maidstone and South Godstone decreasing rapidly to the South. This was a very severe storm with rainfalls in excess of 5 inches (127.0 mm)being recorded over a period of about 16 hours. The very high rainfalls on the northern edge of the catchment caused flood flows of exceptional size in the Rivers Eden, Medway, Bourne and Len. The two major tributaries on the southern edge of the catchment - the Rivers Beult and Teise had moderate flows as did the Medway above Penshurst.*

Severe flooding was caused by this flood, in many cases the worst on record. All low lying agricultural land between Penshurst and Maidstone was flooded, the Eden Valley above Penshurst and large scale urban flooding took place in Edenbridge, Tonbridge, East Peckham, Yalding and Maidstone. The flood damage caused was probably aggravated by the unexpectedness of a large flood in September, its exceptional severity and the speed with which the flood waters arrived..."

Table C.1: Peak recorded flows (m^3/s) for flood events on the River Medway between 1814 and 2000.

Date	Maidstone	East Farleigh	Tonbridge	Leigh	Date
1814	374	-	-	-	1814
1825	277	-	-	-	1825
1860	282	-	-	-	1860
1861	303	-	-	-	1861
1862	249	-	-	-	1862
1865	229	-	-	-	1865
1866	259	-	-	-	1866
1900	371	-	-	-	1900
1909	270	-	-	-	1909
1911	266	-	-	-	1911
1914	234	-	-	-	1914
1922	221	-	-	-	1922
1924	198	-	-	-	1924
1925	262	-	-	-	1925
1927	330	-	-	-	1927
1928	217	-	-	-	1928
1935	228	-	-	-	1935
1937	194	-	-	-	1937
1943	201	-	-	-	1943
1947	242	-	165	-	1947
1950	215	-	129	-	1950

Date	Maidstone	East Farleigh	Tonbridge	Leigh	Date
1951	-	-	133	-	1951
1952	-	164	64	-	1952
1955	215	-	145	-	1955
1957	-	-	108	-	1957
1958	-	-	108	-	1958
1960	297	295	156	-	1960
1963	221	224	136	-	1963
1964		184	82	-	1964
1965		99	91	-	1965
1966		142	91	-	1966
1967		192	156	-	1967
1968	-	286	227	-	1968
1979	-	-	-		1979
1982	-	160	-	144	1982
1984	-	159	-	-	1984
1985	-	201	-	121	1985
1986	-	132	-	80	1986
1987	-	176	-	100	1987
1989	-	204	-	110	1989
1993	-	180	-	90	1993
1994	-	173	-	-	1994
1999	-	176	-	75	1999
2000	-	275	-	260	2000

The event in mid October 2000 has interesting parallels with the September 1968 event with very intense rainfall over specific parts of the county. In 1968 the worst of the flooding in the Medway arrived from the Eden subcatchment whilst the Upper Medway subcatchment to the south was only moderately affected. Whereas in October 2000 the centre of concentration of the severe rainfall was further south and it was the Upper Medway and catchments further south such as the Teise and the Rother that suffered the worst. As was the case in 1968, the floodwaters in October arrived

with unexpected rapidity giving very little opportunity for effective countermeasures against flooding.

The worst flood event after the commissioning of the Barrier but prior to October 2000 was in December 1982 when the incoming flow to the Barrier was logged at 144 cumecs, (a return period of nominally 1 in 9 years). The maximum gauged discharge through Tonbridge was 92 cumecs, a flow that caused little or no flood damage to property in the town. The mid October 2000 event with a peak inflow to the Barrier of 260 cumecs was significantly worse than the 1968 event which, but for the Leigh Barrier, would have had devastating consequences for Tonbridge.

C2 GREAT STOUR

Flooding took place in a number of locations in Ashford and neighbouring villages on the Great Stour in December 1985, January 1986 and November 1986. It was as a result of these floods that the flood storage reservoirs upstream of Ashford at Aldington and Hothfield were built on the East Stour and the Great Stour respectively.

C3 RIVER ROTHER

Records indicate that floods have previously occurred on the River Rother at Robertsbridge in 1946, 1960, 1979 and 1993. During the December 1993 event around eight properties in Rutley Close and Northbridge Street suffered internal flooding.

C4 RECENT FLOODING

In the years immediately prior to the October 2000 event flooding has occurred in several locations in the Kent Area. On 30th December 1993, the village of Lamberhurst was inundated by serious flooding from the Teise, which affected ten properties and caused the closure of the A21 London to Hastings Road for over five hours. On the 25th December 1999 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. Reports of flooding were also received for the River Teise at Lamberhurst. The Leigh Barrier on the River Medway was brought into operation over a four day period. Flooding of properties from 'main river' was reported at:-

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

Flooding of properties from Internal Drainage Board watercourses was recorded at:-

- Lamberhurst – 10 properties
- Five Oak Green – 35 properties

- Paddock Wood – Approximately 50 properties

In April 2000 flooding affected the Stour catchment causing both Aldington and Hothfield storage reservoirs to impound. High river levels resulted in 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 properties in Lamberhurst.

In conclusion, therefore, it is evident that the mid October 2000 flood event on its own was probably the worst on the Medway, and probably in the Kent Area, since 1927. The combination of the three serious flood events in autumn 2000 can therefore be rightly identified as an extremely rare sequence of events.

APPENDIX D: VIEWS OF PROFESSIONAL PARTNERS

A report by external Emergency Management consultants Stirling Reid based on a short customer survey is given below. We have used a consultancy for this work as we believe this prompts customers to be more open.

This is a repeat of the survey used after the May 2000 flooding event in Southern Region, all results when compared show improvement.

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

Key issues and common themes are:

- Kent 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.

D.1 REPORT ON ENVIRONMENT AGENCY SOUTHERN REGION QUESTIONNAIRE SENT TO PROFESSIONAL PARTNERS IN JANUARY 2001

D.1.1 Summary

Overall, most professional partners seem to feel that the Agency is providing a better service now that in May 2000. 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 partners, or too much!

Two partners have written separately to the Agency to raise specific issues: we have not attempted to summarise their letters. Others have raised several points of details which are listed below.

D.1.2 General

This report covers three things:

summary of the 'multiple choice' responses

responses to individual questions

responses to telephone follow-up conducted by Stirling Reid.

D.1.3 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 expect, and also that we have had less time to analyse them. Against this, more questionnaires were sent out, so there are three times the number of replies available in May 2000. A spreadsheet summarising the results has been emailed separately, but he main points are given in this report.

2001 results show an improvement on the 2000 questionnaire in all average scores except q6 (Did you feel that the Agency had a clear understanding of your role in this incident?) which is slightly lower.

Most dramatic improvements over 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?

Standard deviations are higher for the 2001 results than for the 2000 results in all questions except 'Did you feel the Agency gave you enough information about events and/ or its own activities?' and '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 suggests that the Agency is being more successful in communication 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 in these two questions. (one 'very poor' each in 2000, none in 2001. This is despite the much larger number of responses: you would expect more of each kind of response in 2001).

There were 'very poor' responses to only three questions in 2001. These were:

q4: 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' - RWVS, Tandridge DC)

q5: Did you feel that you clearly understood the Agency's role in this incident? (1 'very poor' - Tandridge DC)

q6: Did you feel that the Agency had a clear understanding of your role in this incident? (2 'very poor' - RWVS, Tandridge DC)

(Comparison with 2000 results is not meaningful here because there are so many more 2001 results.)

RWVS were not included in the 2000 questionnaire and we suspect they have not worked with the Agency before. Tandridge, where drainage is almost entirely ordinary watercourses where the Local Authority is itself the lead drainage authority is a special case and has written to Sir J Harman outlining its problems. (See also our interviewer's comments below.)

D.1.4 Responses to individual questions:

Note: in the following tables we have not included all comments - only those which make substantive points. (So we would not include a comment like 'relations with Agency very good' as this should be reflected in the scores.)

Where mathematical scores exist (i.e. for multiple choice questions) we have give 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. The nearest multiple choice option is repeated next to the average score. In general, average scores below 0 are bad; above 1 are excellent.

Please note also that we did not transcribe the 'freeform' replies ourselves. In some cases they do not entirely make sense and this may be due to illegible handwriting on the original reply form.

Replies to the first three questions were purely factual, and depended on the partner concerned and have therefore not been summarised.

1. Between what times/ dates was your agency/ service involved with the

Environment Agency in responding to the October/ November flooding incident?

2. Briefly, what was the nature of your agency/ service's involvement?

3. Which part(s) of the Environment Agency did you deal with?

Replies to remaining questions are:

4	**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?**
Average response	0.9: just below "clear about most things"
Number choosing best response: 'Understand them very well'	8
Number choosing worst response: 'Do not understand Agency at all'	2
Freeform comments	
Seeboard	The flood warning system is good for passing information about possible flooding but does not report actual flooding. E.g. After flooding starts it would be useful to know actual localities amenities that are flooded.
SE Water	Seminar held in Maidstone in the Kent Area provided to be very useful when 'real' floods came in November
Surrey Police	There was a common belief that the agenda would provide more information than they did, i.e. historical information on areas likely to be flooded. Also, in many cases warnings tended to be vague/ non-specific.

5	**Did you feel that you clearly understood the Agency's role in this incident?**
Average response	1.2: just above "clear about most things"
Number choosing best response: 'Very clearly'	13
Number choosing worst response: 'Did not understand Agency role/ actions at all'	1 (Tandridge DC)
Freeform comments	
Railtrack Southern	Flood Warnings not likely to affect railway should not be issued to us.
E Sussex Fire Brigade	Demarcation between the Agency and water authority areas of responsibility was not clear at times.

6	**Did you feel that the Agency had a clear understanding of your role inthe incident?**
Average response	0.8: rather under "Agency were clear about most things we did or needed"
Number choosing best response: 'Agency understood us very clearly'	9
Number choosing worst response: 'Agency had totally inadequate understanding of our work and needs'	2 (WRVS, Tandridge DC)
Freeform comments	
Railtrack Southern	We only need to know about floods near railways.
Surrey CC	Surrey is only a very small part of Agency's southern region, so sometimes Agency is not expecting contact with Surrey. Also V. IMPORTANT the Agency 'Floodline' does not include Eden and Edenbrook on Surrey rivers. This can be a problem for duty officers.

7	**Did you feel the Agency gave you enough information about events and/or its own activities?**
Average response	1: "Good information about most issues"
Number choosing best response: 'Very good information on all issues'	8
Number choosing worst response: 'Totally inadequate information from Agency'	0

Freeform comments

Railtrack	Railtrack do not need warnings for Isle of Wight.
Ashford BC	Sufficient information given but more would have been needed if actual flooding of properties had occurred. However, the new flood warning system is causing confusion! This is compounded by the grossly pessimistic and in some cases, wrong, flood warning maps. See comments elsewhere in this response.
SE Water	Initial flooding problems and anticipated flood levels/ warnings were not issued from the Sussex area - 12/13 October. Initial contact from the Kent Area forwarded it to the wrong fax number. Once the incidents started, attendance at Gold Control meant that the info flow improved. Prior to this, the info received from Agency was similar to what the rest of the public received.
Surrey Police	Flood warnings were received on a regular basis and were then passed onto the areas Concerned. On a number of occasions the information was too vague and did not make the supply of logistics support to those areas likely to be affected, a straightforward process.

8	**Did you find the revised Flood Warning system more helpful than the old one?**
Average response	0.7: somewhat under "Yes"
Number choosing best response: 'Yes, very much so'	5
Number choosing worst response: 'Very much worse'	0

Freeform comments

E Sussex CC	The accuracy rate of flood and severe flood warnings does not seem very high, and so does not provide a very clear guide upon which to make tactical decisions.
Dartford BC	Received comment from Invicta Life line (the Council's out of house contractor) that the flood warnings and watches were not annotated with the Coastal Zone or River catchment codes which made it difficult to know which District Council to contact for which warning. A copy of the flood warning plan for Kent would have assisted.
Canterbury CC	Many problems of the public were happier once they had translated warnings into yellow amber red.
Ashford BC	I believe the new system is causing confusion the general public.
Sevenoaks DC	I think that there should be a different term used to avoid confusion between a catchment "watch" and a river "watch".

9a	**Which aspects of Flood Warnings are the most and least useful to you? Information about severity of flooding?**	
Average response		0.7: 'useful'
Number choosing best response: 'very useful'		23
Number choosing worst response: 'less useful'		1

9b	**Which aspects of Flood Warnings are the most and least useful to you? Information about timing of flooding?**	
Average response		0.7: 'useful'
Number choosing best response: 'very useful'		28
Number choosing worst response: 'less useful'		0

9c	**Which aspects of Flood Warnings are the most and least useful to you? Information about duration of flooding?**	
Average response		0.6: 'useful'
Number choosing best response: 'very useful'		25
Number choosing worst response: 'less useful'		1

9	**Which aspects of Flood Warnings are the most and least useful to you?**
	Freeform comments
E Sussex CC	Not all flood warnings incorporate the area codes leaving room for confusion and slowing the process.
W Sussex FB	There were periods of "silence" between warnings / watches and the all clear.
Dartford BC	It would have been very useful to understand the telemetry results better to give more timing to respond to likely severe flood warnings. It assists in pre-positioning specific equipment and resources. It also allows us to organise a briefing meeting and set up control areas before having to react as an emergency.
Ashford BC	I have not indicated a level of satisfaction because there was no flooding in any of the zones for which flood warnings were issued. This indicates that the whole aspect of alerting the public to a danger when it never happened needs to be reviewed - because when the danger actually materialises complacency will have set in.
Sevenoaks DC	The number of warnings was unprecedented but the working of them that flooding is expected appears now to many to be over conscious and may lower the expectation in the future.
Surrey CC	I have had a quick look at the flood warnings received in the last 3/4 months and cannot see any information about timing or duration. The general term 'flood warning' to describe flood watch, flood warning, severe flood warning and all clear, is causing confusion amongst the general public.
Surrey Police	Eden and Edenbrook's flood status occasionally didn't accord with what was happening "on the ground". All information relating to anticipated floods is useful. I would just like to see a more detailed warning indicating anticipated areas of flood.

Note: freeform comments for question 9 are amalgamated.

10	**Did you feel that the Agency acted appropriately and promptly?**
Average response	1.2: better than 'Yes, generally very good'
Number choosing best response: 'Yes, very good at all times'	9
Number choosing worst response:' Generally inadequate or very slow'	0
	Freeform comments
Tandridge CC	Never able to talk to anyone who could help.
SE Water	The initial response from the agency did not meet with our requirements as no flood warnings being received on or about 12/13 October when the initial flooding began.

11	What were the main advantages to you, if any, of working with the Agency during this incident?
	Freeform comments
Note: many respondents mentioned supply of information	
Railtrack Sthn	To be able to alert our structure engineer of severe alert at structures at risk.
Kent CC	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 had to get in many cases, incident answers to questions and to be able to discuss these face to face.
Canterbury CC	Being able to discuss matter directly with your control room - 01732 223145 to find out their views on likelihood of rank, peak of flow in rivers and estimated time of arrival at Canterbury.
Seeboard plc	The experience of the staff involved who would add good practical advice (forecasts) to information.
W Kent Police	Good understandings with the personnel at the Leigh barrier enabled police at local levels to receive information in real time and as such allowed great time scale to act on that information.

12	Were there any areas where you felt the Agency did not provide what you needed or expected?
	Freeform comments
Note: many respondents simply said 'no'	
Railtrack Southern	Yes, we had several lines flooded, but no warnings, the water came from the sky or drainage.
E Sussex Fire Brigade	Only in those areas where there was a conflict of responsibility between Agency and water companies, leaving the fire brigade in a quandary as to who they should be dealing with.
Ashford BC	This agency's flood warning map are grossly pessimistic and in some cases are wrong. This has resulted in many people being panicked into thinking they would flood, when in fact they are not in risk. Many of those people demanded sandbags that were not needed, and those requests took time and resources to deal with. Some others went as far as to move furniture upstairs, in one case it was an OAP. Thank goodness he did not fall or suffer a heart attack! The local agency officers are well aware of these shortcomings and it is hoped that the flood warning maps will be corrected without delay. It is also hoped that the system has not been discredited by the wrong information.
Seeboard plc	Details of areas actually flooded and severity (perhaps we need some datum points in areas prone to flooding. So that we can then we can use this information to identify when flooding of our plant equipment is likely).
Surrey C.C.	Difficult to get information for the Eden and Edenbrook as only a small part of the Agency Southern region, and Eden and Edenbrook not on Surrey river data on 'Floodline'.

13	Do you have any other comments or recommendations which would help the Agency improve its response in future?
	Freeform comments
Dartford BC	Certainly warnings need to go out allowing sufficient time for agency response on both flood warnings and severe flood warnings.
Seeboard plc	Concerns exist because of issuing warnings perhaps to frequently and so lessen their impact particularly with the public.
Coastguard (Dover)	A clear definition needs to be promulgated as to where different responsibilities lie between Agency, water companies, local authorities, etc: especially as regards who may authorise provisions of equipment and any payment attributable.
Kent Fire and Rescue	Local supervisors have identified the needs for more equipment for use in public warnings for example vehicle mounted PA systems. A periodic review of current warnings would help organisations take stock. Every 4-6 hrs an updated list of current warning levels with a brief indication on whether they are expected to rise or fall. Need to review the 'triggers ' for using warnings on the river Darent, North of Devon Road, Sutton at Home and in Dartford town centre (+ Central Park)

D.1.5 Responses to telephone follow-up conducted by Stirling Reid Limited

Summary

Note: interviewees were selected on the basis of their written responses - as agreed with the Agency we chose those who had given either very high or very low scores on multiple choice questions. There was not enough time to complete all interviews.

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.

New flood warning system:

Mixed opinion. On one hand 'there can never be too much information' but this was countered by 'we get far too much.' All depends on the organisation concerned. The Fire Service prefers '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, perhaps, intended too much for the public than emergency services. Some respondents had difficulty remembering the 'old' system!!

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 by not contacting 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.

D.1.6 Southern Electricity

Require only 'severe flood' warnings. All other information is destroyed and can also block machines required for their own purposes!

Information about blocked roads would be very useful to give repair crews forward warning of diversions, etc. In the event, their only role is to repair damaged lines.

Briefings and meetings held by Agency are largely ignored and the problem is too much information as far as they are concerned. However, the information they use (as above) is very good.

Agency have improved. More information and contact.

No other suggestions.

D1.7 Tandridge CC

Very displeased on the grounds they were unable to contact the Agency at all! Their main concern was the help line and 0800 numbers. Apparently both referred the caller back to the council! We asked if they had numbers for the use of local authorities but apparently not. They had considerable numbers of the public telephoning them to express their disquiet over the same matter. The authority did not receive any practical help as a result or information, e.g. they wished to know where the flood plains were, supply of sandbags and so on.

Warning faxes were missed, out of hours but they then said their own agency receives them on their behalf. They thought the new warning system itself was an improvement, being produced more regularly and easier to follow.

No improvement by the Agency as far as they were concerned. Apparently, the Agency are invited to multi-agency meetings but have not turned up for at least the last six.

It was suggested that it depends 'on which office' one telephones depends on the response. Tonbridge being the best. More personal contact would improve the situation.

(Interviewer's note - This authority appears way out of step with everybody else. I have a feeling the authority needs to look at some systems itself. It expects the Agency to supply everything including sandbags. I am surprised they have no other contact number other than the help line. They apparently, do not know where their own flood plains are!)

D.1.8 Kent Fire and Rescue

Appropriate person unavailable.

End of Stirling Reid Report

D.2 AREA ACTIVITY SUMMARY IN DEALING WITH MPS/PROFESSIONAL PARTNERS

Table D.1: Summary of MPs Flood Letters, October – December 2000

Number of MP queries	22
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

All resolved

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

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

APPENDIX E: TELEMETRY

E.1 TELEMETRY SITE TRIGGER LEVELS FOR KEY SITES ON THE RIVER MEDWAY CATCHMENT

Table E.1: Telemetry levels for Yalding 12th October – River Medway

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Medway between Tonbridge By-pass and Yalding	12/10/00 13:35	Yalding Rl U/S	-	-	12/10/00 11:12 10.01Mod	13/10/00 11:12 10.99Mod	13/10/00 20:00 11.21Mod
R.Medway between Yalding and Allington	12/10/00 13:45	Yalding Rl D/S[1]	11/10/00 15:36 8.99Mod	12/10/00 14:48 10.03Mod		13/10/00 00:48 10.52Mod	13/10/00 12:48 11.22Mod

[1] *13:30 13/10/00 Yalding D/S outstation lost, last reading 11.2 mOD Flooding 11:00 12/11/00*

Table E.2: Telemetry levels for Yalding; 12th October, - River Teise

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Teise and Lesser Teise between Lamberhurst and Yalding	12/10/00 08:00	Lamberhurst Rl	11/10/00 23:06 38.02 mOD	12/10/00 00:12 38.51 mOD	12/10/00 05:00 39.75 mOD	N/A only 3 levels	13/10/00 12:48 11.22Mod*

Table E.3: Telemetry levels for Yalding: 12th October – River Beult

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Beult between Pluckley and Bethersden to Yalding	12/10/00 08:30	Smarden Beult Rl	11/10/00 08:00 20.18Mod	12/10/00 01:36 20.47Mod	12/10/00 08:48 21.71Mod	-	12/10/00 15:36 22.10Mod

Table E.4: Telemetry Levels for 29th October – Teise

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Teise and Lesser Teise between Lamberhurst and Yalding	19:30 29/10/00	Lamberhurst Rl	29/10/00 20:41 38.0 mOD	29/10/00 22:24 38.51 mOD	30/10/00 06:10 39.75 mOD	-	30/10/00 08:54 40.09 mOD

Table E.5: Telemetry Levels for 30th October – Beult

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Beult between Pluckley and Bethersden to Yalding	06:10 30/10/00	Smarden Beult RL	29/10/00 09:30 20.19 mOD	29/10/00 23:06 20.51 mOD	30/10/00 07:25 21.69 mOD	-	30/10/00 14:00 21.95 mOD

Table E.6: Telemetry levels for 31st October – Medway

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Medway between Yalding and Allington	01:00 31/10/00	Yalding D/S			30/10/00 11:00 10 mOD	00:45 31/10/00 10.5mOD	18:30 31/10/00 10:92 mOD

Flooding 07:00 30/11/00

Table E.7: Telemetry levels for 6th November - Medway

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Medway between Yalding and Allington	03:40 06/11/00 FLOOD WARNING ISSUED	Yalding D/S			06/11/00	21:15 06/11/00 10.5 mOD	16:30 07/11/00 10.88 mOD

Flooding 05:00 06/11/00

Table E.8: Telemetry levels for 6th November Teise

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Teise and Lesser Teise between Lamberhurst and Yalding	00:00 06/11/00	Lamberhurst Rl	05/11/00 21:31 38.0 mOD	05/11/00 22:33 38.5 mOD	06/11/00 02:12 39.77 mOD	-	06/11/00 03:00 40.08 mOD

Table E.9: Telemetry Levels for 6th November Beult

Name	Time Severe Flood Warning Issued	Measuring station	H1	H2	H3	H4	Max level
R.Beult between Pluckley and Bethersden to Yalding	04:10 06/11/00	Smarden Beult	05/11/00 23:46 20.23 mOD	06/11/00 00;27 20.52 mOD			06/11/00 06:22 21.66 mOD

APPENDIX F: SEVERE FLOOD WARNINGS ISSUED

Table F.1: Severe Flood Warnings Issued

Flood Warning Area No	Description	Date Warning Issued	AVM Log Sheet Warning Queued Time	last AVM Call Made	Agency Area	No.of people warned	% Success Rate
F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	12/10/00	08:00	09:11	Kent	314	97
F8A9	The River Beult from Pluckley and Bethersden to Yalding	12/10/00	08:30	09:29	Kent	208	87
F8A7	The River Bourne between Hadlow and East Peckham	12/10/00	08:30	09:37	Kent	131	89
F5A1	The River Rother between Mayfield and Newenden	12/10/00	10:30	11:59	Kent	122	76
F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	12/10/00	10:45	11:58	Kent	278	84
F8A2	The River Medway between Forest Row and Penshurst	12/10/00	10:45	11:58	Kent	145	87
F9A2	The West Brook	12/10/00	12:00	13:04	Kent	110	83
F9A3	The Swalecliffe Brook	12/10/00	12:00	12:49	Kent	132	89
F8A4	The River Medway between the Tonbridge Bypass and Yalding	12/10/00	13:35	15:19	Kent	923	83
F8A5	The River Medway between Yalding and Allington	12/10/00	13:45	15:19	Kent	118	83
F8A5	The River Medway between Yalding and Allington	13/10/00	06:30	07:20	Kent	116	81
F8A5	The River Medway between Yalding and Allington	13/10/00	20:45	21:58	Kent	114	80
F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	29/10/00	19:30	22:21	Kent	322	85
F5A1	The River Rother between Mayfield and Newenden	29/10/00	21:30	22:40	Kent	119	74
F8A9	The River Beult from Pluckley and Bethersden to Yalding	30/10/00	06:10	07:02	Kent	193	80
F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	30/10/00	07:50	08:51	Kent	269	82
F8A2	The River Medway between Forest Row and Penshurst	30/10/00	07:50	08:58	Kent	140	86
F8A5	The River Medway between Yalding and Allington	31/10/00	01:00	01:38	Kent	111	79
F8A8	The River Teise and Lesser Teise between Lamberhurst and Yalding	06/11/00	00:38 03:59 warning re-queued	03:25	Kent	266	67
F5A1	The River Rother between Mayfield and Newenden	06/11/00	00:55	05:35	Kent	121	78
F8A8	The River Teise and Lesser Teise between Lamberhurst	06/11/00	03:50	05:40	Kent	288	76

Flood Warning Area No	Description	Date Warning Issued	AVM Log Sheet Warning Queued Time	last AVM Call Made	Agency Area	No.of people warned	% Success Rate
	and Yalding						
F8A9	The River Beult from Pluckley and Bethersden to Yalding	06/11/00	04:10	05:40	Kent	181	76
F8A1	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	06/11/00	07:50 09:08 re-issued	09:51	Kent	276	83
F8A2	The River Eden and Eden Brook from Crowhurst and Blindley Heath to Penshurst	06/11/00	07:50	09:03	Kent	145	88
F8A4	The River Medway between the Tonbridge Bypass and Yalding	06/11/00	16:18	17:08	Kent	874	85
F8A7	The River Bourne between Hadlow and East Peckham	06/11/00	16:24	17:29	Kent	130	88
F6A5	The River East Stour between Sellindge and Ashford	06/11/00	20:45	21:51	Kent	121	92
F6A4	The River Great Stour between Ashford and Fordwich	06/11/00	23:15	23:59	Kent	399	78

APPENDIX G: AVM STATISTICS

Table G.1: Regional AVM Statistics: 15th September, 9th October – 15th November

	Voice messages	Fax messages	Pager Messages	Total Calls
Total number of recipients	**72,423**	**46,381**	**4,556**	**123,360**
Aborted calls	14,250	4117	1,425	19,792
Answered calls	**58, 173**	**42,264**	**3,131**	**103,568**
Unsuccessful calls due to recipient[1]	42,836	12,056	656	55,548
Unsuccessful calls due to unobtainable number[2]	8,032	0	0	8,032
Unsuccessful calls due to system failure[3]	5,016	6,627	4,676	16,319
Attempted calls	**113,146**	**59,673**	**7,692**	**180,511**

Notes:

[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 failures.

[4] The number of unsuccessful calls does not *equal the number of recipients that did* not *receive a warning; all unsuccessful calls are attempted three times at ten minute intervals.*

Table G.2: AVM Performance: 15th September 2000

	Voice messages	Fax messages	Pager Messages	Total Calls
Total number of recipients	**452**	**995**	**55**	**1502**
Aborted calls	143	63	28	234
Answered calls	**309**	**932**	**27**	**1268**
Unsuccessful calls due to recipient[1]	240	223	6	479
Unsuccessful calls due to unobtainable number[2]	135	0	0	135
Unsuccessful calls due to system failure[3]	227	119	88	434
Attempted calls	**933**	**1246**	**109**	**2288**

Notes:

[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 failures.

[4] The number of unsuccessful calls does not *equal the number of recipients that did* not *receive a warning; all unsuccessful calls are attempted three times at ten minute intervals.*

Table G.3: AVM Performance: 9th October 2000 to 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	n/a	13 173
Unsuccessful calls due to unobtainable number[2]	1 733	n/a	n/a	1 733
Unsuccessful calls due to system failure[3]	790	1 980	1 416	4 186
Attempted calls	26 003	17 150	2 285	45 438

Notes:

[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 failures.

[4] The number of unsuccessful calls does not *equal the number of recipients that did* not *receive a warning; all unsuccessful calls are attempted three times at ten minute intervals.*

Table G.4: AVM Performance: 20th October 2000 to 26th October 2000

	Voice messages	Fax messages	Pager Messages	Total Calls
Total number of recipients	**1 830**	**2 477**	**427**	**4 734**
Aborted calls	435	137	67	639
Answered calls	**1 395**	**2 340**	**360**	**4 095**
Unsuccessful calls due to recipient[1]	1 415	249	n/a	1 664
Unsuccessful calls due to unobtainable number[2]	51	n/a	n/a	51
Unsuccessful calls due to system failure[3]	52	338	211	601
Attempted calls	**5 178**	**5 541**	**1 065**	**11 784**

Notes:

[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 failures.*

[4] *The number of unsuccessful calls does* not *equal the number of recipients that did* not *receive a warning; all unsuccessful calls are attempted three times at ten minute intervals.*

Table G.5: AVM Performance for Flood Event: 27th October 2000 to 14th November 2000

	Voice messages	Fax messages	Pager Messages	Total Calls
Total number of recipients	**53 540**	**29 566**	**2 787**	**85 893**
Aborted calls	10 254	2 868	912	14 034
Answered calls	**43 286**	**26 698**	**1 875**	**71 859**
Unsuccessful calls due to recipient[1]	30 884	8 708	n/a	39 592
Unsuccessful calls due to unobtainable number[2]	6 113	n/a	n/a	6 113
Unsuccessful calls due to system failure[3]	3 947	4 190	2 961	7 151
Attempted calls	**84 230**	**39 596**	**4 836**	**128 662**

Notes:

[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.*

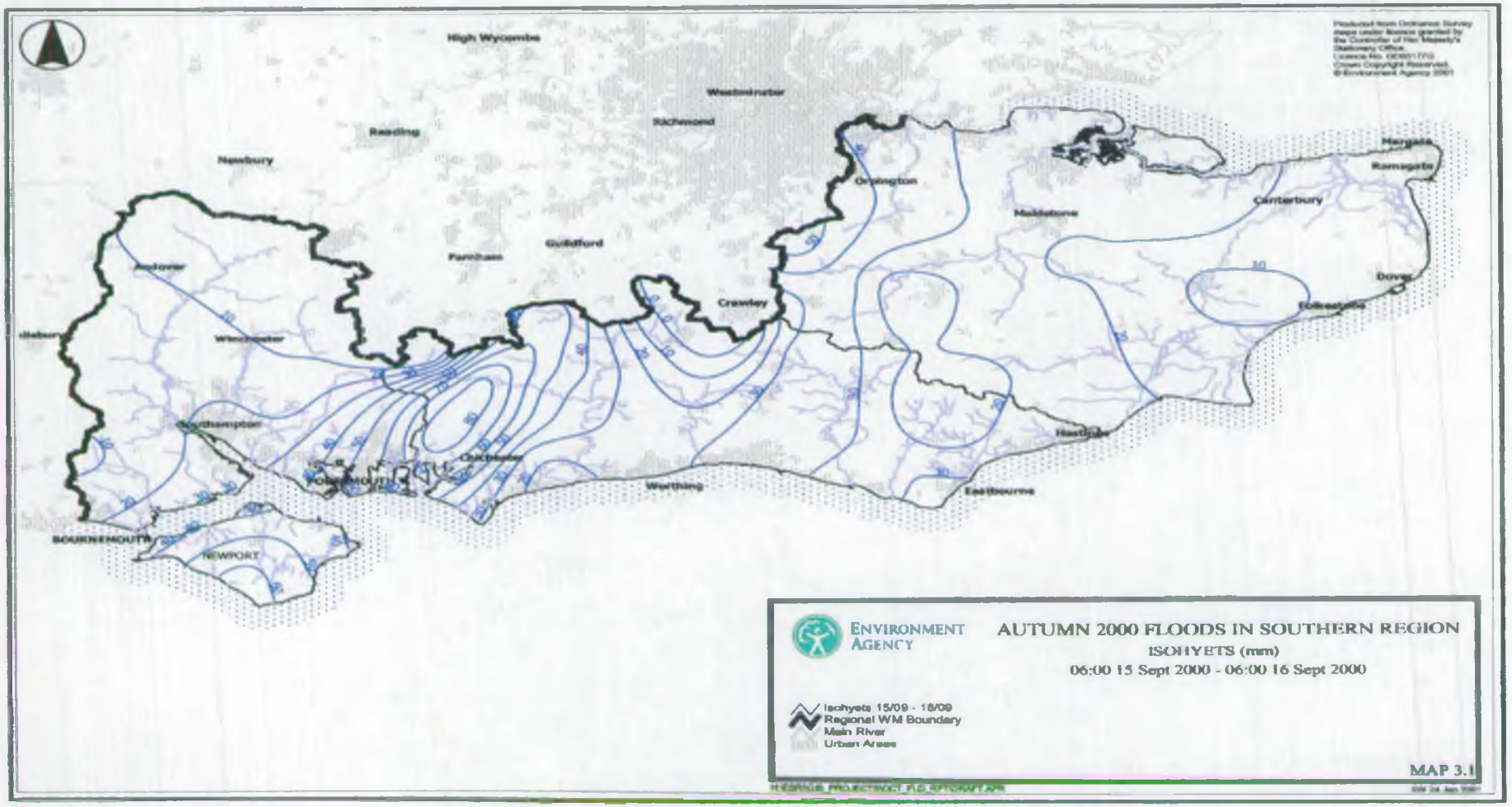
[3] *Includes failure of pager bureaux, etc. as well as AVM failures.*

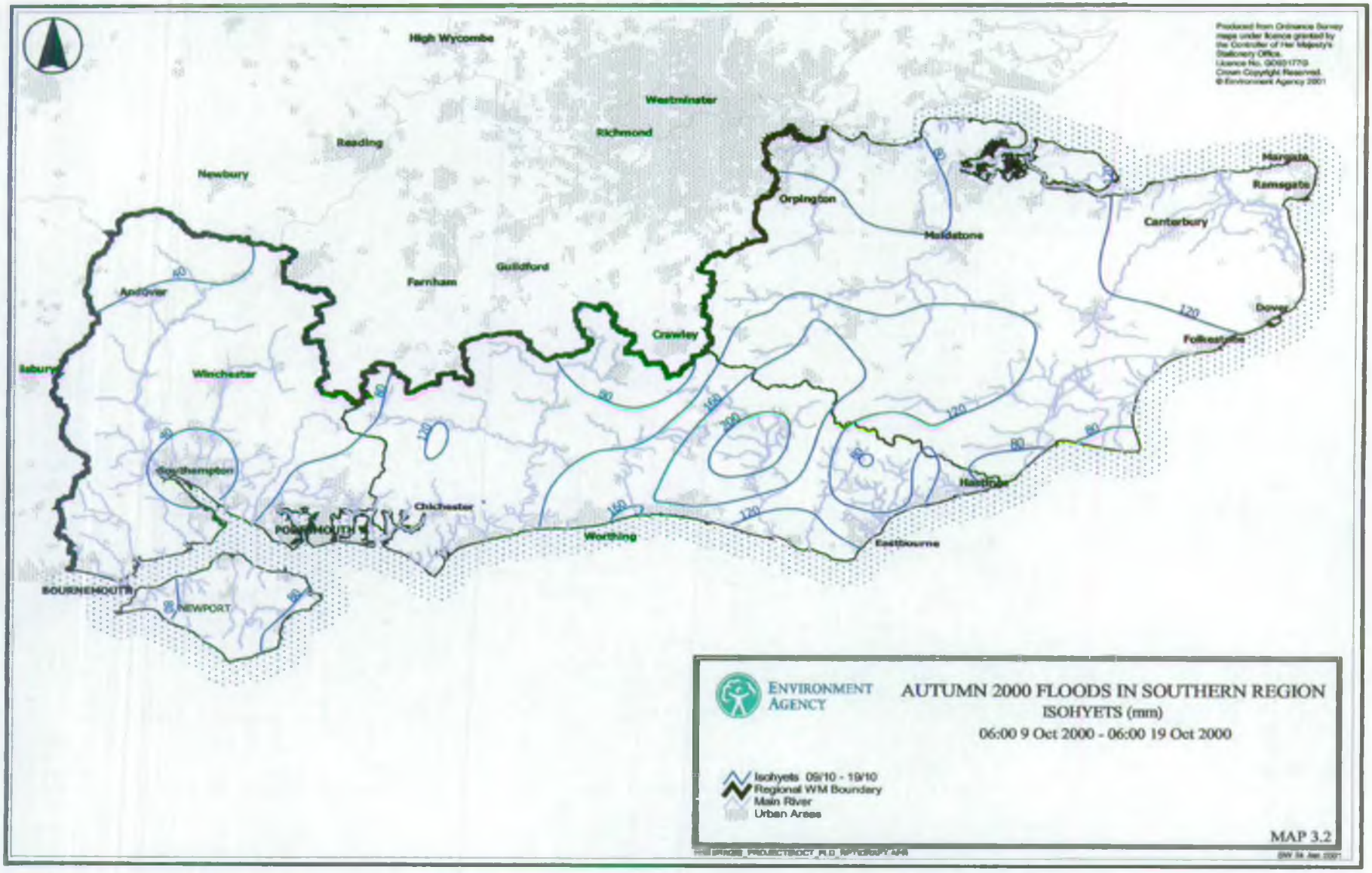
[4] *The number of unsuccessful calls does* not *equal the number of recipients that did* not *receive a warning; all unsuccessful calls are attempted three times at ten minute intervals.*

Table G.6: No. of Attempted Calls from September 12th (Flood Warning Code Change Day) to 15th November 2000

Message type	No. of Calls Made
Voice	122 282
Fax	65 635
Pager	8 294
Total	196 211

APPENDIX H: RAINFALL ISOHYETS

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BOURNEMOUTH
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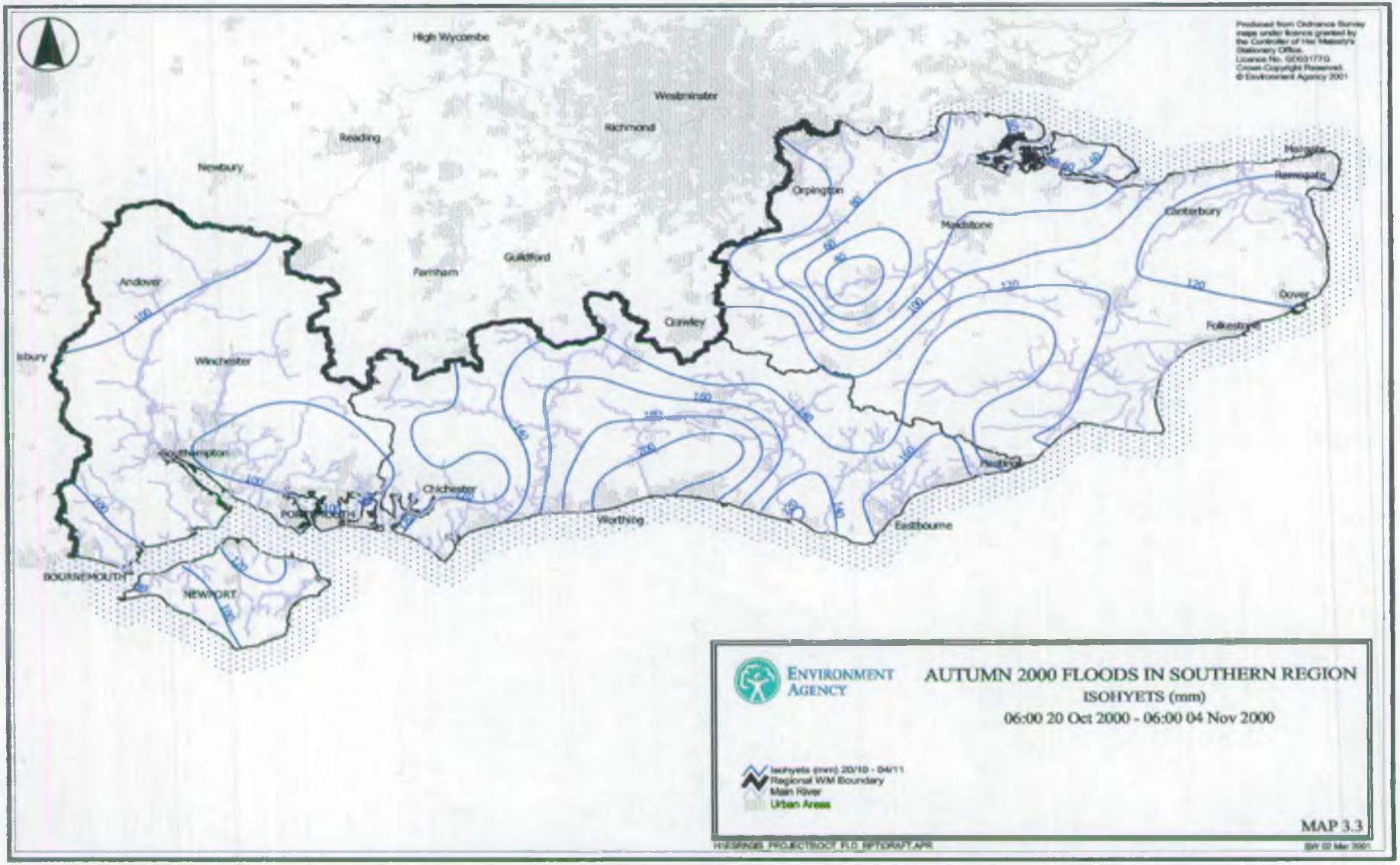
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
ISOHYETS (mm)
06:00 9 Oct 2000 - 06:00 19 Oct 2000
Isohyets 09/10 - 19/10
Regional WM Boundary
Main River
Urban Areas
MAP 3.2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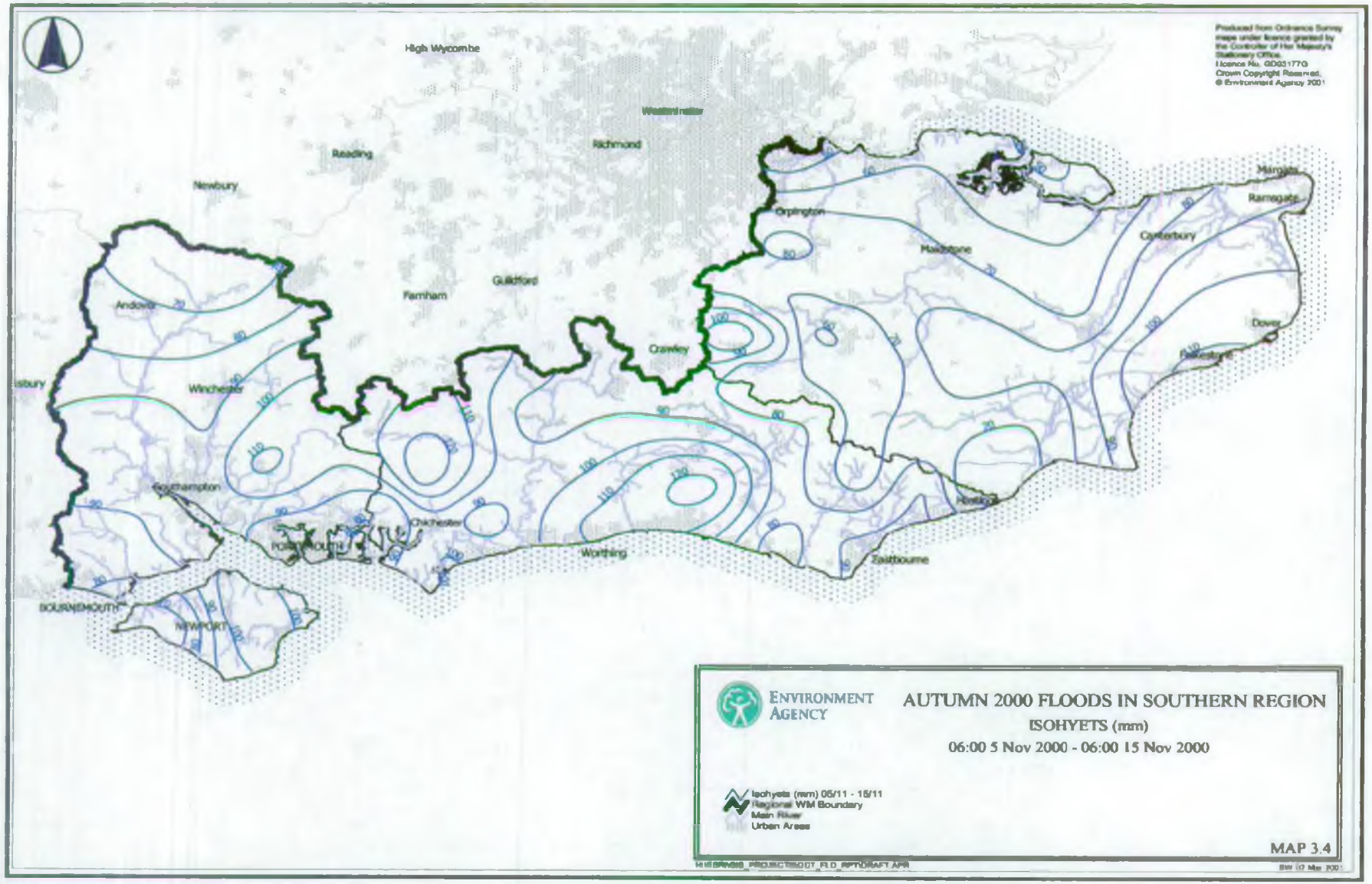
Worthing
Eastbourne
BOURNEMOUTH
NEWPORT
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
ISOHYETS (mm)
06:00 20 Oct 2000 - 06:00 04 Nov 2000
Regional WM Boundary
Main River
Urban Areas
MAP 3.3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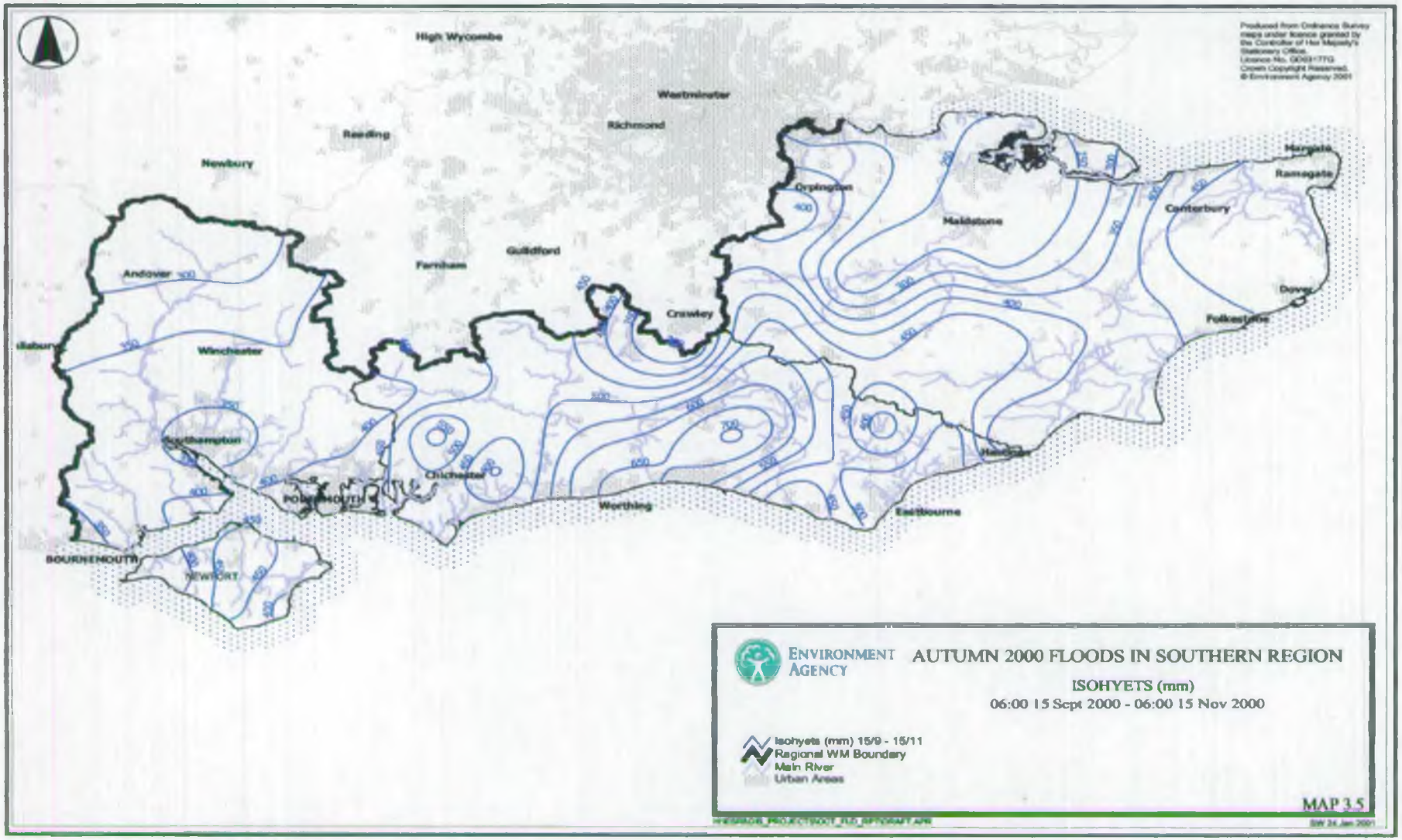
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
ISOHYETS (mm)
06:00 5 Nov 2000 - 06:00 15 Nov 2000
Isohyets (mm) 05/11 - 15/11
Regional WM Boundary
Main River
Urban Areas
MAP 3.4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Eastbourne
BOURNEMOUTH
NEWPORT
ENVIRONMENT AGENCY
AUTUMN 2000 FLOODS IN SOUTHERN REGION
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

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 Officer: 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

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