

The Autumn 2000 Floods in England

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Introduction

During autumn 2000, England suffered devastating river flooding. The worst flooding occurred during three separate time periods covering the approximate dates 10 to 15 October, 28 October to 12 November, and 8 to 14 December. I traveled to affected areas during the first two time periods (Figure 1; see <http://www.streetmap.co.uk> for more detailed maps of the locations). I visited south-east England from 13-15 October 2000, including stops in:

- Partridge Green in West Sussex;
- Bevendean in Brighton, Uckfield, and Lewes in East Sussex; and
- Tonbridge and Yalding (Figure 2) in Kent.

I visited Yorkshire on 8 November 2000, examining mainly the Stockbridge area of Keighley and Malton (Figures 3 and 4). This report describes the visits by looking beyond the extreme rainfall to the non-meteorological causes of the flood disaster.

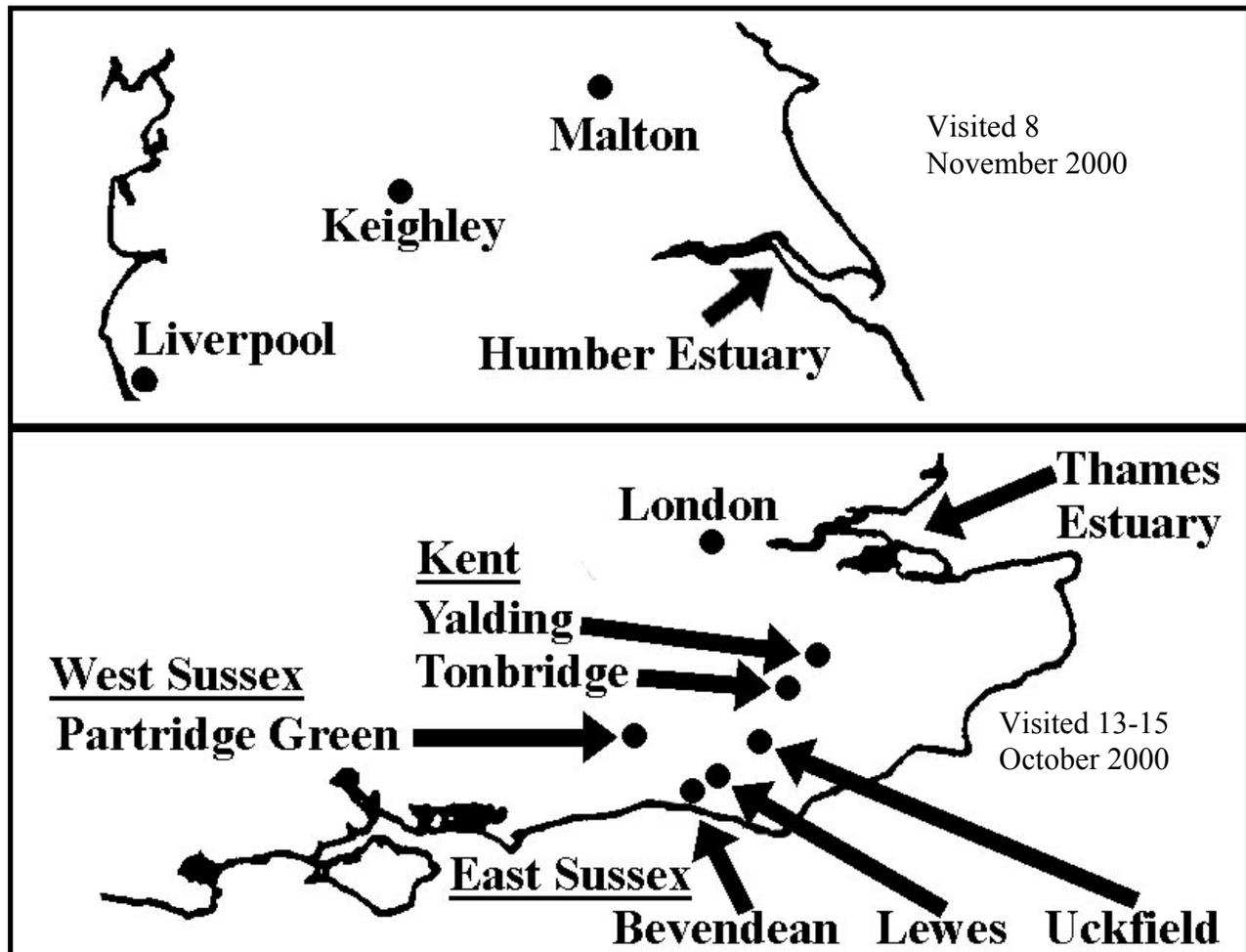


Figure 1: Maps showing the main settlements which I visited.

Flood level



Figure 2: Firefighters pumping water from a flooded house in Yalding.



Figure 3: Fire truck driving through a flooded intersection in Malton.

A Natural Disaster?

A high level of rainfall occurred over England throughout autumn 2000 as part of the wettest twelve-month period in England and Wales since records began in 1766. Climate change was touted as being the root cause of this increased precipitation, but at the time enough evidence did not exist to either affirm or deny this statement. Thus, the rainfall could be deemed to have been predominantly natural, though perhaps with human influences through climate change. Even though the rainfall might have been largely natural, the flood disaster was definitely human-induced.

Specific examples include:

- In Partridge Green, drainage ditches have been inadequately maintained. They were filled with sediment and clogged by vegetation. Rainwater had poor drainage and excessive rainwater produced localized flooding.
- Bevendean lies at the bottom of a cultivated catchment. The farmer, despite warnings against the practice, was cultivating the hill's fields with a technique which augments runoff during rainfall. The sewer system could not cope with the volume of runoff, so mud filled people's homes (Figure 5).
- In Lewes and Keighley, flood water was trapped in properties by structural flood defenses. These defenses significantly increased the duration of water in people's homes.
- In Lewes and Uckfield, community design, namely the orientation and placement of buildings, caused waves and high water velocities.

More generally:

- Structural flood defenses play a dangerous role in augmenting long-term flood vulnerability, as discussed later with respect to Tonbridge and other cases.
- Property development in areas vulnerable to flooding, illustrated by Lewes (Figure 6) and discussed as a national problem later, is a significant problem in England.



Figure 4: Hallway of a flooded house in Malton.

The amount of rain was extreme, yet human influences dictate the flood characteristics—such as duration, water velocity, waves, and mud content—and locales. Therefore, human influences dictate the extent of flood damage. Human activity, not rainfall, causes flood disasters.

Impacts

The main lessons from the impacts of these events are:

1. Flooding Tends to be a Localized Issue.

The meteorological hazard of rainfall was regional or national in scope, depending on the specific event. The flood disaster resulted from highly localized human influences, such as ditch maintenance, cultivation techniques, and structural flood defenses. These human influences resulted in localized flooding affecting only a small number of properties in each location, although each property affected suffered immensely.



Figure 5: Possessions ruined by mud in Bevendean.

Figure 6:
The Old Foundry residences in Lewes, flooded before units had been sold despite the properties being raised several steps from ground level.



Proposed flood management “solutions” often tackle a regional or national “flood problem” with templates applicable over a wide area. For implementation, they must consider local vulnerability characteristics which affect the flood characteristics, and thus flood damage, at a highly localized level.

2. Localized Issues Can Have National Impacts.

The localized flooding in a large number of widespread locations led to a severe, national disaster, mainly reflected by transport. Roads and railways were frequently closed due to flooding and landslips. Furthermore, the floods starting at the end of October affected railways which were already on an emergency, reduced timetable. This timetable was implemented after 17 October 2000 when track failure derailed a train, killing four passengers. Significant speed restrictions were imposed on trains while susceptible tracks were replaced.

The combination of track repairs, flooding, landslips, and continuing background incidents—such as minor crashes and signal failures—caused chaos, each day indirectly affecting far more people than encountered flood water. The floods’ wider impacts were national even though flood water was localized. The floods’ wider impacts were also influenced by other national issues, such as the railways.

Reasons for Impacts

Two main reasons exist for the widespread impacts of these events: event characteristics and increasing vulnerability of the population.

1. Conjunctive Events

Linear: The flooding was not a single, definable event, but a series of at least three separate, major periods of inundation with a background of continuing, exceptional rainfall.

Simultaneous: The widespread effects on transport occurred due to two major, independent, events: rainfall and a train crash. Fear of a protracted gas (petrol) crisis due to demonstrations blocking storage facilities was also present during this time period. Significant protests did not occur.

These conjunctive characteristics made the consequences far more severe physically and psychologically across the country than if no conjunctive characteristics had been present, i.e. if the events had occurred separately in space and time. At the individual level, experiencing continual train delays is frustrating and inconvenient but does not compare to losing one's life, home, or possessions to floods. At the societal level, though, long-term, indirect losses usually surpass immediate, direct losses, so they must be considered.

2. Increasing Vulnerability

Demographic changes have increasingly put people and property in vulnerable areas:

- The expansion of urban areas increases the speed and volume of run-off. Rain water collects in rivers and low-lying areas faster and in larger volumes, more rapidly leading to localized flooding.
- Development has occurred with little regard to the flood vulnerability of locations where the structures are built.

Siting properties in floodplains is not necessarily detrimental, provided that occupants are aware of the risk and that steps are taken to prevent flood losses over the long-term without exacerbating other problems.

The reliance on structural flood defenses is a more challenging problem which has increased society's vulnerability to floods. Individuals and communities tend to have low awareness of both their flood vulnerability and the steps which they can take to reduce their vulnerability. As well, structural defenses tend to supersede more sustainable solutions.

Flood Management Implications

The impacts of the autumn 2000 floods provide lessons for flood management in the U.K. The Environment Agency (EA; <http://www.environment-agency.gov.uk>) is responsible for many aspects of flood management in England and Wales.

1. Information Campaigns (Flood Warnings, Education, Awareness)

For example, the EA provides flood warnings. Their flood warnings during autumn 2000 were generally accurate. Criticisms of the EA tended to refer to the timeliness and effectiveness of the warnings, two issues which are separate from accuracy but difficult to improve.

For timeliness, a tradeoff between early warning and accuracy usually exists. Effectiveness is linked to timeliness, since an accurate warning issued too late makes heeding the warning impossible. Effectiveness also depends on individuals' actions. The EA has neither the authority nor the resources to force people to keep track of or to heed warnings appropriately. The EA makes plenty, clear information available—including modes such as an individual signing up to receive automatic voice messages when local flood warnings are issued—if people themselves choose to seek it and to implement given advice.

Education is thus essential for both warnings and appropriate action. The EA undertook such an education campaign with Flood Action Week from 11 to 17 September 2000, just before the floods. Flood Action Week assisted in publicizing changes to the flood warning system, effective from 12 September 2000. Television commercials, information packages in the mail, and a revised website were part of the strategy. The EA's public education on floods includes its "Indicative Floodplain Maps" published on the web on 7 December 2000 during the flood crisis. These maps have weaknesses, as noted by the EA, but are an excellent tool for education and awareness, essential parts of appropriate, long-term flood management.

The conjunctive and spatial characteristics of the autumn 2000 floods are difficult to predict for preparation and warning. Education and awareness program must be coupled with other flood prevention, mitigation, and adaptation strategies, especially approaches which do not use structural defenses.

2. Flood Management Strategies Other Than Structural Defenses

Tonbridge illustrates the longer-term issues relating to reliance on structural flood defenses. The Leigh Barrier flood defense upstream from Tonbridge is promoted as protecting Tonbridge from flooding. Significant flooding did occur in Tonbridge during autumn 2000, but the extent was less than in pre-Barrier events. This result led engineers to comment that the Leigh Barrier saved Tonbridge from flooding and reduces flood risk. The obvious problems with reliance on structural defenses are that:

- As occurred with the Leigh Barrier during the flooding in Tonbridge in autumn 2000, structural defenses run into difficulty when the flow rate exceeds their design capacity.
- Structural defenses are designed to change the hazard parameters (the flood characteristics) without considering the effects on people's vulnerability. When the design capacity is exceeded, the changed hazard parameters may yield more damage. For example, a structural defense breaching under its water load produces destructive components of high velocity and rapid depth changes which could not have occurred in the absence of the flood defense.
- Structural defenses increase society's vulnerability to flooding because people believe that they are safe due to the visible, large, solid defense. People then alter their behavior to make themselves more flood-vulnerable, such as ignoring flood warnings, avoiding damage-prevention techniques, and failing to educate themselves on the dangers from flooding. This phenomenon was noted in Tonbridge due to the Leigh Barrier and in nearby Mersham where residents assumed they would be entirely protected by the Aldington dam.

One example of a myth regarding structural defenses is the suggestion that across England and Wales "Flood defenses successfully prevented the flooding of 280,000 homes" during the floods (EA, 2001). Given the issues above, this analysis is short-term and ignores the long-term role of structural flood defenses in augmenting flood vulnerability in the absence of simultaneous, complementary flood

management strategies. For example, how many of the 280,000 homes were constructed with the assumption that the flood defenses would protect them always and forever?

Examples—not an exhaustive list—of other flood management strategies include:

1. environmental management:
 - e.g. promoting appropriate vegetation such as trees or habitats such as marshes in appropriate locations to store water.
 - e.g. proper cultivation practices.
2. land use and planning:
 - e.g. not developing in vulnerable locations.
 - e.g. urban design and structure orientation intended to reduce flood velocities and to direct runoff to water storage areas.
3. infrastructure design:
 - e.g. using porous road and pavement surfaces to reduce runoff directly into waterways.
 - e.g. using waterproof materials in the ground floors of properties.
 - e.g. avoiding building bungalows.
 - e.g. using ground floors of residences for garages rather than living space.
4. floodproofing people (discussed later).
5. economic incentives and disincentives:
 - e.g. insurance companies adjusting premiums to reflect flood vulnerability.
 - e.g. government providing financial support for retrofits to floodproof.

Every item is not always appropriate, but a comprehensive flood management strategy involving several components can be successful. Brown *et al.* (1997) examined similar floods in 1986 in comparable locations in Michigan and Ontario. Ontario, with a sustainable approach to floodplain management since the Hurricane Hazel disaster in 1954, incurred economic losses less than 0.5% of Michigan's losses.

People as well as infrastructure must be floodproofed. The psychological effects of the autumn 2000 floods, determined from talking to affected residents, indicated an immense shock and bewilderment that their home or business could be flooded so easily with such damaging consequences. Often, opinions were expressed that the flood defenses should have protected them. Floodproofing people to reduce the human toll would involve encouraging behavioral changes including:

1. Educating oneself about natural hazard risks in one's area.
2. Being aware of available environmental information and warning systems.
3. Knowing the actions to undertake in various scenarios.
4. Changing one's lifestyle to adapt to potential environmental threats.

Number four is as simple as storing valuable photographs on upper floors (irrespective of nearby flood defenses) or as complex as restructuring one's house. In preparation for or in response to flooding, several residents in England have altered their ground floors to raise all electrics, remove carpets, install drains, and use swimming pool tanking (plaster).

The need for promoting attitude and behavioral changes as part of comprehensive flood management is evidenced by political, short-sighted reactions. For example, the EA mentions that one of its immediate post-flood actions is "Re-prioritising the national defense improvement programme according to where needs are greatest and where public expectation has been raised by Government pledges for early alleviation proposals" (EA, 2000). The distinction between the two categories is telling and such an approach is symptomatic of the short-term thinking which caused the flood disaster, both locally and nationally.

Similarly, too much focus for the floods has been placed on climate change, since not enough evidence was available to indicate the role which climate change played in this specific event. Climate change is an important environmental concern, but, at present, cannot be accurately attributed as the cause of any specific flood event. The overwhelming desire to blame a global issue obscures an opportunity to identify and tackle:

- National issues, namely the need for a comprehensive, long-term, sustainable flood management strategy.
- Local issues such as the localized human influences on each flood situation.

The “blame climate change” game was also witnessed during the devastating summer 2002 floods in Central Europe.

As well, the combined railway and flood situation inevitably led to high-profile politics. Between 4 and 17 November 2000, more than £85 million were promised for British flood defense through to 2004. This money covered mainly structural flood defenses, flood warning systems, and flood recovery. Possibilities for other flood management strategies were virtually ignored by decision-makers, although the situation has somewhat improved since then.

One interesting reaction came from the two anonymous reviewers for the journal in which the original version of this paper was published. While they did provide some excellent suggestions, they objected to my statements that the autumn 2000 events were caused by us rather than by rain. They described such comments in the draft submitted for review as “controversial opinions”, “too strident”, “rather speculative and something of a personal diatribe”, and “polemic”. One reviewer even noted “I am not sure what soft defenses are”—a scary remark from someone supposed to be a flood management expert. Fortunately, the editor had a wider perspective and many of my comments were retained after I toned them down and supported them with extensive, if rather obvious, evidence and statements from academic references.

From a flood management point of view, the autumn 2000 floods did not immediately educate decision-makers about the true causes of flood disasters or alternatives for sustainable flood damage reduction. Therefore, we must continue with polemic, personal diatribes, and strident statements to educate people about appropriate approaches.

Conclusions

England experienced exceptional levels of rain during autumn 2000, but the resulting flood disaster was mostly caused by society. An important focus is the many properties built, often recently, in vulnerable areas without understanding, or caring to understand, the consequences. Developers and local authorities must be held more responsible for flood damage in order to attempt to force them into educating themselves about the issues and into considering long-term solutions for reducing flood vulnerability. To provide impetus, the national government may wish to consider undertaking more responsibilities for local flood and development issues.

A possible step is to legislate for vulnerable locations the planning and infrastructure design solutions proposed above. Another possible step is to permit existing institutions to exercise enforcement, particularly the EA which, with appropriate resources, could have a stronger role in decisions on floodplain planning. The EA frequently recommends against new developments on floodplains, such as in Tonbridge (Figures 7 and 8), but has only an advisory capacity.

One caution in expanding its role is that our society generally conveys statutory and strong enforcement powers on institutions which are democratically accountable. The EA is currently not democratically accountable, nor should it be given its mandate. If its powers are to be widened, the accountability issue must be rectified, possibly through an elected head or responsibility directly to a ministry.

Simple solutions do not exist. For example, institutional change and power centralization both have drawbacks. Focusing linearly on changes to infrastructure or environmental education which are relevant only to flood management may cause other problems. Nonetheless, flood damage can be reduced if society is willing to take difficult decisions. Such decisions might entail:

- Focusing on structural flood defenses while fully understanding the vulnerability they create.
- Encouraging vulnerable properties to be permanently abandoned.
- Adapting properties and their owners to be floodable on a regular basis without undue physical or psychological damage respectively.

The danger is that viable options are sidelined because society is willing neither to commence discussing such difficult decisions nor to accept the short-term sacrifices they undoubtedly entail, despite the long-term advantages. The rainfall in England in autumn 2000 was likely a largely natural phenomenon, but we largely caused the resulting flood disaster. The failure to learn the proper lessons from these floods is a much worse, and entirely human-induced, disaster.



Figures 7 and 8:
The swimming pool in Tonbridge, built in a flood-vulnerable area against the EA's advice and flooded. The layer of mud left inside (above) led to indefinite closure (right).



References

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