Autumn 2023 East Anglian Flood Hydrology Investigation

Summary report with results for each community

December 2024

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Environment Agency

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Contract

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This report describes work commissioned by the Environment Agency by an instruction dated 29 January 2024. The Client's representative for the contract was James Ingham. Roxanne Upton, Kirstie Murphy, Duncan Faulkner, Amy Winder, Anthony Hammond, Sam Hardy, Kevin Haseldine and Andrew Waite of JBA Consulting carried out this work.

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1 Introduction

Storm Babet brought heavy rain and flooding to much of eastern Britain on 18-20th October 2023. Two weeks later, Storm Ciaran brought a smaller amount of rain, also leading to some significant flood impacts.

This short report summarises the findings of a hydrological study which looked at the context, magnitude and rarity of the rainfall and river flows during these two events. The study area, shown on the map, was centred on Suffolk and also including parts of south Norfolk and north Essex. For more information, including maps of the results, refer to the main project report.

Following a brief overview of the findings for the whole study area (Section 2), the results are organised by community, i.e. towns or villages (Section 3). The location of each community is shown on the map on the next page.

The rarity of the event is quantified using the annual exceedance probability, AEP. This is the probability that the rainfall, river flow or river level will exceed the amount measured during Storm Babet or Storm Ciaran during the course of a year. The lower the probability, the more extreme the event. AEPs are provided as ranges rather than exact figures to give an indication of the uncertainties involved in their estimation.

2 Whole area

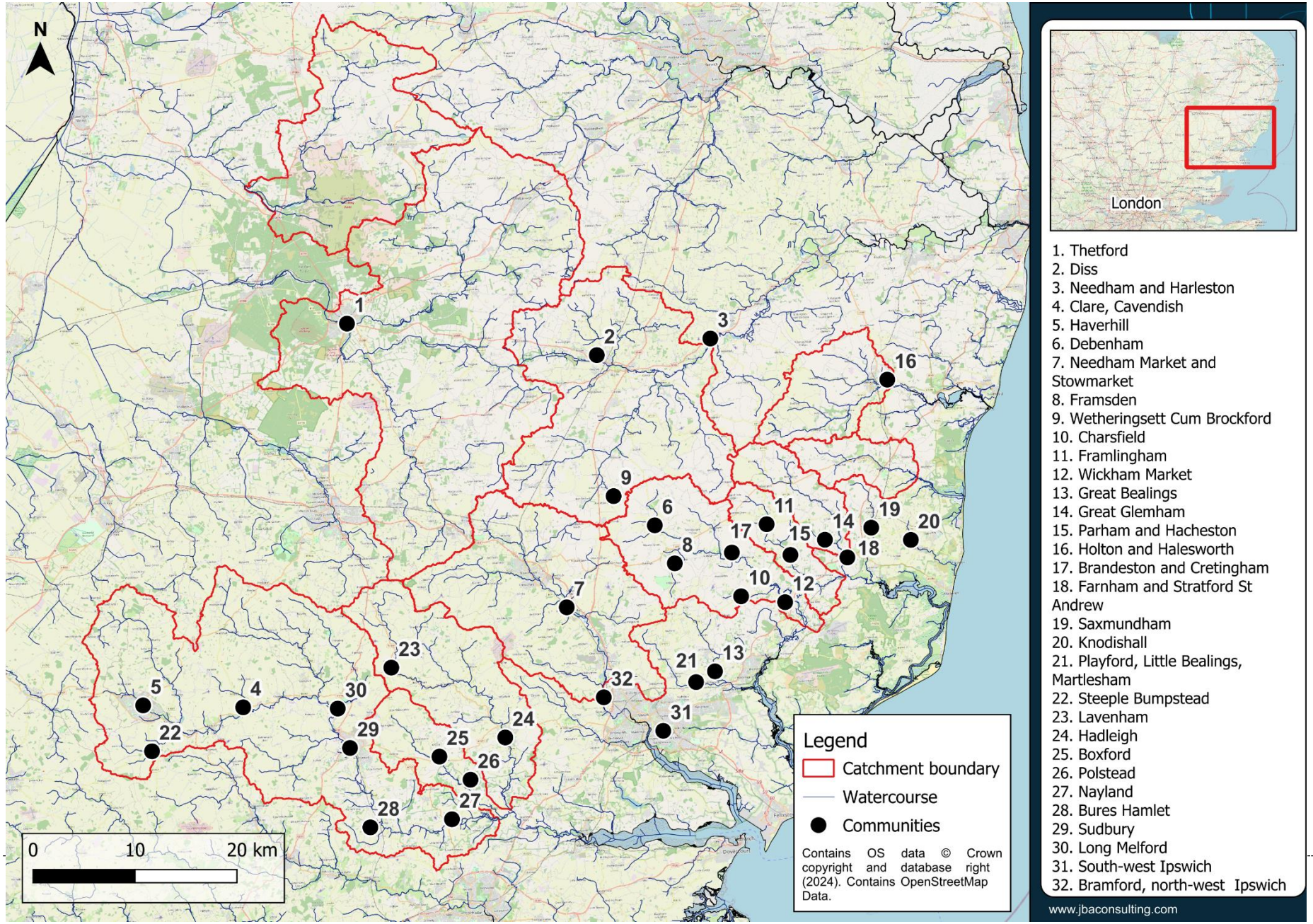
The soil moisture across the study area prior to Storm Babet was not exceptional for the time of year. In contrast, soils were unusually wet for early November prior to Storm Ciaran.

Rainfall was very high during Storm Babet, especially over the Deben and Ore catchments. The most intense rainfall fell in a 48-period.

The resulting peak river flows were most extreme on the Rivers Waveney, Dove, Alde, Deben, Ore, Gipping and Brett. Gauges on these rivers and others nearby recorded their highest flows in at least 50 years of record. The rarity (AEP) of the flows varied a lot across the study area.

Rainfall during Storm Ciaran was not exceptional. The flood flows from Storm Ciaran were mostly more extreme than the rainfall totals, as a result of the elevated soil moisture and river flows in the aftermath of Storm Babet.

The events of October 2023 were just the start of an extremely wet winter across much of England. Over the Gipping, Little Ouse and Thet catchments the maximum rainfalls accumulated during autumn to winter 2023 were the highest in a 61-year record. This was true whether the total was taken over 30, 60 or 90 days, because so much rain fell in Storms Babet and Ciaran.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4. Clare, Cavendish
5. Haverhill
6. Debenham
7. Needham Market and Stowmarket
8. Framsden
9. Wetheringsett Cum Brockford
10. Charsfield
11. Framlingham
12. Wickham Market
13. Great Bealings
14. Great Glemham
15. Parham and Hacheston
16. Holton and Halesworth
17. Brandeston and Cretingham
18. Farnham and Stratford St Andrew
19. Saxmundham
20. Knodishall
21. Playford, Little Bealings, Martlesham
22. Steeple Bumpstead
23. Lavenham
24. Hadleigh
25. Boxford
26. Polstead
27. Nayland
28. Bures Hamlet
29. Sudbury
30. Long Melford
31. South-west Ipswich
32. Bramford, north-west Ipswich
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3 Results by community

The three tables below provide the main results for each community. The communities are grouped by local government districts, starting with Breckland in the north-west and ending with Ipswich in the south-east.

Table 1 provides rainfall depths measured at or near each community, in each storm. Depths are shown for the highest 12-hour and 48-hour rainfall accumulations during Storm Babet and Storm Ciaran. The 48 hour accumulation includes all the rain during each storm. The 12-hour accumulation covers the period of most intense rainfall, over a duration that is expected to cause flooding on many rivers in the area.

AEPs are given for the rainfall during Storm Babet. The rainfall during Storm Ciaran was not extreme, with an AEP greater than 50% at all locations and so these AEPs are not shown in the table.

These results are applicable when considering the impacts of the rainfall on local drainage and surface water flooding for each community.

Table 1: Rainfall depths and AEPs for the closest rain gauge to each community. "n/a" means no nearby rain gauge is available.

Town or village	District	Babet 12 hour depth (mm)	Babet 48 hour depth (mm)	Babet 12 hour AEP (%)	Babet 48 hour AEP (%)	Ciaran 12 hour depth (mm)	Ciaran 48 hour depth (mm)
Thetford	Breckland	n/a	n/a	n/a	n/a	n/a	n/a
Diss	South Norfolk	n/a	n/a	n/a	n/a	n/a	n/a
Needham and Harleston	South Norfolk	53.5	76.9	5-10	2-5	15.7	26.8
Clare, Cavendish	West Suffolk	n/a	n/a	n/a	n/a	n/a	n/a
Haverhill	West Suffolk	27.2	47.6	>50	20-50	20.8	34.4
Debenham	Mid Suffolk	60.1	91.3	2-5	<1	21.0	30.3
Needham Market and Stowmarket	Mid Suffolk	46.8	76.6	5-10	1-2	23.0	31.8
Framsden	Mid Suffolk	60.1	91.3	2-5	<1	21.0	30.3
Wetheringsett cum Brockford	Mid Suffolk	n/a	n/a	n/a	n/a	n/a	n/a
Charsfield	East Suffolk	n/a	n/a	n/a	n/a	n/a	n/a
Framlingham	East Suffolk	60.1	91.3	2-5	<1	21.0	30.3
Wickham Market	East Suffolk	n/a	n/a	n/a	n/a	n/a	n/a
Great Bealings	East Suffolk	47.2	76.8	5-10	1-2	15.6	29

Town or village	District	Babet 12 hour depth (mm)	Babet 48 hour depth (mm)	Babet 12 hour AEP (%)	Babet 48 hour AEP (%)	Ciaran 12 hour depth (mm)	Ciaran 48 hour depth (mm)
Great Glemham	East Suffolk	44.0	73.6	10-20	2-5	15.8	24.8
Parham and Hacheston	East Suffolk	44.0	73.6	10-20	2-5	15.8	24.8
Holton and Halesworth	East Suffolk	53.6	77.6	5-10	2-5	13.8	19.8
Brandeston and Cretingham	East Suffolk	60.1	91.3	2-5	<1	21	30.3
Farnham and Stratford St Andrew	East Suffolk	44.0	73.6	10-20	2-5	15.8	24.8
Saxmundham	East Suffolk	44.0	73.6	10-20	2-5	15.8	24.8
Knodishall	East Suffolk	n/a	n/a	n/a	n/a	n/a	n/a
Playford, Little Bealings, Martlesham	East Suffolk	47.2	76.8	5-10	1-2	15.6	29
Steeple Bumpstead	Braintree	27.2	47.6	>50	20-50	20.8	34.4
Lavenham	Babergh	43.9	67.5	5-10	2-5	22.1	34.7
Hadleigh	Babergh	n/a	n/a	n/a	n/a	n/a	n/a
Boxford	Babergh	40.2	64.8	10-20	2-5	20.6	27.8
Polstead	Babergh	n/a	n/a	n/a	n/a	n/a	n/a
Nayland	Babergh	n/a	n/a	n/a	n/a	n/a	n/a
Bures Hamlet	Babergh	40.2	64.8	10-20	2-5	20.6	27.8
Sudbury	Babergh	40.2	64.8	10-20	2-5	20.6	27.8
Long Melford	Babergh	n/a	n/a	n/a	n/a	n/a	n/a
South-west Ipswich	Ipswich	n/a	n/a	n/a	n/a	n/a	n/a
Bramford, parts of north-west Ipswich	Mid Suffolk / Ipswich	n/a	n/a	n/a	n/a	n/a	n/a

The rainfall results in Table 1 are less relevant when considering flooding from the larger rivers, because those river flows are a result of rainfall over the whole catchment draining towards a community, which may be quite different from the rainfall measured at an individual raingauge local to the community.

Table 2 provides similar information to Table 1 but for catchment-average rainfall. These calculations were carried out for selected communities only. Some communities can be flooded by more than one river. The table indicates which river has been chosen for the catchment rainfall calculations; this will generally be the largest river flowing past each community.

Table 2: Rainfall depths and AEPs for average rain over the catchments draining to selected communities. Depths and AEPs are shown for the highest 12-hour and 48-hour rainfall accumulations during Storm Babet.

Town or village	River catchment over which rain calculated	Babet 12 hour depth (mm)	Babet 48 hour depth (mm)	Babet 12 hour AEP (%)	Babet 48 hour AEP (%)
Thetford	Little Ouse	55.5	80	2-5	2-5
Needham & Harleston	Waveney	51.1	77.2	2-5	2-5
Debenham	Deben	58.4	89.7	1-2	<1
Framsden	Tributary of Deben	57.6	88.8	2-5	<1
Wetheringsett cum Brockford	Tributary of Dove	58.5	89.8	1-2	<1
Charsfield	Potsford Brook	57.0	88.2	2-5	<1
Framlingham	Ore	59.3	90.7	2-5	1-2
Wickham Market	Deben	57.1	88.3	1-2	<1
Great Bealings	Lark	48.1	78.6	5-10	1-2
Great Glemham	Tributary of Alde	43.5	73.9	10-20	2-5
Parham and Hacheston	Ore	52.6	83.5	2-5	1-2
Holton and Halesworth	Blythe	52.6	77.2	5-10	2-5
Farnham and Stratford St Andrew	Ore	47.7	77.5	5-10	2-5
Hadleigh	Brett	39.6	68.9	5-10	1-2
Nayland, Bures	Stour	35.2	59	10-20	5-10
Bramford, parts of north-west Ipswich	Gipping	44.7	73.3	5-10	1-2

Table 3 provides information on the resulting peak river flows or levels, for both Storm Babet and Storm Ciaran. Results are given for the largest river flowing past each community. The peak flows are uncertain because it is difficult to accurately measure flows in flood conditions at many of these river gauging stations.

The AEPs for each community in Table 3 are estimated using one of four methods (explained fully in the main report). The results become progressively less reliable from method 1 to method 4. The methods are:

1. ESS: Local data used in the whole flood frequency analysis ("enhanced single-site" analysis), for gauging stations with more reliable flow measurements.
2. QMED: Local data used to estimate the median annual maximum flood, for gauging stations with less reliable flow measurements.
3. Rank: Local data used to rank the floods compared with others in the gauged record, for gauging stations with unreliable flow measurements or only river level data.
4. Model: No local river measurements so peak flows estimated from rainfall using a hydrological model. At these sites it is not known whether the flow was the highest on record.

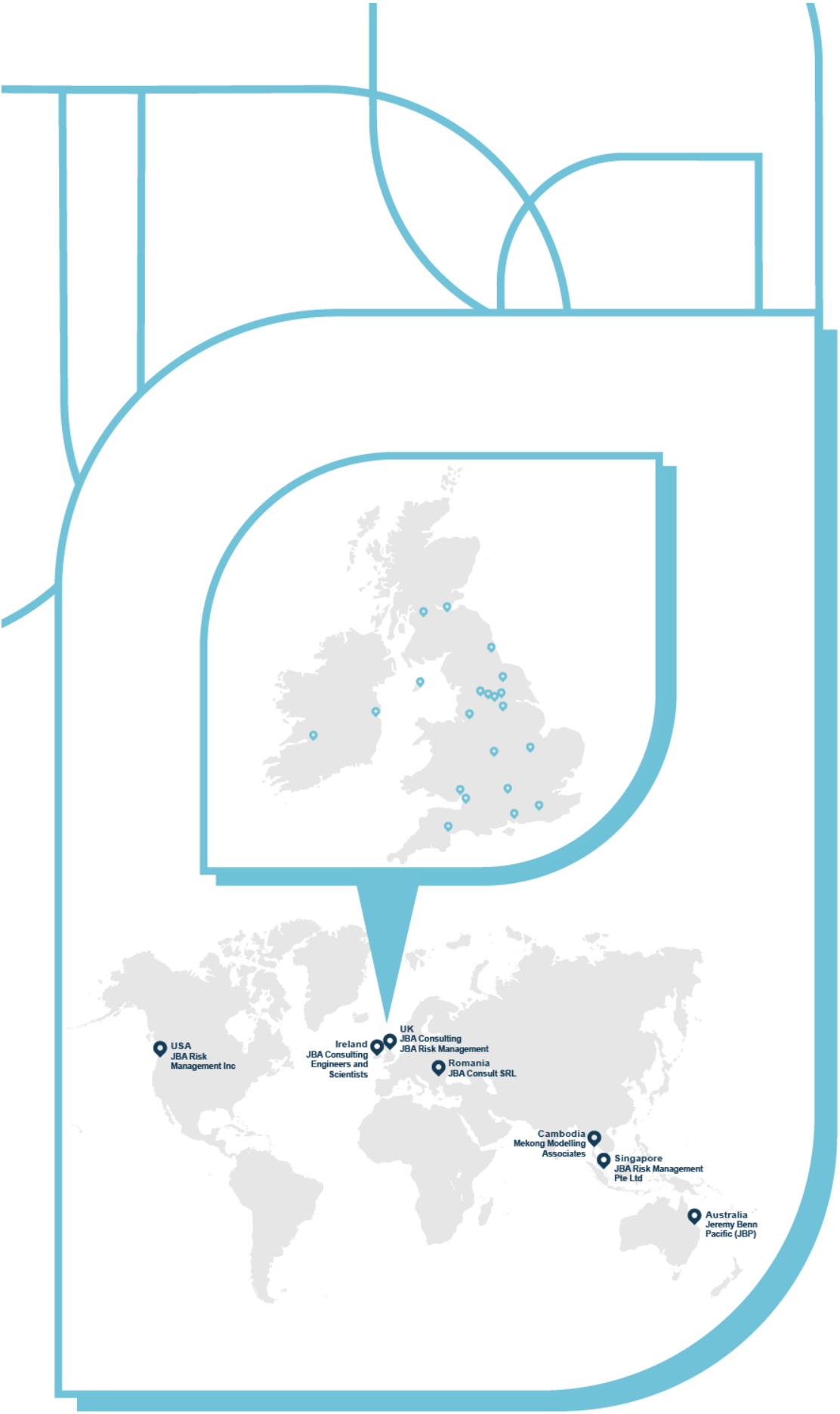
Table 3: Peak river flows or river levels for the largest river flowing past each community. River levels are provided only at gauging stations which are unable to measure flow. All levels are in metres above Ordnance Datum. Numbers in bold indicate that the event was the highest on record at a river gauging station. The "Method" column indicates how the results were obtained and therefore the level of confidence, as explained in the text.

Town or village	River	Flow or level	Babet peak flow (m^3/s) or level (m)	Ciaran peak flow (m^3/s) or level (m)	Babet AEP (%)	Ciaran AEP (%)	Method
Thetford	Little Ouse	Flow	**8.9**	7.8	2-5	5-10	ESS
Diss	Waveney	Level	23.16	23.20	10-20	10-20	Rank
Needham & Harleston	Waveney	Flow	80	30	<1	20-50	QMED
Clare & Cavendish	Stour	Flow	27	30	10-20	5-10	ESS
Haverhill	Stour Brook	Flow	11	10	10-20	10-20	ESS
Debenham	Deben	Flow	11.7	3.4	<1	>50	Model
Needham Market & Stowmarket	Gipping	Flow	33	15	2-5	20-50	ESS
Framsden	Tributary of Deben	Flow	8.4	2.5	<1	>50	Model

Town or village	River	Flow or level	Babet peak flow (m^3/s) or level (m)	Ciaran peak flow (m^3/s) or level (m)	Babet AEP (%)	Ciaran AEP (%)	Method
Wetheringsett cum Brockford	Tributary of Dove	Flow	4.1	1.2	1-2	>50	Model
Charsfield	Potsford Brook	Flow	5.2	1.5	1-2	>50	Model
Framlingham	Ore	Flow	8	2.3	1-2	>50	Model
Wickham Market	Deben	Flow	**35**	23	2-5	20-50	QMED
Great Bealings	Lark	Flow	13.7	5.1	<1	>50	Model
Great Glemham	Tributary of Alde	Flow	3.3	1.1	10-20	>50	Model
Parham & Hacheston	Ore	Flow	**17**	6.9	<1	20-50	QMED
Holton & Halesworth	Blythe	Flow	**1.9**	1.7	2-5	20-50	Rank
Brandeston & Cretingham	Deben	Flow	**22**	21	2-5	10-20	Rank
Farnham & Stratford St Andrew	Ore	Flow	**47**	22	<1	10-20	QMED
Saxmundham	Fromus	Level	11.62	10.74	5-10	>50	Rank
Knodishall	Thorpeness Hundred	Level	10.18	9.95	20-50	>50	Rank
Playford, Little Bealings, Martlesham	Fynn	Flow	**9.1**	5.8	2-5	20-50	ESS
Steeple Bumpstead	Bumpstead Brook	Flow	12	12	20-50	20-50	ESS
Lavenham	Brett	Flow	**11**	8.5	1-2	5-10	QMED
Hadleigh	Brett	Flow	**58**	23	<1	5-10	Rank
Boxford	Box	Level	**26.44**	26.19	2-5	20-50	Rank
Polstead	Box	Flow	7.7	8.3	5-10	2-5	ESS
Nayland	Stour	Flow	25	27	>50	>50	QMED
Bures	Stour	Level	19.34	**19.48**	10-20	2-5	Rank
Sudbury	Stour	Flow	47	50	10-20	10-20	QMED

Town or village	River	Flow or level	Babet peak flow (m^3/s) or level (m)	Ciaran peak flow (m^3/s) or level (m)	Babet AEP (%)	Ciaran AEP (%)	Method
Long Melford	Stour	Flow	27	30	10-20	5-10	ESS
South-west Ipswich	Belstead Brook	Flow	**8.8**	6.7	1-2	5-10	Rank
Bramford, parts of north-west Ipswich	Gipping	Flow	**46**	23	1-2	10-20	Rank

The main report provides additional results for some communities, including AEPs for catchment rainfall accumulated over longer durations (months) and for the volumes of river flow during the floods. This information may be relevant when considering the performance of any flood storage areas during the events.



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