

Appendix E – Cumulative impact assessment methodology

1.1 Introduction

The combined cumulative impact for Southern Staffordshire and the Black Country has been assessed in two parts:

1. Catchments within Southern Staffordshire only
2. Catchments within the Black Country only, and border catchments that cover the Black Country and Southern Staffordshire

Catchments were generated in ArcGIS using the Arc hydrology toolset using 50m DTM.

For each assessment, proposed development and flood risk were assessed using the best available data. The methodology for each assessment has been outlined in detail in this document.

1.2 Part 1 – Southern Staffordshire catchments

1.2.1 Considering historic flood risk

The LLFA's flooding hotspot data was used. The floodspot data was provided on a postcode basis with the number of historic flood events identified for each postcode. Information regarding the number of properties affected or the nature and source of the flooding was not provided as this was sensitive data.

The catchments and the LLFA flooding hotspot data was used to determine the number of historic flood events in each catchment.

1.2.2 Considering surface water flood risk

The LLFA's communities at risk dataset identifies the number of properties at risk of flooding in the 100-year surface water event.

The catchments and the communities at risk dataset was used to determine the number of properties at risk of surface water flooding in the 100-year event.

1.2.3 Considering potential development

The Southern Staffordshire Councils provided GIS data of their potential sites and currently committed sites. This data was used to determine the area of potential development within each catchment, as a percentage of the total catchment area. The most up to date and available data that was used is set out below:

- Cannock Employment Land Availability Assessment (ELAA) and Strategic Housing Land Availability Assessment (SHLAA) sites and employment and residential site options;
- Lichfield ELAA and SHLAA sites;
- South Staffordshire potential sites, employment and housing site allocations, committed housing and employment sites, and land safeguarded for housing;
- Stafford call for sites, local plan employment and housing sites, and sites with extant planning permission;
- Tamworth employment and housing allocations.

Data from all neighbouring authorities was also used to determine the potential development area where catchments fell into multiple authorities.

1.2.4 Considering predicted flood risk from increased runoff upstream

The NRD (National Receptor Database) was intersected with the 100-year and 1,000-year surface water flood extents separately, to determine the number of properties in each.

The difference between the two was then calculated and given as a percentage of the total number of NRD points in the catchment, to give an indication of which areas are most sensitive to increases in surface water runoff from upstream.

E.g. if there were 100 NRD points in a catchment, 15 within the 1,000-year surface water extent and 5 within the 100-year surface water extent, 10% of properties in that catchment have been considered.

1.2.5 Considering risk from sewer flooding

Severn Trent Water's Hydraulic Flood Risk Register (HFFR) was used to determine the number of properties in each catchment at risk from sewer flooding.

1.2.6 Ranking the results

The results were ranked for each of the above assessments and these rankings were combined to give an overall ranking. A RAG rating was then applied to the catchments, with red being high risk, amber being medium risk and green being low risk. Regardless of the overall ranking of the catchment, if >15% of the catchment was proposed for development, at least an amber rating was given to the catchment. The RAG rating is summarised below in Table E-1:

Table E-1 Southern Staffordshire only catchments RAG rating definition

Condition	RAG
Catchments with overall risk ranking 1-8 (Top 9 catchments)	RED
Catchments with overall risk ranking 9-20	AMBER
Catchments with >15% area proposed for development	AMBER
Red/amber rated catchments on the River Trent or River Tame (see section 1.4)	GREEN
All other catchments	GREEN

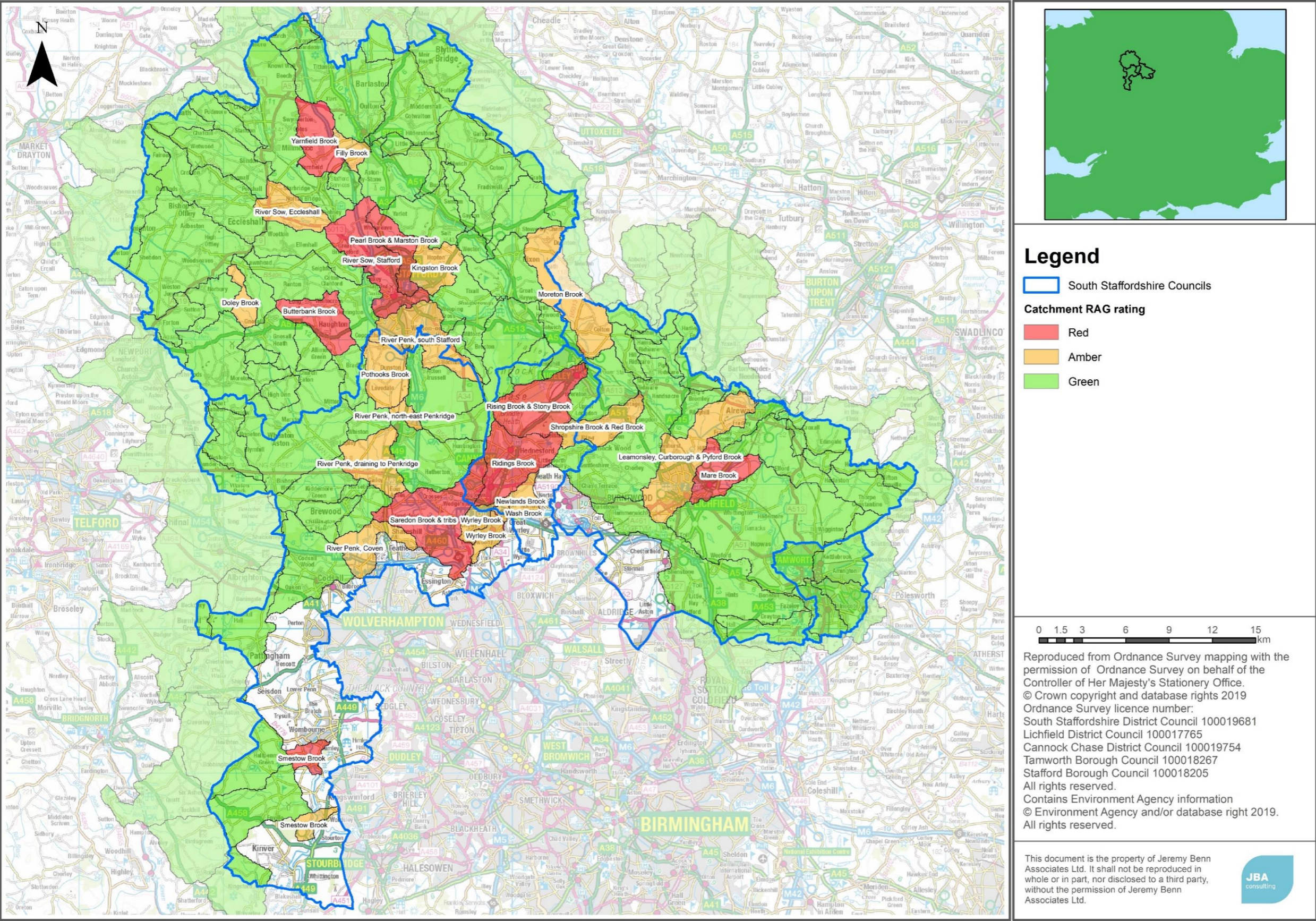
A map of the RAG rating for each catchment is shown in Figure E-1, and a summary of the results of the red and amber rated catchments are shown in Table E-2.

Table E-2 High and medium risk catchments

Catchment name	Number of historic flood incidents	Number of communities at risk from surface water flooding	% area of proposed development	% properties at risk from increased runoff upstream	Properties at risk of sewer flooding	Final combined ranking	RAG score
Ridings Brook, Cannock	35	342	10.4%	4.76%	87	1	RED
Saredon Brook and tributaries, west Cannock to Standeford	49	2111	16.36%	3.75%	15	2	RED
Mare Brook, east Lichfield	2	228	32.23%	5.18%	1	3	RED
Rising Brook and Stony Brook, draining towards Rugeley	22	186	7.92%	4.41%	8	4	RED
Pearl Brook and Marston Brook, Stafford	21	86	53.27%	3.23%	9	5	RED
River Sow, Stafford	28	160	20.16%	2.76%	30	=6	RED
Butterbank Brook	8	0	14.09%	7%	2	=6	RED
Yarnfield Brook, Yarnfield	6	10	11.59%	8.06%	2	7	RED
Smestow Brook, Smestow to Swindon	6	63	9.72%	5.05%	1	8	RED
Doley Brook, draining towards Gnosall	5	0	20.4%	4.05%	0	9	AMBER
River Penk, draining towards Penkridge	15	0	30.13%	3.51%	0	10	AMBER
Smestow Brook Spittle Brook to River Stour	6	0	11.93%	5.31%	0	11	AMBER
Leamonsley, Curborough and Pyford Brook, Lichfield to Alrewas	11	469	16.28%	2.65%	13	=12	AMBER
River Penk, north-east Penkridge	16	0	34.49%	3.31%	1	=12	AMBER
Wyrley Brook, Cheslyn Hay and Great Wyrley	11	203	11.2%	2.97%	42	13	AMBER
Newlands Brook	7	126	36.34%	2.78%	4	=14	AMBER

Catchment name	Number of historic flood incidents	Number of communities at risk from surface water flooding	% area of proposed development	% properties at risk from increased runoff upstream	Properties at risk of sewer flooding	Final combined ranking	RAG score
Filly Brook, draining towards Stone	4	11	24.19%	3.64%	1	=14	AMBER
River Penk, south Stafford	9	332	15.1%	2.26%	43	15	AMBER
River Penk and tributary, Coven	6	0	14.40%	3.93%	0	16	AMBER
River Sow, Eccleshall draining towards Little Bridgeford	14	10	7.51%	3.77%	14	17	AMBER
Shropshire Brook and Red Brook, draining towards Armitage and Handsacre	15	88	8.78%	3.14%	14	18	AMBER
Moreton Brook and tributaries, draining towards Rugeley	13	28	4.28%	6.69%	0	19	AMBER
Wyrley Brook, Cheslyn Hay and Churchbridge	4	46	26.39%	2.95%	10	20	AMBER
Kingston Brook, Stafford	3	38	23.09%	2.91%	1	24	AMBER
Pothooks Brook and tributaries, draining towards the River Penk south of Stafford	7	0	16.51%	2.98%	0	30	AMBER
Wash Brook, Leacroft and Great Wyrley	4	18	18.81%	2.06%	13	33	AMBER

Figure E-1 RAG rating of catchments in Southern Staffordshire (excluding shared catchments with the Black Country Authorities)



1.3 Part 2 – Black Country only catchments and shared Southern Staffordshire and Black Country border catchments

1.3.1 Considering potential development

The Black Country Authorities provided GIS data of their potential sites and some of their currently committed sites. This data was used to determine the area of potential development within each catchment, as a percentage of the total catchment area.

The most up to date and available data that was used is set out below:

- Black Country Call for Sites;
- Wolverhampton committed sites (housing);
- Sandwell committed sites (housing);
- Walsall committed sites (housing and employment);
- Dudley proposed housing sites.

Site data for Southern Staffordshire was used as outlined in section 1.2.3.

Data from all the neighbouring authorities was also used to determine the potential development area where catchments fell into multiple authorities.

1.3.2 Considering predicted flood risk from increased runoff upstream

The NRD data was intersected with the 100-year and 1,000-year surface water flood separately, to determine the number of properties in each.

The difference between the two was then calculated and given as a percentage of the total number of NRD points in the catchment, to give an indication of which areas are most sensitive to increases in surface water runoff from upstream.

E.g. if there were 100 NRD points in a catchment, 15 within the 1,000-year surface water extent and 5 within the 100-year surface water extent, 10% of properties in that catchment have been considered.

1.3.3 Considering risk from sewer flooding

Severn Trent Water's Hydraulic Flood Risk Register (HFFR) was used to determine the number of properties in each catchment at risk of flooding from sewers.

1.3.4 Historic flooding data

The level of detail of the historic flooding data varied greatly between each of the Black Country Authorities and against the Southern Staffordshire data, and therefore historic flooding data could not be simply be ranked by number of events/hotspots and used in the final combined ranking, as results would be biased towards the areas with better quality data.

The following data was therefore normalised as set out below:

- Wolverhampton Surface Water Management Plan (SWMP) hotspots (identified using outputs from the 1 in 30-year surface water event)
- Walsall flooding data from May 2018 (number of properties affected)
- Walsall LLFA flooding hotspots (contains data up to 2012)
- Sandwell flooding hotspots (internal flooding hotspots only)
- Dudley flood events

To normalise the data, the total number of hotspots/events/properties for each dataset was taken, and then number of hotspots/events/properties in each catchment was taken as a percentage of this for each dataset. The catchments were then ranked from high to low on percentage for each dataset and these rankings were then added together and an “average” ranking was taken, by dividing the total ranking by the number of datasets covering the catchment.

An example is shown below (note this is not indicative of the actual results)

- Catchment A is within Wolverhampton and Walsall (3 datasets: 1 Wolverhampton and 2 Walsall)
- Catchment B is entirely in Sandwell (1 dataset)
- Catchment C is in Sandwell and Dudley (2 datasets)
- Catchment D is in Walsall and Sandwell (3 datasets)
- Catchment E is entirely in Dudley (1 dataset)
- Catchment F is in Wolverhampton and Dudley (2 datasets)

Catchment	Number of datasets covered	% of total Dudley flood events in catchment	Rank	% of total Sandwell hotspots in catchment	Rank	% of total Wolverhampton hotspots in catchment	Rank	% of total Walsall hotspots in catchment	Rank	% of total houses flooded in May 2018 in catchment	Rank	Total rank	Average rank	Overall historic rank
A	3	-	-	-	-	60%	1	35%	2	20%	2	6	2	=2
B	1	-	-	20%	3	-	-	-	-	-	-	3	3	4
C	2	30%	2	30%	2	-	-	-	-	-	-	4	2	=2
D	3	-	-	50%	1	-	-	65%	1	80%	1	3	1	=1
E	1	50%	1	-	-	-	-	-	-	-	-	1	1	=1
F	2	20%	3	-	-	40%	2	-	-	-	-	5	2.5	3

The overall historic ranking was used to inform the cumulative impact assessment.

1.3.5 Ranking the results

The results were ranked for each of the above assessments and these rankings were combined to give an overall ranking. A RAG rating was then applied to the catchments, with red being high risk, amber being medium risk and green being low risk. Due to the known flood risk issues and the urban nature of the Black Country, it was deemed appropriate to change green rated catchments to yellow, to highlight that while the risk in these catchments is lower than the red and amber catchments, there is still a notable risk.

Regardless of the overall ranking of the catchment, if >15% of the catchment was proposed for development, at least an amber rating was given to the catchment.

For catchments that are also within Southern Staffordshire, the LLFA historic flooding information and communities at risk (as described in section 1.2.1 and 1.2.2) were also used. The number of historic flood events and number of properties in the communities at risk dataset for each catchment partially located in Southern Staffordshire were taken and compared with the results of the Southern Staffordshire only catchments. Where the results of the border catchments fell within the top 10 rank of the Southern Staffordshire only catchments, the border catchment was given a RAG rating of red. Where the results of the border catchments fell within the top 11-20 rank of the Southern Staffordshire only catchments, the border catchment was given a RAG rating of amber.

The RAG rating is summarised below in Table E-3.

Table E-3 Black Country and border catchments RAG rating definition

Condition	RAG
Catchments with overall risk ranking 1-5 (Top 5 catchments)	RED
Catchments where the number of historic flood events (Southern Staffs data) ranked in the top 10 of all Southern Staffs catchments	RED
Catchments where the number of properties in the communities at risk (Southern Staffs data) ranked in the top 10 of all Southern Staffs catchments	RED
Catchments with overall risk ranking 6-12	AMBER
Catchments where the number of historic flood events (Southern Staffs data) ranked in the top 11-20 of all Southern Staffs catchments	AMBER
Catchments where the number of properties in the communities at risk (Southern Staffs data) ranked in the top 11-20 of all Southern Staffs catchments	AMBER
Catchments with >15% area proposed for development	AMBER
All other catchments	Yellow

A map of the RAG rating for each catchment is shown in Figure E-2, and a summary of the results of catchment rankings are shown in Table E-4.

A map of the RAG rating of all the Southern Staffordshire catchments (within Southern Staffordshire only, and the border catchments with the Black Country) are shown in Figure E-3.

Table E-4 Black Country and border catchments ranking

Catchment name	% area of proposed development	% properties at risk from increased runoff upstream	Properties at risk of sewer flooding	Council historic flood information*	RAG score
River Penk, including Perton, Tettenhall, Bilbrook and Oxley	20.94%	4.97%	63	1 WCC SWMP hotspot 441 SCC communities at risk 25 SCC historic flood events	RED
River Stour, Stourbridge and Brierley Hill	10.69%	4.11%	85	1 DC flood event 24 SCC historic flood events	RED
Smestow Brook, including Kingswinford	12.62%	4.45%	47	4 SCC historic flood events 1 DC flood event	RED
Smestow Brook and Black Brook, Wolverhampton and Seisdon	8.17%	3.55%	134	13 SCC historic flood events 11 SCC communities at risk 5 WCC SWMP hotspots 1 property flooded May 2018 (WC data)	RED
Gains Brook and Wash Brook, including Norton Canes	20.96%	3.90%	13	33 SCC historic flood events 202 SCC communities at risk 3 WC flood hotspots	RED
Crane Brook, Burntwood, draining towards Shenstone	13.28%	2.42%	14	18 SCC historic flood events 291 SCC communities at risk 8 WC flood hotspots	RED
Tipton Brook	8.51%	5.35%	53	1 DC flood event 1 property flooded May 2018 (WC data) 11 SMBC flood hotspots	RED
River Tame East Wolverhampton and Willenhall	5.78%	3.63%	119	8 SCC historic flood events 15 SCC communities at risk 1 WCC SWMP hotspot 36 properties flooded May 2018 (WC data) 60 WC flood hotspots	AMBER
Ford Brook and tributaries, Brownhills and Walsall	7.49%	3.32%	94	2 SCC historic flood events 54 properties flooded May 2018 (WC data)	AMBER

Catchment name	% area of proposed development	% properties at risk from increased runoff upstream	Properties at risk of sewer flooding	Council historic flood information*	RAG score
				138 WC flood hotspots	
Mousesweet Brook and Black Brook, including Rowley Regis, Blackheath and south Dudley	7.71%	5.06%	31	12 SMBC flood hotspots 1 DC flood event	AMBER
River Tame source to Tipton Brook, including Oldbury and Dudley	4.30%	4.79%	64	2 properties flooded May 2018 (WC data) 42 SMBC flood hotspots	AMBER
Tributaries of the Smestow Brook, draining towards Hinksford	10.41%	6.37%	32	6 SCC historic flood events 17 SCC communities at risk	AMBER
Wom Brook and Penn Brook, draining towards Wombourne	10.25%	3.82%	46	21 SCC historic flood events 176 SCC communities at risk	AMBER
River Stour, including Kinver and Dunsley, draining towards Kidderminster	2.53%	1.76%	3	25 SCC historic flood events 90 SCC communities at risk	AMBER
Footherley Brook, draining towards Shenstone	25.76%	2.70%	30	9 SCC historic flood events 85 SCC communities at risk 22 properties flooded May 2018 (WC data) 5 WC flood hotspots	AMBER
Watershead and Featherstone Brook, draining towards Coven	24.45%	3.37%	10	8 SCC historic flood events 17 SCC communities at risk 2 WCC SWMP hotspots 6 properties flooded May 2018 (WC data)	AMBER
River Tame Bilston and Darlaston	5.22%	4.07%	63	1 WC flood hotspot 12 SMBC flood hotspot	AMBER
River Tame, Wednesbury, draining towards West Bromwich	5.11%	3.32%	35	89 SMBC flood hotspots	YELLOW
River Stour, Halesowen and Cradley Heath	4.35%	3.43%	45	1 SMBC flood hotspot 3 DC flood events	YELLOW

Catchment name	% area of proposed development	% properties at risk from increased runoff upstream	Properties at risk of sewer flooding	Council historic flood information*	RAG score
Plants Brook, including Streetly and Sutton Coldfield	3.14%	4.45%	19	2 SCC historic flood event 10 SCC communities at risk 7 properties flooded May 2018 (WC data) 4 WC flood hotspots	YELLOW
River Tame, draining towards Birmingham	3.38%	3.65%	3	4 WC flood hotspots	YELLOW
Hockley Brook, Smethwick and Birmingham draining towards Aston	6.77%	3.27%	24	5 properties flooded May 2018 (WC data) 16 SMBC flood hotspots	YELLOW
River Tame, draining towards Handsworth	3.52%	3.35%	11	2 WC flood hotspots 28 SMBC flood hotspots	YELLOW
Sneyd Brook, including Bloxwich	7.14%	1.96%	10	6 SCC historic flood events 10 communities at risk 14 properties flooded May 2018 (WC data) 14 WC flood hotspots	YELLOW
Bourne Brook, Birmingham	1.50%	4.10%	10	1 SMBC flood hotspots	YELLOW
Full Brook, south-east Walsall	2.52%	3.26%	11	1 property flooded May 2018 (WC data) 17 WC flood hotspots 2 SMBC flood hotspots	YELLOW
Blakedown Brook and tributaries, including Hagley and Blakedown	6.46%	2.23%	0	2 SCC historic flood events	YELLOW

*Council abbreviations

WCC – Wolverhampton City Council

WC – Walsall Council

SMBC – Sandwell Metropolitan Borough Council

DC – Dudley Council

SCC – Staffordshire County Council

Figure E-2 RAG rating of catchments in Black Country and border catchments with Southern Staffordshire

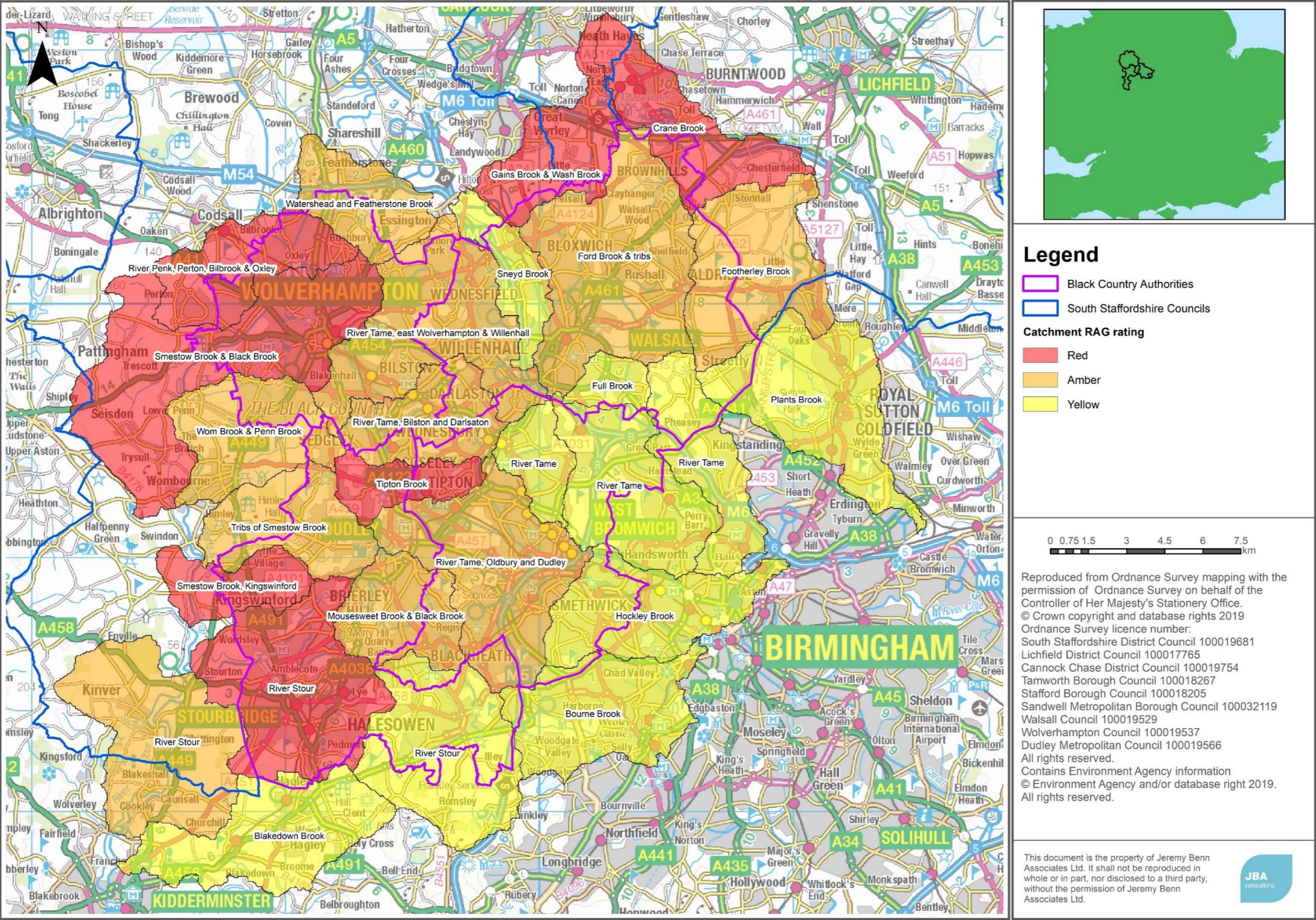
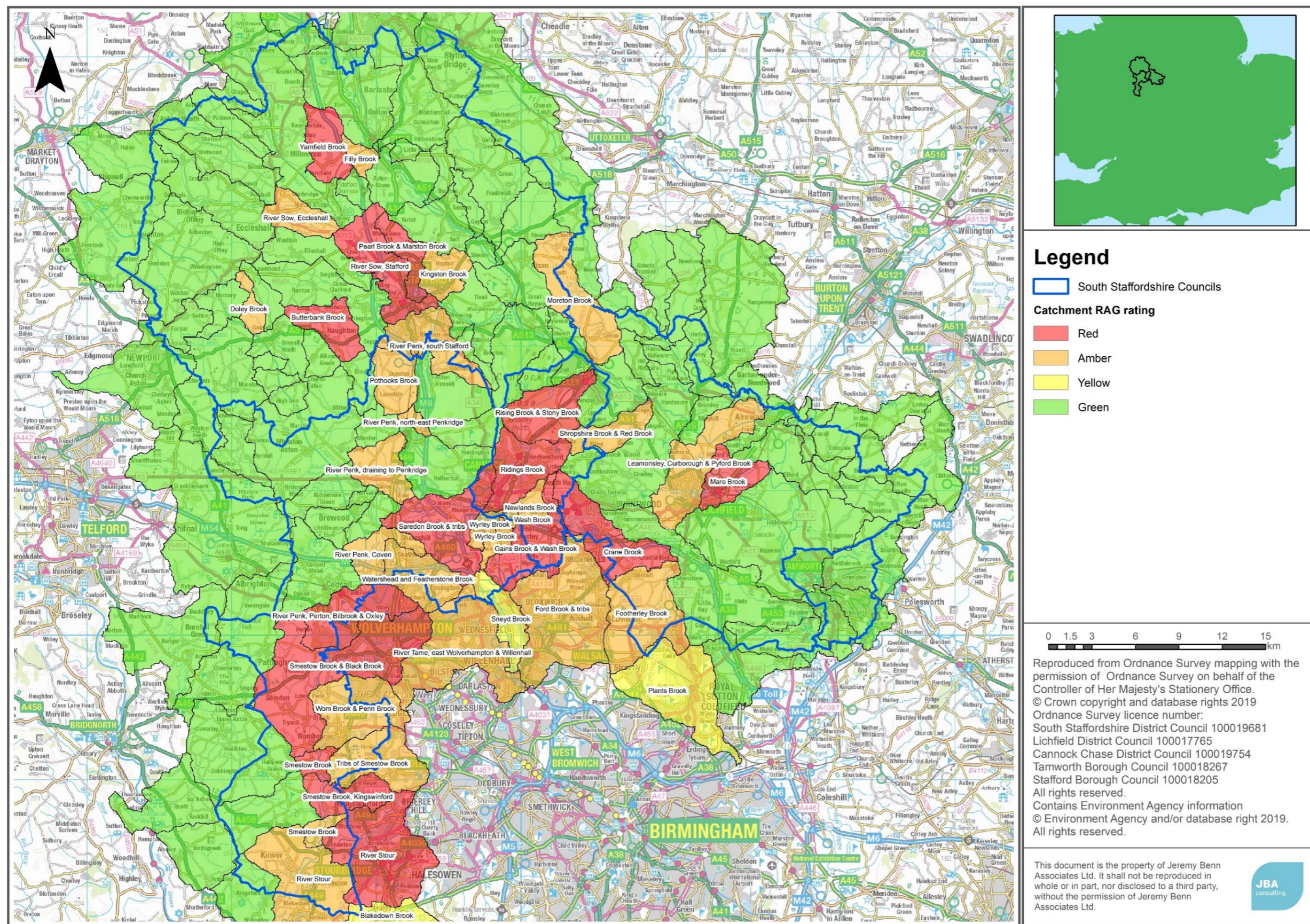


Figure E-3 RAG rating of all Southern Staffordshire catchments



1.4 Additional considerations

Catchments on the border of the study area

The catchment of the Lyme Brook, north of Stafford Borough only had a very small amount of the catchment within the study area and while the catchment was rated as amber in the assessment, this catchment was discounted from the assessment, as measures to reduce flood risk in this catchment would largely be the responsibility of neighbouring authority (Newcastle-under-Lyme Borough Council). Development and flood-risk from neighbouring authorities is considered in more detail in the cross-boundary issues section.

High risk catchments on main rivers

Several catchments were ranked as medium or high risk and were located along the River Trent and River Tame. Any small-scale developments draining into these watercourses are unlikely to have a significant impact on flows on these rivers due to the relative size of the catchment draining in from upstream. For this reason, the River Trent, and River Tame catchments in Southern Staffordshire that were ranked as medium or high risk were given a final ranking of low.

This approach was not taken for the River Tame catchments in the Black Country. The source of the River Tame is within the Black Country authorities and as the river is in its upper reaches, it is more likely to be affected by changes in flows from development, than it is downstream within Southern Staffordshire.

1.5 Assumptions

A number of assumptions had to be made for the cumulative impact assessment, and these are outlined in Table E-5.

1.6 Planning policy recommendations for Southern Staffordshire

The planning policy recommendations from the cumulative impact assessment can be found in chapter 10 of the main SFRA report.

Table E-5 Assumptions of the cumulative impact assessment

Assessment aspect	Assumption made	Details of limitation in method	Justification of method used
Historic flood risk – LLFA flooding hotspot data	Location of flooding incidents	The number of flooding incidents was provided on a postcode basis in the form of polygons. This meant that in some places one flooding hotspot would fall into multiple catchments. As the exact locations of the flooding events were unknown, the total number of flooding incidents per flooding hotspot was used in the sum for each individual catchment, regardless of the number of catchments the hotspot covered. This may lead to an overestimate of historic flood risk.	It was considered most conservative to take the number of flooding incidents per flooding hotspot and add that to the sum for each individual catchment, regardless of the number of catchments the hotspot covered. For example, if one flooding hotspot denoting 4 historic flooding incidents covered 3 separate catchments, 4 historic incidents would be added to the total number of historic events for each of the catchments the hotspot covered.
Communities at risk	Number of properties flooded	Only areas where >10 properties fall within the 100-year surface water flood extent were included in the assessment.	The communities at risk data supplied by Staffordshire County Council only included areas where >10 properties were flooded in the 100-year surface water flooding event.
Sensitivity of catchments to an increase in flood risk that may be influenced by new development	NRD representative of current housing	The NRD was last updated in 2014 and therefore may not include all new build houses since that time. This could therefore result in an inaccuracy of the number of properties at risk of surface water flooding from increased flows.	This was the most consistent data that was available across all of the Southern Staffordshire and Black Country authorities and was therefore chosen as the best method of assessment.
Development scenarios	Inclusion of all sites provided by the Black Country Authorities and the Southern Staffordshire Councils	The study assessed the potential impact of all sites received during the Local Plan process. This included sites which may not be suitable for allocation, as well as more strategic development areas which are often developed in phases. As a result, it presents a 'worst case' assessment of	Although the method was a very conservative estimate, it identified settlements and catchments with the greatest potential for growth.

Assessment aspect	Assumption made	Details of limitation in method	Justification of method used
		growth which is likely to overestimate the risk within each catchment.	
	Assumption of housing density and impermeable areas	As potential development densities were not known for all of the sites, it was assumed that the entire area of the site would contribute surface water runoff to the wider catchment. In reality, landscaping and requirements for SuDS within sites lessen the impacts of new development.	The assessment considered the 'worst case' development scenario, if surface water runoff was not controlled from new developments. With housing densities and proportions of undeveloped areas not known, the approach was conservative.



This page is intentionally left blank