



## **Preliminary Flood Risk Assessment**

**May 2011**



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# Contents

<b>List of Figures.....</b>	<b>iv</b>
<b>List of Tables .....</b>	<b>v</b>
<b>Executive Summary .....</b>	<b>vi</b>
<b>Glossary .....</b>	<b>vii</b>
<b>Acknowledgements.....</b>	<b>ix</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Aim and Objectives.....	2
1.2 Preliminary Flood Risk Assessment .....	2
1.3 Study Area.....	3
<b>2 Lead Local Flood Authority Responsibilities.....</b>	<b>5</b>
2.1 Stakeholder Engagement.....	5
2.2 Further Responsibilities .....	5
<b>3 Data Collection and Review.....</b>	<b>7</b>
3.1 Shropshire Council .....	7
3.1.1 Water Cycle Study .....	7
3.1.2 SFRA Level 1 and 2 .....	7
3.1.3 Mapping .....	7
3.1.4 Watercourses .....	7
3.1.5 Electrical Sub-stations.....	7
3.1.6 Transport Infrastructure.....	7
3.1.7 Schools .....	8
3.1.8 Reservoirs .....	8
3.1.9 Future Developments.....	8
3.1.10 Flood Forum.....	8
3.2 Environment Agency .....	8
3.2.1 AStSWF .....	8

3.2.2	FMfSW .....	8
3.2.3	EA Flood Zone Maps .....	8
3.2.4	Historic Flood Outlines .....	8
3.2.5	AStGWF .....	9
3.2.6	National Receptor Database .....	9
3.2.7	PFRA CD for England .....	9
3.3	Previous Studies .....	9
3.4	Severn Trent Water .....	9
3.5	Other Stakeholders.....	9
<b>4</b>	<b>Methodology .....</b>	<b>11</b>
4.1	Receptors at risk .....	11
4.2	Past and Future Flooding Data.....	12
4.3	Threshold Criteria.....	13
<b>5</b>	<b>Past Flood Risk .....</b>	<b>15</b>
5.1	Surface Water Flooding.....	15
5.2	Groundwater Flooding.....	16
5.3	Sewer Flooding .....	16
5.4	Ordinary Watercourses and Interaction with Main Rivers.....	16
5.5	Significant Consequences from Historic Flood Events .....	16
<b>6</b>	<b>Future Flood Risk.....</b>	<b>18</b>
6.1	Surface Water Flooding.....	18
6.2	Groundwater Flooding.....	19
6.3	Sewer Flooding .....	19
6.4	Ordinary Watercourses and Interaction with Main Rivers.....	19
6.5	The Impacts of Climate Change .....	20
6.6	Key Projections for Severn River Basin District.....	20
6.7	Implications for Flood Risk .....	20
6.8	Adapting to Change.....	21
6.9	Long Term Developments .....	21
<b>7</b>	<b>Review of Indicative Flood Risk Areas .....</b>	<b>23</b>
7.1	EA Assessment .....	23
7.2	Review of EA Assessment .....	25

**8 Identification of Flood Risk Areas..... 28**

8.1 New ‘Blue Squares’ Identified..... 28

8.2 Overall Priority of Flood Risk Areas..... 30

8.3 Mapping of ‘Blue Squares’..... 31

**9 Conclusions and Recommendations..... 32**

9.1 Conclusions..... 32

9.2 Recommendations..... 32

**10 References ..... 34**

**Appendix A – Review of 40 Initial ‘Blue Squares’..... 37**

**Appendix B – New ‘Blue Squares’ Identified ..... 39**

**Appendix C – Overall Priority of Places above Flood Risk Thresholds (‘Blue Squares’) 41**

**Appendix D –Map of Places above Flood Risk Thresholds (‘Blue Squares’)..... 42**

As part of the deliverables for Shropshire Council PFRA, this report should be read in conjunction with:

‘Shropshire Council Preliminary Assessment Report Spreadsheet.XLS’ is a spreadsheet that includes the following:

- Annex 1 – Records of past floods and their significant consequences
- Annex 2 – Records of future floods and their consequences
- Annex 3 – Records of Flood Risk Areas and their rationale

‘Shropshire Council PFRA Review Checklist.XLS’ is a spreadsheet that includes the following:

- Annex 4 – Review Checklist to be completed first by LLFA and then EA.

## List of Figures

Figure 1 – PFRA six yearly cycle process .....	1
Figure 2 – Shropshire Council Extent and Flood Forum boundaries .....	3
Figure 3 – Recommended Delivery Plan for PFRA .....	6
Figure 4 – 40 Initial ‘Blue Squares’ (EA Assessment) .....	25
Figure 5 – 40 Initial ‘Blue Squares’ (29 exceed threshold in latest assessment).....	27
Figure 6 – 28 New ‘Blue Squares’ (Latest Assessment).....	30

## List of Tables

Table 1 – Datasets included in PFRA study .....	11
Table 2 – Criteria for ‘Blue Squares’ and Significant Flood Risk Areas .....	13
Table 3 – Historic Flood Events in Shropshire .....	17
Table 4 – Towns ranked in order of people at risk of the 40 original squares .....	27
Table 5 – Towns ranked in order of number of people at risk (overall assessment) .	31

## Executive Summary

A Preliminary Flood Risk Assessment is a statutory obligation arising from the Flood Risk Regulations 2009 which should be reviewed after six years. This report has been written with reference to the Flood Risk Regulations 2009 and also the Final Preliminary Flood Risk Assessment Guidance, published by the Environment Agency in December 2010. This report should be read in conjunction with other key deliverables that have been issued separately including: the Preliminary Assessment Report Spreadsheet and the Preliminary Flood Risk Assessment Checklist.

The purpose of the Preliminary Flood Risk Assessment is to assess surface water flooding through readily available information obtained from a data collection exercise on past and future flooding. This data has been obtained from within Shropshire Council and from key stakeholders.

A Preliminary Flood Risk Assessment identifies any flood risk areas of national significance (significant flood risk is defined in the Final Guidance as: greater than 30,000 people, 3,000 non-residential properties, or 150 items of critical infrastructure at risk). If a flood risk area of national significance is identified, flood risk maps and surface water management plans must also be produced as stated under the Flood Risk Regulations 2009. However, as no nationally significant flood risk areas have been identified within Shropshire, flood risk maps and surface water management plans are not required under this legislation.

The Preliminary Flood Risk Assessment process also identifies places above the flood risk thresholds (referred to as 'blue squares') defined as greater than 200 people, 20 businesses, or 2 items of critical infrastructure at risk within a 1km<sup>2</sup> square. These are deemed to be locally significant based on past and future flooding data. A total of 57 1km<sup>2</sup> 'blue squares' have been identified in Shropshire. The counts of receptors at risk and maps showing the locations of the 'blue squares' should be used to prioritise future studies.

The priority towns that should be further investigated (i.e. those that are not currently addressed by a Surface Water Management Plan) based on the number of people at risk are: Oswestry, Shrewsbury, Bridgnorth, Albrighton, Gobowen, Weston Rhyn, Whitchurch, Minsterley, Wem, Bishop's Castle and Little Stretton.

Ludlow, Westbury, Market Drayton and Mile Oak should be further investigated based on the number of non-residential properties at risk threshold.

## Glossary

ASiSWF	Areas Susceptible to Surface Water Flooding Maps - 1st generation surface flood water maps produced by the EA in response to the Pitt Report
Blue Squares	A 1 km <sup>2</sup> surface water flood risk area where more than 200 residents or 20 non-residential properties or 2 critical service are at risk
CFMP	Catchment Flood Management Plan
DTM	Digital Terrain Map
EA	Environment Agency
FMfSW	Flood Maps for Surface Water - 2nd generation surface water flood maps produced by the EA in response to the Pitt Report
GIS	Geographic Information System
Key Stakeholder	An organisation which has responsibility for assets, buildings or land in Shropshire area which might be at risk
LiDAR	Light Detection and Ranging. A device that uses pulses of laser light to measure the distance between an aircraft and the ground, used to produce many reference points over an area of land and allow the mapping of large areas.
LLFA	Lead Local Flood Authority
Main Rivers	Watercourses for which the EA is the managing authority
NRD	National Receptor Database mapping datasets supplied by the EA
Ordinary Watercourses	Any watercourse which is not a main river
PFRA	Preliminary Flood Risk Assessment
SAC	Special Area of Conservation
SC	Shropshire Council



Scrutiny Committee	Internal committee within SC to review the PFRA report
SFRA	Strategic Flood Risk Assessment
Significant Flood Risk Area	A cluster of surface water flood risk areas where more than 30,000 residents or 3,000 non-residential properties or 150 critical services are at risk
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
STW	Severn Trent Water
SWMP	Surface Water Management Plan
WCS	Shropshire Outline Water Cycle Study (June 2010)

## Acknowledgements

The contributions of Severn Trent Water Ltd in the provision of the location of asset data and information on local surface water flooding are acknowledged.

The contributions of the Environment Agency for provision of data and advice throughout the production of this PFRA report are acknowledged.

# 1 Introduction

The Preliminary Flood Risk Assessment (PFRA) is a statutory obligation placed upon all Lead Local Flood Authorities (LLFAs) under the Flood Risk Regulations 2009. These regulations implement the European Floods Directive.

The aim of the European Floods Directive is to provide a consistent approach to managing flood risk across Europe. It establishes four stages of activity within a six year flood risk management cycle.

The PFRA is a high level study and is the first stage of this cycle. The PFRA is to assess past and future surface water flooding within a political boundary. The second stage, which is a part of the conclusions of the PFRA, will identify any areas of significant flood risk. The criteria for an area of significant flood risk are a location of surface water flooding affecting 30,000 or more people, 3,000 non-residential properties or 150 critical services. These criteria have been defined by DEFRA.

When locations of significant flooding have been identified, stage three of the cycle is to produce Flood Hazard and Flood Risk Maps. The final and fourth stage is to produce Flood Risk Management Plans for specific locations identified in the Flood Risk Maps. This final stage will seek to implement solutions to surface water flooding at a specific locality. The six yearly cycle process is illustrated in Figure 1.

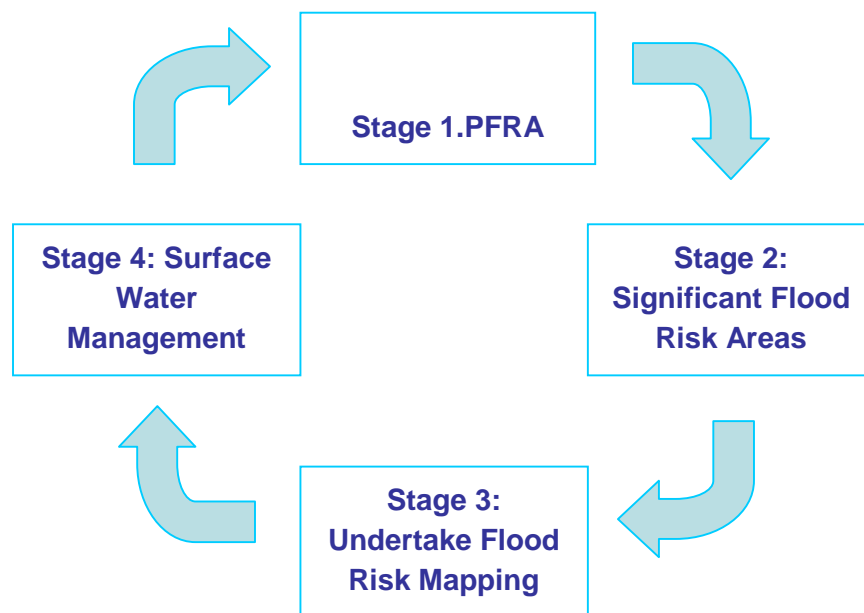


Figure 1 – PFRA six yearly cycle process

If a LLFA does not have any areas of significant flood risk, it is not required to undertake stages 3 and 4 of this cycle.

## 1.1 Aim and Objectives

The regulations require LLFA's to determine whether there is a significant flood risk in their area, based on local flooding, and to identify the Flood Risk Areas. This should be based on existing and readily available information by bringing together national and local data sources on flooding locations.

The key objectives are to:

- develop partnerships and determine ongoing and future stakeholder engagement;
- collate information on past and future floods and their consequences;
- assess the potential harm and consequences of future flooding;
- review indicative Flood Risk Areas and 'Places above flood risk thresholds (blue squares)', and;
- record information, including rationale for changes to Flood Risk Areas, in a Preliminary Assessment Report

## 1.2 Preliminary Flood Risk Assessment

The PFRA was undertaken with reference to the final PFRA guidance provided by the EA in December 2010. In this guidance, it has been stressed that no additional hydraulic modelling or acquisition of new information is needed in order to complete a PFRA.

The PFRA is to be undertaken with readily available information from within SC and the key stakeholders (i.e. an organisation which has infrastructure in the locality, such as a utility provider, internal departments within SC etc). In the PFRA guidance, it is recommended that all key stakeholders are contacted, in order to obtain any specific local knowledge of surface water flooding they may have. Reference has also been made to the Strategic Flood Risk Assessment (SFRA) and the Catchment Flood Management Plan (CFMP), as recommended by the PFRA guidance.

The PFRA base data has been provided by the EA in the form of surface water flood outlines. These maps are used to indicate areas which may be susceptible to surface water flooding. Two generations of these maps have been produced; the first generation, released in April 2009, was the Areas Susceptible to Surface Water Flooding maps (AStSWF) and the second generation, released in November 2010, was the Flood Maps for Surface Water (FMfSW). The local knowledge gathered has been used to verify and also to supplement these surface water flood maps.

The PFRA is to include a report and amended flood risk areas across Shropshire. These maps were produced with the aid of local flooding knowledge gathered. Other key deliverables include the Preliminary Assessment Report Spreadsheet and PFRA Checklist.

### 1.3 Study Area

The extent of the county of Shropshire is the geographical extent of this PFRA study (excludes the Borough of Telford and Wrekin). The total area of land within the Shropshire Council boundary is approximately 3,200 km<sup>2</sup>. The Shropshire Council boundary extent and flood forum areas are shown in Figure 2.

The main urbanised areas are located within Shrewsbury, Oswestry, Wem, Market Drayton, Ludlow, Bridgnorth and Whitchurch. There are other, smaller, urbanised areas located within the Shropshire Council area.



Figure 2 – Shropshire Council Extent and Flood Forum boundaries

The North and East parts of the county are flatter and have a low relief catchment in comparison to the South and West parts which have steeper graded watercourses and hilly terrain.

The majority of the fluvial flooding occurs in the broad bottomed valleys where the main rivers are located and surface water runoff collects. The large urbanised areas of Shrewsbury and Bridgnorth are located in the low lying valley area of the River Severn where both fluvial and surface water flooding occurs.

The main rivers in Shropshire, for which the EA is the managing authority, include the River Severn (218km), River Teme (107km), River Tern (45km), River Roden (43km), Rea Brook (38km), River Perry (30km), River Worfe (28km), River Corve (23km) and River Onny (12km). Although flooding from these watercourses is not within the scope of this study, surface water and main river interaction has been considered.

## 2 Lead Local Flood Authority Responsibilities

The responsibilities of the Lead Local Flood Authority (LLFA) to undertake this PFRA are based on the recommendations of the Pitt Review. They are also consistent with the Flood and Water Management Act 2010.

Shropshire Council, as a LLFA, is responsible for managing local flood risk, in particular, from ordinary watercourses, surface runoff and groundwater.

### 2.1 Stakeholder Engagement

The LLFA should build relationships with external bodies and stakeholders, encouraging data sharing. It is the role of SC to partner the stakeholders: Dwr Cymru Welsh Water, Severn Trent Water and the Environment Agency, to ensure good communication and develop long term commitment in order to progress local flood risk strategy now and in the future.

Steering groups are already set up by Shropshire Council to help advance the Surface Water Management Plans that are already in progress within the county. These are working well in order to share data and ideas between parties and to encourage early stakeholder engagement and support for potential options and future schemes to reduce flood risk.

Stakeholders that are within the Shropshire Council area include:

- Shropshire Council
- Severn Trent Water
- Dwr Cymru Welsh Water
- Environment Agency
- Network Rail
- British Waterways
- Highways Agency
- Fire & Rescue Service
- Police Service
- Town and Parish Councils
- Community action groups
- Internal Drainage Boards

### 2.2 Further Responsibilities

LLFA's are responsible for:

- building partnerships to ensure effective working between authorities that have control over flood risk;

- completing a Preliminary Flood Risk Assessment and reviewing the flood risk areas identified by the EA, to ensure the LLFA are in agreement with the areas identified, in accordance with the criteria for these areas given by DEFRA. To be submitted to the EA by 22<sup>nd</sup> June 2011, refer to Figure 3;
- maintaining highway drainage systems;
- planning for flood emergencies;
- developing, maintaining and applying a local flood risk strategy;
- investigating and recording all significant flooding incidents;
- maintaining a register of flood defence assets, and;
- ensuring use of sustainable drainage on new developments: approve, adopt and maintain.

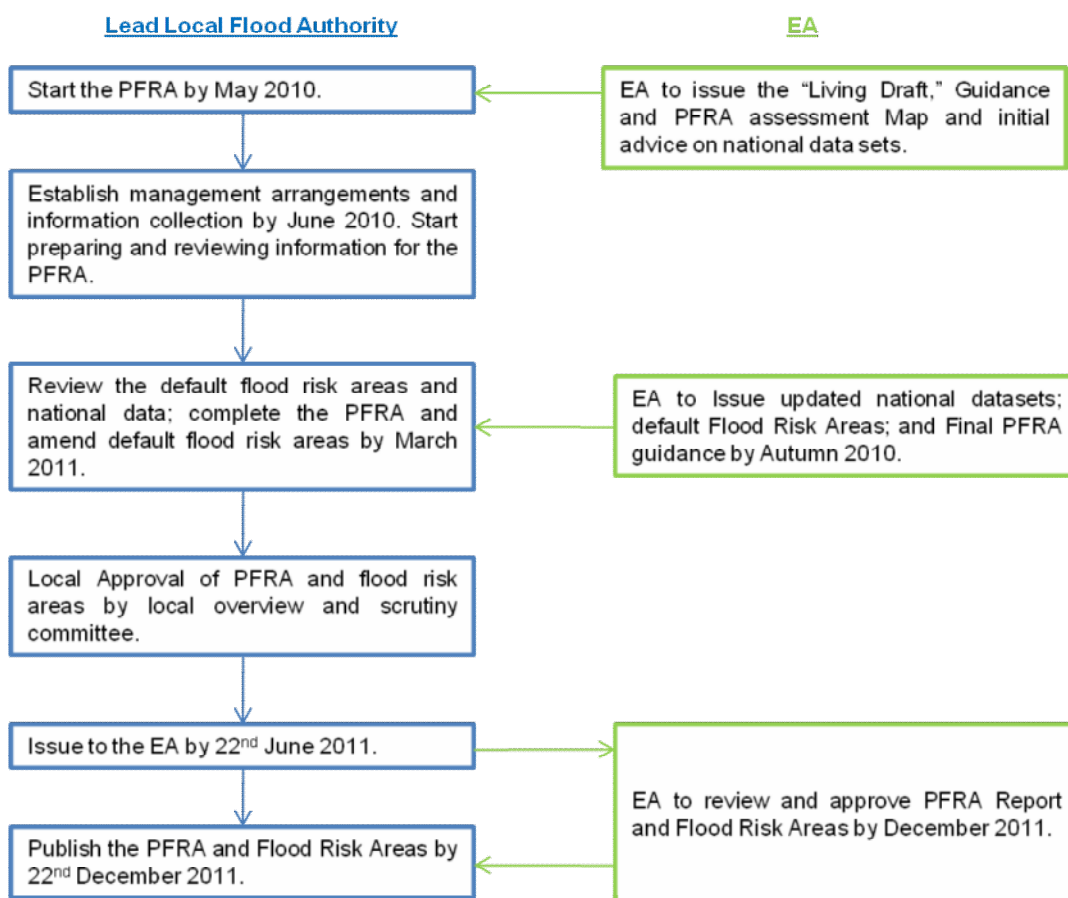


Figure 3 – Recommended Delivery Plan for PFRA



## 3 Data Collection and Review

A large part of this PFRA was undertaking a data collection exercise in order to produce flood outlines to assess flood risk. It was stressed, in the PFRA guidance, that the results of the PFRA should be based on data readily available from stakeholders and additional modelling was not required. In addition to local knowledge, information was requested regarding the location of assets and the location of any critical Infrastructure from stakeholders.

### 3.1 Shropshire Council

Shropshire Council (SC) is in possession of the majority of data required for the PFRA in GIS format.

#### 3.1.1 *Water Cycle Study*

The Shropshire Outline Water Cycle Study was completed in June 2010. This provided a flood risk summary for the main towns in Shropshire and preferred locations for growth.

#### 3.1.2 *SFRA Level 1 and 2*

Five Level 1 Strategic Flood Risk Assessment Reports were undertaken for the former Shropshire districts in September 2007. A Level 2 SFRA study was also completed for Shrewsbury.

#### 3.1.3 *Mapping*

OS maps of the county were filtered to highlight individual buildings. A GIS layer showing the location of main Shropshire towns was also available.

#### 3.1.4 *Watercourses*

A live GIS layer showing centrelines and names of both main rivers and ordinary watercourses was available. The latest version of this was used for the PFRA.

#### 3.1.5 *Electrical Sub-stations*

A GIS layer of locations of electrical sub-stations was available. This supplemented data within the National Receptor Database.

#### 3.1.6 *Transport Infrastructure*

GIS layers of the railway lines, canals and adopted roads in Shropshire were available.

### 3.1.7 Schools

A GIS layer of LEA schools was available. This supplemented data within the National Receptor Database.

### 3.1.8 Reservoirs

The PFRA guidance states to take account of small impoundment reservoirs, which is any reservoir smaller than 10,000m<sup>3</sup>. A GIS layer was not available, however.

### 3.1.9 Future Developments

Information regarding future residential and business development locations to help give an indication of potential future surface water flooding locations has not been assessed.

### 3.1.10 Flood Forum

A GIS layer from the Shropshire Flood Forums which showed locations and some details of past flooding incidents across the county was available. Further details are provided in Section 5.

## 3.2 Environment Agency

### 3.2.1 AStSWF

The Areas Susceptible to Surface Water Flooding map was the first generation map to be issued by the EA in April 2009. It used a 1 in 200 year annual probably rainfall event and three bands of flood depth: less, intermediate and more. Further details of the map are provided in Section 6.

### 3.2.2 FMfSW

The Flood Map for Surface Water was the second generation map to be issued by the EA in November 2010. It used a 1 in 200 year and 1 in 30 year annual probably rainfall and two bands of flood depth: shallow and deep. Further details of the map are provided in Section 6.

### 3.2.3 EA Flood Zone Maps

EA Flood Zone Maps of Zone 2 (1000yr) and Zone 3 (100yr) show flood extents from main rivers but may be useful as they cover ordinary watercourses where the catchment is greater than 3km<sup>2</sup>. The PFRA does not cover flooding from main rivers in isolation, however.

### 3.2.4 Historic Flood Outlines

An attributed spatial flood extent data for records of flooding from all sources but mainly covers EA main rivers.

### 3.2.5 AStGWF

Areas susceptible to groundwater flooding map is a broad scale map showing groundwater flood areas on a 1km<sup>2</sup> grid. It covers consolidated aquifers and permeable superficial deposits and shows the proportion of each 1km grid square susceptible to flooding.

### 3.2.6 National Receptor Database

The National Receptor Database shows features relating to Human Health, Economy, Cultural Heritage and Environment which are vulnerable to flooding. It assigns an MCM code (Multicoloured Manual code) indicating the type of feature it is. Some of this information is also held by SC, the GIS data provided by SC was used in addition to the data in the NRD.

### 3.2.7 PFRA CD for England

A CD was received by every LLFA from the EA containing GIS layers of 'Indicative Flood Risk Areas England' and 'Places Above Flood Risk Thresholds ('Blue Squares') England'.

## 3.3 Previous Studies

Some of the key previous studies available for the River Severn Catchment were:

- Shropshire Outline Water Cycle Study (June 2010);
- River Basin Management Plan (Dec 2009);
- Catchment Flood Management Plan (May 2008), and;
- West Midlands Flood Risk Appraisal (Oct 2007).

## 3.4 Severn Trent Water

Information received from STW included GIS layers showing:

- locations of waste water assets;
- locations of plans for capital programmes, and;
- sewer flooding register (DG5) of past surface water and foul incidents.

A confidentiality agreement was signed between SC and STW for use of this data on the PFRA only.

## 3.5 Other Stakeholders

Other stakeholders potentially with information on locations of critical infrastructure, drainage assets or past flood incidents include English Heritage, the Highways Agency, Natural

England, Network Rail, Town and Parish Councils and Internal Drainage Boards. In light of the short timescale available for data collection and flood risk assessment, data from these organisations was deemed to be included in the GIS information collated via the Shropshire Flood Forums.

## 4 Methodology

The PFRA has been undertaken with close reference to the EA Final PFRA guidance published in December 2010.

A data collection exercise is required as part of this study to provide “local knowledge” of surface water flooding locations. The PFRA guidance states that the LLFA should include all sources of flooding except that from the sea, main rivers and reservoirs. The flooding which should be included in this assessment will therefore include the following:

- surface water;
- groundwater;
- ordinary watercourses;
- canals, and;
- small impoundment reservoirs.

### 4.1 Receptors at risk

The National Receptor Database (NRD) version 1.1 (superseding version 1.0) was obtained from the Environment Agency in a GIS (Map Info) Format. Information included areas of surface water flooding which place at risk the datasets in Table 1.

<b>Category</b>	<b>Data Sets Included</b>
<i>Cultural Heritage</i>	<i>Listed Buildings, Ancient Monuments, Registered Parks and Gardens</i>
<i>Economy</i>	<i>Businesses, Roads, Railways, Agricultural Land</i>
<i>Environment</i>	<i>SSSI, SAC, SPA, Ancient Woodlands</i>
<i>Human Health</i>	<i>Residential Housing, Hospitals, Fire Service, Police Service, Schools, Care-homes, Utility Providers</i>

**Table 1 – Datasets included in PFRA study**

Some of the datasets already held by SC, or provided by other stakeholders, were more up to date than the data provided by the EA. In such cases, both sets of data were considered.

The property points on the NRD v1.1 were separated into various layers (mainly based on the Multi-coloured Manual codes – MCM) and for each were given a different symbol to differentiate between property types:

- residential properties (includes MCM code 1 and 999);
- schools (includes MCM code 610 as well as words associated with education and GIS layer provided by Shropshire Council 'Schools\_LEA');
- hospitals (includes MCM code 660 and word 'hospital');
- nursing/care/retirement/prisons (includes MCM code 625 and associated words);
- police stations (includes MCM code 651 and word 'Police');
- fire and ambulance stations (includes MCM code 650 and associated words);
- sewage treatment works (includes MCM code 840 and words associated with 'sewage' and GIS layer provided by STW 'Sewage\_Treatment\_Works');
- electrical installations (includes MCM code 960 and associated words and GIS layer provided by SC 'Shropshire\_Substations'), and;
- non-residential properties (takes whole of NRD v1.1 and excludes all MCM codes and words mentioned above and also excludes all words in Appendix 1 of the November 2010 EA guidance 'Flood Maps for Surface Water: Property Count Method'. As advised in that document so that ponds and post boxes etc are excluded).

#### Assumption made for Receptors

Based on local knowledge, it was clear that the majority of unclassified properties on the NRD v1.1 which used MCM code 999, were in fact residential properties. Therefore, the MCM code 999 has been included in the residential properties layer. However this has been reviewed on a 'square by square' basis and if the building size/shape and surrounding land-use is clearly commercial then they have been counted in the non-residential property count.

The latest OS mapping for Shropshire was obtained from Shropshire Council. All buildings were selected from the OS layer and a new layer created to show the building outlines clearly. This allowed the building outline to be used to define whether a building was within the flood extents rather than the property point.

#### **4.2 Past and Future Flooding Data**

The first and second generation surface water flooding maps were obtained from the EA known as the 'Areas Susceptible to Surface Water Flooding map (AStSWF) and Flood Map

for Surface Water (FMfSW). These were used as a baseline reference map for surface water flooding.

Local knowledge of flooding has been obtained from both the Shropshire Flood Forums and Severn Trent Water's DG5 register and mapped across the Shropshire Council area. This data was mapped on top of the AStSWF and FMfSW maps and used to verify and supplement the surface water flood maps.

Any flood risk areas which were identified as "above flood risk threshold" or "significant" were noted. The grid weighting system was undertaken using 1 kilometre grid squares, which covered the whole of Shropshire. The purpose of this exercise was to produce a mapping system which will identify high priority flooding locations which can be targeted in more detail in the future.

#### 4.3 Threshold Criteria

A 1km grid square was considered to be a 'blue square' (i.e. at flood risk) if the thresholds in the top row of Table 2 were exceeded.

The criteria for a "significant" flood risk area was specified by DEFRA (and would be made up of a cluster of 1 kilometre grid squares) where the thresholds in the bottom row of Table 2 were exceeded.

<b>Flood Risk Area</b>	<b>Residents Affected</b>	<b>Businesses Affected</b>	<b>Critical Infrastructure Affected</b>
<b>'Blue squares'</b> – where the following thresholds are exceeded with in 1km <sup>2</sup> :	200+	20+	2+
<b>Significant</b> – where clusters of 1km <sup>2</sup> squares exceed the following thresholds:	30,000+	3,000+	150+

Table 2 – Criteria for 'Blue Squares' and Significant Flood Risk Areas

The 1 kilometre squares were analysed and counts undertaken to determine whether the following thresholds were exceeded:

- number of people affected was counted by taking the number of residential properties for which the building outline was within the surface water flood map extents x 2.34 (average number of people per household);

- number of businesses affected was counted by taking the number of non-residential properties for which the building outline was within the surface water flood map extents, or;
- number of critical infrastructure affected was counted by taking the building outline to define whether the service was at risk (and details of which critical infrastructure has been provided).

The PFRA, which includes this report and accompanying appendices, will be reviewed by an internal committee. Amendments are to be made and the final PFRA report has to be completed and submitted to the EA by the 22nd June 2011.



## 5 Past Flood Risk

The best local information regarding past flooding incidents was collected and pooled from EA, SC and STW described in Section 3. It is not possible to assess the return period event of small localised surface water flooding events. The severity of the events collected may vary significantly.

All of the local data was mapped with the surface water flooding maps and receptor data. For the main flood risk areas, concentrated over the main towns in Shropshire, maps have been produced showing the flood forum data and DG5 register along side other datasets. These are discussed later in Section 7.2.

### 5.1 Surface Water Flooding

Surface water flooding is defined as follows:

‘A flood event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer. Usually associated with high intensity rainfall (typically >30mm/hr) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation.’ (*Definition from Making Space for Water - Flooding from other sources (HA4a), 2006, JBA Consulting*).

Surface water flooding can occur from high levels of water coming from the land and due to blocked ditches or road gullies, causing flooding to the surrounding area. Much of the surface water flooding is made worse in the autumn, when leaf fall is high, which can cause culverts and road gullies to block. Regular and thorough maintenance regimes for culverts, road gullies and drainage ditches can be a large contributing factor in reducing surface water flooding.

There are no national datasets from the EA regarding historic surface water flooding. However, local surface water information has been available from Shropshire Council and Severn Trent Water.

The Shropshire Flood Forums database showed 696 locations and some details of past flooding incidents across the county. These were from all sources whether fluvial, surface water or groundwater. The latest version from November 2010 was used for the PFRA. The GIS layer only provided a location and an indication of the type of flooding and consequences. For most locations it did not specify the number of properties affected or when the incident occurred (or frequency of occurrence).

STW's DG5 register showed 21 surface water flooding incident records across Shropshire over the past decade. Dates and grid references were provided and an indication of return period.

## **5.2 Groundwater Flooding**

Groundwater Flooding is defined as that caused by the emergence of water from sub-surface strata. The groundwater may emerge from either point or diffuse locations.

The SFRA's undertaken in 2007 for the 5 former districts indicate that, in general, there should be little concern over groundwater flooding in Shropshire. There are no past incidents of groundwater flooding recorded from any of the former District Councils but there are source protection zones in each. In the SFRA covering the former North Shropshire District, the only specific reference was the following:

'The geology of the catchments gives rise to high permeability rates. The Triassic Sandstone aquifer in North Shropshire is an important part of the Shropshire Groundwater Scheme initiated to preserve flows in the River Severn.'

For the purposes of this PFRA, there are no historic groundwater flooding records with significant consequences.

## **5.3 Sewer Flooding**

STW's DG5 register showed 138 foul water flooding incident records across Shropshire over the past decade. Dates and grid references were provided and an indication of return period.

## **5.4 Ordinary Watercourses and Interaction with Main Rivers**

Historic flood outlines have been provided by the EA but these are mainly along designated EA main rivers. This GIS layer and watercourses database were used to assess whether historic flood outlines affected ordinary watercourse flood extents too. When water levels within main rivers are high, discharge from ordinary watercourses can be restricted. This can cause backing up and flooding to the locality.

## **5.5 Significant Consequences from Historic Flood Events**

There is insufficient data on the consequences of historic flooding from local sources. No historic events have 'significant consequences' in Shropshire (as defined by Defra guidance (>30,000 people, >3,000 businesses or >150 critical infrastructure)). However a number of historic events are considered as 'locally significant and these are recorded in Annex 1 of the Preliminary Assessment Report Spreadsheet (issued as separate document to the PFRA Report 'Shropshire Council Preliminary Assessment Report Spreadsheet.XLS').

In the table below is a selection of flood events which have occurred across Shropshire.

<b>Date</b>	<b>Location</b>	<b>Description</b>
<i>June 2007</i>	<i>Much Wenlock and Farley</i>	<i>Surface water and fluvial flooding through town affecting houses and businesses</i>
	<i>Bridgnorth</i>	<i>Severn Valley Railway line from Bridgnorth was closed after landslips.</i>
	<i>Ludlow</i>	<i>Burway Bridge on River Corve collapsed on the main road into Ludlow, severing a gas main and causing the surrounding area to be evacuated.</i>
	<i>Shifnal</i>	<i>Parts of the town were flooded when the watercourse by some of the residential areas burst its banks.</i>
<i>July 2006</i>	<i>Albrighton and Cosford</i>	<i>Heavy rain causing flash floods, damage to properties, impassable roads and closed schools.</i>
<i>November 2000</i>	<i>Severn Valley: Shrewsbury, Bridgnorth</i>	<i>Widespread damage to properties along River Severn</i>
<i>October 1998</i>	<i>Severn Valley: Shrewsbury, Bridgnorth</i>	<i>Heavy rainfall and flooding along River Severn</i>

**Table 3 – Historic Flood Events in Shropshire**

## 6 Future Flood Risk

There is currently no local information on future surface water flood risk for Shropshire however Surface Water Management Plans are being undertaken for Much Wenlock, Shifnal, Craven Arms and Church Stretton. Outcomes from these studies are likely to include hydraulic models and flood extents for design events. Surface water management plans are also planned for the future in other locations.

### 6.1 Surface Water Flooding

National maps for surface water flooding however have been issued by the Environment Agency and are available as the main source of information. Two generations of surface water flood map have been issued in April 2009 and November 2010 respectively. Each used slightly different data sources and methodologies to produce them.

For the main flood risk areas, concentrated over the larger settlements in Shropshire, the surface water flood maps have been overlaid along side other datasets (past flooding and receptors). These are discussed later, in Section 7.2.

The Areas Susceptible to Surface Water Flooding map (AStSWF), the first generation map, incorporated the following:

- 1 in 200 year annual probability rainfall with 6.5 hour storm duration using a 50% summer profile;
- no infiltration or sewer representation;
- surface roughness assumed Manning's n value of 0.1 everywhere;
- bare earth DTM from LiDAR at 5m resolution with no buildings represented, and;
- threshold bands of 0.1m – 0.3m (less), 0.3m – 1m (intermediate), >1m (more).

The Flood Map for Surface Water (FMfSW), the second generation map, incorporated the following:

- 1 in 30 (for onset of sewer flooding) and 1 in 200 year annual probability rainfalls with 1.1 hour storm duration (produced higher peaks) using a 50% summer profile;
- infiltration reduction in rural and urban areas applied 39% and 70% respectively. Additional reduction of 12mm/hr in urban areas to represent sewer flow;
- surface roughness assumed Manning's n value of 0.1 in rural areas and 0.03 in urban areas;

- most up to date composite DTM used for bare earth at 5m resolution and buildings added to a height of 5m, and;
- threshold bands of >0.1m (shallow) and >0.3m (deep).

The surface water flood maps did not lead to any significant Flood Risk Areas (i.e. where >30,000 people were affected in a cluster, therefore considered as significant consequences) but did lead to 'blue squares' that exceeded the thresholds outlined within 1km<sup>2</sup> (see previous Table 2). As no locations within Shropshire are considered to have significant consequences, none are recorded in Annex 3 of the Preliminary Assessment Report Spreadsheet (issued as separate document to the PFRA Report 'Shropshire Council Preliminary Assessment Report Spreadsheet.XLS')

Using the FMfSW map the number of properties at risk of surface water flooding within Shropshire has been estimated by the EA. For a rainfall event with a 1 in 200 annual chance of occurring, 35,900 properties are at risk from flooding to a depth of 0.1m and 11,500 properties are at risk from flooding to a depth of 0.3m. Of these properties at risk, over half are residential properties. Further details on the potential harmful consequences of future flooding are included in Annex 2 of the Preliminary Assessment Spreadsheet (issued as separate document to the PFRA Report 'Shropshire Council Preliminary Assessment Report Spreadsheet.XLS').

## **6.2 Groundwater Flooding**

The Areas Susceptible to Groundwater Flooding map (AStGWF) considers 1km grid squares and assigns one of the five bands of susceptibility (0, <25%, 25-50%, 50-75% and >75%). This map has not lead to any additional flood risk areas or 'blue squares'.

## **6.3 Sewer Flooding**

At the time of data request to STW it was not possible to get any sewer model extents/outputs or X-X diagrams/drainage area plans) - these are diagrams that provide the design flow of the pipes (capacity of the system) and also the return period when surcharging from the system occurs). There is, therefore, no future flood risk data for sewers as part of the PFRA.

## **6.4 Ordinary Watercourses and Interaction with Main Rivers**

Flood Zone maps (Zone 2 – 1000yr and Zone 3 – 100yr) have been provided by the EA but these show flood extents from main rivers and significant ordinary watercourses only. However the EA Flood Zone 2 map and the centrelines of all watercourses were used to assess future flood extents from ordinary watercourses caused by backing up when main river levels downstream are high. It was noted on a square by square basis whether the EA flood maps made flooding worse for ordinary watercourses and main rivers (in comparison to surface water flooding extents).

## 6.5 The Impacts of Climate Change

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

Over the past century around the UK sea levels have risen and more winter rain is falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

There is enough confidence in large scale climate models to say that change must be planned for. There is more uncertainty at a local scale but model results can still help planning for adaptation. For example it is understood rain storms may become more intense, even if about it isn't known exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

## 6.6 Key Projections for Severn River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- winter precipitation increases of around 12% (very likely to be between 2 and 26%);
- precipitation on the wettest day in winter up by around 9% (very unlikely to be more than 22%);
- relative sea level at Bristol very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss), and;
- peak river flows in a typical catchment likely to increase between 9 and 18%.

Increases in rainfall are projected to be greater in the south of the county.

## 6.7 Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding along the Severn and its tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers. The unexpected should be prepared for.

Many drainage systems in Shropshire have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, local studies to understand climate impacts in detail, including effects from other factors like land use, should be completed. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

## **6.8 Adapting to Change**

Past emission means some climate change is inevitable. It is essential the future is planned for. Preparation can be made by understanding the current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, local decisions must be made with some uncertainty. Therefore a range of measures should be considered to retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that vulnerability to flooding does not increase.

## **6.9 Long Term Developments**

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

In Wales, Technical Advice Note 15 (TAN15) on development and flood risk sets out a precautionary framework to guide planning decisions. The overarching aim of the

precautionary framework is "to direct new development away from those areas which are at high risk of flooding."

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).



## 7 Review of Indicative Flood Risk Areas

### 7.1 EA Assessment

The original EA assessment of Shropshire led to:

- no areas of significant flood risk (i.e. where >30,000 people, >3,000 non-residential properties, or >150 critical infrastructure were affected), and;
- 40 'blue squares' (i.e. where >200 people, >20 non-residential properties or >1 critical infrastructure were affected in 1km<sup>2</sup>).

The assessment was based mainly on the FMfSW where people, business and critical infrastructure might be flooded to a depth of 0.3m by a rainfall event with 1 in 200 of occurring in any given year. The AStSWF map was also used to verify the results and to include additional Flood Risk Areas in England where there are significant differences between the two maps.

The locations and results of the EA assessment of 'blue squares' were provided as a GIS layer. The results are summarised in Figure 4 with the names of towns with flood risk to people shown in descending order on the graph, as well as the number of non-residential properties and critical infrastructure at flood risk.

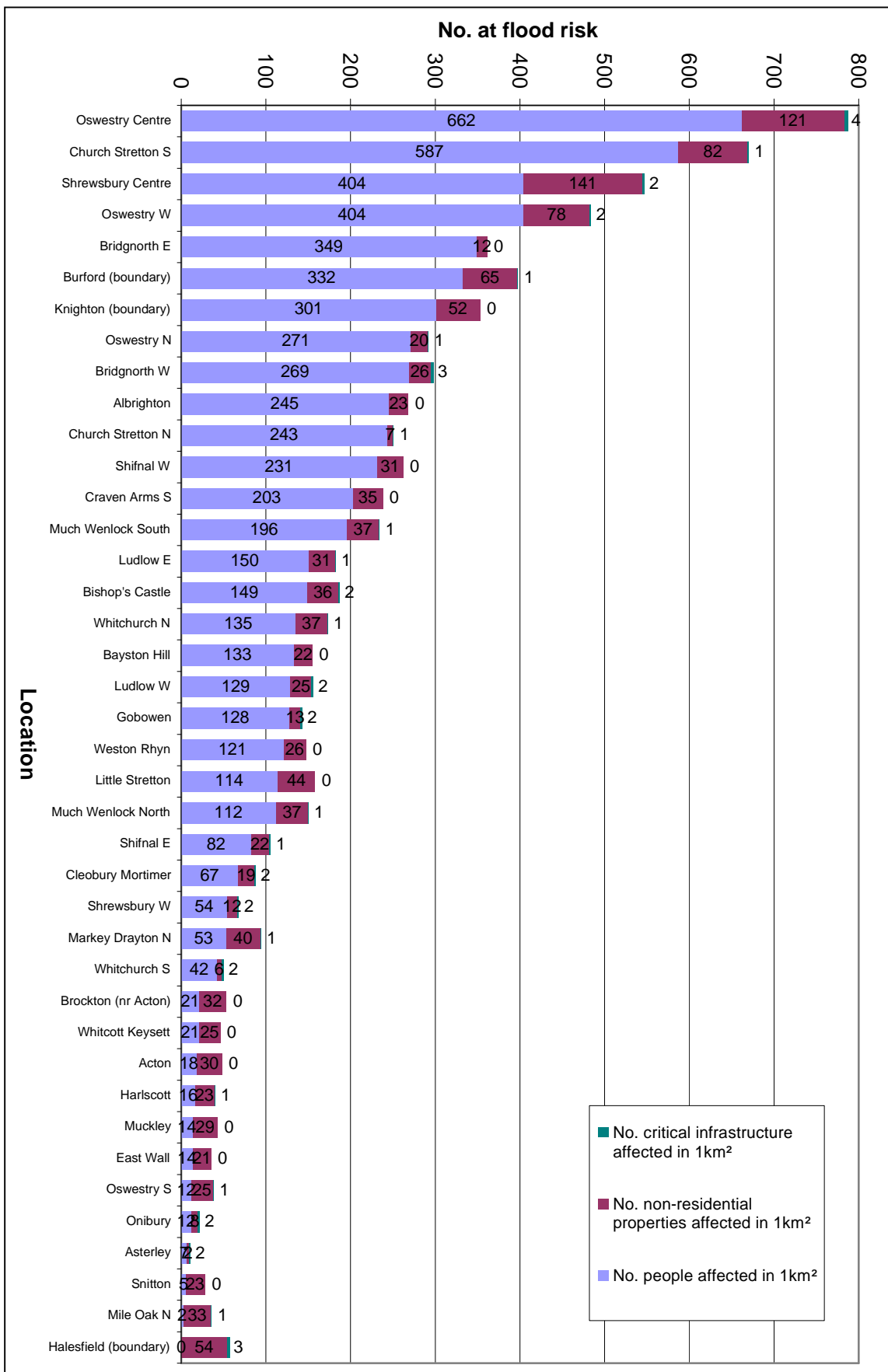


Figure 4 – 40 Initial ‘Blue Squares’ (EA Assessment)

## 7.2 Review of EA Assessment

A comparison was made between the FMfSW, the AStSWF map and additional local knowledge of flooding obtained from the Flood Forums and STW’s DG5 register. It was clear, when overlaying these layers, that evidence of past flooding often lay within the flood extent of the AStSWF map (which generally showed a greater area of flood extent) rather than the FMfSW for many locations in Shropshire. It was also important to consider that the information obtained from FMfSW does not supersede that within the AStSWF map.

Therefore, in order to check the ‘blue squares’, it was appropriate to use both the FMfSW and AStSWF map. The rainfall event with 1 in 200 of occurring in any given year was used, similar to the EA assessment. The flood extent based on the deep FMfSW (>0.3m) was used (similar to the EA assessment) and the flood extent of the intermediate AStSWF (0.3m – 1m) map was also used.

The initial assessment focussed on the 40 EA ‘blue squares’ for Shropshire - which were based on v1.0 of the National Receptor Database (NRD v1.0). The latest assessment used the NRD v1.1, additional GIS layers from SC and the building outlines (all detailed in Section 4.1). Each of the 40 ‘blue squares’ were analysed individually and the following counts undertaken:

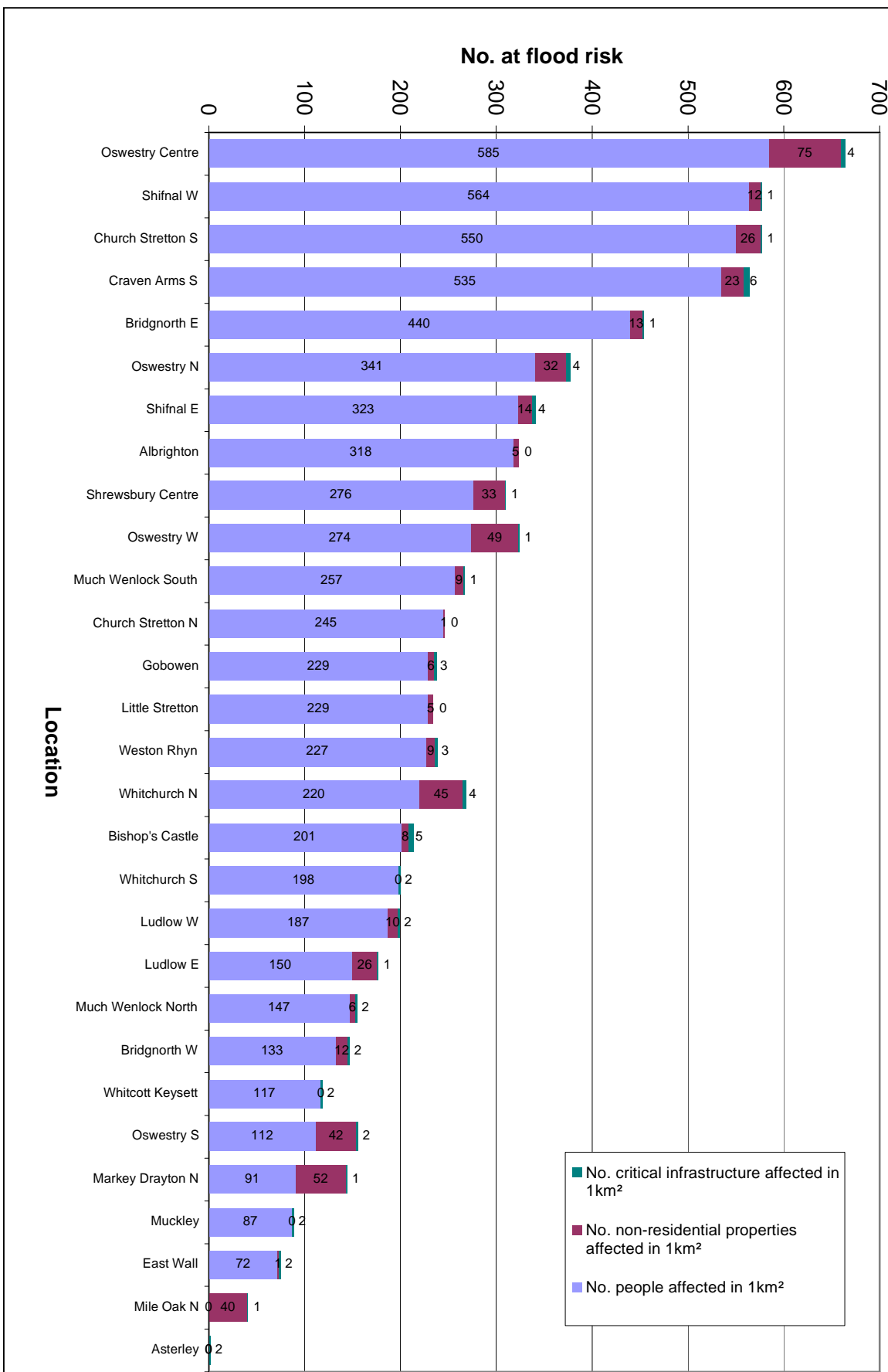
- the number of people affected was counted;
- the number of businesses affected was counted, and;
- the number of items of critical infrastructure affected was counted.

A spreadsheet showing the full analysis (both EA assessment and the latest) is provided in Appendix A. The spreadsheet details the number of receptors at risk and provides further evidence of harmful consequences based on past flooding history, fluvial flooding and groundwater flooding. The latest analysis on the 40 original squares is shown in Figure 5.

From the checks, only 29 of the 40 ‘blue squares’ identified by the EA were found to be over the thresholds specified. Of these 29, two ‘blue squares’ exceed the thresholds because fluvial flooding from ordinary watercourses has been considered (based on EA Flood Zone 2 map) as well as the surface water flood risk.

Of the other eleven ‘blue squares’ (originally identified by the EA analysis):

- three (Burford, Knighton and Halefield) cross boundaries with other counties and the thresholds were NOT exceeded within the Shropshire Council area;
- 8 were found to be below the threshold so would not be considered to be blue squares based on the latest assessment.



**Figure 5 – 40 Initial ‘Blue Squares’ (29 exceed threshold in latest assessment)**

Using the number of people at flood risk (that exceed 200) to rank the towns in order of priority, Table 4 shows the EA assessment and the latest PFRA assessment for towns at risk:

<b>Ranking</b>	<b>EA Assessment</b>	<b>Latest PFRA Assessment</b>
1.	Oswestry (Centre)	Oswestry (Centre)
2.	Church Stretton (South)	Shifnal (West)
3.	Shrewsbury (Centre)	Church Stretton (South)
4.	Oswestry (West)	Craven Arms (South)
5.	Bridgnorth (East)	Bridgnorth (East)
6.	Burford (crosses boundary)	Oswestry (North)
7.	Knighton (crosses boundary)	Shifnal (East)
8.	Oswestry (North)	Albrighton
9.	Bridgnorth (West)	Shrewsbury (Centre)
10.	Albrighton	Oswestry (West)
11.	Church Stretton (North)	Much Wenlock (South)
12.	Shifnal (West)	Church Stretton (North)
13.	Craven Arms (South)	Gobowen
14.		Little Stretton
15.		Weston Rhyn
16.		Whitchurch (North)
17.		Bishop’s Castle

**Table 4 – Towns ranked in order of people at risk of the 40 original squares**

## 8 Identification of Flood Risk Areas

### 8.1 New 'Blue Squares' Identified

The rest of the county was analysed (not just those squares found by the EA) and a further 28 'blue squares' were identified. No significant flood risk areas were identified. A spreadsheet of the new 'blue squares' is provided in Appendix B (shown in dark blue).

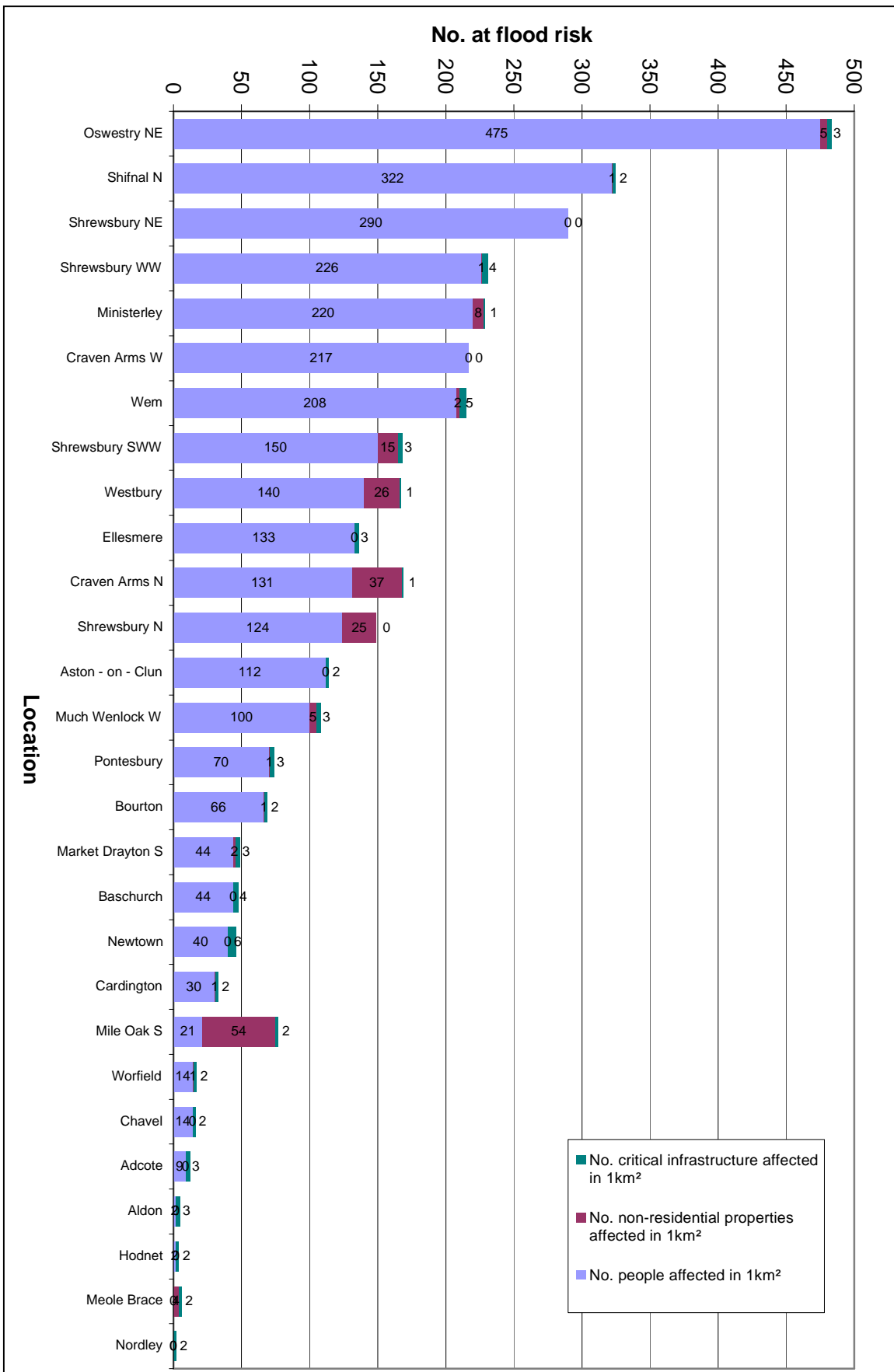
Many of the additional 'blue squares' fall into the criteria because of two items of critical infrastructure at risk (often sewage treatment works) rather than people being at risk. There are only 7 new squares that exceed 200 people at risk:

- Oswestry (North East);
- Shifnal (North);
- Shrewsbury (North East);
- Shrewsbury (Far West);
- Minsterley;
- Craven Arms (West), and;
- Wem.

Reasons for these squares not being identified previously (and any changes compared to the EA assessment) are:

- both AStSWF and FMfSW flood extents being used;
- building outlines have now been used to define flood risk instead of property points;
- additional information has been collected to locate critical infrastructure such as words as well as MCM codes and additional GIS layers received on locations of schools, treatment works and electrical sub-stations, and;
- MCM code 999 is now assumed to be residential (unless obviously commercial based on surrounding land-use and building size/shape).

The latest analysis showing the 28 new squares is in Figure 6, detailing the number of non-residential properties and items of critical infrastructure at risk as well as number of people.



**Figure 6 – 28 New ‘Blue Squares’ (Latest Assessment)**

## 8.2 Overall Priority of Flood Risk Areas

The original ‘blue squares’ and the new ‘blue squares’ identified have been combined and a chart showing all 57, ranked in order of the number of people at flood risk, is provided in Appendix C.

Using number of people at flood risk (that exceed 200) to rank the settlements in order of priority, Table 5 shows the overall PFRA assessment for kilometre squares within settlements at risk. Reference has also been made as to whether the locations have been identified in a previous study.

<b>Ranking</b>	<b>Overall Assessment</b>	<b>Identified in Previous Studies?</b>
1.	Oswestry Centre	WCS, SFRA Level 1
2.	Shifnal W	WCS, SFRA Level 1, SWMP
3.	Church Stretton S	WCS, SFRA Level 1, SWMP
4.	Craven Arms S	WCS, SFRA Level 1, SWMP
5.	Oswestry NE	WCS, SFRA Level 1
6.	Bridgnorth E	WCS, SFRA Level 1
7.	Oswestry N	WCS, SFRA Level 1
8.	Shifnal E	WCS, SFRA Level 1, SWMP
9.	Shifnal N	WCS, SFRA Level 1, SWMP
10.	Albrighton	WCS
11.	Shrewsbury NE	WCS, SFRA Level 1 and 2
12.	Shrewsbury Centre	WCS, SFRA Level 1 and 2
13.	Oswestry W	WCS, SFRA Level 1
14.	Much Wenlock S	WCS, SFRA Level 1, SWMP
15.	Church Stretton N	WCS, SFRA Level 1, SWMP



16.	Gobowen	WCS, SFRA Level 1
17.	Little Stretton	SFRA Level 1
18.	Weston Rhyn	SFRA Level 1
19.	Shrewsbury W	WCS, SFRA Level 1 and 2
20.	Whitchurch N	WCS, SFRA Level 1
21.	Minsterley	WCS, SFRA Level 1
22.	Craven Arms W	WCS, SFRA Level 1, SWMP
23.	Wem	WCS, SFRA Level 1
24.	Bishop's Castle	WCS

**Table 5 – Towns ranked in order of number of people at risk (overall assessment)**

Based on Table 5 it is clear that the Water Cycle Study in June 2010 and the Level 1 Strategic Flood Risk Assessments for the five former districts identified the majority of the locations with fluvial or surface water flooding issues. The key locations that require further investigation (i.e. not addressed by a SWMP or Level 2 SFRA to date) based on the number of people at risk are: Oswestry, Bridgnorth, Albrighton, Gobowen, Weston Rhyn, Whitchurch, Minsterley, Wem, Bishop's Castle and Little Stretton.

Ludlow, Westbury, Market Drayton and Mile Oak are also recommended to be investigated further based on the number of non-residential properties at risk threshold (see Appendix C).

### **8.3 Mapping of 'Blue Squares'**

A map of Shropshire showing the places above flood risk thresholds ('blue squares') has been produced and is shown in Appendix D.

The 'blue squares' are divided in to 3 categories (using three colours):

- Agree with the EA Assessment (light blue)
- New 'blue squares' identified (dark blue)
- Squares to be removed (red)

## 9 Conclusions and Recommendations

### 9.1 Conclusions

- No significant flood risk areas have been identified in Shropshire (significant flood risk defined in PFRA as: >30,000 people, >3,000 non-residential properties, or >150 critical infrastructure at risk in a cluster).
- 57 1km<sup>2</sup> 'blue squares' have been identified in Shropshire ('blue squares' are defined as >200 people, >20 businesses, or 2 or more critical infrastructure at risk within a 1km<sup>2</sup> square). This is an increase from the 40 originally identified by the EA.
- Of the 57 'blue squares' identified:
  - 24 'blue squares' exceed the 200 people at risk threshold;
  - 8 'blue squares' exceed the 20 non-residential properties at risk threshold (but not the 200 people at risk threshold), and;
  - 25 'blue squares' exceed the two items of critical infrastructure at risk threshold (but neither the people nor non-residential properties at risk thresholds).
- Maps, showing the locations of the 'blue squares' and counts of the number of receptors at risk, are provided in Appendices C and D.

### 9.2 Recommendations

- The priority towns that should be investigated further (those not currently addressed by a SWMP) based on the number of people at risk are: Oswestry, Shrewsbury, Bridgnorth, Albrighton, Gobowen, Weston Rhyn, Whitchurch, Minsterley, Wem, Bishop's Castle and Little Stretton.
- Ludlow, Westbury, Market Drayton and Mile Oak should be investigated further based on the number of non-residential properties at risk threshold.
- Many of the 'blue squares' that have been flagged due to two items of critical infrastructure at risk only (i.e. electrical sub-stations and sewage treatment works) should be addressed using flood defence measures locally, rather than making wider changes to watercourses, drainage or land management.
- The investigation of future flood events should be continued with the collection, assessment and storage of information regarding any new flooding incidents.

- Preparations and resources should be in place such that Shropshire Council is capable of undertaking its new responsibilities as a Lead Local Flood Authority, as set out in the Flood and Water Management Act 2010. Some of these new responsibilities are highlighted in Section 2.2.

## 10 References

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**Environment Agency (Dec 2010)** *Preliminary Flood Risk Assessment (PFRA), Final Guidance*, Report – GEHO1210BTGH-E-E, December 2010

**Environment Agency (1<sup>st</sup> Mar 2011)** *Flood Risk Regulations - PFRA FAQ's version 2*, Document 110301, 1<sup>st</sup> March 2011

**Environment Agency (Mar 2011)** *Preliminary Flood Risk Assessment (PFRA), Annexes to the Final Guidance*, Report – GEHO1210BTHF-E-E version 2, March 2011

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**Flood Risk Regulations (2009)** More information is available at:  
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**TAN15 (July 2004)** *Planning Policy Wales, Technical Advice Note 15: Development and Flood Risk, Welsh Assembly Government, Crown Copyright July 2004*

**URS Scott Wilson (Jan 2011)** *Essex County Council PFRA, Final Report, Jan 2011*

**Workshop Slides (2011)** *PFRA: Practitioners Workshop, "How to get the most out of your PFRA" Part of DEFRA's Capacity Building Strategy, Scott Wilson and Capita Symonds Presentation, 2011*

## Appendix A – Review of 40 Initial ‘Blue Squares’

Column 3 provides a summary of whether the checks agree with EA analysis of ‘blue squares’ and a comparison of counts is shown in Columns 4 - 9. The spreadsheet has been ranked in order of number of people affected with the most people affected at the top.

Columns 10 & 11 indicate whether fluvial flooding makes the area at greater flood risk based on EA flood zone maps.

Additional information from the flood forum and DG5 register from STW and historical flood outlines on past floods is also provided for each 1km<sup>2</sup> square.

Town Name	Grid Reference	Agree with ‘Blue Square’?	EA analysis			FMfSW & AStSWF			EA Flood Map		Historic Flood Outline		Flood Forum		DG5 register		Groundwater Flooding
			People	Non-res Properties	Critical Infra	People	Non-res Properties	Critical Infra	Any flooding?	Making it worse?	Any flooding?	Making it worse?	Any past flooding?	Incidents / Type	Any past flooding?	Incidents / Type	Range
Oswestry Centre	329, 329	Yes	662	121	4	585	75	2 Nursing, 1 School, 1 Electric	No	-	No	-	Yes	1 sewers	Yes	24 foul	>75%
Shifnal W	374, 307	Yes	231	31	0	564	12	1 Electric	Yes	No	No	-	Yes	3 surface water	Yes	2 foul, 1 surface water	>75%
Church Stretton S	345, 293	Yes	587	82	1	550	26	1 Electric	Yes	Yes	No	-	Yes	12 incidents	Yes	6 incidents	50-75%
Craven Arms S	343, 282	Yes	203	35	0	535	23	1 Ambul, 1 Fire, 1 Police, 1 School, 2 Electric	Yes	Yes	No	-	Yes	6 incidents	No	-	50-75%
Bridgnorth E	372, 292	Yes	349	12	0	440	13	1 Electric	Yes	Yes	Yes	Yes	Yes	1 blocked pipes	No	-	25-50%
Oswestry N	329, 330	Yes	271	20	1	341	32	1 Sewage, 3 Electric	No	-	No	-	No	-	No	-	>75%
Shifnal E	375, 307	Yes	82	22	1	323	14	4 Electric	Yes	No	No	-	Yes	1 highway & property	No	-	<25%
Albrighton	381, 304	Yes	245	23	0	318	5	0	Yes	No	No	-	Yes	1 surface water	No	-	25-50%
Shrewsbury Centre	349, 312	Yes	404	141	2	276	33	1 Police	Yes	Yes	Yes	Yes	Yes	15 fluvial & highways	No	-	50-75%
Oswestry W	328, 329	Yes	404	78	2	274	49	1 School	No	-	No	-	Yes	1 road	Yes	1 foul	>75%
Much Wenlock South	362, 299	Yes	196	37	1	257	9	1 Electric	Yes	Yes	No	-	Yes	5 in sufficient capacity culvert. 2 field & highway runoff	Yes	1 foul	<25%
Church Stretton N	345, 294	Yes - Flood Map	243	7	1	245	1	0	Yes	Yes	No	-	Yes	1 park	No	-	25-50%
Gobowen	330, 333	Yes	128	13	2	229	6	1 Nursing, 1 Sewage, 1 Electric	Yes	Yes	No	-	Yes	1 highway, 1 property	Yes	1 repeated foul	>75%

Little Stretton	344, 291	Yes - Flood Map	114	44	0	229	5	0	Yes	Yes	No	-	Yes	1 watercourse	No	-	25-50%
Weston Rhyn	328, 335	Yes	121	26	0	227	9	3 Electric	Yes	No	No	-	Yes	1 carriageway	No	-	>75%
Whitchurch N	354, 341	Yes	135	37	1	220	45	2 Electric, 1 Police, 1 Fire	Yes	Yes	Yes	No	Yes	1 carriageway	No	-	50-75%
Bishop's Castle	332, 288	Yes	149	36	2	201	8	1 Hospital, 1 Sewage, 1 School, 2 Electric	No	-	No	-	No	-	No	-	>75%
Whitchurch S	354, 340	Yes	42	6	2	198	0	1 School, 1 Electric	Yes	Yes	Yes	No	No	-	No	-	50-75%
Ludlow W	351, 274	Yes	129	25	2	187	10	1 Electric, 1 Sewage	Yes	Yes	Yes	No	Yes	a few fluvial	Yes	1 foul	25-50%
Ludlow E	352, 274	Yes	150	31	1	150	26	1 Electric	Yes	No	Yes	No	Yes	5 surface water	No	-	<25%
Much Wenlock North	362, 300	Yes	112	37	1	147	6	1 Electric, 1 School	Yes	No	No	-	Yes	10 incidents of runoff / surface water. 2 foul	Yes	1 foul	<25%
Bridgnorth W	371, 292	Yes	269	26	3	133	12	1 Sewage, 1 Electric	Yes	Yes	Yes	Yes	Yes	1 highway	No	-	25-50%
Whitcott Keysett	327, 282	Yes	21	25	0	117	0	2 Sewage	Yes	No	No	-	No	-	No	-	50-75%
Oswestry S	329, 328	Yes	12	25	1	112	42	2 Electric	Yes	No	No	-	Yes	1 highway	Yes	1 repeated foul	50-75%
Markey Drayton N	367, 334	Yes	53	40	1	91	52	1 Electric	Yes	Yes	No	-	Yes	1 highway	Yes	1 foul	<25%
Muckley	364, 295	Yes	14	29	0	87	0	2 Sewage	Yes	No	No	-	Yes	2 field runoff	No	-	25-50%
East Wall	352, 293	Yes	14	21	0	72	1	1 Electric, 1 School	Yes	No	No	-	Yes	1 property	No	-	>75%
Mile Oak N	330, 327	Yes	2	33	1	0	40	1 Electric	Yes	No	No	-	Yes	1 fluvial	No	-	0%
Asterley	337, 306	Yes	7	2	2	0	0	2 Sewage	Yes	No	Yes	No	No	-	No	-	>75%
Brockton (nr Acton)	332, 285	No	21	32	0	145	1	0	Yes	No	No	-	Yes	1 fluvial	No	-	50-75%
Cleobury Mortimer	367, 275	No	67	19	2	114	3	1 School	Yes	No	No	-	Yes	1 watercourse maintenance	Yes	1 incident	<25%
Shrewsbury W	348, 312	No	54	12	2	112	8	1 School	Yes	Yes	Yes	Yes	Yes	6 fluvial & highways	No	-	25-50%
Acton	331, 284	No	18	30	0	82	0	0	Yes	No	No	-	No	-	No	-	50-75%
Harlscott	350, 316	No	16	23	1	68	9	1 School	Yes	No	No	-	Yes	1 fluvial	No	-	0%
Bayston Hill	347, 308	No	133	22	0	44	9	0	No	-	No	-	Yes	1 culvert back up	No	-	<25%
Onibury	345, 279	No	12	8	2	31	1	0	Yes	No	No	-	Yes	Village Hall, road closure	No	-	<25%
Snitton	355, 275	No	5	23	0	22	0	0	No	-	No	-	No	-	No	-	<25%
Burford (boundary)	359, 268	No	332	65	1	28 (shrop)	3 (shrop)	0 (shrop)	Yes	Yes	Yes	Not in Shropshire	Yes	1 surface water	No	-	>75%
Knighton (boundary)	328, 272	No	301	52	0	15 (shrop)	0 (shrop)	0 (shrop)	Yes	No	No	-	Yes	Fluvial Teme	No	-	25-50%
Halesfield (boundary)	371, 304	No	0	54	3	0 (shrop)	0 (shrop)	0 (shrop)	Yes	Yes	No	-	No	-	No	-	<25%

## Appendix B – New ‘Blue Squares’ Identified

Column 3 provides a summary of whether it is a new ‘blue square’ to be added. Counts are in Columns 4 – 6. Spreadsheet ranked in order of number of people affected with the most people affected at the top.

Columns 7 & 8 indicate whether fluvial flooding makes the area at greater flood risk based on EA flood zone maps.

Additional information from the flood forum and DG5 register from STW and historical flood outlines on past floods is also provided for each 1km<sup>2</sup> square.

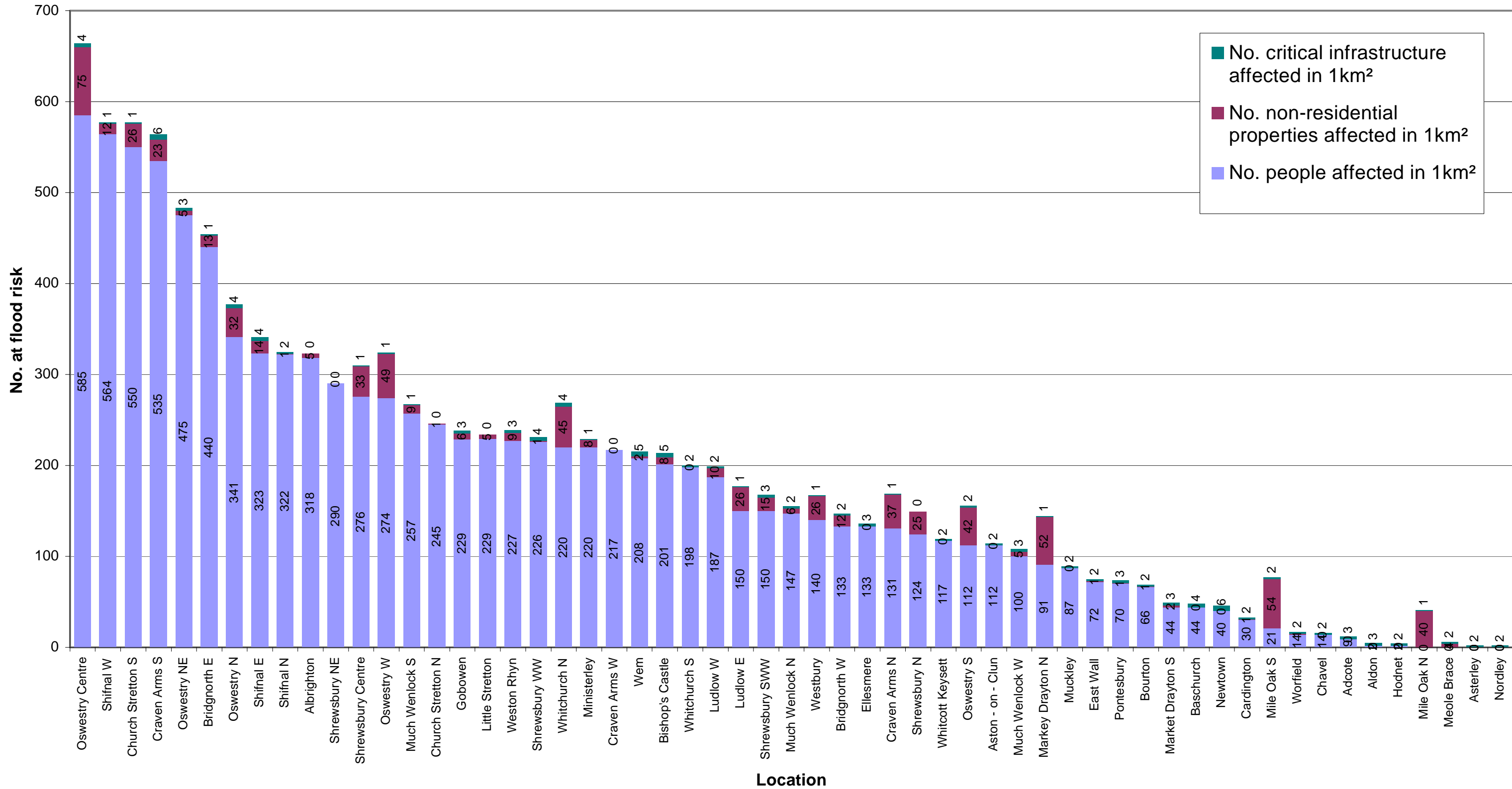
Town Name	Grid Reference	New ‘Blue Square’	FMfSW & AStSWF			EA Flood Map		Historic Flood Outline		Flood Forum		DG5 register		Groundwater Flooding
			People	Non-res Properties	Critical Infra	Any flooding?	Making it worse?	Any flooding?	Making it worse?	Any past flooding?	Incidents / Type	Any past flooding?	Incidents / Type	Range
Oswestry NE	330, 330	New	475	5	2 Electric, 1 School	No	-	No	-	Yes	1 cycle lane	No	-	>75%
Shifnal N	375, 308	New	322	1	2 Schools	No	-	No	-	No	-	No	-	25-50%
Shrewsbury NE	350, 313	New	290	0	0	Yes	Yes	Yes	Yes	Yes	4 fluvial	Yes	1 foul highway	50-75%
Shrewsbury W	347, 312	New	226	1	1 School, 3 Electric	Yes	No	No	-	Yes	2 sewer, 1 property	Yes	3 foul	>75%
Minsterley	337, 305	New	220	8	1 Sewage	Yes	Yes	No	-	Yes	1 business	Yes	1 foul	>75%
Craven Arms W	342, 282	New	217	0	0	Yes	Yes	No	-	Yes	1 surface water	No	-	50-75%
Wem	351, 328	New	208	2	2 Schools, 1 Sewage, 1 Electric, 1 Fire	Yes	Yes	No	-	No	-	Yes	9 foul (near river)	>75%
Shrewsbury SWW	347, 311	New	150	15	2 Electric, 1 School	Yes	No	No	-	Yes	3 culvert / trash screens	No	-	25-50%
Westbury	335, 309	New	140	26	1 Sewage	Yes	Yes	No	-	No	-	No	-	>75%
Ellesmere	339, 334	New	133	0	2 Electric, 1 School	Yes	Yes	No	-	Yes	1 fluvial	No	-	0%
Craven Arms N	343, 283	New	131	37	1 Nursing	Yes	No	No	-	No	-	No	-	50-75%
Shrewsbury N	349, 313	New	124	25	0	Yes	Yes	Yes	Yes	Yes	4 surface water, 1 fluvial	Yes	5 foul, 1 highway	>75%
Aston - on - Clun	339, 281	New	112	0	1 Electric, 1 Sewage	Yes	Yes	No	-	Yes	Properties & highway	No	-	>75%
Much Wenlock W	361, 299	New	100	5	2 Sewage, 1 Nursing	Yes	Yes	No	-	Yes	3 runoff & poperties	No	-	<25%
Pontesbury	340, 305	New	70	1	2 Schools, 1 Electric	No	-	No	-	Yes	1 ford	Yes	1 foul	50-75%
Bourton	359, 296	New	66	1	2 Sewage	Yes	No	No	-	Yes	3 surface water	No	-	<25%
Baschurch	342, 322	New	44	0	2 Schools, 2 Electric	No	-	No	-	No	-	No	-	50-75%
Market Drayton S	367, 333	New	44	2	3 Electric	Yes	No	No	-	No	-	No	-	50-75%
Newtown	347, 331	New	40	0	1 School, 1 Sewage, 4 Electric	Yes	Yes	No	-	No	-	No	-	>75%
Cardington	350, 295	New	30	1	2 Sewage	Yes	No	No	-	Yes	1 Highway	No	-	50-75%
Mile Oak S	330, 328	New	21	54	2 Electric	No	-	No	-	No	-	No	-	0%
Chavel	342, 313	New	14	0	2 Sewage	No	-	No	-	Yes	1 surface water	Yes	1 foul highway	>75%



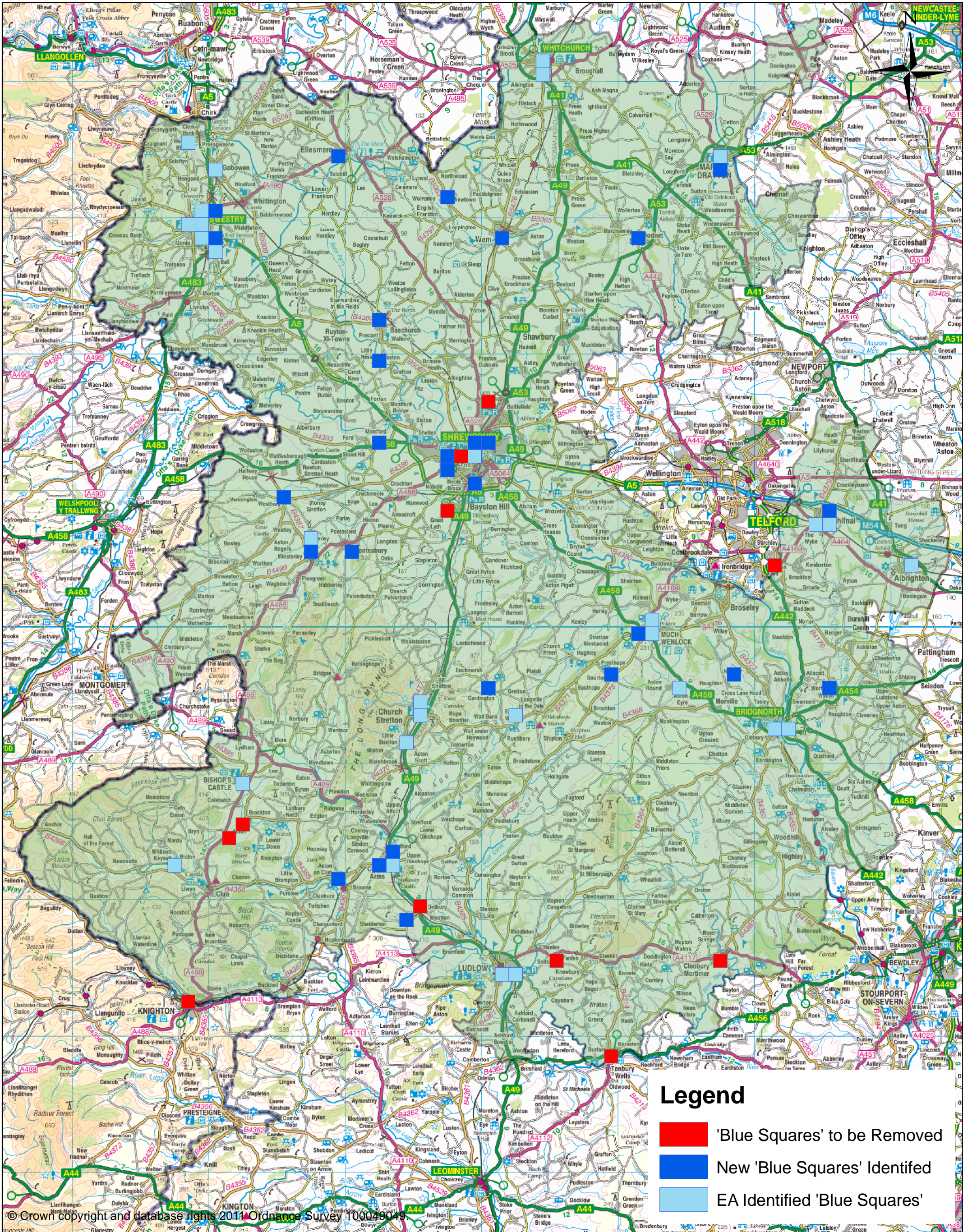
Worfield	375, 295	New	14	1	1 School, 1 Sewage	Yes	No	Yes	No	Yes	Highways & sheltered housing	No	-	25-50%
Adcote	342, 319	New	9	0	1 Sewage, 2 Electric	Yes	Yes	No	-	No	-	No	-	<25%
Aldon	344, 278	New	2	0	3 Sewage	Yes	No	No	-	No	-	No	-	<25%
Hodnet	361, 328	New	2	0	1 Sewage, 1 Fire	Yes	No	No	-	No	-	No	-	<25%
Nordley	368, 296	New	0	0	2 Sewage	No	-	No	-	No	-	No	-	<25%
Meole Brace	349, 310	New	0	4	2 Electric	Yes	Yes	Yes	No	Yes	3 roads /carriageways	No	-	25-50%

## Appendix C – Overall Priority of Places above Flood Risk Thresholds ('Blue Squares')

Chart showing counts of all locations above flood risk thresholds ('blue squares') in Shropshire. Ranked in order of number of people at risk (from left to right).



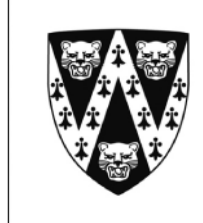
## Appendix D –Map of Places above Flood Risk Thresholds ('Blue Squares')



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### Legend

- 'Blue Squares' to be Removed
- New 'Blue Squares' Identified
- EA Identified 'Blue Squares'



# Shropshire Council

## Locally Significant Flood Risk Areas in Shropshire

**Development Services**  
 The Shirehall, Abbey Foregate,  
 Shrewsbury, Shropshire, SY2 6ND  
 Scale : 1:250,000