Shropshire Council

Church Stretton Surface Water Management Plan

Detailed Assessment and Options Appraisal Report

Final

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Final

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Glossary

Term	Definition
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
AMP	Asset Management Plan
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Critical Infrastructure	For the purposes of this SWMP, this is identified as being Infrastructure identified from the Environment Agency NRD datasets as being hospitals, schools, power (generation & distribution), water, transport etc. For the purposes of this assessment, these items have been defined as being critical so as to identify the risk of surface water flooding to assets other than residential and commercial.
Culvert	A structure that conveys a watercourse below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload.
DTM	Digital Terrain Model
EA	Environment Agency
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
FCERM	Flood and Coastal Erosion Risk Management -
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Forum	A group set up to gather information from and to provide flooding and drainage support and advice to communities in the South West Shropshire area.

Term	Definition
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations (FRR)	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a watercourse
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LDF	Local Development Framework
Lead Local Flood Authority (LLFA)	Local Authority responsible for taking the lead on local flood risk management. In Shropshire, Shropshire Council is the LLFA.
LiDAR	Light Detection and Ranging
Local Resilience Forum (LRF)	A multi-agency forum, bringing together all the organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
LPA	Local Planning Authority
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency is the managing authority and has certain powers
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary Watercourse	All watercourses that are not designated Main River. The local authority, in this case Shropshire Council is the managing authority for ordinary watercourses and has certain powers in this regard under the Land Drainage Act.
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
PPS25	Planning and Policy Statement 25: Development and Flood Risk
RBMP	River Basin Management Plan
River Basin Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river basin catchment to identify and agree policies to secure the long-term improvement to the water environment.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.

Term	Definition
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	As defined by the Floods and Water Management Act
RMA	Risk Management Authority
SC	Shropshire Council
STWL	Severn Trent Water Limited
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer/urban drainage system.
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner.
Surface water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
WaSC	Water and Sewerage Company
WW	Dyr Cymru Welsh Water

1 Introduction

1.1 Terms of Reference

Hyder Consulting (UK) Limited (HCL) was appointed by Shropshire Council (SC) to produce a Surface Water Management Plan (SWMP) for three Shropshire Towns: Shifnal; Church Stretton and Craven Arms. This report has been written for Church Stretton; Shifnal and Craven Arms are considered in separate reports.

1.2 What is a Surface Water Management Plan

A Surface Water Management Plan (SWMP) is a plan which outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, small water courses and ditches that occurs as a result of heavy rainfall.

This SWMP study has been undertaken as part of the Shropshire Towns SWMP Framework in consultation with key local partners who are responsible for surface water management and drainage across Shropshire – including Severn Trent Water and the Environment Agency. The Partners have worked together to understand the causes and effects of surface water flooding and agree the most cost effective way of managing surface water flood risk for the long term.

This document also establishes a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. Future iterations will be required to help address the historical decisions and to help achieve stronger water quality drivers associated with surface water management.

1.3 Background

The wide scale flooding experienced during 2007 precipitated the publication of the Pitt Review[1] which contained a large number of recommendations for Central Government to consider. The key recommendation in the Pitt Review with respect to surface water management is Recommendation 18, reproduced below, which in turn refers to Planning Policy Statement 25 Development and Flood Risk (PPS25)[2].

> Recommendation 18: "Local Surface Water Management Plans, as set out in PPS25 and coordinated by local authorities, should provide the basis for managing all local flood risk. "
>
> Surface Water Management Plans (SWMPs) are referred to in Planning Policy Statement 25 (PPS25) as a tool to manage surface water flood risk on a local basis by improving and optimising coordination between relevant stakeholders. SWMPs will build on Strategic Flood Risk Assessments (SFRAs) and provide the vehicle for local organisations to develop a shared understanding of local flood risk, including setting out priorities for action, maintenance needs and links into local development frameworks and emergency plans.

Guidance on the production of SWMPs was published in March 2010[3] informed by the Integrated Urban Drainage (IUD) Pilot Studies carried out under the Government's Making Space for Water (MSfW)[4] strategy.

A SWMP outlines the preferred strategy for the management of surface water in a given location. The associated study is carried out in consultation with local partners having responsibility for the management of surface water and any associated drainage systems in that area. The goal of a SWMP is to establish a long term action plan and to influence future strategy development for maintenance, investment, planning and engagement.

The framework for undertaking a SWMP is illustrated using a wheel diagram, reproduced from the Defra Guidance[3] as shown in Figure 1.1.

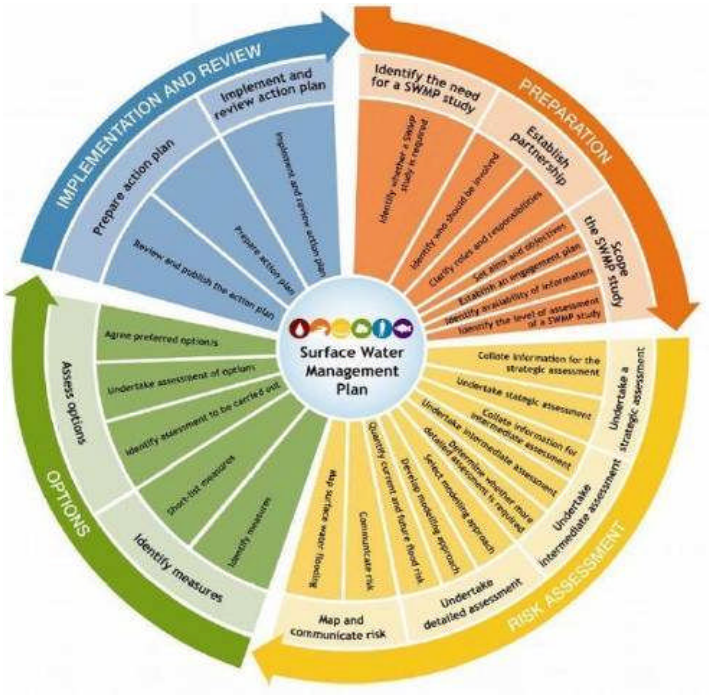


Figure 1-1 SWMP Wheel (Defra guidance[3])

The SWMP process is formed of four principal phases;

- preparation;
- risk assessment;
- options, and;
- implementation and review.

Green text boxes at the start of each chapter summarise the elements of the guidance addressed within the subsequent text.

This current round of SWMP development has been predominantly focused on delivering improvements in understanding and awareness of the risks associated with surface water flooding. However, the management of surface waters should not be wholly focussed on quantity improvements as better and more sustainable approaches will help to deliver multiple benefits, including the ability to help improve the health and quality of the water within the watercourses.

Further works are required to help redress the issues resulting from the development across Shropshire Council and as such water quality improvements should feature high within the current Action Plan and future iterations of the SWMP. Furthermore, specific studies should be commenced to help deliver these requirements to help address additional drivers, such as the Water Framework Directive.

1.4 Flooding Interactions

Planning Policy Statement 25 (PPS25) (Communities and Local Government, 2010) provides explanations on the different sources of flooding, and these explanations are provided below.

1.4.1 Sources of Flooding

Flooding From Rivers (Fluvial Flooding)	
Watercourses flood when the amount of water in them exceeds the flow capacity of the watercourse channel. Where flood defences exist, they can be overtopped or breached during a severe event. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and development can have a strong influence on flooding from watercourses. Flooding can also occur as a result or culverts and bridges becoming blocked with debris.	
Flooding from Surface Water (Pluvial Flooding)	
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas, this flood water can become polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Flooding can be exacerbated if development increases the percentage of impervious area and it is not appropriately managed.	
Groundwater Flooding	
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.	
Sewer Flooding	
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall, or become blocked. Sewer flooding continues until the water drains away.	
Flooding from Other Artificial Sources (i.e. reservoirs, canals, lakes and ponds)	
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.	

Table 1-1 Sources of Flooding (Adapted from PPS25, Annex C)

1.4.2 Surface Water Flooding

In the context of SWMPs, the technical guidance[3] defines surface water flooding as:

- Surface water runoff; runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing flooding (known as pluvial flooding);
- Flooding from groundwater where groundwater is defined as all water which is below the surface of the ground and in direct contact with the ground or subsoil;
- Sewer flooding; flooding which occurs when the capacity of underground systems is exceeded due to heavy rainfall, resulting in flooding inside and outside of buildings. Note that the normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters as a result of wet weather or tidal conditions;

- Flooding from open-channel and culverted watercourses which receive most of their flow from inside the urban area and perform an urban drainage function;
- Overland flows from the urban/rural fringe entering the built-up area; and
- Overland flows resulting from groundwater sources.

This report aims to consider surface water flooding issues in the Church Stretton area as above but it does not address sewer flooding where it is occurring as a result of operational issues, i.e. blockages and equipment failure. It should also be noted that the compilation of all historical flooding within the study area does include some flooding due to main rivers, although further investigation of these occurrences is outside the remit of this report.

1.5 Linkages with Other Plans

The increased focus on flood risk over recent years is an important element of adaptation to climate change. The clarification of the role of SC as the Lead Local Flood Authority (LLFA) is welcomed. The work on developing a SWMP for Church Stretton links to several existing documents:

1.5.1 Regional Flood Risk Appraisal (RFRA)[5]

This was produced by the West Midlands Regional Assembly in 2007[5] and updated in 2009[6], and gives a regional overview of flooding from all sources. The RFRA should be updated in 2012 to reflect the additional information on local sources of flood risk collated from Catchment Flood Management Plans (CFMP), Preliminary Flood Risk Assessment (PFRA), SWMPs and IUD Studies in the intervening time. This may also generate new policies that would be incorporated into local planning when it is reviewed.

The initial RFRA provides thirteen recommendations. More specifically the regional policies that reflect similar recommendations considered as part of this SWMP in the context of the entire study area are detailed below.

- LPAs should be encouraged to collect and record data relating to flooding incidents in a common and consistent manner to enable more precise flood risk indicators to be developed across the region.
- Drainage strategies at regional and strategic level should focus on measures to avoid the risk of flooding and pollution resulting from major development, whilst incorporating wildlife habitat and amenity enhancements wherever possible.
- Drainage strategies at regional and strategic level should also take into account the likely effects of climate change on flood risk over the next hundred years.
- Drainage strategies at regional and strategic level should emphatically recommend that SuDS solutions should be seriously considered for all significant new developments.
- Consideration should be given to extending the coverage of the Environment Agency's 'Warnings Direct' flood warning scheme as urban development in the region proceeds.
- LPAs should be encouraged to develop SWMPs as Supplementary Planning Documents as recommended in PPS25. These should contain policy statements on managing flood risk and a local surface water management plan including :
    - Promoting the use of SuDS at a strategic level for the control of surface water runoff from urban development at source
    - Promoting the use of SuDS, where appropriate, for all major development

- Providing on-site attenuation and treatment of surface water runoff from urban development and highways prior to discharge into watercourses
- Using public open spaces to deliver multiple benefits such as the creation of flood storage areas and, where possible, providing facilities for environmental enhancement in the form of wetlands and ponds
- Protection of watercourse corridors, including the avoidance of culverting and encouraging the reopening of culverted watercourses.
- Considering, where feasible, the retrofitting of SuDS when large 'brownfield' sites are redeveloped.

The updated RFRA identified one further recommendation in relation to development in Flood Zones 1 and 2 showing to be at risk from surface water and identified a sequential approach to delivering safer development in these areas including site based layout alterations to reduce the level of risk experienced.

1.5.2 The River Severn Catchment Flood Management Plan

The River Severn Catchment Flood Management Plan was published in 2008 by the Environment Agency and sets out policies for the sustainable management of flood risk across the whole of the Severn catchment over the long-term (50 to 100 years) taking climate change into account. More detailed flood risk management strategies for individual rivers or sections of river may sit under these.

The Plan emphasises the role of the floodplain as an important asset for the management of flood risk, the crucial opportunities provided by new development and regeneration to manage risk, and the need to re-create river corridors so that rivers can flow and flood more naturally.

This Plan will be periodically reviewed, approximately five years from when it was published, to ensure that it continues to reflect any changes in the catchment. The Teme is the policy sub area relating to Church Stretton and it falls within the preferred policy unit of Policy Option 3. This is defined as 'Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase overtime from this baseline)'. The promoted actions relevant to Church Stretton for this Policy Option 3 are:

1. Review effectiveness of all raised defences through Asset Management Plans and System Asset Management Plans (SAMPs).
2. Review maintenance expenditure.
3. Catchment Sensitive Farming Officers working with land managers to promote Environmental Stewardship Schemes.
4. Sustainable agricultural practices promoted via production of Whole Farm Plans.
5. Environmentally Sensitive Area Agreements and Countryside Stewardship Agreements for landowners within the catchment.
6. Identify opportunities in the Teme for improving conditions for fish by removing obstructions in the Upper Teme through our River Severn Salmon Action Plans.
7. Review of current maintenance activities to reduce inappropriate weed control via co-operation with Natural England.
8. Contribute towards the realisation of UK and county biodiversity action plans including targets for wet grassland, reedbed and wet woodland habitats and local objectives for wetlands. This will be done via Strategic Asset Management Plans and Asset Management Plans.

9. Working with our strategic partners we wish to help implement and support the Shropshire & Borough of Telford & Wrekin Flooding Response Plan, the Herefordshire County Flood Plan, and the South Shropshire District Council Emergency Plan.
10. We wish to implement our own...Local Flood Warning Plan for Shropshire County & Borough of Telford & Wrekin.

Specific CFMP actions for the sub-area to help achieve the long term vision are:

- Better manage surface water through application of SuDS and through an integrated approach to flood risk management;
- To gain a more complete understanding of surface water and drainage related flooding so that any future improvements are part of a wider strategy for addressing these sources of flooding.
- To ensure that current maintenance operations are proportionate to risk and that they are the most suitable operations / activities for that location.
- Promote the uptake of resistant and resilient flood impact reduction measures.
- Promote sustainable drainage (SuDS) for new development and encourage retrofitting.
- Encourage land management practices that would deliver localised flood risk management benefits.

1.5.3 The Severn River Basin Management Plan (RBMP)

The Severn River Basin Management Plan was published in 2009 by the Environment Agency. In accordance with the Water Framework Directive, the RBMP contributes to the requirement of all countries throughout the European Union to manage the water environment to consistent standards. This plan focuses on the protection, improvement and sustainable use of the water environment.

The RBMP describes the river basin district, and the pressures that the water environment faces. It shows what this means for the current state of the water environment, and what actions will be taken to address the pressures as well as setting out what improvements are possible by 2015 and how the actions will make a difference to the local environment including the catchments, the estuaries and coasts, and groundwater.

This plan has been prepared under the Water Framework Directive, which requires all countries throughout the European Union to manage the water environment to consistent standards. Each country has to:

- prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- aim to achieve at least good status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;
- meet the requirements of Water Framework Directive Protected Areas;
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;

- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- contribute to mitigating the effects of floods and droughts.

Shropshire lies within the Shropshire Middle Severn Catchment Policy Unit, which is largely rural, however faces significant pressure for urban development.

Several relevant key actions are proposed to help address the key pressures across the catchment to help maintain the current level of water bodies achieving good ecological status over the plan period. These are listed below and could also have an impact on the surface water flood risks exhibited across the catchment:

- initiatives to provide advice to farmers under the England Catchment Sensitive Farming Delivery Initiative, and;
- investigations to assess the impacts of abstraction on the environment under the Restoring Sustainable Abstraction programme.

1.5.4 Preliminary Flood Risk Assessment

The PFRA for Shropshire was completed in May 2011. Church Stretton was not identified as a significant flood risk area as defined in the final PFRA guidance[5]. However, the PFRA did identify 'blue squares' (where >200 people, >20 non-residential properties or more than one item of critical infrastructure were affected in 1km²) within Church Stretton. Two blue squares within the study area were identified by the Environment Agency. The PFRA did not identify any new blue squares within the zone of the SWMP study area.

1.5.5 Level 1 Strategic Flood Risk Assessments[7] for the Former Shropshire Districts / Boroughs

In 2007, Halcrow was commissioned to undertake the Level 1 Strategic Flood Risk Assessments (SFRAs) for each of the five former district and borough councils within Shropshire (Tier 2 local authorities) to help inform the Local Development Plan for the former Shropshire County Council. The study focused on the main market towns within the council area including Church Stretton; the issues identified are expanded below.

Church Stretton, included in the former South Shropshire District Council SFRA

Church Stretton lies at the headwaters of the Quinny Brook and Cound Brook and therefore the Environment Agency's national flood maps had not identified the extent or route of fluvial flooding since the catchment areas were less than 3 km^2. Therefore, there were no defined flood zones within Church Stretton.

To resolve this issue, historical evidence and a visual walkover was used to help define the extent of Flood Zone 3 for Quinny Brook and Cound Brook. While this was an appropriate approach for a strategic level assessment, it is clearly an issue that should be addressed by detailed localised modelling studies of the watercourses.

1.5.6 Shropshire Outline Water Cycle Study[8]

An outline Water Cycle Study (WCS) for Shropshire was completed by Halcrow in June 2010. In terms of fluvial flood risk, Church Stretton was classified as 'red' signalling that flood risk is a constraint to the current settlement. A key requirement of the WCS was to identify locations at

greater risk of surface water flooding within the county to inform the development of a surface water policy for the county.

The Environment Agency AStSWF map (see Section 3.2.1 for further details) was used in conjunction with information from the Level 1 SFRA and the River Severn CFMP. County wide mapping was undertaken to identify the SuDS suitability in any given location. The key findings for Church Stretton are summarised in Table 1-2.

Type	Flood Risk
Fluvial Flood Risk	Settlement affected by Flood Zones 2 and 3; the head waters of the Cound Brook and the Onny flow from the settlement and large parts of valley floor are known to flood during the winter. Combination of pluvial and fluvial flooding
Surface Water Flood Risk	Church Stretton was identified as a settlement with high susceptibility for surface water flooding; over 15% of the existing settlement is shown to be affected by the AStSWF map.
Surface Water Flood Risk	Church Stretton has 0.2 historic incidents (ditch and drain blocked) per hectare which ranks it ninth for historic incidents in Shropshire.
Surface Water Runoff	During the winter, large parts of the valley floor, particularly to the south of the town can flood. Combination of pluvial and fluvial flooding
SuDS Suitability	Highly varied permeability and presence of SPZ1 to the west of the settlement means the types of SuDS will depend heavily on development location.

Table 1-2 Findings from the Shropshire Water Cycle Study[9]

Overall, the WCS recommended that for Church Stretton:

- Further assessment should be undertaken to determine the overall risk of flooding and to identify options for mitigating this risk, taking into consideration future development
- A SWMP should be produced which assesses existing surface water flood risk and strategically plans the provision of drainage for all new development
- SWMPs should focus on risk management and optimising the provision of strategic and sustainable surface water drainage infrastructure (SuDS). They should also take account of the risks of surface water and sewer flooding and the interactions with fluvial flooding.

Shropshire Council has also received communication from local residents highlighting their concerns about flooding in Church Stretton. Church Stretton is therefore taken forward from the strategic assessment phase to the intermediate assessment phase.

1.5.7 Local Development Documents (LDD)

LDDs including the Core Strategy, Development Planning Documents, Supplementary Planning Documents and relevant Area Action Plans (AAPs) will need to reflect the results from this SWMP. This may include policies for the whole borough or for specific parts of boroughs, for example the 'Wetspot' areas. There may also be a need to review Area Action Plans where surface water flood risk is a particular issue. Any future updates to the SFRA will assist with this as will the reviewed RFRA.

1.5.8 Local Flood Risk Management Strategies

The Flood and Water Management Act 2010 (FWMA) requires each LLFA to produce a Local Flood Risk Management Strategy (LFRMS). Whilst this report is not actually a LFRMS, the SWMPs, PFRAs and their associated risk maps will provide the necessary evidence base to

support the development of LFRMS. No new modelling is anticipated to produce these strategies.

The schematic diagram below (Figure 1-2) illustrates how the CFMP, PFRA, SWMP and SFRA link to and underpin the development of a Local Flood Risk Management Strategy.

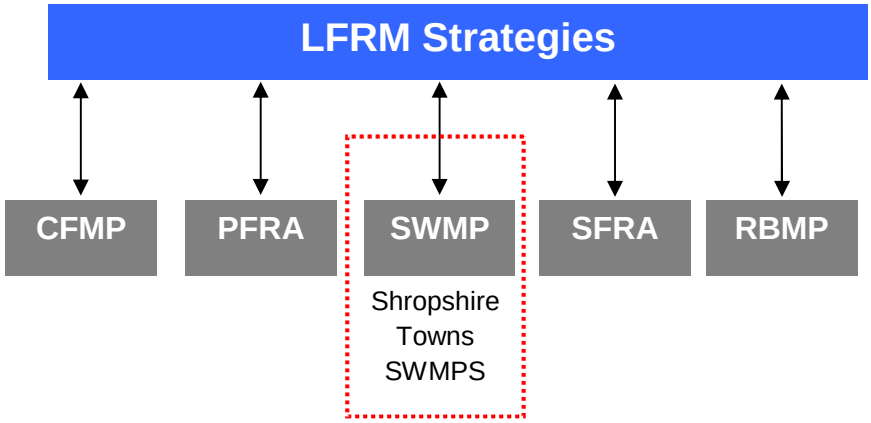


Figure 1-2 Supporting studies used to develop a Local Flood Risk Management Strategy

1.6 Existing Legislation

1.6.1 Flood Risk Regulations 2009

The Flood Risk Regulations 2009 (FRR) transpose the European Floods Directive 2007/60/EC into English and Welsh law. The Regulations bring together key partners to manage flood risk from all sources and in doing so reduce the consequences of flooding on key receptors. Local authorities are assigned responsibility for management of surface water flooding.

As part of the ongoing cycle of assessments, mapping and planning, the FRR required the undertaking of a 'Preliminary Flood Risk Assessment'. National guidance was published by the Environment Agency initially as a 'living draft' in July 2010 which was subsequently replaced by the final guidance issued in December 2010[9].

The Regulations require three main types of assessment / plan:

1 Preliminary Flood Risk Assessments (maps and reports for Sea, Main River and Reservoirs flooding) to be completed by Lead Local Flood Authorities and the Environment Agency by the 22 December 2011. Flood Risk Areas, at potentially significant risk of flooding, will also be identified. Maps and management plans will be developed on the basis of these flood risk areas.

2 Flood Hazard Maps and Flood Risk Maps. The Environment Agency and Lead Local Flood Authorities are required to produce Hazard and Risk maps for Sea, Main River and Reservoir flooding as well as 'other' relevant sources by 22 December 2013.

3 Flood Risk Management Plans. The Environment Agency and Lead Local Flood Authorities are required to produce Flood Risk Management Plans for Sea, Main River and Reservoir flooding as well as 'other' relevant sources by 22 December 2015.

The PFRA, now complete, confirms that Church Stretton required further more a detailed, local investigation. This is due to the number of people and businesses identified as being at risk of local flooding within the town. National datasets were used for the PFRA process.

1.6.2 Flood and Water Management Act 2010

The Flood and Water Management Act 2010 (FWMA) presents a number of challenges for policy makers and the flood and coastal risk management authorities identified to co-ordinate and deliver local flood risk management (surface water, groundwater and flooding from ordinary water courses). 'Upper Tier' local authorities have been empowered to manage local flood risk through new responsibilities for flooding from surface and groundwater.

The FWMA reinforces the need to manage flooding holistically and in a sustainable manner. This has grown from the key principles within Making Space for Water (Defra, 2005) and was further reinforced by the summer 2007 floods and the Pitt Review (Cabinet Office, 2008). It implements several key recommendations of Sir Michael Pitt's Review of the Summer 2007 floods, whilst also protecting water supplies to consumers and protecting community groups from excessive charges for surface water drainage.

The FWMA must also be considered in the context of the EU Floods Directive, which was transposed into law by the Flood Risk Regulations 2009 (the Regulations) on 10 December 2009. Figure 1-3 illustrates how this SWMP fits into the delivery of local flood and coastal risk management, and where the responsibilities for this lie.

1.6.3 Planning Policy Statement 25

Planning Policy Statement 25 (PPS25) requires that new development should not increase flood risk; a SWMP will support this by informing the Local Planning Authority (LPA) of areas at risk of surface water flooding and developing policy for new development.

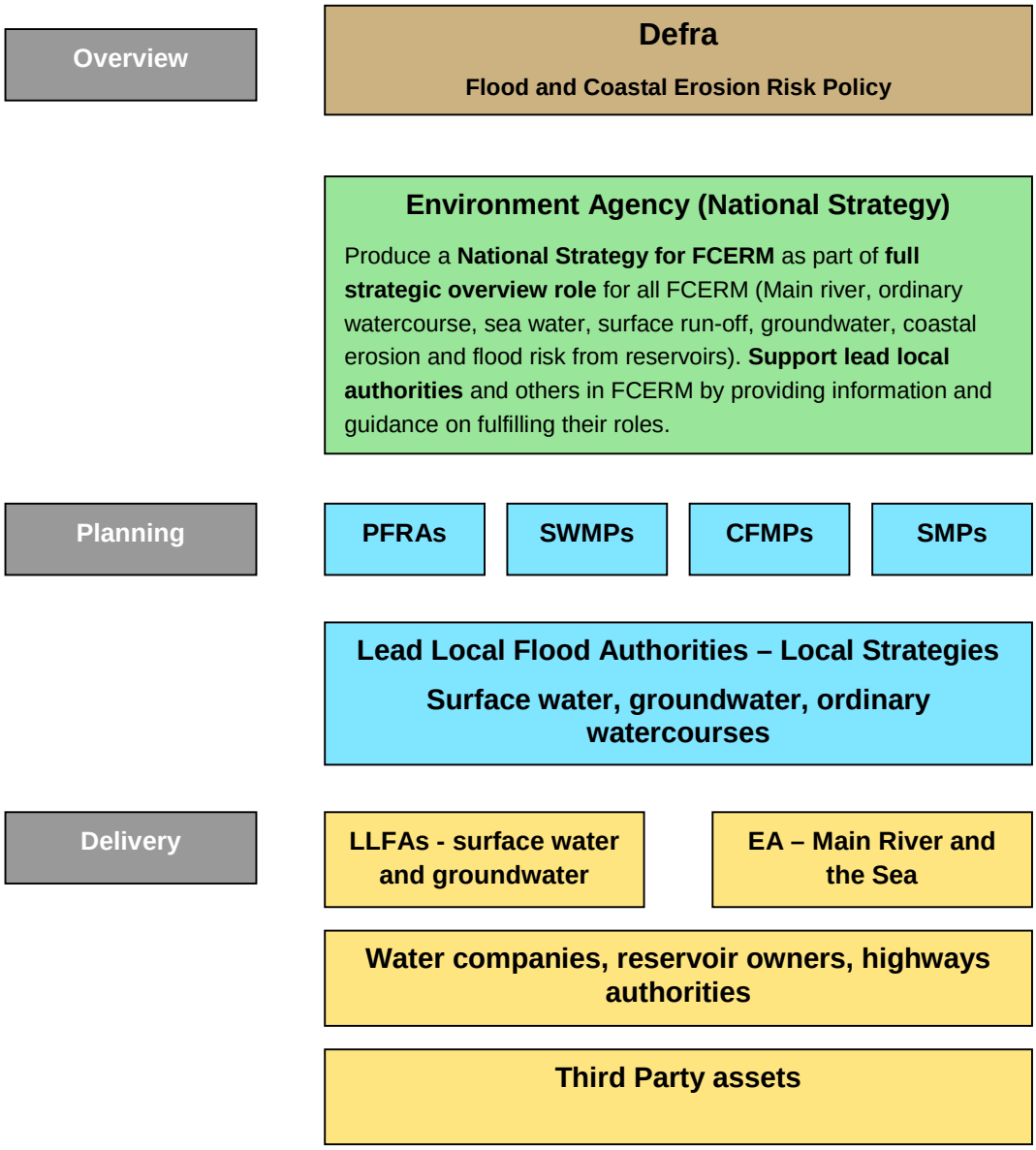


Figure 1-3 Local Flood Risk and Coastal Management Responsibilities

1.7 Sustainable Drainage Systems (SuDS)

Throughout this report, reference is made to SuDS. SuDS encompass a range of techniques which aim to mimic the natural processes of runoff and infiltration as closely as possible. SuDS schemes should be based on a hierarchy of methods termed the 'SuDS management train' as illustrated in Figure 1-4.

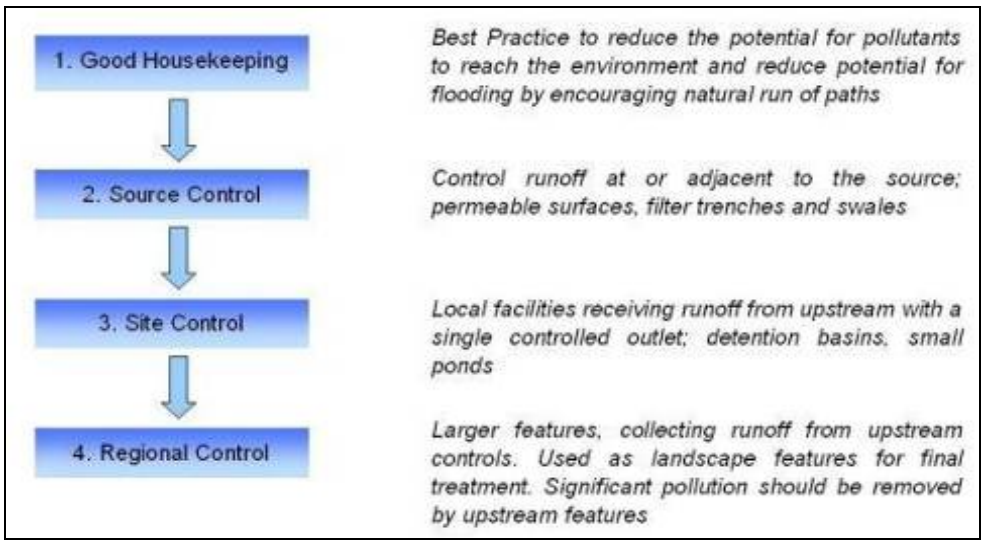


Figure 1-4 SuDS Management Train

CIRIA Report C522 (Sustainable Urban Drainage Systems – Design Manual for England and Wales, 2000) suggests an approach for setting the level of treatment that surface water runoff should pass through before being discharged. It recommends that the management of surface water runoff should use a combination of site specific and strategic SuDS measures, encouraging source control where possible to reduce flood risk and improve water quality. Table 1-3 describes some of the SuDS techniques considered in the development of the SWMP

Type	Description
Balancing Pond	A pond designed to attenuate flows by storing runoff during the peak flow and releasing it at a controlled rate during and after the peak flow has passed. The pond always contains water. Also known as wet detention pond.
Detention Basin	A vegetated depression, normally dry except after storm events constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground
Filter Strip	A vegetated area of gently sloping ground designed to drain water evenly off impermeable areas and filter out silt and other particulates.
Green Roof	A roof with plants growing on its surface, which contributes to local biodiversity. The vegetated surface provides a degree of retention, attenuation and treatment of rainwater, and promotes evapotranspiration. (Sometimes referred to as an alternative roof).
Infiltration Basin	A dry basin designed to promote infiltration of surface water to the ground.
Road Side Rain Garden	Reversing historical trends in developing impermeable front gardens to green open areas to help attenuate flows at a property level and improve and link habitats.
Permeable Surface	A surface formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration of water to the sub-base through the pattern of voids, e.g. concrete block paving.
Rainwater Harvesting	A system that collects rainwater from where it falls rather than allowing it to drain away. It includes water that is collected within the boundaries of a property, from roofs and surrounding surfaces and re-used within the property.
Swale	A shallow vegetated channel designed to conduct and retain water, but may also permit infiltration; the vegetation filters particulate matter

Table 1-3 SuDS Techniques (source Ciria[10])

SuDS techniques can be divided into two main groups; infiltration based or attenuation based. Infiltration based SuDS facilitate the discharge of water directly into the ground through soil and rocks; this is only possible where the underlying geology is permeable enough to allow the passage of water downwards. Attenuation based SuDS retain water on a site and allow it to discharge at a prescribed and controlled rate into a watercourse or sewer.

1.8 Geographic Extents

Define the geographic extent of the report and relate to the relevant river basin district and relevant maps

This SWMP has been undertaken for the town of Church Stretton, it's location within the county is shown in Figure 1-5.

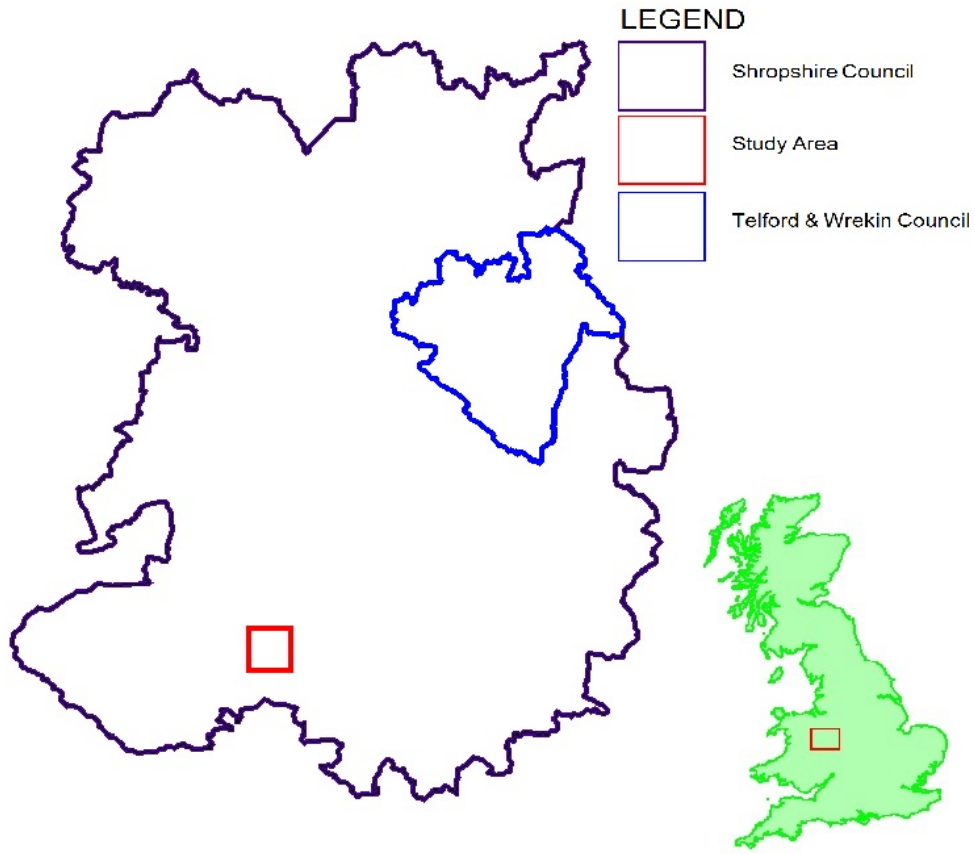


Figure 1-5 Church Stretton SWMP Study Area

Church Stretton is located within the Severn River Basin District and is served by one Water and Sewerage Company – Severn Trent Water. The study area is served by the Environment Agency Midlands West Region and is part of the Midlands Regional Flood and Coastal committee.

Church Stretton is a small historic market town situated between Shrewsbury and Ludlow. It is predominantly residential, with a small commercial centre, industrial area to the east and is surrounded by farmland. The Church Stretton study area includes the higher lands of the Long Mynd to the west and Ragleth Hill, Hazler Hill, Hope Bowdler Hill and Caer Caradoc Hill to the east.

Ash Brook, an ordinary watercourse, flows from west to east off the Long Mynd through Carding Mill Valley. Downstream of Shrewsbury Road it is known as the Cound Brook, an Environment

Agency classified Main River, which then flows north easterly along the route of the A49, towards its confluence with the River Severn near Eyton on Severn.

The Marsh Brook flows from a similar source on the Long Mynd before turning to the south in Church Stretton (locally known as World's End or Quinny Brook) before flowing to the south and joining the River Onny. The March Brook is Environment Agency classified main river downstream of the culvert through the town. The Church Stretton study area is shown in Figure 1-6.

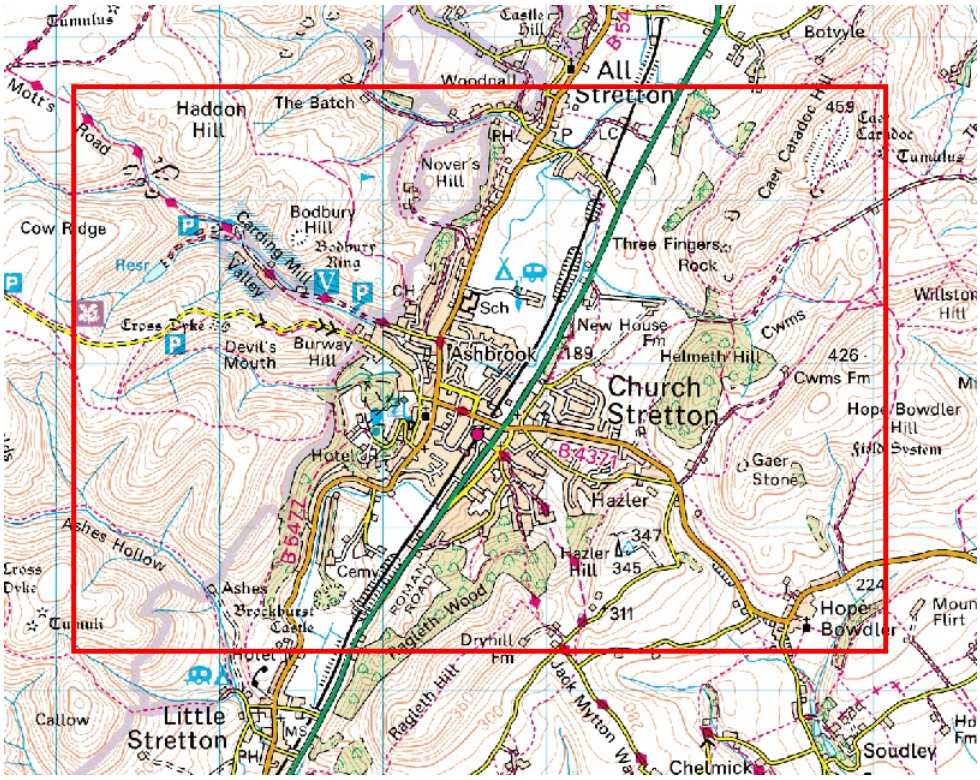


Figure 1-6 Church Stretton Study Area (c) Crown copyright and database rights 2011 Ordnance Survey 100049049

1.9 Methodology

The methodology used to carry out this SWMP follows the advice set out in the Defra SWMP guidance as shown in Figure 1-7. Further details on the methodology are discussed throughout the report in the relevant sections.

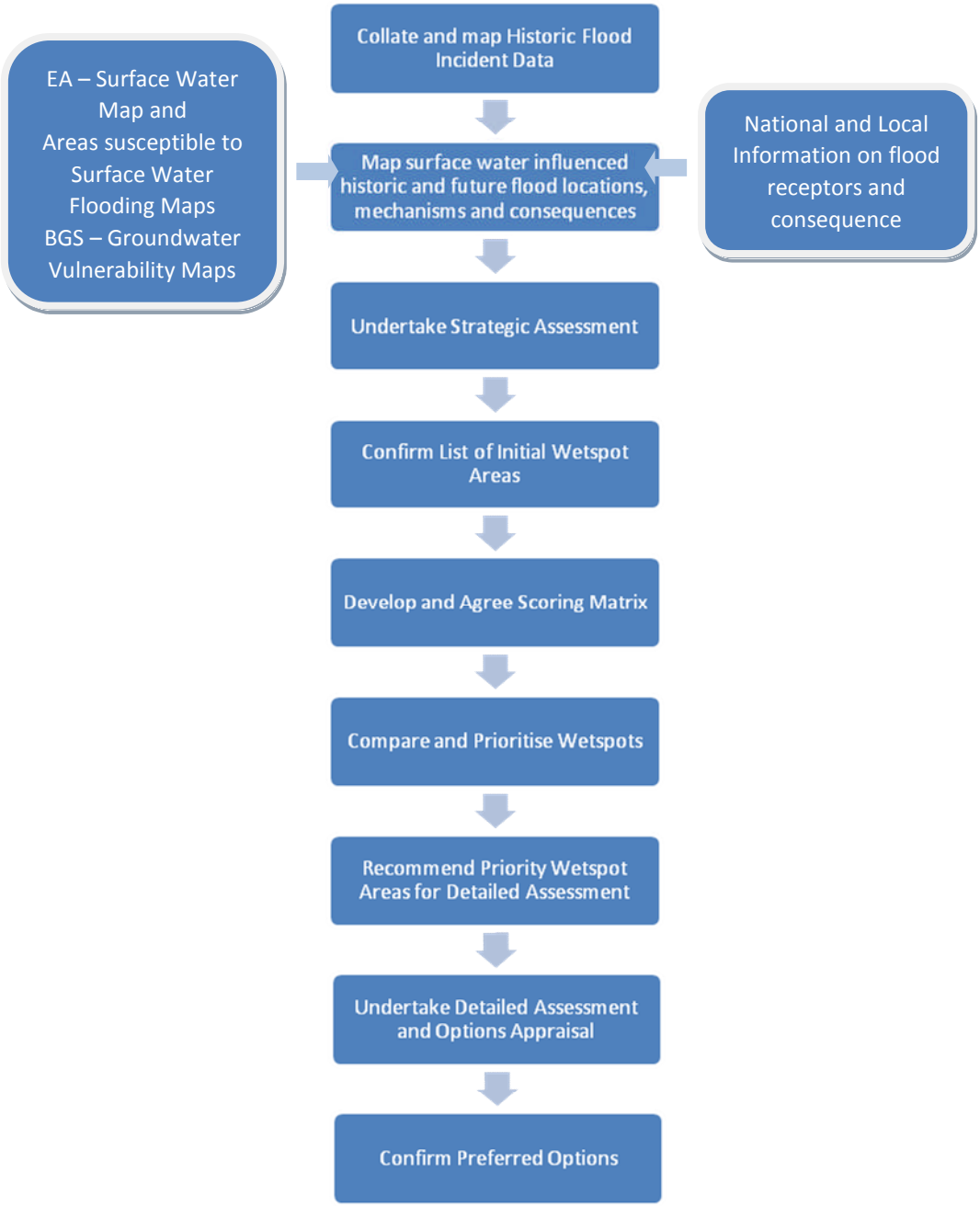


Figure 1-7 Overall Approach to Study Methodology

The specific methodology adapted for this study is further explained in Sections 2 to 5.

2 Phase 1 – Preparation

2.1 Need for SWMPs in Shropshire

Preparation Phase; Identify the need for a SWMP study

2.1.1 National Settlement Ranking

In 2009, Defra allocated £16 million of funding for Local Authorities to address flood risk. As part of the funding process, Defra ranked 4,350 settlements in England with regard to their susceptibility to surface water flooding. The data used for the assessment was based upon the first generation surface water flood maps (AStSWF) produced by the Environment Agency.

The top 77 ranked settlements were each given a share of the funding. Shropshire Council did not receive any Defra funding and therefore made a decision to fund SWMPs internally. The top ten settlements in Shropshire, out of a total of 41 listed within the county, are shown below; Church Stretton is ranked seventh.

Country-wide Settlement Rank	Settlement Name	Estimated Properties at Risk
213	Shrewsbury	1600
383	Oswestry	820
457	**Shifnal**	**660**
577	**Craven Arms**	**480**
701	Wem	350
803	Ludlow	280
811	**Church Stretton**	**270**
1020	Bridgnorth	190
1198	Market Drayton	140
1201	Albrighton	140

Table 2-1 Top ten settlements at risk from surface water flooding in Shropshire, based on first generation AStSWF map (source Defra)

2.2 Partnerships

Preparation Phase; Establish Partnerships

The formation of partnerships has an important role in the undertaking of a SWMP, and is required under Defra's SWMP guidance documentation. The SWMP guidance details the identification of those partners / organisations that should be involved and what their roles and responsibilities should be.

It recommends the formation of an engagement plan, which should include objectives for the individual partners, and detail how and at what stages of the SWMP the engagement with stakeholders should take place.

The following sections describe the partners, their roles and responsibilities and their objectives as required by the SWMP guidance.

2.2.1 Partners

Partners are defined as those with responsibility for decisions or actions regarding surface water management. In Shropshire, these are:

- Shropshire Council (SC)
- Severn Trent Water (STW)
- Welsh Water Dwr Cymru (WW)
- Environment Agency (EA)

2.2.2 Roles and Responsibilities

The roles of the partner organisations are set out below.

SC, as the Lead Local Flood Authority has a number of specific responsibilities:

- to lead and co-ordinate the delivery of the relevant Pitt Review recommendations;
- to ensure a consistent approach in the management of current and future flood risk issues in the borough;
- to fulfil any new duties arising from the FWMA when enacted; and
- to coordinate the delivery of actions arising from the EU Floods Directive and FRR.

In conjunction with these, SC and the other partner organisations have further responsibilities to share relevant information and co-operate to facilitate the management of flood risk.

STW and WW are water and sewerage undertakers for the SC area and have a statutory obligation to supply water and wastewater services to their customers. STW currently has the responsibility to effectually drain the Church Stretton area and maintain the public sewerage network[11].

The EA is a non-departmental public body and has responsibilities for protecting and enhancing the environment as a whole (air, land and water) and contributing to the government's aim of achieving sustainable development in England and Wales. Following the Pitt review of the 2007 Floods and the Flood and Water Management Act 2010, the EA was given the strategic overview role for the management of all types of flooding, including the management of surface water.

2.2.3 Stakeholders

Stakeholders are defined as those affected by, or interested in, a problem or solution relating to surface water management. In Shropshire, it is anticipated at this stage that the following additional stakeholders are involved in, or will become involved in, the SWMP:

- Flood forums

- Residents
- Highways Agency
- Network Rail

As the SWMP develops, it is possible that other stakeholders will be identified and become involved; these organisations will be highlighted in future reports and outputs as required.

2.3 Data Collection

Preparation Phase; Identify Availability of Information

The collection and collation of strategic level data was undertaken during this Scoping/Screening study. Data was collected from each of the following organisations:

- Shropshire Council
- Environment Agency
- Highways Agency
- Natural England
- Severn Trent Water

A list of the data provided by stakeholders to date is below.

Stakeholder	Information Provided	
	Publicly Available	Not Publicly Available
Shropshire Council	Former South Shropshire District Council SFRA – Level 1 (2007); Shropshire Core Strategy Final Plan (2010), Outline Water Cycle Study (2010)	Ordinary watercourses, critical infrastructure (fire stations, schools etc), historical flooding locations, transport infrastructure, Administrative boundaries, OS 10k and 50k Mapping, OS Master Maps
Environment Agency	River Severn Catchment Flood Management Plan, River Severn River Basin Management Plan	National Receptor Databases, historical and modelled flood event outlines, main rivers, detailed river network, modelled flood outlines for surface and fluvial sources, LiDAR
Highways Agency		Drawings of drainage assets (where available) for several main highways across the county
Natural England	SACs, SSSIs, SPAs, Ancient woodland, LNRs, NNRs, RAMSARs, woodland, agricultural land classifications	
Severn Trent Water		Sewerage networks, asset information, DG 5 Register

Table 2-2 Stakeholders contacted and the information provided

The documents and anecdotal evidence provided by SC provided the main source of information on local flood risk used within this SWMP. The two SFRAs and the WCS were completed within the last 5 years and have been reviewed and approved by SC and the

Environment Agency. This suggested that these were reliable sources to use to establish the main local flood risk areas across Church Stretton.

2.3.1 Data Review

The SWMP guidance highlights the importance in understanding the quality of the data in order to inform the later stages of the SWMP. Therefore, data incorporated into the data registers was assigned a quality score between one and four based on a high level assessment:

1 Best Possible

2 Data with known deficiencies

3 Gross assumptions

4 Heroic assumptions

2.3.2 Data Use & Licensing

A number of datasets used in the preparation of this SWMP are subject to licensing agreements and use restrictions.

The following national datasets provided by the Environment Agency are available to local authorities and their consultants for emergency planning and strategic planning purposes:

- Flood Map for Rivers and the Sea
- Areas Susceptible to Surface Water Flooding
- Flood Map for Surface Water
- National Receptor Database

A number of the data sources used are publicly available documents, such as:

- Strategic Flood Risk Assessments
- Catchment Flood Management Plan

The use of some of the datasets made available for this SWMP has been restricted and licensed to SC for use under the Shropshire Towns project, which includes the production of this SWMP. The restricted datasets include records of property flooding held by the Council and by Severn Trent Water, and data licensed by the Environment Agency.

Necessary precautions must be taken to ensure that, where it is permitted, all information given to third parties is treated as confidential. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

2.4 Much Wenlock Integrated Urban Drainage Management Plan

Shropshire Council in conjunction with the Environment Agency and STW, and supported by Much Wenlock Town Council and the Much Wenlock Flood Action Group, undertook a study into the flooding issues affecting Much Wenlock. The aim of the work was to provide a plan that will appropriately reflect the known flooding issues and suggest the most suitable ways to reduce their impact; the preferred options were then short listed. This work has resulted in the formation of working partnerships between stakeholders which can then be built upon.

2.5 Scope the SWMP

Preparation Phase; Scope the SWMP Study

2.5.1 Objectives

The objectives of the Church Stretton SWMP overall are to:

- Develop a robust understanding of surface water flood risk in and around the study area, taking into account the challenges of climate change, population and demographic change and the potential for increasing urbanisation in Church Stretton;
- Identify, define and prioritise 'wetspots' (areas considered to be at risk of flooding), including further definition of existing local flood risk zones and mapping new areas of potential flood risk;
- Establish and consolidate partnerships within Shropshire between key drainage stakeholders to facilitate a collaborative culture of data, skills, resource and learning sharing and exchange, and closer coordination to utilise cross boundary working opportunities;
- Make holistic and multifunctional recommendations for surface water management which improve emergency and land use planning, and enable better flood risk and drainage infrastructure investments in the study area;
- Undertake engagement with stakeholders to raise awareness of surface water flooding, identify flood risks and assets, and agree mitigation measures and actions; and
- Deliver outputs through a robust Action Plan and guidance that will help deliver change on the ground rather than just reports and models, whereby partners and stakeholders agree to commit to delivery and maintenance of the recommended measures and actions.

2.5.2 Public Engagement

Some members of the public have valuable information to contribute to the SWMP and to help improve the understanding and management of local flood risk within the study area and are currently engaged through the works included within the local Flood Forums lead by SC.

Public engagement provides significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the probability of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

However, it is also recognised that it is crucial to plan the level and timing of engagement with communities predicted to be at risk of flooding from surface water, groundwater and ordinary watercourses. This is to ensure that the potential for future management options and actions is adequately understood and costed without raising expectations before solutions can reasonably be implemented. All stakeholders should agree the level of detail that should be made generally available to the public prior to its publication.

It is important to undertake some public engagement when formulating local flood risk management plans (including LFRM Strategies) as this will help to inform future levels of public engagement. It is recommended that SC follow the guidelines outlined in the Environment

Agency's "Building Trust with Communities" which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

2.6 Phase 1 Summary

Phase 1 of the SWMP has:

- Engaged key stakeholders including the Environment Agency, Severn Trent Water, and Shropshire Council, to discuss and agree on local flood risk management within Church Stretton in the future;
- As part of the first phase of Shropshire Towns SWMPs, a local flood risk partnership working approach across Shropshire was engaged for managing local flood risk in the future, and;
- Collected and reviewed flood risk data and knowledge from key stakeholders and partner organisations.

3 Phase 2 – Risk Assessment

3.1 Strategic Level Assessment

Risk Assessment Phase; Undertake a Strategic Assessment

The first stage of the SWMP risk assessment phase, as defined by Defra guidance, is the strategic assessment. A strategic level assessment identifies broad locations which are considered to be more or less vulnerable to surface water flooding and is valuable at the county level. This then informs the locations requiring an intermediate assessment.

The strategic assessment phase was undertaken by Shropshire Council, prior to the commissioning of this report, through the SFRA, WCS, national ranking from Defra and the likely level of future development. The SFRA and WCS reviewed available data and both highlighted the requirement to provide a SWMP for Church Stretton. Further discussion on these is given in Section 1.5.

3.1.1 Asset Register

The FWMA requires all LLFAs to maintain a register of structures or features which they consider have a significant effect on flood risk in their area. It is recommended that Shropshire Council is the custodian of this asset data and through this role is responsible for coordinating the maintenance of the databases / registers.

To ensure that the databases remain current and thus useful, all partners should be assigned the responsibility for providing updates to their assets in GIS format (at least on a yearly basis). There are two main options for keeping these databases current;

1 The data custodian at SC receives updated data and alters it on the local system

2 All partners have access to a web enabled interface which allows individual organisations to update their data

Currently SC have commenced works on collating information on assets into an internal GIS based Asset Register, which is aimed primarily at capturing all the 'readily available information'. With this information in place, SC will be able to identify what additional data is required to meet the current requirements under the FWMA. The information being collated currently and entered into the register includes:

- Received As Built information
- Historical Records
- Information collated during routine site inspections.

3.1.2 Flood Incident Register

Shropshire Council maintains a list of all flooding incidents as reported by residents. The register lists the date reported and the incident address, along with a source of the flooding from one of the following categories:

- Ditch – blocked
- Drain – blocked
- Flood

- Water standing

Those designated as “flood” have been used in the identification of wetspots, as discussed further below. In addition, anecdotal evidence from the local flood forum is also maintained in digital format.

A similar principle to the asset database can be applied to the incident database although a web based system would facilitate the entering of event data at the time thus making it a highly useful repository for historical flood information.

3.2 Intermediate Assessment

Risk Assessment Phase; Undertake Intermediate Assessment

3.2.1 Surface Water Flooding

Introduce the local sources of flood risk being considered for past floods and possible future floods.
Assess past floods which had significant harmful consequences for human health, economic activity, cultural heritage and the environment.

This chapter sets out the evidence base used to inform the intermediate risk assessment and covers occurrences of historical flooding, work previously carried out to assess future flooding and existing maintenance regimes.

Overview

The definition of surface water flooding is given in section 1.4.2. For Church Stretton surface water runoff occurs as a result of high intensity rainfall causing water to pond on or flow over the ground surface before entering an underground drainage network or watercourse, or when water cannot enter the network due to insufficient capacity.

In these conditions surface water builds up locally where ground terrain is flat and then would travel following prevailing terrain gradients. Surface water flooding then occurs at locations where surface water flow paths converge, at local dips in the ground and/or due to overland obstructions.

Surface water flooding may in some cases, be exacerbated by the misuse of the below ground infrastructure (for example partial of full blockages resulting from the accumulation of fats, oils and greases within the sewer network) or the failure of infrastructure.

No single organisation has overall responsibility for surface water flooding with responsibility for different aspects of the drainage systems (watercourses, drains and sewers) falling to the Highway Authority (in this case SC), Severn Trent Water and riparian owners.

Local Reports of Historical Flooding

The following sections outline the historical surface water flooding recorded in Church Stretton within the context of the definition given in Section 1.4 of this report. The following sources of flooding have been considered.

- Surface Water Flooding
- Groundwater Flooding

- Sewerage Flooding
- Open Channel / Culverted Watercourse Flooding
- Flood Risk from the Urban Rural Fringe
- Overland flows from Groundwater sources

This report is based on the information supplied by partners up to September 2010; the occurrence of surface water flooding is not static and thus this represents an understanding of the situation as of then. A data quality score was assigned in line with Table 3-1 of the SWMP guidance. In this case all data has been tagged as '2' which is data with known deficiencies, indicating that further work could be undertaken to improve the data set. Table 3-1 details the sources of historic flooding data.

Data	Source	Information Included	Data Quality Score
Historic Flooding Hotspots	EA, SC	Locations of flooding	2
Flood Forum Datasets	Data from SC Flood Forum meetings attended by Church Stretton Town Council	Locations of flooding and interpretations of cause and effects	2
SFRA Shape files	EA, SC	All sources of flooding available at SFRA publication (including Historical Fluvial events)	2
Floods Database	Severn Trent Water Limited	Sewer Flooding (to 2010) –	2

Table 3-1 Summary of historic data set types received

Parts of Church Stretton are known to experience problems of surface water flooding. The sustainable management of surface water is therefore important through the use of SuDS.

Locations of historical surface water runoff occurrences were provided by a number of sources, including Shropshire Council and the Environment Agency. There are a number of reported incidences of surface water flooding in Church Stretton. The majority of the reports attribute flooding to blockages of the surface water drains. For example on Essex Road, a resident commented subjectively that 'flooding always happens when we have heavy rain due to the road not being swept and cleaned properly'. While there could be a maintenance issue at this location, other reported incidents have not presented any information about the possible mechanism of flooding. Therefore it is possible that they are either maintenance issues or are related to undersized sewer capacity / rarity of the runoff volume.

On both Hazler Road and Sandford Avenue, there are reported incidences of 'flooding' or 'standing water'. It is believed this flooding is caused by a small watercourse which flows at the rear of the properties on both these roads. The watercourse then emerges onto Hazler Road where it is then culverted. Similar reports have also been made at the junction of Sandford Avenue (B4731) and Watling Street South.

It must be noted that, due to the nature, type and quantity of this data, it cannot be deemed to be overly comprehensive and as such it is impossible to verify its accuracy. It is suggested that this information is used as a guide only to areas that have suffered flooding from all sources, not as a surrogate for historical information being an indicator of vulnerability to flooding

Environment Agency Areas Susceptible to Surface Water Flooding (AStSWF) Maps

The Environment Agency produced the outputs of a simple surface water flood modelling exercise at a national scale. The modelling did not take into account underground sewerage and drainage systems or smaller over ground drainage systems. No buildings were included and a single rainfall event was applied. The model parameters used to produce the maps were:

- 0.5% AEP (1 in 200 chance of occurring in any given year)
- 240 minute storm duration
- 1km² resolution
- No allowance for underground pipe network
- No allowance for infiltration

The AStSWF map gives three bandings indicating areas which are 'less', 'intermediate' and 'more' susceptible to surface water flooding. The map is not suitable for identifying individual properties at risk of surface water flooding.

These maps were updated and republished in January 2009.

Environment Agency Flood Map for Surface Water (FMfSW)

Following on from the release of the Areas Susceptible to Surface Water Flooding, The Environment Agency updated the original mapping in order to produce the Flood Map for Surface Water (FMfSW), which was released in October 2010. The existing map was updated to take account of buildings and the underground drainage system, and more storm events were analysed. The model parameters used to create these new maps were:

- External Publication Scale 1:25,000
- 3.33% AEP (1 in 30 chance of occurring in any given year) and 0.5% AEP (1 in 200 chance of occurring in any given year)
- 66 minute storm duration
- 5m² resolution with country split into 5km squares
- Adjustment of 12mm/hr to take into account underground drainage network capacity
- In rural areas, rainfall was reduced to 39% to represent infiltration
- In urban areas, rainfall was reduced to 70% to represent infiltration
- Global use of Mannings 'n' of 0.1 for rural and 0.03 urban areas

The new maps have two bandings of "deep" or "shallow" and are produced for both 3.3 % AEP (1 in 30 annual chance of occurring in any given year) and 0.5% AEP (1 in 200 chance of occurring in any given year) events.

Summary of Results

As a result of the National Surface Water modelling undertaken (ASTSWF and FRMfSW) the following mechanisms of flooding were identified:

- Ponding of flow in topographical depressions.
- Ponding upstream of structures with small underpasses/subways
- Overland flow along topographical lows and valley channels such as residential streets, gardens and through property

The surface water modelling was validated through a comparison of the FMfSW shallow and deep outlines, Areas Susceptible modelling and the historic flood incidents to establish if there was a correlation between the mapped areas identified at risk.

The mapping did not correspond with all of the historic flood incidents, however it may be that the source and location of the exact flood incident has not been accurately reported or recorded in the past.

3.2.2 Fluvial Flooding

Watercourses are designated as either Main Rivers or Ordinary Watercourses. Responsibility for the maintenance of all watercourses ultimately lies with the owner of the land through which they pass.

Main Rivers are designated by Defra and are generally the larger river and streams, along with some smaller watercourses that have local significance. The Environment Agency is the managing authority for Main Rivers and they are, currently, the only watercourses that the EA can provide flood warning and protection for. There is no specific requirement for this SWMP to investigate flooding from main rivers, unless there is clear evidence of interactions with surface water.

Ordinary Watercourses are all rivers, streams, ditches and drains that have not been designated as main rivers. Shropshire Council, as the Land Drainage Authority, is the managing authority for ordinary watercourses.

The Church Stretton study area contains two Main Rivers; Cound Brook and Marsh Brook, and a number of ordinary watercourses. There have been a number of high return period rainfall events that have resulted in localised flooding from the watercourses. Landowners, particularly in urban areas, are often unaware of their responsibilities for the maintenance of watercourses as riparian owners. Additionally, landowner erected structures have encroached into the natural floodplain and have resulted in the channel becoming compromised. Of particular concern is the risk of blockage of the channels where they pass under roads or the railway at the bottom of the valley. In 2000, the railway line was flooded, which resulted in the line being closed for some time and the signal box being removed from the station.

In December 2006, flooding was reported from Ash Brook in Carding Mill Valley, just upstream of the houses between Carding Mill Valley Road and Longhills Road. The upstream property was badly affected and overland flow occurred down Carding Mill Valley road. However, this location has been subject to flooding in the past (1953, 1978 and in the summer of 2007), and upstream of the site a sediment trap was installed to reduce the sediment load during storm events which had been blocking the channel. An added impact at this location is the construction of boundary fences across the channel which can act as barriers to flow during storm conditions.

In the summer of 2007, Town Brook experienced out-of-bank flooding at Greenhills, close to the point at which the B5477 becomes the B4370. The flooding, illustrated in Figure 3.1 below, was mainly confined to the waterlogged fields either side of Cemetery Road, just off the main road. However, there are properties backing onto these fields which could be affected by more extreme flood events. It is thought that the flooding results from a combination of poor channel maintenance leading to both a reduction in channel capacity and blockages in culverts. It should be noted, however, this area is within the flood plain of the Town Brook. The EA has undertaken strategic maintenance along this stretch of the watercourse to improve the channel's capacity.

Figure 3.2 identifies the watercourses and flooding locations.

Figure 3-1 Flooding at Greenhills, Church Stretton, 2007

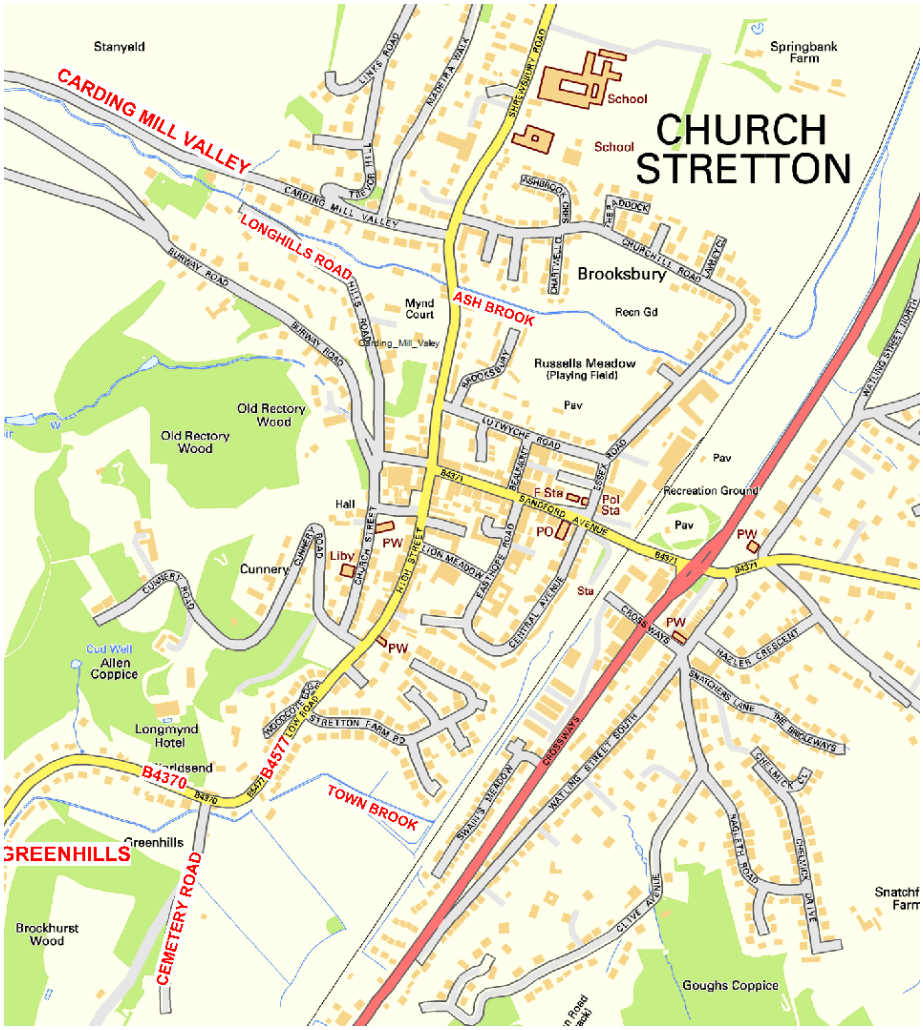


Figure 3-2 Watercourses and Flooding Locations in Church Stretton

3.2.3 Groundwater Flooding

A groundwater flood event results from a rise in the groundwater level sufficient for the water table to intersect with the ground surface and inundate low lying areas or unlined basements in buildings. Common mechanisms include:

- prolonged rainfall that causes the water table to rise in unconfined aquifers, usually when antecedent groundwater levels are high (most common in upper reaches of chalk catchments within the UK)
- lateral flow through river banks (particularly raised embankments) into low lying areas as river levels rise
- blockage of groundwater flow routes (such as by a hard defence) which artificially raises the water table

In terms of groundwater flooding sources, the upper catchments of both Ash Brook and Town Brook are moderately permeable (the FEH CD-ROM reports their base flow indices to be over 0.7). This means that following prolonged rainfall (during which a high proportion of water rapidly soaks into the ground), the catchment can become saturated resulting in rapid runoff.

The management of groundwater flooding is responsibility of the LLFA. However, there have been no recorded instances in which the water table has risen resulting in overland flow and subsequent flooding of property. The lower catchments of these watercourses are less permeable, and there have been no known recorded instances of groundwater levels rising above property thresholds and causing flooding / damage.

BGS Groundwater Vulnerability Maps

Groundwater flood risk has been assessed by the British Geological Survey (BGS) for the whole country via national flood hazard maps. The groundwater flooding susceptibility data shows the degree to which areas of England, Scotland and Wales are susceptible to groundwater flooding on the basis of geological and hydro-geological conditions.

The dataset provided does not show the likelihood of groundwater flooding occurring, i.e. it is a hazard not risk-based dataset. The risks have been derived using set ‘rules’ in order to identify areas “based on geological considerations, where groundwater flooding could not occur, i.e. areas where non-aquifers are present at the ground surface” (BGS).

Areas susceptible to groundwater accumulation were then passed through a second set of rules in order to create a groundwater level surface (this was taken from groundwater contours, inferred river levels, borehole data and other BGS datasets). The final groundwater level was then compared to a DTM, and the resulting modelled depths of groundwater level above the surface were translated into associated risk categories ‘Very High’, ‘High’, ‘Moderate’ and ‘Low’.

BGS note that “The susceptibility data is suitable…to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. In all cases it is strongly recommended that the confidence data is used in conjunction with the groundwater flooding susceptibility data”. In addition, “the susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding”.

At this stage of the SWMP, these maps have been used only in a limited capacity, however, it is expected that during future stages, these maps will be used more extensively to inform the optioneering process.

3.2.4 Sewer Flooding

Introduction

Sewer flooding can be caused by excess surface water, blockages collapses or plant failure.

For public sewers, sewerage undertakers, in this case STW, are obliged under the Water Industry Act to provide, maintain and operate systems of public sewers and works for the purpose of effectually draining their area. There is no universal level of service associated with the sewer network. Table 3-2 details the three main sewer asset types in urban areas.

Asset Type	Description
Public foul sewer	Maintained and operated by STW, these should carry only foul sewage but, through misconnections, often also carry surface water
Public surface water sewer	Maintained and operated by STW. They should carry only surface water. Highway drains are often connected to public surface water sewers.
Public combined sewer	Public combined sewers are maintained and operated by STWL. They carry both foul sewage and surface water, and include the recent transfer of private sewers and lateral drains, that are connected to the public sewerage system, on the 1st October 2011[12]. Again, highway drains are often connected to public combined sewers

Table 3-2 Public Sewerage Systems

Since the publication of Sewers for Adoption in 1980, this document has become the standard for the design and construction of sewers to adoptable standards in England and Wales. Sewers for Adoption currently requires public surface water sewers to accommodate flows up to a 3.33% AEP (1 in 30 year chance) design storm.

It is highlighted however that this level of service will change if increasing amounts of contributing area is connected to the sewer over time. The design standard also does not account for the capacity of connections such as gutters, gullies, highway drains and private drains which may limit the flow discharging to the sewer.

Severn Trent Water Data - DG5 Register

STWL maintains a register of confirmed internal and external sewer flooding locations due to hydraulic overloading. The Register only contains properties and areas at risk of internal and external flooding if they have suffered flooding from public sewers due to overloading of the system. A sewer is overloaded when the flow from a storm is unable to pass through it due to permanent problem (e.g. small pipe, flat gradient).

The Register does not include properties or areas flooded due to temporary operational problems e.g. blockage, siltation, collapse, equipment failure or operational failure. The Register does not contain properties or areas that have been subject to a flood alleviation scheme (to a satisfactory level of protection) or if new information reveals that the property or area does not meet the criteria to be on the register. STWL has provided its DG5 database for the study area.

As of February 2011 there were seven entries on the DG5 register within the Church Stretton SWMP Study area. A scheme to address one of the areas is being considered and is at feasibility stage. Properties must be recorded on the DG5 register before a scheme to reduce risk is considered. STWL are required to undertake capacity improvements to alleviate some of the most severe sewer flooding problems on the DG5 register during the current 5 Year Asset Management Period (2010-15) with priority being given to more frequent internal flooding

problems. There are currently no plans, other than the on-going investigation within the current AMP cycle, to address surface water flood risk in Church Stretton.

At this stage, it must be noted that these events occurred during the large floods of 2007 and whilst they did suffer flooding from the combined system, it is also possible that the properties were affected by the higher river levels in the Marsh Brook, preventing local floodwaters from the urban area from discharging into the watercourse.

Severn Trent Water Data - Sewer Network Location

STW also provided information on their drainage infrastructure including sewers, pumping stations and outfalls. This information has been overlain onto the OS mapping and flood mapping to help identify opportunities for collaboration to help reduce the risk across the area. Subject to their being sufficient cause, STW is keen to work with Councils in order to manage flood risk and would assist in undertaking combined studies to help provide greater benefits from potential mitigation options.

The majority of Church Stretton is served by separate foul and surface water sewerage systems.

Sewer Flood Risk Summary

The risk of sewer flooding is shown to be ***low*** across Church Stretton, however future urban growth plans should be undertaken in consultation and agreement with STWL and in line with SC Guidance on surface water management for new developments.

The below ground drainage systems often rely on gravity assisted dendritic systems, which convey water in trunk sewers located at the lower end of the catchment. Failure of these trunk sewers would have serious consequences, which are often exacerbated by topography, as water from surcharged manholes will flow into low-lying urban areas. .

3.2.5 Maintenance Regimes

Maintenance regimes are critical to ensuring the continued and effective functioning of assets to manage surface water flood risk. Existing maintenance tasks and responsibilities have been reviewed as part of the SWMP where information is currently available and these are listed below. The SWMP will also assist in identifying and focussing needs in terms of future maintenance.

Shropshire Council

SC, as the highway authority, has responsibility for non trunk road highways and associated structures throughout the council area, and operates programmes of inspection and maintenance for the following:

- Bridges
- Retaining walls and highway structures (including large culverts)
- Carriageway and footway gully cleaning

Severn Trent Water

The majority of regular maintenance is carried out on foul / combined sewers since surface water sewers do not convey as many solids in comparison, and so are less prone to blockages. STWL have historically received fewer reports of blockages on surface water sewers. Where

there is demonstrable benefit in regular maintenance, in line with the current Business Plan, STWL will undertake this work, regardless whether it is storm or foul.

STWL carry out a range of pro-active CCTV, predictive modelling and cleansing activities, as well as reacting to reports of operational issues as part of the annual maintenance activities, further details of which can be obtained from STWL, if required.

Environment Agency

The Environment Agency can carry out maintenance on those rivers or streams designated as main rivers. Details of the Environment Agency's maintenance programmes[13] for Shropshire are shown in Table 3-3.

Maintenance Type	Watercourses included in Programme
Critical Maintenance	River Onny, River Teme,
Weed Cutting	Worldsend Brook
Access Improvements[14]	Marsh Brook - One planned intervention adjacent to Ludlow Road.

Table 3-3 Environment Agency Maintenance Programme

3.2.6 Wetspot Selection and Prioritisation

The assessment of the possible harmful consequences of future floods from local sources of flood risk

Approach

The strategic assessment identified Church Stretton as a broad location susceptible to surface water flooding. The intermediate phase will now look in more detail at Church Stretton to identify the higher risk areas within the town. This chapter describes the selection and prioritisation of the areas; these are:

- Identification of potential wetspot areas within Church Stretton using historical flooding incidences and / or future flood risk based on the FMfSW.
- Multi-Criteria Assessment (MCA) Methodology. This describes the MCA approach agreed with Shropshire Council.
- Prioritisation of wetspots within Church Stretton using the MCA methodology.

The objective of the MCA assessment and prioritisation is the identification of wetspots to be taken forward to the intermediate assessment stage.

The first stage of the assessment was to identify those areas within Church Stretton where flooding had occurred historically, and to digitise a wetspot polygon that encompassed all flooding in the nearby vicinity.

The next stage was to incorporate the Environment Agency's National Receptor Database (NRD) property points into the wetspots. All the property points falling within the 0.5% AEP (1 in 200 year annual chance of flooding) deep or shallow FMfSW zones were identified. If these locations were within an existing wetspot, then no further action was taken. Those property points outside a wetspot were analysed to identify if an existing wetspot could be expanded to incorporate them. Finally, for areas where more than 10 properties in an area fell within the deep or shallow FMfSW, new wetspots were created if not previously included.

Some of the identified wetspots either only had main river flooding incidents within them, or a significant proportion of the properties in the FMfSW zones are also within fluvial flood zones 2 and 3. These factors indicate main river dominance or a high level of interaction between the main river and other surface water systems.

3.2.7 Flood Receptor Identification

A flood receptor is anything in the built or natural environment that can be affected by flooding, so can include property, infrastructure and environmental sites. The flood receptors within Church Stretton have been identified using a number of data sources, including those received from the Environment Agency, Shropshire Council and STWL.

Once all flood receptors had been compiled, they were divided into a number of categories:

- Domestic Properties
- Critical Infrastructure
- Non-Domestic Properties
- Transportation
- Statutory Environmental Areas
- Cultural

3.2.8 Domestic and Non Domestic Properties and Critical Infrastructure Identification

Property point data was obtained from the Environment Agency for the whole of the county area. This National Receptor database contains information on all known properties/land features within the area and lists its usage, for instance dwelling, school, pond etc. This database was interrogated to identify domestic properties, critical infrastructure and non-domestic properties for use during the Multi-Criteria Analysis stage.

Critical Infrastructure

Critical infrastructure properties are those properties identified as having a greater cost or impact on the community in the event of them being affected by flooding. This cost can be based on the number of people in a property, emergency services, utilities and the possibility of pollution. Those properties identified as critical infrastructure, for the purposes of this investigation, are listed below:

- Education Premises
- Hospital /Surgery / Health Centre / Residential Care Home
- Emergency Service – Fire / Police / Ambulance / Response Centre
- Water / Wastewater Treatment Works[1]
- Pumping Station[1]
- Gas / Electrical Infrastructure – Refinery / Power Station / Sub-station

[1] Note - STWL maintain a separate register of their assigned Critical Infrastructure to that identified within the National Datasets used for this study.

- Telecommunications Infrastructure
- Landfill Site / Waste Licensed Site / Radioactive Site / Integrated Pollution Prevention and Control (IPPC)

Domestic Properties

All those properties listed as “dwelling” within the property point database were identified. All domestic properties were then divided into their property type (detached, semi-detached, terrace or flat) using the “house type” provided in the property point database.

Non-Domestic Properties

Property points not previously classified as domestic or critical were then analysed to identify non-domestic properties. These include shops, hotels, factories and playing fields etc. It should be noted that the NRD property database also contains locations such as ponds, farming or post-boxes but these have not been included within the strategic assessment.

Transportation Infrastructure

Transportation information was taken from the NRD which defines roads as A Roads, B Roads, Local Streets, Minor Roads, Motorways and Private Roads.

Land and Public Open Space

Land and public open space information was obtained from Natural England. This data lists all statutory areas, such as Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs) and city and county wildlife sites. A full list is shown below:

- Special Area of Conservation (SAC)
- Special Area of Protection (SPA)
- RAMSAR Site
- Site of Special Scientific Interest (SSSI)
- County & City Wildlife Site
- County & City Nature Reserve
- RSPB Reserve
- Ancient Woodland, Fens & ESAs
- World Heritage Site
- English Heritage Site
- National Park
- County Park
- Parks and Gardens of Special Historical Interest
- Scheduled Ancient Monuments (SAMs)
- Agricultural Land Classes

Cultural Receptors

Listed buildings, conservation areas and Article 4 Definitions were obtained from the NRD.

3.2.9 Multi-Criteria Analysis (MCA) Methodology

Introduction

Multi-Criteria Analysis is a scoring and weighting methodology by which the impact of flooding on a wide range of receptors can be evaluated. It is frequently used in conjunction with benefit cost analysis to prioritise and determine investment strategies to mitigate the risk of flooding. MCA allows for the comparison of severity of flooding between regions based upon the perceived value of buildings, infrastructure, commercial enterprise and services. The receptor types discussed in Sections 3.2.8 have been used within the MCA.

Multi-criteria can be adapted through the adjustment of weightings as required to reflect changing needs. This may be of particular concern where there are social, amenity or environmental factors considered to be important but where it is difficult to assign an economic value. For the Church Stretton SWMP, MCA has been used as a high level decision making tool to compare and prioritise wetspots. The MCA calculations are based on a flood susceptibility weighting multiplied by a weighting for each receptor type. The general format of the formulae used for the Church Stretton SWMP is:

MC Score = Number x Type Weighting x Flood Susceptibility Weighting

Type Weighting - Domestic Properties

The multi-criteria scoring system for domestic properties is:

MC Score = Number of Properties x Type Weighting x Social Class x Flood Susceptibility Weighting

The Type weighting has been set to 2.34 to reflect the average occupancy rates within properties across the United Kingdom. The MCA in this case reflects the number of people affected by flooding. In addition, a social class weighting can be applied to each domestic property although this has not been used in this case.

Type Weighting - Commercial Properties

MC Score = Number of Properties x Type Weighting x Flood Susceptibility Weighting

The property types and associated weightings are based upon the Multi-Coloured Manual (MCM) and include a range of commercial categories which are shown in Appendix C.

Type Weighting - Critical Infrastructure

MC Score = Number of Items of Critical Infrastructure x Type Weighting x Flood Susceptibility Weighting

The type weightings include a range of categories which are shown in Appendix C.

Type Weighting - Transport Infrastructure

The type weighting for the impacted roads has been based on their designation; the categories including weightings are shown in Appendix C.

It has been assumed that roads within the shallow zone only (depths up to 300mm) will remain passable to vehicular traffic; consequently these have been assigned a weighting equal to ¼ of the “deep” weighting. For example, an A-road within a deep zone will have a weighting of 400, but an A-road within the shallow zone will have a weighting of 100.

Type Weighting - Land and Public Open Space

The multi-criteria scoring system for Land and Public Open Space is:

MC Score = Area x Type Weighting x Flood Susceptibility Weighting

The type weightings include a range of categories which are given in Appendix C.

The score for land and public open space is based on the size of the area rather than the number of receptors within the wetspot.

Type Weighting - Cultural Receptors

MC Score = Number of Receptors x Type Weighting x Flood Susceptibility Weighting

Any building designated as a listed building is assigned a type weighting of 1.

3.2.10 Flood Susceptibility Weighting

The FMfSW was used to assign a surface water flood risk weighting score to each flood receptor described above. Any receptor falling within the 0.5% AEP (1 in 200 annual chance of flooding in any given year) shallow zone was assigned a susceptibility score of 1, while receptors in falling within the 0.5% AEP (1 in 200 annual chance of flooding in any given year) deep zone were assigned a susceptibility score of 2. Therefore, the higher the susceptibility score, the greater the risk of surface water flooding of that receptor.

3.2.11 Area Adjustment

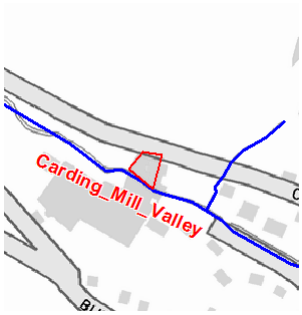
The MCA score was divided by the area of the wetspot in order to provide an unbiased score.

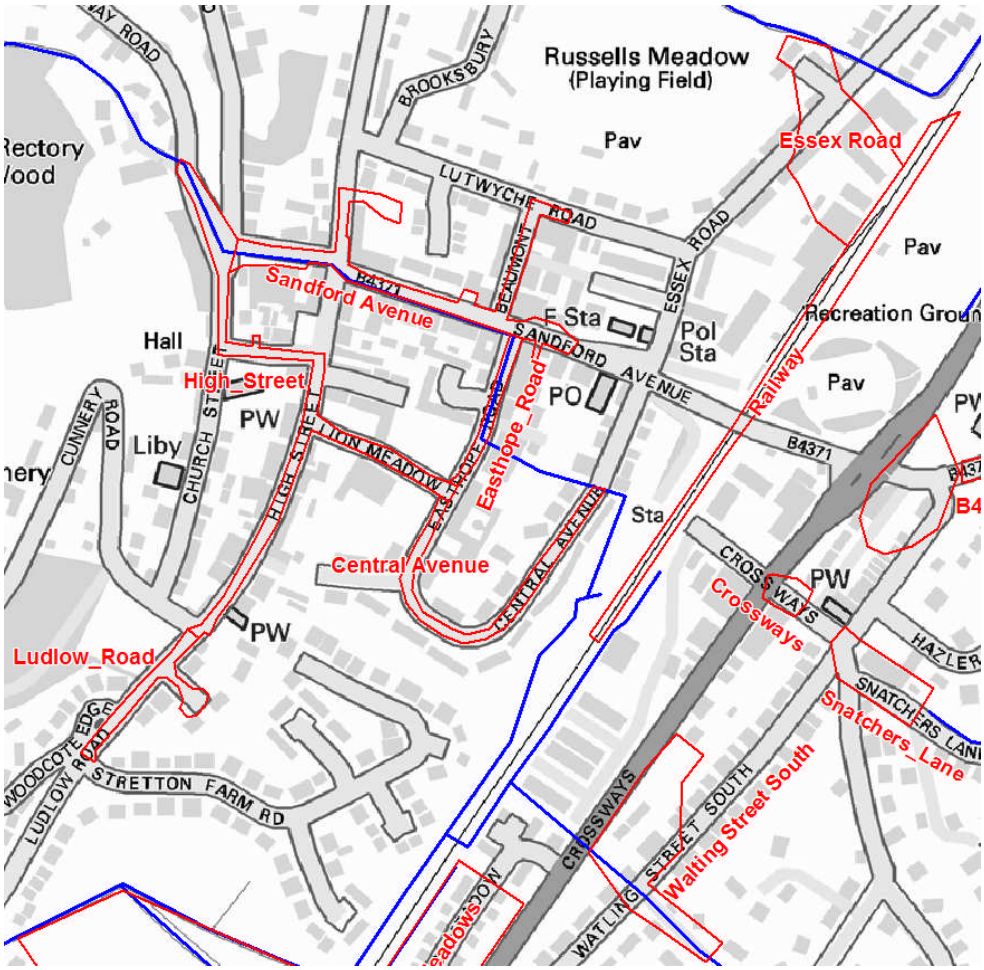
3.2.12 Influence of Historic Incidents

In order to reflect the weight that historic events have on the prioritisation of wetspots, a rank score was assigned based on the number of flood incidents recorded in the wetspot. This was then used as a multiplier for the MCA rank to give an overall priority score.

3.2.13 Church Stretton Wetspots

Using the process outlined above, a total of 17 wetspots were identified. The definition of the wetspots was based upon historical flood records and the revised watercourse modelling. Seven of the wetspots relate specifically to the flooding of the local road network within Church Stretton, while one is a result of the railway becoming inundated. The wetspots are shown in Figure 3-3


Carding_Mill_Valley


Russells Meadow
(Playing Field)
Pav
Essex Road
Pav
Recreation Ground
Sandford Avenue
B4371
F Sta
Pol Sta
Hall
High_Street
PW
Liby
PO
Railway
Pav
Eastthope_Road
Sta
Central Avenue
Crossways
PW
Ludlow_Road
PW
Snatchers_Lane
STRETTON FARM RD
Walting Street South
LUTWYCHE ROAD
BROOKSBURY
BEAUMONT
ESSEX ROAD
SANDFORD AVENUE
CHURCH STREET
HIGH STREET
LION MEADOW
EASTTHOPE ROAD
CENTRAL AVENUE
CROSSWAYS
CUNNERY ROAD
LUDLOW ROAD
WOODCOTE EDGE
WATLING STREET SOUTH
B4371

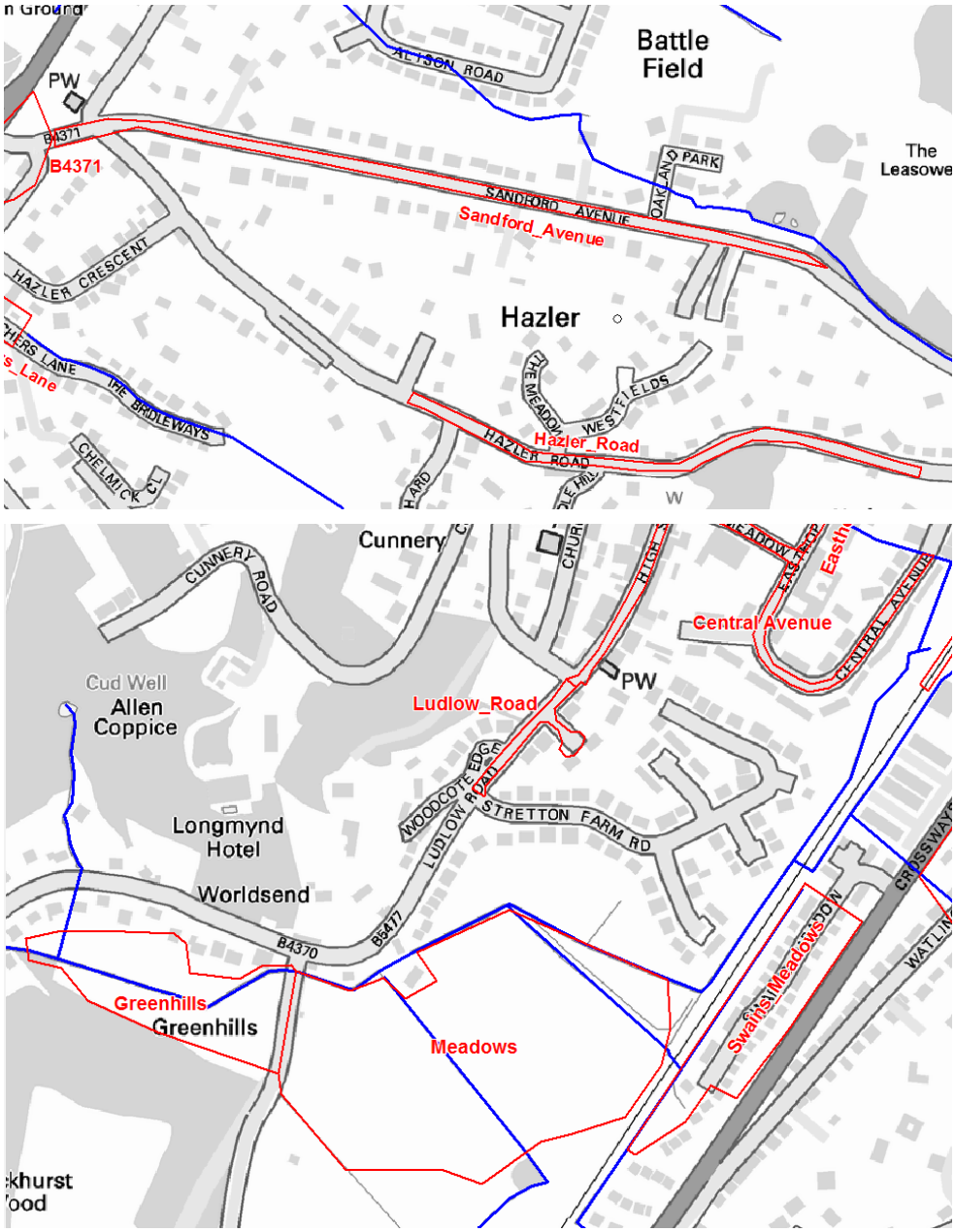


Figure 3-3 Identified Wetspots in Church Stretton

Following their identification, the MCA was then carried out to identify those wetspots with the highest score, and hence, highest vulnerability to surface water flooding. The results of the MCA for Church Stretton are shown in Table 3-4.

Wetspot	No. Of Historical Reports	MCA Score
Essex Road	-	636
Railway	1	400
Swains Meadow	1	818
Watling Street South	1	341
Crossways	1	400
B4371	1	519
Snatchfields Lane	1	503
Greenhills	1	505
Meadows	1	502
High Street	1	602
Carding Mill Valley	1	302
Sandford Avenue West	1	304
Easthope Road	-	300
Ludlow Road	1	400
Central Avenue	1	400
Sandford Avenue East	1	300
Hazler Road	1	300

Table 3-4 Results of MCA for Church Stretton Wetspots

From these wetspots, three have been prioritised based on their MCA score and have been progressed for specific comment in the optioneering stage. The three are:

- Essex Road had the second highest score.
- Railway had a score lower than other but due to the significance of the railway this has been taken forward.
- Swains Meadow had the highest score.

These wetspots are also all located along the main watercourse corridors. Discussion of the river modelling undertaken as part of this SWMP is given in Section 3.3.

3.3 Detailed Assessment

Risk Assessment Phase; Undertake detailed Assessment

3.3.1 Church Stretton Modelling

Background

Church Stretton is characterised by two open watercourse systems which drain through the town. These are known as Ash Brook and Town Brook, and both have a number of smaller tributaries feeding them at various locations throughout the town. Ash Brook originates from

part of the Long Mynd massif to the west, and flows through Carding Mill Valley before turning north and heading to the Cound and onto the Severn. Some smaller tributaries flow into Ash Brook from the east.

Town Brook also originates from part of the Long Mynd massif to the west. It enters the long Town Brook culvert at the north western part of the town, and flows beneath the High Street before exiting close to the railway line. It then makes its way west to the Onny and then the Teme. Again, smaller tributaries flow in from the east to join Town Brook.

To identify potential flood risk areas where the primary source is fluvial flooding, hydrodynamic models were developed of the Ash Brook system and the Town Brook system. Hydrological inflows were developed using methods set out in the Flood Estimation Handbook and its subsequent updates. 1D hydraulic models based on topographic survey of the watercourse (in-bank only) were constructed using ISIS. The models of individual tributaries were developed separately, and where applicable and possible, they were combined. Design events for the 1% AEP (1 in 100 chance of occurring in any given year) were subsequently simulated using the hydraulic model.

The 'watercourse identifier' code has been specifically generated for the purpose of the hydraulic modelling and reporting. The Ash Brook model consisted of four watercourses:

Watercourse Identifier	Name / Description
ASHB01	Main Ash Brook watercourse
ASHB02	Unnamed connecting watercourse
ASHB03	Battlefield Brook
ASHB04	Sandford Brook

Table 3-5 Watercourse identifiers and descriptions associated with Ash Brook

A fifth watercourse (ASHB05) named Windyridge Brook was not modelled explicitly but was included as a direct inflow to the hydraulic model.

The Town Brook hydraulic model consisted of six watercourses:

Watercourse Identifier	Name / Description
TOWN01	Main Town Brook watercourse
TOWN02	Snatchfield Brook
TOWN03	Unnamed watercourse
TOWN04	Unnamed watercourse (drains under railway to TOWN05)
TOWN05	Unnamed watercourse (drains under railway from TOWN04)
TOWN06	Unnamed connecting watercourse

Table 3-6 Watercourse identifiers and descriptions associated with Town Brook

Locations of the above watercourses are shown in Figure 3-4.

Figure 3-4 Watercourse Locations in Church Stretton

3.3.2 Hydrological Assessment

Design event inflows were generated using standard methods set out in the Flood Estimation Handbook and its subsequent updates. The estimation process involved two stages – the estimation of peak flows and the generation of a suitable hydrograph for each inflow boundary (which was scaled to the associated peak flow estimate).

Initially, the various sub-catchments draining the watercourses of Church Stretton were identified with the aid of the FEH CD-ROM. These sub-catchments in general corresponded with the watercourses identified in Tables 3-5 and 3-6. However, some watercourses do not have selectable catchments on the FEH CD-ROM, and some watercourses do not have definable contributing catchments.

Peak flows for a range of return periods were estimated using the FEH Statistical Method at a range of estimation points throughout Church Stretton. These included the upstream study limits of both the Ash Brook and Town Brook watercourses, and the downstream limits of a number of smaller associated tributaries. The downstream limits were chosen for these tributaries since the catchment areas involved were small, and thus the variation in peak flows would be negligible (and the estimate obtained would be conservative). However, for those tributaries that were modelled, the peak flow was applied at the upstream limit.

Since neither Ash Brook nor Town Brook was gauged at the time of the study, data from donor gauges were used to develop the peak flow estimates. Tables 3-7 and 3-8 provide peak flow values at a range of return periods for the relevant flow estimation points (FEPs).

1 in x chance of flooding	Ash Brook	Ash Brook	Battlefield Brook	Sandford Brook	Windyridge Brook
	ASHB01 U/S	ASHB01 D/S	ASHB03	ASHB04	ASHB05
2	0.54	1.18	0.11	0.16	0.35
5	0.77	1.68	0.16	0.23	0.50
10	0.95	2.06	0.19	0.28	0.62
20	1.16	2.49	0.24	0.34	0.75
25	1.24	2.64	0.25	0.37	0.80
50	1.50	3.16	0.30	0.44	0.97
75	1.67	3.51	0.34	0.49	1.08
100	1.80	3.77	0.37	0.53	1.17
200	2.17	4.50	0.44	0.64	1.41
500	2.78	5.69	0.57	0.82	1.81
1000	3.35	6.78	0.68	0.99	2.18

Table 3-7 Peak flow estimates (m^3/s) for Ash Brook and tributaries

1 in x chance of flooding	Town Brook	Town Brook	Snatchfield Brook	N/A	N/A
	TOWN01 U/S	TOWN01 D/S	TOWN02	TOWN03	TOWN05
2	0.18	0.86	0.13	0.08	0.05
5	0.26	1.20	0.19	0.12	0.07
10	0.32	1.44	0.24	0.15	0.09
20	0.38	1.71	0.29	0.18	0.11
25	0.41	1.81	0.31	0.19	0.12
50	0.50	2.13	0.38	0.23	0.14
75	0.55	2.34	0.42	0.26	0.16
100	0.60	2.50	0.45	0.28	0.17
200	0.72	2.93	0.55	0.33	0.20
500	0.92	3.61	0.70	0.43	0.26
1000	1.11	4.23	0.84	0.51	0.32

Table 3-8 Peak flow estimates (m^3/s) for Town Brook and tributaries

Hydrographs were generated using the Revitalised Flood Hydrograph (ReFH) rainfall-runoff method. This involved selecting the catchments for each tributary inflow using the FEH CD-ROM, extracting the catchment descriptors, and importing these into the ReFH unit within ISIS in order to calculate the hydrograph.

The resulting hydrograph was subsequently scaled to the required peak flow. The storm duration was determined as the most appropriate for the entire Ash Brook / Town Brook catchment. In some cases, the tributary catchment was not selectable on the FEH CD-ROM due to its small size. Where this occurred, catchment descriptors were transferred from adjacent/similar catchments. The catchment area was determined from contour maps.

3.3.3 ISIS TUFLOW Model

Model Extents

Each hydraulic model was initially developed as an individual model. No structures were included, and initial conditions were generated with the minimum flow possible that allowed the hydraulic model to run. Due to the small design flows associated with the smaller tributaries, many of the minimum flows were in excess of the lower return period design flows. Once stable initial conditions had been generated, the various structures were added in sequence (culverts and bridges were chosen based on the surveyed geometry, dimensions and expected hydraulic behaviour of the structure).

Once the in-bank model had been completed and was running in a reasonably stable state, it was connected to a 2D domain using TUFLOW. The connectivity between the 1D and 2D model was achieved by using the surveyed data to define bank heights and the linear spills between the channel and the floodplain.

The final ISIS-TUFLOW linked model was used to simulate the 1% AEP (1 in 100 chance of occurring in any given year) design event, and to subsequently map and assess the flood risk throughout Church Stretton from fluvial flooding.

Modelling Issues

There were a number of modelling issues which limited the development of complete and consistent hydraulic models of all surveyed watercourses. These issues arose from the steep nature of the tributaries, the small flow capacity of the watercourses and the complex nature of the urban drainage system.

A suitable hydraulic model of TOWN03 was not completed due to the negligible size of the pipe culvert in the garden upstream of Clive Avenue. However to represent the flow from this channel the inflow hydrograph was represented within the TUFLOW domain as a point source.

A suitable hydraulic model of TOWN05 was not completed due to the negligible size of the pipe

TOWN04 was developed as a working model in the form of an individual tributary, and combined with the full 1D model without difficulty. However, due to the complex flow paths at the downstream end of the Meadows it was necessary to only connect the upper section of the model to the TUFLOW domain.

The upstream section of TOWN01, prior to the connection with the main Town Brook culvert, is particularly steep and therefore the upper section of the hydraulic model was developed using ESTRY (a 1D model available within the TUFLOW modelling package), while the downstream section from the exit of Town Brook culvert was developed in ISIS.

Model Verification

Flooding has occurred in Church Stretton. Although no historic outlines are available, anecdotal evidence of flooding was provided for a number of locations across Church Stretton. No assessment of the rain event which generated flooding in these locations has been undertaken

however the locations are within the modelled 1% AEP (1 in 100 chance of occurring in any given year) flood outline.

3.3.4 Model Results

There were no major flooding issues uncovered through the hydraulic modelling, and those that were highlighted had already been identified prior to the study. The most pertinent issues to note are:

- Flooding of the right bank from the weir adjacent to the houses off Ascot Close. This is due to low bank levels.

- Flooding of fields adjacent to Cemetery Road/Ludlow Road at the Meadows.

The issue of flooding at the entrance to the main Town Brook culvert has not been identified by the hydraulic model, despite significant overbank flow originating from this location during the floods of summer 2007, causing widespread overland flow throughout Church Stretton town centre. It is possible that during the summer 2007 flooding the culvert trash screen became blocked by woody debris, which effectively blocked the watercourse at the culvert entrance, forcing it over the lower right bank and onto the roads.

This theory was tested using the TUFLOW model - complete blockage of the culvert entrance during the 1% AEP (1 in 100 chance of occurring in any given year) design event would cause overtopping of the right bank and flooding of the road and town in the mechanism and routes observed. The depth of flooding would obviously depend on the actual magnitude of the June 2007 floods, but the exercise indicated the potential issues that could arise should the trash screen become blocked.

The purpose of a trash screen is to prevent foreign material from blocking culvert openings and reducing capacity. However, it effectively becomes redundant if it traps material but fails to allow it to be lifted clear of the water surface during high flows.

Flood depth and hazard maps for the modelled events are given in Appendix B.

3.4 Flood Hazard Maps

Risk Assessment Phase; Map and Communicate Risk

3.4.1 Flood Hazard Maps

Flood depth and flood hazard mapping has been produced for Church Stretton based upon the ISIS TUFLOW models defined above. Flood hazard is an important factor in the assessment of flood risk and evacuation of the general public.

Three categories of flood hazard have been identified in the DEFRA / Environment Agency Documents: Flood Risk Assessment Guidance for New Development[15], (DEFRA Report FD2320) and Flood Risks to People Methodology[16] (DEFRA Report FD2321).

These are “Danger for All”, “Danger for Most” and “Danger to Some”. The equation below gives the relationship between hazard, depth, velocity and debris:

H = (v+0.5) x d +Df

Where: H = hazard
v = velocity
d = depth
Df = 0.5 for d < 0.25m
Df = 1.0 for d > 0.25m

The mapping presented in the SWMP has been based upon the following thresholds, taken from DEFRA Report FD2320:

- Danger to Some Category 1 H > 0.75
- Danger to Most Category 2 H > 1.25
- Danger to All Category 3 H > 2.00

It is noted that DEFRA Report FD2321 places a different hazard rating at the transition to Category 3; the change occurs at 2.0 in FD2320 and 2.5 in FD2321. This will have a significant impact on the interpretation of the results for the SWMP as the results presented are conservative. The information for each of the wet spots identified for the optioneering stage is:

- Essex Road

The flooding of Essex Road and Ascot Close is generated by the overtopping of Ash Brook on its right bank at the rear of Ascot Close. The flood waters then flow overland between the houses, over Essex Road and towards the railway line. The indicative depths are a maximum of 100mm.

- Railway

The flooding of the railway is a direct result of the overland flow from overtopping of Ash Brook at Ascot Close/Essex Road. The floodwaters enter the railway track and flow southwards where the depth of flooding increases to 250mm in the vicinity of the station platforms.

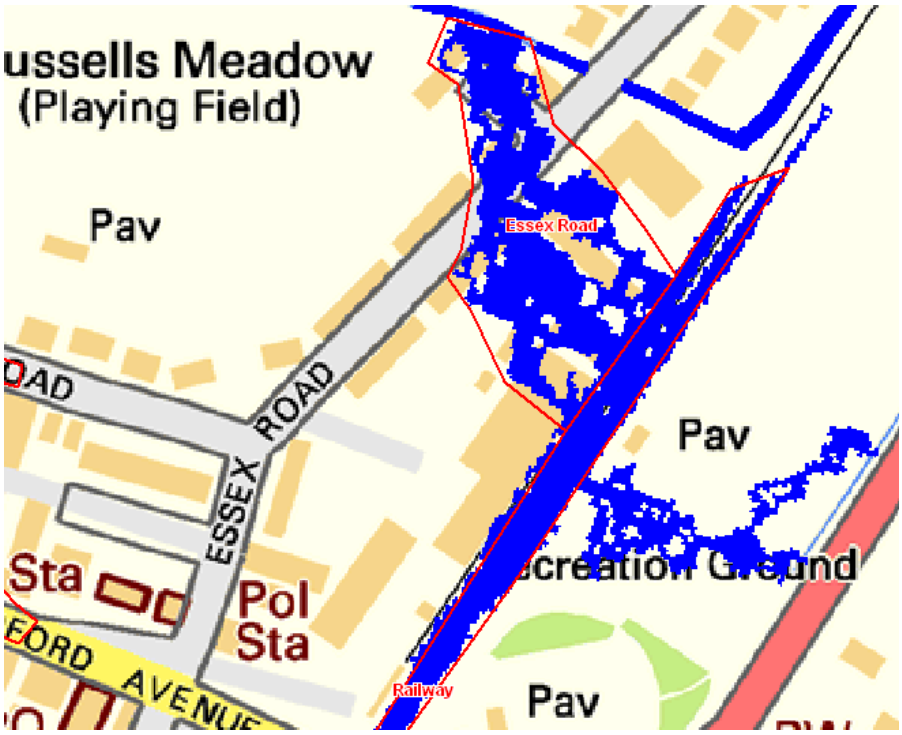


Figure 3-5 Flooding of Essex Road and Railway

There is evidence that silt and stones are being transported in the Ash Brook from upstream of the town and deposited where the river bends and the flow velocity reduces downstream of the railway culvert. This has the potential to further reduce the channel's capacity.

- Swains Meadow

The flooding in the vicinity of Swains Meadow is caused directly by the under capacity of the open channel surface water drainage systems that drain the eastern side of Church Stretton. This is particularly relevant to watercourse TOWN03.

Floodwaters travel overland to the natural low spot at the bottom of the valley and try to enter the small drainage channel at the rear of Swains Meadow. The floodwaters cross Watling Street South, Crossways and through the gardens at Swains Meadow. The roads also act as conduits allowing the surface flooding to spread.

The depth of flooding in this location ranges from 100-300mm with low velocities.

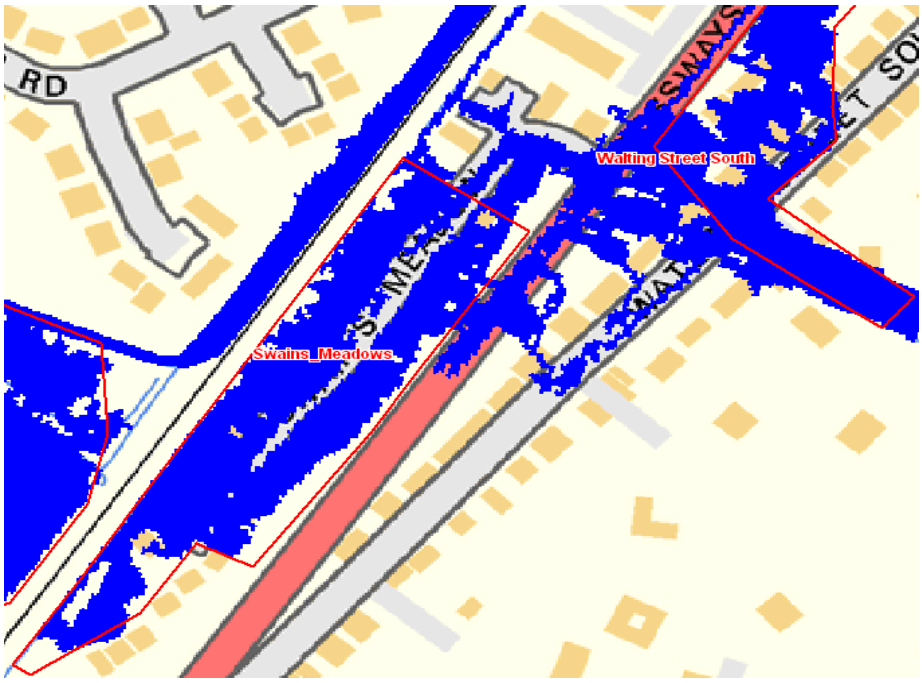


Figure 3-6 Flooding of Swains Meadow

- Entrance to the main Town Brook culvert

The issue of flooding at the entrance to the main Town Brook culvert at Rectory Gardens has not been identified by the hydraulic model despite significant overbank flow originating from this location during the floods of summer 2007. It is, therefore, assumed that historical flooding originating from this point is a result of a blockage or partial blockage.

4 Phase 3 – Options

4.1 Identify Measures

Options Phase; Identify Measures

4.1.1 Approach

The options that will be evaluated in this section are based upon employing the most appropriate techniques for the various sites. Where possible and economical, the use of sustainable drainage systems (SuDS) and surface water reduction strategies has been promoted over hard infrastructure alternatives such as the upgrading of existing piped drainage systems. The key constraints associated with the implementation of all of the options are space and cost.

The street environment is also a constraint in terms of installing and improving drainage infrastructure. Within these areas techniques including permeable paving, filter drains, and road side rain gardens may be suitable; these methods are discussed in the following sections.

Section 4.1.2 gives a brief introduction to the range of measures reviewed as part of this SWMP for Church Stretton. Section 4.1.8 then discusses the applicability of these measures to resolving the known issues in Church Stretton, in particular the identified wetspots. Section 4.2 takes these measures and develops them into specific options for Church Stretton. These are then assessed from Section 4.2.3 onwards.

4.1.2 Potential Mitigation Measures

The following sections discuss the potential measures that could be implemented in Church Stretton in order to mitigate surface water flooding.

Improved Maintenance

This measure involves increasing the level of maintenance of the existing drainage infrastructure to help ensure that any blockages, as a result of excess vegetation or deposition, will not reduce the hydraulic capacity. This will apply to the land drainage, watercourses, highway gullies, storm and foul sewers for known sites where poor maintenance is potentially an issue.

Maintenance works include regular inspections of assets, cutting, mowing, pruning, jetting and clearance of debris, gravel and siltation where required. The objective of these works would be to reduce the amount debris available to block, constrain or otherwise impair the capacity surface water drainage assets. Improved maintenance also assumes the enforcement of any notices served under the Land Drainage Act[17]. The advantages and disadvantages of improving the maintenance regime are given in Table 4-1.

Measure	Advantage	Disadvantage
Improved Maintenance	Clearance of drains will ensure that water drains optimally at the design capacity. Regular and effective maintenance and record keeping could help to support flood defence funding decisions. Regular maintenance is more likely to result in local pride and ownership whereby communities want to look after their assets	Increased inspection frequency and maintenance tasks will have increased cost and time implications

Table 4-1 Improved Maintenance Advantages and Disadvantages

Sustainable Drainage Systems (SuDS)

Attenuation Basins

An attenuation basin is a large area of ground laid to grass which is dry for the majority of the time and fills up with water during periods of heavy rainfall. Stored water is then released slowly. Permanent ponds may be incorporated towards inlets and outlets for visual amenity and settlement of silts. They can also act as offline storage structures when positioned alongside existing watercourses, which fill when river levels are high. This can help to alleviate pressure on the drainage network elsewhere in the catchment.

Swales

Swales are landscape elements designed to remove silt and pollution from surface runoff water. They consist of a drainage channel with gently sloped sides and filled with vegetation. The flow path along the wide and shallow ditch is designed to maximise the time water spends in the swale, which aids the trapping of pollutants and silt and reduces flood risk. A common application is around car parks or alongside roads, where substantial automotive pollution is collected by the paving and then flushed by rain. The swale can treat the runoff before discharging it.

Infiltration Basin

An infiltration basin is used to manage surface water runoff, prevent flooding and downstream erosion, and improve water quality. It is essentially a shallow artificial pond that is designed to infiltrate surface water though permeable soils into the groundwater aquifer. Infiltration basins do not discharge to a surface water body under most storm conditions, but can be designed with overflow structures (pipes, weirs, etc.) that operate during flood conditions.

Permeable Paving

Permeable paving systems are designed to allow water to infiltrate to the underlying granular sub-grade material and eventually provide local groundwater recharge. They provide significant benefits in relation to rainfall interception and the removal of surface water volume using the voids between the paving or infiltration through a permeable surface.

Road Side Rain Gardens

A road side rain garden system creates a chain of surface water storage areas each connected with a filter / French drain. Surface water is temporarily stored in the soil and granular layer at the base of the structure before being gradually released into the groundwater through infiltration into the ground below. Intentionally situated in roadside verges, they can provide

areas of storm water infiltration and planting into the smallest of places. Road side rain gardens typically contain hydrophilic flowers, grasses, shrubs and trees.

Advantages and Disadvantages

The advantages and disadvantages of the above SuDS measures are summarised in Table 4-2.

Measure	Advantages	Disadvantages
Attenuation Basins	Attenuation of storage of flood water Can manage the rate of runoff and reduce flooding caused by urbanisation. Encourage natural groundwater recharge	Potential health and safety implications of adding flood storage areas in and around urban areas and the need for warning requirements
Swales	A decreased conveyance of overland flow of flood water toward an area with historical records of flooding. Manage the rate of runoff and reduce flooding caused by urbanisation. Encourage natural groundwater recharge	Temporary closure of the areas during construction. Swales to route flow in to structures will need regular maintenance.
Infiltration Basin	A decreased conveyance of overland flow of flood water toward an area with historical records of flooding. Manage the rate of runoff and reduce flooding caused by urbanisation. Encourage natural groundwater recharge	Temporary closure of the areas during construction. Usage dependent on underlying ground conditions / soil type Swales to route flow in to structures will need regular maintenance.
Permeable Paving	Permeable paving surfaces have been demonstrated as effective in managing and reducing runoff from paved surfaces. Management of potential flooding at the source, ‘upstream’ of any high risk areas. Sustainable alternative to creating a larger capacity sewer network. Encourage natural groundwater recharge. Water treatment by pollutant removal. Reduces net volume required by the storm sewer system.	Construction within the road will lead to temporary road closures. High associated construction cost Can only be constructed on highways with low traffic volumes where speed restrictions not exceeding 30mph are present. Annual inspection of permeable pavement will be required.
Roadside Rain Garden	Road side rain gardens have been demonstrated as effective in managing and reducing runoff conveyed by highway surfaces. Sustainable alternative to creating a larger capacity sewer network. Encourage natural groundwater recharge. Reduces net volume required by the storm sewer system. Contribution to aesthetic appeal and habitat in urbanised areas. Flexible for use in areas of various shapes and sizes.	Regular maintenance of vegetation, such as weeding, soil replacement and watering during dry periods. Inspection following large rainfall events. This includes clearing of the access channel from the road to the soil. Periodic replacement of planting is required.

Table 4-2 Advantages and Disadvantages of SuDS Measures

4.1.3 Sub-Surface Drainage Network Improvements

Improvements to the drainage network could involve the upsizing of sewers / culverts, construction of off or on-line storage tanks etc. Their advantages and disadvantages are listed in Table 4-3.

Measure	Advantage	Disadvantage
Improve sub surface drainage network	Storage tanks control volume/rate of surface water entry into network. Reduce surcharge risk of system. Increase capacity	Cost of underground construction compared to above ground construction. Temporary closure of roads during construction causing disruption. Network improvements are generally expensive to carry out. Problems tend to be passed downstream

Table 4-3 Advantages / Disadvantages of sub-surface network drainage improvements

4.1.4 Watercourse and Culvert Improvements

Watercourse improvements can involve bank raising, building of walls and increasing channel size, etc. Associated with watercourse improvements is the replacement of inadequate culverts. Their advantages and disadvantages are listed in Table 4-4.

Measure	Advantage	Disadvantage
Watercourse/ Culvert Improvements	Increases conveyance.	Can be expensive to carry out. Problems passed downstream

Table 4-4 Advantages / Disadvantages of Watercourse and Culvert Improvements

4.1.5 Property Level Protection

Property level protection incorporates resistance and resilience measures. Examples of resistance measures at a property level include flood boards for property access points, air brick covers, threshold raising and building 'skirt' systems. Property level resilience measures include replacing timber floors with waterproofed concrete, raising electricity points, replacing gypsum plaster with lime plaster and the use of metal and plastic fittings rather than chipboard or similar. The advantages and disadvantages of these systems are shown in Table 4-5.

Measure	Advantage	Disadvantage
Property Level Resistance	Will keep water wholly out of a property up to a given depth Directly protects property therefore benefits are simple to determine	Can be expensive, especially for prolonged flooding. Can be complicated to fund and assign responsibility
Property Level Resilience	Damage to the property is limited and residents remain out of their properties for less time	Measures can be more expensive than like for like non flood resilient products Can be complicated to fund and assign responsibility

Table 4-5 Advantages / Disadvantages of Property Level Protection

4.1.6 Planning Policy and Development Control

Planning policies can be used to set out a framework for best practice and also where work has shown that deviation from national guidance would be appropriate. Further detail and recommendations are set out in Section 4.2.8.

Interim Guidance for Developers

Shropshire Council has produced a guidance document for developers which sets out the council's requirements for surface water management. Consultation on this document was closed in March 2011. It is the aspiration that this document will eventually be replaced by the proposed Water Management SPD.

Supplementary Planning Documents (SPD)

Supplementary planning documents provide guidance on local planning matters. As they are not required to be listed in the Local Development Scheme, they can be brought forward as circumstances change. An SPD is subject to a process of consultation and engagement with relevant parties. They will take the form of:

- Masterplans
- Development briefs
- Issue based documents (provides additional information on a specific theme)
- Design Guides

Development Management Polices

Development Management Policies set out local authority detailed policies for managing development in the unitary area and support the core strategy.

Development Control

The role of development control is important in ensuring that planning regulations are followed correctly. For example, in certain circumstances, the paving over of areas greater than 5m² without planning consent is not permitted.

4.1.7 Campaigns and Communication

Raising awareness of surface water flooding and efficient communication of the associated risks and responsibilities are important elements in managing surface water flood risk. Further detail and recommendations are set out in Section 4.2.14.

4.1.8 Measures Review

Table 4-6 sets out the applicability of the measures listed above for specific use within Church Stretton wetspots.

Measure	Applicability in Church Stretton	Suitable Wetspots
Improved Maintenance	Ash Brook and Town Brook	All
Attenuation Basins	Not Applicable	
Swales	Green margins besides roads	All where space is available.
Infiltration Basin	Not Applicable.	
Permeable Paving	Not Applicable.	
Roadside Rain Garden	Many roads in Church Stretton have existing green space between the carriageway and property curtilages.	Majority, at least partially.
Improve Drainage Network	Requirement for further information on these potential assets and their current capacity/performance	All
Watercourse Improvements	Ash Brook	Essex Road Railway Swains Meadow Town Brook Culvert

Table 4-6 Applicability of Measures in Church Stretton

4.2 Assess Options

Options Phase; Assess Options

This section of the report identifies the options available for the mitigation of surface water flooding in Church Stretton.

4.2.1 Priority Wetspots – Capital Works

Table 4-7 gives a description of the capital options identified. The nature, feasibility and benefits associated with each of the options are discussed in the following sections.

Option Reference	Option Name	Wetspot	Description	Justification
CS-1	Watercourse Improvements*[1]	Essex Road and Railway	Raise land levels or re-profile the right bank of the channel	This will reduce the flow entering Essex Road and adjacent areas during higher rainfall events, keeping flow within the channel and away from the urban area and rail infrastructure.

Option Reference	Option Name	Wetspot	Description	Justification
CS-2	Watercourse Improvements	Railway	Reinstate silt trap in Ash Brook at Carding Mill Valley	This will reduce transport of silt and stones and maintain channel capacity downstream of railway culvert.
CS-3	Culvert Improvements*[2]	Swain Meadow	Assess the required capacity and improve the culverts draining the west of Church Stretton. Increasing capacity within the brook should be investigated in Swain Meadow to provide additional storage/capacity	This will ensure the culverts have the ability to pass flow forward without flooding properties. Increased capacity within the open channel sections to offset potential increase risk downstream
CS-4	Culvert Improvements	Town Brook Culvert	Design and construct trash screen to current standards at entrance to Town Brook culvert at Rectory Gardens	This should greatly reduce the frequency and severity of the surface water flooding
CS-5	Improve Maintenance	All	Implement effective maintenance regime for all existing drainage systems. Maintenance would include regular inspection, cutting / mowing / vegetation and clearance of debris as required	This will reduce the potential for blockages by vegetation or deposition which could result in reduced hydraulic capacity.
CS-6	Planning Policy & Development Control	All	Develop and implement planning policies and development control for any proposed developments.	Planning policy has a key role in guiding the principles of surface water management and ensuring that they are sustainable, appropriate and enforceable. Development control is important in ensuring that planning regulations are followed correctly.

Table 4-7 Church Stretton Wetspot Options

*[1] The implication of the change to bank level or channel profile should be investigated to ensure flooding downstream is not increased.

*[2] The channel improvement would also require liaison with Network Rail due to the limited footprint available for any improvement and also the connection to Town Brook at the southern end of the drainage channel.

4.2.2 Non Priority Wetspots

For the wetspots which were not selected as top priority, the wider principles and non capital options set out in Section 4.2.8 should be followed.

4.2.3 Assessment of Capital Options

Methodology

Modelled Options

In order to assess the technical viability of the options presented, the ISIS TUFLOW models were altered accordingly.

CS1 Watercourse Improvements - Essex Road and Railway

The modelling indicates that the flooding of Essex Road and Ascot Close is generated by overtopping of Ash Brook on its right bank at the rear of Ascot Close. The flood waters then flow overland between the houses, over Essex Road and towards the railway line. The flooding only occurs for return periods in excess of 1.33% AEP (1 in 75 chance of occurring in any given year) and the indicative depths are a maximum of 100mm.

The flooding of the railway is a direct result of the overland flow from overtopping of Ash Brook at Ascot Close/Essex Road. The floodwaters enter the railway track and flow southwards where the depth of flooding increases to 250mm in the vicinity of the station platforms.

Raising the level of the low point in the bank would allow flows for the 1% AEP (1 in 100 chance of occurring in any given year) event to remain in channel and reduce flooding to 60 properties in Essex Road and the railway. However, a detailed survey of the bank levels is required to accurately determine the amount of bank works required.

The model has been re-run and indicates that if the flooding was prevented in this location the risk of flooding would not significantly increase to existing properties in other locations.

CS3 Culvert Improvements – Swain Meadows

The modelling shows that the flooding in the vicinity of Swains Meadow is caused directly by the under capacity of the open channel surface water drainage systems that serve the eastern side of Church Stretton. This is particularly relevant to watercourse TOWN03.

Floodwaters travel overland to the natural low spot at the bottom of the valley and try to enter the small drainage channel at the rear of Swains Meadow. The floodwaters cross Watling Street South, Crossways and through the gardens at Swains Meadow. The roads also act as conduits allowing the surface flooding to spread.

Improving the capacity of the culverts would reduce the risk of flooding to 68 properties, however further detailed modelling and inspections will be required to identify the locations for improvement works.

The depth of flooding in this location ranges from 100-300mm with low velocities.

CS4 Culvert Improvements – Town Brook Culvert

The issue of flooding at the entrance to the main Town Brook culvert has not been identified by the hydraulic model, despite significant overbank flow originating from this location during the floods of summer 2007, causing widespread overland flow throughout the Church Stretton town centre. It is possible that during the summer 2007 flooding the culvert trash screen became blocked by woody debris, which effectively blocked the watercourse at the culvert entrance, forcing it over the lower right bank and onto the roads.

The model was run with a complete blockage of the culvert entrance during the 1% AEP (1 in 100 chance of occurring in any given year) event and this was shown to cause overtopping of the right bank and flooding of the road and town in the mechanism and routes observed.

4.2.4 Non-Modelled Options

CS2 Watercourse Improvements – Railway

Silt and stones have been deposited in the Ash Brook channel downstream of the railway culvert where the velocity of flows is reduced due to a right angle bend in the river. This build up of material has not been modelled but large quantities of debris have recently been removed from this location.

There is the remains of a silt trap in the vicinity of Carding Mill Valley which if reinstated would reduce the transportation of silt and stones through the town.

CS5 Improved Maintenance

Improved maintenance has not been modelled explicitly as to do this would require additional details on the extent and condition of the surface water drainage network, and also the condition of the watercourses in order to assess the benefits in quantifiable terms

4.2.5 Environmental Assessment

At this stage, an assessment of the impacts of each option on the environmental, amenity and cultural receptors has not been undertaken. As part of a pre-feasibility study, a review of the potential impacts, positive and negative, on these receptors must be carried out.

4.2.6 Economic Assessment

In order to justify and present a business case for a proposed scheme, an economic assessment is required. In line with the latest Defra guidance[18] funding levels for a given scheme will relate directly to the number of households protected, level of damage prevented and the other benefits afforded by the scheme.

In a change from previous protocol, grants for surface water management and property level protection schemes will also be available. Where full funding for a scheme is not available, this new approach clarifies how much additional funding need be sourced or by how much the project costs need to be reduced. This contributes to meeting the recommendation from the Pitt Review which states that 'government should allow and encourage communities to invest in measures to protect them, so that more can be done whilst giving communities a bigger say'.

Further work will be required to undertake this economic assessment which will determine the costs and benefits associated with each proposed option.

Costs

The costs of providing the options have been estimated from industry standard pricing methods and are for indicative purposes only to be compared with the potential benefits derived. The costs are a guide as to the potential capital costs for implementation of the scheme only. As a result, costs have been provided as cost bands, reflecting the strategic nature of the SWMP study and options identification:

- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimum bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints

- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

Benefits

The benefits for any option has been derived by using the strategy level project appraisal method of calculation property damages in the DEFRA multicoloured manual.

4.2.7 Results

CS1 Watercourse Improvements - Essex Road and Railway

Assuming the bank needs to be raised by 0.45m over a length of 500m with a 2m crest width the estimated cost would be about £25,000.

In addition to the above capital cost the raised bank will need to be maintained for the 100 year lifetime. Assuming £100/year = £10,000

Total coats = £35,000

The annual average damages based on moving the flooding from a 75 year flood to a 100 year flood for 60 properties would be approximately ~ £675 – 700,000.

The benefit to cost ratio is therefore 1:19

With the above positive ratio it is recommended that this option is taken forward.

CS2 Watercourse Improvements – Railway

To build a new silt trap in a similar location to the existing is estimated to cost approximately £15,000.

In addition to the above capital cost the silt trap will need to be maintained for the 100 year lifetime. Assuming £100/year = £10,000

If these works were undertaken at the same time as CS1 then the total costs would be approximately £50,000.

Using the annual average damages calculated above the benefit to cost ratio would be 1:14.

With the above positive ratio it is recommended that these options CS1 and CS2 are taken forward together.

CS3 Culvert Improvements – Swain Meadows

Further detailed modelling will be required to determine the optimum size of culverts and priority locations for improvement. Assuming 500m of culvert will need replacing the estimated cost would be about £250,000.

In addition to the above capital cost the culvert will need to be maintained for the 100 year lifetime. Assuming minimal maintenance as new culverts designed to be self cleaning say £100/year = £10,000

Total costs approximately £260,000

The annual average damages based on moving the flooding from a 75 year flood to a 100 year flood for 68 properties would be about £750 – 800,000.

The benefit to cost ratio is therefore 1:3

(Note: as a sensitivity test if we assumed £500/year maintenance cost = £50,000 and the total cost = £300,000 the benefit to cost ratio would be 1:2.6)

With the above positive ratio it is recommended that this option is taken forward.

CS4 Culvert Improvements – Town Brook Culvert

The cost to construct a new trash screen is estimated to be approximately £7,500.

In addition to the above capital cost the screen will need to be maintained for the 100 year lifetime. Assuming £100/year = £10,000

Total costs – approximately £17,500

The annual average damages are difficult to assess, however with a relatively small capital investment it is recommended that this option is taken forward.

4.2.8 Non Capital Options

This chapter considers the non capital options that could be implemented in Church Stretton. They are discussed under the following headings:

- Data and Asset Management (Section 4.2.9)
- Planning Policy (Sections 4.2.10 – 4.2.12)
- Development Control (Section 4.2.13)
- Campaigns and Communication (Section 4.2.14)
- Emergency Planning (Section 4.2.5)

4.2.9 Data and Asset Management

Shropshire Council should ensure that it keeps up to date with current guidance concerning the development and maintenance of asset registers. Shropshire Council is currently using GIS to assimilate existing information and this should be continued. As the database develops, Shropshire Council will be in a position to identify those assets which they consider critical.

In addition, opportunities should be sought to obtain additional data on the drainage network to improve understanding. This may include new surveys, condition assessments and capacity analysis for example.

4.2.10 Planning Policy - Existing

Planning policy has a key role in guiding the principles of surface water management and ensuring that they are sustainable, appropriate and enforceable. There is one key planning policy document locally which discusses surface water management in relation to planning policy.

Core Strategy

The Shropshire Council Core Strategy[19] was published in February 2010 and includes Policy CS18 Sustainable Water Management which states, in relation to surface water management, that:

All development within local surface water drainage areas, as identified by the Water Cycle Study, and any major development proposals, demonstrate that surface water will be managed in a sustainable and coordinated way. Proposals should be supported by either a Surface Water Management Statement or Plan, depending on the scale of the development;

All developments, including changes to existing buildings, include appropriate sustainable drainage systems (SuDS) to manage surface water. All developments should aim to achieve a reduction in the existing runoff rate, but must not result in an increase in runoff

Further guidance on designing safe developments, surface water management and water efficiency will be provided in a Water Management SPD.

4.2.11 Planning Policy - Future

It is recommended that the policy CS18 from the Core Strategy is pursued.

SPD

The proposed future Water Management SPD should be used to communicate local solutions for mitigating any increases in surface water flood risk as well as adapting to the existing risks. The SPD should make use of the wide evidence base collected as part of the Local Development Framework and consequently share this with planning applicants, the development industry and the community. The Planning Advisory Service[20] notes the following benefits to addressing sustainable development through SPDs:

Sustainability SPDs can address sustainable development and climate change by:

- Providing more detail on policies in the core strategy;
- Giving local evidence and guidance to applicants on the requirements and opportunities in an area;
- Being flexible enough to account for changing local, regional and national policies;
- Helping development management officers implement strategic policies;
- Forming the basis for collaboration and internal training with officers, councillors and external partners; and
- Making the case for sustainable development by outlining the benefits to developers and the community.

Local Flood Risk Management Strategy (LFRMS)

The FWMA states that a LFRMS must contain certain information and draft guidance was produced by the Local Government Association (LGA) in February to assist LLFAs in producing the first round of local FRM strategies[21]. The local FRM strategy will specify the following:

- The risk management authorities in the LLFA area and what flood and coastal erosion risk management functions they may exercise in relation to the area. It will be important

for the local strategy to identify any special arrangements agreed in the area where functions normally carried out by one authority are done by another.

- The objectives for managing local flood risk. These should be relevant to the circumstances of the local area and reflect the level of local risk. The Regulations have a narrow scope focussing on identifying and addressing 'significant' flood risk. The scope of the local FRM strategy is not specified in FWMA and can be much wider to reflect the local circumstances.

- The measures proposed to achieve the objectives.

- How and when the measures are expected to be implemented.

- The costs and benefits of those measures and how they are to be paid for.

- The assessment of local flood risk for the purpose of the strategy. In the first instance it is likely that the LLFA will use the findings from the PFRA and any other studies that are available, such as Catchment Flood Management Plans and Strategic Flood Risk Assessments. The strategy can identify gaps in understanding of the local flood risk and specify what actions need to be taken to close these gaps.

- How and when the strategy is to be reviewed. A review cycle is not specified, so it is up to the LLFA to decide what is appropriate. It may be advisable to link it to the cycles for the Flood Risk Regulations outputs.

- How the strategy contributes to the achievement of wider environmental objectives

The LFRMS must consider a full range of measures including resilience and other approaches which minimise the impact of flooding. It must also interact with the National Flood and Coastal Erosion Risk Management strategy (published May 2011)[22] whilst maintain distinct objectives relevant to the local community.

The National strategy sets out long-term objectives for flood and coastal erosion risk management and how these will be achieved. The LGA draft LFRMS guidance is to be updated in line with this recent publication. In guiding the LFRMS, the national strategy aims to improve the communities who are at greatest risk. The strategy should also aim to encourage more effective risk management by enabling people, communities, business and the public sector to work together to:

- Ensure a clear understanding of national and local flood and erosion risks in order to effectively prioritise investment in risk management;

- Make clear and consistent risk management plans for risk management so that communities and businesses can make informed decisions;

- Encourage innovative management of flood and coastal erosion risks taking account of the needs of communities and the environment;

- Support communities in their response to flood warnings whilst also ensuring that emergency responses to flood incidents are effective;

- Assisting communities with rapid and effective recovery post flooding.

The LLFA has a duty to maintain and monitor the LFRMS.

4.2.12 Planning Policy - Specific

The following specific policies for Church Stretton should be considered as part of the SPD or future Development Management Policies:

Definition and maintenance of blue and green corridors

Efforts should be made and opportunities taken to create additional and protect the existing blue and green corridors. This will incorporate deculverting of watercourses, protection of the natural floodplain and seeking ways to link existing areas.

Regular and effective maintenance of watercourses

All watercourses should be inspected and maintained regularly to ensure that they are free of debris. Any structures on or in the watercourse should also be regularly inspected and maintained. Any known restrictive points in the system should be proactively inspected prior to significant rainfall events.

4.2.13 Development Control

Planned New Development

Although the level of planned development at present appears low, due attention should be paid to that which is planned and also to the potential for windfall sites. It is also highlighted that the cumulative impacts of piecemeal development can also be significant.

Existing Shropshire Council Guidance

Shropshire Council has produced an interim guidance document for developers which sets out the council's requirements for surface water management. Consultation on this document was closed in March 2011. It is the aspiration that this document will eventually be replaced by the proposed water management SPD. Shropshire Council should be consulted with reference to the key guidance points from this document which fall under the heading of:

- Runoff Rates; considering new development and re-development
- Surface Water Drainage; disposal methods, network requirements, ownerships and responsibilities
- SuDS; location, capacity, maintenance and responsibilities
- Designing for exceedance: principles and assessment of routes
- Role of river corridors

Proposed Additional Guidance

It is recommended that the following additional development guidance is provided:

- Information should be provided on any contributions required for strategic measures or local schemes. Refer to section 4.2.3 (economic assessment) for information on funding protocol.
- Information on any planned deviation from national guidance, permitted development rights or Article 4 Directions.
- Who should be consulted on new development and links to the asset register required under the FWMA in order to clarify ownership and responsibility.

- Use of the wetspots identified in this SWMP to further guide site specific flood risk assessments.
- Encouragement to use green roofs where appropriate
- How to generate / where to find information on SuDS suitability and proposals. For example CIRIA guidance, Buildings Regulations, ground investigations.

SuDS Specific Guidance

As well as the interim guidance produced by Shropshire Council, the following should be consulted and adhered to where necessary.

Standards and Regulations

The existing CIRIA SuDS guidance (SuDS Manual[23], Preliminary Rainfall Runoff Management for New Development[24] , Model Agreements and Interim Code of Practice for SuDS[25]) are referenced in the Shropshire Council guidance and provide a useful starting point for promoting SuDS uptake in Church Stretton.

Following the Flood and Water Management Act, Defra are developing national standards for the design, operation and maintenance of SuDS which will set out the criteria on which the type of drainage appropriate to any given site or development can be determined. These national standards will however make allowance for local conditions and take into account the costs and benefits of SuDS. These standards will be consulted on prior to their publication; consultation is currently expected in October 2010. Following this, the requirements of the Flood and Water Management Act relating to sustainable drainage are not expected to come into effect before April 2012.[26]

Adoption

The FWMA introduces the concept of a SuDS Approving Body (SAB), to be constituted by unitary authorities or county councils (LLFAs).

The role of a local SAB will be to approve local SuDS applications where construction work will have implications for the drainage system. They will apply strict standards that will achieve benefits for water quality as well as flood management. The SAB also has a duty to adopt SuDS providing they are constructed in accordance with the approved proposals and the system functions accordingly. As part of the approval process, the SAB can require a non-performance bond to be paid which would be refunded in full once the work was completed to the satisfaction of the approving body.

The FWMA also enables SABs to devolve the responsibility of SuDS adoption to other organisations such as land owners on the condition that all partners are in agreement.

This will ensure that the proposed ownership responsibilities are suitable and, in particular, that the responsibility for SuDS serving more than one property rests with an organisation that is both durable and accountable.

4.2.14 Campaigns and Communication

Alongside any capital schemes and proposed planning policies, there is a need to engage communities with the concept of surface water flood risk. Education is key to achieving this and therefore it is recommended that Shropshire Council, in conjunction with the Environment Agency, Severn Trent Water and Church Stretton Town Council where appropriate, consider the following:

Raising awareness of the impacts of increased impermeable areas

Educate residents and businesses with regard to the impacts of increasing impermeable areas within their properties. Use this opportunity to encourage the minimisation of impermeable areas. In conjunction with this raise awareness of the STW scheme for reduced sewerage charges which gives a 36% reduction if a property owner can demonstrate that no surface water drains to the public sewer system[27]. Shropshire Council should also look for opportunities to provide subsidies for permeable materials and any national schemes to this effect.

The responsibilities of riparian owners

Raising awareness of the duties of riparian owners, who are the riparian owners and how failure to meet the requirements of riparian ownership will impact on the immediate and wider area.

Supporting community groups

Continued support of community groups and forums as well as looking to broaden their understanding of surface water flooding. Engage these groups to assist Shropshire Council by monitoring the local area for littering of assets, rising water levels etc.

Community flood plans

A community flood plan helps community members and groups plan how they can work together to respond quickly in the event of a flood. The Environment Agency produce a guidance document for communities which is available on their website[28]. A flood plan will:

- Improve communication and ensure the most appropriate people are involved at each stage
- Optimise resources
- Help share knowledge
- Clarify responsibilities
- Encourage involvement of volunteers
- Reduce damage and distress

Developer forums

Facilitate developer forums where necessary to consider cumulative impacts and strategic solutions, as well as opportunities to reduce local flood risk.

Cumulative benefits of individual actions

Increase the uptake of water butts by householders and businesses either by raising awareness of existing subsidy schemes or by developing a Shropshire specific scheme. This will, cumulatively, help slow runoff into the surface water system.

Encourage residents to ‘green’ their gardens and cartilages, again to slow the entry of water into the surface water network.

4.2.15 Emergency Planning

Multi Agency Flood Plan

The information provided in the SWMP, including outputs from the FMfSW, AStSWF and modelling should be used to assist in the future development and revisions of the Shropshire Multi Agency Flood Plan (MAFP) which Category 1 Responders (SC in this case) are required

to produce[29]. Specifically this will include identifying safe evacuation routes, meeting points, traffic management arrangements, shelters and reception centres, vulnerable people, critical infrastructure as listed in the MAFP checklist[30].

Environment Agency Flood Warning

Church Stretton is not within an Environment Agency flood warning area.

5 Phase 4 – Implementation & Review

5.1 Action Plan

Implementation & Review Phase; Prepare Action Plan

The final output from a SWMP is an action plan which sets out the tasks identified, the responsibility for leadership and the timescales. The tasks below are a summary of the actions developed throughout this SWMP report and therefore previous Sections should be consulted for further details. The Church Stretton action plan is set out in Table 5-1.

ID	Action	Lead Responsibility	Timescale
CS1	Implement an effective maintenance regime for all existing council owned drainage systems. Maintenance would include regular inspection, cutting / mowing vegetation and clearance of debris / de-silting.	Shropshire Council	Continuous
CS2	Investigate the viability of raising land levels against re-profiling the right bank of Essex Road Channel. Includes a detailed design of watercourse improvements.	Shropshire Council	Medium Term
CS3	Investigate the opportunity to improve the conveyance and capacity of culverts draining west of Church Stretton.	Shropshire Council	Medium Term
CS4	Investigate the opportunity to increase the channel capacity within the brook in Swains Meadow to provide additional storage/ capacity.	Shropshire Council	Medium Term
CS5	Investigate the opportunity to undertake detailed design for construction of a silt trap at Carding Mill Valley.	Shropshire Council	Medium Term
CS6	Investigate the opportunity to undertake design of new trash screen for Town Brook culvert.	Shropshire Council	Medium Term
CS7	Assess the need to produce a route map of the watercourse and culverts in the Sandford Avenue area and contact riparian owners with a view to ensuring appropriate maintenance is undertaken.	Shropshire Council	Short Term
CS8	All parties to understand the location and status of their assets, so as to assist in the derivation of 'Critical' Assets.	Shropshire Council Severn Trent Water Environment Agency	Medium Term
CS9	Investigate feasibility and economics of property level protection in identified wetspots	Shropshire Council	Medium Term

ID	Action	Lead Responsibility	Timescale
CS10	Support and actively encourage Core Strategy Policy CS18	Shropshire Council	Immediate
CS11	Ensure that any proposed actions, guidance and policies make appropriate links to the Church Stretton Place Plan.	Shropshire Council	Continuous
CS12	Publish the proposed Water Management SPD	Shropshire Council	Short Term
CS13	Write LFRMS ensuring consistency with the principles of the national strategy. Consider the need for scrutiny and consultation.	Shropshire Council	Short Term
CS14	Review the most appropriate vehicle for implementing surface water drainage policies, noting that SPDs can only provide guidance rather than setting policy.	Shropshire Council	Short Term
CS15	Monitor and maintain the Shropshire Council Interim Guidance	Shropshire Council	Immediate
CS16	Ensure duties of the SAB, when they arrive, are maintained either by Shropshire Council or by devolving the responsibility to a third party	Shropshire Council	Short Term
CS17	Enhance communication with communities to develop the notion of responsibility for and ownership of flood risk management.	Shropshire Council / Church Stretton Town Council	Short Term
CS18	Continue to develop and maintain the Shropshire Multi Agency Flood Plan (MAFP)	Shropshire Council	Immediate
CS19	Encourage the Environment Agency Flood to establish a flood warning area.	Shropshire Council / Church Stretton Town Council / Environment Agency	Immediate

Table 5-1 Church Stretton Action Plan

5.1.1 Additional Hydraulic Modelling

In future, if further flooding occurs, Shropshire Council should consider whether additional hydraulic modelling would be beneficial in assessing solutions and quantifying flood risk. This could include more detailed and integrated urban drainage modelling to include for the presence of the sub-surface drainage network as well as the topographical catchment drainage network.

6 Conclusions and Recommendations

The key findings from this report are summarised below:

- A Surface Water Management Plan has been written for the market town of Church Stretton in Shropshire. This report presents the findings from all four phases of the SWMP process.
- Church Stretton lies at the headwaters of the Quinny Brook and Cound Brook.
- The partners identified as part of the Church Stretton SWMP are Shropshire Council, Severn Trent Water and the Environment Agency. Data sharing and licensing agreements were put in place to facilitate data sharing between partners

Strategic Level Assessment

- A strategic level assessment was carried out using existing information concerning flood risk for the whole of Shropshire:
  - Church Stretton was ranked seventh in Shropshire by DEFRA in terms of susceptibility to surface water flooding
  - Church Stretton was identified in the former Shropshire Districts Level 1 SFRA, whereby the Environment Agency's national flood maps had not identified the extent or route of fluvial flooding since the catchment areas were less than 3 km^2. Therefore, there were no defined flood zones within Church Stretton and should be addressed by detailed localised modelling studies of the watercourses.
  - The Shropshire Water Cycle Study identified Church Stretton as highly susceptible to surface water flooding. Flood risk is a constraint to development planned in Church Stretton.
  - Shropshire Council has also received communication from local residents highlighting their concerns about flooding in Church Stretton.
- Church Stretton was therefore progressed to the intermediate assessment phase.

Intermediate Assessment

- The intermediate assessment phase looked in detail at flood risk in Church Stretton:
  - The majority of the reports attribute flooding experienced to be the result of blockages of the surface water drains.
  - On both Hazler Road and Sandford Avenue the flooding is believed to be caused by a watercourse which flows at the rear of the properties on both these roads. Similar reports have also been made at the junction of Sandford Avenue (B4731) and Watling Street South.
  - Of particular concern is blockage of the channels where they pass under roads or the railway at the bottom of the valley. In 2000 the railway line was flooded.
  - In December 2006, flooding was reported from Ash Brook in Carding Mill Valley, just upstream of the houses between Carding Mill Valley Road and Longhills Road. Overland flow occurred down Carding Mill Valley road. This location has been subject to flooding in the past (1953, 1978 and in the summer of 2007), and upstream of the site a sediment trap was installed to reduce the sediment load during storm events which had been blocking the channel. An added impact at this location is the construction of boundary fences across the channel which can act as a barrier to flow during storm conditions.

- In the summer of 2007, Town Brook experienced out-of-bank flooding at Greenhills, close to the point at which the B5477 becomes the B4370. The flooding, illustrated in Figure 3.1, was mainly confined to the waterlogged fields either side of Cemetery Road, just off the main road. However, there are properties backing onto these fields which could be affected by more extreme flood events. It is thought that the flooding results from a combination of poor channel maintenance leading to both a reduction in channel capacity and blockages in culverts. It should be noted, however, this area is within the flood plain of the Town Brook. The EA has undertaken strategic maintenance along this stretch of the watercourse to improve the channel's capacity.
- It is noted that as of February 2011 there were seven entries on the DG5 register within the Church Stretton SWMP Study area.
- There have been no known recorded instances of groundwater levels rising above property thresholds and causing flooding / damage.
- Surface water flood risk is highlighted in Church Stretton by both the AStSWF and FMfSW maps.

- The intermediate phase identified areas of higher risk, termed wetspots, within Church Stretton based on historical flood records and future flood risk to properties and infrastructure.
- A type weighting and flood susceptibility weighting were applied to each receptor group as part of a 'multi criteria analysis' (MCA). The MCA score was divided by the area of the wetspot in order to provide an unbiased score. A rank score was then assigned based on the number of flood incidents recorded in the wetspot which was used as a multiplier for the MCA rank to give an overall priority score.
- In total, 17 wetspots were identified; nine due to historical flooding, and a further four with a likely future flood risk based on the FMfSW:
  - Essex Road
  - Railway
  - Swains Meadow
  - Walting Street South
  - Crossways
  - B4371
  - Snatchfields Lane
  - Greenhills
  - Meadow
  - High Street
  - Carding Mill Valley
  - Sandford Avenue West
  - Easthope Road
  - Ludlow Road
  - Central Avenue
  - Sandford Avenue East
  - Hazler Road
- From these wetspots, three have been progressed for specific comment in the optioneering stage. The three are:
  - Essex Road
  - Railway
  - Swains Meadow

Options Review

- The following potential high level mitigation measures were identified for further assessment:
  - Improved maintenance for all existing drainage systems. Maintenance would include regular inspection, cutting / mowing of vegetation and clearance of debris.
  - SuDS including attenuation basins, swales, infiltration basins, permeable paving, road side rain gardens
  - Raise land levels or re-profile the right bank of the channel along Essex Road
  - Reinstate silt trap in Ash Brook at Carding Mill Valley
  - Design and construct trash screen to current standards at entrance to Town Brook culvert at Rectory Gardens
  - Improve the conveyance and capacity of culverts draining the west of Church Stretton.
  - Increasing capacity within the brook in Swains Meadow to provide additional storage/capacity
  - Planning Policy and Development Control employed for potential developments in Church Stretton.
- An ISIS TUFLOW model was developed for Church Stretton and used to identify baseline flood risk and subsequently used to assess the attenuation options:
  - There were no major flooding issues uncovered through the hydraulic modelling, and those that were highlighted had already been identified prior to the study.
  - Flooding of the right bank from the weir adjacent to the houses off Ascot Close. This is due to low bank levels.
  - Flooding of fields adjacent to Cemetery Road/Ludlow Road at the Meadows
  - Modelling indicated the potential issues that could arise should such a trash screen not remain clear.
  - The flooding of Essex Road and Ascot Close is generated by the overtopping of Ash Brook on its right bank at the rear of Ascot Close. The flood waters then flow overland between the houses, over Essex Road and towards the railway line. The indicative depths are a maximum of 100mm.
  - The flooding of the railway is a direct result of the overland flow from overtopping of Ash Brook at Ascot Close/Essex Road. The floodwaters enter the railway track and flow southwards where the depth of flooding increases to 250mm in the vicinity of the station platforms.
  - The flooding in the vicinity of Swains Meadow is caused directly by the under capacity of the drainage systems that drain the eastern side of Church Stretton. The roads also act as conduits allowing the surface flooding to spread. The depth of flooding in this location ranges from 100-300mm with low velocities.
  - The issue of flooding at the entrance to the main Town Brook culvert at Rectory Gardens has not been identified by the hydraulic model despite significant overbank flow originating from this location during the floods of summer 2007.
- Both the Core Strategy and Church Stretton Place Plan indicate that surface water management is on the local agenda and further work should be done to consolidate this.

- The proposed future Water Management SPD should be used to communicate local solutions for mitigating any increases in surface water flood risk as well as adapting to the existing risks.
- Shropshire Council has produced a developer guidance document; this should be implemented as a specific SPD and Section 4.2.13 suggests some further points that could be incorporated.
- Section 4.2.14 sets out a series of recommendations in respect of campaigns and communication including responsibilities and ownership, community flood plans and groups and developer forums.
- The existing Multi Agency Flood Plan should be kept live and the existing Environment Agency flood warning scheme (due to be updated) should be actively communicated and developed with local residents and businesses.
- A Local Flood Risk Management Strategy (LFRMS) for Shropshire should be prepared that is informed by national guidance and includes for the specific elements identified within this SWMP report and Shropshire's PFRA.
- Shropshire Council should keep informed of the developing SuDS guidance and protocols and ensure that all duties both for internally and for third parties, are complied with.

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