Catchment Based Management in Worcestershire

Technical Background Document

June 2018

Environment Agency

Environment Agency West Midlands Area

worcestershire county council

Executive Summary

A key driver of the Worcestershire Minerals Local Plan is to consider the potential for mineral development in Worcestershire to positively impact on green infrastructure. The Environment Agency and Worcestershire County Council (in its role as Mineral Planning Authority and as Lead Local Flood Authority) have therefore been working together to develop a robust evidence base in support of this objective, setting out the water environment evidence and subsequent recommendations which can be used to inform a robust green infrastructure policy approach within the Local Plan. It is hoped that this detailed evidence base has the potential to be widened to inform the development of other strategic planning documents across Worcestershire in the future.

This technical background document sets out the joint approach that has been followed by the Environment Agency and Worcestershire County Council. It outlines the local evidence on flood risk, water quality and river morphology pressures and future management opportunities that has been brought together by the partners. It explains how this best available evidence has been combined into a catchment based tool for Worcestershire and sets out management guidelines and green infrastructure recommendations as a basis for targeting appropriate local policy.

In order to develop a comprehensive understanding of the water environment within Worcestershire, a number of local datasets have been combined by the partners.

The Communities at Risk dataset is an Environment Agency evidence base which, for the Worcestershire area, is owned and maintained by the Environment Agency West Midlands Area office. It is an established tool used by the Environment Agency, using modelled data, to identify areas of residential and commercial properties at flood risk and to provide a strategic steer on where these risks may need to be managed.

The Lead Local Flood Authority floodspot dataset provides a local record of historic flood incidents impacting residential properties, non-residential properties and key infrastructure within Worcestershire. When combined with the Communities at Risk dataset, it provides the best available evidence of flood risk across Worcestershire, taking into account both modelled future risks alongside known historic evidence of flood impacts.

The Water Framework Directive (WFD) classifies all waterbodies in England in terms of five Ecological classes (high, good, moderate, poor or bad). The ecological classes are a measure of the overall health of the waterbody based on water quality, hydromorphology and the biology that the waterbody supports.

These datasets have been overlain to catchment boundaries across Worcestershire, enabling a prioritisation based on each catchment's evidence of risk. The output of this work is a mapping tool for Worcestershire, which brings together an assessment of the datasets into a catchment based approach, enabling effective evidence based

targeting of flood risk management infrastructure and Water Framework Directive measures.

In terms of flood risk, a count has been made of the number of receptors (residential properties, non-residential properties and key infrastructure) to identify where there are particular clusterings of known flood incidents or future modelled risk. Each catchment has therefore been prioritised as follows:

- **LOW RISK** – 1 to 49 receptors
- **MEDIUM RISK** – 50 to 250 receptors
- **HIGH RISK** – More than 250 receptors

In terms of water quality, consideration has been given to the WFD overall status, the risk of deterioration and the presence of EU Natura 2000 (N2K) designated sites or drinking water protected areas. Based on these considerations, the catchments have been ranked as follows:

- **LOW RISK**- WFD good status or lower but the WFD objective has been met
- **MEDIUM RISK**- WFD status is less than good status and the WFD objective has not been met.
- **HIGH RISK**- WFD status is less than good status, there is a risk of or actual deterioration OR the catchment includes an at risk N2K water related site or Drinking Water Protected Area.

It is important to note that the assessment of risk differs according to whether it is in relation to flood risk (where the assessment is based on number of receptors) or water quality (where the assessment is based on WFD status and objectives). It is therefore necessary to review both these elements independently in order to gain a complete picture of catchment risk and relevant management measures. For example, a catchment may be low risk in terms of flood risk but high risk for water quality or vice versa. The below tables therefore set out the separate guidelines for risk based on whether it is flood risk or water quality.

Based on the evidence, the following general guidelines have been developed:

Overarching Aims:

- **For all new developments to prevent a deterioration in any WFD status, improve resilience to flooding and deliver a reduction in overall flood risk, wherever possible.**
- **To use the mapping tool to embed a catchment based approach in which the targeted delivery of flood risk management infrastructure and Water Framework Directive measures are appropriate in both scale and location to the proposed development.**
- **To use a catchment based approach to provide multifunctional green infrastructure benefits.**

To use the evidence as a basis for encouraging proactive engagement between developers and both the County Council, as the Lead Local Flood Authority, and the Environment Agency, to identify and assist the appropriate delivery of multifunctional flood risk management infrastructure to achieve betterment.

Worcestershire's Catchments	Mapping Evidence	Flood Risk Management Guidelines
All Catchments	• All of Worcestershire's catchments have some level of existing flood risk (No catchments have 0 receptors)	• Any developments across all catchments should not make the existing level of flood risk any worse, take into account the impacts of climate change and where possible deliver a reduction in overall flood risk.
Lower Risk Catchments	• 1-50 receptors	• Wherever possible developments should take opportunities to improve the existing situation through implementing on-site betterment measures. • Measures should provide a net gain in flood risk management as part of a multifunctional green infrastructure approach.
Medium Risk Catchments	• 51-250 receptors • Evidence of a clustering of existing receptors at flood risk. • Cumulative impact of development in these catchments is likely to make these existing catchment capacity constraints worse eg via permitted development which does not benefit from flood risk mitigation measures.	• Any developments should contribute to some level of reduction in flood risk within the catchment they are located. • Contributions can be made through implementation of relevant on-site flood management measures, such as: - multifunctional sustainable drainage techniques, - restoration of watercourses including culvert removal and floodplain reconnection, - flood risk management measures as part of wider infrastructure delivery eg local highway works. • Contributions to off-site measures such as: - assisting the delivery of offsite flood risk management projects - Natural flood management approaches - Local programmed flood risk management projects - Wider infrastructure delivery to incorporate drainage measures as part of an integrated infrastructure approach where appropriate and where it meets the tests of being necessary, related and proportional to the proposed development.
High Risk Catchments	• 251-2712 receptors • Significant clustering of	• In addition to the guidelines for medium risk catchments, developments in the

Worcestershire's Catchments	Mapping Evidence	Flood Risk Management Guidelines
	existing receptors at flood risk. • Cumulative impact of development in these catchments is likely to make these existing catchment capacity constraints worse eg via permitted development which does not benefit from flood risk mitigation measures.	higher risk catchments should provide evidence through their Flood Risk Assessment (FRA) of how the proposal delivers some level of reduction in the level of flood risk within the catchment they are located. • Given the scale of clustering in terms of the existing receptors, it is likely that the high risk catchments are particularly sensitive to the cumulative impacts of development.

Worcestershire's Catchments	Mapping Evidence	Water Framework Directive Guidelines
All Catchments	• All waterbodies must at least maintain current WFD status.	• Any developments across all catchments must prevent any deterioration in WFD status.
Lower Risk Catchments	• Waterbodies that are currently achieving their required WFD status objective.	• Wherever possible developments should take opportunities to improve the existing situation through implementing on-site betterment measures. • Measures should provide a net gain in water quality as part of a multifunctional green infrastructure approach
Medium Risk Catchments	• Waterbodies that currently not achieving their WFD status objective.	• Any developments should contribute to delivering of WFD improvement measures within the catchment they are located. • Contributions can be made through implementation measures, such as: - multifunctional sustainable drainage techniques, - restoration of watercourses including culvert removal and floodplain reconnection, - measure to tackle diffuse pollution • Contributions to off-site measures, such as assisting the delivery of WFD improvement projects where appropriate and where it meets the test of being necessary, related and proportional to the proposed development.
High Risk Catchments	• Waterbodies that contain a WFD 'Protected Area or Site'. • Waterbodies that have deteriorated in WFD status.	• In addition to the guidelines for medium risk catchments, developments in the higher risk catchments should contribute to the delivery of measures highlighted in the relevant Protected Area Plans for N2K sites, Drinking Water Protected Area Plans or required to reverse a deterioration in WFD status.

The guidelines seek to recognise that the catchment boundaries represent a whole system of interlinked watercourses and flow pathways. Interventions, such as new development proposals, in a part of a catchment can therefore have direct impacts in other parts of the catchment and an integrated approach to managing water is therefore recommended. A particular emphasis is placed on exploring how partnership working, particularly with the Environment Agency and the LLFA, can be used to deliver a set of integrated measures based on whole catchment risk and consider the full range of management opportunities that are available. This approach supports the proposed revisions set out in the consultation on the draft revised National Planning Policy Framework (March 2018) which clarifies that future Local Plans should have regard to the cumulative impacts of flood risk, rather than just the flood risk to or from individual development sites (paragraph 155).

In addition to the general guidelines, a detailed assessment has been undertaken for each proposed strategic corridor within the Minerals Local Plan. These strategic corridors seek to reflect where clusters of mineral resources exist and to direct appropriate green infrastructure enhancement measures which are best suited to the individual corridor in order to deliver multifunctional benefits. The detailed evidence on catchment flood risk and water quality has therefore been used alongside LiDAR data to identify the most appropriate green infrastructure measures, based on the specific environmental characteristics of each corridor.

1.0 Introduction

1.1 In partnership, the Environment Agency and Worcestershire County Council (in its role as Mineral Planning Authority and as Lead Local Flood Authority) have been working together to develop a robust evidence base in support of a green infrastructure policy approach within the Worcestershire Minerals Local Plan.

1.2 As part of the Green Infrastructure considerations, a particular focus has developed around Worcestershire's water environment highlighting how management at a catchment scale can deliver the multiple benefits of reducing flood risk whilst improving water quality and river ecology. This technical background document sets out the joint approach that has been developed by the Environment Agency and Worcestershire County Council. It outlines the local evidence on flood risk, water quality and river morphology pressures that has been brought together by the partners and explains how this can be applied through a catchment based tool to target appropriate local policy considerations through the draft Minerals Local Plan, with the potential for this to be widened to inform the development of other strategic planning documents in future

2.0 Background of Flood Risk Datasets

In order to develop a comprehensive understanding of existing flood risk within Worcestershire, a number of local data sets need to be considered.

2.1 Communities at Risk Data

2.1.1 The Communities at Risk dataset is an Environment Agency evidence base which, for the Worcestershire area, is owned and maintained by the Environment Agency West Midlands Area office. It is an established tool used by the Environment Agency to identify areas of residential and commercial properties at flood risk and to provide a strategic steer on where these risks may need to be managed.

2.1.2 The Communities at Risk dataset (see guidance in Appendix A) is based on all properties (commercial and residential) that fall within the Flood Zone 2 boundary. The established flood zone datasets use a combination of JFlow (generic modelling) and detailed hydraulic modelling, where available. In using the flood zone information, the Communities at Risk dataset therefore uses the best available evidence.

2.1.3 It is important to note that there are properties at risk of flooding that fall outside of this definition of a 'Community at Risk'. However, for the purpose of this document, the definition of 'a community' (as set out in Appendix A) enables understanding of where there is a clustering of areas at risk. As such, it provides merely a starting point for further investigation and discussion based on an understanding of where properties subject to flood risk is densest. Those areas falling outside the above definition of a

'community at risk' are likely to be recorded in other datasets, such as the Lead Local Flood Authority evidence base.

2.2 Lead Local Flood Authority Data

2.2.1 To ensure a comprehensive understanding of local risk, the Communities at Risk dataset should be used in combination with other localised flood risk data, evidence and intelligence.

2.2.2 The Lead Local Flood Authority (LLFA) has an extensive evidence base containing over 1,700 known floodspots in Worcestershire (see guidance in Appendix B). These floodspots are locations which are known to have flooded at some point in the past and include attribute data about: the flooding source; the number of impacted properties, businesses and pieces of critical infrastructure; the status of any mitigation work, and the lead Risk Management Authority. This LLFA floodspot data is the best available evidence of known flooding in Worcestershire.

3.0 Background of Water Framework Directive Datasets

3.1 The Water Framework Directive (WFD) classifies all waterbodies in England in terms of five Ecological classes (high, good, moderate, poor or bad). The ecological classes are a measure of the overall health of the waterbody based on water quality, hydromorphology and the biology that the waterbody supports. Waterbodies are required to meet Good Ecological Status (GES) by 2027.

3.2 Ecological status is reported on a triennial basis. Information is also available through River Basin District Management Plans on the pressure on waterbodies and the measures required to deliver WFD requirements.

4.0 Identifying Catchment Based Risk- Methodology for mapping tool

4.1 Purpose of Mapping Tool

4.1.1 In creating this mapping tool, the aim is to use the most up to date evidence of flood risk and the Water Framework Directive requirements to inform planning policy development in relation to prioritised and targeted catchment based interventions for the future management of flood risk and the wider environment.

4.1.2 It is intended that the mapping tool is a 'live' evidence base of catchment based data which will change over time as new evidence becomes available. As such, the tool captures and reflects the best available data at the time of publication and will be updated as and when significant chances to the source data occur.

4.2 Methodology- Developing the Mapping Tool

Catchment Boundaries

4.2.1 A key driver in developing the mapping tool was a recognition across the partners that flood risk management and the Water Framework Directive need addressing at a catchment scale rather than just at the site specific level. This is because water moves across water bodies and across landscapes, and therefore what happens in one part of a catchment can have a direct impact on another part of a catchment.

WFD Catchment Boundaries

4.2.2 There are 11 River Basin Districts in England and Wales. Worcestershire is wholly within the "Severn River Basin District". The River basin districts can be further broken down using The Water Framework Directive (WFD) waterbody catchments boundaries dataset. This is the smallest scale sub-set of the “Severn River Basin District”. These catchments contain no more than 1 waterbody stretch that meets any of the criteria for the WFD. There are 63 catchments in Worcestershire and they are used as the basis for the spatial analysis in the tool.

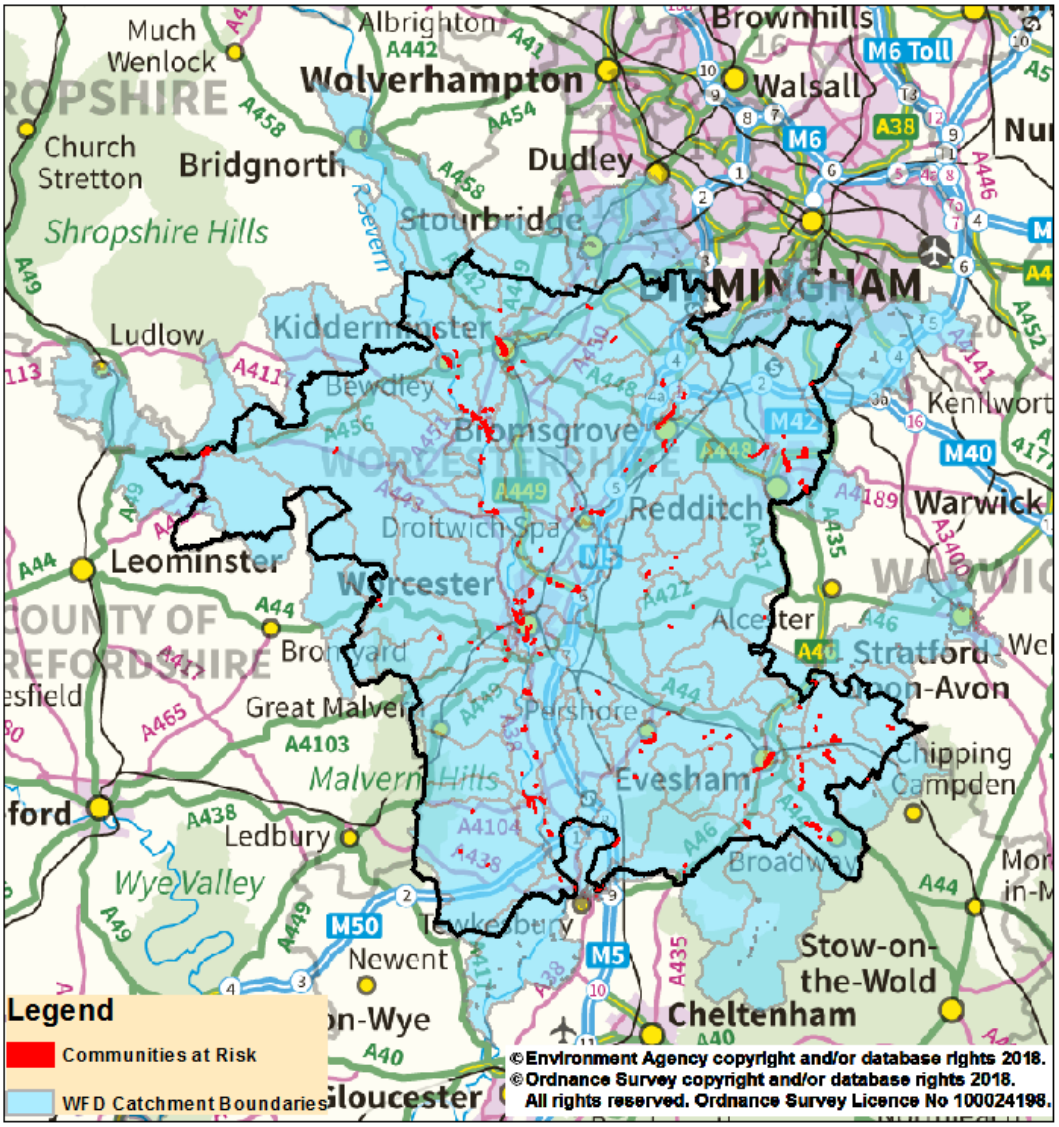
4.2.3 It should be noted, that whilst the focus of the tool is on Worcestershire County, the catchment based approach recognises that water movement and resultant management does not stop at the Local Authority administrative boundary. As such, the cross boundary parts of each WFD catchment have been included as part of the mapping process and will help steer cross boundary working between relevant partners in appropriate future flood risk management.

Understanding Flood Risk

Connecting Communities at Risk Data with WFD Waterbody Catchment Boundaries

4.2.4 To understand the existing evidence of flood risk within the above catchment boundaries, an initial step was taken to overlay the Environment Agency Communities at Risk GIS data with the WFD waterbody catchment boundaries.

Figure 1. Communities at Risk data overlying WFD waterbody catchment boundaries

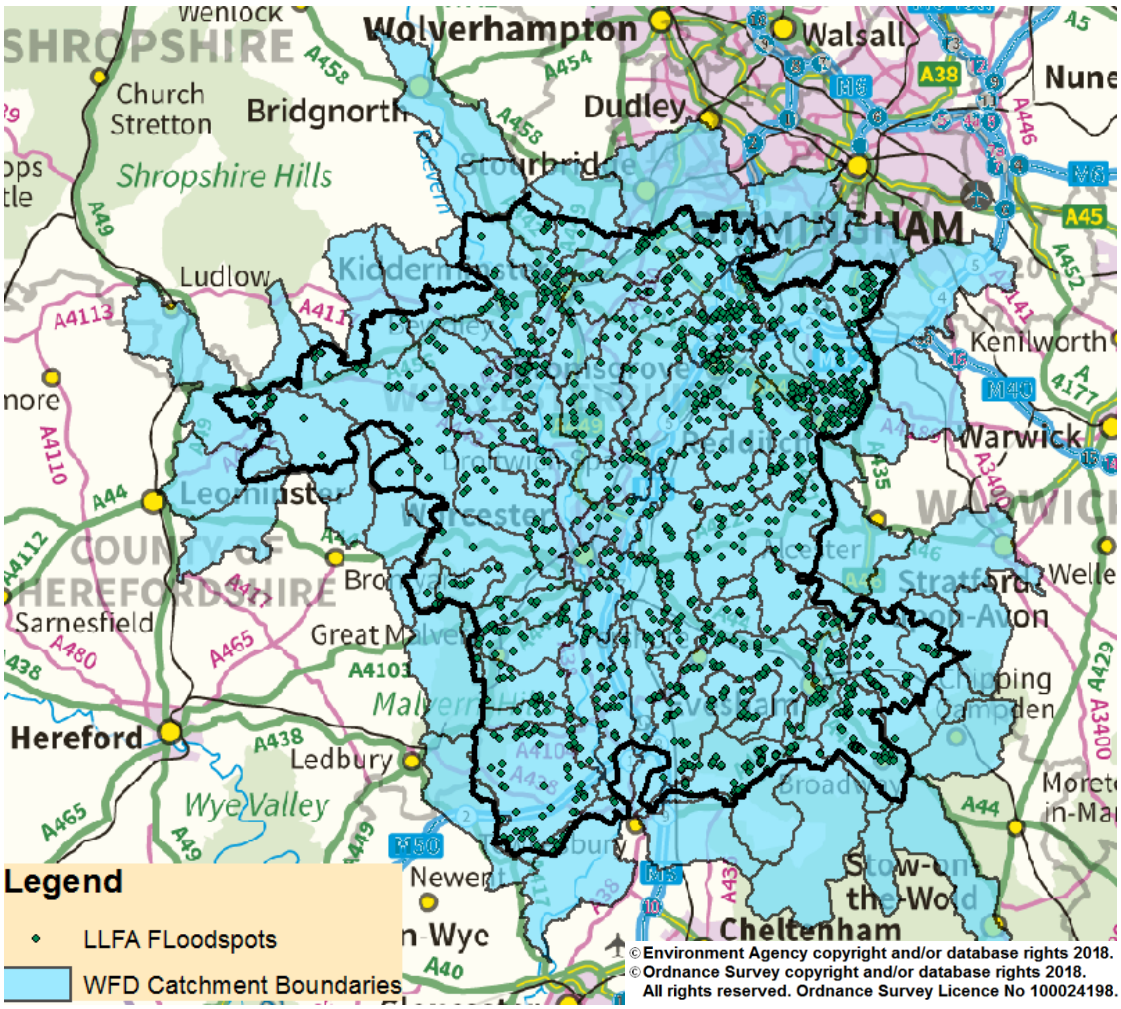


4.2.5 The resultant GIS layer provides a count per catchment of the number of receptors (residential and non-residential properties) at existing flood risk using the Catchment at Risk dataset. It therefore picks up any clustering of 10 or more residential and non-residential properties within each WFD catchment and provides a total count per catchment boundary.

Overlaying LLFA Floodspot Data with WFD Waterbody Catchment Boundaries

4.2.6 The same process was carried out for the LLFA floodspot data in terms of overlaying the dataset with the WFD waterbody catchment boundaries.

Figure 2. LLFA floodspot data overlying WFD waterbody catchment boundaries

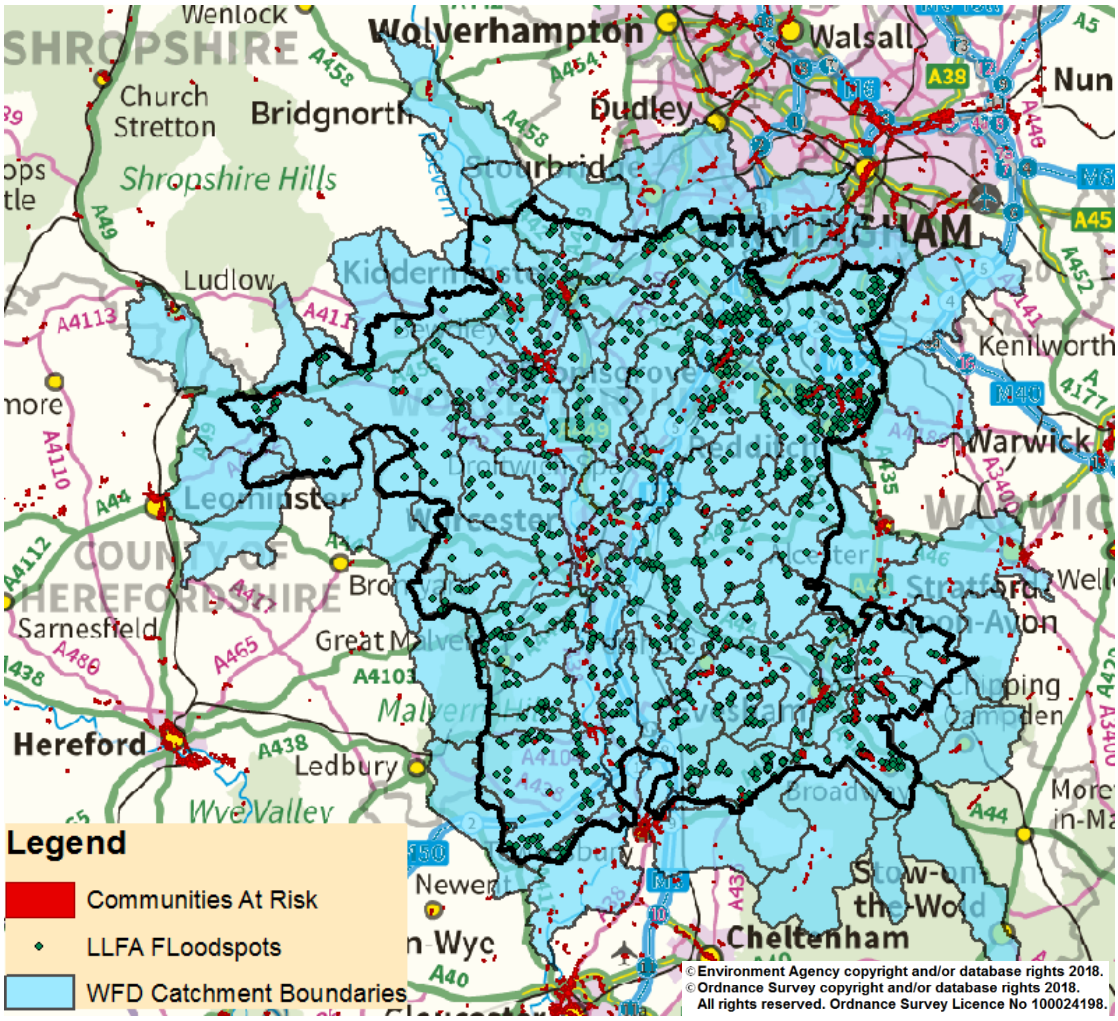


4.2.7 The combined LLFA floodspot and waterbody catchment boundaries dataset also provides a count per catchment on the number of receptors (residential properties, non-residential properties and critical infrastructure) which have experienced flooding at some point in the past.

Combining evidence on flood risk

4.2.8 To create a complete picture of existing flood risk across the catchment boundaries, both catchment maps were merged together to provide a combined dataset. This enables a picture to be established of both the modelled flood risk (Communities at Risk dataset) and historic evidence of flood incidents (LLFA dataset) across Worcestershire. As such, it provides us with our best available information on local flood risk across the catchment boundaries.

Figure 3. Communities at Risk and LLFA floodspot data overlying WFD waterbody catchment boundaries



Removing Double Counting

4.2.9 Work was undertaken to ensure that combining the modelled and historic flood risk mapping did not result in double counting. Where flood receptors appear in both the Communities at Risk and LLFA datasets, floodspots that are located within the boundary of a Community at Risk have been removed if:

- the source of flooding was from an Ordinary Watercourse, or;
- the source of flooding was from a Main River.

This is due to the inclusion of main rivers and ordinary watercourses in the modelling behind the Communities at Risk data. Floodspots created due to other sources of flooding were not removed, however. In taking this approach, we ensure that we are only picking up floodspots resulting from other sources of flooding within our Communities at Risk areas and are therefore removing any double counting.

4.2.10 There is a limitation with this filtering approach which means that there is not complete confidence all double counting has been removed. This limitation is due to how the LLFA dataset has been represented as a GIS layer.

4.2.11 Whilst the historic evidence of local flood incidents represented in the LLFA dataset are shown as points, it should be noted that this point data is the central location for each reported incident. It could therefore represent a number of properties rather than each individual property at risk. As such, there may still be some double counting where the central point within the LLFA dataset falls outside a Community at Risk boundary.

4.2.12 Given that this limitation is based on the original datasets rather than any interpretation of the data, it remains that the catchment based tool is based on the best available information. It is also felt that this limitation does not result in any spatial bias between catchments as this limitation applies to all catchments and does not therefore adversely impact one more than the other. As it applies across the whole of the study area it does not impact on how the catchments are prioritised based on the evidence of local flood risk.

Weighting for Historic Evidence

4.2.13 Consideration was given as to whether there should be some weighting added to the LLFA historic events dataset as this is based on known incidents rather than the modelled data within the Community at Risk dataset. However, the LLFA and EA agreed that equal consideration should be given to both the modelled Community at Risk dataset and the LLFA historic flood incident dataset as collectively they provide the best available evidence. It was also felt that any weighting would result in an unnecessary level of subjectivity which is not considered helpful for the purposes of this evidence led approach.

Catchment Size

4.2.14 It is recognised that the catchments vary significantly in size. Consideration was therefore given as to whether the outcomes of the combined data should be shown by density per catchment area, to reflect the size difference between catchments, or simply by the total number of receptors within each catchment.

4.2.15 It was agreed by the LLFA and EA that using the total count of receptors in each catchment most accurately reflects the local evidence of flood risk. It was also felt that consideration of the scale of the catchment and appropriate management measures would be most appropriately addressed through subsequent policy approaches rather than as part of the evidence based mapping tool.

Risk Thresholds- High, Medium and Low Risk Catchments

4.2.16 In order for the combined dataset to guide future flood risk management discussions in Worcestershire, there needs to be some interpretation on what

the combined evidence shows. To provide a high level assessment of local flood risk, it was agreed that the catchments should be simply ranked as to whether they are considered to be high, medium or low risk in relation to the existing evidence. This simple ranking of the catchments limits any subjectivity in how the datasets are interpreted.

4.2.17 The risk thresholds were selected through an iterative approach to refine initial Jenks natural breaks (statistically significant thresholds automatically set by ArcGis software- see glossary). Using professional experience and judgement by Environment Agency and Lead Local Flood Authority staff, the threshold levels were refined to most appropriately reflect the point at which a significant number of properties at flood risk require different levels of partner engagement to identify and deliver the most appropriate flood risk management measures.

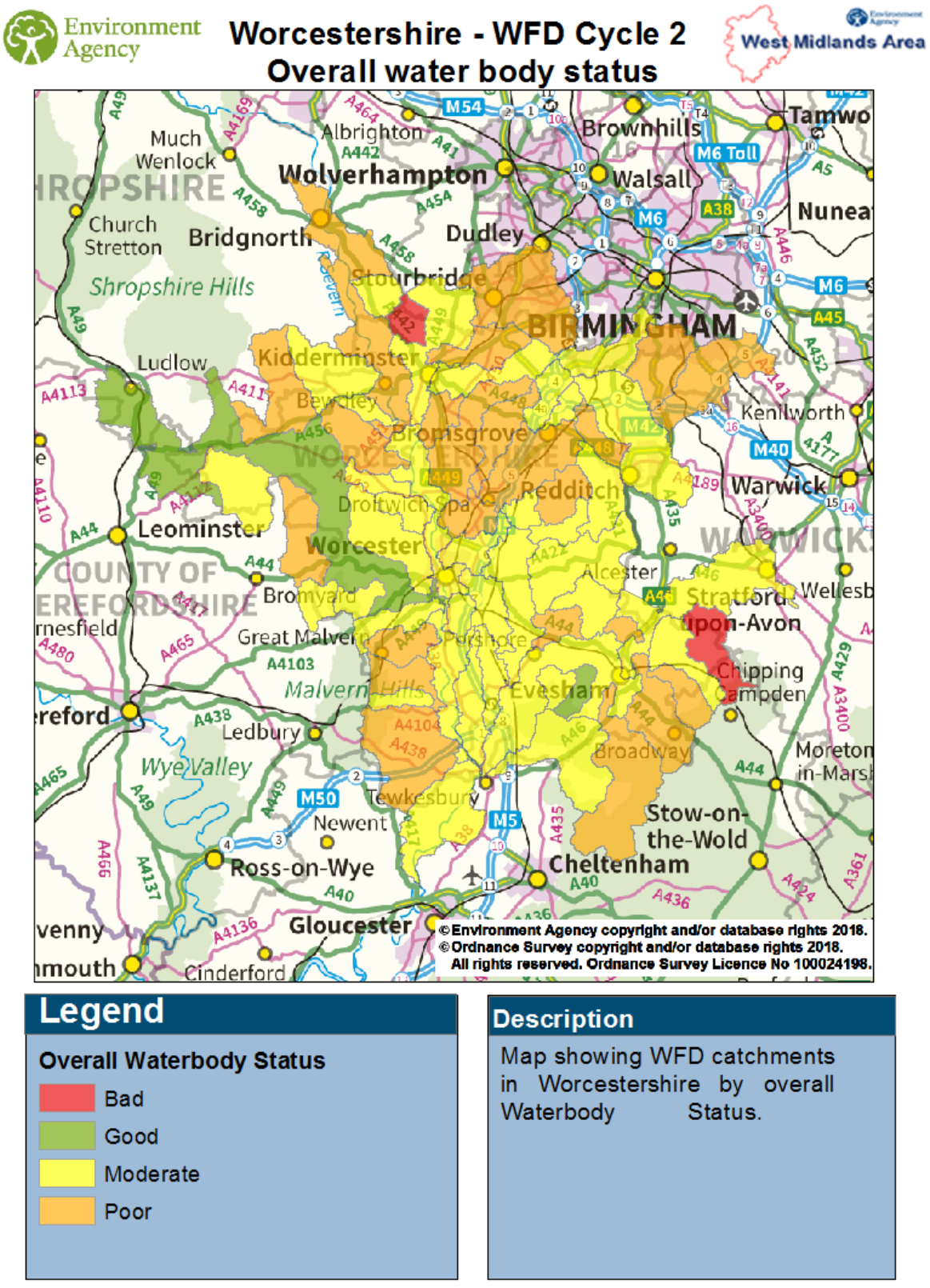
4.2.18 As a result of this process, the risk thresholds have been set as follows:

LOW RISK catchments – 1 to 49 receptors
MEDIUM RISK catchments – 50 to 250 receptors
HIGH RISK catchments – More than 250 receptors

Understanding Water Framework Directive Requirements

4.2.19 The below map sets out the waterbody status for each of the catchments within Worcestershire.

Figure 4. WFD Cycle 2 overall waterbody status



4.2.20 As with the flood risk evidence, some interpretation of this WFD evidence is needed in order to understand the overall catchment based requirements. To provide a summary overview of catchment based risk, the more detailed WFD catchment evidence has been brought together, to develop an understanding of which catchments are considered to be high, medium or low risk. This aligns with the approach undertaken for flood risk, enabling the evidence to be brought together into a single catchment based mapping tool.

4.2.21 In prioritising the catchments in this way, consideration has been given to the WFD overall status, the risk of deterioration and the presence of EU Natura 2000 (N2K) designated sites or Drinking Water Protected Area.

4.2.22 Based on these considerations, the catchments have been ranked as follows:

- **LOW RISK**- WFD good status or lower but the WFD objective has been met
- **MEDIUM RISK**- WFD status is less than good status and the WFD objective has not been met.
- **HIGH RISK**- WFD status is less than good status, there is a risk of or actual deterioration OR the catchment includes an at risk N2K water related site or Drinking Water Protected Area.

4.0 Verification of Draft Mapping Results

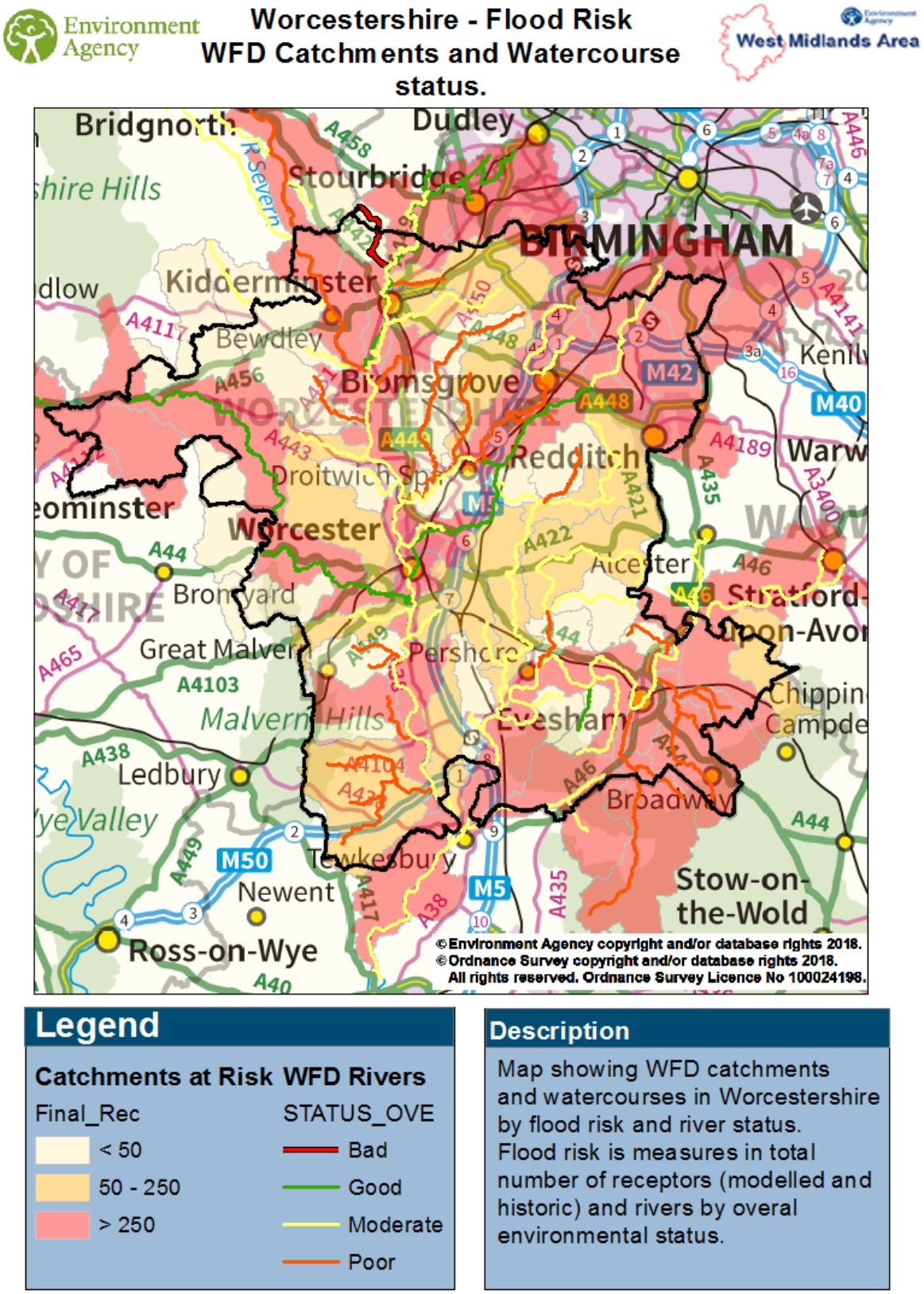
4.1 In developing the catchment based tool, it has been important to verify the mapping outcomes with both the original datasets and with local knowledge and experience on flood risk and Water Framework Directive requirements within the Worcestershire area.

4.2 Numerous meetings have therefore formed part of the work to develop the final mapping tool, including detailed conversations across the Environment Agency's Flood and Coastal Risk Management Teams, including officers from both the Partnerships and Strategic Overview Team and the Flood Risk Asset Performance Team alongside the Lead Local Flood Authority. These officers have in-depth local knowledge of flood risk and water quality within the Worcestershire area, having operated and dealt with local flood risk or water quality evidence for many years. These discussions verified the mapping outputs. No amendments were made to the mapping outcomes as a result of these discussions, as it was felt that the tool provides an accurate reflection of our local understanding of flood risk and water quality within Worcestershire.

5.0 Results

5.1 The below map set out the final catchment based mapping outcome, combining the local flood risk and WFD evidence base.

Figure 5. Flood risk and WFD watercourse status



5.2 As a complete tool, it is important to note that the thresholds shown provide a visualisation of the total number of receptors from both datasets and not an average. As such, the mapping tool provides our best evidence of the total known local flood risk within each catchment boundary across Worcestershire.

6.0 Recommendations

6.1 Context- A Catchment Based Approach

6.1.1 Over recent years, there has been a growing realisation that there is a need to develop an integrated catchment scale approach to managing the UKs rivers and floodplains. As identified by DEFRA, in the policy document 'Catchment Based Approach: Improving the quality of our water environment' (May 2013), catchments are a natural scale to consider the sustainable management of water bodies as they represent whole systems of interlinked watercourses and flow pathways.

6.1.2 As a result, nationally the Environment Agency has worked with partners to produce Catchment Flood Management Plans (CFMPs) and River Basin Management Plans (RBMPs). A Catchment based approach has therefore developed which recognises the need to link these River Basin Management Plans (detailing what action is required to achieve WFD outcomes) and CFMPs to promote sustainable approaches to managing the water environment and delivering multiple benefits. Given this strategic context, it is considered appropriate to build our understanding and develop effective water management measures at a catchment scale, when working locally to set local policy frameworks for decision making.

6.2 Opportunities- Effective Catchment Management

6.2.1 Catchment based management enables us to better understand the scale and extent of water management requirements now and in the future and enables better targeting of interventions to more effectively reduce the consequences of any environmental risks. Through the use of catchment based mapping, we have the opportunity to better understand where water management risks are likely to occur at a local level, and use this intelligence to:

- manage the risk in the catchment through influencing the layout, location and design of new developments; and
- implement the most appropriate and effective management measures.

6.2.2 Taking a catchment based approach therefore enables development of local water management policies which will deliver sustainable management for the longer term. This is essential if we are to make the right investment decisions for the future and to help prepare ourselves effectively for the impact of climate change.

6.2.3 To deliver positive and sustained outcomes for the water environment at a local level requires collaboration across the public, private and voluntary

sector. Engagement and collaboration therefore sits at the heart of a catchment based approach.

6.2.4 Developing and delivering an integrated set of catchment measures places a focus on how partnership working can be used to most effectively manage local flood risk. It enables the collaborative identification of options to address the level of risk and encourages agreement on implementing the most effective management mechanisms.

6.2.5 Development of a suite of catchment based management options therefore assists in reducing the potential impact on development viability. It enables a shift in approach from purely focusing on private sector site by site management, to one of true partnership at a catchment scale, with the resultant opportunity to pursue widespread collaborative delivery, bringing together collective resources to maximise water management outcomes.

6.2.6 The catchment based mapping for Worcestershire provides a robust baseline of local evidence to inform local policy requirements as part of the Worcestershire Minerals Local Plan.

6.2.7 Traditional approaches to flood risk management and the Water Framework Directive through planning focus on ensuring new development mitigates its impact by steering development to lowest risk areas. Such an approach, whilst ensuring new development does not increase risk elsewhere, does not however improve the existing level of risk within an area. For example, it means that communities and businesses remain vulnerable to the impact of existing flooding, which may become more extreme as a result of climate change. Effective water management must therefore include consideration of opportunities to combine mitigation and betterment outcomes.

6.2.8 The Worcestershire mapping tool aims to assist implementation of a catchment risk based approach which enables conversations around combined mitigation and betterment opportunities. It provides an evidence based framework for identifying opportunities and appropriate measures to deliver environmental betterment through implementation of on and off site management measures which could be embedded within planning policy and to guide proactive discussions between applicants for mineral workings within Worcestershire and the Lead Local Flood Authority and the Environment Agency. Such measures must be appropriate to both the scale and location of the proposed mineral developments, but identifying opportunities at a catchment scale means that, collectively, contributions could be made across multiple developments over the lifetime of the Minerals Local Plan which lead to greater results than if each site was considered individually.

6.2.9 The aim of this approach is not to place the onus solely on new developments to deliver catchment betterment measures, alongside their on-site mitigation. Instead it seeks to ensure that opportunities to jointly contribute to a reduction in flood risk and improve the waterbody status in terms of the Water Framework Directive are explored through proactive partnership working. The

aim is to ensure opportunities for partnership working are an integral part of the development management approach in Worcestershire from the outset.

6.2.10 The delivery of on and off site water management measures is also a central part of the Green Infrastructure approach which is embedded within the draft Worcestershire Minerals Local Plan. Such measures, albeit focused on providing betterment in terms of overall catchment risk, offer multiple environmental and socio-economic benefits, in terms of providing environmental assets which enhance biodiversity, landscape character and provide recreational resources.

6.3 Catchment Guidelines

6.3.1 Whilst it is important for any resultant catchment policies to be relevant and proportional to the proposed developed, the mapping tool and associated guidelines seek to ensure that local evidence of risk is taken into account.

General Principles

- **For all new developments to prevent a deterioration in any WFD status, improve resilience to flooding and deliver a reduction in overall flood risk, wherever possible.**
- **To use the mapping tool to embed a catchment based approach in which the targeted delivery of flood risk management infrastructure and Water Framework Directive measures are appropriate in both scale and location to the proposed development.**
- **To use a catchment based approach to provide multifunctional green infrastructure benefits.**

To use the evidence as a basis for encouraging proactive engagement between developers and both the County Council, as the Lead Local Flood Authority, and the Environment Agency, to identify and assist the appropriate delivery of multifunctional flood risk management infrastructure to achieve betterment.

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Lower Risk Catchments	• 1-50 receptors	• Wherever possible developments should take opportunities to improve the existing situation through implementing on-site betterment measures.

Worcestershire's Catchments	Mapping Evidence	Flood Risk Management Guidelines
		• Measures should provide a net gain in flood risk management as part of a multifunctional green infrastructure approach.
Medium Risk Catchments	• 51-250 receptors • Evidence of a clustering of existing receptors at flood risk. • Cumulative impact of development in these catchments is likely to make these existing catchment capacity constraints worse eg via permitted development which does not benefit from flood risk mitigation measures.	• Any developments should contribute to some level of reduction in flood risk within the catchment they are located. • Contributions can be made through implementation of relevant on-site flood management measures, such as: - multifunctional sustainable drainage techniques, - restoration of watercourses including culvert removal and floodplain reconnection, - flood risk management measures as part of wider infrastructure delivery eg local highway works. • Contributions to off-site measures such as: - assisting the delivery of offsite flood risk management projects - Natural flood management approaches - Local programmed flood risk management projects - Wider infrastructure delivery to incorporate drainage measures as part of an integrated infrastructure approach where appropriate and where it meets the tests of being necessary, related and proportional to the proposed development.
High Risk Catchments	• 251-2712 receptors • Significant clustering of existing receptors at flood risk. • Cumulative impact of development in these catchments is likely to make these existing catchment capacity constraints worse eg via permitted development which does not benefit from	• In addition to the guidelines for medium risk catchments, developments in the higher risk catchments should provide evidence through their Flood Risk Assessment (FRA) of how the proposal delivers some level of reduction in the level of flood risk within the catchment they are located. • Given the scale of clustering in terms of the existing receptors, it is likely that the high risk catchments are particularly sensitive to the cumulative

Worcestershire's Catchments	Mapping Evidence	Flood Risk Management Guidelines
	flood risk mitigation measures.	impacts of development.

Worcestershire's Catchments	Mapping Evidence	Water Framework Directive Guidelines
All Catchments	• All waterbodies must not be allowed to deteriorate from their current status.	• Any developments across all catchments must prevent any deterioration in WFD status.
Lower Risk Catchments	• Waterbodies that are currently achieving their required WFD status objective.	• Wherever possible developments should take opportunities to improve the existing situation through implementing on-site betterment measures. • Measures should provide a net gain in water quality as part of a multifunctional green infrastructure approach
Medium Risk Catchments	• Waterbodies that are currently not achieving their required WFD status objective.	• Any developments should contribute to delivering of WFD improvement measures within the catchment they are located. • Contributions can be made through implementation measures, such as: - multifunctional sustainable drainage techniques, - restoration of watercourses including culvert removal and floodplain reconnection, - measure to tackle diffuse pollution • Contributions to off-site measures, such as assisting the delivery of WFD improvement projects where appropriate and where it meets the test of being necessary, related and proportional to the proposed development.
High Risk Catchments	• Waterbodies that contain a WFD 'Protected Area or Site'. • Waterbodies that have deteriorated in WFD status.	• In addition to the guidelines for medium risk catchments, developments in the higher risk catchments should contribute to the delivery of measures highlighted in the relevant Protected Area Plans for N2K sites, Drinking Water Protected Areas or required to reverse a deterioration in WFD status.

6.4 Explanation of Management Guidelines

6.4.1 This approach recognises that catchment boundaries represent a whole system of interlinked watercourses and flow pathways. Interventions, such as new development proposals, in a part of a catchment can have direct impacts in other parts of the catchment and an integrated approach to managing water is therefore required.

6.4.2 The suggested guidelines are aimed at complementing the traditional site focussed policy mechanism, where development is steered to less vulnerable parts of a site. It provides a supportive policy approach recognising that developments can have impacts on the catchment beyond the site boundary and explores how partnership working can be used to deliver a set of integrated measures based on whole catchment risk and consider the full range of management opportunities that are available. As such, it supports the proposed approach set out in the consultation on the draft revised National Planning Policy Framework (March 2018) which clarifies that future Local Plans should have regard to the cumulative impacts of flood risk, rather than just the flood risk to or from individual development sites (paragraph 155).

6.4.3 Developing and delivering an integrated set of catchment measures in a collaborative way, is considered to be the most effective means of managing the water environment in the long term. It can also be the most cost effective option, through jointly exploring a suite of management measures, including:

- non-structural measures
    - new / improved flood warnings
    - flood resilient buildings
- green infrastructure assets
    - flood storage areas
    - wetlands
    - natural flood management
- conventional engineering infrastructure
    - flood walls
    - embankments

6.4.5 Using a suite of options to address water management will assist in reducing the potential impact on development viability as it encourages discussion with relevant partner organisations, enhancing the identification of collaborative delivery opportunities.

6.4.6 To explore such collaborative opportunities for delivering betterment within catchments which are necessary to make the development acceptable in planning terms, are directly related and are fairly and reasonably related in scale and kind to the development, applicants should engage proactively with the Environment Agency's Partnership and Strategic Overview Team on flood

risk management elements and the Land and Water Team for wider environmental enhancements, alongside Worcestershire County Council, as the Lead Local Flood Authority. The Environment Agency does also offer a bespoke technical advisory service for planning applications, to review and comment on the suitability of detailed proposals, which is delivered through the Sustainable Places Team.

7.0 Evidence of Betterment

Delivery of a Reduction in Catchment Flood Risk

7.1 Under the 2012 National Planning Policy Framework (NPPF) there is a requirement to complete Site Specific Flood Risk Assessments (FRAs) for all developments in flood zone 2 and 3 and all developments in flood zone 1 that are more than 1ha in size. As such, it is likely that all new mineral developments will require evidence of assessing local flood risk.

7.2 These site specific FRAs already include a detailed assessment of flood risk in relation to the development proposal. As such, this established requirement for detailed assessment can be used as a mechanism to provide evidence of delivery of betterment. The FRA should consider flood risk, both to the development and arising from the development, in the wider context of the catchment in which the development sits. Submitted FRA documents should also include full details of the betterment measures proposed that will deliver a reduction in the overall level of flood risk within the catchment.

7.3 The requirement to work proactively with both the County Council, as the Lead Local Flood Authority, and the Environment Agency enables early discussions and agreement on what approach is proportional to the development. Whilst the level of betterment required from a proposal is commensurate with the development's scale, the possible methods for demonstrating betterment may be similar, and include:

- creation of new, or updating of existing, hydraulic models which demonstrate reductions in peak flows in the catchment;
- visualisations which depict reduced flood outlines within the catchment and the subsequent reduction of flood risk to receptors;
- confirmation from delivery partners that the assistance of delivery of offsite betterment measures will result in reduced flood risk within the catchment.

8.0 Worcestershire Minerals Local Plan Strategic Corridors

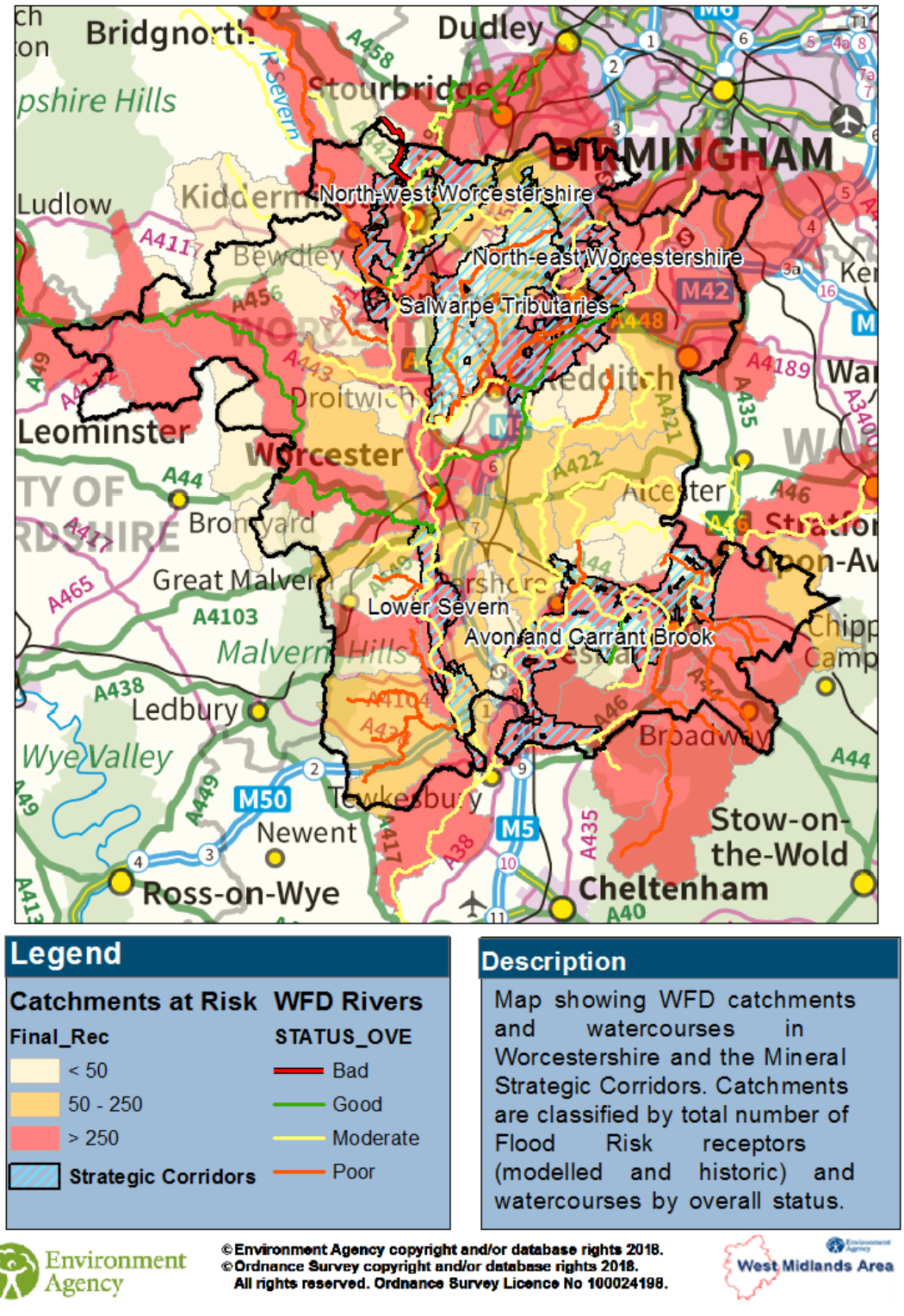
8.1 In order to direct mineral development to appropriate locations and realise the potential for minerals development to address some of Worcestershire's important economic, environmental and social issues, the Worcestershire Minerals Local Plan Third Stage Consultation (2017) identifies five strategic corridors for where mineral development should be located. These have been refined in developing the Fourth Stage Consultation.

8.2 A key driver of the Minerals Local Plan is to consider the potential for mineral development in Worcestershire to positively impact on green infrastructure. The strategic corridors therefore seek to reflect where clusters of mineral resources exist and to direct appropriate green infrastructure enhancement measures which are best suited to the individual corridor in order to deliver multifunctional benefits.

8.3 As the water environment is a key element of green infrastructure, the five strategic corridors have been overlain onto the catchment based mapping tool to identify the specific flood risk, WFD and river ecology considerations for each of the strategic corridors.

8.4 The below map provides an overview of the strategic corridors and the catchment based mapping evidence for flood risk and WFD.

Figure 6. Strategic corridors and catchment mapping evidence



Corridor Specific Evidence and Guidelines

8.5 Whilst the above sections of this document set out the evidence and general guidelines applicable to all catchments within Worcestershire, based on the

understanding of their existing environmental risk, it is important to look in more detail at the evidence for each of the strategic corridors. In this way corridor specific guidelines on the green infrastructure requirements and opportunities can be developed. This can be used to deliver the Plan's objective for mineral development in Worcestershire to positively impact on green infrastructure. As such, the below evidence should be used to inform the corridor specific policy requirements within the Minerals Local Plan.

General Principles

8.6 All development has the potential for impact downstream and upstream of its location. The extent and magnitude of the impact upstream will depend on site and activity specific criteria. However, the impact on receptors situated outside the strategic corridor boundary will be largely limited by the direction of the flow and its position relative to the works being carried out. Similarly, the impact on surface water flood risk is likely to be limited to receptors located within or around close proximity to the location of the mineral development.

Recommendations for All corridors
• All development consider downstream impact and mitigation • All development which may constrain conveyance must consider impact upstream. • All development which may affect multiple watercourses to consider sensitivities for potential impacts and mitigation opportunities at river confluences. • All development to take account of the specific recommendations for the catchment they are located within, set out in the catchment specific guidelines below.

1. Avon and Carrant Brook Strategic Corridor

Summary description

The Avon and Carrant Brook Strategic Corridor intersects 11 catchments. In terms of flood risk, 5 of these catchments are classified within the mapping tool as being high risk, 2 are classified as medium risk and 4 are classified as low risk. The majority (72%) of the strategic corridor is within catchments with a high risk of flooding. The corridor is therefore considered to be sensitive in terms of existing flood risk.

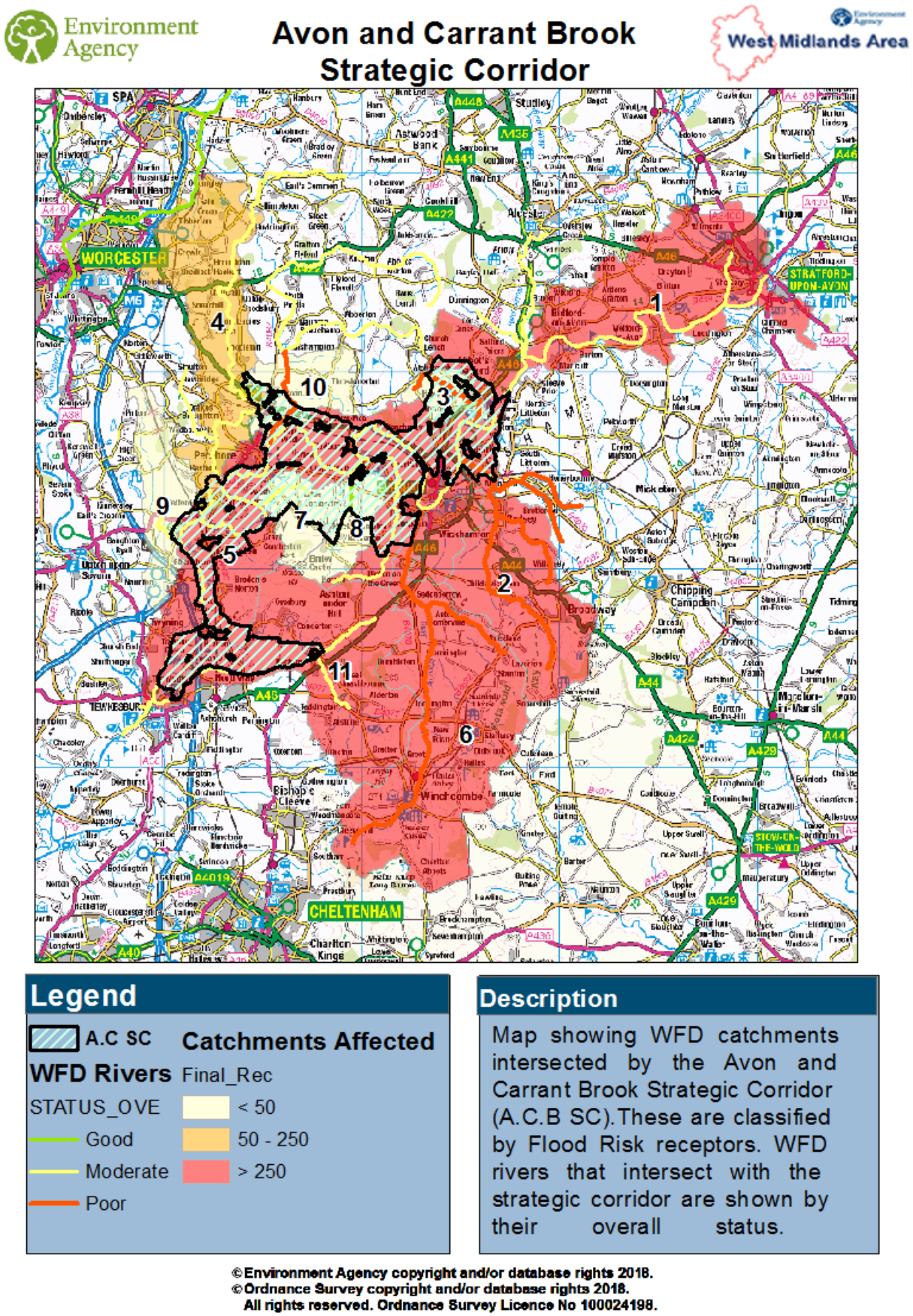
The corridor is mainly affected by fluvial flooding from the river Avon flowing in a north-eastern to south-western direction. Using currently best available modelled data and historic records, fluvial risk predominantly affects Tewksbury, Evesham, Pershore and Broadway. Local data suggests surface water flooding has historically affected multiple locations including Evesham, Lower Moor and Kemerton. There are also known ground water risk at Broadway, Bricklehampton, Cropthorne and Evesham.

In terms of WFD 8 of watercourses in the corridor are considered as Medium priority as they are not meeting their 2026 objective of Good Ecological Status (GES), 1 watercourse currently meets GES and is therefore Low priority. Actions required for some watercourses to meet GES have been assessed as either not technically feasible or non-cost beneficial. In these cases an alternative objective has been set. The remaining 2 watercourses fall

within this category and are considered as a Low priority as detailed in the Severn River Basin District Management Plan[1].

[1] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

Figure 7. Avon and Carrant Brook Strategic Corridor and catchment mapping evidence



Detailed Water Environment Evidence for Avon and Carrant Brook Strategic Corridor

(Please note the below figures are based on spatial analysis and are merely included to provide an indicative view on the data relating to each strategic corridor)

Floodspot data

Total Number of Floodspots in all catchments intersected by Strategic Corridor	Total Number of Floodspots inside Strategic Corridor	Total Number of Receptors associated to floodspots in all catchments	Total Number of Receptors associated to floodspots inside the strategic corridor	Source of flood risk for all Receptors (receptors can have more than one source of flood risk)							
				Main* River		Ordinary* WCR		Surface* Water		Ground* Water	
251	68	1316	261	290	135	441	67	1002	150	38	18

* (Left hand columns = in all catchments & Right hand columns = inside the Strategic corridor)

i) Communities at Risk data

Total Number of Communities at Risk in all catchments intersected by Strategic Corridor	Total Number of Communities at Risk inside Strategic Corridor	Total Receptors in all catchments intersected by Strategic Corridor	Total Receptors inside Strategic Corridor	Source for all Receptors			
				Main River*		Ordinary * WCR	
52	19	4193	1639	3753	1526	440	113

* (Left hand columns = in all catchments & Right hand columns = inside the Strategic corridor)

ii) Water Framework Directive data

Total number of watercourses in catchments intersected by Strategic Corridor	Total number of watercourses at 'Good' status	Total Number of 'Moderate' status	Total number at 'Poor' status	Main reasons for classification
11	1	6	4	• Physical modification to water courses. • Diffuse pollution from agriculture. • Impacts on flow from abstractions • Pollution from wastewater

iii) Catchment data

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
Avon Tramway Brook Stratford to Workman Brook Evesham. (1)	**HIGH RISK** - The catchment marginally encroaches into the corridor through the River Avon, including the confluence with the Harvington Brook. Main settlements include Offenham, Stratford and Evesham. Data suggests there are 19 historic and 2156 modelled receptors at risk, predominantly situated in the upstream reach of the catchment and around the boundary of the corridor in Evesham. The latter could be vulnerable to interventions inside the catchment and the corridor.	**MEDIUM PRIORITY –** The brook is at Moderate Status due to impacts from physical modifications and diffuse pollution resulting in elevated phosphate levels.
Broadway Badsey Brook source to confluence River Avon (2)	**HIGH RISK** - The catchment is only very marginally within the corridor on its northern extent at the confluence with the River Avon and excludes most of the vulnerable areas such as Broadway where the EA are currently building a flood storage area. Data suggests there are 9 receptors inside the corridor, from surface water and ordinary watercourse sources. Works on southern boundary should consider impact to upstream receptors such as Aldington and Badsey. This catchment has been selected as part of a Natural Flood Management (NFM) scheme. In total there are 213 receptors from historic sources and 566 from modelled data.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Harvington Brook Source to confluence River Avon (3)	**LOW RISK**- Most of the catchment is situated within the corridor, the Harvington Brook flows south into the Avon north of Evesham. Data suggests 19 receptors from historic data, predominantly	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.

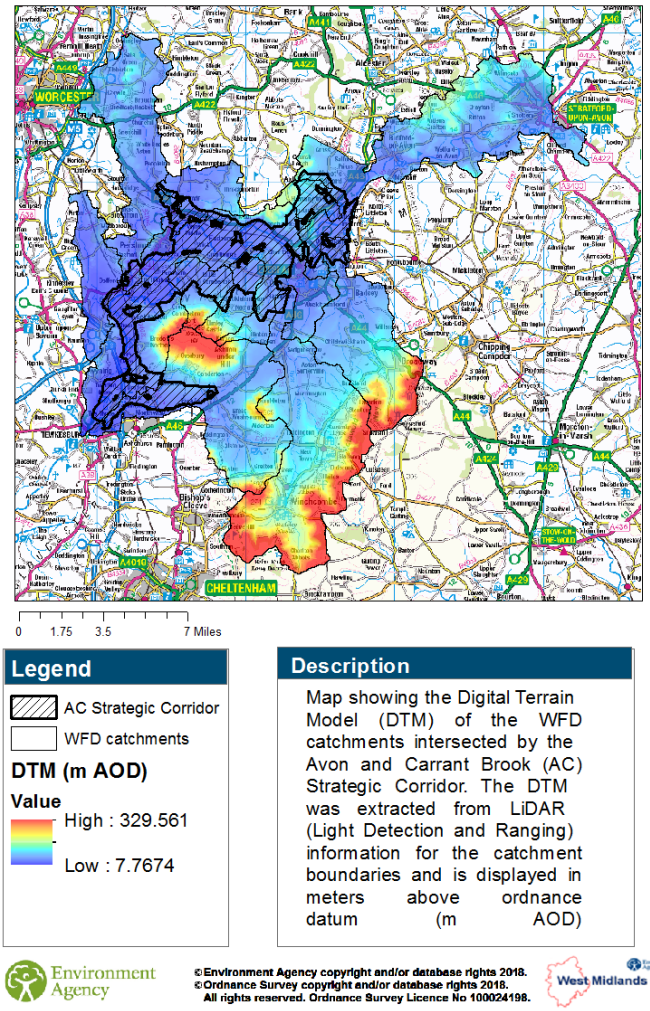
Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
	from surface water. There are no modelled receptors from our communities at risk database.	
Bow Brook & Shell Brook to Confluence River Avon (4)	**MEDIUM RISK**- Catchment marginally encroaches into the corridor alongside the Bow Brook east of Drakes Broughton and in Defford at the confluence with the River Avon. Records of historic flooding suggest surface water issues at Pinvin. There is a total of 212 receptors. On the other hand communities at risk information does not show any data within the catchment.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels.
Avon confluence Workman Brook, Evesham to confluence River Severn (5)	**HIGH RISK** - Covering 52% of the corridor's area and around 35km of the River Avon, this is therefore main catchment of the Avon and Carrant Brook strategic corridor. This catchment also contains the main settlements including Evesham and Pershore and has over 240 receptors that have historically experienced surface water flooding. Modelled data also suggests there are 2358 receptors vulnerable to fluvial flooding, 211 of which benefit from an existing raised embankment and wall in Pershore. For the most part modelled receptors are located in Tewkesbury, Evesham and Pershore. In total there are 499 receptors from historic records.	**LOW PRIORITY –** The brook is at Moderate status due to impacts from, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The River currently meets its required status. The River is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.
Isbourne Source to confluence River Avon (6)	**HIGH RISK** - Only a very small area of this catchment intersects with the corridor near the confluence with the River Avon (less than 1km^2 square out of a total 87km^2 squared). In addition, the boundary does not extend into the River Isbourne itself, therefore the potential for	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications and diffuse pollution resulting in elevated phosphate levels and impacts on river ecology.

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
	impact in this catchment is very small and limited to measures inside the catchment affecting drainage and runoff into the Isbourne. This catchment has been selected as part of a NFM scheme. In total there are 36 receptors from historic records and 403 from modelled data.	
Mary Brook Source to confluence River Avon (7)	**LOW RISK**- The corridor encroaches into the northern boundary of the catchment including Bricklehampton and Little Comberton. The Mary brook is an ordinary watercourse flowing from east to west into the River Avon. In addition, it largely flows through agricultural land and potential to impact residential or commercial receptors is therefore small. Historic evidence suggests 43 receptors have been affected by flooding predominantly from surface water and ordinary watercourse. This catchment has been selected as part of a NFM scheme. There are no modelled records from our communities at risk database.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Elmley Castle Source to confluence River Avon (8)	**LOW RISK**- The mineral corridor encroaches into the northern section of the catchment at the confluence with the Avon in Cropthorne. Data suggests 22 receptors predominantly from ordinary watercourse and surface water, impacts affect highways infrastructure. In addition there are 14 receptors from our communities at risk database at Cropthorne.	**LOW PRIORITY –** The brook currently meets Good Status. Any developments in the catchment must not cause the Brook to deteriorate from this status.
Bourne Brook Source to confluence River Avon	**LOW RISK-** Historic records suggest 30 receptors vulnerable to surface water flooding. In addition, there are no modelled records from our	**LOW PRIORITY –** The brook is at Moderate status due to impacts from, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
(9)	communities at risk database. The corridor follows and touches the boundary of this catchment but there is no tangible encroachment. Impact from work in the corridor is therefore unlikely.	in low dissolved oxygen, elevated phosphate levels and impacts on river ecology. The River currently meets its required status.
Piddle Brook confluence Whitsun Brook to Home FM, Pinvin (10)	**LOW RISK**- The minerals corridor encroaches into the catchment at Wyre piddle including the confluence with the River Avon. Historic data suggests there are 39 receptors vulnerable to surface water and the ordinary watercourse. This includes highway infrastructure. In addition, modelled data shows 10 receptors at Wyre Piddle.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Carrant Brook Source to confluence with River Avon (11)	**HIGH RISK**- Catchment is partially within the corridor along its eastern boundary towards the confluence with the river Avon. Modelled information suggests there are 1996 receptors at risk of fluvial flooding, these are primarily in Tewksbury and therefore outside of the corridor boundary. However these could be vulnerable to interventions inside the corridor affecting the river Avon and the Carrant Brook. In addition, historic records suggest 179 receptors have been affected by flooding, primarily from ordinary watercourse and surface water. The main settlement inside the corridor is Beckford.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.

Avon and Carrant Brook Strategic Corridor Recommendations

This corridor predominantly covers the lower parts of the WFD river catchment it intersects with. As expected, LiDAR shows this corridor is therefore located amongst flat valleys with wide floodplains away from the source of runoff generation. From a flood risk perspective, in this corridor the greatest benefits will therefore be realised through Green Infrastructure measures associated with flood storage and floodplain connectivity. This will have the potential to reduce flood risk by increasing storage volumes and encouraging overland flows in less vulnerable floodplain areas. The shape or form of these green infrastructures measures can vary but the overarching aim should be to attenuate river flood flows and pathways to provide onsite and offsite benefits. In addition, measures such as channel re-meandering and woody debris may not be suitable for a river of the size and volume of the River Avon but are likely to be more appropriate in the smaller watercourses. These green infrastrucutre measures will also have the potential to contribute to WFD improvements through improving water quality and river habitat.



Examples of Green infrastructure measures

1. **Floodplain and Riverside Vegetation:**

This intervention involves planting up floodplain and riverside woodlands to slow overland flows, increase infiltration and interception of rain and slow the velocity of water entering rivers. Other vegetation types (such as hedgerows and trees along watercourses) may be suitable if these provide similar benefits through increased roughness.

2. **Woody Debris:**

As this corridor is in the lower reaches of the catchment, suitable techniques are likely to take the form of securely installing woody debris to assist the transfer of water from the river to the floodplain to increase floodplain storage volumes, or slow down flows within the channel, to increase the lag to peak and reduce peak levels.

3. **Built Water Storage:**

This involves diverting water from the river network to create temporary storage (ponds, washland, reconnected floodplain) and attenuate flood risk downstream. The storage feature would usually drain through an outflow structure at a controlled rate.

4. **Urban flood corridors:**

Given that there are some urbanised areas in the vicinity of the corridor, there may be opportunities for 'making Space for water' along urban rivers through the creation of floodways with room to store and convey flood water, particularly if these opportunities can be linked to new or redevelopment. This may also include culvert removal, channel naturalisation and SuDS.

5. Channel re-meandering:
This involves meandering straightened rivers or reconnecting historic meanders. These measures attenuate flood risk by improving links between the river and the floodplain and slowing the flow by reducing river slope and increasing length.

2. Lower Severn Strategic Corridor

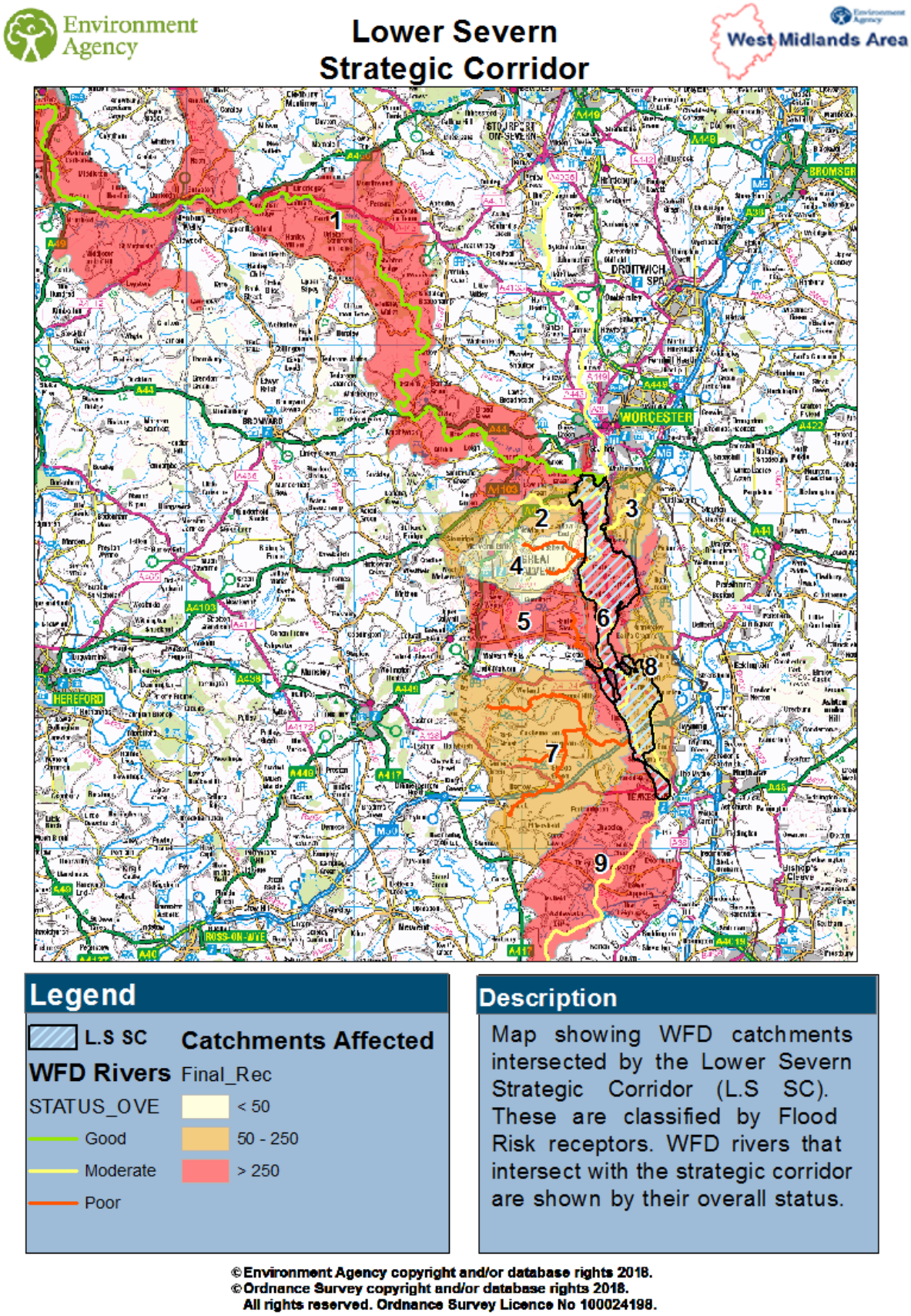
Summary description
The Lower Severn Strategic Corridor intersects 10 catchments. In terms of the flood risk, 5 of these catchments are classified within the mapping tool as being high risk, 4 are classified as medium risk and 1 is classified as low risk. The majority (69%) of the strategic mineral corridor is within catchments with a high risk of flooding. The corridor is therefore considered to be sensitive in terms of existing flood risk.

The corridor is mainly affected by fluvial flooding from the river Severn flowing in a north to south direction. Using currently best available modelled data and historic records, fluvial risk in these catchments predominantly affects Upton Upon Severn, Worcester, Kempsey and Tewksbury. In total, modelling suggests 3415 receptors are at risk from fluvial flooding, 1138 of which are located inside the strategic corridor. Local data suggests surface water flooding has historically affected multiple locations including Hanley Castle, Severn Stoke and Naunton. There are also known ground water issues in the upper Severn and the Bushley Longdon Brook river catchments.

In terms of WFD, 1 watercourse is considered to be a High priority as it designated as a Drinking Water Protected Area, 7 of watercourses in the corridor are considered as Medium priority as they are not meeting their 2026 objective of Good Ecological Status. Actions required for some watercourses to meet GES have been assesses as either not technically feasible or non-cost beneficial. In these cases an alternative objective has been set. The remaining 2 watercourses fall within this category and are considered as a Low priority as they are meeting this alternative objective as detailed in the Severn River Basin District Management Plan[2].

[2] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

Figure 8. Lower Severn Strategic Corridor and catchment mapping evidence



Detailed Water Environment Evidence for Lower Severn Strategic Corridor

(Please note the below figures are based on spatial analysis and are merely included to provide an indicative view on the data relating to each strategic corridor)

i) Floodspot data

Total Number of Floodspots in all catchments intersected by Strategic Corridor	Total Number of Floodspots inside Strategic Corridor	Total Number of Receptors associated to floodspots in all catchments	Total Number of Receptors associated to floodspots inside Strategic Corridor	Source of flood risk for all Receptors (receptors can have more than one source of flood risk)							
				Main River*		Ordinary WCR*		Surface Water*		Ground Water*	
219	21	426	47	57	11	192	15	253	25	4	0

* (Left hand columns = in all catchments & Right hand columns = inside the Strategic corridor)

ii) Communities at Risk data

Total Number of Communities at Risk in all catchments intersected by Strategic Corridor	Total Number of Communities at Risk inside Strategic Corridor	Total Receptors in all catchments intersected by Strategic Corridor	Total Receptors inside Strategic Corridor	Source for all Receptors			
				Main River*		Ordinary WCR*	
54	16	2396	1138	1628	882	768	370

* (Left hand columns = in all catchments & Right hand columns= inside the Strategic corridor)

iii) Water Framework Directive data

Total number of watercourses intersected by Strategic Corridor	Total number of watercourses at 'Good' status	Total Number of 'Moderate' status	Total number at 'Poor' status	Main reasons for designation
10	1	6	3	• Physical modification to water courses. • Diffuse pollution from agriculture. • Impacts on flow from abstractions • Pollution from wastewater.

iv) Catchment data

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
Teme - conf R Onny to conf R Severn (1)	**HIGH RISK –** This catchment follows the river Teme from Ludlow to its confluence with the River Severn where it encroaches into the corridor boundary. Modelled data suggests there are 749 receptors from fluvial flood risk, these are primarily concentrated in Ludlow and Tenbury. Historic records suggest 72 receptors spread throughout the catchment with the greatest numbers located in Eardiston. These are mainly affected by Surface water flooding.	**HIGH PRIORITY –** The River is designated as a Drinking Water Protected Area and actions to protect and improve water quality (from nutrients and pesticides) are a priority. The River is at Good status.
Careys Bk - source to conf R Severn (2)	**MEDIUM RISK –** The Careys Brook flows on a west to east direction draining into the strategic corridor and the River Severn near Powick. Modelling information in this catchment suggests 30 receptors at risk from fluvial flooding, of which 21 receptors benefit from a current scheme in Powick. Historic records suggest 24 recorded receptors at risk including surface water issues particularly at the top of the catchment; and flooding from the ordinary watercourse following the brook.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from Sewage Treatment Works discharges and diffuse pollution, resulting in elevated phosphate levels.
Hatfield Bk - source to R Severn (3)	**MEDIUM RISK –** This brook flows through Kempsey and into the River Severn; where it encroaches into the mineral corridor. Any impacts and opportunities for betterment raised by the mineral works should consider the interaction between the two watercourses and the effects on Kempsey. Historic records suggests 18 receptors and modelled data 151, 96 of which currently benefits from a capital scheme in Kempsey.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from Sewage Treatment Works discharges and diffuse pollution, resulting in elevated phosphate levels.
Madresfield Bk -	**LOW RISK –** The Madresfield	**MEDIUM PRIORITY –** The brook is

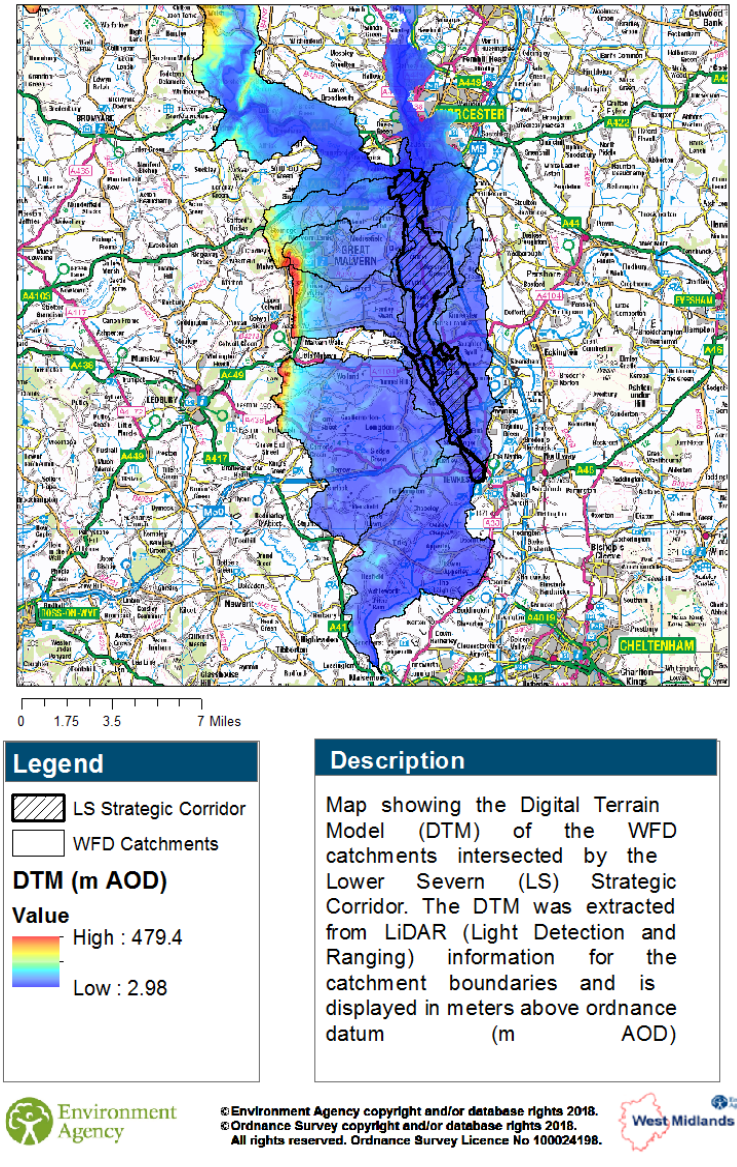
Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
source to conf R Severn (4)	Brook flows in a West to East direction into the River Severn upstream of Severn Stoke. Modelled records suggest there are no sizeable groups of receptors at fluvial risk. However these may not extend to the upper most reaches of the watercourse, where local historic evidence suggests flooding issues impacting on 41 receptors primarily from the ordinary watercourse and affecting the north of Great Malvern and Madresfield.	at Poor status due to impacts from Sewage Treatment Works discharges and diffuse pollution, resulting in elevated phosphate levels.
Pool Brook - source to conf R Severn (5)	**HIGH RISK –** This catchment encroaches into the corridor near its confluence with the River Severn. Although this is a high risk catchment 636 of its total 676 receptors come from the River Severn, not the Pool Brook (at Upton on Severn). Local recorded data suggests there are 40 receptors, 13 from the brook, primarily at the top of the catchment in Lower Wyche. There are also surface water issues at Hanley Swan.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from Sewage Treatment Works discharges and diffuse pollution, resulting in elevated phosphate levels.
Severn - conf R Teme to conf R Avon (6)	**HIGH RISK –** This catchment covers most of the strategic corridor, from the confluence with the River Teme to its southern boundary upstream of Tewkesbury. This includes 1008 receptors from fluvial sources (informed by modelling) and some of the main settlements at risk such as Upton upon Severn, Kempsey and Severn Stoke. Historic records show 62 receptors along the catchment.	**LOW PRIORITY –** The brook is at Moderate status due to impacts from, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The River currently meets its required status. The River is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.
Bushley Longdon Bk - source to conf R Severn (7)	**MEDIUM RISK –** This catchment drains into the Severn and marginally encroaches the corridor along its south western boundary at the confluence. Flood risk	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications and diffuse pollution, resulting in elevated phosphate levels and impacts on river ecology.

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
	includes 41 receptors from modelled sources at Welland, Castlemorton and Longdon. However these are located upstream and are unlikely to be affected by mineral works. Historic records also show there are flood risk issues from the Longdon Brook and its tributaries but these are also unlikely to be affected by works in the corridor. In total these records show 91 receptors primarily from the ordinary watercourse and surface water.	
Ripple Bk - source to conf R Severn (8)	**MEDIUM RISK –** This catchment encroaches into the corridor in its southern boundary north of Upton on Severn. Some fluvial flood risk issues in this catchment are shared with the River Severn as it includes communities in Upton upon Severn and Uckinghall which are not at risk from the Ripple Brook. However, the brook does affect communities particularly at Ripple with 30 receptors. In addition, flooding from surface water has been shown to primarily affect Naunton and Ryall and affect 48 receptors. In total modelled data suggests 184 receptors (44 benefitting from a scheme in Uckinghall) and 52 from historic records.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from physical modifications and diffuse pollution, resulting in reduced dissolved oxygen levels, elevated phosphate levels, impacting on river ecology.
Severn - conf R Avon to conf Upper Parting (9)	**HIGH RISK–** This catchment encroaches the corridor on its southern boundary near Tewkesbury. Works in this catchment would therefore occur at the top end leaving opportunities for impact and betterment downstream. Nonetheless, there may be limited scope as most of the modelled 472 receptors at risk from fluvial sources are located either too far downstream of the corridor or are influenced by	**LOW PRIORITY –** The brook is at Moderate status due to impacts from, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The River currently meets its required status. The River is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
	other watercourses. However consideration should still be given to betterment opportunities. Historic data has shown 20 receptors primarily at Corse Lawn.	will be available in due course.

Lower Severn Strategic Corridor Recommendations

This corridor follows the river Severn and covers the lower parts of the WFD river catchments it intersects with. As expected from the river Severn at this location, LiDAR shows this corridor is located amongst flat valleys with wide floodplains away from the source of runoff generation. From a flood risk perspective, in this corridor the greatest benefits will therefore be realised through Green Infrastructure measures associated with flood storage and floodplain connectivity. This will have the potential to reduce flood risk by increasing storage volumes and encouraging overland flows in less vulnerable floodplain areas. The shape or form of these green infrastructures measures can vary but the overarching aim should be to attenuate river flood flows and pathways to provide onsite and offsite benefits. In addition, as shown by the catchment boundaries, most of the other watercourses included such as the Pool Brook or the Ripple Brook drain into the river Severn and only cover parts of the corridor boundary around their confluence. For this reason green infrastructure measures within the corridor such as woody debris or channel remeandering are unlikely to be suitable for a watercourse of this size. The green infrastucutre measures will also have the potential to contribute to WFD improvements through improving water quality and river habitat.



Examples of Green infrastructure measures

1. **Floodplain and Riverside Vegetation:**

This intervention involves planting up floodplain and riverside woodlands to slow overland flows, increase infiltration and interception of rain and slow the velocity of water entering rivers. Other vegetation types (such as hedgerows and trees along watercourses) may be suitable if these provide similar benefits through increased roughness.

2. **Built Water Storage:**

This involves diverting water from the river network to create temporary storage (ponds, washland, reconnected floodplain) and attenuate flood risk downstream. The storage feature would usually drain through an outflow structure at a controlled rate.

3. North East Worcestershire Strategic Corridor

Summary description

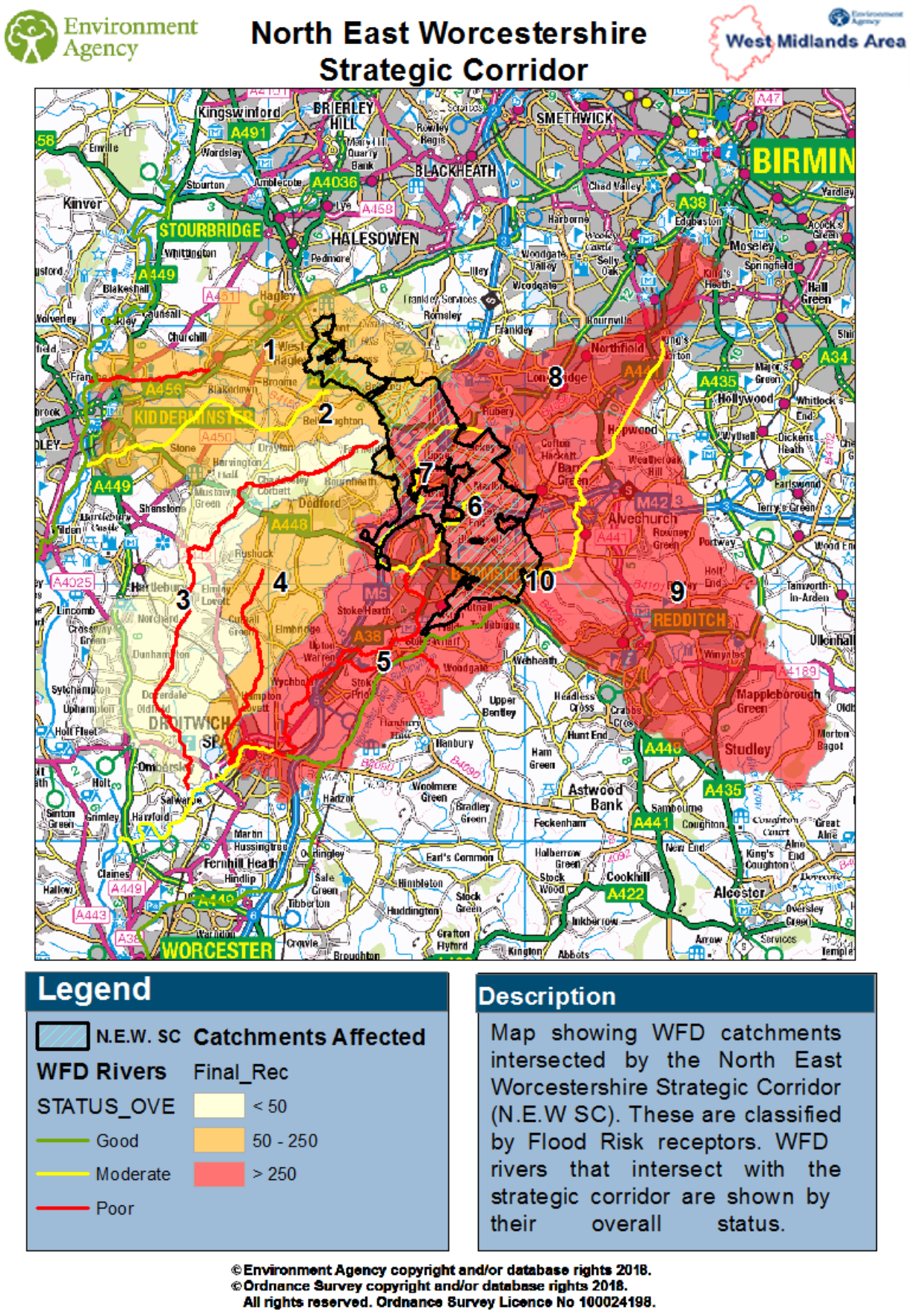
The North East Worcestershire Strategic Corridor intersects 10 catchments. In terms of flood risk, 6 of these catchments are classified within the mapping tool as being high risk, 3 are classified as medium risk and 1 is classified as low risk. The majority (80%) of the strategic corridor is within catchments with a high risk of flooding. The corridor is therefore considered to be sensitive in terms of existing flood risk.

The corridor is affected by multiple watercourses including the Salwarpe and the Blakedown brook on the West, the River Arrow on the East, and the Spadesbourne Brook towards the centre. Using currently best available modelled data and historic records, fluvial risk predominantly affects Bromsgrove, Bournheath, Redditch and Droitwich. Local data suggests surface water flooding has historically affected multiple locations including Bournheath, Catshill, Droitwich, Hagley and Belbroughton. There are also known ground water risks in the Salwarpe and Battlefield Brook catchments.

The Water Framework Directive (WFD) requires all watercourses to meet Good Ecological Status (GES) by 2021. Currently 7 of watercourses in the corridor are considered as Medium priority, i.e. they are not meeting their 2026 objective. Actions required for some watercourses to meet GES have been assessed as either not technically feasible or non-cost beneficial. In these cases an alternative objective has been set. The remaining 3 watercourses fall within this category and are considered as Low priority as they are meeting this alternative objective, as detailed in the Severn River Basin District Management Plan[3].

[3] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

Figure 9. North East Worcestershire Strategic Corridor and catchment mapping evidence



Detailed Water Environment Evidence for North East Worcestershire Strategic Corridor

(Please note the below figures are based on spatial analysis and are merely included to provide an indicative view on the data relating to each strategic corridor)

i) Floodspot data

Total Number of Floodspots in all catchments intersected by Strategic Corridor	Total Number of Floodspots inside Strategic Corridor	Total Number of Receptors associated to floodspots in all catchments	Total Number of Receptors associated to floodspots inside the strategic corridor	Source of flood risk for all Receptors (receptors can have more than one source of flood risk)							
				Main River*		Ordinary WCR*		Surface Water*		Ground Water*	
401	36	888	54	137	7	438	35	688	45	33	5

* (Left hand columns= in all catchments & Right hand columns= inside the Strategic corridor)

ii) Communities at Risk data

Total Number of Communities at Risk in all catchments intersected by Strategic Corridor	Total Number of Communities at Risk inside Strategic Corridor	Total Receptors in all catchments intersected by Strategic Corridor	Total Receptors inside Strategic Corridor	Source of flood risk for all Receptors			
				Main River*		Ordinary WCR*	
50	4	4291	193	3184	0	1107	193

* (Left hand columns= in all catchments & Right hand columns = inside the Strategic corridor)

iii) Water Framework Directive data

Total number of watercourses in catchments intersected by Strategic Corridor	Total number of watercourses at 'Good' status	Total Number of 'Moderate' status	Total number at 'Poor' status	Main reasons for Classification
17	4	8	5	Physical modification to water courses. Diffuse pollution from agriculture. Impacts on flow from abstractions Pollution from wastewater.

iv) Catchment data

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
Blakedown Bk - source to conf R Stour (1)	**MEDIUM RISK –** The heavily culverted brook flows on an east to west direction through West Hagley, Kidderminster and its confluence with the river Stour. Modelled information suggests there are 45 receptors from fluvial flood risk in West Hagley. Local historic records agree with this information and include a total of 104 recorded receptors primarily impacted by fluvial and surface water flooding. In terms of encroachment of the corridor, the catchment is only situated marginally inside the corridor on the top of the catchment.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Hoo Bk - source to conf R Stour (2)	**MEDIUM RISK –** This catchment encroaches into the strategic corridor along its northern boundary, at the top of the catchment. The Hoo Brook flows on a north-eastern to south-western direction into Kidderminster and its confluence with the River Stour. Modelled data suggests 3 communities and 73 receptors are at risk from fluvial flooding. These include Kidderminster and Belbroughton. In addition, historic records suggests 70 receptors have experienced flooding primarily from Surface Water and Ordinary Watercourse. The main areas for targeting flood risk management interventions are Belbroughton, Chaddesley Corbett and Kidderminster.	**LOW PRIORITY –** The brook is at Moderate status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The Brook currently meets its required status.
Hadley Bk - source to conf R Salwarpe (3)	**LOW RISK –** This catchment only borders the corridor near its boundary with Bournheath. Data suggests there is very little impact on flood risk from fluvial sources and instead, Surface Water is the main	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
	source of the 35 recorded receptors. These are largely spread along the catchment and most records do not affect more than 1 receptor. There are no modelled records.	impacts on river ecology.
Elmbridge Bk - source to conf R Salwarpe (4)	**LOW RISK-** A fraction of the top of the catchment is situated inside the Minerals corridor. Although this catchment is not characterised by large, urban settlements, it does cover part of Droitwich Spa, including 66 modelled receptors at risk from fluvial flooding. However, given the position of the catchment potential for impact or opportunities for benefit based on works inside the corridor are limited to northern areas such as Bournheath. Based on historic records (61 receptors), this settlement is vulnerable to surface water flooding.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Salwarpe - source to conf Elmbridge Bk (5)	**HIGH RISK –** This catchment occupies part of the south western boundary of the strategic corridor including Bromsgrove upstream and Droitwich downstream. As expected from these large conurbations modelled results suggest there are 1382 receptors from fluvial flood risk. Based on their position relative to the corridor works may require to consider impact and opportunities for benefit upstream but are unlikely to affect areas downstream. Local historic data also suggests there are 126 receptors primarily from Surface Water, Ordinary Watercourse and Main River particularly in Bromsgrove and Stoke Prior.	**MEDIUM PRIORITY –** The River is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Spadesbourne Bk - source to conf	**HIGH RISK** – This catchment is almost entirely situated	**MEDIUM PRIORITY –** The brook is at Moderate status due to

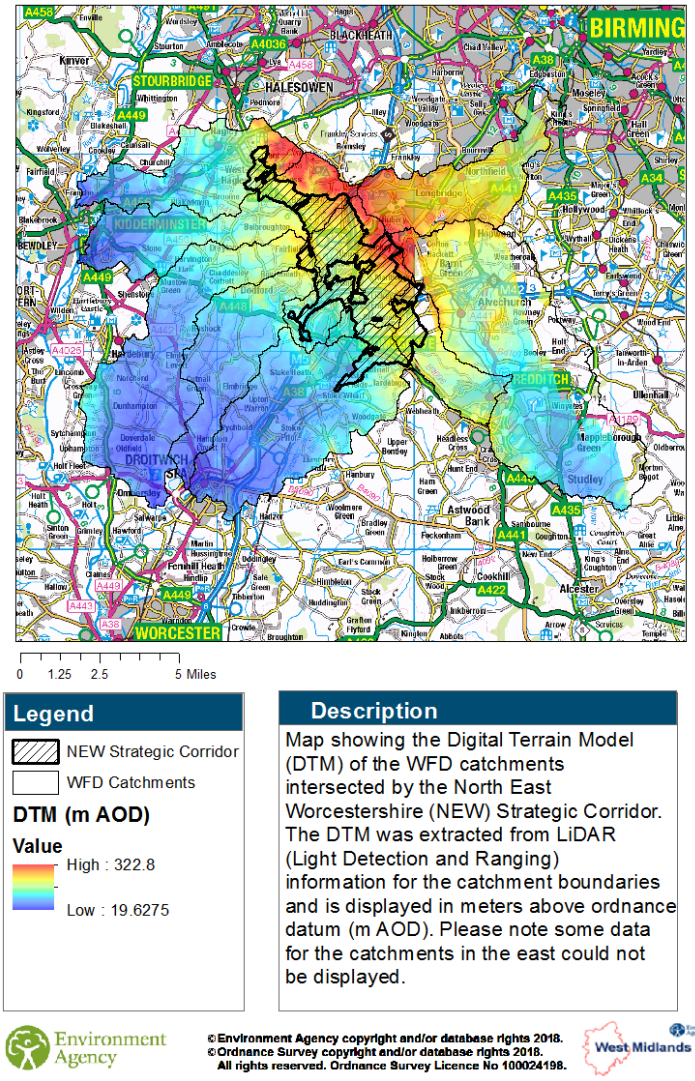
Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
Battlefield Bk (6)	inside the strategic corridor, particularly the top end. The brook flows from a north eastern to South western direction into Bromsgrove and its confluence with the Battlefield Brook. For this reason and in consideration of our flood risk data (61 historic receptors and 804 from modelled data) works in this catchment should consider the potential impacts and opportunities for betterment for Bromsgrove.	impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The Brook is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.
Battlefield Bk - source to conf Spadesbourne Bk (7)	**HIGH RISK -** This catchment encroaches into the main body of the corridor. There are 89 flood risk receptors based on recorded events, primarily from Surface water and Ordinary Watercourse. In addition, modelled fluvial data points towards Catshill and Bromsgrove (bordering this catchment) as the main areas for fluvial flood risk (917 receptors).	**MEDIUM PRIORITY –** The brook is at Moderate Status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Rea source to Bourn Brook (8)	**HIGH RISK–** This catchment borders the corridor on its eastern boundary near Beacon Hill. Although this is a designated as a high risk catchment, all of the modelled receptors (1654) are situated upstream at Longbrige and towards Birmingham. For this reason mineral works should avoid reducing conveyance around the southern boundary of the catchment. Historic records show 38 receptors at Longbridge primarily from surface water.	**LOW PRIORITY -** The river is classified as a Heavily Modified Waterbody is at Moderate status due to impacts from; physical modifications, diffuse pollution and discharges from the sewerage network, resulting in elevated phosphate levels and impacts on river ecology. The River currently meets its required status.
Arrow - source to Spernall Hall Fm, Studley (9)	**HIGH RISK–** The corridor encroaches the top of the catchment at Barnt Green, Bromsgrove. Modelled records show 763 receptors vulnerable to fluvial flood risk. These are	**LOW PRIORITY –** The River is at Moderate status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD designation
	all situated inside Redditch. The top of the catchment and the boundary of the corridor itself include a number of historic receptors to surface water flood risk, particularly at Barnt Green and Alvechurch. In total there are 211 historic receptors spread around the catchment.	elevated phosphate levels and impacts on river ecology. The River currently meets its required status.
Batchley Bk - source to conf R Arrow (10)	**MEDIUM RISK** – The brook flows from a north western to a south eastern direction into Redditch and its confluence with the River Arrow. Our model records suggest there are 181 receptors at risk from the ordinary watercourse. In addition, historic records suggest there are 93 receptors at risk from the brook and /or surface water. These are largely concentrated at the bottom of the catchment when the river flows into Redditch. For this reason works at the top end of the catchment may consider options to attenuate flows downstream.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The Brook is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.

North East Worcestershire Strategic Corridor Recommendations

This corridor predominantly covers the upper parts of the WFD river catchment it intersects with. As expected, LiDAR shows this corridor is therefore located amongst steep valleys at the source of runoff generation. From a flood risk perspective, in this corridor the greatest benefit will therefore be realised through Green Infrastructure measures associated with the control and attenuation of runoff. This will have the potential to reduce downstream flood risk and increase drought resilience. The shape or form of these green infrastructures measures can vary but the overarching aim should be to intercept and attenuate hydrological flow pathways to provide onsite and offsite benefits.

These Green Infrastrucutre measures will also have the potential to contribute to WFD improvements through improving water quality and river habitat.



Examples of Green infrastructure measures

1. **Overland flow interception:**

This involves the creation of a barrier (soil, wood or stone) across a flow path to create storage. These features should be designed to drain slowly and as such the barrier may be 'leaky', have an outlet or drainage pipe.

2. **Scrapes, Swales, Wetlands / Rural SuDS:**

This involves the creation of hydrological attenuation or interception features to manage local flow pathways to catch and store runoff and sediments, slowing the water before it reaches the river. These features should be built into the topography of the site, rather than requiring bunds.

3. **Changes to vegetation and sediment management:**

This involves soil and vegetation management to reduce compaction and lower the water table. This includes measures to increase vegetation and root penetration or reduce erosion, compaction and hydrophobicity. In doing so, soil water storage capacity is increased and surface runoff is reduced, thereby increasing the lag to peak and reducing peak flows.

4. **Field drain and under- drainage blocking:**

This technique involves damming gullies or similar flow routing structures to result in the formation of pools. In doing so new storage is created and flows can be slowed down.

5. **Woody Debris:**

As this Corridor is predominantly in the upper reaches of the catchments, suitable techniques are likely to involve securely installing and retaining large woody material to hold water back.

6. **Urban SuDS and channel naturalisation:**

Given that there are some urban areas in the vicinity of the corridor it may be applicable to provide SuDS or naturalise segments of the watercourse, including removal of culverts or other redundant structures, channel naturalisation works and 'making space for water'.

7. Two stage channel

This measure can be applied to smaller watercourses and is particularly beneficial where water levels can vary drastically between low flows and peak flows. This can offer an array of environmental and flood risk benefits by increasing velocity and depth during low flows whilst increasing in-channel capacity and reducing velocity during peak flows.

4. North West Worcestershire Strategic Corridor

Summary description

The North West Worcestershire Strategic Corridor intersects 25 WFD catchments. In terms of flood risk, 10 of these catchments are classified as high risk, 7 are classified as medium risk and 8 are classified as low risk. However, the majority (66%) of the corridor is within catchments with a high risk of flooding. The corridor is mainly affected by fluvial flooding from the river Severn flowing in a north to south direction and also the River Stour flowing in a North-east to South-west direction. Using currently available modelled data and historic records, fluvial risk predominantly affects Bewdley, Worcester, Kidderminster and Stourport on Severn. Local data suggests surface water flooding has historically affected multiple locations including Bewdley, Belbroughton, Kidderminster, Hagley and Wolverley. There are also known ground water risk at Bewdley, Stourport on Severn and Hartlebury. A number of communities currently benefit from reduced flood risk through an existing capital asset including Bewdley (Severnside and Riddings Brook), Worcester (Hylton Road and Perdiswell) and Kidderminster. Communities throughout the corridor may also benefit from existing maintenance activities and the Environment Agency's flood warning and alert services.

In terms of WFD, 1 watercourse is considered to be a High priority as it has deteriorated in WFD status. 6 of the watercourses in the corridor are considered as Medium priority as they are not meeting their 2026 objective of Good Ecological Status. Actions required for some watercourses to meet GES have been assessed as either technically feasible or non-cost beneficial. In these cases an alternative objective has been set. The remaining 1 watercourse falls within this category and are considered as a Low priority as they are meeting this alternative objective, as detailed in the Severn River Basin District Management Plan[4].

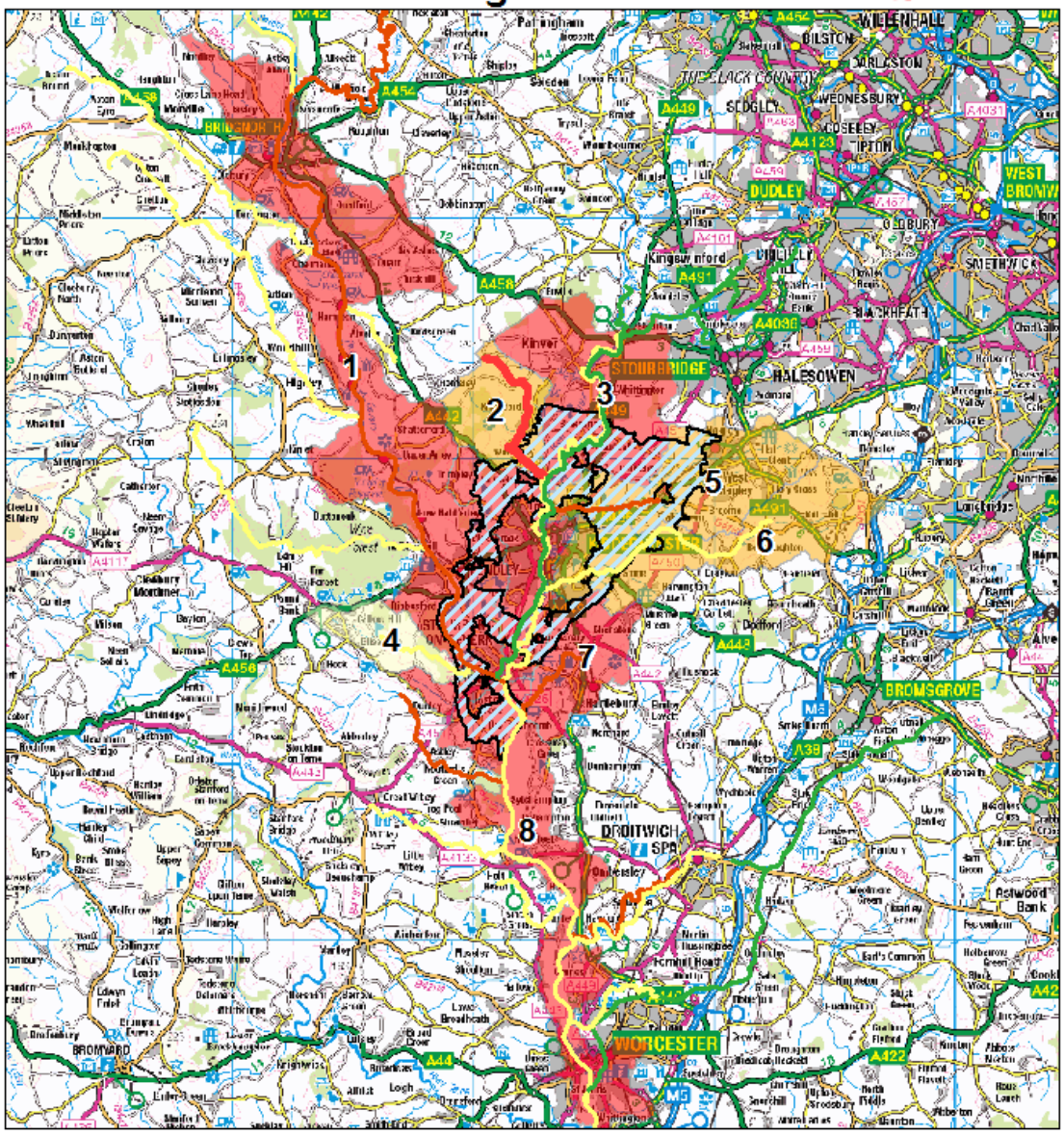
[4] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

Figure 10. North West Worcestershire Strategic Corridor and catchment mapping evidence

Environment Agency

North West Worcestershire Strategic Corridor

West Midlands Area



Legend

N.W.W. SC **Catchments Affected**

WWFD Rivers Final_Rec

STATUS_OVE

- Bad
- Good
- Moderate
- Poor

< 50

50 - 250

> 250

Description

Map showing WFD catchments intersected by the North West Worcestershire Strategic Corridor (N.W.W SC). These are classified by Flood Risk receptors. WFD rivers that intersect with the strategic corridor are shown by their overall status.

Detailed Water Environment Evidence for North West Worcestershire Strategic Corridor

(Please note the below figures are based on spatial analysis and are merely included to provide an indicative view on the data relating to each strategic corridor)

i) Floodspot data

Total Number of Floodspots in all catchments intersected by Strategic Corridor	Total Number of Floodspots inside Strategic Corridor	Total Number of Receptors associated to floodspots in all catchments	Total Number of Receptors associated to floodspots inside Strategic Corridor	Source of flood risk for all Receptors (receptors can have more than one source of flood risk)							
				Main River*		Ordinary WCR*		Surface Water*		Ground Water*	
183	28	440	46	138	12	157	19	273	39	42	6

* (Left hand columns= in all catchments & Right hand columns= inside the Strategic corridor)

ii) Communities at Risk data

Total Number of Communities at Risk in all catchments intersected by Strategic Corridor	Total Number of Communities at Risk inside Strategic Corridor	Total Receptors in all catchments intersected by Strategic Corridor	Total Receptors inside Strategic Corridor	Source for all Receptors			
				Main River*		Ordinary WCR*	
44	17	3690	990	3457	804	233	186

* (Left hand columns = in all catchments & Right hand columns= inside the Strategic corridor)

iii) Water Framework Directive data

Total number of watercourses intersected by Strategic Corridor	Total number of watercourses at 'Good' status	Total Number of 'Moderate' status	Total number at 'Poor' status	Main reasons for classification
23	3	13	6	• Physical modification to water courses. • Diffuse pollution from agriculture. • Impacts on flow from abstractions • Pollution from wastewater.

iv) Catchment Data

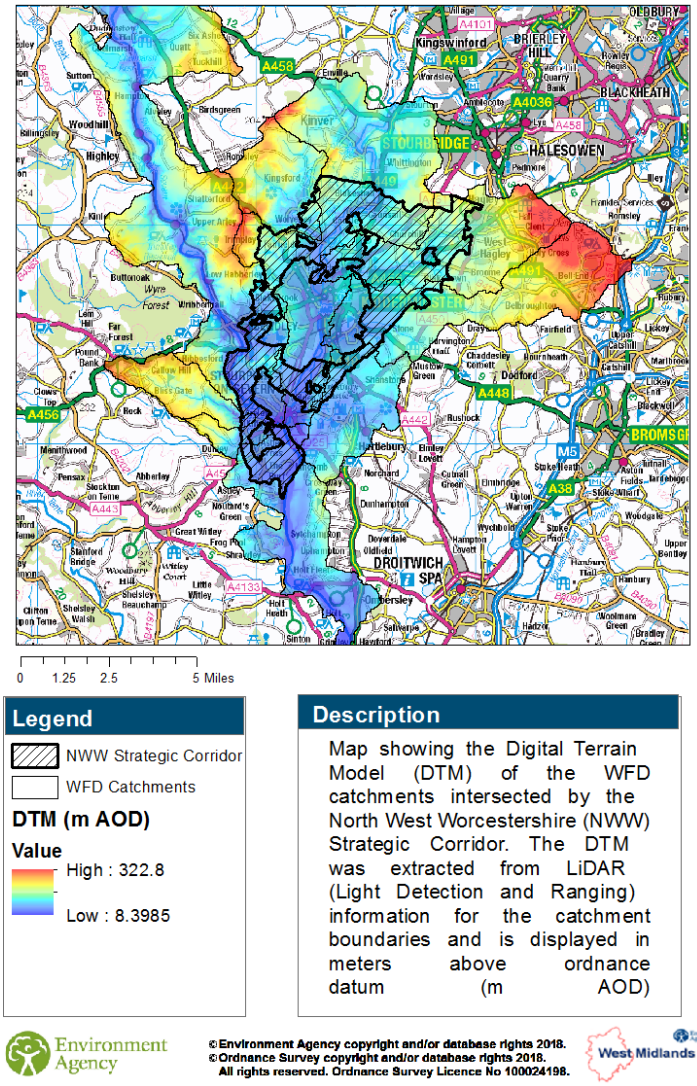
Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD Classification
Severn – confluence River Worfe to confluence stour (1)	**HIGH RISK -** Settlements affected by this corridor include Bewdley which falls just outside of the corridor boundary (upstream) but contains a significant population at risk of fluvial flooding from the River Severn. Capital flood defence assets in Bewdley include Severnside North and South, Beales Corner and Wribbenhall flood defence on the Riddings Brook. Modelled data suggests 1255 receptors (389 benefitting from schemes). Stourport on Severn contains significant populations at risk. Historic data suggests there are 113 receptors affected by a combination of surface water, main river and ordinary watercourse. These are particularly centred around Bewdley and Stourport on Severn.	**MEDIUM PRIORITY –** The River is at Poor status due to impacts from discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Drakelow Brook source to confluence R.Stour. (2)	**LOW RISK** – Historic records are found at Kingsford following the brook and upstream of the corridor. These suggests 7 receptors vulnerable to ordinary watercourse and / or surface water. In addition, modelled data suggests 33 receptors within the corridor at Wolverley. These could be affected by increased runoffs from development within this catchment.	**HIGH PRIORITY –** The River is at Poor status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The brook has deteriorated from baseline station and reversing this is a priority. The River is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.
Stour - confl Smestow Bk to confl R.Severn. (3)	**HIGH RISK –** Historic records show 68 receptors distributed throughout the catchment. These are primarily vulnerable to surface water flooding and affect areas such as Caunsall	**MEDIUM PRIORITY –** The River is at Bad status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD Classification
	and Kidderminster. Modelled data shows 33 receptors at risk in Wolverley near the boundary of the corridor and the Drakelow Brook catchment. In addition, there are a total of 655 modelled receptors particularly in Kidderminster and Stour port on Severn, enveloped by the minerals corridor and vulnerable to impacts upstream and downstream.	impacts on river ecology.
Gladder Brook – source to confluence (4)	**LOW RISK** – Historic records only suggests 3 receptors in this catchment. These are primarily related to highways infrastructure and are located around Pound Bank and Heightington. On the other hand modelled records do not suggests any further receptors.	**MEDIUM PRIORITY –** The River is at Moderate status due to impacts from physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Blakedown Bk-source to confl R.Stour. (5)	**MEDIUM RISK** – Modelled and historic records suggests most vulnerable receptors are situated in or around West Hagley just upstream of the corridor. For this reason development in this catchment has the potential to affect flood levels upstream through loss of conveyance. In total, historic records suggest there are 104 receptors and the greatest source of risk is Surface Water and Ordinary Watercourse, modelled records show 45 receptors at West Hagley.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from diffuse pollution resulting in elevated phosphate levels.
Hoo Brook source to confluence R.Stour (6)	**MEDIUM RISK** – This catchment is partly within the strategic corridor which intersects with the lower end of the Hoo Brook near its confluence with the River Stour. Modelled and historic records suggest the most vulnerable locations are found at Belbroughton and the Spennels and Hoo Brook	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD Classification
	areas of Kidderminster. In total these suggests there are over 70 receptors from historic records and 73 from modelled information.	
Hartlebury Bk – source to confl R.Severn (7)	**HIGH RISK** – This catchment is partly within the strategic corridor on its eastern boundary which also includes the confluence with the river Severn. Historic records suggest 8 receptors particularly affecting Highways Infrastructure between Summerfield and Hartlebury. Within the corridor itself our modelled data suggests there are 321 receptors between the Hartlebury and river Severn catchments in Stourport on Severn.	**LOW PRIORITY –** The brook is at Moderate status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The Brook currently meets its required status.
Severn – confl R.Stour to confl R.Teme (8)	**HIGH RISK–** This catchment is found at the lower end of the strategic corridor and flows south passed Worcester. Within the corridor most receptors (1738) are attributed to our modelled records and the communities at risk database in and around Stourport On Severn. Historic records suggests 67 receptors with the most recurring issue being surface water. Some of the areas affected include Arley Kings and Holt Heath with the largest number of historic receptors.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications and diffuse pollution, resulting in elevated phosphate levels and impacts on river ecology.

North West Worcestershire Strategic Corridor Recommendations

This corridor predominantly covers lower parts of the WFD river catchments it intersects with particularly along the River Severn and the Hoo Brook. However it is also located within more upper parts of the Stour and Blakedown catchments. From a flood risk perspective, in this corridor the greatest benefit will therefore be realised through Green Infrastructure measures associated with flood storage and floodplain connectivity but there will be some opportunities for control and attenuation of runoff. This will have the potential to reduce flood risk by increasing storage volumes and encouraging overland flows in areas located away from the source and slowing flows and increasing lag to peak in areas closest to the source. The shape or form of these green infrastructures measures will vary across the landscape and should reflect site specific characteristics within the catchment.



These Green Insfrastucture measures will also have the potential to contribute to WFD improvements through improving water quality and river habitat.

Examples of Green infrastructure measures

1. **Floodplain and Riverside Vegetation:**

This intervention involves planting up floodplain and riverside woodlands to slow overland flows, increase infiltration and interception of rain and slow the velocity of water entering rivers. Other vegetation types (such as hedgerows and trees along watercourses) may be suitable if these provide similar benefits through increased roughness.

2. **Woody Debris:**

In the middle and lower parts of the catchment this may take the form of securely installing woody debris to assist the transfer of water from the river to the floodplain to increase floodplain storage volumes, or slowing down flows within the channel to increase the lag to peak and reduce peak levels. In addition, in the upper reaches of the Blakedown and Stour this technique should be employed to hold water back, attenuating flood risk downstream.

3. **Built Water Storage:**

This involves diverting water from the river network to create temporary storage (ponds, washland, reconnected floodplain) and attenuate flood risk downstream. The storage feature would usually drain through an outflow structure at a controlled rate.

4. Channel re-meandering:
This involves meandering straightened rivers or reconnecting historic meanders. These measures attenuate flood risk by improving links between the river and the floodplain and slowing the flow by reducing river slope and increasing length.

5. Two stage channel:
This measure can be applied to smaller watercourses and is particularly beneficial where water levels can vary drastically between low flows and peak flows. This can offer an array of environmental and flood risk benefits by increasing velocities and depth during low flows whilst reducing velocity and increasing in-channel capacity and reducing velocity during peak flows.

6. Urban flood corridors:
Given that there are some urbanised areas in the vicinity of the corridor, there may be opportunities for 'making Space for water' along urban rivers through the creation of floodways with room to store and convey flood water, particularly if these opportunities can be linked to new or redevelopment. This may also include culvert removal, channel naturalisation And SuDS.

7. Runoff control and attenuation measures
This corridor is also likely to attract diffuse green infrastructure measures associated with the control and attenuation of surface runoff at its source. This will be more relevant at the upper parts of the Blakedown and Stour catchments where the corridor intersects upper areas of steeper floodplain and include measures such as vegetation, gully and soil management or flow interception.

5. Salwarpe Tributaries Strategic Corridor

The Salwarpe Tributaries Strategic Corridor intersects 11 WFD catchments. In terms of flood risk, 4 of these catchments are classified as high risk, 3 are classified as medium risk and 4 are classified as low risk. In addition, there is a relatively even spread of flood risk across the corridor with 39% of its total area inside catchments with a low risk of flooding, 33% inside high risk and 28% inside medium risk catchments. The corridor is mainly affected by fluvial flooding from the river Salwarpe and Spadesbourne Brook, flowing in a north-eastern to south-western direction. Using currently best available modelled data, fluvial risk predominantly affects Bromsgrove, Worcester and Droitwich. Recorded events of fluvial flooding suggest the north-east of the catchment around Bromsgrove and Catshill have the highest known records of historic flooding from this source. Local data also suggests surface water flooding has historically affected multiple locations including Bournheath, Bromsgrove, Catshill and Stoke Prior. There are also known ground water issues at Stourport-on-Severn, Bromsgrove and Stoke Prior. Currently, only Worcester benefits from reduced flood risk through an existing capital asset. However, communities throughout the corridor may also benefit from existing maintenance activities and the Environment Agency's flood warning and alert services.

In terms of WFD, 1 watercourse is considered to be a High priority as it has deteriorated in WFD status. 9 of the watercourses in the corridor are considered as Medium priority as they are not meeting their 2026 objective of Good Ecological Status. Actions required for some watercourses to meet GES have been assessed as either not technically feasible or non-cost beneficial. In these cases an alternative objective has been set. The remaining

watercourse falls within this category and is considered as a Low priority as it is meeting this alternative objective, as detailed in the Severn River Basin District Management Plan[5].

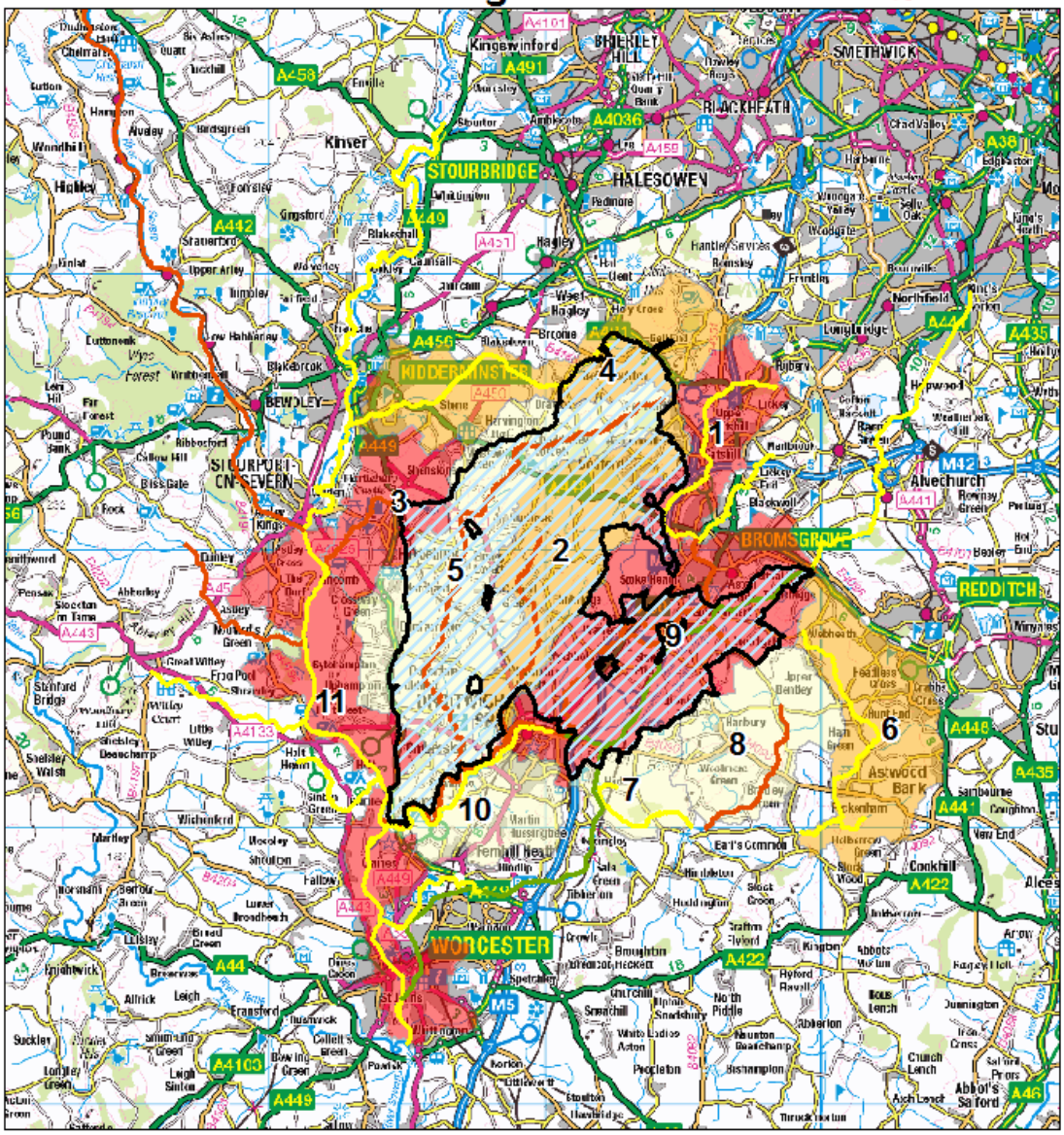
[5] https://www.gov.uk/government/publications/severn-river-basin-district-river-basin-management-plan

Figure 11. Salwarpe Tributaries Strategic Corridor and catchment mapping evidence

Environment Agency

Salwarpe Tributaries Strategic Corridor

West Midlands Area



Legend

S.T SC — **Catchments Affected**

WFD Rivers — Final_Rec

STATUS_OVE

- Good
- Moderate
- Poor

- < 50
- 50 - 250
- > 250

Description

Map showing WFD catchments intersected by the Salwarpe Tributaries Strategic Corridor (S.T SC). These are classified by Flood Risk receptors. WFD rivers that intersect with the strategic corridor are shown by their overall status.

Detailed Water Environment Evidence for Salwarpe Tributaries Strategic Corridor

(Please note the below figures are based on spatial analysis and are merely included to provide an indicative view on the data relating to each strategic corridor)

i) Floodspot data

Total Number of Floodspots in all catchments intersected by Strategic Corridor	Total Number of Floodspots inside Strategic Corridor	Total Number of Receptors associated to floodspots in all catchments	Total Number of Receptors associated to floodspots inside Strategic Corridor	Source of flood risk for all Receptors (receptors can have more than one source of flood risk)							
				Main River*		Ordinary WCR*		Surface Water*		Ground Water*	
275	78	563	114	111	26	259	52	460	85	41	8

* (Left hand columns= in all catchments & Right hand columns = inside the Strategic corridor)

ii) Communities at Risk data

Total Number of Communities at Risk in all catchments intersected by Strategic Corridor	Total Number of Communities at Risk inside Strategic Corridor	Total Receptors in all catchments intersected by Strategic Corridor	Total Receptors inside Strategic Corridor	Source for all Receptors			
				Main River*		Ordinary WCR*	
37	6	3319	240	2841	100	478	140

* (Left hand columns= in all catchments & Right had columns= inside the Strategic corridor)

iii) Water Framework Directive data

Total number of watercourses intersected by Strategic Corridor	Total number of watercourses at 'Good' status	Total Number of 'Moderate' status	Total number at 'Poor' status	Main reasons for classification
21	1	12	8	• Physical modification to water courses. • Diffuse pollution from agriculture. • Impacts on flow from abstractions • Pollution from wastewater.

iv) Catchment Data

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
Battlefield Bk - source to conf Spadesbourne Bk (1)	**HIGH RISK -** This catchment encroaches the corridor along its southwest boundary. There are 89 flood risk receptors based on recorded events, primarily from Surface water and Ordinary Watercourse. In addition, modelled fluvial data points towards Catshill and Bromsgrove (bordering this catchment) as the main areas for fluvial flood risk (917 receptors).	**MEDIUM PRIORITY –** The brook is at Moderate Status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Elmbridge Bk - source to conf R Salwarpe (2)	**LOW RISK-** This catchment is entirely within the corridor and covers almost 25% of its total area. Although this catchment is not characterised by large, urban settlements, it does cover part of Droitwich Spa, including 55 recorded receptors at risk from fluvial flooding near the confluence with the Salwarpe. In addition, the top of the catchment includes Bournheath where 61 receptors to surface water flooding have been recorded based on historic events. Lastly, modelled data suggests 66 receptors in Droitwich Spa.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Hartlebury Bk - source to conf R Severn (3)	**HIGH RISK-** This catchment encroaches into the corridor along its western boundary near Hartlebury. Historic records suggest 8 receptors primarily from surface water including highways infrastructure. From a fluvial perspective, modelling of the	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from physical modifications and diffuse pollution, resulting in elevated phosphate levels and impacts on river ecology.

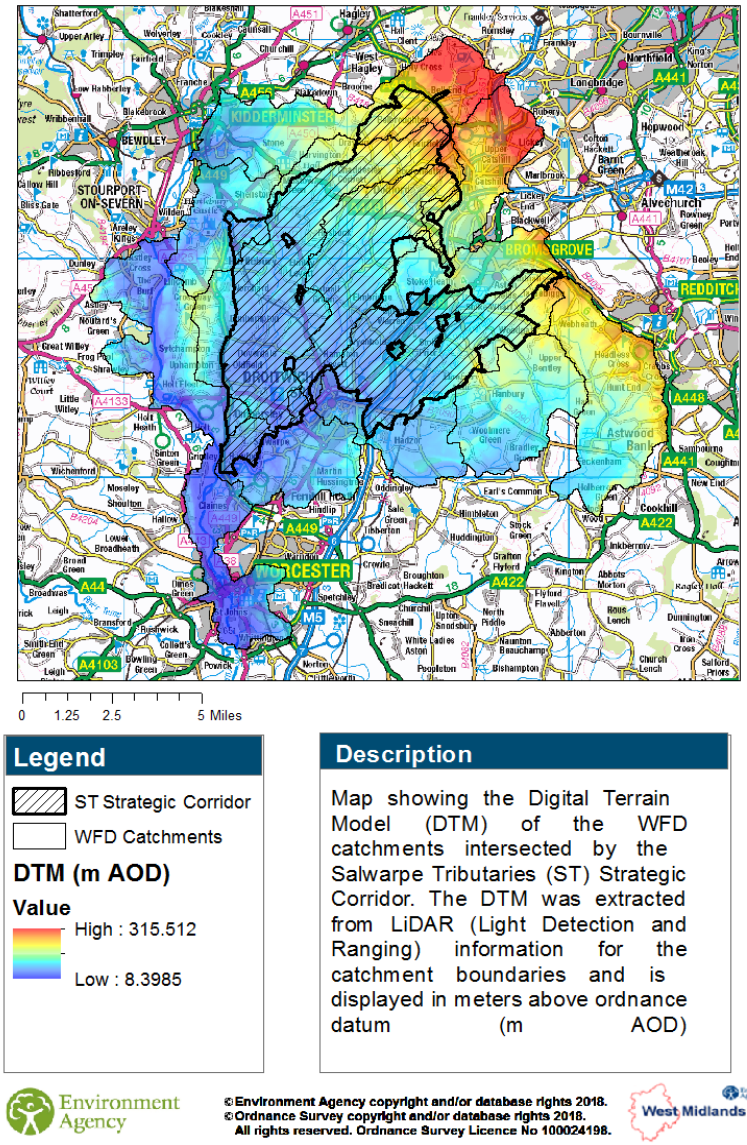
Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
	brook suggests there are no large numbers of receptors at risk. However, the catchment crosses the boundary of some communities at risk in Stourport-on-Severn, meaning it shares its associated 321 receptors from the River Severn.	
Hoo Bk - source to conf R Stour (4)	**MEDIUM RISK–** This catchment marginally encroaches into the strategic corridor along its northern boundary. The Hoo Brook flows on a north-eastern to south-western direction into Kidderminster and its confluence with the River Stour. Modelled data suggests 3 communities and 73 receptors are at risk from fluvial flooding. These include Kidderminster and Belbroughton. In addition, historic records suggests 70 receptors have experienced flooding primarily from Surface Water and Ordinary Watercourse. The main areas for targeting flood risk management interventions are Belbroughton, Chaddesley Corbett and Kidderminster.	**LOW PRIORITY –** The brook is at Moderate status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The Brook currently meets its required status.
Hadley Bk - source to conf R Salwarpe (5)	**LOW RISK–** This catchment is almost completely within the strategic corridor and covers around 40% of its total area. Data suggests there is very little impact on flood risk from fluvial sources and instead, Surface Water is the main source of the 35 recorded receptors. These are largely spread along the catchment and most records do not affect more than 1 receptor. There are no modelled records from our communities at risk dataset.	**MEDIUM PRIORITY –** The brook is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Bow Bk - source	**LOW RISK–** The corridor	**MEDIUM PRIORITY –** The brook is

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
to Lett's Mill (6)	follows and touches the boundary of this catchment but there is no encroachment. For this reason and given the brooks position and flow direction relative to the corridor impact from mineral works are considered unlikely. There are 56 receptors from historic records predominantly from surface water. There are no modelled records from our communities at risk dataset.	at Moderate status due to impacts from abstractions and diffuse pollution, resulting in elevated phosphate levels and impacts on river ecology.
Dean Bk - source to conf Bow Bk (7)	**LOW RISK -** The corridor follows and touches the boundary of this catchment but there is no encroachment. In addition, the Dean Brook flows south and away from the corridor. For these reasons impact from mineral works are considered unlikely. There are 9 receptors from historic records predominantly from surface water. There are no modelled records from our communities at risk dataset.	**MEDIUM PRIORITY –** The brook is at Moderate status due to impacts from diffuse pollution resulting in elevated phosphate levels and impacts on river ecology.
Seeley Bk - source to conf Bow Bk (8)	**LOW RISK -** The corridor follows and touches the boundary of this catchment but there is no tangible encroachment. For this reason and given the brooks position and flow direction relative to the corridor impact from mineral works are considered unlikely. There are 19 receptors from historic records predominantly from a mixture of fluvial and surface water sources. There are no modelled records from our communities at risk dataset.	**HIGH PRIORITY –** The brook is at Poor status due to impacts from diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels. The brook has deteriorated from baseline station and reversing this is a priority.
Salwarpe - source to conf Elmbridge Bk (9)	**HIGH RISK –** This catchment occupies most of the eastern boundary of the strategic corridor including Bromsgrove and Droitwich. As expected from these large conurbations modelled results suggest there	**MEDIUM PRIORITY –** The River is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and

Catchments intersecting with Strategic Corridor	Flood Risk Classification and Evidence	WFD classification
	are 1382 receptors from fluvial flood risk. Based on their position relative to the corridor works may require to consider impact upstream (Bromsgrove) as well as impact downstream (Droitwich Spa). Local historic data also suggests there are 126 receptors from Surface Water, Ordinary Watercourse and Main River particularly in Bromsgrove and Stoke Prior.	impacts on river ecology.
Salwarpe - conf Elmbridge Bk to conf R Severn (10)	**LOW RISK-** This catchment is partially within the corridor along its Southern Boundary. Data suggests there is generally low risk from fluvial sources and this only includes 13 receptors at Porter's Mill, Droitwich. Historic records suggest a total of 23 receptors primarily from surface water, however, these are largely situated outside the corridor's boundary and therefore unlikely to impact from mineral works.	**MEDIUM PRIORITY –** The River is at Poor status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology.
Severn - conf R Stour to conf RIver Teme (11)	**HIGH RISK** – This catchment only marginally encroaches the strategic corridor along its southwest boundary near Ombersley. The main source of flood risk is the fluvial, particularly the river Severn. In total, our modelled data suggest 1738 receptors are at risk from fluvial sources. However, the potential impact from mineral works on these receptors is largely constrained due to the limited watershed and drainage networks between the Severn and other catchments inside this corridor. In addition, historic records suggest 67 receptors primarily from surface water and affecting some local infrastructure.	**MEDIUM PRIORITY –** The River is at Moderate status due to impacts from; abstractions, physical modifications, diffuse pollution and discharges from Sewage Treatment Works, resulting in elevated phosphate levels and impacts on river ecology. The River is also classed as a Heavily Modified Waterbody (HMWB). This classification is currently under review. Further information on the required mitigation measures for this HMWB will be available in due course.

Salwarpe Tributaries Strategic Corridor Recommendations

This corridor covers a range of upper and lower parts of the WFD river catchments it intersects with. Generally the northern parts of the corridor are closest to the source of the watercourse whereas the middle and lower parts cover areas situated further downstream. As expected, LiDAR therefore shows a variety of terrains exhibiting different hydrological characteristics. From a flood risk perspective in this corridor there will be opportunities for Green Infrastructure measures associated with flood storage and floodplain connectivity as well as opportunities for control and attenuation of runoff. This will have the potential to reduce flood risk by increasing storage volumes and encouraging overland flows in areas located away from the source and slowing flows and increasing lag to peak in areas closest to the source. The shape or form of these green infrastructures measures will vary across the landscape and should reflect site specific characteristics within the catchment.



These Green Insfrastucture measures will also have the potential to contribute to WFD improvements through improving water quality and river habitat.

Examples of Green infrastructure measures

1. **Overland flow interception:**

This involves the creation of a barrier (soil, wood or stone barrier) across a flow path to create storage. These features should be designed to drain slowly and as such the barrier may be 'leaky', have an outlet or drainage pipe.

2. **Scrapes, Swales, Wetlands / Rural SuDS:**

This involves the creation of hydrological attenuation or interception features to manage local flow pathways to catch and store runoff and sediments, slowing the water before it reaches the river. These features should be built into the topography of the site, rather than requiring bunds.

3. **Field drain and under-drainage blocking:**

This technique involves damming gullies or similar flow routing structures to result in the formation of pools. In doing so new storage is created and flows can be slowed down.

4. Woody Debris:
In the middle and lower parts of the catchment this may take the form of securely installing woody debris to assist the transfer of water from the river to the floodplain to increase floodplain storage volumes, or slow down flows within the channel, to increase the lag to peak and reduce peak levels. In addition, in the upper reaches of the Hadley Brook, Elmbridge Brook and the River Salwarpe this technique should be employed to hold water back, attenuating flood risk downstream.

9.0 Future Updates- mapping tool

9.1 To ensure a robust evidence base to guide future collaborative working and appropriately target flood risk and water quality management, it is important that the catchment mapping tool is kept up to date and continues to use the best available evidence.

9.2 There is a recognition that both the Environment Agency and Local datasets will need to be regularly updated, as more detailed information is available as a result of:

- updates to Communities at Risk data
- new or updated hydraulic modelling
- updated information on local flood incidents
- climate change assumptions
- WFD status and progress

9.3 The mapping tool will also need to take account of the betterment measures that are implemented across Worcestershire as a result of any future development and policy approach.

9.4 Consequently, there is a commitment from the Environment Agency and Worcestershire County Council to continue to work together, maintaining the catchment tool, as appropriate.

Glossary

Floodspot

Each floodspot represents a location where it is known there has been at least one flood event. A floodspot does not therefore represent a property that is impacted by flooding but a location where that has been a recorded flood incident. The nature of the floodspots therefore means that they cannot be used to identify flood outlines or properties or other receptors at risk.

Hydraulic Modelling

Computer, mathematical or physical modelling of a fluid flow system.

Jenks Natural Breaks

A method of manual data classification that seeks to partition data into classes based on natural groups in the data distribution. This statistical method was used to define the flood risk thresholds, which were automatically generated by the ArcGIS software.

JFlow

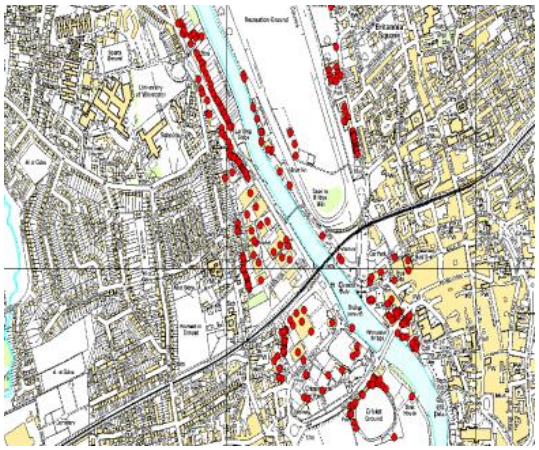
Generalised 2d modelling developed by JBA to map large scale floodplain flooding. JFlow is a unique modelling tool in that the only inputs required are inflow data and a Digital Terrain Model. Given the scale and purpose of this tool hydraulic behaviour is simpler in comparison to traditional hydraulic modelling. In doing so water transfer is based on depth and ground level of the adjacent cells.

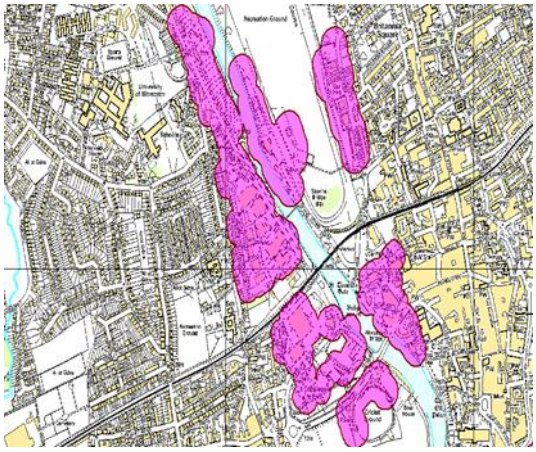
Risk Management Authority (RMA)

RMAs have duties, under the Flood and Water Management Act 2010, to effectively manage flood risk. Different RMAs are responsible for the management of different types of flood risk. The RMAs of relevance to this document are:

Risk Management Authority	Responsible for the management of
Environment Agency	• Flood risk arising from designated main rivers. • Flood risk and coastal erosion arising from tidal waters
Lead Local Flood Authority (Worcestershire County Council)	• Flood risk arising from ordinary watercourses • Flood risk arising from surface water • Flood risk arising from ground water

APPENDIX A- Communities at Risk Dataset





1. The Communities at Risk tool is an established EA dataset used for identifying communities of flood risk to residential and commercial properties.
2. Properties at risk of flooding in Flood zone 2 (FZ2) were identified and given a buffer (35m in urban areas and 50m in rural areas for the West Midlands). Where 10 or more of those buffer outlines touch, that constitutes a community.
3. In setting a different buffer for rural and urban areas, consideration was given to the property density of urban areas and the need to not unduly discount the sparser nature of the more rural areas, hence providing a larger buffer in these cases. These buffers can also vary across the country to better reflect local characteristics.
4. In addition, different options were considered to determine the threshold that constitutes a community. However, it was concluded that 10 properties would form a 'Community at Risk'.
5. This was agreed for national consistency and was based on resource prioritisation and potential number of outcome measures (OMs). In doing so this data helps target clusters of properties at risk, enabling more robust and transparent decision making.
6. Please note, communities are created using UNDEFENDED outlines so some of the communities may already fully or partially defended. In addition, the communities at risk dataset does not implicitly account for the impact of climate change. Instead it uses the 1 in 1000 year event (or Flood Zone 2) to define properties at risk of fluvial flooding. In using this low probability event we have therefore taken the most precautious approach (at this point in time) to capture properties at risk.
7. The communities at risk work is a TOOL to identify areas of risk and help to prioritise future works or opportunities for partnership projects.
8. There are 137 communities at risk in Worcestershire.

Appendix B- LLFA Floodspots Dataset

An extensive evidence base has been compiled comprising over 1,700 known floodspots across Worcestershire and a wealth of information about each of them.

For the first time this information, along with the EA modelled surface water mapping, allows us to see and articulate to others both the general scale and more specific details of flood risk in Worcestershire.

Early scoping exercises led to a decision to carry out a strategic, county-wide assessment of flood risk from all sources, not just surface water, and to identify priority locations for further action based upon these findings.

All locations which are known to have flooded in the County at some point in the past have been identified and mapped through:

- An extensive series of workshops with experienced and knowledgeable officers from a range of disciplines within the Risk Management Authorities
- A thorough examination of flood reports and records including district council Strategic Flood Risk Assessments and reports produced after the severe 2007 flooding event

This exercise, with the addition of new locations emerging from flood events which occurred during the assessment period, has produced approximately 1,700 floodspots.

Each floodspot represents a location where it is known there has been at least one flood event. However, the nature and scale of these flood events varies significantly. Therefore, a large number and variety of workshops, interviews and desk top assessments has led to the collation of attribute data for almost every floodspot including:

- Flooding source (Ground Water, Main River, Ordinary Watercourse, Surface Water);
- Number of impacted properties;
- Number of impacted businesses;
- Number of impacted pieces of critical infrastructure;
- Status of mitigation work, and;
- Lead Risk Management Authority

In terms of defining ‘critical infrastructure, the National Receptors Database contains a list of infrastructure, which was edited to include only those seen as 'critical infrastructure'. For the purposes of this evidence base, an edited list was used, plus highways which are felt to be of particular importance e.g. key emergency service routes or those which have few or no alternative diversion possibilities.

For info this list includes the following infrastructure:
Aqueduct
Burial ground
Cemetery
Clinic
Electricity sub station
Health centre
Hospice

Mortuary
Nursing home
Police services
Pump house
Pumping
Sewage pumping
Surgery
Telecommunications
Telephone exchange
Water filtration
Water regulating

Where impact numbers weren't available, a 50m buffer was created around the centre of the floodspot and overlaid with the National Receptor Database (NRD). In many locations this method exaggerated the number of receptors at risk. Therefore, the resulting theoretical numbers of properties, businesses and pieces of critical infrastructure were passed to the relevant lead RMA to be truthed, to give a correct indication of risk in the floodspot location. At time of writing some RMAs are still truthing the data.

Each floodspot has been provisionally allocated to a lead RMA who will be expected to carry out further investigation before confirming whether they are the lead RMA. Once the lead RMA and other relevant RMAs for each floodspot has been confirmed, the lead RMA will ensure that the floodspot is appropriately taken through the Surface Water Management Plan (SWMP) process which defines how floodspots are recorded, studied and managed to implement flood mitigation measures. This also includes the RAG status sequence (Red, Amber, Green). RAG status will be dynamic and the attributes are regularly updated to reflect its associated flood mitigation status:

- Red: not yet investigated
- Amber: Being investigated or a scheme being developed
- Green: Mitigation work completed, not viable or not necessary

Many floodspots will involve more than one source of flooding and, therefore, require a multiple-RMA approach.

Floodspots and their attribute data have been recorded in a GIS in order that that they can be used most effectively and made as appropriately and fully accessible as possible.

Wherever possible this data is being made available on the WCC website. However, some of the data is more sensitive and, subject to data protection and access to this needs to be appropriately restricted.

Additional data, beyond that held in the core floodspot attribute spreadsheets, is held by the relevant RMAs in a range of formats. It is intended that this data will gradually be digitised and made accessible via a floodspot web-mapping system.