Worcestershire County Council

BIODIVERSITY AND MINERAL SITES IN WORCESTERSHIRE

GUIDANCE FOR THE SUSTAINABLE MANAGEMENT OF BIODIVERSITY ACTION PLAN HABITATS AT WORCESTERSHIRE MINERAL SITES

TECHNICAL RESEARCH PAPER

"**Biodiversity is the variety of all life forms around us. The inter-relations between different species and between species and habitats are vital for the food chain and provide valuable services to mankind. Particularly in view of our limited understanding of the processes, we interfere with them at long-term risk to ourselves. Moral and aesthetic arguments add to the practical, social and economic ones for promoting biodiversity**".

The Potential Contribution of the Mineral Extraction Industries to the UK Biodiversity Action Plan. English Nature Research Reports No. 279.

Executive Summary

Mineral companies are increasingly aware of the potential contribution and important role they play in biodiversity conservation. The minerals industry has already made a considerable contribution to the conservation of habitats and species across the country as well as here in Worcestershire. Many restored sites balance biodiversity conservation with the delivery of the broader 'Green Infrastructure' objectives and a considerable amount of knowledge and expertise has now accumulated in formulating, implementing and monitoring restoration strategies.

Working minerals in Worcestershire poses a unique opportunity: quarry restoration can contribute at a landscape scale towards Biodiversity Action Plan targets; providing a net-gain in biodiversity and improving the coherence and resilience of ecological networks, enabling wildlife to respond to a range of environmental pressures. Establishing a coherent and resilient ecological network capable of contributing to the ecosystem demands of our growing population is an essential element in halting and reversing biodiversity loss whilst also benefiting our local communities (examples and case-studies are included within this document).

The opportunity exists to co-ordinate future habitat creation and restoration efforts in strategic locations; drawing on existing experience and expertise to maximise the potential of mineral site restoration to make the most significant contribution possible in improving our ecological networks.

This process is best delivered through:

1. Pro-active engagement: working in partnership throughout the full life-cycle of mineral schemes ensures that restoration strategies are successfully delivered and that their sustainable legacy is embraced by local communities to the benefit of the local landscape, local businesses and locally appropriate biodiversity. This document includes guidance designed to support the mineral planning processes.

2. A targeted approach: a clear and well-defined set of restoration goals will ensure that the most effective use of resources can be made. This document includes a framework to guide the decision-making process for a biodiversity-led approach to mineral site restoration. A clear set of priorities (refer to page 17) will help focus habitat restoration efforts to maximise their effectiveness through strategic location throughout the county. Additionally an appended ‘habitat creation toolbox' will help guide restoration strategies in identifying key actions and the means to achieve them.

3. Smart restoration aims: practical and creative restoration plans set out phased operations with clear timescales; are sensitive to pre-existing biodiversity interest and incorporate the principles of strategic habitat creation which include elements of natural regeneration and non-native species control from the outset in order to minimise capital expenditure and future maintenance costs.

To deliver this targeted approach, biodiversity-led restoration strategies should focus effort on creating and extending locally appropriate Biodiversity Action Plan habitats, especially in key locations (such as “Biodiversity Delivery Areas”). This will contribute most significantly to the existing and complementary conservation efforts. More detail on the habitats appropriate for these areas has been provided and a Habitat Creation Toolbox is appended to this document.

On the accompanying webtool[1] spatial synergies with other environmental initiatives are also identified so that, where minerals are extracted outside a Biodiversity Delivery Area, restoration plans can continue to ensure that biodiversity conservation efforts are tailored to a range of prioritised Biodiversity Action Plan habitats appropriate for that locality. More information on the habitats appropriate for each “Ecological Zone” in which minerals may be extracted is also provided within this document. Within Biodiversity Delivery Areas restoration strategies should contribute to the priorities identified by the

[1] available at http://gis.worcestershire.gov.uk/website/mineralspublishing/maps.aspx

Worcestershire Biodiversity Partnership[2] as it is believed that site restoration efforts which are primarily focused on creating locally appropriate BAP habitat will have the most strategically beneficial effect at a County level. The vision for restoration strategies of mineral sites outside a Biodiversity Delivery Area is for the delivery of a range of services which might include productive agricultural land, Green Infrastructure, flood attenuation or forestry, as is appropriate on a site-by-site basis, but in a manner which can also sustainably deliver a significant contribution towards Biodiversity Action Plan targets most appropriate and achievable for each locality.

This document also aims to enable the long-term positive management for biodiversity of mineral sites, throughout their full life-cycle. These same measures will contribute to adapting and mitigating likely climate change effects in Worcestershire by: making our transport links more resilient, providing new flood attenuation and alleviation features, and new public open space which in turn will benefit our health through new recreation and access opportunities. Crucially this can be achieved while protecting and enhancing Worcestershire's natural heritage.

In combination these efforts should reduce costs for mineral operators and provide additional security and financial value to our local communities whilst making Worcestershire's natural environment a more cohesive, resilient and attractive place for all.

[2] Available at www.gis.worcestershire.gov.uk/website/mineralspublishing/maps.aspx

Contents

1. Introduction

1.1 The minerals industry has already made a considerable contribution to biodiversity (Nature After Minerals/RSPB, 2006[3]) with many positive effects such as the creation of lakes for wildfowl and deep hard rock quarries that provide nesting habitat for some of our rarest birds.

1.2 Mineral sites have demonstrated that extraction can support a variety of flora and fauna both as a result of the final restoration and by providing temporary habitats during the operational phases of the site. This is reflected in the fact that many former local quarries are now designated as either Local Wildlife Sites (LWS), Local Geological Sites (LGS) and/or Sites of Special Scientific Interest (SSSI).

1.3 For the foreseeable future there will be a continuing need for the extraction of minerals in Worcestershire and there remains enormous potential for schemes which contribute significantly to our nature conservation objectives.

1.1 Purpose

1.1.1 The opportunities for the creation of new Biodiversity Action Plan (or "BAP" – refer to Section 3.10) priority habitats in Worcestershire are considerable: over 230 hectares of land are currently being worked for mineral extraction in Worcestershire; the restoration of these sites poses an exciting opportunity to make significant and highly valuable gains for Worcestershire's biodiversity, people and places. The biodiversity-led restoration strategies of mineral sites, when applied in a concerted and strategic manner, will realise a significant benefit for Worcestershire.

1.1.2 The document supports the mineral industry and stakeholders by providing a framework through which the restoration-led mineral extraction can provide a net-gain for biodiversity through strategically coordinated Biodiversity Action Plan habitat creation.

This Document's Primary Objectives:

1. To promote opportunities for biodiversity within the full lifecycle of mineral sites in Worcestershire.
2. To guide the creation of locally appropriate BAP habitats,
3. To make the existing network of BAP habitats in Worcestershire more cohesive and resilient.

This Document's Secondary Objectives:

To promote the range of ecosystem services provided by biodiversity-led restoration of mineral sites, including:

- Creation of new flood attenuation/alleviation resources.
- Water quality improvements (in support of Water Framework Directive objectives).
- To realise education/cultural growth opportunities.
- Promote opportunities for public access and recreation (where compatible with habitat restoration aims).
- To promote economic growth (industrial, agricultural & eco-services).
- To support the policy formulation process of the emerging Worcestershire Minerals Local Plan.

[3] Nature After Minerals: how mineral site restoration can benefit people and wildlife' (RSPB, 2006).

Past action has often taken place on too small a scale. We want to promote an ambitious, integrated approach, creating a resilient ecological network across England. We will move from net biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and coherent ecological networks.

Making Space for Nature: A review of England's Wildlife Sites and Ecological Network. **Lawton, September 2010.**

1.2 Preparation

1.2.1 This paper has been prepared in partnership with Natural England, the Environment Agency, Forestry Commission, RSPB, Nature After Minerals and Worcestershire Wildlife Trust through a desktop review and drawing together of the key policies, guidance, emerging best practice and available evidence as it relates to Worcestershire. A consultation exercise has been undertaken with key stakeholders on the draft paper.

1.3 Scope and Status

1.3.1 This is one in a series of natural resource technical research papers[4] prepared by Worcestershire County Council.

1.3.2 The intended audiences for this paper are mineral industry operators, land-managers, ecologists, planning officers, Local Nature Partnership, the local strategic partnership, biodiversity partnership and other strategic stakeholders with an interest in biodiversity and mineral sites in Worcestershire.

1.3.3 Although the paper has benefited from scrutiny and consultation with stakeholders it is not a statutory document and holds the status of a research paper that provides evidence to inform best practice in planning and preparation for operation of mineral sites as well as the development of statutory documents such as the Worcestershire Minerals Local Plan.

1.3.4 In drawing together the available evidence and key policies, the paper is intended to be a useful tool to policy makers, but does not diminish the need for the reader to be alert to both existing and emerging evidence and policy with regards either biodiversity or minerals. To help the reader a suggested list of guidance and best practice is appended.

Local Biodiversity Action Plan Priority Habitat	Target for BAP Habitat Creation in Worcestershire 2010 - 2017
Arable field margins	315 Ha
Floodplain grazing marsh	22 Ha
Hedgerows	5 km
Lowland calcareous grassland	2 Ha
Lowland dry acid grassland	2 Ha
Lowland heathland	13 Ha
Lowland meadows	66 Ha
Lowland mixed deciduous woodland	430 Ha
Ponds	18 Sites
Reedbeds	130 Ha
Traditional Orchards	120 ha
Wet woodland	5 Ha
Wood-pasture and parkland	1 Site

(Above) Priority habitat creation/expansion targets 2010-2017. Source: Worcestershire Biodiversity Partnership

[4] Others either prepared or in preparation include Planning for Soils, Planning for Renewable Energy, Planning for Water, Planning for Climate Change and Planning for Green Infrastructure. Available at www.worcestershire.gov.uk/planning

Planning for Mineral Sites

2. A restoration-led approach

2.1. The approach for restoring mineral sites in the past has shown considerable diversity: while many sites are infilled with inert material and put to agricultural use, some sites have been restored for amenity use - frequently featuring large and regular shaped waterbodies supporting activities such as fishing or water-sports. Many sites have featured an area set aside for 'nature conservation' purposes and a number of restoration strategies have created multi-functional sites which deliver many of these features. In this paper a framework is established for a cohesive and spatially strategic approach to biodiversity-led restoration plans. This will maximise the benefits which can be delivered through mineral site restoration in Worcestershire. This supports the aspirations of Biodiversity 2020: a strategy for England's wildlife and ecosystem services (see information box).

Restoration Planning

2.2 Site Selection & Engagement

2.2.1. Pre-application planning discussions are an important part of the planning process. Seeking advice prior to the formal submission of a planning application should ensure that the quality of a development is improved and that certainty in the outcome can be increased for the application. Worcestershire County Council welcomes and strongly encourages pre-application consultation by mineral operators.

Biodiversity 2020: A strategy for England's Wildlife and ecosystem services

Our mission is to halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.

Outcome 1 – Habitats and ecosystems on land (including freshwater environments)

By 2020 we will have put in place measures so that biodiversity is maintained and enhanced, further degradation has been halted and where possible, restoration is underway, helping deliver more resilient and coherent ecological networks, healthy and well-functioning ecosystems, which deliver multiple benefits for wildlife and people, including:

- **1A. Better wildlife habitats with 90% of priority habitats in favourable or recovering condition and at least 50% of SSSIs in favourable condition, while maintaining at least 95% in favourable or recovering condition;**
- **1B. More, bigger and less fragmented areas for wildlife, with no net loss of priority habitat and an increase in the overall extent of priority habitats by at least 200,000 ha;**
- **1C. At least 17% of land and inland water, especially areas of particular importance for biodiversity and ecosystem services, conserved through effective, integrated and joined up approaches to safeguard biodiversity and ecosystem services including through management of our existing systems of protected areas and the establishment of nature improvement areas;**
- **1D. Restoring at least 15% of degraded ecosystems as a contribution to climate change mitigation and adaptation.**

What are Ecosystem Services?

Resources and processes supplied by natural ecosystems are known as ecosystem services. These include products like food and clean drinking water as well as processes such as the decomposition of wastes and the control of flood water.

(Ecosystem services: novel case studies, Natural England Technical Publication (31/03/2013)

Why is having a coherent and resilient ecological network important?

England's wildlife and landscapes have inspired and delighted through generations. There are strong moral arguments for recognising the intrinsic values of other species and for passing on the natural riches we have inherited to future generations.

We have also recently begun to better understand (or perhaps remember) that our natural world is not a luxury: it is fundamental to our well-being, health and economy. The natural environment provides us with a range of benefits – *ecosystem services* including food, water, materials, flood defences and carbon sequestration – and biodiversity underpins most, if not all, of them.

The pressures on our land and water are likely to continue to increase and we need to learn how to manage these resources in ways which deliver multiple benefits, for example, achieving profitable and productive farming while also adopting practices which enhance carbon storage, improve flood water management and support wildlife.

***Making Space for Nature: A review of England's Wildlife Sites and Ecological Network.* Lawton, September 2010.**

2.2.2. In preparing a restoration plan, due consideration should be given to the established and emerging frameworks such as the Worcestershire Green Infrastructure Strategy[5] as well as tools including the Worcestershire Landscape Character Assessment[6], the Forestry Commission's Woodland Opportunity Map[7] and the Worcestershire Woodland Guidelines[8] to ensure cross-compliance with landscape priorities.

2.2.3. When selecting sites, future mineral operations should aim to minimise impacts to existing biodiversity identified through baseline ecological surveys (further information on baseline ecological surveys refer to Appendix 4), by locating extraction sites in a manner which buffers and protects or extends existing designated nature conservation sites and which contributes to the value and cohesiveness of these sites through implementing appropriate restoration strategies formulated at the outset of the scheme's feasibility studies.

2.2.4. The Worcestershire Biological Record Centre (see Appendix 7) should be consulted in conjunction with undertaking an ecological study of a potential extraction site and its environs in order to determine both the biodiversity interest on site and in the locality, and to gauge the value of these resources at appropriate geographic scales. This process will help inform the fine detail of a restoration plan's objectives.

2.2.5. A restoration-led approach may make it acceptable for extraction sites to be located in more sensitive locations which traditionally would not have been worked. For instance: extraction could provide an opportunity for mineral sites which abut a water course to include additional riverine braided channels or enhanced river profiles using new marginal and emergent vegetation as part of an appropriate restoration plan and this would also contribute to the catchment's Water Framework Directive objectives (refer to Appendix 3 for further information).

2.2.6. Alternatively, new and emerging mechanisms such as biodiversity offsetting may offer the opportunity to contribute to BAP network cohesiveness and resilience through acquisition and offsite creation of BAP habitat where the restoration of mineral sites to BAP habitat is not feasible (refer to Section 2.8.1 for further information).

2.3 The Restoration Plan

2.3.1 Restoration plans should draw on the framework and guidance established

[5] www.worcestershire.gov.uk/cms/strategic-planning/planning-green-infrastructure.aspx
[6] www.worcestershire.gov.uk/cms/landscape-character-assessment.aspx
[7] www.forestry.gov.uk/forestry/infd-6n4gzu
[8] www.worcestershire.gov.uk/cms/worcestershire-woodland-guide.aspx

within this document. The plan must be developed as an integral part of the scheme's preparation, together with plans to address onsite and local ecology throughout the full lifecycle of the scheme. These plans must be submitted in support of an application for planning permission.

2.3.2 It is crucial that proposals for site restoration are accompanied by a site-specific restoration plan. This should identify key activities to be undertaken on site and should be detailed enough to identify features such as planting lists, management prescriptions and anticipated water levels (where these are an important feature in the final restoration strategy). At the same time, the restoration plan must be clear and concise to be implemented by site contractors (more concise contractor briefing sheets might be included within a restoration plan's appendices for instance). Where extraction is anticipated over an extended timeframe, multiple restoration plans which address each phase of site activity might be beneficial in guiding the site towards the aims of the final restoration strategy (see also 'Phased Extractions').

2.3.4. A process of drafting a restoration plan will also be important in assessing the feasibility of a scheme; evaluating whether it is practical, achievable and appropriate to its immediate locality. The collation of information, through desk studies and site investigations, provides data and enables the identification and evaluation of the existing wildlife interest and the potential for restoration on a site-by-site basis. Understanding elements such as soil type, hydrology, topography, structure, site size, altitude and aspect, fertility and surrounding land-use will be critical in assessing the success of proposed habitat creation projects and ensuring the long-term site management together with any biodiversity mitigation or compensation measures.

2.3.5. From the outset, restoration plans should recognise that creating locally appropriate BAP habitat and contributing towards local BAP targets (either through seeding, planting or natural regeneration) can often be a much cheaper alternative than alternate restoration approaches.

2.4 The Development of the Restoration Framework

2.4.1. BAP habitats describe communities of vegetation which, when favourably managed, can support a diversity of wildlife. In many cases BAP priority species are specialists reliant on good quality BAP habitats to forage, disperse, breed or over-winter. These species are prioritised for conservation effort due to their national scarcity and vulnerability. There is a unique opportunity through mineral site restoration to improve the cohesiveness and resilience of the network of BAP habitats in the local landscape. This supports the objectives and targets established in the Mineral Products Association Biodiversity Strategy[9].

2.4.2. Establishing a coherent and resilient ecological network capable of contributing to the ecosystem demands of our expanding populations and respond to increasing environmental stress (from a variety of factors including climatic change and habitat fragmentation amongst others) is a fundamental issue for halting and reversing biodiversity loss. As the location of mineral resources is mapped by the BGS and the location, nature and extent of BAP habitats has been mapped via the Worcestershire Habitat Inventory, it is now possible to

[9] www.mineralproducts.org/sustainability/pdfs/MPA_Biodiversity_Strategy.pdf

identify habitat networks which will likely be associated with future mineral working in Worcestershire (refer to the webtool at: www.gis.worcestershire.gov.uk/website/mineralspublishing/maps.aspx for further detail).

Minerals in Worcestershire

2.4.3. Current estimates on workable reserves within the emerging Minerals Local Plan are based BGS geological memoirs and on 1:50,000 scale British Geological Survey Digital Data. Deposits larger than 10 hectares in area or more than 200 meters wide have been assessed based on known information about the size and depth of deposits. Where resource areas are thought to hold significant reserves they have been identified and aggregated into clusters (called "areas of search") at which there is greatest potential to deliver strategic benefits at a landscape scale.

2.4.4. No assessment is made within the remit of this document as to the economic viability of mineral extraction in any given location.

2.4.5 Further information on the apportionment, supply and demand of aggregate in Worcestershire for the period 2012-2030 can be found in the Local Aggregate Assessment for Worcestershire, May 2013[10]. By far the greatest available mineral resource and largest apportionment for mineral delivery in a Worcestershire context is sand and gravel aggregate; during the life of the 2015-2030 Minerals Local Plan, 14-23 million tonnes are likely to be required. In contrast between 3-9 million tonnes of hard (crushed) rock are likely to be required over the same period. There is therefore considerable value in focusing strategic restoration efforts on sand and gravel mineral resource areas.

2.4.6. The contribution to Biodiversity Action Plan targets that restoration of hard rock and other mineral workings can make in Worcestershire **should not be underestimated**; for instance the network of heathland and acid grasslands associated with West Worcestershire and the Malvern Hills (together with the opportunities for wildlife that features such as cliffs, ledges, spoil and scree can provide) have considerable value in their county context. This is further enhanced where strong BAP habitat networks are found in proximity. While many of the measures outlined within this document regarding pre-works and phased extraction of mineral sites, many measures will also be applicable to hard-rock and other quarries, it is not the primary intention of this document to provide detailed technical guidance for mineral working or land restoration for BAP gain at these sites.

2.4.8. The underlying geology within sand and gravel mineral resource areas has a deep and inexorable association with its biodiversity (as explored in more detail in Appendix 2). The three broad sources of sand and gravel are restricted to:

a) solid deposits which are mainly found in the north-east of the county;
b) river terrace deposits which are most widespread in the Severn, Avon and Salwarpe Valleys to the east of the Malvern Hills;
c) glacial deposits which are found in association with boulder clay in the north-east of the County and also to the northwest of Evesham around the Lenches.

[10] www.worcestershire.gov.uk/amr

Ecological Zones

2.4.9. Ecological Zones[11] are landscape - scale units established[12] to describe broadly similar assemblages of land-use, habitats and species. The Ecological Zones associated with the Mineral resource Areas are broadly categorised as "Alluvial Fenlands", "River Terrace" and "Forest Sandstone".

2.4.10. In recognition of the landscape-scale opportunities through which conservation efforts can most successfully deliver Worcestershire's BAP targets, areas within these Ecological Zones have been recognised by the Worcestershire Biodiversity Partnership as 'Biodiversity Delivery Areas' ("BDAs").

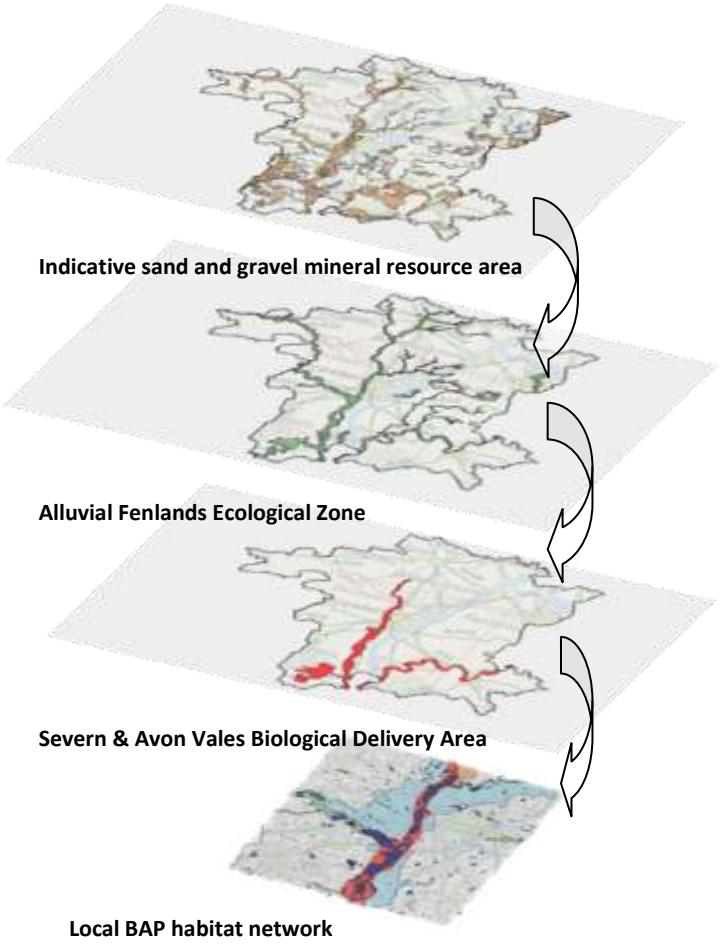
2.4.11 The Biodiversity Delivery Areas were agreed by the Worcestershire Biodiversity Partnership in 2009 to indicate, spatially and strategically, where, according to current knowledge and resources, the targets within the Biodiversity Action Plan can best be delivered over the next 5-year period (refer to Section 3.5 for further information).

Fig 1

	Ecological Zone		
	River Terraces	**Alluvial Fenlands**	**Forest Sandstones**
Worcestershire Biodiversity Partnership target areas:	• Severn and Avon Vales BDA • "Wetlands West" target area (refer to Section 3.6).		• Wyre Forest Acid Grassland and Heaths BDA
BDA Action Plan priority habitats (refer to Appendix 2 for further information)	• Fen and Marsh • Lowland wet grassland • Rivers and streams • Neutral grassland • Wet woodland • Reedbed		• Acid grassland • Lowland heathland
Habitat-led restoration schemes should make use of the Appended Habitat Creation Toolbox alongside Trees and Woodland In Worcestershire: Biodiversity & Landscape Guidelines for their planting and management. Worcestershire County Council/Forestry Commission, 2010.			
BDA Action Plan priority species	• Wetland birds • Water vole • Common club-tailed dragonfly • Otter		• Adder • Hornet robberfly
Other protected and notable species likely to encounter:	• Great crested newt • Bats • Slow-worm • Common lizard • BAP invertebrates • Scarce plant species including uncommon arable flora and black poplar		

[11] Ecological Zones are based on J.J.Day's biogeographical treatment of Worcestershire (available at www.wbrc.org.uk/worcRecd/Issue10/natarea.htm); which identified cohesive areas of flora, substrate, hydrology, relief, climate, altitude and land-use.

[12] www.worcestershire.gov.uk/cms/worcestershire-woodland-guide.aspx



Scope of the Framework's focus

2.4.12. Given the anticipated focus on sand and gravel extraction within Worcestershire, this Framework focuses on the BAP habitats prioritised for conservation action within the Biodiversity Delivery Areas associated within the three Ecological Zones in which the Mineral Resource Areas are predominantly located.

2.4.13. Although much of the advice within the Habitat Creation Toolbox is appropriate when establishing, restoring or extending habitats at mineral sites, it should be noted that many of the approaches set-out within this document are applicable to any stage of a mineral site's life-cycle. However, biodiversity consideration (especially with regards site restoration) is most effective when considered at the earliest (i.e. feasibility) stages.

2.4.14. Within Appendix 2 are a range of toolkits assembled to promote good working practice in creating, maintaining and enhancing the priority BAP habitats identified within the Wyre Forest Acid Grassland and Heaths and the Severn & Avon Vales BDA's. This information should be used in conjunction with the interactive online tool (available at http://gis.worcestershire.gov.uk/website/mineralspublishing/maps.aspx) to identify, on a site-by-site basis, how any given site can contribute to the cohesiveness and resilience of local BAP networks.

2.4.15 The following list of priorities forms the basis of the Restoration Framework (shown on Page 17):

- Where located inside a Biodiversity Delivery Area (BDA) it is believed that site restoration efforts which are primarily focused on creating locally appropriate BAP habitat will have the most strategically beneficial effect at a County level.

- Outside a BDA, sites can still deliver strategic benefits by contributing towards a number of key landscape-scale habitat management initiatives:

✓ Where located inside Flood Zones 2 or 3, or within the Wetlands West (refer to Section 3.6) target areas or areas identified within the County's emerging Surface Water Management Plan or emerging Flood Risk Management Strategy, there may be an opportunity for biodiversity-led restoration plans to create new flood alleviation or attenuation features through restoration or creation of wetland habitats (refer to Appendix 2).

✓ In areas already identified as having moderate to high biodiversity value there is especial value in focusing restoration plans exclusively on creating locally appropriate BAP habitats which contribute to

reconnecting the existing natural assets.

- ✓ Where located outside a BDA or similar target areas, and in areas identified as moderate-to-low biodiversity value, restoration plans can still make a significant contribution towards the cohesiveness and resilience of the surrounding BAP habitat networks:

- ✓ Sites can be restored in line with Woodland Planting framework[13] objectives, and can contribute towards BAP habitat targets[14] and water management[15] objectives.

- ✓ Sites restoration plans which aim to deliver new Green Infrastructure resources can make a significant contribution towards BAP targets whilst also contributing towards improving local community's access to natural greenspace[16].

- ✓ Sites restored for agricultural might be able to benefit from Agri-Environment Schemes: set-asides for biodiversity (such as new hedgerows, ponds and conservation headlands) can also be a significant saving in the restoration scheme's capital costs.

Areas in Worcestershire's Flood zone 2, as mapped by the Environment Agency, covers all land where there is between a 1 in 100 (1%) and 1 in 1000 (0.1%) chance of flooding from rivers in any one year. Flood Zone 3 covers all land where there is a 1 in 100 years (1%) or greater chance of flooding from rivers in any one year.

Wetland habitats can ameliorate the effects of flooding: adding water storage capacity in flood events and slowly returning the water to the catchment after peak-flows, alleviating the downstream effects of flooding,

Other ecosystem services provided by wetland habitats include particulate filtration and breakdown of some organic pollutants, improving water course quality and the biodiversity value of the catchment; in turn contributing towards the Water Framework Directive objectives for catchment management strategies in Worcestershire.

Restoration plans are encouraged to draw on the Worcestershire Surface Water Management Plan and Flood Risk Management Strategy. In addition it should be noted that Flood Zone maps primarily show flooding from main rivers, not ordinary watercourses (with a catchment of less than 3km2). An up to date assessment of flood risk associated with the Ordinary Water Courses will be necessary to inform restoration master plans.

[13] www.forestry.gov.uk/forestry/infd-6n4gzu

[14] www.worcestershire.gov.uk/cms/biodiversity/action-plans/trees-and-woodland.aspx

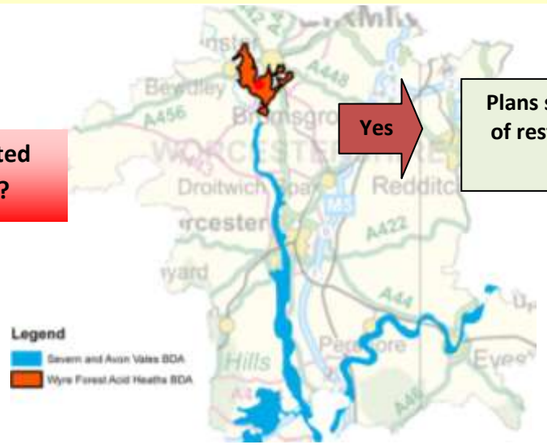
[15] www.worcestershire.gov.uk/cms/pdf/WT%20Woods%20and%20Water%20Management.pdf

[16] www.naturalengland.org.uk/regions/east_of_england/ourwork/gi/accessiblenaturalgreenspacestandardangst.aspx

START HERE

Step 1 Locate the proposed mineral extraction site using the webtool available at: www.gis.worcestershire.gov.uk/website/mineralspublishing/maps.aspx

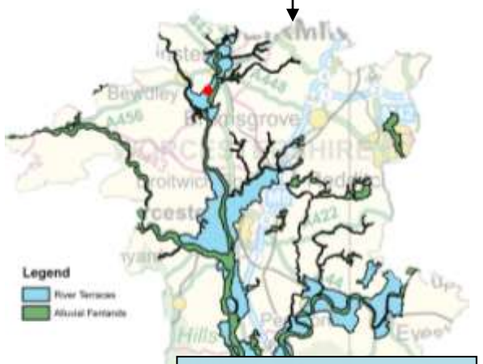
Step 2 **Is the site located inside a BDA?**



Yes → **Plans should aim to contribute 100% of restoration area to following Key BAP habitats:**

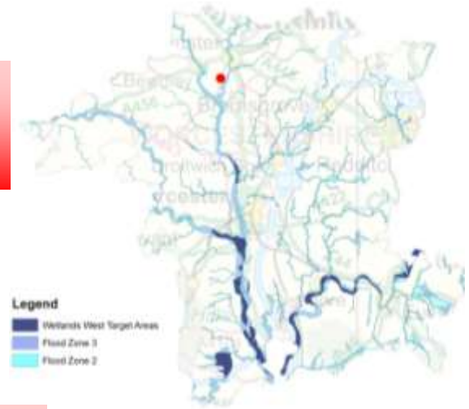
- **Forest Sandstones Ecological Zone**
  - Acid grassland
  - Heathland

- **River Terrace & Alluvial Fenland Ecological Zones**
  - Fen & Marsh
  - Wet grassland
  - Neutral grassland
  - Rivers & streams
  - Wet woodland
  - Reedbeds



No

Step 3 **Is the site located inside Flood Zones 2 or 3, or within Wetlands West target area**



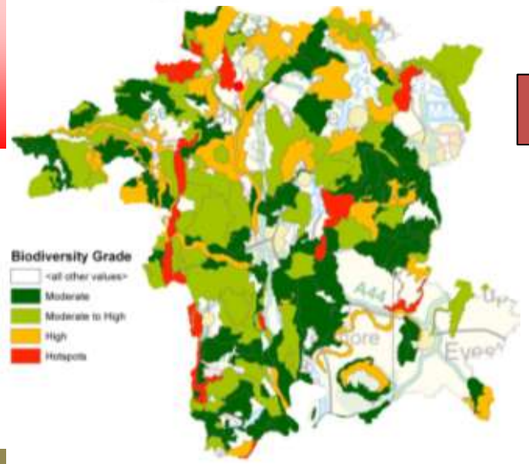
Yes → BAP habitats can provide flood water attenuation and alleviation features and should comprise a significant **(>50%)** proportion of the restoration plan

No

Step 4 **Is the site located inside an area identified within the Biodiversity Basemap as having "Moderate" or greater value.**

or

Is this an extension of an existing minerals site?



Yes → **Especially where site occurs within 500m of the site, a significant proportion (>50%) of restored land should aim to focus on BAP habitat creation to link surrounding habitats**

No

Step 5 **If site is outside these zones, consider the following restoration options**

- **Green Infrastructure provision. Consider integrating BAP habitat creation & management principles into:**
  - Public Open Space
  - Blue Infrastructure (running & standing water)
  - Biodiversity set-asides
- **Best and Most Versatile Agricultural Land (AGLV 1)**

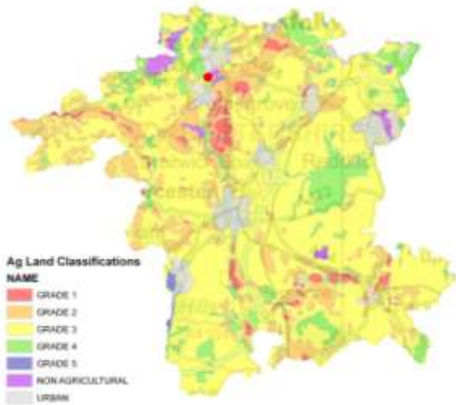
  Consider Agri-Environment Scheme options
- **Woodland Opportunity Target Area**

  Restoration should primarily focus on following Key BAP habitats:
  - Woodland
  - Wet Woodland

Complementary biodiversity habitats and agricultural land-use

Especially where site occurs within 500m of the site, restoration plans should aim to contribute a significant **(>50%)** proportion of land to the following BAP habitats:

- Arable margins
- Ponds
- Hedgerows & hedgerow trees



Use the webtool's query tool (in conjunction with Section 3 "Interpreting BAP Networks") to identify and assess BAP habitat networks within 500 meters of the site.

Refer to Section 4 for worked examples

2.5. Restoration Plan Principles

Policy framework

2.5.1. The National Planning Policy Framework sets out the general principles of development with regards biodiversity interest (also known as the 'development hierarchy'). Paragraph 118 states the aims of biodiversity conservation and enhancement: to avoid significant harm (e.g. through locating development on alternative sites which pose less harmful impacts). Or, failing this, by providing adequate mitigation to minimise the damage caused or, "as a last resort" compensating for such damage.

2.5.2. Following the guidance proposed in Lawton (2010), in implementing the Restoration Framework, restoration plans should adopt the following principles:

Restoration-plan principles

2.5.3. Where mineral extraction is proposed which would adversely impact BAP habitats, this would only be supported where the following measures can be secured:

- Adequate protection for habitats which will be indirectly impacted (e.g. noise, vibration, dust, de-watering). This might be through buffering (e.g. through new habitat creation), or through phased operations and careful timing of certain stages of extraction (to avoid more significant impacts).

- Adequate mitigation for any direct impacts, e.g. through new habitat provision, contributions to habitat monitoring and management (not necessarily financial).

- Adequate compensatory measures such as new BAP habitat provision (preferably onsite, but potentially achieved via offsite habitat creation and management where this can be secured e.g. by S.106). Habitat translocations can have significant cost implications and a long-term commitment to monitoring and management of translocated habitats will be anticipated.

- Adequate enhancement measures: where an adverse impact to BAP habitats is likely, developments should achieve more than "no-net-loss" for biodiversity by restoring a significantly larger extent of those habitats destroyed by mineral working.

- Where mineral extraction is proposed **abutting a BAP habitat**, restoration strategies should aim to **extend the existing BAP habitats** using sympathetic seeding or planting, preferably using the adjacent habitats as a cheap source of vegetative material.

- Where mineral extraction is proposed **in the proximity** of known BAP habitats(e.g. within 500 meters), the restoration plan should aim to make a significant contribution (e.g. >50% of

Extraction located on existing BAP habitats...

Within certain areas (especially where identified in the Worcestershire Habitat Inventory) there will be elevated risks of impact to existing BAP habitats and species through mineral working.

In these cases the County Planning Authority will anticipate that applications will contain sufficient detail to demonstrate the avoidance, mitigation and/or compensation of impact to these features and a commitment to the long-term management of such sites for the benefit of biodiversity. It will be anticipated that restoration plans (or other strategies such as compensation or enhancement measures secured through biodiversity offsetting) will ensure 'no-net-loss' for biodiversity is achieved.

Compensation for BAP habitat loss should achieve a net increase in BAP habitat provision.

land restored) of similar BAP habitat to improve the cohesiveness and resilience of the network

More detail on this process is provided in Section 3 "Interpreting BAP Networks":

2.6. Phased extractions

2.6.1 Phased extraction of mineral sites also provides opportunities for biodiversity such as:

- Set-asides and wildlife refuges which can be used to harbour wildlife moved from the active extraction zone in advance[17]. Note that double-handling of soils should be avoided where possible by storing overburden as close as possible to its final 'restoration' location. This will minimise costs associated with soil movement; should minimise risk of impact to biodiversity which might occupy the overburden in the interval between handling; and should also give vegetation and invertebrates the opportunity to colonise the soil as early as possible after initial disturbance.

- Where waterbodies are planned, the early identification of landforms such as peninsulas or islands can save time and money later during restoration phases if these can be identified, created and protected during phased extraction.

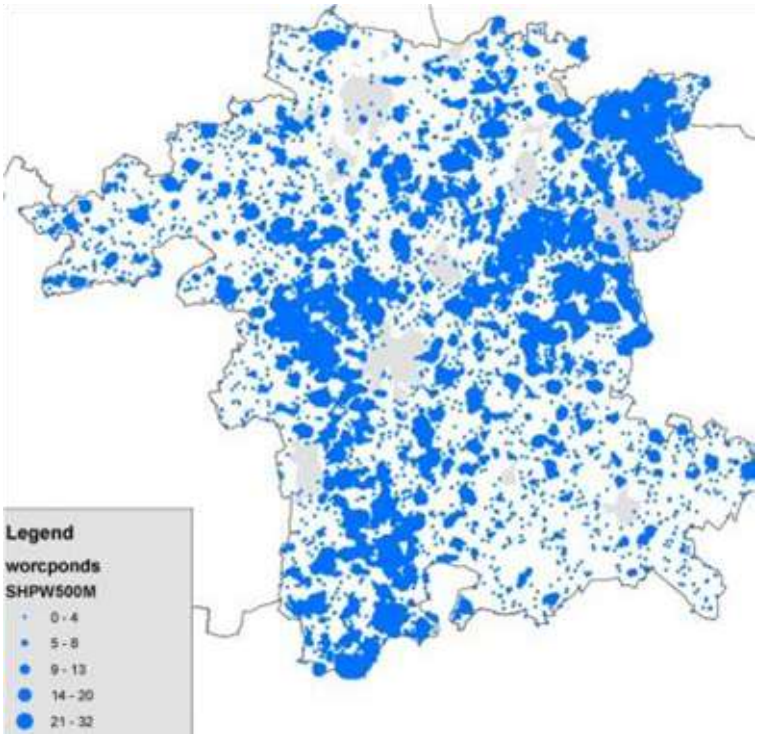
- Creation of new opportunities for wildlife such as sand martin banks which could encourage colonisation of wildlife away from actively worked areas.

Examples of opportunities for wildlife found during phased mineral extraction:		
Feature	**Mineral type**	**Species**
Hard rock	Granite Limestone Sandstone	Protected features can support species such as birds of prey and roosting bats as well as uncommon plant species.
Sand banks	Sand and gravel Sandstone	Protected sandbanks can provide nesting opportunities for species such as kingfishers, sand martins and uncommon invertebrates.
Temporary pools/lagoons	All	Even temporary water features are important for amphibians and invertebrates such as scarce dragonflies and damselflies. Small mammals including water voles can benefit from habitat creation such as off-line ponds which can also contribute to flood attenuation efforts.
Ruderal vegetation, overburden and grassed mounds Grassed screening and overburden	All	Leaving field edges to naturalise can support a range of species including small mammals, farmland birds such as skylarks and owls, reptiles and amphibians, scarce invertebrates and uncommon arable wild-flowers.
Open water and flooded voids	Sand, gravel and crushed rock	The floodplains of the Rivers Severn and Avon are a significant resource for overwintering and breeding birds and additional large expanses of water, if designed appropriately, can make a significant contribution during phased extraction. The value of smaller watercourses/drainage ditches and pond for biodiversity should also be noted.
Tree planting	All	Can be important foraging and shelter opportunities for small mammals and birds during their establishment.

[17] Note that the translocation of certain species may require derogation from the Protection of Habitats and Species Regulations (2010) as amended.

- Creation of buffers to prevent colonisation of the working area by protected species (such as a network of ditches and ponds which mediate dispersal of reptiles and amphibians in areas protected from heavy vehicle movements).

- Creation of new BAP habitat on completed sections of quarries or land marginal to working quarries to contribute to the network of local BAP habitats. Even as a transitory habitat these features can offer valuable opportunities for wildlife.



"the aftercare period" means a period of five years from compliance with the restoration condition or such other maximum period after compliance with that condition as may be prescribed; and in respect of any part of a site, the aftercare period shall commence on compliance with the restoration condition in respect of that part.

Town and Country Planning Act, 1990 (as amended) Schedule 5.

2.6.2. The Worcestershire Habitat Inventory can be used to identify where new wetland features will contribute most significantly in the county. In the example below the network of standing water in the county is highlighted; where larger numbers of ponds are found within 500 meters of each other larger blue aggregations indicate the strength of the waterbody network. Such networks are essential for species such as wading and wintering birds and amphibians who exist in 'meta-populations' and require a strong network of ponds in order to survive; for instance great crested newts are generally believed to disperse up to around 500 metres from a breeding pond, and therefore the number of good quality ponds or lakes in an area is likely to be a constraining factor in the viability of a great crested newt meta-population. The mapping resource can therefore indicate where new ponds or lakes can contribute to defragmenting the existing network, and also where networks can be extended into areas where water-features have been lost. Even temporary water-features created during phased extraction can have significant value to species such as great crested newts (temporary ponds rarely having the opportunity to accumulate species which predate newts), but mineral operators must plan carefully to ensure that wildlife is duly protected during operational phases, for instance creating set-asides and safe corridors for movement of wildlife and vehicles.

2.6.3 Further advice with regards priority habitats and species found within the sand and gravel mineral resource areas is provided within Appendix 2.

2.7 Long-term management

2.7.1 Economically viable long-term management is an essential consideration for any restoration plan regardless of intended end-use. However, the likely legacy of a site is key to planning restoration strategies. Early engagement with stakeholders will help identify what features will be most valuable for a given locality; will drive the final site masterplan and can establish local partnerships or community trusts which will contribute towards the site's perpetuity.

2.7.2 Carefully planned restoration and aftercare strategies for both operating and worked-out mineral sites can deliver multiple benefits[18] in addition to facilitating the conservation of Worcestershire's natural heritage. In designing multi-functional and sustainable sites, the long-term sustainability of the end-use should be carefully considered; for further information on funding sources see also Appendix 1.

2.7.3 Currently, aggregate companies are required (as per Schedule 5 of the 1990 Town and Country Planning Act) to comply with any aftercare programme imposed on the planning permission. The need for aftercare conditions stems from the recognition that land, which is to be fully reclaimed, needs not only the replacement of soils or soil-making materials but also needs cultivation and the initial establishment and maintenance of vegetation.

2.7.4 The aftercare period should be for a minimum of five years but can be extended.

2.7.5 There are other means of addressing the long-term conservation management of a site extending beyond the statutory 5-year aftercare period. For example; payments can be secured that offset the costs of conservation management and habitat improvements through an Agri-Environment scheme (where there are no cross-compliance issues). A carefully prepared restoration strategy can build on the principles secured through the planning process to achieve additional support through a number of environmental management grants (further information is provided at Appendix 1).

2.7.6 Any application for Agri-Environmental support under the emerging Rural Development Programme will likely need to demonstrate environmental benefits above and beyond compensation measures which address biodiversity impact through site development. In addition, sites should ideally be located within a Target Area identified by Natural England. Refer to the webtool for further information.

Facilitating the sustainable use of minerals

"In preparing Local Plans, local planning authorities should:

...put in place policies to ensure worked land is reclaimed at the earliest opportunity, taking account of aviation safety, and that high quality restoration and aftercare of mineral sites takes place, including for agriculture (safeguarding the long term potential of best and most versatile agricultural land and conserving soil resources), geodiversity, biodiversity, native woodland, the historic environment and recreation".

NPPF, Paragraph 143

[18] "Integrating Mining and Biodiversity Conservation: Case studies from around the world", IUCN and ICMM, 2004.– available at http://www.oecd.org/dataoecd/16/16/34982001.pdf

2.7.7 Where there is no long-term commitment to conservation management it is better that a site is designed to achieve the best conservation gains possible, given the management input available. For instance: a number of lakes created at mineral sites have subsequently, with minimal intervention, developed into wet woodland. In contrast, maintaining an open site character desired by breeding birds may require significant and long-term commitment to scrub clearance.

2.7.8 Where there is no long-term commitment, it will therefore be desirable to accept a minimum intervention strategy and begin by creating optimum conditions and design features for the development of naturally occurring habitats where desired.

2.8. Offsite mitigation, compensation and enhancement measures.

2.8.1 Biodiversity offsetting is an emerging mechanism to enable sustainable development in Worcestershire. While biodiversity protection and enhancement will be integral to the full life cycle of any mineral extraction scheme, including its restoration plan, biodiversity offsetting offers several benefits over and above site focused restoration alone:

- Where restoration of a site for a given BAP habitat is found to be unpractical or incongruous, biodiversity offsetting can contribute elsewhere in the immediate habitat network or at wider scales. For instance: supporting conservation projects on local watercourses can contribute to Water Framework Directive objectives (refer to Appendix 3), or supporting tree planting projects offsite can contribute to Woodland Opportunity target areas.
- Conservation efforts supported through biodiversity offsetting are not dependent on the timescales of mineral extraction, meaning that mitigation, compensation and enhancement measures can be delivered simultaneously or even before extraction begins.

Ark Sites

Mineral extraction offers a unique opportunity to provide refuge for our native wildlife which is otherwise being pushed towards extinction across the country. Mechanisms to protect and promote the conservation status of certain species could be established at quarries where, through restoration plans, the opportunities to sustain their populations can be created and safeguarded.

Buglife have recently published guidelines to identify new ark sites for native white clawed crayfish: this species is thought to be present in Worcestershire in only a small number of populations which are now fragmented and highly susceptible to a variety of threats such as disease and out-competition by non-native species.

Ark sites should ideally have very low risk of colonisation by predators but be able to support foraging and breeding native wildlife and most importantly, be capable of supporting these populations in the long-term.

Quarries in Worcestershire might potentially offer refuge for species such as white-clawed crayfish, water vole or perhaps even species not traditionally associated with our County, such as natterjack toad.

For further information about habitat creation and management at quarries for invertebrate biodiversity, refer to: www.buglife.org.uk/conservation/currentprojects/Habitats+Action/Bringing+Aggregate+Sites+to+Life

Fig 2 – Species which might benefit from conservation at ARK sites: water vole, white clawed-crayfish and natterjack toad .

3. Interpreting BAP networks.

3.1 Ecological Zones

3.1.1 The three Ecological Zones in which sand and gravel deposits are found (thought to be of principle interest for BAP habitat gain in Worcestershire in the foreseeable future) are the focus of this Framework: Worcestershire's River Terraces, Alluvial Fenlands, and Forest Sandstones. Further information on Worcestershire's Ecological Zones can be found in Trees and Woodland in Worcestershire[19], a document accompanying the Worcestershire Woodland Guidelines[20].

3.1.2. John Day's work defining Worcestershire's Natural Areas, on which the Ecological Zones have in part been based, can be found at: www.wbrc.org.uk/worcRecd/Issue10/natarea.htm.

3.2 River Terraces

Fig 4 - Worcestershire's River Terraces (highlighted here in blue)

3.2.1 The river terraces mainly represent the ghosts of the ancient rivers extending back in time some half a million years. They are associated with the county's rivers and streams, occurring mainly in the valleys of the Severn, Avon, Stour, Salwarpe and as smaller downwash areas from local high ground such as the Cotswold Scarp, Bredon Hill, Bromyard Plateau, Clent and Lickey Hills. They frequently run parallel courses to the rivers and occur as localised raised plateaus above the watercourses. Soils are light, freely draining, sandy and have a high pebble content. Natural fertility and pH are low.

3.2.2 This is an intensively managed landscape and the majority of the terrace landscape is devoid of semi-natural habitats. The main land use is arable cropping but significant areas are under urban development and mineral extraction sites for sand and gravel.

3.2.3 Mineral workings have over the past fifty years provided the main locus for biodiversity on the river terraces. They have the potential to rejuvenate the diversity of habitats and reintroduce wetlands to a largely drained and dry landscape. The lowering of the ground levels and the removal of sand and gravel in the river terraces often provides conditions similar to those that naturally occur in the alluvial fenlands. In these situations, it is important to make reference to, and consider the habitats identified within those terraces.

3.2.4 Most of the large aggregate sites in the river terraces have however been returned to agriculture and the restoration to wetland has largely been overlooked. Nevertheless, there still remains enormous scope for the creation of wetland habitats including wet grassland, fen and marsh, wet woodland and areas of open water in the river terraces. These wetlands could make an enormous contribution towards BAP habitat targets, and would be especially important for breeding and passage birds that travel along the network of rivers throughout the county.

3.2.5 **BAP Habitats**

- **Wetlands** are generally a scarce habitat within this freely draining landscape and **reedbeds, swamps, fens, marshes and wet grasslands** are by and large confined to restored mineral extraction sites. Here

[19] www.worcestershire.gov.uk/cms/worcestershire-woodland-guide.aspx

[20] www.worcestershire.gov.uk/cms/worcestershire-woodland-guide.aspx

they can be extensive and of very high conservation value. Similarly, **ponds and lakes** are mainly confined to the same sites and are also of high conservation value, particularly as an important habitat for migrant and passage birds. Many of these water bodies, primarily those with non-agricultural catchments, support **rich aquatic communities**. Very locally, small flushes of high wetland interest occur.

- **Wet woodland** is mostly confined to areas where it has been created in restored mineral workings but often occurs naturally (in the form of Sallow woodland) in close association with other wetland habitats. Semi-natural wet woodland is a valuable asset to these wetland communities.

- There are few **streams** on the terraces. However, there is great potential to create water habitats which adjoin drains leading to open water bodies or nearby rivers. These "off-line water habitats" are in themselves important wetland habitats and act as a refuge for a variety of species. They are particularly important as they provide nurseries for fish fry.

- **Semi-natural, unimproved grassland** is very scarce. The naturally occurring communities are generally calcifugous (acid grassland). Often the low nutrient soils at sand and gravel quarries attract many uncommon and scarce species characteristic of acid grasslands during the operational phase and there is enormous scope for their creation in the final restoration. Surviving examples of other grasslands are confined principally to the urban fringe and along the scarp slopes associated with streams and rivers. The latter group support a range of soil conditions and hence communities, including **neutral grassland.**

- The principal land use of the terraces is **arable**. The open ground communities are of interest, especially the calcifuge (acidic) communities of sandy soils.

- The landscape is relatively open with large scale fields. **Hedges** tend to be of enclosure age, species poor and in a declining condition and their creation is a welcome addition to this largely impoverished landscape. A few ancient boundary features of high historical interest occur.

- **Orchards** and nurseries are a traditional feature of the terrace landscape and important for a whole variety of species. Few survive today.

- **Woodland** is a very scarce habitat and tree cover is very low. The wildwood was dominated by Small-leaved Lime, however, none now survives on the terrace soils in Worcestershire. The only areas of ancient semi-natural woodland are microfragments associated with banks, trackways and other small-scale features. Secondary woodlands are mainly plantations. Included here are screen planting schemes associated with mineral workings. Overall, **veteran trees** are few and most occur within towns and the urban fringe.

- **Verges** are locally valuable as loci for native grassland and associated species.

BAP Species	
Otter	Frequent major watercourses and may occur occasionally on suitable habitats within the terraces
Bats	Concentrations are known to occur around former mineral extraction sites
Water vole	Formerly common and widespread but now likely extinct or possibly very scarce
Slow worm	Resident
Great crested newt	Common but patchily distributed due to lack of good pond networks
Nightingale	Very occasional due to lack of suitable habitat
Black poplar	Rare
Stag beetle	Very rare. Known to occur at Upton-upon-Severn
Birds	Important assemblages of both farmland and scarce migrant species.

3.3 Forest Sandstones

Fig 5 – Showing Worcestershire's Forest Sandstones areas (highlighted here in orange).

3.3.1 The forest sandstones occupy a broad crescent-shaped swathe across north central Worcestershire. They are situated on a range of Triassic sandstones and conglomerates, which give rise to sandy, infertile and frequently acidic soils. Soils are easily worked and freely draining. Clearance was early (around half of the wildwood had been cleared in Britain by 500BC) but infertility restricted the land use of a significant area to extensive systems including forest, park, common, rough grazings, heaths and plantations.

3.3.2 More recently, on the deeper soils and especially those of the Bromsgrove Sandstones, the use of agri-chemicals has allowed the development of intensive arable cropping. The topography is gently sloping, from adjoining uplands but with frequent deeply incised valleys. Towards the west the landscape becomes more convoluted and rugged. Where they are not impounded, streams are mainly of steep gradient and fast flowing.

3.3.3 There are a number of large sand quarries in this natural area, many of which are still operational. For the most part these quarries have been, or are destined to be, landfilled and restored to agriculture, an approach which Worcestershire's Waste Core Strategy discourages in future mineral operations. There is therefore enormous future potential for the creation of scarce habitats of high conservation value including heathland, acid grassland and scrub. Quite often characteristic species of these habitats occur naturally on the low nutrient soils that are exposed during the operational phase. There is also the possibility of creating some rare mire and bog communities in damper areas.

BAP Habitats

- The **grassland** resource is predominantly **acidic.** Traditionally, the grasslands were permanent pastures and were sited, mainly, on steeper slopes and the best remaining examples all occur in such situations. Good examples are scarce, often occurring as fragments within larger units and are concentrated in the west. The exposed sandy soils at quarry sites provide ideal conditions for naturally occurring acid grassland.

- **Heathland** and rough grazings (grass-heath) are traditional features and formerly covered extensive areas within this ecological area. Most of the county's best heathland sites are here. Losses have occurred as a consequence of urban expansion, arable farming and afforestation and remaining sites are generally small and isolated. Many surviving sites have suffered losses to natural woodland regeneration, following a cessation in grazing. As with acid grassland, acidic soils are likely to be appropriate for heathland creation schemes. Proximity to existing sites is always an important factor.

- **Scrub** is widespread and can be extensive and an important component of heaths and acid grassland. The inclusion of Gorse and Broom scrub within the above is therefore highly desirable.

- The freely-draining sandy, infertile soils of the area support a most interesting **open-ground flora**, wherever it is allowed to develop. Local scarce species such as Corn Marigold have a stronghold here, whilst it also provides a principal locus for national rarities such as Tower Mustard and Grey Hair Grass. **Arable** land and open/disturbed areas within **urban**, industrial and extraction sites provide important refugia.

- Traditionally a region of rough grazings and open-field arable, the boundary features are mainly **hedges** that date from the enclosure period. English Elm, Hawthorn, Blackthorn and Damson are the

principal component species. Holly can also be found locally. There is a smaller but important group of ancient boundaries. The hedgerow resource is generally in a poor and declining condition.

- The **woodland** resource is varied. The region was cleared early and Ancient Woodland sites are very few and of high conservation value. They are confined to locations relatively inaccessible to arable farming, such as incised valleys, bluffs and rocky outcrops. The wildwood appears to have been dominated by Small-leaved Lime. Oak woods occur widely and Birch is noticeable in the Stour basin. Since 1700 there has been an increase in tree cover, notably from widespread and medium scale re-afforestation. Estate woods are mainly conifers, Oak and Sweet Chestnut. In the post-WWII period natural regeneration and amenity planting, associated with urban expansion, has increased tree cover.

- Belts of linear **wet woodlands** are situated along many of the watercourses, although these reach their best development downstream within the alluvial fenland natural areas. There are a few Alder woods associated with hill flushes.

- The **wood pasture** tradition was strong and is represented by local concentrations of **veteran trees**. These include Oaks and Limes, in old forest areas, and Sweet Chestnut, on former commons.

- **Traditional orchards** are very scarce in the north and east but are a feature of the south-western part of the zone.

- **Road verges** are in the main of limited conservation interest. Locally high value sites occur providing refugia for heath, acidic grassland and scrub and open-ground communities.

- Western **streams** occupy rejuvenated incised valleys and tend to be fast flowing and of high water quality. Those in the east have less severe gradients and many are heavily modified. Impoundments and widespread abstraction has affected flows and many small streams dry up in summer. Eutrophication derived from human pressure, both from settlements and arable farming are very apparent.

- **Pools**. The landscape is freely draining with standing water, mainly confined to clusters of medium sized former mill pools, associated with early industrialisation.

- The **reedswamps** and successions to Alder woods are often good quality and include rare species and communities.

- Other **wetland habitats** are scarce, small scale and fragmented. Most wetland is currently located along watercourses as linear strips of tall-herb fen and Alder/Willow wood. The quality of these watercourses has been affected by abandonment, eutrophication, desiccation and falling water tables.

BAP Species	
Bats	Good concentrations occur in the Stour valley and west of the Severn
Water vole	Some urban areas support viable populations
Otter	Frequents watercourses running through the region
Adder	Native resident in small numbers and often associated with heathlands.
Slow worm	Present
Great crested newt	Widespread but localised by habitat
White clawed crayfish	Now highly restricted to a small network of known tributaries. Formerly widespread.
Hornet robberfly	Only known location in Worcestershire
Black poplar	Very rare

3.4 Alluvial Fenlands

Fig 6 – Showing Worcestershire's Alluvial fenlands (highlighted here in blue).

3.4.1 The alluvial fenlands are distributed throughout the county, occurring on riparian floodplains and in poorly drained basins in close association with the river terraces. The water tables are high for much of the year and many sites experience seasonal inundation. The result of which is soils of high fertility that have proved attractive to agricultural improvement. Each historic period has witnessed agricultural inroads into the zone, with the greatest impacts occurring in the mid-nineteenth century and over the past 50 years. Drainage schemes have had a considerable impact in this landscape with the drying out of the formerly extensive wetlands in exchange for permanent pastures and arable crops. Intensive agriculture is the norm and remaining wetland habitats are highly fragmented and mainly small. Remaining wetland fragments are characteristically of high wildlife value.

3.4.2 Quarrying in these areas exists in close association with the sand and gravels of the river terraces; the pattern of deposition is often complex and variable. The changed and lowered landscape, which occurs at sand and gravel sites in the river terraces, often provides conditions similar to those naturally occurring in the alluvial fenlands. Apart from the few sand and gravel sites, quarrying has been chiefly restricted to small-scale clay extraction sites at former brickworks, many of which date back to the 19th and early 20th century. The remaining conditions following extraction at these older sites have provided for some of the most biodiverse wetland habitats in Worcestershire. These former clay extraction sites include examples of rich wetland habitats including fen, wet grassland and wet woodland that have been created inadvertently through natural succession in the absence of design. The critical factor has been the lowering of the ground levels enabling natural succession to a diversity of wetland communities.

3.4.3 BAP Habitats

- The natural character of **the wetlands** is a function of the origin of the derived silts and ground waters. They can be grouped into two main classes. A northern group linked to more oligotrophic or low nutrient geologies (Teme, Upper Severn, Stour Valleys) and a southern more eutrophic, nutrient rich group (Lower Severn, Avon, Salwarpe Valleys).

- **Wet grasslands, marshes and fens** are widespread but scarce, generally small and highly fragmented. They occur mainly as linear strips along the smaller streams whilst on the major rivers most occur on ancient river channels. The county's largest sites and most important concentrations are sited in the Stour valley and its tributaries. In the Severn valley most of the best examples are associated with former brickworks and paleochannels. There are a few relatively small isolated fenland sites overlying peats in the east of the county. Highly localised, nationally rare inland halophytic (salt tolerant) communities occur in association with former brine extraction sites.

- **Swamp and reedbeds** are widespread but scarce, being located mainly within river channels, along canals or around floodplain pools.

- There is a small but very valuable eutrophic **open water** resource, supporting a rich assemblage of scarce species. Most are small ponds but the majority of these are natural and derived from former river channels. Those that have been created through extraction are extremely valuable for wildlife.

- **Wet woodland** is rare and most is secondary (i.e. regenerated rather than

semi-natural and more biodiverse). It occurs mainly within the Stour catchment and on former brickworks in the Severn valley. Included here are a number of interesting Willow woodlands. Most tree cover is associated with linear belts along watercourses.

- **Neutral permanent grasslands** are an extensive and important component of the landscape. These sites are naturally eutrophic with a limited species composition. Most of the resource is improved but a significant proportion can be classed as semi-improved. Unimproved flood meadows are scarce but characteristic of the alluvial flood plains. Included here are some traditional large and communally managed **hay meadows** called Hams (National Vegetation Classification code MG4), situated in the Lower Severn and Avon valleys.

- **Veteran trees** are a notable feature of the floodplains. Considerable numbers and concentrations of ancient Willow (Crack and White) pollards occur and ancient coppiced Alders are located within surviving woodland fragments. Old Oak pollards are well represented and are a derivative from wood pasture systems.

- **Hedges** are variable in character and their ecological interest relates to the timing of the earliest agricultural exploitation of a particular area. Field boundaries in the Avon and Lower Severn valleys tend to be the oldest and most diverse. Many are associated with drainage lines and provide valuable corridors.

- **Woodland** is the natural dominant habitat of Worcestershire's floodplains and fenlands. This consisted of mosaics of wet (Alder/Willow) and drier (Oak/Ash) woods. Early exploitation seems to have developed as **wood pasture** systems. Very few blocks of natural woodland survive and all remaining ancient semi-natural woods have a high conservation value.

- **Scrub** is limited and mainly dominated by Willow. It occurs along river banks and around other wet ground features and almost always occurs to some extent around former extraction sites. Osier beds are a traditional land use feature on wet ground, especially in the Avon, Stour and Lower Severn valleys. Many small overgrown remnants remain but only a handful of working beds are extant.

- Most **rivers and streams** are lowland and within the coarse fish zone, although the Rivers Teme and Upper Severn are within the grayling zone. All rivers are eutrophic and water quality is, in general, moderate to good. Floodplain ditches are extensive and often contain important relic floodplain vegetation assemblages.

- The creation of linked ditch networks in association with water bodies and rivers would be a welcome addition at former aggregate sites. Most of the county's **canal** network falls within this area. As with ditches, canals are important for **reedbeds** and other swamp communities.

- **Arable** is incompatible with fenland interests. The past 50 years has seen a considerable extension of intensive arable cropping onto the flood plains and within the alluvial basins.

BAP Species	
Otter	Frequents the major watercourses and adjoining riparian habitats
Bats	Foraging concentrations occur along the main rivers and open water. Roosts are associated with veteran trees
Water vole	Formerly common and widespread but currently either very scarce or possibly extinct
Marsh warbler	Breeding populations were characteristic of this area and in the 1940s extended up the Lower Severn, Lower Teme, Avon Valleys and occasionally elsewhere. Contraction occurred to a core area in the Avon valley but is now lost as a breeding species.
Nightingale	Very occasional as a breeding species in the south
Shad - Allis & Twaite	Migratory fish occur in the Rivers Severn and Teme
Slow worm	Resident
Great crested newt	Widespread and locally frequent in ponds
White clawed crayfish	Formerly widespread resident in suitable brooks. Now Extinct
Black Poplar	A classic floodplain species. Several hundred trees present, mainly as individuals.
Club-tailed dragonfly	Strong populations in the Rivers Teme, Severn and Avon

3.5 Worcestershire's Biological Delivery Areas

3.5.2 Each BDA (refer to Section 3.6) has a suite of LBAP (Local Biodiversity Action Plan) habitats and species which are locally prioritised for conservation efforts and which are distinctive and characteristic of that area. Within the three Ecological Zones identified here, there are two BDA's in which sand and gravel mineral extraction is thought likely.

3.5.3 Where extraction of minerals is proposed within a BDA, restoration plans should aim to restore 100% of the restored land area to the locally appropriate BAP habitats.

3.6 The Severn and Avon Vales BDA (and Wetlands West Partnership target areas)

3.6.1 The Severn and Avon Vales priority area encompasses the two river systems with their associated floodplains. Wetland features found along their lengths include wet pasture, meadows, reedbed, wet woodland, ditches and old pollards. Much of the landscape is intensively farmed: water quality issues must be addressed along the length of the two rivers and currently fragmented riparian habitat restored or newly created. The BDA is entirely found within the River Terrace and Alluvial Fenlands Ecological Zones.

3.6.2 A significant policy and legislative background exists to drive work here - the European Water

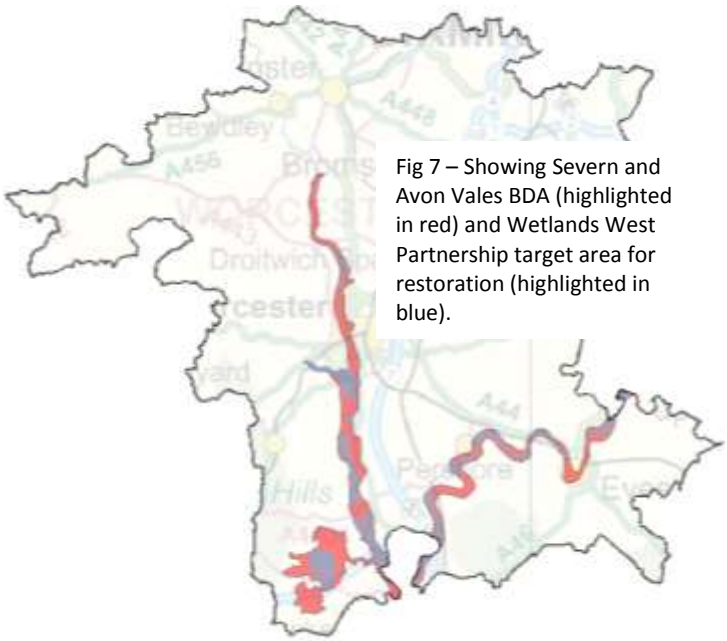


Fig 7 – Showing Severn and Avon Vales BDA (highlighted in red) and Wetlands West Partnership target area for restoration (highlighted in blue).

Framework Directive and the development of the Environment Agency's River Basin Management Plans. The Severn and Avon Vales Wetlands Partnership[21] ("Wetlands West") has significant support at a national level as a major mechanism for delivery of wetland targets within England.

3.6.3 The Partnership combines the efforts and expertise of organisations including the British Trust for Ornithology, the Environment Agency, Worcestershire County Council, Gloucester City and County Councils, Wychavon District Council, Gloucestershire, Warwickshire and Worcestershire[22] Wildlife Trusts, Drainage Boards, Natural England and the RSPB,

3.6.4 This work is informed by the study "re-creation options for the River Severn/Avon flooplain wetlands" as prepared by Ecoscope in 1999 and evaluates the potential for BAP habitat recreation at 18 sites within the wider (cross-border) floodplain complex.

[21] www.severnwetlands.org.uk/community.asp

[22] Also see Worcestershire Wildlife Trust's Avon Vale Living Landscape work: www.worcswildlifetrust.co.uk/your-living-landscape

3.6.3 A key aim of the Partnership is to "Work with the aggregates industry and appropriate partners to develop wetland habitat creation opportunities linked to mineral extraction sites and plans most especially reedbed and wet woodland".

Fig 8 – **Showing floodplain grassland (NVC "MG4 community"). 90% of traditional species rich meadows have been destroyed since 1945.**

Fig 9 – Showing Wyre Forest Acid Grasslands and Heaths BDA (highlighted in red)

3.7 The Wyre Forest Acid Grasslands and Heaths BDA

3.7.1 Acid grassland and heathland is a particularly uncommon habitat in Worcestershire (recorded acid grassland covers just under 0.5% of the county) and are both habitats particularly vulnerable to fragmentation and insensitive habitat management such as heavy grazing, development pressure, afforestation and nutrient enrichment. When in favourable condition the habitats support a wealth of specialist and scarce invertebrates, small mammals, reptiles, bird species of conservation concern and uncommon plants. Recorded heathland covers around 0.1% of the county.

3.7.2 These habitats are heavily dependent on the underlying geology and outside several large nature reserves exist scattered and fragmented sites largely in private ownership. Although acid grassland can be found in mosaics with heathland along the flanks of the Malvern Hills, the same habitats can be found patchily distributed on the urban fringes of Kidderminster, Bewdley and Stourport in the North of the county. Here these habitats are under considerable human pressure and have been prioritised through the partnership's designation of a Biodiversity Delivery Area.

3.7.3 The Worcestershire Biodiversity Partnership aims to create 13 hectares of new heathland in Worcestershire by 2017 and sand and gravel extraction can contribute significantly towards these targets.

3.7.4 Much of the land surrounding the BDA is of high agricultural value. However, where agricultural restoration is proposed within the BDA, small conservation headlands, buffers and borders set-aside and appropriately managed can make a significant difference to the cohesiveness and resilience of these habitat networks and will contribute to the survival of the wildlife which these habitats support.

3.8 Networks of Designated Sites

3.8.1 The Worcestershire Local Sites Partnership[23] has already recognised much of Worcestershire's most valuable BAP habitat through the Local Site listing process and is responsible for approving any new sites and ensuring reporting is undertaken on an annual basis: contributing to the monitoring of progress against national and local indicators as well as Worcestershire State of the Environment targets. Currently Worcestershire has:

- Four National Nature Reserves (NNR)
- Two Special Areas of Conservation (SAC's)
- 114 Sites of Scientific Interest (SSSI's)
- 553 Local Sites (LS's)
- 44 Roadside Verge Nature Reserves (RVNR's)

3.8.2 Although much fragmented and reduced in area, Worcestershire's contribution to the country's natural environment is significant, the West Midlands is thought to contain:

- 9% of England's total lowland heathland
- 20% of England's total of lowland meadows
- 10% of England's broad-leaved woodland, and
- 9% of England's total lowland woodland parkland and pasture.

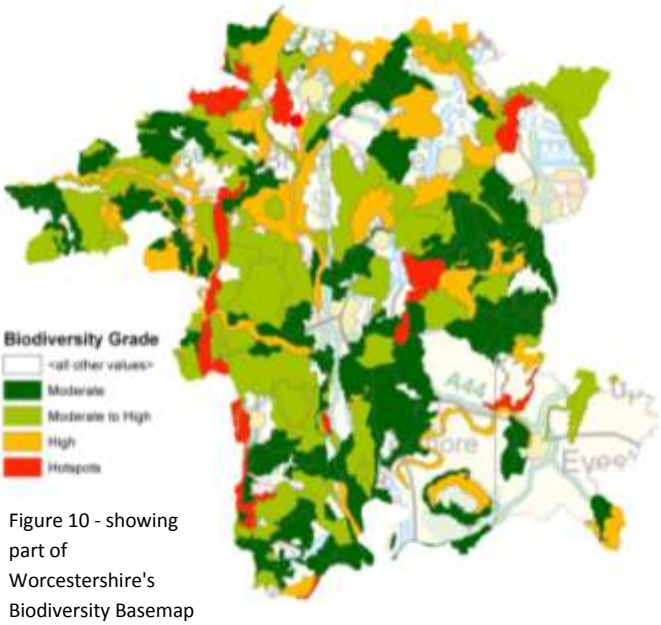


Figure 10 - showing part of Worcestershire's Biodiversity Basemap

3.9 Biodiversity Basemap

3.9.1 Analysis of a combination of datasets which includes the known networks of ancient woodland, grasslands, heathland, veteran tree distribution and ancient countryside was undertaken to produce a Biodiversity Basemap. This was designed for use in grading the value of land for biodiversity at a sub-regional scale.

3.9.2 For practicality, a number of datasets were not included within this analysis, including wetlands, hedgerows and verges. This limits the robustness of the tool for certain functions, particularly at lower scale resolutions.

3.9.3 At a high (strategic) scale of resolution, this is a particularly useful tool to indicate the broad value of certain landscape parcels for biodiversity.

3.9.4 Where extraction is proposed in areas identified as having Moderate or greater value for biodiversity, plans should aim to restore a significant proportion of land (>50%) to locally appropriate BAP habitats.

3.10 Worcestershire's BAP Networks

3.10.1 The UK Biodiversity Action Plan was first published in 1994 in response to the 1992 Convention on Biological Diversity and set out a shared vision and objectives for the conservation of UK biodiversity: identifying a number of target threatened habitats and species. Progress towards BAP objectives is recorded via the Biodiversity Action and Reporting System (BARS) at: www.ukbap-

[23] www.worcestershire.gov.uk/cms/ecology/local-sites-partnership.aspx

reporting.org.uk. In 2011 the UKBAP was superseded by "Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services" which sets out the strategic direction for biodiversity policy for the next decade on land and at sea.

The Worcestershire BAP highlights the estimated losses to our natural environment. For example:

- **Around 70-85% of Worcestershire's valuable traditional orchards have been destroyed over the last 40-50 years.**
- **97% of our lowland meadow has been lost from England, but 20% of England's remaining lowland meadow is thought to be in Worcestershire.**
- **Around half the number of ponds which were recorded in Worcestershire in 1920 are thought to remain, many having dried out or been in-filled.**
- **Around 100 hectares of lowland heathland have been destroyed in Worcestershire since the late eighteenth century; with over 90% of Worcestershire's remaining heathland being found in just four sites.**
- **In Britain, around 25% of species depend on wetland habitats for their survival, but many wetlands have been drained to facilitate improved agricultural production. Before drainage around 20% of Worcestershire was covered by wetland – currently wetland habitats comprise around 1% of the county.**

More information on the Worcestershire BAP is available on the internet at www.worcestershire.gov.uk/biodiversity or alternatively from the Worcestershire Biodiversity Partnership

3.10.2 The Worcestershire Biodiversity Action Plan (the "LBAP') identifies habitats and species that are of local nature conservation importance. The LBAP provides targets for the restoration of locally appropriate BAP habitats. This is spatially mapped using the Worcestershire Habitat Inventory.

Worcestershire Habitat Inventory

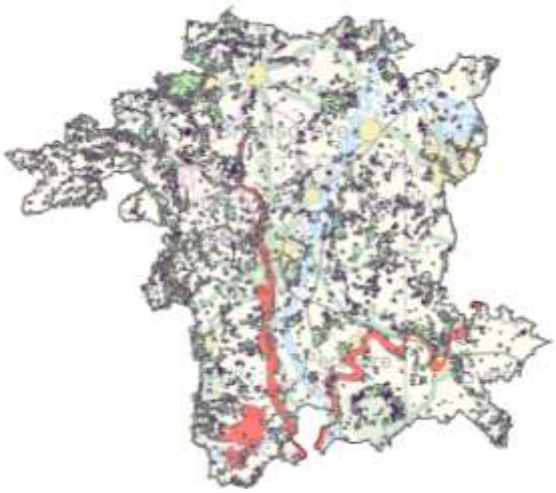


Figure 11 - showing Worcestershire's network of BAP habitats overlaid on the Severn and Avon Vales BDA

3.10.3 The Worcestershire Habitat Inventory is a systematic survey of Worcestershire on a field-by-field basis; mapping habitats into a GIS database and drawing on existing datasets such as existing Local Wildlife Sites, the Grassland Inventory, pre-existing 'ground-based' survey data and the results of aerial photograph interpretation undertaken between 2005 and 2009.

3.10.4 The WHI dataset should be used to identify the network of BAP habitats which occur in proximity to a proposed mineral extraction site; this will inform restoration proposals as to the practicality of achieving BAP habitats together with the efficacy of the restoration plan in contributing to BAP habitat cohesiveness and resilience. Further: the dataset might also help identify seed sources, if natural regeneration is considered an inappropriate approach for a given site.

3.10.5 Network analysis forms only one facet of the WHI dataset and broader issues need to be considered when appraising ecologically functional

connectivity between a site and the wider landscape. For instance, the WHI does not consider linear features, ancient countryside features such as parish boundaries and is limited to assessing certain BAP habitats (for instance acid grassland obscured from aerial photographs under tree canopy cover). Further information must always be sought from both the Worcestershire Biological Records Centre and site-based ecological surveys to prepare a robust analysis of a site's position and connectivity in the local BAP habitat network.

WHI analysis: Distribution of Acid Grassland

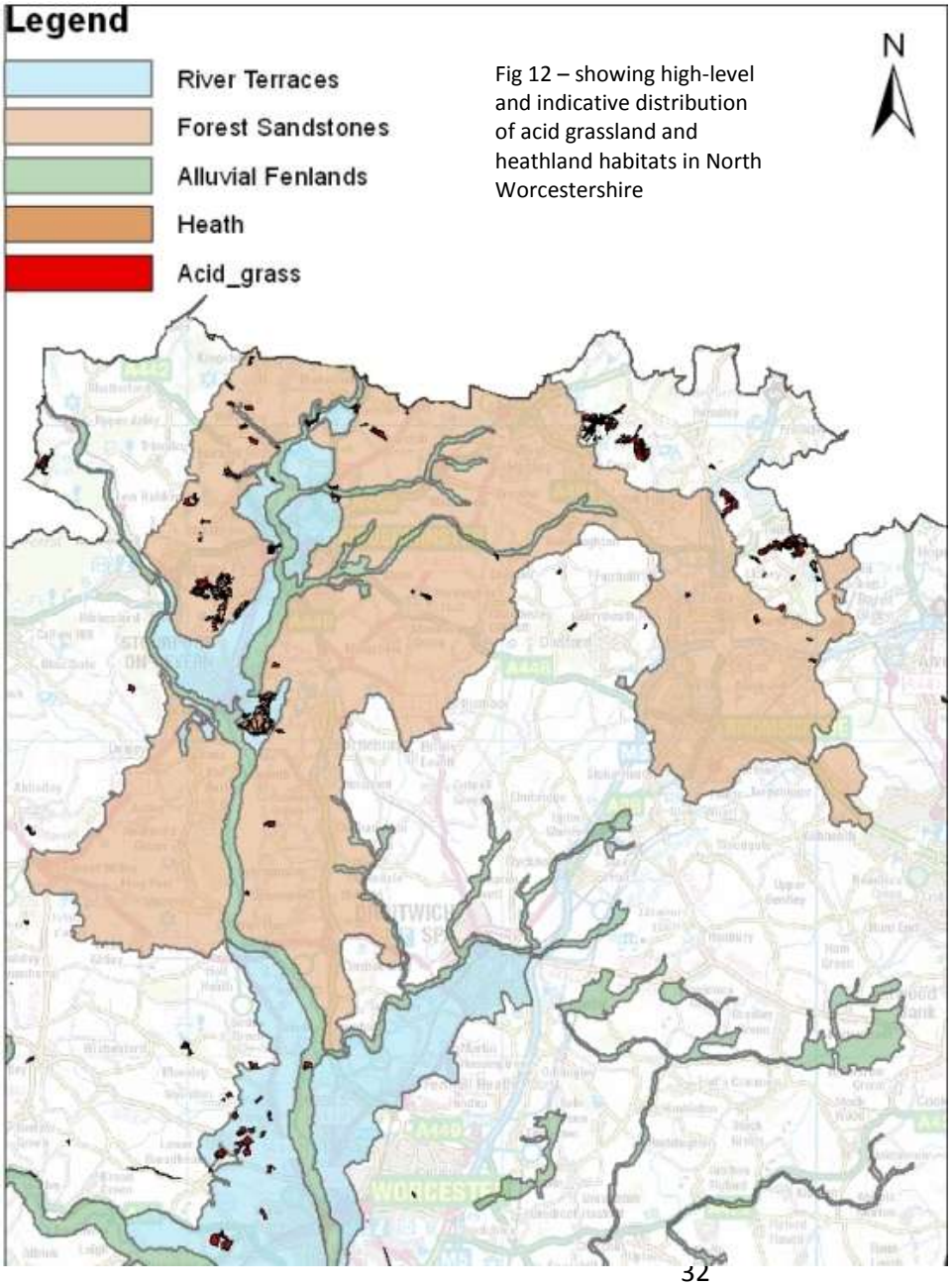


Fig 12 – showing high-level and indicative distribution of acid grassland and heathland habitats in North Worcestershire

3.10.6 The Wyre Forest Sandstone deposits have been identified (within the context of the WHI) as being of overall low biodiversity value, with small semi-natural areas and habitats confined to scarps, bluffs, valleys and outcrops, with the remainder being intensively exploited by agriculture The area contains important and fragmented areas of habitat which include wet woodland, heathland, acid grassland, wetland, ponds and broadleaved woodland. The heathland recorded here is some of the largest in area within the county. Within a wider context of north Worcestershire, the Wyre Forest National Nature Reserve contains a variety of habitats such as wood heath, unimproved grasslands, pastures and meadows (including neutral, and acid grasslands) and traditional orchards as well as coniferous, broadleaved and mixed woodland . A mosaic of grasslands and arable land extends south-west from the edge of the Wyre Forest into the Bayton area with scattered pockets of broadleaved woodland and an important resource of traditional orchards. The Stour Valley has possibly the largest concentration of wetland habitats (such as open & running water, marsh, fen and carr) although in declining condition; much of the area is heavily urbanised or arable land. Despite this, the fragments of semi-natural habitat have relatively high biodiversity value with good opportunities for restoration.

WHI analysis: Distribution of Wetland

3.10.4. A study of wetland distribution has been undertaken using WHI resources and was constrained by a number of factors: the remaining wetland habitats are widespread and generally consist of micro-features within otherwise drier habitats (there are very few sizable areas of wetland remaining within Worcestershire); as such, outside the network of designated sites described above, wetlands are frequently under-recorded in the county.

3.10.5 In Figure 13, data is merged for several wetland habitats to illustrate the distribution and extent of these BAP habitats. WHI analysis indicates that wetland occurs over 0.1% of the County. Included in this merged layer are features such as floodplain grazing marshes, wet woodland, fen, springs, flushes, marginal swamp, reedbeds, fens and other wet grasslands

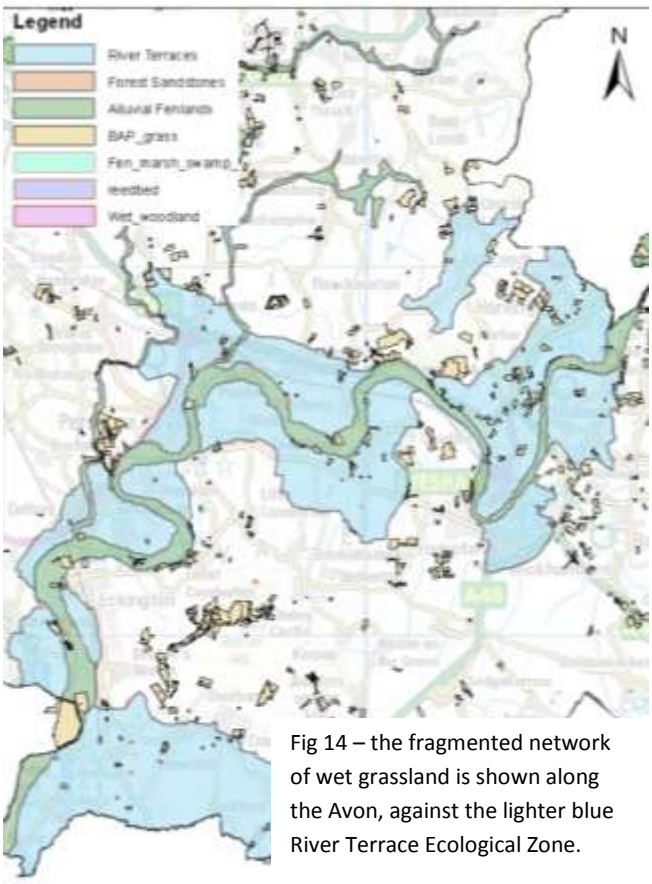


Fig 14 – the fragmented network of wet grassland is shown along the Avon, against the lighter blue River Terrace Ecological Zone.

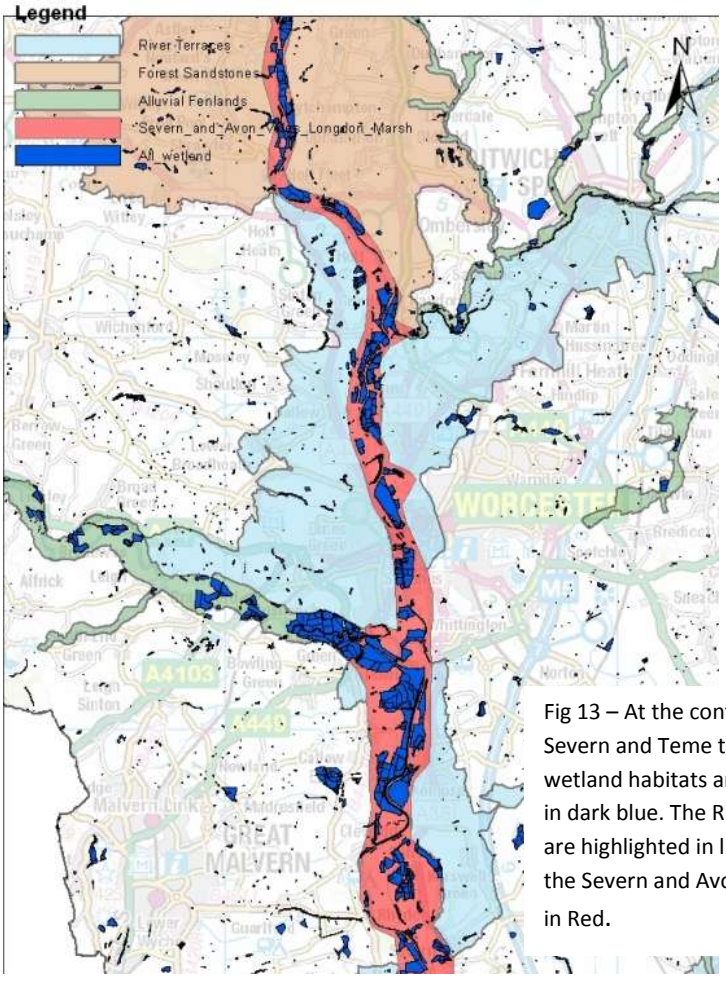


Fig 13 – At the confluence of the Severn and Teme the network of wetland habitats are highlighted in dark blue. The River Terraces are highlighted in light blue and the Severn and Avon Vales BDA in Red.

together with standing and running water. However, as much of the data which WHI wetland basemaps have drawn upon are more than 10 years old, it is unlikely to be a robust representation of Worcestershire's current network of wetlands. However, as it draws upon information provided by the Worcestershire Biodiversity Partnership and Wetlands West target area data, this representation may indicate where restoration efforts may prove valuable in restoring wetland networks and while contributing to flood alleviation efforts and Water Framework Directives.

4. Worked Examples of the Restoration Framework in Practice

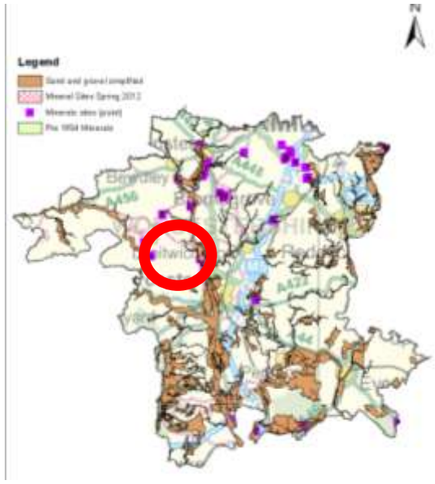
In these worked examples the Restoration Framework is demonstrated using a number of hypothetical mineral extraction sites.

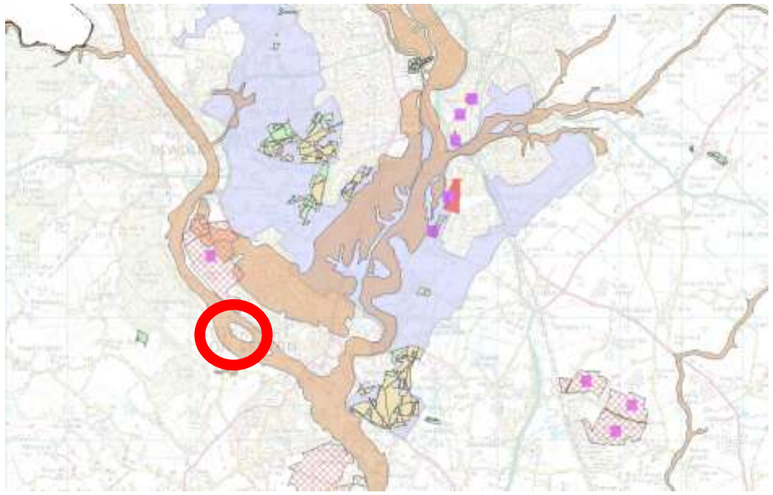
4.1 Theoretical case-study: heathland restoration

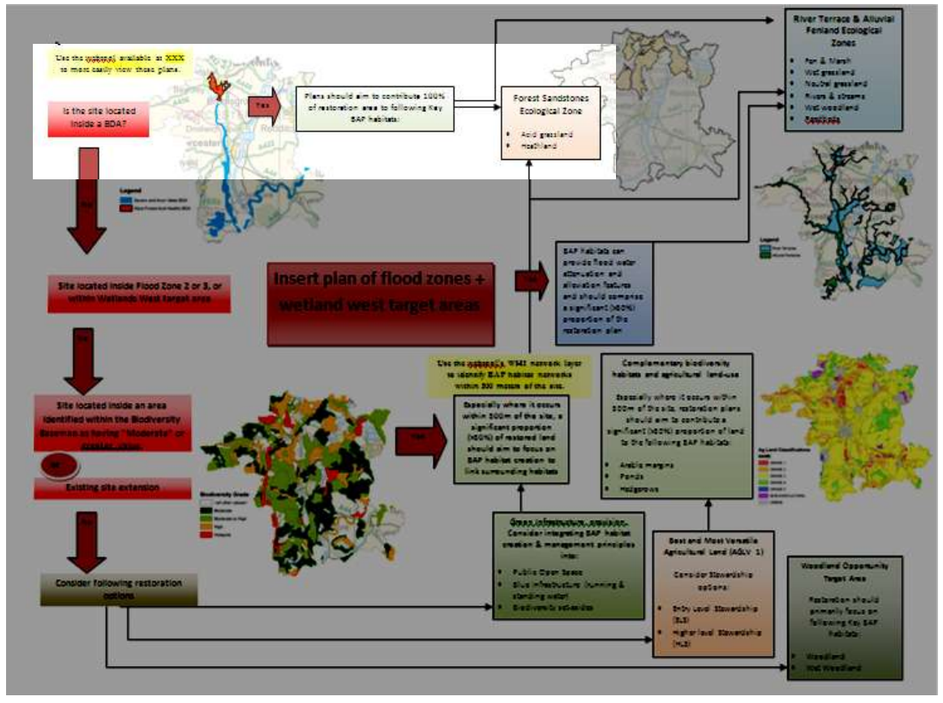
4.1.1. A theoretical mineral extraction site is proposed within the sand and gravel deposits of north Worcestershire. The site is in proximity to the Wyre Forest Acid Grasslands BDA and analysis reveals a fragmented network of designated nature conservation sites and BAP grasslands in the area.

4.1.2. Using the Restoration Framework, the site is targeted as a priority for BAP habitat restoration and in this case restoration to heathland will be much cheaper to achieve than alternate restoration schemes: heathland species will easily colonise the bare sandy substrate but this process can be kick-started by engaging with local nature reserve land managers (SSSIs shown here in red and Local Wildlife Sites shown in green) and seeding the land to be restored using stock from surrounding heathlands and acid grasslands.

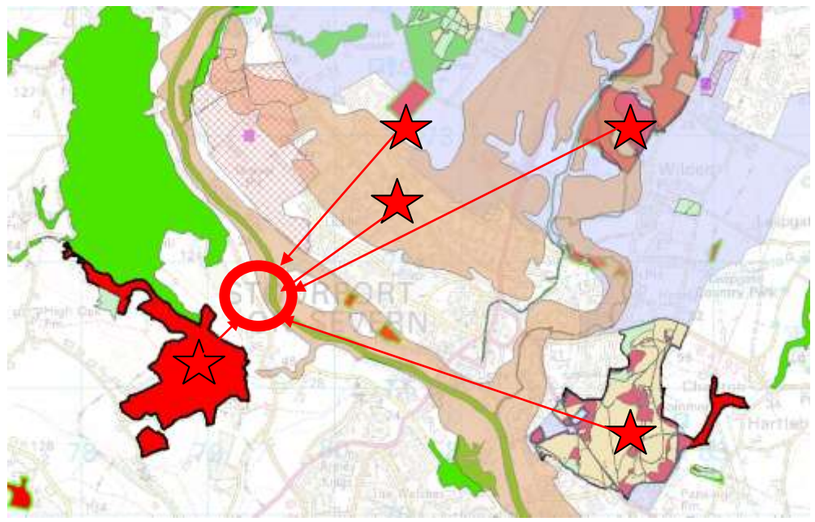
4.1.3. Even in its transitory stages the exposed sandy soil will provide important opportunities for invertebrates and plants in the area, providing stepping stones between existing wildlife sites and an opportunity for dispersal. Managing phased extractions with set-aside for wildlife can make a significant difference for biodiversity in this area.







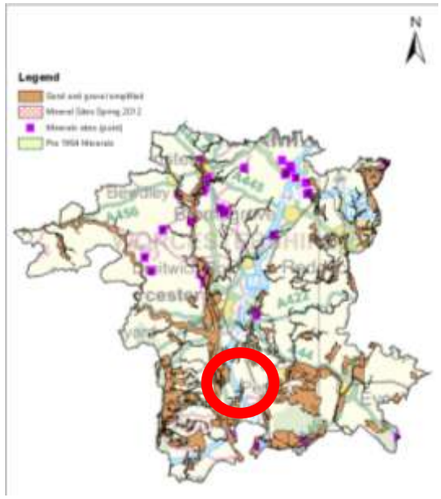
Habitat restoration or creation at this site would act to link the surrounding sites – shown here by red lines to indicate the distance to known similar habitats

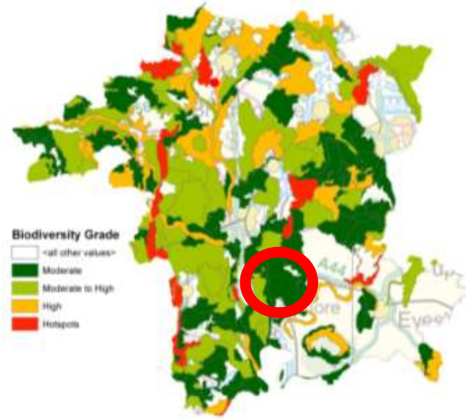


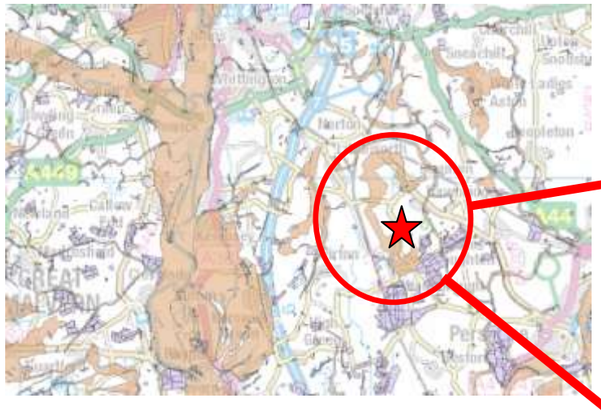
4.2. Theoretical case-study: wet woodland restoration

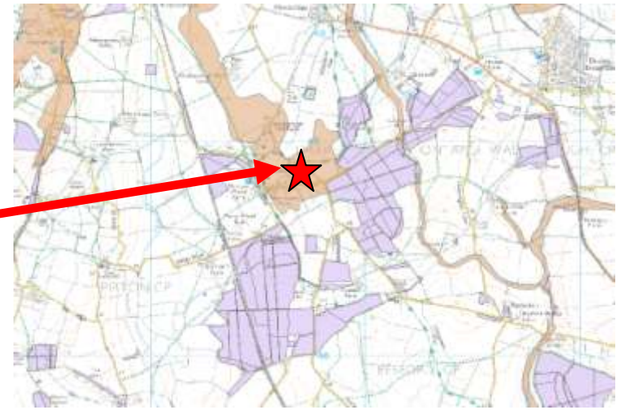
4.2.1 A theoretical mineral extraction site is proposed within the sand and gravel deposits of south-central Worcestershire. This area is located within the River terraces Ecological Zone. Although not located within a Biodiversity Delivery Area the webtool indicates that the site is in an area of moderate biodiversity value and is surrounded by a landscape of fragmented and discrete stands of BAP woodland (highlighted here in purple).

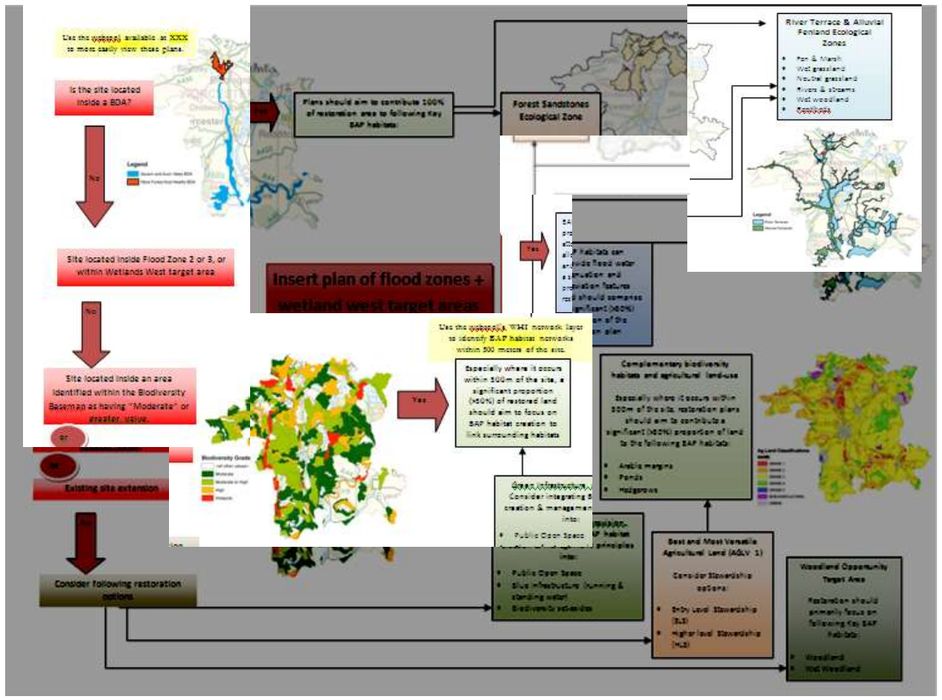
4.2.2. Analysis of the network reveals both broadleaved and wet woodland (shown map and aerial photograph overleaf). Further analysis reveals the area is in the Woodland Opportunity Map "Priority Area 1" a key target set by the Forestry Commission for new woodland planting schemes. Grants are available from the FC to assist with new planting schemes.











4.3. Theoretical case-study: wet grassland restoration

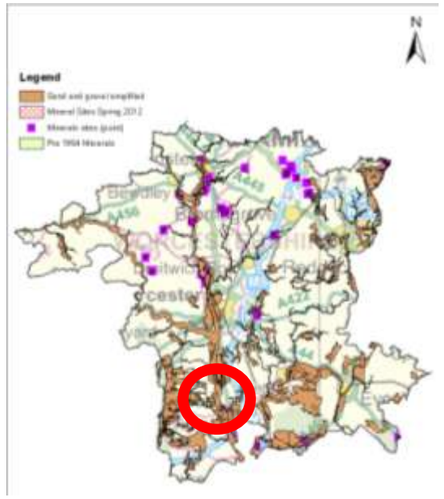
4.3.1. A theoretical mineral extraction of sand and gravel deposits is proposed in south Worcestershire, located within the Severn and Avon Vales BDA and Wetlands West Partnership target area. This area is located within the Alluvial Fenlands Ecological Zone.

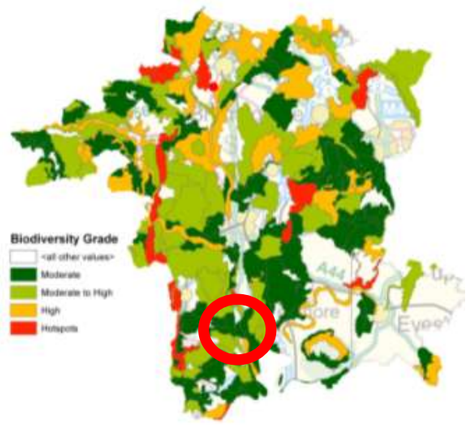
4.3.2. Analysis of the webtool reveals the site is located in an area of moderate to high value for biodiversity and has a fragmented network of wet grasslands mostly represented within a network of nature conservation sites.

4.3.3. Located roughly equidistant between these grasslands, the mineral site could contribute to the cohesiveness of this network by acting as a 'stepping-stone' between BAP habitats.

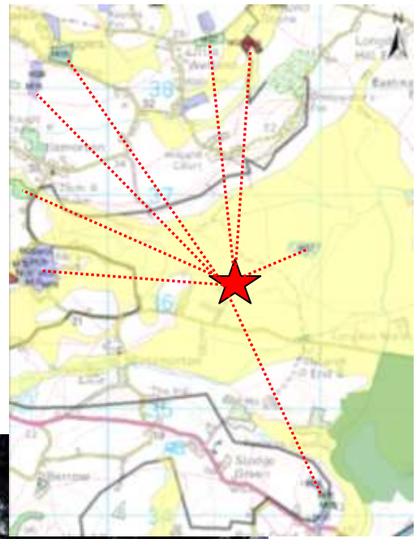
4.3.4. On restoration to wet grassland, the site contributes to BAP targets by offering the opportunity for species to disperse and colonise in the local landscape, this adds to the viability of the surrounding sites and creates a new biodiversity and green infrastructure resource.

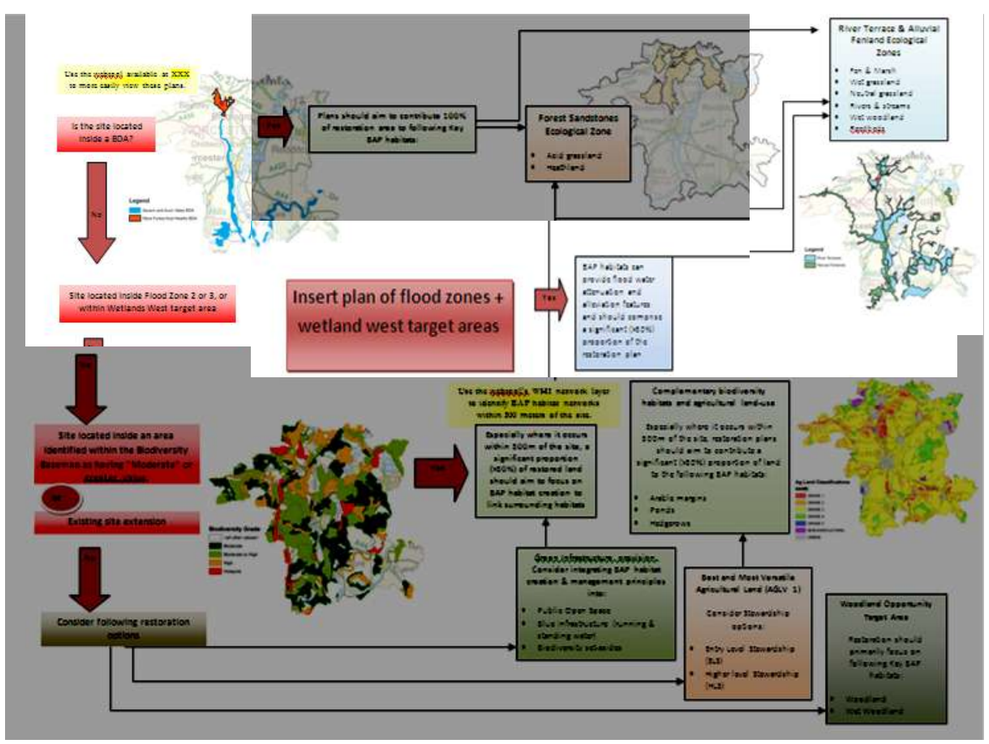
4.3.5. The site's ability to store flood water also helps reduce downstream flooding events as surface water is slowly released to the water cycle, saving thousands of pounds in flood damage and improving local water quality.





Habitat restoration or creation at this site would act to link the surrounding sites – shown here by dotted red lines to indicate the distance to known similar habitats





5. Case-Study: National Memorial Arboretum, Staffordshire

Operator: Lafarge Aggregates Ltd in partnership with The National Memorial Arboretum Co. Ltd
Size: 60 hectares
Restored to: Nature Conservation/Contribution to Biodiversity and Recreation/Leisure
Further information:
www.thenma.org.uk

The National Memorial Arboretum is the UK's memorial to those who have given their lives in the service of their country. Comprising over 60 hectares of trees and memorials, it has been created on land restored by Lafarge Aggregates Ltd following sand and gravel extraction. The National Memorial Arboretum compliments the restoration plans for the Lafarge site which incorporates more than 50,000 planted trees to create wooded parkland. However, there is also a rich tapestry of lakes, ponds, riverine habitat, grassland, reedbeds and wetland.

Biodiversity has been promoted through hedge laying, willow sculpture, willow hedge construction and the building of an artificial otter holt. The Arboretum, located near where the rivers Tame, Trent and Meese meet, is an important wildlife corridor. Otters, brown owls, kingfishers, brown hares and lapwings have all been spotted. Within the Arboretum is the impressive Armed Forces Memorial, which commemorates servicemen killed on duty since 1948. The design of this memorial was partly inspired by a 3000 year old Bronze Age burial mound also preserved on the site.

The site provides full public access, with car-parking, visitor centre, café, meeting rooms, chapel and interpretation boards. Over 100 volunteers work at the Arboretum. There is a Wildlife Watch Group for younger people, supported by the Staffordshire Wildlife Trust, and a well-used Lafarge Education Resource Centre. The Alrewas site has been restored by Lafarge Aggregates Ltd and National Memorial Arboretum Co. Ltd into a historic, peaceful place of national, international and personal significance for visitors. The wide variety of trees and habitats has also greatly enhanced biodiversity. For these special social and environmental reasons, The National Memorial Arboretum has been recognised by the Mineral Products Association as an outstanding example of restoration planning and has been awarded the 2009 Cooper-Heyman Cup.

Case study – St Aidens, Leeds

Size: 55ha
Location: Nr Castlefield, Leeds.
Operator: UK Coal
Mineral Type: Coal.
Further information:
www.rspb.org.uk/reserves/guide/s/staidans

The extraction of some 4 million tonnes of coal was brought to a halt in 1988 when the bank of the adjoining River Aire was breached and 17 million cubic metres of water flooded into the site. After construction of the Aire and Calder Navigation was completed water was pumped from the site and extraction of a further 2.8 million tonnes of coal was recovered before the site ceased production in November 2002[24].

Habitats Created: 55 hectares of wet grassland, standing water, reedbed and ditches.
Habitat Creation Details: The grassland area is approximately 1km long from north-to-south and is divided into 3 units separated by carrier ditches which, together with the low flood bank profile and ridge and furrow design, help draw water from the abutting lake into the grassland. The flood relief channels (connected via sluice to the carrier ditches), provide a simple water management system which controls the water flow during high flows and enables the grassland to function as a proper washland in the event of large flooding events on the River Aire. The simple linear system makes habitat creation easy and permits the reuse of spoil and overburden to create topographical variation essential for plant and animal diversity. The site layout is designed with ease of access and maintenance in mind from the outset.
Public Benefits: In addition to the 6million cubic metres of washland capacity designed to help protect local communities from flooding events, the site is anticipated to become a major countryside visitor attraction; adding value and sense of place to local communities while contributing to the cohesiveness of the local habitat networks.

Long-term management of the site: A trust fund was set up to fund management of the site once UK Coal had finished restoration. The site was then handed to St Aidens Trust, a body set up by Leeds City Council and UK Coal to manage it in perpetuity in agreement with the RSPB as both a nature conservation area and as an area of open countryside that can be enjoyed by the local community.

24 http://miranda.hemscott.com/servlet/HsPublic?context=ir.static.jsp&client=ukc&path=util&service=getPage&page=surface_mines_restoration_sites&banner=surface_mines&left=surface_mines&right=surface_mines

Case-Study - Sandy Heath Quarry, Bedfordshire

Size: 28ha
Location: Bedfordshire
Operator: Lafarge Aggregates Ltd
Mineral Type: Sand
Habitats Created: lowland dry acid grassland & heathland.
Further information: www.agg-net.com/resources/articles/a-shared-vision-0

Background

Sandy Heath Quarry is situated on the Greensand Ridge, an elevated area of land in Bedfordshire. Between the late medieval period and the mid-nineteenth century, the region around Sandy and the nearby Everton Heath formed an extensive landscape of open heathland, comprising a mixture of heather, grassland and bare ground, which survived almost intact until around 1825. Since then, much of the heath has been lost to agricultural encroachment and tree planting, and little heathland vegetation now remains.

Sandy Heath Quarry presents an opportunity to create a large heathland block that will contribute to both national and local Biodiversity Action Plan targets. Sand extraction sites provide good conditions for heathland creation, as there is no problem with excessive soil fertility, which is usually one of the main obstacles to successful heathland creation.

Planning history

Sand has been extracted in the Sandy area for around 40 years, with permission for extraction first given in 1965 and a further permission awarded in 1985. Early plans for restoration of Sandy Heath Quarry included tree planting, but since 1990 the emphasis has shifted towards the re-establishment of heathland and grassland.

Habitat creation details

Land-forming of worked areas is carried out by the operators, LaFarge. The establishment and management of habitat on the site are undertaken by the RSPB, under a management agreement with LaFarge. Existing nature conservation interest at Sandy Heath Quarry centres on early successional bare ground and acid grassland habitats and their associated invertebrate and plant communities. The aim of restoration is to create a mosaic of heathland habitats characteristic of the local area, maintaining early successional habitats in some areas whilst encouraging the colonisation of mature heathland communities in others. Site restoration on recently quarried areas aimed to create a landform similar to that found locally in peri-glacial valleys on other parts of the Greensand Ridge. Sand extraction lowered the site surface by up to 30m, and the final landform was designed to create three valley forms which flow between and around retained areas of woodland. Areas of steeper slopes were created as part of the later landscaping. Over these patches the sand is unstable and continuously falls, exposing bare sand. A suite of rare invertebrates specialise in colonising bare sand, which is an increasingly rare habitat. Many rare and important species of wasp and spider have already been recorded – including Biodiversity Action Plan listed species, and even a wasp recorded for the first time in Britain.

Heather establishment has been achieved in a number of ways. Firstly, year-old heather plants grown from local provenance seed have been transplanted onto the site. Heather litter and heather seed have been spread, and some areas have been fenced to exclude rabbits. Acid grassland establishment has been left to natural regeneration on the nutrient poor mineral soil. This has been successful, with numerous specialist plants species appearing and resulting in a very interesting community. Gorse is an important part of this set of habitats, providing nesting sites for a number of bird species including Dartford warbler, and crucial habitat for a range of invertebrates. A few plants colonised naturally, and more have been planted.

Public benefits

Local people are already enjoying the site. Guided walks by RSPB staff introduce visitors to the range of plants and animals there, and provide an opportunity for enjoyment of the natural world. In the near future, information boards and paths will allow members of the public to visit the restored areas at any time. In years to come the site will become a valuable asset to the local community providing contact with nature in an otherwise intensively agricultural region.

Long term management of the site

The RSPB has a management agreement with LaFarge for the continued conservation management of the site. The challenge at Sandy Heath Quarry is striking a balance between the establishment of mature heather communities and the maintenance of bare ground and the naturally colonising early successional habitat important for the existing invertebrate assemblage. Maintaining early successional habitats requires reasonably heavy grazing (by rabbits in this case). Early management is essential as coarse grassland and scrub can develop within a few years on ungrazed areas, and once developed it can be hard to redress.

There has been an issue on the site with broom colonisation; the majority of the dry scrub on site is broom, and although the plant supports a significant invertebrate fauna (including at least one Nationally Scarce species), it is capable of rapidly colonising new areas. Broom is a nitrogen-fixing legume, and so can raise soil nutrient levels to the point where communities requiring low nutrient status are unable to establish.

Rabbit grazing has been generally successful at maintaining an open-structured vegetation community, and more recently sheep grazing has been introduced. The sheep have successfully grazed broom and cleaned up straggling heather. As heavy grazing is detrimental to the successful establishment of heather, once areas have been cleared of broom they are fenced to allow heather to flourish.

6. Appendices

Appendix 1 – Funding Mechanisms

Funding mechanism	Supports	Details	Type of funding
Agri-environment funding	Land management	Agri-environment funding can be secured by landowners and managers for changes to the management of land which benefit the natural environment. Agri-environment funding is a part of the Rural Development Programme for England, which is currently being renegotiated as part of CAP reform across the EU. In applying for Environmental Stewardship, applicants must demonstrate biodiversity gain over-and-above those mitigation & compensation measures secured through planning permission to facilitate mineral working.	Capital and revenue
English Woodland Grant Scheme	Land management / minerals / infrastructure	Funding is available for woodland creation and for the management of existing woodland. English Woodland Grant Scheme funding is a part of the Rural Development Programme for England, which is currently being renegotiated as a part of CAP reform across EU. For further information: www.forestry.gov.uk/pdf/Woodland_and_WFD_mapping.pdf/$file/Woodland_and_WFD_mapping.pdf	Capital and revenue
Hypothecated taxes	New development	A tax levied for a specific purpose. Taxes can be levied on new development and reserved for green infrastructure. This model has been successfully applied on both small and large scale development sites.	Revenue
Endowments	New development / minerals / infrastructure	Site endowments may be successfully used to create a long term income for the management of land. It may be appropriate that these are dedicated to a specific charitable trust which can use the income to manage the land. There are also a number of charitable companies which specialise in using endowments to manage land.	Revenue
Management companies	New development / minerals	Land ownership is retained by the developers, but responsibility for the management is transferred to a management company with agreed standards and management plan.	Revenue
Local authority	New development / minerals/ infrastructure	A traditional method of securing new Green Infrastructure on development sites with the long term management transferred to the relevant local authority. Although becoming less commonplace, this mechanism may be appropriate for certain strategic sites.	Revenue

Worcestershire's Acid Grassland

Lowland acid grassland typically occurs on nutrient-poor, generally free-draining soils with pH ranging from 4 to 5.5 overlying acid rocks or superficial deposits such as sands and gravels. Acid grassland is characterised by a range of plant species such as Heath Bedstraw, Sheep`s-fescue, Common Bent, Wavy hair grass, Harebell and Sheep`s Sorrel and often develops under a canopy of Bracken. In more parched or open situations the community may show an interesting array of early successional species including Hares-foot Clover, Bird's Foot and Cudweed's. These communities often occur naturally at sand and gravel quarries on spoil during extraction. Many rare invertebrate species such as sand burrowing solitary wasps, bees and beetles thrive in these sandy habitats. Similar acidic grasslands also occur on exposed scree slopes and bare rock in the historic granite quarries of the Malvern Hills. Acid grassland often occurs as an integral part of lowland heath landscapes.

Acid grassland losses have occurred largely as a consequence of intensive agricultural activities such as ploughing and reseeding or the use of high nutrient fertilisers, lime and herbicides. Remaining patches of acid grassland can be found in the Forest Sandstone areas of north Worcestershire and also on the acidic hard rocks of the Malverns.

The exposed low nutrient, acidic soils and substrates offer ideal conditions for the natural development of acid grassland communities. Some exceptional examples have occurred at both sand and gravel, and hard rock quarries in the County. The prime sites for restoration are the sand and gravel sites of the Forest Sandlands and the River Terraces. They are also a feature of some of the hard rock quarries of the Malvern Hills.

Acid grasslands mostly occur on marginal areas such as scree slopes, cliffs and areas of exposed bare sand within aggregate sites. These smaller patches of acid grassland give an indication of the potential for restoration of larger areas (pasture) of acid grassland that could be created and managed through grazing. In situations where the restoration is to more intensive agricultural systems, there are opportunities to retain low nutrient soils and create acid grassland in more marginal areas such as along field boundaries.

Bunds and mounds and other areas of exposed sandy soils of low nutrients are a common feature of operational quarries and in a relatively short time period, often become home to a variety of acid grassland plants and invertebrates. They are especially good habitat for reptiles and sand-burrowing invertebrates.

The retention of either low nutrient sandy or skeletal soils is the most important factor when considering the creation of acid grassland. Topsoil should only be used where it does not contain high concentrations of available nutrients.

(Left) Although unkempt, marginal areas of sand provide conditions for acidic grassland plants such as Hare's-foot Clover, Bird's-foot and Musk Mallow as well as creating habitat for burrowing invertebrates.

Gorse and Broom scrub and Bracken often occur naturally within acid grassland, and managed in the right proportions, increase the diversity of species substantially. There should be no need to plant scrub. Management will need to retain a balance between the amount of scrub and grassland.

Creating Acid Grassland

Evidence from former aggregate sites suggests that the introduction of acid grassland vegetation is unnecessary as even the most isolated quarries rapidly attract a desired acid grassland species assemblage. Only where a nurse crop is required to stabilise the surface or where natural regeneration is unsuccessful, should introductions be considered. Only use seed vegetation of local provenance.

Tree planting should be discouraged in places where acid grassland is likely to occur.

Increased structural diversity within the final design, which includes features such as scree slopes, cliff ledges, bunds, banks and spoil and other mounds, will increase diversity and wildlife value. (Smooth surfaces may require ripping if colonisation is slow). These features should be created and planned for during the operational Phase. The Malvern quarries contain examples of a good diversity of acidic communities occurring within a small area.

Ongoing management in the form of grazing (or cutting where grazing is unfeasible) will be required to prevent succession to rank grassland or scrub. Steep slopes and other unstable surfaces may not need managing for many years. Rabbits often occur at these grasslands. The tight-cropped swards that are created by rabbit grazing are often some of the most interesting.

Opportunities during extraction

Opportunities should be made to create and maximise acid grassland habitats during the operational phase. Bunds and banks of spoil provide a potential locus for development. Disturbance should be kept to minimum where invertebrates such as solitary wasps and rare plants occur. Temporary habitats of high conservation importance should be considered and if possible brought into the restoration plan. They are likely to give an indication of the potential for restoration.

(Above) This temporary bund is grazed by sheep. Grazing has maintained a short sward and exposed bare sandy areas which adds to the diversity of this grassland.

(above) Acid grassland naturally succeeding on a scree slope at North Quarry in the Malvern Hills. The close proximity of similar communities on the surrounding hills aids colonisation. This community contains an interesting assemblage of plants, mosses and lichens. Bordering Gorse scrub also adds value.

Opportunities for action before and after Extraction

Opportunities should be made to link to existing acid grassland or heathland communities. Attempt to create a diverse landscape during extraction by including areas of spoil, steep slopes and numerous cliff ledges.

Worcestershire's Meadow & Pasture (Including other neutral grasslands)

This description includes the traditionally managed neutral meadows and pastures including the MG4 and MG5 grasslands and other neutral grassland types that are of conservation importance but are not managed using traditional methods.

Meadow and pastures are species-rich grasslands that have not been significantly altered by recent agricultural intensification. Unimproved pastures have developed their interest through livestock management whilst hay meadows are shut up from early spring to summer and support a somewhat changed floristic content. Both contain a rich assemblage of wildflowers that in turn are important for a diversity of animals.

(Above) The creation of traditional herb-rich hay meadows such as this at former aggregate sites would make a significant contribution to Biodiversity in Worcestershire.

Worcestershire is one of the country's strongholds for the species-rich crested dog's tail and common knapweed community (NVC MG5), which was once widespread throughout much of Britain and is now nationally scarce, having declined by about 99% since 1945. The lowland flood plain meadow grassland is characterised by Meadow Foxtail and Great Burnet (NVC MG4). It occurs on low-lying land on the alluvial plains of the larger rivers such as the Severn, Avon and Teme.

MG4 grassland depends on seasonal flooding to replenish the site with nutrients. Also of importance are those grasslands referred to as MG6 communities. These are generally species-poor (in comparison to MG5) and characteristic of agricultural improvement but often retain significant interest. The False Oat-grass grassland (NVC MG1), which is characteristic of road verges, provides refugia for many species which no longer exist within the agricultural landscape. Re-seeding, drainage, use of herbicides and artificial fertilizers are some of the reasons for the loss of traditional meadows and pasture in Worcestershire.

Creating meadow & pasture

There is enormous potential to create and include species-rich meadows and pasture in agricultural restoration schemes. There are also a variety of other neutral grasslands types, including early successional and rank grassland communities, that are appropriate for restoration schemes but are better suited to the more marginal situations where grazing or hay-making is inappropriate.

- Species-rich hay meadows are the result of many years of traditional management on low nutrient soils. Best practice management is often complex and skilled advice should be sought for the creation and long-term management of these grasslands.

- The choice of community depends on the soil, climatic and the hydrological conditions of the site. An important requirement for species-rich grassland communities are soils of a low nutrient status. If the topsoil is too nutrient-rich then the habitat should be created directly on the subsoil. Rank or species-poor grasslands (similar to those found on roadside verges) are still valuable and appropriate for soils of higher nutrient content. Many invertebrates, mammals and birds depend on these communities for their survival. These communities are often maintained by periodic mowing and are appropriate in situations where grazing is unsuitable.

- It is important to analyse the soil to establish its nutrient status. Phosphate and pH are of particular significance.

- Natural succession is the preferred method of colonisation. This has greater chance of success where the soil contains a suitable seed bank or where the site is in close proximity to an existing meadow and pasture. In certain situations, natural succession can be slow and the earlier stages of succession will include species of open habitats. For the most part, these species are beneficial to wildlife, but occasionally weeds may require suppressing if they prevent grassland establishment. Naturally occurring grassland at mineral sites may not require managing for some time.

- Hay strewing, seed collection or planting can be effective methods of reintroducing species. However, seed and hay sources must be sourced locally and care must be taken not to damage existing habitats.

  Seed mixtures should incorporate the plants growing in the nearest unimproved grasslands on the same soil type. Follow up management regimes (cutting and/or grazing) are essential for the continued establishment of species. If a grass cover is required quickly, an annual nurse crop can be sowed. The advantage of a nurse crop is that it stabilises the soil and dies back, having provided the conditions for the establishment of wildflowers and grasses more appropriate to the locality.

- Artificial fertilizers are not recommended.

- Neutral grasslands of varying types often develop in marginal areas including the perimeter area along the quarry boundary. Where possible, tree planting is discouraged in areas where neutral grassland is likely to develop.

- Bare areas of ground created through compaction can be beneficial for biodiversity and adds to the diversity of habitats created on site.

(Above) Re-seeding at Shavers End. Successful and distinctive species such as Oxeye daisy give the desired effect and offer refuge for invertebrate species. Such introduced floras often do not reflect those of the immediate locality.

Appendix 2 – Habitat Creation Toolbox

Worcestershire's Lowland Wet Grassland

Wet grassland is seasonally waterlogged low-lying grassland where the drainage is poor or impeded. Typical management is by grazing or cutting for hay or silage.

In the main, the communities are dominated by grasses such as Tufted hair grass and Yorkshire Fog and rushes including Soft Rush and Hard Rush. Wildflowers are not a major component of wet grasslands. Nevertheless, this does not detract from their importance for a variety of flora and fauna.

(Above) Unimproved wet grassland at Clifton Quarry.

Like other wetland habitats, wet grassland has undergone a considerable decline over the last 60 years in response to agricultural intensification in the form of land drainage and agricultural fertilization. According to the Worcestershire grassland inventory, around 32 ha of wet grassland has been lost in the last 20 years with 49 ha remaining on relatively small sites.

Wet grassland habitat has a high conservation value and is vital for a number of species, particularly passage migrants and breeding wading birds such as Curlew and Redshank - species which have declined considerably in the last 20 years.

The distribution of sand and gravel quarries is much the same as that of wet grasslands, typically occurring in the low lying Alluvial Floodplains and River Terraces. There is therefore an outstanding opportunity for wet grassland recreation through mineral site restoration strategies.

NVC community	Water table depth below ground surface (m)				
	June	July	Aug		Feb
MG9	-0.3	-0.6	-0.8	Dry	-0.1
S25	0	-0.4	-0.7	Dry	0

Table 2. Showing the maximum water-table depth tolerated by two wetland communities

The suitability of the local conditions, particularly at sand and gravel sites on the River Terraces and Alluvial Floodplains, means that wet grassland creation should be considered as a high priority within other wetland features such as swamps and open water.

Creating lowland wet grassland

The suitability of a site for wet grassland creation is largely determined by the seasonal hydrological changes. The zone of the water table variation, being typically, either close to flooding or shallowly flooded in winter and only a little above the summer water level. The table above (adapted from Souch *et al*, 2000) gives an indication of the levels required for creating wet grassland and swamp communities.

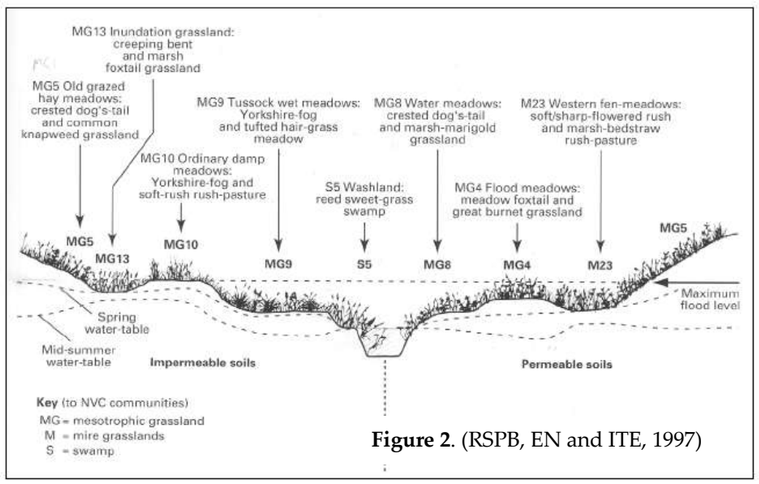


Figure 2. (RSPB, EN and ITE, 1997)

Figure 2 shows the distribution of wet grassland plant communities on a hypothetical lowland floodplain managed for hay with aftermath grazing, in relation to soil type and water regime. The diagram illustrates the variations in topography, permeability, spring and winter water table and the resultant vegetation community.

- Wet grassland is likely to succeed naturally as seed is often made available through inundation. Certain wet grasslands such as the Tufted Hair-grass community may succeed quickly.

- Isolated sites may require hay strewing or seeding if soil erosion is a problem or where natural succession does not occur.

- Water quality,nutrient levels, suspended sediments and contaminants affect vegetation composition and therefore need to be understood prior to creation.

If the final water levels are unknown, or in situations where the ground level is raised far above the water table, it may be necessary to use an appropriate water control system incorporating a system of ditches and sluices to artificially maintain a raised water level. For example, the Worcestershire Wildlife Trust has developed a system that uses wind turbines to artificially fill a series of scrapes and ditches at their Gwen Finch Reserve. This has enabled the creation of reedbed and other wetland habitats on areas of raised ground. These artificial systems should reflect the natural surroundings and should be avoided if the conditions are suitable for drier habitats.

Generally, natural hydrological systems are more sustainable and cost effective solutions.

Action needed when key habitat is close to a proposed mineral workings

Mineral extraction can threaten adjacent habitats through dewatering. Isolate the effects of lowering the ground water levels. No levels should be raised which would block flood waters or seasonal inundation.

Opportunities during extraction

Wet grassland often regenerates naturally, given the right conditions, during the operational period. Smaller wet grasslands typically occur in mosaics with ponds, scrapes and ditches. These temporary habitats are of significant conservation importance and often attract wildfowl and invertebrates such as Dragonflies and Damselflies.

Operations should minimise disturbance to these habitats. The critical period being during the spring and summer months. Natural regeneration will give an indication of the final restoration potential of the site.

Opportunities for action before and after extraction

Extraction should only occur on areas downgraded by drainage, flood defence works, neglect, eutrophication and so forth. Proposals which demonstrate enhanced linkage with similar habitats in the local landscape are encouraged.

Although the creation of networks of small ponds have high value for biodiversity, it is important to select the most appropriate BAP habitat for the restoration opportunity. (Above), wet grassland would have provided higher biodiversity value in comparison to the area of open standing water. Note: the higher ground receives no inundation and therefore remains dry.

Worcestershire's Fen, Marsh & Reedbed

The term 'Fen and Marsh' covers a range of habitats that contain permanently or seasonally waterlogged vegetation frequently associated with springs, floodplains and lakesides. The plains communities described here are the swamp and mire communities that typically exist in close association and often form mosaics with the marshy grassland communities.

(Above) Common Reed rapidly takes over habitats such as silt ponds. Creating the right conditions can save considerable time and expense.

Mire grasslands are similar in appearance to wet grasslands, but generally comprise lower growing sedges and a variety of rushes. Swamps are almost always permanently waterlogged and comprise stands of species-poor vegetation often dominated by one or two species such as Common Reed, Reedmace, Reed sweet- grass, Greater pond-sedge and Branched bur-reed Fen & Marsh has undergone massive declines, primarily a consequence of agricultural drainage and intensification.

Some of the County's most important fen, marsh & reedbed habitats are found at former quarries. Prime examples can be found at former brickpits that are situated on Alluvial Fenlands. Included here is Grimley Brick pits and Northwick marshes. Sand and gravel quarries also provide ideal conditions for the establishment of fen, marsh and swamp and there are many situations where these communities now occur.

Creating fen, marsh and reedbeds

It is imperative when designing open water bodies for conservation purposes to have sinuous edges with extensive drawdown zones. In the case of creating opportunities for swamp and mire generation, these extensive shallow areas are critical in ensuring that swamp vegetation has the opportunity to establish.

The guidelines for creating marshy grassland also apply to the creation of fen and marsh habitats, except that fen and marsh communities generally occupy habitats with a higher water table. As with marshy grassland, the resultant habitat is dependent on water availability, water quality and soil conditions. They are particularly appropriate to mineral sites situated on the Alluvial Fenlands and River Terraces, but should also be a component of all wetland habitats, regardless of location.

- Shallow water is a critical factor when developing fen and marsh habitat. Ideally shallow water should be < 1.5m in depth. But variations in depth within these shallow waters will promote a greater diversity of species (See also Marshy Grassland). Where extensive monocultures are desired for breeding birds, ground levels of a more uniform design are appropriate. Large Reedbed swamps are frequently created for these purposes.

- **Reedbed.** Extensive areas of Reedbed are of greater benefit than smaller pockets situated along lake margins. Reedbeds require a reliable water supply and a very shallow gradient and they will support more birds if the edge habitat is increased. Establishment and ongoing management of reedbeds can be very time consuming. Planting young reeds can fail as they are frequently grazed by certain bird species, in particular Coot and Canada Geese. (See RSPB, 1990 for techniques for the establishment of reedbeds)

- Nutrient levels, suspended sediments and contaminants also affect vegetation composition and should be considered prior to creation.
- Swamps are likely to succeed naturally in open water and often colonise quickly where there is a local seed source or periodic inundation. If there is a need to introduce species through planting, gather native plants from a nearby site with similar soils and hydrology. Variations in plant community will occur if the topography is variable.

(Above) Reedmace is often one of the first swamp species to arrive and is important for many invertebrate species.

- In certain circumstances, where the quantity of water is not available, it may be necessary to artificially raise levels and provide supplementary water using bunds, dams and sluices. (At the Gwen Finch Reserve the Worcestershire Wildlife Trust developed a system which uses wind turbines to fill a series of scrapes and ditches). Generally, natural hydrological systems are more sustainable than solutions requiring engineering.

- Adjoining ditches containing swamp vegetation will link habitats and provide important additional off-water habitat for fish and amphibians. They are also a characteristic feature of Worcestershire's floodplains that support a significant proportion of Worcestershire's swamp habitat.

- Acidic and calcareous mire communities are very rare in Worcestershire. Although none have been created at former quarries there is the potential (given the right conditions) to develop these habitats along seepage lines and flushes.

Action needed when key habitat is close to a proposed mineral working site

Isolate the effects of lowering the ground water if a dewatering regime affects water levels.

Opportunities during extraction

Attempt to link existing habitats with ditch

(Above) Bredon's Hardwick. Swamp vegetation strictly confined to the lake edge.

Landscaping schemes which utilise more extensive areas of shallow waters can extend this valuable habitat.

Worcestershire's Open Water

(Above) Years of succession have provided many stages of wildlife interest at this former quarry.

As wet woodland, the site still contains enormous wildlife value. However, In the absence of management, pools and other wetland features including fen habitat, will inevitably lost.

Open Water is an extremely valuable wildlife habitat in Worcestershire. A huge variety of invertebrate, plant, amphibian and bird life is dependent upon still, enclosed water bodies for part or all of their life-cycle. The diversity and type of wildlife varies enormously according to the local environment, lake structure and water chemistry. Artificial open water habitat created through extraction has occurred at many of the quarries in Worcestershire including the clay brick pits of the Mercian mudstones, sand and gravel quarries in the alluvial fenlands and River Terraces and also in the hard rock quarries of the West Worcestershire and Malvern Hills. Many of these sites are now used for recreational purposes such as boating and fishing, some have been left to natural succession and others have been designed to benefit wildlife.

Limestone extraction in the Abberley Hills has created a number of limestone lakes at Woodbury Quarry and Shavers End, the low nutrient conditions particularly important for the Stonewort (*Charophyte)* populations. Earnshall Quarry in the Malverns has also developed botanical interest in its shallow waters. Where clay has been extracted on the alluvial fenlands, a range of open water and wetland habitats have been created.

Sand and gravel extraction offers great potential for the creation of open water habitats. Mineral workings have rejuvenated the diversity of habitats and re-introduced wetlands to a largely drained and dry landscape. These large open water bodies are particularly important for both passage and breeding birds. Reasons for the loss or degradation of open water bodies include; infilling, development and increased eutrophication.

The creation of areas of open water are of enormous benefit to wildlife and likely to increase the biodiversity of an area. Where open waterbodies are planned, the incorporation of serpentine and sinuous edges with significant shallow areas and a broad drawdown zone is encouraged.

It is particularly important to recognise that features that are designed for conservation purposes complement and enhance recreational lakes designed for fishing and water sports, and should therefore be included in the final design.

Creating new ponds and lakes

A number of resources [25]are available through Pond Conservation to help in the design and creation of new ponds.

- There are a number of design features that allow for greater habitat diversity of open water, but of these perhaps shallow water is the most valuable for wildlife. Ponds and lakes designed with deeply shelving banks (which provide little room for the development of marginal vegetation) are discouraged.
- Marginal vegetation is of enormous conservation value and provides valuable habitat for breeding birds and a number of invertebrates and amphibians. Variations in depth within these shallow waters, including artificial reefs will promote an even greater diversity of species and prevent the development of monocultures. As with all wetland communities, an understanding of the final, seasonal water levels is essential.
- Creating scalloped or sinuous edges with bays and spits will maximise the extent of the marginal habitat.
- Where possible, create a variety of water bodies including smaller ones attached to the main water body. Individual ponds are likely to contain different species and increase greater diversity. Islands will also add valuable habitat and provide sanctuaries for birds.
- Where possible, consider creating off water habitats that join rivers as these often act as nurseries for small fish and extend the area of open water and marginal habitat.
- Ensure that there are sheltered areas (bays and inlets out of the wind) for invertebrates.
- Seasonal ponds that dry up annually are also of value, particularly for amphibian species such as the Great Crested Newt.
- Include additional wetland habitat such as fen and marsh in the restoration.
- Bank erosion, caused by wave action at sand and gravel quarries, can be a serious problem. Wind direction and the strategic positioning of shelterbelts, piers and islands should be considered. Wave cut banks can provide valuable habitat, but must be located carefully.
- Tree planting is often undesirable as it may detract from the open habitat favoured by birds. The effects of shading from trees will also diminish the marginal interest over time.
- Planting of aquatic vegetation is rarely necessary as species local and natural to the immediate area will naturally occur. If there is a need to introduce species through planting, gather native plants from a nearby site with similar soils and hydrology. Beware of alien species supplied through commercial suppliers. For example, an alien form of Spiked Water-milfoil is often misidentified as a native species.

(Above) When landscaping open water habitats, features such as straight, steep banks and overhanging trees should be avoided and features such as those demonstrated at Retreat Farm (left) should be considered. Features such as extensive shallows, sinuous margins, islands and sheltered areas for invertebrates will attract a variety of birdlife and develop a diverse array of marginal plant species.

- The introduction of fish can diminish healthy populations of amphibians and invertebrates. Where fish are introduced, shallow water, bays and inlets will provide a refuge for invertebrates and amphibians.
- **Ongoing management** of open-water bodies is related to the conservation aims. For example, to retain the wildlife interest for breeding waders, sites may need considerable input in the form of scrub clearance. Without management many open water bodies will silt up and can become scrubbed over in a very short time.
- Controlled grazing is an excellent way of containing scrub and adding to the diversity at the lake or pond edge.
- Prevent run-off from agrochemicals and fertilizers from adjacent fields with buffers such as grassy field margins.

Action needed when key habitat is close to proposed mineral workings

Isolate the effects of lowering the ground water if a dewatering regime affects water levels.

Opportunities during extraction

Temporary ponds and lakes attract a variety of wildlife E.g. Creation of ponds, wader scrapes and ditches often attract wildfowl during extraction Silt

25 http://www.pondconservation.org.uk/millionponds/pondcreationtoolkit

ponds may turn into extensive Reedbeds or even Osier habitat.

Operational procedure should aim to leave an ongoing supply of maturing habitats. Temporary habitats of high conservation importance should be considered and if possible brought into the restoration plan.

They are likely to give an indication of the potential of the site. Where possible, minimise disturbance to wildlife on these areas, especially during the spring and summer months.

Opportunities for action before and after extraction

Ponds and lakes should not be created on areas with existing wildlife interest. Try to link open water bodies with other areas of wildlife interest such as fens and marshes and other riparian habitats including rivers and streams.

Worcestershire's Wet Woodland

Wet woodland occurs on poorly drained or

Early successional Willow invasion on a silt pond. In the absence of management, this site will become overgrown - although this wet woodland habitat will become important in its own right, the effects of over shading and nutrient build-up will eventually decrease some of the wetland interest.

seasonally wet soils, usually with Alder, Birch and Willows as the predominant tree species, but sometimes including Ash and Oak on the drier riparian areas. It is found on floodplains, as successional habitat on fens and bogs and around water bodies, along streams and hillside flushes, and in localised peaty hollows.

Wet woodlands frequently occur in mosaic with other woodland and open ground habitats. Many Alder woodlands are ancient and have a long history of coppice management. Other wet woodland has developed through natural succession on open wetlands and have little forestry influence. Some are the results of planting of Osiers for basketwork, which through long abandonment have developed into semi-natural stands.

Wet woodland is frequently associated with mineral sites. Recent wet woodland of high conservation value occurs on moist ground in old clay pits such as Grimley Brickpits. Wet Willow woodlands are also frequently associated with sand and gravel quarries, and often succeed in wetter areas along lake and pond margins. In Worcestershire, ancient wet woodland is scarce and often occurs as small stands in drier woodlands. Wet woodland dominated by Alder and Willow has an estimated extent of 224 hectares, 2.0% of all woodland in the county (Worcestershire Red Data Book 1998).

The greatest proportion occurs in the Midland Plateau (38%) and the Severn and Avon Vales (56%). In the former, the River Stour and its tributaries such as the Hurcott Brook contain important linear woods of Alder and Crack Willow which have developed on alluvium or peat and are fed by springs. Reasons for the loss of wet woodland include land drainage, conversion to agriculture, poor water quality and changes in management.

Wet woodland creation, like other wetland habitats, is particularly appropriate for quarries situated in the low lying Alluvial Fenlands and the River Terraces. They offer habitat for a variety of birds, invertebrates, plants, mammals and fungi and compliment other wetland habitats such as marshy grassland and swamp.

- Detailed information regarding woodland creation is available in the "Woodland Guidelines" (Worcestershire County Council, 2004). This document provides information on woodland planting in Worcestershire and makes reference to the appropriateness of species to a particular area. The guidelines should be considered prior to any new planting scheme.

- Applicants should also review the Regional Woodland Opportunities Map which is available through the Forestry Commission website: this sets out "preferred", "neutral" and "sensitive" woodland creation zones and helps guide where new woodland would be most appropriate in a regional context.

- Wet woodland is a common component of aggregate sites and almost always succeeds rapidly during the operational period. For example, almost all sand and gravel sites provide the moist ground conditions for wet willow woodland that is similar to that found in the surrounding landscape. Natural regeneration is therefore an effective and a low cost alternative that requires minimum effort. Seeds and plants of local provenance will have a pattern of flowering and fruiting more in tune with the lifecycles of our native birds and other wildlife and will therefore be of greater benefit. Ideally, seed should be gathered from a local ancient wood (with permission), come from the next closest source for collection or be available at the local tree nursery. Local seed can be grown in pots or sown directly on site.

- The choice of wet woodland is dependant largely on water availability, water quality and soil conditions. As with other wetland habitats, the hydrological conditions need to be suitable for the creation of wet woodland and an understanding of the water availability and final seasonal water levels is essential. Consider water level controls where levels are insufficient to maintain wet woodland but be aware of implementing costly engineered schemes where other habitats are more appropriate.

- In the absence of management, wet woodland rapidly shades out, and out-competes marginal vegetation. Some method of management, either by grazing or manual clearance, will be required to retain a balance of habitats.

- Natural regeneration is the favoured method of establishment. However, where instant cover is needed species should reflect the immediate locality and be of local provenance. The use of non-native species in restoration planting schemes, especially willows cultivars or hybrids, is discouraged. A combination of planting and natural succession should be used where colonisation is slow.

- *See also Woodland creation for a list of design features.*

- Attempt to link to other woodlands either directly or using hedges and do not create woodland on areas of existing wildlife interest or where there is a greater potential of creating another type of BAP habitat. In particular, wet grasslands, fen and swamp.

- Where possible, retain treeless areas around open water features, as this may deter nesting birds and increase corvid and mammal predation.

- Where appropriate, consider developing traditional Osier woodland or planting small numbers of willows if appropriate management can be secured (for instance by pollarding in later years).

Action needed when key habitat is close to a proposed mineral workings

Opportunities should be made to link to existing habitat. Precautions need to be made in the event of dewatering at existing wet woodland sites.

(Above) Lakeside planting can detract from the wildlife potential of an open water body.

Breeding and passage birds are often deterred from a site where there is immediate woodland cover. Bankside habitats often develop into interesting communities in the absence of planting.

Opportunities during extraction

In sand and gravel and clay quarries, wet willow woodland will rapidly colonise the edges of water bodies and other moist areas. Established woodlands should be considered within the final restoration plan. Minimise disturbance to wet woodland wildlife, especially during the spring and summer months.

Opportunities for action before and after extraction

Opportunities to extend wet woodland habitat should be made.

Worcestershire's Woodland

The woodland character of much of the Worcestershire resource reflects the relicts of wildwood which developed over thousands of years. However development within the agricultural environment has resulted in considerable diversity in size, complexity and also, wildlife interest. Our most treasured woodlands are the Ancient Semi-Natural Woodlands (ASNW) that have been in existence since at least the 17th C. A significant proportion of Ancient Woodland is now replanted and the remaining wildlife interest is dependent on the degree of modification. For example, close-set conifer swards are generally less species-rich than broadleaved plantations. Secondary woodlands are those planted more recently or those which have developed through natural succession. There remains approximately 13,000 ha of woodland in the county, about 7.4% of the County's land area.

The most important areas of Ancient Woodland Sites and ASNW are on the West Malvern to Abberley Hills ridge north from the Malvern Hills, the Teme Valley woodlands and the Wyre Forest in the north-west of the county. The woods of the West Worcestershire Hills form an interesting series of limestone woodlands with a species-rich shrub and ground layer flora. Small-leaved Lime, Large-leaved Lime and Wild Service-tree are frequently present in these woods.

Some of the negative effects on the biodiversity of woodlands include loss, increased fragmentation, conversion to modern plantations and the invasion of undesirable plants such as Rhododendron.

Woodlands frequently occur at aggregate sites, occurring both naturally and through design in a number of situations. They are extremely important for wildlife and capable of providing habitats for a diversity of wildlife including rare mammals, birds and invertebrates.

- Careful consideration should be paid when creating BAP quality woodlands to the species composition to ensure that this is appropriate to the locality. In more recent years there has been an increased recognition of the importance of creating woodlands that are both characteristic and appropriate to a particular location. Detailed information regarding woodland creation is now available in a document named the "Woodland Guidelines" (Worcestershire County Council, 2004). This document provides information on woodland planting in Worcestershire and makes reference to the appropriateness of species to a particular area. The guidelines should be considered prior to any new planting scheme.

- Evidence from older sites has shown that natural regeneration often results in a woodland that is characteristic of the immediate locality. For example, older quarries in the West Worcestershire Hills, now reflect those semi-natural woodlands in the surrounding area. This can also be said for wet woodland at sand and gravel sites. Natural regeneration is therefore an effective method of woodland creation at former aggregate sites. It is also a low cost option which requires minimum effort. Seeds and plants of local provenance will have a pattern of flowering and fruiting more in tune with the lifecycles of our native birds and other wildlife and will therefore be of greater benefit. Ideally, seed should be gathered from a local ancient wood (with permission), come from the next closest source for collection or be available at the local tree nursery. Local seed can be grown in pots or sown directly on site.

- Where instant cover is required, species should reflect the immediate locality and be of local provenance. A combination of planting and natural succession can be effective.

(Above) This woodland scheme would have benefited from natural regeneration. The adjacent Semi-natural Woodland would have acted as a donor site.

- Although natural regeneration can be slow, all of the intermediate habitats existing over time, from bare ground to grassland, scrub and immature woodland, including the mosaics that exist between these habitats, are likely to be of considerable conservation benefit also.

- Often tree planting schemes fail because the soil and hydrological conditions are inappropriate. A description of planting techniques can be found in White *et al*, 2003 & Gilbert *et al*, 1998. See alsothe Hedgerows section within this appendix for a list of tree and shrubs and the associated soil requirements of individual species.

- The creation of woodland on areas of existing wildlife interest is discouraged. Similarly, woodland creation on areas where there is a greater potential of creating other habitats of significant conservation value (e.g. unimproved grassland) is discouraged.

- Planting patterns should be designed with a complex structure. Variations in canopy height and spacing are better than ordered lines of trees. Consideration should be paid to

understorey species composition, including scrub. A survey of the surrounding woodlands will give some indication of what species to plant.

- Glades and woodland edge should form a significant component. Woodland edges and rides should take on the various stages of succession from open ground to scrub and ultimately wood. Natural regeneration provides for this variation in structure.

- Attempt to link to other woodlands and habitats either directly or using hedges.

- Standing and fallen dead wood are important for wildlife and should be retained.

- Erect bat and bird boxes where possible.

- **Alternatively, consider planting traditional orchards as these are also of benefit to wildlife and are a feature of the Worcestershire landscape.**

Action needed when key habitat is close to proposed mineral workings

Protect woodlands from dust and drainage regimes prior to extraction. Avoid disturbance to hedgerow tree roots and ensure there is no disturbance to resident and foraging species, in particular birds and bats.

Opportunities during extraction

Temporary habitats of high conservation importance should be considered and if possible brought into the restoration plan. They are likely to give an indication of the restoration potential of the site.

Opportunities for action before and after extraction

Extraction should not occur on any areas of existing woodland habitat. Opportunities should be made to link and extend existing habitats.

Screen planting can often take place on marginal areas that have the potential to develop into much more valuable species-rich grasslands

Worcestershire's Scrub

The term 'scrub' encompasses a variety of habitats characterised by a wide range of low-growth, woody species. It occurs in many situations, often forming mosaics as a transitional stage between grassland or heathland and woodland or sometimes forming stands on its own. It is a characteristic feature of quarries and often takes over in abandoned areas in a number of situations.

The various scrub habitats could be considered under the following headings :

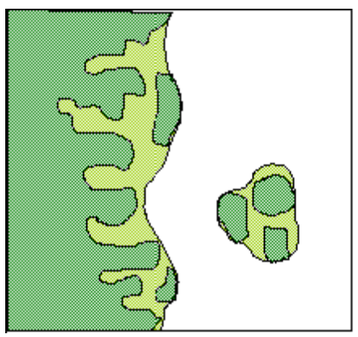
<u>Scrub as a habitat on its own</u>.

Examples would be: Hawthorn scrub which has particular value for breeding birds such as Linnet, Bullfinch, Turtle dove, Blackcap, Whitethroat, Lesser Whitethroat and so forth – many of these are Worcestershire BAP species. Blackthorn scrub is particularly valuable for species such as Brown Hairstreak butterflies and Longtailed Tits.

In each case there will be many other species, especially invertebrates that would benefit or depend on this habitat. The old-growth scrub communities that are associated with pastoral systems on the Bredon and the Malvern Hills have a very high conservation value.

<u>Scrub as part of a mosaic</u>.

Examples would include: scrub/grassland mosaic (breeding birds, butterflies etc); scrub/wetland mosaic (e.g. scrub on the edge of



A diverse and sinuous edge structure provides additional opportunities for wildlife

reedbeds provides a major feeding area for sedge and reed warblers, plus a breeding/resting area for Otters); scrub/heath mosaic comprising Gorse and Broom (Turtle Dove, Redpoll, Yellowhammer, Green Hair-streak).

Factors such as agricultural intensification and the historic misconception of scrub habitat being of low conservation value has led to a decline in this habitat. Scrub is often overlooked or actively disparaged as a habitat. It is, however, very important since it supports large numbers of species, many of which are listed in the UK Biodiversity Action Plan. The creation of a managed proportion of scrub is a welcome addition to all restoration schemes.

- Scrub almost always develops to a certain extent at aggregate sites. At sand and gravel quarries willow often takes over the moist ground and lake edges, Blackthorn and Hawthorn scrub succeeds at Limestone quarries and Gorse and Broom develop on dry ground in more acidic situations. The common misconception of scrub constituting "unsightly waste ground" with limited conservation interest must be challenged and restoration strategies are encouraged to simply permit some scrub development naturally on site.

- The variations in structure, shelter and close assemblage of species, provides ideal conditions for a whole variety of invertebrate species. Even within productive agricultural systems, there is

Gorse and Broom scrub (above) is a valuable component of acid grassland and heathland. These species are characteristic of impoverished soils in the Forest Sandstone area.

always the possibility of including scrub habitats in marginal areas.

- Natural regeneration should be the favoured option. Benefits of natural regeneration include the presence of species local to the immediate area. It also provides a balanced age structure and spatial distribution.

- In certain situations, non-native species will occur and a decision will need to be made on the desirability of that species and whether it detracts from the conservation objectives. For example, the Butterfly Bush (*Buddleia davidii*) is present in high numbers at some of the Malvern quarries. The impracticality of removing this species, plus its perceived benefits for a wide variety of invertebrates means that the species is regarded as acceptable here.

- Structural variation will increase the number of niches in which different species can breed and feed. Areas of scrub should aim to include variations in height, canopy, shape and spacing. The diagram above shows the preferred sinuous edges (dark green) which benefit wildlife. The balance of management should aim to diversify the structure of scrub. This may occur as a response to grazing but can be enhanced through cutting and thinning.

- There is rarely the need to plant scrub. However, in circumstances where it is deemed appropriate, the same techniques for planting trees should be used. Again, it is imperative that plants local to the area are used.

- Screen planting should also include the design features mentioned above.

- Nightingale (BAP Species) Habitat. Scrub thickets with a dense vigorous growth of Blackthorn or Hawthorn are favoured. Suitable scrub patches have a canopy that descends to the ground. Detailed information on creating habitat for Nightingales in South Worcestershire can be obtained from the Worcestershire BAP.

- Scrub development should be controlled around open water bodies as it can detract from the marginal interest and wildlife that frequents these areas.

- Scrub should remain an important component of woodland, especially where rare species occur.

- Some scrub may take over very quickly. Examples include Sallow and Osier on moist ground. Some scrub can be tolerated but not at the expense of more interesting habitats. Although scrub enhances the diversity of a site, it should not be allowed to smother sites with existing wildlife interest. For example willows on wet grassland or Hawthorn, Blackthorn and Elder on calcareous grassland.

Opportunities during extraction

Temporary scrub is a valuable habitat for a variety of wildlife including breeding birds and invertebrates. Where possible, minimise disturbance to wildlife on areas of scrub especially during the spring and summer months. Temporary habitats of high conservation importance should be considered and if possible brought into the restoration plan. They are likely to give an indication of the potential of the site.

Opportunities for action before and after extraction

Extraction should ideally only occur on scrub with low wildlife interest. Where unavoidable, any biodiversity impact must be adequately mitigated and compensated.

Worcestershire's Hedgerows

A hedgerow is a boundary that combines the wildlife benefits of scrub, wood and woodland edge habitats. The diversity of habitat and species is further increased where there is a ditch. It is this diversity that makes hedgerows one of the most biodiverse features in the landscape.

There is considerable variation in the composition and structure of hedges. Some of Worcestershire's oldest hedges may have existed since the Iron Age or earlier whereas others were planted much later during the Parliamentary Enclosures. Many species-rich hedges were derived from woodland, the remains of assarts, the practice of felling woodland for agriculture whilst leaving a stock proof barrier or a markation of land. These hedges are very much reminders of our ancient landscape. The much later enclosure hedges, are more often less species-rich, linear in outline and often dominated with Hawthorn, but nevertheless important wildlife habitats.

Hedges frequently contain trees and these can sometimes be of considerable age (veteran trees). These have great landscape value and are important for bat roosts, bird nest holes and refuges for many insects associated with old and decaying wood. In the west of Worcestershire old hedges often contain uncommon woodland trees such as Small-leaved Lime, Large-leaved Lime and Wild Service Tree.

These trees are frequently ancient in age and often show evidence of past management such as laying or coppicing. There is also a local Worcestershire tradition of planting fruit trees such as Damsons, Apples and Pears in hedgerows.

This Osier screen at the Kemerton Reserve (left) is designed to minimise human interference, link areas of woodland and also provide habitat in itself.

Most of the hedgerow losses are attributed to field enlargement. Hedges have also become structurally poor, leggy and gappy as they are no longer managed using traditional methods. The extensive use of agricultural fertilizers and pesticides have also led to a decline in their wildlife interest.

Hedgerow restoration can be incorporated into all restoration schemes and add great value to sites that are destined to be restored to agricultural use.

- Hedges vary considerably, reflecting the local landscape of a particular area. The design of new hedgerows should reflect the hedges in the immediate landscape in terms of structure, shape and composition. It is important to study the pattern of hedgerows in the immediate locality. For example, a sinuous, medieval type of hedge would be unsuitable in an area solely comprised of straight enclosure hedges. Find out more about the landscapes of Worcestershire at www.worcestershire.gov.uk/cms/environment-and-planning/landscape-character-assessment.aspx

- Hedgerow planting schemes require careful examination of the receptor site to ensure success. Species should be chosen with regard to soil type, hydrology and geographical location. A preliminary survey of the species mix of the hedges in the immediate locality will give an indication of those suitable to the area.

Adapted from

(Watkins, C

1991)

* = not native

e = extinct

Soil Preference of trees

	Wet soils	Light dry soils	Heavy soils	Acid	Neutral or alkaline	Exposed sites
Alder	O					
Apple, crab	O	O		O		
Ash	O	O	O		O	O
Aspen			O		O	
Beech *	O		O	O	O	
Birch, downy	O	O	O	O	O	O
Birch, silver	O	O	O	O	O	
Blackthorn	O	O	O		O	O
Box *		O			O	
Broom		O		O		O
Buckthorn, alder				O	O	
Buckthorn, purging	O		O	O	O	
Butchers-broom *					O	
Cherry, bird	O				O	
Cherry, "gean"			O		O	
Dogwood	O	O		O		
Elder	O	O		O		
Elm, wych			O		O	O
Gorse	O		O	O	O	
Guelder-rose	O		O		O	
Hawthorn, common	O	O	O	O	O	
Hawthorn, midland			O		O	
Hazel	O	O		O	O	
Holly	O		O	O		
Hornbeam		O	O	O		
Juniper e	O		O	O	O	
Lime, Small Leaved	O	O	O	O		
Lime, Large Leaved			O		O	
Maple, field	O	O		O		
Oak, pedunculate	O		O	O	O	
Oak, sessile	O		O	O	O	
Pine, scots *		O		O		O
Poplar, black	O		O		O	O
Poplar, grey *	O				O	
Privet	O	O		O		
Rose, dog	O	O		O	O	
Rose, field			O		O	O
Rowan		O		O		
Service tree		O	O	O	O	
Spindle			O		O	
Spurge-laurel	O	O		O		
Wayfaring tree	O	O		O		
Whitebeam		O			O	
Willow, almond	O				O	O
Willow, bay	O				O	
Willow, crack	O				O	
Willow, goat	O		O		O	O
Willow, grey	O			O	O	O
Willow, osier	O				O	O
Willow, purple	O				O	
Willow, white	O				O	O
Yew	O	O			O	O

A detailed methodology for hedge planting can be found in RSPB, 2004.

Appendix 2 – Habitat Creation Toolbox

- Care should be taken to ensure that tree and shrub species to be planted are of local origin.

- Planting of hedgerows includes a consideration of the following; ground preparation, spacing between shrubs, fencing, protection with guards, annual maintenance and weed control.

- Where hedgerow removal is proposed, due consideration must be demonstrated to the Hedgerow Regulations, 1997.

- Hedgerow planting on an area with existing wildlife potential (for example, unimproved grasslands) must be avoided.

- Hedgerow translocation is now recognised as a successful practice. It has the advantage of retaining local species.

- A replacement hedge should aim to follow the original boundary and be similar in composition and structure to the original hedge.

- Attempts should be made to link habitats as hedges act as wildlife corridors.

- Ditches, hedgerow trees, banks and field margins will add considerably to the wildlife potential of the hedgerow.

- Hawthorn and Blackthorn are more appropriate if the hedge is to be used as a stock-proof barrier.

- Although hedges can be hugely beneficial, they may, if planted in close proximity to open water bodies, reduce breeding bird numbers as they can harbour predatory mammals and provide perching posts for corvids. Careful consideration of hedgerow location and design should be made prior to creation.

- Very often hedges are planted on the perimeter of quarries for reasons of landscape impact, noise and safety, but sometimes screen planting takes place as a matter of course. Limit screen planting where possible, especially if the trees are to be planted on areas with existing wildlife interest.

- Badger gates must be incorporated where species are present.

- Ongoing hedgerow management should include a 10-15 year laying period and a two to three year clipping rotation, which is restricted to the winter period.

Action needed when key habitat is close to a proposed mineral workings

Disturbance to hedgerow tree roots must be minimised. Disturbance to resident and foraging species, in particular birds and bats must be avoided. Changes in the hydrology may also be progressively detrimental to hedgerows.

Opportunities during extraction

Where screening is essential, species should reflect the locality and be of local provenance.

Opportunities for action before and after extraction

Extraction should attempt to retain all existing hedgerows. Consider linking existing habitats such as woodlands and ponds with hedgerows.

Hedgerows often contain veteran trees. These are very important, offering a great many habitats for a variety of species including bats and rare beetles. Veteran trees not only include the huge trees such as Oaks but any tree old enough to be hollow or to contain rotting heart wood.

This Field Maple (left) at Clifton is likely to be over 500 years in age.

Worcestershire's Heathland

Uncommon plants such as Birds-foot occasionally turn up at sand and gravel sites.

Heathland cover in Worcestershire is low but they were formerly extensive in this area and were generally restricted to the sandstones in the north. Despite this, they are of considerable regional and national conservation importance. Worcestershire's heaths typically exist within a mosaic of other habitats including acid grassland and scrub.

Characteristic species include heather, bell heather, cross-leaved heath, gorses, broom, purple moor-grass, wavy-hair grass and common bent. Many associated wildlife species are similarly rare, requiring the specific heathland conditions for their

survival. Heathlands offer bare ground conditions for rare and distinctive invertebrates including many species of burrowing sand wasps and beetles including the Minotaur Beetle and Heath Tiger Beetle. Reptiles including the Adder and Sand Lizards can also be found at some of our remaining heathlands.

Heathland in Worcestershire was originally derived from woodland clearance. Enclosure and agricultural improvement has been the major cause of decline – the principal periods were the 12th C, post reformation and the parliamentary enclosures. However, the last couple of centuries have witnessed a severe loss of heathland through agricultural improvement, woodland planting and succession through lack of management to woodland or scrub. The total recorded loss of heathland in Worcestershire in the last 225 years is 973 ha (Barker, 1997) but this is undoubtedly an underestimation. The comparison between this figure and the tiny area of 107 ha now remaining highlights how little heathland Worcestershire now contains and the urgent need to implement conservation and restoration measures.

Many quarries, especially those situated in the Forest Sandlands, offer suitable conditions for the creation of heathland owing to the low nutrient, acidic, sandy soils that are exposed as a consequence of extraction. There are number of examples of successful heathland creation at former sand and gravel extraction sites in the country.

- Lowland heathlands in Worcestershire occur on sandy soils. Wet heath establishes on the seasonally waterlogged areas, humid heath in less moist conditions and dry heath on free draining sandy soils with little moisture content. Heathland communities will also establish on acidic hard rock substrates. For example, the cliffs and scree slopes of some of the Malvern quarries now comprise established heathland vegetation. Their development is aided by the close proximity of existing heathland habitat.

- The creation of heathland is particularly opportune at sand and gravel quarries due to the exposure of low nutrient sandy soils that are ideal for the establishment of heathland vegetation. However, a problem regarding heathland creation is that of isolation from existing sites, and although heathland formerly existed in areas where extraction is now underway, it is unlikely that a local seed resource remains. Consequently, natural succession to heathland is uncertain and the only option remaining is to import a seed source from the nearest and most appropriate donor site. For these reasons, heathland creation may be less desirable than the creation of alternative habitats such as acid grassland.

- For the establishment of heathland it is imperative that soils are of very low fertility (pH between 3-5). Reducing fertility and pH can be considerably difficult and it is important, therefore, to retain soils and substrates of a low nutrient status and avoid the redistribution of high-nutrient topsoil in the restoration.

- In the absence of natural regeneration, there are a number of methods which can be adopted to introduce heathland seeds. Expert advice is needed for any of the following operations. Topsoil and turf application, litter and brash transfer, harvesting and sowing seed from donor sites and planting seedlings and plants. (Cuttings or any material used for heathland creation will most probably have to come from a designated SSSI and the appropriate statutory agency must be consulted. The seeds need to be sourced locally).

- Variations in landforms and local topography will diversify the community and benefit a greater variety of species. Consider creating suitable micro-habitats for the establishment of heathland communities. For example, ledges and spoil offer appropriate conditions at hard rock quarries. Similar variations at former sand and gravel sites will help to diversify the range of heathland and mire habitats.

- Bare ground is in itself a very important habitat that is utilised by many invertebrates. A certain proportion is always desirable at heathland sites.

- Heathland communities need to be carefully managed to prevent succession to scrub and damage to wildlife. Methods of heathland management include burning, cutting and grazing. The merits and disadvantages of which are discussed in detail in a number of documents including, RSPB, 2003.

- Gorse and Broom scrub, which is often a frequent component of heathland, is also a very scarce and declining habitat in Worcestershire and its presence adds to the wildlife value of heathlands. It is, nevertheless, important to prevent scrub from smothering and degrading the heathland habitat. Scrub management can be time consuming, and consequently, expensive. Consideration of the local invasive species should be made prior to restoration. For example, small areas of Birch woodland can contribute a large amount of seed which will be an additional cost in managing heathland.

Action needed when key habitat is close to a proposed mineral working site

Opportunities should be made to link to existing heathland habitat. Precautions need to be made in the event of dewatering at existing heathland sites.

Opportunities during extraction

An assessment of the potential restoration capabilities should be made during extraction. This should include trial plots of techniques used in heathland creation.

Monitoring should also aim to identify any heathland vegetation occurring during extraction. The occurrence of any ericaceous species locally is a good indicator for the potential of heathland restoration schemes.

Opportunities for action before and after extraction

Attempt to recreate heathland on former heathland sites.

(Above) Hartlebury Common is similar in appearance to many sand and gravel quarries, which also comprise sandy soils and may be appropriate for the potential restoration to heathland. Minor variations in the landscape at Hartlebury Common are to some extent a consequence of aggregate extraction in the 19th and early 20thC. This variation has added to the diversity and provided habitat for some rare invertebrate species and vascular plants. It is therefore probable that Hartlebury Common and the Wyre Forest heathlands could act as potential donor sites for heathland creation schemes.

Worcestershire's Arable Land

The need for a Worcestershire Arable Farmland Biodiversity Action Plan is due to the loss in biodiversity associated with modern arable cropping. There has been a severe decline in the number and distribution of arable species in the last

50 years, this decline has been particularly marked in the last 20 years. Species that were once common such as Cornflower and Shepherd's Needle are now threatened severely in Worcestershire. The Brown Hare remains widespread in its distribution but has also suffered a substantial decrease in numbers since the 1960s. Many once common bird species including Bullfinch, Corn Bunting, Grey Partridge and Skylark have significantly declined in numbers.

Modern agricultural practices have greatly exacerbated losses of many arable weeds. Species in significant decline include Cornflower, Corn Buttercup, Upright Hedge Parsley, Bur Chervil and Corn Marigold. Many of these wildflowers are important nectar sources for invertebrates such as Bumblebees. Although some weeds and insects have undesirable effects, the vast majority are benign.

Technological progress over the last fifty years has resulted in enormous advances in the efficiency of food production, providing improved weed control, larger, faster machinery, new crop varieties with different timing of sowing and harvesting, increased land drainage and less reliance on traditional crop rotations with grass. It is this efficiency that has led to the drastic declines in the wildlife associated with arable habitat.

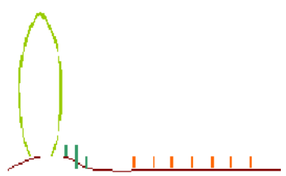
Many aggregate sites that are returned to agricultural use have considerable potential to incorporate a variety of wildlife friendly arable schemes such as field margins and conservation headlands. There are also many other situations where there is considerable opportunity to create similar gains on open ground in a number of situations at former aggregate sites.

Following is a brief description of the different types of wildlife friendly habitat that are being created in the arable landscape.

Arable field margins are strips of grassland situated at the field edge. They provide valuable habitat for invertebrates, small mammals and farmland birds. Dense grass cover can contain over 1500 beetles and spiders per square metre. Pesticide reduction in these areas means that predatory insects are available to attack crop pests. Natural regeneration is the favoured method of establishment but in instances where weeds are a recognised problem, it may be necessary to plant a selection of grasses of local provenance.

Conservation headlands are strips of arable crop situated between the field margin and the crop. This area, which is exempt from spraying and the application of artificial fertilizers, can have great wildlife value, especially where they adjoin another habitat of interest. They should result in reduced crop pests and weed problems. They are excellent habitats for Grey Partridge and many arable weeds.

Set-aside. This is an area of land which is exempt from agricultural production. When allowed to regenerate naturally these areas provide a diversity of vegetation which are important as food sources and breeding habitat for many species. The sward is likely to be more interesting and attract desirable arable wildflowers if the remaining soils have a low nutrient status.



Hedge Field margin Conservation headland
There is a variety of niches found in arable land, from ditch and bank systems, to hedgerows, field margins and conservation margins.

The tillage effect, which provides bare ground for many arable weeds, can be created in a variety of situations at former quarries. The important factor is an ongoing disturbance regime that keeps the ground open. Without disturbance such species are out-competed by more vigorous plants.

- Pesticides should not be applied as they are partly responsible for the loss of many species within arable fields and adjacent habitats such as hedges and ponds.

- Fertilizers also have significant effect on wildlife, often favouring a few common species that out compete rarer ones. Organic manures are far less detrimental because they release nutrient concentrations far more slowly

Opportunities during extraction

Disturbed ground can provide habitat for rare arable weeds and other species of open ground. In the farmed landscape they provide important refugia sites and where extensive may become very important for seed-eating birds including flocks of finches and Tree Sparrows. Where possible, try to maintain a continuous supply and allow these areas to develop naturally. The use of Herbicides, artificial fertilisers and lime is discouraged.

Buffers to headlands and hedgerows should be wide enough to allow colonisation. These areas will act as a source of plant and animal material for colonising restored areas.

Opportunities for action before and after extraction

Where the site is to be returned to intensive agriculture, efforts should be made to leave low nutrient soils along field margins.

At the former sand and gravel quarry, Aston Mill, an area of natural regeneration provides an island of biodiversity value surrounded by land restored to agricultural use.

The species composition can be described as rich and varied and similar in composition to an area of set-aside. This site effectively provides feeding and sheltering habitat for a variety of invertebrates and birds and provides feeding and refugia for a diversity of wildlife in this largely arable landscape. For example, Skylark and solitary wasps are present in large numbers at this site.

This habitat could remain in its current state and quite easily managed using a disturbance regime using, for example, a chain harrow.

Appendix 3 - Policy Context

"Minerals development is different from other forms of development because minerals can only be worked where they naturally occur. Potential conflict can therefore arise between the benefits to society that minerals bring and impacts arising from their extraction and supply."

1. European context

1.1 The Bern Convention

The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) was adopted in Bern, Switzerland in 1979, and was ratified by the UK in 1982. The principal aims of the Convention are:

- To ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention).
- To increase cooperation between contracting parties.
- To regulate the exploitation of those species (including migratory species) listed in Appendix 3.

To this end the Convention imposes legal obligations on contracting parties, protecting over 500 wild plant species and more than 1000 wild animal species.

To implement the Bern Convention in Europe, the European Community adopted Council Directive 79/409/EEC on the Conservation of Wild Birds (the EC Birds Directive) in 1979, and Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the EC Habitats Directive) in 1992. Among other things the Directives provide for the establishment of a European network of protected areas (Natura 2000), to tackle the continuing losses of European biodiversity on land, at the coast and in the sea to human activities.

1.2 European Habitats Directive

The Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) was adopted in 1992 as an EU response to the Bern Convention. The Directive identifies some 220 habitats of importance in their European context and requires member states to designate such sites for the protection of these habitats where they occur. These sites, known as Special Areas of Conservation (SACs), when considered together with the existing Special Protection Areas (SPAs) form a network of valuable habitats across Europe known as Natura2000.

In addition the Directive identifies approximately 1000 species listed within its appendices which require strict protection.

1.3 The Wild Birds Directive

Directive 2009/147/EC (Birds Directive) provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. It sets broad objectives for a wide range of activities, although the precise legal mechanisms for their achievement are at the discretion of each Member State.
The main provisions of the Directive include:

- The maintenance of the populations of all wild bird species across their natural range (Article 2) with the encouragement of various activities to that end (Article 3).
- The identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species, paying particular attention to the protection of wetlands of international importance (Article 4).
- The establishment of a general scheme of protection for all wild birds (Article 5).
- Restrictions on the sale and keeping of wild birds (Article 6).

- Specification of the conditions under which hunting and falconry can be undertaken (Article 7).
- Prohibition of large-scale non-selective means of bird killing (Article 8).
- Procedures under which Member States may derogate from the provisions of Articles 5-8 (Article 9) — that is, the conditions under which permission may be given for otherwise prohibited activities.
- Encouragement of certain forms of relevant research (Article 10 and Annex V).
- Requirements to ensure that introduction of non-native birds do not threatened other biodiversity (Article 11).

1.4 European Landscapes Convention

The requirements of the European Landscape Convention (ELC) became binding in the UK in March 2007. The Convention emphasises not only the importance of all landscapes, whether designated or not, but also our shared responsibility in guiding future landscape change. Perceiving landscape as an integrating framework for social and economic as well as environmental well being, it seeks to encourage groups, organisations and authorities to establish policies that protect, manage and plan landscapes.

The ELC also requires member states to have due regard to the Habitats Directive. While it recognises that all landscapes are of value, it requires a systematic accommodation of landscape objectives within policy development formulation. Worcestershire County Council has set out its objectives for the protection and enhancement of Worcestershire's valuable landscapes through the development of a Landscape Character Assessment tool (available at: www.worcestershire.gov.uk/lca).

1.5 Water Framework Directive

'Directive 2000/60/EC' of the European Parliament and of the Council of 23 October 2000 established a framework for Community action in the field of water policy .The Water Framework Directive (WFD) was adopted and came into force in December 2000. The purpose of the Directive is to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It will ensure that all aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands meet 'good status' by 2015 or 2027, depending on the water body.

This is transposed into national legislation through The Water Environment (Water Framework Directive)(England and Wales) Regulations 2003. The status of each watercourse is classified using a set of over 30 individual measures grouped into ecological status (including biology and elements such as phosphorous and pH) and chemical status ('priority substances'). The Environment Agency note that some waterbodies will never achieve 'good ecological status' because they have been physically altered for specific use such as navigation, recreation, water storage or flood protection. However mineral working may offer the opportunity to re-naturalise sections of watercourse (while complying with the County's Surface Water Management Plan and Flood Risk Strategy) towards the Water Framework Directive objectives.

2. National context

2.1 Habitats Regulations

In the UK, the European Habitats Directive is implemented by the Conservation of Habitats and Species Regulations, 2010 – more commonly known as the Habitats Regulations. This makes it an offence to deliberately kill, injure, capture or disturb a European protected species (listed within Schedule 2 of the Regulations), or to damage, obstruct or destroy the breeding site or resting place of such an animal. In addition the regulations protect from uprooting or other forms of damage protected species of plants, as listed within Schedule 5.

Plans and projects which have potential to affect European sites of nature conservation importance have to be assessed against the requirements of the habitats regulations.

Provision to derogate certain operations which would otherwise detrimentally affect such species is permitted within the Regulations. Derogation licences are available from the Statutory Nature Conservation Agency: Natural England.

2.2 Wildlife and Countryside Act

The Wildlife and Countryside Act 1981 (as amended) is the principle mechanism for the legislative protection of wildlife in Great Britain.

Part One of the Act details the protection afforded to animals, including wild birds and their nests, together with certain species of vulnerable and endangered plant species, and addresses the prohibition of introduction "to the wild" of certain invasive, non-native plant species. The Act also sets out the financial penalty and/or period of imprisonment incurred per offence.

3. National Planning Context

3.1 National Planning Policy Framework

Published in March 2012, the NPPF replaces a suite of Minerals Policy Guidance and Planning Policy Statements to set out a number of requirements which facilitate 'sustainable development'; the following Paragraphs are relevant to this paper:

Sustainable development should perform a number of roles, including:

7 **...** *contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy*.

9. *Pursuing sustainable development involves seeking positive improvements in the quality of the built, natural and historic environment, as well as in people's quality of life, including (but not limited to):*
   - *making it easier for jobs to be created in cities, towns and villages;*
   - *moving from a net loss of bio-diversity to achieving net gains for nature;*
   - *replacing poor design with better design;*
   - *improving the conditions in which people live, work, travel and take leisure; and*
   - *widening the choice of high quality homes.*

17. *Within the overarching roles that the planning system ought to play, a set of core land-use planning principles should underpin both plan-making and decision-taking. These 12 principles are that planning should* (inter alia):
   - *always seek to secure high quality design and a good standard of amenity for all existing and future occupants of land and buildings;*
   - *contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework;*
   - *encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value;*
   - *promote mixed use developments, and encourage multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions (such as for wildlife, recreation, flood risk mitigation, carbon storage, or food production);*
   - *take account of and support local strategies to improve health, social and cultural wellbeing for all, and deliver sufficient community and cultural facilities and services to meet local needs.*

57. *It is important to plan positively for the achievement of high quality and inclusive design for all development, including individual buildings, public and private spaces and wider area development schemes.*

73. *Access to high quality open spaces and opportunities for sport and recreation can make an important contribution to the health and well-being of communities. Planning policies should be based on robust and up-to-date assessments of the needs for open space, sports and recreation facilities and opportunities for new provision. The assessments should identify*

specific needs and quantitative or qualitative deficits or surpluses of open space, sports and recreational facilities in the local area. Information gained from the assessments should be used to determine what open space, sports and recreational provision is required.

75. *Planning policies should protect and enhance public rights of way and access. Local authorities should seek opportunities to provide better facilities for users, for example by adding links to existing rights of way networks including National Trails.*

94. *Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations.*

99. *Local Plans should take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure.*

100. *Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Local Plans should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:*

- *applying the Sequential Test;*
- *if necessary, applying the Exception Test;*
- *safeguarding land from development that is required for current and future flood management;*
- *using opportunities offered by new development to reduce the causes and impacts of flooding; and*
- *where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking* opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

109. *The planning system should contribute to and enhance the natural and local environment by:*

- *protecting and enhancing valued landscapes, geological conservation interests and soils;*
- *recognising the wider benefits of ecosystem services;*
- *minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;*
- *preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and*
- *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.*

110. *In preparing plans to meet development needs, the aim should be to minimise pollution and other adverse effects on the local and natural environment. Plans should allocate land with the least environmental or amenity value, where consistent with other policies in this Framework.*

111. *Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value. Local planning authorities may continue to consider the case for setting a locally appropriate target for the use of brownfield land.*

114. *Local planning authorities should:*

- *set out a strategic approach in their Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure;*

117. *To minimise impacts on biodiversity and geodiversity, planning policies should:*

- *plan for biodiversity at a landscape-scale across local authority boundaries;*

- *identify and map components of the local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation;*
- *promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets, and identify suitable indicators for monitoring biodiversity in the plan;*
- *aim to prevent harm to geological conservation interests; and*
- *where Nature Improvement Areas are identified in Local Plans, consider specifying the types of development that may be appropriate in these Areas.*

118. *When determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by applying the following principles*

- *if significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;*
- *proposed development on land within or outside a Site of Special Scientific Interest likely to have an adverse effect on a Site of Special Scientific Interest (either individually or in combination with other developments) should not normally be permitted. Where an adverse effect on the site's notified special interest features is likely, an exception should only be made where the benefits of the development, at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of Sites of Special Scientific Interest;*
- *development proposals where the primary objective is to conserve or enhance biodiversity should be permitted;*
- *opportunities to incorporate biodiversity in and around developments should be encouraged;*
- *planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss; and*
- *the following wildlife sites should be given the same protection as European sites:*
    - *potential Special Protection Areas and possible Special Areas of Conservation;*
    - *listed or proposed Ramsar sites; and*
    - *sites identified, or required, as compensatory measures for adverse effects on European sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.*

119. *The presumption in favour of sustainable development (paragraph 14) does not apply where development requiring appropriate assessment under the Birds or Habitats Directives is being considered, planned or determined.*

143. *In preparing Local Plans, local planning authorities should:*

- *put in place policies to ensure worked land is reclaimed at the earliest opportunity, taking account of aviation safety, and that high quality restoration and aftercare of mineral sites takes place, including for agriculture (safeguarding the long term potential of best and most versatile agricultural land and conserving soil resources), geodiversity, biodiversity, native woodland, the historic environment and recreation.*

3.2 Technical Guidance to the National Planning Policy Framework

Published in March 2012, the Technical Guidance accompanying the NPPF provides additional guidance to local planning authorities to ensure the effective implementation of the planning policy as set out in the National Planning Policy Framework on development. The Guidance describes how mineral extraction proposals should demonstrate the suitability of the proposed restoration and after-use scheme:

36. Reclamation schemes should indicate how the restoration and aftercare of the site is to be integrated with the working scheme, and should demonstrate the

suitability of the proposals of the proposed after-use. Before designing a reclamation scheme, the operator should undertake a comprehensive site survey to identify any existing features on the site that may be incorporated into the reclamation scheme, together with a survey of the soil resource and site hydrology. Consideration should also be given to the potential impacts of the reclamation proposals on adjacent land.

37. *To demonstrate that a site can be reclaimed to an acceptable standard and after-use, the applicant is advised to prepare, at the outset, a working plan which includes restoration proposals and is based upon findings from the site investigation.*

38. *Where a permission is granted, the conditions should be drafted in such a way that, even if the interest of the mineral operator applying for permission is subsequently disposed of, the requirements for reclamation can still be fulfilled, whether by a new operator or in the case of default, by the land-owner.*

39. *Planning conditions for reclamation should be specific to the proposed site and should normally be framed with the intended after-use in mind. They will vary according to:*
    - *the characteristics of the individual site;*
    - *the intended after-use;*
    - *the type of mineral to be worked;*
    - *the method of working;*
    - *the timescale of the working;*
    - *the general character of, and planning policies for the area.*

39. *For after-uses which involve some form of plant growth (e.g. for agriculture, forestry or amenity including some forms of nature conservation), the plan will usually involve a number of key stages:*

    i. stripping of soils and soil-making materials and either their storage or their direct replacement (i.e. 'restoration') on another part of the site;
    ii. storage and replacement of overburden;
    iii. achieving the landscape and landform objectives for the site, including filling operations if required, following mineral extraction;
    iv. restoration, including soil placement, relief of compaction and provision of surface features;
    v. aftercare.

44. *The preparation of a successful aftercare scheme requires two levels of information from the mineral operator:*
- *an outline strategy of commitments for the five year aftercare period; and*
- *a detailed programme for the forthcoming year.*

45. *The outline strategy should broadly outline the steps to be carried out in the aftercare period and their timing within the overall programme. These should include, as appropriate:*
    - *timing and pattern of vegetation establishment;*
    - *cultivation practices;*
    - *secondary treatments;*

- *drainage;*
- *management of soil, fertility, weeds etc;*
- *irrigation and watering.*

46. *A map should accompany the outline, identifying clearly all areas subject to aftercare management, with separate demarcation of areas according to differences in the year of aftercare and proposed management. Where a choice of options is retained this should be made clear together with criteria to be followed in choosing between them.*

47. *The detailed programme should cover requirements for the forthcoming year. It should:*

- *amplify the outline strategy for work to be carried out in the forthcoming year;*
- *confirm that steps already specified in detail in the outline strategy will be carried out as originally intended;*
- *include any modifications to original proposals e.g. due to differences between actual and anticipated site conditions.*

48. *The programme should provide for specific steps where appropriate, including:*

- *vegetation establishment;*
- *vegetation management;*
- *secondary treatments;*
- *field drainage;*
- *irrigation/watering;*
- *tree and hedge establishment.*

4. Local Context

4.1 Worcestershire County Structure Plan

The Worcestershire County Structure Plan 1996-2011 is no longer part of the development plan in Worcestershire, and all Structure Plan policies have now been revoked.

See http://www.worcestershire.gov.uk/cms/planning/planning_policy__strategy/archived_files/structure_plan.aspx

4.2 Hereford & Worcester Minerals Local Plan

The plan sets out policies for the extraction and restoration of minerals sites within the County with the greater focus on the extraction of aggregates and elaborates on policies for minerals within the County Structure Plan.

Certain policies contained in the Minerals Local Plan no longer form part of the development plan for Worcestershire, having expired on 27th September 2007. However the following "saved" policies have relevance to this Supplementary Planning Guidance document and are criteria against which development proposals are assessed in the planning process:

POLICY 1 - PREFERRED AREAS
In areas defined on the proposal map as preferred areas for sand and gravel extraction, planning permission will be granted for sand and gravel extraction, subject to an evaluation against other relevant development plan policies.

POLICY 2 - OTHER SAND AND GRAVEL DEPOSITS

Applications for planning permission to extract sand or gravel in an area not within an identified preferred area for sand and gravel extraction will first be assessed against the methodology set out in paragraphs 5.3 and 5.4 of this plan. If the area is subject to no constraints or only one secondary constraint, planning permission will be granted subject to an evaluation against other relevant development plan policies. If the area is subject to a primary constraint or more than one secondary constraint planning permission will not normally be granted.

POLICY 5 – Cumulative Impact: Abberley Hills Quarrying Policy
Within the area shown on the proposals map as the Abberley hills quarrying policy area, unless it can be shown that the need for the mineral overrides environmental considerations, no further planning permissions will be granted by the county council for quarrying apart from the possible modification of working subject to environmental considerations within the existing lateral limits of Woodbury and Shavers end quarries.

POLICY 6 - Cumulative Impact: Extraction of Minerals other than Aggregates
Any application for planning permission for the surface extraction of minerals other than sand and gravel will be considered and evaluated against the constraints and other criteria specified in structure plan policy m4and ctc.7a.

POLICY 7: Cumulative Impact: Preferred Hard Rock Extension Areas
In areas of hard rock defined on the proposals map as preferred extension areas to existing quarries, planning permission for crushed rock extraction will be granted, subject to an evaluation of the application against other relevant development plan policies. In all other areas of hard rock defined on the proposals map, applications for crushed rock extraction will be evaluated against the criteria in paragraphs 5.3 and 5.4 of this plan, except that, for the reasons set out in paragraph 3.8, Areas of Outstanding Natural Beauty and areas of great landscape value will not be treated as constraints in the sieve process. However, applications for crushed rock extraction will be also evaluated under other relevant development plan policies and in particular structure plan policies m6, m7, m8 and ctc7a.

Note: Although both the Hereford and Worcester Minerals Local Plan and Worcester County Structure Plan are material considerations in decision making and part of the development plan for Worcestershire the weight given to these policies will diminish over time unless they accord with the NPPF.

4.3 Sustainable Community Strategies

4.3.1 Partnership towards excellence – the Sustainable Community Strategy for Worcestershire (2008 – 2013)

Sustainable Community Strategies (SCS's) were introduced by the Local Government Act 2000. Their aim is to improve the social, environmental and well being of their areas, consequently contributing to sustainable development.

Through the SCS, authorities are expected to co-ordinate the actions of local, public, private, voluntary and community sectors. Responsibility for producing SCS's may be passed to Local Strategic Partnerships, which include local authority representatives.

Worcestershire Sustainable Community Strategy identifies three cross-cutting themes: climate change, community engagement and community cohesion, and six strategic sustainability issues for the county:

- Communities that are safe and feel safe;
- A better environment for today and tomorrow;
- Economic success that is shared by all;
- Meeting the needs of children and young people;
- Improving health and wellbeing; and
- Stronger communities.

Appendix 3 - Policy Context

There are a number of priority outcomes set out in the SCS which are appropriate to this Supplemental Guidance document including;

Tackling the challenges of Climate Change

- To assist adaptation to the impacts of climate change in the county

Community Engagement

- To empower local people to have a greater choice and influence over local decision making and a greater role in the planning, design and delivery of public service

A better environment for today and tomorrow

- To enhance Worcestershire's countryside and urban green space and appropriate access to them while protecting the natural and historic environment.
- To address issues of water quality, supply and consumption and land drainage in Worcestershire (this includes flood risk)

These priority outcomes have been considered in developing the vision, objectives and policy framework set out in the second edition of 'Partnership Towards Excellence - A Community Strategy for Worcestershire 2003 – 2013'.

4.4 Worcestershire County Council Corporate Plan "Worcestershire: Fit for the Future[26]"

The Corporate Plan establishes key areas of focus and commits the County Council to "maximise our environmental assets in order to deliver sustainable economic growth"

Key themes within the Corporate Plan which this document supports are:

- Open for Business
- The Environment
- Health and well-being

4.5 The Worcestershire County Council Consultation Document "Mineral Local Plan Background Document: Contributing Towards Worcestershire's Priorities"[27]

In discussing bio-and-geodiversity the following statements are of relevance:

3.13. The Minerals Local Plan will need to consider the protection and enhancement of biodiversity during both the working and restoration phases of activity. This will include making appropriate provision to protect designated or locally important environmental assets and will need to complement the wider regulatory regime relating to the protection of species and habitats. However there may be the need to balance temporary adverse effects against the long-term gains that could be realised through appropriate restoration.

3.14. Appropriate restoration can provide significant environmental gains where it is sympathetic to the local environment and the specific needs of the locality. For example restoration schemes can deliver Local Biodiversity Action Plan Priority

[26] www.worcestershire.gov.uk/cms/general-council-information/corporate-plan-2011-2017.aspx

[27] Available at: www.worcestershire.gov.uk/cms/pdf/2012%2010%2008%20Links%20to%20corporate%20priorities.pdf

Habitats or enhancing networks of green infrastructure. Geodiversity can also be enhanced through the exposure of interesting geological features.

3.18. There are also opportunities to increase climate change resilience through the restoration of mineral operations. For example restoration schemes could be tailored to contribute towards flood attenuation or water storage, or to enhance wildlife corridor to improve the resilience of the natural environment to climate change.

Appendix 4 - Ecology Survey Notes

Points to note regarding ecological surveys:

- For certain species and habitats surveys can be carried out at any time of year, but for other species, particular times of year are required to give the most reliable results, as indicated in table below.
- Surveys conducted outside of optimal times may be unreliable. For certain species (e.g. Great Crested Newt), surveys over the winter period are unlikely to yield any useful information. Similarly, negative results gained outside the optimal period should not be interpreted as absence of a species and further survey work maybe required during the optimal survey season. This is especially important where existing surveys and records show the species has been found previously on site or in the surrounding area. An application may not be valid until survey information is gathered from an optimum time of year.
- Species surveys are also very weather dependent so it may be necessary to delay a survey or to carry out more than one survey if the weather is not suitable, e.g. heavy rain is not good for surveying for otters, as it washes away their spraint (droppings). Likewise bat surveys carried out in wet or cold weather may not yield accurate results
- Absence of evidence of a species does not necessarily mean that the species is not there, nor that its habitat is not protected (e.g. a bat roost is protected whether any bats are present or not).
- Worcestershire Biological Records Centre may have useful existing information and records.
- Competent ecologists should carry out any surveys. Where surveys involve disturbance, capture or handling of a protected species, then only a licensed person can undertake such surveys (e.g. issued by Natural England). Surveys should follow published national or local methodologies.

Further details may be found on the following web sites:

Institute of Ecology & Environmental Management, technical guidance for survey and reporting: www.ieem.net/technical-guidance-series-tgs-

Natural England, standing advice to Local Authorities regarding compliance with statutory protection of species and habitats:

www.naturalengland.org.uk/ourwork/planningdevelopment/spatialplanning/standingadvice/default.aspx

Biodiversity Planning Toolkit: www.biodiversityplanningtoolkit.com/default.asp

Key: Optimal Survey Time

Extending into

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Badgers												
Bats Hibernation Roosts												
Bats Summer Roosts												
Bats Foraging/ Commuting												
Birds Breeding												
Birds Over Wintering												
Dormice												
Great–Crested Newts						TERRESTRIAL						
		AQUATIC										
Otters												
Reptiles												
Water Voles												
White-Clawed Crayfish												
Habitats/Vegetation												

Appendix 5 - Glossary

Abstraction	The removal of water from a river, stream, reservoir, lake, pond, canal, spring or underground source. A Catchment Management Strategy (CAMS) licence is likely to be required if more than 20 cubic metres (4,000 gallons) of water is proposed for abstraction per day. The legal duties as per the Conservation Regulations, 1994 and the Wildlife and Countryside Act, 2000 should be considered where abstraction might threaten (directly or indirectly) valuable habitats or species.
Afforestation	The conversion of bare or cultivated land into forest. While afforestation can have significant benefit in terms of carbon capture, amenity and community use or commercial timber production, sites must be selected carefully to avoid damaging other important features (e.g. wildflower meadows). Refer to Woodland Opportunities Map and Woodland Guidelines for further information.
Alluvial	Soil, clay, silt or gravel which has been deposited by streams or rivers. Alluvial terraces are plains created by the deposition of sediment over long periods of time by one or more rivers.
Ancient Semi-Natural Woodland	Land that has had continuous woodland cover since at least 1600AD. Before this period planting of new woodland was uncommon, so a wood present in 1600 is likely to have developed naturally. Ancient semi-natural woodland may have been managed by coppicing or felling but allowed to regenerate naturally. Where extensive areas of native trees have historically been felled and replaced (usually with conifers for commercial rather than biodiversity value), these woodlands are termed "ancient replanted woodland".
Assart	Formerly forested land cleared of trees and understorey vegetation, usually for agricultural or other purposes.
Biodiversity	Derivation of biological diversity. The full diversity of plant and animal life in a particular area, encompassing variety at the genetic, species and habitat levels. Often used as a measure of health of biological systems.
Calcareous	Composed of or containing or resembling calcium carbonate or calcite or chalk. Referring to limestone or lime-rich soils or chalky sands or shales. Alkaline or 'basic'.
Calcifuge	A species that does not tolerate alkaline soil. Calcifuge plants are also known as 'ericaceous'.
Colonise	Colonisation is the process by which a species spreads into new areas. The term can be used to describe colonisation on a small scale (i.e. where a species moves into new areas at a particular site, perhaps as a result of a change in conditions) or on a large scale (i.e. where a species expands its range to encompass new areas).
Corvid	A member of the bird family *Corvidae* which includes crows, ravens, jays and coughs.
Disperse	To spread over a wider area: "ecologically functional networks" permit the dispersal of wildlife, in response to factors such as their natural lifecycle, to create new populations and in response to climate change.
Drawdown Zone	The margins of a pond, lake or reservoir which are revealed whenever water levels drop. These ephemeral habitats are of particular value to wildlife, supporting a range of specialised species. Waterbodies with a wide drawdown zone (i.e. at least one bank with a long and shallow sculpted margin, preferably with several scrapes to retain some level of water) provide excellent opportunities for wildlife.

Appendix 5 - Glossary

Ecologically Functional	The functionality of an ecosystem is a measure of both the quality of the ecosystem (i.e. its ability to support the biodiversity adapted to that habitat) and also a measure of the ecological services which the niche can provide. For instance, an expanse of well maintained amenity playing fields will have both low biological productivity and low permeability for most species to disperse. A traditional orchard in contrast will support a wealth of biodiversity, will have higher permeability to permit animals and plants to disperse, colonise and thrive as well as offering a healthy ecological service (in this case delivered through the horticulture of fruit, but also indirectly through promotion of opportunities for animals such as bats which control insect levels, and bumblebees which provide foodstuffs).
Ecological Service	Ecological functions of healthy ecosystems which serve all living organisms through purification of air and water, maintenance of biodiversity, decomposition of wastes, soil and vegetation generation and renewal, pollination of crops and natural vegetation, groundwater recharge through wetlands, seed dispersal, greenhouse gas mitigation, and aesthetically pleasing landscapes.
Edge Effect	Habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the more-or-less well-defined boundary between ecosystems, as, for example, between open areas and adjacent forest.
Eutrophic	Excessive nutrients in a lake or other body of water, usually caused by runoff of nutrients (animal waste, fertilizers, sewage) from the land, which causes a dense growth of plant life; the decomposition of the plants depletes the supply of oxygen, leading to the death of animal life – eutrophication.
Floodplain	The lowlands adjoining the channel of a river, stream, or watercourse, or ocean, lake, or other body of standing water, which have been or may be inundated by flood water. The channel of a stream or watercourse is part of the floodplain. Floodplains are important both in controlling the impact of flooding on human populations and in supporting a variety of ecosystem services through their nutrient rich soils.
Geodiversity	The variety of earth materials, forms and processes that constitute and shape the Earth, either the whole or a specific part of it
Habitat	A habitat is an ecological or environmental area that is defined by the assemblage of plants and animals which it supports, for instance: woodland or heathland. The natural environment can be divided into many types of habitat, each of which influences and is utilised by the biodiversity which can take advantage of those opportunities. "Microhabitats" are smaller opportunities (or "niches") which wildlife can take advantage of, for instance deadwood can provide a wealth of microhabitats for invertebrates, reptiles and amphibians.
Mesotrophic	A waterbody in a state of moderate productivity in terms of its biomass, fertility and nutrient enrichment.
Hibernaculum	The location chosen by an animal for hibernation. For example, many bats may "hibernate" over-winter in caves, adders might hibernate over-winter in log-piles and many insects will over-winter in dead stems and wood.
Invasive species	"Invasive species" can refer to a non-indigenous species (e.g. foreign plants or animals) that adversely affect the habitats they invade economically, environmentally or ecologically. Examples include Himalayan Balsam, Japanese Knotweed and New Zealand Stonecrop: foreign plants which grow vigorously at the expense of our native species.
Metapopulation	A metapopulation is a group of separated populations of the same species which interact. For instance, great crested newts

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	will use the same pond to breed from year to year, but the survival of the population depends on individuals being able to disperse to other ponds and maintain exchange of their genetic material from sub-population to sub-population. This is why a network of healthy ponds is vital to ensure that all the sub-populations of great crested newts do not become extinct over time.
Off-Water-Habitats	A habitat which adjoins a riverine system, for instance seasonally inundated ponds, networks of reedbeds or ditches which can carry over-flow from canals, rivers or streams. These off-water habitats benefit from the protection which isolation can bring, and can act as important nurseries for invertebrates and fishes as well as mammals such as water vole.
Oligotrophic	A body of water with low productivity usually caused by low levels of dissolved nutrients. Waters are usually quite deep, clear and oxygen rich but with low levels of nitrogen or phosphorous and with little plant life.
Pastoral	Referring to the use of land to raise livestock.
Pioneer Communities	The initial community of colonising species. The first integrated set of plants, animals and fungi found in an area undergoing primary succession.
Pollard	Pollarding is the process of pruning tree limbs, usually around 2 – 4 meters above ground, in order to promote more vigorous and bushy growth of foliage.
Refugia	A place of refuge. Refers both to an area which is isolated or supports a relict population of a once widespread species. Also refers to a microhabitat which offers a place of rest or shelter to wildlife. For instance, reptiles can often be found basking on sheets of tin or carpet in the early morning sun: these opportunities are referred to as "refugia".
RVNR	Abbreviation: Roadside Verge Nature Reserve. Roadside verges have become increasingly important in their own right as a refuge for plants and animals, but they also have a vital role as a lifeline, which will enable our native habitats and species to spread again in the future. Worcestershire has many important verges, many not necessarily associated with other nature reserves. Around 120 of these are designated to protect the flora and/or fauna interest they support, but many other non-designated important verges are widely distributed across the county.
Riparian	Referring to or located on the banks of a river or stream.
Ruderal	A ruderal species is the first to colonise disturbed land (e.g. plants appearing on abandoned farming fields or construction sites). Ruderal species typically dominate the disturbed area for a few years, and are gradually lost, through competition, to other species.
Succession	The gradual and orderly process of change in an ecosystem brought about by the progressive replacement of one community by another until a stable climax is established. For example, progression over time might mean that disturbed bare soil is colonised by ruderal species, eventually forming grassland, scrub and, under the right conditions, woodland. Succession therefore involves a number of transition habitats, each supporting a slightly different assemblage of species. Succession is therefore an important part of supporting biodiversity and mineral sites should aim to allow the natural regeneration of some habitats as, through succession, a greater

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	level of biodiversity can be supported (including in many instances rare and vulnerable plants and animals).
Traditional Orchards	The counties of Worcestershire, Herefordshire and Gloucestershire have always been famous for their fruit production. Worcestershire in particular has a very long association with the growing of fruit trees. While culinary apples have been widely grown since roman times, it is thought that other fruit were gradually introduced by monastic orders during the medieval period. Orchards, especially traditionally managed orchards can be of significant value for wildlife providing nectar, fruit and supporting lichens and mistletoe. The grassland may support wildflowers and a number of nationally notable and scarce invertebrates are associated with orchards. The Worcester Black Pear (a variant of a Roman 'warden' variety) is a feature of the Arms of the City of Worcester.
Unimproved Pastures	Land with no improved pasture species and which has not been fertilised. This permits the growth of nutrient-sensitive native wildflowers. Around 98% of England's wildflower meadows have been destroyed over the past 50 years. Worcestershire supports a wealth of wildflower meadows in its West Midlands context. While calcareous grasslands are limited in number in Worcestershire, there are a number of important hay meadows (or 'hams') remaining and a number of neutral pastures can still be found along river terraces. The principle factors leading to the destruction of these BAP habitats are conversion to intensive agricultural land or pasture; out-competition of native wildflowers from scrub or tree planting; over-grazing from livestock such as horses and developments such as roads, housing, tips and quarries.
Woodland Guidelines	Landscape guidance on pattern, size and location of woodland planting. See: www.worcestershire.gov.uk/cms/environment-and-planning/woodland-guidelines.aspx
Woodland Opportunities Map	Map produced by the Forestry Commission showing priority areas in the West Midlands context for the creation of new woodland. See: www.forestry.gov.uk/westmidlands-woodlandopportunities

Appendix 6 - Further Reading

Further reading

Andrew, J. and Kinsman, D. (1990).*Gravel pit restoration for wildlife. A practical manual.* RSPB, Sandy

Andrew J and Rebane M (1994), *Farming and wildlife: A practical management handbook.* RSPB, Sandy

Carreck, N and Williams, L (1998) *The Economic Value of Bees in the UK*. International Bee Research Association, Cardiff.

Davies A and Weir J (2008) *Creating Environmental Improvements Through Biodiversity*. Sustainable Aggregates, RSPB.

Gilbert, O L and Anderson, P (1998) *Habitat Creation and Repair.* Oxford University Press, Oxford

Rodwell, J (1991) *British Plant Communities. Volume 1. Woodlands and scrub.* Cambridge University Press, Cambridge

Rodwell, J (1991) *British Plant Communities. Volume 2. Mires and heaths.* Cambridge University Press, Cambridge

Rodwell, J (1992) *British Plant Communities. Volume 3. Grasslands and montane communities.* Cambridge University Press, Cambridge RSPB (1994)

Rodwell, J (1995) *British Plant Communities. Volume 4. Aquatic communities, swamps and tall-herb fens.* Cambridge University Press, Cambridge

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RSPB, EN and ITE (1997) *The wet grassland guide: managing floodplain and coastal wet grasslands for wildlife.* The RSPB, Sandy

Symes N, and Day J (2003) *A Practical Guide to the Restoration and Management of Lowland Heathland*. RSPB, Sandy

The Woodland Trust. 2003. *New woods for people. The Woodland Trust's experience of woodland creation.*

White G, and Gilbert J (2003) *Habitat creation handbook for the minerals industry*. RSPB.

Woodland Guidelines. Worcestershire County Council, 2010. http://www.worcestershire.gov.uk/cms/environment-and-planning/woodland-guidelines.aspx

Appendix 7 – Useful Contacts

Worcestershire County Council – Environmental Policy Team
WEB: www.worcestershire.gov.uk/cms/ecology
PHONE: 905 766723
EMAIL: ecology@worcestershire.gov.uk

Worcestershire District Councils: www.worcestershire.gov.uk/planning

Natural England
WEB: www.naturalengland.org.uk/
PHONE: 0845 600 3078
EMAIL: enquiries@naturalengland.org.uk

Worcestershire Wildlife Trust
WEB: www.worcswildlifetrust.co.uk/
PHONE: 01905 754919
EMAIL: enquiries@worcestershirewildlifetrust.org

Environment Agency
WEB: www.environment-agency.gov.uk
PHONE: 03708 506 506
EMAIL: enquiries@environment-agency.gov.uk

Nature After Minerals
WEB: www.afterminerals.com

Forestry Commission
WEB: www.forestry.gov.uk/england

Chartered Institute of Ecology and Environmental Management
WEB: www.cieem.net

Note:

Restoration often goes beyond the area of physical extraction, and such areas are likely to contain deposits of archaeological significance that could be damaged by landscaping and planting works. Therefore it is recommended that the planning advisory section of the Worcestershire Historic Environment & Archaeology Service is consulted at an early stage of designing any proposed restoration scheme to ensure significant remains are not destroyed or that appropriate mitigation measures can be established.

The following sources of information may be useful:

- Worcestershire Historic Environment Record,
- Worcestershire Historic Environment Characterisation Project,
- Worcestershire Historic Environment Appraisal.

Please visit www.worcestershire.gov.uk/cms/environment-and-planning/archeology/information-and-advice for further information.

For queries or responses to this document please contact:

Strategic Planning and Environmental Policy Team

Business, Environment and Community Directorate

Worcestershire County Council

County Hall

Spetchley Road

Worcester

WR5 2NP

ecology@worcestershire.gov.uk

Minicom: 01905 766399

The Biodiversity Action Plan manager can be reached at biodiversity@worcestershire.gov.uk or 01905 766852.

For issues regarding the Minerals local Plan, please contact the Minerals and Waste Planning policy Section 01905 766374, minerals@worcestershire.gov.uk

Planning works best when the process is accessible, but for some it isn't. West Midlands Planning Aid provides a free and independent professional town planning advice and support service to communities and individuals.

The West Midlands Planning Aid Service contact details are:
Unit 319, The Custard Factory, Gibb Street, Birmingham, B9 4AA.
Email: wmcm@planningaid.rtpi.org.uk
Phone: 0121 766 8044
Web: www.planningaid.rtpi.org.uk