# Realising the Biodiversity Potential of Solar Farms

A Practical Guide
by Wychwood Biodiversity and Naturesave Insurance

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**Endoresments**

**About Wychwood Biodiversity and Naturesave Insurance**

Wychwood Biodiversity is a specialist consulting group that focuses on the creation, enhancement and management of wildlife and wild habitats, especially on sites for renewable energy generation. Wychwood is the lead author to this report

Naturesave Insurance is the UK's leading ethical insurance provider for homeowners businesses and charitable organisations. Naturesave is a specialist in renewable energy and leads the market in community renewable energy insurance. Naturesave's activities fund the charty The Naturesave Trust which has funded this publication.

# Foreword

The evidence is now clear that the biodiversity crisis represents a threat as serious as that of climate change, and that it is not possible to solve one without addressing the other. This guide explores how solar farms are uniquely placed to help tackle not just one, but both of these inextricably linked issues.

Limiting global warming to 1.5 degrees will require a seismic deployment of renewable energy generation. Along with wind, solar power will increasingly play a vital role in the race to decarbonise the economy. Today, approximately 35,000 acres of land in the UK is occupied by ground mounted solar farms. For the UK to meet its legally binding net zero goals, the Climate Change Committee has forecast that over 200,000 additional acres will be required to generate the requisite amount of clean energy.

If managed correctly, this change in land use represents an important opportunity to help restore biodiversity loss to the UK, one of the most nature depleted countries in the world. The opportunity derives from the difference in land management between farmland and ground mounted solar farms, which can offer significant opportunities in habitat creation and carbon storage.

Solar farms that deliver ecological benefits in addition to generating green electricity, are far more likely to receive support from local communities. It is also worth noting that these benefits will be magnified, when solar farms are held in community ownership.

**This guide was written by Dr Guy Parker and Joesph Monkhouse of Wychwood Biodiversity. The guide was conceived and published by Naturesave Insurance, with funding by the Naturesave Trust, an environmental charity set up by Naturesave.**

# The Purpose of this Guide

This document is a practical manual designed to help solar farm owners and managers to increase biodiversity on their solar farm. It is written with community-owned sites in mind, but the approaches herein would be appropriate for all solar farms.

We are living through a climate and ecological crisis, in which solar farms will increasingly play a critical role in helping to urgently decarbonising our energy systems. However, the benefits of these sites do not end with renewable energy generation. Solar farms also offer a unique opportunity to tackle biodiversity loss, helping to combat the ecological crisis, an equally serious threat to climate change.

Solar farms are unique in the UK landscape, in that they are available for at least 20 years, the land is already paid for through solar generation and the sites are secure from human disturbance. These factors make solar farms ideal locations for becoming havens for wildlife.[9]

A variety of wildlife habitats are suitable for a solar farm and compatible with their primary purpose of generating renewable power. Wildflowers can grow beneath and around the solar array. Marginal grassland can grow tall and tussocky. Hedgerows, scrub and trees can be planted at the boundaries. Ponds and wetland habitats can also be created. These valuable habitats provide food and shelter for a wide range of wildlife, from insects to birds to reptiles and small mammals. More broadly, such habitats can also provide direct benefits to people too, by encouraging pollinators, promoting natural predators for crop pests and enhancing carbon cycling.

Furthermore, solar farms that succeed in encouraging biodiversity can also deliver further benefits to combat climate change. Onsite biodiversity measures, such as the creation of grasslands and hedgerows, will help absorb carbon throughout the lifespan of the project. At the same time, by providing habitat for native wildlife, solar farms can make the landscape more resilient to the effects of a changing climate.

This document contains good practice guidance for the establishment and management of wildlife habitats for the benefit of biodiversity. The primary focus of the guide will be upon native wildflowers, hedgerows plus ponds and wetlands, all of which are valuable wildlife habitats which can be made compatible with the operations of solar farms. Readers will be taken through a series of short steps that help them to plan, prepare, establish, and manage their new habitats. Where appropriate, diagrams and schematics will help to illustrate certain techniques.

This document draws information from a number of sources, including Buglife, Wildlife Trusts, Conservation NGOs, landscaping companies, solar farm owners and community groups as well as the experiences of the Wychwood team. It should be noted that general principles and guidance are provided. However, conditions on the ground will vary a good deal from site to site, so there is no substitute for local knowledge.

This guide is designed primarily for community solar farms. It is consistent with, and complementary to, the broader **Natural Capital Best Practice Guidance** by Solar Energy UK.

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# 1

# Introduction

**Biodiversity or 'biological diversity' means the variability among living organisms, on land or sea or in fresh water, and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. In short, biodiversity is the variety of life on earth in all its forms and all its interactions [1].**

# Introduction to Biodiversity

Biodiversity plays a key role in supporting life on Earth through regulating the air we breathe, filtering fresh water, and enabling food production, to name a few. These benefits are sometimes termed 'ecosystem services' and they contribute to making our lives both possible and worth living.[2]

Biodiversity also imparts a sense of wonder in humans and contributes to recreation and spiritual wellbeing. People in the UK increasingly value wildlife and wilderness, as our lives become progressively more urbanised.

There is no doubt biodiversity is declining in the UK. The ground-breaking 'State of Nature' report reveals that of the 3,146 species monitored in the UK, 60% have declined over the past 50 years.[3] On a global scale, the UK's biodiversity is faring worse than most other countries. In fact, the recently published Biodiversity Intactness Index ranked the UK 189th out of the 218 countries assessed. Intensive agriculture and climate change are considered to be the two most important threats .[4]

It is well known that wildflower meadows have declined almost to extinction in the UK since the 1950's. Intensive farming is held responsible for this decline, especially the widespread use of herbicides and fertilizers. Wild flower meadows are hotspots of biodiversity, as they harbour many species of plant as well as providing pollen, nectar and seeds for a wide range of insects, birds and small mammals. Old wild flower habitats are likely to host rarer plants such as orchids as well as complex interactions between microbes, fungae and invertebrates in the soil.

Our ability to create and manage wild flower meadows is improving thanks to guidance from a range of sources, including Natural England, the Wildlife Trusts, HabitatAid, and commercial seed producers such as Emorsgate, among many others. With a little know-how, labour and time it is perfectly possible to create a wild flower meadow. We can't hope to create the complex habitats of old wildflower meadows, but it is possible to restore some of the plant diversity, and provide food and shelter for a range of wildlife. And with careful management over time, we can hope that our new meadows develop the complexity of old meadows.

Hedgerows have been an important element of our landscape since the Bronze Age. Like wildflower meadows, hedgerows have declined greatly through the latter half of the 20th Century, mainly due to agricultural intensification. They play an important role in the landscape, defining boundaries and providing shelter for livestock. Further, they provide shelter, food and commuting habitat for birds and mammals, including bats and help to improve air quality and regulate water flow.

Given our long association with hedgerows, there is a great deal of information available about their establishment and care. The same applies to scrub patches (essentially non-linear hedges) and trees. Hedgerows, scrub patches and trees are fairly easy to establish and manage. With some careful planning they can help to screen solar farms and provide valuable wildlife habitats.

# Solar Farms and Biodiversity

Solar farms have a number of unique characteristics which benefit biodiversity. First, the land is paid for through solar power generation, so the pressure to remain agriculturally productive is reduced. Second, solar farms are usually sown with permanent grassland which is managed less intensively than the arable or pastureland it replaces. This means little or no use of herbicides and fertilizers, and considerably fewer tractor movements. Third, aside from basic maintenance, there is very little human activity on solar farms , so they remain fairly undisturbed. Finally, most solar farms have leases that run for 20 years, and some are in the process of being extended to 40 years which is an impressive time horizon. This is a good starting point from which to establish wildlife habitat.[5]

Recent research [9] demonstrates that significant biodiversity benefits can occur on solar farms where they are managed specifically for biodiversity. On such sites, significant increases in plants, invertebrates and birds have been noted. The best results seem to come from sites where a variety of habitats have been established, including wildflowers, tussock grassland, ponds and hedgerows.

In the following sections we take you through a series of steps designed to help you plan, implement and manage wildlife habitats on your solar farm.

# 2

# Project Planning

**In this section, we present the key steps to developing an effective biodiversity management plan for your solar farm. This includes assessing existing biodiversity, identifying suitable biodiversity enhancements for your site, consulting with key stakeholders, and ensuring you have adequate resources to complete the works.**



# Project Planning

This section takes you through some of the key areas to consider when planning your project. It is important to plan even a small project carefully, taking into account the physical characteristics of the site, such as type of habitat, its location and setting, as well as methods and the optimal time of year for establishment, management activities, resources available and the people who should be consulted on the plan. It may be useful to develop a biodiversity management plan which explains the above in simple terms.

# Protecting Existing Biodiversity

Before making any new plans, it is important to assess your site thoroughly and identify any areas of existing biodiversity value. Some species and habitats are protected by law and these must be adequately protected. There may be habitats present that are already of importance for biodiversity, e.g. wetlands, acid grassland, etc., or threatened species e.g. red listed birds or rare aquatic beetles which should be carefully considered in your biodiversity management plan to ensure they are managed appropriately. You should check your new plans are compatible with existing species and habitats of value and should seek to enhance them wherever possible. Your biodiversity management plan should ensure such species and habitats are properly managed, and where possible, enhanced, through the life of the project. Further, any new plans for biodiversity must be compatible with the existing species or habitats of value and should seek to enhance them wherever possible.

# Consulting with Stakeholders

Solar farms usually have a wide range of stakeholders involved in the ownership and management of the site. It is important to identify the key people and organisations involved in the project and ensure they are consulted in the development of the biodiversity plans. Further, it is important to consider the skills available in the local community which may be useful to the project, from bird specialists to horticulturalists.

Key stakeholders may include local community members, site owners, landowners, O&M companies[1], local schools and wildlife interest groups. You may wish to involve these groups in the planning, implementation and management of the project. At different stages in the project you may also wish to seek technical advice from seed merchants, agronomists and environmental consultants, among others.

# Identifying Biodiversity Targets

One of the first steps in planning is to identify simple targets for your biodiversity project. In this guide, we concentrate upon creating new wildflower, hedgerow, pond, scrub and tree habitats, but a range of other options can also be considered.

1. O&M: Operations and Maintenance companies are responsible for the maintenance of the infrastructure and land on a solar farm.

These options should be framed in simple terms and discussed with all relevant stakeholders. Targets should be appropriate for the landscape and achievable. They should also take into account the conditions relating to planning permission (see Box 1. page 20). An example list of targets is shown below;

1. Create native wildflower habitat(s) totalling 0.5Ha / 5% of the site
2. Fill gaps in existing hedgerows totalling 225m with a species-rich mix of native whips
3. Plant new scrub areas x 2 totalling 30m2 with a species-rich mix of native whips
4. Create small pond 15m² with variable depths and planted with native wetland plants
5. Establish nesting boxes for woodland birds at site perimeter; especially pied flycatchers and nuthatches.

# Budget, Resources and Time

At this stage, it is important to define your overall budget as this will determine what activities will be possible. You should consider what volunteer time people may be willing to give during the course of a year, as well as any donations of equipment and goods. It's worth bearing in mind that some elements, e.g. wildflower seed, can be expensive, and costs should be estimated early in the planning process. It is recommended that if contractors are to be used for land preparation and seeding, they visit the site with you and provide a detailed quote before work commences.

# Developing a Biodiversity Management Plan

A biodiversity management plan (BMP) is a document which provides the details of how to achieve your targets, including which areas of the site are suitable for biodiversity enhancement, which plant species to use and when to plant them, and the management of the new habitats throughout the life of the project. The document should be concise (no more than 10 pages) and well-written, such that all stakeholders can make use of it.

**The following are key stages to consider in the development of your plan:**

## Identifying the Key Activities

Activities are likely to include land preparation, weed control, seed and whip purchase, seed sowing and whip planting, and regular monitoring, amongst other things. You should define how to undertake tasks: small seeding areas <100m2 or 0.01Ha may be prepared and sown by volunteers; larger areas of >1000m² are likely to need mechanical equipment. When calculating seed / plant quantities, it is important to retain a contingency of 20% in case areas of seeding / planting fail and need to be replaced. Cables will run beneath the ground at a depth of 50 to 100 cm, so deep excavation and ploughing must





## Land Selection and Suitability

The scale of your biodiversity project will be determined by the area available within the solar farm. In locating the biodiversity options, you should consider the specific constraints of working within a solar farm. For example, panel rows are awkward to work between, especially with larger equipment. Further, the land between and beneath the panels is partially shaded and therefore shade-tolerant plans may be more suitable.

be avoided in these areas – you should confirm the location of all cable runs and sub-surface infrastructure with the O&M company before any ground disturbing activities commence. Finally, some solar farms are protected by infrared movement sensors at the perimeter and it's essential these beams are not affected by taller vegetation.

The simplest solution for new habitats is usually to place them in areas with no solar panels, such as wayleaves for powerlines, voids for archaeology, edges which have been left due to shading from tall hedgerows and trees, or difficult corners which were not suitable for panels. Most sites have such areas, which can range from 20m² to more than 1Ha.

Certain areas of the site may be physically suitable for some options, but not for others. For example, a pond may be appropriate for a low, wet area of the site with standing water, but not for a free draining area at the top of a slope. Likewise, trees and scrub may be appropriate for the northern side of a solar farm, but not to the east, south or west, where they could cast shadows on the panels.

When siting biodiversity options, one must consider the planning conditions that have been placed on the site. A fundamental part of planning consent for many sites is that they must be returned to their former land use at the end of the project (see Box 1). In practice this usually means returning them to arable production or pasture. Any new habitats such as ponds and hedgerows should take this condition into account.

You must consider access for maintenance operations, e.g. panel cleaning, mowing. The location of your biodiversity project must be agreed with the O&M contractor early on, to avoid any conflicting activities in the future.

Finally, it's essential to consider management activities going forwards – will equipment be required for cutting larger areas of wild flowers? Is there adequate access for this equipment to undertake the necessary works?

## Creating and Managing Habitat

Your BMP should provide details of how to establish the specific habitat options you've selected. There should be enough detail for a 3rd party to follow the process, from site selection to timing of operations to seed and plant sourcing to land preparation and sowing / planting. Your BMP should detail the immediate aftercare required as well as the ongoing management for each habitat. See *"Management of Wildflower Habitats" on page 49.* for information on establishing and managing wildflower grasslands, and *"Management of Hedgerows and Trees" on page 53.* for hedgerows, ponds, scrub and trees.

# Planning Permission

**Box 1.**

It is essential to consider any planning conditions for your solar farm as a starting point to developing your Biodiversity Management Plan (BMP). You should read the entire document to ensure all conditions relating to biodiversity are identified. It's worth noting that sometimes a planning condition will refer to part or all of a document, such as a Landscape and Environment Management Plan, which means it will be necessary to become familiar with the details of this document too.

Usually planning consent is contingent upon returning the site to its former land use at the end of the project. You must consider whether major changes such as ponds and woodland affect this condition at your site. Your BMP will be designed to improve the biodiversity value of your solar farm. Nevertheless, you may need to seek agreement or a non-material amendment from your Local Planning Authority (LPA) before carrying out your plans.

# Mapping

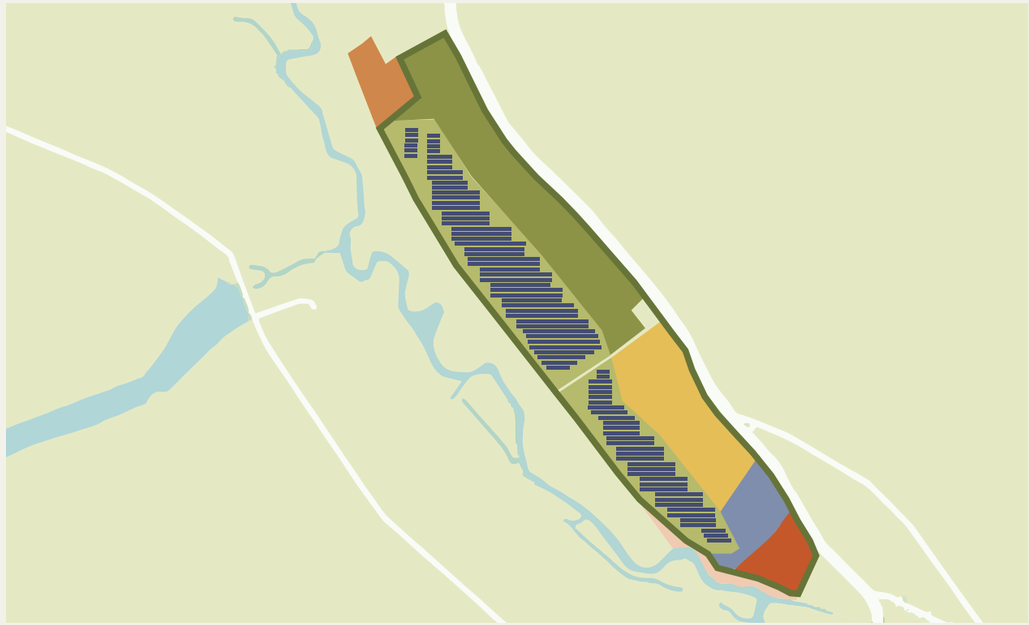
An annotated map is a useful way to share information on what is being planned and where. Usually it's possible to acquire a map of the site showing the layout of the panels, security fencing and tracks, and this is ideal for annotating. Notes can provide more detail and photos, or diagrams can help illustrate what you are planning to achieve. See Figure 1. on page 21 for an example.

Your biodiversity management plan should be socialised with key stakeholders regularly during the course of its development, and contributors should be appropriately acknowledged.





**Figure 1. Example map based on land management at Southill Solar Farm**



**Solar array – North and South fields**
Grassland area within security fencing, beneath solar panels. Total area: 7ha (4ha in N field & 3ha in S field). Sown with a traditional grazing mix (Cotswold Seeds) in autumn 2017.

**Pollinator area**
Grassland area outside security fencing, excluding field margins. Total area: 2ha. Area re-seeded with a pollinator mix (Cotswold Seeds) in autumn 2017

**Wild bird seed mix**
Total area: 1ha. Area re-seeded with a winter bird seed mix (Cotswold Seeds) in spring 2018

**Old wild flower meadow** – DO NOT DISTURB

**Existing grassland along riverside** – DO NOT DISTURB

**Field margins**
6m all the way around the field, excluding the existing meadow to the north, the existing riverine grassland to the south and the stone wall to the south. Total area: 1.8ha. Sown with a tussock grassland and wild flower mix (Cotswold Seeds).

**North meadow**
North field outside solar farm (excluding field margins). Total area: 5Ha. Sown with fine grass mix (Cotswold Seeds) in autumn 2018. Plan to oversow grass with green hay from old meadow and other local sources.

**South meadow**
South field, outside the solar farm excluding field margins. Total area: 3.5ha. Sown with a limestone meadow mix (Cotswold Seeds) in autumn 2017.

# 3

# Creating Wildlife Habitats - General Principles

**In this section we present some general principles that apply to the creation of wildflower meadows, hedgerows and scrub, including soil characteristics and selecting the right types of seed and plants.**

# Creating Wildflife Habitats

This section presents some general principles which should be considered in the creation of new wildlife habitats. The first step is to consider the characteristics of the soil, which in turn will help you to decide which habitats are suitable and where. Some pointers on the types of habitats are provided, along with some advice on selecting suitable plants.

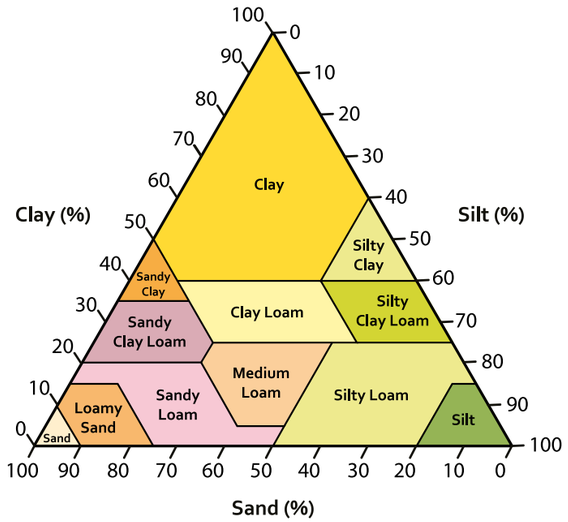
## Soil Characteristics

It is important to understand the characteristics of your soil. Your soil samples may help you decide where to locate your biodiversity options. For example, a sandy soil may not be suitable for siting a pond, whereas a clay rich soil may be ideal, as it will retain water more effectively. Further, your soil results will help you to select a seed mix that is suitable for the soil conditions of your site.

You should take a number of samples from across your site and have them tested in an approved soil laboratory. The laboratory will provide you with guidance on how to select and store your soil samples. The key soil characteristics you should test for are:

- Soil physical composition, i.e. the mix of sand, silt and clay (see Figure 2.);
- Soil pH, which is how acidic / alkaline the soil is; and
- The percentage of organic matter.
- It is also possible to measure soil carbon, which may be useful for tracking how your site stores carbon from the atmosphere over time

**Figure 2. Results of soil analysis, showing physical composition**




| Analysis | Result (%) |
|---|---|
| Sand | 25.40 |
| Silt | 52.13 |
| Clay | 22.47 |
| Soil Type | Clay loam |

| Property | Assesment |
|---|---|
| Available Water | Medium to High |
| Drainage Water | Medium to Slow |
| Inherent Fertility | Medium to High |
| Potential C.E.C | Medium to High |
| Leaching Risk | Medium to Low |
| Warming Rate | Medium |

The **above tests** are fairly inexpensive and will typically cost £25-50 per sample. The number of samples you take will depend upon the size of your site and its variability: a small, level field may only need 2-4 samples, whereas a large site with multiple fields and / or slopes may require as many as 8-10 samples.

There are many laboratories nationally which can undertake soil analyses, e.g. Lancrop Laboratories. It's best to consult your local farmer or conduct an internet search to find the most suitable provider. It's also worth checking with the landowner before testing soil, as this information may already be available.

## Selecting Seed and Plants

You should select seed and plants according to the target habitat you wish to create. When making your selection of plant species, make sure they are suited to the soil type and site conditions.

### Wildflower and Grassland Habitats

For wildflowers, consider the proportion of wildflower to grass seed, and the mix of annuals and perennials (see Table 1.). There are many different types of wildflower meadow to consider:

- Pollinator habitat – many agricultural seed mixes contain common species such as clovers, bird's foot trefoil and exotics such as phacelia. These mixes tend to be inexpensive and provide a long season of nectar production.
- Cornfield annuals - if a primary objective for the habitat is visual impact, then cornfield annuals which are bright and tall may be the most suitable option (see Table 1.).
- Tussock grassland is a common habitat in the marginal areas of a solar farm. Coarse perennial grasses form thick tussocks which are valuable for wildlife, especially through the winter.
- A traditional grazing meadow contains a range of perennial grasses (see Table 1.), plantains and wildflowers which can cope with grazing by livestock.
- Wildflower habitats of high conservation value, e.g. limestone grassland, lowland acid grassland, contain rarer specialist plants and tend to be more expensive and more complex to establish.

**Table 1. Description of Wildflower & Grassland Habitat Types**

| Wildflower Habitat Type | Complexity | Expense | Description |
|---|---|---|---|
| Pollinator habitat | Low | Low | Common agricultural species, e.g. clovers, bird's foot trefoil. Produce nectar for a long period |
| Cornfield annuals | Moderate | Medium | Bright and tall; high visual impact |
| Traditional grazing meadow | Moderate | Medium | Perennial grasses and wildflowers which are tolerant of grazing |
| Specialist meadow, e.g. limestone grassland | High | High | Rarer wildflowers and grasses suited to specific conditions |





### Hedgerow and Scrub Habitats

- For hedgerow and scrub planting, it's important to consider the wetness of the location, desired height of the hedge / scrub, flowering and seeding as wildlife food sources and the number of species (species-rich hedgerows commonly contain 8-10 woody species).
- Most hedgerow and scrub species will cope with moderately wet or dry conditions, e.g. hawthorn, hazel, field maple, blackthorn, ash, holly, elder. For very wet locations, e.g. on a riverbank prone to seasonal flooding, it is best to select water tolerant species such as willow, alder and blackthorn. For very dry conditions, e.g. a hedge bank in lighter soils, it is better to select drought-tolerant species such as birch, beech, holly and even gorse.
- You should also consider the size of the tree to plant. Bare root whips are smallest and cheapest and have the highest survival rate, whereas larger half-standard and standard trees (Table 3. on page 40) provide instant structure but have a lower survival rate. As a general rule, it's usually better to start with smaller whips and invest time and energy into maintaining them so they grow rapidly.
- It is not uncommon for UK trees to be imported, so it is also worth investigating nurseries that grow their trees domestically. Using domestically grown trees generally improves survival rates and reduces the chance of diseases being imported into the country.

### General Seed and Plant Considerations

- Select a seed supplier or nursery who can guarantee plants / seeds are of local provenance. This has two advantages: first, the plants are adapted to local conditions; and second, the species on offer will be appropriate to the locality.
- Purchase seed and plants from a reputable source. It's worth investing more funds on higher quality. Cheaper seed may contain a high proportion of 'foreign' seeds (i.e. non native varieties), and could contain weeds / unwanted species.
- Avoid using whips treated with systemic pesticides, which can harm insects that subsequently feed from the flowers or leaves.
- Consider the time of year for planting / sowing. Woody plants need to be planted between November and March, with the best conditions usually occurring in November. Wild flower and grass seed is usually sown in autumn or spring, when the soil is warm and moist.
- If not using seed immediately, store it carefully in a container that is airtight and safe from rodents. Woody plants are best ordered for delivery on the day of planting, to avoid the need to store them for long periods.
- The quantity of seed you require will depend on the area of your habitat and the type of seed. Seed suppliers will provide you with a sowing rate (weight per area) for each of their seed mixes as a guide.
- There is always a small risk in the UK that a seeding or planting will partially fail. This is usually due to poor weather conditions following the sowing or planting. For this reason, it is recommended you budget for 20% more seed or plants than you plan to use. This can be used to re-sow or plant any areas that do not properly establish.
- If in doubt, please contact your seed supplier / nursery or Wychwood Biodiversity for advice.

## Annual and Perennial Plants

**Box 2.**

Annual plants are those which complete their life cycle within a year, which means they germinate, grow, flower, set seed and die back in the course of a single year. By contrast, perennial plants grow year on year and while the above ground foliage may die back, the roots and often the stem remains alive for the following growing season.

Annual wildflowers tend to provide a vivid show of colour and structure which is strongest in year one but then diminishes with time. They're very popular due to their abundance and ability to bloom rapidly. Annuals go to seed each autumn and drop seeds into the soil. They are self-seeding, and almost self-sufficient but need some intervention in order to maintain their abundance in the following year. They do best with some disturbance of the soil which gives them space to germinate.

**Annual wildflowers** include corn cockle, cornflower, corn marigold, common poppy and corn chamomile.

**Images left to right:** corn cockle, cornflower, marigold, common poppy and corn chamomile.

Perennial wildflowers take longer to establish and may not flower until the second year. But once they are established, they come back year after year. Generally, they are not as colourful or as striking as the annuals. As many perrenial wildflowers are adapted to grassland habitats, the flowers tend to look best when growing amongst an abundance of native grasses.

**Perennial wildflowers** include yellow rattle, red and white clovers, bird's foot trefoil, campions, scabiouses and ox-eye daisies, among many others.

**Images left to right:** yellow rattle, red & white clovers, bird's foot trefoil, campions, scabiouses, ox-eye daisies.

Usually the best results come from a wildflower seed mix that contains both annuals and perennials. On bare soil the annuals will rapidly grow and flower, providing a colourful display in year one that protects the slower perennial wildflowers as they develop.

# 4

# Habitat Creation

**In this section we discuss how to prepare the land for habitat creation. First, we consider the methods for preparing the land for grassland seeding, including mechanical and manual methods and the use of grass parasites. Second, we explore the preparation and planting of hedgerows, scrub and trees. Finally, we present methods for creating ponds and wetlands**

# Sowing Wild Flower Habitat

## Land Preperation

Land preparation can be time consuming but is critical to the success of your wildflower habitat. One of the greatest challenges to establishing a wildflower meadow is agricultural grasses which grow vigorously and out-compete wildflowers. It's essential to remove or reduce existing grasses in order to introduce your new seed and give it space to grow. In the below section we first discuss removing all existing vegetation and creating a new seedbed. We then discuss disturbing up to 50% of vegetation and over sowing. We present the pros and cons of each method. Which approach you select will be dependent on your site conditions, target habitat and budget.

## Seed Bed Versus Oversowing

**Table 2. Pros and cons of seedbed vs. over sowing**

| Method | Description | Sowing Method | Pros | Cons |
|---|---|---|---|---|
| Seed bed | Removal of all existing vegetation | Sow seed into bare seed bed | Removes competing grass; good establishment | Bare soil prone to weed growth; more expensive |
| Over sowing | Removal of 50% of existing vegetation | Over sow seed into gaps in vegetation | Retains some existing vegetation; less expensive | Existing grasses can out-compete wildflowers |

## Seed Bed

To prepare a seed bed, all existing vegetation must be removed. The approach you take to clearing vegetation will depend upon the scale and position of your new habitat. If the area is small (<100m2) or constrained by the solar panels of the solar farm, then it may be best to use manual methods of land preparation and sowing. If the area is larger (>100m2) and has no constraints from solar panels or other infrastructure, then mechanical equipment may be quicker and more efficient. Broadly, these two approaches follow the same steps.

For manual sowing of smaller areas (<100m2) it is important to have good quality tools and plenty of people to assist. The process is as follows:

- Clear land of existing vegetation – break up soil with a garden fork; turn over surface to bury vegetation, as for vegetable beds. This process should be repeated after 2-3 weeks, by which time any remaining weed seeds will have germinated.
- Break up soil clods and create a fine tilth for a seedbed using a stiff rake.

- Sow seed when the soil is dry to moist but not waterlogged, and when rainfall is due in the near future.
- Sow seeds at the prescribed sowing rate. To ensure an even distribution and avoid running out, divide the seed into two or more parts and sow in overlapping sections using a hand sowing device. Remember that all wild flowers require surface sowing and should NOT be drilled or buried.
- Roll or tread in the seeds once sown, to ensure they have good contact with the soil.

## Mechanical Sowing

Mechanical sowing involves the use of powered equipment to prepare a seed bed over larger areas of ground. It is important to select the right sized equipment for the job, and for a skilled operator to undertake the work. Ground conditions are particularly important for mechanical work – if the ground is too wet this can cause compaction – so it's worth seeking advice if you're not sure. The process is similar to seed bed preperation:

- Clear land of current vegetation – shallow plough with tractor to bury surface vegetation. This approach is most effective if done twice, 2-3 weeks apart.[6]
- Create a seed bed by harrowing the area to a fine tilth.
- Sow wild flower seed at the prescribed rate using a surface seed broadcaster. N.B. if wild flowers are in the seed mix the seed MUST be surface broadcast, NOT drilled.
- Roll the ground with a Cambridge roller or similar once the seed has been sown to ensure good contact between the seeds and the ground.

Timing is key to the successful establishment of the seeded habitat. Sowing is usually undertaken in autumn or spring. Seed can be sown at other times of the year if there is sufficient warmth (typically > 70C overnight) and soil moisture, BUT this will be dependent on local conditions, especially temperature and water. It is advisable to discuss seeding times with the landowner.

**Images from left to right:**
1. Sowing a small area by hand
2. A hard rake is ideal for creating seed bed
3. Tractor with harrow is ideal for preparing larger areas





## Over Sowing

As for seedbeds, the approach you take to clearing 50% of vegetation will depend upon the scale and position of your new habitat - if the area is small then it may be best to use manual methods, whereas if the area is larger, then mechanical equipment may be quicker and more efficient. The steps are as follows:

- Break up existing vegetation with a garden fork or stiff rake. Aim to expose 50% soil cover overall. It doesn't matter if there are some larger and smaller bare areas.
- Sow seed when the soil is dry to moist but not waterlogged, and when rainfall is due in the near future.
- Sow seeds into the bare soil at 50% of the prescribed sowing rate. To achieve an even distribution and avoid running out, divide the seed into two or more parts and sow in overlapping sections using a hand sowing device.
- Roll or tread in the seeds once sown, to ensure they have good contact with the soil.
- For larger areas, the steps are as above, but a tractor and harrow will be used to clear 50% of the existing vegetation. Alternatively, good results can be gained from using a small excavator with a land rake (see photo below). A skilled operator and the right equipment are essential, along with suitable ground conditions, i.e. not too wet. It's worth seeking advice if you're not sure.

For all over-sowing, consider including grass parasites in the seed mix (see Box 3. on page 39) as these will help to weaken the existing grasses and encourage the wildflowers to establish.[7]

# Using Grass Parasites

**Box 3.**

If time allows, grass parasites can be used to help wildflowers establish in an existing grassland. There are two native wildflowers which parasitise grasses and weaken them, so creating gaps and allowing other wildflowers to germinate.

Yellow rattle is an attractive native flower which parasitises grasses and legumes by attaching to their roots and feeding on the carbohydrates within. Yellow Rattle must be sown in the autumn, as seed requires a period of chilling to break dormancy before it germinates in early spring. In preparation for sowing, grass must be cut very short (25mm) or grazed very hard. It's important to then open up gaps for germination by harrowing, or raking, aiming to create up to 50% bare soil. The seed should be broadcast on to the prepared surface.

Red bartsia is a short plant with a squarish stem that produces spikes of pinkish purple flowers from June to September. Like its relative yellow rattle, it parasitises the roots of grasses and other meadow plants and reduces their vigour. Red bartsia should be sown in the autumn, as it requires a period of chilling prior to germination.

It takes 2-3 years for these grass parasites to establish. Over time, these plants will reduce the vigour of grasses and create small gaps in the sward. This allows natural colonisation of the gaps by wildflowers, which can be augmented by over-sowing with a purchased seed mix.

Excavator with land rake

Yellow Rattle

Red Bartsia

# Planting Trees and Hedgerows

Scale is important for planting woody habitats, as there is no mechanical approach, and it must be done by hand. One person can plant around 3-400 whips per day, assuming they are bare root and small (e.g. 40-60cm in height), and the ground is soft. Whips require a small slot to be made in the soil so the bare roots can be inserted to the right depth.

The number of trees one can plant in a day is greatly reduced as trees get bigger in size. If planting light standard trees (2.5-3.0m) then the number per day will be nearer 10-15, as trees of this size have large, developed root stock and require a large hole to be dug. See Table 3. for common tree sizes.

## Hedgerows, Scrub Patches and Small Trees

- The best time to plant hedge whips is in autumn. The UK planting season is between November and March, with November and December being the preferred months. Plant later if the ground is saturated with water or frozen solid.
- For hedgerows, it's best to select and plant bare-root whips (with some exceptions e.g. holly, which is usually grown in a container). Plant a wide range of hedgerow species (at least 7), unless there is good reason to limit the number of species. The species mixture should reflect the wider local landscape and should be indigenous. Plant in double-staggered rows with 5-7 whips per linear metre.
- For scrub patches, plant bare-root whips where possible. Smaller plants are most effective; the larger the tree the higher the failure rate.
- Slot planting usually works well for whips in friable soils, but it may be necessary to dig small pits or trenches in areas of heavy clay .
- Apply a thick layer (10cm) of wood chip mulch or use a weed-suppression membrane, such as biodegradable coir mats (photo below right). Weed suppression is essential at time of planting as it reduces the need for weed control and watering.
- Whips and trees must be guarded to prevent rabbit and deer damage. Guards should be expandable and biodegradable.

## Common Tree Sizes

**Table 3.**

| Plant Size | Trunk girth 1 metre above the ground | Approx. Height |
|---|---|---|
| Bare root whip | - | 0.30-0.45m |
| Bare root whip | - | 0.45-0.60m |
| Bare root whip | - | 0.60-0.80m |
| Feathered Tree | less than 6cm | 1.75-2.50m |
| Light Standard | 6-8cm | 2.50-3.00m |
| Regular Standard | 8-10cm | 2.50-3.00m |
| Selected Standard | 10-12cm | 3.00-3.50m |
| Heavy Standard | 12-14cm | 3.00-3.50m |
| Extra Heavy Standard | 14-16cm | 4.25-4.50m |

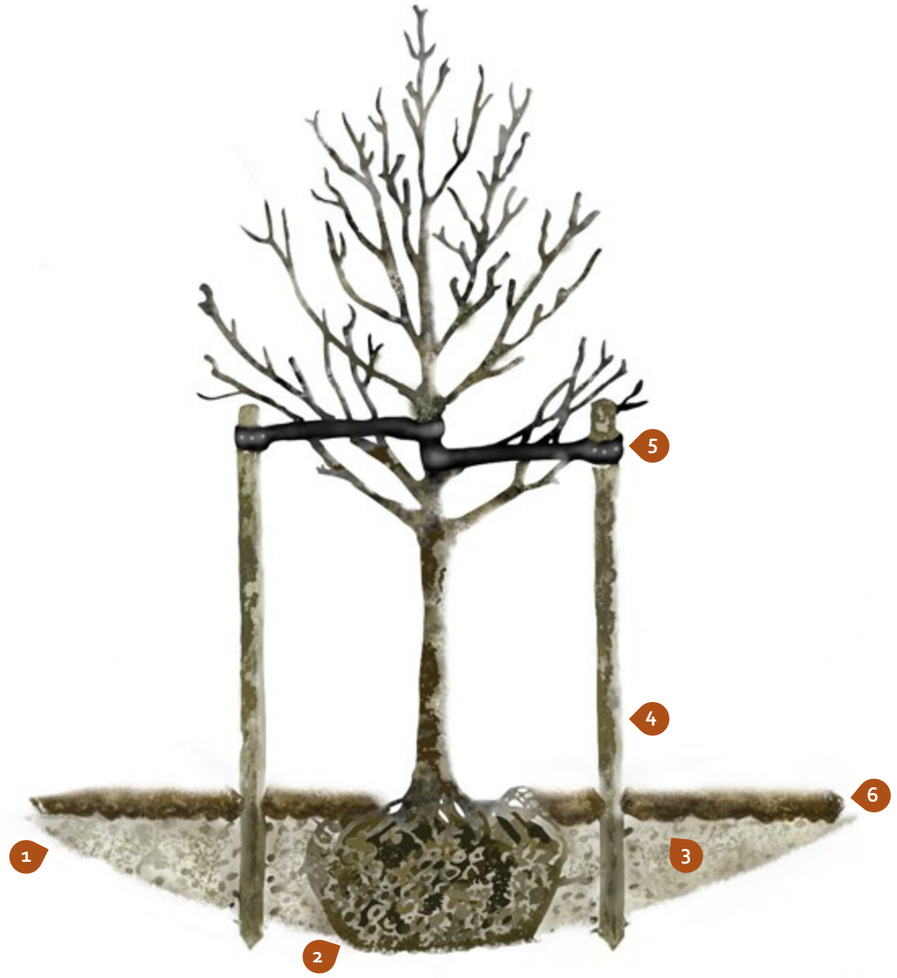
## Planting Larger Trees

- As for small trees, the best time to plant larger trees is in autumn, with November being the preferred month. Plant later if the ground is saturated or frozen.
- Dig a hole at least 1.5 times the diameter of the tree's root ball but no deeper. For larger trees (e.g. heavy, extra heavy) a mechanical excavator is usually the most efficient means of digging the holes. Separate the topsoil and subsoil that is removed from the hole. Loosen the soil around the hole to assist root establishment.
- Remove all plastic packaging and untie the head of the tree. Lift the tree into place using the root ball and not the stem. For larger trees, a mechanical hoist may be necessary. Ideally, the top of the root ball should be raised at least 5cm above the level of the soil.
- Backfill the hole and firm down the soil. If possible, do not reuse compacted or poor-quality soil in the hole. Instead replace it with a high-quality plant substrate.
- Mulch or use a weed-suppression membrane. Weed suppression is essential at time of planting – use either a permeable membrane (e.g. biodegradable coir) or a thick layer (10cm) of wood chip mulch. This reduces the need for weed control and watering.
- Stake and tie standard trees (1-4.5 m height). Ties should be expandable and biodegradable. N.B. the stake is to support the tree, not the tree the stake!
- Trees must be guarded to prevent rabbit and deer damage. Guards should be expandable and biodegradable.





## Planting a Standard Sized Tree




1. Dig a hole at least 1.5 times the diameter of the root ball, but no deeper
2. Remove Packaging from root ball before planting
3. Back-fill hole with topsoil and compost (if available) and firm down soil
4. Stake firmly ensuring stakes are positioned in undisturbed soil
5. Use expandable ties
6. Place a coir weed mat or thick layer of mulch over root area

# Creating Ponds and Marginal Habitats

Some sites may have wetland features such as ditches or ponds. On other sites, there may be low lying wetter areas which lend themselves to building a pond. Such areas are often unsuitable for construction, and so ideal for biodiversity enhancement.

## Locating the Pond

Ponds should be relatively warm to encourage the development of invertebrate and amphibian larvae. Ponds situated in direct sun are preferred, though lines of trees and shrubs acting as windbreaks will also provide a warmer microclimate around the pond. It is best to avoid areas shaded by large trees, such as within woodland, or woodland edge.

To facilitate the movement of species, and aid colonisation, ideally locate ponds adjacent or within other biodiverse habitats such as wet grassland, wild flower meadows or scrub. Locating ponds along a wider network of connecting habitats, such as hedgerows or botanically diverse field margins will also help colonisation and increase the likelihood of species such as bats and amphibians commuting and foraging around the pond.

Ponds are best located in areas away from frequent public access to reduce the risk of disturbance by dogs and the introduction of fish or non-native plants and animals. As many aquatic invertebrates and amphibians are well adapted to move between water bodies, there is rarely a need to introduce live animals; a suitably designed pond will most likely attract wildlife over time.

The cleanest water sources are groundwater or surface water draining from un-polluted areas. For this reason, it is not advised to locate the pond near fields applied with agricultural inputs such as fertilizers or pesticides, or to feed the pond from nearby wet ditches or streams.

## Excavating the Pond

- Large ponds should be excavated with a mechanical excavator using a digging bucket, preferably using a digging bucket. The pond shape is crucial for promoting biodiversity; ensure at least one side of the pond has a long shallow slope, with a series of shelves to accommodate a range of plant species that prefer differing depths. Crucially ponds should contain shallow areas less than 10cm, and a depth of 0.5-1.2m will be sufficient for the centre, depending on the size of the pond.
- Large ponds with high ground water levels may start to fill with water during excavation. Implementing an appropriate pattern of excavation from the start can avoid this (i.e., excavating the centre first and gradually removing spoil towards the edge). Alternatively, a pump can be used to remove the water, ensuring the discharge water is not pumped onto sensitive or valuable habitats.
- The excavated spoil (not topsoil) can be used to further shape the excavated area, creating hummocks, spits, islands, underwater bars, or shallower slopes in the pond itself. Top soil can be set aside for later use in puddling clay application, as described overleaf.





## Applying Puddling Clay and Adding Water

Most ponds require a waterproof liner of some kind to help retain water through the year. In some cases, a plastic or rubber liner can be used, but these tend to degrade in sunlight. A better option is to use a layer of waterproof clay, known as puddling clay.

- Use a clay type containing very few, if any stones, such as Brock Earth or Lias Clays. Obtain enough clay to create a layer of at least 30cm thick, though 60-90cm ft is preferable.
- First, spread the clay in the excavated area with a bulldozer or digger. Second, puddle the clay by adding water from a trailer mounted tank, whilst rotavating the clay with an agricultural rotavator. This process will continue until the correct consistency is achieved, which should be a stiff clay with some plasticity.
- Once the consistency is correct, roll in the clay with a mechanical roller, which causes it to bind into a layer, and creates a hard layer on the top surface to trap moisture. Immediately after rolling, cover the clay with a 15cm layer of soil or subsoil to prevent it from drying out.
- Fill with water as soon as possible from a trailer mounted tank, or pump from a nearby clean waterway.

## Planting up the Pond and Margins

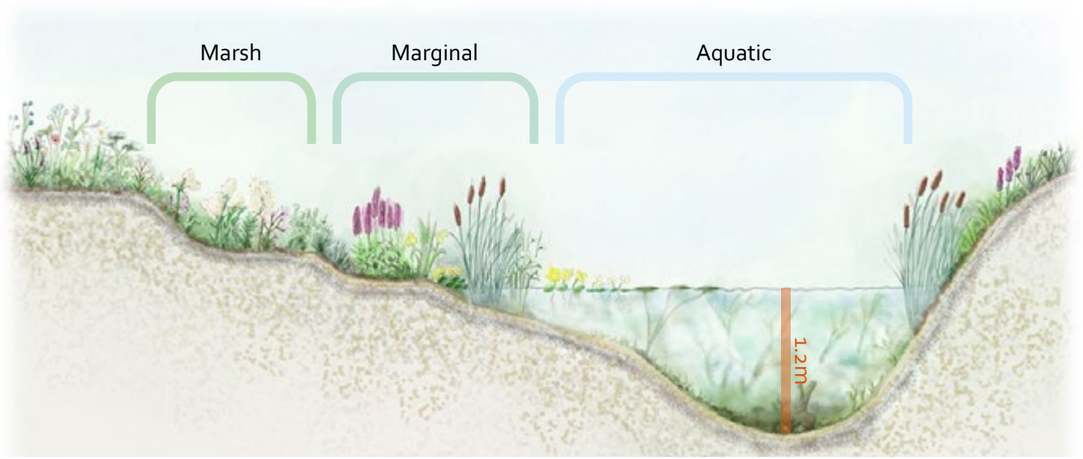
Aquatic and marginal vegetation should be encouraged to colonise naturally, as there is always a 'seed bank' stored within the soil. However, to maximise botanical diversity and limit pernicious vegetation overwhelming the habitat, it is advised to plant native marginal plant plugs on the terrestrial pond edge and introduce aquatic plants into the water. Prior to planting, ensure that the planting location is suitable for the chosen species; wetland, marginal or submergent (see overleaf  for recommended species and planting guidance). Dig a hole deep enough for each individual plant plug, insert the plant root base firmly into the hole, and ensure all roots are covered in soil.

Wetland plant seed mixes are available, however they should be sown on soil prepared on the pondside, and not sown directly into the water (see page 33-35 for wild flower sowing methods).

## Established wildlife pond with botanical diversity


1. **White water lily** *nymphaea alba*
2. **Purple loosestrife** *lythrum salicaria*
3. **Marsh mallow** *althaea officinalis*
4. **Water violet** *hottonia palustris*
5. **Devil's bit scabious**, *succisa pratensis*
6. **Marsh woundwort** *stachys palustris*
7. **Yellow flag Iris** *Iris pseudacorus*
8. **Water crowfoot** *ranunculus aquatilis*
9. **Lesser bullrush** *typha angustifolia*

## Wildlife pond cross section indicating planting depth categories




**See overleaf for - Wetland plants for different depth categories**





| Habitat Requirement | Common Name | Scientific Name | Max margin Depth (cm) |
|---|---|---|---|
| Marsh | Sneezewort | *Achillea ptarmica* | 0 |
| | Marsh Mallow | *Althaea officinalis* | 0 |
| | Cuckoo Flower | *Cardamine pratensis* | 0 |
| | Sedge, Glaucous | *Carex flacca* | 0 |
| | Great Willowherb | *Epilobium hirsutum* | 0 |
| | Meadowsweet | *Filipendula ulmaria* | 0 |
| | Avens, Water | *Geum rivale* | 0 |
| | Marsh Bird's Foot Trefoil | *Lotus pedunculatus* | 0 |
| | Ragged Robin | *Lychnis flos-cuculi* | 0 |
| | Marsh Woundwort | *Stachys palustris* | 0 |
| | Devil's Bit Scabious | *Succisa pratensis* | 0 |
| Marsh/Marginal | Sweet Flag | *Acorus calamus* | 20 |
| | Fool's Water Cress | *Apium nodiflorum* | 15 |
| | Lesser Water Plantain | *Baldellia ranunculoides* | 40 |
| | Flowering Rush | *Butomus umbellatus* | 50 |
| | Marsh Marigold | *Caltha palustris* | 20 |
| | Lesser Pond Sedge | *Carex acutiformis* | 10 |
| | Pendulous Sedge | *Carex pendula* | 30 |
| | Sweet Galingale | *Cyperus longus* | 10 |
| | Cotton Grass | *Eriophorum angustifolium* | 10 |
| | Marsh Pennywort | *Hydrocotyle vulgaris* | 30 |
| | Marsh St John's Wort | *Hypericum elodes* | 5 |
| | Yellow Flag Iris | *Iris pseudacorus* | 30 |
| | Soft Rush | *Juncus effusus* | 5 |
| | Hard Rush | *Juncus inflexus* | 5 |
| | Gypsywort | *Lycopus europaeus* | n/a |
| | Creeping Jenny | *Lysimachia nummularia* | 5 |
| | Yellow Loosestrife | *Lysimachia vulgaris* | 10 |
| | Purple Loosestrife | *Lythrum salicaria* | 30 |
| | Water Mint | *Mentha aquatica* | 30 |
| | Pennyroyal | *Mentha pulegium* | 15 |
| | Bogbean | *Menyanthes trifoliata* | 10 |
| | Water Forget-me-Not | *Myosotis scorpioides* | 10 |
| | Amphibious Bistort | *Persicaria amphibia* | n/a |
| | Pillwort | *Pilularia globulifera* | 40 |
| | Lesser Spearwort | *Ranunculus flammula* | 20 |
| | Water Figwort | *Scrophularia auriculata* | 10 |
| | Branched Bur Reed | *Sparganium erectum* | 40 |
| | Brooklime | *Veronica beccabunga* | n/a |
| Marginal | Water Plantain | *Alisma plantago-aquatica* | 40 |
| | Water Cress | *Nasturtium officinale* | 60 |
| | Arrowhead | *Sagittaria sagittifolia* | 30 |
| | Lesser Bullrush | *Typha angustifolia* | 10 |
| Aquatic | Water Starwort | *Callitriche stagnalis* | 50 |
| | Hornwort | *Ceratophyllum demersum* | n/a |
| | Slender Spike Rush | *Eleocharis acicularis* | 30 |
| | Willow Moss | *Fontinalis antipyretica* | n/a |
| | Mare's Tail | *Hippuris vulgaris* | 200 |
| | Water Violet | *Hottonia palustris* | 60 |
| | Frogbit | *Hydrocharis morsus-rane* | n/a |
| | Brandy Bottle | *Nuphar lutea* | 150 |
| | White Water Lily | *Nymphaea alba* | 180 |
| | Fringed lily | *Nymphoides peltata* | 75 |
| | Water Crowfoot | *Ranunculus aquatilis* | 75 |
| | Water Soldier | *Stratiotes aloides* | n/a |

# 5

# Managing Wildlife Habitats

**In this section we present good practice approaches to managing your wildlife habitats to ensure they thrive. We consider early care during establishment as well as routine long-term maintenance. Methods for managing grasslands are considered first, followed by hedgerows and trees, and finally ponds and wetlands.**



# Management of Wildflower Habitats

Appropriate management is absolutely key to the successful establishment of wildlife habitats, and for their longevity. Developing a plan for the long-term management of each habitat ensures your investment in creating the habitat sees a good return. The flip side of the coin is that poor management will lead to a rapid loss of value in your investment

Managing wildlife habitats usually means decreasing the intensity of management activities, so cutting and trimming less often, and using fewer inputs such as fertilizer and pesticides. As well as being better for the environment, this means the costs of management are lower than more standard agricultural management.

The timing of management activities is very important. For example, wild flower habitats must not be cut during the growing season (April – July), as wild flowers and grasses must flower and set seed. Repeated cutting at this time of year will lead to a loss of many wild flower species from the habitat. Likewise, hedgerows must only be cut between August and February, to avoid the bird breeding season. The best time to cut a hedge is in February, when all the nuts and berries have been eaten by wildlife.

Finally, whilst this may change, there is currently an obligation for all European farmers to maintain their land in Good Agricultural and Environmental Condition (GAEC) under the CAP rules of cross-compliance, so it is important to demonstrate sound stewardship of the land through the lifetime of the solar project.[10]

## Year 1

Meadow mixtures are composed mainly of perennial grass and wild flower species which take at least a full year to establish from sowing. Newly sown areas are most vulnerable to weeds in their first year of growth, as weeds are opportunists that thrive where the ground is disturbed.

Annual weeds such as prickly sow thistle (See Box 4. on page 50) can rapidly colonise areas of bare soil and will flower and set seed early in the summer. These species can be controlled through cutting to remove the flower head before it has a chance to set seed. However, each plant can re-sprout, so several cuts are needed to prevent plants from producing seed.

To control a large flush of annual weeds, it may be necessary to lightly cut an area up to three times through the first spring and summer ( See Box 4. on page 50). Timing of cuts will vary, but a first cut in late March, a second in June and a third in September is likely to be needed. However, if cutting is used to control annual weeds, it will also control any annual wild flowers. If you have annual wild flowers such as poppy and cornflower in your seed mix, then it's best to selectively mow the area of weed growth, to minimise damage to annual wild flowers in the wider area.

## Annual Management

As a general rule, grassland containing wild flowers should not be cut between 1st April and 30th July to allow wild flowers and grasses to flower and set seed. The time of year for grazing / cutting is therefore between 1st August and 31st March. There are exceptions for traditional grazing meadows, which can be grazed at a low stocking density throughout the year.

The frequency of cutting or grazing will depend upon the habitat type. Most grasslands require at least one cut or grazing session per year, but tussock grassland should only be cut every 2-3 years.

Wildflower meadows will ideally be cut and the arisings collected and removed. Removing the arisings reduces the nutrients returning to the soil which favours wildflowers. Further, it avoids a thick layer of thatch forming on the ground, which can suppress wildflowers.

## Weeds and Weed Management

**Box 4.**

Weeds are opportunists which can rapidly colonise bare ground. They usually produce a large number of airborne seeds or spread through their roots. There is a heightened risk of weeds colonising areas of bare soil during seeding and planting operations, but with vigilance and early action, these should not present a major problem.

There are five species of flowering plant which under UK legislation must be controlled by landowners: common ragwort, spear thistle, creeping thistle, broad leaved dock and curled dock. Under the Weeds Act (1959), the Secretary of State may serve a notice on the occupier of land on which injurious weeds are growing, requiring the occupier to take action to prevent their spread. All of the above are perennial weeds, meaning they live through the winter and get larger each year.

The best means of control is to dig these weeds out by the root. In half a day, a team of ten volunteers can clear a hectare or more of such weeds. It's best to remove them with a fork when the soil is moist and workable. The best time of year is April-May, before they have had a chance to flower and set seed. Try to make sure the entire root is removed – a dock can have very long roots.

The Ragwort Code of Practice states that 'common ragwort and other ragwort species are native to the British Isles and are therefore an inherent part of our flora and fauna, along with invertebrate and other wildlife they support. Ragwort has over 30 invertebrate species associated with it and no other plant. The Code does not propose the eradication of common ragwort but promotes a strategic approach to control the spread of common ragwort where it poses a threat to the health and welfare of grazing animals and the production of feed or forage. An excessive carpet of ragwort, especially of common ragwort, is not desired by either conservationists or farmers and the principle of applying control where ragwort has become dominant is well established. What is sought is a tolerance of reasonable quantities of ragwort in locations where it is doing no real harm.



Managing Wildlife Habitats

## Management by Habitat Type

The ongoing management of grassland will be different, depending upon the type of habitat you have created.

### Traditional Grazing Meadow

Once the traditional grazing meadow has fully established (usually after 1 full year), grazing can commence in autumn. Sheep can graze from September through to the following spring and then be taken off site from the beginning of April until the end of July, to allow any wildflowers and grasses to flower and set seed. At the end of August each year the site can be mown to 100mm (if required) and sheep returned to the site for grazing through the autumn and winter. The stocking density should remain low-to moderate at approximately 5-6 sheep per Ha.

### Wild Flower Meadow

Once the wild flower meadow is established, it should not be cut or grazed from spring through to at least the end of July to give the wild herbs an opportunity to flower.

After flowering in July or August a hay cut should be taken with a tractor mower to c 50mm. The hay will be left to dry and shed seed for 1-7 days then removed from site - it will have some value as livestock feed or bedding. The easiest way to remove the cut hay is by bailing. The meadow can then be managed by sheep grazing through autumn and winter.

### Tussock Field Margins

Tussocky field margins are low maintenance and only need to be cut on rotation every 3 years to allow coarse tussocks to develop. The grass should be cut down to ~50mm during autumn. At least one half of the field margins should remain uncut each year in order to provide areas of undisturbed habitat through the winter. Tussock grassland can also be maintained through light grazing with sheep or cattle. Grazing levels should be determined for each individual site based on nutrient levels, ground moisture and growth rates of the grassland species.

## Grazing

**Box 5.**

Grazing with sheep is a popular way to maintain grassland within a solar farm. However, the site needs to be properly prepared for sheep, as detailed below.

Low intensity grazing can provide a low cost means of managing grassland as well as increasing its conservation value. Grazing also enables the land to remain agriculturally productive, although it should be noted that higher intensity grazing is unlikely to be beneficial to wildlife.

Sheep are the usual choice for solar farms, being generally small enough to pass beneath the rows of panels. They are usually available and also easy to handle. Hardy breeds are usually best suited to autumn and winter grazing where the grazing is less nutritious.

A qualified ecologist should assist with the development of a conservation grazing regime to ensure it is suited to the site's characteristics and management objectives, which should be incorporated into the BMP. To ensure biodiversity value, lower stocking density should be maintained so that the grassland retains some structural diversity. Maintaining grassland structure through the winter is good for invertebrates.

Grazing should be stopped for periods during the spring and summer. Stopping grazing in the spring (April – June) will favour early flowering herbs, whereas summer (July-September) will favour summer flowering herbs. Ceasing grazing in April-September will return the greatest biodiversity benefits but it is appreciated this may not always be possible. A combination of low stocking density and breaks in grazing should lead to a high diversity of wildflowers and invertebrates as well as benefiting ground nesting birds and mammals.

A grazing agreement should be established between the grazier and the solar farm owner(s) prior to grazing commencing. This document should detail at a minimum the location and time period(s) for grazing, the maximum number of sheep to be grazed, grazier's and landowner's responsibilities (e.g. fencing, water supply, risk to maintenance staff, welfare standards), the period of agreement and insurances.

Finally, the effects of veterinery wormers upon soil invertebrates should be considered carefully and any harmful treatments named and avoided in the grazing agreement



Managing Wildlife Habitats

# Management of Hedgerows and Trees

## Hedgerow Management

It's important to check hedge planting quarterly in the first 4 years for weeds, drought and damage / disease. Weeds should be controlled by hand pulling or spraying (as a last resort), and replacing mulch or coir matting as necessary.[11] Please note that any grasses or other plants growing in close proximity to a whip will compete for resources and reduce its vitality. If surrounding vegetation grows taler than the whips, it can reduce light levels and eventually smother and kill them. Effective weed control will help your whips and trees to grow and mature much more quickly.

Damaged and diseased plants should be removed and replaced with healthy whips. Watering should not be necessary, unless the planting is in heavy soils or on hedge banks which are prone to drying out. Where whips are growing well, the first light trim of all side branches can be done in the spring after the first growing season, ideally using hand tools. The first light cut with a mechanical flail can be undertaken in year 3.

Stakes and guards can be removed once the whips have become established (generally after 3-5 years, earlier if growth is becoming spindly, dependent on the risk of browsing damage), if the guards are not biodegradable.

Once the hedge is well established, a standard cutting routine can commence. Hedge cutting should be undertaken in alignment with Natural England advice[12], i.e.

- cut every 2-3 years to encourage flower and berry production;
- cut only in January-February once wildlife has benefitted from nuts and berries;
- No hedge cutting will occur during the bird breeding season 1st March – 31st July (all wild birds, their eggs, young and nests are protected by law);
- One side of each hedge should be left uncut every year to leave nuts and berries as winter food for birds and other wildlife.

# Management of Ponds and Marginal Habitats

- Manage pondside herbaceous vegetation with the aim to encourage a natural variation in height and structure. Allow the growth of taller vegetation, and occasionally cut back small areas at a time. Protect water margins from deer and livestock with fences if necessary, allowing more delicate marginal vegetation to prosper.
- Pondside trees and shrubs may require cutting back, as 90% of the pond edges should remain open to allow sunlight into the pond and shallow margins. For large ponds, coppice the surrounding trees and shrubs in late winter on a rotation (i.e., one third every two years) to ensure a portion of the vegetation growth is retained. For small ponds, the edges may require flailing every other year to retain open margins and minimise leaf litter. Providing standing or lying deadwood can help to reduce the amount of vegetation management required. If mature trees dominate the pond margins, consider pruning a small number of lower branches that cast the most shade.
- Trees requiring removal should be replaced like for like, or with other wetland adapted trees such as alder or willow species.
- Managing aquatic vegetation every autumn helps reduce the gradual build-up of nitrates and phosphates, which can result in detrimental algal blooms. Gently rake out vegetation, aiming to leave 25% of the pond with dense aquatic plant cover. Place removed vegetation on the side of the pond overnight to allow amphibians and invertebrates to return to the water. The following day, dispose of the vegetation elsewhere, avoiding species rich habitats (a compost heap for grass cuttings is ideal). Remove all invasive aquatic and marginal plant species entirely, if possible.
- A build-up of pond silt can store accumulated pollution or naturally occurring substances, which can limit vegetation growth and lower the water quality. This can be addressed with dredging, focussed on different portions of the pond centre on rotation. Dredge sensitively to avoid destroying aquatic vegetation or disturbing amphibians, or damaging the pond liner. Dredging should take place in September, when shading is at its maximum. If the pond is considered suitable for great-crested newts, dredge between November and February, when the newts have vacated the water. Relocate the pond silt to off-site arable stubbles or spread thinly over recently coppiced scrub, where the regrowing trees will rapidly grow through the spoil. Avoid relocating the silt to species rich grassland or herbaceous habitats.
- Algal blooms will typically come and go without direct management, and over time, plants will often establish to outcompete the algae, particularly in new or restored ponds. If algal blooms persist, it is important to reduce the nutrients in the pond system. This can be achieved by submersing bails of barley straw, which lock up the phosphates and nitrates in the water.

# 6

# Monitoring Biodiversity

**In this section we consider some of the key aspects of monitoring biodiversity, which is important for ensuring your new habitats are developing as planned, and for identifying any problems early on. An effective monitoring programme can provide information to help improve the management of the site. We consider suitable indicator species and discuss the importance of systematic monitoring.**

Monitoring is a really important part of biodiversity management which helps us assess the development of new habitats, track improvements and highlight any problems relating to land management. This information will also prove valuable in sharing with community members and other stakeholders who generally take a keen interest in the natural environment.

## Indicators for Monitoring

It's not possible to monitor everything, so a small number of biodiversity indicators should be selected. At least one of these should be a botanical indicator which helps you track the progress of your habitat towards its target state. For example, if you are creating a limestone meadow habitat, then you should conduct botanical studies in July each year to see if the target botanical species have established. Another indicator should be the presence and abundance of weeds across the site, which can be assessed through a simple site walkover several times a year. This will help you to identify where and when weeds become a problem and management is required.

To monitor wildlife, several indicator species or groups of species should be selected per site. Which species you choose will vary from site to site and will depend upon the biodiversity project you have chosen. Both breeding birds and common invertebrates such as butterflies or bumblebees are useful indicators of ecosystem health and are fairly straightforward to monitor. Bird surveys are usually undertaken two to four times per year, following British Trust for Ornithology (BTO) methods. For invertebrates, bumblebees and butterflies are best surveyed between May and August, on a suitable weather day (i.e. 20° C, sunny and with low winds).

## Monitoring Approach

It is important to adopt a systematic approach to monitoring. This means using the same methods, and the same amount of effort, each year, which enables comparisons to be drawn between years. You should use recognised methodologies, for example BTO survey methods for birds, and Butterfly Conservation transects for butterflies. To design the surveys, you could ask advice from an ecological consultancy or a College or University. You may find there are local skills within your community that you can call upon to help in the design or undertaking of surveys.

Monitoring should start before your biodiversity project commences, so you can establish a baseline against which changes can be measured. You can decide on the appropriate frequency for monitoring. As a guideline, it's useful to conduct surveys annually for the first 5 years, then every 2-3 years for the life of the solar farm.

Wherever possible records should be shared to the National Biodiversity Network Atlas to allow inclusion in future versions of the State of Nature report or similar analyses of trends and distributions.

# References


1 Convention on Biodiversity, 1992

2 http://uknea.unep-wcmc.org/EcosystemAssessmentConcepts/EcosystemServices/tabid/103/Default.aspx

3 RSPB (2013) State of Nature Report.

4 RSPB (2016) State of Nature Report.

5 Natural England (2014) Wild flower meadow creation and management in land regeneration. BPG Note 15. Forest Research, Alice Holt, Farnham, UK.

6 Habitat Aid, How to make a Wildflower Meadow

7 Sowing and aftercare advice, Emorsgate Seeds

8 Parker, G.E. & Montag, H. (2018) Biodiversity benefits from solar farms? Environmental Scientist 27 (2): 28-33

9 Montag, H. Parker G and Clarkson, T. (2016) The effects of solar farms on biodiversity: a comparative study. Clarkson & Woods and Wychwood Biodiversity (2015)

10 BRE (2014) Agricultural Good Practice Guidance for Solar Farms. Ed J. Scurlock

11 Natural England Hedgerow planting: answers to 18 common questions

12 Natural England (2007) Hedge cutting: answers to 18 common questions


Further reading for pond habitat creation page ("Creating Ponds and Marginal Habitats" on page 42)

https://www.suffolkwildlifetrust.org/pond-restoration-and-management

https://www.woodlands.co.uk/blog/practical-guides/creatin-a-woodland-pond-and-encouraging-pond-life

https://freshwaterhabitats.org.uk/projects/million-ponds/pond-creation-toolkit/#Core%20factsheets