DRAFT LANDSCAPE AND HABITAT MANAGEMENT PLAN

BARNSDALE SOLAR PARK, LEEDS

BANKS RENEWABLES (BARNSDALE SOLAR PARK) LTD

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1 INTRODUCTION

Arcus Consultancy Services Limited (Arcus) was commissioned by Banks Renewables (Barnsdale Solar Park) Ltd. ('the Client') to undertake a draft Landscape and Habitat Management Plan (LHMP) for land at Barnsdale, Leeds (the 'Site') in order to support a planning application for a Solar Park with associated infrastructure ('the proposed Development'). Site boundaries and full details of enhancement areas, including extents, are presented in Figure 4.5 of the Landscape Mitigation and Enhancement Plan. Landscape and ecological mitigation and enhancement measures have been combined in this LHMP as they are closely related.

This Landscape and Habitat Management Plan (LHMP) addresses recommendations set out in the Ecological Appraisal (EA)[1] and Ecological Impact Assessment (EcIA)[2] and thereby aims to ensure that:

- Ecological resources are protected during construction of the proposed Development;
- Enhancement measures are implemented at the beginning of the operational stage of the proposed Development; and
- Existing ecological resources and proposed mitigation and enhancement measures are managed appropriately during the operational stage of the proposed Development.

The measures set out in this LHMP are proportionate to the importance of ecological features identified in the EA and EcIA. With the exception of the central riparian corridor (part of the Leeds Habitat Network), the overall ecological value of the Site is low due to prevalence of arable land. Surveys for bats and birds yielded a low level of activity for the area and habitats recorded. A small great crested newt population was recorded. Consultation was undertaken with the Environment Agency (EA) and Leeds City Council (LCC) regarding the Leeds Habitat Network, which is located in the Site, and further consultation was undertaken with LCC regarding protected/notable species mitigation and enhancement measures.

This LHMP provides a framework for the retention, creation and maintenance of features of ecological importance within the Site, notably habitats, birds, badgers, reptiles, amphibians and commuting and foraging bats, and covers a period of five years following the completion of the construction of the proposed Development.

This LHMP does not provide guidance relevant to any specific future works beyond the basic habitat maintenance, management and monitoring outlined. If any future works other than those outlined in this document are required, an ecological assessment should first be undertaken. If the works are likely to have any long-term ecological or habitat management implications then the LHMP should be revised and reissued, accordingly.

2 THE DEVELOPMENT

The Site is approximately 90 ha and dominated by arable land with well-maintained hedgerows at the field margins. Sheffield Beck runs west to east across the Site, with a further two drainage ditches nearby. Mixed woodland plantation blocks are present in the Site with larger areas of woodland around the boundaries.

The proposed Development consists of a photovoltaic array and access tracks to be constructed mostly within arable land north of Sheffield Beck. Development south of Sheffield Beck will consist of the small remainder of the solar array as well as a welfare area and construction compound.

[1] Arcus (2020) Preliminary Ecological Appraisal Report, Barnsdale Solar Farm, Leeds. Banks Renewables. October 2020.
[2] Arcus (2020) Ecological Impact Assessment. Barnsdale Solar Farm, Leeds, Banks Renewables, October 2020.

3 ENVIRONMENTAL INFORMATION

A number of ecological surveys have been carried out on the Site and are reported in the EA and EcIA:

- Extended Phase 1 Habitat Survey (March 2020);
- Desk Study (March 2020)
- Badger Walkover Survey (March 2020);
- Bat Activity Surveys (May–September 2020);
- Breeding Bird Surveys (April–June 2020);
- Great Crested Newt (GCN) Surveys (May–June 2020); and
- Otter and Water Vole Surveys (June and September 2020).

3.1 Desk Study

The Leeds Habitat Network passes through the centre of the Site along the course of Sheffield Beck. Kippax Meadows Site of Ecological and Geological Importance (SEGI) was located immediately north-west of the Site. The mixed woodland north of the Site is listed under the Natural Environment and Rural Communities Act (NERC) Act 2006 as priority habitat (deciduous woodland). No other priority habitat is present within or directly adjacent to the Site.

3.2 Habitat Types and Evaluation

Existing habitat types are described in the EA and corresponding Phase 1 Habitat Map is provided in Appendix A. The following habitat descriptions have been summarised from the EA.

3.2.1 Cultivated/ Disturbed Land- Arable

The Site is dominated by arable fields which are left to go fallow in the winter months.

This habitat provides limited ecological value, with the application of fertiliser and pesticides limiting its value for invertebrates and foraging potential for a range of common species. The majority of bird activity was focussed on the periphery of the Site, however, grey partridge, lapwing and skylark were recorded utilising arable habitats.

3.2.2 Hedgerows

The arable fields are bounded by a network of well-managed, species-poor, intact hedgerows. Hedgerows were generally composed of hawthorn, dog rose and blackthorn, with cleavers and bramble growing throughout.

The mature hedgerows are a common and widespread habitat that provides suitable bird nesting opportunities and the fruiting species, such as hawthorn, blackthorn and bramble, provide a valuable food source for birds and mammals, as well as a range of pollen and nectar-dependent insects.

3.2.3 Tall Ruderal

Small patches of tall ruderal are located throughout the Site, primarily at field margins. Species included cleavers, common nettle, red dead-nettle, cow parsley, cock's-foot, dock species, dandelion species, spear thistle, sow-thistle species, ground-ivy, willowherb species, clover species, hogweed, bramble, fescue species, Yorkshire-fog and perennial rye-grass.

The tall ruderal offers suitable bird nesting habitat, as well as shelter and foraging habitat for a range of wildlife, including reptiles and nectar- and pollen-dependent insects. Arable field margins are UK and Local BAP habitats; however, the field margins on site were very limited in extent and dominated by a few common and widespread species.

3.2.4 Running/Standing Water

Sheffield Beck flows in a west to east direction through the centre of the Site. It is up to 4 m wide in places with vegetated with gradually sloping earth banks and overhanging trees. Wild garlic, marsh marigold and ivy were present along the banks. A field drainage ditch joins Sheffield Beck at the east of the Site and is vegetated with alder, common reed and bulrush. Furthermore, a drainage ditch with standing water is located just south of, but not connected to, Sheffield Beck.

The field drainage ditches dry up over the summer months and are regularly cleared and dug out in line with arable management, therefore they are of relatively; limited ecological value. Sheffield Beck, however, presents suitable habitat for water vole and otter although no signs were recorded. Bats were recorded foraging and commenting along the riparian corridor and the undergrowth provides suitable nesting opportunities for birds. Sheffield Beck is considered to be the highest value habitat within the Site and is safeguarded within the Leeds Habitat Network.

3.2.5 Marsh/Marshy grassland

A waterlogged area of a grassland field creates a marshy grassland habitat associated with the drainage ditch (D1) connected to Sheffield Beck. Species include bulrush and grasses.

The waterlogged area provides potential temporary opportunities for amphibians although great crested newt was not recorded. It also provides a foraging resources for birds and invertebrates.

3.2.6 Scattered Trees

A line of mature standing trees borders the Sheffield Beck on both sides with scattered scrub in the understory. Species present include: willow, alder, hawthorn, bramble, ash, oak and elder. This provides foraging and nesting opportunities for birds, and foraging opportunities for bats.

3.2.7 Mixed woodland and plantation woodland

Small, discrete areas of mixed woodland are present throughout the Site and all have a similar species composition, consisting of: willow, alder, hawthorn, blackthorn, ash, oak, beech and elder. Silver birch is also present within the woodland to the east of the Site. Woodland adjacent to the beck has a more varied understory than other areas as wild garlic dominates with frequent marsh marigold.

A larger woodland block is present immediately north of the Site, this is subject to increased human disturbance in comparison to other areas; this is evidenced by the presence distinct pathways, discarded barbeques and remnants of small bonfires. Species in this area include: scot's pine, hawthorn, alder, beech, silver birch, sweet violet, red campion, bramble and nettles.

Plantation woodland is present at the centre of the Site and to the southern extent. Tree species include: scot's pine, willow, oak, alder and beech. The understory is limited to common ivy, bramble and primrose at the center of the Site, however the plantation woodland to the south of the Site has more varied understory flora, with bluebells, dog's mercury, lords-and-ladies and hart's-tongue fern also present.

Woodland is a relatively widespread but scarce habitat and one that takes a long time to establish. It provides a habitat for a variety of species including: foraging and nesting birds, foraging, commuting and roosting bats, amphibians and badgers.

3.2.8 Scattered and Dense Scrub

Areas of scrub are present at the far extents of the Site, notably to the south adjacent a drystone wall and within the understory of woodlands. Species include: bramble, hawthorn, cleavers and blackthorn. Scrub is a common and widespread habitats though rarely extensive. It provides suitable habitat for nesting birds and fruiting species provide a valuable food source for birds and mammals, as well as a range of pollen- and nectar-dependent insects.

3.3 Protected Species

3.3.1 Badger

Badgers and their setts are afforded protection under the Protection of Badgers Act 1992 (as amended). This legislation includes protection against damage to badger setts and against interference and disturbance of badgers whilst they are occupying a sett.

The variety of habitats on Site, connected by hedgerows and woodland, provide suitable habitat for badgers, and the gently sloping ground and suitable soil offer opportunities for sett creation. Full details are provided in Confidential Appendix F of the PEAR[1].

3.3.2 Bats

All British bats are strictly protected by the Conservation of Habitats and Species Regulations 2017 and the Wildlife and Countryside Act 1981 (as amended) and all British bats are Species of Principal Importance under Section 41 of the NERC Act 2006.

Bat surveys recorded low to moderate levels of bat activity throughout the Site. Activity was concentrated along the woodland boundaries, river corridor and hedgerows which suggests these habitats provide more suitable foraging opportunities and are of greater value to bats. Overall five taxa were identified utilising Site habitats: common pipistrelle, soprano pipistrelle, noctule, brown long-eared bats and unidentified *Myotis* species.

Fifteen trees in, or within close proximity of, the Site were considered to provide suitable roosting potential, however none of the trees will be removed as a result of the proposed Development.

3.3.3 Birds

All nesting birds are protected under the Wildlife and Countryside Act 1981 (as amended) whilst their nests are being built or are in use. Birds listed under Section 41 of the NERC Act must also be considered during the planning process.

The hedgerow, scrub, tall ruderal and woodland, largely concentrated on field boundaries, had the potential to support breeding birds. Species of conservation concern utilising these habitats include: dunnock, linnet, and yellowhammer[2]. Breeding skylark are numerous within the Site, a minimum of 11 territories were identified within the arable fields. Low levels of lapwing activity was also recorded within the arable areas, however, no successful breeding attempts were recorded[2].

Two Wildlife and Countryside Act 1981 Schedule 1-listed species were recorded: a hobby flew over the Site but did not appear to utilise on-Site habitats and a kingfisher was observed at the sewage works and transiting along a ditch within the south of the Breeding Bird Survey Area (outside of the Site). No suitable kingfisher nesting habitat was noted within the Site Boundary.

3.3.4 Great Crested Newts

GCN are legally protected under the Conservation of Habitats and Species Regulations 2017 as a European Protected Species (EPS). The intentional or reckless killing, injury or taking,

and intentional or reckless disturbance of GCN whilst occupying a 'place used for shelter or protection' is prohibited, as is the destruction of these places.

No habitats suitable for GCN were identified within the Site. A small non-breeding GCN population was recorded in a pond 200 m south of the Site. GCN were absent from all other accessible ponds within 500 m of the Site.

3.3.5 Reptiles

All species of reptile are protected from deliberate killing or injury under the Wildlife and Countryside Act 1981 (as amended) and are listed under Section 41 of the NERC Act 2006, and therefore must be considered during the planning process.

The majority of the Site comprises arable land which is unsuitable for reptiles. Habitats at the margins of the Site, including scrub, tall ruderal, brash piles and a dry stone wall provide some suitable habitat for basking, foraging and sheltering reptiles. No reptile surveys were undertaken as suitable habitats are limited and the Development will largely avoid them.

3.3.6 Water Vole and Otter

Water vole and otter are protected under section 9 of the Wildlife and Countryside Act 1981 (as amended). Otters and their places of shelter are also protected under the Conservation of Habitats and Species Regulations 2017.

Sheffield Beck provides suitable habitat for otter and water vole, however no signs were identified during the riparian surveys.

3.3.7 Other Protected/Notable Species

Brown hare were recorded in the arable fields in March. Brown hare are priority species under Schedule 41 of the NERC Act 2006. Brown hare are sensitive to human disturbance and construction will temporarily displace brown hare into neighbouring agricultural land, although the species will very likely recolonise upon commission[3].

Roe deer were also observed infrequently utilising site habitats. Roe deer are widespread and are not a priority species.

Himalayan balsam (*Impatiens glandulifera*) was identified along the entirety of Sheffield Beck during the completion of the otter and water vole surveys. Himalayan balsam is an invasive, non-native species listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). This means that it is an offence to plant or otherwise cause them to grow in the wild. A minimum separation distance of 7 m will be maintained between construction activities and this species at all times to avoid spreading it within or off-site, therefore further intervention or management will not be necessary.

4 EVALUATION AND OBJECTIVES

4.1 Ecological Value and Impacts

The overall ecological value of the Site is low to moderate and it has the potential to provide suitable habitat for common and widespread species as well as some protected species. It is dominated by low-value arable land but the small areas of woodland and Sheffield Beck are of higher ecological value. Habitats in the vicinity of the Site supported a small population of GCN. Surveys for bats and birds yielded low to moderate levels of activity for the area and habitats recorded.

[3] H. Montag, G Parker & T. Clarkson. 2016. The Effects of Solar Farms on Local Biodiversity; A Comparative Study. Clarkson and Woods and Wychwood Biodiversity.

The Development will not have any significant adverse impact on the ecology and nature conservation features of the Site and surrounding areas. A range of mitigation measures will ensure that important ecological features are protected during construction. Enhancement measures will create new, valuable habitats which, in turn will benefit a range of species.

4.2 Objectives

The objectives of this LHMP are to:

- Protect, maintain and enhance the retained habitats;
- Introduce new native and wildlife-friendly planting within the Site to provide new wildflower grassland habitat for local wildlife;
- Provide features of value for a range of species; and
- Undertake sympathetic management of the Site to ensure the long-term viability of habitats whilst taking into account the continued presence of protected species and other wildlife.

5 LANDSCAPE AND ECOLOGICAL ENHANCEMENTS & MANAGEMENT PERSCRIPTIONS

A checklist of the various prescriptions outlined below is provided in Appendix B. It is the intention for this to be used on an annual basis during management operations.

5.1 Landscape and Habitats

The Landscape Mitigation and Enhancement Plan illustrates mitigation and enhancements which would introduce a number of different habitats including:

- Species-rich meadow grassland on land adjacent Sheffield Beck within the Leeds Habitat Network, to include native species attractive to pollinators;
- A shade tolerant, low maintenance grassland mixture beneath the solar panels and along verges within the Site to include native species;
- Additional hedgerow planting; and
- Tree planting to fortify existing hedgerows and increase connectivity to existing woodland and the riparian corridor on Site

The proposed Development will retain and protect the existing hedgerows (with the exception of a small cut-out required for access), wooded areas, riparian corridor and extent of the Leeds Habitat Network within the Site.

5.2 Planting Methods

In the interest of biodiversity protection, the use of herbicides should be kept to a minimum in the preparation or management of the planted or seeded areas.

- Biodegradable tree and shrub guards to be used throughout the site;
- The handling of plants on Site must be in accordance with National Plant Specification 'Handling and Establishing Landscape Plants'[4]; and
- All plants and planting operations are to comply with the requirements and recommendations of all current relevant British Standard specification including but not limited to:
    - BS 8545. Trees: From Nursery to Independence in the Landscape
    - BS 3936-1:1992. Nursery stock. Specification for trees and shrubs
    - BS 3882:2015 – Specification for topsoil

[4] The National Plant Specification – Handling and Establishment (November 1995). Available at: https://www.csdhub.com/wp-content/uploads/2014/12/The-National-Plant-Specification-Handling-and-Establishment.pdf [Accessed August 2020]

- BS 4428:1989. Code of practice for general landscape operations (excluding hard surfaces) (AMD 6784)
- BS 5837: 2012 Trees in relation to design, demolition and construction. Recommendations

All planting to be carried out during appropriate weather and in the optimal planting period of October to March.

5.3 Planting Specifications and Management Prescriptions

5.3.1 Native Species Hedgerow

A total of 606m of new hedgerows will be planted. Species will be in keeping with the existing hedgerows on Site.

The hedgerows will provide an increase in foraging resources for a range of wildlife, more flight lines for bats, and connective and sheltering habitat for reptiles, amphibians and brown hare. Species will include: field maple (*Acer campestre*), hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*), holly (*Ilex aquifolium*) and blackthorn (*Prunus spinosa*).

Management

For the first five years, annual checks should be undertaken with subsequent pruning and pollarding of trees and replacement planting if necessary. Trimming will be undertaken to encourage bushy growth at the base of the hedge to increase its value for wildlife and trimmed to a maximum height of 3 m during this time. Plants that have failed will be replaced in the subsequent planting season to achieve at least 90% survival and maintain a gap free line to enable wildlife to disperse along the hedge line.

Timing

Avoid cutting in spring and summer (March to August) as birds may be nesting during this time.

5.3.2 Native Species Tree Planting

A total of 2486 m of new treeline will be planted. The native tree planting serves to provide screening from the adjacent road and strengthen the connectivity between woodland blocks and hedgerows. Supplementary tree and shrub planting will be undertaken throughout the Site, in conjunction with existing hedgerows and to form new field boundaries. The following species should be of local provenance:

- Field maple (*Acer campestre*)
- Silver birch (*Betula pendula*)
- Whitebeam (*Sorbus aria*)
- Rowan (*Sorbus aucuparia*)
- Wych elm (*Ulmus glabra*)

Deadwood is an essential habitat for many species, especially invertebrates, bryophytes and fungi. Removal of deadwood and 'tidying up' leads to relatively sterile conditions and takes away an essential habitat. Where possible, all future wood from windblown sources, or arising from management operations, will also be left on Site in suitable locations in log piles or as low brash. In some cases, it can be used as a material in appropriate management tasks on Site, including the creation of 'dead' hedges to restrict access to any sensitive areas.

The creation of a tree belts will provide an increase in foraging habitats for bats, which the current low levels of bat activity suggest may be lacking from the Site. The trees will also provide nesting and foraging habitat for birds and a habitat for a range of other wildlife.

Management

For the first five years, annual checks should be undertaken with subsequent pruning and pollarding of trees and replacement planting if necessary. Plants that have failed will be replaced in the subsequent planting season to achieve at least 90% survival and maintain a gap free line to enable small mammals to disperse along the tree line.

Timing

The timing of any management should be carried out during the late winter months. January/February is ideal as the majority of the berries have been eaten but is before the onset of the main bird nesting season (March to August), which should be avoided.

5.3.3 Shade Tolerant Native Grassland

The species composition of the shade tolerant grassland is shown in in table 1, based on an example seed mix, such as Emorsgate EG10- Tussock Grass Mixture. The aim is to establish a grassland sward with greater ecological value than the existing arable land. Ground preparation may be necessary to establish a clean seed bed into which a grass seed mix can be sown. Grassland will be established by directly sowing a seed mix into the prepared ground. Seed is best sown in the autumn or spring but can be sown at other times of the year if there is sufficient warmth and moisture. Winter and drought periods must be avoided. The mix is diverse and is suitable for sites where soil conditions vary or where soil and site characteristics have not been established before sowing.

Leeds City Council and Leeds University also broached the option of cultivating the Site with reflective crops for research purposes, an avenue the client is keen to pursue. If reflective crops are incorporated within the landscape design at a future date, management plans and the biodiversity metric calculation will be amended accordingly.

Table 1: Proposed Shade Tolerant Mix – Emorsgate EG10 – Tussock Grass Mixture

%	Scientific name	Common name
2.5	*Alopecurus pratensis*	Meadow Foxtail
20	*Cynosurus cristatus*	Crested Dogstail
20	*Dactylis glomerata*	Cocksfoot
5	*Deschampsia cespitosa*	Tufted Hair-grass
30	*Festuca rubra*	Strong-creeping Red-fescue
2.5	*Holcus lanatus*	Yorkshire Fog
12.5	*Schedonorus arundinaceus - (Festuca arundinacea)*	Tall Fescue
7.5	*Schedonorus pratensis (Festuca pratensis)*	Meadow Fescue

Management

Growth and establishment of wild grasses may be slow initially, there will often be a flush of annual weeds from the soil in the first growing season. This weed growth is easily controlled by topping or mowing. Mow all plant growth (sown grasses and weeds) regularly to 40-60mm throughout the first growing season to prevent weeds smothering the slower-growing grasses. Remove cuttings if dense, more frequent and regular topping will minimise the amount of cuttings produced each time so they can be left to disperse.

Once established, tussocky grassland requires minimal maintenance. Unwanted perennial weeds (docks, thistles) may need control by occasional spot treatment. To control scrub and bramble development, tussocky areas may need cutting every 2-3 years. Cutting is

best done on a rotational basis so that no more than half the area is cut in any one year leaving part as an undisturbed refuge for wildlife.

Timing

Avoid cutting in the spring and summer, between October and February is preferable.

5.3.4 Native Species-Rich Meadow Grassland

The species composition of the Native Species-Rich Grassland and wildflower mix is shown in Table 2, based on an example seed mix such as Emorsgate EM3 – General-Purpose Meadow Mixture[5]. This species rich sward is recommended north of Sheffield Beck within the Leeds Habitat Network. The aim is to establish a grassland sward with greater ecological value than the existing arable land, to improve the diversity and connectivity of the adjacent riparian corridor. Ground preparation may be necessary to establish a clean seed bed into which a grass seed mix can be sown. Grassland will be established by directly sowing a seed mix into the prepared ground. Autumn (August to mid-September) sowing is preferred because this favours species that germinate in autumn and species that require a period of cold to break their dormancy before they germinate in spring. Sowing must take place when conditions are warm and moist, and so winter and drought periods must be avoided. The mix is diverse and is suitable for sites where soil conditions vary or where soil and site characteristics have not been established before sowing.

Table 2: Proposed Meadow Mix – Emorsgate EM3 – General Purpose Meadow Mixture

%	Scientific name	Common name
Wildflowers		
0.5	*Achillea millefolium*	Yarrow
2.4	*Centaurea nigra*	Common knapweed
1	*Centaurea scabiosa*	Greater knapweed
0.6	*Daucus carota*	Wild carrot
0.6	*Filipendula ulmaria*	Meadowsweet
0.8	*Galium verum*	Lady's bedstraw
1.5	*Knautia arvensis*	Field scabious
0.3	*Leontodon hispidus*	Rough hawkbit
1	*Leucanthemum vulgare*	Oxeye daisy
1	*Lotus corniculatus*	Bird's-foot trefoil
0.1	*Origanum vulgare*	Wild marjoram
1	*Plantago lanceolata*	Ribwort plantain
0.5	*Plantago media*	Hoary plantain
1.8	*Poterium sanguisorba*	Salad burnet
0.5	*Primula veris*	Cowslip
2	*Ranunculus acris*	Meadow buttercup
1	*Rhinanthus minor*	Yellow rattle
0.6	*Rumex acetosa*	Common sorrel
1	*Silene dioica*	Red campion

[5] http://wildseed.co.uk/mixtures/view/4

0.2	*Silene flos-cuculi*	Ragged robin
1	*Silene vulgaris*	Bladder campion
0.1	*Trifolium pratense*	Wild red clover
0.5	*Vicia cracca*	Tufted vetch
Grasses		
8	*Agrostis capillaris*	Common bent
40	*Cynosurus cristatus*	Crested dog's-tail
28	*Festuca rubra*	Slender-creeping red-fescue
4	*Phleum bertolonii*	Smaller cat's-tail

Management

Two management options are available: sheep grazing or manual management (cutting). Grazing is the preferable method as it is less intensive and requires minimal intervention. Should grazing be implemented further advice should be sought in relation to specific stocking densities and seasonal grazing times. If grazing is not feasible then cutting can be considered.

Grass should be cut on an annual basis late in the year once flowers have set seed and certain invertebrates have completed their life cycle, but preferably on a rotational basis to allow certain areas to remain uncut in any one year. Cuttings should be removed from the area to maintain low nutrient status, favourable to wildflowers, and either moved to dedicated composting areas on the Site or taken off-site as green waste.

Periodic clearance of scrub will be required to maintain the open nature of the grassland, with all arisings retained as low brash in suitable locations on the Site.

Upon decommissioning of the Solar Farm, assuming that over fifteen years of meadow management has been undertaken, soil fertility will be low but the area will remain suitable for arable cultivation.

The general management principles detailed above set out the framework for management. However, it is envisaged that a more detailed, site-specific management regime will be developed upon consent with the input of a specialist contractor.

Timing

If a manual management approach is taken, avoid cutting in the spring and summer. Any annuals should be allowed to flower, then, in late-summer, the grass cut and all arisings removed.

5.4 Protected Species

5.4.1 Amphibians

A small non-breeding population of GCN was recorded in a pond 200 m south of the Site, however, no evidence of amphibians was recorded on Site or considered likely to occur in the majority of the arable land in the Site. Due to the presence of GCN in the immediate area works will be controlled under a non-licenced 'Reasonable Avoidance Measures' which will include:

- The workforce will receive a briefing (either written or verbal) about GCN and their obligations with respect to the species;
- Works with the potential to impact high-value habitats (e.g. hedgerows and scrub but excluding arable land) will only take place if absolutely necessary and during the

seasonal period when GCN are active (March to October) and under suitable weather conditions;
- An Ecologist will identify and search suitable habitats for GCN before works affecting them start;
- If GCN are considered to be absent, works will be undertaken by hand or using handled machinery and will be supervised by an Ecologist; and
- In the unlikely event that GCN are encountered during initial searches or during works, then works will stop immediately and the Method Statement revised. A licence from Natural England may be required to facilitate further works.

5.4.2 Badgers

Non-licenced Reasonable Avoidance Measures will need to be followed to avoid impacts to badgers from the Development. To minimise the risk of harm to badgers there will be a presumption against tracking of heavy machinery or invasive ground works within 30 m of any badger sett. Works within 30 m of a badger sett may be permitted subject to approval from an ecologist who will provide advice on depth/distance appropriateness and any requirement for further mitigation and/or licencing. In order to prevent harm, the following controls will need to be implemented during the works:

- Cover excavations overnight to prevent animals from falling into them. Inspect excavations daily for the presence of animals before recommencing work on them;
- Any deep excavations that are to be left open overnight should include a means of escape for any animal that may fall in;
- Where possible, works should be limited to the hours from dawn to one hour before sunset;
- The creation of large stock piles of earth should be avoided as these may prove attractive for mammals such as badgers;
- Store any building materials above ground on pallets; and
- Should any new mammal burrows be identified, works in the area will need to stop and a suitably experienced Ecologist contacted for advice.

The long-term, operational effects of the Development will be positive for badgers due to the creation of higher value habitats and a reduced level of disturbance.

5.4.3 Bats

The addition of the tree belts, hedgerow and longer sward grassland will greatly enhance the Site for bats. The following controls should be implemented during the works:

- In the unlikely event that any roosting bats are encountered then works will cease and an ecologist must be contacted to advise on appropriate action;
- Night-time lighting disturbance of the river corridor, tree belts and woodland should be minimised during both operation and construction. Any lighting should be designed in line with good practice[6]; and
- A minimum of three bat boxes will be installed on retained mature trees to provide enhanced roosting opportunities. Boxes need to be installed in accordance with good practice guidelines[7]. Long-lasting bat boxes that do not require maintenance and are suitable for pole or tree mounting include: the Schwegler 1FF bat box, or the Vivara Pro Woodstone bat box (or similar). Precise locations will be determined by an ecologist upon completion of construction.

[6] Bat Conservation Trust (2018) *Bats and Artificial Lighting in the UK.*

[7] Bat Conservation Trust (2019) *Bat Boxes: Putting up your box* [Online] Available at: http://www.bats.org.uk/pages/bat_boxes.html [Accessed September 2020]

5.4.4 Breeding Birds

To reduce the likelihood of a legal offence to nesting birds, vegetation clearance will be undertaken outside of the breeding bird season (March–August, inclusive), where possible.

If this is not possible, individual habitats will be inspected for active nests immediately prior to clearance by an experienced ecologist. If an active nest is identified the associated vegetation and a suitable buffer will not be cleared until an experienced ecologist has confirmed that the nest is not in use.

During the survey work undertaken for the Site, a moderate level of bird activity was recorded. The creation and enhancement of tree belts, hedgerows and longer sward grassland and the retention of a small area of arable land will be provide sheltering, nesting and foraging opportunities for a range of birds, including those of conservation concern.

Bird boxes will be installed on retained mature trees to provide enhanced nesting opportunities for a number of different bird species. A minimum of five long-life, hardwearing (Woodcrete or similar) bird boxes will be installed at suitable locations and in accordance with good practice guidelines[8]. Precise locations will be determined by an ecologist upon completion of construction. All bird nesting boxes that have been installed should be cleaned out once a year between September and February.

5.4.5 Brown Hare

Habitats within the Site were considered suitable to support brown hare. The landscape strategy for the Site will enhance the area for brown hare, which favours a mosaic of arable fields, grasses, woodland edge and hedgerows. The meadow grassland, hedgerow and tree belts will provide foraging and sheltering habitat. The Development will create a more structured environment with boundaries. Evidence suggests that this change can be beneficial to brown hare, assuming they have access to the Site, by creating a refuge with secure boundaries that provides food and shelter throughout the year. There is evidence that brown hare numbers on such sites have increased considerably[9]. Mitigation for badgers will adequately safeguard brown hare and other terrestrial animal species during construction.

5.4.6 Water Vole and Otter

No signs of water vole or otter were present within Sheffield Beck. However, due to the presence of suitable habitat, as a precaution, a 10 m buffer form the banks of Sheffield Beck has been incorporated into Development Design. As the Leeds Habitat Network which encompasses the Beck will also be retained, this buffer exceeds 10 m in most areas. All tree and scrub habitat in this area will be retained which will also avoid long-term habitat loss.

5.4.7 Invertebrates

The site presented limited opportunities for invertebrates due to its largely intensive agricultural habitats. The extensive tussocky grassland and notably the meadow grassland to be established within the proposed Development will support a diverse range of invertebrate species, including pollinators. Three insect hotels or log piles should be installed to further attract invertebrates to the area and provide enhanced sheltering opportunities. Precise locations will be determined by an ecologist upon completion of construction.

[8] Royal Society for the Protection of Birds (nd) *Nestboxes: Find out how to provide, or make, nestboxes for birds in your garden*, Available from: www.rspb.org.uk/advice/helpingbirds/nestboxes [Accessed September2020]

[9] H. Montag, G Parker & T. Clarkson (2016) The Effects of Solar Farms on Local Biodiversity; A Comparative Study. Clarkson and Woods and Wychwood Biodiversity.

Insect hotels can be installed ready-made or created from natural material such as moss, brash and logs and discarded construction materials (including wooden pallets, tiles and bricks)[10].

The log piles and insect hotels should be located adjacent existing woodland and tree-lines. In addition to benefitting invertebrates, the log piles provide suitable shelter and overwintering sites for reptiles and amphibians.

Deadwood is an essential habitat for many species, especially invertebrates, bryophytes and fungi. Removal of deadwood and 'tidying-up' leads to relatively sterile conditions and takes away an essential habitat. Where possible, all future wood from windblown sources, or arising from management operations, will also be left on Site in suitable locations in log piles or as low brash.

6 NET CHANGE IN BIODIVERSITY

This report uses the DEFRA Biodiversity Metric 2.0 tool to calculate the net change in biodiversity caused by the Development.

6.1 Methods

This report has been produced in accordance with the methods set out in the following guidance documents:

- The Biodiversity Metric 2.0 *auditing and accounting for biodiversity* User Guide[11]
- The Biodiversity Metric 2.0 *auditing and accounting for biodiversity* Calculation Tool: Short Guide[12]

The Phase 1 Habitat survey (reported in the EA) has been used to determine the size and condition of each baseline habitat type. This was determined by a suitably qualified ecologist.

The distinctiveness of each of the existing and new habitat types was taken from The Biodiversity Metric 2.0 Calculation Tool[13].

The delivery risk/difficulty multiplier for the new habitats to be created post-construction and the baseline habitats predicted to improve in condition post-construction have been taken from Biodiversity Metric 2.0 Calculation Tool: Section A-2 Site Habitat Creation.

The temporal multipliers for the new habitats to be created post-construction and the baseline habitats predicted to improve in condition post-construction have been based on professional judgement and a conservative approach.

6.2 Assumptions

The new tussocky grassland has been classified as fairly poor due to its low species diversity and position under the solar panels. The species-rich grassland planting has been classed as moderate. In order to achieve the calculated biodiversity units the habitat should be maintained in this condition as per the recommendations of this LHMP.

[10] RSPB, Build a Bug Hotel. Available from: https://www.rspb.org.uk/get-involved/activities/give-nature-a-home-in-your-garden/garden-activities/build-a-bug-hotel/ [Accessed November 2020]

[11] Crosher, I., Gold S., Heaver M., Heydon M., Moore L., Panks S., Scott S., Stone D & White N. (2019) The Biodiversity Metric 2.0: *auditing and accounting for biodiversity value*. User guide (Beta Version, December 2019). Natural England [Accessed October 2020]

[12] The Biodiversity Metric 2.0: *auditing and accounting for biodiversity value*. Calculation Tool Short Guide (October 2019) Natural England. Available from: www.gov.uk/natural-england [Accessed October 2020]

[13] The Biodiversity Metric 2.0 Calculation Tool (2019)

6.3 Results

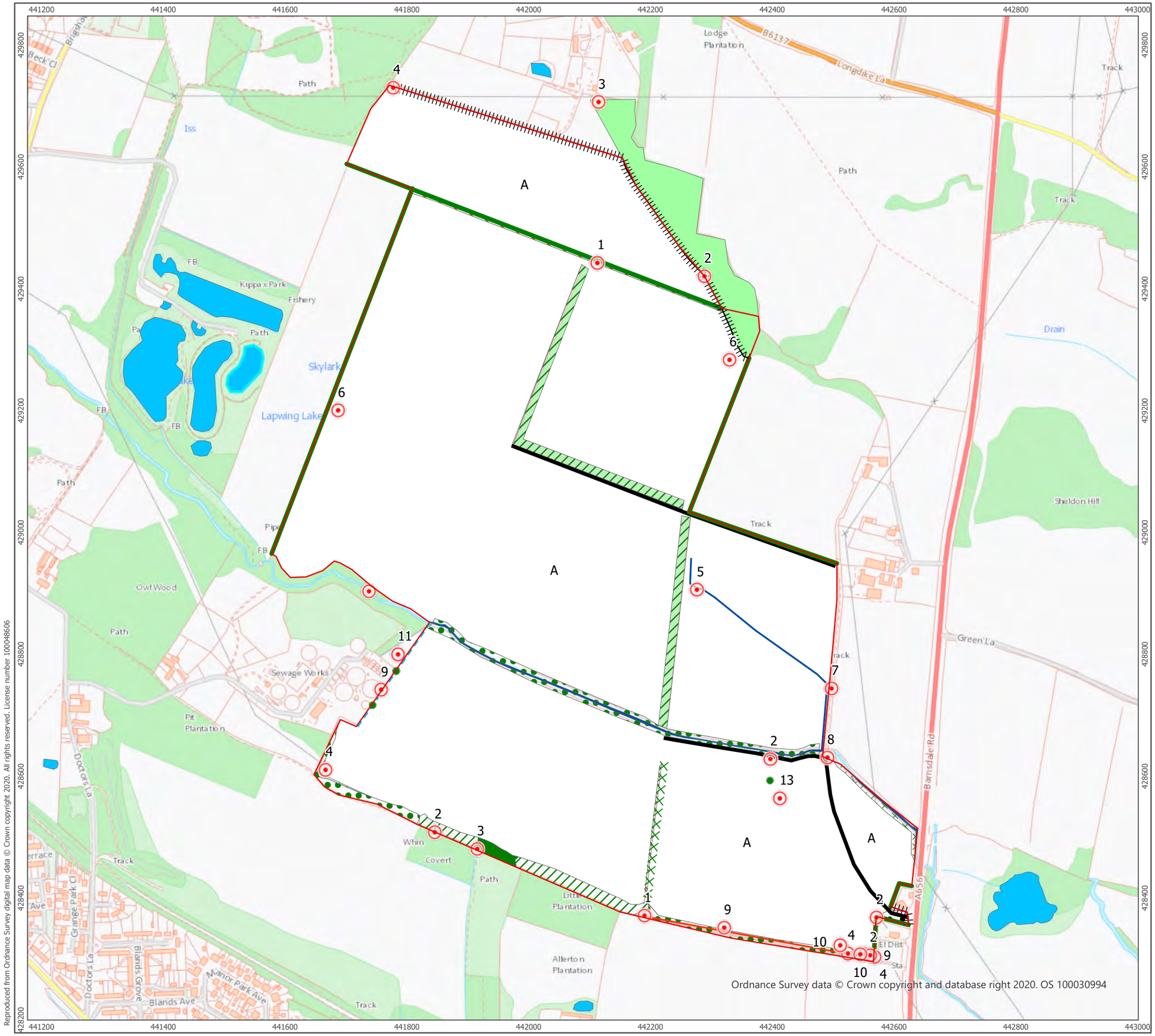
Detailed results are provided in Appendix C. In summary, the scheme delivers a net change of +85.08 % for overall habitat units and +30.03 % for hedgerow units. River units totalled a 0 % net change as this area will remain unaffected by the Development due to its location within the Leeds Habitat Network. Overall, a net gain in biodiversity units, far exceeding the expected 10 %, has been achieved.

7 SUMMARY

The proposed enhancements will increase habitat diversity and complexity by replacing a large area of arable land with species-rich grassland, hedgerows and trees. The native meadow grassland creation will encourage a diverse range of invertebrates which, in turn, will improve foraging opportunities for bats, birds, reptiles and small mammals. A lower input grassland with greater structural complexity will also be beneficial for sheltering reptiles and small mammals. Proposed shrub and hedge planting will deliver a diverse range of pollen, nectar, berries and sheltering resources throughout the year thereby benefitting bats, birds, reptiles and small mammals. Overall, these proposed enhancements will create ecological features and habitats that will complement those existing within and around the Site.

Overall there is a considerable amount of planting proposed and the measures proposed in this LHMP have contributed to a substantial biodiversity net gain of +85.08 % in Habitat Biodiversity Metric units and +30.03 % Hedgerow Biodiversity Metric Units.

APPENDIX A – PHASE 1 HABITAT MAP



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ARCUS

- Site Boundary
- Target Note
- Broadleaved parkland/scattered trees
- Scrub - scattered
- Running water
- Track
- Intact hedge - species-poor
- Wall
- Fence
- Dry ditch
- Broadleaved woodland - semi-natural
- Mixed woodland - semi-natural
- Mixed woodland - plantation
- Other tall herb and fern - ruderal
- Broadleaved Parkland/scattered trees
- Scrub - scattered
- Running water
- Marsh/marshy grassland
- Standing water
- A Cultivated/disturbed land - arable
- Bare ground

1:6,000 Scale @ A3

0 0.1 0.2 km

NORTH

Produced By: NE	Ref: 3768-REP-001
Checked By: SC	Date: 23/10/2020

Phase 1 Habitat Map
Figure 1

Barnsdale Solar Preliminary Ecological Appraisal Report

P:\Projects\Ecology\Projects\3768 Barnsdale Solar\3768 Barnsdale Solar.aprx\3768-REP-001 Fig 1 Phase 1 Habitat Map

APPENDIX B – PRESCRIPTIONS CHECKLIST

Overall Management Objectives	Protect, maintain and enhance the retained habitats; Introduce new native and wildlife-friendly planting within the Site to provide new habitats for local wildlife; Provide features of value for a range of species to include bat and bird boxes and insect hotels; and Undertake sympathetic management of the Site to take into account the continued presence of protected species and other wildlife.
General Management Operations	Annual inspection of all planting with replacement planting as necessary. Annual check and clean of bird boxes (during the winter months) and periodic check of the bat boxes, with cleaning and repairs completed as necessary (Note: any works/checks to bat boxes will require suitably licensed individuals).

Specific Operations	Management Required	Year From Construction					
		0	1	2	3	4	5
Native Tree Planting	Creation of a tree lines. Annual checks undertaken with subsequent pruning, pollarding of trees and replacement planting. Any deadwood to be left on site.		✓	✓	✓	✓	✓
Shade Tolerant Grassland	Controlling weed growth in the first year to allow establishment, followed by rotational cutting every 2-3 years.	✓	✓		✓		✓
Species-Rich Grassland	To be confirmed dependent on management technique selected.						
Native Hedge Planting	Periodic checks, pruning and replacement planting as required. Avoid cutting in spring and summer as birds may be nesting during this time.		✓	✓	✓	✓	✓
Bird/Bat Boxes and Insect Hotels	Install boxes and insect hotels	✓					
	Monitoring for damage, with replacement if required (using licenced individual for bat boxes).		✓	✓	✓	✓	✓
Log Piles	Build log piles in woodland and tree lines. Maintain any dead wood on site.	✓	✓	✓	✓	✓	✓

APPENDIX C – BIODIVERSITY NET GAIN CALCULATION SUMMARY

Site Habitat Baseline

Broad Habitat	Habitat type	Area (hectares)	Distinctiveness	Condition	Ecological connectivity	**Strategic significance**	**Area retained (hectares)**	**Area enhanced (hectares)**
Cropland	Cereal crops	82.35	Low	N/A - Agricultural	N/A	Low Strategic Significance	14.24	0
Woodland and forest	Other woodland; broadleaved	0.13	Medium	Moderate	Low	Low Strategic Significance	0.13	0
Woodland and forest	Lowland mixed deciduous woodland	2.8	High	Moderate	Medium	Low Strategic Significance	2.8	0
Woodland and forest	Other woodland; mixed	2	Medium	Moderate	Low	Low Strategic Significance	2	0
Woodland and forest	Wood-pasture and parkland	1.7	High	Moderate	Medium	Low Strategic Significance	1.7	0
Heathland and shrub	Mixed scrub	0.2	Medium	Fairly Good	Low	Low Strategic Significance	0.2	0
Urban	Vacant/derelict land/ bareground	0.07	Low	Poor	Low	Low Strategic Significance	0	0
Sparsely vegetated land	Ruderal/Ephemeral	0.41	Low	Fairly Poor	Low	Low Strategic Significance	0	0
Grassland	Other neutral grassland	0.05	Medium	Moderate	Low	Low Strategic Significance	0	0
Urban	Built linear features	0.06	V.Low	N/A - Other	N/A	Low Strategic Significance	0.06	0
Lakes	Ditches	0.06	Medium	Poor	Low	Low Strategic Significance	0	0

Site Hedge Baseline

Hedge number	Hedgerow type	length KM	Distinctiveness	Condition	Ecological connectivity	Strategic significance	Length retained	Length enhanced
1	Native Hedgerow	0.12	Low	Moderate	Medium	Low Strategic Significance	0.12	0
2	Native Hedgerow	0.06	Low	Moderate	Medium	Low Strategic Significance	0.06	0
3	Native Hedgerow	0.52	Low	Moderate	Medium	Low Strategic Significance	0.52	0
4	Native Hedgerow	0.66	Low	Moderate	Medium	Low Strategic Significance	0	0.64
5	Native Hedgerow	0.64	Low	Moderate	Medium	Low Strategic Significance	0.01	0.63
6	Native Hedgerow	0.23	Low	Poor	Medium	Low Strategic Significance	0.23	0

Site River Baseline

River type	Length (km)	Distinctiveness	Condition	Strategic significance	Length Retained (km)
Rivers & Streams (Other)	1.07	Medium	Moderate	Low Strategic Significance	1.07

Site Habitat Creation

Proposed habitat	Area (hectares)	Distinctiveness	Condition	Ecological connectivity	Strategic significance	Time to target condition/years	Difficulty of creation category	Notes
Grassland - Other neutral grassland	3.26	Medium	Moderate	Low	Low Strategic Significance	10	Low	Species Rich Grassland (Emorsgate EM3 recommended)
Urban - Developed land; sealed surface	0.004	V.Low	N/A - Other	N/A	Low Strategic Significance	0	Low	
Grassland - Other neutral grassland	65.436	Medium	Fairly Poor	Low	Low Strategic Significance	5	Low	Standard Grassland (Emorsgate EG10 recommended)

Site Hedge Creation

Habitat type	Length (km)	Distinctiveness	Condition	Ecological connectivity	Strategic significance	Time to target condition/years
Native Hedgerow with trees	0.39	Low	Moderate	Medium	Low Strategic Significance	10
Native Hedgerow with trees	0.17	Low	Moderate	Medium	High strategic significance	10
Native Hedgerow with trees	0.35	Low	Moderate	Medium	Low Strategic Significance	10

Site Hedge Enhancement

Baseline habitat	Proposed	Distinctiveness movement	Length KM	Distinctiveness	Condition	Ecological connectivity	Time to target condition/years	Difficulty of enhancement Category
Native Hedgerow	Native Hedgerow with trees	Low - Low	0.64	Low	Moderate	Medium	10	Low
Native Hedgerow	Native Hedgerow with trees	Low - Low	0.63	Low	Moderate	Medium	10	Low

Summary of Results

Units	Total Net Unit Change	Total % Net Change
Habitat Units	+208.59	+85.08%
Hedgerow Units	+2.79	+30.03%
River Units	0	0%