Gloucestershire Highways Biodiversity Guidance

Version 3.2
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Gloucestershire
COUNTY COUNCIL

Contents

Executive Summary

Gloucestershire's Highways & Biodiversity Guidance contains advice to help the County Council implement its statutory duty to conserve and enhance biodiversity (Natural Environment & Rural Communities Act 2006 as amended by the Environment Act 2021) whilst carrying out its highway functions. The document is a useful reference for those involved with matters relating to county highways. The document will be of interest to consultant ecologists but the guide's tables and diagrams are also likely to be useful to County Council staff, highways contractors, utility companies and the general public.

This Gloucestershire Highways & Biodiversity Guidance (GHBG) is relevant to the planning, construction and maintenance of all roads, cycle ways and Public Rights of Way (PRoW). This guidance document excludes activities that are entirely associated with motorways and trunk roads. The latest version of this document will be made available through the Gloucestershire County Council (GCC) website which is currently at this location: www.gloucestershire.gov.uk .

Biodiversity is the richness and variety of species, habitats, and ecosystems. Our quality of life is greatly enriched by biodiversity. It maintains the health of the environment and its people. It contributes to our economy by attracting businesses and also tourists. The county's biodiversity is a precious resource that needs protecting and enhancing for the future and further details can be found on the Local Nature Partnership's website at www.gloucestershirenature.org.uk.

There is a diversity of habitats within and associated with the county highway network. Routes can also pass through, over, or next to grasslands, woodland, wetlands, rivers, and estuaries. Man-made features associated with highways can be important for biodiversity, e.g., boundary trees, rocky cuttings, bridges, ditches, and balancing ponds. Highway land can sometimes support remnants of ancient features, e.g., old meadows on verges and species-rich hedgerows along green lanes. Such features are often refuges for wildlife and can act as corridors that connect wildlife and habitats across the county. Highway land is particularly valuable if it is adjacent to international, national, and local sites designated for their nature conservation importance.

Adverse ecological effects associated with highways construction, operation or maintenance include the loss, modification, disturbance and fragmentation and habitats and/or species.

The GHBG aims to assist in conserving biodiversity by setting out how risks to biodiversity can be identified and then avoided or minimised. The GHBG also advises on identifying opportunities to enhance biodiversity alongside works often achievable at less, similar, or small extra cost compared to a standard highways approach.

Where highways work has the potential to either directly or indirectly affect valued biodiversity the checking of ecological constraints is a vital first consideration. This can avoid dealing with wildlife matters at a late stage. This is not recommended as agreed work schedules and methods will then be more difficult to change. Early consideration of biodiversity impacts reduces the risk of future delays which can be costly and it also allows opportunities for taking wildlife into account to emerge. However, ensuring the safe use of highways for users is a priority over biodiversity considerations particularly in the case of emergency works and actions.

With care many regular highways operations can avoid significant harm to biodiversity if the guidance set out in the GHBG is followed. A recommended procedure for avoiding harm to important biodiversity is presented as a flow diagram (**Box 1** in Section 4 below).

The objectives of the GHBG are:

- *To raise awareness of biodiversity matters affecting highways work;*
- *To ensure highway activities operate within wildlife law;*
- *To reduce the extra costs and delays from not identifying biodiversity issues at the earliest appropriate stage;*
- *To set out practical and realistic activities that will contribute to the protection and enhancement of biodiversity.*

1.0 Introduction

1.1 Purpose

This revised document (Gloucestershire Highways Biodiversity Guidance or GHBG) is relevant to the planning, construction and maintenance of all roads, cycle ways and Public Rights of Way (PRoW). The GHBG is an important part of the County Council's implementation of its general biodiversity duty to have regard for biodiversity whilst carrying out its functions (a requirement of Section 40(1 & 2) of the Natural Environment and Rural Communities Act (as amended). The strategic objectives of this guidance are:

- *To raise awareness of biodiversity matters affecting highways work;*
- *To ensure highway activities operate within wildlife law;*
- *To reduce the extra costs and delays from not identifying biodiversity issues at the earliest appropriate stage;*
- *To set out practical and realistic activities that will contribute to the protection and enhancement of biodiversity.*

1.2 Biodiversity Planning

Biodiversity means the richness and variety of life. It comprises ecosystems, habitats, species, and genetic variation. It is not restricted to what is rare or threatened but includes the whole of the natural world. Our quality of life is greatly enriched by biodiversity. It maintains the health of the earth and the well-being of people. It provides us with food and medicine. It contributes to our economy by attracting businesses and also tourists to the countryside. More on the benefits of biodiversity and the natural world can be found at www.gloucestershirewildlifetrust.co.uk .

Gloucestershire is a highly diverse county and is particularly special for its ancient woodland, unimproved limestone grassland, extensive wetlands, old orchards, and species-rich hedgerows. It supports a range of protected and priority species some of which are becoming increasingly rare such as certain kinds of bats, amphibians, reptiles, invertebrates, and rare plants. The county's biodiversity is a precious resource that needs protecting and enhancing for the future.

The Department for Environment, Food and Rural Affairs (Defra) have produced 'Biodiversity 2020: A strategy for England's wildlife and ecosystem services (2011)[1]' and more recently a 25-year Environment Plan[2]. These aim to ensure that conserving and enhancing (recovering) our environment is considered within all activities. At the local level Gloucestershire County Council is a member the Gloucestershire Local Nature Partnership which encourages and facilitates a county approach to nature conservation which from late 2023 will include a new mandatory Local Nature Recovery Strategy

for Gloucestershire. Further details can be found at www.gloucestershirenature.org.uk .

1.3 Biodiversity Value of the County Network

There is a diversity of habitats and species[3] within and associated with the county highway network. They are usually small, linear, and narrow in extent but within, and next to larger route layouts, there are sometimes more extensive areas of habitat such as on embankments or on large roundabouts. Due to habitat losses elsewhere highway habitats can be significant refuges for some species and can provide links to wider ecological networks within the landscape.

Highway habitats consist mainly of various types of grassland but trees and scrub are also common. Features associated with highways can be important for biodiversity such as boundary hedgerows, ditches, balancing ponds, rocky cuttings and even bridges. Additionally, routes can also pass through, over, or next to other habitats of significance such as woodland, common land, rivers, and estuaries.

As with churchyards, highway land can sometimes support remnants of ancient features, e.g., old meadows on verges and species-rich hedgerows alongside green lanes. They can act as well-established wildlife corridors that facilitate movement across landscapes for some species. Highway habitats are particularly valuable as buffers if situated adjacent to international, national, and locally designated sites for their nature conservation.

The biodiversity value of the highways land holding is not fully known but an indication of the most likely species and habitats that it supports can be attempted. There is a 'List of habitats and species of principal importance for the conservation of biological diversity in England' which is a requirement of Section 41 of the Natural Environment & Rural Communities Act. The species on this list are usually called priority habitats and species and some of these are also legally protected in their own right (e.g., the dormouse). **Table 1** below includes species and habitats that may be associated with highways in Gloucestershire. It is not possible to include everything here especially the full range of invertebrates. The table therefore is included only to reflect the variety of habitats and species that can be encountered on or adjacent to highway land in Gloucestershire.

Table 1 Highways Biodiversity – Priority/Important Habitats & Species

Table 1 Habitats & Species	S41 (NERC Act) List for England	Legal Status
Habitats/Features		
Arable Field Margins & Bare Ground)	✓	
Traditional Orchards	✓	
Hedgerows	✓	HER
Coastal Saltmarsh, Intertidal Mudflats, Saline Lagoons & Estuarine Rocky Habitats	✓	
Lowland Calcareous Grassland (Unimproved Limestone Grassland)	✓	
Lowland Dry Acid Grassland	✓	
Lowland Heathland	✓	
Lowland Meadows (Unimproved Neutral Grassland)	✓	
Coastal & Floodplain Grazing Marsh (Lowland Wet Grassland)	✓	
Wood Pasture & Parkland	✓	
Veteran Trees & Other Trees (in certain situations)		HA, T&CP, FA
Reedbeds (Swamp & Fen)	✓	
Rivers (& streams)	✓	
Eutrophic Standing Waters	✓	
Woodlands (various)	✓	
Plants		
Black Poplar		
Bluebell		WCA
Cotswold Pennycress	✓	WCA
Juniper	✓	
Lichen (*Bacidia incompta*)	✓	
Meadow Clary		WCA
Round-leaved Feather Moss	✓	WCA
Spreading Bellflower	✓	
Stoneworts (various)	✓	
Tower Mustard	✓	
True Fox-sedge	✓	
Wild Daffodil		
Invertebrates		
Glow Worm		
Stag Beetle	✓	WCA
Barberry Carpet Moth	✓	
Butterflies (various) e.g., Small Blue	✓	WCA
Moths (various) e.g., Liquorice Piercer	✓	WCA
White-clawed Crayfish	✓	WCA
Roman Snail		WCA
Snail (*Lauria sempronii*)		
Amphibians / Reptiles		
Adder	✓	WCA
Common Lizard	✓	WCA
Grass Snake	✓	WCA
Slow Worm	✓	WCA
Great Crested Newt	✓	HAR & WCA
Common Toad	✓	

Table 1 (cont'd) Habitats & Species	S41 (NERC Act) List for England	Legal Status
Birds		
All Birds (nesting)		WCA
Barn Owl		WCA
Bittern	✓	WCA
Bullfinch	✓	
Corn Bunting	✓	
Grey Partridge	✓	
Kingfisher		WCA
Linnet	✓	
Nightingale		
Nightjar	✓	
Reed Bunting	✓	
Skylark	✓	
Song Thrush	✓	
Spotted Flycatcher	✓	
House Sparrow	✓	
Tree Sparrow	✓	
Turtle Dove	✓	
Woodlark	✓	WCA
Mammals		
Badger		WCA & PBA
Bats	✓	HAR & WCA
Brown Hare	✓	
Dormouse	✓	HAR & WCA
Hedgehog	✓	
Otter	✓	HAR & WCA
Polecat	✓	
Water Vole	✓	WCA

Note that this list is not exhaustive and works to Public Rights of Way (PRoW) and new highway schemes are likely to encounter a wider range of species. WCA = Wildlife & Countryside Act 1981 (as amended); PBA = Protection of Badgers Act 1992; HAR = Habitats Regulations 2017; HER = Hedgerow Regulations 1997; HA = Highways Act 1980; T&CP = Town & Country Planning Act 1990; FA = Forestry Act 1967. Section 41 refers to the Natural Environment & Rural Communities Act 2006.

Table 2 Summary of designated sites and roads

Approximately as of August 2018

Table 2 Designation Type	Number in the County	Number Over or Next* to a Road	Legal Status (if any)
SAC	7	7	HAR
SPA/Ramsar	2	1	HAR
NNR	4	3	NPAC
SSSI	122	>30	WCA
LNR	11	11	NPAC
Local Wildlife Sites (LWSs)	About 850[i]	>120	
Conservation Road Verges (CRVs)	About 109[ii]	91	

European (International) Sites: SAC = Special Area of Conservation; SPA = Special Protection Area; Ramsar = International Wetland Site; National Sites: SSSI = Site of Special Scientific Interest; Local Sites: LNR = Local Nature Reserve; LWS = Local Wildlife Site, CRV = Conservation Road Verge. Legislation: HAR = Habitats Regulations 2017; NPAC = National Parks and Access to the Countryside Act 1949; WCA = Wildlife & Countryside Act 1981 (as amended).

[i] Contact Gloucestershire Centre for Environmental records for current figure (www.gcer.co.uk)

[ii] See Gloucestershire County Council website for current CRV register (www.gloucestershire.gov.uk)

Table 3 Wildlife Sites with 100m of 'major' roads in Gloucestershire
An analysis of Gloucestershire's motorways, A roads and B roads in November 2005. This reveals that highway works have potential to impact on wildlife sites.

Table 3 Site Type	Motorways	A roads	B roads
SSSIs	2	22	28
Local Wildlife Sites	4	62	87
Conservation Road Verges	0	16	21

1.4 What this Guidance Covers

What is included?

New and existing highways are included covering their construction, alteration, maintenance and use together with the immediate surroundings which are part of or affecting their highway function. Highways matters comprise of considerations concerning county roads, PRoWs, cycle routes, footpaths, bus lanes, street lighting, highways drainage, highways approval/licencing processes, and the Local Transport Plan (LTP). It is expected that utilities services operated/installed within county highways will also be mindful of this guidance.

What is excluded?

Maintenance and new scheme activities that are entirely associated with motorway and trunk roads (e.g., strategic routes such as the M5, M50, and parts of the A419/417 and A40). These are currently the responsibility of the National Highways. Maintenance works on roads that are solely the responsibility of District or other Councils are excluded from the GHBG although use of this guidance is of course welcomed.

2.0 Legislation & Policy

2.1 Legislation and County Council Policy

Also Consult:

'Biodiversity and Legislation – Guidance Notes for Gloucestershire County Council' on Staff Net or from the County Council's Ecologist.

And

The government website at https://www.gov.uk/environmental-management/wildlife-habitat-conservation ***and*** www.wildlifetrusts.org/uk-wildlife-law

The **Natural Environment & Rural Communities Act 2006** (as amended by the Environment Act 2021) gives a duty to conserve and enhance biodiversity for Local Authorities where it is practical to do so whilst carrying out their functions which also includes a regular review of policies. Gloucestershire County Council will take account of the English List (of priority habitats & species), the England Biodiversity Strategy and the emerging mandatory Gloucestershire Local Nature Recovery Strategy when it deals with highway matters. Wherever possible it will help to meet any biodiversity objectives and targets that have been agreed at a sub-county level with communities. The GHBG will be used to help inform the actions of relevant Gloucestershire County Council contractors, parish and town councils, National Highways, utility companies, conservation organisations and landowners.

Three useful internal guidance documents for Council staff supplement the GHBG which are available on StaffNet or from the County Council Ecologist they are:

Bird Nesting Advice Note[4]
Working with Badgers [5]
Biodiversity and Legislation[6]

The third supplementary document to the GHBG listed above covers the most important pieces of wildlife legislation, related policy, and guidance. It includes templates of letters to send to Natural England and flow diagrams/checklists. Here in the GHBG the key pieces of legislation, related policy and guidance are provided including some additional items not included in the 'Biodiversity and Legislation' guide. Readers are always advised to consult the actual legislation itself and take legal advice in complex cases.

Also valuable is Highways England's (now National Highways) 'Design Manual for Roads and Bridges[7] which is currently available (2018) at www.standardsforhighways.co.uk/dmrb/vol10/section4.htm and for managing grassland road verges Plantlife's technical guidance at https://www.plantlife.org.uk/uk/our-work/publications/road-verge-management-guide . For planning applications also see the County Council's ecological planning advice page at www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/ .

2.2 The Conservation of Habitats and Species Regulations 2017

This legislation is also known as the 'Habitats Regulations' for short and derives from a European Directive covering specially protected sites and species. It is currently under review by the government.

If after an initial screening exercise (Stage 1 of Habitats Regulations Assessment – HRA) the effects of a proposal are concluded to be likely to have a 'significant adverse effect' on a European Site (i.e., Ramsar, SPA or SAC) then an Appropriate Assessment (AA) must be carried out (Stage 2 of HRA). A 'competent body' carries out the AA and the Council is considered to

be such a body in relation to highways and planning matters. Natural England (NE) can advise the Council on the scope of an AA but must be consulted to see if they agree with the conclusions of an AA.

For European Protected Species (EPS) such as the dormouse, great crested newt, otter, and all bats there is additional protection to that afforded under the Wildlife & Countryside Act (see below). Important procedures apply when considering planning applications or other proposals that may adversely affect these EPS. The system involves an evaluation procedure and, if required and acceptable, a licensing regime is operated by Natural England. Early consideration of EPS issues is strongly recommended in the planning of many highway works see also the County Council's ecological planning advice page at www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/ .

2.3 Countryside & Rights of Way Act 2000

Section 85 of the CRoW Act places a duty on relevant authorities (which includes GCC) to have regard to the purpose of conserving and enhancing the natural beauty of the AONB. Natural beauty includes biodiversity (flora & fauna) as well as landscape character. An example would be highways works taking account of AONB management plans and related guidance such as the Cotswolds Conservation Board's 'Position Statement on Road Verge Management[8]' and 'Landscape Strategy & Guidelines[9]'.

The CRoW Act also amends the Wildlife and Countryside Act (see below) so that public bodies are obliged to consult Natural England if they or their agents or contractors are undertaking work that may damage a SSSI's wildlife or geological interest. This applies whether the work is being carried out on the SSSI itself or on any other land in such a way that it would affect the SSSI. It is an offence for a public body to carry out, without reasonable excuse, an operation that damages an SSSI without giving adequate notice to Natural England. When going ahead, it is also an offence if they fail to minimise the damage and restore the site as far as practicable. Public bodies can be prosecuted for damaging an SSSI if they fail to follow correct procedures or if they fail to notify Natural England before carrying out or authorising potentially damaging works. For how this operates with planning applications see the County Council's ecological planning advice page at www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/ and the legislation guide on StaffNet for County Council staff or from the Council's Ecologist .

For many routine highway maintenance operations on or near to most SSSIs Natural England has already given the County Council consent under the terms of two special agreements (see Appendix D).

2.4 Wildlife & Countryside Act 1981 (as amended)

The Wildlife & Countryside Act (W&C Act) covers protection of SSSIs (see the CRoW Act above) and also prohibits harm to nesting birds. A useful separate '**Bird Nesting Advice Note**' is available for GCC staff on StaffNet or from the County Council Ecologist.

The W&C Act is also concerned with the treatment and management of protected species listed under Schedule 1 (birds), 5 (mammals, reptiles, fish, and invertebrates) and 8 (plants). The most likely protected species to be encountered in Gloucestershire are listed in **Table 1** of section 1.3. It is an offence to harm a scheduled species but for exact provisions that apply consult the 'Biodiversity & Legislation' guide or the W&C Act or the County Council's Ecologist. The W&C Act also makes it an offence to plant or cause Japanese knotweed, giant hogweed, or Himalayan balsam to grow in the wild.

SSSIs are protected by this Act as amended by the CRoW Act (see above for details).

2.5 Hedgerow Regulations 1997

The District Councils are normally charged with the duty of implementing the Hedgerow Regulations. The Regulations provide protection from removal for hedgerows, which qualify as 'important', based on criteria that include species richness and value to wildlife. In determining a removal application, the Regulations require that the Local Planning Authority serves a Hedgerow Retention Notice on qualifying hedgerows. Only in "exceptional circumstance" such as "in the wider public interest", is the removal of an important hedgerow permitted. Thus, the onus is on the applicant to demonstrate the need for removal. Hedgerow removal can be dealt with outside the Hedgerow Regulations if it is part of a planning application with the standards set out in the Hedgerow Regulations a guide and a material consideration.

2.6 Weeds Act 1959 (as amended by Ragwort Control Act)

The five injurious weeds covered by the Weeds Act are:

Spear thistle (*Cirsium vulgare*)
Creeping or field thistle (*Cirsium arvense*)
Curled dock (*Rumex crispus*)
Broad leaved dock (*Rumex obtusifolius*)
Common ragwort (*Senecio jacobaea*)

In addition to this the **Ragwort Control Act 2003** provides a Code of Practice on how to prevent the spread of Common Ragwort (DEFRA, 2004). Primary responsibility for the control of these weeds rests with the occupier of the land on which the plants are growing. Further guidance on the control of weeds, non-native & injurious plants can be found in Section 5 of the GHBG.

2.7 Protection of Badgers Act 1992

This legislation protects wilful harm to badgers and their setts. Badgers may often forage on roadsides and cross roads at night. Sometimes they may construct setts in roadside embankments and tunnel under the carriageway that can occasionally result in damage to the road from subsidence. A separate guide entitled '**Working with Badgers**' is available for County Council staff on StaffNet or from the County Council Ecologist.

2.8 Wild Mammals (Protection) Act, 1996

The Act makes it illegal to treat any wild mammal cruelly including by crushing, asphyxiating, or drowning. This would include foxes, rabbits, squirrels, stoats, and hedgehogs. So, such animals must always be treated humanely in connection with highways operations.

2.9 Town and Country Planning (Trees) Regulations, 1999

The Town and Country Planning (Trees) Regulations, 1999 places a duty on Local Planning Authorities (District Councils) to make adequate provision for trees and to protect existing trees under a Tree Preservation Order (TPO). New trees may also be covered by a TPO. Trees cannot be cut, lopped, uprooted, or destroyed whilst protected by a TPO unless it is dangerous or the local planning authority (District Council) has given consent. District councils keep lists of TPOs. The regulations also include provision to allow District Councils to protect a tree, group of trees or woodland by placing a TPO on them.

2.10 Water Resources Act, 1991 (& Water Framework Directive)

The Act makes it an offence to cause or knowingly pollute controlled waters. Aquatic habitats are important to wildlife and are vulnerable to pollution or siltation arising from highway land runoff. The objectives of the European Water Framework Directive are currently valid (2018) and also mean that highways operations should aim to reduce risks and impacts to water quality.

2.11 Salmon and Freshwater Fisheries Act, 1975

The Act makes it illegal to poison or injure fish, their spawn, spawning grounds, and the food of such fish. This is important for maintenance operations to bridges or roads adjacent to watercourses where care should be taken that materials do not enter the water. Works involving translocation of fish, due to creation of a diversion channel for example, may require a licence and should be checked with the Environment Agency.

3.0 Highway Impacts and Risks to Biodiversity

3.1 Main Biodiversity Impacts of Highways

Various works on highways can have a negative or positive effect on biodiversity either directly or indirectly. These may be carriageway works or works adjacent to the carriageway such as the removal of vegetation or new habitat creation as part of schemes. Street lighting works associated with highways and developments can also have implications biodiversity. Mitigation of potential impact is discussed further in **Section 5.18** and **Appendix C**.

If there are concerns connected with highways works which are part of a planning application, then these should be passed on to the relevant District Council and their ecologist to see if they are valid observations (or to the County Council Ecologist if a County application). British Standard BS 42020:2013[10] '*Biodiversity. Code of Practice for Planning and Development*' is a useful reference in respect to any planning application (being updated currently).

Managing grass and vegetation adjacent to roads can obviously have an impact on biodiversity. The usual reason for doing such work is safety and maintaining the fabric of the carriageway. Vegetative growth that affects the passage of vehicles, equestrians, or pedestrians and/or obstructs sightlines or the effectiveness of street lighting can significantly compromise road safety. Maintenance of grass and other vegetation is particularly important, this is to secure or improve visibility swathes at junctions and bends. Reducing tree colonisation on verges can also prevent root heave plus related frost damage to highways caused by the growth of mature tree root plates beneath tarmacadam surfaces.

The following items describe the known effects of highway works on biodiversity. These are mainly to do with roads as effects are often much less significant in respect of PRoWs. Recognition of such effects enables positive measures to be taken to mitigate and/or enhance biodiversity. Many of these effects on biodiversity are inter-related.

Habitat Loss and Fragmentation
Habitat loss is a major threat to ecology and ecosystem functioning. In respect of species, it is linked to mortality because survival will depend on the ability of a displaced species to find alternative habitat. Species require minimum habitat requirements to maintain their populations and so the size and the quality of habitat left after a loss is a crucial factor. There is a threshold for many species that makes smaller habitat patches unviable. Research has shown that habitat size is of vital importance to nature conservation, and to a thriving and diverse wildlife (English Nature, 1996[11]; Dufek, 2001[12]; Evink, 2002). The value of a large area of semi natural habitat outweighs its division into smaller areas where alterations, for example to light, hydrology and levels of disturbance can have a radical effect on species survival. To have any

chance reduced habitat extent must be of high quality and not already occupied fully by the same species.

Fragmentation into smaller areas (even of decent quality) can lead to loss of ecosystem functioning plus extinction of predators, larger species, and habitat specialists. It can also affect pollination rates in flora – for example bluebells produce less seed in smaller areas. Road construction and widening can increase fragmentation effects (Treweek, 1999; Evink, 2002; Seiler, 2002). The spatial placement of habitat patches can be more or less favourable for species survival (Treweek, 1999[13]; Evink, 2002[14]; Seiler, 2002[15]). A key issue in a fragmented landscape is the ability of species populations to survive in and move between small, isolated patches of habitat that are scattered through an urban or intensively managed agricultural landscape. Road and wayside habitats can play a role in contributing to an improvement in habitat connectivity and extent and to make species populations (e.g., pollinating insects) more robust. Mitigating habitat loss and fragmentation caused by new highways is difficult and comes down to location, design plus landscaping and if unavoidable offsite compensatory measures.

Physical Barrier

Wildflowers, invertebrates, amphibians, reptiles, and small mammals will be affected by the presence of a highway. Those species, which are unable or reluctant to cross highways, will become isolated and hence lose genetic diversity. This isolation could also lead to the local extinction of some species in the long term, which in turn may affect others up the food chain. The creation of barriers or other obstacles affecting the movement of species may be caused by cumulative development, be it roads and/or housing, within a species range. Road casualties are a significant cause of animal mortality and can continue for decades after construction (Treweek, 1999; Evink, 2002; Seiler, 2002) and numbers are often underestimated from counts (Slater, 2002[16]) as casualties may not all be found within or close to the highway corridor. Collisions with wildlife are also a cause of road traffic accidents and so for this additional reason it is important to try and avoid casualties by good planning and design of highways. Landscaping, green bridges and wildlife underpasses can be measures to mitigate the impact of highways being physical barriers.

Special attention to verge maintenance should be given to locations where large species of mammal could be expected to endanger road users. For example, deer can be seen at certain times of the year and on known rutting routes and clearing a larger depth of verge at these locations can give road users a visibility advantage. There is a review of deer and collisions by Langbein & Putman (2004[17]). **Appendix E** is a useful note produced by the Gloucestershire Wildlife Trust on how highways staff and the public can help to record certain dead mammals on roads which could help with population studies and can identify any road kill hotspots. Collisions with wild boar are increasing in the Forest of Dean and monitoring may help to see if some action can be taken to reduce or stabilise this risk.

Pollution
Pollution from the construction, maintenance and use of highways arises from soil erosion, exhaust emissions, vehicle noise, tyre and road wear, accidents and spillages, excessive use of de-icing materials, lighting, and badly designed drainage. This can result in adverse effects including reduced air quality; the deposition of elevated levels of nitrogen, lead, dust, and particles on surrounding areas; increased noise, vibration, and light impacts on wildlife; and deterioration of watercourses and wetlands (Treweek, 1999; Byron, 2000[18]; Seiler, 2002, Truscott et al., 2005[19]).

The effects of diffuse air pollution on wildflowers can be experienced up to 200 metres away from motorways (Bignal, Ashmore & Power, 2004[20]). Traffic noise has been shown to affect the behaviour of species, e.g., bird densities decline where noise is over 50 dbA. Dutch and Swedish research (Reijnen et al, 1995[21]; Helldin & Seiler, 2003[22]) into breeding bird populations has shown an increased shift away from roads according to the amount and speed of traffic. Artificial lighting can affect the growth of plants; disturb the foraging and breeding of birds and the behaviour of nocturnal species such as bats and moths (Gaston, 2014[23]). Light spill from street lighting can cause a deterrent to some species, such as horseshoe bats, causing fragmentation and making roosts untenable (English Nature, 1996; Byron, 2000). The design of road illumination, where needed, in terms of its spill, brightness and colour is important in controlling the effects on biodiversity. The use of stable or recycled materials in road construction and repair, as well as low emission vehicles, are some further ways that the polluting effects caused by highways might be reduced in the future.

In intensively managed agricultural landscapes run-off onto verges increase levels of enrichment beyond which highways can create alone, e.g., traffic emissions and not clearing away cut vegetation. This can cause problems in maintaining and restoring species-rich grassland vegetation next to highways.

Hydrological and soil changes
The amount and quality of water available within habitats determines the flora and fauna that can survive (Treweek, 1999; Evink, 2002). Rapid surface water run-off from new or changed highways can result in increased flows as well risking water pollution in aquatic environments. The amount of new highway surface, kerbing, drains, balancing ponds, soakaways and berms can be factors in mitigating the adverse effects of highway drainage.

Materials used in highway construction plus spray, emissions, dust, and other particulates from traffic can be deposited on adjacent land or further away via precipitation that can change soil pH, nutrient status, and structure. Vehicle overrun on verges can compact soil and affect its structure and drainage qualities. Soil changes determine which plants and fungi can grow as well as invertebrates that can survive within and above the soil plus other species in food chains (Treweek, 1999; Seiler, 2002).

Changes in numbers of predators and/or prey
Highway changes can affect the balance and numbers of various species within food chains. The increased amount and speed of road traffic can affect airborne invertebrates and small bird populations. Small mammals may eventually increase in new road verges, but this can then attract predators, such as barn owls, resulting in a risk of increased death to these species from traffic collisions if mitigation measures are not put in place (Treweek, 1999; Ramsden, 2004[24]). Here the location, design and landscaping of new highways may be able to mitigate some of these effects.

Disturbance
Changes in patterns of human activity, vehicle use, and polluting effects (see above) can disturb species within habitats next to highways. Such disturbance is of most concern where there is increased public access to or close to sensitive sites. The presence of vehicles and/or humans can cause visual disturbance to some species, for example to wading birds on wetlands and estuaries (Treweek, 1999; Evink, 2002; Seiler, 2002). New street lighting is known to affect wildlife by altering nocturnal conditions for species such as bats and badgers (Outen, 2002[25], Gaston, 2014[26]). Heavy traffic on narrow roads can cause disturbance and damage to verges of biodiversity interest due to overrunning. Mitigation is difficult but comes down to design and controlling speed and levels of use and types of vehicles. The section above on highways being a 'physical barrier' to species is also relevant to 'disturbance'.

Introduction of new habitats
As a result of road construction and changed PRoW routes, new habitats may be introduced as part of landscaping schemes involving earth movements and plant introductions. If not well considered then this may result in the inappropriate introduction of uncharacteristic, non-native, and invasive species mixes which in turn may affect surrounding ecology. Roads are also known to facilitate the dispersal of seed, which can be a concern if inappropriate species have been used (Treweek, 1999; White & Ernst, 2003[27]). An example in Gloucestershire included the use of polyanthus cultivars instead of native primroses and cowslips on a trunk road in the southwest of the County. Introduction of new habitats can of course be positive as an addition and in buffering adjacent areas from the effects of highways.

Inappropriate Maintenance
Lack of suitable or poor-quality management of highways over several years can also lead to some of the effects described above including pollution, habitat loss, fragmentation, and creation of barriers for wildlife. This is a particular focus of the GHBG especially in section 5. Planlife's technical guidance sets out general principles to improve wildflower diversity on grassland verges - www.plantlife.org.uk

3.2 Identifying Risks of Managing the Highways Network

This GHBG aims to make a positive contribution to conserving or enhancing wildlife that is associated with county highways. Unfortunately, as described above, managing the highways network presents risks to biodiversity, which need to be identified so they can be avoided or minimised. The long-term goal should be to conserve or enhance biodiversity (particularly those priority habitats and species on the English List[iii]). If short-term impact is unavoidable then adverse affects on biodiversity need to be appropriately mitigated or compensated.

Section 3.1 above and the following **sections 4 and 5** are relevant to identifying risks. The example of tree and hedgerow work has been entered into a Risk Assessment Table Template (see **Appendix A**). Such a table could be used to facilitate the identification of risk from any highway works. Alternatively, or in addition see the summary flowchart (**Box 1** - Section 4) which shows a recommended general procedure to follow. In considering risks the identification of opportunities to protect and enhance biodiversity should not be missed especially if they can be achieved at reduced, low or no extra cost.

4.0 Checking for Constraints and Opportunities

4.1 Establishing Known Constraints and Likely Impact on Biodiversity

Consult Tables 1, 4 & 5 plus Appendix B (Tables A & B)

Highway's work may have the potential to either directly or indirectly affect valued biodiversity and so the checking of ecological constraints is a vital first consideration at an early planning stage. Dealing with wildlife matters at a late stage is not recommended when work schedules and methods will be more difficult to change. Early preparation of highway plans, projects and work programmes reduces the risk of unnecessary delays that can be costly. This also allows more opportunities for taking biodiversity into account to emerge.

The County Council's Geographic Information System (GIS), a Highways Ecological Advisor, and the Local Biological Records Centre (Gloucestershire Centre for Environmental Records - GCER) can all assist in identifying important sites, habitats and species that might be affected by highways plans, projects and works.

To establish what valued biodiversity might be present two useful checklists at **Appendix B, Tables A & B** should be used as well as **Tables 1, 4 and 5**. The most important task is to request the **Local Biological Records Centre (Gloucestershire Centre for Environmental Records – GCER** at

[iii] Section 41 of the Natural Environment & Rural Communities Act and List of Habitats & Species of Principal Importance in England

www.gcer.co.uk/ **)** to search for important sites, habitats & species within an appropriate distance or area.

4.2 Sites, Habitats and Features of Importance

4.2.1 Designated Sites

Consult Appendix B (Table A)

In Gloucestershire protected (designated) sites include:

International or 'National Network' or 'European' sites:

Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar Sites;

National sites:

Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Areas of Outstanding Natural Beauty (AONBs);

and Local sites:

Local Wildlife Sites (LWSs), Conservation Road Side Verges (CRVs), Local Nature Reserves (LNRs) and Regionally Important Geological/Geomorphological Sites (RIGS).

Special Areas of Conservation (SACs) are designated under the Habitats Directive. They protect important European habitats and species. Special Protection Areas (SPAs) are designated under the Birds Directive. They protect areas of importance for rare and declining European birds. Ramsar sites are internationally important wetland sites and are designated under the Ramsar Convention. All these international sites are protected as 'European Sites' in the UK by the Habitats Regulations and Ramsar government policy.

If work is likely to affect an international or **European Site** advice should be sought from **Natural England** at a very early stage in the planning of highways work. A Habitats Regulations Assessment (HRA) screening exercise should normally be carried out by an ecologist and will normally just involve a desk study but would also be probable to include a visit of the proposed works site(s). If it is established through screening (HRA Stage 1) that there is a likelihood of significant impact to the European Site then an 'Appropriate Assessment' (HRA Stage 2) would then need to be carried out by the Council or other approving authority for the works (e.g., District Council or Environment Agency). It should be remembered that all international sites are also SSSIs and so preventing harm to internationally important features will protect some (but possibly not all) the nationally important features as well. Please consult the County Council's guide 'Biodiversity & Legislation' or an ecologist for further advice on international (European) sites if you are in any doubt as to how to proceed.

SSSIs are Sites of Special Scientific Interest and are designated by Natural England as **national sites** important for their biological or geological features. They form a representative selection of sites that are protected by the Wildlife

& Countryside Act (as amended). If highway works are planned on or near to an SSSI so that it might be affected an assent (or consent) from **Natural England** is required. *For many routine highway maintenance operations on or near to most SSSIs in Gloucestershire Natural England has given the County Council assent under the terms of two special agreements.* There is at the time of writing one agreement to cover roads and another for PROWs (see StaffNet or alternatively obtain copies from the County Council's Ecologist). *For all work operations or sites not covered by the terms of the special agreements Natural England will have to be consulted by way of a formal notice* (for details on how to proceed see the council's 'Biodiversity and Legislation' guidance document available on Staff Net or again alternatively from the County Council's Ecologist).

National Nature Reserves (NNR's) such as the Cotswold Commons and Beechwoods are SSSIs of the very highest quality. NNR aims may include the demonstration of good land management and the carrying out of scientific research.

Local Wildlife Sites (LWSs) are **local sites** important for biodiversity and are identified by the Gloucestershire Local Wildlife Sites Partnership. A handbook has been produced on these sites and information is available on them from the Gloucestershire Wildlife Trust (GWT) website (www.gloucestershirewildlifetrust.co.uk) and also from the Gloucestershire Centre for Environmental Records (GCER at www.gcer.co.uk/). Additionally, Conservation Road Verges (CRVs) are identified by the GWT working in partnership with the County Council. These are a representative selection of sites next to highways that are of biodiversity interest. A register of CRVs is available at www.gloucestershire.gov.uk and on site may be marked between road studs or sometimes additionally signs put up by parish or town councils Finally Regionally Important Geological/Geomorphological Sites (RIGS) sites may be present (e.g. in cuttings or near bridges). These are also known as local sites and may sometimes have some biodiversity value to consider. RIGS are designated by the Gloucestershire Geology Trust (www.glosgeotrust.org.uk).

Local Nature Reserves (LNRs) are designated by Local Authorities with the aim of allowing people to see, learn about and enjoy wildlife (www.magic.defra.gov.uk). They may sometimes also be SACs, SSSIs or Local Wildlife Sites.

Three Areas of Outstanding Natural Beauty (AONBs), the Cotswolds, the Wye Valley and the Malvern Hills are designated to conserve and enhance natural beauty and this includes biodiversity (www.magic.defra.gov.uk). Any of the nature conservation designated sites may also fall within AONBs. The Countryside & Rights of Way Act 2000 confers on Local Authorities a general duty to have regard to the purpose of conserving and enhancing the natural beauty within AONBs. The Cotswolds Conservation Board has produced a position statement on road verges[28] which is relevant to this guidance and can be viewed at www.cotswoldsaonb.org.uk . Relevant to highways maintenance and also new schemes in the Cotswolds AONB, a Cotswolds AONB

Landscape Strategy and Guidelines is also available at www.cotswoldsaonb.org.uk.

4.2.2 Important Habitats and Features

Consult Tables 1, 4 and Appendix B (Table A)

Looking beyond designated sites the existing or proposed highway corridor is most likely to include one or more of the habitats or features listed in **Table 4**. The table also indicates the potential biodiversity issues that may arise or need to be considered. The latest version (once released) of the Gloucestershire Local Nature Recovery Strategy may also have biodiversity priorities for certain habitats, species, and locations and so it is also worth a look - www.gloucestershirenature.org.uk/ .

Table 4 Habitat Sensitivities and Issues on or Adjacent to Highway Land

*Use in conjunction with **Appendix B (Table A)** plus **Tables 1** & **5** and related documents (**Biodiversity & Legislation, Bird Nesting Advice Note, Working with Badgers** – see section 2 above) plus **Table 6** & **Box 1** below.*

Table 4 Highway Land Habitats & Features	Main Sensitivities/Issues (Risks)
Woodland, Scrub, Hedgerows & Trees	Nesting Birds Roosting Bats Dormice Badger setts & foraging habitat Otter holts & resting places (if near watercourses) Ancient Woodland Veteran Trees (important in own right and support beetles, flies, fungi, lichens etc.) Woodland flora (esp. bluebells, wood anemone etc.) Feeding/roosting wintering birds (e.g., redwing and fieldfare) Dead wood invertebrates
Grassland & grass verges/embankments/ cuttings	Unimproved/species-rich grassland Rare, diverse & valued flora (esp. orchids, meadow cranesbill, cowslips etc.) Hunting area for barn owl, kestrel & other predators) Small mammal habitat Badger setts & foraging habitat Slow worm & common lizard habitat; Great crested newt habitat if ponds nearby Glow-worm habitat Tower Mustard habitat Butterflies, moths, beetles Invasion by injurious weeds (e.g., ragwort) Invasion by non-native invasive species (e.g., Japanese knotweed)
Watercourses, Ditches & Ponds, Riparian & Wetland Habitat	Protected and rare species can occur in wetland wildlife habitat (particularly for great crested newt, water vole, crayfish, grass snake, otter, fish, freshwater mussels/snails/beetles) and when this habitat is nearby roads can be crossing points for toads Pollution causing death/loss of fish, invertebrates, and plants Erosion of habitats from high flow/volume of water running off roads Invasion by non-native invasive species (e.g., Himalayan Balsam) Fragmentation of riparian habitat (e.g., to otters) Culverts and pipes can provide barriers to wildlife (e.g., otters) Drying out caused by excessive deepening of roadside ditches Existing & new habitat can alleviate flooding and fit in with road drainage needs
Heathland & Bracken	Heathland is uncommon in the county Scarce heathland wildlife (e.g., nightjar) Adder & common lizard habitat Next to road sites are susceptible to fire
Walls & Rock Faces	May support roosting bats Nesting birds behind vegetation and in crevices Shelter or breeding sites for invertebrates (e.g., snails, bees) Lichen, moss & liverwort habitat Common lizard habitat Tower Mustard habitat Note may have a value for geodiversity may be a RIGS site (check with Gloucestershire Geology Trust)
Bridges, Tunnels & other Structures	May support roosting bats May have nesting birds (e.g., grey wagtail, wren) or insects (e.g., bees) Tunnels can provide routes for wildlife to move through Culverts and pipes can provide barriers to wildlife (e.g., otters) Issues associated with walls & rock faces (above) may also apply

The areas next to and surrounding highway land may include habitat of significant value to biodiversity so potential impacts further afield may need to be assessed. Habitats that may be found next to highway land of biodiversity interest in Gloucestershire include:

- Wetlands (e.g., reedbeds, grazing marsh, lakes, canals, rivers & streams);
- Unimproved and semi-improved grasslands (limestone, neutral & acid);
- Woodlands (broad-leaved, mixed & coniferous plus old orchards);
- Coastal habitats (e.g., estuary, mudflats & salt marsh)
- Other habitats (e.g., heathland, bare ground, rock faces and walls).

A preliminary ecological appraisal (PEA) or fuller ecological impact assessment (EcIA) may be required to properly determine (by survey and desk study) what is present, determine potential effects of works, and derive possible courses of avoidance, mitigation and/or enhancement (section 4.4 below). A general course of action to avoid harm to an important habitat is to be found in **Box 1** (section 4.6 below).

Table 6 details the recommended times of year for habitat (and species) survey work. If a potential adverse impact on a notable habitat or feature (see **Table 4, Appendix B and Table 1**) is identified then measures will be needed to show this will be avoided, reduced, or mitigated/compensated as appropriate. Depending on the location and works involved consultations with the Highways Ecological Advisor, County Council's Ecologist, Gloucestershire Wildlife Trust and/or Natural England may be necessary. Opportunities for enhancing habitats should also normally be explored.

4.3 Important Species

Consult Tables 1, 4, 5 and Appendix B (Table B)

Consider whether the planned work may have the potential to affect important species; this may be the case even if only man-made structures are present. Many works are unlikely to harm important species if the guidance set out in this document (**Table 5 & Appendix B (Table B)**) and related documents (**Biodiversity & Legislation, Bird Nesting Advice Note, Working with Badgers** – see section 2 above) are followed. A general course of action to avoid harm to an important habitat or species is to be found in **Box 1** (section 4.6 below).

In Gloucestershire there are a number of species protected by both UK and European law. For certain species listed in the Wildlife and Countryside Act 1981, e.g., water voles, it is illegal to recklessly or intentionally kill, harm or destroy a place of shelter. *There is no defence if it could have been reasonably known that these certain species were present and likely to be affected by works but measures were not taken to try and avoid harm to these species whilst carrying out a lawful operation.*

For information on important species see **Tables 1 and 4** but particularly **Table 5** and **Appendix B (Table B)**. The Local Records Centre GCER (gcer@gloucestershirewildlifetrust.co.uk or Tel. 01452 383333) can assist in searches for records of protected, priority and scarce species in a given area. The County Council has a Service Level Agreement (SLA) with GCER that operates through the Council's Ecologist and this can be used for certain early investigative enquiries especially if a planning consent is needed at a later stage.

Table 5 summarises some of the **protected** species likely to be encountered in carrying out highway works. However, it cannot be comprehensive and knowledge of the distribution of protected species in the county is still incomplete. Major works and works in sensitive locations are likely to encounter a wider range of species than listed in the table.

A preliminary ecological appraisal (PEA) or fuller ecological impact assessment (EcIA) may be required to properly determine what is present and determine issues and possible courses of action. **Table 6** details the recommended times of year for survey work. You may require a special species licence for highway works to progress legally from Natural England (or via NatureSpace is an option for great crested newts affected in planning applications - https://www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/). The Natural England webpages have licensing details (see www.gov.uk). Consult the Highways Ecological Advisor or the County Council Ecologist for further advice if works planned are likely to affect an important species. A general course of action to avoid harm to important biodiversity is to be found in **Box 1** (section 4.6 below).

Where several notable species are affected by works on the same site or by new construction then enhancement opportunities should normally be focused on the rarest species. This is normally in terms of local populations and to the national context. This does not mean that legal requirements regarding other species present can be waived as minimum requirements under the law must still apply. Advice should be sought from Natural England, the Highways Ecological Advisor or the County Council's Ecologist in difficult situations where more than one protected species is likely to be impacted which appear to have conflicting ecological requirements.

The latest version (once released) of the Gloucestershire Local Nature Recovery Strategy may also have biodiversity priorities for certain habitats, species, and locations and so it is also worth a look - www.gloucestershirenature.org.uk/ .

Table 5 Legally Protected Species Sensitivities and Issues on or Adjacent to Highway Land

Use in conjunction with ***Appendix B (Table B)****) plus* ***Tables 1*** *&* ***4*** *and related documents (****Biodiversity & Legislation, Bird Nesting Advice Note, Working with Badgers*** *– see section 2 above) and* ***Table 6*** *&* ***Box 1*** *below.* * = European Protected Species. Protected by the Habitats Regulations, + = Protected by the Wildlife & Countryside Act, # = Protected by the Protection of Badgers Act. See Natural England website pages for more at www.gov.uk/construction-near-protected-areas-and-wildlife#protected-species

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
Plants		
Protected Plants + e.g., Cotswold Pennycress, Meadow Clary, Round-leaved Feather Moss	Destruction of plants/habitat. Unsympathetic management.	Varies enormously depending on species. Seek expert advice.
Invertebrates		
White-clawed Crayfish +	May be present in clean calcareous watercourses and lakes. Refuges may be found in old or damaged submerged bridge/ retaining wall brickwork, stonework, cracked concrete and/or wooden structures.	Survey watercourses where known or likely to be present. Avoid watercourse bank disturbance. Prevent pollution and silt deposition. Avoid alteration of watercourse or water body. Provide refuges or rock piles. If working in watercourses sterilise equipment and footwear (thoroughly check, clean with hot water and dry completely) before entry to avoid transmission of Crayfish Plague. See www.nonnativespecies.org . Additional consultee is the Environment Agency.
Roman Snail +	May occur on verges with limestone grassland/scrub habitat.	Scrub and grassland cutting is best carried out in winter where this species is known to exist nearby. However, if management outside the winter is required then management of vegetation should be kept to the minimum necessary (extent and just reduce height not cutting to ground level). Management of vegetation on a rotational basis is recommended.
Amphibians & Reptiles		
Great crested newt *+	Ponds may support newts. Ponds mostly occupied in the spring and summer. Also, terrestrial and hibernation phase in hedgerows, beneath hedge banks, piles of rubble, the soft mortar at the bottom of old buildings and beneath hedge banks etc. Road kerbs and gully pots can trap and kill these animals.	Any work that may affect water levels in a pond or pollute it could have an effect on newts. Hedgerow or scrub removal and cclearance of rubble piles within a minimum of 250m of breeding ponds may also affect newts. Determine likely level of impact if great crested newts were to be present. A license is required for disturbance/destruction works of

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
	Roads can fragment metapopulations.	suitable breeding ponds and sometimes too for other habitats with 250m. So, check first if ponds are suitable for great crested newts by assigning a pond suitability index to them. If suitable ponds, then survey for actual presence of great crested newts using eDNA analysis or population levels by using traditional survey methods (bottle trapping/torching). Survey work in both cases to be between April & June and if necessary, foraging/dispersal habitat to be surveyed between June & September. A quicker alternative is to use the District Level Licensing option run by GCC and NatureSpace for great crested newts. See www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/ . Identify and avoid fragmenting known metapopulations of great crested newt. Research and use newt friendly gully and kerb design and try to remove any significant traps identified.
Adder +	Males emerge from hibernation in mid February or early March. From October adders use banks or tumuli - often south facing – with holes/ burrows for hibernation. Adders are mostly associated with heathland although can be found on wet heath, acid/dry grassland, cuttings/embankments, coastal cliffs, partially felled or young conifer woodland and open broadleaved woodland (usually where it occurs next to any of the other aforementioned habitats). Requires safe, warm hibernacula, which are often used in common with other reptiles and amphibian species.	Although some open areas are beneficial avoid over cutting of verges and provide some shelter for them (hibernacula – banks/mounds with cavities within formed by logs/stones) in safe areas such as on south facing embankments. Restrict excavation in verges in areas where snakes occur to outside the period October through January when the species is in hibernation. Prevent establishing any barriers to movement or loss of shelter and foraging/dispersal habitat.
Grass Snake +	Found in wet grassland and ditches throughout. May suffer mortality due to ditch cleaning operations and verge excavation. Requires safe, warm hibernacula, e.g., grass	Avoid over cutting of verges. Restrict ditch cleaning and excavation in verges operations in areas where snakes occur to October through January when the species is hibernation. Prevent establishing any barriers to movement or loss to shelter and foraging/dispersal habitat.

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
	cutting/compost heaps.	Provide winter shelters (hibernacula – see adders above) for them in safe areas. Consider leaving arisings in suitable habitats as compost heaps which can provide good habitat and incubation sites for eggs.
Common Lizard +	Likes open sunny places, and is usually found in dry situations, which may occur in road verges and embankments. Particularly associated with heathland and dry sites. Found also in hedgerows and on grassy banks. In winter can be amongst stones/rocks including walls with cavities. Road kerbs and gully pots can trap and kill these species. Requires safe, warm hibernacula, which are often used in common with other reptiles and amphibian species.	Avoid over cutting verges. Avoid creating unnecessary traps and try to remove any significant raps identified. Prevent establishing any barriers to movement or loss to shelter and foraging/dispersal habitat. Provide shelter (hibernacula – see adders above) for them in safe areas such as on south facing embankments. Avoid disturbance to stone walls/rocks particularly in winter as this is where reptiles can be. Research and use newt friendly gully and kerb design and try to remove any significant traps identified.
Slow Worm +	Favoured habitats include railway lines, derelict land and allotments, heath plus dry and wet grassland. In winter can be amongst stones/rocks including walls with cavities. Road kerbs and gully pots can trap and kill these species. Requires safe, warm hibernacula, which are often used in common with other reptiles and amphibian species.	Avoid over cutting of verges. Avoid creating unnecessary traps and try to remove any significant ones identified. Prevent establishing any barriers to movement or loss to shelter and foraging/dispersal habitat. Research and use newt friendly gully and kerb design and try to remove any significant traps identified. Provide shelter (hibernacula) for them in safe areas using wood, stones etc. Consider leaving arisings in suitable habitats as compost heaps can provide good habitat. Avoid disturbance to stone walls/rocks particularly in winter as this is where reptiles can be.
Birds		
All wild birds +	Must not kill or kill/injure nesting birds or to destroy their eggs plus additionally disturbance to nesting Schedule 1 birds	Timetable works likely to cause disturbance/casualties to avoid the main nesting season, which is March to August for most species. Sand martins, house martins and swallows carry on nesting through September. Even out of the nesting period keep a look out for active nests, e.g., crows & rooks or even blackbirds. Work with potential impact

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
		includes vegetation clearance, e.g., to hedgerows, scrub and trees, work to the underside of bridges, work to waterside banks including piling or deposition of spoil. Also see GCC '**Bird Nesting Advice Note**'
Barn Owl [+]	No disturbance allowed at any time. Juveniles are susceptible to becoming road casualties either whilst hunting along verges/embankments/cuttings or flying across roads.	Consider the maintenance regime and nature of planting/landscaping where casualties occur or could occur. Additional consultee is the Barn Owl Trust. See GCC '**Bird Nesting Advice Note**' and Appendix C.
Kingfisher [+]	No disturbance allowed at any time Riverine species which nest in burrows in vertical banks which can be up to 300 metres away from the watercourse	Avoid works near to watercourses where nest sites are present during the breeding season. All steep bare earth banks should be checked for nests prior to works. See GCC '**Bird Nesting Advice Note**'
Peregrine Falcon [+]	No disturbance allowed at any time. Nests high on cliffs/buildings/quarries	Avoid works close to known nest sites on rock faces and buildings See GCC '**Bird Nesting Advice Note**'
Mammals		
Badger [#+]	Can build setts in road verges or banks, particularly where a woodland or hedgerow is nearby. Highways may intersect with traditional badger foraging routes. Badgers will cross highways and even busy roads where there is no other obvious option. They may tunnel beneath highways particularly where setts are on a slope or embankment. Such activity can damage the highway surface due to subsidence.	Setts may be occupied all year round. Look for signs of badger presence (hairs on fencing, disturbed ground, trails, footprints, and latrines). A licence is required to undertake works with a likelihood of disturbing or damaging a sett. Work usually restricted to the period July to November. Identify schemes/measures that would reduce future road kills or highways damage. See GCC guide – '**Working with Badgers**'
Bats [*+] (all except horseshoe bats – see below)	It is an offence to disturb/harm bats or to damage or obstruct a place of shelter or protection even when temporarily unoccupied. Licence required for all disturbance work.	Bats may occupy some roosts all year round. Survey structures before carrying out repairs to bridges and masonry etc. Avoid removal and/or damage to hedgerows

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
	Old buildings, trees and bridge structures may support bat roosts. Some species sensitive to removal of hedgerows, trees, and culverting of ditches. All species are sensitive to street lighting to some extent and avoid artificially lit areas. Roosts vary according to species – trees, buildings, underground caves/mines. Tree roosts (depending on species and spatial network of habitats) may be adversely affected by works affecting or disturbing the tree or its surrounding habitat.	and watercourses in March to October used by foraging bats (survey may be necessary to check significance of use). Underpasses and guide-in structures in new road schemes need careful consideration. Bats are affected by street lighting in a number of ways so well focused/controlled downlighting with minimal UV and blue/white light is the best choice, e.g., LEDs of suitable colour temperature (less than 4K or with redder component[29] in very sensitive locations).
Bats *+ (Greater & Lesser Horseshoe Bats)*	It is an offence to disturb/harm bats or to damage or obstruct a place of shelter or protection even when temporarily unoccupied. Licence required for all disturbance work. Rely on linear features for commuting routes such as hedgerows, tree lines and ditches. Large trees can also be important (e.g., near roosts). Removal of hedgerows, trees and piping/culverting of ditches may compromise colony survival. Sensitive to artificially lit areas and so can be affected by street lighting illuminating trees, hedgerows etc. in specific locations. Roost in old buildings and Caves/mines.	Bats may occupy some roosts all year round. Identify foraging routes (survey may be necessary). Avoid removal and/or damage to hedgerows, trees and watercourses used by horseshoe bats. Maintain hedgerows as tall bushy structures. Consideration of horseshoe bats in designing new street lighting plus underpasses and guide-in structures in new road schemes. Bats are affected by street lighting in a number of ways so well focused/controlled downlighting with minimal UV and blue/white light is the best choice, e.g., LEDs of suitable colour temperature (less than 4K or with redder component[30] in very sensitive locations).
Dormouse *+	It is an offence to disturb/harm dormice or to damage or obstruct a place of shelter or protection. Licence required for all disturbance work. Hedgerows and woodland are important habitat. Relies on hedgerows and linking tree and shrub canopy branches. Hibernates at the base of hedgerows/trees. Particularly associated with hazel, bramble, and honeysuckle.	Avoid hedgerow / tree removal where dormice are suspected as present. Consider whether it is possible to retain some linking canopy branches when maintaining highways particularly near woods. Additionally carry out new hedgerow planting or gapping up/enhancement with fruit/seed baring species. However, avoid planting hawthorn/blackthorn in and adjacent to areas where dormice are present. Look for realistic opportunities to extend and enhance connectivity

Table 5 Protected Species or Group	Sensitivities/Issues (Risks)	Timing/Action (Controls)
		of dormouse habitat by working with landowners to reinforce hedgerow planting alongside highways with appropriate species.
Otter *+	It is an offence to disturb/harm otters or to damage or obstruct a place of shelter or protection. Licence required for all disturbance work. May build holts in river/stream banks/under tree roots etc. Relies on dense vegetation, bramble, and scrub along banks to provide cover. When rivers/streams are in spate, Otters are forced to crossroads at some 'problem/poorly designed' bridges.	Search for signs of otter when contemplating riverside or streamside bank clearance work or work to drainage culverts. Applies all year round. Identify schemes that would reduce road kills. Mitigation measures may include barrier fencing and ledges under bridges. Additional consultee is the Environment Agency.
Water vole +	It is an offence to harm these animals or to damage or obstruct their place of shelter. Burrows in the banks of rivers, streams, ditches, canals, and water bodies	Avoid diversion, canalisation, straightening, culverting etc. of watercourses. Maintain buffer zones of vegetation next to watercourses which should have areas of marginal/aquatic vegetation. Do not place weed cuttings, dredged silt etc. on retained margins/habitats. Watercourse margins and aquatic vegetation should be rotationally cut & removed to retain habitat whilst maintaining channel capacity. Do this in late summer as a high cut. This should not be done over long continuous lengths in any one year. Additional consultee is the Environment Agency.

4.4 Surveys, Impact Assessments, Avoidance & Mitigation

For some highway works, plans or projects it will become apparent that a preliminary ecological appraisal (PEA) and/or ecological impact assessment (EcIA) by an ecological consultant is required. A Highways Ecological Advisor or the County Council's Ecologist can assist in the judgement and what may be required. Whether the judgement the overall objective is to conserve any existing biodiversity value and look for enhancement opportunities.

Early notification of works that might affect biodiversity is essential if delays are to be avoided. After a desk study involving checking maps for sites and records and checking with an ecological advisor, surveys may be required to ascertain fully the biodiversity value of areas likely to be affected by highways works. It is essential that if these are needed, they are carried out early in the works planning process. Surveys should be conducted by appropriate experienced persons at the appropriate time of year (see **Table 6**). Note that some sites may require a number of surveys at various times of year. Survey results need to be assessed properly to arrive at implications for planned highway work and to recommended necessary measures including if required revision of the project and works (structures, locations, methods, equipment, timing).

Table 6 Ecological Survey Seasons

It should be noted that highway works would not require all of the following surveys but only those that are relevant to determining the potential impacts. Also, severe and extreme weather patterns can vary these recommended survey periods in certain years.

Key: Optimal Survey Time **Extending into**

Species or Group	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Badgers												
Bats (Hibernation Roosts)												
Bats (Summer Roosts)												
Bats (Foraging/Commuting)												
Birds (Breeding)												
Birds (Over Wintering)												
Dormice												
Great Crested Newts[iv]				TERRESTRIAL (rarely acceptable on their own)								
			AQUATIC									
Invertebrates												
Otters												
Reptiles												
Water Voles												
White-Clawed Crayfish												
Habitats/Vegetation												

A sequential approach to biodiversity impacts should be taken in planning and designing work. The first priority should be given to avoidance, followed by mitigation, with compensation as the last resort when not all impacts can be mitigated. Consistent with the statutory biodiversity duty enhancements or overall benefit for wildlife should be sought wherever possible. Survey methods and Ecological Impact Assessment (EcIA) should follow guidelines published by the Institute of Ecologists and Environmental Management (CIEEM, 2016[31]).

[iv] Use of NatureSpace's District Licensing can avoid need for surveys - www.gloucestershire.gov.uk/planning-and-environment/ecology-and-landscape/ecological-planning-advice/

4.5 Enhancement Measures

Opportunities for enhancement works for biodiversity are best identified early in planning highway activities. Enhancement measures include actions to relieve existing problematic sites for wildlife in the highway network, e.g., toad tunnels to reduce deaths on migration to nearby ponds, raised ledges beneath bridges to reduce the need for them to crossroads in times of flood. It could include reducing verge fertility and better management of grassland verges overall. **Section 5** and **Appendix C** include details of measures that can benefit biodiversity both within and outside of the County's highways land.

4.6 Implementation of Works

See also the whole of Section 5

It is possible for unexpected or unlikely situations to arise particularly with regard to legally protected or priority species. Such species may potentially be found on or near a site after work has started. If this is the case or presence of a protected or other important species is suspected, then work should be stopped and reported to the technician or supervisor for the works as quickly as possible. Advice should be sought from the Highways Ecological Advisor, Natural England, or failing that the County Council Ecologist.

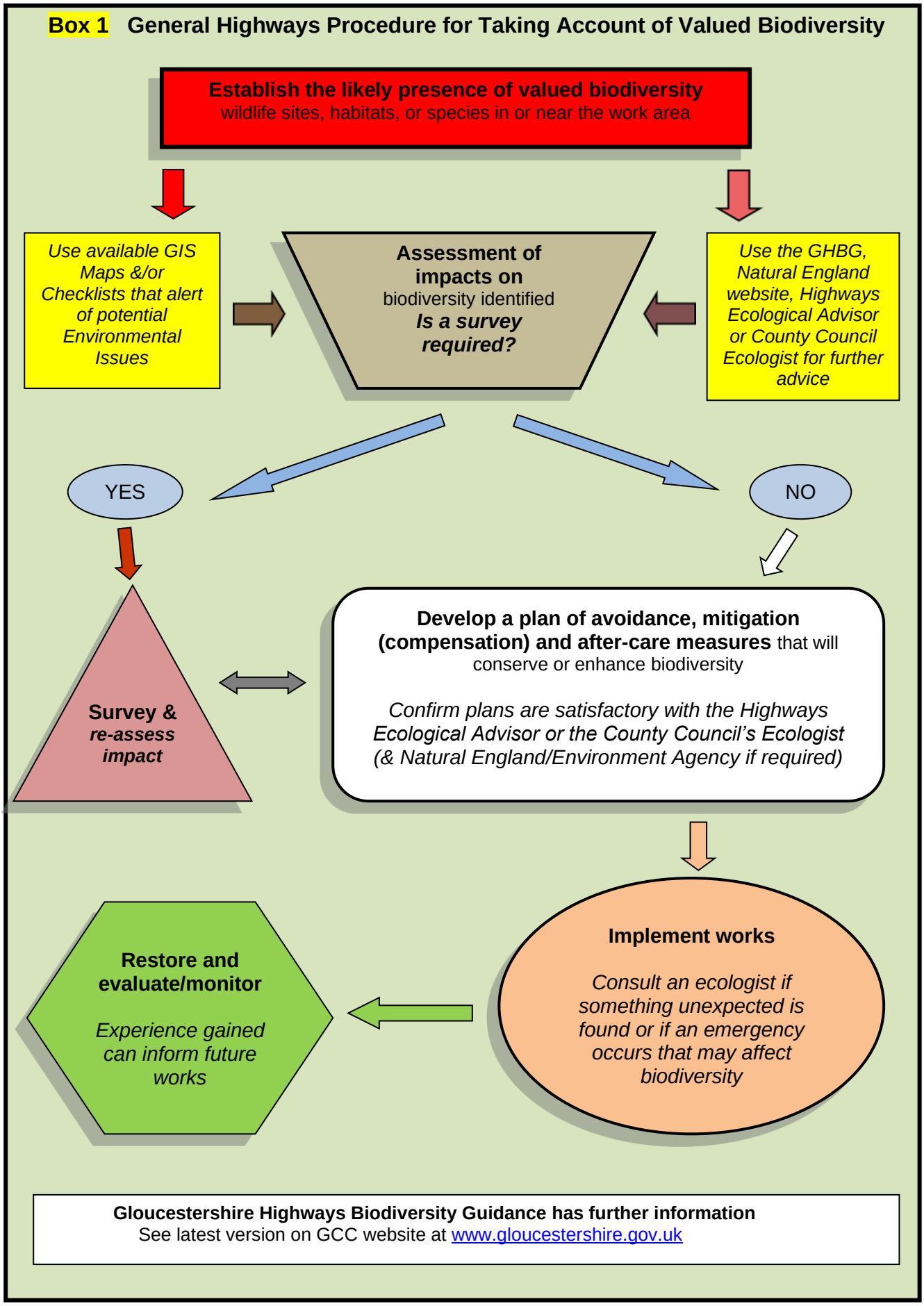
Emergencies can arise within work situations and unexpectedly away from construction, improvement, and maintenance sites. Emergencies are briefly dealt with in **section 5**.

4.7 Summary

Consider whether planned work will involve a significant impact on any designated site, habitat or protected, priority, rare or scarce species. Any adverse impacts should be avoided or if this is not possible then reduced with action taken to mitigate harmful effects. Opportunities for enhancing biodiversity should be sought where possible. Maintaining the safe use of highways for users is always an important concern and in emergency situations can take priority over biodiversity considerations.

If work is likely to affect important sites or species use the guidance contained in this document (sections 2 to 5 & ***Box 1*** *below) to help you take account of biodiversity and to give yourself the best possible chance of avoiding surprises or even prosecution that will result in extra cost and delay. With care many routine operations are unlikely to harm biodiversity.*

Sometimes however it will be evident or advised that ecological surveys and assessments are required before work is confirmed or commences.


Box 1 General Highways Procedure for Taking Account of Valued Biodiversity
Establish the likely presence of valued biodiversity
wildlife sites, habitats, or species in or near the work area
Use available GIS Maps &/or Checklists that alert of potential Environmental Issues
Assessment of impacts on biodiversity identified
Is a survey required?
Use the GHBG, Natural England website, Highways Ecological Advisor or County Council Ecologist for further advice
YES
NO
Survey & re-assess impact
Develop a plan of avoidance, mitigation (compensation) and after-care measures that will conserve or enhance biodiversity
Confirm plans are satisfactory with the Highways Ecological Advisor or the County Council's Ecologist (& Natural England/Environment Agency if required)
Implement works
Consult an ecologist if something unexpected is found or if an emergency occurs that may affect biodiversity
Restore and evaluate/monitor
Experience gained can inform future works
Gloucestershire Highways Biodiversity Guidance has further information
See latest version on GCC website at www.gloucestershire.gov.uk

5.0 Implementing Works to Take Account of Biodiversity

See also Section 4

5.1 General Matters

Highway works need to be *planned* to follow the general guidance set out in **Section 4** above. This part of the document is used to *inform and refine working methods* as necessary. It covers detailed matters that relate to the carrying out of specific tasks and in certain situations. The objective is that highway work that impacts on biodiversity should be minimised and biodiversity is benefited or enhanced wherever possible. Much of what is said here is common sense and is good practice for the Highways Authority as well as for its contractors and partners to follow.

In all situations the chosen approach must *comply with relevant legislation* (see Section 2 above) and avoid significant harm to biodiversity if it is possible to do so. Harm to biodiversity may be unavoidable however if there is only one option (no reasonable alternatives) which may be due to a proven health or safety benefit or imperative economic reasons including that taking a different course of action would incur unreasonably high costs. *Harm that cannot be reasonably avoided will need to be mitigated and produce conservation and ideally enhancement of biodiversity* (Sections 3 & 4 above).

Before any work commences on site make sure that:

- *Any necessary ecological surveys, assessments and consultations have been completed and taken account of;*
- *Communication with the local community (e.g., Parish Council, Community Group and/or adjacent landowners/occupiers) has taken place as appropriate;*
- *All highway personnel are aware of any sensitive sites, habitats and species and the measures that are being adopted to protect or enhance them.*

In general, the commonest highways maintenance and scheme work activities should be carried out in accordance with Table 7 below.

Table 7 Recommended Times for Certain Highway Activity Types

This is intended as a rough guide only. It should be noted that severe and extreme weather patterns can vary these recommended periods in certain years. Also, times are variable depending on species and methods of working to be used.

Key: Optimal works time **Extending into** **Not recommended**

Works Activity	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Grass Verge Cutting												
Visibility Splay Cuts/Amenity Grass within settlements												
Cutting (pruning) trees, shrubs, scrub, bramble & hedgerows												
Sowing Seed												
Planting Bare Rooted trees/shrubs/herbs												
Planting Pot grown trees/shrubs/herbs												
Cleaning/dredging/jetting grips, ditches, ponds												
Herbicide use and other control methods for injurious weeds and non-native invasive species												

5.2 Grassland

The biodiversity value of grassland verges is largely based on whether it is cut, left unmanaged or affected by herbicides, fertilisers, salt, oil, dust or atmospheric pollution. The *frequency and method of cutting* is an important influence on species composition and abundance[32] despite other factors operating. *Removal of cuttings* on nutrient rich sites[v] can have the added benefit of maintaining or improving plant biodiversity. Where cuttings are not removed tall and tussocky growth will often develop and plant diversity will be low. However, one must be mindful that invertebrate, mammal, amphibian, and reptile biodiversity maybe a priority and can sometimes be to the detriment of plant richness in certain situations. There is scope however *on wider verges to provide habitat for a bigger variety of wildlife* if taller, more infrequently cut vegetation is allowed towards the back of the verge. A Gloucestershire example is the Liquorice Piercer Moth which requires about a 4-year rotational cut where the wild liquorice plant is present. Some invertebrates will need both patches of taller and shorter vegetation to survive but plant species composition can be important too.

[v] Increasingly seems to be the case and is likely due to water running over verges from adjacent fertilised agricultural land as well as general nitrogen deposition from the atmosphere and more specifically from passing traffic emissions. This can temper what is possible from verge management methods alone.

It can sometimes be difficult to set exact times for cutting a particular verge with a biodiversity interest. This is because of *seasonal variations* in climate that can affect growth rates and flowering patterns. A slightly flexible period can be used and cutting targeted within this depending on the amount of vegetative growth or plant height or flowering/seeding patterns recorded. A general rule of *annual cutting in August (mid July) to the end of September* is ideal for *plant diversity*[33] and on vigorously growing verges another cut in October to February can be taken. This is what Plantlife[vi] have advocated as the basic management for enclosed, grassy verges. This allows the verge to be left alone in spring and most of the summer so that plants can flower and set seed. Where it is possible cut material is best removed (easiest on level wide verges) and then either left in a sacrificial area or taken for composting/bio-fuel use). Over time this should reduce the amount of vegetation needing cutting and frequency for no more than once a year.

Cuts made later in the year (October/November) can encourage annual plants (e.g., grass vetchling, white campion, Cotswold Pennycress, Tower Mustard, yellow wort & autumn gentian) and late flowering perennials (e.g., field scabious, sweet cicely, wild carrot & common toadflax). Late summer cuts also give protection to ground and other nesting birds if they are suspected of occurring on a site (August/September).

Cuts carried out too early in the growing season can prevent some plants from flowering and/or setting seed. A large number of invertebrates such as beetles, flies and bees depend on flowers for their survival. Birds such as linnet and goldfinch make use of the seeds (especially thistles and docks). If *invertebrate conservation* is more a priority, then *cutting is best done between October to February* and cutting across a verge is done at *different heights and some areas cut on a longer rotation*.

Frequent cutting, which is often carried out in urban areas or where visibility is a crucial safety issue, are usually of limited value for biodiversity. Such treatment kills off many plant species and reduces cover for animals. Where there is cutting from June to September only flora of spring flowering and annual species can be supported but these may not be scarce in the county and so not a priority.

Infrequent or no cutting benefits bramble, scrub and trees and can support a range of animal species. However, if the grassland is an important one (SSSI, LWS or Conservation Road Verge (CRV)) or important views of the landscape need to be maintained from a highway then this should not be the preferred approach. Good species-rich grassland (meadow) is a rarer habitat.

The main points for implementing highways grassland maintenance are:

[vi] Managing Grassland Verges – Plantlife 2019 - https://www.plantlife.org.uk/uk/our-work/publications/road-verge-management-guide

1. *Communications* between contractors and area highways/PRoW officers should take place pre-season (January to April) to establish where basic grass cutting, special cutting treatments and no grass cutting at all is to happen. In this respect it is important that *Conservation Road Verges* (CRVs) or other designated sites are clearly identified on digital mapping, printed plans &/or on site as these will need to be taken into account in confirming the cutting regime for each year. Check where Parish/Town Councils have agreements with the Highways Authority to manage most or some of the verges in their area.
2. If possible, *remove grass cuttings* from the verge or path that would normally be left where it falls. The cuttings can be left in a sacrificial area or taken to green waste recycling/composting or biofuel facilities. On designated sites and CRVs there are real identifiable biodiversity gains to be had from removing grass cuttings. This removal will generally need to take place at the time of cutting or only a few days afterwards in the interests of reducing the nutrients being returned to the soil. Steep banks on shallow soils and in heavily shaded areas may not always need cuttings to be removed to sustain their characteristic/valued flora.
3. It is generally recommended that *the first cut should be delayed* until at least mid July and normally completed where needed by September. This should be achievable on many roads where it is safe to do so, e.g., away from junctions and visibility splays. Alternatively, or additionally cuts between October and February in dry conditions can be considered. If the site is shaded and has a good spring woodland flora (e.g., bluebells, wood anemone, wild daffodils) then winter cutting after December is not recommended.
4. *Cuts between mid April and early July* should be restricted to locations and zones where there are safety concerns such as to maintain visibility on corners and junctions or where a path meets a road. On certain urban routes and on complex road junctions (that require high visibility) then cutting may need to be frequent throughout the spring and summer months. On PRoWs in high growth years second and third cuts may be necessary in some places to facilitate continued access.
5. Grass cutting operators should be aware of the presence of ground and other *nesting birds*, particularly when cutting PRoWs where they are more likely to occur (See '**Bird Nesting Advice Note**').
6. On some paths and carriageway edges a ***'no cutting regime'*** is possible and could be adopted where safety is not an issue. This can be done where a more self-sustaining habitat of value has become established but ultimately a cut every 3 to 6 years will probably be needed to avoid scrub and tree colonisation.
7. Generally, there is agreement with the Gloucestershire Wildlife Trust and other Conservation Bodies and some Parish/Town Councils that if there is doubt there should be no cutting on *Conservation Road Verges* (CRVs) due to their biodiversity value. However, this value is most often sustained by at least general basic verge management (see 3 above) *or sometimes by specific or experimental treatments* for particular species including wildflowers, shrubs, invertebrates, and

mammals. An example of this is conservation of the liquorice piercer moth or the use of the use e of yellow rattle to suppress growth of vigorous grasses[3435].

8. A *cutter bar that is set no lower than 10cm*, will allow small plants to flower and set seed (English Nature, 1999[36]).
9. *Width of cut* is usually about 1m but should be considered for up to 3 m on wider road verges and paths. Wider cuts may not be possible where certain rare invertebrates or other valued species are known to be present that need conserving in a different way. An alternate to full width cutting especially on narrower verges and paths is to only cut intermittent sections (up to 100m long per section[37]). PRoWs are cut to the width necessary to allow use of the path without encroachment from vegetation, e.g., wet vegetation hanging into the path. This will be approximately 1 metre for a footpath and up to approximately 3 metres for a bridleway to allow horses to pass each other. Widths vary depending on what is specified in Definitive statement and other PRoW records.
10. Between October and February in dry conditions a *full width* or *restorative cut* is recommended between 1 and 5 years maximum. This is for where grassland is to be maintained and scrub/woodland development avoided.
11. Restoration by *removing the top soil and exposing sub-soil* of verges (which should be roughened up) can reduce fertility and promote a species-rich flora. Use of local green hay or seed can be additionally used but nay dressing or top soil should only be very lightly returned to the surface to speed up restoration.[38]

5.3 Hedgerows

For hedgerow trees also see the section on trees that follows.

Hedgerows are often important features for biodiversity. They are habitats that can function as wildlife corridors linking other habitats. Hedgerows can also have landscape and historical value.

The County Council owns relatively few hedgerows, they usually belong to the adjacent landowner, and so GCC Highways does not often carry out hedge trimming. If a hedgerow is causing visibility or access problems on a highway, the landowner will be asked to cut it. If it is not possible to get hedgerows cut in any other way, the County Council may take action.

Dense and mature hedges, especially when associated with grassy verges, are valuable for wildlife and support birds like chaffinch, dunnock, greenfinch, robin, song thrush, tree sparrow, whitethroat, wren, and yellowhammer. Late winter management of hedgerows will mean that berries and other fruits are left for over wintering birds such as fieldfares, redwings or even waxwings.

Hedgerows need to be managed sensitively not only for biodiversity but for their original intended use as an effective stock proof barrier and also a

characteristic feature of many landscapes. Where a hedgerow also consists of a large raised (often ancient) bank this should be managed as a hedgerow, grass verge or wall which ever is most appropriate. The general rule is not to manage too harshly so that damage does not occur to the bank or wall which can have a historical as well as biodiversity value.

Annual trimming is usually only necessary on the on the roadside face of hedges to maintain a safe width for the highway user. Sometimes the top will also need to be trimmed especially if the hedge is owned by the council and continuing health and value as a feature is required. Trimming should be anticipated as a need before it becomes a problem to highway users in the summer months to follow. It should be carried out in autumn or winter when trees and shrubs are still dormant (February is the ideal month for woody plant health and to retain fruits and seeds for birds for as long as possible). Different shrub species in hedges respond in different ways to trimming. Continued rather than occasional trimming, of hazel for example, will lead to a weak and gappy hedge that will not be stock-proof or hold much value for wildlife. Other species, like hawthorn and blackthorn can respond well to more frequent trimming.

Flailing undertaken responsibly can produce dense and bushy hedges that are thick at the base. For cutting back older, thicker stems consideration should be given to using a circular or other appropriate saw.

For a practical means of *reducing hedge size and rejuvenating* the growth of many woody species hedge laying may be a consideration. This is a traditional form of management and can be carried out as infrequently as once every twenty years. This was once a widespread practice although not every hedge was laid. Longer lengths over a few hundred metres are unlikely to be suitable for this treatment unless tackled on a rotational basis over several years.

Some roadside 'hedges' more closely *resemble woodland edge* and may never have been managed as a hedge. This type of scrub may be coppiced using an appropriate saw or lopper (i.e., cut down to near ground level and allowed to re-sprout). This is done in winter on a regular cycle of 3 - 10 years.

There is less predation of chicks from nests in *A-shaped and sloping hedges* created by appropriate cutting. This is thought to be due to better cover and camouflage. Conversely, nests are highly visible in a flat-topped hedge leading to a greater loss of young birds.

Taller, thicker hedges offer:

- ***Shelter to stock*** - Reduced wind speed, which can have an effect into the field up to 12 times the hedge height.
- ***Shelter to crops -*** As above - higher field temperature will lead to an increased soil temperature, particularly important in the spring.

- ***Greater wildlife value -*** More food sources, nest sites, song posts and protection in a higher, bulkier hedge for birds, small mammals, and insects.
- ***Saplings can develop*** - These can be tagged (to be highly visible to the trimmer if needed to grow the next generation of hedgerow trees.
- ***Savings on trimming bill -*** Less frequent trimming can save money and time even with a greater volume of material to remove.

Where a highways scheme or operation proposes to *remove or significantly alter* the structure or alignment of a hedgerow, public safety may be considered an "exceptional circumstance" to permit this. However, where the hedgerow is deemed to be an important one under the 1997 Regulations it may be considered that its retention would out-weigh any potential gain in public safety (District Council will advise). Details of safety issues must be provided in a qualified and reasoned approach that is understandable to the non-specialist. Any mitigation measures should accompany any hedgerow removal application to the District Council, e.g., translocation or planting of a new hedgerow.

If anything, more than maintenance trimming is planned, e.g., thinning the width by more than 50%, setting back the position of a hedge or complete or partial removal, then the Hedgerow Regulations 1997 may apply, and the District Council should be contacted.

The main points for implementing highways hedgerow maintenance are:

1. ***Time of year***
   Trim/cut back/restore hedges in winter (November to February). Try to avoid extensive lengths always leave some to cut in a year or so unless there is plenty of similar adjoining habitat on non-highway hedges. Ideally carry out cutting of *in late winter* (February) to leave fruit for birds and mammals throughout the autumn and winter. Never trim when frost is highly likely or during the bird nesting season (March to August) as it is an offence to disturb nesting birds.

2. ***Frequency***
   A 2 – 4(10) year rotation is recommended to allow some sections of hedge to *flower and set fruit* every year. Gappy hedges can be grown tall and restored by laying and coppicing. Continue to trim roadside hedges annually in winter to maintain visibility at critical points.

3. ***Depth of Cutting***
   If only trimming do so a few centimetres further out from the last cut if possible. Cutting back to the same point will remove the new branching points, so new growth will have to come from old wood which will not happen readily in all species. When cut repeatedly this way the whole plant may also become weakened and may even die. Trimming further out with each successive cut will allow the hedge to grow in height and width. This can then be *trimmed back on a long restorative rotation (between 10*

and 25 years).

4. ***Dealing with hedgerow trimmings***
   Trimmings should not be left on the carriageway or path or vulnerable habitat for any prolonged length of time. Substantial amounts of trimmings and cut branches/logs can be a particular hazard for cyclists and sometimes horses and walkers also. Hedgerow trimmings can also damage ground flora if left in thick piles. Remove these if possible or if they must be left on site try and chip woody material and spread it over small areas which have low biodiversity value (around tree/hedge bases especially if in dense shade with little existing vegetation). Chippings or log remains should particularly avoid species-rich grassland or ponds/ditches.

5. ***Hedge profiles (shape)***
   Shaping the hedge to a profile, rather than 'flat topping' is an effective way of developing taller, thicker hedges and it also one of the most beneficial yet simplest ways of helping wildlife. Trimming at a 30-45 degree angle has many benefits over the traditional 90 degree cut – it will let more sunlight penetrate the body of the hedge to stimulate growth, allow saplings to develop and hedges to give more blossom and fruit. Leave hedge tops uncut and trees in places for birds. Annually or biennially trim the side of the hedge to prevent it encroaching into a path, track, or highway. The top of the hedge is best trimmed in alternate or intermittent sections preferably in February or failing that November to March. This will avoid removing sources of food (berries/fruit) for wildlife (such as birds) during the winter months.

6. ***Tunnel Structures***
   Where hedges have grown up on both sides of a highway to create a *'tunnel'* structure, trimming should not destroy this effect or at the very least maintain some canopy links across the highway width. Tunnels can provide important habitat links for species such as dormice and bats.

7. ***Hedge gaps***
   Gaps in hedgerows should be filled in by allowing natural regeneration to occur or by replanting with native species found in nearby hedgerows. Native species of local provenance (progeny of plants growing close by or as near as is practicably possible) should always be used in preference to exotic species, unless there are exceptional circumstances, for example a restoration of long-established ornamental hedge or certain urban situations amidst hard landscaping.

8. ***Selection of species***
   Species mixes for new hedgerows will be specified in the ecological report accompanying highway schemes that include hedgerow works/landscaping.

5.4 Trees

The County Council owns only those trees that have been planted or have established themselves within the highway limits, but otherwise *most trees near to roads usually belong to the adjacent landowner* (almost exclusively the case with PRoWs). This means *tree management is not often carried out by the County Council as highways authority*. However, if a tree is causing visibility or access problems on a highway, the landowner will be asked to undertake appropriate management. Where trees are causing a safety issue and this cannot be dealt with in any other way the County Council will take action. In an emergency situation (such as after a storm where trees and branches have fallen across main roads) the County Council will normally take immediate action.

Where mature trees are present on a work site and may be at risk from damage the County Council will establish opinion from the relevant District Council if such trees might be protected by a *Tree Preservation Order* (TPO) or be within a Conservation Area. The District Councils usually consider applications for works to protected trees within 8 weeks. Large, old trees are often called *veteran trees* and can have special biodiversity value (e.g., for insects and bats) so these need an opinion from the District Council's tree officer and/or ecological advisor about risks and appropriate working methods.

Indirect works such as *trenching or cabling* have potential to damage tree roots. The County Council and utility companies should avoid locations with roots or if this is not possible employ hand digging or other techniques that will minimise unnecessary root loss. The Centre for Ecology & Hydrology has produced a review and guidance called Tree Roots in the Built Environment (Roberts et al., 2013[39]) and also available is BS 5837: 2012[40] '*Trees in relation to design, demolition, and construction. Recommendations'* from the British Standards Institution.

Tree cutting (surgery) may be necessary on occasions in relation to safety issues or new highway schemes. Occasionally on highways overhanging growth will be removed from shrubs or trees adjacent to routes to allow safe access. Recently tree disease has become a more common safety reason for a tree to need removing particularly those with or almost certain to succumb to ash die-back disease (see the Local Nature Partnership's Position Statement on Ash Die-back at www.gloucestershirenature.org.uk and GCC website at www.gloucestershire.gov.uk/planning-and-environment/climate-change/greener-gloucestershire-climate-action/trees/ash-dieback/replanting-two-trees-for-every-diseased-tree-felled/). 'It is good practice to inform the local District tree or landscape officer but particularly the Parish Council if a tree has to be felled. All such work is best done between November and February. Tree surgery on 'veteran or significant' trees (e.g., very mature & TPO trees) should be carried out with the minimal work as necessary (should either be unavoidable for safety reasons or a positive measure to prolong the life of the tree). The Highways or County or District Arboriculturalist should be contacted for advice on any work that may affect trees. Tree surgery methods that can be employed include pruning and pollarding but good practice and the following of British Standards such as BS 3998[41] or BS5837 (see above) should be used as appropriate.

Where trees in hedges have grown up on both sides of the highway to create a *'tunnel'* structure, trimming should allow traffic to pass without destroying this effect. Tunnels can provide important habitat links for species such as dormice and so should be managed sympathetically, i.e., limited tree pruning carried out for safety and access reasons. At worst canopy links should be maintained in a number of places.

Felling of any tree should preferably be avoided and if time allows the District and local Parish or Town Council should be informed. Trees should only be felled if it is diseased (or soon will be) or damaged or causing an obstruction and constitutes an unacceptable safety risk. Roadside trees exhibiting any clear signs of danger such as die back, split limbs and excessive lean require attention, especially for the safe passage of commercial vehicles and public transport, to avoid shifted road position. Age itself is not a reason for felling. If safe to do so consideration should be given to retain the tree trunk as a tall 'monolith', which would provide dead wood habitat for a period of years. If the old tree stump is not considered to be dangerous it should be left in situ either to re-grow or provide a niche for dead wood invertebrates and fungi. Stumps may be treated with an approved biodegradable herbicide if it is imperative for safety reasons that the tree should not re-grow (Defra and Environment Agency provide guidance on the use of pesticides especially near water). Cutting back re-growth repeatedly over several years can weaken the growth and make the use of herbicides unnecessary.

How *woody material is disposed of* depends upon the quantity involved and arrangements that can be made with the adjoining landowner or Parish Council etc. Woody waste material can be a particular hazard for cyclists and sometimes horses and walkers so this must be considered. Wood is usually stacked and left on the land (creating dead wood habitat piles), or it may be arranged for the County Council, highways contractor, landowner, or local residents/volunteers to remove and use it. It is more likely that large pieces of wood would be removed from site, but this has to be balanced with the accessibility of the site for removing the wood & associated costs and safety issues. Large logs are of benefit to wildlife so if they can be left in a safe and hidden place without damaging too large an area of valuable flora then do so. Chippings and sawdust should be removed from good grassland sites but on less sensitive sites may be spread thinly (e.g., on bare patches under trees/hedgerows where there is a poor flora) or left in small, scattered piles away from sight.

When a tree has been felled a *replacement* of the same species, or an appropriate alternative native species should be considered if it is safe to do so because an important landscape, amenity or ecological reason exists. The GCC Tree Officer and the Cotswold Conservation Board hold lists of suitable tree species to plant. Usually, the new tree should be planted adjacent to the stump of the felled tree and given some aftercare (weed clearance and watering in a drought, pruning and subsequent removal of any tree guard remains) for a period of at least 3 years. If the tree was felled because it was dangerous by virtue of its location, a replacement should be planted at an

acceptable nearby or other location (such as part of a landscape or ecological network initiative).

Further useful guidance on managing trees within the highway have been produced by the Forestry Commission (Highway Tree Management : Operations Note 51[42] at https://www.gov.uk/government/publications/highway-tree-management-operations-note-51?utm_source=7dedc539-832d-4da3-af35-9ed2bc5b0274&utm_medium=email&utm_campaign=govuk-notifications&utm_content=daily).

5.5 Scrub and Saplings

Scrub supports a range of species and is particularly good as a food source (e.g., berries) or shelter. Where roadside scrub needs to be cut back, it should be *coppiced* on a regular cycle, commonly between 3- 10 years. Scrub growing within two metres of the carriageway should be cut every three years. Common species include hazel, hawthorn, and blackthorn. The cut stumps should normally be allowed to re-grow, and not be removed or treated with a herbicide.

However, on PRoWs and on wider road verges that are infrequently cut clearance of scrub may sometimes be necessary not just for safety and access reasons but also for environmental ones. There can be landscape character benefits by its careful removal if open views are sought). In suitable highway locations the removal of young trees and shrubs followed by regular and wide swathe cutting can deliver the following benefits:

- *conservation/enhancement of species-rich grassland and habitat connectivity;*
- *opening up of scenic views and the distinctive character of landscapes.*

Scrub and sapling work is *best done in the winter* during the period November to February and this also means that the bird-nesting season is avoided. How woody material is disposed of is considered in the section on trees above.

Sometimes scrub and young tree (sapling) cutting may necessitate the *removal of stumps* or their treatment with an approved herbicide to prevent re-growth. Cutting back re-growth repeatedly over several years can weaken the growth and make the use of herbicides unnecessary.

5.6 Planting and Sowing

If possible and acceptable disturbed and newly exposed ground should *be left to re-colonise* naturally, e.g., rock faces, where it is adjacent to existing good quality habitat, too small or costly to landscape. This will provide good diversity and be of lower fertility and require less management in most cases.

Some weed or non-native species control follow up can sometimes be needed though (see also sections 5.5 & 5.17).

Avoid new planting and sowing close to the carriageway where there is a high risk of damage by salt, e.g., on major priority routes identified by the winter maintenance programme (see section 5.9 below). Newly planted and sown areas may need aftercare such as watering during dry periods and some follow up pruning or weeding (see also sections 5.4 & 5.17).

Prior to planting and sowing (where deemed a requirement) some *re-profiling of the soil or cultivation* may be needed to provide a good planting or seed bed. This may include scarifying, digging, rotovation and some gentle compaction perhaps for seeding. The best time for tree and shrub planting is between November and February. The best times for seed sowing are usually April or September. Best wildflower seed beds are low in fertility so sub-soil with a little or no top 'soil' dressing is sufficient. Often natural colonisation of suitably roughened up bare substrates is the best option.

Seeds and plants should be suited to the location, be native species of local, regional, or English/Welsh origin. Mixtures should be based on natural plant communities except perhaps in more formal settings within urban or village locations. The Highways Ecological Advisor or the County Council's Ecologist can advise further on this matter. The former Flora Locale organisation published a useful publication called '*Go Native! Planting for biodiversity*'[43] which is still relevant.

New or landscaped ground sown with an appropriate wild flower/grass seed mixture (see above) must be able to *tolerate* the required management regime as well as soil/substrate type, aspect, and degree of wetness. In urban areas and within smaller settlements more *formal* hard wearing amenity grass areas may be established. However, it is recommended that in places these improved grass areas should be enhanced with bulbs, beds of nectar-rich colourful floral displays or if appropriate trees/shrubs that are known to benefit butterflies, bees, other invertebrates, birds, and mammals. This can include creating annual displays each year on cultivated ground such as of cornfield annuals. Non-native (but non-invasive) species can be used with caution if they have a biodiversity value (e.g., nectar rich flowers, edible fruits, and seeds).

5.7 Visibility Splays and New Verges, Embankments & Cuttings

Visibility splays are often necessary on roads to provide clear sight lines for road users, especially on bends and junctions. Although rarely present in connection with PRoWs they can be important to create where PRoWs lead onto and across a busy road. *Sight lines can be useful where large animals such as deer and wild boar or even badgers are known to cross the road*. This is useful for road users but also to the animals themselves which might be deterred from crossing when traffic is near.

Newly created splays, verges, embankments, and cuttings should reflect the vegetation found on adjacent areas or substrate/soil in place. New splays can be usefully created by removing top soil so that regrowth is sparse, low growing and of more biodiversity interest in some cases. If planting or sowing is deemed to be necessary then see section 5.6 above.

Avoid importing topsoil but if this cannot be avoided make sure it is of low nutrient status and does not contain injurious weeds, invasive or non-native species (see section below). Topsoil should also be of the same type as the adjoining verge.

The main points for visibility splays are:

- *Visibility splays need to be free of scrub, saplings, tall grass, and herbaceous vegetation and this can require more frequent cutting and often within the period which for biodiversity reasons is not favourable, i.e., March to mid July. This is deemed acceptable.*
- *Tall trees can often be retained within a visibility splay providing lower branches do not represent a safety hazard.*
- *Avoid creating new visibility splays unless there is a proven evidential need (highways or ecology).*

5.8 Drainage and Soil Movement/Excavation (including creation and maintenance of ditches, drains, grips, gullies, balancing ponds, service tunnels, trenches, and pits)

Ditches and water features next to highways *usually belong to adjacent landowners*. They are not usually County Council owned unless within the highway limits and specifically created to drain the carriageway or path. *Grips* may be found in the verge and these can be the responsibility of the Council as Highways Authority to maintain. Trenches and pits are often *temporarily required* for testing and cable or pipe work as part of the construction or maintenance of highways, paths, bridges, fences/barriers/stiles, utilities as well as to facilitate new housing and business developments.

The main points concerning drainage and soil movement/excavation are:

- If possible, *avoid locations and methods that will result in serious damage to trees and hedges*. Preferably all excavations should be created by hand digging where the root zone of trees and hedges might be significantly damaged (approximately more than a third of root plates). If these operations involve tree branch or root surgery or even removal to effect works then check with the appropriate District Council if the affected tree or hedgerow might be a protected one (see section 5.4 above).
- *Features holding water require* careful management and maintenance to be of biodiversity value. Where there is identifiable value (e.g., good aquatic and marginal flora) work needs to be timed carefully and/or done in alternate sections especially to avoid unlawful actions if protected

species such as water voles, great crested newts or otters are present (see **Table 5** above). If in doubt seek the advice of an ecologist.

- Before *stripping soil for trenches or small work areas retain grass turves* and stack them green side to green side. Keep them watered and cover with a tarpaulin especially during hot weather or when frost is forecasted. After reinstating the surface replace the turves and water in thoroughly. Re-water during hot weather after works have completed.
- Where *machinery* is used such as tractors, mini diggers, or large mechanical excavators, follow the guidance in section 5.16 below. Avoid *soil compaction* especially where natural re-colonisation is chosen as the restoration method.
- *Badly designed drainage openings/grills/gully pots can trap and kill* significant numbers of small mammals, reptiles, and amphibians in certain locations. If installing new openings or grills consider this issue in selecting designs. **Table 5**, **Appendix C** and the Design Manual for Roads and Bridges (DMRB) have some reference and advice on these matters. Kerbing can be offset around drainage covers so that amphibians can follow kerbs without falling in.
- Similarly, *steep sided ditches or trenches present traps* to amphibian, reptiles, and mammals if they fall in. If they are water filled some animals can drown or otherwise die from exhaustion or hunger. Features such as temporary or permanent ramps should be designed in to enable wildlife to escape. If the ditch or trench is a temporary one then it can be covered or fenced off with boards when unattended so that it does not pose a trap to animals.
- *Clearance to maintain storage capacity* where there is good aquatic flora and fauna should be carried out in the winter months. Ideally the job should be done gradually in small (preferably intermittent) sections over 2 to 6 years. Do not place weed cuttings, dredged silt etc. on large areas of verge but place near to waterside margins so that small invertebrates and amphibians can return to the water. Consultation with the Environment Agency and Natural England may be necessary at some locations (see **section 4**).
- *Drainage pipes and culverts may be used by wildlife*, such as badgers, water voles, grass snakes and otters, both temporarily and permanently. Care should be taken prior to the commencement of works involving the renewal of pipe work and/or culverts. Stream culverts that pass under the road should include a raised “platform track way” on one side of the culvert that will enable badgers and other species to use them to cross beneath roads in most conditions including floods if possible. Search particularly for signs of otter and water vole when contemplating work to drainage culverts or pipes. See also section 5.14, **Table 5** and **Appendix C** for further relevant information.
- *Gullies and drains should be ideally emptied or jetted in autumn and winter*. Gully emptying is mostly done once a year but drain jetting is more reactive often in response to a flooding problem, and therefore may need to be carried out at short notice (see section 5.19 on emergencies).
- *Features that have filled in* with vegetation, debris, or by material pushed in where a heavy vehicle has mounted the verge, are usually dug out by machine but on PRoWs this can sometimes be done by hand. *The*

removed material should be taken away, but in reality, it can be acceptable for small amounts of material to be spread out along highway land if not of high conservation value that would be damaged by this action. So before doing this make sure the land is not a designated site such as a Conservation Road Verge (see section 4 above), if unsure of how to proceed consult an ecologist.

- If the *land has been compacted and squashed in*, the resulting removed material may be used to reconstruct a *bank* that may previously have existed. Such banks can become *new areas* for grassland, hedgerows or trees by natural colonisation or planting (see section 5.6 above).
- *Reinstatement should restore the natural soil profile and surface levels* existing prior to work commencing. Storing topsoil and subsoil separately is recommended and replaced in correct order in the restoration process. Imported topsoil should not be used as a verge surface except in amenity areas. The use of nutrient-poor subsoil benefits wildflowers and contributes to counteracting nitrogen deposition from motor vehicles. Pay attention to levelling as an uneven surface can create hazards for walkers and horse riders using highways. Surplus soils should be graded or removed from site.
- *Verges should not be re-seeded* without first obtaining advice from either the Highways Ecological Advisor or County Council Ecologist. Amenity seed mixtures should never be used, except in built up/formal areas (see section 5.6 above).

Useful further guidance on ditches has been produced by Thames Catchment partners in 2014[44].

5.9 Winter Maintenance

Compared to all other highway pollutants *salt* is probably the greatest threat to vegetation especially if it is newly planted or sown. Direct contact and via root uptake can result in stunted growth, defoliation, and death. Salt provides an attractive mineral lick that can sometimes attract deer and other animals to the roadside. There are also reports of finches dying after eating beechnuts contaminated by de-icing salt (Dumfries & Galloway Council, 2000[45]). So, for biodiversity (and economic) reasons a *Minimal Salt Programme* should be adopted to reduce salt usage through accurate forecasting and improved application techniques. Measures to reduce salt use include early morning inspections to be carried out at night in marginal weather conditions, use of sensors and improving salt spreading to avoid over salting.

Manage any large snow piles created that contain salt so that they do not sit for any prolonged time on or next to sensitive vegetation or left where they may melt into any important freshwater rivers, streams, ponds, lakes, or wetlands.

Locations of any new salt bins/heaps should be very carefully selected and kept away from important sites for biodiversity (see also sections 4 and 5.16 below). Salt should ideally be kept in a covered building or in bins that have

an impervious floor or bottom. All vegetation is susceptible to some degree but areas in the vicinity of small streams and ditches are particularly sensitive.

Salt and salt spray on major routes does provide a *niche for salt loving plants* (e.g., scurvy grass[46]) but this is not really seen as a biodiversity gain as it can sometimes be at the expense of other more characteristic vegetation.

5.10 Pot-hole repair, Patching and Minor Highway Subsidence

Guidance in sections 5.8 and 5.16 is also relevant here. It is vital that care should be taken to ensure that repairs to holes or depressions are not carried out (without further investigation) where the tunnels or chambers of a *badger sett* are the cause of the collapse. *Rabbit* and other burrows occasionally cause structural problems too. All work should be carried out with regard for the Wild Mammals (Protection) Act 1995 and for Badgers the Badger Protection Act 1992. See the 'Working with Badgers' guide for County Council staff for additional advice on the law and badgers and recommended approaches (available on StaffNet or from the County Council's ecologist).

5.11 Kerbing and Steps

These are more common in urban and semi-rural areas but can be found almost anywhere especially next to roads. Avoid the use of kerbing and badly designed drainage openings (section 5.8) where it is next to good wildlife habitat as they can trap and kill significant numbers of small mammals, reptiles, and amphibians. In kerbed sections of the highway, or where new kerbing is planned, *dropped kerbs* should be formed in the run to enable these species to escape. Also, where a drainage grating is present a *small offset* of the kerb away from it or an overhanging kerb with space beneath can provide a way past the grating for animals as they tend to follow the kerb edge.

Steps should be installed only where necessary for safety reasons and with sensitivity to avoiding damage to vegetation, soils, burrows, or setts etc. Steps should *ideally be installed by hand*. Use of *tanalised wood* and *concrete* is appropriate.

Sections 5.8, 5.14 and 5.16 are also relevant to these operations.

5.12 Surface Modification (especially dressing & rolling)

Avoid the spillage of dressing materials beyond the carriageway on to nearby vegetation. On PRoWs the rolling of soft surfaces should be kept to the minimum extent and frequency necessary to maintain safe access for users.

Guidance in sections 5.8 and 5.16 is also relevant to these operations.

5.13 White Line and Other Painting

Avoid the spillage of paint beyond the carriage on to nearby vegetation. Any *road kills should be removed prior to working and a record made of any notable species* (these can be passed to the County Council's ecologist or GCER the Biological Records Centre or recorded on iRecord at www.brc.ac.uk/irecord . See also Appendix E on road kills. Guidance in sections 5.8 and 5.17 is relevant to these operations.

5.14 Bridges, Underpasses and Overpasses

There are over 1,500 bridges and other related structures in Gloucestershire. Bridges can support or be associated with a number of species that are protected by law. The protected species include *bats, otters, water voles, badgers, nesting birds, reptiles, or amphibians*. Epiphytic flora (attached to masonry), snails, insects and small mammals may also occur. Trees, shrubs, and other vegetation can form a valuable habitat in association with structures and should be retained as much as is reasonably practicable.

Before bridge maintenance or restoration works are confirmed *environmental checks* should be made. If a potential harmful impact on biodiversity is likely then a specialist ecological assessment and survey may need to be undertaken by a suitably qualified person. The objective will be to ensure that no adverse impact on any *protected or priority species* occurs. Records of bats and other notable species should be passed to the County Council's Ecologist on iRecord at www.brc.ac.uk/irecord or directly to GCER the Biological Records Centre for the County.

Works such as bridge *painting or fence erection* can normally be progressed without specialist surveys and assessments however if unsure check with the highways ecological advisor or the County Council's Ecologist.

When undertaking bridge maintenance or replacement activity, measures should be taken to *maintain the quality of flowing water*, including ground water, against silting and/or chemical pollution. Fresh mortar is very alkaline and can cause serious pollution to a watercourse. Particular care should be taken with the use of these materials when working on a structure near a watercourse. Reference to the Environment Agency's *pollution prevention guidelines* is recommended.

The PRoW team install and repair many smaller bridges each year. In the bulk of cases this means removing an old structure and replacing it with a standard kit footbridge or bridlepath bridge. Impact on *surrounding soil and vegetation* is the main consideration here.

Any valued tree or shrub or habitat in the vicinity should be *retained and protected*, through the erection of a fence for the duration of any works. Vegetation (e.g., ivy and trees) will only be removed or managed from

December to March and normally in advance of works. The exception is if there is a safety issue or after an incident, e.g., falling of a tree after a storm.

Provision for *assisting some wildlife occupation* within highways and structures should be given some consideration if not already harbouring some valued biodiversity. This would depend on the nature of the structure and its location in relation to species populations and their movements. This is mainly about introducing features to conserve or enhance biodiversity on/around bridges. Animal *boxes and ledges/cavities/crevices* can be incorporated into bridges and opportunities for providing them as appropriate should be taken up whenever possible (see **Appendix C**).

When undertaking structural replacement, strengthening or alteration work, the installation of a *mammal tunnel or ledge* should be a consideration as part of the overall design. Such features can also include *fencing or bunding or ramps* at each end to help funnel animals into tunnels and on to ledges (wildlife guidance system).

Bridges with watercourses underneath should look to have *high-level ledges* installed under them for otters and other animals to use in times of flood. This will allow otters to pass above watercourses when they are at spate level. In the case of culverts that will become completely water filled an *alternative pipe or underpass placed slightly above/outside* the maximum spate level is strongly recommended particularly for watercourses being spanned by busy roads. Where the water may occupy the full span and height of a bridge then consideration should be given to a separate underpass alongside the bridge in its embankment. If the bridge is a listed structure the County or District Council's Heritage/Archaeological Service will need to be consulted before such ledges/pipes are put in place.

Ideally new bridges should be designed to have a *clear span and should never be full when a watercourse is in spate*. A clear span bridge has enormous benefits in that it can take more water and allows the easy passage of wildlife underneath it.

Guidance in sections 5.3, 5.4, 5.5, 5.8, 5.16 and **Appendix C** is also relevant to these operations.

5.15 Miscellaneous Highway Structures and Furniture (such as crash barriers, fences, walls, cattle grids, signs, waymarks, stiles & gates)

Some stone walls (in common with bridges) may support *protected species such as nesting birds, bats, reptiles, and amphibians*. Epiphytic flora (attached to walls) small mammals and insects may also be present. Fences and crash barriers may have overgrown vegetation at their base that will provide a niche for some small animals and certain plants.

Do not attach signs, waymarks or fence cross members or wires on to trees if this can be avoided. Use posts instead or attach to other structures such as walls, fences, gates, or stiles.

Use of *aggregate* and *concrete* in postholes is acceptable *as long as excess is not left on site*. Even better is the *re-use of the dug-out material* in the hole around the post to make it firm.

Use of *tanalised wood* is appropriate but so is heavy duty recycled plastic although its use may be less favoured if very visible within an AONB.

Signs located within hedgerows/shrubs/trees will need *vegetation to be cleared* in front of them so as not to obscure the plate from approaching road or PRoW users. The hedge/shrub/tree should be *trimmed for the minimum amount in front of the sign* so that it is visible to the on coming road/path user. This work should be carried *outside of the bird-breeding season* (September - February). Cutting should be *severe enough to prevent new growth obscuring* the sign during the spring and summer months but *not to permanently harm any important vegetation*. If it is found that a sign has become obscured during the bird-breeding season the vegetation should be surveyed to ensure that no nest sites are present (see 'Bird Nesting Advice Note').

Cattle grids are a major cause of mortality facing *hedgehogs*, *toads*, *reptiles,* and other small animals in the highways. Those that cannot escape from them will either die a slow death through starvation or by drowning if the cattle grid pit fills with water. Not all cattle grids are likely to have functioning escape ramps. *So as part of routine maintenance, ramps (if not already present) should be placed inside near to an edge to form a series of steps to help small animals escape*.

Guidance in sections 5.3, 5.4, 5.5, 5.8 and 5.16 is also relevant to these operations.

5.16 Storage and Use of Equipment and Materials

Care should be taken to prevent *chemical contamination of wildlife habitats and features* either directly into the soil or substrate or indirectly via water or air.

The main points are:

- *Avoid physical damage* caused by the movement and storage of vehicles, plant, and materials.
- Consider installing *temporary protective barriers* for sensitive wildlife habitats and features.
- *Handle materials and equipment safely* and in a manner that reduces the risk of pollution spills occurring, which would cause direct or indirect contamination to biodiversity.
- *Do not leave 'litter'* on site after work has been completed.

5.17 Control of Injurious Weeds and Non-native Invasive Species

Injurious weeds

The five 'injurious weeds' covered by the Weeds Act 1959 are:

- Spear thistle (*Cirsium vulgare*)
- Creeping or field thistle (*Cirsium arvense*)
- Curled dock (*Rumex crispus*)
- Broad leaved dock (*Rumex obtusifolius*)
- Common ragwort (*Senecio jacobaea*)

In addition to this the Ragwort Control Act 2003 provides a Code of Practice on how to prevent the spread of Common Ragwort (Defra, 2004). *Primary responsibility for the control of these weeds rests with the occupier of the land on which the plants are growing.*

Complaints concerning land that is not owned or managed by the County Council should be directed to the person or organisation concerned. If this does not resolve the issues then an injurious weeds complaint form can be filled out and sent Natural England (Technical Services) by email weedenquiries@naturalengland.org.uk). Further details can be found on the government website at www.gov.uk/guidance/prevent-the-spread-of-harmful-invasive-and-non-native-plants#complain-about-harmful-weeds .

Problems with these plants are often associated with *disturbed land*. Disturbed land is mainly associated with new or road improvement schemes but maintenance works can also provide disturbed ground where weed species can thrive for a time. The County Council receives very few complaints about the growth of the two dock and thistle species on highway land. Most reports received concern *ragwort*. This is mainly because ragwort is so obvious when in flower and also because when in a dried state it is poisonous to stock, especially horses.

It should not be forgotten that all the five injurious weeds (and ragwort) are native species and are *important for biodiversity in their own right*. They provide food and shelter for a wide range of bees, butterflies, moths, and other insects. Birds, especially finches are especially attracted to the seeds of thistles and docks.

Good management of grassland will avoid most injurious weed problems. The key is to keep the grass sward tight to prevent seeds and seedlings from establishing themselves. If compatible with biodiversity objectives perennial weed plants can also be weakened if surrounding grass is regularly allowed to grow tall or alternatively the weed plants are cut frequently.

Where a *need for control is identified (large concentrations)* care should be taken to use the most appropriate method for the circumstances of each site.

Do not take action to control plants unless they have been *correctly identified*. *If* any injurious weed or non-native plant material is to be *removed* from site view the government website and contact the Environment Agency or the local District Council for advice on how and where to dispose of the material safely.

On highway land troublesome *common ragwort* concentrations should normally be cut and this is best done *before it flowers* (i.e., from June onwards). *Regular cutting* each year should inhibit ragwort within 5 years. If the number of plants is not too great, they may be pulled out by hand. In extreme cases herbicide applications may be the only option and should be done with hand held, back pack units which can be used to spot or area treat. The herbicide used should be one approved by the Environment Agency and /or Natural England. The Ragwort Control Act 2003 resulted in Defra producing a 'Code of Practice on how to prevent the Spread of Ragwort' which was first published in 2004. This is guidance document has now been withdrawn (replaced by website information) but is still a useful reference and currently can be found at www.gov.uk/government/publications/code-of-practice-on-how-to-prevent-the-spread-of-ragwort .

General actions to prevent injurious weeds infestation (if these do not compromise more critical issues of safety or nature conservation) include:

- *mow only as frequent as is necessary* and not too short so as to disturb the soil surface;
- *minimise the area of land disturbed* during all operations;
- make good any large, disturbed area through allowing natural colonisation or appropriate sowing of native grassland (wildflower) seed or the dense planting of trees and shrubs. Alternatively store grass turfs from disturbed areas, keep watered and then replace once works have been completed;
- *control weeds in early years following verge disturbance and/or creation* is often necessary.
- *prevent users of the highway eroding verges and banks*;
- *encourage adjacent landowners* to adopt appropriate ragwort control measures.

Such actions will avoid many problems from arising but if there is an injurious weed problem on adjoining land, i.e., out of the council's remit, then effective control may be difficult.

The spraying of other non injurious 'weeds' is sometimes done in *formal* areas and between *crevices within hard surfaces* of the highway. This is mainly an urban activity and on certain *structures*, *pavements,* and *junctions* elsewhere.

Non-native invasive species

The Wildlife & Countryside Act 1981 (Section 14 & Schedule 9) makes it an offence to plant or cause the non-native species Japanese knotweed (*Fallopia japonica*), giant hogweed (*Heracleum mantegazzianum*) and Himalayan

balsam (*Impatiens glandulifera*) to grow in the wild. It is *not an offence to have these species growing on your land* however but they are a threat to biodiversity by also excluding native vegetation. New Zealand pigmyweed (Australian Stonecrop) is another problematic species of ponds and is banned from sale. The government produces useful website information on the control of invasive non-native species at www.gov.uk/guidance/prevent-the-spread-of-harmful-invasive-and-non-native-plants#complain-about-harmful-weeds but for species information go to the GB Non-native Species Secretariat at www.nonnativespecies.org/factsheet/index.cfm . The Natural Environment and Rural Communities Act 2006 gave the Secretary of State a power to approve a Code of Practice for selected invasive non-native species. Specialist contractors to the highways authority are often employed to deal with this invasive non-native species.

Spraying the leaves or injection of mature canes (late summer/early autumn) of Japanese knotweed with a *glycophosphate herbicide* provides an effective long-term solution. *Regular cutting* can also weaken the plant and eventually remove it. *Digging out the soil and all of the rhizomes* is an expensive option and is usually confined to new road schemes. Cut material should normally be left on site to dry out before being burnt. Beware that small plant fragments left on or in the soil may regenerate and so this is a good reason to re-check the site for re-emergence in the following season. The Devon Local Nature Partnership's website has useful additional information on Japanese Knotweed at www.naturaldevon.org.uk/home/devon-invasive-species-initiative/japanese-knotweed/. Also see the Non-native Species Secretariat website at http://www.nonnativespecies.org/index.cfm?pageid=226 .

Giant hogweed should be controlled by appropriate *herbicide* before it seeds. *Cutting through the roots below soil level* can sometimes be effective as can *digging up the plant and then burying it deeply*. *Regular cutting in a single year* to prevent flowering can also be effective. Sap from hairs or cut surfaces of the plant will react *with sunlight on the skin to produce chemical burns* and so is a hazardous plant to deal with. Close contact with the giant hogweed will require you using protective clothing, gloves, hood, and a full-face visor. More information on this very tall plant see the Non-native Species Secretariat website at http://www.nonnativespecies.org/index.cfm?pageid=154 .

Himalayan balsam prefers waterside and other damp locations where there is bare substrate present such as in eroding areas and those frequently flooding. It can be controlled by regularly mowing but a single cut over a few years in May or June is usually enough to remove it. However, if the same environmental conditions persist it is likely to re-invade if present in the general area. The plant is an annual and propagates by seeds which can travel a long way often via water. Additional information on this plant can be found on the Non-native Species Secretariat website at http://www.nonnativespecies.org/index.cfm?pageid=147 .

Australian stonecrop (*Crassula helmsii*) and Parrot's Feather (*Myriophyllum aquaticum*) are two of several non-native aquatic plants that can be a localised problem in roadside ponds and ditches. It is very difficult to eradicate

(*shading out by covering* is one option). Also, on verges the garden escape winter heliotrope (*Petasites fragrans*) when in leaf can obliterate native flora and should be discouraged. Additional information on Australian stonecrop and other problematic species can be found on the Non-native Species Secretariat website e.g., at http://www.nonnativespecies.org/index.cfm?pageid=168 .

Where highways pass through or next to woodland invasive rhododendron (*Rhododendron ponticum*) may be present. This shrub will take over woodlands and shade out the ground flora (e.g., bluebells). It is rarely controlled just by cutting; digging out and *herbicide* treatment is usually needed to eradicate it. Occasionally the butterfly bush (*Buddleja davidii*) may proliferate on drier verges and walls. This shrub is a good nectar source for butterflies and moths but if it is compromising other habitats and species or damaging masonry then it may need to be controlled by *cutting*, *digging ou*t or spot treatment with an appropriate *herbicide*. Additional information on this persistent shrub can be found on the Non-native Species Secretariat website at http://www.nonnativespecies.org/index.cfm?pageid=225 .

As all the above plants can be either persistent and/or produce a lot of seed so there may need to *return to the same location to control the plants over a number of years in the worst cases*. *Herbicide treatments close to water should be avoided* but if they must be used near a watercourse an application to do so to the Environment Agency must be made.

Planting of cultivated daffodils into rural verges and hedgerows can be a problem as they affect native flora and more especially interbreed with the wild native daffodil. *Any requests to plant daffodils should be considered very carefully in the context of location and existing populations of wild daffodil*. Further advice can be sought from the County Council Ecologist.

If any non-native invasive species plant material is to be removed from site, contact the Environment Agency or the local District Council for advice on how and where to dispose of the material safely if you are unsure of what to do.

Non-native invasive crayfish species are worth mentioning here as working near watercourses (e.g., bridges) may pose a risk of assisting their spread. The North American signal crayfish carries a plague that kills the smaller native white-clawed crayfish which is legally protected and rapidly declining. Further information on this issue is available on the GB non-native species secretariat website at www.nonnativespecies.org/factsheet/index.cfm. Similarly, there is a risk of spreading other non-native invasive aquatic species such as the zebra and quagga mussels which can block up drainage and pipes as well as affect the ecology of waters. *Whilst working in water (rivers, streams, ditches, lakes & ponds) try to always use the standard bio-security procedure of check (for presence of animals, young and eggs on clothing and equipment), clean (use water [hot if you can] to remove biological material and mud/sediment/gravel) and then thoroughly dry everything that has come into contact with water.*

5.18 Lighting

Lighting roads is a factor in reducing night time road traffic accidents. However, there can be significant negative effects on wildlife from some lighting. Street lighting in areas where rare species occur should be particularly carefully considered, especially impacts on bats and insects. Street lighting is known to disturb flight, navigation, vision, migration, oviposition, mating, feeding and seclusion (crypsis) in moths (English Nature, 1994, Outen, 2002, Buglife, 2011, Gaston et al., 2014[47], Holzhauer, 2015[48], Wakefield et al. 2016[49]). It also leads to increased predation, which may affect the population viability of rare species. Many species are known to avoid artificial lighting whereas fast-flying bat species are attracted to feed on night flying insects attracted to the light (English Nature 1996, Outen, 2002,). Plant function and bird behaviour can also be affected (Gaston et al., 2014).

The best guidance for mitigating lighting impact on bats is the ILP and the Bat Conservation Trust guidance[50] found at https://theilp.org.uk/publication/guidance-note-8-bats-and-artificial-lighting/ .

Street lamps should be maintained to utilise fittings that *prevent lighting above the horizontal plane* and so the *beam points downwards*. There are merits in using *LED lighting* (which is now standard for Gloucestershire street lighting) including energy saving, controllability, UV free and variable colour temperature (spectra).

Measures for adapting street lighting to reduce adverse impacts on biodiversity include:

• Use of *LEDs* of a colour temperature away from blue/white spectra towards *warmer (red) spectral signatures is preferred* although will not suit all species. A *max of 4,000K* for highways is recommended;
• Use of bulbs of as *low a brightness level as permissible* (these are of less attraction to insects and reduce disturbing circadian rhythms);
• Fitting *shades or deflectors* that restrict light to only where it is needed;
• Fitting *ultra violet filters to non-LED lamps* (especially mercury); and
• *Turning off/Dimming lamps (via timers)* close to vulnerable sites outside key periods of human activity providing this does not put people at risk

Where a scheme requires the installation of *new streetlights* a search should be made early in the process for the presence of vulnerable species particularly *bats and rare insects* (see section 4 above). The installation of new street lighting can cause disruption or disturbance, which could make a breeding site, roost, flyway or feeding site unusable. One example is where new street lighting forms a barrier to foraging bats crossing the landscape. *The location of light columns, shades (shrouds), angling and choice of bulb type and illumination area should be planned accordingly* (Limpens (2005) '*Bats and road construction*'[51]). What *times of the day and year can the lighting be dimmed or switched off* to minimize impact on biodiversity is

another factor to consider? The analysis of lux (intensity of light) isoline diagrams can help to determine where dark areas for biodiversity will remain when lighting is switched on. *Landscaping can when mature can moderate illumination* so this needs to be considered when looking at isolines (which could be showing a worse case scenario). *Illumination on existing vegetation is to be avoided much above 1.0lux* to protect bats and other species potentially.

5.19 Dealing with Emergencies and Wildlife Casualties

In cases where there is an emergency that involves a threat to the safety of people then this should be *dealt with immediately and in the most appropriate manner*. If the guidelines in this section of the document can be followed to preserve biodiversity, then they should be but only if the circumstances allow. *If an SSSI is involved then Natural England should be informed as soon as it is practicable to do so* (see the 'Biodiversity & Legislation' guidance document).

Injured wildlife should be taken to a veterinary practice if practical. Extreme caution should be used. For example, a badger or fox can deliver a *severe bite in self-defence* and ideally *protective gloves* and a *cage* should be used. *Injured wild boars could prove dangerous if approached*. The RSPCA or Wildlife Rescue Centres* may also be useful contacts in certain situations. In the case of certain dead mammals see **Appendix E**. A review of deer collisions on roads is useful background reading (Langbein & Putman, 2006)

* RSPCA Oak and Furrows Wildlife Rescue, Somerford Keynes www.oandf.co.uk Tel. 01793 640136
Vale Wildlife Rescue Centre, Beckford www.valewildlife.org.uk/ Tel. 01386 882288

6.0 Implementation

Successful implementation of this Gloucestershire Highways and Biodiversity Guidance (GHBG) should be referenced as an integral part of relevant *service plans, procedures, and work programmes*.

Implementation will be progressed when relevant and where it is consistent with the proper exercise of Council functions as follows:

- In accordance with the statutory duty biodiversity will be conserved overall and opportunities for biodiversity enhancement whilst carrying out County Council highway related functions will be sought.
- The highways biodiversity guidance can be used as an aid for the planning and delivery of schemes and works but additional specific advice of a professional ecologist is often likely to be required.
- The biodiversity guidance will be highlighted through the County Council's website, by the County Ecologist, by highways staff and by ecological advisors/consultants to highways and utility contractors.
- The highways biodiversity guidance will be regularly monitored and updated if required. Minor updates will be implemented by officers and only major updates should need to be signed off by a Director and/or County Councillor(s).
- A full review of the biodiversity guidance content and format should take place sometime between 2024 and 2029.

7.0 Abbreviations

GHBG	Gloucestershire Highways Biodiversity Guidance
ALGE	Association of Local Government Ecologists
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CRoW	Countryside & Rights of Way (Act)
CRV	Conservation Road Verge
CWP	Cotswold Water Park
Defra	Department of Environment, Farming & Rural Affairs
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EcIA	Ecological Impact Assessment
EPS	European Protected Species (under the Habitats Regulations)
GCC	Gloucestershire County Council
GCER	Gloucestershire Centre for Environmental Records
GIS	Geographic Information System
GWT	Gloucestershire Wildlife Trust
IEEM	Institute of Ecologists and Environmental Management
LBAP	Local Biodiversity Action Plan (such as the Cotswold Water Park BAP)
LNR	Local Nature Reserve
LNRS	Local Nature Recovery Strategy
LWS	Local Wildlife Site (Local Wildlife Site)
NE	Natural England

NERC	Natural Environment and Rural Communities (Act)
NI	National Indicator
NNR	National Nature Reserve
PRoW	Public Right(s) of Way
Ramsar	Wetland Site of International Importance (after Ramsar Convention)
RIGS	Regionally Important Geological/Geomorphological Site (Local Geology Site)
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation (European site important for habitats and species)
SLA	Service Level Agreement
SPA	Special Protection Area (European site important for birds)
SSSI	Site of Special Scientific Interest
SDS	Sustainable (Urban) Drainage System
TPO	Tree Preservation Order
W&C	Wildlife & Countryside (Act)

8.0 Contacts

County Ecologist

Heritage Team
Gloucestershire County Council
Block 5 - Floor 1 (West)
Shire Hall
Gloucester GL1 2TG

Tel: 01452 425679
Email: ecology@gloucestershire.gov.uk

Natural England

The local team for Gloucestershire is the Mercia Team.

General Enquiries:

Natural England Enquiries
County Hall,
Spetchley Road
Worcester
WR5 2NP

Tel: 0300 060 3900
Email: enquiries@naturalengland.org.uk

Formal Consultations:

Natural England consultation service
Hornbeam House
Electra Way
Crewe Business Park
Crewe
Cheshire
CW1 6GJ

Email: consultations@naturalengland.org.uk and for matters related to protected sites (but not for planning applications) ProtectedSites@naturalengland.org.uk

Environment Agency

General Enquiries:

Environment Agency
PO Box 544
Rotherham
Yorkshire
S60 1BY

Email: enquiries@environment-agency.gov.uk

Gloucestershire Wildlife Trust

Dulverton Building
Robinswood Country Park
Reservoir Road
Gloucester
Gloucestershire
GL4 6SX

Tel: 01452 383333
Email: info@gloucestershirewildlifetrust.co.uk

9.0 Acknowledgements

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This document and previous versions have benefited from the input of many staff at Gloucestershire County Council, other Local Authorities, Amey, Atkins, Halcrow, Ringway, Highways England (now National Highways), Gloucestershire Wildlife Trust, Natural England, Herefordshire Council, Oxfordshire County Council, and certain members of the Association of Local Government Ecologists.

Appendix A Example Biodiversity Risk Assessment Table for a Highways Activity

How risk is evaluated
The aim of this example risk assessment is to help to demonstrate taking account of biodiversity issues by avoiding or minimising the adverse impact on wildlife. Many activities involve some hazards that can mean an adverse effect on biodiversity occurring. The table here lists possible hazards associated with various activities and the risk of each to biodiversity has then been evaluated - where Risk = Hazard Severity x Probability of Occurrence (see codes below).

Risk
Risks can be categorised as follows:
1-6 = Acceptable (Low) 8-10 = Broadly acceptable (Medium) 11 - 16 = Not acceptable (High). It is recommended that you do not carry out any activity in the 'broadly acceptable' category without reference to the ‘Gloucestershire Highways Biodiversity Plan’ and/or specialist ecological advice. For activities that fall into the ‘not acceptable’ category specialist ecological advice must be obtained and followed.

Hazard severity codes
1 = No or negligible impact
2 = Impact is not significant
3 = Significant impact
4 = Severe impact

Probability of occurrence codes
1 = Very improbable
2 = Remote
3 = Could possibly occur
4 = Likely
5 = Highly Likely. It is predictable that biodiversity will be adversely affected.

Summary advice: This template can be used to help produce a specific risk assessment for any plan, project, or job on biodiversity. It should not be used as it as it is for guidance only and just gives an indication of risks associated with one particular activity type.

Activity (see sections 3, 4 & 5 in the GHBG)	**Hazards** (see sections 3, 4 & 5 in the GHBG)	**Severity**	**Probability**	**Risk**	**Action to reduce risk** (see sections 3, 4 & 5 in the GHBG)
<u>Wide verge on A4444 at Upbridge</u> Removal of scrub on verge. Cutting back of overhanging trees and trimming of overgrown hedgerow.	Habitat loss/damage (e.g., clearance of dead wood or leaf litter habitat, damage/loss of hedge bottom, feeding area of leaves, fruits, and seeds for animals)	3	3	9	• Dead wood will not be removed from site but stacked up and scattered through the verge area but away from first 2 metres beyond carriageway • Cutting back and trimming will be carried out in late winter (February) • Scrub habitat will be mainly lost but this will open up patches of former species-rich grassland on the verge
	Habitat fragmentation	2	2	4	• Hedgerow and most trees will remain although will be thinned. Surrounding land has a good continuous network of hedgerows with trees.
	Impact on legally protected species and their resting, feeding, and breeding places (esp. bats, birds, badgers, dormice, great crested newts)	2	2	4	• No protected species recorded within 500m of the highway corridor (search results with Local Biological Records Centre) • Ecologist has visited site and reports no evidence of badger setts nearby and impact on bat roosts is very unlikely. No significant impact on protected species identified although presence of dormice cannot be completely ruled out. • Clearance in February to avoid core bird nesting season (no evidence of early nesting species using this site)
	Impact on priority and other notable species and their resting, feeding, and breeding places (esp. hedgehogs, woodland flora/fungi/mosses, invertebrates)	1	2	2	• Woodland flora very restricted beneath a few large trees which will only be cut back where they overhang the carriageway. Conditions should still suit those species present (bluebells, wood anemones). • Dead wood supports some common species of invertebrate, fungi & mosses which will still have a lot of suitable habitat remaining (see above) • Habitat for hedgehogs (a priority species) will be slightly modified but still good for them with plenty of surrounding habitat in adjacent areas • Clearance of invading scrub will restore long grassland habitat for lost rare flora and also small mammals and invertebrates.

Appendix B – Table A. Checklist to assist in determining when a highway proposal may trigger an Ecological Survey and/or Impact Assessment - *Designated Sites, Priority Habitats and Other Features*

This can be used in addition to any Contractor/Utility Company Checklist of Environmental Issues and/or Environmental Information.

GCER (gcer@gloucestershirewildlifetrust.co.uk or Tel. 01452 383333 and www.gcer.co.uk/) can check all items 1 to 3 in the table below. However also check www.magic.defra.gov.uk/ and aerial photography (Google & Bing Maps) as a preliminary check or whilst waiting to hear back from GCER. A 'YES' against any question will trigger further analysis by a suitably qualified ecologist. The Highways Ecological Advisor can help to confirm if a Survey and Impact Assessment is really needed and scope its content.

Clear Exceptions when an Ecological Survey and/or Impact Assessment may not be required

International and National Sites: A survey and impact assessment will not be required where Natural England, confirms in writing that they are satisfied that the proposed works or plan/project will not affect any statutory sites designated for their national or international importance.

Regional and Local Sites and Priority Habitats and Other Features: A survey and impact assessment will not be required where you can provide copies of correspondence with the Highways Ecological Advisor or County Council's Ecologist that show they are satisfied that the proposed works or plan/project will not affect any regional or local sites designated for their local nature conservation importance or any other priority habitats or listed features.

1. DESIGNATED SITES

Internationally designated sites	Special Protection Area (SPA) Special Area of Conservation (SAC) Ramsar Site
Nationally designated sites	Site of Special Scientific Interest (SSSI) National Nature Reserve (NNR)
Regionally and locally designated sites	Local Sites (*e.g., Local Wildlife Site*) Local Nature Reserve (LNR) Conservation Road Verge (CRV)

Check www.magic.defra.gov.uk/ and contact **GCER** (see above)

Designated Sites likely to be affected by the proposal? Yes/No
(The Highways Ecological Advisor or County Council's Ecologist can help with this judgment and its implications)

2. HABITATS OF PRINCIPAL IMPORTANCE FOR BIODIVERSITY
under S.41 of the NERC Act 2006. In Gloucestershire, these priority habitats include:

- Coastal habitats (e.g., saltmarsh, intertidal mudflats, estuarine rocky habitats, saline lagoons, sub tidal sands and gravels,)
- Coastal and floodplain grazing marsh
- Eutrophic standing open water (including lakes and canals), mesotrophic lakes and ponds
- Rivers
- Fen, marsh & swamp (including reedbeds & rush pastures)
- Lowland raised bog
- Lowland beech and yew woodland
- Wet woodland
- Lowland mixed deciduous woodland (e.g., ancient woodland)
- Hedgerows
- Wood-pasture and parkland
- Lowland calcareous grassland (e.g., species-rich limestone grasslands)
- Lowland heathland and/or dry acid grassland
- Lowland meadows (e.g., species-rich neutral flower meadows)
- Traditional orchards
- Open mosaic habitats on previously developed land

The most recent list of habitats of Principal Importance for Biodiversity for England is the reference to be used. See the JNCC or government website for this. For known distribution of habitats and features in Gloucestershire check the Nature Recovery Network at https://naturalcapital.gcerdata.com/ and www.magic.defra.gov.uk/ or contact **GCER**.

Priority Habitats likely to be affected by the proposal? Yes/No
(The Highways Ecological Advisor or County Council's Ecologist can help with this judgment and its implications)

3. OTHER BIODIVERSITY FEATURES
(including those identified by the Gloucestershire or Cotswold Water Park Biodiversity Plans)

- Secondary Woodland and Mature/Veteran Trees
- Caves, scowles, sink holes and disused tunnels and mines (*e.g.,* roosts for bats)
- Trees, scrub, and structures used for nesting by breeding birds
- Previously developed land with biodiversity interest (e.g., supporting habitats and notable plants, invertebrates, amphibians, or any reptile)
- Urban green space (*e.g.,* parks, allotments, flower-rich road verges and railway embankments)
- Other habitats and features identified by the Gloucestershire Local Nature Partnership and/or the Cotswold Water Park Trust.

For information on local biodiversity features see www.gloucestershirenature.org.uk (and additionally in the Cotswold Water Park see www.waterpark.org). Distribution of sites supporting these features might also be obtained by looking at aerial photography (Google or Bing Maps) and contacting GCER.

Other Biodiversity Features likely to be affected by the proposal? Yes/No
(The Highways Ecological Advisor or County Council's Ecologist can help with this judgment and its implications)

Appendix B - Table B. Checklist to assist in determining when a highway proposal may trigger an Ecological Survey and/or Impact Assessment - *Legally Protected Species*

See www.jncc.gov.uk and www.gov.uk and https://nbnatlas.org/ for information on species protection and contact GCER (gcer@gloucestershirewildlifetrust.co.uk or Tel. 01452 383333 and www.gcer.co.uk/) who can check for known records of all notable species. Where there is a black dot under a species column this indicates a survey & assessment trigger for that species. If the proposal matches the trigger, then a 'Yes' should be checked in the final column. If advice/evidence from the Highways Ecological Advisor, County Council's Ecologist or other qualified ecologist indicates otherwise then this must be stated under the 'No' column and the advice/evidence referenced here. See further notes beneath this table.

Highways Proposals That Will Normally Trigger a Legally Protected Species Survey	Bats	Barn Owls	Breeding Birds	Gt. Crested Newts[7]	Otters	Dormouse	Water Vole	Badger	Reptiles	Amphibians	Plants	White-clawed Crayfish	No	Yes
Proposed work which includes the modification conversion, demolition or removal of buildings and structures (especially roof voids) involving the following:														
▪ all agricultural buildings (*e.g.,* farmhouses and barns) of traditional brick or stone construction and/or with exposed wooden beams greater than 20cm thick;	●	●	●											
▪ all buildings with weather boarding and/or hanging tiles that are within 200m of woodland and/or water;	●													
▪ pre-1960 detached buildings and structures within 200m of woodland and/or water;	●													
▪ pre-1914 buildings within 400m of woodland and/or water;	●													
▪ pre-1914 buildings with gable ends or slate roofs, regardless of location;	●													
▪ all tunnels, mines, kilns, ice-houses, adits, military fortifications, air raid shelters, cellars and similar underground ducts and structures;	●													
▪ all bridge structures, aqueducts, and viaducts (especially over water and wet ground).	●													

[7] NatureSpace or the Council's Ecologist can check great crested risk zones associated with the District level Licensing option

Highways Proposals That Will Normally Trigger a Legally Protected Species Survey	Bats	Barn Owls	Breeding Birds	Gt. Crested Newts	Otters	Dormouse	Water Vole	Badger	Reptiles	Amphibians	Plants	White-clawed Crayfish	No	Yes
Proposals involving lighting of old buildings or areas within 50m of woodland, water, field hedgerows or lines of trees with obvious connectivity to woodland or water.	●	●	●											
Proposals affecting woodland, or field hedgerows and/or lines of trees with obvious connectivity to woodland or water bodies.	●		●			●		●			●			
Proposed tree work (felling or lopping) and/or work affecting: ▪ old and veteran trees that are older than 100 years; ▪ trees with obvious holes, cracks, or cavities, ▪ trees with a girth greater than 1m at chest height;	 ● ● ●		 ● ● ●											
Proposals affecting gravel pits or quarries or scowles and natural cliff faces and rock outcrops with crevices, caves, or swallets/sinkholes.	●		●						●					
New highway or major alterations within 500m of a pond or for other proposals within 250m of pond				●										
Proposals affecting rivers, streams, canals, lakes, or other aquatic habitats.	●		●		●		●			●	●	●		
Proposals affecting: 'derelict' land (brownfield sites), allotments and railway land			●	●				●	●	●				
Proposed works affecting any buildings, structures, storage or waste piles and other suitable features that protected species may be reasonably likely to inhabit or locations where protected species are known to be present *on site or in the immediate vicinity	●	●	●	●	●	●	●	●	●	●	●	●		

* Confirmed as present by either a data search (for instance from GCER) or as notified to you by the County Council, and/or by Natural England, the Environment Agency or other nature conservation organisation.

Clear Exceptions for when a Protected Species Survey and Impact Assessment may not be required

a. Following consultation, the Highways Ecological Advisor or County Council's Ecologist or NatureSpace (for great crested newts and planning applications) has stated in writing that no protected species surveys and impact assessments are required.

b. If it is clear that no protected species are present, despite the guidance in the above table indicating that they are likely, the proposer should provide evidence to demonstrate that such species are absent. For example, this might be in the form of a letter or brief report from a suitably qualified and experienced person, or a relevant local nature conservation organisation or report that site conditions have changed significantly in some way.

c. If it is clear that the proposal is not likely to affect any protected species present, then only limited information needs to be submitted. This information should, however, (i) demonstrate how there will be no likely significant affect on protected species and (ii) include a statement acknowledging that the proposer is aware that it is a criminal offence to disturb or harm protected species should they subsequently be found or disturbed and work is not halted. Note for European Protected Species sites where the species is only temporarily absent should be treated as if present in an appropriate way, e.g., roosting bats out of season or just not recorded for one or two years but known before this at the location

In some situations, it may be appropriate for a proposer to provide a protected species survey and report for only one or a few of the species shown in the Table above, *e.g.,* those that are likely to be affected by a particular activity, plan, or project. Proposers should make clear which species are included in the report and which are not because exceptions apply and these species have been scoped out.

Appendix C Mitigation and Enhancement Measures for Biodiversity (Additional Information)

*Also see **Sections 4 and 5** first*

1. Habitat Creation

Wildflower seed

The specification and sowing of wildflower seed is a simple yet effective way of enhancing habitats for biodiversity, particularly invertebrates. This can be incorporated into most schemes where excavation, earth moving, and re-instatement occurs. However, it is important to establish which flora species are appropriate to the location and whether allowing natural colonization by plants to occur. The Highways Ecological Advisor or the County Council Ecologist can help to specify a seed mix appropriate to the location. Sub-soils with no or little topsoil/compost should normally be used for 'natural' landscaping, planting and/or sowing. The use of sub-soils alone counteracts the additional nitrogen deposition that occurs alongside roads. Use of topsoil poses a risk to a good result and achieving low fertility and aftercare costs. Topsoil may also contain seeds of competing grasses, thistles, docks, and rushes. Perennial flower swards need to be managed more than once in the first year to establish good rooting and spread. A simple regular inspection as part of the maintenance regime could be established to monitor growth and that management is satisfactory. Seeds should be sourced from a local supplier who can make up the required mix. An improvement on this is the sole or additional use of some seed or green hay from local meadows which can be strewn across the surface in late summer/autumn. Use of yellow rattle seed can also be useful in some suitable locations to maintain low fertility and reduced grass growth rates.

Trees (and shrubs)

The planting of native trees (and shrubs) may enhance the road verge for wildlife although not where important wildflowers and/or open landscape views are present. Trees should ideally be locally sourced and be of a native species and appropriate to the location in which they are to be planted (i.e., occur nearby or would normally be present). When planting new trees, consideration should be given to interference with visibility sight lines, other detriments to road safety plus location of overhead cables and utility services. Trees too close to highways can damage surfaces and structures including drainage features. Make sure there is enough room for trees to grow to their full spread, if not consider if shrubs or no woody plants at all maybe more appropriate. Consideration should be given to other ecological factors, such as hawthorn should not be planted in areas where there are dormouse populations. Fruit bearing plants attractive to wildlife, should be avoided in areas where there are or could be high bird casualties such as on central reservations or fast corners. Guidance on species selection, planting and maintenance should be obtained from the Highways Ecological Advisor, Highways or County Arboriculturalist or County Council Ecologist.

Pond creation

Opportunities for pond creation should be considered as part of drainage schemes where highway land is available. These will benefit a number of species including toads, newts, and invertebrates such as insects and snails. Ponds may be used as part of a Sustainable Drainage System (SDS or SuDS see below).

2. Sustainable (Urban) Drainage Systems (SDS or SuDS)

Sustainable Drainage Systems (SDSs) are an alternative to piped drainage systems that use natural drainage systems to store, convey and improve the quality of the water discharged away from the highway. These can take the form of filter strips and swales; filter drains and other permeable surfaces; infiltration devices; basins and ponds. If possible SDSs should be used in preference to the use of piping and other hard built structures. Vegetative systems can be designed to supplement or replace conventional drainage systems. Swales, for example, are wide, shallow, and grassed channels located adjacent to the highway, and suited to where roads are on a gently sloping embankment. Infiltration basins can store and

treat water and can reduce downstream flooding and pollution. The shape and size of the basin depend on the availability of land. Pond creation is described above. The planting of reedbeds in highway ditches or ponds should be considered where appropriate. Wildflower mixes may be appropriate to sow along swales.

3. Bird Boxes

It is unlikely that bird boxes installed on or near highway land will be successful, both Dutch (Reijnen & Foppen, 2006[52]) and Swedish (Helldin & Seiler, 2003[53]) research shows that road traffic generally displaces nesting birds away from highways. However, in areas where there is a low traffic flow of less than two thousand vehicles per day and along quieter PRoWs, installation may be successful. Boxes for some species, such as passerines (for example blue tits) and kestrels along busier roads (Hill, 2001[54]) should not be ruled out if carefully located (e.g., entrance facing away from the road or path). The use of nest boxes for barn owls should be discouraged near roads however, as their death at night by passing vehicles is highly likely to be increased (see also item 10 below). The type of box erected should be considered in relation to the habitat and the presence of the bird species in the area for which it is intended. Provision for birds can be made within bridge maintenance and construction (not over busy roads) by installing bird boxes or by providing holes for nesting and ledges for species such as dippers or grey wagtail.

4. Bats

Bat boxes

Bat boxes can be sited where bats are known to feed if it is considered there are few potential roosts (mature trees, buildings with suitable roof spaces). Woodland rides and glades are ideal, particularly if close to a marsh, pond, or river. Woodland edges on roads with low traffic flow would be favourable sites.

- Place boxes in sheltered and wind-free areas exposed to the sun for part of the day, up to three boxes per tree.
- An area around the box needs to be cleared to allow bats direct and easy access to the box entrance (which should ideally be facing away from the road or path); Access to the box should be from the landside not highway side.
- Most species will use higher positioned boxes (around 5m high), although long-eared bats may use a box 2m above the ground;
- Boxes in public areas should be considered only if the risk of vandalism and of the probability of the box being accessible to cats is deemed to be low;
- Place the box as high as it is safe to do; and use headless or domed nails not fully hammered home to allow a growing tree to push the box off without splitting, or strap the box to the tree. Iron nails can only be used on trees with no commercial value. Copper nails can be used on conifers, but best choice are aluminum alloy nails which are less likely to damage saws and chipping machinery.

For details of construction and suppliers see The Bat Conservation Trust website - www.bats.org.uk . Once bat boxes are installed, highway's staff should be made aware that it is illegal to disturb bats unless a licence is obtained from Natural England. A qualified and licensed person can however monitor boxes.

Bat Bricks and Crevices

New roosting sites for bats can be created within structures. Some are crevice dwelling whilst others require more open spaces. Bat features normally need to be installed during the construction process (although sometimes can be retro fitted). They need to create the required thermal properties and microclimates that encourage bats. This can be achieved by using purchasable bat units or special bricks. These often consist of a hollow cube with three

open sides (top, bottom, and front) that are placed within a structure and faced with access bricks that have slits permitting entry by bats. Where opportunities arise to incorporate bat roosting crevices into structures during repairs, these should be taken up. These should be sited within the span of the bridge or as high up an abutment as possible. Known or likely bat roosts can only be monitored and checked by a qualified and licensed person.

Bat Crossings

Bats are vulnerable to loss of hedgerows and alterations to roadside vegetation such as tree pruning. They are especially affected by severance caused by new road construction. They can also become road casualties. Therefore, new highway schemes should seek to identify bat flyways early in the planning stage of a scheme in order that adequate and robust mitigation can be designed and built into the scheme programme.

In new roads the design should include underpasses in order that the integrity of bat foraging patterns can be maintained. These should also include suitable planted lead in structures/features to ensure bats use the designed route rather than risk crossing the road elsewhere or abandoning the flyway altogether which could result in local population loss. Lead in structures may require planting with trees/shrubs before the main construction of the scheme commences. Further guidance and research can be found in '*Bats and road construction*' (Limpens et al., 2005), Boonman (2012)[55], Abbott et al. (2012)[56] and Berthinussen & Altringham (2012)[57].

Mitigation and enhancement for bats on existing roads can include the planting of trees to join up canopies either side of the road or the use of artificial structures consisting of telegraph posts and 'netting' across the road in order to strengthen existing flyways and reduce road casualties or severance effects. However, there is doubt to the effectiveness of these – see Berthinussen & Altringham (2012). Specially designed land or green bridges are better and can help with dormice, reptile, amphibian, and badger severance too but are expensive (see item 12). New bridges could be designed with a vegetative strip of shrubs and trees suitable for bat flyways.

If poorly sited or specified street lighting could compromise the effectiveness of bat crossing. Red LED bulbs are the least disturbing to bats.

5. Dormice

In areas where dormice are known to be present several enhancement measures may aid the local survival of the endangered species. The following should be considered:

- The erection of nesting boxes;
- Retention of flowering/fruiting shrubs e.g., bramble, honeysuckle, raspberry, wayfaring tree, blackthorn, hawthorn, crab apple, cherry etc.;
- Planting/re-planting shrub species beneficial to the species, e.g., hazel, oak, honeysuckle, hawthorn, blackthorn etc, especially where hedgerows have become fragmented;
- Coppicing hazel, etc where it occurs on highway land. This should be on a long rotational basis with a 7-year minimum between cuts; and
- Creating 'green bridges' over roads to reduce its effect in causing a barrier to movement and dispersal the species from one side of the road to the other (see item 12)

Once nesting boxes have been located highway's staff should be made aware that it is illegal to disturb dormice unless for monitoring purposes under a special licence from Natural England.

6. Otters

All watercourses in Gloucestershire are potentially used by otters, including small streams. Where highway verges are adjacent to a watercourse a few measures might be incorporated into a scheme. Where watercourses run parallel to a road, scrub should be planted or encouraged in the verge to discourage otters using the road in times of spate. Felled trees or rock piles might be left on riverbanks to provide shelters, and artificial holts constructed from logs, but not close to busy roads. See also items 11 on underpasses and 13 on reflective posts.

7. Water Voles

When carrying out drainage operations and as part of new highway schemes there are opportunities for habitat enhancement through restoration of vegetated bankside corridors. Linking existing corridors will help minimise and even reverse local population declines and help the viability of small populations of water voles. Any new ditches created should be profiled so that the banks enable water voles to burrow into them. A useful overview to water vole issues and solutions can be found in the Water Vole Conservation Handbook (Strachan & Moorhouse, 2011[58])

8. Barn Owl, Kestrel, and other Raptors

Young barn owls are susceptible to a high casualty rate from collision with vehicles using the highway (up to 50% of the young can be lost). Kestrel and tawny owl casualties are reported to be even higher than those of barn owls. Where there are road casualty 'hotspots' (indicated by data) remedial measures could be implemented as part of a schemes and maintenance programme.

At appropriate locations wide verges can be enhanced by creating habitats of rough grassland for small mammals, which are the prey of the barn owls and other raptors. However, this is only recommended under quite particular circumstances. It is best done on the margins of adjacent fields that run near to roads rather than within the highway corridor itself. Habitat enhancement by long grass establishment should only be encouraged where verges/embankments are wide enough to accommodate a hedge or scrub barrier quite close to the carriageway. Any grass immediately next to the highway must be kept short to reduce barn owl and other bird of prey attractiveness and thereby casualties. Further useful information can be found in Ramsden (2004)[59]. Where safe habitats for birds of prey such as kestrels and barn owls occur (e.g., on minor roads and major roads where the above criteria are met) then consideration of introducing nestboxes nearby on adjacent land (but not within the highway corridor) might be considered.

9. Signing

Permanent signing indicating the possible presence of wild animals is ineffective, as drivers become used to the sign and pay no heed to it. Therefore, other enhancement measures, such as clearing sightlines or creating underpasses (as detailed below) should be implemented at key likely crossing points with accident/near miss records. Where there is a seasonal problem, for instance when common toads migrate across roads to and from breeding ponds then temporary signs may be deployed with volunteer patrols to transfer toads from one side to another (after a risk assessment has deemed it feasible). Nonetheless, underpasses (or green bridges/overpasses) would give a more permanent solution to the problem.

10. Amphibians and Reptiles

Amphibians are subject to road mortality when migrating between hibernation sites and breeding ponds in spring. Temporary 'toad' signs may be used but consideration should be given to constructing an underpass (see items 9 and 11). Creation of ponds will benefit amphibians and some reptiles (grass snakes). Substitute ponds may be necessary where roads, especially new ones, bisect migratory routes to avoid barrier effects and road casualties. Details of construction can be found in Anderson (1993): *Roads and Nature Conservation*.

Hibernation sites for reptiles may be created on site by the stacking of log or rock piles towards the back of verges. These hibernacula and smaller piles of rocks and wood can act as feeding and sheltering sites for some species. Spoil and debris from the maintenance works can be used to create terrestrial habitat too. Small top opening chambers of stone can be constructed within south facing embankments on new works as hibernation sites. This should be used in combination with reptile fencing at the top of the embankment to reduce the risk of roadkill. Stones can be left as basking sites for Adders. Design of winter hibernation sites for great crested newts is given is English Nature's '*Great crested newt mitigation guidelines*' (2001). Scrub clearance will help provide basking areas where reptile species are known to be present. A range of different habitats benefits reptiles.

Amphibians and reptiles can get trapped on the carriageway by kerbing. Gully pots and sheer sided chambers, cattle grids, road drains and pipe work may also act as a trap for amphibians and other small animals (e.g., reptiles and mammals). Sustainable Drainage Systems should be used wherever possible so to avoid using gully pots and 'hard engineered' drainage features. Kerbing "breaks" formed using dropped kerbs or offset kerbs or overhanging kerbs can provide escape or a refuge at the carriageway edge for amphibians where there are gully pots (drainage grills) nearby (see also Section 11 on 'underpasses' below). Any cattle grids should provide ladders or slopes for small animals such as amphibians and hedgehogs to escape.

11. Underpasses for Mammals/Amphibians/Reptiles

Existing roads form a barrier to wildlife and the scale of the barrier increases with the intensity of traffic on a road particularly for invertebrates, amphibians, reptiles, and small mammals. Roads with little traffic (below 1,000 vehicles per day) are still permeable to most wildlife; but those with 4,000 to 10,000 vehicles per day impose a strong barrier. Noise and movement will repel many and those that try to cross may become casualties. Roads with over 10,000 vehicles per day are considered to be impermeable to most species (Dufek J, 2001[60]).

If improving sightlines for drivers and animals themselves is not a feasible or successful option, then wildlife casualties at 'hotspots' can be minimised by the installation of various types of underpass. Consideration should also be given to underpasses where wildlife corridors meet the highway, in order to facilitate movement of species across roads. In addition to saving wildlife benefits may also be obtained through potential reduction in personal injury accidents resulting from wildlife collisions with large animals (e.g., deer and wild boar). Underpasses usually take the form of pipe, culvert or tunnel inserted under the carriageway from one side of the verge to the other. The size of the pipe will vary according to the species that the underpass is intended for and the distance between verges. Underpasses also need to be constructed with fencing/planting/landscaping to guide the animal to the crossing point. Guide specification for Amphibians, Badgers and Otters is given below.

<u>Specification for Animal Underpasses</u>

<u>A. Otters</u>

Ledges for otters and other wildlife under bridges can be made of solid concrete construction as an integral part of the bridge or made of gabion baskets. Alternatively, they may be from

steel or other durable material and bolted onto the side of the bridge. Another type of ledge is a floating pontoon of hardwood with a polystyrene core. All ledges should be 30 to 35 centimetres wide. They must be designed not to obstruct flow or floating debris during flooding.

Otter underpasses/tunnels should be constructed with pipe work of the following dimensions dependent on length needed under the highway:

- Up to 20 metres long – 600mm internal diameter minimum
- 20 metres to 50 metres long - 900mm internal diameter minimum

The underpass/tunnel need not be straight, or a line of sight maintained. It should be kept as short as possible and can be located up the embankment. Locating it up the embankment will increase the otter's awareness that it is associated with a road crossing. The underpass/tunnel should not fill with water and be watertight. A channel should be dug up to the tunnel entrances as a lead in for otters. The correct lead in to the tunnel is important and 'guide in' fences are also recommended to 'funnel' the otter into using it both sides of the road. This should lead out in the form of a 'V' if possible. If it is not possible to use a 'V' feature a fence should run parallel with the road above the tunnel at least 150 metres either side of the road/bridge. It is essential that fencing is erected both sides of the road; otherwise this could result in trapping the otter on the carriageway.

Fences should preferably be of metal (galvanized) weld mesh of 3mm gauge and 30 to 40mm square not of chain link. Badgers have been known to enlarge and deform chain link so that otters can pass through. Otters are capable of squeezing through gaps of 50mm. Otters are also capable of climbing chain link up to a height of 2 metres. The fence therefore should be 1500mm high with a 300mm overhang angled out at 45 degrees away from the road and 300mm sunk into the ground. Where jointly used for badgers as well (see below), the mesh should also be sunk into the ground 500mm (prevents badgers digging underneath). A lesser specification may have to be used in many circumstances.

B. Badgers

Badger underpasses/tunnels must be located where badger trails indicate that badgers regularly cross the road. They should be positioned 100mm above existing ground level, if located within an embankment, and the pipe tunnel should drop slightly after the entrance before continuing level under the road. The pipe should be 600mm diameter preferably of concrete and waterproof. Spreading soil through the pipes will help 'naturalise' the tunnel. There should be at least 300mm of shelter above the tunnel entrance and a concrete portal may be formed at this point. Usually lead in fencing is required and this should be as specified for otter underpasses (above), although away from the proximity of otters the overhang is not required and the height of 1500mm is sufficient. However, the weld mesh should be sunk in the ground 500mm and returned away from the road 300mm (prevents badgers digging underneath).

C. Polecats

Research is still needed to see what could be done in hotspots to reduce polecat casualties. Polecats have increased in recent years and have recently recolonized most parts of England now. Measures for badgers and otters and possibly amphibians (see below) will probably also help polecats.

D. Amphibians and Reptiles

Amphibians prefer tunnels that are buried close to or immediately level with the ground surface. Amphibians may be killed from surface residues on standard concrete pipes; therefore polymer concrete pipes should preferably be used. The position and size (length and diameter) of underpasses and the angle by which they are approached is critical for

amphibians. Small tunnels/pipes may need cleaning out at intervals to ensure silt and or leaves etc. do not block them. Approximately 300mm high screening fences/panels should be used to guide amphibians towards the tunnel entrance ('V' funneling – see above under otters). These should have an overhang of about 50mm or a flat panel erected at an angle pointing away from the road. Froglife can provide further information on this topic including contact details of suppliers of tunnel and fence systems - www.froglife.org .

12. Overpasses and 'Green Bridges'

Overpasses/bridges can be an expensive option for inclusion. The use of single strand 'rope' bridges as an inexpensive option for smaller arboreal mammals such as dormice at appropriate locations is not yet proven. More substantial wildlife bridges are sometimes unavoidable to facilitate the movement of wildlife, particularly larger mammals over new roads (Bank et al, 2002). They can also reduce collisions with vehicles especially likely at night when such animals are more likely to cross a road and not be seen by vehicle users. In the UK examples include the M25 at Epping Forest (Anderson, 2002), the A21 at Lamberhurst in Kent and A556 in Cheshire. Natural England has carried out review of green bridges in the UK and internationally where they are more common (Natural England, 2016[61]). These should be considered within the design of new roads where appropriate to relieve the effects of fragmentation and barriers to movement. The use of some form of overpass would help relieve the isolation of wildlife populations caused by roads in those areas where this occurs. Landscaping and planting may be needed to funnel animals towards these structures crossing roads. Hybrid green bridges are possible where there is also a need for a path or farm track to cross a road beneath.

13. Reflective/Reflector Posts

Reflective posts may be effective in helping to prevent wildlife casualties at 'hotspots' or known crossing places. They deter animals from approaching the road by means of the reflected light. They can be used for species such as deer, otters, and badgers. The use of reflective posts for badgers has been tried both in the Netherlands and in the UK. However, there is still doubt about their efficiency. Nonetheless, it has been reported that they are very successful in West Sussex where the local badger group manages the posts. Reflective posts need setting up by an expert at night to obtain the correct angle of reflection. To be successful, regular maintenance is required to prevent vegetation obscuring the reflective surfaces. Verge cutting can also damage the posts and locations need to be identified on verge cutting schedules. The uses of acoustic wildlife warning reflectors were tried and monitored for effectiveness for deer in Somerset and Hertfordshire during 2005 and 2006. A useful review of methods designed to reduce deer collisions on roads is given by Putman, Langbein & Staines (2004)[62]. There may now be more up to date evidence on such methods.

14. Invertebrates

Apart from managing the highways estate to provide invertebrate habitat (nectar rich wildflowers, taller grass, some bare ground, small ponds etc.) other areas for shelter and breeding can be created. After completion of work leaving several flat stones can be left scattered on the verge or embankment (below any cutting height, e.g., under 50mm thick stones) can be beneficial. This will provide shelter for species such as ground beetles and centipedes. Log piles in shady areas will also benefit invertebrate species including stag beetles. In structures (walls etc.) nest sites can be provided for solitary bee and wasp species using drilled blocks of wood, blanked off drainage pipe off cuts or tin cans filled with bamboo canes. '*Habitat Management for Invertebrates: A Practical Handbook*' published by the Royal Society for Birds (2002 and re-printed 2011 by Peter Kirby). The Buglife website is also a useful source of information on measures you can take to support invertebrates e.g. at www.buglife.org.uk/activities-for-you/wildlife-gardening .

15. Translocation

Species and habitats can be translocated, i.e., “rescued” and moved to suitable alternative sites. Translocation can be used in major schemes but should always be used as a last resort. It is a difficult operation and may not always be successful and is dependent on several factors. The recipient site must meet the requirements of the translocated species or habitat and must not adversely compete with an existing species population or habitat at the recipient site. Assessments and a detailed specification, including management and monitoring, will need to be prepared by a specialist ecologist and any relevant licences obtained.

Appendix D NOTICE AND ASSENT AGREEMENTS FOR MAINTENANCE WORKS UNDERTAKEN WITHIN OR NEAR TO SITES OF SPECIAL SCIENTIFIC INTEREST

There are two agreements (one for roads and the other for Public Rights of Way) covering routine maintenance works on or in the vicinity of SSSIs. These are to be found on the GCC intranet (StaffNet) for staff at staffnet.gloucestershire.gov.uk or for others it is available from the County Council Ecologist (see above - Section 8 'Contacts').

Appendix E Note on Dead/injured Otters, Badgers, Polecats & Bats

1. Recording Dead Otters, Badgers, Polecats, Bats, or other notable species

STEP1: If a member of the public or employee reports a road casualty that is a notable (priority) species then please record, or ask them to record this information (see steps below),

STEP 2: Collect/record as much information as possible, e.g., name of species, date found, site location (road name/number, grid ref [or post code], adjoining habitats), description of species condition/size/age/sex, numbers found, and the contact details of whoever found it. This info then needs to be submitted on iRecord at www.brc.ac.uk/irecord or directly to the Gloucestershire Centre for Environmental Records (GCER) at www.gcer.co.uk or Tel. 01452 383333.

STEP 3: Inform the relevant District Council for collection/disposal if necessary because a carcass is causing a hazard or nuisance. Contact a nearby vet, the RSPCA or one of the contacts below if the animal is injured and further advice or assistance is needed.

2. Injured Animals

In emergency contact a nearby vet or the RSPCA Tel. 03001 234999

RSPCA Oak and Furrows Wildlife Rescue, Somerford Keynes, nr. Cirencester www.oandf.co.uk Tel. 01793 640136

Vale Wildlife Rescue Centre, Beckford, nr. Tewkesbury www.valewildlife.org.uk/ Tel. 01386 882 288 (**For casualties between 5pm & 7am take animal to the centre direct as it is manned 24/7 but phones are not**).

If you find an injured or dead bat, please call the Bat Conservation Trust's (BCT) Helpline Tel. 0845 1300 228 for advice (also see http://www.bats.org.uk/pages/contact.html). Although the bat rabies virus (EBLV) is very rare in the UK, and bats are usually quite docile, you should avoid handling bats without calling the helpline or referring to the Bat Conservation Trust's website for further information. Anyone who is bitten by a bat should visit their doctor for medical advice. There is an effective treatment available from your doctor for those exposed to EBLV; this must be administered as soon as possible after exposure.

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