



# **Mitigation of the effects of road construction on sites of high ecological interest**

**Prepared for Quality Services (Traffic Safety and Environment),  
Highways Agency**

L Chinn (TRL), J Hughes (SWRC) and A Lewis (SWRC)

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## Executive Summary

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This report was produced for Project E212D/HH, Project Officer Mrs Sally Dyke of Quality Services (Traffic Safety and Environment) of the Highways Agency.

The objective of this study was to examine measures provided for the mitigation of adverse ecological effects of road construction on designated sites and protected species, and to determine the extent of their success. In particular, the design and management of such measures was examined in this study. Fourteen sites were selected as case studies. These were either designated sites (Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), both of which are the UK's most important sites for nature conservation) or the habitats of protected species. The sites were selected by TRL from information supplied by the Highways Agency, and English Nature, and from the examination of Environmental Statements held by the Highways Agency (for schemes after the 1988 implementation of Environmental appraisal in the UK). They were chosen to provide a spread of habitat types (woodland, grassland, heathland, wetland and freshwater), age of scheme, geographic location, and mitigation techniques. These techniques included habitat creation, translocation of species and habitat, use of plant material propagated from local sources, natural regeneration and increased intensity of management of existing sites or remaining areas of affected sites.

This report describes each of the case study sites in terms of its ecological interest, the extent of the impact of road construction on the site, the mitigation measures taken, and assesses the success of these mitigation measures. At eleven of the sites assessment of the mitigation was by field surveys conducted during 1996 or 1997, by Scott Wilson Resource Consultants, under contract to TRL. At the remaining three sites assessment of the mitigation methods relied on documented evidence.

Of the fourteen schemes studied, possibly only three could be regarded as successful. Of the remainder, most could be considered partially successful, or their success is uncertain at the present time, and three could be regarded as failures. The main reasons for failure was inadequate management of the implementation of the scheme, or inadequate post-implementation management.

In addition to making specific recommendations for future design and management of ecological mitigation schemes, the report draws the general conclusion that the success of the mitigation adopted may be attributed to one or more of the following main factors:

- the quality and appropriateness of the ecological advice
- ease of creation/ re-creation of the habitat type
- the introduction and maintenance of appropriate management.



# 1 Introduction

The Highways Agency's objectives for nature conservation are contained in the Design Manual for Roads and Bridges, Volume 11 (Department of Transport, 1993) and these are:

- the maintenance of the diversity and character of the countryside, including its wildlife communities and important geological and physical features; and
- the maintenance of viable populations of wildlife species, throughout their traditional ranges, and the improvement of the status of rare and vulnerable species.

When a new road is designed, consideration is given to its impact on the pre-existing ecology. Avoidance of sites of ecological importance by careful route alignment is the preferred solution but this cannot always be achieved. Impacts upon ecological areas might arise from direct habitat loss or the severance of habitats and through indirect effects, such as changes to the hydrology of an area, or because of pollution from road run-off. However, measures may be incorporated into designs to mitigate the effects of road development on individual species or whole habitats.

The objective of this study was to establish the extent to which ecological design and management has been successful in reducing the adverse ecological impacts of road construction and operation on sites and species of nature conservation interest. Fourteen sites were selected as case studies. These were either designated sites (Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), both of which are the UK's most important sites for nature conservation) or the habitats of protected species. The

sites were selected by TRL from information supplied by the Highways Agency, and English Nature, and from the examination of Environmental Statements held by the Highways Agency (for schemes after the 1988 implementation of Environmental appraisal in the UK). They were chosen to provide a spread of habitat types (woodland, grassland, heathland, wetland and freshwater), age of scheme, geographic location, and mitigation techniques. These techniques included habitat creation, translocation of species and habitat, use of plant material propagated from local sources, natural regeneration and increased intensity of management.

Table 1 provides a list of the fourteen sites.

This report describes each of the case study sites in terms of their ecological interest, the extent of the impact of road construction on the site, the mitigation measures undertaken, and assesses the success of these mitigation measures. At eleven of the sites, assessment of the mitigation was by field surveys conducted during 1996 or 1997, by Scott Wilson Resource Consultants, under contract to TRL. At the remaining three sites (Hares Down, Knowstone and Rackenford Moor SSSI, St Catherine's Hill and Itchen Valley SSSI, and Hazelborough Wood) assessment of the mitigation methods relied on documented evidence. The report draws general conclusions from the case studies, and makes general recommendations for future ecological mitigation and management practices.

**Table 1 Selected study sites**

<i>Scheme</i>	<i>County</i>	<i>SSSIs</i>	<i>Ecological interest</i>
1 A41 Berkhamsted and Kings Langley Bypass	Hertfordshire/ Buckinghamshire	Roughdown Common	Chalk grassland, badgers
2 A564 Foston Hatton Hilton bypass	Derbyshire	Hilton Gravel Pits	Dragonflies
3 A14, A1-M1 link	Northamptonshire	Southfield Farm Marsh	Tall grass washland
4 A14, A1-M1 link	Northamptonshire	Brampton Meadows	Meadow
5 A361, North Devon Link Road	Devon	Hares Down, Knowstone, Rackenford Moor	Culm grassland
6 M40	Oxfordshire	Shabbington Wood	Deciduous, coniferous and mixed woodland, butterflies
7 A43 Silverstone bypass	Northamptonshire	Hazelborough Woods (not a designated site)	Dormice
8 M3 Winchester Bypass	Hampshire	St Catherine's Hill, Itchen Valley	Chalk grassland, butterflies, flood meadows
9 M6	Lancashire	Red Scar Wood	Woodland
10 A6 Quorn/Mountsorrel Bypass	Leicestershire	Barrow Gravel Pits	Uncommon invertebrates
11 A658 Harrogate and Knaresborough Bypass	Yorkshire	Birkham Wood	Ancient woodland
12 M6	Cheshire	Wooltson Eyes	Lagoons
13 M40	Oxfordshire	Aston Rowant NNR	Chiltern scarp with beech woods, mixed scrub and chalk grassland
14 A11 Thetford to Bridgham	Norfolk	Brettenham Heath NNR	Heathland

## 2 Survey methods

### 2.1 Introduction

The principal objective of the surveys was to assess the current value of the SSSI or site of ecological interest to that which would have existed had the road construction not taken place. It was therefore necessary to compare the value of what remained of the original resource, plus any new mitigation land, with the value of the resource before road construction. It was, however, understood that the sites may have undergone some change whether or not the road was constructed, although it was not always possible to take this into account.

Methods used involved both studies of background documentation and reports of field studies already completed (when available), and new field surveys. TRL employed Scott Wilson Resource Consultants (SWRC) to carry out these field surveys. Generally, the method used in the field study was to compare that part of the SSSI affected by a road scheme, or new mitigation land, with a part of the original SSSI unaffected by the road scheme. That part of the original SSSI was chosen to be similar in character to the affected land or the character that the mitigation land was attempting to recreate.

### 2.2 Documented information

For each case study site, documented evidence was sought on the ecological value of the original site, the site subsequent to road construction, and any additional areas which were created to mitigate for ecological loss.

The main source of information on the ecological importance of the SSSIs prior to road construction was from the English Nature SSSI Citations, and subsequent consultation with English Nature and the Wildlife Trusts. Details of mitigation measures, management plans and monitoring records were studied when available. Much information on these subjects was made available at the Public Inquiry for the scheme, or from the Ecological Consultants for the scheme employed by the Highways Agency. Subsequent Highways Agency correspondence, where made available, was also studied.

### 2.3 Site overview

Initially, SWRC carried out a walkover survey to enable management practices and specific mitigation features to be identified. The appropriateness and health of any tree and shrub planting schemes were assessed and, where present, deer and badger fencing was inspected to check for effectiveness.

General descriptions of vegetation were taken, where appropriate, to provide supporting information to the data gathered subsequently using quadrat recording (ie a defined sampling area is used for recording plant species or other biological data) (see also Section 2.4).

The frequency of plant species was recorded using the DAFOS scale:

D (pre)dominant

A abundant

F frequent

O occasional

S scarce

The prefix L is used to denote 'locally' distributed species.

### 2.4 Vegetation - survey method

The aim of the vegetation surveys conducted by SWRC was to evaluate the success with which mitigation sites mirrored the original site habitat (as it was at the time of the survey, rather than as it was before road building commenced - since it may have improved or deteriorated irrespective of the road's presence). To test this, at each site randomly distributed quadrats were recorded in relatively homogenous areas of vegetation, both in translocated/sown areas and in remaining areas of the original SSSI (controls).

From each quadrat all vascular plants, bryophytes (mosses and liverworts) and macrolichens were recorded. Some plants, such as dandelions, were not identified to species level, and some of the diminutive mosses and especially hepatics (liverworts) may have been overlooked in the field. The species cover/abundance within each quadrat was recorded using the Domin scale<sup>1</sup> as detailed below:

Percentage cover	Domin Scale
91-100	10
76-90	9
51-75	8
34-50	7
26-33	6
11-25	5
4-10	4
<4, with many individuals	3
<4, with several individuals	2
<4, with few individuals	1

Quadrat data from the vegetation surveys is reported separately (Chinn et al, 1998).

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<sup>1</sup>The Domin scale combines, in part, a measure of abundance and coverage thereby reducing bias introduced from plant size and distribution.

## 2.5 Vegetation - data analysis

The use of computer programmes to assist in the analysis of multivariate data such as those collected from vegetation surveys has become an increasingly useful tool. The definition of vegetation types, through the classification (grouping) of the floristic samples taken by programmes such as TWINSPAN, aids in the description of vegetation and allows the similarity or dissimilarity between areas of the same and different vegetation to be explored in an objective manner by programmes such as MATCH. In addition, ordination (ordering) techniques (such as DECORANA) can assist in explaining the trends seen in the vegetation.

The publication of a National Vegetation Classification (Rodwell et al, 1991a, 1991b, 1992, 1995 and in prep.) has provided a standard for the description of plant communities in this country; all vegetation sampled may now be attributed to a National Vegetation Classification (NVC) type. Again, computer programmes facilitate this process.

Two-way Indicator Species Analysis (TWINSPAN; Hill, 1979a) groups and orders samples, amalgamating those with a similar species composition, and then uses this classification to group the species, according to their distribution amongst the samples. A table of species versus samples is produced, with the species and samples both ordered. This table may be studied, the groupings assessed by eye, and the skill and experience of the investigator applied to determine the vegetation types to be defined. Such a method combines the objectivity of the computer programmes with the expertise of the researcher.

Using the computer programme MATCH (Malloch, 1990), in association with the NVC keys, the various end groups derived from the multivariate data analyses may be attributed to an NVC community. MATCH mathematically compares the sample data with the constancy profiles for all the NVC communities/sub-communities and produces a list of similarity coefficients, allowing a short-list of possible community types to be composed.

The relationship between the plant species/communities and various environmental variables that define vegetation types may be investigated using Detrended Correspondence Analysis (DECORANA; Hill, 1979b). This is an ordination program classifying species and samples along four axis of ordination. The representation of particularly the samples but also the species on a two-dimensional plot along the extracted ordination axes of maximum variation in the data is an attractive method of presenting data and can be a powerful aid in assessing the relationships between the individuals (that is, species or samples) and also between the individuals and those variables which may be reflecting factors controlling the vegetation. This technique is useful not only to confirm the NVC groupings derived from classification but also to explain the variation within the vegetation.

## 2.6 Badger survey

At Roughdown Common, where the presence of badgers had been recorded, an area enclosing the SSSI and up to 1km on either side of the new road was surveyed for signs of their continued presence. The local badger group was consulted

regarding historical sett records and road kill information.

During a walk over survey of the area, the locations, number of entrances and level of use of all badger setts were noted. Each sett was categorised according to its importance to the local badger population, and its level of use. The presence of hairs, footprints, pathways, dung pits and feeding signs were also noted and used to plot the patterns of movement of the badgers. It is possible to confirm that a pathway is used by badgers if there is a clear link to a sett or if there is additional evidence of badger activity nearby (such as dung pits, hairs, footprints or feeding signs). Evidence of measures such as fencing or crossing points that may have been incorporated into the road scheme to mitigate or reduce impacts on badgers was noted. The success of these mitigation measures was then assessed using information gathered during the survey and from consultation.

## 2.7 Dragonfly survey

This survey was undertaken at the Hilton Gravel Pit SSSI. Adult insects were counted from fixed points at pond edges that allowed good visibility, and any signs of ovipositing were noted. Any dragonflies disturbed from adjacent vegetation whilst walking around the ponds were also counted. Sweep netting was undertaken at accessible points to locate dragonfly larvae, this being undertaken at each point for three minutes with a 30 cm diameter net.

## 2.8 Butterfly survey

A survey for butterflies was undertaken at Shabbington Woods. Adult insects were counted from a fixed transect that had been established during previous monitoring work by Butterfly Conservation using the methodology of the national Butterfly Monitoring Scheme (BMS). In this methodology, the transect is walked at a fixed pace and all butterflies seen as far as 5 metres from the observer are recorded. Counts are only undertaken between 10.45h and 15.45h and only when the temperature is above 13°C (and above 17°C if cloudy).

## 2.9 General invertebrate survey

A general invertebrate survey was carried out at Barrow Gravel Pits. Insects were sampled using a sweep-net and additionally a suction sample was randomly taken from each habitat on the site. The horsetail flea beetle *Hippuriphila modeeri* was identified during consultation as being of particular interest. A small patch of water horsetail that might support the species was examined in detail. At the start of sampling, a sheet was placed adjacent to the plants which were then drawn over the sheet by hand and vigorously shaken to dislodge any beetles. The remainder of the site was then sampled and after about three hours, the plants were thoroughly sampled using a stout sweep-net. A further hour elapsed before the patch of horsetail was subjected to suction sampling, using a narrow nozzle to enable penetration of the vegetation to the litter layer beneath. (These timings allowed the beetles to return to the vegetation after the disturbance of the previous sampling). After this, the suction sampler was

also randomly used on the areas of the river bank where cut stems of horsetail were evident. In addition to these sampling techniques, sight and sound observations were made throughout the site.

## 2.10 Birds

Woolston Eyes was visited twice (April and May) to map the distribution of territorial birds within 250 metres of the new road viaduct. In the absence of any suitable control data, the territories mapped were compared with breeding bird data for the entire site. Bird territories are mapped by marking the locations of all individual birds showing territorial behaviour. After a number of visits, it is possible for an experienced surveyor to determine approximate territory boundaries.

## 2.11 Other species

Records were taken of any casual observations of animals made during the walkover and other species surveys.

# 3 Case studies

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## 3.1 Roughdown Common

### 3.1.1 Background

Roughdown Common SSSI is to the south-east of Hemel Hempstead, Hertfordshire. The SSSI was first notified in 1953 (under the National Parks and Access to the Countryside Act, 1949). It is species-rich unimproved calcareous grassland of which few examples remain in Hertfordshire. The SSSI is the also only site in the county where *Juniperus communis* (juniper) is able to regenerate naturally. In addition, a number of badger setts have been located within the SSSI and the surrounding area.

Construction of the A41 Berkhamsted and Kings Langley bypass began in 1991 and the road was opened in 1993. It cuts across the southern part of the SSSI causing the loss of a small area of chalk grassland. Formerly the SSSI had covered an area of 3.6 hectares, and the land lost to the road construction was less than half a hectare. The road construction resulted in the destruction of two badger setts, although these were not located within the SSSI. A map showing the SSSI and the route of the A41 is given in Figure 1. Information on the history of the scheme has been supplied by English Nature and the Boxmoor Trust.

### 3.1.2 Mitigation

An L-shaped area of arable farmland (approximately 2 hectares in area, and considerably larger than the land lost) adjacent to the SSSI was purchased. There has been an attempt to recreate a chalk grassland sward on this land (also shown in Figure 1), as well as on the new cutting slopes by sowing grass and wildflower mixes. The upper slope of the cutting (2:1 slope) was sown with a wildflower mix in 1992 (for details see Chinn et al 1998), and the lower cutting slope was sown at the same time with *Festuca rubra ssp. commutata* (Chewing's fescue). The L-shaped area was sown with a meadowgrass and

Westerwold's ryegrass (a variety of *Lolium multiflorum*), also in 1992. (Westerwold's Ryegrass is an annual intended to provide rapid cover for the bare ground, and to be mown before seeding). However a survey in 1993 (by Emmorsgate Seeds for Landscape Partnership - the Landscape Architects for the scheme) revealed that the vegetation was dominated by *Lolium alterniflorum* (Italian ryegrass) and *Trifolium repens* (white clover), neither of which were specified in the original seed mix, and inappropriate for the ecological mitigation purposes. Consequently the area was scraped almost bare in 1993/94 and was resown with the originally specified seed mix. A broad hedgerow feature has been planted along the southern edge of the L-shaped land (see Figure 2). The purpose of this hedge was to physically separate the land from the adjacent field by providing a dense vegetative barrier, to link with other hedgerows visually and provide a wildlife corridor. The hedge was also intended to to soften distant views from Boxmoor and screen any high sided vehicles travelling on the A41. Saplings were also planted within the remainder of the L-shaped land. The existing juniper population was not thought to be threatened by the road construction, since it was regenerating naturally in the chalk-pit area (see Figure 1), but additional juniper cuttings were planted in autumn 1996. Badger-proof fencing has been erected along both sides of the cutting.

### 3.1.3 Site surveys

Site surveys were undertaken on 8 August 1996, 2 September 1996 and 22 July 1997.

In 1996 quadrats species were recorded for the seeded areas (the L-shaped area of land (5 quadrats) and the upper 2:1 slope of the cutting (4 quadrats)) and were compared with existing areas (the species-rich chalk turf around the upper edge of the chalk pit within the SSSI (4 quadrats), and the strip of land adjacent to the cutting (2 quadrats)). The method of assessment followed that detailed in Section 2.2. A badger survey was undertaken and this followed the methodology described in Section 2.6. A walkover survey assessed additional mitigation measures, such as the planted broad hedgerow feature along the southern edge of the L-shaped area.

In 1997 the juniper planting (which had not been undertaken at the time of the 1996 SWRC surveys) was assessed by a walkover survey, during which each individual planting was checked to determine the survival rate to date. The percentage cover of the *Festuca* species on the habitat creation land was assessed by recording four quadrats for this species alone, since it had been difficult to distinguish the different species at the time of year of the 1996 surveys (see Section 3.1.4).

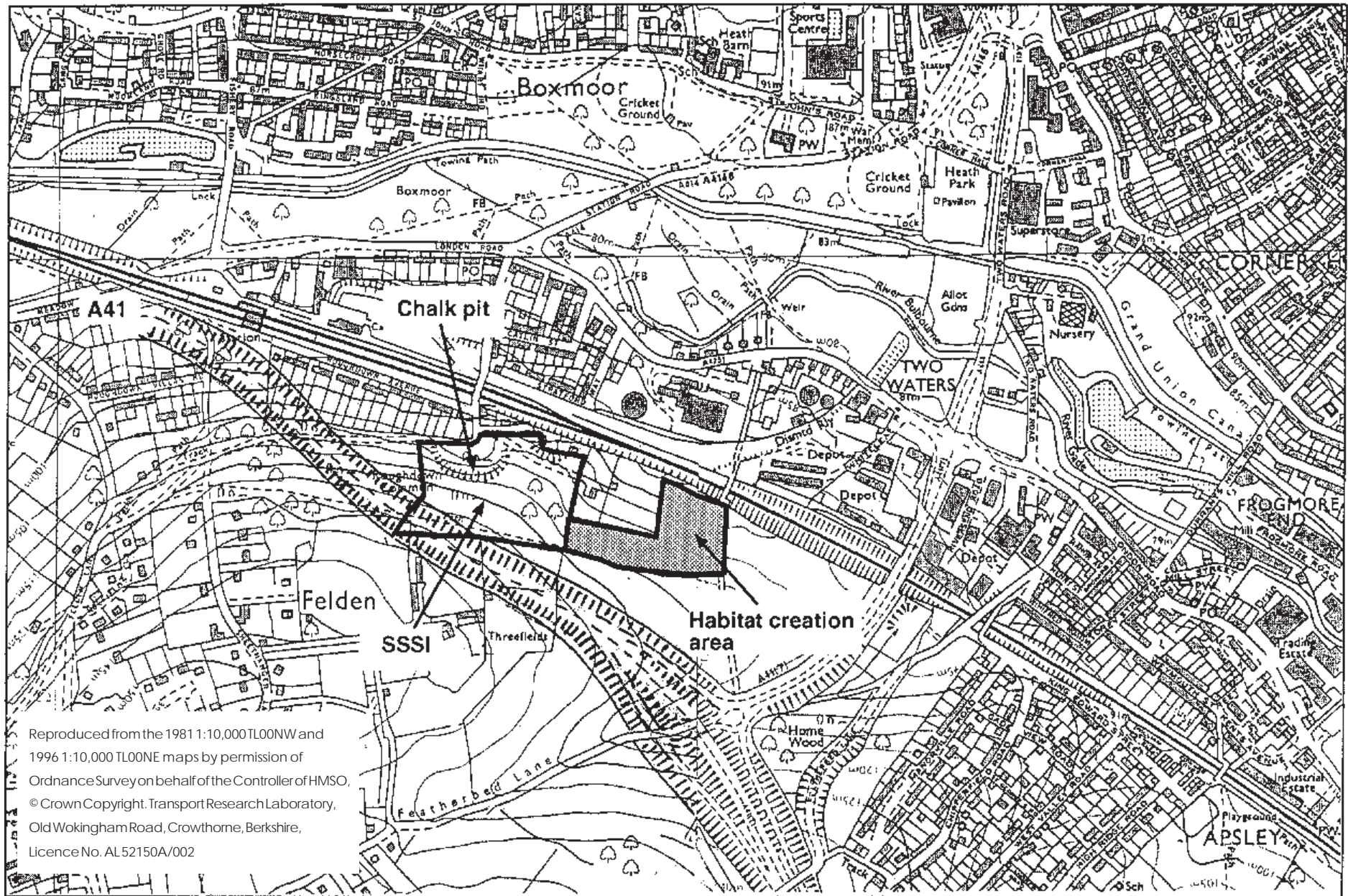
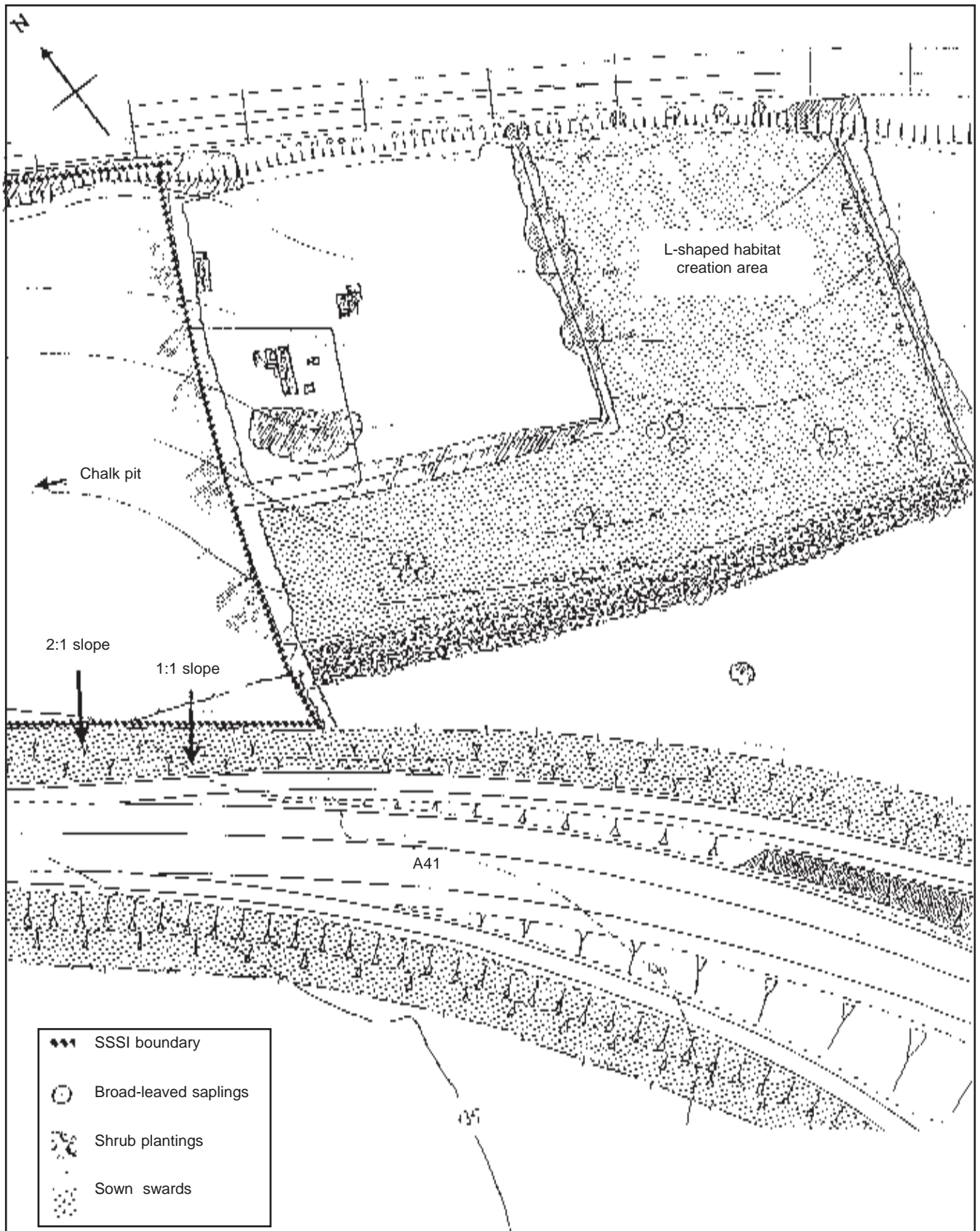


Figure 1 A41: Roughtdown Common SSSI (pre road construction) and habitat creation area. Scale 1:7,000 approx.



**Figure 2** Ecological mitigation measures, Roughdown Common. Scale 1:2000 approx.

### 3.1.4 Survey results

#### a Vegetation

##### i Chalk grassland

###### Upper pit margins of the SSSI

The grassland around margins of the chalk pit had been grazed heavily by rabbits and supported a very short, tight sward, dominated by *Festuca ovina* (sheep's fescue). Where grazing pressure was lower *Helictotrichon pratense* (meadow oat-grass) and *Bromopsis erectus* (upright brome) increased in frequency. Both *Briza media* (quaking-grass) and *Koeleria macrantha* (crested hair-grass) were present throughout but their frequency is likely to have been underestimated because both species flower in early summer. *Carex flacca* (glaucous sedge) was also frequent throughout the area. The most conspicuous and frequent herbs within this community were *Pimpinella saxifraga* (burnet saxifrage), *Pilosella officinarum* (mouse-ear hawkweed), *Sanguisorba minor* (salad burnet), *Hypochaeris radicata* (cat's-ear) and *Lotus corniculatus* (common bird's-foot-trefoil). Of lower frequency but of interest were *Cirsium acaulis* (dwarf thistle), *Carlina vulgaris* (carline thistle), *Dactylorhiza fuchsii* (common spotted-orchid), *Gentianella autumnalis* (autumn gentian) and *Euphrasia pseudokernerii* (eyebright). The Boxmoor Trust had indicated that *Gymnadenia conopsea* (fragrant orchid) was present. This assemblage of plants is the community that the sown areas should replicate.

###### Strip adjacent to 2:1 slope

The strip of grassland adjacent to the top of the cutting appeared to have suffered disturbance during construction of the road and much of the area supported rank grassland with abundant *Cirsium arvense* (creeping thistle) and *Rumex obtusifolius* (broad-leaved dock). A few areas were rabbit grazed and in these areas *Centaurea nigra* (common knapweed) and *Leucanthemum vulgare* (ox-eye daisy) were prominent. It is probable that these areas were subject to some reseeding locally although this may perhaps have been unintended (when adjacent cutting slopes were seeded).

###### 2:1 slope

The established vegetation covered an estimated 50-70% of the chalk and was overwhelmingly dominated by the sown species with a few self-sown weed species. *Festuca rubra* ssp. *commutata* (Chewing's fescue) typically attained a Domin score of 5-6 and was the only frequent grass species present. The most frequent herbs were the sown *Leucanthemum vulgare* (ox-eye daisy), *Centaurea nigra* (common knapweed), *Sanguisorba minor* ssp. *muricata* (fodder burnet), *Scabiosa columbaria* (small scabious) and *Lotus corniculatus* var. *sativa* (bird's-foot-trefoil).

###### 1:1 slope

The lower slope of the north-facing cutting was bare in many areas, but the average total vegetation cover was estimated at 25%. The vegetation was composed almost entirely of *Festuca rubra* ssp. *commutata* (Chewing's fescue) with *Lotus corniculatus* var. *sativa* (bird's-foot-trefoil) locally abundant. A one-metre wide strip of herb-

poor rank grassland dominated by *Arrhenatherum elatius* (false oat-grass) was present between the base of the slope and the road edge.

###### L-shaped habitat creation land

In 1996 the turf was dominated by fine-leaved *Festuca* species with *Poa* attaining a low Domin score in all quadrats. It proved impossible to attain accurate Domin scores for the presence of the three *Festuca* species present within the grazed turf, namely *Festuca ovina* (sheep's fescue), *Festuca rubra rubra* (red fescue) and *Festuca rubra commutata* (Chewing's fescue), since individual fresh leaf sheaths and/or presence/absence of rhizomes have to be investigated for each individual plant and spikelets were not available for examination at the time of the 1996 survey. In 1996 the Domin score for *Festuca rubra commutata* was estimated since the plant frequently has a blue-grey hue lacking in typical forms of the other taxa.

Apart from the fine-leaved fescues, species attaining prominence throughout in 1996 included *Cynosurus cristatus* (crested dogstail), *Phleum pratense* (Timothy grass), *Poa pratensis* (smooth meadow-grass), *Trisetum flavescens* (yellow oat-grass), *Prunella vulgaris* (selfheal) and *Trifolium repens* (white clover). The prominence of a number of these species is not typical of characteristic chalk grassland communities.

A few species were not detected within the quadrats in 1996, but were present within the L-shaped land; these were *Rhinanthus minor* (common yellow rattle), *Senecio jacobea* (ragwort), *Cirsium arvense* (creeping thistle), *Rumex obtusifolius* (broad-leaved dock) and *Tripleurospermum inodorum* (scentless mayweed). The latter four species were all associated with the western edge of the field in which there was evidence of recent localised disturbance.

The surveys by Emorsgate, in 1995, recorded several herb species not detected during the 1996 survey. These include *Origanum vulgare* (marjoram), *Reseda lutea* (wild mignonette) and *Trifolium pratense* (red clover). One species sown in the 1993/94 mix was *Filipendula vulgaris* (dropwort) but this species has not been recorded in any subsequent survey.

When revisited in 1997, it was not difficult to tell *Festuca ovina* from *Festuca rubra* (based on leaf and spikelet morphology), but the critical determination of *Festuca rubra* (into the native subspecies *Festuca rubra rubra* and the non-native subspecies *F. r. commutata*) proved difficult. The compact thin soil makes the detection (and almost certainly the production) of the distinctive rhizomes of *Festuca rubra rubra* difficult and it is thus problematic to separate the two subspecies with confidence. The two subspecies of *Festuca rubra* are not separated within the NVC so this does not affect the TWINSPAN/MATCH re-evaluation of the community.

The results of the *Festuca* survey are presented in Table 2. Compared to the previous year (surveyed on 8 August and 2 September 1996), the most conspicuous difference to the eye was the abundance of *Lotus corniculatus* (bird's-foot-trefoil) throughout the field, apparently of the native form (unlike the var. *sativa* sown on the A41 cutting). Although

**Table 2 Festuca species recorded on habitat creation land, 1997**

Species	Domin score			
	Q1	Q2	Q3	Q4
<i>Festuca ovina</i>	4	5	3	2
<i>Festuca rubra rubra</i>	4	4	5	5
<i>Festuca rubra commutata</i>	2	3	4	2

Domin scores of up to 4 were recorded in quadrats during 1996, the average Domin score of this species in the field in 1997 was at least 4 and locally approached 7-9.

#### Vegetation analysis

Analysis using the MATCH programme demonstrated that the short species-rich grassland within the chalk pit has affinities to the NVC community, CG2b *Succisa pratensis* - *Leucanthemum vulgare* sub-community of the *Festuca ovina* - *Avenula pratensis* calcicolous grassland. Constant species within this community include *Festuca ovina* (sheep's fescue), *Helictotrichon pratensis* (meadow oat grass), *Carex flacca* (glaucous sedge), *Briza media* (quaking grass), *Pilosella officinarum* (mouse-ear hawkweed), *Koeleria macrantha* (crested hair grass) and *Leontodon hispidus* (rough hawkbit). The sub-community is suggested by the frequency of *Cirsium acaule* (dwarf thistle) amongst others and the presence of *Succisa pratensis* (devil's bit scabious).

Comparison of the analysis of the 1996 vegetation data for the habitat creation land and the 1997 analysis indicated that separation of *Festuca ovina* and *Festuca rubra* had increased the similarity of the vegetation to mesotrophic grassland types MG5 and MG5b, with a greater increase in the similarity to calcareous grassland types CG2c and CG6, although the similarity to the latter was still poor. The results of the analyses are shown in Table 3.

The vegetation still showed poor resemblance to the calcareous grassland associated with the chalk pit (unaffected by road construction). The floral characteristics of the sown sward did not reflect the underlying strata. Herb species within the sward were more appropriate than the grass mix and typical of calcareous communities. In the long term, grazing is perhaps likely to favour the establishment of a community more typical of the underlying strata.

**Table 3 Vegetation affinities of habitat creation area land and chalk grassland\***

Habitat creation land 1996		Habitat creation land 1997		Chalk grassland (pit edge)	
Community <sup>1</sup>	Similarity coeff <sup>2</sup>	Community	Similarity coeff	Community	Similarity coeff
MG5	43.0	MG5b	47.6	CG2b	60.0
MG5b	42.5	MG5	47.1	CG2	59.7
MG5a	41.2	MG5a	44.5	CG3a	59.6
CG2c	39.2	CG2c	43.8	CG3b	58.6
CG4c	36.3	CG6	41.7	CG2a	58.6
CG4	35.9	CG4c	41.6	CG2c	57.0

\* For each analysis the six plant communities with the highest similarity coefficients are presented

<sup>1</sup> As defined in the National Vegetation Classification (Rodwell, 1995)

<sup>2</sup> Similarity coefficient = 100 when communities are identical

The vegetation of the upper cutting was more difficult to place within the NVC. MATCH analysis indicated that it showed some affinities to both mesotrophic and calcicolous grassland communities. The coefficients of similarity indicated that these affinities are weak.

The vegetation of the grassland strip adjacent to the top of the cutting was also difficult to place within the NVC. MATCH analysis indicated some affinities to mesotrophic and calcicolous grassland communities and to weed communities. The coefficients of similarity indicated that these affinities are weak. These results are unsurprising since the sward appeared to have been subject to some seeding (probably accidentally).

#### ii Hedgerow and tree planting on the L-shaped land

A total of 17 tree saplings had been planted and staked in five groups within the L-shaped land. Those alive in 1996 were one *Quercus robur* (pedunculate oak), four *Acer campestre* (field maple) and one *Betula sp* (birch). Only a few of the planted trees had been protected by tree guards and most had been debarked by sheep. A total of eleven trees were already dead with two of the living trees in very poor condition.

The following numbers of planted shrubs are estimates for the entire 290m hedgerow based on a sample 40m length:

<i>Prunus sp(p)</i> (includes <i>spinosa</i> )	cherry	320
<i>Euonymus europaeus</i>	spindle	40
<i>Cornus sanguinea</i>	dogwood	105
<i>Corylus avellana</i>	hazel	30
<i>Sambucus nigra</i>	elder	10

The survival rate (ie the percentage of the original plantings surviving to date) of these shrub species was almost 100%. In addition to these shrubs, there were a number of staked standard trees (2-4m high) along this hedgerow feature; only 25% of these trees have survived. The surviving trees included several *Acer campestre* (field maples), *Quercus robur* (pedunculate oak), a single *Betula sp* (birch) and one *Sorbus intermedia* Swedish whitebeam. This last species is not native.

### iii Juniper planting

Cuttings of *Juniperus communis* were planted in autumn 1996, generally in clusters of eight or nine with each cutting being provided with a tree guard and a weed mat. A total of 165 had been planted along the upper edge of the northern face of the A41 cutting whilst 21 had been planted within the L-shaped field.

The survival rate at the time of the survey for those cuttings along the A41 was 85% whilst for the L-shaped field it was 67%. About 25-50% of those cuttings left alive were not in a good state of health and it was thought that within a further year, the survival rate was likely to drop to below 50%. It was too early to say if the planting had, in general terms, been a success, since the final objective is to establish a regenerating population. There were, at the time of the survey, sufficient healthy cuttings to be at least moderately optimistic.

### b Badgers

A survey for badgers revealed seven setts in or around the SSSI and mitigation area. (Two further setts were known to have been lost to the road). Six of the seven setts were present before the road was constructed, and were occupied by one social group of badgers. The main sett prior to road construction was abandoned, although it was not clear whether this was due to the road construction. A further sett had been created since the road was built, although it was not clear whether or not it was occupied by the same badgers as the previously existing setts.

The mitigation which had been provided consisted only of badger-proof fencing and there were no badger tunnels or specially created badger crossing points. Despite this lack of safe crossing points, the badgers had not attempted to breach the fence. This is likely to be because they had sufficient food available within the reduced range available. Where the mitigation measures were inadequate and badger proof-fencing was absent (away from the SSSI), road kills had occurred. This may be because badgers were walking along the fence and crossing the road where it ended.

### 3.1.5 Site management

The management regime for the site was proposed by the JGK Environmental Consultancy. It was specified that the chalk grassland within the L-shaped land be mown before the annual ryegrass flowered, until sheep were introduced 3 to 5 years after sowing. After this the area should be grazed with livestock at a density equivalent to 7 ewes per hectare.

The mitigation land, the remaining SSSI and the upper slopes of the cutting are all managed by the Boxmoor Trust. As part of the management of the site eleven ewes grazed the L-shaped land in 1996. These were used to graze the field for a period of about two months between July and September. This allows the majority of plant species a chance to seed. The ewes had been removed from the field by the time of the second site visit on 2 September 1996.

In addition, calves were used to graze the 2:1 slope of the cutting and the adjacent strip of land which are fenced as one unit. The calves grazed this area in 1995 from August to September before being moved onto the remaining SSSI for several weeks. They are able to maintain pathways through areas of encroaching scrub.

The Boxmoor Trust had hoped to bring calves back onto the site for a similar period in 1996 but these were not on site by 2 September 1996.

The Boxmoor Trust has indicated that it hopes, by limited tree removal and cattle grazing, to create more open 'grassland corridors' to link the currently rather isolated species-rich grassland of the chalk pit rim (see Figure 1) to the sown grassland areas. This may enable natural 'seeding in' of the latter areas by desired species. However, this is likely to prove to be a two-way process and could potentially lead to deterioration of the quality of the established chalk grassland (over a long period of time), if for example *Sanguisorba minor muricata* began to replace *Sanguisorba minor minor* in these areas. (The former of these is the robust agricultural 'fodder burnet' while the latter is the native form).

Post-planting management of the junipers might have improved the survival rate. There was, at the time of the surveys, no indication of ongoing management.

### 3.1.6 Summary

At the time of the surveys, the establishment of chalk grassland within the habitat creation land had not been successful. Although a species-rich community had been created on the L-shaped mitigation land, and may be maintained by grazing, the mix of species sown (and established) did not resemble that of adjacent species-rich chalk grassland around the chalk pit edge. There was one non-native taxon within the seed mix. It would appear that the land was inadequately prepared and/or the seeds mixes were poorly chosen, the latter being the more likely, such that a more neutral grassland type has established. Had monitoring of the vegetation been undertaken, it would be possible to ascertain whether the vegetation is moving towards chalk grassland or whether its affinities remain firmly with neutral (mesotrophic) grassland. However, if the neutral nature of the grassland is due primarily to the seed mix used it is possible that chalk grassland will develop over time.

The sown vegetation of the cuttings did not approximate to any chalk grassland community within the NVC.

The establishment of the broad hedgerow feature along the southern edge of the L shaped mitigation land appeared to have been successful. However, the majority of the standard saplings and the standards within the L-shaped habitat creation area had either died or were generally in poor health.

It is too early to say whether the juniper planting has been successful but it was already clear that careful management of the planting will be required to ensure a regenerating population.

SWRC reported that the mitigation which had been provided for badgers consisted only of badger-proof fencing and there were no badger tunnels or specially created badger crossing points, contrary to the proposed measures. Despite this lack of safe crossing points, the badgers present on both sides of the road had not attempted to breach the fence. Where the mitigation measures were inadequate and badger proof-fencing was absent (away from the SSSI), road kills had been reported.

## 3.2 Hilton gravel pits

### 3.2.1 Background

Hilton Gravel Pits SSSI lies just to the north of the village of Hilton in South Derbyshire. The SSSI was notified in 1981 (under the National Parks and Access to the Countryside Act, 1949) and in 1986 when the southern boundary was revised (under the 1981 Wildlife and Countryside Act). It is important for its range of breeding birds as well as being one of the most important sites in the middle region of the Trent valley for wintering wildfowl. The largest lake supports such species as mallard, little grebe, great crested grebe, tufted duck, teal and pochard. Sedge and reed warblers and whitethroats also inhabit the surrounding scrub. The numbers of wildfowl present vary according to disturbance at other sites in the area, and numbers increase considerably in hard winters. English Nature has indicated that the ornithological importance of the site had declined prior to road construction as the pits are old and becoming heavily vegetated, but that the site had gained in importance because of its dragonfly fauna. The site is also of interest for its neutral grassland and nationally important for its paleolithic remains.

During 1993-1995 the A456 Foston Hatton Hilton bypass was constructed across the southern part of the SSSI resulting in the loss of one pond, birch woodland, willow scrub and a small area of grassland. The terrestrial vegetation affected was not of great nature conservation significance. The pond which was lost had been derelict, but a few great crested newt larvae had been found in it in 1989. However, the species was known to occur in the other ponds within the SSSI. Formerly, the site had covered an area of 32 hectares in total. The road construction resulted in the loss of 2.2 hectares. The original site and the road is shown in Figure 3. The overall direct effect of the bypass on the SSSI was expected to be small, but the objection to the route made by English Nature and the Derbyshire Wildlife Trust was the possible effect on two dragonflies - the emerald damselfly and the ruddy darter. Both species are uncommon in central England, including Derbyshire.

### 3.2.2 Mitigation

The bypass construction gave the opportunity for the creation of new habitats of increased diversity. The ecological mitigation works created additional ponds within the original area of the SSSI; no new land was purchased.

Design of the new ponds involved early discussions with English Nature, who said that the most desirable and important habitat to create was shallow ponds surrounded by long grass and open on the south side. Most of the existing habitat comprised large, relatively deep, steep sided lakes with little marginal vegetation. This latter habitat is of value for roosting, breeding and over-wintering birds but of little value for newts, dragonflies and aquatic plants. This dearth of shallow aquatic habitats was therefore augmented by the creation of new ponds.

The original landscape design indicated that five new ponds would be created to mitigate the loss of freshwater

habitat. However, the original plans were indicative only (for costing purposes), and the pond excavation was supervised on site by the consultant ecologist. The westernmost pond (Pond 1), illustrated in Figure 4, was created by enlarging an existing shallow pond. The three ponds to the east of this (Ponds 2, 3 and 4) were newly excavated. The small population of great crested newts was translocated from the pond lost to road construction. The construction of the new ponds was completed in 1992.

The anticipated impact of the road on the populations of breeding birds and wintering wildfowl was considered to be negligible. However, the provision of nest boxes (for kingfishers, barn owls and tawny owls in particular) was proposed. Plantings of both willows and black poplar (a native species which is nationally rare, but abundant locally) were also proposed. These plantings would provide shelter and diversity of habitat.

### 3.2.3 Site surveys

The survey was undertaken on 14 August 1996. A site walkover was undertaken to identify and assess the ecological mitigation works and current management practices.

A dragonfly survey was carried out with particular attention being given to the three new ponds (2, 3 and 4). For comparison purposes surveys were conducted at four accessible points on the main pit complex. The dragonfly survey was split into two parts: the first was a survey of adult insects utilizing the site on the date of the visit, while the second was a sweep net survey of ponds at suitable points to record larvae. This methodology is detailed more fully in Section 2.6. As mentioned in 3.2.1 above, species of particular interest were *Lestes sponsa* (emerald damselfly) and *Sympetrum sanguineum* (ruddy darter).

The single survey date, whilst ideal to record the target dragonfly species, did not allow for a full survey of all expected (adult stage) species utilizing the site since the date falls at the end of their normal flight period. To some extent this constraint was overcome by the sweep net survey which had the potential of recording all breeding species. The adult stages of *Coenagrion puella* and *Enallagma cyathigerum*, whilst relatively easy to separate at close range are difficult, if not impossible, to separate at longer range. Larval stage specimens of some species (particularly some genera of damselflies) are difficult to separate.

Access was a limiting factor during the survey of the main pit complex since the pits were heavily fringed and shaded by dense *Salix*. Access points were few and typically supported little vegetation due to high levels of human disturbance. Such areas are generally poor for dragonflies (both adults and larvae) and significant survey bias is likely to have been introduced. It is difficult to separate this survey bias from the general observation that the vegetation of the main pit complex was largely unsuitable for dragonflies.

In this survey, attention was given also to the vegetation of three new ponds (Ponds 2, 3 and 4) with an overview of the (reprofiled) western pond (Pond 1) and the main pit complex.

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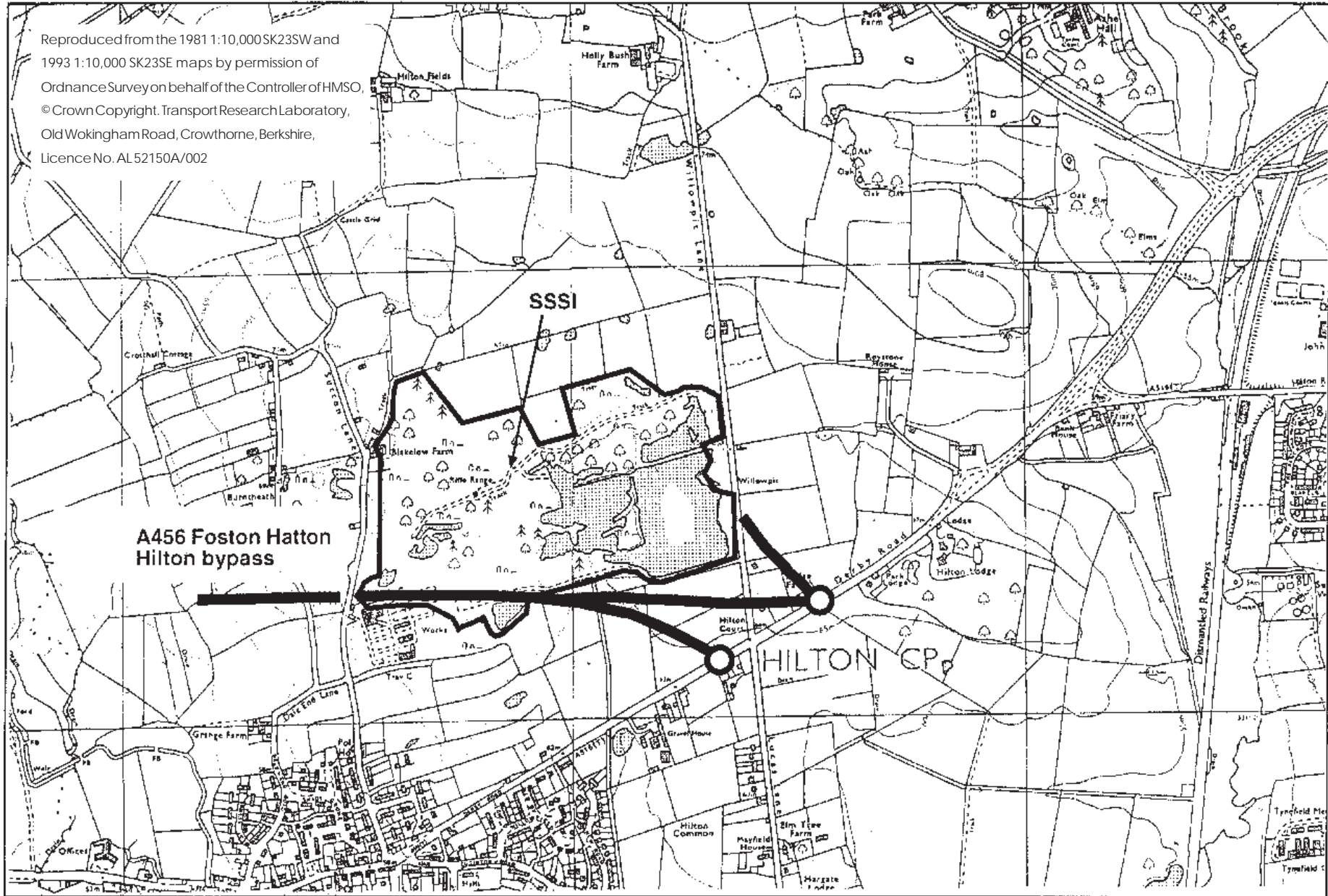
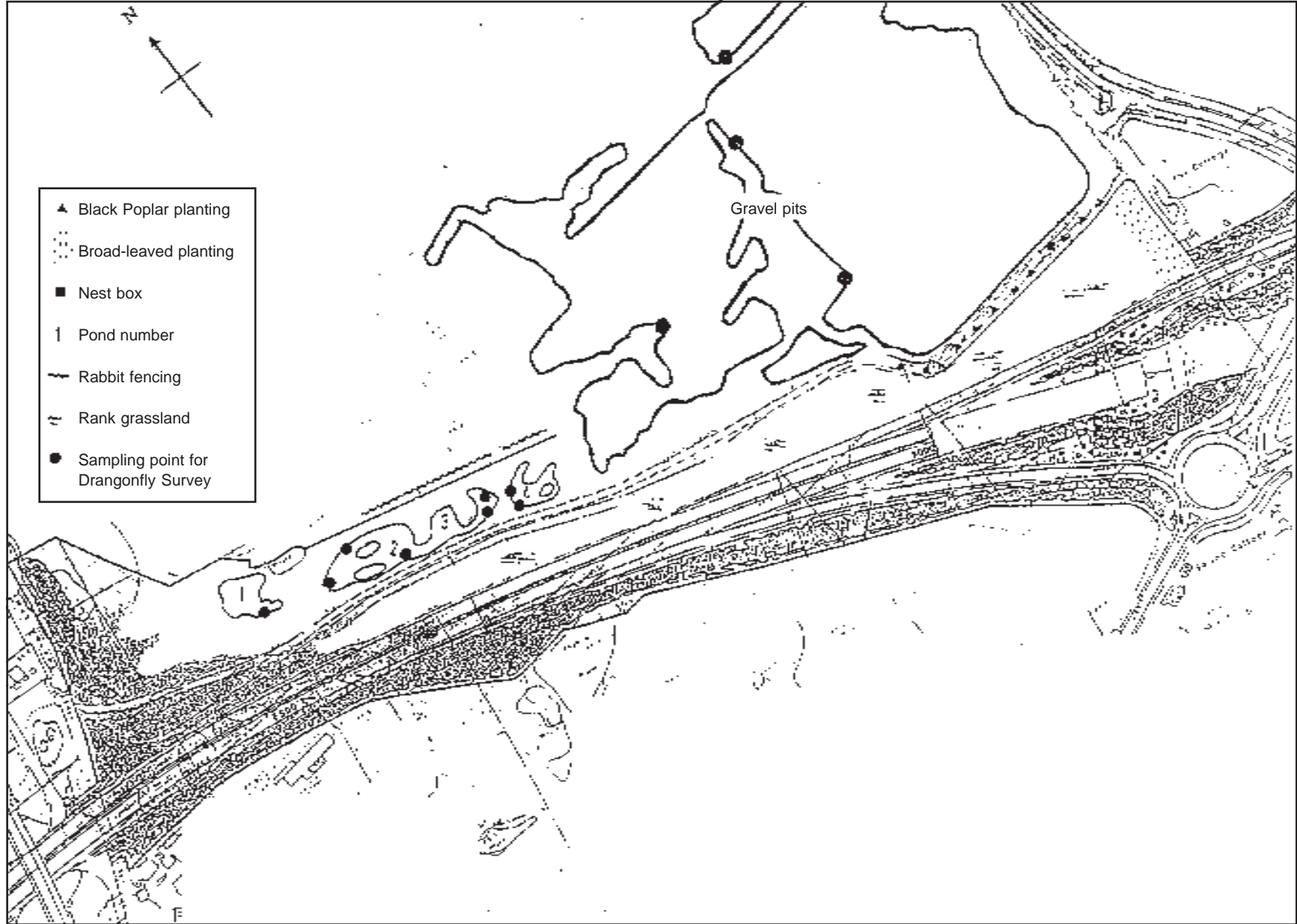


Figure 3 A456: Hilton Gravel Pits SSSI (pre road construction). Scale 1:10,000 approx.



**Figure 4** Ecological mitigation measures, Hilton Gravel Pits. Scale 1:3,500 approx.

### 3.2.4 Survey results

#### a Dragonflies

The results of surveys for dragonflies are recorded in full in Chinn et al, 1998. Nine species were observed including those which were recognised as being of principal interest, namely the emerald damselfly (*Lestes sponsa*) and the ruddy darter (*Sympetrum sanguineum*). These two principal species plus seven other species were identified at the mitigation ponds. Three species (adults) were observed at the main pond complex, but these did not include the ruddy darter or emerald damselfly. No dragonfly larvae were recorded at the main pit sampling points. The substrate at all points was bare gravel with some washed up aquatic plant material (uprooted) locally. It is likely that sampling bias was introduced by the accessible points being less vegetated than elsewhere. Most of the remaining margins were overhung and heavily shaded by *Salix sp(p)* willow and unlikely to be suitable for dragonfly larvae.

#### b Tree planting

Black poplars (*Populus nigra betulifolia*) had been planted along the northern side of the track bordering the southern edge of the main gravel pit complex (see Figure 4). A total of about 30 trees were recorded which may have been rootstock pieces or cuttings. Suckering appeared to have taken place in a few cases, although these small plants may have been less well developed original plantings. It was impossible to determine the survival rate of the trees since they were not marked or staked. Those observed appeared to be in excellent health with extensive new and vigorous growth. They were up to 1m in height with considerable branching from the base. There had been no weed control, and no stakes or tree guards were present.

No obvious willow plantings were located although it is possible that some of the bushes in the vicinity of the main mitigation ponds (ponds 2-4) were planted. None of these bushes were marked, staked or guarded.

A 10m wide strip of oak (*Quercus robur*), elder (*Sambucus nigra*), hazel (*Coryllus avellana*), blackthorn (*Prunus spinosa*) and hawthorn (*Crataegus monogyna*) had been planted along the eastern edge of the eastern grassland area (see Figure 4). Only the oak had tree guards and were staked. The survival rate for these was about 90%, but it was impossible to gauge the survival rate of the others since they were not marked.

#### c Birds

Without detailed information of bird interest at the site before the road construction, the effect on breeding birds and wintering wildfowl could be estimated only by determining whether or not suitable conditions still existed at the site. The area of the pond lost to the road was insufficient to support significant numbers of wildfowl in relation to the size of the complex as a whole. The newly created ponds were unlikely to support wildfowl for more than a few hours because of disturbance by walkers. The lost ponds may have supported breeding birds such as sedge and reed warblers, whitethroats and grasshopper warblers. Suitable areas for these species also occurred in

the undisturbed areas. The new ponds had created suitable habitat for reed and sedge warblers, but not whitethroats and grasshopper warblers. However, scrub encroachment over time may make the new areas suitable for these species. Nest boxes for several species were to be erected at the SSSI. However, no details as to the locations of these boxes (if they were provided) could be obtained from Derbyshire Wildlife Trust. No boxes suitable for barn owl or tawny owl were recorded although it is possible that they were erected away from the land adjacent to the SSSI. A single nestbox with a circular hole approximately 8cm in diameter was found on the top of the bank of the southern edge of the main pit. The box was of a non-opening type and so it was not possible to tell if the box had been used. There were no droppings or feathers around the entrance and no evidence of use.

The kingfisher boxes and perch at Sutton Brook and Foston Brook were not located. One kingfisher was observed whilst surveying the main pit.

#### d Vegetation

##### i Ponds 2, 3 and 4

The marginal zone of the ponds was dominated by *Juncus effusus* (soft rush). *Typha latifolia* (and perhaps the hybrid with *Typha angustifolia*) was dominant over shallower bays of the ponds (particularly ponds 3 and 4). There were some smaller stands of *Carex riparia* (greater pond sedge) and *Carex pseudocyperus* (cyperus sedge) and one of *Iris pseudocorus* (yellow iris). Frequent species included *Juncus articulatus* (jointed rush), *Lycopus europaeus* (gypsywort), *Myosotis scorpiodes* (water forget-me-not) and *Mentha aquatica* (water mint), the latter locally abundant on the adjacent grassland areas.

The lower marginal zone of ponds 2 and 3 (between winter filled and summer levels) was dominated by the invasive *Crassula helmsii* (New Zealand pygmyweed). *Elodea canadensis* (Canadian waterweed) was the dominant aquatic species in all three ponds although in ponds 3 and 4 *Lagarosiphon major* (curly water-thyme) was locally co-dominant. The above three species are established aliens. *Crassula helmsii* dominated the ecologically important marginal zone. The native *Potamogeton natans* (broad-leaved pondweed) was locally prominent with good populations in all three ponds. As is typical elsewhere, the dominance of the submerged alien *Elodea canadensis* did not seem to affect these populations. A small amount of both *Hippuris vulgaris* (mare's-tail) and *Ranunculus circinatus* (fan-leaved water crowfoot) was present and these may have seeded in from adjacent areas. A small number of *Nymphaea alba* (white water-lily) are believed to have been planted.

Land within the mitigation pond enclosure supported an abundance of *Juncus effusus* with some small areas of drier grassland. *Lotus pedunculatus* (greater bird's-foot trefoil) is frequent in damper areas. Several large *Betula spp.* (birches) had been left around the area of the mitigation ponds including a few on the small islands in pond 2. *Salix spp.* (willows) (predominantly *S. cinerea*) bushes to 3m in height were present at several points around the northern edges of the ponds and on the island in pond 4. It is

believed that these were established plants which were retained during the creation of the ponds.

#### *ii Grassland*

A brief survey of the eastern triangle of grassland outside the SSSI but within the Compulsory Purchase Order land (see Figure 4) indicated that the main grass species were *Arrhenatherum elatius* false oat-grass and *Dactylis glomerata* cocksfoot typical of the generally species-poor, ubiquitous MG1 *Arrhenatherum elatius* mesotrophic grassland community within the NVC. The landscape plan submitted indicated that areas of species-rich grassland would be created, although this did not appear to have been undertaken anywhere on the site.

#### **3.2.5 Site management**

Management of Hilton Gravel Pits was, at the time of writing, the responsibility of the DOT/County Council, but should be transferred to the Derbyshire Wildlife Trust at some future date. Management and maintenance of habitat creation areas was the responsibility of the Contractors for the first 12 months following the completion of the scheme, including mowing the new grasslands created around the ponds.

Derbyshire Wildlife Trust have expressed concern (private communication) that little or no management of the site is currently being undertaken. The 1996 SWRC survey indicated that the eastern triangle of grass was the only part of the site that is mown. This appears to have taken place in early/mid-July. The cuttings were not entirely removed and no evidence of raking was seen. Similar areas of rank grassland along the southern edge of the site have not been mown whilst the grassland at the westernmost end of the CPO land was heavily grazed by rabbits. The rabbit grazing allows a tight sward to develop that, while not species rich, is of more interest botanically than the rank grassland of the eastern area.

Rabbit fencing was present only along the northern edge of the mitigation ponds and here it was incomplete with one point where rabbits had made an access point under the fence. A small area of the grassland here was the only part of the fenced enclosure containing the three mitigation ponds which was grazed by rabbits, but did not cause a significant problem. The main fencing around the pond complex was complete and sufficient to exclude the frequent dog walkers and dogs that use the adjacent track. The two gates had signs requesting that the public do not enter and several further signs at the edge of the site advise people not to introduce frog spawn since this results in the introduction of exotic plant species.

#### **3.2.6 Summary**

The new pond complex and surrounding terrestrial vegetation structure provides excellent breeding and foraging habitat for the dragonfly species. The habitat of the ponds appears to be much more favourable than the remaining large pit complex for dragonflies with a total of nine species being recorded. Indeed, English Nature has indicated that the site no longer qualifies for SSSI status on ornithological grounds, but the diversity of the site for

dragonflies has risen since the mitigation ponds were constructed such that it now qualifies for SSSI status due to the dragonfly population.

Management of encroaching vegetation (*Typha*, *Betula* and *Salix*) will be needed if the ponds are not to become too shaded in the longer term. The aquatic invertebrate fauna of the ponds may change if *Crassula helmsii* becomes more dominant in the submerged aquatic zone, but the aquatic habitat at the time of the surveys was excellent for this group. Of the three ponds the western pond was the best, with its shallower margins and restricted *Typha* fringe. Both *Sympetrum sanguineum* (ruddy darter) and *Lestes sponsa* (emerald damselfly) are thriving in this new habitat.

Black poplar plantings appear to have established successfully although monitoring would be advisable. The majority of trees within the hedgerow feature at the eastern end of the site also appear to have established successfully. Grassland management, in the form of mowing, has been carried out although the value of this is debatable since the sward is species poor.

The breeding bird interest at the site may have declined very slightly at the site with some loss of habitat for whitethroats and grasshopper warblers, but this may recover over time with scrub encroachment. Since only one nest box was located it is not possible to confirm the success of the planned programme of nest box installation, if this was indeed undertaken.

### **3.3 Southfield Farm Marsh**

#### **3.3.1 Background**

Southfield Farm Marsh SSSI lies to the south of Kettering, Northamptonshire. The SSSI was designated in 1984 when the area was the largest known area of long-established tall grassland washland in Northamptonshire. The site supported base-rich mire on silty peats providing habitat for a specialized and uncommon invertebrate fauna. The wetland is created naturally by a spring line which breaks the ground surface and flows to the nearby river Ise.

During 1988-1990 the A14 dual carriageway was constructed across the centre of the SSSI. Consequently slightly over 1 hectare of the SSSI was lost. The site formerly covered an area of 8.7 hectares. The site is shown in Figure 5.

#### **3.3.2 Mitigation**

During the preparation of the road scheme there was considerable liaison with English Nature over a period of nine years. This led to the acquisition of mitigation land and drainage measures to maintain the spring line, the area of land being roughly equal to that area of the original SSSI lost to road construction.

An area of low lying land, adjacent to the SSSI, was purchased and the soil from the line of the new road was translocated to this adjacent land. This area of land is shown in Figure 5. The A14 bisects this land as well as the original SSSI. The course of a stream was diverted westward to feed the new area habitat. The original stream channel was retained as a watercourse across the site.

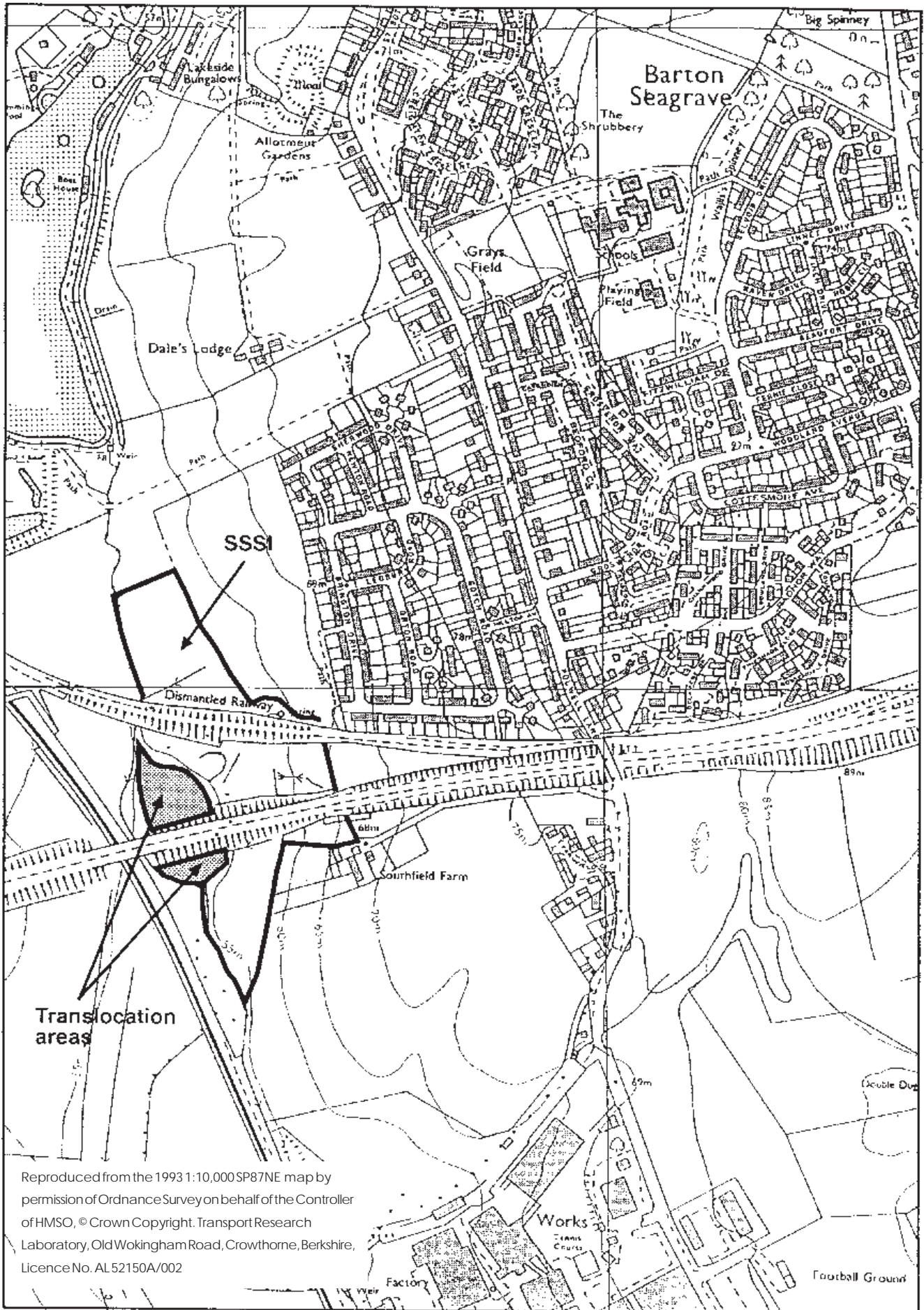


Figure 5 A14: Southfield Farm Marsh SSSI and translocation area. Scale 1:7000 approx.

Initially the contractors connected the spring line (which keeps the marsh wet) to the road drainage in error. This connection was stopped up and the current arrangement (as specified in the design plans) installed: Engineering plans supplied by Northamptonshire County Council indicate that the old spring line was intercepted by two field filter drains in a funnel arrangement. From the 'funnel' (downhill) is a 1m deep soakaway (1.5m x 1.5m square in plan view). A 150mm diameter pipe carries the water from the soakaway to emerge at a headwall, above the SSSI, constructed of concrete filled sandbags.

The owner of the part of the SSSI south of the A14, reported that the translocation of soil/vegetation was undertaken using a large earth removal machine and a lorry. The receptor site was apparently not prepared (by removal of existing top soil) and the transported material was dumped and levelled with a bulldozer.

No specific mitigation measures for the specialised invertebrate fauna were undertaken, other than the translocation and drainage measures above to provide suitable habitat.

### 3.3.3 Site surveys

The vegetation was surveyed on 9 August 1996 by a site overview and quadrat surveys. A total of 8 quadrats were surveyed in the transplanted areas in the marsh areas only: *Phalaris* stands - 3 quadrats to south and 1 to north of road, and *Carex Riparia* swamp - 4 quadrats to the north of the road. A total of 12 quadrat surveys were undertaken in the original spring line and marsh areas: 4 in *Epilobium hirsutum* stands, 4 in *Carex acutiformis* swamp (all north of the road), 4 in *Phalaris* stands (south of road).

The specialised invertebrate fauna of the original SSSI was entirely dependent on its habitat for its existence. Since the vegetation of the translocated area was surveyed to establish whether or not a suitable habitat had been created, it was not considered necessary to conduct an invertebrate survey.

### 3.3.4 Survey results

#### SSSI south

The botanical interest on the remnant SSSI, to the south of the A14, was created by the influence of one spring line which ran south along the eastern edge of the site to join a stream at the southern apex of the site. Immediately above the spring line is an area which contained *Epilobium hirsutum* (great willowherb) with other species at lower frequencies including *Filipendula ulmaria* (meadowsweet), *Sanguisorba officinalis* (great burnet) and *Angelica sylvestris* (wild angelica). Along the spring line itself *Glyceria maxima* (reed sweet-grass) was dominant, with the above species and *Scutellaria galericulata* (skullcap) present occasionally. West of the spring line, the vegetation was dominated by *Phalaris arundinacea* (reed canary-grass) with one extensive area of *Carex acutiformis* (lesser pond-sedge). The remainder of the SSSI was rank grassland, dominated by *Arrhenatherum elatius* (false oat-grass) with locally abundant *Cirsium arvense* (creeping thistle) and *Urtica dioica* (common nettle).

The course of an old stream was evident and was dominated by *Glyceria maxima* (reed sweet-grass) with patches of *Sparganium erectum* (branched bur-reed) and occasional *Sagittaria sagittifolia* (arrowhead).

#### Translocation site (south)

The translocation area supported a thick rank sward of *Elytrigia repens* (common couch) with *Deschampsia cespitosa* (tufted hair-grass) and *Ranunculus repens* (creeping buttercup). Smaller patches of *Phalaris arundinacea* (reed canary-grass) occurred in damper hollows within this sward and one deeper hollow contained a smaller area of *Glyceria maxima* (reed sweet-grass). *Atriplex prostrata* (hastate-leaved orache) was occasional throughout these communities. Wetland communities constituted approximately 10% of the southern translocated area.

#### SSSI (North)

The remainder of the SSSI, to the north of the new A14, can be considered as two discreet areas. The western half had been subject to illegal tipping on an area of over an acre (subsequently removed). This part of the SSSI supported a stand of *Conium maculatum* (hemlock) with frequent *Cirsium arvense* (creeping thistle). A drainage line through this area was dominated by *Glyceria maxima* (reed sweet-grass), with the bank zones dominated by *Cirsium arvense* (creeping thistle). To the east of this part of the SSSI was a spring line whose influence was similar to that in the southern fragment of site. The upper edge of the spring line was similarly dominated by *Epilobium hirsutum* (great willowherb) but locally included associates such as *Equisetum fluviatile* (water horsetail), *Lycopus europaeus* (gipsywort), *Glyceria maxima* (reed sweet-grass), *Rumex conglomeratus* (clustered dock) and *Scrophularia auriculata* (water figwort) all at low frequency. In areas subject to regular inundation there were some extensive stands of *Carex acutiformis* (lesser pond-sedge) with scarcer associates including *Equisetum fluviatile* (water horsetail), *Scrophularia auriculata*, *Angelica sylvestris* (wild angelica) and *Galium aparine* (cleavers). The interface between these two zones supported additionally *Scutellaria galericulata* (skullcap) and *Mentha aquatica* (water mint). The old river course had been left as a feature and is dominated by *Glyceria maxima* (reed sweet-grass) with two small *Salix viminalis* (osier) bushes.

#### Translocation site (north)

This area was a complex mosaic of rank grassland habitats, stands of *Phalaris arundinacea* (reed canary-grass) and one small stand of *Carex riparia* (greater pond-sedge). Most of the northern and eastern edge of this area supported rank grassland dominated by *Arrhenatherum elatius* (false oat-grass). Other areas supported a thick sward of *Elytrigia repens* (common couch) with scattered *Deschampsia cespitosa* (tufted hair-grass), *Ranunculus repens* (creeping buttercup) and *Geranium pratense* (meadow crane's-bill). The last of these species would not normally be associated with rank grassland habitats. Most of the limited areas subject to frequent or constant inundation were dominated by *Phalaris arundinacea*

(reed canary-grass) with scattered bushes of *Salix fragilis* (crack willow) and *Salix cinerea ssp cinerea* (grey willow). The one small area of marsh dominated by *Carex riparia* (greater pond-sedge) contained also *Filipendula ulmaria* (meadowsweet), *Juncus effusus* (soft-rush) and *Angelica sylvestris* (wild angelica). A few scattered individuals of the following species were recorded in the translocation site: *Myosoton aquaticum* (water chickweed), *Hypericum tetrapterum* (square-stalked St John's wort), *Sanguisorba officinalis* (great burnet), *Juncus effusus* (soft-rush), *Juncus inflexus* (hard rush) and *Myosotis scorpioides* (water forget-me-not).

#### *Spring lines*

Run-off from the carriageway runs along the base of the embankment to an outfall above the old river channel. The effect of this is likely to be increased salinity (intermittent) and chance of pollution (from oil spillage etc.). No conclusive evidence of increased salinity could be detected in the vegetation of the old river channel.

Analysis of the vegetation revealed that areas of *Phalaris arundinacea* best fits NVC community type S28a *Phalaris arundinacea* tall-herb fen within the NVC for both parts of the original and translocated sites. This is a common community, defined by the presence of one dominant species and this result would be anticipated. It is probable that the community would have arisen without translocation. Indeed it is not clear that *Phalaris* was in the vegetation that was translocated.

Vegetation of other samples within the original spring line areas fits NVC community type OV26 other vegetation and the S7 *Carex acutiformis* marsh community within the NVC. These communities were not represented within the translocated areas although a small patch of the similar S6 *Carex riparia* marsh community was identified from quadrats within the northern translocation site.

#### **3.3.5 Site management**

Northamptonshire Wildlife Trust were responsible for managing the site. However, the land adjacent to the site was sold by the County Council and access to the site and therefore management (ie cattle grazing) could not be carried out.

#### **3.3.6 Additional information**

English Nature believes that surface run-off from the road is affecting the water quality of the SSSI to some extent, and no provision was made for culvert clearance in the A14 design: the culverts are too small and the peak flows are insufficient to clear out the culverts. During storm flows, foul water from the housing estate to the north of the A14 impacts on the SSSI. According to information from English Nature, the northern springline is now dry, although whether this is due to the construction of the road or the recent dry summers is unclear.

#### **3.3.7 Summary**

The vegetation of the translocated area in general does not resemble that of the remaining swamp/spring line

fragments. Apart from the small area of *Carex riparia* greater pond-sedge swamp (S6) and areas of *Phalaris arundinacea* reed canary-grass swamp (S28a) there are no swamp or tall herb communities comparable to those of the remaining SSSI fragments. The stands of *Phalaris* are perhaps likely to have arisen *in situ* rather than have been a major part of the vegetation translocated. Neither the translocation nor the drainage measures can be regarded as a success.

### **3.4 Brampton Meadows**

#### **3.4.1 Background**

Brampton Meadow SSSI lies to the west of the village of Brampton in Cambridgeshire (formerly Huntingdonshire), and is a species rich meadow with a distinctive ridge and furrow topography. It formerly covered an area of 0.79 hectares. It was designated as an SSSI in 1986 as it exhibits plant communities of the calcareous clay pasture type. Grasslands of this type are restricted to the south of the country and are generally declining due to changes from traditional management practices.

In 1991 the A14 (A1/M1 link road) was constructed through the SSSI, fragmenting it, and taking almost one-quarter of its area. The site is shown in Figure 6.

#### **3.4.2 Mitigation**

To mitigate the effect of the road, the species-rich turf along its route was translocated. Originally the Department of Transport attempted to purchase land adjacent to the SSSI to use as a receptor site for the transplanted turf. However, the landowner was unwilling to sell, and the receptor site chosen was the northern section of the SSSI which was at that time covered with scrub (see Figure 7). English Nature had envisaged difficulties in recreating the ridge and furrow topography of the donor site at the receiver site, it being almost impossible to ensure that turves from ridges are replaced on newly created ridges, and turves from the furrows are replaced in furrows.

The turf translocation was carried out under an Advance Ecological Works Contract. The contract specified that all existing vegetation, including all roots greater than 5mm diameter should be removed from the receptor site, and the existing surface remodelled such that ridges and furrows, aligned with those on the remainder of the SSSI, were created of subsoil at a height such that when the turves were laid, they would be contiguous with the remaining SSSI. The surface should be compacted, and then scarified prior to laying the turves. It was specified that all turves should be 300mm deep and at least 1m square, and they should be relaid (within 8 hours of cutting) in the order they were cut, in the corresponding position and orientation on the new ridge or furrow.

#### **3.4.3 Monitoring**

The vegetation of the SSSI was monitored annually from 1987 by English Nature prior to road construction. After translocation it was again monitored annually, by consultants from 1992-1994 (Chris Blanford Associates, 1994) to determine changes and gauge the success of the

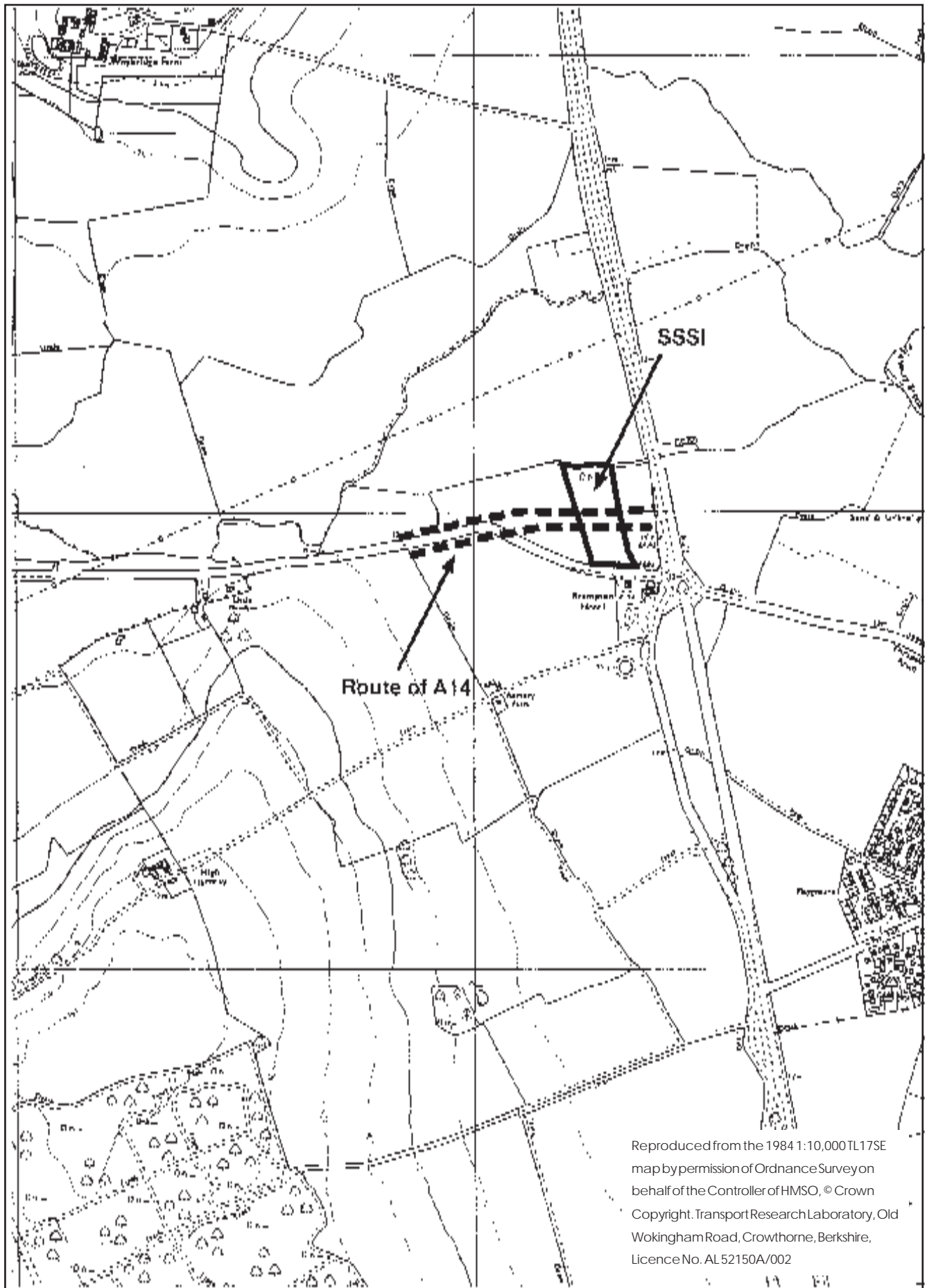
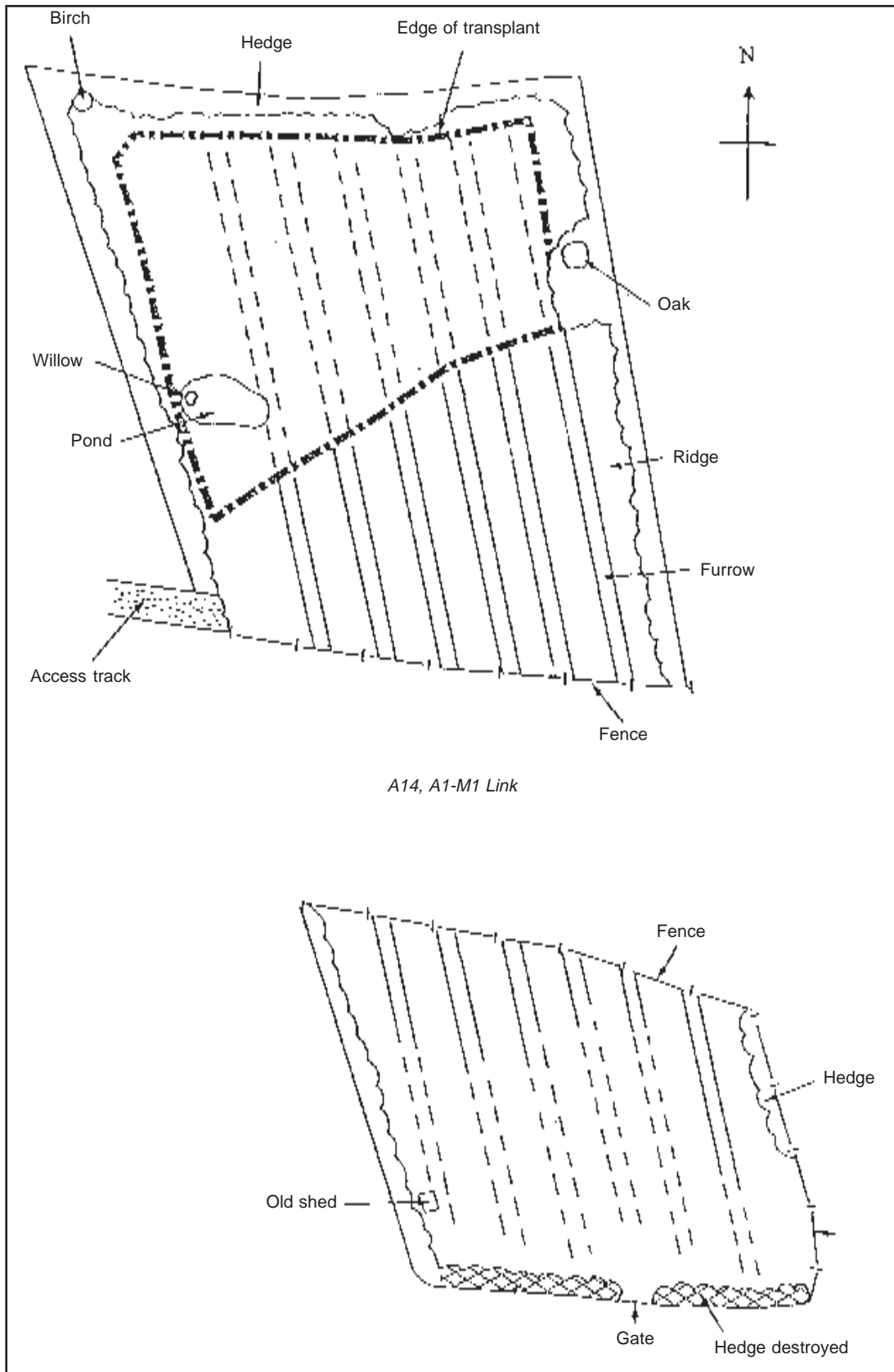


Figure 6 A14: Brampton Meadows SSSI. Scale 1:10,000 approx.



**Figure 7** Translocation area at Brampton Meadows. Scale 1:1,000 approx.

transplantation, following the methods of the English Nature surveys. The monitoring indicated that the transplant area differed markedly from the undisturbed areas of grassland. By comparison with undisturbed areas, the transplant had changed to a tall rank vegetation with few species, and it was concluded that the transplant had failed to maintain the diversity of the original turf.

The consultants conducting the monitoring in 1994 suggested that because changes in management (the removal of grazing) occurred concurrently with the transplant, it was unclear whether or not the transplant would have survived if appropriate management such as cutting regularly with removal of cut vegetation had occurred. Lack of management was considered a major factor in the scheme failure. Removal of grazing was also causing the interest of the remainder of the original SSSI to decline.

#### 3.4.4 Site surveys

The survey by SWRC was undertaken on 22 August 1996.

A walkover survey was conducted, and searches were made for nine key species targeted by earlier monitoring programmes; where these were found their locations were recorded. Special effort was made to locate known populations of all of these species. As with previous monitoring surveys a comprehensive species list was also made for both the northern and southern parts of the site. Details of sward height were also recorded. However, the date of the survey was found to be too late to record several of the target species. The survey date also affected significantly the perceived frequency and cover of grass species. It was for this reason that quadrat surveys were also undertaken at this site, as described below.

In order to compare the vegetation of the translocated area to that of the original SSSI fragments, quadrat surveys were undertaken in both areas and the results compared. A total of five quadrats were recorded within grassland areas of the translocation site with a further five being recorded in both of the remaining SSSI fragments.

#### 3.4.5 Survey results

##### *Translocated area*

The area of translocated turf supported a species-poor rank grassland dominated by *Arrhenatherum elatius* (false oat-grass) with smaller amounts of *Heracleum sphondylium* (hogweed). Stands of *Conium maculatum* (hemlock) were encroaching upon the translocated area from the western edge and *Rubus caesius* (dewberry) were encroaching along the eastern edge. The only herb species that appeared to have survived the translocation in any quantity and were still extant are *Galium verum* (ladies bedstraw) and *Centaurea nigra* (black knapweed) and even these species were less common than in the original SSSI fragments. *Sanguisorba minor* (salad burnet) was present in very small quantity.

##### *SSSI North*

The surviving SSSI fragment still supported most of the scarce species recorded in 1994 although most appear to

have decreased. It was not possible to be sure that several species were absent, particularly *Ophioglossum vulgatum* (adder's-tongue fern) and *Bromopsis erectus* (upright brome) although the fact that the habitat of the former was very dry and overgrown with *Rubus caesius* strongly suggested that the species was likely to be very scarce if not extinct. Lack of management (in the form of grazing or mowing) had led to the increasing prominence of *Arrhenatherum elatius* (false oat-grass) and a resultant decrease in herb cover and diversity. *Rubus caesius* extended at least locally up to 10m into the field along both the eastern and western edges and was probably a factor in the loss of *Silene silaus* (pepper saxifrage) and perhaps *Ophioglossum vulgatum* (adder's-tongue fern) from the easternmost furrow. Flooding from the new roadside ditch may have affected the vegetation.

The pond was dry at the time of survey with the pond base supporting a community of *Potentilla anserina* (silverweed) and *Atriplex patula* (common orache).

##### *SSSI south*

The southern fragment of the SSSI supported species-poor rank grassland. This was locally heavily grazed by rabbits although this appeared to be of relatively recent occurrence since *Arrhenatherum elatius* is still dominant although generally unable to withstand sustained grazing pressure. Herbs that were still present in moderate quantity include *Senecio jacobea* (common ragwort) *Centurea nigra* (black knapweed) and *Galium verum* (ladies bedstraw) and these were most prominent as non-flowering specimens in areas of highest grazing pressure. Along the western edge of the field there had been much dumping of garden waste, in particular cut branches. None of the scarce species recorded in previous years could be located despite extensive search and this SSSI fragment appeared to have lost its floral interest since separation from the northern part. As well as lack of management one additional reason for this may have been a change in drainage patterns. The hedgerow on the southern side of the site had been devastated by construction and piles of builder's rubble remain along the ditch. Caravans were not present on the site at the time of the survey although these had been observed in the past.

Using MATCH, all of the samples from the site were determined as NVC community MG1a *Arrhenatherum elatius* mesotrophic grassland of the *Festuca rubra* sub-community. Quadrats from the remaining fragment of the SSSI north of the A14 could be distinguished from the other samples by the prominence of both *Agrostis capillaris* and *Festuca rubra*. Both the translocated site and the remaining SSSI fragment south of the road were more difficult to classify according to NVC communities. The prominence of the tall rank herbs *Heracleum sphondylium* and *Cirsium arvense* had increased in the translocated site.

Comparison with earlier monitoring was possible although the survey in 1996 took place later in the year than those of 1992 and 1994. There had been a decrease in the diversity of the flora characteristic of the original habitat. In general, and as might be expected, species that

had appeared on the site which were previously absent were ruderal weed species. Examples were *Conium maculatum*, *Geranium molle*, *Picris echioides*, *Senecio vulgaris*, *Sonchus arvensis* and *Sonchus oleraceus*. The apparent large decline in the diversity of the southern field may have been exaggerated by the difficulty in locating species within areas of heavily rabbit-grazed turf. Comparisons with earlier surveys are given in more detail in Chinn et al, 1988.

Also noticeable was the apparent loss of some of the more notable species. Of these key species, the population of only one (*Viola hirta*) appeared stable, three others were present but in decline, the populations of a further two were thought to be in decline (but a definitive position cannot be taken because of the lateness of the survey date) and four were thought to be extinct.

Although the 1996 survey date was not ideal, a survey earlier in 1997 was not considered worthwhile. This is because the key species that might have been overlooked due to the timing of the 1996 survey were not recorded during the earlier monitoring of previous years, and given the lack of site management and the development of coarse grassland it is unlikely that the species would colonise the site.

#### 3.4.6 Site management

The consultants responsible for the turf translocation were responsible for maintenance of it for the following two years. Since then the site has remained unmanaged.

#### 3.4.7 Summary

Vegetation analysis confirmed that the transplanted area of grassland resembled the remainder of the SSSI in terms of its NVC community. It would appear, however, that this is due to the deterioration of the diversity of the vegetation of the original SSSI fragments and does not necessarily represent a translocation success.

The translocation cannot be regarded as a success since all except one key species had been lost from the translocated area and this species (*Sanguisorba minor*) only survives in very small numbers. It is predicted that it will disappear within a few years. The lack of management of the remainder of the SSSI had led to scrub encroachment, the general deterioration of the floral diversity and the loss or decrease of most of its notable plant species.

### 3.5 Hares Down, Knowstone and Rackenford Moor

#### 3.5.1 Background

The Hares Down, Knowstone and Rackenford Moors SSSI is the largest area of diverse lowland heathland remaining in north Devon, covering an area of 217.6 hectares. It was originally notified in 1981, and last notified in 1988. It supports both species rich and species poor heaths and some plant associations that are nationally rare. While the SSSI is primarily of importance because of its plant communities, the birds and insects, which largely depend on these plants are also recognised as important. At the Public Inquiry the importance of its insect fauna was mentioned. The Nature Conservancy Council provided

evidence of 105 different species which had been collected from the site.

The A361, North Devon Link Road was opened to traffic in 1988, after a construction period of approximately 2 years. The road crosses the moors in an east-west direction, generally on low embankments. However, the embankments are up to 10m high adjacent to a viaduct over the River Sturcombe. The road is in a 6m deep cutting at the eastern edge of Hares Down, where it is crossed by a minor road. The SSSI and A361 are shown in Figure 8.

#### 3.5.2 Mitigation

Mitigation concentrated upon the re-establishment of roadside areas by seeding. In 1988 the verges were seeded, and this was followed by a programme of planting trees and shrubs over 1989/90. The continuance of grazing is a prerequisite to maintaining the existing flora within the SSSI. To allow this to continue a viaduct was provided under which cattle could pass from one side of the moor to the other.

English Nature had expressed concern that surface water might be chemically affected as it passed beneath the road, resulting in a change in pH and consequently affecting the vegetation. Such a pH change might occur if material such as limestone were used for the construction of the road base, or possibly by the use of concrete drainpipes. It was therefore specified that in the area of the SSSI any imported fill material be either sandstone or gritstone from quarries within the same geological strata, and that drainpipes be glazed clay or inert uPVC.

#### 3.5.3 Monitoring

SGS Environment was commissioned in 1994 by the Highways Agency to undertake a post-restoration monitoring programme, continuing until 2000. The first of these surveys, conducted in 1994, has been reported (SGS Environment, 1995), but the report of later surveys will not be published until August 1998.

The 1995 survey included the monitoring of permanent quadrats, established initially in 1992 by SGS. These quadrats were established on the outside verges of the road, the inner verges (adjacent to the carriageway) were not included in the survey, as they are intensively managed, and affected by salt spray and oil. A record was made of plant species within each quadrat with an estimate of the ground cover for each species (converted to the DOMIN scale). The route over the moor was divided into sections and 5 quadrats per section of the route were surveyed in this manner. The resulting information was analyzed using the MATCH computer programme to determine the best fit NVC classification for the quadrats.

Air photography was used to examine the effects of the road on grazing patterns and vegetation cover, and the effects of using non-calcareous fill were monitored by taking soil samples (top soil and sub soil) along transect lines across the road at two points. These samples were analyzed for conductivity and pH for comparison with the existing moorland soils.

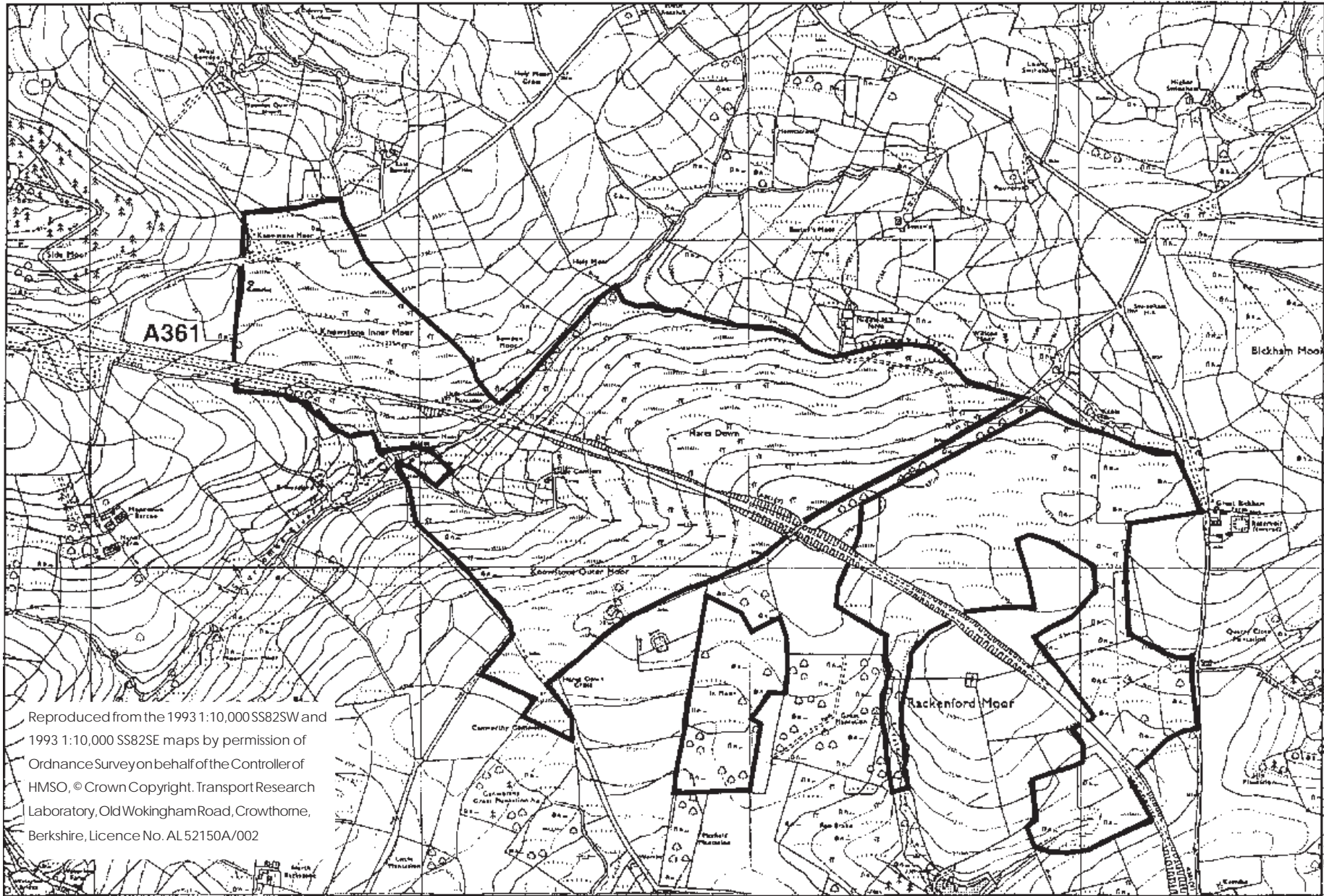


Figure 8 A361: Hares Down, Knowstone and Rackenford Moors SSSI. Scale 1:20,000 approx.

### **3.5.4 Monitoring Results**

#### **a Vegetation survey**

SGS reported that the roadside verges were dominated by those grass species which were used in the initial sowing, but that the existing SSSI acted as a seed source and that some similarities were developing between the verges and the adjoining areas of moor. SGS believed that the early stage of development of the verges made it impossible to draw firm conclusions on the development of the verge communities.

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SGS compared their results with those of earlier surveys. An English Nature survey of 1979 indicated that over half of the habitats described were covered with a species rich, wet, grassy dwarf shrub heath. However, the information was not comparable with the SGS survey as NVC was not undertaken. SGS noted that there was a lack of moss cover, particularly of the Sphagnum species along the roadside verge areas. A possible reason for this may be that many moss and lichen species are known to be intolerant of atmospheric pollution. It is also possible that this is an artificial, developing community and the bryophyte cover may develop later.

The Devon Wildlife Trust identified the main NVC communities in the SSSI in 1992. SGS compared the results of their surveys for six of the seven sections with those of the Devon Wildlife Trust for the adjacent communities within the SSSI. (Devon Wildlife Trust did not survey adjacent to the seventh section). None of the NVC classifications of SGS matched those of the Devon Wildlife Trust, although many of the species were common to both. Generally the match varied from 'little similarity' to 'good similarity', as described by SGS. At one section it was considered by SGS that the road verge would develop to resemble the SSSI in time.

#### **b Air photography survey**

The aerial photographs taken in 1995 for SGS were compared with photographs of 1969 from the National Monuments Record, and of 1975 from the consulting engineers who built the North Devon Link Road.

The 1975 and 1995 photographs showed markedly similar patterns of vegetation on the SSSI, indicating stable vegetation communities, although there was a widespread increase in gorse throughout the SSSI. Gorse had also invaded some of the surveyed road verge sections. This invasive species can become dominant under favourable circumstances, particularly in disturbed ground.

The aerial photographs revealed that the patterns of poaching caused by livestock had altered, as movement from one side of the road to the other is restricted to bridges. In 1969 and 1975 there were a number of tracks crossing the line of the road. In the 1995 photographs strong tracks

parallel to the road were discernable. There were no clearly discernable bands of different vegetation on the SSSI running parallel to the road in 1995, but SGS suggested that the different pressure from grazing and poaching now in operation may have an effect in the future.

#### **c Non- calcareous fill**

SGS monitored the pH and conductivity of soils along transects of the roadside verges and extending into the undisturbed moorland soils. It has recorded results for surface soils in the range pH 4.6 to pH 6.2 and in the range pH 5.0 to pH 5.9 for sub-soils. It was noted that moorland soils might typically be more acidic (pH 4.3) than the soils sampled.

SGS noted that calcareous fill had been used on the roadside verges through Rackenford Moor, where non-calcareous fill should have been used (see 3.5.2 above).

The conductivity survey indicated no serious contamination. If conductivity levels had been significantly higher, it would have indicated that one or more of the constituents of the soil was present in unusual concentrations.

### **3.5.5 Site Management**

The roadside verges were managed during a three year aftercare period, ending in 1993, by contractors for the Department of Transport.

SGS noted in its report of 1995 that gorse had been cut along some areas of the verges but clearly was unaware of any management agreements. It recommended that a coordinated programme was initiated to cut and remove gorse and to treat the cut stumps.

Grazing is an important factor in maintaining the desired flora of the SSSI and a viaduct was provided to allow cattle to cross beneath the proposed route to access grazing land. To reduce the concentration of cattle movements SGS suggested the provision of additional crossing points 100-150 m either side of the viaduct. Factors influencing the grazing regime should be considered through negotiation with English Nature.

### **3.5.6 Other ecological interest**

At the Public Inquiry into the scheme the findings of a local amateur naturalist were reported. He had recorded 29 species of butterflies and 151 species of moths. Some of the species, it was noted, were migrants and do not breed on the reserve. Twelve species of moths were noted as being locally rare in Devon and were in need of special protection, but none of these are listed in the Red Data Book (Shirt, 1987), or included in the Wildlife and Countryside Act 1981. The food plants of eleven of these species are all common; bedstraw, birch, willow, oak, beech, hawthorn, lichen and various grasses grow within and without the SSSI. One species of moth, however, the Purple-bordered gold, has been recorded as feeding on the marsh cinquefoil which has not been recorded from the SSSI, though it has been found in this area of Devon. This species of moth has not been well studied and may have other, more common food plants.

It was suggested that factors other than the availability of food plants was important to the distribution of these rare species. It was noted that the road may tip the balance

in some way, which is, as yet, not understood.

Evidence was presented to the Public Inquiry about the birdlife of the SSSI. It was suggested however that few species noted are restricted to heathland. The stonechat, however, is one of these heathland inhabitants and the SSSI was recognised as supporting a substantial part of the population of the birds in Devon. The Whinchat and Wheatear also favours heath although it can be found in other lowland habitats.

The Nightjar is an uncommon bird to Britain. At the Public Inquiry it emerged that the species had been recorded occasionally at the SSSI but was it not thought to breed there. The Nightjar is crepuscular (active at dusk) and nocturnal.

The effect of the trunk road upon birds and insects is unknown. Changes in drainage, pH or the structure and composition could have an effect, but so far these effects seem to be minimal, and unlikely to cause significant change. Lack of detailed information on the moorland fauna prior to road construction mean that post construction surveys would not be of any value in determining the road's impact.

### 3.5.7 Summary

The roadside verges were dominated by those grass species which were used in the initial sowing, but the existing SSSI is acting as a seed source, and some similarities were developing between the verges and the adjoining areas of moor. The early stage of development of the verges made it impossible to draw firm conclusions on the development of the verge communities, and in particular, on the effect of using non-calcareous fill.

The aerial photographs revealed that the patterns of poaching caused by livestock had altered, as movement from one side of the road to the other is restricted to bridges. It was suggested that the different pressure from grazing and poaching now in operation may have an effect in the future. The future grazing regime should be considered, and management to remove gorse initiated.

## 3.6 Shabbington Woods

### 3.6.1 Background

The Shabbington Wood SSSI in Oxfordshire covers an area of 305 hectares. It is an area of ancient semi-natural woodland, and is the largest remaining relict of the once extensive medieval Royal Forest of Bernwood. It was first notified as an SSSI in 1981.

Much of the wood has been gradually coniferised since the mid-1950s, but the margins still retain a wide variety of trees, shrubs and herbs as surviving relicts of ancient woodland. The insect fauna is particularly rich in species associated with ancient deciduous woodland; the butterflies and several other groups including hoverflies and beetles are of national importance. Over forty species of butterfly have been recorded from the site, the most notable is the black hairstreak and areas of blackthorn thicket have been managed specifically for it. This species has a very restricted distribution in Britain, being mainly found in woods between Peterborough and Oxford. The blackthorn hedgerows also provide a habitat for the uncommon brown hairstreak butterfly. Other nationally

uncommon butterfly species include the Duke of Burgundy, wood white, purple emperor, pearl-bordered fritillary and marsh fritillary.

All three species of British newt breed in the ponds scattered about the woodland and grass snake and slow worm are common. A large number of bird species are recorded from the wood, including tree pipit, grasshopper warbler and crossbill.

The route of the M40 was published in 1985, and the road was opened to through traffic in 1991. The route avoided the bulk of the wooded area, but as a result of other constraints, the eastern edge of Shabbington Woods was included in the landtake. An ecological survey found that the route would destroy some minor black hairstreak colonies, but would avoid locations with strong colonies. Indeed, the road would affect principally a plantation of conifer and oak whose nature conservation interest was not as great as the majority of the SSSI. Following this investigation, English Nature agreed to the route on the condition that mitigating land was provided for habitat creation purposes. The SSSI and the M40 is shown in Figure 9.

### 3.6.2 Mitigation

An area of 4.7 hectares, comprising two fields between the M40 route and the wood were given over, planted and managed for nature conservation purposes. The southern field was formerly in arable production and the northern field was a grass ley which had been sheep grazed. The woodland boundary of these two fields contained black hairstreak larvae and it was considered that these would have a good chance of spreading, providing the right conditions were created. The site landscape works were implemented in early spring 1990, followed by a four year establishment and maintenance programme. The mitigation area is shown in Figure 9.

The design encompassed a maze of dense, sheltered but unshaded scrub, with many south-facing aspects. *Prunus spinosa* (blackthorn), which is the larval food plant of black and brown hairstreaks, was a dominant component (60%) of the scrub, along with *Salix caprea* (goat willow) and *Ulmus glabra* (wych elm), the food plants of the purple emperor and white-letter hairstreak, respectively. There were five main mixes in the southern field:

- i *Prunus spinosa* with small patches of *Ligustrum vulgare* (privet);
- ii *Salix caprea*;
- iii *Prunus avium* (wild cherry);
- iv *Quercus robur* (oak)/*Fraxinus excelsior* (ash) mix including smaller patches of *Sorbus torminalis* (wild service-tree), *Acer campestre* (field maple) and *Prunus avium*;
- v other shrub patches including *Corylus avellana* (hazel), *Rosa canina* (dog-rose), *Crataegus monogyna* (hawthorn) and *Frangula alnus* (alder buckthorn).

The northern field had four different planting types:

- i *Prunus spinosa* with small patches of *Ligustrum vulgare*, *Frangula alnus* and *Rosa spp*;
- ii *Salix caprea*;
- iii *Quercus robur*/*Fraxinus excelsior* mix;
- iv salvaged *Corylus* stools and *Prunus spinosa*.

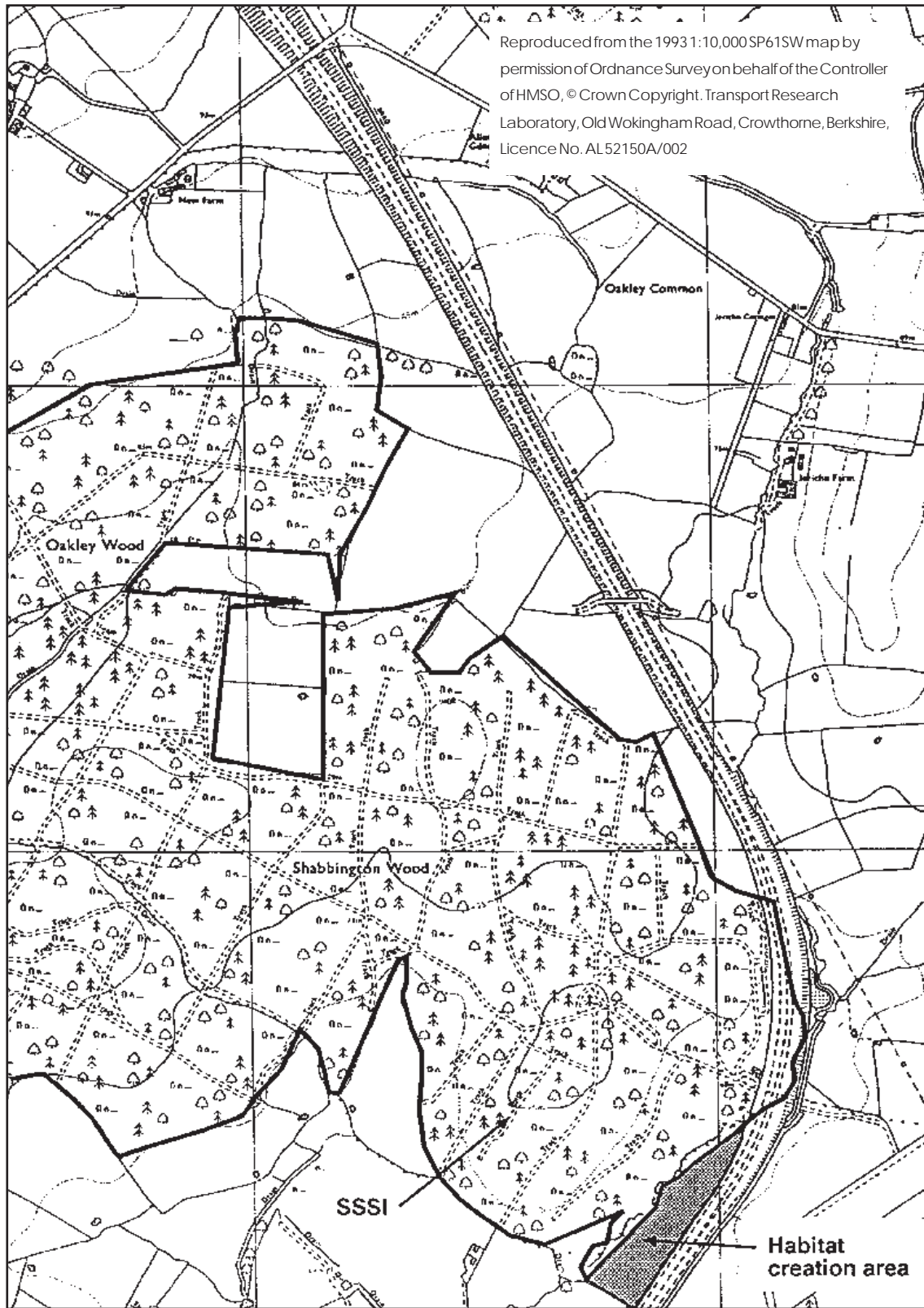


Figure 9 M40: Shabbington Wood SSSI (pre road construction) and habitat creation area. Scale 1:10,000 approx.

In addition, *Alnus glutinosa* (alder) and *Crataegus laevigata* (Midland hawthorn) were planted.

The two farm hedges within the site and the edge of the woodland were allowed to grow unmanaged, in order to encourage the suckering of *Prunus spinosa*. All trees and shrubs were of native stock. Some of the blackthorn was propagated under contract from suckers of local bushes on Otmoor rifle range. The black hairstreak requires mature bushes on which to breed, so such bushes with a small number of overwintering larvae were transplanted to the site. This was thought to be important since there is some evidence that the butterfly is selective even between blackthorn bushes. Hazel stools were also transplanted to the site.

Wild flower glades were created between the bands of trees and shrubs. To achieve a suitable growing medium, the topsoil was stripped from the arable field and used to make low mounds (0.5-2 m high) on which many of the trees and shrubs were planted. The wildflower seed source was provided from the hay crop taken from a local, traditionally managed, flower-rich hay meadow. Meadow vetchling and tufted vetch provided food plants to encourage the wood white butterfly. Devils bit scabious were planted to attract butterflies such as the marsh fritillary.

In total about 25,000 forestry transplants were planted, 60 percent of these being blackthorn. The planted area totalled 11,100 m sq. The grassland areas (rough ley and meadow) covered 17,500m sq, about 60 percent being seeded with the hay meadow mix.

The entire site was fenced to protect the establishing plants from browsing by deer and rabbits. Swinging gates were installed across Thomley Brook to prevent deer entering under the fence at this point.

### 3.6.3 Monitoring

The Department of Transport funded the monitoring of the mitigation site at Shabbington Wood for its first four years. The management and monitoring were conducted by Symonds Travers Morgan (Symonds Travers Morgan, 1997a and 1997b).

The grassland was monitored in midsummer annually from 1991 to 1995 by STM. Fifteen random 1m sq quadrats were sampled for the sown grassland area in the southern field and the percent ground cover of each species of higher plant occurring in each quadrat was recorded.

Butterflies were monitored by the Institute of Terrestrial Ecology from 1989 to 1994, who examined all the blackthorn edges throughout the reserves each winter, counting the number of black or brown hairstreak eggs present. In addition, a sample of the planted blackthorn bushes in the two fields were examined and a visual assessment of the development of the bushes was made. Similar counts were made each year along stretches of edges elsewhere in Bernwood Forest, for control purposes.

From 1991 onwards other butterfly species were monitored by members of Butterfly Conservation, who made weekly counts of numbers of adult butterflies along a fixed transect through the mitigation site, using the methodology of the national Butterfly Monitoring Scheme. The transect was divided into seven sections. The results were compared with the annual changes in numbers of each

species recorded by the national scheme, including elsewhere in Shabbington Wood. The 1991 transect provided a baseline against which the relative numbers of each species could be compared in future years.

### 3.6.4 Surveys

#### a Desk study

Reports produced by Symonds Travers Morgan for the Highways Agency (Symonds Travers Morgan, 1997a and 1997b) were used to provide full details of the mitigation implemented and details of monitoring work. Butterfly monitoring data for 1996 and 1997 were requested from Butterfly Conservation.

#### b Site visit

Field survey was undertaken by SWRC (13 August 1997) to confirm the works and results reported by Symonds Travers Morgan. Following the lead of Symonds Travers Morgan, plants and butterflies were surveyed within the habitat compensation area. Lists of higher plant species and their frequencies were noted for the grassland areas. For butterflies, a fixed transect was walked through the reserve along the route set up by members of Butterfly Conservation, using the methodology of the national Butterfly Monitoring Scheme (see Section 2.8). Lastly, details were noted on the general health of the plantings, the condition of the deer fencing and evidence of current management.

### 3.6.5 Results

#### a Tree and shrub planting

##### *Symonds Travers Morgan monitoring*

A high proportion of the initial planting of shrubs, especially the *Prunus spinosa*, failed during the dry summer of 1990. These were replaced in the second and subsequent years, as necessary. The high initial failure appeared to have been caused by some species being sensitive to the herbicide application required for weed control. Whilst locally propagated *Prunus* was available for the initial replanting, in subsequent years native nursery stock had to be used. By 1995 the planted *Prunus* was well established and had begun to sucker and the shrub species were beginning to grow together to form sparse hedges of scrub. The planted disease-resistant elm failed but elm in the old hedge had grown into substantial 3m to 5m high bushes by 1994.

##### *SWRC survey*

The shrubs and trees found in the planted belts are listed in Table 4.

Although *Alnus glutinosa*, *Crataegus laevigata*, *Rosa canina* and *Sorbus torminalis* were included in the scrub woodland planting, the species were not located.

It was not possible to assess the overall survival rate of planted stands as tree guards had already been removed. Reference to the Symonds Travers Morgan monitoring report indicated that extensive supplementary replanting of some of the original planted stands was required. At the

**Table 4 Planted trees and shrubs recorded by SWRC from Habitat Creation Area**

Trees and shrubs		Frequency
<i>Acer campestre</i>	field maple	LF
<i>Corylus avellana</i>	hazel	O
<i>Crataegus monogyna</i>	hawthorne	O
<i>Frangula alnus</i>	alder buckthorn	O
<i>Fraxinus excelsior</i>	ash	F
<i>Ligustrum vulgare</i>	wild privet	O
<i>Prunus avium</i>	wild cherry	O
<i>Prunus spinosa</i>	blackthorn	LD
<i>Quercus rour</i>	pedunculate oak	O
<i>Salix caprea</i>	goat willow	S

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally

time of the survey, the vast majority of trees (95% or more) were in good health although a small percentage of the *Quercus* saplings within the woodland planting were suffering from significant mildewing. Both the scrub belts and the woodland belts had retained their planted profiles and the plantings may be regarded as successful.

### b Butterflies

#### *Symonds Travers Morgan and Butterfly Conservation data 1989-1995*

The newly created grasslands were colonised first by the more common butterfly species which increased and then maintained their numbers (relative to the national trend). By 1994, the site supported all the more common butterfly species characteristic of southern grasslands with the exception of wall brown. Colonies of marbled white and brown argus appeared in 1994, with the first white-letter hairstreak (associated with the elm suckers) appearing in 1995. Brown hairstreak densities in the compensation area increased dramatically during 1990-1993, so that by 1993 the colony was one of the largest in Britain. Although numbers were down in 1994, this merely reflected the national situation. Over the four-year period, there has been a move from the northern field to the southern one: in 1991, 50% of the total number of all butterflies were recorded from the smaller, northern field; by 1994, 78% of all individuals were in the southern field. This may be explained by the fact that the southern field had changed from arable use to an area specifically designed to be suitable for butterflies; the northern field, in contrast, has been subject to fewer modifications and supported (unmanaged) rank vegetation of lesser value to butterflies than the maturing habitats of the southern field. By 1995 the planted *Prunus spinosa* was thought to have become marginally suitable for black hairstreak although none had been recorded. The species were recorded during this period are given in Table 5.

#### *Butterfly conservation data 1996 and 1997*

**Black hairstreak:** This had not colonised the site at the time of the latest survey. However, emergence of this species was early during 1997 and numbers were low.

**Brown hairstreak:** A strong colony had established within the mitigation area, although numbers were low in 1997, reflecting the national situation.

**Table 5 Butterfly species recorded during 1989 and 1995 (Butterfly Conservation Data)**

Species	
Brimstone	Orange tip
Brown argus	Painted lady
Brown hairstreak	Peacock
Clouded yellow	Red admiral
Comma	Ringlet
Common blue	Small copper
Essex skipper	Small heath
Green-veined white	Small skipper
Hedge brown	Small tortoiseshell
Holly blue	Small white
Large skipper	Speckled wood
Large white	White admiral
Marbled white	White-letter hairstreak
Meadow brown	

**White-letter hairstreak:** Casual sightings of adults indicated that they were still present but in summer 1997 some of the elm was showing signs of Dutch Elm Disease, putting the future of this species, which is dependent upon elm, in doubt. However, there was plenty of sucker growth.

**Marbled white:** Colonisation continued, with a steady increase to 1996, more than double the 1994 count.

**Other species:** In 1996, most species counts were down, many to their lowest since the start of the transect; this was attributed to the severe drought. However, gatekeepers reached an all time high of 251 and the other browns and the skippers maintained healthy numbers. In common with other areas, the holly blue reappeared in 1996 and there was an unprecedented invasion of painted ladies during the same year, 166 being recorded on the transect.

There was much more flowering of nectar plants in 1997, mainly due to the rain in June, and the numbers of butterflies appeared to be recovering well (although figures were not available at the time of writing).

#### *SWRC survey data*

The sightings made on the butterfly transect are shown in Table 6.

**Table 6 Butterfly transect sightings (SWRC 1997)**

Species	Sightings northern field	Sightings southern field
Brown argus	0	1
Brown hairstreak	0	2
Common blue	3	21
Gatekeeper	1	1
Large white	2	6
Meadow brown	0	1
Small copper	0	1
Small skipper	0	2
Small tortoiseshell	0	1
Small white	1	2
Speckled wood	0	1

The most notable species recorded during the transect was the brown hairstreak since this is one of the species of importance that has colonised the site. A total of two females were seen both of which were watched ovipositing on *Prunus spinosa*. The results of this survey confirmed the

greater value of the southern field for butterflies.

At the outset of the project, the presence of black hairstreak within the habitat compensation area was perhaps anticipated by 1997. This was principally because the survey in 1986 suggested that a colony of black hairstreak existed along the edge of the wood bordering the southern field of the habitat compensation area and so it was expected that the species would colonise relatively readily into the new habitat area. However, 1985 and 1986 were exceptional years for the butterfly and it is likely that this stretch of woodland edge was only temporarily occupied. If this sedentary species was absent from areas immediately adjacent to the habitat creation area at the time of the latter's establishment, then it is likely that it will take several years for the species to colonise the area and build up to detectable numbers.

### c Grassland

#### *Symonds Travers Morgan data*

A herb-rich grassland was beginning to develop in the southern field by 1995. Although initially vegetation was dominated by annuals and there was much bare ground, by 1993 increases in the mean percentage cover were being recorded for longer-lived perennial grassland species, and by 1995 a number of valued species such as *Briza media* (quaking grass), *Prunella vulgaris* (self-heal), *Silvaum silaus* (pepper saxifrage), *Orchis morio* (green-veined orchid), *Lathyrus nissolia* (grass vetchling) and *Viola hirta* (hairy violet) were established. Adjacent to the topsoil mounds, higher nutrient levels resulted in the development of a less species-rich grassland, dominated by species such as *Holcus lanatus* (Yorkshire-fog) and *Trifolium pratense* (red clover). The periphery (roughly 5m wide) of the southern field was allowed to develop naturally into rough grassland, characterised by patches of *Ranunculus repens* (creeping buttercup), *Deschampsia cespitosa* (tufted hair-grass), *Centaurea nigra* (common knapweed) and *Lathyrus pratensis* (meadow vetchling).

#### *SWRC survey data*

The species recorded in the rough grassland areas and the sown, species-rich grassland areas did not match well with those in the Appendix to the Symonds Travers Morgan report (Symonds Travers Morgan 1997a). It is however difficult to draw conclusions about any differences, as it is unclear which areas were covered by the Symonds Travers Morgan surveys. The apparent absence in 1997 of some of the uncommon or target species recorded in previous years, such as *Orchis morio* and *Succisa pratensis* is of concern and, if confirmed, would suggest that the quality of the grassland is now declining.

The vegetation present approximates to that of a lowland meadow and may be regarded as a good example of a recently created grassland. To assess the true success of the meadow creation, it would be necessary to compare quadrat data collected from the meadow with similar data collected from Bernwood and Murcott meadows which formed the source of the seeds mix.

### 3.6.6 Management

The development of the reserve (both the new planting/seeding and the existing woodland) requires management to promote a structured woodland/scrub/grassland mosaic with a microclimate that provides a habitat suitable for butterflies, particularly the black hairstreak.

Management prescriptions have been prepared, by consultants to the Highways Agency, for eleven subdivisions of the mitigation area by location and habitat type. Each of these compartments has been described in terms of the vegetation and given an overriding management objective. Management prescriptions detail the key operations during the twenty year period of the plan, sub-divided where appropriate by vegetation type. The management prescriptions are grouped into four habitat types: grassland; scrub; hedgerow; woodland.

The consultants advise that there should be a major review of the management plan after 20 years, but that a review should take place every five years to be reactive to the results of monitoring.

However, Forest Enterprise indicated that there was currently no on-going management, despite a 20-year management plan having been prepared. On the survey visit there were no signs that the butterfly transect had been mowed at any time during the year or indeed that any maintenance had been undertaken. It appears that the site has not been managed since the winter of 1994, apart from a grass cut and minimal management of the more vigorous planting (willow) in the summer of 1996.

### 3.6.7 Summary

The habitat creation area had, at the time of the SWRC survey, progressed well towards its stated objectives, namely the encouragement of butterflies. The value of the mitigation plantings of *Prunus spinosa* in two specially prepared fields to the scarce brown hairstreak is confirmed as being high. The main target species, the nationally rare black hairstreak, has yet to colonise from adjacent areas although the size of the bushes at the site appear to be suitable for the species. Although the planted elms failed, management to encourage elm suckering has resulted in the arrival of white-letter hairstreak. Two other target species, purple emperor and marsh fritillary have not yet been recorded, despite the deliberate introduction of their food plants.

The design and implementation of the habitat creation proposals appear to have been excellent. The initial failure of the shrub and tree planting was resolved by replacement planting and careful management and appropriate management to 1994 encouraged the initial development of species-rich grassland.

Perhaps most importantly, the monitoring of grassland and butterflies which took place in the years immediately following the establishment of the habitat compensation area not only unequivocally demonstrated the success of the mitigation, it also allowed appropriate action to be taken where necessary, such as in the replacement planting, particularly of *Prunus spinosa*.

The future of the site is, however, less assured. Without management, the grassland will slowly be taken over by scrub, which will become more and more dense. Whilst the hairstreak butterflies will be encouraged by the free development of scrub, other species of butterfly and other animals and plants will be severely disadvantaged by the uncontrolled development of dense scrub throughout the site.

### 3.7 Hazelborough Woods

#### 3.7.1 Background

Hazelborough Wood is an ancient replanted wood, in which 170 year old oaks can be found. It was once a Royal Wood and dates back to 1299. It covers an area of 195 hectares. Much of the wood is coniferised, containing norway spruce and scots pine. However, it also contains areas of broadleaf woodland (oak, lime, ash, hazel, maple, blackthorn, hawthorn, dog rose, beech, willow, aspen, elder and holly), with ancient woodland flora. Muntjac deer are common within the woods.

It is currently owned by the Forestry Commission. Forest Enterprise, which is part of the Forestry Commission and is responsible for management, periodically carry out felling and regeneration planting. The A43 bisects the wood.

The Environmental Statement, giving details of preferred route for the A43 Silverstone Bypass, was published in 1991. It had been anticipated that a contract for the bypass construction would be let in late 1997, but the road had been dropped from the current programme at the time of writing. The published route follows the old road for much of its length through the wood, with the north bound carriageway to the west of the existing road. Towards the northern boundary of the wood it swings across the old road into the eastern edge of the existing wood. The route will result in the loss of approximately 200 m of roadside woodland from 'the Straights' and the entire roadside strip (1.1 km) of woodland from Hazelborough Wood (See Figure 10). Dormice are known to inhabit these areas.

The dormouse is specially protected under the Wildlife and Countryside Act, 1981 and the Conservation (Natural Habitats & c) Regulations, 1994. It is an offence to intentionally kill, injure or capture any wild dormouse or damage or destroy dormouse resting or breeding places.

#### 3.7.2 Dormouse ecology

The common dormouse (*Muscardinus avellanarius*) was once widespread in England and Wales but is now restricted principally to southern and western counties.

Dormouse ecology is not very well understood, but it is accepted that the species is generally dependent on mixed deciduous woodland habitats with a good diversity of native trees and shrubs, the fruits and flowers of which form the majority of its diet.

Dormice are generally found today only in large woodlands, but are also known to occasionally inhabit hedgerows adjacent to or between woodlands. They live in low population densities; ideal conditions sustain a maximum of 8-10 individuals per hectare. The period from October to April is spent in a state of hibernation in nests

at ground level. From May to September dormice live in the trees and shrubs in an almost exclusively arboreal manner. They are nocturnal; nights are spent foraging and days spent in nests of woven vegetative material built in dense bramble or holes in trees. An interlocking canopy is very important to dormice as they rarely venture onto the woodland floor when foraging but move from shrub to shrub or tree along overlapping branches.

When available, hazelnuts are much sought after by dormice and form an important part in their diet. Hazelnuts opened by dormice are distinguishable from nuts opened by other small animals, and provide evidence of dormouse activity.

#### 3.7.3 Preliminary dormouse surveys

A preliminary dormouse survey was conducted by consultants. The proposed corridor for the A43, and 100m either side of that corridor was assessed initially through a desk top survey whereby areas of hedgerow and woodland patterns were identified. The area was visited in 1993 and the leaf litter of hedgerows and woodlands was searched for hazelnuts opened by dormice.

Such evidence of dormice was found within the survey corridor in areas of Hazelborough Wood, the Straights, Lodge Copse and Earl's Wood. A dormouse hibernation nest was found in the Straights and within 5 m of the present road verge.

Along each side of the existing A43 were strips of mature relatively unmanaged woodland acting as shelter belts to the more intensively managed woodland behind. In this 20 m wide corridor, along each side of the old road as it passes between the woods, the evidence of dormouse activity was highest. In the more intensively managed areas of woodland the process of clearfelling and thinnings periodically leave the areas unsuitable for dormice.

The consultants recommended mitigation measures (to either move the dormice or encourage them to move themselves), and further surveys beyond the 100m corridor to determine whether any other suitable dormouse habitats existed, and whether or not these habitats contained a dormouse population.

Further surveys of dormice were conducted by Forest Enterprise in 1993/94. Dormouse boxes were erected in trees in 6 survey areas (A to F). Area A was the north and south of the roadside - the area from which the dormice should be moved. A total of 159 boxes were erected in this region. The remaining areas B to F were possible relocation areas, and 192 boxes were spread across this region. The aim of the surveys was:

- i to encourage dormice in area A to use the boxes for sleeping and breeding, and then to monitor the population and breeding success in 1994 by inspecting the boxes.
- ii to confirm the presence or absence of dormice in areas B to F and to monitor the population.
- iii to relocate dormice in area A, under guidance from English Nature into other suitable habitats by October 1994.

When the boxes were inspected in October 1994 only one box in area A was inhabited by dormice, and non inhabited in the remaining areas, although several were occupied by wood mice.

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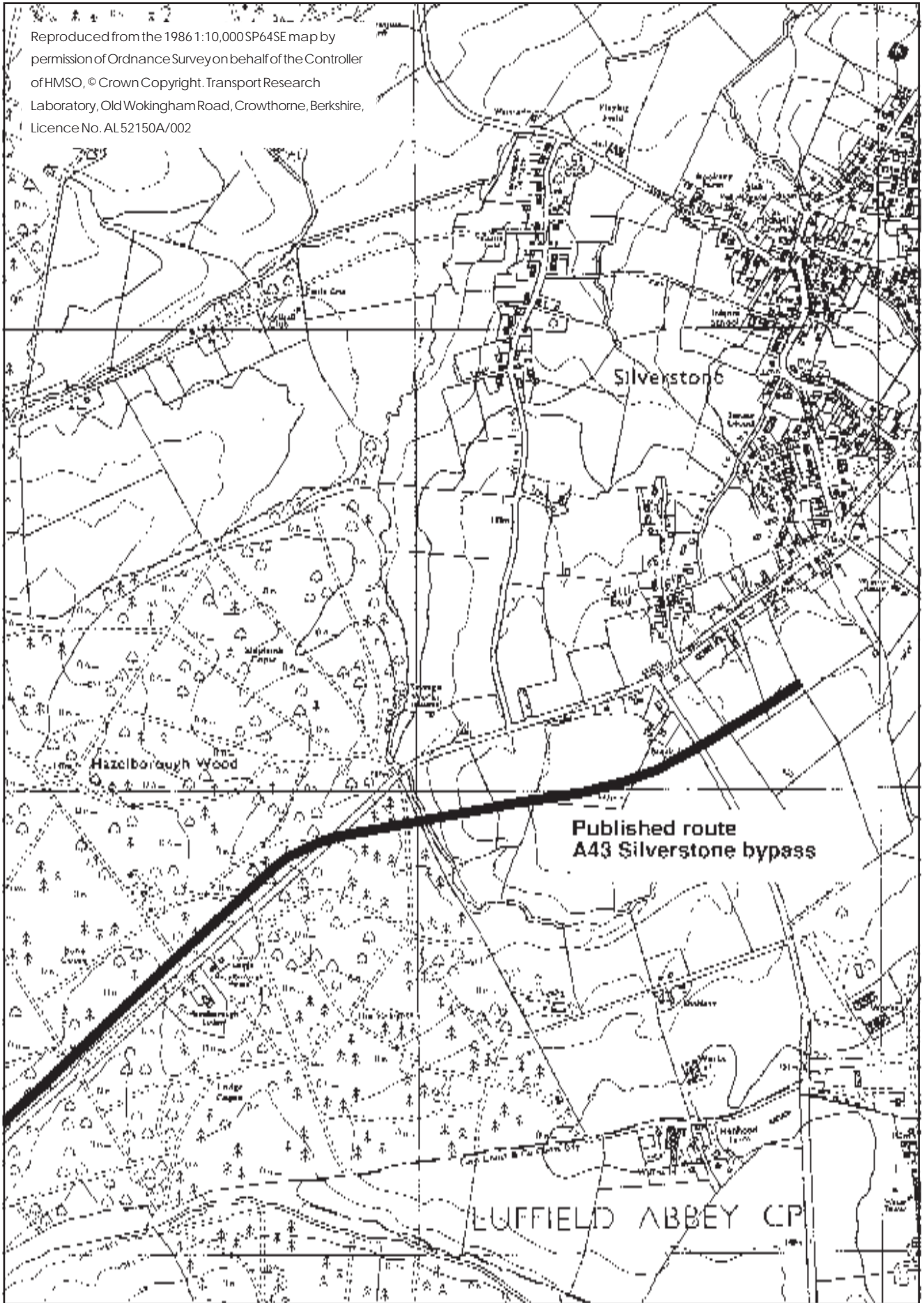


Figure 10 A43: Hazelborough Wood. Scale 1:10,000 approx.

### 3.7.4 Mitigation

To comply with statutory obligations it was necessary to relocate dormice from the area of the proposed road improvement. This may be done by encouraging the dormice to move themselves or to capture and release them elsewhere. No attempts may be made to move dormice during the period of hibernation, nor during the breeding cycle. The recommended period to attempt movement is September. To encourage dormice to move by themselves a procedure of gradual felling of the woodland is recommended.

A felling regime was designed to move the dormice before the then anticipated start of motorway construction. This would move dormice naturally along existing vegetation corridors and avoid isolating animals in areas of unsuitable vegetation. Felling of trees and shrubs took place over two years. Working was limited to the period from mid-August to the end of September in each year. A strip of woodland 1km by 15 - 20 m wide north of the road was cleared in total. This length was divided into 22 sections, with alternate areas cleared in 1994, and the remaining 11 areas cleared in 1995. The main felling operation carried out in 1994 was designed to move the dormice sideways into the 1995 areas. The 1994 felling areas had no suitable habitat behind them, whereas the 1995 areas were connected to the rest of the forest by corridors of suitable habitat. In 1995 the retained trees were felled in 10 m strips starting at the road side, clearing the timber as it was felled. This clearance was designed to move the dormice naturally through the connecting corridors into suitable habitat in the adjoining sections of wood. The clearance is shown diagrammatically in Figure 11.

All forestry contractors carrying out the work received memoranda from the managing company, Fountain Forestry, providing background information, roles, nature of the work and risk assessment. The Northants Dormouse Group also provided a written circular advising the required course of action should a dormouse be found by contractors. (The contractors were also under threat of a £5000 contract penalty if they failed to comply with the required course of action).

Deer fencing was erected on both sides of the road to protect the vegetation regrowth from browsing by the increasing deer herd. The absence of a fence could result in the shortage of suitable habitats at a crucial time.

### 3.7.5 Monitoring

The dormouse boxes erected by Forest Enterprise are being monitored by the Northants Dormouse Group. In 1995 dormice were observed in boxes in 5 of the 6 areas. In one area 14 of the 39 boxes were being used. The dormouse group is continuing to monitor the boxes, to assess the success or otherwise of the method used for felling for the road widening scheme. The report of later monitoring was not available at the time of writing, but personal correspondence with the Northants Dormouse Group (January 1998) revealed that the dormice had not fared well. No Dormice had been located close to the road, and they were located in only one area deeper in the wood. However, it was difficult to say whether or not the tree felling was responsible for the dormouse decline. Fine early springs, followed by late frosts are bad for dormice, and these had occurred in both 1996 and 1997.

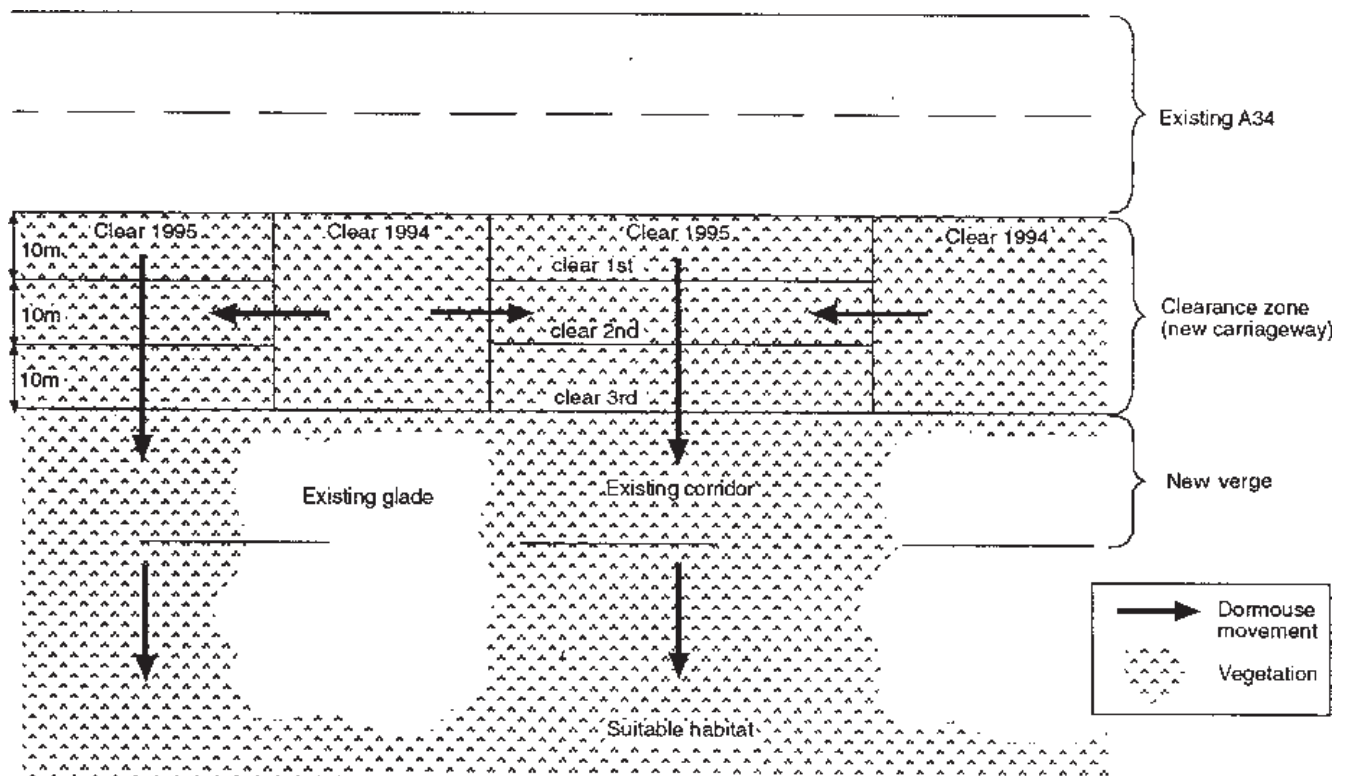


Figure 11 Hazelborough Wood: Clearance of vegetation and dormouse movement

### 3.7.6 Management

Management within the forest is the responsibility of Forest Enterprises, but currently this consists of allowing natural regeneration of the forest to provide suitable habitat for the dormice.

Management of the 'new verge' zone (see Figure 11) will be avoided in the medium term so that it may act as a buffer until the area behind becomes a more suitable habitat. This 'new verge' zone is the area which will, if the road is built, be adjacent to the new road and will be cleared of trees which are considered potentially liable to fall onto the new carriageway.

To prevent regrowth in the 'clearance' zone (see Figure 11), particularly the coppice growth of hazel which would in a short time make the area attractive once again to dormice, the area is 'swiped'. This is done while the shoots are small enough to be cut by tractor mounted machinery and still unattractive to dormice. The swiping is carried out every two years by Forest Enterprise, and at the time of writing it was intended that this should continue until the bypass is constructed.

### 3.7.7 Summary

The presence of dormice in a corridor of land proposed for the A43 improvement presented an obstacle to the development of the route, for the species is afforded statutory protection. The problem was identified at an early stage for appropriate mitigation to be provided. Appropriate mitigation measures were considered in consultation with all interested parties.

The evidence points to the success of the operation, although the dormouse population has suffered a setback due to the weather of the winters of 1996 and 1997. TRL's assessment of the reasons for success of the operation are:

- early consultation involving all interested parties;
- involvement of local knowledgeable personnel; and
- the cooperation of Forest Enterprise.

Ownership of the woodland by the Forestry Commission and the pragmatic role of Forest Enterprise has been hugely beneficial to the operation of this pre-construction mitigation programme.

The road was planned to be constructed under a DBFO contract, although it has currently been dropped from the roads programme. If, at some later date, the road is constructed, then arrangements for the future maintenance of the roadside area should be established in the DBFO contract.

## 3.8 St Catherine's Hill

### 3.8.1 Background

The St Catherine's Hill SSSI was first notified in 1951 and it covers an area of 41.5 hectares. The site comprises chalk grassland scrub occupying the spur of St Catherine's Hill, and an adjoining dry valley. The varied topography, soil depth and aspect gives rise to distinctive plant communities. There is an Iron Age hill fort at the summit of the St Catherine's Hill. The grassland supports colonies of the locally distributed chalkhill blue butterfly, particularly at the

eastern end of the site (the 'Dongas'), and the more sheltered parts of the site are rich in invertebrates.

The Itchen Valley (Winchester Meadows) SSSI was first notified in 1979. It covers 99 hectares and comprises the flood plain of the River Itchen and is largely grazed meadow on alluvium. The meadows are dominated by grasses and are rich in herbs and sedges, including some exceptionally rich populations of orchids. The site is rich in wetland invertebrates.

In 1990 the final decision on the route for the M3 around Winchester was announced. The route chosen ran through agricultural land for the greater part, but affected the East Hampshire Area of Outstanding Natural Beauty, parts of both the St Catherine's Hill (slightly more than 1 hectare) and Itchen Valley SSSIs were lost, and the easterly part of St Catherine's Hill SSSI (the 'Dongas') was isolated by the new road. The SSSIs and the line of the M3 is shown in Figure 12. The road was constructed during the period 1992 to 1994.

### 3.8.2 Surveys prior to road construction

From 1990 the Institute of Terrestrial Ecology (ITE), under contract to the Highways Agency, have been responsible for advising the DOT on ecological mitigation measures, supervising their implementation, and monitoring the results.

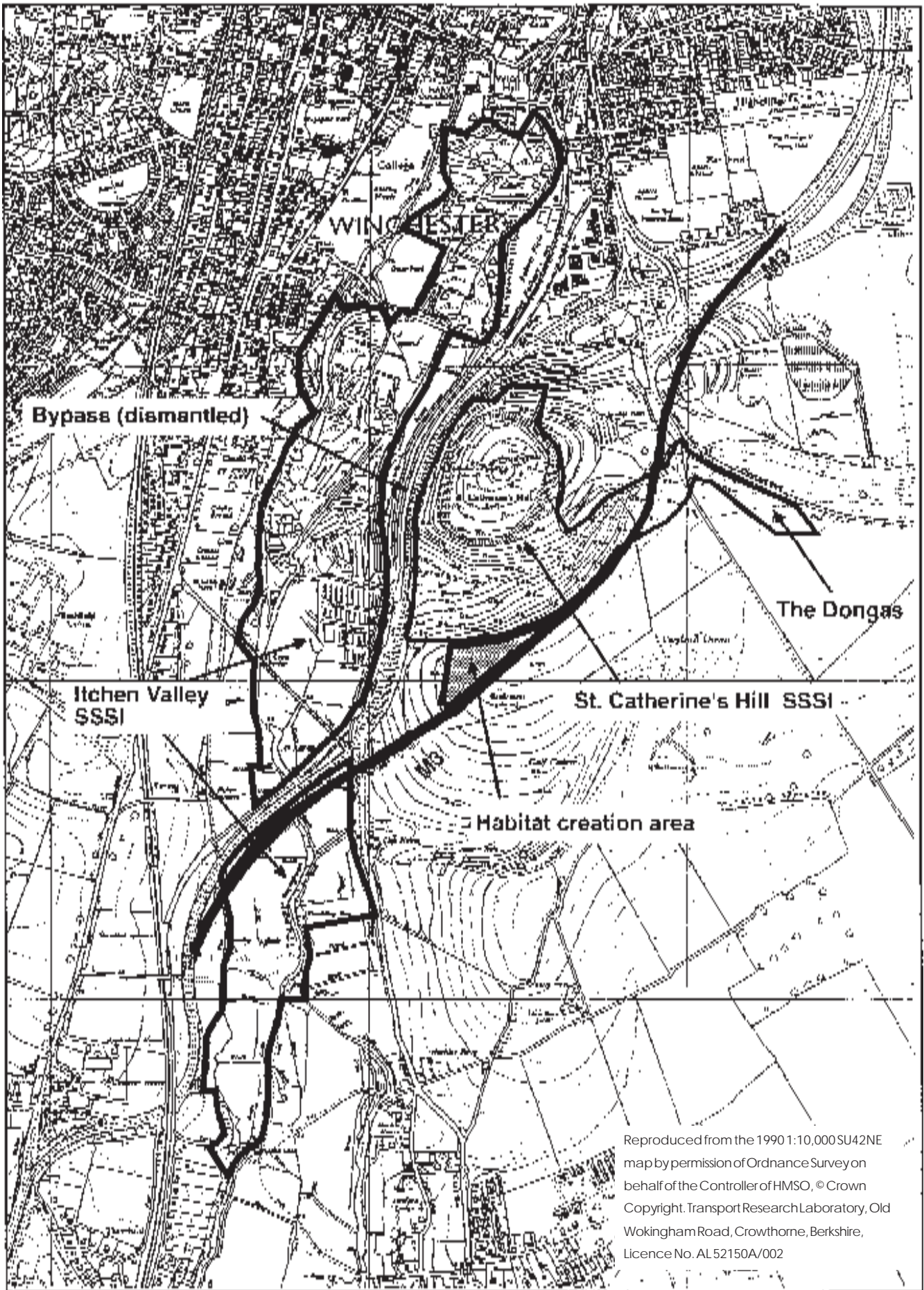
In 1991 and 1992 (prior to road construction) ITE conducted ecological surveys (Snazell et al (1991), Snazell et al (1993) and Snazell (1993)) to identify any factors which might need special provision in the construction of the motorway (for example, deer or badger crossing points), and any habitats or species of particular conservation interest which lay in the path of the new road. They also established the plant and animal communities on the existing downland so that any newly created downland would fit into the mosaic of the adjacent areas, particularly at the Dongas and St Catherine's Hill.

The survey determined that no special provision for deer or badgers was required, and identified Hockley Flood Meadows and the Dongas as areas of special interest (see below) on the line of the new road.

### 3.8.3 Mitigation

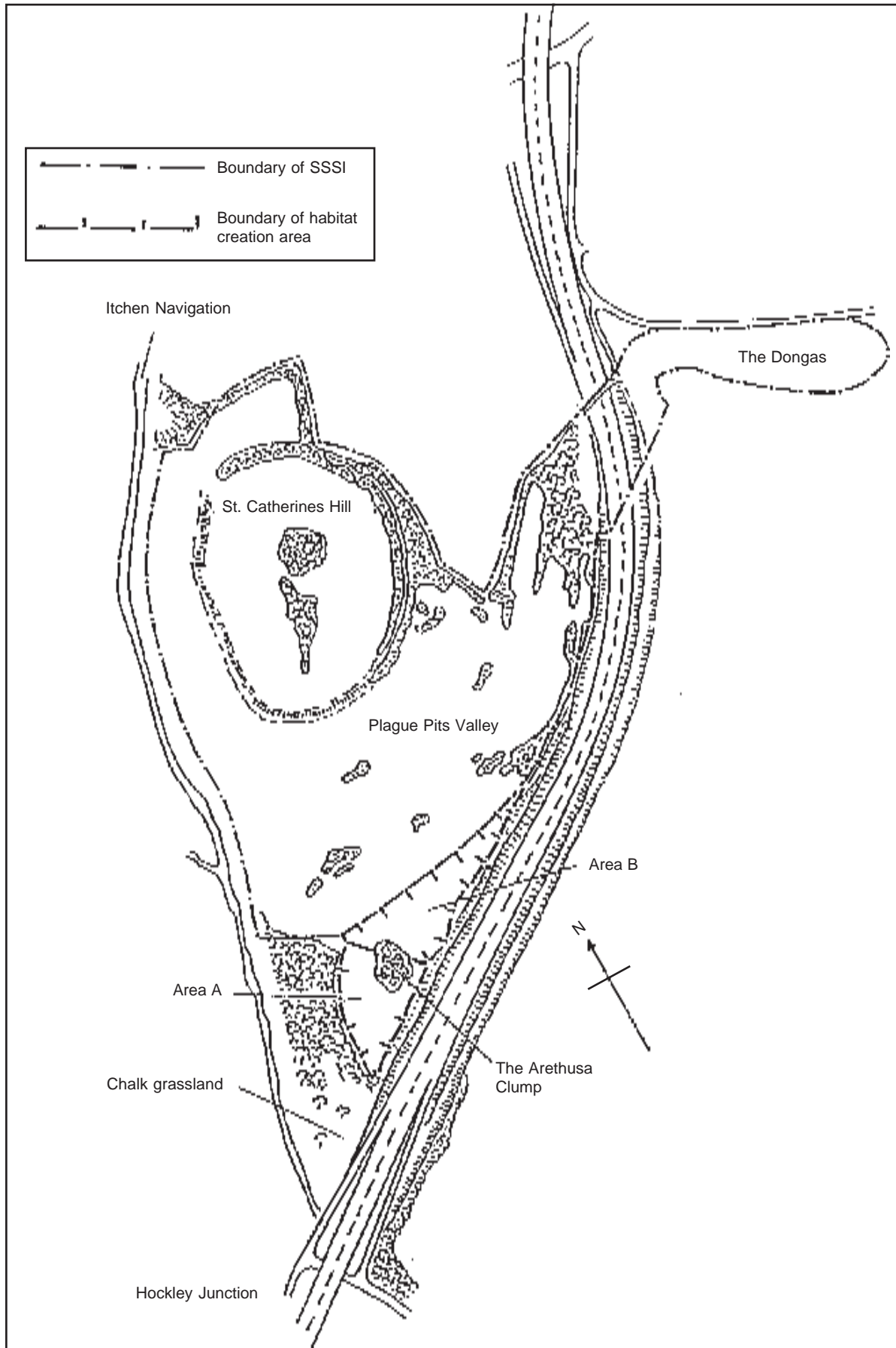
In response to concerns expressed during the Public Inquiry, the provision of habitat suitable for downland butterflies, particularly the Chalkhill Blue, has been a priority of the mitigation programme. To mitigate the habitat loss, new areas of downland were created on an area of previously arable land surrounding Arethusa Clump (referred to as Arethusa A and Arethusa B) (see Figure 13), and on the restored route of the old Winchester bypass (A33). It was anticipated that this would create areas of downland (providing suitable habitat for the chalkhill blue butterfly) which would be considerably greater than those lost. The restoration of the old bypass route would, in addition, provide a link between the Winchester Water Meadows and St Catherine's hill, improving access to the downs from the city.

The principal mitigation programme is outlined below by area.



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Figure 12 M3: St Catherine's Hill and Itchen Valley SSSIs and habitat creation area. Scale 1:20,000 approx.



**Figure 13** Arethusa habitat creation area, St Catherines Hills. Scale 1:10,000 approx.

### *i The Dongas*

Part of the St Catherine's Hill SSSI, the 'Dongas' are thought to be ancient trackways linking Winchester with the Downs. The area is species-rich downland, but the M3 route chosen passed through an area where scrub encroachment had caused much of the conservation interest to be lost, and contained no chalkhill blue habitat. The turf in this area was used in the first stage of downland restoration at Arethusa A (see below).

### *ii Hockley flood meadows*

This area of flood meadow (0.5 hectares) in the Itchen Valley lay in the path of the M3. Although it contained no particularly rare species, it was a good example of a declining habitat. A receptor site was found for the area (an island on the River Test) which was previously poor agriculturally improved pasture. The receptor site was prepared by removing the low quality turf such that the new turves could be laid at the same hydrological level as they had been at the donor site, to enable their species richness to be retained.

During March 1992 (Ward et al, 1992), all the species-rich turf at Hockley was cut as 'macroturves' and moved to the prepared receptor site. The 'macroturving' technique uses large scale turving equipment developed jointly by ITE and Alaska Environmental Contracting. Turves are moved that measure 2.4m by 1.2m and up to 30cm thick. This method has the advantage of virtually eliminating frost and drought damage, and most burrowing invertebrates and deep rooted plants survive. Turves were moved, six at a time, to the receptor site. To avoid damage, the turves were at no time placed on top of each other. From cutting to relaying took about 1.5 hours. When in place, closely packed to avoid gaps, the turves were flattened and packed down using the low impact tracks of an excavator. All disturbed areas and trackways were made good and sown with appropriate seed mixes.

### *iii Downland restoration areas*

#### **a Arethusa A**

The area, 1.5 hectares of previously arable land, had the topsoil removed to provide the thin nutrient-poor soil required for downland creation. In order that the final surface was level more soil was stripped from the area where turves from the Dongas were to be laid.

In February 1992, 500 sq m of herb rich turf from the slopes above Hockley Junction (which would have been lost to road construction) were cut by hand and moved onto the site. In December 1992 3000 sq m of turf was moved from the Dongas, using the macroturving technique. The most species rich turves were laid in the optimal positions, while those of lesser richness were placed in less favourable areas. The areas not turfed were seeded in March 1993, with 3 distinct seed mixes. One was a short turf mix for the area surrounding the species rich turf, one mix was for a longer turf, and the third mix was of seed collected from local sites using suction equipment. Over the following 18 months 31,000 pot plants of seven downland species (kidney vetch *Anthyllis vulneraria*, horseshoe vetch *Hippocrepis comosa*, rockrose

*Helianthemum nummularium*, thyme *Thymus praecox*, clustered bellflower *Campanula glomerata*, cowslip *Primula veris* and hairy violet *Viola hirta* - all except the last being grown from local seed or cutting) were planted in the area (Ward and Stevenson, 1992, Stevenson and Ward, 1993). Two hundred juniper plants were also planted in rabbit and stock proof enclosures.

#### **b Arethusa B**

Arethusa B was also previously arable land, covering an area of 2 hectares. The topsoil was stripped from the site in November 1993, and the area was seeded as no turf was available. A single seed mixture was used for the entire area, which consisted of 59 species in all, of commercial origin, and hand collected seed of species otherwise unobtainable. Twenty-two thousand plants of six downland species (devil's bit scabious *Succisa pratensis*, horseshoe vetch, cowslip, hairy violet, clustered bellflower and rockrose) were also planted. The motorway cutting top slope, and the narrow strip between the top slope and the fence were seeded, the latter area also being planted.

#### **c The restored A33**

The old A33 was closed in July 1994. The road was broken up and the cutting faces and banks were cleared of scrub. During August and September chalk from the excavation of the northbound M3 carriageway was used to fill the site, care being taken to recreate as closely as possible the original shape of the hill. Some of the turfs at the top of one of the cuttings were preserved. A thin layer of topsoil (75mm) was spread over the area which was to become downland, while a thicker layer (300mm) was spread where trees and shrubs were to be planted. The area was seeded with a downland mix of 51 species. One particular area at the foot of St Catherine's Hill which, because of its aspect, was potentially of interest, was sown with a richer mix of 37 short turf species. In May 44,500 plants of eight downland species (those at Arethusa A plus devil's bit scabious) were planted. All species planted in the downland creation areas were either important butterfly food or unlikely to grow from seed. All shrub and tree planting was protected by stock proof enclosures. Thus an area of 3.5 hectares was restored to chalk grassland (Snazell et al, 1994)

#### **3.8.4 Monitoring**

Monitoring is taking place in the summers of years 1,2,3,4,6,8 and 10 at each of the newly created areas. Fixed botanical quadrats are being used to monitor the development of the sward. Pitfall traps and a suction sample is being used at the Arethusa areas to monitor invertebrate groups. Butterflies are being monitored fortnightly by means of a Standard Butterfly Monitoring Scheme transect covering the downland restoration areas, part of the St Catherine's Hill reserve and the Dongas.

Additional research on the Chalkhill blue butterfly was carried out in 1996. This was to estimate the absolute number and population structure of the Chalkhill blues colonies on St Catherine's Hill, The Dongas and Arethusa and the extent to which each colony was isolated from the

others, using mark-recapture experiments. The research also aimed to determine optimum conditions for egg-laying (Thomas et al, 1997).

### **3.8.5 Monitoring results**

#### **a Flood meadow translocation**

In 1994 a botanical survey (Ward and Stevenson, 1995) revealed that the large turves translocated by machine to an area where the soil had been removed to raise the water table had maintained their species richness. There was, however, some turnover of species - marsh orchid and devil's bit scabious were recorded for the first time, but blunt flowered rush, marsh arrow grass and purple loosestrife were not found.

However, small turves translocated by hand had lost wetland species, apparently because of drying out and insufficient grazing. Other patches of larger machine translocated turf had sunk down below the peaty soil, become wetter and lost the species of drier ground.

The vegetation was taller in 1994 than in 1993, but it was difficult to judge whether the changes were related to insufficient grazing or translocation to a drier habitat. The seeded areas were improved in 1994 compared to 1993, with fewer weeds, and in the quadrats 29 of the 33 species sown were recorded. However the total wetland species had declined from 45 to 38.

In 1995 (Ward, 1995), the area of turves translocated by machine to that part of the receptor site which had topsoil removed had maintained the species richness of wetland meadow plants, although there was a small reduction in the important wetland species in total and in the quadrats. There was some turnover in detail of species. Small patches of turf, especially those translocated by hand had regained the species lost in 1994, the improvement being attributed to increased grazing. The problem of turves sinking in 1994 appeared to be extending to other areas in 1995. The process is attributed to drying out and mineralisation of the underlying peat in the very dry conditions of spring and summer 1995. This may result in changes to the sedge community which cannot withstand long periods of submersion, and may already be happening in areas of machine translocated turves.

The seeded areas had a good general appearance in 1995 (Ward, 1995), with more species flowering. There were, however, a few additional losses of sown wetland species.

#### **b Downland restoration**

The three downland areas are at different stages of colonisation, but are judged by ITE to be progressing well. Botanical surveys of all areas are described below. Invertebrate surveys of the Arethusa areas, which have been established slightly longer are also reported.

##### *i Botanical surveys*

Full botanical surveys of the Arethusa Clump areas have been conducted by ITE. (Ward and Stevenson, 1994, Ward and Snazell, 1996).

The results of the 1994 survey showed that the chalk grassland species richness of the translocated turf was the same

as at the time of transfer, with slight increases in total chalk grassland species. In the hand translocated plots, 49 species were recorded compared to 42 and 41 in 1993 and 1992 respectively. Few important species were not found and a few species were found that had not been detected in the previous year. There was a slight reduction in the mean number of species in the quadrats, and an increase in vegetation height indicating that mowing or grazing was necessary.

The chalk species in the seeded areas of Arethusa A were well represented, with more than 75 percent of the sown species appearing in the sample quadrats. Legumes grew unexpectedly well in 1994, and the seeded areas were therefore cut to reduce the risk of shading out other species under their canopy. The over representation of legumes was adjusted in the seed mix used in Arethusa B and on the A33 restoration.

The seed mix used on Arethusa B had the highest diversity of all mixes used until then on the M3 restoration areas, and botanical assessment showed that it was very successful compared to the mixes used on Arethusa A, with a mean of 14.4 species per quadrat in 1994 compared to a maximum of 11.3 per quadrat on Arethusa A. There were many species of weed on Arethusa B, but they were less dense than on Arethusa A.

Arethusa A and B were cattle grazed for the first time in late spring 1995, reducing the vegetation height, and more intensively with sheep in autumn 1995. The hand translocated turf showed very minor changes in 1995, compared to 1994. Virtually all chalk grassland species had been maintained, and bare ground had been colonised, and most weeds had disappeared. The machine translocated turves showed slight reductions in chalk grassland species, with a trend towards the loss of the smaller species. Weeds were not a problem in 1995. Where checker-boards of turf were laid chalk grassland species colonised the open areas, and weeds continued to decline.

In 1995 the seeded areas on Arethusa A supported increased numbers of chalk grassland species. Most of the quadrats were still dominated by legumes, but there had been a turnover of the species involved. Species cover values in the quadrats were still not comparable to those in the true chalk grassland. In 1995 junipers in the enclosures of Arethusa A had declined to 74 percent of those planted initially.

Arethusa B, when surveyed in 1995, had a very open, short grassland with good representation of chalk grassland species. The mean number of sown species was better than on Arethusa A, legumes had not become so dominant, and smaller species had not been suppressed. There was more bare ground than on Arethusa A, but weeds had decreased.

The ecological restoration of the A33 was judged by ITE to have begun well. The mean total species number per quadrat and the chalk grassland species per quadrat were the highest of all the M3 seeded restorations in their first year. Weeds were abundant, as is usual, in the first year. Vegetation height was taller than the sown areas in Arethusa A, and the percentage of bare ground was less. This indicates a greater fertility on the A33 restoration, and suggests a grazing/cutting management regime is important for this area.

### ii *Invertebrate survey*

Full invertebrate surveys of the Arethusa Clump area have been conducted by ITE (Snazell, Rispin, Thomas and Elmes, 1996).

The survey which was conducted in 1995 showed that the expected colonisation of Arethusa A by invertebrates had occurred. The initial number of early invasive species is declining and being replaced by downland species. This is best shown by the spider fauna. The main species of primary colonisers taken in pitfall traps decreased from 81 percent of the population in 1993 to 12 percent in 1995. This has been matched by an increase in the number of *Pardosa* wolf spiders from 3 percent to 51 percent of the population in the same period. The trend is expected to continue until equilibrium is reached.

The colonisation of Arethusa B is progressing well, although more slowly than Arethusa A, primarily because no turf was translocated to this area from which species could colonise. Colonisation is from adjacent downland which lies on one side of the site only. The fall in early colonisers and the increase in open turf late colonisers is not as marked on Arethusa B due to the slower development of the sward.

The butterfly population (as monitored by the Standard Butterfly monitoring Scheme) on Arethusa A indicates that this aspect of the recreation has been successful. The chalkhill blue was well established in 1995, and the brown argus and dingy skipper had also colonised the area, while some species (including the chalkhill blue and brown argus) were also present on Arethusa B. The population of chalkhill blue in the Dongas area increased during 1995, following the national trend.

### iii *Chalkhill blue butterfly survey (1996)*

The Chalkhill blue butterfly survey revealed that the three areas (The Dongas, St Catherine's Hill and Arethusa) each had a self-contained population. The Dongas population was estimated to be exceptionally large (6000), that on St Catherine's Hill was estimated as large (2500), while the newly created Arethusa supported a medium sized population (900), figures given being totals for 1996. In the years since the motorway was built and opened the population of chalkhill blues on the Dongas had increased by about 1000, densities had been maintained on St Catherine's Hill, and the whole population there had increased due to the extra butterflies on the extended breeding area of the A33 route. About four percent of the butterflies that were recaptured had migrated from one site to another between captures, and it was estimated that about 150 Chalkhill blues had crossed the motorway in one direction or another in 1996. Thus no population is genetically isolated, and the existence of three colonies rather than two improves the metapopulation structure.

The project has demonstrated that it is possible to create habitat for the chalkhill blue on former arable land. The establishment of *Hippocrepis comosa* (horseshoe vetch) - the foodplant of the chalkhill blue - was most successfully achieved through seeding and turf translocation. The planted pot-plugs did not prove to be particularly successful. The study also showed that a shorter sward, so

that the horseshoe vetch attains a height of 2-5 cm in summer, would increase the suitability for the chalkhill blue. The study proposed increased grazing in early and mid summer for the newly created Arethusa area.

### 3.8.6 *Management*

Management of each of the restoration areas is currently considered individually as they are in an early development stage. Initial management of the downland restoration areas involved the erection of rabbit and stock proof fencing to protect the developing turf and invertebrate populations.

A five year management plan was drawn up for the period 1994 to 1999 for the Arethusa Clump area, based on the English Nature Specification. The management plan was left fairly flexible to allow for responses to rapid changes in ecological conditions. A similar plan has been drawn up for the restored A33 area. Grazing is the preferred form of management for St Catherine's Hill, but for small isolated areas mowing is more practical. For newly sown areas, mowing is the most satisfactory form of management to prevent the invasion of coarser vegetation, and scrub. Mowing may be replaced by grazing after 2 years. As soon as practical the areas will be managed as an integral part of the St Catherine's Hill Reserve by Hampshire Wildlife Trust.

### 3.8.7 *Summary*

The M3 construction resulted in the loss of two small areas of potential interest - one of degraded downland (the Dongas), and one of herb-rich flood meadow (Hockley), and fragmentation of the Dongas from the rest of the St Catherine's Hill SSSI. Turves from both areas have been translocated relatively successfully, and an area of downland has been created (7 hectares - considerably greater than the area lost to the road) on land which was previously arable, or occupied by the old road.

The flood meadow turves were translocated to an island on the river Test. The macro turves moved by machine were successful in retaining their species, while those moved by hand were slightly less successful due to some drying out and insufficient grazing.

The downland turf translocation has also been successful, as have the seeding of the areas Arethusa A and B. Early colonisation by invasive invertebrate species has occurred, but these are being replaced by downland species. The colonisation of Arethusa B has taken longer than Arethusa A as turf translocation from which species could colonise was not used at this site. The ecological restoration of the A33 was judged to have begun well, the seeding being particularly successful so far. The created downland areas show every indication of attaining higher ecological value and well as covering a greater area than the land lost to the motorway. The restoration of the A33 has also resulted in a reduction in the fragmentation of the two SSSIs, which must be set against the fragmentation of the Dongas mentioned above.

A Chalkhill blue butterfly survey of 1996 showed that three distinct colonies of this species had established. A very large colony now existed in the Dongas, that on St

Catherine's Hill had expanded into the newly created area on the old A33, and a new colony had established on the specially created habitat in the Arethusa areas. There was some small migration of individuals between these areas and across the new road. The Brown argus and Dingy skipper butterflies were also colonising Arethusa A, while the former was also colonising Arethusa B. The project has demonstrated that it is possible to create butterfly habitat, and in particular habitat for the Chalkhill blue, on former arable land.

### 3.9 Red Scar and Tun Brook Woods

#### 3.9.1 Background

Red Scar and Tun Brook Woods (including Boilton wood) is a large valley woodland SSSI to the east of Preston, Lancashire, covering an area of 64 hectares. The SSSI was designated in 1979 because of the extensive examples of western valley ash-wych elm wood and valley alderwoods on neutral-alkaline soils which are typical of woodlands in the Ribble and Hodder valleys on soils derived from glacial drift. The SSSI also constitutes one of the largest areas of deciduous woodland in Lancashire. *Fraxinus excelsior* (ash), *Ulmus glabra* (wych elm) and *Acer pseudoplatanus* (sycamore) are the main trees, with both *Alnus glutinosa* (alder) and *Prunus avium* (wild cherry) locally frequent. There are numerous base-rich flushes within Red Scar Wood supporting a rich lime-loving flora including the uncommon *Carex pendula* (pendulous sedge), *Chrysosplenium alternifolium* (alternate-leaved golden saxifrage) and *Lamium galeobdolon* (yellow archangel), the latter reaching its northernmost limit in Britain. There is a good woodland bird assemblage including hawfinch and there are badger setts within the SSSI. Uncommon invertebrates include the white-letter hairstreak and the oak bush-cricket, both scarce in north-west England.

The M6 motorway bisected Boilton Wood and the south-western boundary of the SSSI is on the east of the M6; the fragment of Boilton Wood which lies on the western side of the M6 is not included within the SSSI. Proposed widening of the M6 motorway threatened the south western corner of the SSSI. Figure 14 shows the SSSI and motorway prior to widening.

During preparation of the Environmental Statement for the road scheme in 1989, a fragment of herb-rich grassland covering 0.3 ha and known as Brockholes Meadow (approximating to NVC grassland type MG5 *Cynosurus cristatus*-*Centaurea nigra* grassland) located within the motorway verge, just to the west of the M6 and immediately to the south of the fragment of Boilton Wood, was identified (see Figure 15). (An ecological survey of Boilton Wood was prepared by the Lancashire Wildlife Trust in July 1989 under contract to Rendell, Palmer and Tritton Design and Consulting Engineers.) In order to avoid landtake to the grassland which was judged to be of greater ecological value than the woodland, the motorway widening was carried out to the east (construction work being carried out during 1993), resulting in the loss of a small triangle (area unknown) of Boilton Wood (within the SSSI) on the eastern side of the M6.

#### 3.9.2 Mitigation

Proposed mitigation for the loss of a small area of woodland SSSI (about which little information is available) was two-fold: firstly, the exclusion of the herb-rich grassland site from the motorway fenceline to allow the introduction of ongoing management to prevent its degeneration to scrub and, secondly, dense tree and shrub planting on the widened motorway cutting, with particular emphasis on woodland restoration along the periphery of Boilton Wood. On the eastern verge adjoining the SSSI, the vegetation works also included the spreading of woodland topsoil from the lost area. Only canopy species were to be used in the plantings in order to minimise competition with any naturally developing groundflora and understorey.

The extent to which the landscape planting using native species undertaken on the cutting adjacent to the wood was designed to be ecological mitigation per se has been questioned by the Lancashire Wildlife Trust.

#### 3.9.3 Existing information

The herb-rich grassland site (Brockholes Meadow), including the surrounding scrub margin, was designated as a Site of Biological Importance by the Lancashire Wildlife Trust/Lancashire County Council in 1992. The total area of the Site of Biological Importance is 1 ha, while that of the herb rich grassland is 0.3 ha. The site is also known as the M6 Embankment. Records of species at the site held by the County Council are given in Chinn et al, 1998.

#### 3.9.4 Site surveys

The site was surveyed on 17 July 1997. To assess the current value of the herb-rich grassland at the site, homogenous areas were sampled by five 2m x 2m quadrats to determine the grassland community present. In addition, a full species list was recorded from the grassland area. Lastly, an assessment was made of the overall invasion of scrub species into the grassland area.

An attempt was made to assess the status and value of the tree planting schemes on the eastern and western sides of the M6 cutting. It was not possible to inspect the cutting directly because of access constraints and they were surveyed through binoculars. Whilst detailed inspection of the landscape planting was impossible, it was possible to record the species present and the condition of living trees at a distance.

#### 3.9.5 Survey results

##### a Vegetation survey

###### *i Brockholes Meadow.*

The walkover survey determined that the grassland measured approximately 90m x 25m and was roughly rectangular in shape. It was completely surrounded by dense scrub dominated by *Crataegus monogyna* (hawthorn) with frequent *Sambucus nigra* (elder) and some *Acer pseudoplatanus* (sycamore) and this was invading the grassland along all margins. The interface was variously dominated by stands of *Rubus fruticosus*

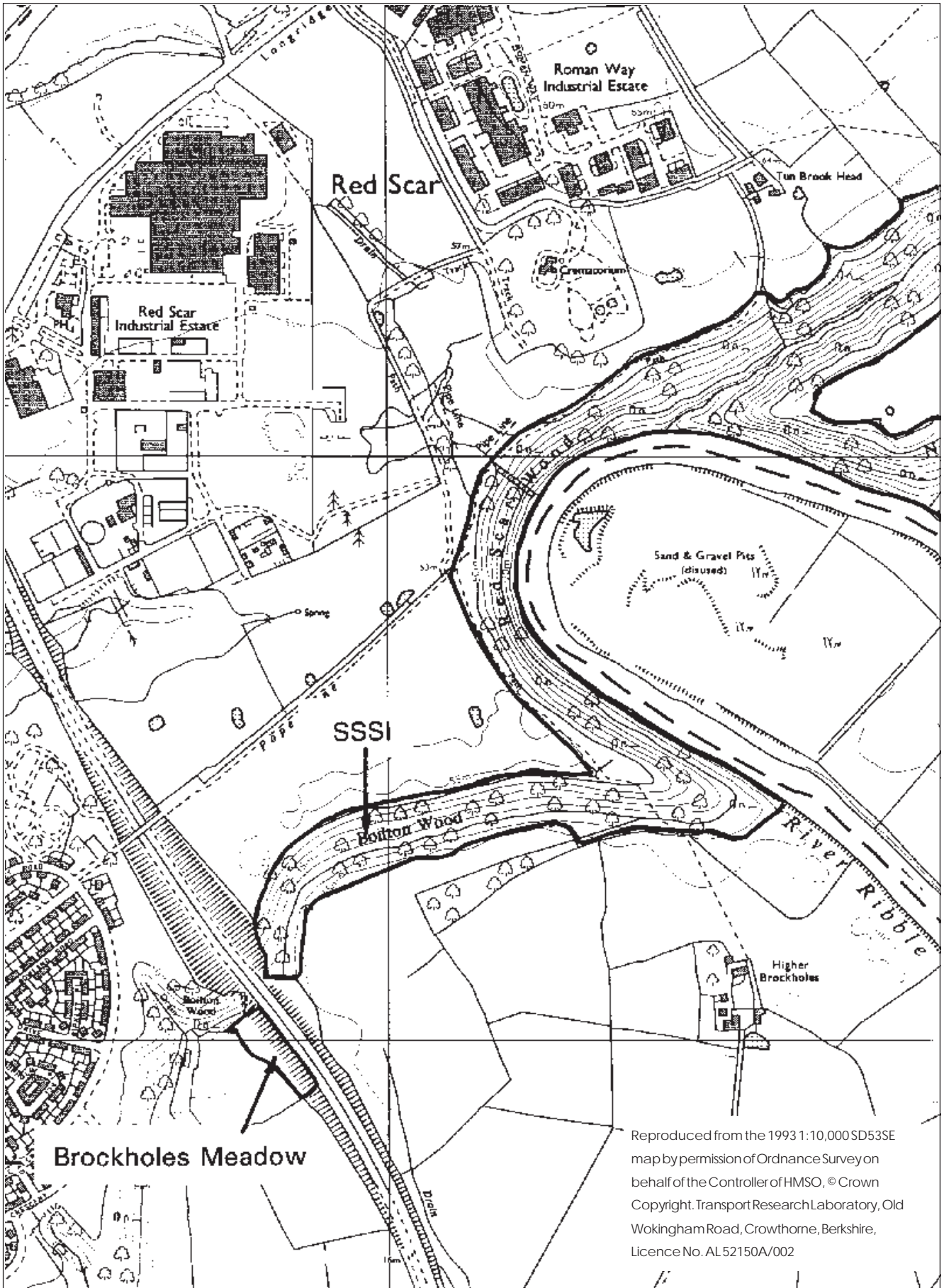
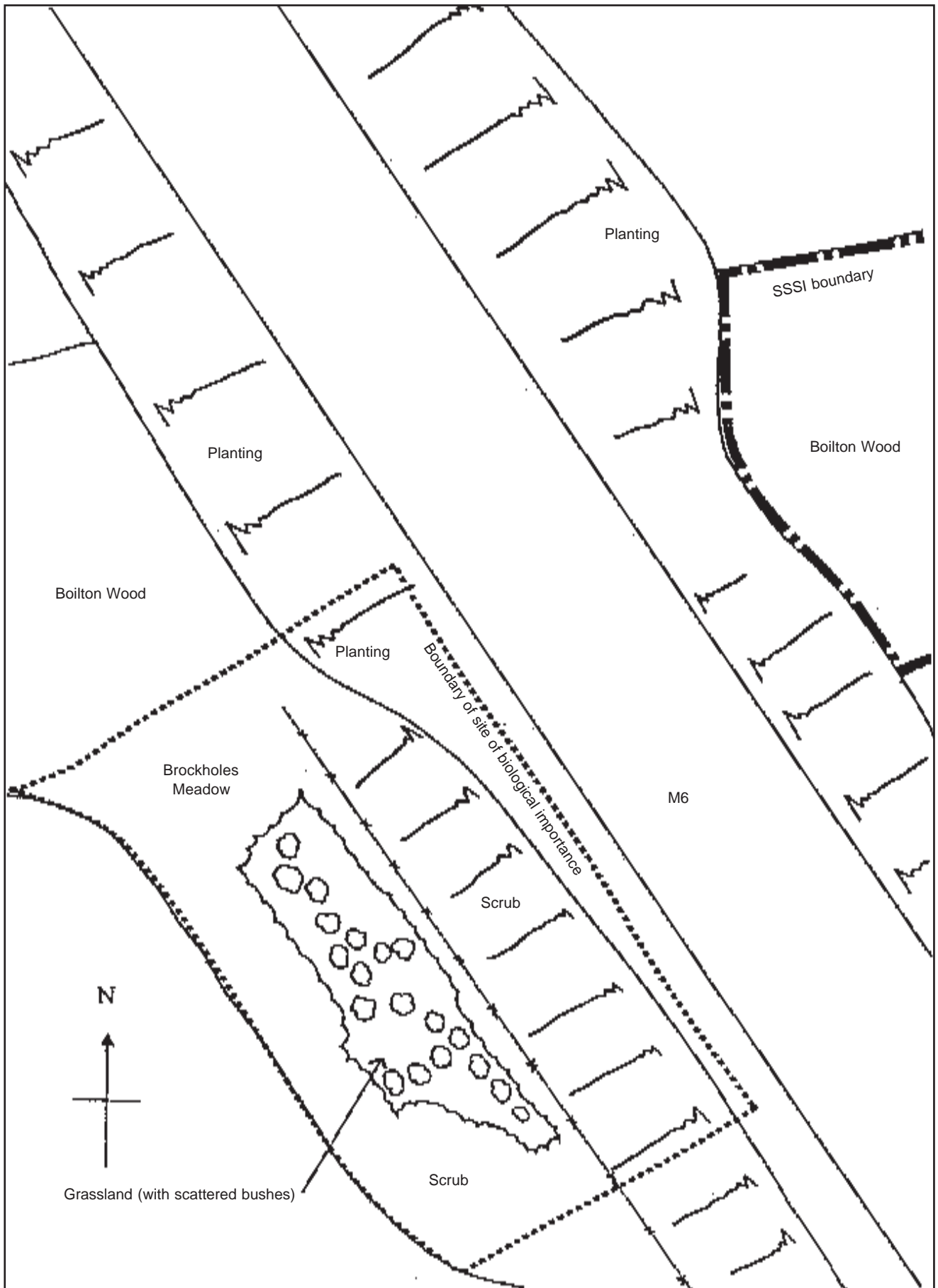


Figure 14 M6: Red Scar and Tun Brook Woods SSSI (pre road construction), and Brockholes Meadow. Scale 1:10,000



**Figure 15** Brockholes Meadow and mitigation plantings. Scale 1:150 approx.

(bramble), *Urtica dioica* (common nettle) and locally *Solidago gigantea* (early golden-rod). Small bushes of *Crataegus monogyna* (to 2m) were scattered across the grassland, with occasional small saplings of *Fraxinus excelsior* (ash) and *Acer pseudoplatanus*. There was a small stand of *Ulex europaeus* (common gorse) along the upper edge of the site (at the base of the motorway embankment) and several scattered *Cytisus scoparius* (broom) around all margins.

The grassland itself appeared to be becoming increasingly rank at the margins with *Arrhenatherum elatius* (false oat-grass) locally prominent. Generally, however, remaining patches of grassland appeared to retain the floral diversity recorded in 1989, with a high percentage cover of herbs. *Hypericum perforatum* (perforate St John's-wort) and *Centaurea nigra* (black knapweed) were generally abundant and attain high Domin scores locally. Of the eight species of grass recorded, none attained high Domin scores for percentage cover although some were frequent. There was a ground carpet of the ubiquitous pleurocarpous moss *Brachythecium rutabulum* which was replaced locally in the sward by *Rhytidiadelphus triquetrus*. It was clear that without management, in the form of cutting back encroaching scrub, the value of the grassland will decline.

No species that are rare or scarce either in the national context or in Lancashire were found on the site.

Table 7 lists the species which were recorded prior to the road widening and were not recorded during 1997.

**Table 7 Species recorded at Brockholes Meadow in 1992 prior to road widening, but not found in 1997**

Species	
<b>Herbs and grasses</b>	
<i>Angelica sylvestris</i>	wild angelica
<i>Anthyllis vulneraria</i>	kidney vetch
<i>Bellis perennis</i>	daisy
<i>Dactylorhiza praetermissa</i>	southern marsh orchid
<i>Hypericum tetrapterum</i>	square-stalked St. John's-wort
<i>Juncus acutifolius</i>	sharp-flowered rush
<i>Petasites hybridus</i>	butterbur
<i>Primula veris</i>	cowslip
<i>Senecio sylvaticus</i>	heath groundsel
<i>Solidago virgaurea</i>	goldenrod
<i>Stellaria holostea</i>	greater stitchwort
<b>Ferns and horsetails</b>	
<i>Equisetum telmateia</i>	great horse-tail

The continued presence of *Dactylorhiza praetermissa* (southern marsh-orchid) was queried even in 1992 and appeared to have been lost since the initial survey undertaken by the Lancashire Wildlife Trust in 1989. Several of the other species listed may have been overlooked if present only in small quantity, but the real loss of *Anthyllis vulneraria* (kidney vetch) and *Solidago virgaurea* (goldenrod) in the intervening years is likely. Both *Dactylorhiza praetermissa* and *Anthyllis vulneraria* are scarce in Lancashire.

Analysis using MATCH confirmed that the site supports MG5 grassland which appeared to be reverting to MG1

*Arrhenatherum elatius* grassland, since elements of that community were present.

MG5 grasslands are typically traditional lowland meadows which are mown in late summer and then grazed by stock in autumn and winter. MG1 grasslands, whilst now associated mainly with road verges, are characteristic of hay meadows which are mown in summer but are ungrazed. When grazing ceases on MG5 grasslands, there is usually an expansion of coarser grasses and an eventual invasion of shrubs. There is thus a progression to various types of MG1 grassland, as seen at Brockholes Meadow.

#### ii Tree and shrub planting (west of motorway)

The adjacent section of wood on the western side of the motorway was surveyed for both canopy and understorey species to enable the appropriateness of the plantings to be determined. *Acer pseudoplatanus* was frequent to locally dominant in the canopy whilst *Fraxinus excelsior* and *Quercus spp* (oak) were occasional to locally frequent. Both *Betula spp* (birch) and *Prunus avium* were occasional in the canopy. In the understorey *Crataegus monogyna* and *Sambucus nigra* were locally frequent. The eastern side of the motorway could not be accessed directly but surveying through binoculars indicated that the canopy constituents at least were similar in frequency and cover to those of the western side.

The western bank of the cutting supported a large number of *Fraxinus saplings* (to 12m in height). There were smaller numbers of *Betula sp* (birch) and *Prunus avium* (wild cherry) saplings whilst the margin of the cutting adjacent to the wood was dominated by a stand of *Crataegus monogyna*. Overall the planting had a patchy appearance including large trees (some to perhaps 15m) immediately adjacent to the wood, which may have been from the landscape plantings associated with the original M6 construction and saplings which had self seeded.

The eastern bank of the cutting supported a small number of *Fraxinus* saplings (to 12m in height) and scattered *Crataegus monogyna* bushes along its upper edge.

Further tree planting works in the eastern area of the verge are planned to be completed by the end of the 97/98 planting season. These have been reported to include a mix of *Alnus glutinosa*, *Fraxinus excelsior*, *Prunus avium*, *Sorbus aucuparia* and *Quercus petraea*. Apart from rowan (*Sorbus aucuparia*), these species are consistent with those observed in the adjacent original woodland. At this time it was also stated that the spreading of the conserved woodland topsoil had taken place, but its limited volume meant that only the lower regraded portion of the verge had been covered.

#### b Other observations

Badger droppings were found around the site, as was a moderately well-worn badger path disappearing into the scrub on the northern edge of the site. It was clear that badgers were foraging on the site and it is likely that there was a sett in the adjacent section of the wood. No badger paths were found leading through the motorway fencing although these may be present away from the meadow in areas of adjacent scrub.

No bird species were recorded utilising the grassland although it was likely that some species used the site for foraging. The dense scrub surrounding the site was probably of value for nesting birds and a woodpigeon with young was seen.

### **3.9.6 Management**

The ownership and future management of the herb-rich grassland site was to have been passed from the Department of Transport to the Lancashire Wildlife Trust. The Trust indicated that the planned management had not been implemented as vehicular access to the site had not been negotiated. At the time of writing the matter remained unresolved and the continuing lack of management was confirmed during the site survey. Without management of the encroaching scrub the value of the grassland will decline. The site has however been excluded from the motorway boundary fencing so as to facilitate management.

### **3.9.7 Summary**

The loss of a small area of SSSI woodland to the motorway widening was to have been mitigated by the planting of appropriate species of trees and shrubs adjacent to the woodland fragments (especially the SSSI boundary on the eastern side of the motorway cutting) and by the purchase of Brockholes Meadow and its handover to the Lancashire Wildlife Trust for management.

Access difficulties and lack of planting schedules prevented a full assessment of the appropriateness of tree and shrub planting adjacent to the Boilton Wood fragments.

Vegetation survey and analysis confirmed that Brockholes Meadow retained the higher plant interest for which it was designated as a Site of Biological Importance in 1992, both in terms of community and species diversity, although the spatial extent of the grassland was decreasing due to scrub encroachment. Two species that are probably scarce in Lancashire appeared to have been lost from the site over the last few years. Mitigation measures in the form of active management have not yet been implemented due to access difficulties and it is likely that within five to ten years the value of the site will be lost.

Assessment of the appropriateness of the mitigation and of its success is handicapped by the absence of information on the quality and size of the woodland fragment affected by the widening works and on the subsequent landscape plantings. Nonetheless, the proposed mitigation appears to have been adequate and to have represented a pragmatic solution to the inevitable difficulties associated with the widening caused by the original motorway route alignment which cut across Boilton Wood. The need for vehicular access to Brockholes Meadow must have been apparent during negotiations and consequences of the failure to resolve this problem are likely to negate the value of the proposed mitigation as the grassland site degenerates in the absence of management.

## **3.10 Barrow Gravel pits**

### **3.10.1 Background**

Barrow Gravel Pits SSSI lies just to the east of Quorn, adjacent to the River Soar in Leicestershire. It covers an area of 36 ha. The SSSI was notified in 1981 as one of the best remaining complexes of open water, grassland, scrub and woodland in Leicestershire and possesses a rich flora and fauna representative of flood-plain habitats in the English Midlands (see Figure 16). The site is of particular interest for its varied aquatic invertebrate interest, several locally scarce plants and a varied breeding bird community.

Following confidential consultation on three possible route corridors, the Department of Transport carried out public consultation in 1984 on two possible routes for the A6 Quorn-Mountsorrel Bypass, one which passed to the west of Quorn and one which passed to the east. Both affected Sites of Special Scientific Interest, with the potential effect of the western route upon Buddon Wood and Swithland Reservoir SSSI of greater concern to the former Nature Conservancy Council than the effect of the eastern route upon Barrow Gravel Pits SSSI. Public opinion also favoured the eastern route and this was chosen.

During 1990/91, the A6 Quorn-Mountsorrel Bypass was constructed across the extreme north-eastern corner of the SSSI.

### **3.10.2 Mitigation**

In 1986, the Nature Conservancy Council (now English Nature) was consulted on the preliminary engineering drawings for the bypass. It noted that the alignment would destroy the northern extremity of the SSSI, including scrub habitat which provided nesting sites for birds, and requested reconsideration of the potential for horizontal realignment of the road to avoid the SSSI. Whether or not such realignment were possible, there was a need to ensure that polluting run-off from the road did not enter the waterbodies of the SSSI.

Following publication of the draft orders for the road in 1988, the Department of Transport agreed, with the Nature Conservancy Council, the following mitigation measures:

- 1 a 2m high earth mound would be constructed on the south side of the bypass embankment adjacent to the SSSI, to be landscaped with dense planting, to reduce run-off and spray reaching the SSSI;
- 2 a suitable method of keeping water in the new drainage channel (at the base of the embankment) separate from the gravel pits would be included within the design;
- 3 fencing would prevent incursion by contractors into the SSSI outside the zone of construction;
- 4 permanent timber post and rail fencing would be erected along the highway with careful and remote (closest 300m) siting of lay-bys to minimise unauthorised pedestrian access to the SSSI.

Furthermore, a firm commitment was given that surface water run-off from the proposed bypass would not outfall into the SSSI.

Due in part to access difficulties at the site, the Nature Conservancy Council was unable to provide detailed

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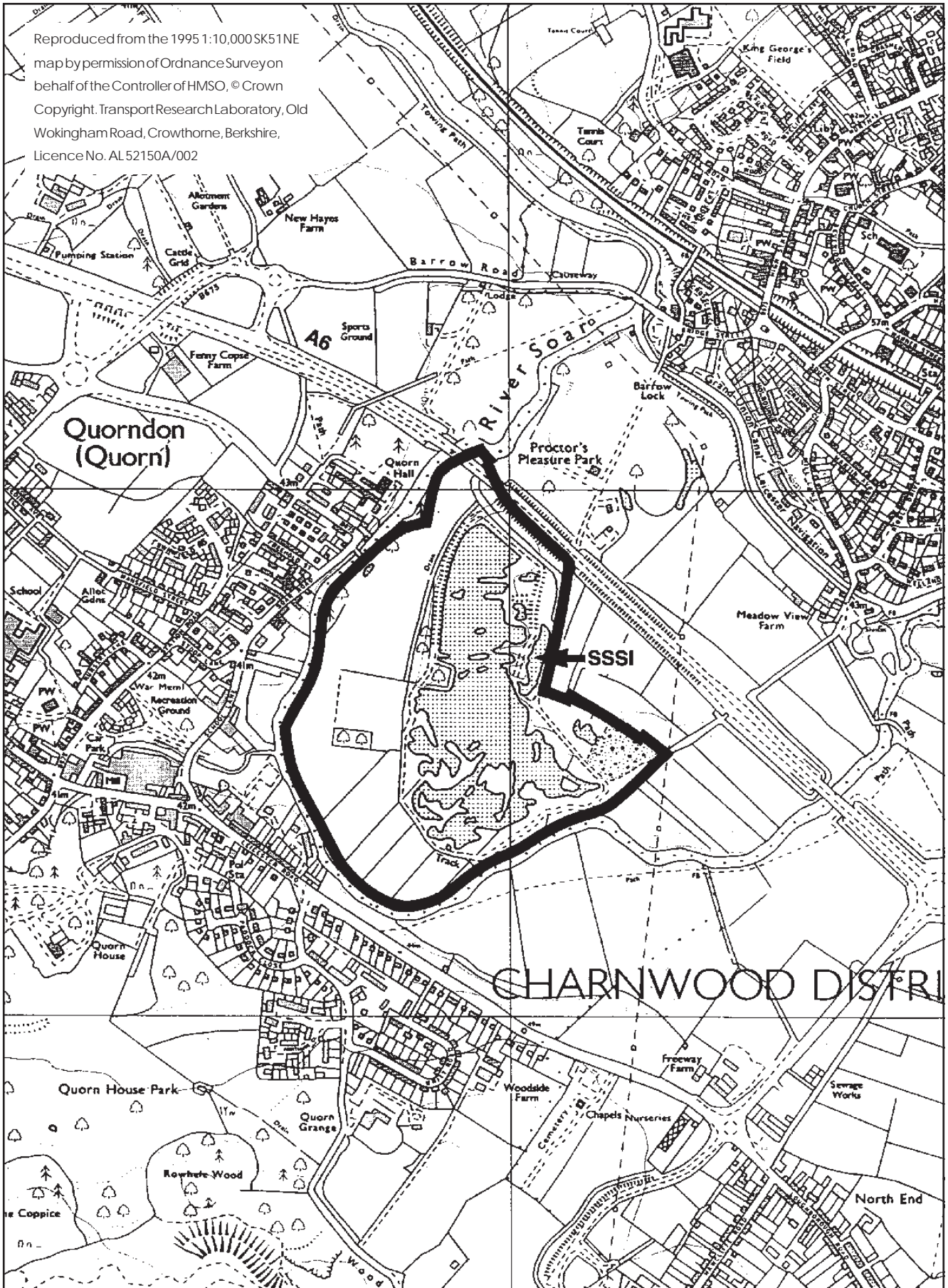


Figure 16 A6: Barrow Gravel Pits SSSI (pre road construction). Scale 1:10,000

information about the likely effects upon the SSSI of the loss of the north-eastern extremity of the site and in consequence only broad-scale mitigation was agreed with the Department of Transport.

During the public inquiry into the scheme in 1988, more detailed information about the ecology of the northern part of the SSSI was presented by a member of the public, resulting in further, more detailed mitigation being developed at a relatively late stage in the project planning. This member of the public submitted an objection into the route on landscape and ecological grounds, and concluded that although the major part of the SSSI lay outside the line of the proposed route, the affected area had a distinctive character. He outlined a number of features of particular note (identified by the letters A to G on Figure 17):

- A An earth bank along the track (a vegetated spoil heap from the gravel working) provided a regular breeding site for kingfishers and would be lost to the road.
- B Horsetail growing by the track which supported the locally notable flea beetle *Hippuriphila modeeri* would be lost. Meadow crane's-bill found in the grassland close to the horsetail and which would be lost to the road supported the locally notable weevil *Zacladus gerannii*.
- C A drainage channel, which would need to be infilled, was different from all other pools within the SSSI because it connected to the River Soar. Scarce aeshna dragonfly (*Aeshna mixta*), which had only recently started to breed in Leicestershire, had been observed on the channel and little grebe nested there.
- D The largest area of marsh in the SSSI and the only important area of *Typha angustifolia* (lesser bulrush) would be lost to the road construction. *T. angustifolia* marshes were uncommon in Leicestershire, where *T. latifolia* (bulrush) is the more usual species.
- E Adjacent to the *Typha* marsh and also affected by the route was an important area of *Salix viminalis* (osier), which supported breeding populations of turtle dove, reed warbler, sedge warbler and reed bunting.
- F Part of a shallow ditch which supported a rich community of spiders and beetles including the nationally notable water beetle *Anacaena bipustulata* would be destroyed.
- G Of three river backwaters shaded by willow carr, one would be lost to the road and another would be affected by construction. The backwaters supported an interesting beetle fauna including the nationally notable rove beetle *Carpelimus impressus* and the only Leicestershire locality of a ground beetle, *Agonum viduum*.

The Inspector directed that further consideration be given to mitigation designed to accommodate these features. Indeed, a meeting had already been set up between the member of the public, the Department of Transport, the Nature Conservancy Council, the project engineers, the landscape/ecology consultants and the landowner, to discuss appropriate mitigation measures. At this meeting, the degree of impact upon these features was confirmed and the potential for mitigation was discussed, as follows:

- A Alternative nest sites could be provided by the construction of a similar earth/clay bank approximately 2m high.
- B The flea beetle community might survive if the horsetail were translocated to another location within the SSSI. (No reference was made to the weevil and its meadow crane's-bill host.)
- C No mitigation was required because the drainage channel has been constructed recently (within the last 20 years) and so a similar invertebrate community was likely to colonise the new channel in due course.
- D Consideration could be given to re-creating the *Typha angustifolia* marsh elsewhere in the SSSI.
- E It should be possible to minimise effects upon the osier bed by careful construction practice.
- F It should be possible to minimise disruption to the shallow ditch by careful construction practice.
- G The river backwaters would not, in fact, be affected by construction.

Features D to F would be affected by a new drainage channel; consideration was to be given to its realignment in order to reduce impact upon these three features.

It is not clear whether the new drainage channel was realigned and/or whether *Typha* marsh was re-created. The horsetail was translocated and carefully managed, and a bank for kingfishers was created. Unfortunately, a contractor tipped spoil on the site of the horsetail translocation and all (or part) of the horsetail community was lost. It is not clear whether the translocation had been successful, that is, the horsetail was flourishing and the flea beetles had been found, prior to the loss. Use of the bank by kingfishers was not monitored.

### 3.10.3 Site surveys

Site surveys were conducted on 7 July 1997 (invertebrates) and 15 July 1997 (vegetation).

The invertebrate survey was undertaken at sites both close to the A6 and around the lake. Any species characteristic of saline or polluted habitats (that may be associated with road run-off) were specifically targeted. Insects were sampled using a sweep-net and additionally, a suction sample was randomly taken from each habitat on the site. The horsetail flea beetle *Hippuriphila modeeri* was identified during consultation as being of particular interest, due to its localised distribution. A small patch of water horsetail that might support the species was examined in detail (see section 2.9). In addition to these sampling techniques, sight and sound observations were made as the invertebrate surveyor progressed around the site.

A walkover botanical survey of the area of the SSSI in the vicinity of the A6 was undertaken (see Figure 18) and a detailed search was made for any species that might be indicative of increased salinity or hydrocarbon pollution. A grapnel was used to detect submerged macrophytes. The roadside planting was examined to assess its appropriateness and success.

In addition, a general site walkover survey was undertaken to assess the ecological mitigation works and current management practices.

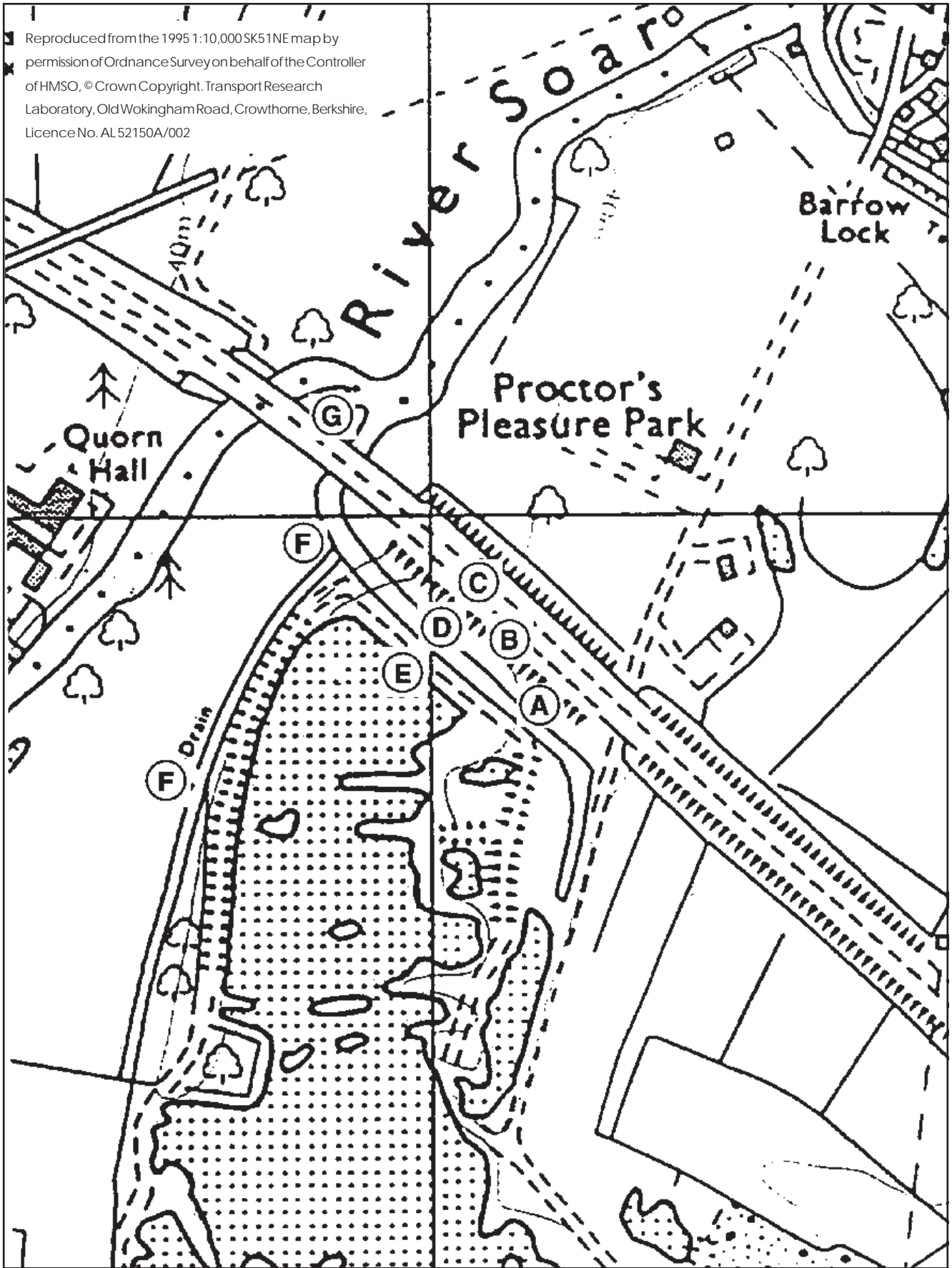


Figure 17 Features of ecological interest noted at Public Inquiry (Derek Lott, 1988) (see Section 3.10.2)

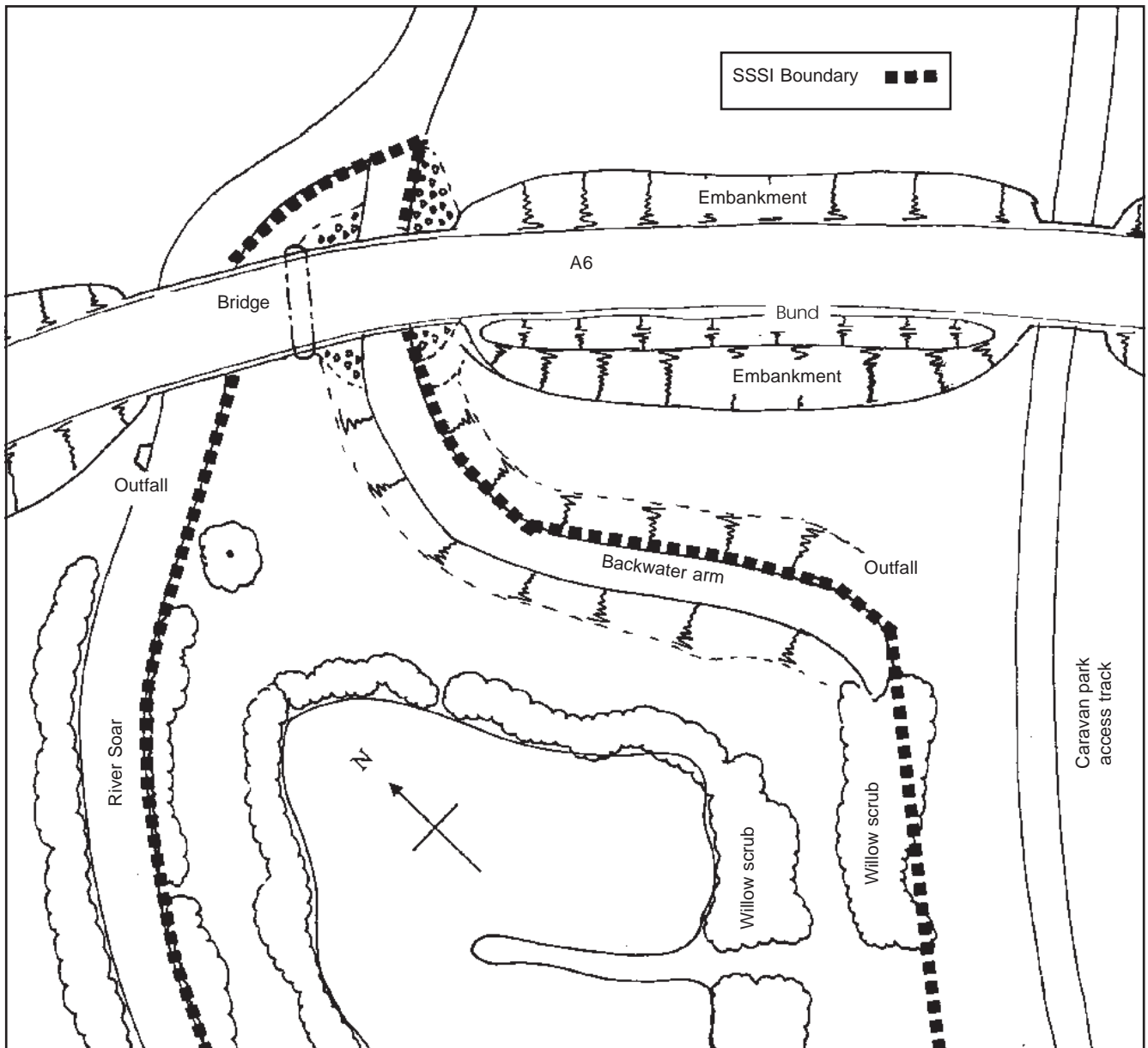


Figure 18 Sketch plan of A6 bund and other features, Barrow Gravel Pits

### 3.10.4 Survey results

#### a Invertebrates

A list of all the identified species from the site on the survey date is presented in Chinn et al, 1988. Despite prolonged sampling, the horsetail flea beetle *Hippuriphila modeeri* was not encountered. The absence of this flea beetle from an isolated small patch of horsetail does not of necessity indicate that it is no longer present on the site.

Some species were not widespread across the site but were found to be associated with the river and backwater and the gravel pit; these are identified separately in Chinn et al, 1988. Excluding widespread species, a total of 27 species were recorded around the lake margins and 57 species were recorded along the riparian margins. A total of 18 species were recorded in both zones. The greater number of species recorded along the riparian margins may reflect a greater diversity of habitats present. No element of the recorded fauna gave any indication of increased salinity or of any other pollutant. It has,

therefore, to be concluded that the presence of the new road has had no apparent effect on the invertebrate assemblages on the site and thus it appears that the bund has been effective in achieving its stated purpose.

#### b Plants

The new drainage channel (backwater) was isolated from the gravel pit to the west. The margins of the backwater supported a heterogeneous mix of aquatic species. The species are listed, together with an indication of their frequency in Chinn et al, 1998

No species that are indicative of increased salinity or hydrocarbon pollution were present in the adjacent backwater or the adjacent sections of the river. A survey of the gravel pit margins also produced no such species.

A survey of the A6 roadside verge within the bund and within 1m of the road edge revealed that several of the plant species within 1m of the road were typical of high levels of salinity (asterisked in Table 8).

**Table 8 Species recorded from roadside verge**

Species		Frequency
<i>Atriplex prostrata</i> *	spear-leaved orache	O
<i>Elytrigia repens</i>	common couch	LF
<i>Festuca rubra</i>	red fescue	LF
<i>Lepidium ruderales</i> *	narrow-leaved pepperwort	LF
<i>Polygonum aviculare</i>	knotgrass	LF
<i>Puccinellia distans</i> *	reflexed saltmarsh-grass	F

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally

All of the species asterisked are now common along trunk road and motorway margins where these are sprayed by salt in the winter. The fact that none of these species was detected away from the immediate road margin suggests that the bund is preventing salt spray from impacting more distant areas. The run-off is piped to the storm water outfall on the northern edge of the river where it is immediately diluted by the river to a concentration which does not produce observable changes in vegetation.

### c Tree planting

The bund was to have been planted with suitable natives to reinforce its value as a screen to the spray. Table 9 lists the species which have been planted and are still visible.

**Table 9 Tree and shrub species planting on bund**

Species		Frequency
<i>Crataegus monogyna</i>	hawthorn	F
<i>Fraxinus excelsior</i>	ash	O
<i>Prunus spinosa</i>	blackthorn	O
<i>Salix caprea</i>	goat willow	O

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally.

The planting used suitable native species. The planting density appeared to have been too low to guarantee the dense screen that was proposed. Tree guards were not used and thus it was not possible to assess the survival rates of the plantings. There were large gaps between the visible planting and the distribution of saplings was rather irregular: both of which suggest a low survival rate. The saplings struggled to compete with vigorous weedy growth including an abundance of *Lactuca serriola* (prickly lettuce), due to lack of management. The fence which was to have been erected to minimise the risk of casual entry into the SSSI from the road did not appear to have been constructed.

### d Other species

No riparian bird or mammal species were noted on the River Soar. The only species noted on the adjacent gravel pits were coot, moorhen, mallard and mute swan, all of which were confirmed to be breeding within the SSSI. The survey was undertaken too late in the summer for any assessment of the continued presence of a valued scrub breeding bird community to the north of the gravel pit. The bund itself supported no vegetation suitable for nesting

birds but seeding weedy species were likely to be suitable for foraging finches and buntings in the late summer and autumn. The main value of the bund to breeding birds will be in reducing traffic noise since high background road noise levels are thought to reduce breeding success (Foppen and Reijnen 1994a, 1994b, Reijnen et al. 1995, Reijnen and Foppen 1995). No evidence of kingfisher nesting sites was found; it was not possible to locate the mound which was created to replace that used by kingfishers prior to construction of the road.

### 3.10.5 Management

At the time of writing there was no management of the newly planted areas.

### 3.10.6 Summary

No invertebrate or plant species that are indicative of increased salinity or hydrocarbon pollution were present within the SSSI. This suggested that drainage from the road was not adversely affecting the water quality of the SSSI and that the combined bund and drainage system installed has been a success in this regard. Tree planting of the bund was sparse, suggesting some failures, although the species chosen were appropriate to the location. As the planting was intended to form a dense screen, restocking and management are required to maximise the value of the mitigation.

Turning to the more detailed mitigation agreed following the public inquiry, it was not possible to locate the translocated horsetail (if indeed any survived) or the new kingfisher nesting mound and so it has been impossible to comment upon the success of those measures. It is unclear whether the new drainage channel encroached upon the *Typha angustifolia* marsh and if so, whether this was re-created elsewhere on the site. Similarly, it is unclear whether the drainage channel encroached upon the osier bed and the shallow ditch with its rich assemblage of spiders. A further site visit, accompanied by the ecological consultant to the scheme, was planned to identify those mitigation measures not located during the original site visits. However, access to the site was denied by its owner.

## 3.11 Birkham Wood

### 3.11.1 Background

Birkham Wood is an ancient woodland on the bank of the River Nidd to the south of Knaresborough, North Yorkshire, designated as a SSSI in 1988 (see Figure 19). It covers an area of 28 hectares. The majority of the woodland within the SSSI lies upon acidic glacial drift, with the dominant tree species in the canopy being *Quercus robur* (pedunculate oak) and *Betula pubescens* (downy birch) and *B. pendula* (silver birch). *Sorbus aucuparia* (rowan) is frequent throughout. The ground flora is dominated by a mosaic of *Hyacinthoides non-scripta* (bluebell), *Pteridium aquilinum* (bracken) and patches of *Rubus fruticosus* (bramble). *Holcus mollis* (creeping soft-grass) is locally dominant whilst other species attain only very local prominence. Such species

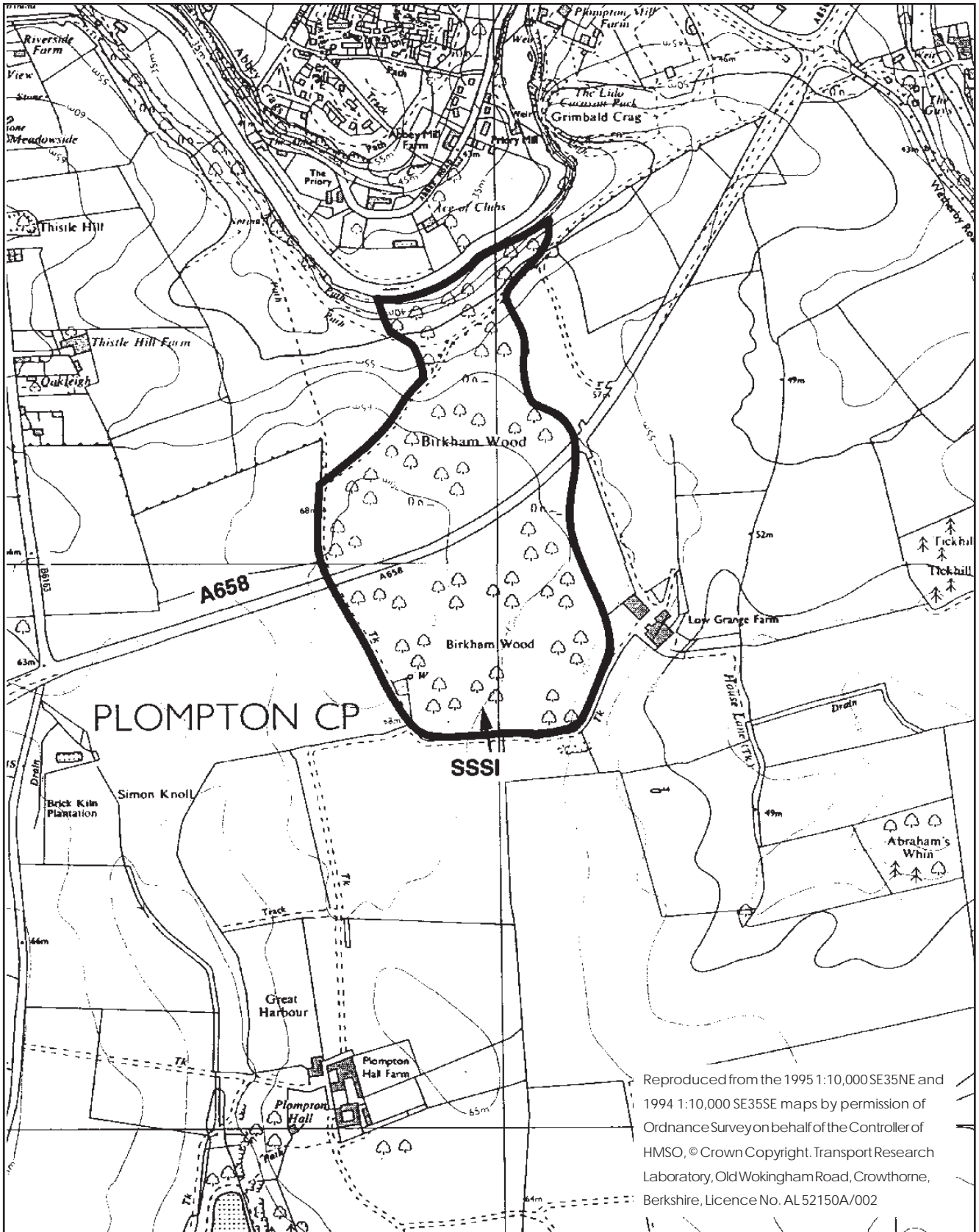


Figure 19 A658: Birkham Wood SSSI. Scale 1:10,000

associations are characteristic of W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland within the National Vegetation Classification.

To the north, where the superficial glacial drift deposits are not found, the influence of the underlying Magnesian limestone becomes stronger. In consequence, the wood contains a sharply defined ecotone from acid woodland to a base-rich woodland characterised by the dominance of *Fraxinus excelsior* (ash) in the canopy and the appearance of *Corylus avellana* (hazel) and *Acer campestre* (field maple) in the understorey. The ground flora is diverse and path sides are particularly species-rich. The ecotone itself, which contains an unusual mixture of acid-loving and base-loving species forming a rich mosaic, is of particular interest. The base-rich part of the wood (which lies well to the north of the road) is not considered further within this report. Prior to the construction of the new road, the wood supported a varied breeding bird fauna with 52 species recorded, giving it regional importance.

During 1991 and 1992, the A658 South Knaresborough bypass was constructed through the SSSI, running west-south-west to east-north-east and cutting the SSSI into two almost equal halves. Landtake to the SSSI was approximately 0.9ha, equivalent to 3% of the 28.2ha site.

### 3.11.2 Planning and mitigation

The South Knaresborough bypass was proposed by North Yorkshire County Council in 1981. Of five routes considered during the planning process in the late 1980s, three were routed through Birkham Wood. The Inspector's report of the 1989 Public Inquiry confirmed North Yorkshire County Council's preferred route, which was in ecological terms the most damaging, passing through the ecotone between the two woodland habitat types. Subsequent efforts by the former Nature Conservancy Council focused on working with North Yorkshire County Council's landscape consultants, to ensure that in fine-tuning the alignment of the road it took the least damaging route. To this end a number of surveys were undertaken to identify features of particular importance within the wider road corridor, including the sharp ecotone between the acidic and more base-rich woodland types, the locations of uncommon *Tilia cordata* (small-leaved lime) trees, the main east-west woodland ride and a poorly drained area colonised by *Sphagnum* moss.

The Proof of Evidence prepared by the landscape consultants for the 1989 Inquiry demonstrated a clear understanding of the likely effects of the road upon the nature conservation resource of Birkham Wood SSSI: landtake, including several old trees; severance of hedgerows; severance of animal pathways resulting in animal fatalities; edge effects to the woodland (windblow and changes in light and microclimate); disturbance to breeding birds and other animals during both the constructional and operational phases; interruption of groundwater flow; and pollution including salt spray and exhaust fumes. It also contained a detailed account of proposed mitigation, which is summarised in the following paragraphs.

### Alignment

The mapping of the extent of the ecotone zone by the former Nature Conservancy Council and others in October 1988 resulted in the movement of the road alignment to the south to avoid this valuable area of the wood (new road alignment plans dated December 1988). In moving the road to the south, intrusion into the base-rich woodland area, which contains most of the uncommon plant species found within the SSSI, was also avoided. In addition, the more southerly route was located along the watershed between the Rivers Nidd and Crimble. Compared with the more northerly original route, this had the advantage of avoiding the interruption of the woodland groundwater which had been identified as a potential problem with the original route. In addition, the vertical alignment of the road was refined to maximise the length which was at grade through the SSSI, in order to minimise landtake to the ancient woodland.

### Tree planting

New woodland planting (2.2 ha) immediately to the west of the SSSI was proposed to compensate for the loss of approximately 0.9ha of SSSI to the road. This was designed as a band of planting some 40m wide along the northern edge of the new road between the B6163 and Birkham Wood (see Figure 20). The nutrient-rich agricultural topsoil was to be removed from this area prior to the establishment of the new woodland. The trees and shrubs to be planted in this area were in the main to be established from seed and/or vegetative material taken from Birkham Wood, with particular reference to *Tilia cordata*. The mix of trees and shrubs to be planted was to reflect the presence within the area of both acidic and base-rich soils, mirroring Birkham Wood itself (see Appendix 12). Any dead wood found within the construction corridor through the SSSI was to be carried over to the new woodland planting area, aiding the introduction of invertebrates, fungi etc. Ongoing management was proposed, to ensure the development of maximum nature conservation interest in the maturing woodland.

New hedgerow planting adjacent to the road to the west of the SSSI was designed to link existing hedgelines severed by the road alignment. Again, only locally occurring native plant species were to be used.

### Treatment of verges within Birkham Wood

Within the SSSI, topsoil was to be carefully collected from the area of landtake and stored during construction of the road and then replaced along the new road verges. No seeding or planting was to take place, rather natural regeneration was to be allowed to encourage the natural development of woodland ride vegetation.

The idea of transplanting turfs from the proposed route was considered as an alternative to collecting topsoil from the route but was rejected, with the agreement of the former Nature Conservancy Council. To maximise the chances of success the turfs would have had to be re-located within the existing woodland rather than the proposed woodland (to ensure appropriate microclimate conditions) and this would have resulted in further destruction of the existing woodland flora.

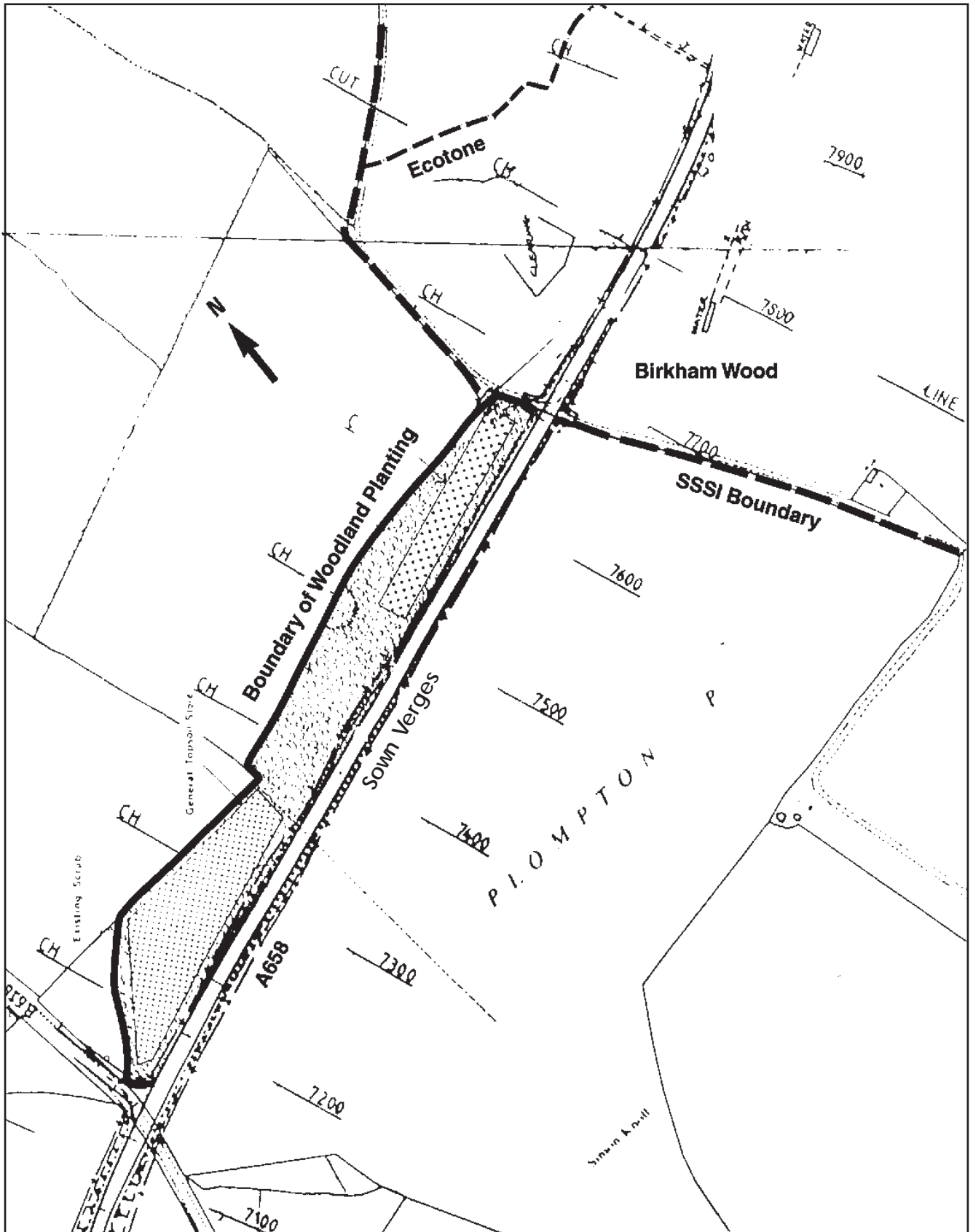


Figure 20 Mitigation Features, Birkham Wood. Scale 1:1,750

### *Treatment of verges within the new woodland planting*

Within the new woodland planting, the verges of the new road were to be seeded with an appropriate seeds mix (see Chinn et al,1998). Again, a defined management regime was to be followed, as described above.

### *Road drainage*

To prevent the contamination of the woodland soil by surface water runoff from the carriageway, the surface water was to be fed via trapped gulleys into sealed longitudinal carrier drains.

### **3.11.3 Existing information**

As part of the Environmental Assessment of the road scheme, a list of species found within the zone of SSSI landtake associated with the new road and including an additional 20m margin either side was made on 30 May 1989 (see Chinn et al,1988)

### **3.11.4 Site surveys**

The site survey was conducted on 22 April 1997. The vegetation of both the road corridor through the SSSI and of the new mitigation planting to the west of the SSSI was surveyed. Within the SSSI, 30 quadrats were surveyed to identify any changes in the woodland groundflora close to the road. Fifteen quadrats were located within the woodland edge vegetation adjacent to the road and 15 further from the road, in order to allow a comparison of the vegetation along the newly created edge with that within the woodland. A survey of the vegetation along the road verges through the SSSI was also undertaken to provide an indication of how much the stated aim of creating a characteristic woodland ride flora by natural succession had been achieved. To this end, the presence of any invasive weedy species and salt-tolerant species in particular was noted. Lastly, trees and shrubs along a transect through the acidic part of the SSSI woodland were recorded, to allow comparison with the trees and shrubs found within the mitigation planting outside the SSSI.

A detailed inspection of the mitigation planting to the west of the SSSI was undertaken. A series of short transects were used to assess the relative proportions of woody species within the planting. A survey of the vegetation along the road verges within the mitigation planting was carried out to allow comparison of the existing vegetation with the seeds mix used. Lastly, the large hedgerow established to the immediate west of the SSSI, along the southern boundary of the A658, was surveyed.

### **3.11.5 Survey results**

#### **a Vegetation**

#### *i Road verges within the SSSI*

Within the SSSI, the road verges were to be spread with carefully stripped and stored woodland topsoil. The aim was to create woodland ride vegetation. The survey showed road verges adjacent to the wood supported a mixture of coarse grasses and herbs, some of which were typical of the adjacent woodland areas (see Chinn et al 1998).

Apart from the immediate road margins, which were dominated by salt-tolerant species such as *Cochlearia danica* (Danish scurvy-grass) and *Atriplex prostrata* (haste-leaved orache), weedy annuals, which are characteristic of disturbed areas and not of woodland rides, were generally absent.

Comparison of this list with the lists of species recorded from the zone of landtake within the woodland (both woodland/ride and bridleway) indicated a move away from woodland ride vegetation to that of disturbed pastureland. For example, *Carex sylvatica* (wood sedge), *Dryopteris dilatata* (broad buckler-fern), *Poa nemoralis* (wood meadow-grass), *Allium ursinum* (ramsons), *Conopodium majus* (pignut), *Mercurialis perennis* (dog's-mercury) and *Viola riviniana* (common violet) were absent, whereas *Juncus spp.* (rushes) species, *Cerastium fontanum* (common mouse-ear), *Cirsium palustre* (marsh thistle), *Dactylis glomerata* (cock's-foot), *Festuca rubra* (red fescue), *Plantago lanceolata* (ribwort plantain), *Rumex spp.* (docks) and *Taraxacum officinale* (dandelion) were present. There is no evidence that the monitoring of vegetation which was proposed at the time of the Public Inquiry had taken place (English Nature, pers. comm.) and so it is difficult to assess whether the vegetation was moving away from that of disturbed grassland towards woodland ride vegetation as it became more established. This is, perhaps, likely to be the case. The continuing presence of many of woodland ride species, such as *Stachys sylvatica* (hedge woundwort), *Luzula sylvatica* (great wood-rush) and *Hyacinthoides non-scripta* (bluebell) was clear indication of the partial success of the soil translocation.

#### *ii Roadside woodland within the SSSI*

The woodland canopy on both sides of the road was dominated by *Quercus robur* (pedunculate oak) and *Betula sp* (birch) with frequent saplings of *Sorbus aucuparia* (rowan) reaching in the subcanopy. The understorey was typically rather open with frequent *Corylus avellana* (hazel). *Prunus avium* (wild cherry) was occasional whilst there were several mature *Tilia cordata* (small-leaved lime) on the northern side of the road.

Full details of the 30 ground flora quadrats recorded are presented in Chinn et al, 1998. There appeared to be no obvious differences between the ground flora of the acidic woodland areas close to the road and those areas more remote from it. The most prominent species, which all attained local dominance, were *Pteridium aquilinum* (bracken), *Holcus mollis* (creeping soft-grass), *Hyacinthoides non-scriptus* (bluebell) and *Rubus fruticosus* agg. (bramble). The late summer dominance of *Pteridium aquilinum* would certainly have been underestimated during the visit. *Lonicera periclymum* (honeysuckle) and *Dryopteris dilatata* (broad buckler-fern) were both locally frequent but other herbs were few and the ground flora could be regarded as being rather species poor at least in terms of vascular plants.

Analysis of the quadrat data confirmed that there was no significant influence of distance from the road upon the vegetation recorded. Thus, the quadrats taken at 5m from

the road are not distinct from those taken 25m away. Indeed, the difference between the quadrats taken from the north side of the road and those taken from the south side of the road was more marked than any effect of distance from the road. This is probably related to changes in the underlying geology and thus the edaphic conditions.

The quadrats fell into two broad groups: those with *Acer pseudoplatanus* and *Hyacinthoides non-scripta* and those with more *Sorbus aucuparia*. The former grouping may be subdivided into those quadrats with more *Betula pubescens* and those with *Sorbus aucuparia* and more *Corylus avellana*. The differences between the three groupings are slight: the full data set and each of the three separate vegetation types all show similarities to NVC subcommunity type W10c *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland *Hedera helix* subcommunity, a common woodland type.

### iii Mitigation planting (west of wood)

The mitigation planting on the land to the west of the wood has been undertaken although it was not possible to discern any zoning between the alkaline and the acidic planting mixes. The ground appeared to have been prepared before the saplings were planted by the removal of topsoil. A series of transects were taken through the planting area to help to determine the ratios within the plantings. Results are given in Chinn et al, 1998.

The planting mix included species characteristic of both acidic and basic soils (to reflect the varying nature of the substrate of the planted area) and so was not truly representative of the exclusively acid woodland lost due to the construction of the bypass. To assess the relative frequency of the woody species within the SSSI, a 10m wide transect was surveyed through the northern side of the wood (acidic area). The counts refer to individual trees (or saplings) reaching a height of at least 2m and whilst this does not provide a definitive way of assessing biomass of each species within the wood, it does provide an estimate of the relative frequency (see Table 10).

Thus, a comparison may be made between the mitigation planting and the area of SSSI woodland lost as represented by the area of SSSI woodland to the immediate north of the road (Table 11).

The transect data for the area of SSSI woodland lost to the road showed the approximate mix of woody species within the acidic woodland just to the north of the new

**Table 10 Trees and shrubs: relative frequency within SSSI**

Species	Transect count	%
<i>Acer pseudoplatanus</i>	4	2
<i>Betula spp</i>	83	38
<i>Corylus avellana</i>	58	26
<i>Crataegus monogyna</i>	2	1
<i>Ilex aquifolium</i>	1	0.5
<i>Prunus avium</i>	10	5
<i>Quercus robur</i>	38	17
<i>Salix cinerea</i>	1	0.5
<i>Sorbus aucuparia</i>	22	10
Total	219	100

**Table 11 Trees and shrubs: presence within mitigation planting versus presence within SSSI**

Species	Presence within mitigation planting (%)	Included within proposed mitigation planting mix	Presence within SSSI (%)
<i>Acer campestre</i>	8	Yes	0
<i>Acer pseudoplatanus</i>	0	No	2
<i>Betul spp</i>	13	Yes	38
<i>Cornus sanguinea</i>	0	Yes	0
<i>Corylus avellana</i>	18	Yes	26
<i>Crataegus monogyna</i>	20	Yes	1
<i>Euonymus europaeus</i>	0	Yes	0
<i>Fraxinus excelsior</i>	2	Yes	0
<i>Prunus avium</i>	4	Yes	5
<i>Prunus Spinosa</i>	3	Yes	0
<i>Quercus robur</i>	10	Yes	17
<i>Rosa arvensis</i>	0	Yes	0
<i>Rosa canina</i>	5	Yes	0
<i>Sambucus nigra</i>	0	Yes	0
<i>Sorbus aucuparia</i>	15	Yes	10
<i>Tilia sp</i>	0	Yes	0
<i>Viburnum opulus</i>	1	Yes	0

road. The northern edge of Birkham Wood supported woodland typical of basic soils and these included many of the species that were recorded in the planting transect, and in the overall context of Birkham Wood the species present in the planting can thus be generally regarded as appropriate. There was however a minor exception in that several planted specimens of *Salix viminalis* (osier) were located within the planting (outside the transect). Although this species is a common native in the district, the species did not appear to be present within Birkham Wood itself. It was not possible to establish whether or not the planting consisted of woody material propagated from trees and shrubs within Birkham Wood, as proposed.

The survival rate of the planting (calculated from the transect data) was approximately 90%. The saplings were all staked and guarded and although weed mats had not been used, the problem of vigorous weedy growth was avoided by stripping the original topsoil. There were a few saplings which had been blown over but these constituted less than 1% of the total planting. There appeared to be no ongoing management but most of the saplings had reached the stage that even a dramatic upsurge in coarse grasses within the planting compartment would be unlikely to reduce the survival rate significantly. Although there was little evidence of any woodland herbs seeding in, the mitigation planting can, thus far, be regarded as a success. Once a canopy is established, it is anticipated that woodland herbs will begin to appear.

### iv Road verges within the mitigation planting

After construction the verges of the new road west of the wood were sown with a wildflower mix. During the present survey both verges were surveyed to confirm the continued presence of the sown species and also to note an invasion by weedy species and rank grasses. Table 12 details those species listed in the wildflower mix and their observed frequency during the survey.

**Table 12 Survival of sown species within the verge mitigation planting, Birkham Wood**

Herbs		1997 survey
<i>Ajuga reptans</i>	bugle	not recorded
<i>Conopodium majus</i>	pignut	not recorded
<i>Digitalis purpurea</i>	foxglove	not recorded
<i>Filipendula ulmaria</i>	meadowsweet	not recorded
<i>Galeobdolon luteum</i>	yellow archangel	not recorded
<i>Geranium robertianum</i>	herb robert	not recorded
<i>Hyacinthoides non-scriptus</i>	bluebell	not recorded
<i>Lysimachia nemorum</i>	yellow pimpernel	not recorded
<i>Primula veris</i>	cowslip	LF
<i>Primula vulgaris</i>	primrose	not recorded
<i>Stellaria holostea</i>	great stitchwort	S

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally.

Other species were recorded on the sown verges but were not contained within the wildflower mix (Table 13).

Given the apparently low establishment of species included within the seed mix and the significant invasion of *Cirsium arvense* (creeping thistle) into the verges, the mitigation seeding of the road verges must be regarded as a failure.

**Table 13 Presence of new species within the verge mitigation planting, Birkham Wood**

Herbs and grasses		1997 survey
<i>Centaurea nigra</i>	black knapweed	S
<i>Cirsium arvense</i>	creeping thistle	LD
<i>Cynosurus cristatus</i>	crested dogstail	LF
<i>Festuca rubra</i>	red fescue	LD
<i>Rumex obtusifolius</i>	broad-leaved dock	S

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally.

#### v Hedgerow west of Birkham Wood

A hedgerow feature was established along the southern edge of the road west of Birkham Wood opposite the mitigation woodland planting on the north side of the road. The hedge was dense with *Crataegus monogyna* (hawthorn) typically dominant and both *Acer campestre* (field maple) and *Corylus avellana* (hazel) occasional. The hedge should be regarded as a success in terms of both establishment and species suitability. By connecting with the SSSI woodland and hedgerows to the west, the value of the hedgerow and the overall pattern of hedges and woodland, had been enhanced.

#### b Other observations

The only bird species of interest recorded during the site visit were single blackcap and great spotted woodpecker in the northern part of the wood. Information available about breeding bird usage prior to road construction is limited and so it was decided that it was not appropriate to assess the current value of the wood to breeding birds. There is, as yet, little value in the planted stand of saplings to breeding or foraging birds but in the long-term this area is likely to form a valuable extension to the remaining block of woodland to the north of the road. However, studies in

the Netherlands have demonstrated that road noise can lead to reduced breeding success in willow warblers (Foppen and Reijnen 1994a, 1994b, Reijnen et al. 1995, Reijnen and Foppen 1995). This is also likely to be the case for other species in particular small, highly territorial passerine species. The potential future value of the planted area to breeding birds therefore needs to be seen in the context of possible reduction in the breeding success of some species close to the road.

A number of presumed badger paths were found in the northern part of the wood, away from the road. The environmental assessment of the road scheme found no evidence of badgers in the vicinity of the road corridor.

#### 3.11.6 Management

At the time of the Public Inquiry it was proposed that a corridor 1.5m wide along the verges within Birkham Wood was to be cut annually in late August/early September to 100mm; the remainder of the verge was to be cut in alternate years to 200mm. In this way, scrub encroachment would be prevented and a typical ride vegetation type would be maintained. Monitoring of the vegetation was to be undertaken to ensure the development of an appropriate plant cover.

Responsibility for the maintenance of the road verges within the SSSI (and also the mitigation planting and adjacent verges) passed to North Yorkshire County Council at the end of the road works landscaping contract in April/May 1997. At the time of writing the form of the future maintenance of these areas had yet to be decided and will partly depend on whether they are included in the Council's general roadside grass maintenance works, or given special status because of their relation to the SSSI. In the latter case they would be included in a separate landscaping programme. In either case, overall budget constraints will affect the type and frequency of cutting that can be carried out, and it has been indicated that in the case of the road verges within the SSSI the cutting of the complete verge to 200mm in alternate years would not be possible.

#### 3.11.7 Summary

The new woodland edges adjacent to the new road were surveyed and compared to areas further back from the road. No significant differences in percentage cover between the new edge ground flora and the woodland interior were found for any of the species surveyed. Similar results were obtained by comparing the plant communities close to the road with those further away. Thus in the short term, no effects from edge effects or run-off were identified.

The tree planting mitigation may, thus far, be regarded as a success with a survival rate of about 90% and the appropriate use of species that occur in the wood. Further studies would be needed to assess the long-term success of the woodland planting, particularly with regard to the colonisation of the site by ground flora species. The hedgerow which was established on the southern side of the road had also fulfilled its objectives.

Where woodland soils were spread along the verge of the new road within the SSSI and natural regeneration allowed to take place in order to establish a natural ride

vegetation, the plant community that has developed, whilst it had some characteristics of damp pastureland, also included a number of woodland ride species and may be regarded as a partial success. There was no evidence that the vegetation monitoring proposed at the time of the 1989 Public Inquiry had taken place.

The seeding of the road verges through the area of woodland planting to the west of the SSSI had not been so successful, with few species persisting.

Overall, the mitigation appeared to have been implemented successfully, with the exception of the establishment of appropriate vegetation on the road verges through the mitigation planting to the west of the SSSI. The continuing success of the mitigation is less certain, since the management and monitoring of the planted woodland and the woodland ride vegetation of the SSSI road verges, which was proposed as part of the mitigation measures, did not appear to have been implemented.

Whilst the mitigation measures were carefully designed and, apparently, meticulously implemented, it was difficult to assess whether the mitigation was adequate to negate the impact of the road. The fragmentation of ancient woodland is generally and somewhat anecdotally considered to have a serious effect upon populations of woodland animals (and perhaps, to a lesser extent, plants). No experimental monitoring was undertaken at this site to identify the general effects of fragmentation upon the woodland populations and so, ultimately, the success of the mitigation in these respects cannot be evaluated.

### **3.12 Woolston Eyes**

#### **3.12.1 Background**

Woolston Eyes SSSI lies to the east of Warrington on the River Mersey in Cheshire (see Figure 21). It covers an area of 260 ha and consists of four large silt lagoons used to deposit dredgings from the adjacent Manchester Ship Canal. In 1985 the site was designated as a SSSI for its nationally important wintering wildfowl totals. The species of particular importance at the time of designation included teal (2.1% of the Great Britain wintering population), pintail (1.5%), shoveler (4%) and pochard (1.5%). The site also supports a large and diverse breeding bird community, including large numbers of breeding warblers.

The area has been crossed for many years by the M6 viaduct. The second Thelwall crossing was built across the SSSI just to the west of the original viaduct from 1994-1995 as part of the M6 widening programme. According to the Woolston Eyes Conservation Group, the value to wintering birds of those areas of the SSSI close to the M6 was already in marked decline before the construction of the new viaduct, undoubtedly largely as a result of the drying of the silt beds and willow encroachment.

#### **3.12.2 Mitigation**

The Environmental Statement prepared by the Department of Transport for the M6 motorway widening between junctions 20 and 21A predicts only one impact to the SSSI: 'some disruption during construction'; the predicted effect is given as 'slight'. Indeed, given that the M6 had crossed

the SSSI on viaduct for many years and that disturbance to birds could be anticipated from the ongoing dredging operations, it was likely that additional disturbance to birds during the operational phase of the road would be minimal and that disturbance during construction would be slight. No wetland areas suitable for important wildfowl species were subject to landtake.

No mitigation was proposed to reduce disturbance to birds during construction. Rather, the Environmental Statement focused upon the scope for landscape planting and noted that, with regard to mitigating any effects to the SSSI:

'Planting is considered impractical in this area due to both the continuing use of the Eyes as a dredging deposit ground and because of the potential problem of interfering with the ecology of the Eyes. Planting would be contrary to the requirements of the Nature Conservancy Council with respect to the management of the Site of Special Scientific Interest. ... The northern bund of the Eyes, next to the River Mersey is already well colonised with maturing tree species and provides an attractive local horizon. Substantial belts of planting are proposed to the north and south viaduct approach embankments to help integrate the motorway into the surrounding landscape.'

In the summary statements with regard to the scheme as a whole, the Environmental Statement included the following: 'The scheme provides a valuable opportunity to provide extensive new planting to link with and reinforce existing hedgerows, woods and planted areas to improve the quality of the existing landscape and increase the range and diversity of wildlife habitats'.

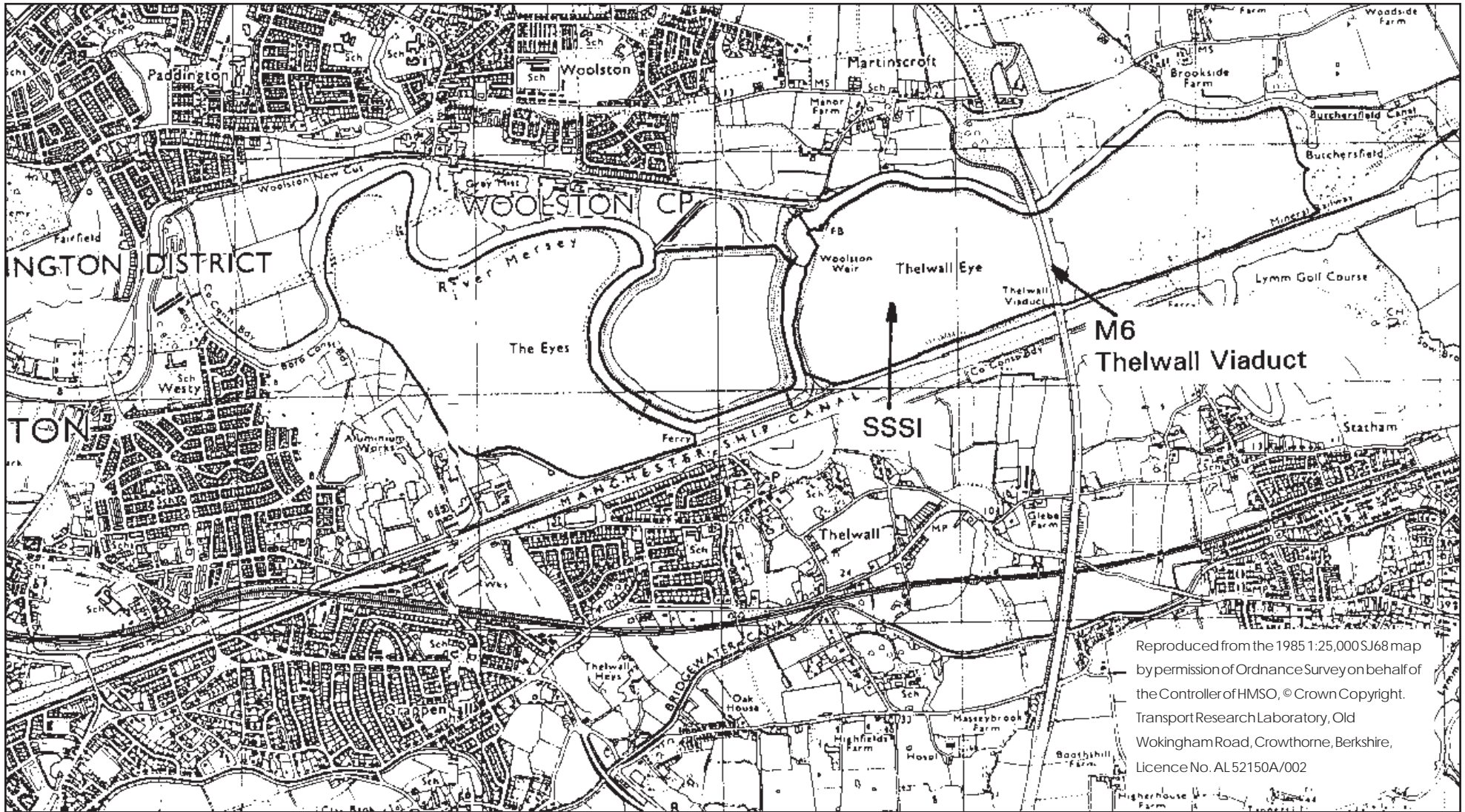
#### **3.12.3 Existing information**

Population trends for the SSSI as a whole of wintering wildfowl and of breeding warblers were available from the Woolston Eyes Conservation Group Annual Reports. These were analyzed by SWRC for the years 1992 to 1996 (Woolston Eyes Conservation Group 1992, 1993, 1994, 1995 and 1996). The new viaduct was built during 1994 and 1995 and so any disturbance effects during construction should be revealed by the counts for 1992 to 1996.

#### **3.12.4 Site surveys**

As it was clear that the remaining concentrations of wintering wildfowl were remote from the viaduct because of habitat loss due to willow encroachment and the drying up of those lagoons closest to the viaduct, it was decided not to undertake a survey of wintering birds. Survey effort (SWRC) was instead directed towards a breeding bird survey as at least some of the site value lies in its breeding bird assemblage. Surveys were conducted on 29 April and 13 May, 1997.

The breeding bird survey focused upon that part of the site close to the new viaduct, since other data were available to provide some context and a coordinated count of the whole of the SSSI divided into zones parallel to the new viaduct would have required resources beyond those available for this study.



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Figure 21 M6: Woolston Eyes SSSI and Thelwall Viaduct. Scale 1:25,000

The site was visited twice in the early morning to map the distribution of territorial birds in the spring within 250m of the new crossing on the western side (see Figure 22). A 250m wide survey band was chosen as beyond this distance, any disturbance effects are likely to be diluted. The survey was restricted to the western side of the new viaduct as to the east any disturbance effects are likely to be primarily related to the old viaduct.

The locations of singing adults of each species were recorded on field maps. The records from the two visits were then compiled and the experience of the surveyor used to identify territory boundaries. The maximum number of territories for each species within this zone was then used for the comparison with data for the SSSI as a whole. Two visits were made in order to pick up different seasonable periods of song activity for different species.

Although all birds were recorded, comparative data were available for the warbler species only (for which this site is important). An attempt was made to relate the numbers of breeding warbler species recorded within the potential disturbance zone of the new viaduct to the numbers within the SSSI as a whole, in order to make a basic assessment of the degree of operational disturbance.

In addition the area was examined for evidence of landscape plantings.

### 3.12.5 Results

#### a Birds

##### *i Wintering wildfowl data*

Maximum counts for the SSSI for each of the winters 1992 to 1996 (counted as September to April) for each of the important species is given in Table 14.

**Table 14 Wintering wildfowl at Woolston Eyes SSSI: maximum counts**

Species	Early 92	92/93	93/94	94/95	95/96	Late 96
Gadwall	22	31	23	40	44	37
Teal	2500	2100	1500	2500	1150	850
Pintail	280	110	83	67	52	27
Shoveler	55	68	64	150	187	180
Pochard	83	472	349	548	720	165
Tufted Duck	140	197	128	224	436	306

Source: Woolston Eyes Conservation Group Annual Reports

The trends are illustrated in Figures 23 and 24. As suggested by consultees, there were no declines which can be obviously attributed to the second crossing.

Fluctuations in some species (pochard) and general declines in others (teal, pintail) resulted from other rapid changes in the value of the wetland habitats for individual species. Pochard suffered badly from the drainage of No. 3 bed; the species had virtually deserted Woolston by 1992 (both wintering and important breeding populations). Indeed at the end of 1992, the maximum count was only two birds. The population has recovered in more recent years but totals remain unpredictable and the birds rather erratic in appearance and site fidelity.

##### *ii Breeding warbler data*

Table 15 presents the maximum recorded number of territories of each species of warbler on the site, typically determined by an annual coordinated count in mid-May. A coordinated count involves the use of a suitable number of observers (likely to be five to ten for a site of this size), who count sections of the site at the same time on the same date. If the same effort is used on a year-to-year basis and if the survey coincides with the peak period of activity for the target species, the data can be used to analyze trends in breeding numbers. It should be noted that the apparent decline in the number of reed warblers is unlikely to be real, since the majority of reed warblers arrive at the site after the coordinated count. Indeed, in 1992 and 1993, second later counts were undertaken specifically for this species. The trends are summarised in Figure 25.

**Table 15 Warblers at Woolston Eyes SSSI: Maximum number of territories**

Species	Year 92	93	94	95	96	5 year mean
Grasshopper warbler	8	3	9	9	11	8
Sedge warbler	120	167	185	240	217	186
Reed warbler	25	50	14	9	9	21
Lesser whitethroat	1	2	4	2	2	2
Whitethroat	79	28	24	30	30	28
Blackcap	28	28	24	30	30	28
Willow warbler	45	34	78	94	90	68

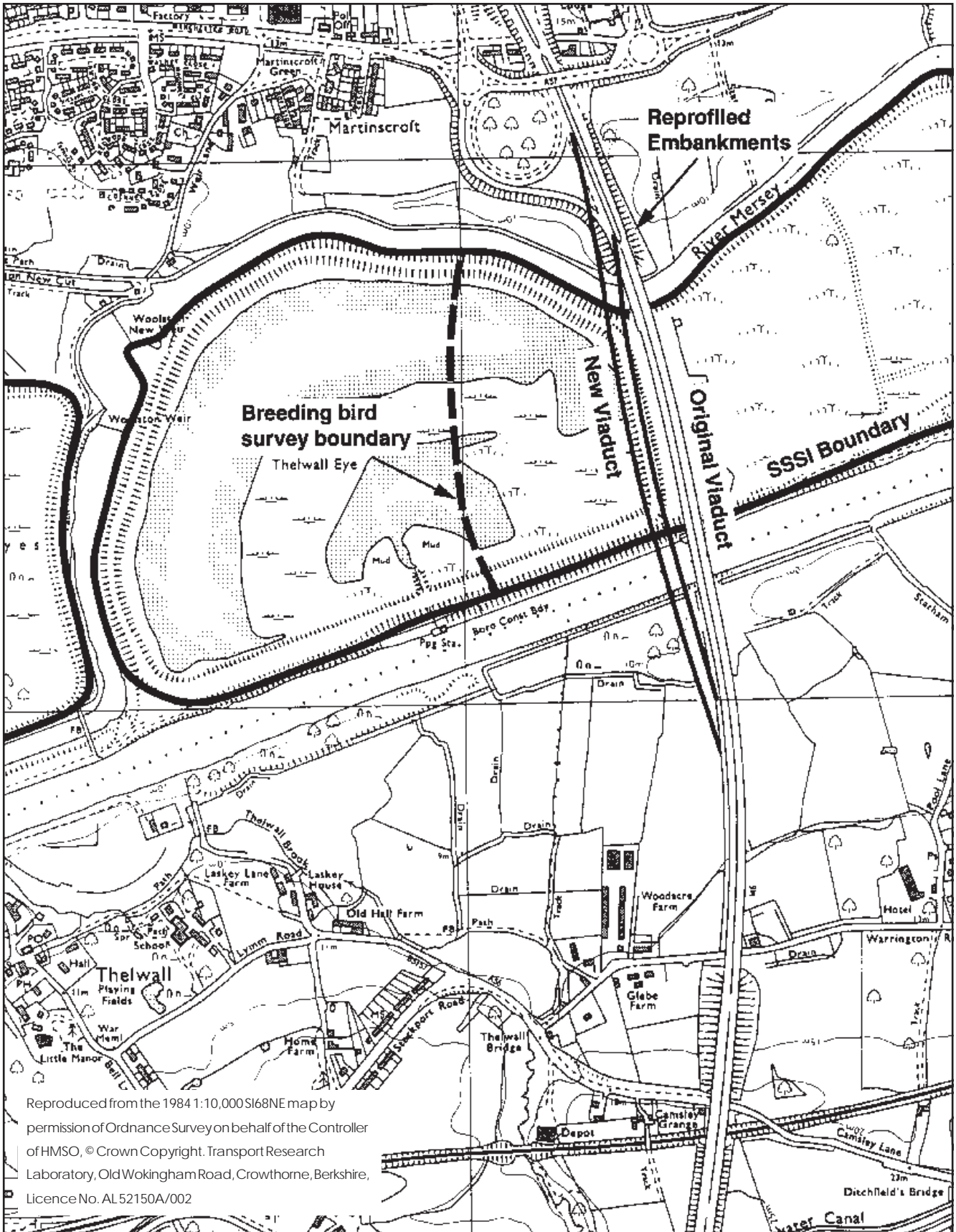
Source: Woolston Eyes Conservation Group Annual Reports

The effect of the construction of the second crossing cannot be picked up against the background changes in breeding bird populations at the site. Indeed populations of most of the warbler species at the site increased throughout the period of construction, reflecting national trends.

##### *iii Results of the territory mapping*

The results of the two site visits are given in Table 16. Species recorded within 250m of the new crossing (west side only) are given. Context to these observations is provided by analyzing breeding bird data for the whole SSSI. In the context of the totals presented above, the totals recorded within the survey area were low. The survey area covered some 5-10% of the SSSI and if the habitats were broadly similar across the site, a similar proportion of the overall totals for each species might be expected for the survey area. Since no full count data are available for 1997, a five year mean has been used for the comparison (Table 17).

For most species for which a comparison was possible, there appeared to be a significant difference between the observed and the expected numbers of pairs. These results suggested that there were lower densities of breeding species close to the M6. It is however possible that differences are entirely stochastic, due to variations in habitat quality over the site or due to year on year variations. To establish with certainty a relationship between territory density and proximity to the M6 would require repeated and more extensive surveys. More importantly, any additional



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Figure 22 Second viaduct and survey boundary, Woolston Eyes. Scale 1:10,000

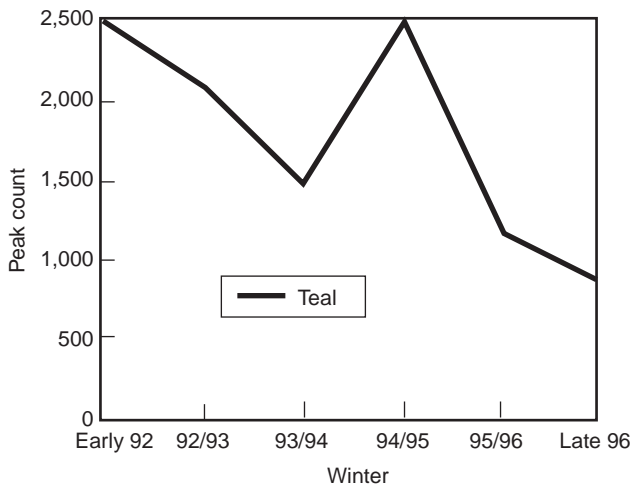


Figure 23 Peak winter counts for Teal, Woolston Eyes

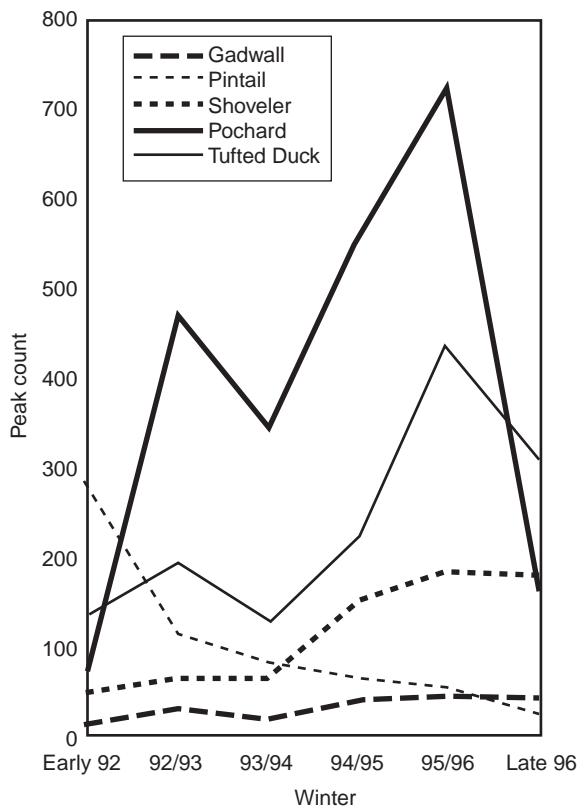


Figure 24 Peak winter counts for wildfowl, Wooston Eyes

Table 16 Results of SWRC breeding bird survey 1997, Woolston Eyes

	29 April 1997	13 May 1997
Mute swan	1 pr	
Grasshopper warbler	1	
Sedge warbler		1
Reed warbler		1
Blackcap	1	1
Lesser whitethroat		1
Whitethroat		2
Willow warbler	1	
Blackbird	1	

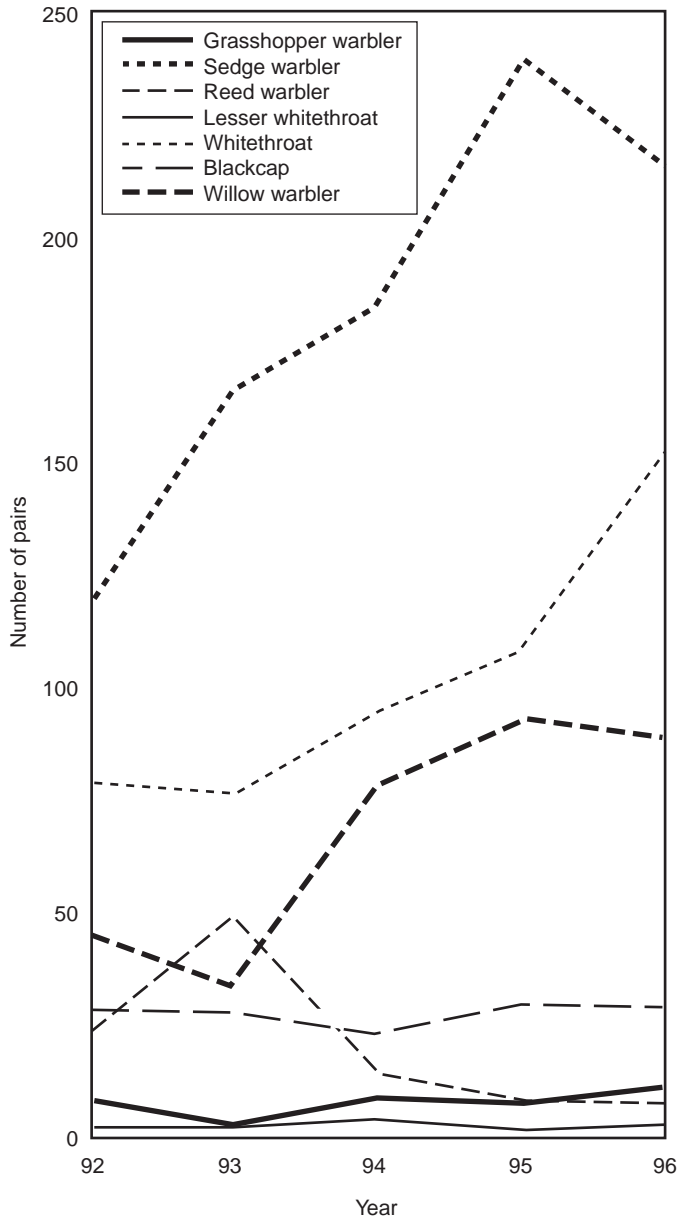


Figure 25 Warbler population, Woolston Eyes

Table 17 Warblers at Woolston Eyes SSSI: Comparison of number of territories expected and observed within survey corridor

	Five year mean	5-10% range expected	Observed
Grasshopper warbler	8	0-13	1
Sedge warbler	186	9-19	1
Reed warbler	21	1-2	1
Lesser whitethroat	2	-	1
Whitethroat	102	5-10	2
Blackcap	28	1-3	-
Willow warbler	68	3-7	1

Source: Woolston Eyes Conservation Group Annual Reports (for expected data)

negative impact as a result of the second crossing cannot now be isolated from the overall operational impact of the M6 from such an approach.

## **b Landscape planting**

The Environmental Statement for the second viaduct stressed the valuable opportunity to provide extensive new plantings. In the area currently managed by Cheshire County Council, landscape plantings in disturbed areas and any additional planting were planned to be completed by the end of March 1998. The planting will use a mix of predominantly shrub species (*Crataegus monogyna* and *Rosa rugosa*) with 30 percent tree species (*Quercus*, *Fraxinus excelsior*, *Betula*). Areas managed by Warrington Borough Council will use different mixes of tree and shrub species including *Acer campestre*, *Betulus pendula*, *Sorbus Aucuparia*, *Corylus avellana*, *Crataegus monogyna*, *Ilex aquifolia*, *Ligustrum vulgare* and *Pinus sylvestris*.

### **3.12.6 Management**

Management is the responsibility of Cheshire County Council and Warrington Borough Council (see above). However, at the time of the surveys there were no signs of any management for nature conservation close to the viaduct. No plans for management were mentioned in the documentation associated with the scheme.

### **3.12.7 Summary**

Broad successional changes unrelated to the construction of the second M6 crossing have led to a decrease in the extent and quality of habitat for important waterfowl and corresponding decreases in wintering totals. No landtake of important wintering habitats occurred. Natural population fluctuations (including some dramatic increases) have obscured any impacts of the second crossing on breeding birds although no significant impacts were predicted to have occurred.

Proposed landscape planting in the immediate vicinity of the viaduct, which may have provided secondary ecological benefits, had not been undertaken at the time of the survey.

All available evidence suggested that there have been no changes in the value of the SSSI which may be attributed to the effects of the construction of the new viaduct. Thus, the decision that no ecological mitigation was required, as no significant ecological effects were anticipated, appears to have been justified.

## **3.13 Aston Rowant**

### **3.13.1 Background**

The Aston Rowant NNR and SSSI, designated in 1973, is one of the largest surviving complexes of beech woodland, mixed scrub, juniper and chalk grassland habitats in the Chilterns, covering an area of 130 ha (see Figure 26). The woodland areas are dominated by beech with a wide variety of less frequent woody associates and a number of uncommon groundflora species typical of the Chilterns. The grassland areas support closely grazed species-rich chalk communities. A large number of local plant and

invertebrate species are associated both with these chalky areas and also with scattered junipers around the site.

The importance of the area was recognised extremely early in the history of nature conservation: Aston Rowant NNR was proposed as a National Nature Reserve in 1943 in the British Ecological Society memorandum on 'national habitat reserves and scheduled areas'. The area proposed as a NNR covered some 560 acres; of this, 212 acres were included in the reserve at the time of the construction of the M40.

In the 1960s, plans were drawn up to construct a dual-carriageway road from London to Oxford, to alleviate traffic congestion on the A40. The Nature Conservancy (the forerunner of English Nature) was in discussion with the Ministry of Transport from 1962 regarding means of crossing the Aston Rowant NNR. A number of horizontal and vertical route alignments were considered during the 1960s. In 1967, after studying detailed plans, the Nature Conservancy concluded that an open cutting was less damaging than a tunnel alignment which it had previously supported. The Public Inquiry into the scheme, held in April 1969, considered two surface routes: the Ministry's draft scheme and an alternative alignment (the so-called, Arup-Jellicoe route) developed by opposition groups (including the Berks, Bucks and Oxon Naturalists' Trust). At the time of the Inquiry, the Nature Conservancy had not had adequate time to consider the relative merits of the Arup-Jellicoe route, which ran north of the A40 over the lower escarpment near Chinnor; it subsequently judged the Arup-Jellicoe route to be less damaging than the draft scheme (because the woodland associations that would be lost were represented adequately elsewhere within the NNR and the important chalk grassland areas were avoided). Nonetheless, on 4 March 1970, the Minister of Transport supported the Inquiry Inspector and announced that the draft scheme would be built.

The Nature Conservancy did not object to the draft scheme at the Inquiry, rather, as stated in its Proof of Evidence:

'being conscious of the Ministry's needs in the context of its national programme, they agreed with the greatest reluctance to raise no objections to the proposed route'.

File records show that the Nature Conservancy took the attitude that the road was bound to traverse an area of high interest at some point along the escarpment, it had influenced the final route alignment and had secured agreement to the fullest consultation in landscaping and revegetation matters.

Aston Rowant was the scene of a grazing experiment initiated in 1964 and included in the British national contribution to the International Biological Programme. The Nature Conservancy had therefore been keen to avoid impact upon the grazing plots. File notes at the time indicated that the final route alignment avoided the experimental plots. Concern was therefore focused upon the loss of two areas of particularly valuable vegetation: an area of juniper found on the north-facing slope of the spur found between Beacon and Bald Hills and an associated



area of unusual chalk grassland, dominated by *Helictotrichon pubescens* (downy oat-grass). These areas lay outside the NNR but within the proposed NNR. To the east of the Chiltern ridge, both the new road itself and the realigned Christmas Common Road ran through the NNR beech woodlands of Grant's Plantation and Hailey Wood. As both woods had been clear-felled in the late 1960s, loss of mature woodland was not an issue.

In the early 1970s, the M40 motorway was built through the site in a deep cutting, with the loss of woodland, juniper scrub and chalk grassland. Most of the spoil from the cutting was used to build up the land to the immediate west in order to integrate the western approach of the motorway to the cutting into the landscape. The 'new' land to the west, which lies outside the SSSI, but within the NNR, was returned to permanent pasture.

### 3.13.2 Mitigation

Four areas of ecological mitigation have been identified, principally from the brochure prepared for the opening of this section of M40 (see Figures 27 and 28):

- 1 the planting of juniper (propagated from local stock) at the base of the upper slope of the southern cutting;
- 2 planting of native trees and shrubs along the woodland edge created by the cutting (on the northern side);
- 3 the creation of 'new' chalk grassland at the top of the southern cutting, to be managed by sheep grazing;
- 4 the erection of a deer fence to prevent fatalities.

The slopes and vertical faces of the cutting were sown with a mixture containing species recommended by the Nature Conservancy in the winter of 1972/73. The original intention was to include *Festuca ovina* (sheep's-fescue), *Onobrychis viciifolia* (sainfoin) and *Anthyllis vulneraria* (kidney vetch) in the mixture but seed could not be obtained and *Festuca rubra commutata* (Chewings fescue) and *Achillea millefolium* (yarrow) were substituted. The following seeds mix was used:

<i>Lolium multiflorum</i>	Westerwolds annual rye-grass	20%
<i>Festuca rubra rubra</i>	red fescue	15%
<i>Festuca rubra commutata</i>	Chewings fescue	20%
<i>Agrostis stolonifera</i>	creeping bent	15%
<i>Plantago lanceolata</i>	ribwort plantain	2.5%
<i>Trifolium pratense</i>	red clover	5%
<i>Sanguisorba minor</i>	salad burnet	5%
<i>Trifolium repens</i>	red clover	2.5%
<i>Achillea millefolium</i>	yarrow	5%

In addition, the chalk grassland at the top of the southern cutting and the permanent pasture established to the west of the cutting were leased to what was then the Nature Conservancy (subsequently the Nature Conservancy Council and now English Nature). The fields, which are

excluded from the SSSI, provide valuable grazing land for the sheep flock which grazes the SSSI at times when the animals need to be off the Nature Reserve.

### 3.13.3 Monitoring

It would appear that no monitoring was undertaken at Aston Rowant to provide an indication of the success of the mitigation. The only recent vegetation study that has been undertaken is on the western meadows (those created by the raising of land). That study looked at the effect of pollutant deposition at varying distances from the motorway (Davis, 1997). The study concluded that there are elevated heavy metal levels in soils and vegetation located close to the road, but that all values were below the Interdepartmental Committee for the Redevelopment of Contaminated Land limits for soil to be developed for recreational use and also below the values associated with contamination in plants. Thus, although the NNR appears to be impacted by the M40, 'the metals present within the soils and vegetation are below levels of concern and, at the current rates of input, are unlikely to be of concern in the near future'.

### 3.13.4 Site surveys

The site was surveyed on 21 July 1997.

Since no details of the seeds mixes used to establish the chalk grassland on the southern upper slope of the cutting (and possibly elsewhere on the upper cutting slopes) are available, it is not possible to assess the success of the establishment of individual species. To assess the character of the sown swards, as well as regenerating bare areas, these were compared with immediately adjacent semi-natural grasslands, which were apparently undisturbed during construction of the motorway.

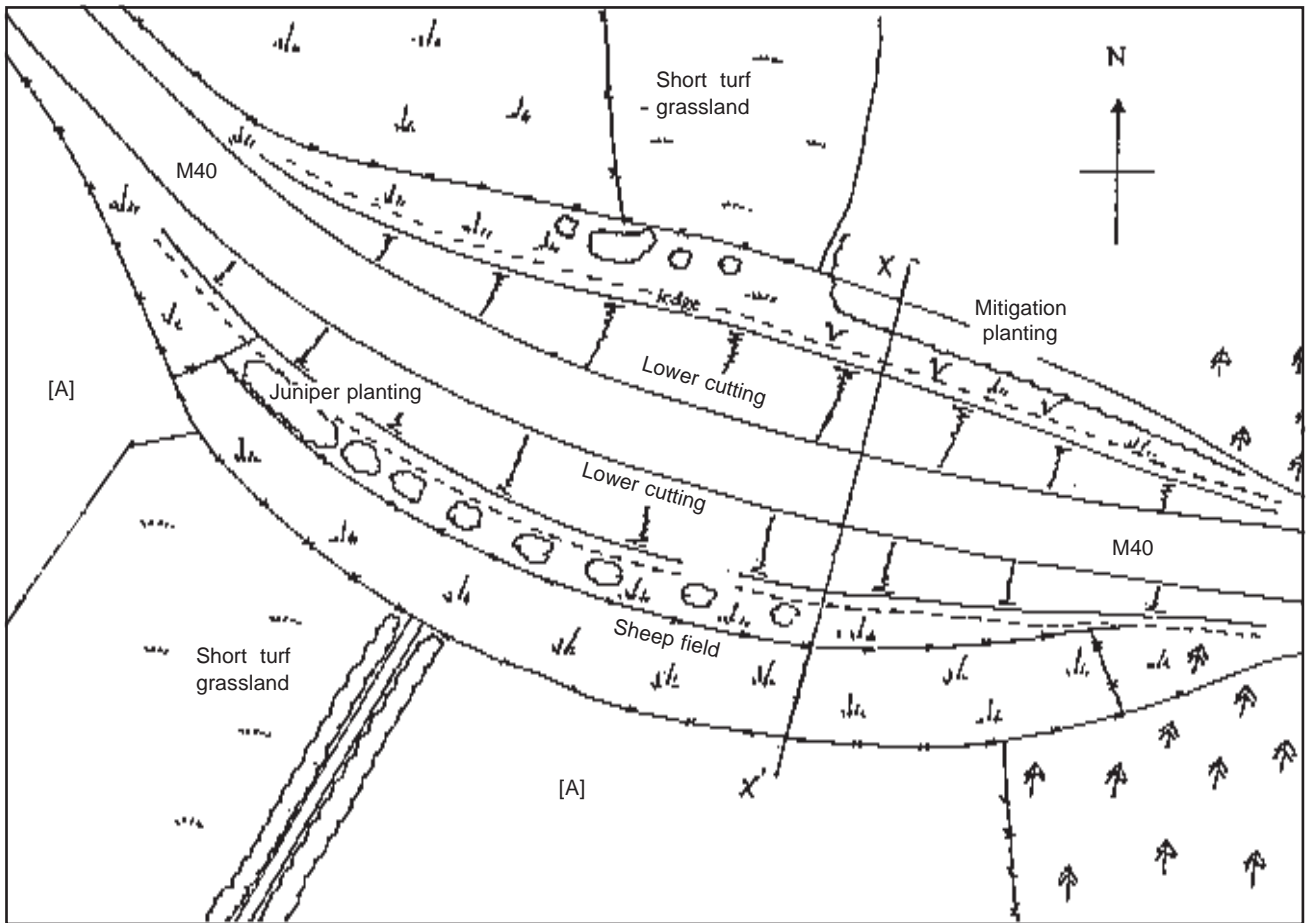
Five quadrats were recorded in the herbaceous/grassland community along the upper edge of the northern face of the cutting and a further five were recorded in the field that forms the upper edge of the southern face of the cutting. The context for the comparisons was provided by five quadrats recorded in the species-rich grassland immediately adjacent to the northern edge of the cutting, which was typical of the short turf grassland of the majority of the reserve.

A walkover survey was undertaken to assess the suitability and health of the tree and shrub planting at the top of the northern slope of the cutting and of the juniper planting at the top of the southern slope.

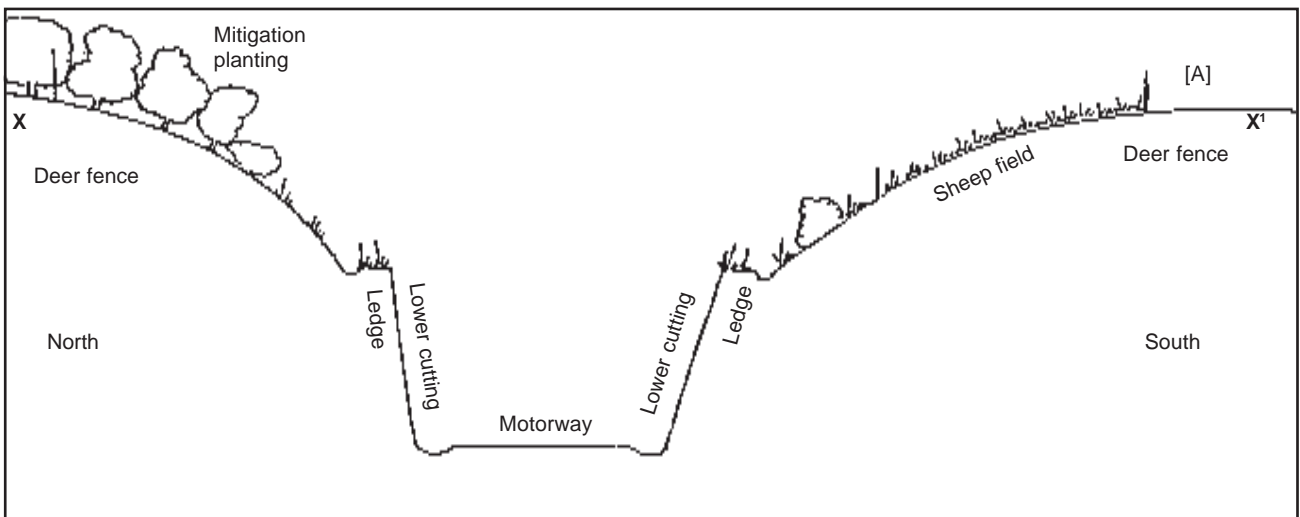
For safety reasons, the lower cutting slopes were not surveyed.

### 3.13.5 Survey results

The motorway cutting profile is shown in Figure 28. Above the steep lower cutting faces, there is a ledge and ditch designed to prevent rock falls and erosion of the cutting faces. Above the ledge, the cutting sides slope steeply and then gradually more gently up to the undisturbed ground surface. The boundary between the undisturbed ground and motorway cutting is delineated by a high deer fence.



**Figure 27** Plan of motorway cutting, Aston Rowant SSSI



**Figure 28** Cross section of motorway cutting, Aston Rowant SSSI

## a Grassland

### Northern face: upper slope

The uppermost edge of the upper slope abuts the woodland areas of the ridge to the north and had been planted with broad-leaved species (see below). Below the edge of the trees the slope appeared to have been left bare and had been subsequently colonised by a mosaic of scattered scrub, sparse grassland communities and a variety of herbs. Scattered *Crataegus monogyna* (hawthorn) and *Ulex europaeus* (gorse) were the most prominent scrub species although *Rubus fruticosus* agg. (bramble) was locally dominant around the margins of the denser patches of scrub. There were a small number of small bushes of *Sorbus aria* (common whitebeam) on the slope.

Grass cover was typically less than 10% on the slope except at the margins of scrub where *Arrhenatherum elatius* (false oat-grass) was locally dominant. The most prominent species, all of which were locally abundant, within the herbaceous flora of the slope were *Erigeron acer* (blue fleabane), *Centaurea erythraea* (common centaur), *Achillea millefolium* (yarrow) and *Plantago lanceolata* (ribwort plantain). Only towards the western end of the slope was there a community which supported species characteristic of the adjacent chalk grassland. At this point, colonisation of some species, such as *Cirsium acaule* (dwarf thistle) and *Thymus polytrichus* (wild thyme), had been successful. Nonetheless, even within this community grasses are sparse and appear to be unsuccessful in colonising the bare areas present.

At the foot of the upper slope, there is a concrete ditch which collects run-off. On the outer edge of the ditch, there is a 4-6 metre-wide ledge of rank grassland dominated by *Arrhenatherum elatius* (false oat-grass), before the slope falls away steeply to the lower cutting face. There were several large stands of *Dipsacus fullonum* (teasel) but other herbs are uncommon within the community. The species recorded along this ledge are listed in Chinn et al. 1998.

### Southern face: upper slope

The upper slope of the southern side of the cutting forms an enclosed field, which was intended to be returned to chalk grassland by seeding with an appropriate mix as part of the mitigation proposals. The upper edge of the field has locally abundant *Trifolium repens* (white clover) and frequent *Heracleum sphondylium* (hogweed). The dominant grass in the sward was *Trisetum flavescens* (yellow oat-grass) with *Festuca rubra* (red fescue) locally frequent. *Festuca ovina* (sheep's-fescue) was not recorded but may occur in small quantity. *Centaurea nigra* (black knapweed) of a rayed form was locally frequent toward the eastern end of the field. The rayed form of this species is often indicative of sown leys.

The lower edge of the field suffers from local rabbit grazing pressure and this, combined with the thinner soils on the steeper lower slopes, had produced a more herb-rich community with species characteristic of thin chalky soils. As on the northern face of the cutting, there was little sign of colonisation by the fine-leaved sward species such as *Festuca ovina* although small herbs such as *Linum*

*catharticum* (fairy flax) and *Euphrasia* sp (eyebright) were locally frequent. One spike of *Anacamptis pyramidalis* (pyramidal orchid) was found on the lower edge of the field adjacent to a small colony on the middle face of the cutting and two spikes of *Orobancha minor* (common broomrape) were located in the centre of the field.

Below the sheep fence on the upper cutting, there was a broad strip of rather rank grassland with scattered scrub (*Crataegus monogyna* and *Rosa canina*), sloping down to a concrete drainage channel of similar design to that on the northern cutting face. At the western end of this strip there was a planted stand of approximately 100 *Juniperus communis* (junipers) (see below). Between the concrete channel and the drop-off to the lower cutting is a 4-5 metre-wide ledge dominated by species-poor rank grassland. All these grassland areas were dominated by *Arrhenatherum elatius* with locally frequent *Trisetum flavescens*. *Achillea millefolium* (yarrow) was locally abundant with both *Torilis japonica* (upright hedge-parsley) and *Centaurea nigra* being locally frequent. A small colony of *Anacamptis pyramidalis* was found close to the *Juniperus* stand.

### Vegetation analysis

The established chalk grassland within the SSSI was CG2a *Festuca ovina*-*Avenula* (*Helictotrichon*) *pratensis* grassland *Cirsium acaule*-*Asperula cynanchica* sub-community. The open vegetation found on the upper cutting on the northern side had affinities to CG7 *Festuca ovina*-*Hieracium pilosella*-*Thymus polytrichus* grassland, whereas that of the field established at the top of the southern cutting slope was closer to CG6 *Avenula* (*Helictotrichon*) *pubescens* grassland; neither showed strong affinities to CG2.

CG2a is typical chalk grassland of south-east England, particularly where there is heavy sheep or rabbit grazing. CG7 grassland is characteristic of thin, stony soils, often with a history of disturbance; it has an open sward with much bare ground. It is the vegetation type that one would expect next to CG2 where conditions are not suitable for the development of a closed sward, or where there has not been sufficient time for a closed sward to develop following a period of disturbance. In the absence of grazing, it could develop towards a ranker sward dominated by coarse calcicolous grasses, rather than to CG2.

CG6 grassland is usually dominated by *Festuca rubra* and the two species of *Helictotrichon*, which gives the sward a ranker character. It typically occurs on more mesotrophic calcareous soils where there is often a history of disturbance and little or no grazing.

## b Tree plantings along northern cutting edge

It was not possible to assess the survival rate of this area of tree planting since some 20 years has elapsed since planting. There was some evidence of thinning at the margins including several birches (*Betula* sp.), further hampering any attempts to assess survival rates. The species visible in the planted stands are listed in Table 18.

The beeches attained a height of up to 15m at the interface with the existing woodland. Beeches were locally

**Table 18 Trees within mitigation planting at top of northern cutting, Aston Rowant**

Species		Frequency
<i>Fagus sylvatica</i>	beech	LD
<i>Prunus avium</i>	wild cherry	LF
<i>Sorbus intermedia</i>	Swedish whitebeam	LF

Key: D dominant, A abundant, F frequent, O occasional, S scarce, with L locally.

dominant in the adjacent woodland so this planting can be regarded as appropriate, as well as being successful. Although *Prunus avium* was not located in the adjacent native woodland, it was known to occur within the SSSI and may therefore be considered to be appropriate in the planting scheme although perhaps not at the high frequency observed. *Sorbus intermedia* (Swedish whitebeam) is not native to Britain and therefore is inappropriate in the planting scheme.

### c Juniper plantings: southern slope

A strong population of some 100 junipers (*Juniperus communis*) was present as a dense colony at the western end of the southern face of the cutting. No tree guards were visible and so it was not possible to estimate the survival rate. The population originates from planted cuttings and should be regarded as successful mitigation.

#### 3.13.6 Management

The deer fencing was complete and in good condition, as was the sheep fencing associated with the field on the upper slopes of the southern cutting. Survey indicates that there is no management of the grassland below the deer fencing on the northern side of the cutting and only light or limited grazing to the field on the southern side. Apart from some evidence of thinning to the trees planted along the woodland edge at the top of the northern cutting, no other management appeared to have taken place.

The introduction of (heavier) sheep grazing on the sown field at the top of the southern cutting would probably result in a change towards more characteristic species. As with the field at the top of the southern cutting slope, grazing is likely to be relevant in the development of the grassland at the top of the northern cutting face; here the sward was typical of the early successional stages of CG2 but in the absence of grazing, a different, ranker grassland type is likely to develop.

#### 3.13.7 Summary

The grassland that has been established on the upper slopes of the southern side of the cutting does not mimic well the characteristic chalk grassland of the SSSI. It is likely that this reflects not only a non-specific seeds mix but also the character of the soils in this field, which appear to be deeper and more neutral than the thin, chalky soils found under the grasslands elsewhere in the SSSI. However, whilst the seeds mix may not have replicated the local CG2a grassland, all the species detected within the sown sward in the field at the top of the southern cutting face are natives and are common locally.

Elsewhere, the motorway cutting did not support

vegetation communities characteristic of the adjacent highly-valued chalk grasslands. Although the grassland areas of the cutting were typically species-rich, a number of the characteristic grass species (notably *Festuca ovina*, *Briza media*, *Helictotrichon pratensis* and *Koeleria macrantha*) had been unable to seed in from adjacent chalk grassland. The herb species present at high frequencies and percentage covers in the swards found on the cutting sides, whilst typical of calcareous soils, were often not present at such frequencies or Domin scores in the adjacent short turf areas.

Plantings of trees, particularly beech and wild cherry, along the upper edge of the northern cutting had been successful although the use of a large number of the alien Swedish Whitebeam (*Sorbus intermedia*) at the margins of the NNR was highly inappropriate. Existing information was inadequate to assess whether a greater range of species were introduced in the original plantings but were selectively lost. The juniper plantings on the southern face of the cutting have been successful.

Overall, the mitigation works have not been totally successful: the grassland established on the upper slopes of the southern cutting did not mimic the adjacent, highly valued chalk grasslands of the SSSI and the tree and shrub planting on the upper northern slopes was unimaginative and includes a large number of alien *Sorbus intermedia*. Given the years of discussion between the Nature Conservancy and the Ministry of Transport and the history of the NNR as a centre of experimental work, it is perhaps particularly unfortunate that monitoring was not undertaken at this site to establish the success of the mitigation.

## 3.14 Bridgham and Brettenham Heaths

### 3.14.1 Background

Bridgham and Brettenham Heaths SSSI in south-west Norfolk was designated in 1970 as the two heaths form part of the largest remaining block of Breckland Heath, covering 446 ha. Brettenham Heath is also designated as a National Nature Reserve (NNR). The predominant habitat is dry acid heath and grassland dominated by *Deschampsia flexuosa* (wavy hair-grass) and *Calluna vulgaris* (heather). A small area along the eastern edge of the SSSI shows the influence of the underlying chalk, with more species-rich neutral to calcareous grassland. There is substantial invasion of *Pteridium aquilinum* (bracken) in many areas and small patches of scrub and woodland, the latter dominated by *Betula pendula* (silver birch) and *Quercus robur* (pedunculate oak). The site is notable for breeding nightjar and curlew. The SSSI is shown in Figure 29.

In 1992 the A11 which separates Bridgham Heath from Brettenham Heath was widened from a single carriageway in each direction to a dual carriageway. This was achieved by widening the road along its southern edge, with significant landtake (of unknown area) of acidic grassland across the northern edge of the southern section of the SSSI (see Figure 30).

The decision to widen the road on the southern side of the existing carriageway was taken in order to minimise the landscape impact. As the SSSI lies on both sides of the road, the decision had little effect upon the severity of the impact upon the SSSI, although it resulted in landtake to the NNR.

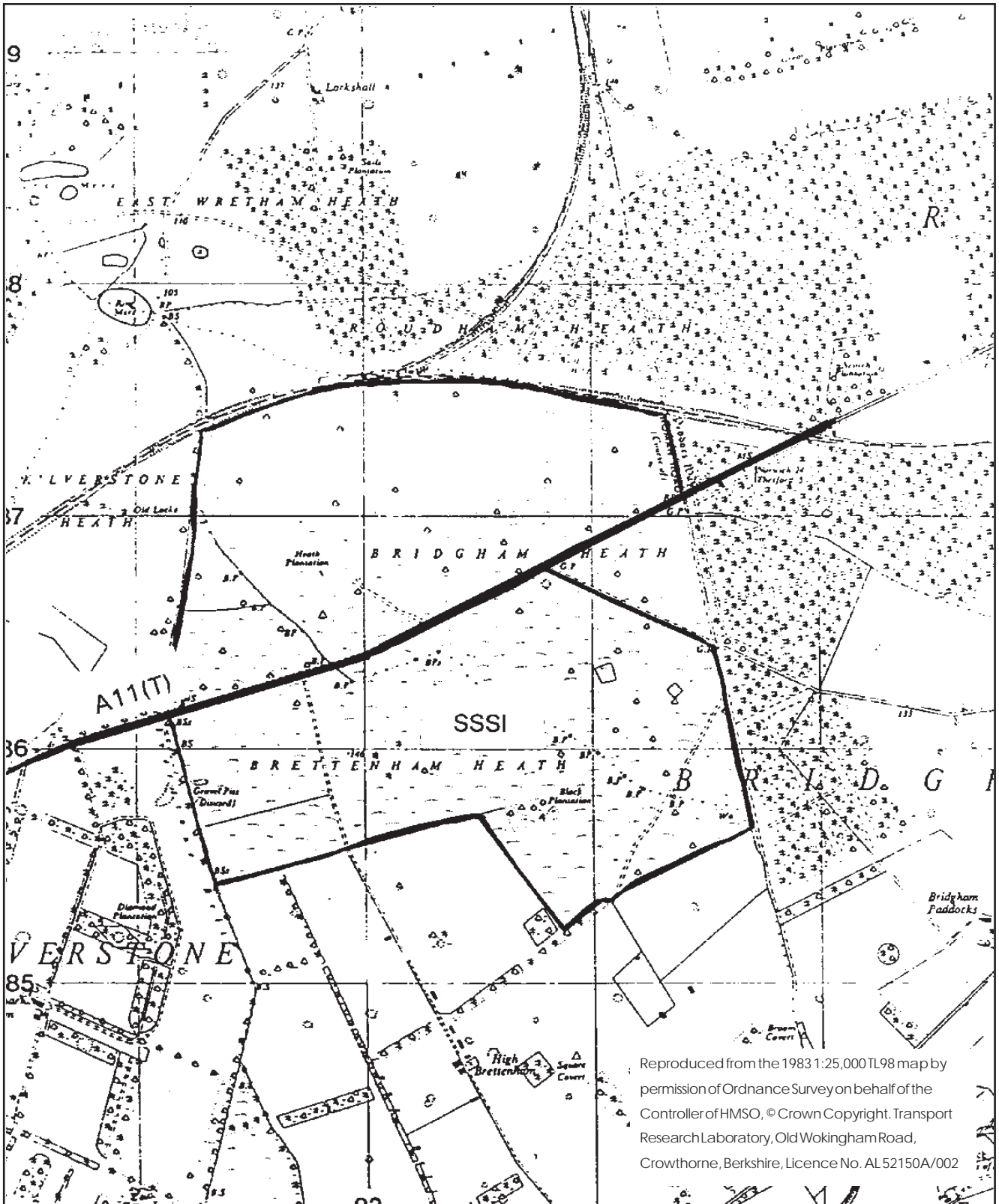


Figure 29 A11: Bridgham and Brettenham Heath SSSI. Scale 1:25,000

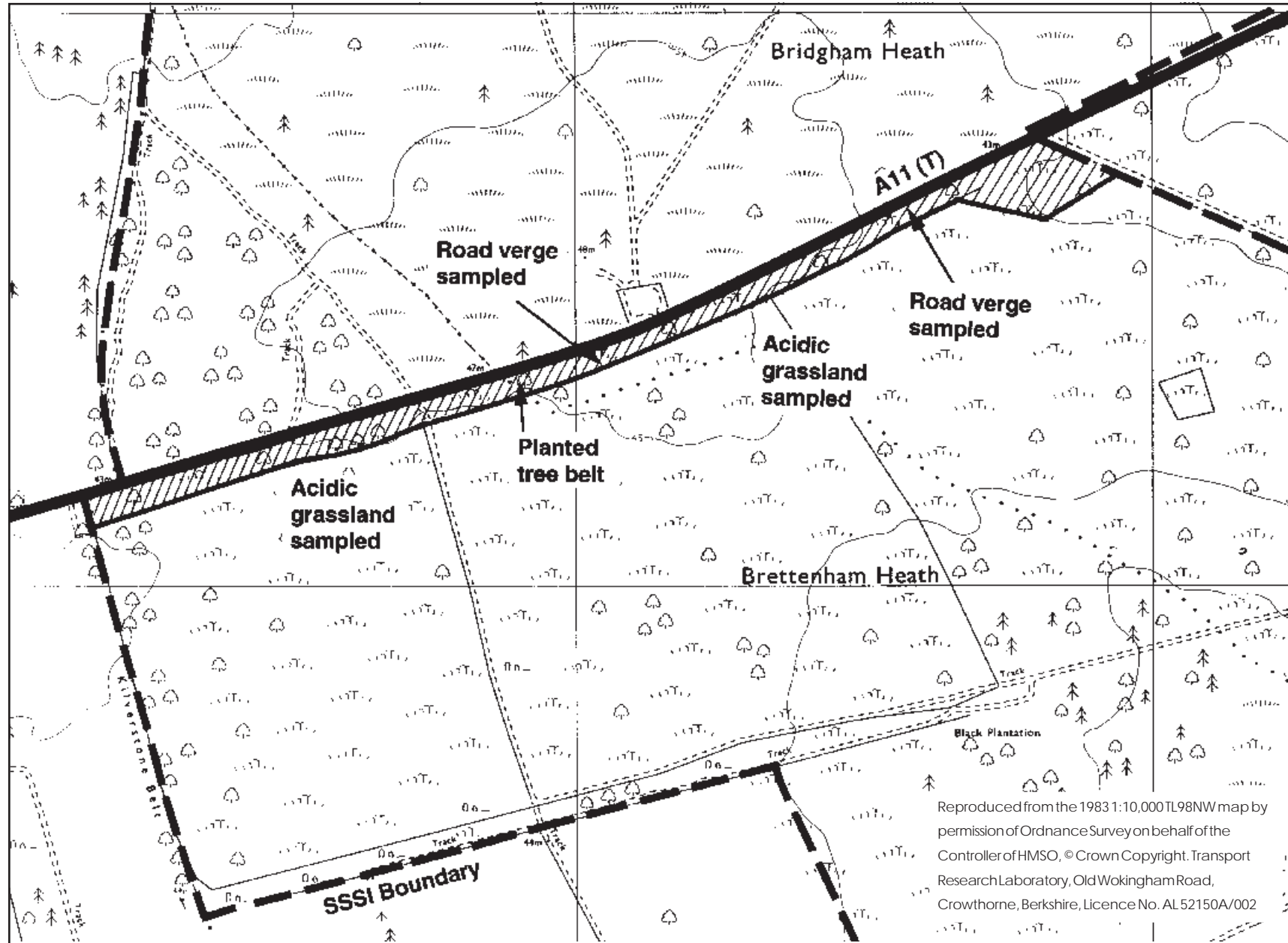


Figure 30 Mitigation and SWRC survey sampling points, Brettenham Heath. Scale 1:10,000

### 3.14.2 Mitigation

Mitigation for the loss of heathland SSSI (including the Breckland hedge which formed the boundary along the southern side of the old road) was identified in the 1991 Environmental Statement:

‘The strip of land between the back of the new verge and the existing fenceline will be planted and landscaped in conjunction with English Nature to maintain the character of the area. Topsoil removed from the area of the SSSI will be replaced on the earthworks slopes and the central reserve of the completed scheme to encourage the establishment of similar species to those within the SSSI.’

Some 2000 trees and shrubs were to be planted as a shelter belt between the road and the NNR/SSSI.

### 3.14.3 Site surveys

Site surveys were conducted on 24 July 1997. A total of 10 quadrats were recorded with five of these along the southern verge and five within the closest area of acidic grassland within the SSSI immediately to the south of the new shelter belt. The sample locations were chosen to allow comparison of ‘typical grassland’ of the SSSI with the area where topsoil was understood to have been spread in order to encourage the re-development of such characteristic grassland.

It had been hoped to undertake a transect through the planted shelter belt in order to obtain an objective assessment of the nature of the landscape planting but the dense nature of the surrounding vegetation, including gorse (*Ulex europaeus*) and *Pteridium aquilinum*, made this impossible. Instead, a number of spot samples at accessible points were taken, to provide an idea of the species mix and survival rates.

In addition, a walkover survey of the road verges and central reservation, along with the areas of SSSI adjacent to the road was undertaken.

### 3.14.4 Survey results

#### a Grassland

The SSSI to the south of the shelter belt supported unimproved acidic grassland dominated by *Deschampsia flexuosa* with abundant *Galium saxatile* (heath bedstraw). *Rumex acetosella* (sheep’s sorrel) was frequent throughout whilst *Agrostis capillaris* (common bent) and *Festuca ovina* (sheep’s fescue) were locally prominent. *Pteridium aquilinum* was invading locally, particularly along the northern edge of the SSSI.

Along the southern verge of the A11, a one-metre wide strip along the immediate road margins was dominated by the typical suite of salt-tolerant species including *Puccinellia distans* (reflexed saltmarsh-grass), *Atriplex prostrata* (hastate-leaved orache), *Atriplex littoralis* (grass-leaved orache), *Festuca rubra* (red fescue), *Plantago coronopus* (buck’s-horn plantain) and *Polygonum aviculare* (knotgrass).

Further from the immediate road margin, the verge community was typically dominated by *Arrhenatherum elatius* (false oat-grass) with locally frequent *Urtica dioica* (common nettle), *Achillea millefolium* (yarrow), *Pastinaca sativa* (wild parsnip) and *Malva moschata* (musk mallow).

Towards the western end of the section adjacent to the SSSI, *Bromus hordeaceus* (soft brome) and *Holcus lanatus* (Yorkshire fog) became locally dominant and the prominence of *Cirsium arvense* (creeping thistle) increased.

There were a few bare or rabbit grazed areas within the sward which supported a scattering of annuals including locally frequent *Conyza canadensis* (Canadian fleabane), *Arenaria serpyllifolia* (thyme-leaved sandwort) and *Erigeron acer* (blue fleabane). Towards the western end of the verge there was a small population of *Medicago sativa falcata* (sickle medick) with hybrid forms *M. x varia*. *Medicago sativa falcata* is a nationally scarce plant, confined in the United Kingdom as a native species to the Breckland. It is often found on roadsides in this area, although many of the plants show signs of introgression with the introduced fodder plant *Medicago sativa sativa* (lucerne). Most of the plants at Brettenham roadside appeared to be relatively pure *Medicago sativa falcata*. Ironically the species did not appear to be present on the adjacent SSSI, presumably since it is unable to tolerate grazing.

At the eastern edge of the verge, the rank grassland quickly gave way to a dense stand of *Ulex europaeus* further from the road. At this point the central reservation was also dominated by *Ulex europaeus*, although further west this changed to a mixture of salt-tolerant species, species-poor rank grassland and stands of *Elytrigia repens* (common couch).

The shelter belt was fenced off from both the A11 to the north and the SSSI to the south. As well as an extensive stand of mature, existing *Betula pendula*, the original vegetation was acidic grassland (dominated by *Deschampsia flexuosa* as in adjacent grassland to the south) with some large stands of *Pteridium aquilinum*.

The species found on the roadside in the rank grassland are listed in Chinn et al, 1998. There was a clear separation of the quadrats from the verge and those from the acidic grassland within the SSSI. The quadrats from the acidic grassland within the SSSI were representative of U2 *Deschampsia flexuosa* grassland within the NVC. In contrast, those from the new road verge were poor examples of MG1 *Arrhenatherum elatius* grassland.

The results of the vegetation analysis and the observations made during the walkover botanical survey indicated that the attempt to recreate heathland vegetation upon the verges and central reservation close to the road had not been successful. The suggestion has been made that the transplantation of topsoil from the strip of SSSI destroyed to the reinstated road margins may not have taken place (English Nature, pers. comm.).

#### b Tree plantings

The planting itself could not be surveyed in detail by transect due to locally dense vegetation but the trees were all securely guarded and staked. There appeared to be no on-going management although the rather nutrient-poor soil had ensured that vigorous weeds had generally not become established where saplings had been planted. The take-up rate was high with those inspected exceeding 90%. The trees in the planting, together with approximate frequencies, are shown in Table 19.

**Table 19 Trees planted within the shelter belt**

<i>Trees</i>		<i>Frequency</i>
<i>Acer campestre</i>	field maple	O
<i>Betula pendula</i>	silver birch	F (50% of all plantings)
<i>Betula pubescens</i>	downy birch	O
<i>Crataegus monogyna</i>	hawthorne	O
<i>Cytisus scoparius</i>	broom	S
<i>Fraxinus excelsior</i>	ash	O
<i>Pinus sp cf nigra*</i>	pine, probably black	S
<i>Populus tremula</i>	aspen	S
<i>Populus sp*</i>	poplar	S
<i>Quercus robur</i>	penunculate oak	O

\* indicates non-native species

Of the species within the planting all were appropriate natives with the likely exception of the small numbers of poplars thought to be *Populus x canadensis*, and those pines that were inspected had needles more typical of the introduced *Pinus nigra* (black pine) group than *Pinus sylvestris* (Scot's pine). A number of species were more characteristic of basic soils, particularly *Acer campestre* (field maple), although they appeared to be in good health, may not thrive in the long-term in the free-draining, acid soils.

### 3.14.5 Management

At the time of the survey there was no evidence that the verge or plantings had been managed.

### 3.14.6 Summary

Topsoil collected from the area of SSSI lost to the construction of the widened road was to have been spread over the southern verge and central reservation of the new road to encourage the natural regeneration of heathland vegetation. In fact, the southern road margin supported rank mesotrophic grassland, completely different to the *Deschampsia flexuosa*-dominated acid grassland of the adjacent SSSI. This would suggest that rather than a thin layer of sandy, acidic heathland soil, the verge was covered by a deep layer of neutral soil. Heavy application of de-icing salt has also had implications for the vegetation. One scarce plant characteristic of Breckland (*Medicago sativa falcata*), which was not found in the adjacent SSSI, had seeded in to this verge in small quantity.

Planting of locally occurring native tree species in a broad strip between the southern verge and the acid grassland to the south had been successful, although at least some of the pine appeared to be the non-native *Pinus nigra*, whilst a *Populus* species, probably the non-native *Populus x canadensis* was also present in small numbers. Furthermore, the planting was principally designed as landscape mitigation and had limited ecological value.

Overall, the effect of the road widening upon the SSSI was slight, resulting in landtake of a small percentage of the site. The proposed mitigation, to spread soil carefully removed from the area of the SSSI to be lost to the road on the new verges, was appropriate, but it has not been possible to establish why this was not carried out.

## 4 Summary tables of case studies

	<i>Roughdown Common</i>	<i>Hilton Gravel pits</i>	<i>Southfield Farm Marsh</i>
Nature conservation interest and value of original SSSI.	Species-rich Calcareous grassland, with naturally regenerating juniper, 3.6ha.	Breeding birds and wintering wildfowl, dragonflies, neutral grassland, 32ha.	Tall grassland washland. Habitat for specialized and uncommon invertebrates, 8.7ha.
Factors outside road scheme which may have affected the SSSI.	None known.	Bird interest has declined, but dragonfly interest has increased.	None known.
Effect of road scheme on SSSI.	<0.5 hectares of southern edge of SSSI lost to road construction (1991 to 93).	2.2ha lost to road, including one pond, birch woodland, willow scrub and grassland. Road construction 1993 to 95.	Site bisected by road. About 1ha lost to road construction in 1990.
Nature of proposed mitigation measures (including constraints).	New chalk grassland to be created on 2ha of adjacent land and on road cuttings, hedgerow and juniper plantings.	New shallow ponds created within SSSI for newts and dragonfly. Nestboxes, and plantings of willow and poplar. New grassland.	About 1ha of land adjacent to SSSI purchased. Soil from line of road translocated to this area. Drainage to maintain wetland of SSSI and translocation land.
Appropriateness of mitigation measures proposed.	Good.	Excellent for encouraging increased dragonfly population. Wide ranging and arguably overcomplicated.	No specific mitigation for specialised invertebrates. Translocation of soil possibly not most effective mean of habitat recreation.
Implementation of mitigation measures.	Wrong seed mix originally used. Area scraped and resown in 1994 when either land was inadequately prepared and/or seed mix poorly chosen. Junipers planted successfully.	Pond excavation and planting good (1992), poplars planted but not willows. Other tree species planted successfully. Only one bird box located. No evidence of new grassland.	Receptor site not prepared by removal of topsoil. Initial problems with drainage were rectified.
Monitoring and management.	Grazed by sheep and cattle.	Some grassland has been mown, but management generally inadequate.	No access to site so no management has been carried out.
Effectiveness of mitigation measures/ Present condition of mitigation site.	Species rich grassland community has been established, but it does not resemble that of adjacent SSSI.	Pond complex and vegetation provide excellent habitat for dragonflies. Poplar and other trees successfully established.	The vegetation of the mitigation site does not resemble wetland of remaining SSSI.
Judgement of overall success of scheme.	Hedgerow and juniper plantings successful. Grass unsuccessful to date, but chalk grassland might successfully develop over time.	Creation of ponds excellent. Tree planting successful. No grassland and probable failure of nest boxes.	Unsuccessful -poor management of translocation, and lack of subsequent management. Drainage measures appear to be unsuccessful.

	<i>Brampton Meadows</i>	<i>Hares Down, Knowstone, Rackenford Moor</i>	<i>Shabbington Wood</i>
Nature conservation interest and value of original SSSI.	Species rich meadow with ridge and furrow topography, 0.79ha.	Lowland heathland -species rich and species poor heaths, 217.6ha.	Ancient woodland. Many species of butterfly, including rare black hairstreak, 305ha.
Factors outside road scheme which may have affected the SSSI.	Scrub encroachment prior to road construction. Removal of grazing causing the site to decline. Illegal tipping and disturbance affecting southern part of SSSI.	None known.	None known.
Effect of road scheme on SSSI.	Site bisected by road. About one quarter of site lost to road in 1991.	New road crosses moors. Construction 1988 to 90.	M40 crossed SE edge of wood (construction completed 1991), affecting some minor black hairstreak colonies.
Nature of mitigation measures proposed (including constraints).	No adjacent land for receptor site. Turves translocated to scrub area within SSSI. Problems recreating ridge and furrows known.	Seeding of verges, tree and shrub planting, underpass to enable cattle to graze freely, use of non calcareous fill in road construction to prevent change in pH of surface waters.	4.7 ha adjacent to SSSI planted for nature conservation, particularly butterflies. Blackthorn planted (larval food of black hairstreak).
Appropriateness of mitigation measures proposed.	A receptor site outside SSSI would have been preferable.	Adequate. Natural regeneration of heathland from seedbank or by natural colonisation preferable on all verges.	Excellent.
Implementation of mitigation measures.	Turf translocation, carried out under Advance Ecological Works contract, appears to have been conducted correctly.	Post construction surveys indicated that calcareous fill had been used through Rackenford Moor.	Excellent. Habitat created in 1990.
Monitoring and management.	Monitored before and after translocation. Grazing removed at time of translocation. No current management.	Monitoring until 2000. Roadside verges managed for first 3 years.	DoT monitored for first 4 years. Also monitored by Butterfly Conservation. 20 year management plan drawn up, but no evidence of recent management.
Effectiveness of mitigation measures/present condition of mitigation site.	Vegetation matches the rest of SSSI which itself has deteriorated. All but one key species lost from translocation area.	Verges dominated by species of original seed mix. In localised areas similarities developing between the verges and SSSI, due to seeding from SSSI. Additional crossing points for cattle desirable. Programme of gorse removal from verges is required.	Initial failure of plantings rectified due to monitoring. Plantings now established and blackthorn is suitable for black hairstreak, although none observed to date. A strong brown hairstreak colony established.
Judgement of overall success of scheme.	Unsuccessful - probably due to lack of management by grazing.	Latest reported survey (1994) too early to be confident of the success of the scheme, although species do appear to be seeding in from the SSSI.	Successful - early monitoring has played an important part in the success. Need for ongoing management and monitoring so initial success is not negated.

	<i>Hazelborough Wood (not a designated site)</i>	<i>St Catherine's Hill</i>	<i>Red Scar and Tun Brook Woods</i>
Nature conservation interest and value of original SSSI.	Ancient replanted woodland, with dormouse population.	Chalk grassland with butterflies particularly chalkhill blue 41.5 ha. Also Itchen Valley -herb and sedge rich water meadows with wetland invertebrates, 99ha.	Deciduous woodland, ash, wych elm and alder woods, uncommon invertebrates, 64ha.
Factors outside road scheme which may have affected the SSSI.	Weather may have affected dormouse population.	One of the areas of downland lost was already degraded.	SSSI already affected by original motorway construction.
Effect of road scheme on SSSI.	Proposed road construction would affect existing roadside vegetation, and strip of woodland through Hazelborough Wood - habitat for dormice.	Part of St Catherine's Hill and Itchen Valley lost to M3 construction. Part of St Catherine's Hill isolated.	Small fragment of SW corner of SSSI (woodland of unknown value) taken by M6 widening.
Nature of mitigation measures proposed (including constraints).	Relocation of dormice by a specified felling regime, and erection of deer fencing to protect dormouse habitat. Habitat enhancement through management to increase capacity for dormice.	Construction of new downland on previously arable land and route of old Winchester bypass by macro turf translocation and seeding (total 7ha). Translocation of flood meadow turves by hand and machine cutting to an island on river Test. Work carried out 1992-94.	Area of herb rich grassland to south of M6 was excluded from motorway fenceline. Tree and shrub planting on motorway cuttings. Spreading of woodland topsoil from lost area onto verges.
Appropriateness of mitigation measures proposed.	Good.	Excellent. Area of downland created much greater than that which was lost .	Herb rich grassland (designated in 1992) safeguarded at expense of small area of woodland. Balancing the loss of a small area of woodland with a grassland site is questionable.
Implementation of mitigation measures.	Appears to have been carried out successfully during 1994 and 95.	'Macro turving' and seeding carried out successfully. Translocation of turves to watermeadow site by hand slightly less successful.	Trees remain to be planted on verges 4 years after construction works.
Monitoring and management.	Dormice monitored by Northants Dormouse Group. Woodland is managed to provide suitable habitat, and cleared area swiped to prevent dormice returning.	Well structured 10 year monitoring programme and 5 year management plan. Also survey of chalkhill blues butterflies.	No management of grassland due to problems of access.
Effectiveness of mitigation measures/present condition of mitigation site.	Dormouse population has declined, but this is thought to be due to weather, rather than the felling regime.	Downland invertebrate species colonising the most established areas. Chalkhill blue colonies established in new downland areas. Degeneration of water meadows due to changes in water table - possibly due to dry summers.	Access difficulties prevent a full assessment of the woodland plantings. Grassland suffering scrub encroachment and loss of species due to lack of management.
Judgement of overall success of scheme.	Mitigation plan appears to have been carried out successfully. On going monitoring required to establish long term effects on dormouse population.	Downland creation very successful to date. Watermeadow translocation moderately successful.	Unsuccessful - degradation of grassland due to unresolved access difficulties makes value as mitigation for woodland loss even more debateable. Not clear to what extent the SSSI has been affected.

	<i>Barrow Gravel Pits</i>	<i>Birkham Wood</i>	<i>Woolston Eyes</i>
Nature conservation interest and value of original SSSI.	Open water, grassland, scrub and woodland. Flora and fauna of flood plain habitats, aquatic invertebrates and birds, 36ha.	Ancient woodland, which contains ecotone from acid woodland to base rich woodland, 28 ha.	Silt lagoons for dredgings from Manchester Ship Canal. Important for wintering wildfowl and breeding birds, 260ha.
Factors outside road scheme which may have affected the SSSI.	History of problems with management of sites.	None known.	Value for wintering wildfowl has declined due to drying of silt beds.
Effect of road scheme on SSSI.	Road constructed across extreme NE corner of SSSI during 1991-92.	Road construction (1991-92) bisected site, fragmenting it and taking 0.9ha.	Second M6 viaduct built (1994-95) across SSSI to west of original viaduct.
Nature of mitigation measures proposed (including constraints).	An earth mound with dense planting to stop runoff and spray reaching the SSSI. Drainage measures. Translocation of horsetail to protect flea beetle. Construction of bank for kingfishers.	Within narrow corridor alignment moved to avoid most interesting part of the wood. Woodland planting adjacent to SSSI, new hedgerow. Topsoil from area lost spread on verges in SSSI. Verges within new woodland seeded.	No mitigation proposed for disturbance to birds, but plantings to north and south on viaduct approach embankments.
Appropriateness of mitigation measures proposed.	Lack of understanding of impacts possibly rendered detailed mitigation somewhat ill conceived.	Good , possibly over elaborate in detail (eg use of both acid and calcareous species in same zone). Scope for additional hedgerow planting.	No impacts were identified so no specific mitigation was either required or provided.
Implementation of mitigation measures.	Contractor dumped spoil on the site of the horse tail translocation.	Excellent, in general. Unclear whether tree and shrub planting matched proposals.	Landscape plantings not yet undertaken.
Monitoring and management.	No monitoring or management.	No monitoring and management to date. Maintenance programme yet to be decided.	No signs of ongoing management.
Effectiveness of mitigation measures/present condition of mitigation site.	Tree planting is sparse, although appropriate species were planted. Restocking and management is required to maximise value of plantings.	Plantings progressing well with the exception of the seeded verges through the new woodland plantings. Absence of management threatens future value of mitigation.	Viaduct construction does not appear to have affected bird population. Quality of habitat was already declining. No specific mitigation was required.
Judgement of overall success of scheme.	Success of scheme in doubt since kingfisher bank and horsetail translocation not found during site visit.	Plantings generally successful. Effect of fragmentation on woodland animals is unknown, so overall success of mitigation cannot be evaluated.	Successful since bird population was not affected by viaduct construction. Plantings not yet undertaken, so potential gain not yet realised.

	<i>Aston Rowant</i>	<i>Bridgham and Brettenham Heaths</i>
Nature conservation interest and value of original SSSI.	Beech woodland, mixed scrub, juniper and chalk grassland habitats, 130ha.	Dry acid heath and grassland, 446ha.
Factors outside road scheme which may have affected the SSSI.	Changes in grazing pressure can affect rate of succession of chalk grassland through scrub to woodland.	None known.
Effect of road scheme on SSSI.	M40 built through site in deep cutting in early 1970s. Loss of juniper scrub, chalk grassland and woodland.	Road separating Bridgham and Brettenham Heath widened by extra carriageway to the south, with landtake (1992).
Nature of mitigation measures proposed (including constraints).	Juniper plantings, native trees and shrubs planted along woodland edge, creation of new chalk grassland, erection of deer fencing.	Soil from area lost to be replaced on earthwork slopes and central reserve. Trees planted to provide shelter belt.
Appropriateness of mitigation measures proposed.	Adequate, plantings taking place in early 70s.	Tree plantings for landscaping purposes and of limited ecological value. Roadside areas are not ideal for recreation of areas of nature conservation value.
Implementation of mitigation measures.	Inadequate soil preparation for grassland areas. Some alien tree species used in woodland plantings.	Doubtful if topsoil translocation was carried out. Some of trees planted were inappropriate species.
Monitoring and management.	Limited grazing and tree thinning. Some areas would benefit from heavier grazing.	No evidence of management.
Effectiveness of mitigation measures/present condition of mitigation site.	Created grassland and motorway cuttings do not resemble grassland of the SSSI due to difference in soils and absence of grazing respectively. Juniper plantings well established.	Vegetation of verges does not resemble that of SSSI, but characteristic of neutral soil. Planted trees well established.
Judgement of overall success of scheme.	Grassland creation not totally successful. Juniper planting successful. Alien species in woodland.	Mitigation was largely unsuccessful.

## 5 Discussion and conclusions

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### 5.1 Ecological mitigation in SSSIs

It is well established that for road schemes affecting SSSIs, the most effective mitigation for any potential impact is the choice of alignment of the route. The alignment preferably should minimise the landtake and/or avoid areas of higher importance or sensitivity to disturbance, and to avoid severance of habitats, particularly of protected species. Basing the argument on the interpretation of sustainable development in the Government paper *This Common Inheritance* (HMSO 1990), the English Nature report *Roads and Nature Conservation* (1993) states that 'if it is impossible to re-create the habitat or geophysical features, for whatever reason, then the site should be avoided'. For many, SSSIs form part of the 'critical capital' which should be protected at all cost.

It is Government policy to avoid SSSIs wherever possible, but this in itself may not prevent indirect effects. There may also be cases where the actual effect on the value of the SSSI is minor and other gains are possible. For example, at Shabbington Wood the M40 crossed the edge of the wood affecting some minor black hairstreak butterfly colonies, but an area much larger than that lost was planted and managed for conservation purposes and, in particular, habitat suitable for the rare black hairstreak was created. In some cases there are other constraints (ie non ecological) on the road alignment and a balance is struck between the conflicting needs to provide a safe, environmentally acceptable, and economically viable solution.

In order to avoid damage to SSSIs from new road schemes, strategic environmental assessment associated with the planning of whole routes is essential. Some of the SSSIs included in the study were damaged by the construction of sections of roads where the earlier completion of the adjacent section(s) of new road severely constrained the choice of route alignment in the vicinity of the SSSI. However, for the local improvement of existing schemes constraints often mean that avoidance is difficult.

There is a need to evaluate whether effective mitigation is possible and to communicate the factors which are important to achieving a successful outcome where mitigation is deemed to be possible. In order that an Environmental Statement may state the predicted adverse effects on SSSIs and protected species, and the significance of these, it is necessary to know the extent that any proposed mitigation may be effective. The potential of proposed mitigation to replicate what was lost, with appropriate management over time, needs to be assessed.

In many cases the potential for mitigation will be low. Many ancient semi-natural habitats are essentially irreplaceable and so their loss can never be fully mitigated. Such habitats have developed over many years under management regimes related to traditional uses and farming methods that may no longer be practised. They could not be replicated over a short period of time. Where such habitats (e.g. ancient woodlands, old hay meadows) are involved, efforts to reduce the effects of roads should in general be directed towards avoiding or minimising the area of landtake and fragmentation.

The value of a site is usually related to its size and so in order to mitigate the effects of habitat fragmentation it may, in theory, be necessary to undertake extensive habitat creation works to create at least one area of habitat of the original size. Size of habitat in relation to its value may depend on the species present, the way in which species use the habitat, and the relationship of separate habitat patches with each other (Kirby, 1995). Habitat fragmentation has not often been considered when carrying out Environmental Assessments for road schemes and consequently fragmentation effects have not been taken into account in much detail in the preparation of designs for mitigation. This is primarily due to a lack of understanding of the significance of fragmentation effects at any one site.

### 5.2 Deficiencies in site records

It proved difficult to assess the success of the mitigation measures undertaken at many of the SSSIs included in this study, primarily because of a lack of information. It was impossible to obtain the necessary details about the schemes, even those which have taken place in recent years. In some cases this was because records had been lost, while in others the documentation was not sufficiently comprehensive.

In many cases, information on the mitigation undertaken was obtained not from project files but rather as verbal communications from consultees, leading to both a degree of ambiguity and some uncertainty about its accuracy.

The most detailed source of information on the mitigation schemes for the sites has often been found to be that included in the different environmental statements for the schemes. However, even for these high nature conservation value sites, it was found that in many cases the information was of a general nature and the objectives of the mitigation were often only described within the overall landscaping schemes. The original site surveys and assessments, which form the basic knowledge on which the prediction of effects and design of the scheme was based, was often missing or poorly presented. Plans and planting/seeding schedules which would have illustrated accurately the mitigation undertaken were rarely available. There was also an almost total lack of information as to how the proposed schemes had been translated into contractual specifications and limited records on site implementation.

It is therefore difficult to identify clearly what works had been carried out in different parts of the site, and whether the ineffectiveness of many of the mitigation schemes was due to inappropriate choice of mitigation, weakness in the basic design or a lack of implementation on the ground. It was also more difficult to predict the likely future development of the re-vegetation and define remedial measures.

By contrast some schemes were extremely well documented. In particular, St Catherine's Hill and Itchen Valley SSSIs, where the scheme was designed, implemented and reported by the Institute of Terrestrial Ecology, the standard of the documentation was such that further ecological surveys were not required for this study. In addition, the Shabbington Wood was well documented,

although additional site surveys were undertaken to confirm the conclusions of the reports and to extend the period of monitoring. It is clear that in such cases where the assessment, design and implementation is systematically dealt with and documented, the outcome of the mitigation has been largely successful.

### 5.3 Re-establishment of lost habitat versus habitat creation

The mitigation associated with schemes should have the primary design objective of eliminating or reducing the significant ecological effects, identified through the environmental impact assessment process. However, in none of the case studies (with the possible exception of St Catherine's Hill) is it considered that the specialised plant communities lost have been re-established. In many cases the re-vegetation work was successfully carried out, but only very rarely did areas have the potential to develop into the vegetation types lost. This potential is dependent on future active management.

This inability to re-create the plant communities lost did not reflect consistent failure of any specialised revegetation works but that the re-establishment of the complex plant communities of SSSIs is difficult to achieve. Where a site is allocated SSSI status as a result of the presence of some important populations of fauna, e.g. Odonata and Lepidoptera, the recreation of valuable habitat is more readily possible. For example the butterfly habitat creation can be considered to be successful in the case of the Shabbington Woods Complex SSSI.

In addition, where the areas disturbed by the scheme or additional areas of adjacent land have been managed to provide habitat of increased value, these areas in themselves could not be considered to compensate for the loss to the SSSI. Nonetheless, any measures to increase the wildlife habitat value of road schemes are important and should be encouraged. Indeed, in some cases it may be entirely appropriate, having identified and evaluated the likely effects of the road scheme, to conclude that mitigation of the adverse ecological effects would not be achieved through attempts to create fragile and highly specialised habitats. In such cases, channelling resources and effort into the creation of alternative habitats or into other types of mitigation works may be both more practical and more effective. In none of the case studies included in this project was this process explicitly followed, although in many cases a general enhancement approach (see 5.4 below) was followed. For example at Hilton Gravel pits new habitats of increased diversity were created.

### 5.4 Planning of mitigation

For some of the schemes included in the study, there was a sense of a 'blunderbuss' approach having been taken, where a range of general ecological enhancement works had been undertaken without a clear sense of which impacts, if any, they were designed to mitigate. This is perhaps most noticeably the case where specialist ecological consultants were not employed by the highways engineer or client, resulting in mitigation being led by the

'wish lists' of consultees. Red Scar and Tun Brook Woods and Woolston Eyes are examples where this approach has been adopted. It should be noted, however, that in both these cases the schemes adopted pre-date the introduction of DMRB Volume 11.

Other habitat enhancement measures introduced as additional benefits should be selected based on the characteristics of the receiving site and availability of resources for establishment and future management. There is also value in using a comprehensive checklist of all available options for ecological mitigation. This would avoid the situation, found in many studies here (eg Birkham Wood), where the mitigation package consisted of an almost *ad hoc* selection of initially apparent measures. Other opportunities for enhancement were often possible but missed, e.g. further planting to establish or improve the links between existing habitat fragments.

Comprehensive advice is already available on the approach to be taken in the planning of mitigation packages on the disturbance of sites of nature conservation importance (English Nature 1993, DMRB 10 and 11). In the case of the DMRB there is value in providing an additional advice note which directs the user to the different sections of relevance to SSSIs. As the more important aspects of the mitigation schemes for SSSIs are also usually related to works implemented outside the road corridor, there is perhaps a need to expand the scope of the existing advice. There would also be value in providing specific advice on the design and management of mitigation for effects on sites of nature conservation importance, and on habitat translocation and recreation, in the highway context, within DMRB. This should include advice on site assessment, setting objectives, alternative sites and access, planning and overseeing the work, before and after monitoring, and the importance of ensuring long term management.

### 5.5 Contractual arrangements

Many forms of the specialised re-vegetation works required to mitigate for the loss of SSSI habitat can be readily incorporated into large-scale road engineering and landscaping schemes. This includes earthworks, drainage works, tree planting and establishment of species-rich grassland. However, the initial works for other types of habitat re-creation and generally longer term management for most types of sites requires a high level of 'fine tuning' which involves more specialised inputs. To ensure the successful implementation of the plans for these areas the placement of contracts should recognise the need for individual treatment of these areas, with the use of specialised contractors in many cases.

On-site supervision by ecologists may be required where sensitive habitats and/or species are involved. Effective protection of areas is essential during the high levels of activity associated with the construction phase so that damage to undisturbed and newly created habitat areas does not occur. At St Catherine's Hill the use of a landscape clerk of works during the implementation phase avoided any such problems.

## 5.6 Aftercare

One important reason for failure of the mitigation was the absence of appropriate aftercare. Sometimes, for example at Shabbington Wood (M40), management had been built into the general landscaping programme, providing guaranteed short-term management. With wildlife habitats, management well beyond five years is usually required to ensure the establishment, development and maintenance of the wildlife value. Arrangements therefore need to be made to ensure that both short and longer term management will be implemented. Any constraints on this such as problems with access (eg Southfield Farm Marsh and Red Scar Woods) or lack of funding (eg Birkham Wood) are likely to significantly affect the viability of the mitigation scheme.

In several of the schemes, on the handover of responsibility for site management, insufficient information on the history, outstanding works and future management of the site was made available to the site manager. Examples of this are Brampton Meadows, Barrow Gravel Pits and Birkham Wood.

More specific information on the proposed schemes therefore needs to be available at all stages of site management, including in the evaluation of the initial proposals, the construction stage on site and, after road completion, along the chain of handover of the responsibility for the management of the site. This information (ie site history record) should include:

- clear objectives of the mitigation proposed;
- clear plans of proposed works on site, also clearly showing which areas need to be protected from disturbance;
- description of works required including site preparation, materials specification, time constraints for different activities and ongoing management requirements;
- records of implementation including dates, type of works carried out and reason and form of any variance in planned activities.

Valuable use is made of local conservation groups including the county wildlife trusts particularly in the longer term management of sites and this could be explored further. Due to the limited resources of these groups and the lower priority given to these recently created and therefore lower value sites, provision should be included to facilitate the management of the areas by the conservation groups.

Legally binding management agreements need to be made, and funded, for the long term management of the site and achievement of the design objectives. Mitigation works specified at the Public Inquiry are analogous to planning conditions, and resources and priority must reflect this, in management agreements with wildlife trusts or other bodies.

The lack of secure long term funding for management is illustrated at Birkham Wood, where at the time of writing the form of the maintenance of road verges within the SSSI was still to be decided, but the budgetary constraints of North Yorkshire County Council, to whom responsibility for maintenance has passed, mean the cutting regime will almost certainly be inadequate.

Similarly, at Shabbington Wood, despite the existence of a well researched 20 year management plan, the absence of ongoing management is already threatening the continued success of the excellent mitigation measures that were adopted.

## 5.7 Monitoring

There is also a clear need for monitoring programmes associated with mitigation. Not only do such programmes facilitate auditing against the aims of the mitigation but they also allow remedial works to be undertaken if the mitigation is not successful in reducing or preventing negative ecological impacts. Monitoring need not be costly if well designed. Monitoring the numbers and vigour of indicator species, for example, can provide equally effective information on the quality of a habitat as a complete list of species present, and in some cases the maintenance of a viable population of a particular species may be one of the objectives of the scheme.

Monitoring needs to be long term, perhaps as long as the site exists, and managed to mitigate the effects of the road. Monitoring for the first 3 to 5 years is not sufficient, since it is unlikely that habitat of the mitigation scheme will have developed during that time. Monitoring intervals can be extended as the habitat is developed. The difficulty in assessing the success or potential for success due to lack of monitoring is discussed in a number of the case studies (eg Roughdown Common).

## 5.8 Habitat-specific conclusions

A number of further, habitat-specific conclusions may be drawn from the study:

- when species-rich grassland is established on road verges, the area within the range of the spray (about 3m) should be considered unsuitable, due to both the spray and nature of the substrate which may not replicate the conditions of the area being replaced by a mitigation proposal. If mitigation is confined to the road verge a site specific management regime needs to be implemented together with funding and a method of ensuring it is carried out;
- the hydrological conditions of damp or wet habitats are very difficult to create;
- grassland translocation was found to be effective in dry grassland and heath areas where large turves were used, although careful management of these translocations will have been important in their success.

## 5.9 Scope for more creative mitigation

Mitigation for ecological effects has traditionally been restricted to or focused upon habitat creation or re-creation. With some habitat types, this is an ineffective form of mitigation. Implementing management to enhance the quality of remaining habitat blocks may be a more appropriate form of mitigation, *per se*.

## 5.10 Recommendations

The recommendations listed below will help to ensure the success of any ecological mitigation plans. Briefly, these are:

- to ensure that they are effective, mitigation works should be designed in the context of a professional and independent ecological impact assessment;
- planning should use a comprehensive checklist of all possible options for ecological mitigation;
- specialist advice should be used to interpret the suitability of different sites for different types of habitat;
- areas close to the road have limitations in their value for some types of wildlife habitat. In particular, verges have limited value for the creation of new habitat, or as a receptor site for translocation;
- clear objectives for mitigation works should be drawn up;
- the distinction between re-establishment of lost habitat and other habitat creation/enhancement should be made. While the latter may be desirable and may be considered in addition to or instead of mitigation where mitigation would stand little chance of success, it should not be considered as mitigation itself;
- selection of suitable plant species and planting stock should consider the original flora of the area, soils and other characteristics of the planting site, ease of establishment of different species and availability of future management. The use of local genotypes or material of local provenance is desirable;
- woodland planting schemes should use a species mix and planting pattern which mimics the local communities;
- special provision should be made in the contractual arrangements for the schemes for the use of specialist contractors;
- details of the mitigation works should be well documented and readily available;
- to maintain the value of habitat creation areas, the design and implementation of appropriate management is essential. Legally binding and properly funded agreements need to be made for the long term management of sites;
- monitoring should be undertaken to demonstrate whether mitigation has been successful and in order to inform ongoing management.

## 5.11 General conclusion

The procedures included in the DMRB establish a basis for carefully considered impact assessment and the design and implementation of effective mitigation for any adverse effects. However, it is likely that none of the schemes included in this study were developed under the guidelines of DMRB. Volume 10 was published in 1992, and Volume 11 in 1993. Certainly, it is to be hoped that many of the shortcomings revealed by the case studies will be avoided in future, through adherence to the DMRB guidelines.

The success or otherwise of the mitigation adopted in each of the case studies may be attributed to one or more of three main factors:

- i quality and appropriateness of ecological advice;
- ii ease of creation/re-creation of habitat type;
- iii introduction and maintenance of appropriate management.

The Shabbington Woods Complex SSSI and St Catherine's Hill SSSI may be regarded as having been successful. For these schemes, appropriate specialists were involved in the planning, implementation and aftercare of the mitigation measures. In addition, the scrub and grassland communities were comparatively easy to create and long term management was carried out. Nevertheless, at Shabbington Woods the uncertainty of ongoing management means that the quality of the habitat compensation area may decline in the future.

## 6 Acknowledgements

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## Abstract

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This report describes a study which examined measures provided for the mitigation of adverse ecological effects of road construction on designated sites and protected species, and determined the extent of their success. In particular, the design and management of such measures was examined. Fourteen sites were selected as case studies. These were either designated sites (Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), both of which are the UK's most important sites for nature conservation), or the habitats of protected species.

This report describes each of the case study sites in terms of its ecological interest, the extent of the impact of road construction on the site, the mitigation measures taken, and assesses the success of these mitigation measures. At eleven of the sites assessment of the mitigation was by field surveys conducted during 1996 or 1997, by Scott Wilson Resource Consultants, under contract to TRL. At the remaining three sites assessment of the mitigation methods relied on documented evidence.

Of the fourteen schemes studies, possibly only three could be regarded as successful. Of the remainder, most could be considered partially successful, or their success is uncertain at the present time, and three could be regarded as failures. The main reasons for failure was inadequate management of the implementation of the scheme, or inadequate post-implementation management.

## Related publications

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