SUNNICA ENERGY FARM DCO EXAMINATION

DEADLINE 5 SUBMISSIONS

SAY NO TO SUNNICA ACTION GROUP LTD

13 January 2023

Introduction

1.1. The Say No to Sunnica Action Group Limited (**SNTS**) is an interested party (ID No 20031080) in the DCO examination. It is an action group representing the interests of many community members around the proposed development site, along with industry bodies interested in Newmarket and its surrounding area. It is incorporated as a limited company (company number 13804465).

1.2. In this document SNTS provides submissions in respect of certain documents produced by the Applicant at **Deadline 4**. In line with the approach set out in SNTS's letter to the Examining Authority dated **11 January 2023**, SNTS provides the following documents:

- **Appendix A**: A briefing note produced by Reading Agricultural Consultants responding to the Applicant's written summary of oral submissions at ISH3 [**REP4-032**].
- **Appendix B**: A briefing note produced by SNTS commenting on the decision in the Hatchfield Farm case, arising out of the action points set by the Examining Authority for ISH3.
- **Appendix C**: A briefing note produced by Michelle Bolger Expert Landscape Consultancy responding to question 2.7.4 of the Examining Authority's written questions and requests for information (ExQ2) [**PD-021**].

Appendix A

Sunnica Energy Farm (EN010106) Deadline 5

13 January 2023

Peter Danks – Reading Agricultural Consultants:

Response to the Applicant's written summary of oral submissions at ISH3 on 8th December 2022 [REP4-032] (EN010106/APP/8.58)

Instructions

Reading Agricultural Consultants Ltd (RAC) is instructed by Say No To Sunnica Action Group Ltd (SNTS) to respond to the agricultural aspects of the Applicant's written summary of oral submissions to the Issue Specific Hearing 3 (ISH3) of 8th December 2022 **[REP4-032]** regarding Sunnica Ltd's application for a Development Consent Order (DCO) for the construction, operation and decommissioning of Sunnica Energy Farm.

These comments have been prepared by Peter W Danks, Senior Director of RAC.

Agenda Item 3 – Socio-economic and land use

4.1.5 – Benefit to soil health:

The applicant makes much of Defra Project SP08016, the summary report of which sets out the benefits and disbenefits of converting tillage land to permanent grassland.

Any benefits that might accrue from the conversion of tillage land to permanent grass for the lifetime of the proposed solar development are short term and will be temporary.

The Manual of Methods for 'Lowland' Agriculture section of Defra SP08016 **Appendix 1** to this response states at p12 that:

> *"Only if land is taken permanently out of cultivation (i.e. to permanent grassland or woodland), will the benefits of SOM accumulation and C storage be realised over the long-term".*

And at bullet 6 on p14 that:

> *"Taking land permanently out of production will result in a loss of farm income and reduces the land area for food production.*"

Any benefits to soil health that might accrue from the use of land for a solar farm will be temporary and can only be long term if the land is taken out of production permanently.

Further, it is necessary to establish a baseline for soil health and biodiversity in the proposed development area in order to determine whether or not the levels of improvement claimed are being achieved. No such baseline for soil has been assessed.

4.1.6 – Soil inspection pits:

This is dealt with in detail at Paragraphs 29-38 of RAC's submission post-ISH3 **[REP4-121 pp128-145]**.

It is acknowledged that six soil inspection pits were excavated but it is clear from mapping **[REP4-121 pp137-141]** that they were located at sites with good access, where poorer quality soils might be found. They are not representative of the soils of the proposed development area and no images showing soil profiles or stone volumes are provided.

The density of soil inspection pits excavated across the proposed development area is one per 163.5ha, compared with one per 22.7ha on the nearby land surveyed by ADAS for MAFF in 1992 and included (unverified) in the baseline assessment. The detailed observation density across land surveyed by DBSC is inadequate.

It is unlikely that the images of the archaeological trenches are representative of the soils of proposed development area, which comprise a range of soil series.

The locations of the archaeological trenches, of which several hundred were excavated across the proposed development area, are not shown on a map or plan.

4.1.7 – ALC:

It is accepted that ALC is based on the permanent physical qualities of soil profiles, topography and the long-term climatic characteristics of sites. Crop type, condition and productivity are frequently used as indicators of land quality but should not be used to classify land. The use of agricultural land for food production should be considered when deciding on the appropriateness of sites where the development of agricultural land is demonstrated to be necessary, as set out at paragraph 178 of the 2022 consultation draft of the NPPF **[Appendix 2 to this response]**.

As stated by Mr Baird, large scale (1:250,000) thematic maps are generally limited to strategic use but in the case of the proposed development area all existing ALC-related mapping is informed by highly detailed surveys of soil series' carried out by the Soil Survey and mapped at 1:10,560 scale **[REP4-132**

pp130-131 & 138-141]. The available published 1:63,360 soil series mapping is commonly accepted to be accurate to about 30m and thus is suitable for the prediction of ALC at better than strategic scale.

The mapping and supporting information available is adequate to make an accurate assessment of the presence or absence of BMV land within the proposed development area. The assessment of available evidence, supported by field observations, indicates that BMV land is present across more than 50% of the proposed development area, a significantly greater area than that found by DBSC.

This incongruity should be reconciled by an independent or joint ALC survey, including the excavation of inspection pits.

4.1.8 – Third party ALC surveys included in the Sunnica baseline assessment:

The baseline assessment of ALC grades in the proposed development area includes 51.6ha surveyed and mapped by ADAS on behalf of MAFF and 3.3ha surveyed and mapped by RAC.

It is consistently claimed by DBSC and Sunnica that the findings of both third-party surveys are consistent with and therefore support the conclusions of the baseline assessment for the balance of the proposed development area. This is not the case.

The RAC report **[APP-115 pp23-39]** correctly assesses as Grade 4 land now occupied by and associated with a sand and gravel extraction operation. The soils of the area are non-calcareous medium sandy formed in sand and gravel deposits and their extent in the proposed development area is very limited. The findings of the RAC survey cannot be related to any significant part of the DBSC baseline assessment.

The ADAS/MAFF reports **[APP-115 pp41-64]** assess land within the proposed development area as 55% BMV, discounting irrigation. The soils of this area are calcareous medium sandy loams to clay loams, being derived from variable chalk deposits, with depths between 80cm and 120cm. These soils are directly comparable with those of much of the proposed development area.

The DBSC observations do not reflect the findings of the ADAS/MAFF reports, finding shallow soils across much of the proposed development area and less than 1% BMV land. This incongruity should be further investigated and the DBSC baseline assessment adjusted where necessary in the light of independent or agreed verification.

4.1.9 - Irrigation:

It is a matter of dispute between the parties as to the taking into account of irrigation in ALC specifically or the assessment generally. Evidence of policy and guidance history in this area is before

the ExA **[REP2-240d pp35-37 & 233-239]** and it is for the Examiners to decide on the role of irrigation in production and ALC grading.

It is accepted that overwinter abstraction for filling irrigation reservoirs will have a limited effect on flooding in the Lark catchment.

Regarding the Cam and Ely Ouse ALS **[REP4-032 pp67-120]**, it was informed by climate change projections estimated using data from UKCP09, thus events of a similar nature to the 2022 drought are taken into account in its conclusions.

The Lea Brook catchment, within which the proposed development area lies is predominantly in arable use, dominated by Chalk geology with some Boulder Clay and terrace deposits. Runoff is influenced by groundwater abstraction and recharge as well as by agricultural surface water abstractions. Winter abstraction from surface waters in the proposed development area does not significantly affect groundwater recharge and winter abstractions for irrigation water storage subject to complex flow restrictions are generally available subject to the granting of a permit by the Environment Agency. The 2022 drought has not had an impact on the recharge of winter storage reservoirs.

Alternative approaches to sustainable water abstraction with the adoption of advanced water efficiency measures, such as the use of drip and trickle techniques, and night-time irrigation means that water will continue to be available for the irrigation of crops in the area.

4.1.10 – Access to land for verification:

Notwithstanding refusals by landowners to permit access to land for verification surveys, SNTS has made further requests to landowners for permission to access land with DBSC, subject to agreement, in order to confirm the observations made in the course of the baseline assessment and excavate soil pits representative of all soil types across the proposed development area.

Technical Note: Clarification requested by Natural England on Agricultural Land Classification [REP4-032 pp38-44]

This technical note is in response to a request by Natural England (NE) to clarify elements of the soils baseline assessment accompanying the Environmental Statement **[APP115]** particularly the reasoning behind grading decisions made in the course of the assessment of ALC.

The request was made as a consequence of verbal clarifications made by DBSC at remote meetings held between NE and DBSC at which advisers to SNTS were not represented. In order to avoid

protracted exchanges regarding issues concerning soils survey and ALC, it is requested that SNTS' professional advisers are represented at any future meetings where soils and agriculture are discussed.

ALC grading interpretation – 2:

It is agreed that the predominant limitation on ALC grading in the proposed development area is droughtiness. Droughtiness is governed by: climate; soil texture; stoniness; and rooting depth in the soil profile.

The soil survey undertaken by DBSC was on a fixed 100m grid with no additional observations in areas where grid points were located outside the survey area leaving areas unsurveyed. The resulting density of observations is 0.84 per hectare, less than the 1.0/ha recommended in NE's TIN049 Agricultural Land Classification: protecting the best and most versatile land **[REP2-240o]**. By comparison, the 100m grid used in ADAS/MAFF survey included in the baseline was positioned to optimise coverage at a density of 1.01 observations per hectare.

Similarly, the density of soil inspection pits, used to verify soil texture, stoniness and profile depth, is extremely low at one per 163.5ha in the DBSC survey, compared with one per 22.7ha in the ADAS/MAFF survey. No images are provided by DBSC to support evidence found in soil inspection pits.

The methodology and detailed observation density across land surveyed by DBSC are inadequate.

The highly selective images of archaeological trenches provided to support the assertion that shallow soils are dominant across the whole of the proposed development area. The locations where the images were taken are not shown on a map or plan.

The aerial photographs at Appendix 1 of the Technical Note **[REP4-032 pp43-44]** clearly reflect the complexity soils in the area, showing soils affected by periglacial action with signs of relatively shallow chalk bands surrounded by much deeper mineral soils. These chalk bands are notably porous and water therein can be exploited by roots as described in the Soil Survey's Special Survey of the Cambridge and Ely District[1]. Ploughing is recognised to spread shallow chalk into deeper areas exaggerating the size of those features. The DBSC observations, carried out on a systematic 100m grid, fail to recognise in a representative way expected from an exercise of this type the deeper soils seen in these aerial images.

Paragraphs 2.1.4 and 2.1.6 indicate the amount of professional judgement that is necessary to deliver an accurate ALC survey. Conventionally, this would be supported by a denser observation pattern to

[1] Seal R.S. & Hodge C.A.H., Soils of the Cambridge and Ely District: A soil association map. Soil Survey Special Survey N°10. Harpenden 1976

properly take into account variation in soil type as well as soil pit inspections supported by photographs of soil profiles and stone samples. None of the supporting evidence that would normally be expected in an ALC survey of complex soils in a potentially contentious area has been adduced by DBSC.

Uncertainty regarding the accuracy of the soil survey associated with lack of evidence suggests that this evidence should not be relied upon.

Moisture balance calculation – 2.1.6:

This section attempts to clarify the inconsistencies evident in the DBSC assessment of ALC grades set out in the soils baseline assessment **[APP115 pp91-146]**. It is not helpful insofar as it fails it identify to which observations this allowance was applied or how the allowance was arrived at and justified. ALC grading should be carried out in line with guidance using observations supported by evidence and/or conventional interpretation of conditions. This assumption is not supported by any photographic evidence or assigned to identified soil inspection pits.

Recalculation of the example profiles examined by RAC **[REP2-240d pp146-162]** in order to prepare its original report using the DBSC assumption of a further +20cm of topsoil with +20% stone beyond maximum auger depth show that this assumption only works when applied to one (CPa31) of more than 50 profiles tested. This strongly suggests that the assumption identified in the technical note was not applied uniformly across the observations. CPa31 was observed as being topsoil only (0-25cm mSL with 20% stone).

The application of an additional allowance for 'unobserved' soils in an ALC assessment is extremely uncommon although DBSC has used similar provisions in its own work **[REP2-240d p97 paras 165-166]**.

Uncertainty over how and where this grading allowance has been made make the findings of the soil survey unreliable and thus it should not be relied upon.

Gaps in sample point data – 2.1.7 *et seq.*:

It is acknowledged by DBSC that "*a handful of gaps appear in the sample point data*". The number of missing observations identified in this section is 31, that is more than 4% of the published number of and cannot be regarded as a 'handful' in the context of an extensive and potentially contentious survey.

Outdoor pigs are normally present in a field for one year only, the precise timing of movement being reliant on crop rotations. Given the time available for surveys, and DBSC's multiple visits to site for auger and pit observations, it would normally be expected that all land would be surveyed.

The apparently random exclusion of points that were "*clipped to the red line boundary*" or missed in a transfer exercise is not consistent with a rigorous professional soil survey. A cursory inspection of the data **[APP115 pp91-146]** makes it clear that data are missing and the baseline should not have been published with omissions, some of are understood to remain unaccounted for. The lack of confidence in the consistency, existence and inclusion of data used in the assessment suggests that this evidence should not be relied upon.

In summary, the technical report submitted by DBSC is largely unconvincing. It is evident that inadequate diligence has been applied in the undertaking of the ALC survey and the interpretation of the findings of observations that are incongruous in the light of published soils information. In the light of this and the failure of the ALC baseline report to satisfy the British Society of Soil Science's own validation check, the findings of the survey should be confirmed by either a joint investigation, an independent third party, or authority. In the absence of independent confirmation of the results, the evidence should be discounted.

Appendix 1

Best Practice for Managing Soil Organic Matter in Agriculture

Manual of Methods for 'Lowland' Agriculture

July 2009

Prepared as part of Defra project SP08016

Prepared by:
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EXECUTIVE SUMMARY

Protecting and enhancing soil organic matter (SOM) levels is a key objective of the Defra draft Soil Strategy for England, and will have beneficial effects for overall soil quality/fertility, carbon storage and erosion control. This report reviews and synthesises recent research on practices for managing SOM in 'lowland' agriculture and identifies best practices for recommendation in England. A partner report (Worrall & Bell, 2009), considers best practices for SOM management in 'upland' agriculture.

Key findings

- Focusing largely on UK studies and reviews, practices that potentially benefit SOM were identified and summarised in a *matrix of management options*, taking into account variations in soil type, agricultural systems and cropping/land-use wherever possible, as well as considering the relative costs, benefits and environmental impacts.

- Two clear 'drivers' were identified for SOM management:
  - *Protection and maintenance* of existing SOM levels for their soil quality and fertility benefits.
  - *Enhancement* of SOM levels for soil carbon storage (to contribute to the mitigation of climate change)

  Management practices (methods) could be broadly divided between these two categories, although some of the methods for the protection and maintenance of existing SOM could also potentially enhance levels.

- Methods that enhance SOM (and carbon storage) were largely associated with *land-use change,* typically taking land out of cultivation thereby reducing SOM oxidation and increasing carbon inputs, viz;
  - Convert tillage land to permanent grassland
  - Establish permanent woodlands
  - Grow biomass crops
  - Introduce rotational grass
  - Water table management (increase the height of the water table)

  It is envisaged that these methods would most likely be incentivised via Environmental Stewardship (as there is an element of 'income forgone' to the farmer).

- Methods that protect and maintain existing SOM levels (and potentially enhance SOM) could be divided into *3 categories*, viz:
  - Reduce soil erosion and hence SOM losses (9 methods)
  - Change tillage practices to reduce SOM oxidation and erosion (adopt reduced or zero tillage systems)
  - Increase organic matter additions via cover cropping, incorporation of crop residues, addition of livestock manures and importing materials high in organic matter (e.g. composts, biosolids, paper crumble, industrial 'wastes' etc.).

  It is envisaged that these methods would most likely be delivered via Cross Compliance measures and incorporated into the requirement to maintain soils in Good Agricultural and Environmental Condition (GAEC).

- A further 6 potential methods for SOM management are cited in the report, but are largely speculative and deemed *insufficiently robust* to promote to farmers/land managers without further investigation and evidence.

- Each method has been described in detail with an assessment of the relative benefit (to SOM and carbon storage), cost, practicality, likely uptake and environmental impact. Both positive (e.g. a reduction in diffuse pollution, increased biodiversity) and negative (e.g. increased risk of soil erosion or gaseous emissions) environmental impacts have been considered, as there were some examples of "pollution swapping". For example, reduced tillage has the potential to *decrease* erosion and diffuse pollution, but could potentially *increase* nitrous oxide emissions.

- All methods were reviewed and revised (as appropriate) at an Expert Workshop held in London on 17th March 2009, by industry, research and policy representatives.

- A key knowledge gap was the *lack of field measurements* (under UK conditions) of the potential carbon storage/saving benefits of many of the proposed methods, across a range of soil types i.e*. the evidence base to support policy implementation is weak*.

1. INTRODUCTION

1.1. Background

Soil organic matter (SOM) is fundamental to the maintenance of soil fertility and functions, as well as being an important carbon store. However, there is some evidence that soils in the UK may be losing SOM/carbon, probably as a consequence of land-use change; particularly the drainage of peat soils and a legacy of ploughing out grasslands, and this could have implications for climate change (Bellamy *et al.,* 2005; Webb *et al.,* 2001). Protecting and enhancing SOM levels will have beneficial effects for overall soil quality/fertility, carbon storage and erosion control. A key objective of the Draft Defra Soil Strategy (priority area 2) is to "reduce the rate of soil organic matter decline and protect habitats based on organic soils, such as peat bogs, to maintain carbon stores and soil quality" (Defra, 2008). Moreover, the Sustainable Farming and Food Strategy has a target "to halt the decline in soil organic matter in vulnerable agricultural soils by 2025, whilst maintaining as a minimum, the soil organic matter of other agricultural soils, taking into account the impacts of climate change" (Defra, 2002a). In a recent review of the Environmental Stewardship Scheme (Defra & NE, 2008) "providing and protecting carbon storage" was also identified as a key means by which agriculture and land management could contribute to climate change mitigation. Management practices that lead to small increases in SOM storage per hectare of agricultural land could lead to important increases in overall carbon storage at a national level, considering that there are *c.*7.3 million ha of agricultural land in England (comprising *c.*3.4 million hectares of tillage land; *c.*3.3 million hectares of managed grassland; and *c.*0.6 million hectares of rough grazing). This report reviews and synthesises recent research on practices for managing SOM in 'lowland' agriculture (defined as land below the intake wall) and identifies best practices for recommendation in England. A partner report has been prepared by Worrall & Bell (2009), which considers best practice for SOM management in 'upland' agriculture (i.e. peat soils on land above the intake wall).

1.2. Objectives

The overall objective of this work was to review recent research on practices for managing soil organic matter (SOM) in agriculture and identify best practices for recommendation in England

More specifically the objectives of the project were:

- To review recent research on practices for managing SOM in *'lowland'* agriculture and identify which practice, or combination of practices, achieves the greatest benefits for SOM in England.
- To review recent research on practices for managing SOM in *'upland'* agriculture and identify which practice, or combination of practices, achieves the greatest benefits for SOM in England (see Worrall & Bell, 2009).
- To identify any broader environmental or economic benefits/disbenefits of each management practice.
- To consider how the findings can be translated into *advice* for farmers/land managers and incorporated into current Cross Compliance Guidance or incentivised via Environmental Stewardship.
- To hold an *expert workshop* to discuss the findings and identify areas of uncertainty/knowledge gaps for consideration in the final report.

1.3. Methodology

Previous studies for Defra have identified a range of methods for reducing diffuse water pollution, ammonia emissions and greenhouse gas emissions from agriculture (Cuttle *et al*., 2007; Misselbrook *et al*.; 2008, Moorby *et al*., 2007). These have been published as 'User Manuals' containing succinct information on the relative effectiveness, cost, practicality and benefit of each of the methods in order to guide policy decisions. To give a consistent approach and enable easy 'read across' with these 'manuals', recent research on practices for managing SOM in lowland agriculture has been reviewed and summarised in a similar format. Focusing largely on UK studies and reviews (Table 1), practices that potentially benefit SOM were identified and summarised in a matrix of management options, taking into account variations in soil type, agricultural system and cropping/land use wherever possible, as well as considering the relative costs, benefits and environmental impacts. These methods were then reviewed and revised (as appropriate) at an expert workshop held in London on 17th March 2009, by industry, research and policy representatives (see appendix 1 for details).

Management practices (methods) could be broadly divided into those which aim to protect and maintain (and potentially enhance) existing SOM levels for their soil quality and fertility benefits (e.g. reduce soil erosion, change tillage practices and increase organic matter additions) compared with more extreme measures (such as permanent land-use change) with the aim of increasing soil carbon (C) storage (for climate change mitigation); Table 2. It is envisaged that the former would most likely be delivered via Cross Compliance measures, whereas the latter would be more appropriate for incentivisation as part of Environmental Stewardship (where there is a potential loss in income to the farmer). Additional methods are cited in the report, but are largely speculative, based on established theories of SOM turnover (and controlling factors), rather than robust experimental evidence. These were deemed to be insufficiently developed to promote to farmers/land managers without further investigation. It should be noted that within each section methods are given in no particular order.

A brief introduction to each category of methods (land-use change, erosion control, tillage practices, and organic matter additions) describes the mechanism of action and rationale for adopting the methods. Each method has then been given a number and brief title that is used in the tables and for reference. This is followed by a description of the method and its application, arranged into the following sections:

(i) *Description*: a description of the actions to be taken to implement the method.
(ii) *Potential for applying the method*: an assessment of the farming systems, regions, soils and crops to which the method is most applicable.
(iii) *Practicability*: an assessment of how easy the method is to adopt, how it may impact on other farming practices, problems with maximising effectiveness and possible resistance to uptake.
(iv) *Likely uptake*: an assessment of the potential uptake of the method; low, medium or high.
(v) *Costs:* estimates are presented of how much it would cost to implement the method in terms of investment and operational costs, on a per ha basis where available. These were primarily derived from Cuttle *et al.* (2007).
(vi) *Carbon storage effectiveness*: estimates are presented (where available) of the effectiveness of the method in storing carbon (and hence increasing SOM levels). In most cases, estimates were taken from previous Defra projects (e.g. Bhogal *et al.,* 2007; Dawson & Smith, 2006; King *et al.,* 2004); Note: the available data did not provide sufficient information to derive separate estimates for different soil types.

(vii) *Other benefits or risks*: this section provides a largely qualitative assessment of the potential environmental impact of adopting the method. In particular, its impact on diffuse water pollution (nitrate-NO_3, phosphorus-P and faecal indicator organisms-FIOs), gaseous emissions (ammonia-NH_3; nitrous oxide-N_2O and methane-CH_4), soil erosion, biodiversity and energy use (CO_2-C costs/savings).

Using the detailed method descriptions, a summary matrix of the relative benefits/disbenefits of each of the best practice methods was drawn up (Table 3). The relative benefit to SOM (or effectiveness) was broadly quantified using C storage estimates (as detailed above), and compared across soil types (light, medium/heavy or organic/peaty) and land-uses (arable or grass), using expert opinion. Costs (largely from the data in Cuttle *et al.* 2007) were given relative gradings: high, medium or low, none or saving. Similarly, the practicality/likely uptake was graded high (very likely to be taken up), medium or low. Finally, two separate categories were given for environmental impact: positive (e.g. reduction in diffuse pollution, increased biodiversity), or negative (e.g. increased soil erosion or gaseous emissions), as in many cases there were clear examples of “pollution swapping”. For example, reduced tillage has the potential to decrease soil erosion and diffuse pollution (and enhance SOM), but could potentially increase nitrous oxide emissions.

Table 1. Sources of literature on methods to maintain/enhance SOM in 'lowland' agriculture

Report/source	Authors/ Affiliation	Date	Summary
Bioenergy crops and carbon sequestration in soils - a review - NF0418	Cranfield	2001	Reviews current knowledge on the potential for soil carbon sequestration under bioenergy crops and presents data on C sequestration rates for short rotation coppice.
Development of economically & environmentally sustainable methods of C sequestration in agricultural soils - SP0523	ADAS	2003	• Listed management practices that may affect SOM. • Quantified the effect on CO2 and other GHG emissions. • Identified most promising options with respect to cost-effective C sequestration. Detailed assessment of 18 methods. Data on annual C sequestration potential for each method (also spatial distribution).
An Inventory of Methods to Control Diffuse Water Pollution from Agriculture (DWPA) – USER MANUAL (ES0203)	Cuttle *et al*; IGER/ADAS	2007	The User Manual provides succinct information on the cost and effectiveness of various diffuse water pollution control methods. Concentrates on nitrate, phosphorus (P) and faecal indicator organisms (FIOs). 44 methods included.
Benefits and Pollution Swapping: Cross-cutting issues for Catchment Sensitive Farming Policy (WT0706)	IGER/ADAS	2006	Estimates the public benefits from a set of policy options based on the 44 DWPA-User Manual methods (Cuttle *et al*., 2007). These methods were designed to reduce agricultural emissions of nitrate, phosphorus, faecal indicator organisms (FIOs) and sediment.
Vulnerability of organic soils - SP0532	Leeds, Durham, Manchester Universities	2006	Describes potential threats to organic soils in E&W and estimates their likely magnitude, occurrence and impact. A number of management strategies for conserving organic soils were evaluated.
Research into the current and potential climate change mitigation impacts of Environmental Stewardship – BD2302	University of Hertfordshire	2007	Reviews major processes and changes in land use that contribute to GHG emissions in UK agriculture. Applies these processes to changes in land use associated with individual options in each of the three ES Schemes. Recommends preferred ES options to mitigate GHG emissions and suggests other options. Includes data on the potential C sequestration rates of different options
ECOSSE – Estimating Carbon In Organic Soils Sequestration And Emission	Smith et al; Aberdeen University, Macaulay, CEH, NSRI, Rothamsted	2007	The ECOSSE model was developed to predict the impacts of changes in land use and climate change on GHG emissions from organic soils. An objective was to suggest best options for mitigating C and N loss from organic soils.
SP0561 The effects of reduced tillage practices and organic material additions on the carbon content of arable soils	ADAS, Rothamsted	2007	Reviews to what extent reduced tillage practices and organic material returns could increase the C content of arable soils in E&W. Concludes that there is only limited scope for additional soil C storage/accumulation from zero/reduced tillage practices and organic material additions. Questions the implications for N_2O/GHG emissions.
A Review of Research to Identify Best Practice for Reducing Greenhouse Gases from Agriculture and Land Management (AC0206)	Moorby *et al*; IGER/ADAS	2007	Identifies 8 mitigation methods *currently* available as best practice to reduce GHG emissions. Four of the methods apply solely to reducing nitrous oxide (N2O) emissions, two apply to reducing methane (CH4) emissions, and two apply largely to carbon dioxide (CO2) emission mitigation as a result of land use change.

Report/source	Authors/ Affiliation	Date	Summary
Carbon Baseline Survey Project (Natural England FST20-63-025)	Laurence Gould Partnership Ltd, CRED University of East Anglia	2008	This report looked at GHG emissions from typical farm types and used the CALM (Carbon Accounting for Land Managers) tool to estimate these - collecting data from about 200 farms. The report concentrates on estimating typical levels of emissions from the different farm types. Although there is some information on C sequestration rates from the typical farm types (e.g. cereals, dairy, horticulture).
Ammonia Mitigation User Manual	Misselbrook et al; IGER/ADAS/CEH/AEA Technology	2008	Provides information on a range of potential ammonia mitigation methods. 25 methods are described of which 20 are considered to be immediately applicable within the industry, 3 require more development and 2 are speculative.
Environmental Stewardship and Improved Greenhouse Gas Mitigation – Amending Current, and Introducing New Options (BD 2305).	Jarvis and Unwin	2008	Follow on from BD2302. Considered Environmental Stewardship (ES) as a means to implement climate change (CC) mitigation methods. Current ES options were reviewed and new ones suggested. An assessment was made of the potential contribution for CC mitigation and changes recommended to increase their impact. Summary tables of the methods were provided, with comments on the impact on soil C stocks.
User Manual –ALL (WQ0106)	ADAS	Ongoing	Contains a summary of 94 methods to control diffuse water pollution, ammonia and GHG emissions etc. Looks at impacts of the methods on a range of water and air pollutants.
Soils within the Catchment Sensitive Farming Programme: Project to deliver improvements in soil management - SP08014	Rothamsted, GY Associates	Ongoing - accessed Dec 2008	The KEYSOIL website has 30+ case studies showing how farmers have used different OM management strategies (or combinations of methods) to increase profitability. The case studies provide details of the methods used and an estimate of costs and benefits – but no quantification of how much SOM was increased.
Review of carbon loss from soil and its fate in the environment (SP08010)	Dawson & Smith	2006	Provides estimates of total UK terrestrial C stocks and reviews processes and factors influencing C loss and subsequent fate. Includes a section on management options to reduce C loss with some estimates of potential C storage due to land-use change.
The impacts on water quality and resources on reverting arable land to grassland (ES0106)	Williams *et al*.	2008	Measured changes in soil C storage resulting from arable reversion at the Faringdon experimental platform site in Oxfordshire.

2. BEST PRACTICE METHODS

Table 2. Summary of methods which may have beneficial effects on SOM in 'lowland' agricultural systems.

Category	Benefit	Method No.	Method description	Comment
Methods that enhance SOM (and C storage)				
A. Change land use	SOM levels will gradually increase as a result of reduced cultivation (and soil erosion), increased organic C inputs and soil wetness Note: methods 2 & 3 will take land out of food production	1	Convert tillage land to permanent grassland	a) Large scale (whole fields/farms) b) Small scale (e.g. buffer strips, field margins).
		2	Establish permanent woodlands	a) Large scale (whole fields) b) Small scale (e.g. new hedges, shelter belts)
		3	Grow biomass crops	Large scale
		4	Introduce rotational grass	Would need to be established for 2 or more years to provide a benefit.
		5	Water table management	Increase height of water table (at a catchment scale) and /or allow field drainage systems to deteriorate (block drains), to increase soil wetness and reduce SOM oxidation rates
Methods that maintain existing SOM levels				
B. Reduce soil erosion	Reduced SOM losses with particulate material, or as DOC in drainage waters	6	Take action to reduce soil erosion on tillage land and grassland	i. cultivate compacted tillage soil ii. leave autumn seedbeds rough iii. cultivate across the slope iv. manage over-winter tramlines v. early establishment of winter crops vi. fence off rivers and streams from livestock vii. move feed/water troughs at regular intervals viii. loosen compacted soil layers in grassland fields ix. reduce stocking density
Methods that maintain existing SOM levels and potentially enhance C storage				
C. Change tillage practices	Reduction in SOM oxidation and risks of erosion	7	Adopt reduced or zero tillage systems	Reduce the number and/or depth of cultivations.
D. Increase organic matter additions/ returns	Maintain/ enhance SOM levels. Improved soil structure will reduce erosion.	8	Establish cover crops or green manures in the autumn	Will reduce soil erosion and nitrate leaching. Use of deeper rooting species and/or crop residues resistant to decomposition may provide further benefits.
		9	Incorporate straw/crop residues	Increased crop productivity will enhance the amount of residue returned
		10	Encourage use of livestock manures	Increased OC application e.g. by changing to solid manure management, avoiding incineration of poultry litter etc.
		11	Import materials high in OC	Increased OC application e.g. by green and green/food compost, paper crumble, biosolids, mushroom compost, water treatment cake, industrial 'wastes' etc. (biochar)

Speculative methods				
E. Various		12	Convert to organic farming systems	Limited evidence for specific benefit of certified ‘organic’ systems.
		13	Extensification of outdoor pig and poultry systems onto tillage land	No supporting experimental evidence of a benefit to SOM, although established grassland and animal excreta returns will increase OC inputs. However, soil erosion and diffuse pollution are likely to increase (particularly on sloping land).
		14	Place OM deeper in soil	No supporting experimental evidence. Protects the OM from loss.
		15	Use clover in grassland (mixed sward)	Limited experimental evidence. Relevant to extensive systems and farmers wishing to decrease inorganic fertiliser N use.
		16	Reduce use of lime on grasslands and highly organic soils	Limited experimental evidence. Allowing the pH of organic soils to decrease (e.g. <pH 5.0) can reduce C decomposition rates and DOC solubility. However, sward productivity will decrease, particularly where legumes are an important part of the ecosystem.
		17	Minimise fertiliser (i.e. NPK) use on organic soils	Limited experimental evidence. Fertiliser addition to organic soils can increase SOM decomposition rates (‘priming effect’).

Table 3. Summary matrix of the relative benefits/disbenefits of best practice methods for managing SOM in 'lowland' agriculture.

	Benefit to SOM (C storage)[1]					Cost	Practicality	Environmental impact[2]	
Land use	Tillage		Grass						
Method / Soil texture	Light	Medium/ heavy	Light	Medium/ heavy	Organic/ peaty			+ ve	- ve
Methods that enhance SOM: A. Land-use change									
1a. Convert tillage land to permanent grassland	✱✱✱	✱✱✱	n/a	n/a	✱✱✱	£££[3]	+	↑↑	~
1b. Buffer strips	✱✱✱	✱✱✱	n/a	n/a	✱✱✱	£	+++	↑	~
2a. Establish permanent woodlands	✱✱	✱✱	✱	✱	✱✱	~ to +£[4]	+	↑↑	~
2b. Hedges, shelter belts	✱✱	✱✱	✱	✱	✱✱	£	+++	↑	~
3. Grow biomass crops	✱✱	✱✱	✱	✱	✱✱	~ to +£	+	↑↑	~
4. Introduce rotational grass	✱	✱	n/a	n/a	✱✱	~ to £	++	↑	↓
5. Water table management	n/a	n/a	✱✱	✱✱	✱✱✱	£ to £££	+	↑	↓
Methods that maintain existing SOM: B. Reduce soil erosion									
6. i) Cultivate compacted tillage soil	✱✱	✱	n/a	n/a	✱	£	+++	↑	~
6. ii) Leave autumn seedbeds rough	✱✱	✱	n/a	n/a	✱	£	+	↑	↓[5]
6. iii) Cultivate across the slope	✱✱	✱	n/a	n/a	✱	£	+	↑	~
6. iv) Manage over-winter tramlines	✱✱	✱	n/a	n/a	✱	£	++	↑	~
6. v) Early establishment of winter crops	✱✱	✱	n/a	n/a	✱	£	+	↑	~
6. vi) Fence off rivers and streams from livestock	n/a	n/a	✱✱	✱	✱	££	+	↑	~
6. vii) Move feed/water troughs at regular intervals	n/a	n/a	✱	✱	✱	£	++	↑	~

Method / Soil type	Benefit to SOM (C storage)					Cost	Practicality	Environmental impact	
	Sandy/ shallow	Medium/ heavy	Sandy/ shallow	Medium / heavy	Lowland peat			+ve	-ve
6. viii) Loosen compacted soil layers in grasslands	n/a	n/a	✱✱	✱	✱	£	++	↑	~
6. ix) Reduce stocking density	n/a	n/a	✱	✱	✱	£££	+	↑	~
Methods that maintain existing SOM levels and potentially enhance C storage: C. Change tillage practices & D. Increase organic matter additions									
7. Reduced/zero tillage	✱	✱	n/a	n/a	✱	~ to +£	++	↑	↓
8. Establish cover crops/green manures	✱	✱	n/a	n/a	✱	£	++[6]	↑	~
9. Straw/crop residue incorporation	✱	✱	n/a	n/a	✱	£	+++	~	~
10. Encourage use of livestock manures	✱✱	✱✱	✱	✱	✱	~ to +£	+++	↑[7]	↓
11. Import high OC materials	✱✱	✱✱	✱	✱	✱	~ to +£	+++	↑[7]	↓

Carbon storage effectiveness		Cost	Practicality (likely uptake)	Environmental impact
✱✱✱	Very effective	£££ high	+++ high	↑↑ Highly beneficial (impact over large area); ↑ medium/low benefit
✱✱	Moderately effective	££ medium	++ medium	↓ risk of "pollution swapping"
✱	Some effect	£ low	+ low	~ neutral (no benefit or risk)
n/a	Not applicable	~neutral		
		+£ saving		

[1] The relative benefit to SOM was broadly quantified using C storage estimates where available (see individual method sheets for details).
[2] Environmental impact separated into positive (e.g. reduction in diffuse pollution, increased biodiversity), or negative (e.g. increased soil erosion or gaseous emissions), as in many cases there were clear examples of "pollution swapping". See individual method sheets for details.
[3] Cost estimates assume conversion to extensive grassland
[4] Cost high in establishment phase, but potential for long-term income from selling wood products
[5] Possible increased need for herbicides and slug damage.
[6] Not practical on many medium/heavy soils
[7] The *overall* environmental benefit will only be positive under 'best practice' management.

3. METHOD DETAILS

3.1. CATEGORY A: LAND-USE CHANGE

Rationale/mechanism of action: Permanent cropping can increase SOM (& C) storage due to the avoidance of annual cultivations which stimulate the mineralisation of organic matter leading to carbon losses as CO_2. Changing from arable agriculture to *permanent* cropping (grassland & biomass production) is therefore expected to markedly reduce C losses and enhance SOM levels. Similarly, the creation of farm woodlands can enhance SOM levels (by reducing losses via mineralisation) and increase C storage (in both soils and vegetation). Converting areas of land on a farm to grass buffer strips, hedges/shelter belts etc will have a similar effect, albeit on a smaller scale. Likewise, avoiding the ploughing out of grasslands to tillage land will markedly reduce C losses. Indeed the extensification of grassland (i.e. from improved grassland with periodic ploughing and reseeding, to semi-improved or unimproved grassland with no ploughing and reseeding) has been suggested to increase SOM levels.

In a comprehensive review of C loss from soil and its fate in the environment, Dawson and Smith (2006) provided estimates of the potential gains/losses of soil C for a range of land-use changes under temperate conditions, using data from studies undertaken largely in Europe, USA, Australia and New Zealand. The conversion of grassland or permanent cropping to tillage cropping was estimated to result in C losses in the range 2.2 to 6.2 tCO_2e/ha/year. These losses were largely due to vegetation clearance, increased soil organic matter decomposition rates upon cultivation and losses of C through erosion (Freibauer *et al.,* 2004). For example, Figure 1 clearly demonstrates soil OC loss as a result of ploughing out grassland for tillage cropping at two sites on silty soils in Lincolnshire (Garwood *et al.,* 1998). Here, the decline in soil C (0-15 cm) was equivalent to 33 t C/ha and 13 t C/ha (i.e. 3.8 and 1.5 tCO_2e/ha/year), respectively.

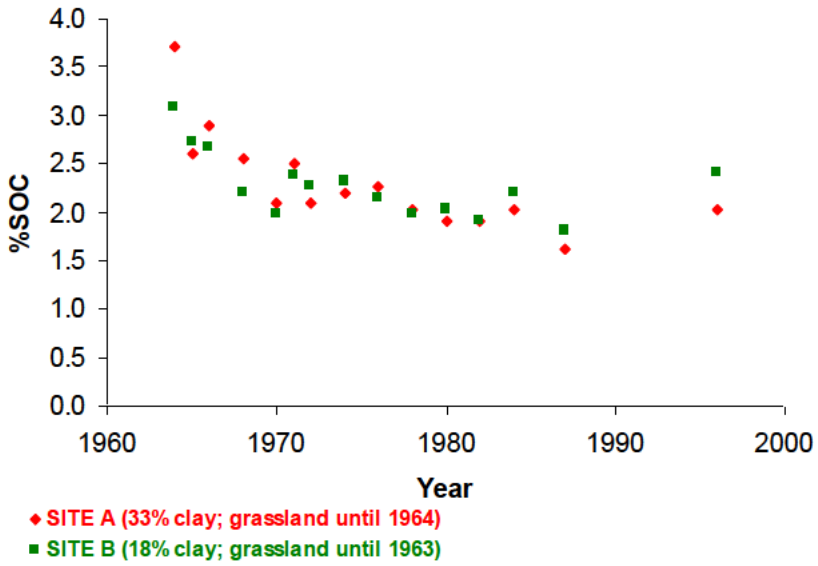

Figure 1. Decline in topsoil (0-15cm) organic carbon (SOC) following the ploughing-out of long-term grassland in Lincolnshire, UK (Garwood *et al.,* 1998).

In contrast, the conversion of tillage land to grassland can result in increased C storage in the range 1.1 to 7.0 tCO_2e/ha/year (Dawson & Smith, 2006). Indeed, recent results from a medium-term arable reversion experiment on a heavy clay soil (54% clay) at Faringdon in Oxfordshire (Figure 2; Williams *et al*., 2008) showed a 24% increase in soil C (0-15 cm) after 6 years of arable reversion to grassland (equivalent to 9.2 tCO_2e/ha/year). Conversion of tillage land/grassland to forestry has been estimated to increase soil C storage in the range 0.4 to 2.3 tCO_2e/ha/year (Dawson & Smith, 2006). However, there will also be C stored in the vegetation itself, which Dawson and Smith (2006) estimated to range between 0.3 and 5.6 tCO_2e/ha/year depending on the tree species, harvest frequency and climatic conditions.

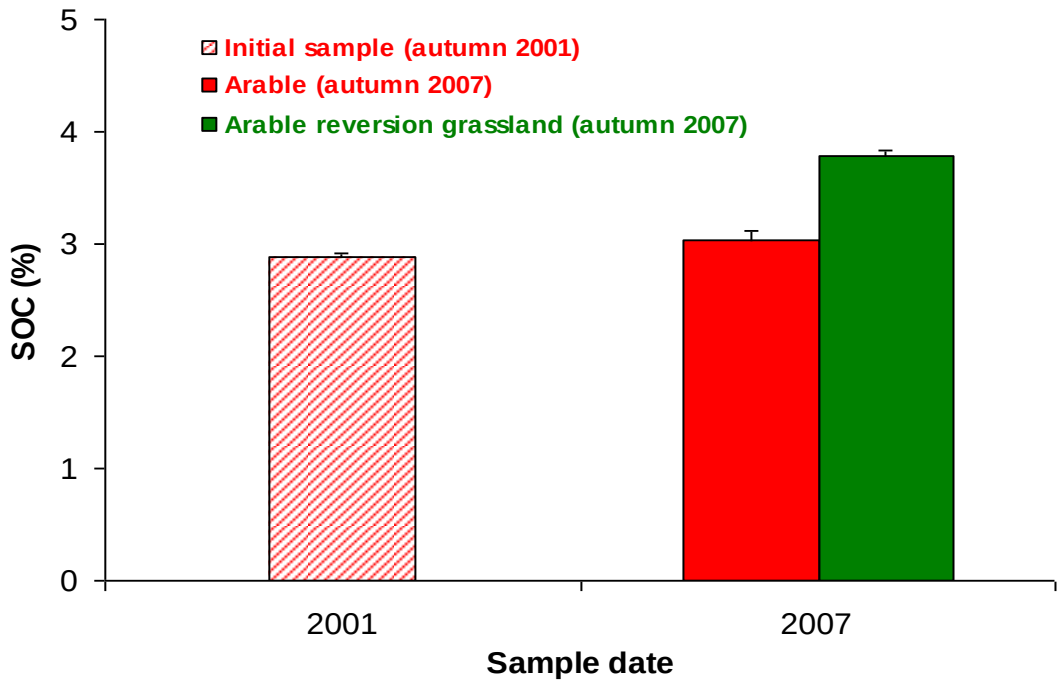

Figure 2. Changes in soil organic carbon (SOC) on arable reversion grassland plots at Faringdon (Oxfordshire) between 2001 and 2007.

The quantity of C that can be stored in any soil is finite. After a change in management practice, SOM (& C) levels increase (or decrease) towards an equilibrium value (after *c.*100 years or more) that is characteristic of the soil type, land use and climate (Johnston & Poulton, 2005). The relatively 'high' annual rate of SOM accumulation (C storage) in the early years after a change in land-use cannot be maintained indefinitely and the annual rate of SOM increase will decline (eventually to zero) as a new equilibrium is reached. It is therefore unlikely that the initial rate of increase in SOM following a change in land-use/management practice will be sustained over the longer term (>50 years), as a new equilibrium level is reached. Carbon storage is also reversible. Maintaining a soil at an increased SOM level, due to a change in management practice, is dependent on continuing that practice indefinitely. Indeed, SOM is lost more rapidly than it accumulates (Freibauer *et al.,* 2004). Only if land is taken *permanently* out of cultivation (i.e. to permanent grassland or woodland), will the benefits of SOM accumulation and C storage be realised over the long-term. This obviously has implications for rotational cropping, although the introduction of rotational grass or grass/clover leys has been shown to increase SOM by *c*.1%/yr (Smith *et al*., 1997) due to a reduction in the frequency of tillage (equivalent to a saving 1.76 tCO_2e/ha/yr; King *et al.,* 2004), although the evidence for this is limited.

Method 1a. Convert tillage land to permanent grassland

Description: Increase SOM by changing the land use from tillage land to either ungrazed or grazed permanent grassland.

Potential for applying the method: The method is applicable to all forms of tillage land, but whole-scale conversion is potentially most suited to marginal tillage land that was historically kept as grazing land (e.g. steeply sloping land, shallow soils). Benefits will be greatest on soils low in organic matter.

Practicability: Large scale conversion of tillage land to permanent grassland is an extreme change in land use that is unlikely to be adopted by farmers, without the provision of suitable financial incentives. It may be particularly suited to areas where the converted land would have amenity or conservation value.

Likely uptake: Uptake of large-scale conversion is likely to be low due to the drastic impact on farm practice, requiring a complete change in farm business outlook.

Costs:

Total cost		£/ha
Ungrazed	Capital	0
	Annual	95
Grazed	Capital	890
	Annual	195

There is no capital cost where the land is un-grazed. However there are significant costs annually due to the loss of income from the arable crops, plus the cost of cutting.
In a grazed system there is a very significant initial capital outlay, due to the cost of purchasing livestock. The annual costs are also greater, however, profit from the livestock would largely offset this (Cuttle *et al*., 2007)

Carbon storage effectiveness: Where land use change is to permanent grassland, increased soil C storage is likely to initially (estimated to occur for up to 20 years) be in the range 1.9 to 7.0 tCO_2e/ha/year (Dawson & Smith, 2006). The actual value will depend on soil type, previous land use and climate, as well as the land area undergoing conversion, and rates will slow and eventually cease when a new equilibrium of soil C is reached (estimated to be after 50-100 years).

Other benefits or risks:

- The method is very effective in reducing nitrate (NO_3) leaching. Conversion to ungrazed grassland has been estimated to reduce NO_3 losses by >95% (Cuttle *et al*., 2007). If the converted land is used for extensive grazing (e.g. beef/sheep farming) NO_3 leaching losses are likely to be reduced by >50% (Cuttle *et al.,* 2007).
- Emissions of nitrous oxide (N_2O) would be reduced according to the area of land taken out of annual cultivation. Direct N_2O emissions are likely to be reduced as a result of lower inorganic fertiliser N additions (depending on previous inorganic fertiliser N addition levels) and indirect N_2O emissions as a result of lower nitrate leaching losses. However, indirect N_2O emissions would increase from grazed grassland as a result of emissions from livestock manure management.
- Conversion to grazed grassland would result in increased ammonia (NH_3) emissions, as a result of livestock and manure management.

- Conversion has been estimated to result in a *c.*50% reduction in the loss of P in the absence of grazing and a *c*.42% reduction under extensive grazing (Cuttle *et al.,* 2007).
- Conversion to ungrazed grassland would have no effect on faecal indicator organisms (FIOs), but extensive grazing would increase losses at the farm-scale because of the livestock providing a source of viable FIOs (Cuttle *et al.,* 2007).
- If the land was grazed (compared to previous tillage cropping), methane (CH_4) emissions would increase at the farm level, due to grazing ruminant livestock. However, this would only increase national CH_4 emissions if they were additional stock.
- There is much potential for a change in biodiversity value with changes in land use, although such improvements are not certain (e.g. Cole *et al*., 2007). A detailed analysis of this aspect of change in land use is beyond the scope of this study.
- There would be reductions in energy use on the farm and hence indirect CO_2-C savings.
- ***Taking land permanently out of production will result in a loss of farm income and reduces the land area for food production***.

Method 1b. Establishment of permanent field or riparian buffer strips

Description: Increase SOM by the establishment of permanent in-field or riparian grass buffer strips (as in Entry Level Stewardship-ELS; or Higher Level Stewardship-HLS), as well as permanent set-aside.

Potential for applying the method: The method is applicable to all forms of tillage farmland. Benefits will be greatest on soils low in organic matter.

Practicability: The establishment of permanent buffer strips is often more achievable than large scale conversion to permanent grassland.

Likely uptake: Uptake is likely to be dependent on the financial rewards offered by incentive schemes.

Costs: There is no capital cost. However, there will be some loss of income from the reduced area available for arable cropping.

Total cost		£/ha
Capital		0
Annual	In-field	32
	Riparian	16

(Cuttle *et al*., 2007)

Carbon storage effectiveness: See Method 1a - overall C storage will be lower because of the smaller land areas involved. However, in-field and riparian buffer strips would have an added advantage of reducing soil C losses through soil erosion from adjacent sloping tillage land (see Method 6).

Other benefits or risks:
- See Method 1a.

Method 2a. Establish permanent woodlands

Description: Increase SOM by changing the land use from tillage or grassland to permanent woodland.

Potential for applying the method: The method is applicable to all forms of tillage land and grassland, but large-scale conversion is potentially most suited to marginal tillage land that was historically kept as grazing land.

Practicability: Large-scale woodland creation is an extreme change in land use that is unlikely to be adopted by farmers, without the provision of suitable financial incentives. It may be particularly suited to areas where the converted land would have amenity or conservation value. Grants are currently available to establish new woodlands (e.g. the Forestry Commission's English Woodland Grant Scheme).

Likely uptake: Uptake of large-scale woodland creation is likely to be low due to the drastic impact on farm practice, requiring a complete change in farm business outlook.
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Cost: There is a potential saving of £150/ha of tillage land or grassland due to reduced inputs and cultivation (D. Harris ADAS, pers. comm.). However, there would be a significant cost annually due to the loss of income from the farming system (although the sale of wood products could offset this over the long-term).

Carbon storage effectiveness: Reported estimates of soil C storage from the conversion of tillage land to forestry are variable. For example, Dawson & Smith (2006) estimated an initial (20 years) increase in soil C storage in the range 1.1 to 2.3 tCO_2e/ha/year (50% uncertainty) for tillage land conversion, with a lower estimate for grassland conversions (0.4 tCO_2e/ha/year; 95% uncertainty). Estimates from Defra project BD2302 suggested a C storage rate of 3.0 tCO_2e/ha/year for tillage land and 3.4 tCO_2e/ha/year for grassland, whereas King *et al.* (2004) suggested an increase of 2-3 tCO_2e/ha/year for arable land and no change for grassland. In practice, C storage will depend on soil type, previous land use and climate, as well as the land area undergoing conversion, and rates will slow and eventually cease when a new equilibrium of soil carbon is reached (estimated to be after 50-100 years).

Other benefits or risks:

- The method is very effective in reducing NO_3 leaching. Woodland creation has been estimated to reduce NO_3 losses by >95% (Cuttle *et al.,* 2007).
- A reduction in direct N_2O emissions through lower inorganic N fertiliser inputs would be expected, according to the area of land taken out of annual cultivation, and depending on the previous inorganic fertiliser N addition levels. Indirect N_2O emissions would decrease as a result of lower nitrate leaching losses.
- In the longer term, there may be green house gas (GHG) substitution benefits through the increased use of timber products.
- Long-term biomass stocks (and associated C storage) would be increased with woodlands, with C storage in the biomass estimated in the range 0.3 and 5.6 tCO_2e/ha/year depending on the tree species, harvest frequency and climatic conditions (Dawson & Smith, 2006), although higher values have been reported (e.g. Defra, 2007).

- Creation of farm woodland has been estimated to reduce the loss of P by 50% in the absence of cultivation, with similar sediment loss reductions in surface runoff expected.
- A reduction in FIO losses would be expected through a change from grazed land to woodland, otherwise no change would be expected.
- There is much potential for a change in biodiversity value with changes in land use, although such improvements are not certain (e.g. Cole *et al.,* 2007). A detailed analysis of this aspect of change in land use is beyond the scope of this study.
- There would be reductions in energy use on the farm and hence indirect CO_2-C savings.
- ***Taking land permanently out of production will result in a loss of farm income and reduces the land area for food production.***

Method 2b. Establish farm woodlands/hedges

Description: Increase SOM by the small-scale creation of farm woodland/hedges, as described in various ES options (e.g. new hedges, shelter belts, in field trees and field corner management options).

Potential for applying the method: The method is applicable to all forms of tillage farmland and grassland.

Practicability: The establishment of small 'pockets' of woodland, new hedges and in-field trees may be more achievable than large scale schemes.

Likely uptake: Uptake is likely to be dependent on the financial rewards offered by incentive schemes.

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Cost: There will be some loss of income from the reduced area available for tillage cropping or grass production.

Carbon storage effectiveness: See Method 2a - overall C storage will be lower because of the smaller land areas involved. However, establishing new hedges would have an added advantage of reducing soil C losses through soil erosion from any adjacent sloping tillage land (see Method 6).

Other benefits or risks:

- See Method 2a

Method 3. Grow biomass crops (i.e. willow, poplar, miscanthus)

Description: Increase SOM by growing perennial biomass crops (e.g. willow, poplar, miscanthus) to displace fossil fuel use, either through direct combustion or through biofuel generation (e.g. by gasification).

Potential for applying the method: The method is applicable to all forms of tillage farmland. There would be little or no benefit to SOM levels through converting grassland to biomass crops.

Practicality: A change in land use to biomass cropping is unlikely to be adopted by farmers, without the provision of suitable financial incentives. Defra's Energy Crop Scheme closed to new applications for establishment grants in June 2006.

Likely uptake: Low, due to changes to the farming system, unless financial remuneration is available.

Cost: Neutral up to potential savings of £10/ha of tillage land (D. Harris, ADAS, pers. comm.)

Carbon storage effectiveness: Estimates of the potential C storage from biomass cropping are largely based on those for woodland creation where poplar or willow are grown, and from arable reversion to grassland where miscanthus or other energy grasses are grown. Conversion of tillage land to *permanent* willow or poplar cropping has been estimated to *initially* (10 years) increase soil C storage in the range 2.0-3.0 tCO_2e/ha/year, depending on soil type, previous land use and climate (King *et al*., 2004). For miscanthus and other energy grasses, estimates were slightly lower at 1.8-2.7 tCO_2e/ha/year. Dawson and Smith (2006) estimated a value of 2.4 tCO_2e/ha/year for conversion to bioenergy production. As with woodland creation, there will also be significant C storage in the biomass itself. However, it should be noted that most biomass crops have a life-span of *c.*25 years (20 years for switch grass and 5 years for reed canary grass) before re-establishment.

Other benefits or risks:

- This method will be effective in reducing NO_3 leaching because the land is not cultivated annually and inorganic fertiliser N rates are low-moderate.
- Direct emissions of N_2O would be reduced due to reductions in inorganic fertiliser N addition rates and indirect emissions due to the absence of annual cultivation and associated lower NO_3 losses.
- It has been estimated that permanent biomass cropping would result in an overall 50% reduction in the loss of P (in the absence of cultivation), with similar sediment loss reductions in surface runoff expected.
- The effects of biomass crops such as short-rotation coppice willow and miscanthus on biodiversity and wildlife value have been encouraging (e.g. Sage *et al.,* 2006), although not entirely clear; and are being investigated further in Defra project IF0104.
- Biomass crops have a greater demand for water than most tillage crops.
- A change of land use from food (human and livestock) crops to biomass crops has implications for the sustainability of food production in the UK. Increased use of prime land for energy crop production would lead to greater reliance on food imports. Also, increased production of cereals in other countries to supply UK needs

may lead to greater deforestation of land to grow crops and use of practices (overseas) that result in a net increase of GHG emissions, in addition to increase fuel use for food transport.

Method 4. Introduce rotational grass

Description: Increase SOM by introducing rotational grass or grass/clover leys for 2 years (or more) in a 6 year rotation (often termed agricultural extensification), thereby reducing the frequency of tillage operations.

Potential for applying the method: The method is applicable to all forms of tillage farmland.

Practicality: A change in land use to rotational cropping is unlikely to be adopted by farmers without the provision of suitable financial incentives.

Likely uptake: Low, due to the changes to the farming system, unless financial remuneration is available.

Cost: Would depend on farm specific circumstances i.e. the proportion of cover and longevity of the grass ley, plus any livestock produce from the grassland area.

Carbon storage effectiveness: The benefits to soil C storage of introducing ley-arable cropping are questionable, with conflicting evidence. In particular, there is uncertainty about how much of the potential increase in SOM from a 2 year ley will be maintained over the long-term. Results from the long-term ley-arable experiments at Rothamsted and Woburn, demonstrate that the inclusion of 1-3 years grass leys within an arable rotation, have very little effect on SOM (Johnston & Poulton, 2005), with a 1 year ley having no effect on SOM levels, and a 3 year ley increasing SOM by 13-28% (measured after 15-28 years), compared to annual tillage cropping. Using these results, together with results from two European studies, Smith *et al.,* (1997) estimated a potential C storage rate of 1.02%/yr compared to annual tillage cropping, equivalent to 1.76 tCO_2e/ha/yr (King *et al.,* 2004).

Other benefits or risks:

- Increased risk of NO_3 leaching on ploughing out the grass leys. However, this is likely to be balanced (or indeed outweighed) by N 'immobilisation' in accumulated SOM reserves.
- Direct emissions of N_2O could be reduced during the ley phase of the rotation due to reductions in inorganic fertiliser N addition rates (dependent on the management of the ley).
- A reduction in P losses is likely during the ley phase, due to the permanent grass crop cover.
- There would be reductions in energy use through the lack of annual cultivations and hence indirect CO_2-C savings.
- Depending on use of the ley phase of the rotation there could be a reduction in potential food and fibre production (and hence farm incomes).

Method 5. Water table management

Description: Increase the height of the water table (at a catchment scale) and/or allow existing (old) drainage systems to naturally deteriorate, i.e. cease to maintain them (or block them). This will increase soil wetness and reduce SOM oxidation rates.

Potential for applying the method: This method is most applicable to grassland soils. It is also highly relevant to lowland organic/peaty soils, such as the Fens, where peat shrinkage and subsidence following drainage has led to considerable SOM losses (Holden *et al.,* 2007). The rewetting of Fenland soils has therefore been proposed as a measure for peat conservation. However, rewetting will inevitably limit the current use of this land for high output arable production and most likely result in arable reversion to grassland. There are around 6 million hectares of drained soils in England and Wales. Drainage deterioration is compatible with the HLS Scheme hence farmers may be able to obtain payment by, for example, restoring traditional water meadows. However, this method is not applicable to tillage land, as without an effective drainage system, economically sustainable arable cropping would not be possible on many heavy soils, particularly for farmers growing potatoes and sugar beet in the east of the country.

Practicability: The method is easy to implement, with the natural deterioration of drains requiring no necessary action. However, at the catchment scale an integrated Water Management Plan would need to be developed and approved by stake holders.

Likely uptake: Low, with considerable resistance from farmers to adopting this method as a deliberately managed activity, without any financial incentive. Although, the natural deterioration of many field drainage systems is probably occurring in practice, because farmers do not have the funds to replace ageing systems.

Cost: There will be a substantial loss of income due to reduced production levels.

Carbon storage effectiveness: There have been a limited amount of studies on the effects of raising the water table on soil C storage in lowland agricultural systems. Evidence from drainage studies largely conducted on upland peat soils have shown that soil respiration would decrease, but methane production would increase (see upland report by Worrall & Bell, 2009). Rewetting Dutch peat grasslands reduced the production of CO_2 from the soil by 14% (Best and Jacobs, 1997).

Other benefits or risks:

- Drainage systems can accelerate the delivery of agricultural pollutants from land to a watercourse, by acting as a preferential (by-pass) flow route. Allowing drainage systems to deteriorate therefore reduces hydrological connectivity and the potential transfer of pollutants to the watercourse. Also, water is forced to percolate through the soil at a slower rate, thereby increasing the opportunity for the retention or transformation of potential agricultural pollutants through physical filtration and biological activity in the soil. However, on sloping land there is a potential for surface run-off losses to increase. This method was assessed in balance to reduce both nitrate leaching and P losses (Cuttle *et al.,* 2007).
- If soils are wetter for longer, it is likely that nitrous oxide emissions will increase, though the size of any increase will depend mainly on inorganic fertiliser addition rate changes from previous management.

- There is a risk of increased poaching and surface run-off if drains are allowed to deteriorate (but overall losses of P, sediment and FIOs are likely to be smaller than from drained systems).
- The risk of pollutant transfer in surface run-off is particularly high where organic manures and inorganic fertilisers are applied to waterlogged soils on sloping ground.
- Undrained grassland will wet up earlier in autumn so that stock need to be removed earlier to avoid poaching. Overall stocking rates will also need to be reduced.
- Methane production is likely to increase for example, Best & Jacobs (1997) measured reduced CO_2 production by rewetting peat grasslands, but methane production increased 3-fold.

3.2. CATEGORY B: REDUCE SOIL EROSION

Rationale/mechanism of action: Soil erosion by water or wind can result in a significant loss of SOM associated with the eroding soil particles from agricultural fields, as well as in dissolved forms (DOC). In the Woburn Erosion Reference Experiment (Bedfordshire), loss of C by erosion accounted for 2-50% of soil C change (Quinton *et al*., 2006). For England and Wales, estimates of the amount of C-mobilized by erosion processes range between 200 and 760 ktC/yr, of which 80-290 ktC/yr is re-deposited and 120-460 ktC/yr is transported to surface waters (Quinton *et al*., 2006). Whenever soil particles are detached and carried by surface flow, silt and clay particles and organic matter are carried farthest – often to streams and rivers far away from the field of origin (Anon., 2005a). According to the Defra 2007 Farm Practice Survey, at least one incidence of soil erosion happens on 12% of holdings every year and on a quarter of holdings at least every 3 years (Anon., 2007). Soil erosion of some description has been observed on over 50% of farms.

Lighter soils, such as those with a high sand or silt content, tend to be more prone to erosion than those with stronger structures. In a study across England, mean annual soil erosion data varied between 0.22 t/ha/yr (medium and light loams, Cumbria) to 4.89 t/ha/yr (medium silts and loams, Somerset), (Brazier *et al*., 2001). However, the factors that control soil erosion and deposition are complex, and although inherent soil properties play a role in determining the level of erosion, slope angles and forms, weather and cropping management all affect loss rates.

There are two types of erosion by water; sheet erosion (from flows over the soil surface) and channel (rill and gully) erosion, with the latter tending to occur where soils lack vegetative cover (Dawson and Smith, 2006). However, on many farmland hill slopes, erosion rates from cultivation operations are similar to erosion rates caused by water (Govers *et al*., 1999). Surface run-off usually occurs during heavy storms or following prolonged rainfall, but can be accelerated if soil infiltration rates are reduced. Wind erosion can also cause a substantial loss of SOM in exposed landscapes (Smith *et al*., 2001). In England, this mainly affects agricultural land in the Midlands, East Anglia and Yorkshire (Dawson and Smith, 2006). Wind speed timing, soil dryness and surface roughness, texture and land use are important determinants of wind erosion potential

Maintaining good soil structure and promoting water infiltration and through-flow, reduces soil erosion risks and subsequent loss of SOM. In addition, good soil structure also promotes the efficient use of soil nutrients. Woodlands and the establishment of permanent pasture or cover crops (methods 1, 2 & 8) reduce erosion as the vegetation cover helps to protect the soil from the erosive impact of rainfall. In addition, minimal tillage cultivation systems (method 7) reduce soil disturbance and retain crop residues on the soil surface, thus reducing the risk of soil erosion. For bare soil or where there is little residue or vegetation to intercept rainfall, surface run-off risks will be increased. However, an increase in surface roughness through appropriate cultivations will encourage infiltration, as well as help reduce the erosive energy of any surface flow that is generated. Where land is sloping, furrows, tramlines and tracks orientated down the slope will tend to collect water and develop concentrated surface flow paths. This risk will be reduced if they are aligned across the slope (where slopes are even), increasing down-slope surface roughness and reducing the risk of developing surface sheet and rill flow.

Vegetated in-field buffer strips located along the contour on upper slopes or in valley bottoms function as sediment traps, and reduce the transfer of diffuse pollutants in surface

run-off from agricultural land to water. Likewise hedges act as ‘natural’ buffer strips and sediment traps and help to protect soils from wind erosion. According to the 2008 Defra Farm Practice Survey, the most common actions taken to reduce run-off, water and wind erosion in the last 12 months were working across rather than down slopes, loosening of tramlines and fencing watercourses to prevent stock eroding banks (Anon., 2008).

Appropriate land management can thus, help to reduce the risks of surface run-off and erosion, and maintain or enhance SOM.

Method 6. Take action to reduce soil erosion on tillage and grassland

A large (i.e. whole field) or small-scale (e.g. buffer strips or new hedges) change in land use, for example from tillage land to permanent grassland (including the establishment of field margins and buffer strips, methods 1 a&b) or the establishment of farm woodlands/hedges/shelter belts (methods 2 a&b) will reduce soil erosion. Other methods that reduce soil erosion, include the establishment of cover crops (method 8) and reduced/zero tillage systems (method 7). These methodologies are described in more detail in the relevant section of this document. The following section outlines a number of additional methods to reduce soil erosion and retain SOM in both tillage and grassland systems.

i. Cultivate compacted tillage soil

Description: Reduce soil erosion through the cultivation of compacted tillage soil, with discs or tines during dry conditions, well ahead of the start of drainage in late autumn. When soils are compacted or capped and there is little crop residue or vegetation to intercept rainfall, land can be susceptible to the generation of surface run-off and the movement of pollutants to a water body. Cultivation can disrupt soil surface compaction/crusts and increase surface roughness, enhancing water infiltration and drainage through the soil profile, rather than creating surface run-off. To further reduce erosion, a vegetative cover could be established over-winter either from natural regeneration or from broadcast grain etc.

Potential for applying the method: The method is applicable to tillage land where soils are compacted, particularly in high winter rainfall areas.

Practicality: The cultivation itself is straightforward. However, for the method to be effective it should be carried out in the late summer to early autumn (i.e. when soils are dry), when there can be many other competing demands for the farmer's time.

Likely uptake: Where compaction is identified as an issue uptake is likely to be high due to the simplicity of the method.

Cost: Light surface cultivation of tillage land to reduce soil erosion risks costs *c*.£4/ha/yr (Cuttle *et al.,* 2007).

Carbon storage effectiveness: Reductions in soil/sediment losses by cultivating compacted tillage soils have been estimated at 25% for a clay loam soil and 35% for a sandy loam soil (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique. However, this may partly be offset by increased oxidation losses following tillage (see category 3).

Other benefits or risks:

- Cultivation of compacted tillage soils in the autumn will enhance the mineralisation of soil organic N and water infiltration rates into the topsoil. This will increase the risk of NO_3 leaching by a small extent over the winter.
- A reduction in the soil component of phosphorus loss by an estimated 25% for a clay loam soil and a 35% reduction for a sandy loam soil (Cuttle *et al*., 2007).

ii. Leave autumn seedbeds rough

Description: Reduce soil erosion through the avoidance of operations that create a fine seedbed that will 'slump' and run together. A more open seedbed is achieved by using a reduced number of cultivations, particularly from powered cultivation equipment, and by avoiding the use of a heavy roller. This helps to reduce the risk of surface run-off by reducing soil capping and enhancing infiltration of surface water into the soil. A rough seedbed also helps to break up any surface flow that is generated, reducing the risk of sheet wash and rill/gully development.

Potential for applying the method: Applicable to the establishment of autumn-sown crops on tillage land. It is most applicable to winter cereal crops that can establish well in coarse seedbeds.

Practicality: The method is best suited to those crops that are able to establish effectively in a rough seedbed. As a result, it is not well suited to crops such as oilseed rape and reseeded grassland that require fine, clod-free seedbeds. Herbicide activity is most effective in firm and fine seedbeds; a rough seedbed can reduce activity. Also rough seedbeds can exacerbate slug problems.

Likely uptake: Low, due to the associated weed/pest control problems.

Cost: The cost may be zero (or even a saving on cultivation costs), but could be up to *c.*£100/ha if yield losses and increased costs from slug and weed control occurred; an average of £40/ha has been estimated (Cuttle *et al*., 2007).

Carbon storage effectiveness: Reductions in soil losses by leaving autumn seedbeds rough have been estimated at 25% for a clay loam soil and 35% for a sandy loam soil on sloping land (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other benefits or risks:

- 'Patchy' crop establishment or indeed crop failure due to a rough seedbed would reduce yields and lead to an increased risk of NO_3 leaching over the winter following harvest, as well as the risks associated with sediment losses from bare soils over winter following drilling.
- Enhanced infiltration rates may increase NO_3 leaching losses to a small extent as the water passes through the soil profile rather than over the surface as run-off.
- Herbicide activity is most effective in firm and fine seedbeds. A rough seedbed could reduce activity
- A rough seedbed may not be appropriate when there is a high risk of slug damage.
- A reduction in P losses of 35% and 25% for sandy loam and clay loam soils, respectively, has been estimated (Cuttle *et al*., 2007).

iii. Cultivate across the slope

Description: Furrows and tramlines orientated down the slope will tend to collect water and develop concentrated surface flow paths. Soil erosion can be reduced through cultivating and drilling across the slope. This reduces the risk of developing sheet and rill flow as the ridges created across the slope increase down-slope surface roughness and provides a barrier to surface run-off. Soils cultivated across the slope will also hold more water in surface depressions.

Potential for applying the method: Applicable to all tillage soils on sloping land, where slopes are regular.

Practicality: The method is more time-consuming and requires greater skill than conventional field operations. Cultivation and drilling should not be carried out across very steep slopes, due to the risk of machinery overturning. Consequently, this method is only likely to be effective for crops grown on gently sloping fields, with simple slope patterns. For steeper sloping fields with complex slope patterns, it is not practical to follow the contours accurately. In these fields, attempts at cultivations across the slope often lead to channelling of run-off water, particularly in tramlines or wheelings, which can cause severe gully erosion. For furrow crops, such as potatoes and sugar beet, harvesters only work effectively up and down the slope and therefore limit the practicality of this method being used.

Likely uptake: Low, as a result of only being practicable to cultivate across the slope on gently sloping fields with simple patterns; however, in localised areas it can be a useful technique.

Cost: The additional time required will depend on the size and configuration of the field. The cost of this method has been estimated at £3/ha (Cuttle *et al*., 2007). However, if more sophisticated techniques, such as a hillside combine, were needed, the cost could be higher.

Carbon storage effectiveness: Reductions in soil losses by cultivating across the slope have been estimated at 25% for a clay loam soil and 35% for a sandy loam soil (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other costs and benefits:

- Depending on soil type a reduction in P losses of between 25% (clay loam) and 35% (sandy loam) have been estimated, accompanied by a corresponding reduction in sediment loss (Cuttle *et al*., 2007).
- The method has no effect on nitrate leaching losses.

iv. Manage over-winter tramlines

Description: The management of over-winter tramlines can help to prevent soil erosion, as tramlines can act as flow pathways increasing surface run-off. Therefore, avoiding their use in winter can reduce run-off volumes and prevent the down-slope transport of sediment-bound and soluble pollutants. If tramlines are required (e.g. for the application of pesticides), then tines can be used to disrupt the tramlines and increase surface roughness to encourage water infiltration, or they can be superimposed on the drilled crop.

Potential for applying the method: This method (either avoiding or disrupting/drilling tramlines) is applicable to winter cereals in all arable farming systems, particularly on light soils in areas with high winter rainfall. Tramline management (rather than avoidance) could also be potentially useful method to reduce soil erosion for a range of winter cropping.

Practicability: The avoidance of tramlines will only be possible where winter access to land, e.g. for pesticide application, is not required. However, in these situations tramline disruption or drilling are simple methods that can reduce the incidence of soil erosion.

Likely uptake: Where winter access is not required the uptake is likely to be medium.

Cost: If the spraying out of tramlines in spring was required there would be a need to mark out and make adjustments to the sprayer to treat only selected rows. This would be more time consuming and costly than conventional spraying. The cost of this has been estimated at £4.50/ha (Cuttle *et al.,* 2007).

Carbon storage effectiveness: Reductions in soil losses by tramline management have been estimated at 25% for a clay loam soil and 35% for a sandy loam soil (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other costs and benefits:

- Depending on soil type a reduction in P loss of between 25% (clay loam) and 35% (sandy loam) has been estimated, accompanied by a corresponding reduction in sediment loss (Cuttle *et al*., 2007).
- The method has no effect on nitrate leaching losses.

v. Early establishment of winter crops

Description: Harvest crops such as maize and sugar beet early (e.g. September rather than October), and establish autumn sown crops early (ideally by mid September). Earlier harvesting of crops, especially those that are traditionally harvested late, will mean that harvesting is likely to be undertaken when soil conditions are drier, avoiding severe compaction and soil damage that can generate surface run-off. Also, the early establishment of autumn sown crops means the crop will be in the ground earlier, and will result in more established vegetation cover to protect the soil from the erosive impacts of rainfall.

Potential for applying the method: The method is applicable to all tillage systems growing late harvested crops, especially in high rainfall areas.

Practicality: The early harvesting of crops such as maize and sugar beet can 'clash' with the harvesting of winter cereals, creating more work at a time when farmers are already very busy.

Likely uptake: Medium, there can be yield penalties from early harvesting and there may be a 'clash' with other farm operations.

Cost: No added harvesting/cultivation costs – but there may be a yield penalty in some situations.

Carbon storage effectiveness: This is has not been quantified as there are no experimental data available on the potential reduction in soil erosion by adopting this method, however, similar reductions to those delivered by method 8 can be expected.

Other costs and benefits:

- This method is likely to reduce nitrate leaching due to a reduction in the time soils are left fallow in the autumn, as well as soil P losses, due to a reduction in soil erosion.

vi. Fence off rivers and streams from livestock

Description: Reduces soil erosion of river/stream banks by the construction of stock-proof fences in grazing fields and on tracks adjoining rivers and streams. Livestock, particularly cattle, can cause severe trampling damage to river/stream banks when attempting to gain access to drinking water. The vegetative cover is destroyed and the soil badly poached, leading to erosion of the bank and increased transport of soil particles and associated P into the watercourse. Fencing to prevent access to the banks eliminates this source of erosion and SOM loss, as well as associated waterway pollution (particularly from FIOs).

Potential for applying the method: The method is applicable to farms with grazing livestock and to all soil types. Benefits will be greatest on heavily stocked farms, particularly those with cattle. The method is not applicable to outdoor pigs, as these are more securely fenced and do not have access to rivers or streams.

Practicality: The method would be less feasible on upland beef/sheep farms with extensive areas of rough grazing and considerable lengths of unfenced river/stream banks. There would also be a need to provide an alternative source of drinking water.

Likely uptake: This method is only likely to be adopted where stream bank erosion is severe and an alternative water source can be provided.

Costs: There will be an initial capital investment in fencing required (*c.*£3/m), as well as maintenance costs and a requirement for an alternative water source in many cases. For a dairy farm with twelve fields adjacent to water Cuttle *et al.* (2007) estimated annual costs of £11/ha (including amortised capital costs).

Carbon storage effectiveness: The method has been estimated to reduce soil losses by 50% from the area at risk to stream bank erosion (Cuttle *et al*., 2007). However, this will only be a small proportion of the total farm area, even for farms with large river/stream bank areas.

Other benefits or risks:

- Livestock can add nutrients and FIOs directly by urinating and defecating into the water. Preventing access eliminates this source of pollution (Cuttle *et al*., 2007).
- The method has been estimated to reduce the soil and manure components of P losses by 50% (Cuttle *et al*., 2007).
- The method will also reduce water pollution risks from ammonium-N, suspended sediment and enhanced levels of biological oxygen demand (BOD).

vii. Move feed/water troughs at regular intervals

Description: Feeding troughs, feeding racks and water troughs for outdoor stock should be re-positioned at regular intervals to reduce damage to the soil and improve the distribution of excreta. Troughs and racks should be moved more frequently when the soil is wet and easily poached. They should not be sited close to water courses.

Potential for applying the method: The method is more applicable to beef/sheep systems than dairy, where feed is commonly provided in the field (except for buffer feeds). It is especially relevant to farms where livestock are out-wintered. Indeed, feed troughs and feeding points are already routinely moved on some farms. There is a greater risk of poaching from cattle than from sheep, with outdoor pigs particularly destructive. The potential to reduce poaching will be greatest on imperfectly and poorly drained soils.

Practicability: The regular re-positioning of feeding troughs/racks is a simple method, with few limitations to its implementation. However, it is more difficult to vary the position of water troughs. This would probably require use of a bowser or installation of a number of permanent drinking points within the field, as used on dairy farms that employ a strip-grazing system. However, this can be a considerable cost to the business. This method may not be applicable to land that is very easily poached, where frequent moving of feeding points may increase the number of poached areas and make the situation worse. So, the method would only really be effective when applied in combination with method 6ix) to reduce field stocking rates when soils are wet. In some situations, it may be necessary to locate the feeding point on a hard-standing. In all cases, feeders and troughs should be located away from water courses to break the hydrological link between the poached area and surface water.

Likely uptake: Medium, depending on the location of water sources

Cost: Low cost (<£10/ha, D. Harris, pers. comm.), for moving feed troughs/racks, but more expensive if water troughs need to be moved.

Carbon storage effectiveness: The method has been estimated to reduce soil losses by 15% (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other benefits or risks:

- This method will have minimal effect on nitrate leaching losses.
- Introduction of this method has been estimated to reduce soil P losses by 15% and losses by 10% (Cuttle *et al.,* 2007).
- The method would also reduce water pollution from ammonium-N, sediment and enhanced levels of BOD.
- There may also be reductions in gaseous losses of ammonia, nitrous oxide and methane.

viii. Loosen compacted soil layers in grassland fields

Description: Reduce soil erosion and loss of organic matter from grassland fields by shallow spiking or topsoil loosening to disrupt compacted soil layers in dry/moist conditions. Trampling by livestock, particularly cattle, and the passage of heavy farm machinery can compact the upper layers of grassland soils in both grazing and silage fields. As the soil is cultivated only infrequently, the compaction can persist and build-up over a number of years. As a result, porosity is reduced and this impedes the percolation of rainwater and slurry, increasing the risk of surface run-off. Shallow spiking or topsoiling can break up the compacted layer and allow more rapid infiltration of water, thus reducing run-off from the soil surface. In addition, soil aeration can be improved and roots are able to penetrate deeper into the soil, which will increase water and nutrient uptake from deeper soil layers.

Potential for applying the method: The method is applicable to all grassland farms, but particularly those with high cattle stocking rates.

Practicality: There are few limitations to the adoption of this method although loosening operations may be more difficult on stony soils. Also, the timing of the loosening operation is important so as not to damage the grass sward or to cause smearing of the soil.

Likely uptake: Where compaction is identified as an issue, uptake is likely to be high due to the simplicity of the method.

Cost: For a typical dairy farm, the costs of topsoil loosening (using a flat-lift) have been estimated at £43/ha (Cuttle *et al*., 2007).

Carbon storage effectiveness: The method has been estimated to reduce the soil component of P loss by 70% and 50% for sandy loam and clay loam soil types, respectively (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique. However, this may partly be offset by increased oxidation losses following cultivation (see category 3).

Other costs and benefits:

- A reduction in the soil component of P loss by 70 and 50% for sandy loam and clay loam soil types, respectively (Cuttle *et al*., 2007).
- Reduced surface run-off will also decrease water pollution by nutrients etc., particularly following manure/inorganic fertiliser applications.
- Where slurry has been applied, increased infiltration will reduce gaseous ammonia emissions.
- Improved infiltration and aeration of the soil will reduce nitrous oxide emissions but may slightly increase nitrate leaching losses.

ix. Reduce stocking density

Description: Poaching can exacerbate the transport of sediment (and nutrients) to watercourses by exposing bare soil and increasing surface run-off. A reduction in stocking density can help to minimise soil structural damage from poaching and hence reduce soil/sediment losses.

Potential for applying the method: The method is applicable to all livestock farms, but will have the greatest impact on heavily stocked units where the risks of soil structural damage are greatest. Poaching is generally more severe with cattle grazing than with sheep, and is particularly severe with outdoor pigs.

Practicality: The method is relatively simple to put into practice, but the main factor limiting its adoption would be the reduction in farm income resulting from reduced stock numbers. It is most likely that a reduction in livestock would be achieved through a reduction in the number of livestock farms, rather than by reducing the numbers of stock on individual farms. A moderate reduction in the overall stocking rate can be achieved on dairy farms by reducing the cow replacement rate, so that fewer young stock need to be kept on the farm. Some dairy farms may convert to extensive beef/sheep systems. Reducing stock numbers might encourage farms to become more reliant on clover-based swards to reduce costs by replacing inorganic N fertiliser with biologically fixed N.

Likely uptake: Very low, due to the impact on overall farm profitability. In most cases farmers' would require additional funding incentives to reduce stocking rates.

Costs: Cuttle *et al*. (2007) estimated the cost of a 50% reduction in livestock numbers on individual farms to result in a halving of the gross margin on dairy, beef and outdoor pig farms.

Annual cost for farm systems	**Dairy**	**Beef**	**Outdoor pigs**
Cost £/ha	309	55	2,700
With additional change to a clover-based system using no inorganic fertiliser N			
Cost £/ha	274	35	n/a

Source: Cuttle *et al*., (2007)

Carbon storage effectiveness: The method has been estimated to reduce the soil component of P loss by 18% for a sandy loam soil (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other benefits or risks:

- Reducing the number of stock will reduce the amounts of excreta and manure produced per unit area. In particular, much of the NO_3 leached from grazed pastures originates from urine patches. With lower stocking rates, there would be fewer urine patches and less NO_3 available for leaching.
- A 50% reduction in livestock numbers has been estimated to reduce N leaching by 10-25 kg N/ha on a dairy farm; and 3-5 kg N/ha on a beef/sheep farm (Cuttle *et al*., 2007).
- Reducing stock numbers (by 50%) has been estimated to result in a reduction in soil, manure and inorganic fertiliser P losses from dairy or beef farms of up to 35% on clay loam soils (Cuttle *et al*., 2007).

- As the farm would need to produce less forage, inorganic fertiliser rates would also be reduced.
- There will also be reductions in NH_3, CH_4 and N_2O losses, as well as FIOs (Cuttle *et al*., 2007).

3.3. CATEGORY C: CHANGE TILLAGE/CULTIVATION PRACTICES

Rationale/mechanism of action: Most commonly, tillage crops are established in the UK by mouldboard ploughing to a depth of at least 20 cm (typically 20-25 cm), followed by secondary cultivations (e.g. harrow, powered tillage, disc/tine) to provide a seedbed for drilling ('conventional tillage'). Cultivations are carried out in the autumn for all winter-sown and some spring-sown crops. Reduced tillage is a term that is used to describe all non-plough based cultivation practices. At the extreme, zero tillage ('no-till') is where seed is drilled directly into an uncultivated soil surface ('direct drilling') or simply broadcast onto the soil surface. Most commonly in reduced tillage systems, crops are established using shallow cultivation techniques (i.e. discs or tines) working to 10-15 cm (or less), or even just following rotary-harrowing of the soil surface (i.e. combined harrow and drill techniques). In England and Wales in 2005, *c*.50% of primary tillage practices used mouldboard ploughing ('conventional tillage') and *c.*43% used reduced tillage methods (i.e. heavy discs, tines or powered cultivators), with direct drilling/broadcasting (i.e. no cultivation) occurring on *c.*7% of the tillage area (Anon., 2005). Provisional figures for 2006 suggest a similar distribution (Anon., 2006a). The main drawbacks to zero tillage in the UK have been grass weed and disease problems, and the build-up of soil compaction.

Reduced tillage has been widely promoted as a potential means of increasing SOM levels and storing C within soils, due to less soil disturbance (and hence SOM decomposition) and reduced soil erosion rates. The effects of tillage practices on SOM levels have largely been derived from medium-long term experiments measuring changes in soil C following the adoption of a particular tillage practice. Bhogal *et al.* (2007) critically reviewed the extent to which reduced tillage practices could increase the C content of arable soils in the context of England and Wales. Most studies reported in the literature have been carried out in North America and Australia (e.g. Alvarez, 2005; Follett, 2001; VandenBygart *et al*., 2003; West & Post, 2002,) where the benefits of reduced tillage are recognised (in terms of water conservation) and zero-tillage is widely carried out. Although even here, many of the increases in SOM measured following reduced/zero tillage were confined to the top 10-15 cm. Where deeper soil samples have been taken, apparent differences between tillage systems have often disappeared (Baker *et al.,* 2007; Machado *et al.* 2003).

There have only been a limited number (6 studies) of contrasting tillage studies in the UK (Cannell and Finney, 1973; Powlson and Jenkinson, 1981; Chaney, 1985; Ball, 1994). Taking an average of the soil C changes measured in these studies, Bhogal *et al.* (2007) estimated an initial C storage potential of 1.14 tCO_2e/ha/yr for zero tillage under UK conditions (up to c.20 years). This equates to c.0.35% of the typical organic C content of an arable soil in England and Wales (@ 91 t/ha, assuming 28 g/kg C in the topsoil; Webb *et al.,* 2001). Reduced tillage was estimated to have half the C storage potential of zero tillage at 0.59 tCO_2e/ha/yr. These estimates of potential C storage increases from zero and reduced tillage should NOT be considered to be annually cumulative, as typically tillage land in the UK is ploughed every 3 to 4 years to reduce the build-up of weeds, diseases and soil compaction levels. It is arguable that much (if not most) of the stored C will subsequently be released as a result of the soil disturbance caused by ploughing.

There is also limited evidence that zero/reduced tillage can increase direct emissions of nitrous oxide (N_2O) by up to an equivalent of *c*.0.70 tCO_2e/ha/year (compared with conventional tillage), due to an increase in topsoil wetness and/or reduced aeration as a result of less soil disturbance (MacKenzie *et al.,* 1998; Goulding *et al*., 2007). Nitrous oxide is a powerful greenhouse gas with 310 times the global warming potential of CO_2, such

that overall, increased N_2O emissions may completely offset the balance of greenhouse gas emissions compared with the amount of C potentially stored through changing from conventional to reduced/zero tillage practices. However, the evidence is not clear and further work is required to determine the effect of contrasting tillage systems on N_2O emissions, C storage and the overall balance of greenhouse gas emissions.

Any tillage practice that reduces the level of soil disturbance is likely to have an impact on SOM levels, due to a potential reduction in SOM decomposition rates and losses. Therefore, the avoidance of root crops and associated deep cultivations could potentially help maintain SOM levels in vulnerable soils.

Method 7. Adopt reduced or zero tillage systems

Description: Reduce SOM decomposition rates, by using discs or tines as a primary cultivation (rather than ploughing) in seedbed preparation (reduced till); or direct drill into stubbles (zero-till).

Potential for applying the method: This method is already adopted on a number of arable farms, with around 1.5 million hectares cultivated using discs or tines in England and Wales. It is most commonly applied to medium to heavy soils, although the practice is increasingly being carried out on lighter soils.

Practicability: No-till is generally unsuitable for light soils, largely because of compaction build-up risks. Reduced tillage is less appropriate in a wet autumn and only where any lower topsoil/subsoil structural problems have been alleviated. Reduced tillage may increase resistant weed populations and therefore increase reliance on chemical control (Davies *et al.,* 2006). Commonly reduced tillage land is ploughed every 3-4 years to relieve compaction problems and to control grass weeds/diseases.

Likely uptake: Aside from the issues raised above, the expense of purchasing new equipment is the largest barrier to uptake, as such it is only likely to be used on larger predominately combinable crop farms.

Cost: Implementation is likely to result in a net saving due to reduced labour and tractor time (Cuttle *et al.,* 2007).

Annual **savings**	Arable
Likely net **savings** £/ha	40

Carbon storage effectiveness: Crop establishment using zero tillage has been estimated to have an initial C storage potential of 1.14 tCO_2e/ha/yr under UK conditions (95% confidence interval: -0.5, 2.79). Reduced tillage has been estimated to have half the C storage potential of zero tillage at 0.59 tCO_2e/ha/yr (Bhogal *et al.,* 2007; Chambers *et al*., 2008). These estimates can only be regarded as the initial rate of increase (up to <20 years), and will slow and eventually cease when a new equilibrium soil C level is reached. They should also not be considered to be annually cumulative, as arable land in the UK is typically ploughed every 3 to 4 years to reduce the build-up in weeds, diseases and soil compaction levels. It is arguable that much (if not most) of the stored C from reduced/zero tillage practices will subsequently be released as a result of the increased soil disturbance caused by periodic ploughing.

Other benefits or risks:

- There are many benefits of adopting reduced/zero tillage cultivation systems besides the possibility of increasing soil C levels. Reduced tillage is effective at protecting and therefore maintaining existing SOM from decomposition, leading to improvements in soil structure, infiltration and water retention. Reduced tillage also protects soils against soil water/wind erosion, with reductions in surface run-off particularly effective when a mulch of crop residues is left on the surface.
- Reduced soil erosion will lead to a decrease in P and sediment losses. In the short-term, total P losses in surface run-off have been estimated to decrease by 5% from clay loam soils (Cuttle *et al.,* 2007). However, in the long-term following repeated reduced tillage research has shown that dissolved P losses can increase.

- Nitrate leaching will decrease to a small extent (0-5 kg N/ha) compared with ploughing, through reduced mineralisation of SOM following autumn cultivation (Cuttle *et al*., 2007).
- There is a possibility in some circumstances that the incorporation of large volumes of straw into a small volume of soil under a reduced tillage system may immobilise so much N that it will restrict crop growth and create a need for autumn application of inorganic fertiliser N. Note: recommended inorganic fertiliser N application rates are currently the same on ploughed and reduced/zero tilled land (Anon., 2000).
- There will be reduced production costs and fossil fuel savings due to a reduction in cultivation energy inputs. These have been estimated to be 0.08 tCO_2e/ha/year from reduced/zero tillage compared with ploughing (Bhogal *et al.,* 2007).
- There is limited evidence that zero/reduced tillage can increase direct emissions of N_2O by up to an equivalent of *c*.0.70 tCO_2e/ha/year (compared with conventional tillage), due to an increase in topsoil wetness and/or reduced aeration as a result of less soil disturbance (MacKenzie *et al.,* 1998; Goulding *et al.,* 2007). In contrast, reduced tillage systems have been estimated to decrease indirect N_2O emissions by up to *c.*0.03 tCO_2e/ha/year, due to decreased nitrate leaching losses (0-5 kg/ha) following autumn cultivation (Cuttle *et al*., 2007). Nitrous oxide is a powerful greenhouse gas with 310 times the global warming potential of CO_2, such that overall, increased N_2O emissions may completely offset the balance of greenhouse gas emissions compared with the amount of C potentially stored through changing from conventional to reduced/zero tillage practices.

3.4. CATEGORY D: INCREASE ORGANIC MATTER ADDITIONS/RETURNS

Rationale/mechanism of action: A steady decline in livestock numbers over recent years in the UK coupled with high output of livestock production, has led to a decrease in the amounts of livestock manure applied to land (Jenkinson, 1988; FAO, 2005). In addition, advances in harvest efficiency have meant more effective removal of agricultural crops with consequently fewer crop residues left on the field, and the breeding of shorter straw length cereals has led to lower straw residue returns. Changes to grassland management practices, such as the increased production of silage rather than hay (Poulton, 1996), have also reduced the quantity of organic matter returned to soil. Furthermore, improvements in farm machinery (such as combine harvesters and silage cutters) have also led to increased crop residue removal (Dawson and Smith, 2006).

Topsoil organic matter increases can be directly related to organic matter inputs (Dick & Gregorich, 2004), with increases measured following both the application of organic manures and inorganic fertilisers, the latter due to increased crop residue returns (Schjonning *et al.,* 1994; Christensen & Johnston, 1997; Nicholson *et al.,* 1997). The recycling of organic materials to land is generally considered to be the best practicable environmental option for utilising the properties of these materials. Currently, around 90 million tonnes of farm manures (Williams *et al.,* 2000), 3-4 million tonnes of biosolids (Gendebien *et al.,* 1999; Chambers, 1998) and 4 million tonnes of industrial 'wastes' (Gendebien *et al.,* 2001) are applied (on a fresh weight basis) annually to agricultural land in the UK. These materials provide a valuable source of both nutrients and organic matter that could potentially increase SOM levels (Table 4). In addition to these organic materials, crop residues (particularly cereal straw), provide a means of returning C to soils, with an estimated 15 million tonnes of C potentially returned to UK arable soils (5 million ha) in straw, stubble and chaff each year (Bhogal *et al.,* 2007). Cover crops/green manures also have the potential to increase SOM, by protecting the soil from erosion over winter, and adding C following soil incorporation. The C:N ratio is an important determinant of residue quality and can influence initial nutrient turnover rates from applied sources (Dawson and Smith, 2006). The use of deeper rooting species and decomposition resistant crop residue species (high C:N ratio) may provide further benefits.

Table 4. Typical organic carbon additions from selected organic materials applied at a rate of 250 kg/ha total N (Anon., 2000; Chambers, 1998; Gendebien *et al*., 1999, 2000; Gibbs *et al.,* 2005)

Manure type	Application rate (t or m^3/ha FW)	Dry matter (%)	Organic C (t/ha)
Cattle FYM	42	25	4
Dairy slurry	83	6	2
Broiler litter	8	60	2
Digested sludge cake	33	25	3
Green waste compost	36	65	5
Paper crumble	75[a]	40	9

[a]Typical application rate of primary or secondary chemical/physically treated paper crumble = 75 t/ha fresh weight (equivalent to 150 kg/ha total N), Gibbs *et al.* (2005).

Method 8. Autumn establishment of cover crops or green manures

Description: Increase SOM through the establishment of cover crops on land that would otherwise be bare over-winter, an effective cover crop may be established immediately post-harvest or, at the latest, by mid-September. An alternative is to under-sow spring crops with a cover crop that will be in place to take up nutrients and provide vegetation cover once the spring crop has been harvested. In order to protect the soil surface throughout the period when runoff could occur, the cover crop should be destroyed close to the land being prepared for the following crop.

Potential for applying the method: This method is particularly applicable on light soils (and especially sloping land) where there are significant areas of spring crops. The cover crop can be established cheaply through seed broadcast followed by a light tine cultivation and rolling. The method can also be used in some grassland systems by under-sowing maize and spring barley, with a grass seed mixture.

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Practicality: It is difficult to establish a cover crop that will develop sufficient biomass to benefit SOM levels and reduce NO_3 leaching losses, ahead of sowing most autumn crops. For under-sown spring crops, some farmers prefer to wait until the main crop is established before under-sowing. However, this may only be practicable on well-drained soils. A cover crop can also be broadcast into the main crop before harvest, however, this may damage the standing crop and lead to some yield losses. Except where grass is being established as the following crop, autumn or post-harvest establishment of mustard (or a similar crop) is likely to provide the most effective cover.

Likely uptake: Depends on the crop rotation and soil type. Where cover cropping is possible, a medium uptake is expected. However, overall uptake is expected to be low because of soil type and cropping limitations.

Costs: In most combinable crop fields, there will be good ground cover of volunteer plants and weeds following harvest if left uncultivated. In this case, the root balls of the harvested crop plants will hold the soil together well and a light spring tine harrowing may be all that is necessary to assist re-growth and ground cover at a cost of £10/ha/year. In other crops, ground cover may be poor due to the lack of re-growth and the time of year of the harvest operation. Cultivation costs would then be incurred for cover crop establishment at *c.*£17.50/ha plus an average cost of £50/ha for the seed, giving a total of £67.50/ha (Cuttle *et al*., 2007).

Carbon storage effectiveness: Cover cropping has been shown to result in short-term (less than one season) increases in SOM (Sainju *et al.* 2000; 2001; 2002). Additionally, the annual use of cover cropping has been shown to maintain SOM levels, where SOM had otherwise decreased. For example, Sainju *et al.* (2002) measured a 25% decrease in SOM following six years of conventional tillage without cover crops, whereas with a hairy vetch cover crop (returning *c.*0.7 tC/ha/yr) SOM levels only declined by 1 % and with a rye cover crop (returning *c.*3.7 tC/ha/yr) SOM levels increased by 3-4 %. In the UK, cover crops such as mustard, rye, volunteer wheat/barley/oats have been shown to be an effective management tool for reducing over-winter nitrate leaching losses (Cook & Froment, 1996). No measurements of potential C storage increases have been made, but with typically only 0.5-1.0 t/ha above-ground biomass production (Harrison & Peel, 1996), soil incorporation is likely to have limited benefit to SOM levels. Indeed, the main benefit of cover cropping is likely be due to a reduction in soil erosion and associated loss of soil C

on sloping land, rather than organic matter addition via crop incorporation, as the green material tends to rapidly decompose. The method has been estimated to reduce the soil component of P loss by 25% on a sandy loam soil and 35% on a clay loam (Cuttle *et al*., 2007). It can be assumed that similar reductions in SOM losses would be expected by adoption of this technique.

Other benefits or risks:

- Depending on growth of the cover crop and the time of onset of drainage, typical nitrate leaching loss reductions have been estimated in the range 10 to 45 kgN/ha in the year of establishment (Cuttle *et al*., 2007).
- Cover cropping has been estimated to reduce the soil component of P losses by 25% and 35% on clay loam and sandy loam soils, respectively (Cuttle *et al*., 2007).
- Soil structural damage caused by establishing a cover crop late in wet conditions may compromise cover crop establishment. Residual NO_3 will be at risk of leaching from soils with a poorly established cover crop and soil structural damage will increase the risk of soil erosion and the loss of P and sediment.

Method 9. Incorporation of straw/crop residues

Description: Increase organic matter additions through the incorporation of straw or crop residues directly into the soil after harvest.

Potential for applying the method: Crop residues, particularly cereal straw, provide a means of returning organic C to soils, with an estimated 15 million tonnes of C returned to UK arable soils (5 million ha) in straw, stubble and chaff each year (Bhogal *et al*., 2007). The incorporation of straw and crop residues is widely practised in UK agricultural systems, where straw burning in the field is no longer permitted. Improved harvest efficiency in recent years has tended to minimise the amount of straw and crop residue remaining for incorporation after harvest. Additionally, plant breeding has reduced cereal straw lengths.

Practicality: The practicality of this method is high and it is already common practice on a wide range of farming systems.

Likely uptake: Uptake is already high and it is debatable whether it is practical to increase straw residue incorporation on a large-scale given the competing demands for straw as animal bedding, field vegetable mulches, as an energy source etc.

Cost: There will be a small cost for straw chopping on a combine and cultivation into the soil (*c*.£10/ha).

Carbon storage effectiveness: The incorporation of cereal straw has the potential to increase SOM of agricultural soils in England and Wales by 50 kg C/ha/yr/t straw applied (with 95% CI in the range 20-80 kg C/ha/yr/t), based on measurements at 8 study sites in England (Bhogal *et al.,* 2007). At typical incorporation rates (7.5 t/ha fresh weight), this equates to an increase of 0.37 t C/ha/yr (1.36 tCO_2e/ha/yr), which represents *c.*0.41% of the typical carbon content of an arable topsoil in England and Wales (assuming 28 g/kg soil organic C, 1.3 g/cm^3 bulk density and 25 cm soil depth; Webb *et al.,* 2001). However, this can only be regarded as the initial rate of SOM increase (up to *c.*20 years), as SOM accumulation rates decline with time.

Other benefits or risks:

- Incorporating crop residues that do not contain much nitrogen, such as cereal straw, into the soil in autumn will lead to small (<5kgN/ha) reductions in the amount of nitrate leached. In comparison with straw/crop residue removal, straw incorporation will cause some additional retention of N in SOM. This may cause short-term immobilisation of N, which in some circumstances may lead to the need for additional inorganic N fertiliser.

Method 10. Encourage use of livestock manure

Description: Increase organic matter additions through the regular application of livestock manures.

Potential for applying the method: The method can be applied to all types of cropping system where livestock manure is available or could be brought-in. It is particularly relevant to arable systems where it has been suggested (e.g. King *et al.,* 2004; Smith *et al.,* 1997) that manure should be preferentially targeted (rather than grassland), because arable soils tend to have lower SOM contents and hence a greater potential for increased SOM storage, although there are no robust scientific data to support this view. However, as most farm manures (the exception being *c*.580,000 tonnes of poultry litter that are used for electricity generation) are currently applied to land and livestock numbers are decreasing, sourcing additional supplies of livestock manure may be difficult for arable farms, particularly in areas where livestock farming is scarce.

There are several Codes of Practice and pieces of legislation that seek to 'control' the application of farm manures to agricultural land e.g. The Water Code (MAFF, 1998), Nitrate Vulnerable Zones (NVZs) Action Programme (Defra, 2002b) and recently introduced Cross Compliance measures and associated Statutory Management Requirements. In particular in NVZs, the application of organic materials should not exceed the field rate limit of 250 kg/ha total N per annum, and the overall farm N loading rate on arable land of 170 kg/ha total N.

Practicality: The addition of livestock manure to land is common practice on stocked farming systems and within many arable systems. However, there may be practical limitations to the uptake of this system on stockless systems related to manure availability and sourcing. Where the farmland is in a Nitrate Vulnerable Zone (NVZ), the application of manures must comply with the NVZ Action Programme rules (2009) on application rate limits (no more than 250 kg/ha total N may be spread as handled manure) and 'closed period' timings for high readily available N manures (i.e. slurries and poultry manures) on all soil types.

Likely uptake: High, although uptake will depend both on the availability of livestock manure for land application, as well as the price of inorganic fertiliser alternatives and the logistics of handling manures.

Cost: The use of livestock manures is likely to be at least cost neutral or most probably will result in a saving (due to the saving in inorganic fertiliser use).

Carbon storage effectiveness: The application of livestock manures to agricultural soils in England has the potential to increase SOM by an average of 60 kg C/ha/yr per tonne of manure dry solids applied, with 95% confidence intervals in the range 16-102 kgC/ha/yr/t (Bhogal *et al*., 2007). At a typical application rate equivalent to 250 kg/ha total N, *c*.0.63 t/ha/year (2.3 t CO_2e/ha/yr) additional carbon could be retained in the topsoil. This equates to 0.7% of the typical C content of an arable soil in England and Wales (*c.*91 t/ha, assuming 28 g/kg soil organic C, 1.3 g/cm^3 bulk density and 25 cm soil depth; Webb *et al.,* 2001). However, this can only be regarded as the initial rate of SOM increase (i.e. up to *c*.20 years), as SOM accumulation rates will decline over time. Dawson and Smith (2006) estimated that the incorporation of either solid manure or slurry could sequester between 0.73-5.5 t/ha CO_2e/ha/yr.

Other benefits or risks:

- Livestock manures provide a valuable source of plant available nutrients, particularly nitrogen (N), phosphorus (P), potassium (K), sulphur (S) and magnesium (Mg), thereby reducing the need for inorganic fertiliser inputs and usually result in considerable financial savings to the farmer.
- A reduction in inorganic fertiliser usage will result in energy consumption savings involved in manufacturing inorganic fertilisers (particularly N), with estimates in the range 0.2-0.3 tCO_2e/ha from a typical livestock manure application (Bhogal *et al.,* 2007).
- The application of livestock manures also presents a risk of environmental pollution, *if not handled and managed carefully*. Applications therefore need to be managed to limit N losses by NH_3 volatilisation and N_2O emission to air, and NO_3, P and FIO losses to water.
- Nitrate leaching losses can occur following autumn/winter manure applications, depending on factors such as application timing, speed of incorporation and rainfall after application. Cuttle *et al.* (2007) suggest that there could be an increase in nitrate leaching of 1-10 kg N/ha from regular additions of livestock manure. Leaching risks are greatest from high readily available N manures (e.g. slurries and poultry manures) when applied to nitrate leaky sandy and shallow soils.
- Significant soil P enrichment can occur where manures are applied annually, which can in the long-term lead to increased P losses, principally via soil erosion. Also, in the short-term, incidental P losses can occur in surface runoff and drainflow soon after manure application.
- Ammonia volatilisation losses following the land application of livestock manures can be elevated, particularly for high readily available N manures where they are not rapidly soil incorporated after application.
- Nitrous oxide emissions of *c*.1.96% of the readily available N remaining after ammonia loss have been measured following livestock manure additions to land (Thorman *et al.* 2006), with emissions following a typical livestock manure application (at 250 kg/ha total N) estimated to be equivalent to 0.18-0.73 t CO_2e/ha (Bhogal *et al.,* 2007). However, if inorganic fertiliser N rates are reduced to account for the crop available N supplied by the livestock manure, there will be a reduction in N_2O emissions from this source.

Method 11. Import materials high in organic carbon

Description: Increase SOM levels through the addition of carbon rich materials such as green and green/food compost, biosolids (treated sewage sludge), paper crumble, mushroom compost, water treatment cake, industrial 'wastes' etc. There has also been increasing interest in the potential use of Biochar (produced by the pyrolysis of crop residues/biomass) as a means of increasing soil C storage and improving soil structure and fertility (Lehmann, 2007), although the use of this material for improving SOM levels should currently be considered 'speculative'.

Potential for applying the method: The method can be applied to all types of cropping systems provided that regulatory rules are adhered to. There are several Codes of Practice and pieces of legislation that seek to 'control' the application of these materials to agricultural land e.g. The Water Code (MAFF, 1998), Nitrate Vulnerable Zones (NVZs) Action Programme (Defra, 2002a), The Sludge (Use in Agriculture) Regulations (SI, 1989 & 1990), the Waste Framework Directive (91/156/EEC amending 75/442/EEC) and recently introduced Cross Compliance measures and associated Statutory Management Requirements. In particular in NVZs, the application of organic materials should not exceed the field rate limit of 250 kg/ha total N per annum (Defra/EA, 2008).

Products arising from 'waste' sources, such as green and green/food compost, cease to be classified as waste (i.e. are no longer subject to the control mechanisms within the Waste Framework Directive) once they have been fully recovered. The Compost Quality Protocol sets out criteria for the recovery/production of quality compost from source segregated biodegradable waste, which includes compliance with PAS 100 for composted materials (BSi PAS 100). Non-adherence to the Quality Protocol (WRAP and Environment Agency, 2008) will result in the compost being considered to be a waste and subject to waste management controls. In these cases, an exemption from the Environmental Permitting regulations may be obtained from the Environment Agency, if land treatment is for 'agricultural benefit or ecological improvement'.

Biosolids applications are subject to the "Sludge Use in Agriculture Regulations" which set out legal obligations for both biosolids suppliers and farmers. There are a number of restrictions associated with the use of biosolids that are detailed in the ADAS "Safe Sludge Matrix". The regulations restrict the potential use of this material, particularly in vegetable and grassland cropping systems.

At present over 1.1 million tonnes of green and green/food compost and *c.*700,000 tonnes of paper crumble are currently recycled to agricultural land (Association for Organics Recycling, 2008; Gibbs *et al.,* 2005); such applications are only presently made to relatively small areas of land (<50,000 ha). However, compost use on agricultural land is expected to increase at least 2-3 fold over the next decade. Despite this predicted increase, limited supplies of some 'land ready' sources of carbon rich materials (e.g. green compost and paper crumble) could restrict the widespread application of this method.

Practicality: These organic materials may be applied to land using equipment that is currently used for the application of solid livestock manures. However, without further 'land ready' sources of these organic additions, supply is likely to limit the practical application of this method.

Likely uptake: Initial uptake is likely to be low, especially for the more novel sources of organic matter additions such as paper crumble (and Biochar). The regulatory and record keeping requirements associated with compost application and/or the necessity to seek exemption from Waste Management Licensing Regulations, may also provide a barrier to the likely uptake of this method.

Costs: The application of organic materials is likely to be at least cost neutral and most probably will result in cost savings (due to potential savings in inorganic fertiliser use).

Carbon storage effectiveness: Results from the Woburn 'classical market garden experiment' (Johnston, 1975). and the "Long-term Sludge Experiments" (Gibbs *et al.*, 2006) show that the application of biosolids to agricultural soils in Britain has the potential to increase SOM by 180 kg C/ha/yr per tonne of digested sludge (ds) applied (with 95% confidence intervals in the range 130-230 kg/ha/yr/t ds; Bhogal *et al*., 2007). For green compost, results from four Enviros study sites (Wallace, 2005; 2007) indicate that the application of green compost to agricultural soils in England has the potential to increase SOM by 60 kg C/ha/yr per tonne compost dry solids applied (95% CI in the range 36-84 kgCha/yr/t ds; Bhogal *et al*., 2007). Bhogal *et al.* (2007) considered that the broad composition of carbon compounds within paper crumble was similar to livestock manures, and hence used livestock manure data to estimate C accumulation in soils following the application of paper crumble i.e. 60 kg C/ha/yr/t dry solids applied.

At typical application rates (250 kg/ha total N for compost and biosolids, 75t/ha for paper crumble), a total of 1.4, 1.5 and 1.8 t C/ha/yr could be retained in the topsoil following the application of compost, biosolids and paper crumble, respectively (Bhogal *et al*., 2007). This is equivalent to 5.1-6.6 tCO_2e/ha and equates to *c*.1.5% of the typical carbon content of an arable soil in England and Wales (*c.*91t/ha, assuming 28 g/kg soil OC, 1.3 g/cm^3 bulk density and 25 cm soil depth; Webb *et al.,* 2001). However, this can only be regarded as the initial rate of SOM increase (up to *c.*20 years), as SOM accumulation rates decline with time.

Other costs and benefits:

- The application of C-rich organic materials (particularly composts and biosolids) can provide a valuable source of plant available nutrients, particularly nitrogen (N) phosphorus (P), potassium (K), sulphur (S) and magnesium (Mg), thereby reducing the need for inorganic fertiliser inputs; and usually result in financial savings to the farmer. However, compensatory inorganic fertiliser N is required following the application of chemically/physically treated paper crumble (because of N immobilisation), to ensure crop yields are not compromised (Gibbs *et al.* 2005).
- A reduction in inorganic fertiliser will result in energy consumption savings involved in manufacturing inorganic fertilisers (particularly N), estimated at *c.*0.1tCO_2e/ha from a typical biosolids application (Bhogal *et al.,* 2007).
- The application of organic materials also presents a risk of environmental pollution, *if not handled and managed carefully*. Applications therefore need to be managed to limit N losses by NH_3 volatilisation and N_2O emission to air, and NO_3, P and FIO losses to water.
- The repeated application of biosolids and composts may lead to the build of heavy metals in the soil.
- Materials high in organic C help to maintain soil structure and aggregate stability, which in turn can increase soil water retention and water infiltration rates (thereby reducing the risks of soil erosion) and improves plant nutrient uptake.

3.5. CATEGORY E: SPECULATIVE METHODS

The review of current literature (Table 1) identified a number of additional methods that could potentially maintain or enhance SOM (Table 2). However, these were largely speculative, with many based on established theories of SOM turnover (and controlling factors), rather than robust experimental evidence. The methods were therefore deemed to be insufficiently robust to promote to farmers/land managers without further investigation. A brief summary of the rationale underpinning each of the proposed methods is given below, with supporting data where available.

Method 12. Convert to organic farming systems

Organic farming relies on the management of SOM to enhance soil fertility (Watson *et al.,* 2002). Therefore, by definition, an increase in SOM would be expected. The benefit is largely perceived to be a result of the use of fertility building grass or clover leys (method 4), cover crops/green manures (method 8) and greater reliance on organic manures (method 10) (Stockdale *et al.,* 2001). There is conflicting evidence on the benefits of organic systems to SOM levels, with some reports suggesting an increase, while others have reported no change (e.g. Gosling & Shepherd, 2005). It has been suggested that OC inputs in organic systems may be of a different 'quality' to those in conventional systems, which may confer a greater benefit to SOM. For example, Marriot and Wander (2006) found that soils under organic management contained more particulate OM, with a lower C:N ratio, than in soils from conventional systems. However, it has been suggested that higher yields in conventional systems (and hence crop residue returns), the rapid decomposition of green manures/cover crops/fertility building leys in organic systems (due to low C:N ratios) and similar manure inputs, result in no additional benefit of an organic system compared to its conventional counterpart (Gosling & Shepherd, 2005).

Method 13. Extensification of pig and poultry systems onto arable land.

Transferring a proportion of the national housed pig herd and poultry flock to outdoor units set up on temporary (typically 2 year) ley grassland in arable areas has been suggested to potentially increase SOM levels (King *et al.,* 2004). As in method 4, SOM would potentially be increased by introducing rotational grass for 2 years (or more) in a 6 year rotation, thereby reducing the frequency of tillage operations. There may also be an additional benefit from the input of excreta deposited on the ley (method 10). However, as detailed in method 4, the benefits to C storage of introducing short-term grass leys into arable cropping systems are questionable, with conflicting evidence, due to uncertainty over how increases in SOM from the 2 year ley will be maintained over the long-term. Soil damage and erosion losses from outdoor pig production, in particular, can be very pronounced and there is likely to be an increased risk of diffuse pollution (particularly via NO_3 leaching and P/FIO losses in surface run-off).

Method 14. Place OM deeper in soil

Placing organic matter inputs deeper into the soil could reduce decomposition rates (colder temperatures) and protect against erosive losses (Dawson & Smith, 2006). However, there is no supporting experimental evidence for this method, with most methods of deep incorporation likely to increase soil disturbance and hence aeration and decomposition rates.

Method 15. Use clover in grassland (mixed sward)

In a survey of French grassland soils, Sousanna *et al* (2004) showed that grassland management strongly affected SOM levels. Using a combination of measurements and modelling, annual C storage rates of between 0.2 and 0.5 t C/ha/yr (0.7-1.8 t CO_2e/ha/yr) were estimated to result from changes in forage production. These were largely a consequence of reducing N fertiliser inputs to highly intensive grass leys, increasing the duration of grass leys, converting pure grass leys to grass-legume mixtures and moderately intensifying nutrient poor permanent grasslands. In a review of 115 studies worldwide, Conant *et al*. (2001) also showed that improvements in grassland management can lead to increases in soil C storage in the range 0.1-3.0 t C/ha/yr (0.03-11 t CO_2e/ha/yr), with a mean of 0.5 t C/ha/yr (1.8 t CO_2e/ha/yr). The management practices included fertilisation, improved grazing management and sowing legumes, and were largely associated with improvements in forage production (and hence C inputs). UK studies included within the review were largely from extensive, upland grassland systems (e.g. Bargett *et al.,* 1993), where improvements in grassland nutrition and productivity (e.g. by the inclusion of clover) were likely to be responsible for measured increases in SOM levels. In contrast, King *et al*. (2004) suggested such studies (i.e. in extensive upland systems) were not relevant to managed grassland soils in the UK, and therefore assumed there would be no direct C storage benefit from greater use of clover in UK grasslands (only an indirect benefit due to an energy saving from reduced fertiliser N use).

Method 16. Reduce use of lime on grasslands and organic/peaty soils

Many organic/peaty soils are naturally acidic (pH<5.0) and this is generally considered to limit the microbial activity of decomposer organisms, which favour a neutral environment, aiding the build up of SOM (Scottish Executive, 2007). Decreasing the use of lime on grassland and high in organic matter (i.e. organic and peaty) soils, could therefore potentially increase SOM levels, by reducing decomposition rates. Experiments have shown that liming can increase the concentrations of organic matter and DOC (dissolved organic carbon) in soil drainage waters with the impact greatest in the pH 4 to 5 range (Scottish Executive, 2007). Persson and Wiren (1989) reported that increasing the acidity of forest soil from pH 3.8 to 3.4 reduced CO_2 production by 83%, and from pH 4.8 to 4 by 78%. This suggests that increasing the pH of naturally acidic soils by the addition of lime will increase CO_2 emissions and reduce soil OC stocks. This is supported by a study on an upland grassland, which showed that liming caused more rapid C turnover (Rangel-Castro *et al*., 2004). Soil pH may have a varying impact depending on aeration and water logging. For example, Bergman *et al.* (1999) compared CO_2 production rates at pH 4.3 and 6.2, and found that under anaerobic conditions rates were 21-29 times greater at the more neutral pH (depending on temperature), while under aerobic conditions rates were 3 times greater at 7 C on the neutral pH soil, but soil pH had no significant effect at 17 C. This suggests that liming will have a greater impact on SOM levels on wet organic soils.

Method 17. Minimise fertiliser use on organic soils

Fertilisation is generally considered to increase SOM levels in mineral soils, due to increased residue returns (method 9). In organic soils, however, this assumption may not hold true. The added nutrients, combined with aerobic conditions, can accelerate organic matter decomposition and increase CO_2 emissions (Byrne *et al*., 2004). This effect may be particularly enhanced where lime is also applied (see Method 16), making conditions more favourable for decomposition, as well as supplying extra nutrients. SOM decomposition

rates on organic soils could therefore be reduced by minimising fertiliser use and to a lesser extent by timing fertilisation to coincide with periods of greatest crop growth when best use can be made of the applied nutrients.

4. BEST PRACTICES FOR MANAGING SOM IN 'LOWLAND' AGRICULTURE: CONCLUSIONS & KNOWLEDGE TRANSFER

This review has identified at least 11 practices (methods) for managing SOM in 'lowland' agriculture (Table 2), and provided a largely qualitative comparison of their relative benefits (to SOM and C storage), costs, practicality and environmental impacts across a range of soil types (Table 3). The methods were broadly divided into those which aimed to protect and maintain existing SOM levels for their soil quality and fertility benefits (e.g. reduced soil erosion, changed tillage practices and increased organic matter additions), with the potential added benefit of enhancing SOM, compared with more extreme measures (such as permanent land-use change), whose ultimate goal was to increase soil C storage. The latter (category A in table 2) have been identified as having the *greatest potential* for increasing SOM (and hence soil C storage and overall carbon savings). However, many would involve an extreme change in the way agricultural land is currently managed (contrary to the requirement for food and fibre production) and would require changes at policy level for widespread implementation, with suitable financial incentives.

The division of methods in this manner is compatible with the way agricultural production is currently regulated and incentivised via Cross Compliance measures and Environmental Stewardship (ES). Cross Compliance requires farmers to maintain soils in Good Agricultural and Environmental Condition (GAEC) and comply with certain Statutory Management Rules in order to be eligible for the Single Payment Scheme (Anon., 2006b). Preparation of a Soil Protection Review is a key requirement and identifies ways in which soils will be managed to maintain SOM and soil structure, and minimise erosion. The methods identified in categories B-D (methods 6-11), whose aim is largely to protect and maintain SOM levels, would therefore most naturally be promoted by this route. It is also this group of methods that could be used either singularly or in combination to achieve added benefit, depending on the situation and overall goal (e.g. increasing organic inputs via cover crops, manures or other organic materials could quite readily be employed with many of the erosion control methods on the same unit of land).

Environmental Stewardship (ES) aims to deliver improvements in biodiversity, landscape, protection of the historic environment and natural resources. Entry Level Stewardship (ELS) is open to all farmers, but Higher Level Stewardship (HLS) is actively targeted at land of particular environmental value and is a competitive scheme in which only those assessed as delivering the best outcomes are selected. It will also only incorporate methods where there has been income forgone by the farmer. To this end, methods in category A (land-use change) would be best promoted by this route.

Besides incorporation into current Cross Compliance Rules or Environmental Stewardship, these methods should also be promoted via the provision of farmer advice (e.g. alongside the England Catchment Sensitive Farming Delivery Initiative) and included within the Code of Good Agricultural Practice.

5. RECOMMENDATIONS FOR FUTURE WORK

- There would be value in confirming, via field measurements (under UK conditions) the C storage/saving benefits of many of these methods, and the effect of soil type. This is particularly important to those methods proposed in category A (land use change), which have been identified as (probably) offering the greater potential for soil C storage/savings on agricultural land. And similarly, there would be value in quantifying C emissions following the ploughing out of grassland, as regularly occurs at reseeding in ley/arable rotations, or where a farm converts from grassland to tillage crop production or from grassland to maize growing (as commonly occurs on dairy farms that have either stayed in milk production, via maize growing, or have given up milk production to grow combinable crops).
- There is a need to continue existing long-term field studies (e.g. The "Long-term Sludge Experiments", "SOIL-QC" and the classical experiments at Rothamsted) to evaluate the effects of SOM management methods on soil carbon storage and soil function, along with overall impacts on soil quality/fertility, agricultural productivity and wider impacts on the environment (e.g. water and air quality).
- Nitrous oxide is a powerful greenhouse gas, with a global warming potential that is 310 times that of CO_2. Due to increased soil wetness and reduced aeration, there is the potential for increased N_2O emissions following zero and probably reduced tillage, which could completely offset any CO_2-C saving achieved due to increased SOM levels, although the evidence for this is currently unclear. There is therefore a need to establish unequivocally whether reduced/zero tillage practices increase N_2O emissions (compared with conventional tillage), the amounts emitted and the factors affecting losses. This will help underpin the development of 'smart' N_2O emission factors currently being derived in Defra project AC0101.
- The oxidation and erosion of 'lowland' organic soils has been identified as a major contributor to the decline in SOC in UK topsoils. Further research on the impact of raising the water table in these regions on SOC and the overall balance of GHG emissions is required.
- Subsoil (> 30cm) C storage and dynamics is poorly understood. Further research on the impact of agricultural management practices (particularly subsoiling) on subsoil C storage is required.

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APPENDIX 1. BEST PRACTICE WORKSHOP

1. Invitation

BEST PRACTICES FOR MANAGING SOIL ORGANIC MATTER IN AGRICULTURE

Tuesday 17th March 2009
10am– 4pm
Chemical Industries Association,
Kings Buildings, Smith Square, London

On behalf of Defra, we would like to invite you to participate in the above workshop on best practices for managing soil organic matter in agriculture. Protecting and enhancing SOM levels is a key objective of Defra's proposed Soil Strategy because of the beneficial effects for overall soil quality/fertility, carbon storage and erosion control. This workshop aims to draw together scientists and practitioners with expertise in the management of soil organic matter to review and advise on best practices for inclusion in revised soil management guidance in England. The workshop will be divided into two key sessions in order to consider practices most appropriate for 'lowland' and 'upland' agriculture (draft agenda attached). As well as identifying best practice, the workshop will discuss the relative costs and benefits of each measure and explore how the results can be translated into advice for farmers and land managers, and incorporated into current Cross Compliance Guidance for Soil Management or via incentivised Environmental Stewardship.

Please could you confirm (by 6th March) whether you are able to attend this meeting, which session you hope to attend (lowland/upland/both) and whether you will require lunch.

With kind regards

Yours sincerely

Anne Bhogal
ADAS Gleadthorpe
[redacted]

2. Agenda

BEST PRACTICES FOR MANAGING SOIL ORGANIC MATTER IN AGRICULTURE

Tuesday 17th March 2009: 10am– 4pm; Chemical Industries Association, Kings Buildings, Smith Square, London

Draft Agenda

10:00 am Coffee

10:15 am Managing SOM in 'lowland' agriculture (land below the intake wall/fence)

Policy introduction (Judith Stuart, Defra)

Best Practice for lowland agriculture (Anne Bhogal, ADAS)

- Land use change
- Tillage
- Erosion control
- Organic inputs
- Other

Discussion (all)

- Are these methods appropriate, effective and achievable?
- Under which conditions (soil and farm types) are these methods most suitable?
- Any gaps?
- How can these methods be translated into advice for farmers & incorporated into Cross Compliance Guidance or Environmental Stewardship?

1:00 pm Lunch

2:00 pm Management SOM in 'upland' agriculture (land above the intake wall/fence)

Policy introduction (Judith Stuart, Defra)

Best Practice for upland agriculture (Fred Worall, Durham University)

Discussion (all)

- Are these methods appropriate, effective and achievable?
- Under which conditions are these methods most suitable?
- Any gaps?
- How can these methods be translated into advice for farmers & incorporated into Cross Compliance Guidance or Environmental Stewardship?

3.30 pm Close & tea

3. List of delegates

Name	Affiliation
Anne Bhogal	ADAS
Fiona Nicholson	ADAS
Andy Whitmore	Rothamsted Research
Graham Merrington	WCA Environment
Matthew Shepherd	Natural England
Derek Holliday	CLA
Morag Cuthbert	Defra
Claire Denniss	Defra
Judith Stuart	Defra
Fred Worrall	Durham University
John Kay	National Trust
Nathan Morris	TAG
Aarun Naik	NFU
Ruben Sakrabani	Cranfield University
Madeline Bell	Durham University

Appendix 2

Department for Levelling Up,
Housing & Communities

National Planning Policy Framework

Showing indicative changes for consultation

This publication is available at www.gov.uk/government/publications

Any enquiries regarding this publication should be sent to us at

Department for Levelling Up, Housing and Communities,
Fry Building, 2 Marsham Street, London, SW1P 4DF

or complete the form at http://forms.communities.gov.uk/

Contents

1. Introduction

1. The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied[1]. It provides a framework within which locally-prepared plans can provide for sufficient housing and other development in a sustainable manner.~~can be produced.~~ Preparing and maintaining up-to-date plans should be seen as a priority in meeting this objective.

2. Planning law requires that applications for planning permission be determined in accordance with the development plan[2], unless material considerations indicate otherwise[3]. The National Planning Policy Framework must be taken into account in preparing the development plan, and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

3. The Framework should be read as a whole (including its footnotes and annexes). General references to planning policies in the Framework should be applied in a way that is appropriate to the type of plan being produced, taking into account policy on plan-making in chapter 3.

4. The Framework should be read in conjunction with the Government's planning policy for traveller sites, and its planning policy for waste. When preparing plans or making decisions on applications for these types of development, regard should also be had to the policies in this Framework, where relevant.

5. The Framework does not contain specific policies for nationally significant infrastructure projects. These are determined in accordance with the decision-making framework in the Planning Act 2008 (as amended) and relevant national policy statements for major infrastructure, as well as any other matters that are relevant (which may include the National Planning Policy Framework). National policy statements form part of the overall framework of national planning policy, and may be a material consideration in preparing plans and making decisions on planning applications.

6. Other statements of government policy may be material when preparing plans or deciding applications, such as relevant Written Ministerial Statements and endorsed recommendations of the National Infrastructure Commission.

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[1] This document replaces the previous version of the National Planning Policy Framework published in ~~February 2019~~July 2021.

[2] This includes local and neighbourhood plans that have been brought into force and any spatial development strategies produced by combined authorities or elected Mayors (see Glossary).

[3] Section 38(6) of the Planning and Compulsory Purchase Act 2004 and section 70(2) of the Town and Country Planning Act 1990.

2. Achieving sustainable development

7. The purpose of the planning system is to contribute to the achievement of sustainable development, including the provision of homes and other forms of development, including supporting infrastructure in a sustainable manner. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs[4]. At a similarly high level, members of the United Nations – including the United Kingdom – have agreed to pursue the 17 Global Goals for Sustainable Development in the period to 2030. These address social progress, economic well-being and environmental protection[5].

8. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

   a) **an economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

   b) **a social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

   c) **an environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

9. These objectives should be delivered through the preparation and implementation of plans and the application of the policies in this Framework; they are not criteria against which every decision can or should be judged. Planning policies and decisions should play an active role in guiding development towards sustainable solutions, but in doing so should take local circumstances into account, to reflect the character, needs and opportunities of each area.

10. So that sustainable development is pursued in a positive way, at the heart of the Framework is a **presumption in favour of sustainable development** (paragraph 11).

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[4] Resolution 42/187 of the United Nations General Assembly.
[5] Transforming our World: the 2030 Agenda for Sustainable Development.

The presumption in favour of sustainable development

11. Plans and decisions should apply a presumption in favour of sustainable development.

For **plan-making** this means that:

a) all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects;

b) strategic policies should, as a minimum, provide for objectively assessed needs for housing and other uses, as well as any needs that cannot be met within neighbouring areas[6], unless:

i. the application of policies in this Framework that protect areas or assets of particular importance provides a strong reason for restricting the overall scale, type or distribution of development in the plan area[7]; ~~or~~

ii. any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole~~.~~; such adverse impacts may include situations where meeting need in full would mean building at densities significantly out of character with the existing area[8]; or

iii. there is clear evidence of past over-delivery, in terms of the number of homes permitted compared to the housing requirement in the existing plan~~,~~; in which case this over-delivery may be deducted from the provision required in the new plan.

For **decision-taking** this means:

c) approving development proposals that accord with an up-to-date development plan without delay; or

[6] As established through statements of common ground (see paragraph 27).
[7] The policies referred to are those in this Framework (rather than those in development plans) relating to: habitats sites (and those sites listed in paragraph 184) and/or designated as Sites of Special Scientific Interest; land designated as Green Belt, Local Green Space, an Area of Outstanding Natural Beauty, a National Park (or within the Broads Authority) or defined as Heritage Coast; irreplaceable habitats; designated heritage assets (and other heritage assets of archaeological interest referred to in footnote 77); and areas at risk of flooding or coastal change.
[8] Taking into account any design guides or codes which form part of the development plan for the area, or which are adopted as supplementary planning guidance.

d) where there are no relevant development plan policies, or the policies which are most important for determining the application are out-of-date[9], granting permission unless:

   i. the application of policies in this Framework that protect areas or assets of particular importance provides a clear reason for refusing the development proposed[7]; or

   ii. any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole.

12. The presumption in favour of sustainable development does not change the statutory status of the development plan as the starting point for decision-making. Where a planning application conflicts with an up-to-date development plan (including any neighbourhood plans that form part of the development plan), permission should not usually be granted. Local planning authorities may take decisions that depart from an up-to-date development plan, but only if material considerations in a particular case indicate that the plan should not be followed.

13. The application of the presumption has implications for the way communities engage in neighbourhood planning. Neighbourhood plans should support the delivery of strategic policies contained in local plans or spatial development strategies; and should shape and direct development that is outside of these strategic policies.

14. In situations where the presumption (at paragraph 11d) applies to applications involving the provision of housing, the adverse impact of allowing development that conflicts with the neighbourhood plan is likely to significantly and demonstrably outweigh the benefits, provided ~~all of~~ the following apply[10]:

a) the neighbourhood plan became part of the development plan ~~two~~ five years or less before the date on which the decision is made; and

b) the neighbourhood plan contains policies and allocations to meet its identified housing requirement~~;~~.

~~c) the local planning authority has at least a three year supply of deliverable housing sites (against its five year housing supply requirement, including the appropriate buffer as set out in paragraph 74); and~~

~~d) the local planning authority's housing delivery was at least 45% of that required[11] over the previous three years.~~

[9] This includes, for applications involving the provision of housing, situations where the local planning authority cannot demonstrate a five year supply of deliverable housing sites ~~(with the appropriate buffer, as set out in paragraph 74~~and ~~its~~ the ~~relevant~~ housing requirement set out in strategic policies is more than five years old, unless these strategic policies have been reviewed and found not to require updating); or where the Housing Delivery Test indicates that the delivery of housing was ~~substantially~~ below ~~(less than~~ 75% of~~)~~ the housing requirement over the previous three years (unless permissions for housing in excess of 115% of the requirement over the same period have been granted, as set out in footnote 49].

[10] Transitional arrangements are set out in Annex 1.

[11] ~~Assessed against the Housing Delivery Test, from November 2018 onwards.~~

3. Plan-making

15. The planning system should be genuinely plan-led. Succinct and up-to-date plans should provide a positive vision for the future of each area; a framework for ~~addressing~~ meeting housing needs and addressing other economic, social and environmental priorities; and a platform for local people to shape their surroundings.

16. Plans should:

a) be prepared with the objective of contributing to the achievement of sustainable development[12];

b) be prepared positively, in a way that is aspirational but deliverable;

c) be shaped by early, proportionate and effective engagement between plan-makers and communities, local organisations, businesses, infrastructure providers and operators and statutory consultees;

d) contain policies that are clearly written and unambiguous, so it is evident how a decision maker should react to development proposals;

e) be accessible through the use of digital tools to assist public involvement and policy presentation; and

f) serve a clear purpose, avoiding unnecessary duplication of policies that apply to a particular area (including policies in this Framework, where relevant).

The plan-making framework

17. The development plan must include strategic policies to address each local planning authority's priorities for the development and use of land in its area[13]. These strategic policies can be produced in different ways, depending on the issues and opportunities facing each area. They can be contained in:

a) joint or individual local plans, produced by authorities working together or independently (and which may also contain non-strategic policies); and/or

b) a spatial development strategy produced by an elected Mayor or combined authority, where plan-making powers have been conferred.

18. Policies to address non-strategic matters should be included in local plans that contain both strategic and non-strategic policies, and/or in local or neighbourhood plans that contain just non-strategic policies.

[12] This is a legal requirement of local planning authorities exercising their plan-making functions (section 39(2) of the Planning and Compulsory Purchase Act 2004).
[13] Section 19(1B-1E) of the Planning and Compulsory Purchase Act 2004.

19. The development plan for an area comprises the combination of strategic and non-strategic policies which are in force at a particular time.

Strategic policies

20. Strategic policies should set out an overall strategy for the pattern, scale and design quality of places~~,~~ (to ensure outcomes support beauty and placemaking), and make sufficient provision[14] for:

    a) housing (including affordable housing), employment, retail, leisure and other commercial development;

    b) infrastructure for transport, telecommunications, security, waste management, water supply, wastewater, flood risk and coastal change management, and the provision of minerals and energy (including heat);

    c) community facilities (such as health, education and cultural infrastructure); and

    d) conservation and enhancement of the natural, built and historic environment, including landscapes and green infrastructure, and planning measures to address climate change mitigation and adaptation.

21. Plans should make explicit which policies are strategic policies[15]. These should be limited to those necessary to address the strategic priorities of the area (and any relevant cross-boundary issues), to provide a clear starting point for any non-strategic policies that are needed. Strategic policies should not extend to detailed matters that are more appropriately dealt with through neighbourhood plans or other non-strategic policies.

22. Strategic policies should look ahead over a minimum 15 year period from adoption[16], to anticipate and respond to long-term requirements and opportunities, such as those arising from major improvements in infrastructure. scale developments such as new settlements or significant extensions to existing villages and towns form part of the strategy for the area, policies should be set within a vision that looks further ahead (at least 30 years), to take into account the likely timescale for delivery.[17]

23. Broad locations for development should be indicated on a key diagram, and land-use designations and allocations identified on a policies map. Strategic policies should provide a clear strategy for bringing sufficient land forward, and at a sufficient rate, to address objectively assessed needs over the plan period, in line with the presumption in favour of sustainable development. This should include planning for and allocating sufficient sites to deliver the strategic priorities of the area (except insofar as these needs can be demonstrated to be met more

[14] In line with the presumption in favour of sustainable development.
[15] Where a single local plan is prepared the non-strategic policies should be clearly distinguished from the strategic policies.
[16] Except in relation to town centre development, as set out in chapter 7.
[17] Transitional arrangements are set out in Annex 1.

appropriately through other mechanisms, such as brownfield registers or non-strategic policies)[18].

Maintaining effective cooperation

24. Local planning authorities and county councils (in two-tier areas) are under a duty to cooperate with each other, and with other prescribed bodies, on strategic matters that cross administrative boundaries.

25. Strategic policy-making authorities should collaborate to identify the relevant strategic matters which they need to address in their plans. They should also engage with their local communities and relevant bodies including Local Enterprise Partnerships, Local Nature Partnerships, the Marine Management Organisation, county councils, infrastructure providers, elected Mayors and combined authorities (in cases where Mayors or combined authorities do not have plan-making powers).

26. Effective and on-going joint working between strategic policy-making authorities and relevant bodies is integral to the production of a positively prepared and justified strategy. In particular, joint working should help to determine where additional infrastructure is necessary, and whether development needs that cannot be met wholly within a particular plan area could be met elsewhere.

27. In order to demonstrate effective and on-going joint working, strategic policy-making authorities should prepare and maintain one or more statements of common ground, documenting the cross-boundary matters being addressed and progress in cooperating to address these. These should be produced using the approach set out in national planning guidance, and be made publicly available throughout the plan-making process to provide transparency.

Non-strategic policies

28. Non-strategic policies should be used by local planning authorities and communities to set out more detailed policies for specific areas, neighbourhoods or types of development. This can include allocating sites, the provision of infrastructure and community facilities at a local level, establishing design principles, conserving and enhancing the natural and historic environment and setting out other development management policies.

29. Neighbourhood planning gives communities the power to develop a shared vision for their area. Neighbourhood plans can shape, direct and help to deliver sustainable development, by influencing local planning decisions as part of the statutory development plan. Neighbourhood plans should not promote less development than set out in the strategic policies for the area, or undermine those strategic policies[19].

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[18] For spatial development strategies, allocations, land use designations and a policies map are needed only where the power to make allocations has been conferred.
[19] Neighbourhood plans must be in general conformity with the strategic policies contained in any development plan that covers their area.

30. Once a neighbourhood plan has been brought into force, the policies it contains take precedence over existing non-strategic policies in a local plan covering the neighbourhood area, where they are in conflict; unless they are superseded by strategic or non-strategic policies that are adopted subsequently.

Preparing and reviewing plans

31. The preparation and review of all policies should be underpinned by relevant and up-to-date evidence. This should be adequate and proportionate, focused tightly on supporting and justifying the policies concerned, and take into account relevant market signals.

32. Local plans and spatial development strategies should be informed throughout their preparation by a sustainability appraisal that meets the relevant legal requirements[20]. This should demonstrate how the plan has addressed relevant economic, social and environmental objectives (including opportunities for net gains). Significant adverse impacts on these objectives should be avoided and, wherever possible, alternative options which reduce or eliminate such impacts should be pursued. Where significant adverse impacts are unavoidable, suitable mitigation measures should be proposed (or, where this is not possible, compensatory measures should be considered).

33. Policies in local plans and spatial development strategies should be reviewed to assess whether they need updating at least once every five years, and should then be updated as necessary[21]. Reviews should be completed no later than five years from the adoption date of a plan, and should take into account changing circumstances affecting the area, or any relevant changes in national policy. Relevant strategic policies will need updating at least once every five years if their applicable local housing need figure has changed significantly; and they are likely to require earlier review if local housing need is expected to change significantly in the near future.

Development contributions

34. Plans should set out the contributions expected from development. This should include setting out the levels and types of affordable housing provision required, along with other infrastructure (such as that needed for education, health, transport, flood and water management, green and digital infrastructure). Such policies should not undermine the deliverability of the plan.

[20] The reference to relevant legal requirements refers to Strategic Environmental Assessment. Neighbourhood plans may require Strategic Environmental Assessment, but only where there are potentially significant environmental effects.

[21] Reviews at least every five years are a legal requirement for all local plans (Regulation 10A of the Town and Country Planning (Local Planning) (England) Regulations 2012).

Examining plans

35. Local plans and spatial development strategies are examined to assess whether they have been prepared in accordance with legal and procedural requirements, and whether they are sound. Plans are 'sound' if they are:

a) **Positively prepared** – providing a strategy which~~, as a minimum,~~ seeks to meet the area's objectively assessed needs so far as possible, taking into account the policies in this Framework[22]; ~~and is informed by agreements with other authorities, so that unmet need from neighbouring areas is accommodated where it is practical to do so and is consistent with achieving sustainable development;~~

~~b) **Justified** – an appropriate strategy, taking into account the reasonable alternatives, and based on proportionate evidence;~~

~~c)~~b) **Effective** – deliverable over the plan period, and based on effective joint working on cross-boundary strategic matters that have been dealt with rather than deferred, as evidenced by the statement of common ground; and

~~d)~~c) **Consistent with national policy** – enabling the delivery of sustainable development in accordance with the policies in this Framework and other statements of national planning policy, where relevant.

36. These tests of soundness will be applied to non-strategic policies[23] in a proportionate way, taking into account the extent to which they are consistent with relevant strategic policies for the area.[24]

37. Neighbourhood plans must meet certain 'basic conditions' and other legal requirements[25] before they can come into force. These are tested through an independent examination before the neighbourhood plan may proceed to referendum.

[22] Where this relates to housing, such needs should be assessed using a clear and justified method, as set out in paragraph 61 of this Framework.
[23] Where these are contained in a local plan.
[24] Transitional arrangements relating to the tests of soundness are set out in Annex 1.
[25] As set out in paragraph 8 of Schedule 4B to the Town and Country Planning Act 1990 (as amended).

4. Decision-making

38. Local planning authorities should approach decisions on proposed development in a positive and creative way. They should use the full range of planning tools available, including brownfield registers and permission in principle, and work proactively with applicants to secure developments that will improve the economic, social and environmental conditions of the area. Decision-makers at every level should seek to approve applications for sustainable development where possible.

Pre-application engagement and front-loading

39. Early engagement has significant potential to improve the efficiency and effectiveness of the planning application system for all parties. Good quality pre-application discussion enables better coordination between public and private resources and improved outcomes for the community.

40. Local planning authorities have a key role to play in encouraging other parties to take maximum advantage of the pre-application stage. They cannot require that a developer engages with them before submitting a planning application, but they should encourage take-up of any pre-application services they offer. They should also, where they think this would be beneficial, encourage any applicants who are not already required to do so by law to engage with the local community and, where relevant, with statutory and non-statutory consultees, before submitting their applications.

41. The more issues that can be resolved at pre-application stage, including the need to deliver improvements in infrastructure and affordable housing, the greater the benefits. For their role in the planning system to be effective and positive, statutory planning consultees will need to take the same early, pro-active approach, and provide advice in a timely manner throughout the development process. This assists local planning authorities in issuing timely decisions, helping to ensure that applicants do not experience unnecessary delays and costs.

42. The participation of other consenting bodies in pre-application discussions should enable early consideration of all the fundamental issues relating to whether a particular development will be acceptable in principle, even where other consents relating to how a development is built or operated are needed at a later stage. Wherever possible, parallel processing of other consents should be encouraged to help speed up the process and resolve any issues as early as possible.

43. The right information is crucial to good decision-making, particularly where formal assessments are required (such as Environmental Impact Assessment, Habitats Regulations assessment and flood risk assessment). To avoid delay, applicants should discuss what information is needed with the local planning authority and expert bodies as early as possible.

44. Local planning authorities should publish a list of their information requirements for applications for planning permission. These requirements should be kept to the minimum needed to make decisions, and should be reviewed at least every two

years. Local planning authorities should only request supporting information that is relevant, necessary and material to the application in question.

45. Local planning authorities should consult the appropriate bodies when considering applications for the siting of, or changes to, major hazard sites, installations or pipelines, or for development around them.

46. Applicants and local planning authorities should consider the potential for voluntary planning performance agreements, where this might achieve a faster and more effective application process. Planning performance agreements are likely to be needed for applications that are particularly large or complex to determine.

Determining applications

47. Planning law requires that applications for planning permission be determined in accordance with the development plan, unless material considerations indicate otherwise. Decisions on applications should be made as quickly as possible, and within statutory timescales unless a longer period has been agreed by the applicant in writing.

48. Local planning authorities may give weight to relevant policies in emerging plans according to:

a) the stage of preparation of the emerging plan (the more advanced its preparation, the greater the weight that may be given);

b) the extent to which there are unresolved objections to relevant policies (the less significant the unresolved objections, the greater the weight that may be given); and

c) the degree of consistency of the relevant policies in the emerging plan to this Framework (the closer the policies in the emerging plan to the policies in the Framework, the greater the weight that may be given)[26].

49. However, in the context of the Framework – and in particular the presumption in favour of sustainable development – arguments that an application is premature are unlikely to justify a refusal of planning permission other than in the limited circumstances where both:

a) the development proposed is so substantial, or its cumulative effect would be so significant, that to grant permission would undermine the plan-making process by predetermining decisions about the scale, location or phasing of new development that are central to an emerging plan; and

b) the emerging plan is at an advanced stage but is not yet formally part of the development plan for the area.

[26] During the transitional period for emerging plans submitted for examination (set out in paragraph 220), consistency should be tested against the original Framework published in March 2012.

50. Refusal of planning permission on grounds of prematurity will seldom be justified where a draft plan has yet to be submitted for examination; or – in the case of a neighbourhood plan – before the end of the local planning authority publicity period on the draft plan. Where planning permission is refused on grounds of prematurity, the local planning authority will need to indicate clearly how granting permission for the development concerned would prejudice the outcome of the plan-making process.

Tailoring planning controls to local circumstances

51. Local planning authorities are encouraged to use Local Development Orders to set the planning framework for particular areas or categories of development where the impacts would be acceptable, and in particular where this would promote economic, social or environmental gains for the area.

52. Communities can use Neighbourhood Development Orders and Community Right to Build Orders to grant planning permission. These require the support of the local community through a referendum. Local planning authorities should take a proactive and positive approach to such proposals, working collaboratively with community organisations to resolve any issues before draft orders are submitted for examination.

53. The use of Article 4 directions to remove national permitted development rights should:

    a) where they relate to change from non-residential use to residential use, be limited to situations where an Article 4 direction is necessary to avoid wholly unacceptable adverse impacts (this could include the loss of the essential core of a primary shopping area which would seriously undermine its vitality and viability, but would be very unlikely to extend to the whole of a town centre)

    b) in other cases, be limited to situations where an Article 4 direction is necessary to protect local amenity or the well-being of the area (this could include the use of Article 4 directions to require planning permission for the demolition of local facilities)

    c) in all cases, be based on robust evidence, and apply to the smallest geographical area possible.

54. Similarly, planning conditions should not be used to restrict national permitted development rights unless there is clear justification to do so.

Planning conditions and obligations

55. Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition.

56. Planning conditions should be kept to a minimum and only imposed where they are necessary, relevant to planning and to the development to be permitted,

enforceable, precise and reasonable in all other respects. Agreeing conditions early is beneficial to all parties involved in the process and can speed up decision-making. Conditions that are required to be discharged before development commences should be avoided, unless there is a clear justification[27].

57. Planning obligations must only be sought where they meet all of the following tests[28]:

a) necessary to make the development acceptable in planning terms;

b) directly related to the development; and

c) fairly and reasonably related in scale and kind to the development.

58. Where up-to-date policies have set out the contributions expected from development, planning applications that comply with them should be assumed to be viable. It is up to the applicant to demonstrate whether particular circumstances justify the need for a viability assessment at the application stage. The weight to be given to a viability assessment is a matter for the decision maker, having regard to all the circumstances in the case, including whether the plan and the viability evidence underpinning it is up to date, and any change in site circumstances since the plan was brought into force. All viability assessments, including any undertaken at the plan-making stage, should reflect the recommended approach in national planning guidance, including standardised inputs, and should be made publicly available.

Enforcement

59. Effective enforcement is important to maintain public confidence in the planning system. Enforcement action is discretionary, and local planning authorities should act proportionately in responding to suspected breaches of planning control. They should consider publishing a local enforcement plan to manage enforcement proactively, in a way that is appropriate to their area. This should set out how they will monitor the implementation of planning permissions, investigate alleged cases of unauthorised development and take action where appropriate.

[27] Sections 100ZA(4-6) of the Town and Country Planning Act 1990 will require the applicant's written agreement to the terms of a pre-commencement condition, unless prescribed circumstances apply.
[28] Set out in Regulation 122(2) of the Community Infrastructure Levy Regulations 2010.

5. Delivering a sufficient supply of homes

60. To support the Government's objective of significantly boosting the supply of homes, it is important that a sufficient amount and variety of land can come forward where it is needed, that the needs of groups with specific housing requirements are addressed and that land with permission is developed without unnecessary delay. The overall aim should be to meet as much housing need as possible with an appropriate mix of housing types to meet the needs of communities.

61. To determine the minimum number of homes needed, strategic policies should be informed by a local housing need assessment, conducted using the standard method in national planning guidance. The outcome of the standard method is an advisory starting-point for establishing a housing requirement for the area (see paragraph 67 below). There may be ~~ – unless~~ exceptional circumstances relating to the particular characteristics of an authority which justify an alternative approach to assessing housing need; in which case the alternative used ~~which~~ should also reflect~~s~~ current and future demographic trends and market signals. In addition to the local housing need figure, any needs that cannot be met within neighbouring areas should also be taken into account in establishing the amount of housing to be planned for[29].

~~61.~~62. The Standard Method incorporates an uplift for those urban local authorities in the top 20 most populated cities and urban centres. This uplift should be accommodated within those cities and urban centres themselves unless it would conflict with the policies in this Framework and legal obligations[30].

~~62.~~63. Within this context of establishing need, the size, type and tenure of housing needed for different groups in the community should be assessed and reflected in planning policies (including, but not limited to~~,~~ : those who require affordable housing~~,~~ ; families with children~~,~~ ; older people including for retirement housing, housing-with-care and care homes;, students~~,~~ ; people with disabilities~~,~~ ; service families~~,~~ ; travellers[31]~~,~~ [32]; people who rent their homes and people wishing to commission or build their own homes[33]).

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[29] Transitional arrangements are set out in Annex 1.

[30] In doing so, brownfield and other under-utilised urban sites should be prioritised, and on these sites density should be optimised to promote the most efficient use of land, something which can be informed by masterplans and design codes. This is to ensure that homes are built in the right places, to make the most of existing infrastructure, and to allow people to live near the services they rely on, making travel patterns more sustainable.

[32] Planning Policy for Traveller Sites sets out how travellers' housing needs should be assessed for those covered by the definition in Annex 1 of that document.

[33] Under section 1 of the Self Build and Custom Housebuilding Act 2015, local authorities are required to keep a register of those seeking to acquire serviced plots in the area for their own self-build and custom house building. They are also subject to duties under sections 2 and 2A of the Act to have regard to this and to give enough suitable development permissions to meet the identified demand. Self and custom-build properties could provide market or affordable housing.

~~63.~~64. Where a need for affordable housing is identified, planning policies should specify the type of affordable housing required[34], and expect it to be met on-site unless:

a) off-site provision or an appropriate financial contribution in lieu can be robustly justified; and

b) the agreed approach contributes to the objective of creating mixed and balanced communities.

~~64.~~65. Provision of affordable housing should not be sought for residential developments that are not major developments, other than in designated rural areas (where policies may set out a lower threshold of 5 units or fewer). To support the re-use of brownfield land, where vacant buildings are being reused or redeveloped, any affordable housing contribution due should be reduced by a proportionate amount[35].

~~65.~~66. Where major development involving the provision of housing is proposed, planning policies and decisions should expect at least 10% of the total number of homes to be available for affordable home ownership[36], unless this would exceed the level of affordable housing required in the area, or significantly prejudice the ability to meet the identified affordable housing needs of specific groups. Exemptions to this 10% requirement should also be made where the site or proposed development:

a) provides solely for Build to Rent homes;

b) provides specialist accommodation for a group of people with specific needs (such as purpose-built accommodation for the elderly or students);

c) is proposed to be developed by people who wish to build or commission their own homes; or

d) is exclusively for affordable housing, an entry-level exception site or a rural exception site.

~~66.~~67. Strategic policy-making authorities should establish a housing requirement figure for their whole area, which shows the extent to which their identified housing need (and any needs that cannot be met within neighbouring areas) can be met over the plan period. The requirement may be higher than the identified housing need, if it includes provision for neighbouring areas, or reflects growth ambitions linked to economic development or infrastructure investment. Within this overall requirement, strategic policies should also set out a housing requirement for designated neighbourhood areas which reflects the overall strategy for the pattern and scale of development and any relevant allocations[37]. Once the strategic policies have been adopted, these figures should not need re-testing at the neighbourhood plan

[34] Applying the definition in Annex 2 to this Framework.
[35] Equivalent to the existing gross floorspace of the existing buildings. This does not apply to vacant buildings which have been abandoned.
[36] As part of the overall affordable housing contribution from the site.
[37] Except where a Mayoral, combined authority or high-level joint plan is being prepared as a framework for strategic policies at the individual local authority level; in which case it may be most appropriate for the local authority plans to provide the requirement figure.

examination, unless there has been a significant change in circumstances that affects the requirement.

~~67.~~68. Where it is not possible to provide a requirement figure for a neighbourhood area[38], the local planning authority should provide an indicative figure, if requested to do so by the neighbourhood planning body. This figure should take into account factors such as the latest evidence of local housing need, the population of the neighbourhood area and the most recently available planning strategy of the local planning authority.

Identifying land for homes

~~68.~~69. Strategic policy-making authorities should have a clear understanding of the land available in their area through the preparation of a strategic housing land availability assessment. From this, planning policies should identify a sufficient supply and mix of sites, taking into account their availability, suitability and likely economic viability. Planning policies should identify a supply of:

a) specific, deliverable sites for years one to five of the plan period[39]; and

b) specific, developable sites or broad locations for growth, for years 6-10 and, where possible, for years 11-15 of the plan.

~~69.~~70. Small and medium sized sites can make an important contribution to meeting the housing requirement of an area, and are often built-out relatively quickly. To promote the development of a good mix of sites local planning authorities should:

a) identify, through the development plan and brownfield registers, land to accommodate at least 10% of their housing requirement on sites no larger than one hectare; unless it can be shown, through the preparation of relevant plan policies, that there are strong reasons why this 10% target cannot be achieved;

b) use tools such as area-wide design assessments and Local Development Orders to help bring small and medium sized sites forward;

c) support the development of windfall sites through their policies and decisions – giving great weight to the benefits of using suitable sites within existing settlements for homes; and

d) work with developers to encourage the sub-division of large sites where this could help to speed up the delivery of homes.

~~70.~~71. Neighbourhood planning groups should also give particular consideration to the opportunities for allocating small and medium-sized sites (of a size consistent with paragraph 69a) suitable for housing in their area.

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[38] Because a neighbourhood area is designated at a late stage in the strategic policy-making process, or after strategic policies have been adopted; or in instances where strategic policies for housing are out of date.

[39] With an appropriate buffer, as set out in paragraph 74. See Glossary for definitions of deliverable and developable.

~~71.~~72. Where an allowance is to be made for windfall sites as part of anticipated supply, there should be compelling evidence that they will provide a reliable source of supply. Any allowance should be realistic having regard to the strategic housing land availability assessment, historic windfall delivery rates and expected future trends. Plans should consider the case for setting out policies to resist inappropriate development of residential gardens, for example where development would cause harm to the local area.

~~72.~~73. Local planning authorities should support the development of entry-level exception sites, suitable for first time buyers (or those looking to rent their first home), unless the need for such homes is already being met within the authority's area. These sites should be on land which is not already allocated for housing and should:

a) comprise of entry-level homes that offer one or more types of affordable housing as defined in Annex 2 of this Framework; and

b) be adjacent to existing settlements, proportionate in size to them[40], not compromise the protection given to areas or assets of particular importance in this Framework[41], and comply with any local design policies and standards.

~~73.~~74. The supply of large numbers of new homes can often be best achieved through planning for larger scale development, such as new settlements or significant extensions to existing villages and towns, provided they are well located and designed, and supported by the necessary infrastructure and facilities (including a genuine choice of transport modes). Working with the support of their communities, and with other authorities if appropriate, strategic policy-making authorities should identify suitable locations for such development where this can help to meet identified needs in a sustainable way. In doing so, they should:

a) consider the opportunities presented by existing or planned investment in infrastructure, the area's economic potential and the scope for net environmental gains;

b) ensure that their size and location will support a sustainable community, with sufficient access to services and employment opportunities within the development itself (without expecting an unrealistic level of self-containment), or in larger towns to which there is good access;

c) set clear expectations for the quality of the places to be created and how this can be maintained (such as by following Garden City principles); and ensure that appropriate tools such as masterplans and design guides or codes are used to secure a variety of well-designed and beautiful homes to meet the needs of different groups in the community;

d) make a realistic assessment of likely rates of delivery, given the lead-in times for large scale sites, and identify opportunities for supporting rapid

[40] Entry-level exception sites should not be larger than one hectare in size or exceed 5% of the size of the existing settlement.
[41] i.e. the areas referred to in footnote 7. Entry-level exception sites should not be permitted in National Parks (or within the Broads Authority), Areas of Outstanding Natural Beauty or land designated as Green Belt.

implementation (such as through joint ventures or locally-led development corporations)[42]; and

e) consider whether it is appropriate to establish Green Belt around or adjoining new developments of significant size.

Maintaining supply and delivery

~~74.~~75. Strategic policies should include a trajectory illustrating the expected rate of housing delivery over the plan period, and all plans should consider whether it is appropriate to set out the anticipated rate of development for specific sites. Local planning authorities should monitor their deliverable land supply against their housing requirement as set out in adopted strategic policies[43]. When the housing requirement set out in strategic policies becomes more than five years old[44], local planning authorities should identify and update annually a supply of specific deliverable sites sufficient to provide a minimum of five years' worth of housing against ~~their housing requirement set out in adopted strategic policies[45], or against~~ their local housing need (taking into account any previous under or over-supply as set out in planning practice guidance) ~~where the strategic policies are more than five years old[46]. The supply of specific deliverable sites should in addition include a buffer (moved forward from later in the plan period) of:~~

~~a) 5% to ensure choice and competition in the market for land; or~~

~~b) 10% where the local planning authority wishes to demonstrate a five year supply of deliverable sites through an annual position statement or recently adopted plan[47], to account for any fluctuations in the market during that year; or~~

~~c) 20% where there has been significant under delivery of housing over the previous three years, to improve the prospect of achieving the planned supply[48].~~

~~75.~~76. A five year supply of deliverable housing sites~~, with the appropriate buffer,~~ can be demonstrated where it has been established in ~~a recently adopted plan, or~~ in an ~~subsequent~~ annual position statement which:

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[42] The delivery of large scale developments may need to extend beyond an individual plan period, and the associated infrastructure requirements may not be capable of being identified fully at the outset. Anticipated rates of delivery and infrastructure requirements should, therefore, be kept under review and reflected as policies are updated.

[43] For the avoidance of doubt, a five year supply of deliverable sites for travellers – as defined in Annex 1 to Planning Policy for Traveller Sites – should be assessed separately, in line with the policy in that document.

[44] Unless these strategic policies have been reviewed and found not to require updating. Where local housing need is used as the basis for assessing whether a five year supply of specific deliverable sites exists, it should be calculated using the standard method set out in national planning guidance.

~~[45] For the avoidance of doubt, a five year supply of deliverable sites for travellers – as defined in Annex 1 to Planning Policy for Traveller Sites – should be assessed separately, in line with the policy in that document.~~

~~[46] Unless these strategic policies have been reviewed and found not to require updating. Where local housing need is used as the basis for assessing whether a five year supply of specific deliverable sites exists, it should be calculated using the standard method set out in national planning guidance.~~

~~[47] For the purposes of paragraphs 74b and 75 a plan adopted between 1 May and 31 October will be considered 'recently adopted' until 31 October of the following year; and a plan adopted between 1 November and 30 April will be considered recently adopted until 31 October in the same year.~~

~~[48] This will be measured against the Housing Delivery Test, where this indicates that delivery was below 85% of the housing requirement.~~

a) has been produced through engagement with developers and others who have an impact on delivery, and been considered by the Secretary of State; and

b) incorporates the recommendation of the Secretary of State, where the position on specific sites could not be agreed during the engagement process.

77. To maintain the supply of housing, local planning authorities should monitor progress in building out sites which have permission. Where the Housing Delivery Test indicates that delivery has fallen below ~~95% of~~ the local planning authority's housing requirement over the previous three years, the following policy consequences should apply:

a) where delivery falls below 95% of the requirement over the previous three years, the authority should prepare an action plan ~~in line with national planning guidance,~~ to assess the causes of under-delivery and identify actions to increase delivery in future years;

b) where delivery falls below 75% of the requirement over the previous three years, the presumption in favour of sustainable development applies, as set out in footnote 9 of this Framework[49], in addition to the requirement for an action plan.

~~76.~~78. The Housing Delivery Test consequences set out above will apply the day following the annual publication of the Housing Delivery Test results by DLUHC.

~~77.~~79. To help ensure that proposals for housing development are implemented in a timely manner, local planning authorities should consider imposing a planning condition providing that development must begin within a timescale shorter than the relevant default period, where this would expedite the development without threatening its deliverability or viability. For major development involving the provision of housing, local planning authorities should also assess why any earlier grant of planning permission for a similar development on the same site did not start.

Rural housing

~~78.~~80. In rural areas, planning policies and decisions should be responsive to local circumstances and support housing developments that reflect local needs, including development proposals from community-led housing groups. Local planning authorities should support opportunities to bring forward rural exception sites that will provide affordable housing to meet identified local needs, and consider whether allowing some market housing on these sites would help to facilitate this.

~~79.~~81. To promote sustainable development in rural areas, housing should be located where it will enhance or maintain the vitality of rural communities. Planning policies should identify opportunities for villages to grow and thrive, especially where this will support local services. Where there are groups of smaller settlements, development in one village may support services in a village nearby.

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[49] The presumption is, however, not to be applied if permissions have been granted for homes in excess of 115% of the authority's housing requirement over the applicable Housing Delivery Test monitoring period.

~~80.~~82. Planning policies and decisions should avoid the development of isolated homes in the countryside unless one or more of the following circumstances apply:

a) there is an essential need for a rural worker, including those taking majority control of a farm business, to live permanently at or near their place of work in the countryside;

b) the development would represent the optimal viable use of a heritage asset or would be appropriate enabling development to secure the future of heritage assets;

c) the development would re-use redundant or disused buildings and enhance its immediate setting;

d) the development would involve the subdivision of an existing residential building; or

e) the design is of exceptional quality, in that it:

- is truly outstanding, reflecting the highest standards in architecture, and would help to raise standards of design more generally in rural areas; and
- would significantly enhance its immediate setting, and be sensitive to the defining characteristics of the local area.

6. Building a strong, competitive economy

~~81.~~83. Planning policies and decisions should help create the conditions in which businesses can invest, expand and adapt. Significant weight should be placed on the need to support economic growth and productivity, taking into account both local business needs and wider opportunities for development. The approach taken should allow each area to build on its strengths, counter any weaknesses and address the challenges of the future. This is particularly important where Britain can be a global leader in driving innovation[50], and in areas with high levels of productivity, which should be able to capitalise on their performance and potential.

~~82.~~84. Planning policies should:

a) set out a clear economic vision and strategy which positively and proactively encourages sustainable economic growth, having regard to Local Industrial Strategies and other local policies for economic development and regeneration;

b) set criteria, or identify strategic sites, for local and inward investment to match the strategy and to meet anticipated needs over the plan period;

c) seek to address potential barriers to investment, such as inadequate infrastructure, services or housing, or a poor environment; and

d) be flexible enough to accommodate needs not anticipated in the plan, allow for new and flexible working practices (such as live-work accommodation), and to enable a rapid response to changes in economic circumstances.

~~83.~~85. Planning policies and decisions should recognise and address the specific locational requirements of different sectors. This includes making provision for clusters or networks of knowledge and data-driven, creative or high technology industries; and for storage and distribution operations at a variety of scales and in suitably accessible locations.

Supporting a prosperous rural economy

~~84.~~86. Planning policies and decisions should enable:

a) the sustainable growth and expansion of all types of business in rural areas, both through conversion of existing buildings and well-designed, beautiful new buildings;

b) the development and diversification of agricultural and other land-based rural businesses;

[50] The Government's Industrial Strategy sets out a vision to drive productivity improvements across the UK, identifies a number of Grand Challenges facing all nations, and sets out a delivery programme to make the UK a leader in four of these: artificial intelligence and big data; clean growth; future mobility; and catering for an ageing society. HM Government (2017) *Industrial Strategy: Building a Britain fit for the future*.

c) sustainable rural tourism and leisure developments which respect the character of the countryside; and

d) the retention and development of accessible local services and community facilities, such as local shops, meeting places, sports venues, open space, cultural buildings, public houses and places of worship.

~~85.~~87. Planning policies and decisions should recognise that sites to meet local business and community needs in rural areas may have to be found adjacent to or beyond existing settlements, and in locations that are not well served by public transport. In these circumstances it will be important to ensure that development is sensitive to its surroundings, does not have an unacceptable impact on local roads and exploits any opportunities to make a location more sustainable (for example by improving the scope for access on foot, by cycling or by public transport). The use of previously developed land, and sites that are physically well-related to existing settlements, should be encouraged where suitable opportunities exist.

7. Ensuring the vitality of town centres

~~86.~~88. Planning policies and decisions should support the role that town centres play at the heart of local communities, by taking a positive approach to their growth, management and adaptation. Planning policies should:

a) define a network and hierarchy of town centres and promote their long-term vitality and viability – by allowing them to grow and diversify in a way that can respond to rapid changes in the retail and leisure industries, allows a suitable mix of uses (including housing) and reflects their distinctive characters;

b) define the extent of town centres and primary shopping areas, and make clear the range of uses permitted in such locations, as part of a positive strategy for the future of each centre;

c) retain and enhance existing markets and, where appropriate, re-introduce or create new ones;

d) allocate a range of suitable sites in town centres to meet the scale and type of development likely to be needed, looking at least ten years ahead. Meeting anticipated needs for retail, leisure, office and other main town centre uses over this period should not be compromised by limited site availability, so town centre boundaries should be kept under review where necessary;

e) where suitable and viable town centre sites are not available for main town centre uses, allocate appropriate edge of centre sites that are well connected to the town centre. If sufficient edge of centre sites cannot be identified, policies should explain how identified needs can be met in other accessible locations that are well connected to the town centre; and

f) recognise that residential development often plays an important role in ensuring the vitality of centres and encourage residential development on appropriate sites.

~~87.~~89. Local planning authorities should apply a sequential test to planning applications for main town centre uses which are neither in an existing centre nor in accordance with an up-to-date plan. Main town centre uses should be located in town centres, then in edge of centre locations; and only if suitable sites are not available (or expected to become available within a reasonable period) should out of centre sites be considered.

~~88.~~90. When considering edge of centre and out of centre proposals, preference should be given to accessible sites which are well connected to the town centre. Applicants and local planning authorities should demonstrate flexibility on issues such as format and scale, so that opportunities to utilise suitable town centre or edge of centre sites are fully explored.

~~89.~~91. This sequential approach should not be applied to applications for small scale rural offices or other small scale rural development.

~~90.~~92. When assessing applications for retail and leisure development outside town centres, which are not in accordance with an up-to-date plan, local planning authorities should require an impact assessment if the development is over a proportionate, locally set floorspace threshold (if there is no locally set threshold, the default threshold is 2,500m^2 of gross floorspace). This should include assessment of:

a) the impact of the proposal on existing, committed and planned public and private investment in a centre or centres in the catchment area of the proposal; and

b) the impact of the proposal on town centre vitality and viability, including local consumer choice and trade in the town centre and the wider retail catchment (as applicable to the scale and nature of the scheme).

~~91.~~93. Where an application fails to satisfy the sequential test or is likely to have significant adverse impact on one or more of the considerations in paragraph 90, it should be refused.

8. Promoting healthy and safe communities

~~92.~~94. Planning policies and decisions should aim to achieve healthy, inclusive and safe places and beautiful buildings which:

a) promote social interaction, including opportunities for meetings between people who might not otherwise come into contact with each other – for example through mixed-use developments, strong neighbourhood centres, street layouts that allow for easy pedestrian and cycle connections within and between neighbourhoods, and active street frontages;

b) are safe and accessible, so that crime and disorder, and the fear of crime, do not undermine the quality of life or community cohesion – for example through the use of beautiful ~~attractive~~, well-designed, clear and legible pedestrian and cycle routes, and high quality public space, which encourage the active and continual use of public areas; and

c) enable and support healthy lifestyles, especially where this would address identified local health and well-being needs – for example through the provision of safe and accessible green infrastructure, sports facilities, local shops, access to healthier food, allotments and layouts that encourage walking and cycling.

~~93.~~95. To provide the social, recreational and cultural facilities and services the community needs, planning policies and decisions should:

a) plan positively for the provision and use of shared spaces, community facilities (such as local shops, meeting places, sports venues, open space, cultural buildings, public houses and places of worship) and other local services to enhance the sustainability of communities and residential environments;

b) take into account and support the delivery of local strategies to improve health, social and cultural well-being for all sections of the community;

c) guard against the unnecessary loss of valued facilities and services, particularly where this would reduce the community's ability to meet its day-to-day needs;

d) ensure that established shops, facilities and services are able to develop and modernise, and are retained for the benefit of the community; and

e) ensure an integrated approach to considering the location of housing, economic uses and community facilities and services.

~~94.~~96. Planning policies and decisions should consider the social, economic and environmental benefits of estate regeneration. Local planning authorities should use their planning powers to help deliver estate regeneration to a high standard.

~~95.~~97. It is important that a sufficient choice of school places is available to meet the needs of existing and new communities. Local planning authorities should take a proactive, positive and collaborative approach to meeting this requirement, and to development that will widen choice in education. They should:

a) give great weight to the need to create, expand or alter schools through the preparation of plans and decisions on applications; and

b) work with school promoters, delivery partners and statutory bodies to identify and resolve key planning issues before applications are submitted.

~~96.~~98. To ensure faster delivery of other public service infrastructure such as further education colleges, hospitals and criminal justice accommodation, local planning authorities should also work proactively and positively with promoters, delivery partners and statutory bodies to plan for required facilities and resolve key planning issues before applications are submitted.

~~97.~~99. Planning policies and decisions should promote public safety and take into account wider security and defence requirements by:

a) anticipating and addressing possible malicious threats and natural hazards, especially in locations where large numbers of people are expected to congregate[51]. Policies for relevant areas (such as town centre and regeneration frameworks), and the layout and design of developments, should be informed by the most up-to-date information available from the police and other agencies about the nature of potential threats and their implications. This includes appropriate and proportionate steps that can be taken to reduce vulnerability, increase resilience and ensure public safety and security; and

b) recognising and supporting development required for operational defence and security purposes, and ensuring that operational sites are not affected adversely by the impact of other development proposed in the area.

Open space and recreation

~~98.~~100. Access to a network of high quality open spaces and opportunities for sport and physical activity is important for the health and well-being of communities, and can deliver wider benefits for nature and support efforts to address climate change. Planning policies should be based on robust and up-to-date assessments of the need for open space, sport and recreation facilities (including quantitative or qualitative deficits or surpluses) and opportunities for new provision. Information gained from the assessments should be used to determine what open space, sport and recreational provision is needed, which plans should then seek to accommodate.

~~99.~~101. Existing open space, sports and recreational buildings and land, including playing fields, should not be built on unless:

a) an assessment has been undertaken which has clearly shown the open space, buildings or land to be surplus to requirements; or

[51] This includes transport hubs, night-time economy venues, cinemas and theatres, sports stadia and arenas, shopping centres, health and education establishments, places of worship, hotels and restaurants, visitor attractions and commercial centres.

b) the loss resulting from the proposed development would be replaced by equivalent or better provision in terms of quantity and quality in a suitable location; or

c) the development is for alternative sports and recreational provision, the benefits of which clearly outweigh the loss of the current or former use.

~~100.~~102. Planning policies and decisions should protect and enhance public rights of way and access, including taking opportunities to provide better facilities for users, for example by adding links to existing rights of way networks including National Trails.

~~101.~~103. The designation of land as Local Green Space through local and neighbourhood plans allows communities to identify and protect green areas of particular importance to them. Designating land as Local Green Space should be consistent with the local planning of sustainable development and complement investment in sufficient homes, jobs and other essential services. Local Green Spaces should only be designated when a plan is prepared or updated, and be capable of enduring beyond the end of the plan period.

~~102.~~104. The Local Green Space designation should only be used where the green space is:

a) in reasonably close proximity to the community it serves;

b) demonstrably special to a local community and holds a particular local significance, for example because of its beauty, historic significance, recreational value (including as a playing field), tranquillity or richness of its wildlife; and

c) local in character and is not an extensive tract of land.

~~103.~~105. Policies for managing development within a Local Green Space should be consistent with those for Green Belts.

9. Promoting sustainable transport

~~104.~~106. Transport issues should be considered from the earliest stages of plan-making and development proposals, so that:

a) the potential impacts of development on transport networks can be addressed;

b) opportunities from existing or proposed transport infrastructure, and changing transport technology and usage, are realised – for example in relation to the scale, location or density of development that can be accommodated;

c) opportunities to promote walking, cycling and public transport use are identified and pursued;

d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains; and

e) patterns of movement, streets, parking and other transport considerations are integral to the design of schemes, and contribute to making high quality places.

~~105.~~107. The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making.

~~106.~~108. Planning policies should:

a) support an appropriate mix of uses across an area, and within larger scale sites, to minimise the number and length of journeys needed for employment, shopping, leisure, education and other activities;

b) be prepared with the active involvement of local highways authorities, other transport infrastructure providers and operators and neighbouring councils, so that strategies and investments for supporting sustainable transport and development patterns are aligned;

c) identify and protect, where there is robust evidence, sites and routes which could be critical in developing infrastructure to widen transport choice and realise opportunities for large scale development;

d) provide for attractive and well-designed walking and cycling networks with supporting facilities such as secure cycle parking (drawing on Local Cycling and Walking Infrastructure Plans);

e) provide for any large scale transport facilities that need to be located in the area[52], and the infrastructure and wider development required to support their operation, expansion and contribution to the wider economy. In doing so they should take into account whether such development is likely to be a nationally significant infrastructure project and any relevant national policy statements; and

f) recognise the importance of maintaining a national network of general aviation airfields, and their need to adapt and change over time – taking into account their economic value in serving business, leisure, training and emergency service needs, and the Government's General Aviation Strategy[53].

~~107.~~109. If setting local parking standards for residential and non-residential development, policies should take into account:

a) the accessibility of the development;

b) the type, mix and use of development;

c) the availability of and opportunities for public transport;

d) local car ownership levels; and

e) the need to ensure an adequate provision of spaces for charging plug-in and other ultra-low emission vehicles.

~~108.~~110. Maximum parking standards for residential and non-residential development should only be set where there is a clear and compelling justification that they are necessary for managing the local road network, or for optimising the density of development in city and town centres and other locations that are well served by public transport (in accordance with chapter 11 of this Framework). In town centres, local authorities should seek to improve the quality of parking so that it is convenient, safe and secure, alongside measures to promote accessibility for pedestrians and cyclists.

~~109.~~111. Planning policies and decisions should recognise the importance of providing adequate overnight lorry parking facilities, taking into account any local shortages, to reduce the risk of parking in locations that lack proper facilities or could cause a nuisance. Proposals for new or expanded distribution centres should make provision for sufficient lorry parking to cater for their anticipated use.

Considering development proposals

~~110.~~112. In assessing sites that may be allocated for development in plans, or specific applications for development, it should be ensured that:

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[52] Policies for large scale facilities should, where necessary, be developed through collaboration between strategic policy-making authorities and other relevant bodies. Examples of such facilities include ports, airports, interchanges for rail freight, public transport projects and roadside services. The primary function of roadside services should be to support the safety and welfare of the road user (and most such proposals are unlikely to be nationally significant infrastructure projects).

[53] Department for Transport (2015) *General Aviation Strategy*.

a) appropriate opportunities to promote sustainable transport modes can be – or have been – taken up, given the type of development and its location;

b) safe and suitable access to the site can be achieved for all users;

c) the design of streets, parking areas, other transport elements and the content of associated standards reflects current national guidance, including the National Design Guide and the National Model Design Code [54]; and

d) any significant impacts from the development on the transport network (in terms of capacity and congestion), or on highway safety, can be cost effectively mitigated to an acceptable degree.

~~111.~~113. Development should only be prevented or refused on highways grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe.

~~112.~~114. Within this context, applications for development should:

a) give priority first to pedestrian and cycle movements, both within the scheme and with neighbouring areas; and second – so far as possible – to facilitating access to high quality public transport, with layouts that maximise the catchment area for bus or other public transport services, and appropriate facilities that encourage public transport use;

b) address the needs of people with disabilities and reduced mobility in relation to all modes of transport;

c) create places that are safe, secure and attractive – which minimise the scope for conflicts between pedestrians, cyclists and vehicles, avoid unnecessary street clutter, and respond to local character and design standards;

d) allow for the efficient delivery of goods, and access by service and emergency vehicles; and

e) be designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations.

~~113.~~115. All developments that will generate significant amounts of movement should be required to provide a travel plan, and the application should be supported by a transport statement or transport assessment so that the likely impacts of the proposal can be assessed.

[54] Policies and decisions should not make use of or reflect the former Design Bulletin 32, which was withdrawn in 2007.

10. Supporting high quality communications

~~114.~~116. Advanced, high quality and reliable communications infrastructure is essential for economic growth and social well-being. Planning policies and decisions should support the expansion of electronic communications networks, including next generation mobile technology (such as 5G) and full fibre broadband connections. Policies should set out how high quality digital infrastructure, providing access to services from a range of providers, is expected to be delivered and upgraded over time; and should prioritise full fibre connections to existing and new developments (as these connections will, in almost all cases, provide the optimum solution).

~~115.~~117. The number of radio and electronic communications masts, and the sites for such installations, should be kept to a minimum consistent with the needs of consumers, the efficient operation of the network and providing reasonable capacity for future expansion. Use of existing masts, buildings and other structures for new electronic communications capability (including wireless) should be encouraged. Where new sites are required (such as for new 5G networks, or for connected transport and smart city applications), equipment should be sympathetically designed and camouflaged where appropriate.

~~116.~~118. Local planning authorities should not impose a ban on new electronic communications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of electronic communications development, or insist on minimum distances between new electronic communications development and existing development. They should ensure that:

a) they have evidence to demonstrate that electronic communications infrastructure is not expected to cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

b) they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and electronic communications services.

~~117.~~119. Applications for electronic communications development (including applications for prior approval under the General Permitted Development Order) should be supported by the necessary evidence to justify the proposed development. This should include:

a) the outcome of consultations with organisations with an interest in the proposed development, in particular with the relevant body where a mast is to be installed near a school or college, or within a statutory safeguarding zone surrounding an aerodrome, technical site or military explosives storage area; and

b) for an addition to an existing mast or base station, a statement that self-certifies that the cumulative exposure, when operational, will not exceed International Commission guidelines on non-ionising radiation protection; or

c) for a new mast or base station, evidence that the applicant has explored the possibility of erecting antennas on an existing building, mast or other structure and a statement that self-certifies that, when operational, International Commission guidelines will be met.

~~118.~~120. Local planning authorities must determine applications on planning grounds only. They should not seek to prevent competition between different operators, question the need for an electronic communications system, or set health safeguards different from the International Commission guidelines for public exposure.

11. Making effective use of land

~~119.~~121. Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land[55].

~~120.~~122. Planning policies and decisions should:

a) encourage multiple benefits from both urban and rural land, including through mixed use schemes and taking opportunities to achieve net environmental gains – such as developments that would enable new habitat creation or improve public access to the countryside;

b) recognise that some undeveloped land can perform many functions, such as for wildlife, recreation, flood risk mitigation, cooling/shading, carbon storage or food production;

c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land;

d) promote and support the development of under-utilised land and buildings, especially if this would help to meet identified needs for housing where land supply is constrained and available sites could be used more effectively (for example converting space above shops, and building on or above service yards, car parks, lock-ups and railway infrastructure)[56]; and

e) support opportunities to use the airspace above existing residential and commercial premises for new homes. In particular, they should allow upward extensions where the development would be consistent with the prevailing height and form of neighbouring properties and the overall street scene, is well-designed (including complying with any local design policies and standards), and can maintain safe access and egress for occupiers. They should also allow mansard roof extensions where their external appearance harmonises with the original building, including extensions to terraces where one or more of the terraced houses already has a mansard. Where there was a tradition of mansard construction locally at the time of the building's construction, the extension should emulate it with respect to external appearance. A condition of simultaneous development should not be imposed on an application for multiple mansard extensions unless there is an exceptional justification.

[55] Except where this would conflict with other policies in this Framework, including causing harm to designated sites of importance for biodiversity.
[56] As part of this approach, plans and decisions should support efforts to identify and bring back into residential use empty homes and other buildings, supported by the use of compulsory purchase powers where appropriate.

~~121.~~123. Local planning authorities, and other plan-making bodies, should take a proactive role in identifying and helping to bring forward land that may be suitable for meeting development needs, including suitable sites on brownfield registers or held in public ownership, using the full range of powers available to them. This should include identifying opportunities to facilitate land assembly, supported where necessary by compulsory purchase powers, where this can help to bring more land forward for meeting development needs and/or secure better development outcomes.

~~122.~~124. Planning policies and decisions need to reflect changes in the demand for land. They should be informed by regular reviews of both the land allocated for development in plans, and of land availability. Where the local planning authority considers there to be no reasonable prospect of an application coming forward for the use allocated in a plan:

a) it should, as part of plan updates, reallocate the land for a more deliverable use that can help to address identified needs (or, if appropriate, deallocate a site which is undeveloped); and

b) in the interim, prior to updating the plan, applications for alternative uses on the land should be supported, where the proposed use would contribute to meeting an unmet need for development in the area.

~~123.~~125. Local planning authorities should also take a positive approach to applications for alternative uses of land which is currently developed but not allocated for a specific purpose in plans, where this would help to meet identified development needs. In particular, they should support proposals to:

a) use retail and employment land for homes in areas of high housing demand, provided this would not undermine key economic sectors or sites or the vitality and viability of town centres, and would be compatible with other policies in this Framework; and

b) make more effective use of sites that provide community services such as schools and hospitals, provided this maintains or improves the quality of service provision and access to open space.

Achieving appropriate densities

~~124.~~126. Planning policies and decisions should support development that makes efficient use of land, taking into account:

a) the identified need for different types of housing and other forms of development, and the availability of land suitable for accommodating it;

b) local market conditions and viability;

c) the availability and capacity of infrastructure and services – both existing and proposed – as well as their potential for further improvement and the scope to promote sustainable travel modes that limit future car use;

d) the desirability of maintaining an area's prevailing character and setting (including residential gardens), or of promoting regeneration and change; and

e) the importance of securing well-designed and beautiful, attractive and healthy places.

~~125.~~127. Area-based character assessments, design guides and codes and masterplans can be used to help ensure that land is used efficiently while also creating beautiful and sustainable places. Where there is an existing or anticipated shortage of land for meeting identified housing needs, it is especially important that planning policies and decisions avoid homes being built at low densities, and ensure that developments make optimal use of the potential of each site. In these circumstances:

a) plans should contain policies to optimise the use of land in their area and meet as much of the identified need for housing as possible. This will be tested robustly at examination, and should include the use of minimum density standards for city and town centres and other locations that are well served by public transport. These standards should seek a significant uplift in the average density of residential development within these areas, unless it can be shown that there are strong reasons why this would be inappropriate;

b) the use of minimum density standards should also be considered for other parts of the plan area. It may be appropriate to set out a range of densities that reflect the accessibility and potential of different areas, rather than one broad density range; and

c) local planning authorities should refuse applications which they consider fail to make efficient use of land, taking into account the policies in this Framework. In this context, when considering applications for housing, authorities should take a flexible approach in applying policies or guidance relating to daylight and sunlight, where they would otherwise inhibit making efficient use of a site (as long as the resulting scheme would provide acceptable living standards).

12. Achieving well-designed and beautiful places

~~126.~~128. The creation of high quality, beautiful and sustainable buildings and places is fundamental to what the planning and development process should achieve. Good design is a key aspect of sustainable development, creates better places in which to live and work and helps make development acceptable to communities. Being clear about design expectations, and how these will be tested, is essential for achieving this. So too is effective engagement between applicants, communities, local planning authorities and other interests throughout the process.

~~127.~~129. Plans should, at the most appropriate level, set out a clear design vision and expectations, so that applicants have as much certainty as possible about what is likely to be acceptable. Design policies should be developed with local communities so they reflect local aspirations, and are grounded in an understanding and evaluation of each area's defining characteristics. Neighbourhood planning groups can play an important role in identifying the special qualities of each area and explaining how this should be reflected in development, both through their own plans and by engaging in the production of design policy, guidance and codes by local planning authorities and developers.

~~128.~~130. To provide maximum clarity about design expectations at an early stage, all local planning authorities should prepare design guides or codes consistent with the principles set out in the National Design Guide and National Model Design Code, and which reflect local character and design preferences. Design guides and codes provide a local framework for creating beautiful and distinctive places with a consistent and high quality standard of design. Their geographic coverage, level of detail and degree of prescription should be tailored to the circumstances and scale of change in each place, and should allow a suitable degree of variety.

~~129.~~131. Design guides and codes can be prepared at an area-wide, neighbourhood or site-specific scale, and to carry weight in decision-making should be produced either as part of a plan or as supplementary planning documents. Landowners and developers may contribute to these exercises, but may also choose to prepare design codes in support of a planning application for sites they wish to develop. Whoever prepares them, all guides and codes should be based on effective community engagement and reflect local aspirations for the development of their area, taking into account the guidance contained in the National Design Guide and the National Model Design Code. These national documents should be used to guide decisions on applications in the absence of locally produced design guides or design codes.

~~130.~~132. Planning policies and decisions should ensure that developments:

a) will function well and add to the overall quality of the area, not just for the short term but over the lifetime of the development;

b) are visually attractive as a result of good architecture, layout and appropriate and effective landscaping;

c) are sympathetic to local character and history, including the surrounding built environment and landscape setting, while not preventing or discouraging appropriate innovation or change (such as increased densities);

d) establish or maintain a strong sense of place, using the arrangement of streets, spaces, building types and materials to create attractive, welcoming and distinctive places to live, work and visit;

e) optimise the potential of the site to accommodate and sustain an appropriate amount and mix of development (including green and other public space) and support local facilities and transport networks; and

f) create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users[57]; and where crime and disorder, and the fear of crime, do not undermine the quality of life or community cohesion and resilience.

~~131.~~133. Trees make an important contribution to the character and quality of urban environments, and can also help mitigate and adapt to climate change. Planning policies and decisions should ensure that new streets are tree-lined[58], that opportunities are taken to incorporate trees elsewhere in developments (such as parks and community orchards), that appropriate measures are in place to secure the long-term maintenance of newly-planted trees, and that existing trees are retained wherever possible. Applicants and local planning authorities should work with highways officers and tree officers to ensure that the right trees are planted in the right places, and solutions are found that are compatible with highways standards and the needs of different users.

~~132.~~134. Design quality should be considered throughout the evolution and assessment of individual proposals. Early discussion between applicants, the local planning authority and local community about the design and style of emerging schemes is important for clarifying expectations and reconciling local and commercial interests. Applicants should work closely with those affected by their proposals to evolve designs that take account of the views of the community. Applications that can demonstrate early, proactive and effective engagement with the community should be looked on more favourably than those that cannot.

~~133.~~135. Local planning authorities should ensure that they have access to, and make appropriate use of, tools and processes for assessing and improving the design of development. The primary means of doing so should be through the preparation and use of local design codes, in line with the National Model Design Code. For assessing proposals there is a range of tools ~~These~~ includinge~~e~~ workshops to engage the local community, design advice and review arrangements, and

[57] Planning policies for housing should make use of the Government's optional technical standards for accessible and adaptable housing, where this would address an identified need for such properties. Policies may also make use of the nationally described space standard, where the need for an internal space standard can be justified.
[58] Unless, in specific cases, there are clear, justifiable and compelling reasons why this would be inappropriate.

assessment frameworks such as Building for a Healthy Life[59]. These are of most benefit if used as early as possible in the evolution of schemes, and are particularly important for significant projects such as large scale housing and mixed use developments. In assessing applications, local planning authorities should have regard to the outcome from these processes, including any recommendations made by design review panels.

~~134.~~136. Development that is not well designed should be refused, especially where it fails to reflect local design policies and government guidance on design[60], taking into account any local design guidance and supplementary planning documents such as design guides and codes. Conversely, significant weight should be given to:

a) development which reflects local design policies and government guidance on design, taking into account any local design guidance and supplementary planning documents such as design guides and codes; and/or

b) outstanding or innovative designs which promote high levels of sustainability, or help raise the standard of design more generally in an area, so long as they fit in with the overall form and layout of their surroundings.

~~135.~~137. Local planning authorities should ensure that relevant planning conditions refer to clear and accurate plans and drawings which provide visual clarity about the design of the development, and are clear about the approved use of materials where appropriate, to make enforcement easier. They should also seek to ensure that the quality of approved development is not materially diminished between permission and completion, as a result of changes being made to the permitted scheme (for example through changes to approved details such as the materials used).

~~136.~~138. The quality and character of places can suffer when advertisements are poorly sited and designed. A separate consent process within the planning system controls the display of advertisements, which should be operated in a way which is simple, efficient and effective. Advertisements should be subject to control only in the interests of amenity and public safety, taking account of cumulative impacts.

[59] Birkbeck D and Kruczkowski S et al (2020) *Building for a Healthy Life*
[60] Contained in the National Design Guide and National Model Design Code.

13. Protecting Green Belt land

~~137.~~139. The Government attaches great importance to Green Belts. The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open; the essential characteristics of Green Belts are their openness and their permanence.

~~138.~~140. Green Belt serves five purposes:

a) to check the unrestricted sprawl of large built-up areas;

b) to prevent neighbouring towns merging into one another;

c) to assist in safeguarding the countryside from encroachment;

d) to preserve the setting and special character of historic towns; and

e) to assist in urban regeneration, by encouraging the recycling of derelict and other urban land.

~~139.~~141. The general extent of Green Belts across the country is already established. New Green Belts should only be established in exceptional circumstances, for example when planning for larger scale development such as new settlements or major urban extensions. Any proposals for new Green Belts should be set out in strategic policies, which should:

a) demonstrate why normal planning and development management policies would not be adequate;

b) set out whether any major changes in circumstances have made the adoption of this exceptional measure necessary;

c) show what the consequences of the proposal would be for sustainable development;

d) demonstrate the necessity for the Green Belt and its consistency with strategic policies for adjoining areas; and

e) show how the Green Belt would meet the other objectives of the Framework.

~~140.~~142. Once established, Green Belt boundaries should only be altered where exceptional circumstances are fully evidenced and justified, through the preparation or updating of plans. Green Belt boundaries are not required to be reviewed and altered if this would be the only means of meeting the objectively assessed need for housing over the plan period. Strategic policies should establish the need for any changes to Green Belt boundaries, having regard to their intended permanence in the long term, so they can endure beyond the plan period. Where a need for changes to Green Belt boundaries has been established through strategic policies, detailed amendments to those boundaries may be made through non-strategic policies, including neighbourhood plans.

~~141.~~143. Before concluding that exceptional circumstances exist to justify changes to Green Belt boundaries, the strategic policy-making authority should be able to demonstrate that it has examined fully all other reasonable options for meeting its identified need for development. This will be assessed through the examination of its strategic policies, which will take into account the preceding paragraph, and whether the strategy:

a) makes as much use as possible of suitable brownfield sites and underutilised land;

b) optimises the density of development in line with the policies in chapter 11 of this Framework, including whether policies promote a significant uplift in minimum density standards in town and city centres and other locations well served by public transport; and

c) has been informed by discussions with neighbouring authorities about whether they could accommodate some of the identified need for development, as demonstrated through the statement of common ground.

~~142.~~144. When drawing up or reviewing Green Belt boundaries, the need to promote sustainable patterns of development should be taken into account. Strategic policy-making authorities should consider the consequences for sustainable development of channelling development towards urban areas inside the Green Belt boundary, towards towns and villages inset within the Green Belt or towards locations beyond the outer Green Belt boundary. Where it has been concluded that it is necessary to release Green Belt land for development, plans should give first consideration to land which has been previously-developed and/or is well-served by public transport. They should also set out ways in which the impact of removing land from the Green Belt can be offset through compensatory improvements to the environmental quality and accessibility of remaining Green Belt land.

~~143.~~145. When defining Green Belt boundaries, plans should:

a) ensure consistency with the development plan's strategy for meeting identified requirements for sustainable development;

b) not include land which it is unnecessary to keep permanently open;

c) where necessary, identify areas of safeguarded land between the urban area and the Green Belt, in order to meet longer-term development needs stretching well beyond the plan period;

d) make clear that the safeguarded land is not allocated for development at the present time. Planning permission for the permanent development of safeguarded land should only be granted following an update to a plan which proposes the development;

e) be able to demonstrate that Green Belt boundaries will not need to be altered at the end of the plan period; and

f) define boundaries clearly, using physical features that are readily recognisable and likely to be permanent.

~~144.~~146. If it is necessary to restrict development in a village primarily because of the important contribution which the open character of the village makes to the openness of the Green Belt, the village should be included in the Green Belt. If, however, the character of the village needs to be protected for other reasons, other means should be used, such as conservation area or normal development management policies, and the village should be excluded from the Green Belt.

~~145.~~147. Once Green Belts have been defined, local planning authorities should plan positively to enhance their beneficial use, such as looking for opportunities to provide access; to provide opportunities for outdoor sport and recreation; to retain and enhance landscapes, visual amenity and biodiversity; or to improve damaged and derelict land.

~~146.~~148. The National Forest and Community Forests offer valuable opportunities for improving the environment around towns and cities, by upgrading the landscape and providing for recreation and wildlife. The National Forest Strategy and an approved Community Forest Plan may be a material consideration in preparing development plans and in deciding planning applications. Any development proposals within the National Forest and Community Forests in the Green Belt should be subject to the normal policies for controlling development in Green Belts.

Proposals affecting the Green Belt

~~147.~~149. Inappropriate development is, by definition, harmful to the Green Belt and should not be approved except in very special circumstances.

~~148.~~150. When considering any planning application, local planning authorities should ensure that substantial weight is given to any harm to the Green Belt. ‘Very special circumstances’ will not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm resulting from the proposal, is clearly outweighed by other considerations.

~~149.~~151. A local planning authority should regard the construction of new buildings as inappropriate in the Green Belt. Exceptions to this are:

a) buildings for agriculture and forestry;

b) the provision of appropriate facilities (in connection with the existing use of land or a change of use) for outdoor sport, outdoor recreation, cemeteries and burial grounds and allotments; as long as the facilities preserve the openness of the Green Belt and do not conflict with the purposes of including land within it;

c) the extension or alteration of a building provided that it does not result in disproportionate additions over and above the size of the original building;

d) the replacement of a building, provided the new building is in the same use and not materially larger than the one it replaces;

e) limited infilling in villages;

f) limited affordable housing for local community needs under policies set out in the development plan (including policies for rural exception sites); and

g) limited infilling or the partial or complete redevelopment of previously developed land, whether redundant or in continuing use (excluding temporary buildings), which would:

- not have a greater impact on the openness of the Green Belt than the existing development; or
- not cause substantial harm to the openness of the Green Belt, where the development would re-use previously developed land and contribute to meeting an identified affordable housing need within the area of the local planning authority.

~~150.~~152. Certain other forms of development are also not inappropriate in the Green Belt provided they preserve its openness and do not conflict with the purposes of including land within it. These are:

a) mineral extraction;

b) engineering operations;

c) local transport infrastructure which can demonstrate a requirement for a Green Belt location;

d) the re-use of buildings provided that the buildings are of permanent and substantial construction;

e) material changes in the use of land (such as changes of use for outdoor sport or recreation, or for cemeteries and burial grounds); and

f) development, including buildings, brought forward under a Community Right to Build Order or Neighbourhood Development Order.

~~151.~~153. When located in the Green Belt, elements of many renewable energy projects will comprise inappropriate development. In such cases developers will need to demonstrate very special circumstances if projects are to proceed. Such very special circumstances may include the wider environmental benefits associated with increased production of energy from renewable sources.

14. Meeting the challenge of climate change, flooding and coastal change

~~152.~~154. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Planning for climate change

~~153.~~155. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[61]. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

~~154.~~156. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

~~155.~~157. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, and their future re-powering and maintenance, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

[61] In line with the objectives and provisions of the Climate Change Act 2008.

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

~~156.~~158. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

~~157.~~159. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

~~158.~~160. When determining planning applications[62] for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to significant cutting greenhouse gas emissions;

b) approve the application if its impacts are (or can be made) acceptable[63]. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas; and

c) approve an application for the repowering and life-extension of existing renewables sites, where its impacts are or can be made acceptable. The impacts of repowered and life-extended sites should be considered for the purposes of this policy from the baseline existing on the site.

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[62] Wind energy development involving one or more turbines can be granted through Local Development Orders, Neighbourhood Development Orders and Community Right to Build Orders, if it can be demonstrated that the planning impacts identified by the affected local community have been appropriately addressed and the proposal has community support.

[63] Except for applications for the repowering of existing wind turbines, a proposed wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in either the development plan, or a supplementary planning document identifies an area as suitable for wind energy development (where the development plan includes policy on supporting renewable energy); and, following consultation it can be demonstrated that the planning impacts identified by the affected local community have been ~~fully~~ satisfactorily addressed and the proposal has ~~their backing~~ community support.

161. To support energy efficiency improvements, significant weight should be given to the need to support energy efficiency improvements through the adaptation of existing buildings, particularly large non-domestic buildings, to improve their energy performance (including through installation of heat pumps and solar panels where these do not already benefit from permitted development rights). Proposals affecting conservation areas and listed buildings should also take into account the policies set out in chapter 16 of this Framework.

Planning and flood risk

162. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

~~162.~~163. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

~~163.~~164. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

~~164.~~165. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

~~165.~~166. If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the

exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

~~166.~~167. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

~~167.~~168. Both elements of the exception test should be satisfied for development to be allocated or permitted.

~~168.~~169. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

~~169.~~170. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[64]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

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[64] A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

~~170.~~171. Applications for some minor development and changes of use[65] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

~~171.~~172. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

Coastal change

~~172.~~173. In coastal areas, planning policies and decisions should take account of the UK Marine Policy Statement and marine plans. Integrated Coastal Zone Management should be pursued across local authority and land/sea boundaries, to ensure effective alignment of the terrestrial and marine planning regimes.

~~173.~~174. Plans should reduce risk from coastal change by avoiding inappropriate development in vulnerable areas and not exacerbating the impacts of physical changes to the coast. They should identify as a Coastal Change Management Area any area likely to be affected by physical changes to the coast, and:

a) be clear as to what development will be appropriate in such areas and in what circumstances; and

b) make provision for development and infrastructure that needs to be relocated away from Coastal Change Management Areas.

175. Development in a Coastal Change Management Area will be appropriate only where it is demonstrated that:

a) it will be safe over its planned lifetime and not have an unacceptable impact on coastal change;

b) the character of the coast including designations is not compromised;

c) the development provides wider sustainability benefits; and

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[65] This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

d) the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast[66].

176. Local planning authorities should limit the planned lifetime of development in a Coastal Change Management Area through temporary permission and restoration conditions, where this is necessary to reduce a potentially unacceptable level of future risk to people and the development.

[66] As required by the Marine and Coastal Access Act 2009.

15. Conserving and enhancing the natural environment

177. Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;

c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate;

d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

178. Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework[67]; take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries.

179. Great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty which have the highest status of protection in relation to these issues. The conservation and enhancement of wildlife and cultural heritage are also important considerations in these areas, and should be given great weight in National Parks

[67] Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality. The availability of agricultural land used for food production should be considered, alongside the other policies in this Framework, when deciding what sites are most appropriate for development.

and the Broads[68]. The scale and extent of development within all these designated areas should be limited, while development within their setting should be sensitively located and designed to avoid or minimise adverse impacts on the designated areas.

~~179.~~180. When considering applications for development within National Parks, the Broads and Areas of Outstanding Natural Beauty, permission should be refused for major development[69] other than in exceptional circumstances, and where it can be demonstrated that the development is in the public interest. Consideration of such applications should include an assessment of:

a) the need for the development, including in terms of any national considerations, and the impact of permitting it, or refusing it, upon the local economy;

b) the cost of, and scope for, developing outside the designated area, or meeting the need for it in some other way; and

c) any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

181. Within areas defined as Heritage Coast (and that do not already fall within one of the designated areas mentioned in paragraph 176), planning policies and decisions should be consistent with the special character of the area and the importance of its conservation. Major development within a Heritage Coast is unlikely to be appropriate, unless it is compatible with its special character.

Habitats and biodiversity

182. To protect and enhance biodiversity and geodiversity, plans should:

a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity[70]; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation[71]; and

b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.

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[68] *English National Parks and the Broads: UK Government Vision and Circular 2010* provides further guidance and information about their statutory purposes, management and other matters.
[69] For the purposes of paragraphs 176 and 177, whether a proposal is 'major development' is a matter for the decision maker, taking into account its nature, scale and setting, and whether it could have a significant adverse impact on the purposes for which the area has been designated or defined.
[70] Circular 06/2005 provides further guidance in respect of statutory obligations for biodiversity and geological conservation and their impact within the planning system.
[71] Where areas that are part of the Nature Recovery Network are identified in plans, it may be appropriate to specify the types of development that may be suitable within them.

183. When determining planning applications, local planning authorities should apply the following principles:

a) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;

b) development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;

c) development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons[72] and a suitable compensation strategy exists; and

d) development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to improve biodiversity in and around developments should be integrated as part of their design, especially where this can secure measurable net gains for biodiversity or enhance public access to nature where this is appropriate.

184. The following should be given the same protection as habitats sites:

a) potential Special Protection Areas and possible Special Areas of Conservation;

b) listed or proposed Ramsar sites[73]; and

c) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites.

185. The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site.

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[72] For example, infrastructure projects (including nationally significant infrastructure projects, orders under the Transport and Works Act and hybrid bills), where the public benefit would clearly outweigh the loss or deterioration of habitat.

[73] Potential Special Protection Areas, possible Special Areas of Conservation and proposed Ramsar sites are sites on which Government has initiated public consultation on the scientific case for designation as a Special Protection Area, candidate Special Area of Conservation or Ramsar site.

Ground conditions and pollution

186. Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

187. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

188. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[74];

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

189. Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when

[74] See Explanatory Note to the *Noise Policy Statement for England* (Department for Environment, Food & Rural Affairs, 2010).

determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.

190. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

191. The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

16. Conserving and enhancing the historic environment

192. Heritage assets range from sites and buildings of local historic value to those of the highest significance, such as World Heritage Sites which are internationally recognised to be of Outstanding Universal Value[75]. These assets are an irreplaceable resource, and should be conserved in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of existing and future generations[76].

193. Plans should set out a positive strategy for the conservation and enjoyment of the historic environment, including heritage assets most at risk through neglect, decay or other threats. This strategy should take into account:

a) the desirability of sustaining and enhancing the significance of heritage assets, and putting them to viable uses consistent with their conservation;

b) the wider social, cultural, economic and environmental benefits that conservation of the historic environment can bring;

c) the desirability of new development making a positive contribution to local character and distinctiveness; and

d) opportunities to draw on the contribution made by the historic environment to the character of a place.

194. When considering the designation of conservation areas, local planning authorities should ensure that an area justifies such status because of its special architectural or historic interest, and that the concept of conservation is not devalued through the designation of areas that lack special interest.

195. Local planning authorities should maintain or have access to a historic environment record. This should contain up-to-date evidence about the historic environment in their area and be used to:

a) assess the significance of heritage assets and the contribution they make to their environment; and

b) predict the likelihood that currently unidentified heritage assets, particularly sites of historic and archaeological interest, will be discovered in the future.

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[75] Some World Heritage Sites are inscribed by UNESCO to be of natural significance rather than cultural significance; and in some cases they are inscribed for both their natural and cultural significance.
[76] The policies set out in this chapter relate, as applicable, to the heritage-related consent regimes for which local planning authorities are responsible under the Planning (Listed Buildings and Conservation Areas) Act 1990, as well as to plan-making and decision-making.

196. Local planning authorities should make information about the historic environment, gathered as part of policy-making or development management, publicly accessible.

Proposals affecting heritage assets

197. In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant historic environment record should have been consulted and the heritage assets assessed using appropriate expertise where necessary. Where a site on which development is proposed includes, or has the potential to include, heritage assets with archaeological interest, local planning authorities should require developers to submit an appropriate desk-based assessment and, where necessary, a field evaluation.

198. Local planning authorities should identify and assess the particular significance of any heritage asset that may be affected by a proposal (including by development affecting the setting of a heritage asset) taking account of the available evidence and any necessary expertise. They should take this into account when considering the impact of a proposal on a heritage asset, to avoid or minimise any conflict between the heritage asset's conservation and any aspect of the proposal.

199. Where there is evidence of deliberate neglect of, or damage to, a heritage asset, the deteriorated state of the heritage asset should not be taken into account in any decision.

200. In determining applications, local planning authorities should take account of:

a) the desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation;

b) the positive contribution that conservation of heritage assets can make to sustainable communities including their economic vitality; and

c) the desirability of new development making a positive contribution to local character and distinctiveness.

201. In considering any applications to remove or alter a historic statue, plaque, memorial or monument (whether listed or not), local planning authorities should have regard to the importance of their retention in situ and, where appropriate, of explaining their historic and social context rather than removal.

Considering potential impacts

202. When considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset's conservation (and the more important the asset, the greater the weight should be). This is irrespective of whether any potential harm amounts to substantial harm, total loss or less than substantial harm to its significance.

203. Any harm to, or loss of, the significance of a designated heritage asset (from its alteration or destruction, or from development within its setting), should require clear and convincing justification. Substantial harm to or loss of:

a) grade II listed buildings, or grade II registered parks or gardens, should be exceptional;

b) assets of the highest significance, notably scheduled monuments, protected wreck sites, registered battlefields, grade I and II* listed buildings, grade I and II* registered parks and gardens, and World Heritage Sites, should be wholly exceptional[77].

204. Where a proposed development will lead to substantial harm to (or total loss of significance of) a designated heritage asset, local planning authorities should refuse consent, unless it can be demonstrated that the substantial harm or total loss is necessary to achieve substantial public benefits that outweigh that harm or loss, or all of the following apply:

a) the nature of the heritage asset prevents all reasonable uses of the site; and

b) no viable use of the heritage asset itself can be found in the medium term through appropriate marketing that will enable its conservation; and

c) conservation by grant-funding or some form of not for profit, charitable or public ownership is demonstrably not possible; and

d) the harm or loss is outweighed by the benefit of bringing the site back into use.

205. Where a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal including, where appropriate, securing its optimum viable use.

206. The effect of an application on the significance of a non-designated heritage asset should be taken into account in determining the application. In weighing applications that directly or indirectly affect non-designated heritage assets, a

[77] Non-designated heritage assets of archaeological interest, which are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.

balanced judgement will be required having regard to the scale of any harm or loss and the significance of the heritage asset.

207. Local planning authorities should not permit the loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred.

208. Local planning authorities should require developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible[78]. However, the ability to record evidence of our past should not be a factor in deciding whether such loss should be permitted.

209. Local planning authorities should look for opportunities for new development within Conservation Areas and World Heritage Sites, and within the setting of heritage assets, to enhance or better reveal their significance. Proposals that preserve those elements of the setting that make a positive contribution to the asset (or which better reveal its significance) should be treated favourably.

210. Not all elements of a Conservation Area or World Heritage Site will necessarily contribute to its significance. Loss of a building (or other element) which makes a positive contribution to the significance of the Conservation Area or World Heritage Site should be treated either as substantial harm under paragraph 201 or less than substantial harm under paragraph 202, as appropriate, taking into account the relative significance of the element affected and its contribution to the significance of the Conservation Area or World Heritage Site as a whole.

211. Local planning authorities should assess whether the benefits of a proposal for enabling development, which would otherwise conflict with planning policies but which would secure the future conservation of a heritage asset, outweigh the disbenefits of departing from those policies.

[78] Copies of evidence should be deposited with the relevant historic environment record, and any archives with a local museum or other public depository.

17. Facilitating the sustainable use of minerals

212. It is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs. Since minerals are a finite natural resource, and can only be worked where they are found, best use needs to be made of them to secure their long-term conservation.

213. Planning policies should:

a) provide for the extraction of mineral resources of local and national importance, but not identify new sites or extensions to existing sites for peat extraction;

b) so far as practicable, take account of the contribution that substitute or secondary and recycled materials and minerals waste would make to the supply of materials, before considering extraction of primary materials, whilst aiming to source minerals supplies indigenously;

c) safeguard mineral resources by defining Mineral Safeguarding Areas and Mineral Consultation Areas[79]; and adopt appropriate policies so that known locations of specific minerals resources of local and national importance are not sterilised by non-mineral development where this should be avoided (whilst not creating a presumption that the resources defined will be worked);

d) set out policies to encourage the prior extraction of minerals, where practical and environmentally feasible, if it is necessary for non-mineral development to take place;

e) safeguard existing, planned and potential sites for: the bulk transport, handling and processing of minerals; the manufacture of concrete and concrete products; and the handling, processing and distribution of substitute, recycled and secondary aggregate material;

f) set out criteria or requirements to ensure that permitted and proposed operations do not have unacceptable adverse impacts on the natural and historic environment or human health, taking into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality;

g) when developing noise limits, recognise that some noisy short-term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction; and

h) ensure that worked land is reclaimed at the earliest opportunity, taking account of aviation safety, and that high quality restoration and aftercare of mineral sites takes place.

[79] Primarily in two tier areas as stated in Annex 2: Glossary

214. When determining planning applications, great weight should be given to the benefits of mineral extraction, including to the economy[80]. In considering proposals for mineral extraction, minerals planning authorities should:

a) as far as is practical, provide for the maintenance of landbanks of non-energy minerals from outside National Parks, the Broads, Areas of Outstanding Natural Beauty and World Heritage Sites, scheduled monuments and conservation areas;

b) ensure that there are no unacceptable adverse impacts on the natural and historic environment, human health or aviation safety, and take into account the cumulative effect of multiple impacts from individual sites and/or from a number of sites in a locality;

c) ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source[81], and establish appropriate noise limits for extraction in proximity to noise sensitive properties;

d) not grant planning permission for peat extraction from new or extended sites;

e) provide for restoration and aftercare at the earliest opportunity, to be carried out to high environmental standards, through the application of appropriate conditions. Bonds or other financial guarantees to underpin planning conditions should only be sought in exceptional circumstances;

f) consider how to meet any demand for the extraction of building stone needed for the repair of heritage assets, taking account of the need to protect designated sites; and

g) recognise the small-scale nature and impact of building and roofing stone quarries, and the need for a flexible approach to the duration of planning permissions reflecting the intermittent or low rate of working at many sites.

215. Local planning authorities should not normally permit other development proposals in Mineral Safeguarding Areas if it might constrain potential future use for mineral working.

Maintaining supply

216. Minerals planning authorities should plan for a steady and adequate supply of aggregates by:

a) preparing an annual Local Aggregate Assessment, either individually or jointly, to forecast future demand, based on a rolling average of 10 years' sales data and other relevant local information, and an assessment of all supply options (including marine dredged, secondary and recycled sources);

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[80] Except in relation to the extraction of coal, where the policy at paragraph 217 of this Framework applies.
[81] National planning guidance on minerals sets out how these policies should be implemented.

b) participating in the operation of an Aggregate Working Party and taking the advice of that party into account when preparing their Local Aggregate Assessment;

c) making provision for the land-won and other elements of their Local Aggregate Assessment in their mineral plans, taking account of the advice of the Aggregate Working Parties and the National Aggregate Co-ordinating Group as appropriate. Such provision should take the form of specific sites, preferred areas and/or areas of search and locational criteria as appropriate;

d) taking account of any published National and Sub National Guidelines on future provision which should be used as a guideline when planning for the future demand for and supply of aggregates;

e) using landbanks of aggregate minerals reserves principally as an indicator of the security of aggregate minerals supply, and to indicate the additional provision that needs to be made for new aggregate extraction and alternative supplies in mineral plans;

f) maintaining landbanks of at least 7 years for sand and gravel and at least 10 years for crushed rock, whilst ensuring that the capacity of operations to supply a wide range of materials is not compromised[82];

g) ensuring that large landbanks bound up in very few sites do not stifle competition; and

h) calculating and maintaining separate landbanks for any aggregate materials of a specific type or quality which have a distinct and separate market.

217. Minerals planning authorities should plan for a steady and adequate supply of industrial minerals by:

a) co-operating with neighbouring and more distant authorities to ensure an adequate provision of industrial minerals to support their likely use in industrial and manufacturing processes;

b) encouraging safeguarding or stockpiling so that important minerals remain available for use;

c) maintaining a stock of permitted reserves to support the level of actual and proposed investment required for new or existing plant, and the maintenance and improvement of existing plant and equipment[83]; and

d) taking account of the need for provision of brick clay from a number of different sources to enable appropriate blends to be made.

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[82] Longer periods may be appropriate to take account of the need to supply a range of types of aggregates, locations of permitted reserves relative to markets, and productive capacity of permitted sites.

[83] These reserves should be at least 10 years for individual silica sand sites; at least 15 years for cement primary (chalk and limestone) and secondary (clay and shale) materials to maintain an existing plant, and for silica sand sites where significant new capital is required; and at least 25 years for brick clay, and for cement primary and secondary materials to support a new kiln.

Oil, gas and coal exploration and extraction

218. Minerals planning authorities should:

a) when planning for on-shore oil and gas development, clearly distinguish between, and plan positively for, the three phases of development (exploration, appraisal and production), whilst ensuring appropriate monitoring and site restoration is provided for;

b) encourage underground gas and carbon storage and associated infrastructure if local geological circumstances indicate its feasibility;

c) indicate any areas where coal extraction and the disposal of colliery spoil may be acceptable;

d) encourage the capture and use of methane from coal mines in active and abandoned coalfield areas; and

e) provide for coal producers to extract separately, and if necessary stockpile, fireclay so that it remains available for use.

219. When determining planning applications, minerals planning authorities should ensure that the integrity and safety of underground storage facilities are appropriate, taking into account the maintenance of gas pressure, prevention of leakage of gas and the avoidance of pollution.

220. Planning permission should not be granted for the extraction of coal unless:

a) the proposal is environmentally acceptable, or can be made so by planning conditions or obligations; or

b) if it is not environmentally acceptable, then it provides national, local or community benefits which clearly outweigh its likely impacts (taking all relevant matters into account, including any residual environmental impacts).

Annex 1: Implementation

221. The policies in this Framework are material considerations which should be taken into account in dealing with applications from the day of its publication. Plans may also need to be revised to reflect policy changes which this Framework has made.

222. However, existing policies should not be considered out-of-date simply because they were adopted or made prior to the publication of this Framework. Due weight should be given to them, according to their degree of consistency with this Framework (the closer the policies in the plan to the policies in the Framework, the greater the weight that may be given).

223. The policies in the original National Planning Policy Framework published in March 2012 will apply for the purpose of examining plans, where those plans were submitted on or before 24 January 2019. Where such plans are withdrawn or otherwise do not proceed to become part of the development plan, the policies contained in this Framework will apply to any subsequent plan produced for the area concerned.

224. For the purposes of the policy on larger-scale development in paragraph 22, this applies only to plans that have not reached Regulation 19 of the Town and Country Planning (Local Planning) (England) Regulations 2012 (pre-submission) stage at the point th~~is~~e previous version of this Framework was ~~is~~ published on 20 July 2021 (for Spatial Development Strategies this would refer to consultation under section 335(2) of the Greater London Authority Act 1999).

225. For the purposes of the tests of soundness in paragraph 35 and the policy on renewable and low carbon energy and heat in plans in paragraph 156, these policies apply only to plans that have not reached Regulation 19 of the Town and Country Planning (Local Planning) (England) Regulations 2012 (pre-submission) stage, or that reach this stage within three months , of the publication of this version. For Spatial Development Strategies, this applies to plans that have not reached consultation under section 335(2) of the Greater London Authority Act 1999, or are within three months of reaching this stage. For all other plans, the policy contained in the corresponding paragraph in the National Planning Policy Framework published in July 2021 will apply.

226. From the date of publication of this revision of the NPPF, for the purposes of changes to paragraph 61, for decision-taking, where emerging local plans have been submitted for examination or where they have been subject to a Regulation 18 or Regulation 19 (Town and Country Planning (Local Planning) (England) Regulations 2012) consultation which included both a policies map and proposed allocations towards meeting housing need, and the housing requirement as set out

in strategic policies has become more than five years old in the extant plan, local planning authorities should identify and update annually a supply of specific deliverable sites sufficient to provide a minimum of four years' worth of housing against their local housing need instead of a minimum of five years as set out in paragraph 75 of this document. These arrangements will apply for a period of two years from the publication date of this version.

~~224. The Housing Delivery Test will apply the day following publication of the results, at which point they supersede previously published results. Until new Housing Delivery Test results are published, the previously published result should be used. For the purpose of footnote 8 in this Framework, delivery of housing which was substantially below the housing requirement means where the Housing Delivery Test results:~~

~~a) for years 2016/17 to 2018/19 (Housing Delivery Test: 2019 Measurement, published 13 February 2020), indicated that delivery was below 45% of housing required over the previous three years;~~

~~b) for years 2017/18 to 2019/20 (Housing Delivery Test: 2020 Measurement, published 19 January 2021), and in subsequent years indicate that delivery was below 75% of housing required over the previous three years.~~

~~225.~~227. The Government will continue to explore with individual areas the potential for planning freedoms and flexibilities, for example where this would facilitate an increase in the amount of housing that can be delivered.

Annex 2: Glossary

Affordable housing: housing for sale or rent, for those whose needs are not met by the market (including housing that provides a subsidised route to home ownership and/or is for essential local workers); and which complies with one or more of the following definitions:

a) **Affordable housing for rent:** meets all of the following conditions: (a) the rent is set in accordance with the Government's rent policy for Social Rent or Affordable Rent, or is at least 20% below local market rents (including service charges where applicable); (b) the landlord is a registered provider, except where it is included as part of a Build to Rent scheme (in which case the landlord need not be a registered provider); and (c) it includes provisions to remain at an affordable price for future eligible households, or for the subsidy to be recycled for alternative affordable housing provision. For Build to Rent schemes affordable housing for rent is expected to be the normal form of affordable housing provision (and, in this context, is known as Affordable Private Rent).

b) **Starter homes:** is as specified in Sections 2 and 3 of the Housing and Planning Act 2016 and any secondary legislation made under these sections. The definition of a starter home should reflect the meaning set out in statute and any such secondary legislation at the time of plan-preparation or decision-making. Where secondary legislation has the effect of limiting a household's eligibility to purchase a starter home to those with a particular maximum level of household income, those restrictions should be used.

c) **Discounted market sales housing:** is that sold at a discount of at least 20% below local market value. Eligibility is determined with regard to local incomes and local house prices. Provisions should be in place to ensure housing remains at a discount for future eligible households.

d) **Other affordable routes to home ownership:** is housing provided for sale that provides a route to ownership for those who could not achieve home ownership through the market. It includes shared ownership, relevant equity loans, other low cost homes for sale (at a price equivalent to at least 20% below local market value) and rent to buy (which includes a period of intermediate rent). Where public grant funding is provided, there should be provisions for the homes to remain at an affordable price for future eligible households, or for any receipts to be recycled for alternative affordable housing provision, or refunded to Government or the relevant authority specified in the funding agreement.

Air quality management areas: Areas designated by local authorities because they are not likely to achieve national air quality objectives by the relevant deadlines.

Ancient or veteran tree: A tree which, because of its age, size and condition, is of exceptional biodiversity, cultural or heritage value. All ancient trees are veteran trees. Not all veteran trees are old enough to be ancient, but are old relative to other trees of the same species. Very few trees of any species reach the ancient life-stage.

Ancient woodland: An area that has been wooded continuously since at least 1600 AD. It includes ancient semi-natural woodland and plantations on ancient woodland sites (PAWS).

Annual position statement: A document setting out the 5 year housing land supply position on 1st April each year, prepared by the local planning authority in consultation with developers and others who have an impact on delivery.

Archaeological interest: There will be archaeological interest in a heritage asset if it holds, or potentially holds, evidence of past human activity worthy of expert investigation at some point.

Article 4 direction: A direction made under Article 4 of the Town and Country Planning (General Permitted Development) (England) Order 2015 which withdraws permitted development rights granted by that Order.

Best and most versatile agricultural land: Land in grades 1, 2 and 3a of the Agricultural Land Classification.

Brownfield land: See Previously developed land.

Brownfield land registers: Registers of previously developed land that local planning authorities consider to be appropriate for residential development, having regard to criteria in the Town and Country Planning (Brownfield Land Registers) Regulations 2017. Local planning authorities will be able to trigger a grant of permission in principle for residential development on suitable sites in their registers where they follow the required procedures.

Build to Rent: Purpose built housing that is typically 100% rented out. It can form part of a wider multi-tenure development comprising either flats or houses, but should be on the same site and/or contiguous with the main development. Schemes will usually offer longer tenancy agreements of three years or more, and will typically be professionally managed stock in single ownership and management control.

Climate change adaptation: Adjustments made to natural or human systems in response to the actual or anticipated impacts of climate change, to mitigate harm or exploit beneficial opportunities.

Climate change mitigation: Action to reduce the impact of human activity on the climate system, primarily through reducing greenhouse gas emissions.

Coastal change management area: An area identified in plans as likely to be affected by physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion.

Community forest: An area identified through the England Community Forest Programme to revitalise countryside and green space in and around major conurbations.

Community Right to Build Order: An Order made by the local planning authority (under the Town and Country Planning Act 1990) that grants planning permission for a site-specific development proposal or classes of development.

Community-led developments: Community-led developments are those that are driven by non-profit organisations that are owned by and accountable to their community members. The community group or organisation owns, manages or stewards the homes

and other assets in a manner of their choosing, and this may be done through a mutually supported arrangement with a Registered Provider that owns the freehold or leasehold for the property. The benefits to the specified community are clearly defined and legally protected in perpetuity.

Competent person (to prepare site investigation information): A person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation.

Conservation (for heritage policy): The process of maintaining and managing change to a heritage asset in a way that sustains and, where appropriate, enhances its significance.

Decentralised energy: Local renewable and local low carbon energy sources.

Deliverable: To be considered deliverable, sites for housing should be available now, offer a suitable location for development now, and be achievable with a realistic prospect that housing will be delivered on the site within five years. In particular:

a) sites which do not involve major development and have planning permission, and all sites with detailed planning permission, should be considered deliverable until permission expires, unless there is clear evidence that homes will not be delivered within five years (for example because they are no longer viable, there is no longer a demand for the type of units or sites have long term phasing plans).
b) where a site has outline planning permission for major development, has been allocated in a development plan, has a grant of permission in principle, or is identified on a brownfield register, it should only be considered deliverable where there is clear evidence that housing completions will begin on site within five years.

Design code: A set of illustrated design requirements that provide specific, detailed parameters for the physical development of a site or area. The graphic and written components of the code should build upon a design vision, such as a masterplan or other design and development framework for a site or area.

Design guide: A document providing guidance on how development can be carried out in accordance with good design practice, often produced by a local authority.

Designated heritage asset: A World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area designated under the relevant legislation.

Designated rural areas: National Parks, Areas of Outstanding Natural Beauty and areas designated as ‘rural’ under Section 157 of the Housing Act 1985.

Developable: To be considered developable, sites should be in a suitable location for housing development with a reasonable prospect that they will be available and could be viably developed at the point envisaged.

Development plan: Is defined in section 38 of the Planning and Compulsory Purchase Act 2004, and includes adopted local plans, neighbourhood plans that have been made and published spatial development strategies, together with any regional strategy policies that remain in force. Neighbourhood plans that have been approved at referendum are

also part of the development plan, unless the local planning authority decides that the neighbourhood plan should not be made.

Edge of centre: For retail purposes, a location that is well connected to, and up to 300 metres from, the primary shopping area. For all other main town centre uses, a location within 300 metres of a town centre boundary. For office development, this includes locations outside the town centre but within 500 metres of a public transport interchange. In determining whether a site falls within the definition of edge of centre, account should be taken of local circumstances.

Entry-level exception site: A site that provides entry-level homes suitable for first time buyers (or equivalent, for those looking to rent), in line with paragraph 72 of this Framework.

Environmental impact assessment: A procedure to be followed for certain types of project to ensure that decisions are made in full knowledge of any likely significant effects on the environment.

Essential local workers: Public sector employees who provide frontline services in areas including health, education and community safety – such as NHS staff, teachers, police, firefighters and military personnel, social care and childcare workers.

General aviation airfields: Licenced or unlicenced aerodromes with hard or grass runways, often with extensive areas of open land related to aviation activity.

Geodiversity: The range of rocks, minerals, fossils, soils and landforms.

Green infrastructure: A network of multi-functional green and blue spaces and other natural features, urban and rural, which is capable of delivering a wide range of environmental, economic, health and wellbeing benefits for nature, climate, local and wider communities and prosperity.

Habitats site: Any site which would be included within the definition at regulation 8 of the Conservation of Habitats and Species Regulations 2017 for the purpose of those regulations, including candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation, Special Protection Areas and any relevant Marine Sites.

Heritage asset: A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. It includes designated heritage assets and assets identified by the local planning authority (including local listing).

Heritage coast: Areas of undeveloped coastline which are managed to conserve their natural beauty and, where appropriate, to improve accessibility for visitors.

Historic environment: All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.

Historic environment record: Information services that seek to provide access to comprehensive and dynamic resources relating to the historic environment of a defined geographic area for public benefit and use.

Housing Delivery Test: Measures net homes delivered and the number of homes granted permission in a local authority area against the homes required, using national statistics and local authority data. The Secretary of State will publish the Housing Delivery Test results for each local authority in England ~~every November~~each winter.

International, national and locally designated sites of importance for biodiversity: All international sites (Special Areas of Conservation, Special Protection Areas, and Ramsar sites), national sites (Sites of Special Scientific Interest) and locally designated sites including Local Wildlife Sites.

Irreplaceable habitat: Habitats which would be technically very difficult (or take a very significant time) to restore, recreate or replace once destroyed, taking into account their age, uniqueness, species diversity or rarity. They include ancient woodland, ancient and veteran trees, blanket bog, limestone pavement, sand dunes, salt marsh and lowland fen.

Local Development Order: An Order made by a local planning authority (under the Town and Country Planning Act 1990) that grants planning permission for a specific development proposal or classes of development.

Local Enterprise Partnership: A body, designated by the Secretary of State for Housing, Communities and Local Government, established for the purpose of creating or improving the conditions for economic growth in an area.

Local housing need: The number of homes identified as being needed through the application of the standard method set out in national planning guidance (or, in the context of preparing strategic policies only, this may be calculated using a justified alternative approach as provided for in paragraph 61 of this Framework).

Local Nature Partnership: A body, designated by the Secretary of State for Environment, Food and Rural Affairs, established for the purpose of protecting and improving the natural environment in an area and the benefits derived from it.

Local planning authority: The public authority whose duty it is to carry out specific planning functions for a particular area. All references to local planning authority include the district council, London borough council, county council, Broads Authority, National Park Authority, the Mayor of London and a development corporation, to the extent appropriate to their responsibilities.

Local plan: A plan for the future development of a local area, drawn up by the local planning authority in consultation with the community. In law this is described as the development plan documents adopted under the Planning and Compulsory Purchase Act 2004. A local plan can consist of either strategic or non-strategic policies, or a combination of the two.

Main town centre uses: Retail development (including warehouse clubs and factory outlet centres); leisure, entertainment and more intensive sport and recreation uses (including cinemas, restaurants, drive-through restaurants, bars and pubs, nightclubs,

casinos, health and fitness centres, indoor bowling centres and bingo halls); offices; and arts, culture and tourism development (including theatres, museums, galleries and concert halls, hotels and conference facilities).

Major development[84]**:** For housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more. For non-residential development it means additional floorspace of 1,000m^2 or more, or a site of 1 hectare or more, or as otherwise provided in the Town and Country Planning (Development Management Procedure) (England) Order 2015.

Major hazard sites, installations and pipelines: Sites and infrastructure, including licensed explosive sites and nuclear installations, around which Health and Safety Executive (and Office for Nuclear Regulation) consultation distances to mitigate the consequences to public safety of major accidents may apply.

Minerals resources of local and national importance: Minerals which are necessary to meet society's needs, including aggregates, brickclay (especially Etruria Marl and fireclay), silica sand (including high grade silica sands), coal derived fly ash in single use deposits, cement raw materials, gypsum, salt, fluorspar, shallow and deep-mined coal, oil and gas (including conventional and unconventional hydrocarbons), tungsten, kaolin, ball clay, potash, polyhalite and local minerals of importance to heritage assets and local distinctiveness.

Mineral Consultation Area: a geographical area based on a Mineral Safeguarding Area, where the district or borough council should consult the Mineral Planning Authority for any proposals for non-minerals development.

Mineral Safeguarding Area: An area designated by minerals planning authorities which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary sterilisation by non-mineral development.

National trails: Long distance routes for walking, cycling and horse riding.

Natural Flood Management: managing flood and coastal erosion risk by protecting, restoring and emulating the natural 'regulating' function of catchments, rivers, floodplains and coasts.

Nature Recovery Network: An expanding, increasingly connected, network of wildlife-rich habitats supporting species recovery, alongside wider benefits such as carbon capture, water quality improvements, natural flood risk management and recreation. It includes the existing network of protected sites and other wildlife rich habitats as well as and landscape or catchment scale recovery areas where there is coordinated action for species and habitats.

Neighbourhood Development Order: An Order made by a local planning authority (under the Town and Country Planning Act 1990) through which parish councils and neighbourhood forums can grant planning permission for a specific development proposal or classes of development.

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[84] Other than for the specific purposes of paragraphs 176 and 177 in this Framework.

Neighbourhood plan: A plan prepared by a parish council or neighbourhood forum for a designated neighbourhood area. In law this is described as a neighbourhood development plan in the Planning and Compulsory Purchase Act 2004.

Non-strategic policies: Policies contained in a neighbourhood plan, or those policies in a local plan that are not strategic policies.

Older people: People over or approaching retirement age, including the active, newly-retired through to the very frail elderly; and whose housing needs can encompass accessible, adaptable general needs housing through to the full range of retirement and specialised housing for those with support or care needs.

Open space: All open space of public value, including not just land, but also areas of water (such as rivers, canals, lakes and reservoirs) which offer important opportunities for sport and recreation and can act as a visual amenity.

Original building: A building as it existed on 1 July 1948 or, if constructed after 1 July 1948, as it was built originally.

Out of centre: A location which is not in or on the edge of a centre but not necessarily outside the urban area.

Out of town: A location out of centre that is outside the existing urban area.

Outstanding universal value: Cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations. An individual Statement of Outstanding Universal Value is agreed and adopted by the UNESCO World Heritage Committee for each World Heritage Site.

People with disabilities: People have a disability if they have a physical or mental impairment, and that impairment has a substantial and long-term adverse effect on their ability to carry out normal day-to-day activities. These persons include, but are not limited to, people with ambulatory difficulties, blindness, learning difficulties, autism and mental health needs.

Permission in principle: A form of planning consent which establishes that a site is suitable for a specified amount of housing-led development in principle. Following a grant of permission in principle, the site must receive a grant of technical details consent before development can proceed.

Planning condition: A condition imposed on a grant of planning permission (in accordance with the Town and Country Planning Act 1990) or a condition included in a Local Development Order or Neighbourhood Development Order.

Planning obligation: A legal agreement entered into under section 106 of the Town and Country Planning Act 1990 to mitigate the impacts of a development proposal.

Playing field: The whole of a site which encompasses at least one playing pitch as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015.

Previously developed land: Land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure. This excludes: land that is or was last occupied by agricultural or forestry buildings; land that has been developed for minerals extraction or waste disposal by landfill, where provision for restoration has been made through development management procedures; land in built-up areas such as residential gardens, parks, recreation grounds and allotments; and land that was previously developed but where the remains of the permanent structure or fixed surface structure have blended into the landscape.

Primary shopping area: Defined area where retail development is concentrated.

Priority habitats and species: Species and Habitats of Principal Importance included in the England Biodiversity List published by the Secretary of State under section 41 of the Natural Environment and Rural Communities Act 2006.

Ramsar sites: Wetlands of international importance, designated under the 1971 Ramsar Convention.

Renewable and low carbon energy: Includes energy for heating and cooling as well as generating electricity. Renewable energy covers those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass and deep geothermal heat. Low carbon technologies are those that can help reduce emissions (compared to conventional use of fossil fuels).

Rural exception sites: Small sites used for affordable housing in perpetuity where sites would not normally be used for housing. Rural exception sites seek to address the needs of the local community by accommodating households who are either current residents or have an existing family or employment connection. A proportion of market homes may be allowed on the site at the local planning authority's discretion, for example where essential to enable the delivery of affordable units without grant funding.

Recycled aggregates: aggregates resulting from the processing of inorganic materials previously used in construction, e.g. construction and demolition waste.

Safeguarding zone: An area defined in Circular 01/03: *Safeguarding aerodromes, technical sites and military explosives storage areas*, to which specific safeguarding provisions apply.

Secondary aggregates: aggregates from industrial wastes such as glass (cullet), incinerator bottom ash, coal derived fly ash, railway ballast, fine ceramic waste (pitcher), and scrap tyres; and industrial and minerals by-products, notably waste from china clay, coal and slate extraction and spent foundry sand. These can also include hydraulically bound materials.

Self-build and custom-build housing: Housing built by an individual, a group of individuals, or persons working with or for them, to be occupied by that individual. Such housing can be either market or affordable housing. A legal definition, for the purpose of

applying the Self-build and Custom Housebuilding Act 2015 (as amended), is contained in section 1(A1) and (A2) of that Act.

Setting of a heritage asset: The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.

Significance (for heritage policy): The value of a heritage asset to this and future generations because of its heritage interest. The interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting. For World Heritage Sites, the cultural value described within each site's Statement of Outstanding Universal Value forms part of its significance.

Special Areas of Conservation: Areas defined by regulation 3 of the Conservation of Habitats and Species Regulations 2017 which have been given special protection as important conservation sites.

Special Protection Areas: Areas classified under regulation 15 of the Conservation of Habitats and Species Regulations 2017 which have been identified as being of international importance for the breeding, feeding, wintering or the migration of rare and vulnerable species of birds.

Site investigation information: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 Investigation of Potentially Contaminated Sites – Code of Practice).

Site of Special Scientific Interest: Sites designated by Natural England under the Wildlife and Countryside Act 1981.

Spatial development strategy: A plan containing strategic policies prepared by a Mayor or a combined authority. It includes the London Plan (prepared under provisions in the Greater London Authority Act 1999) and plans prepared by combined authorities that have been given equivalent plan-making functions by an order made under the Local Democracy, Economic Development and Construction Act 2009 (as amended).

Stepping stones: Pockets of habitat that, while not necessarily connected, facilitate the movement of species across otherwise inhospitable landscapes.

Strategic environmental assessment: A procedure (set out in the Environmental Assessment of Plans and Programmes Regulations 2004) which requires the formal environmental assessment of certain plans and programmes which are likely to have significant effects on the environment.

Strategic policies: Policies and site allocations which address strategic priorities in line with the requirements of Section 19 (1B-E) of the Planning and Compulsory Purchase Act 2004.

Strategic policy-making authorities: Those authorities responsible for producing strategic policies (local planning authorities, and elected Mayors or combined authorities, where this power has been conferred). This definition applies whether the authority is in the process of producing strategic policies or not.

Supplementary planning documents: Documents which add further detail to the policies in the development plan. They can be used to provide further guidance for development on specific sites, or on particular issues, such as design. Supplementary planning documents are capable of being a material consideration in planning decisions but are not part of the development plan.

Sustainable transport modes: Any efficient, safe and accessible means of transport with overall low impact on the environment, including walking and cycling, ultra low and zero emission vehicles, car sharing and public transport.

Town centre: Area defined on the local authority's policies map, including the primary shopping area and areas predominantly occupied by main town centre uses within or adjacent to the primary shopping area. References to town centres or centres apply to city centres, town centres, district centres and local centres but exclude small parades of shops of purely neighbourhood significance. Unless they are identified as centres in the development plan, existing out-of-centre developments, comprising or including main town centre uses, do not constitute town centres.

Transport assessment: A comprehensive and systematic process that sets out transport issues relating to a proposed development. It identifies measures required to improve accessibility and safety for all modes of travel, particularly for alternatives to the car such as walking, cycling and public transport, and measures that will be needed deal with the anticipated transport impacts of the development.

Transport statement: A simplified version of a transport assessment where it is agreed the transport issues arising from development proposals are limited and a full transport assessment is not required.

Travel plan: A long-term management strategy for an organisation or site that seeks to deliver sustainable transport objectives and is regularly reviewed.

Wildlife corridor: Areas of habitat connecting wildlife populations.

Windfall sites: Sites not specifically identified in the development plan.

Annex 3: Flood risk vulnerability classification

ESSENTIAL INFRASTRUCTURE

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; and water treatment works that need to remain operational in times of flood.
- Wind turbines.
- Solar farms

HIGHLY VULNERABLE

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as ‘Essential Infrastructure’.)

MORE VULNERABLE

- Hospitals
- Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

LESS VULNERABLE

- Police, ambulance and fire stations which are not required to be operational during flooding.

- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the ‘more vulnerable’ class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
- Car parks.

WATER-COMPATIBLE DEVELOPMENT

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

* Landfill is as defined in Schedule 10 of the Environmental Permitting (England and Wales) Regulations 2010.

Appendix B

Introduction

B.1. At issue specific hearing 3 (ISH3) the Examining Authority (ExA) asked the Applicant and Say No to Sunnica (SNTS) to set out the relevant portions of the decision in the Hatchfield Farm case. Unless specified otherwise, references in this note to the Hatchfield Farm case, decision, or report is a reference to the 12 March 2020 decision.

B.2. SNTS is of the view that it is necessary to have all of the 12 March 2020 decision in mind, as it illustrates the focus of the Inspector in the report (and the focus of the submissions of the parties). However, SNTS draws particular attention to paragraphs 438-487 of the Inspector's report [IR438]-[IR487] which were relied upon at paragraphs 16-22 of the decision letter of the Secretary of State [DL16]-[DL-22].

B.3. SNTS now has the benefit of the further report produced by Lichfields dated 18 December 2022 [REP4-039]. To assist the ExA, SNTS produces a response to the suggested 'directly relevant findings' advanced by Lichfields at para 2.14 at the end of this note.

B.4. In summary, SNTS maintains its position that the Hatchfield Farm decision cannot be taken to be of more than minimal relevance to the Sunnica case. We agree that the identification by the Inspector in that case that the HRI in Newmarket is pre-eminent in the world; this is not and never has been in dispute. However, this does not make the remainder of the determinations in that case applicable to Sunnica. Indeed, crucially, the Inspector in Hatchfield Farm was not only considering an entirely different type of development, with different characteristics, but in contrast, the harm there identified was determined to be minimal or non-existent. The distinctions between Hatchfield Farm and the Sunnica application fall into three main categories:

B.5. The nature of impact in the Hatchfield Farm case compared to that posed by the Sunnica scheme: The case concerned principally the impact of traffic and, thus, all evidence and analysis was focused around vulnerability and harm to the HRI related to that traffic impact. The impacts of Sunnica are far wider and engage different categories of vulnerability which go to the heart of the HRI in Newmarket. Where the focus of the inquiry is different, the focus of the outcome is similarly likely to be different as will be the balance to be carried out – if the harm is minimal, the balance would be minimally affected.

B.6. The nature of the vulnerability assessed in the Hatchfield Farm case compared to that arising in respect of the Sunnica scheme: because the scope of the risk was, essentially, traffic, the focus on vulnerabilities was broadly generalist or directly related to traffic impact.

B.7. The nature of the harm arising in respect of the Sunnica scheme when compared to that advanced in the Hatchfield Farm case: Hatchfield Farm concerned not only a case of de minimis harm but also a significant benefit to road safety. There is no benefit to the HRI with the Sunnica scheme. Any comparisons to the significant harm in the case of the development is unhelpful as it obscures where any tipping point for the industry would be.

B.8. Considering these differences, it would be an error of law to take determinations made in respect of entirely different impacts, vulnerabilities, and harms and carry them across to assess the Sunnica scheme. In this way, the Hatchfield Farm decision is more apt to confuse than assist in the analysis.

The Nature of the Impact

B.9. Hatchfield Farm concerned a 400 dwelling development near to Newmarket. The impact focused upon at the Hatchfield Farm inquiry was traffic; in relation to the HRI, the focus was on the impact of traffic on the viability of the industry. This focus is identified by the Inspector at the outset of the section of his report titled 'Impact upon the horse racing industry (HRI) in Newmarket' [IR-438]:

B.10. The focus of concern for NHG was the potential impact of increased traffic levels upon the operations of the HRI and the knock-on implications of that, to whit the relocation of owners and trainers to other towns. This concern had two prongs, being considerations of actual harm and a perception that harm could arise.

B.11. The Inspector's report then proceeds to focus on the risk of an impact posed by the congestion (see, for example, [IR-455] and [IR-468] to [IR-469]). It was also the focus of the submissions in respect of the HRI in the Hatchfield Farm case (see for example the applicant's submissions [IR-307] and what follows). This focus is unsurprising considering the development was spatially distant from Newmarket and locations relevant to the HRI. This is a point the Inspector recognised [IR-472]:

B.12. Addressing the matter of urbanisation head-on, the application site is some distance from the huge swathes of gallops which surround the town. It is difficult to see how it could be perceived as encroaching on their semi-rural setting to any significant extent. Similarly, given the site's location, one would be hard pressed to come to the view that it would have a direct impact upon the town's local heritage and character.

B.13. The impact in the case of the Sunnica application is a wholly different one. The development will have a direct interaction with locations crucial to the HRI. Most notably, this is the

Limekilns gallops opposite Sunnica West A but extends far beyond this. Using the Limekilns as an example, the impact of the Sunnica scheme includes: (1) landscape; (2) visual; and, (3) heritage. The development will overlook the Limekilns gallops and is part of their setting, changing that setting and detaching the connection of that crucial location to its racing heritage.

B.14. That the impacts are very different is stark on the face of the Hatchfield Farm report: the Inspector in that case found that 'the proposal would protect and conserve the importance of the HRI and Newmarket's associated local heritage and character' [IR-511]. In Sunnica's case, the Applicant accepts that the impact in landscape, visual and heritage terms to the Limekilns cannot be mitigated. There is barely any concordance between the impact in Hatchfield Farm and the impact in the case before the ExA.

B.15. This distinction is important in its own terms because any assessment by the Inspector in the Hatchfield Farm of harm requires consideration of the extent of the impact concerned. However, it is also crucial when considering the vulnerability of the receptor of that impact. Put another way: the impact was an alleged traffic impact; thus any vulnerability would need to be one which could be harmed by such a traffic impact. Vulnerability in respect of landscape and heritage would not be vulnerable to such an impact, so there was no reason for the Inspector to make an assessment of the health of the HRI which took in those factors. In contrast, impact on landscape and heritage is clearly in play in respect of Sunnica, and thus vulnerability of the HRI may arise from these features.

B.16. Finally, it was suggested that the impact may instead be the perception that the HRI is not being taken seriously. This requires consideration of what harm (if any) arises, and how that is balanced in planning terms. It was derivative of the main point concerning traffic (i.e. the question was whether the HRI's concerns about traffic were being taken seriously) and cannot make what is otherwise a distinct case concerning traffic of significant relevance to the Sunnica scheme.

Nature of the Vulnerability

B.17. As a starting point, the pre-eminence of Newmarket as the home of horseracing does not seem to be in doubt. It is a point made by SNTS and accepted by the Applicant. It is also a point recognised in the Hatchfield Farm report [IR-439]. However, pre-eminence does not render Newmarket invulnerable.

B.18. First, there is vulnerability in a general sense that any person thing or place at the top of an industry will be the target of challenge. Much as the chef at a world-famous restaurant could receive offers and enticements to move to a different restaurant, so do the significant members of the HRI receive enticements to move to other locations across the globe. Being pre-eminent necessarily has this inbuilt vulnerability. Further, once the pre-eminent falls to second or third place, the status has declined, and it is that much harder to retain the best professionals and employees who seek the best.

B.19. Sunnica point to the fact that nowhere is like Newmarket elsewhere. That is no answer. Every location is different and has different HRIs and factors which make them compete with Newmarket. These include in particular monetary benefits in the form of prizes, salaries and taxation perks, as well as there being increasing proportions of the highest level of competing horses trained away from Great Britain (as Sunnica's own evidence shows).

B.20. However, SNTS say there are further factors which distinguish vulnerability in this case from that assessed in the Hatchfield Farm case. These are: (1) the threat to prospective investors; and (2) the relationship between impact and vulnerability.

Prospective Investors

B.21. An important distinction between the Hatchfield Farm case and the case before the ExA is the receptor of the impacts. In Hatchfield Farm the focus was squarely on owners and investors already invested in the Newmarket HRI. For example, at [IR-467]:

B.22. Certainly, Mr Wicksteed's evidence to the Inquiry was that racehorse owners are "not daft", have "very shrewd buyers who act for them" and, once invested, "behave in a businesslike fashion". There is, in my judgement, little, if any, evidence of them acting, or being likely to act, upon whims.

B.23. This quote precisely makes the point; the focus is on 'racehorse owners' that 'once invested' behave in a business-like fashion. In contrast, SNTS have consistently maintained that footloose prospective investors are of crucial importance. The 'them' referred to by the Inspector in the report does not refer to such prospective investors.

B.24. Investing in horseracing is discretionary spend; investing in horseracing in Newmarket is a further discretion even if a person has decided to invest in horseracing generally. This is a distinct and important category of people with regard to which there was no evidence at the Hatchfield Farm inquiry and to which the report makes no reference. This is unsurprising,

being as though a traffic impact is likely to have limited if any impact on prospective footloose investors (to which see the nature between impact and vulnerability below)

B.25. This is an important point considering the epicentre of the scheme's impact on the HRI: the Limekilns. SNTS has produced evidence that the Limekilns is a showpiece used to advertise Newmarket potential investors. It is the very place where these footloose prospective investors are enticed to have an emotional response to encourage that discretionary spend in Newmarket. How spending is achieved is through the coming together of the horse, the jockey, the trainer, and the location. The Limekilns is the stage upon which the performance aimed at achieving investment is set; the scheme represents a significant blight on that stage.

B.26. Thus, again, the Hatchfield Farm report does not consider a crucial aspect of the vulnerability of Newmarket. It thus can cast little light on this issue for the ExA.

Relationship between Impact and Vulnerability

B.27. As was already trailed above, the nature of the impact alleged to threaten harm must inform the assessment of any vulnerability to said impact. Thus, in the Hatchfield Farm case, the focus was vulnerability that would be a receptor for the impact of an increase in traffic and congestion. In contrast, in the Sunnica case the impacts go far beyond and (crucially) go to the features of Newmarket and its surrounds which contribute to its pre-eminence.

B.28. Considering just the Limekilns, the impacts go to landscape, visual and heritage matters. If we go on to consider what makes Newmarket pre-eminent, and particularly its success with prospective footloose investors, we quickly identify that landscape, visual and heritage matters are core components. As was just suggested above, the Limekilns are the stage upon which enticement to invest is played out. The success of the Limekilns as a location for taking prospective investors is because of its beauty; its connection to the rural and equine landscape; its connection to Newmarket's historic past. The high-quality landscape and the visible and obvious connection to heritage sells horses.

B.29. Considered in this way, the Hatchfield Farm report makes no attempt to consider vulnerability of the HRI to impacts on landscape, visual and heritage considerations because they simply were not relevant to the question of whether traffic arising from the 400 dwelling development would cause harm. Indeed, [IR-472] quoted above identifies as much. Any determination of the susceptibility of the HRI to harm caused by the Sunnica scheme

must assess those vulnerabilities and features that the scheme impacts upon. The Hatchfield Farm report is no proxy for this.

Nature of the Harm

B.30. Finally, we come to the nature of the harm. As a preliminary point, SNTS say that the lack of accordance between the impacts and vulnerabilities in the Hatchfield Farm case and the Sunnica case means that any findings on harm (or lack thereof) in the Hatchfield Farm case cannot be relevant to the Sunnica case.

B.31. Some of the most obvious differences between the two cases can be appreciated from [IR-472] - [IR-473]. The Sunnica scheme:

- Comes very close to the Limekilns and would clearly encroach on their rural setting.
- Given the heritage of the Limekilns and their contribution to the town's local heritage and character it would clearly have an impact on it;

B.32. Notwithstanding the fact that Inspector does not really grapple with the adverse impact on the operational use of an existing HRI policy point, the Sunnica scheme would have such impacts (as SNTS and the NHG have shown) where the Hatchfield Farm scheme didn't.

B.33. However, the matter goes beyond this. First, the conclusion of the Inspector in the planning balance was that the scheme would deliver significant benefit for the HRI [IR-530]-[IR-532]. The highway impacts in respect of the HRI were identified as de minimis at best [IR-470] and [DL-19]. This absence of harm (and, indeed, existence of benefit) is a stark contrast to our case; the landscape and heritage harms to HRI locations is not in doubt (at least in respect of the Limekilns, which the Applicant accepts the view of the development from which cannot be mitigated). It is dangerous to draw parallels from a case of such a different type and magnitude.

B.34. Secondly, and related to this first point, it means any assessment of the 'tipping point' for the HRI was entirely different in the Hatchfield Farm case. This was an idea that both the Inspector [IR-468]-[IR-469] and Secretary of State [DR-17] relied upon. As the Inspector noted at [IR-469]: 'I fully appreciate that one cannot anticipate when a tipping point may be reached'. This is tantamount to the proposition that every case falls to be considered on its own facts; in each and every case it is a 'matter of judgment'.

B.35. Thirdly, it is also important to recognise what passing the 'tipping point' means. The Inspector in Hatchfield Farm took account of evidence that there would not be an 'imploding' of the HRI as a result of that scheme (see e.g. [IR-475]). But that is a straw man; the true harm would be a degrading of Newmarket which causes it to slump over time. A decline over years is as much a harm as an immediate exodus.

B.36. The fact that the Hatchfield Farm inquiry heard evidence that the industry was not about to implode appears to have misled all involved. Implosion is a discrete outcome that sits at one end of wide spectrum of the possible outcomes of development for the HRI. The relevant policy requires decision makers to consider whether the development would threaten the long-term viability of the horse racing industry as a whole. Such an outcome could occur in a multitude of ways, in various magnitudes, and play out over a protracted period of time.

B.37. The likelihood of the industry's long-term viability being impacted by an implosion is very low. The attention and time given to the possibility of an implosion was therefore unhelpful as it was never likely to be an outcome. The impacts on the industry in both cases would be likely to be of a lower magnitude and possibly more nuanced and subtler. What matters, however, is whether they would threaten the long-term viability of the horse racing industry as a whole, which SNTS and NHG have demonstrated to be the case with respect to the Sunnica scheme.

B.38. Fourthly, the policy applying to the weight to be given to the harm is different. The focus in the Hatchfield Farm case was on the Forest Heath Core Strategy (along with its Single Issue Review and Site Allocations Local Plan) and the Joint Development Management Policies Document 2015. However, the East Cambridgeshire DC policy EMP6 is crucial in this case as it is a significant additional weight against the scheme (particularly as the Limekilns falls within that district). The critical differences between JDMPD policy DM48 and ECLP policy EMP6 are:

B.39. DM48 deals with any development which is likely to have a material adverse impact, whereas EMP6 deals with any development that is likely to have an adverse impact (i.e. an adverse impact of any scale); and

B.40. DM48 prescribes that development triggering the criteria it identifies will not be permitted unless the benefits would significantly outweigh the harm to the horse racing industry, whereas EMP6 stipulates that such development will not be permitted (i.e. will not be permitted in any circumstances).

B.41. Drawing analogies between the cases on the basis of where the 'tipping point' is would be inappropriate when the policy landscape is altered.

B.42. Overall, the harm in the case of the Sunnica application is of an entirely different nature and magnitude to that considered in the Hatchfield Farm case. To draw parallels where the nature of the harm would affect the focus, analysis, and evidence is inappropriate.

Lichfields' Para 2.14

B.43. At para 2.14 Lichfields set out a list of findings from the Hatchfield Farm report which they say is of direct relevance to the determination of the case before the ExA. These points are taken in turn.

Point 1

B.44. SNTS does not dissent from this point, although it is a matter of general planning principle. The report adds nothing new.

Point 2

B.45. SNTS does not dissent from this point, but it is essentially agreed between the parties. The report is duplicative of evidence already before the ExA.

Point 3

B.46. SNTS does not dissent from the point that, currently, the setup at Newmarket is not replicated elsewhere. Each location is unique and has its own attributes. This misses the point – it is the decline of Newmarket that is the matter in question, not whether or not another location elsewhere can create the same. If there is a threat of decline in Newmarket HRI as a whole in the long term, the policy test to presume against the incoming development is met; it matters not how or what is done elsewhere. The harm of the proposed scheme is a factor which could materially increase the prospect of enticements to move to other horseracing locations across the globe succeeding. This threatens the decline of the services around Newmarket and the growth of them at competing locations.

Point 4

B.47. SNTS does not dissent from this point, which is in the nature of any industry. However, it is not the core point. While the industry has ups and downs, the harm in this case will cause a down specific to the HRI in Newmarket. Put another way, there is a distinction between a global event which broadly causes a downturn across the industry worldwide, and a specific

event which causes a downturn just in Newmarket. Such a downturn would be directly to the benefit of competing locations and would risk commencing a decline.

B.48. Further, the timeframe to which paragraph [IR477] relates is insufficiently defined. It appears to take into account only the industry's very recent history where it has been on an upwards trend. This cannot be taken as the norm as, at some point, the industry may enter a new phase where the trend is halted or reversed. This could be as a result of harmful developments like Sunnica or other causes, or a combination of both.

B.49. Further still, the fact that the industry has had ups and downs in the past (huge ups and downs in some cases) doesn't mean that that pattern should be allowed to continue. The reason why recent local plans have introduced polices to protect the industry is to prevent the "downs" and to help the industry navigate the path to/of sustainable and sustained growth. To suggest the ups and downs are always set against a backdrop of growth is, as above, choosing only to look at a very limited period of the historic data. In any event, the fact is that when the industry is contracting it's contracting and when it's growing it's growing, regardless of how large or small these fluctuations may be. The policy is presumably designed to prevent and, if it is not possible to do that, minimise the downs.

Point 5

B.50. This is essentially a reformulation of point 3; SNTS repeat the points it made under point 3 above.

Point 6

B.51. SNTS does not dissent from this point, which is the normal approach to an evidence-based analysis. The report adds nothing new.

Point 7

B.52. In respect of 7(a), this quote is from [IR-466]-[IR-467]. It concerns owners already invested. SNTS's focus has been on footloose prospective investors who will make an emotion-based decision of whether to engage in the discretionary spend in horseracing generally, and specifically in Newmarket. As was discussed above, [IR-467] makes the point: such owners 'once invested, "behave in a businesslike fashion"'.

B.53. In respect of 7(b) the same point arises. Hatchfield Farm focuses on those already present and invested. The focus of our case has primarily been on footloose prospective investors.

B.54. In respect of 7(c), SNTS does not dissent from this point, which is in the nature of business-like decision making. However, this point is derivative of whether, in fact, harm to the HRI is found. Furthermore, that trainers will try their best to mitigate harm is not a justification for the harm being allowed to occur.

B.55. In respect of 7(d) again, the same point arises. The question is about footloose prospective owners who have a range of options available to them. SNTS also does not accept an emotional desire to invest is a 'whim' (per [IR-467]). People buy houses and cars based on emotional desire; such decisions are not whims. It is likely the 'whim' here must be seen in the context of the weight to be given to the limited impact of traffic in the Hatchfield Farm case. This is apt to confuse.

B.56. In respect of 7(e), SNTS does not dissent from this point, which is in the nature of business-like decision making. However, in SNTS's view the impacts in this case are significant. In addition, this again fails to consider footloose prospective investors. Indeed, if such footloose prospective investors cease to invest at the same rate as historically, this may then cause existing owners and trainers to leave. Such a decision may be a rational business-like decision by existing owners or trainers in the context of this decline in new investment.

B.57. Thus, overall, these findings are of little assistance in our case. They concern a minimal impact with minimal harm (which, if a decision were based on it, may well be interpreted as a whim), and entirely fail to engage with prospective footloose investors. On many occasions they are also trite points which SNTS does not dissent from. This makes clear why the distinction of impact, vulnerability, and harm is crucial. The Hatchfield Farm decision is too different to our case and is apt to assist rather than hinder analysis.

Point 8

B.58. SNTS does not dissent from this point, although it is a matter of extant fact. Over the past 300 years the HRI has changed and developed alongside the remainder of Newmarket. That it 'can' do so is of no assistance in determining whether it will do so in this case. The report adds nothing new.

Point 9

B.59. SNTS does not dissent from this point, which is a general matter of planning principle. However, the fact that the tipping point was not met in the Hatchfield Farm case cannot assist in respect of the application. The tipping point was not met in the Hatchfield Farm case and could never have been met because the proposals were found to be beneficial to the

industry, did not have an effect on its long-term viability, and did not impact on the use of any operational sites. This is clearly not the case with the Sunnica scheme; however, the impact, vulnerability and harm are considerably different. The Inspector's report is not relevant in this regard because it was a decision based on its own facts.

B.60. It bears noting that the Inspector's determination was based on conclusions of fact relating to traffic evidence. It is an error to elevate these findings, and results arising out of them, to principles of general applicability to Newmarket. Had the Inspector instead preferred the evidence of the traffic experts of the HRI the position may well have been different.

Point 10

B.61. SNTS does not dissent from this point. However, it does not engage with the issue that (1) the question is not one of implosion but a slow decline; and, (2) this provides little assistance in considering the loss of new investment from prospective footloose investors. The report is unhelpful in analysing this prominent aspect of the case.

Point 11

B.62. This is a general matter of planning principle. However, the question is whether policy does in fact protect the HRI commensurate with its status in Newmarket. The Hatchfield Farm report adds nothing new.

Conclusion

B.63. In conclusion, the Hatchfield Farm case has limited relevance to the issues to be determined in the Sunnica case. The conclusions are not directly transferable as the context is very different. It can speak to certain matters which are agreed between the parties (e.g. that Newmarket is pre-eminent), and can speak to general principles of planning judgment (e.g. in abstract, how a 'tipping point' would work). However, these are not matters of themselves in dispute.

B.64. On the other hand, the Hatchfield Farm case risks casting much shade. There is little parallel between the impact of the scheme, vulnerability threatened, and harm arising in the Hatchfield Farm case versus this case. Where such a lack of parallel exists, trying to use conclusions reached by the Inspector in that case is apt to confuse. Planning cases fall to be considered on their own merits; that an Inspector reached a conclusion where the impact of the scheme, the vulnerability threatened, and the harm arising were all of a different nature and magnitude is at best irrelevant and at worst liable to obscure the true planning balance.

B.65. For these reasons, SNTS maintain the position that the Hatchfield Farm decision is of little assistance to the ExA. The ExA has significant evidence and submissions before it; the case should be assessed relying on those materials.

Appendix C

Landscape Briefing Note 11

Project: 1186 Sunnica PVD
Date: 13th January 2023
Purpose: Response to ExQ2.7.4
Reference: 1186 BN11 Sunnica PVD Response to ExQ2.7.4.docx
Author: John Jeffcock CMLI

1. This note has been prepared in response to Question 2.7.4 of the Examining Authority's second written questions and requests for information (ExQ2) [**Ref PD-021**]. Question 2.7.4 is a request for a calculation '*as to the total length of road frontage that will pass between or alongside solar arrays*'.

2. The total length of conventional road frontage that will pass between or alongside solar arrays is **approximately 9,400 metres**.

3. In order to illustrate how this measurement was calculated, two figures are attached to this note which highlight the lengths of road frontage included in the calculation. These figures are based on the applicant's parameters plans [**Ref APP-135** & **APP-136**]. The calculation is based only on road frontage that will pass between or alongside solar arrays. It does not include roads where the solar arrays would be seen by people at a distance, which would otherwise include a greater extent of the highways network (e.g., Freckenham Road). It also does not include the section of A14 in cutting.

   End of Note.

FIGURE 1

Road frontage alongside solar arrays - Sunnica East

PROJECT
1186
Sunnica PVD

CLIENT
Say No To Sunnica

DATE
January 2023

Legend

Road frontage alongside solar arrays

Total road frontage Sunnica East: 5,450m
Total road frontage Sunnica West: 3,950m
Total combined: 9,400m

Source: Figure 3-1 Sunnica East Parameter Plan
Drwg. No. 60589004_ES_SD_001, Rev 0

E01
E02
E03
E04
E05
E08
E09
E10
E33
Office/Warehouse
360m
585m
1,300m
ECO1
ECO2
ECO3
E12
E13
E14
E15
E16
E17
E18
E19
E20
E21
E22
1,070m
E24
E25
E26
E27
E29
E30
E31
E32
655m
1,030m
450m
N
0
500
1,000m

FIGURE 2

Road frontage alongside solar arrays - Sunnica West

PROJECT
1186
Sunnica PVD

CLIENT
Say No To Sunnica

DATE
January 2023

Legend

Road frontage alongside solar arrays

Total road frontage Sunnica East: 5,450m
Total road frontage Sunnica West: 3,950m
Total combined: 9,400m

Source: Figure 3-2 Sunnica West A And B Parameter Plan
Drwg. No. 60589004_ES_SD_002, Rev 0