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## Scenario-based forecasts of land use and management change

Science Report: SC030107/SR

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Steve Killeen

Head of Science

# Executive summary

Land use is a key determinant of environmental quality, and so anticipating land uses is central to planning for future environmental risks. This report explores the implications for land use of four scenarios for 2030 developed by Henley Centre Foresight Vision for the Environment Agency. These implications were the subject of a workshop held in February 2006. The aims of this study were to test the usefulness of the scenarios, understand major changes in land use and management that could result from them, allow experts and stakeholders to test and check the assumptions about the direction and magnitude of changes implied, and highlight priority issues and risks.

Four categories of land use were considered: land released for development, agriculture, forestry, and biodiversity/ecosystem services. Future land uses will depend on relative financial returns, government policies, and on public preferences and legal and social institutions. Development, agriculture and forestry are all heavily influenced by government. There are strong demands for land for development, but also equal and opposite forces limiting development. The likely pattern of future farming will depend particularly on reforms of the Common Agricultural Policy. Beyond this, the position is uncertain, with either continuing decline or a renewed demand in the face of food and/or energy shortages. Timber outputs to 2030 are relatively predictable, but the extent of forestry areas planted and managed remains uncertain. Here too, government policy is fundamental. Biodiversity and ecosystem services (such as flood alleviation or carbon sequestration) are in turn affected by land use, often in ways that are not fully understood.

In developing their four scenarios, the Henley Centre Headlight Vision considered a wide range of drivers of change against two intersecting axes of 'governance' (long-term to short-term) and 'consumption' (material and dematerialised) (Environment Agency, 2006). These were further developed at a workshop held in December 2005, while the implications for land use were the subject of workshop held in February 2006 as part of this project.

The four resulting scenarios are:

- Restoration (long-term governance, dematerialised consumption) - this is a relatively favourable scenario with a far-sighted government and public support promoting environmental protection. Development shifts to the north of the UK and is of a higher environmental standard. Land remains in agricultural and forestry production, with some growth of energy crops, but production practices are subject to tighter regulation. Government intervenes in support of biodiversity and ecosystem services. However, there are signs of the economy slowing down, under pressures of higher production costs and the increasing dominance of the public sector.
- The Krypton factor (long-term governance; material consumption) - a long period of economic growth based on investment in new technologies is reflected in a technological approach to environmental problems. Although this seems to be effective, there is a sense that fundamental problems are neglected as pressures on the environment continue to grow. There are possible contradictions within the scenario, such as how agriculture can be profitable in an era of free trade or why stronger preferences for the environment have not developed in a period of economic prosperity.
- Survivor (short-term governance; dematerialised consumption) - an economic crisis in the mid-2010s has left a weakened economy in a state of slow recovery. The reduced demand for materials has environmental benefits, but the best agricultural land is under pressure, although the position in the uplands is uncertain. There is a much stronger local orientation in production and governance, and changes in production reflect this. Some localities are well managed, but

others tend towards decay and social tension.

- Strike it rich (short-term governance; material consumption) - the UK has had an extended period of economic growth. Low levels of environmental damage have brought little change in behaviour. However, substantial polarisation means that wealthier individuals seek private ways of improving their personal environments. Planning is weak and agriculture and forestry are run by large businesses where profitable, though some areas are abandoned. There are mixed implications for the environment.

This report also reviews these scenarios, discussing environmental and resource qualities, capacities and limits, public preferences and responses to the scenarios, and political processes and decision-making. The scenarios offer a useful context within which to explore the implications of future land uses, although the lack of quantification increases the risk of inconsistencies. Some attempt at quantification might help to strengthen assessments and identify inconsistencies.

# Contents

<b>Executive summary</b>	<b>4</b>
<b>Contents</b>	<b>7</b>
<b>1 Introduction</b>	<b>8</b>
<b>2 Drivers and determinants of land use</b>	<b>10</b>
<b>3 Implications of the scenarios</b>	<b>24</b>
<b>4 Key biodiversity and ecosystem service impacts</b>	<b>36</b>
<b>5 Possible scenario impact indicators</b>	<b>38</b>
<b>6 Reviews of the scenarios and their land use implications</b>	<b>40</b>
<b>7 Conclusions</b>	<b>45</b>
<b>References</b>	<b>47</b>
<b>Appendix 1: Prose narratives of the scenarios</b>	<b>49</b>
<b>Appendix 2: Workshop agenda and attendance</b>	<b>62</b>

# 1. Introduction

Land use has a direct and significant impact on environmental quality, providing space and habitats for biodiversity and shaping the landscape. The way in which land is used affects water storage, flood protection, and both point and diffuse source emissions to water and the atmosphere. It also has a significant impact on carbon sequestration. The configuration of land uses and their intensities, whether in urban or rural areas or for residential or commercial purposes, reflects the spatial distribution of the population and economic activity. These in turn determine patterns of personal travel and the transport of goods; activities that also have major environmental implications. An understanding of land use is thus fundamental to understanding the determinants of environmental quality, where potential future land uses will determine potential threats to and pressures on the environment. Environmental planning must anticipate and develop safeguards against these potential threats. But, given the time lags between the identification of threats and social preparedness or public policies to address them, anticipation of possible changes in land use becomes an important element in environmental planning. The main aim of this report is to explore potential changes in land use over a relatively long period of time, specifically to consider land use up to the year 2030.

Future land use will be determined by economic, social and environmental factors, and could be explored in three ways. One approach might be to construct a model that projects the key drivers of land use and so indicates the probabilities of particular land use changes in the future. This could be a simple extrapolation of historic trends. However, as the future is rarely a simple extrapolation of the past, more complex forms of analysis might need to be undertaken. For instance, Markov chain analysis is sometimes used to describe the transition probabilities of land uses at particular locations changing from one type to another over a defined period. A probabilities matrix is applied to a set of land uses in one period in order to derive the probabilities of a particular set of land uses arising in a subsequent period. Analysis of the trends in the main drivers of land uses is used to determine the transition probabilities. These can include variables such as world prices, economic growth, exchange rates and inflation, population change and migration, household composition and demand. Relationships can be estimated between these variables and particular land uses. However, the longer the time period over which the models are run, the less reliable are the results. In the longer term, changes in the major relationships mean that statistical estimates based on historical data are increasingly unreliable. Models are rarely regarded as valid when used to project economic variables or land uses over periods of more than a decade or so.

An alternative approach might be to explore the drivers and consequent land uses with experts and groups involved in land management, as they often have a detailed appreciation of the forces leading to land use changes, the ways in which particular sectors use land and the likely responses to changes in the short term. In many respects, their understanding covers a richer range of variables than those of standard economic models. For instance, while a model might assume that businesses organise their actions to maximise profits, a more qualitative approach might include some recognition of the different ways in which decision-makers respond to a changing economic environment. However, expert knowledge often relates to a relatively narrow area, with less appreciation of the wider economic environment. Equally, in forecasting land uses, few systems can adequately capture both the detailed decision-making at the micro scale which builds up into higher level changes, and the interactions and feedback effects that can influence the eventual outcome. Over a short time period, macro-economic changes are of less consequence, but they become more

critical in the longer term, and stakeholders may not be well-placed to appreciate their significance.

For these reasons, future possibilities are often explored through the construction of scenarios although, as pointed out by Foresight (2002), scenarios themselves do not predict the future. Scenarios are tools for thinking about the future, based on assumptions about how the various drivers and their outcomes might develop over a given period of time. These tools have recently been applied in a variety of policy and sectoral contexts relevant to land and rural issues (for example, Ward and Ray, 2004). However, because there are many possible futures, scenario development involves rational analysis and subjective judgement in selecting the most suitable approaches on which to concentrate. Scenarios are developed either by anticipating possible futures based on present trends, with some consensus on the most likely future outcomes, or alternatively by identifying the most desirable type of future and working back (backcasting) to determine the actions necessary to achieve the desired outcome. Our approach combined both these aspects, by setting out a range of possible outcomes and examining how present human choices and actions could increase the chances of attaining the more desirable goals and avoiding the least desirable ones. The anticipation of possible future environmental challenges thus offers a means of enhancing the capacity for 'future-proofing' areas of policy-making.

This study was based on the scenarios developed for the Environment Agency by Centre Headlight Vision (Environment Agency 2006). The Centre considered a wide range of drivers of change against two intersecting axes of 'governance' (long-term to short-term) and 'consumption' (material and dematerialised). These were further developed at a workshop held in December 2005. The four resulting scenarios are:

- Restoration - long-term governance, dematerialised consumption;
- The Krypton factor - long-term governance; material consumption;
- Survivor - short-term governance; dematerialised consumption;
- Strike it rich - short-term governance; material consumption.

Prose narratives – hypothetical descriptions of the scenarios - are given in Appendix 1.

The aims of this study were to:

- test the usefulness of the scenarios in developing implications for environmental impacts;
- explore the major changes in land use and management that could result from these scenarios;
- allow experts and groups involved in land management to test assumptions about the direction and magnitude of the changes implied;
- highlight priority issues and risks for regulation and policy on land use management.

The study centred around a workshop held in London in February 2006. Information was circulated prior to the workshop on both the scenarios and a preliminary analysis of their implications for four categories of land use: land for development; agriculture; forestry; and biodiversity/ecosystem services. The workshop agenda and list of participants are given in Appendix 2. The workshop began with an explanation of the scenarios, their development, and their general implications for land use. Four breakout groups then discussed the likely changes in land use arising from each of the four scenarios. After feedback and review from the groups, a plenary discussion ensued. Next, a group exercise focused on the possible implications of the changes identified. A final session drew out the most important



implications from the previous exercise, along with wider conclusions for land use, planning and policy, and for further work.

Section 2 of this report describes the land uses considered along with their key drivers. Subsequent sections then explore land uses that might arise from each of the four scenarios, drawing together the assessment prior to the workshop with the discussion at the workshop. Section 6 reviews the implications raised at the workshop. The final part of the report, Section 7, outlines the conclusions of this study.

# 2 Drivers and determinants of land use

## 2.1 Land uses and their determinants

Information on land use is available from a variety of sources, though there is no single source which offers detailed information on the composition of all land uses and how this has changed over time. Table 2.1 shows that 73 per cent of land in the UK is used for agriculture, with a further 12 per cent under forest and woodland. The remainder comprises urban land and land not otherwise specified, though there is relatively little information available on its constituent sub-categories.

**Table 2.1: Land by agricultural and other uses: 2004**

United Kingdom	Percentage of country					Area (kha)	
	Crops and bare fallow	Agricultural land Grasses and rough grazing <sup>1</sup>	Other <sup>2</sup>	Forest and woodland <sup>3</sup>	Urban land and land not otherwise specified <sup>4</sup>	Total land <sup>5</sup>	Inland water <sup>6</sup>
England	30	37	5	9	19	13,028	76
Wales	3	72	1	14	9	2,073	13
Scotland	7	66	2	17	8	7,792	169
Great Britain	20	50	4	12	15	22,893	258
Northern Ireland	4	75	1	7	13	1,358	64
United Kingdom	19	51	3	12	14	24,251	325

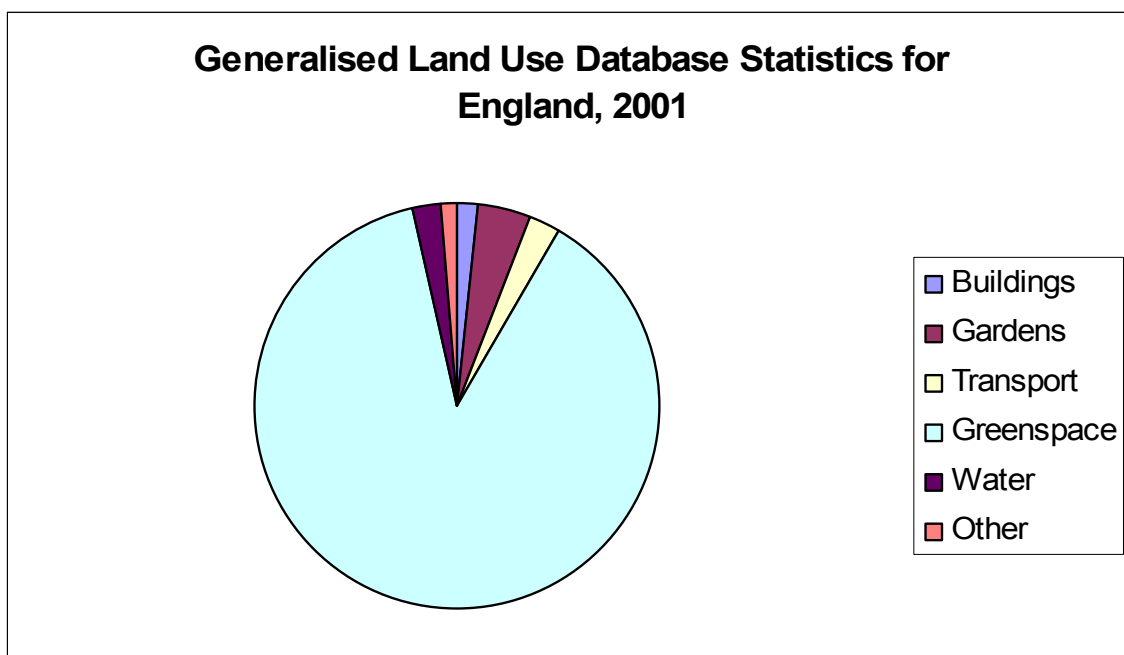
Source: Department for Environment, Food and Rural Affairs; Ordnance Survey; Forestry Commission; Forest Service; - as quoted in Defra (2006).

**Notes on Table 1**

- 1 Includes both permanent and temporary grasses, and sole right and common rough grazing.
- 2 Set-aside and other land recorded on agricultural holdings, such as farm roads, yards, buildings, gardens, ponds.  
Excludes woodland on agricultural holdings which is included in 'Forest and woodland'.
- 3 Forestry data compiled by the Forestry Commission, covering both private and state-owned land. Estimates are based on the provisional results of the National Inventory of Woodland and Trees for 1995-1999 (Forestry Commission, 2002) and extrapolated forward using information about new planting and other changes.  
Data for Northern Ireland compiled separately by the Forest Service, an agency of DARD and also cover both private and state-owned land.
- 4 Figures derived by subtracting land used for agricultural and forestry purposes from the land area. Figures include land used for urban and other purposes, such as transport and recreation, and non-agricultural, semi-natural environments, such as sand dunes, grouse moors and non-agricultural grasslands, and inland waters.
- 5 As at January 2003
- 6 As at January 2001

Source publication: Defra, e-Digest of Environmental Statistics, published January 2006

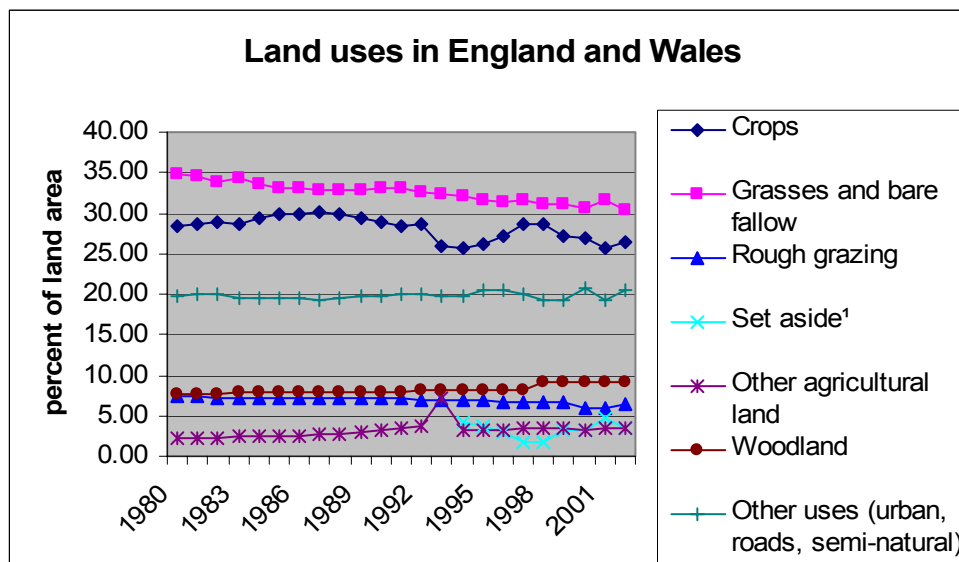
More comprehensive data on land use has recently become available for a single year. A recent study undertaken for the Office of the Deputy Prime Minister (2005) has provided a detailed database on land uses in England in 2001. The statistics have been calculated for each local authority district (as defined in 2003) and also for each census ward. The statistics show the distribution of land across nine categories: domestic buildings, gardens, non-domestic buildings, road, rail, path, green space, water, and other (largely hard standing). These statistics have been aggregated up to the national level and the results are shown for six summary categories in Figure 2.1. The figure shows the predominance of green space, while relatively little land is covered by buildings or transport. By way of simple comparison, the area covered by gardens is very close to the combined areas of oilseed rape and sugar beet, while the total areas of buildings and transport (570 kha) is substantially less than the area put into set-aside (703 kha).



**Figure 2.1: Generalised land use database statistics for England, 2001**

Source: ODPM (2005) Generalised Land Use Database for England, Office of the Deputy Prime Minister.

Detailed information on land use is not available on a time series basis. However, some longer-term trends in broad land uses are shown in Figure 2.2, returning to the same source used in Table 2.1, such that urban areas are amalgamated with 'other' uses and so represent a rather diverse category.



**Figure 2.2: Proportion of land allocated to various uses over the period 1983-2003**

Source: Data from Environment Agency: Environmental Indicator L1

[http://www.environment-](http://www.environment-agency.gov.uk/yourenv/432430/432434/432448/432787/432806/?lang=_e)

[agency.gov.uk/yourenv/432430/432434/432448/432787/432806/?lang=\\_e](http://www.environment-agency.gov.uk/yourenv/432430/432434/432448/432787/432806/?lang=_e)

Figure 2.2 reflects a steady decline in the total agricultural area. In the UK, farm area has fallen from 19 million ha in 1987 to nearly 18.4 million ha in 2004. The causes of this decline and the uses to which this land is now being put are not clear. It seems likely that the trend reflects land that is dropping out of the agricultural census rather than necessarily being converted to non-agricultural uses. Within the overall agricultural area in England and Wales, Figure 2.2 shows a steady decline in grassland and a more variable pattern for crops matching the fluctuation in set-aside through the 1990s.

Three categories of land use appear to cover the majority of land: agriculture, forestry/woodland and urban areas.. This study therefore concentrates on these land uses. However, a substantial proportion of land has multiple uses, especially in supporting habitats, biodiversity and ecosystems, so this category is included in the study.

Any consideration of future land use should include the influence of market conditions, the relative returns to alternative land uses, and government regulation and direction. Government policy has a direct effect on land owned by its departments or agencies, but its influence predominantly works through policies aimed at the major land-using sectors. Both market returns and government policies are mediated through the preferences and values of individuals, themselves subject to social influences. In short, land use is driven by three factors: markets and prices, government policies, and public preferences and civil society.

Land is generally privately owned and put to uses that meet the needs of private land owners and occupiers. Generating income is often the main aim of private landownership, but it is rarely the sole objective. Land use is substantially influenced by the relative returns to alternative land uses, determined by the prices received for products generated by the land and the costs of production, whether this be potatoes, houses or amenity. But other factors will be important too.

The wider social and environmental significance of land use means that it is almost invariably regulated by government. This takes the form of:

- direct regulation of the land uses permitted, with prohibition of unacceptable land uses, perhaps due to their severe environmental impact or by the operation of the planning system;
- market intervention for products from the land, such as intervention in agricultural commodity markets;
- incentives for land owners to manage land in particular ways, such as grants for afforestation or agri-environment schemes to promote biodiversity;
- government intervention involving direct ownership of the land, such as by the Forestry Commission or Ministry of Defence.

Land use is also influenced, though less directly, by social norms, consumer preferences and attitudes and public institutions. Land managers may respond to non-financial incentives, or may fail to respond to changes in financial returns, such as farmers who choose to continue farming when they might be better off outside the agricultural sector. Peer groups may also influence, for example, the stewardship of the land. But land use will also depend on less commercial activities, such as hobby farming or horse riding, where decisions are primarily driven by non-financial interests. Finally, other types of owners can become more important, especially non-profit Conservation Amenity and Recreation Trusts (CARTs), such as the National Trust or Royal Society for the Protection of Birds which own substantial areas of land in the UK. There may also be collective ownership, such as community ownership in Scotland, where a group of individuals occupy areas of land for their collective interest.

## 2.2 Land for development

The bulk of the land coming out of agricultural use is likely to be put to residential use. Land development is strictly controlled through the planning system and is subject to a number of government policies and targets.

Housing land commands significantly higher prices than farmland everywhere in the UK. Table 2.2 shows the differences for England and Wales (London is shown separately for illustration, but we may assume that there will not be any land coming out of agriculture for development in London).

**Table 2: Land prices in England and Wales**

Land prices		£/ha			
England & Wales		Agricultural land			
		Arable	Dairy	Mixed	Hill
Equipped, vacant possession		9,724	10,443	9,287	2,653
Unequipped, vacant possession		6,869	6,849	6,558	1,971

Residential land					
		Small sites <sup>1</sup>	Bulk land <sup>2</sup>	Sites for flats or maisonettes	
E&W excluding London		2,950,000	2,460,000	2,830,000	
Inner London		9,370,000	7,800,000	10,810,000	
Outer London		6,280,000	5,990,000	7,340,000	

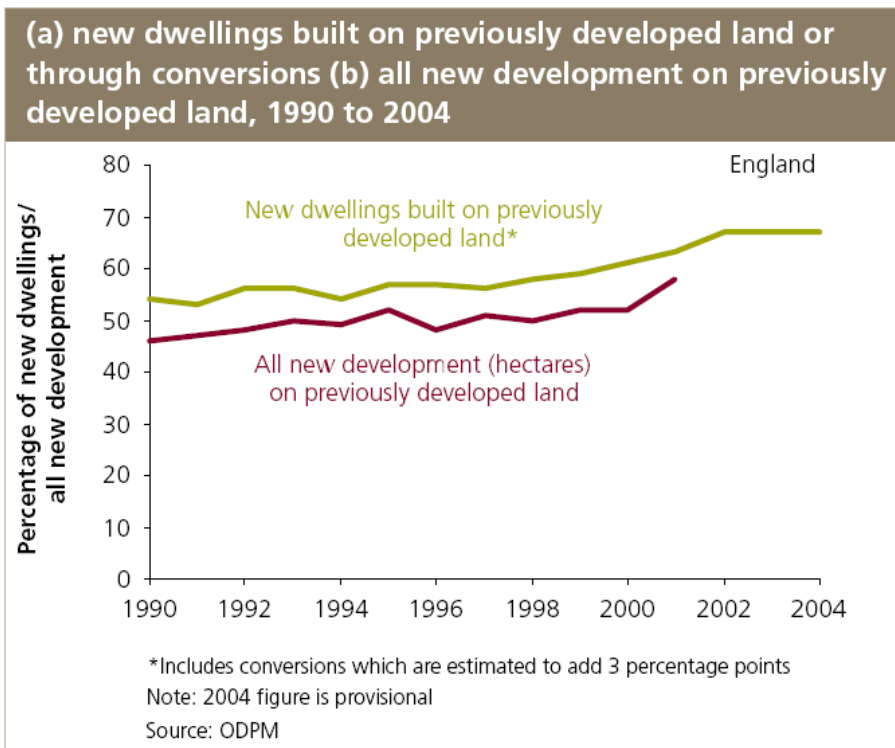
Source: Valuation Office Agency, 2005.

1. Sites for less than five houses
2. In excess of two ha.

Even if we take the highest agricultural land value and round upwards to £10,500 per hectare, and the cheapest residential land (£2.5 million per hectare), the gap is clearly enormous, reflecting both the relative decline in agriculture and the sustained increase in house prices in recent years. Agricultural or greenfield land is preferable to residential developers because of its ease in developing. However, there are important reasons why greenfield land is seen as a critical resource, subject to strict protection.

A number of government policies are designed to protect farmland from development. These include Green Belts around major urban areas, Areas of Outstanding Natural Beauty, Sites of Special Scientific Interest, and National Parks. In addition, rural residents are usually keen to preserve their locality from development and the NIMBY (not in my back yard) lobby is strong in rural and edge-of-town areas. This means that land supply in some areas is extremely constrained, especially where a strong environmental protectionist lobby co-exists with designations to protect the countryside, such as in Surrey, or the Lake District National Park.

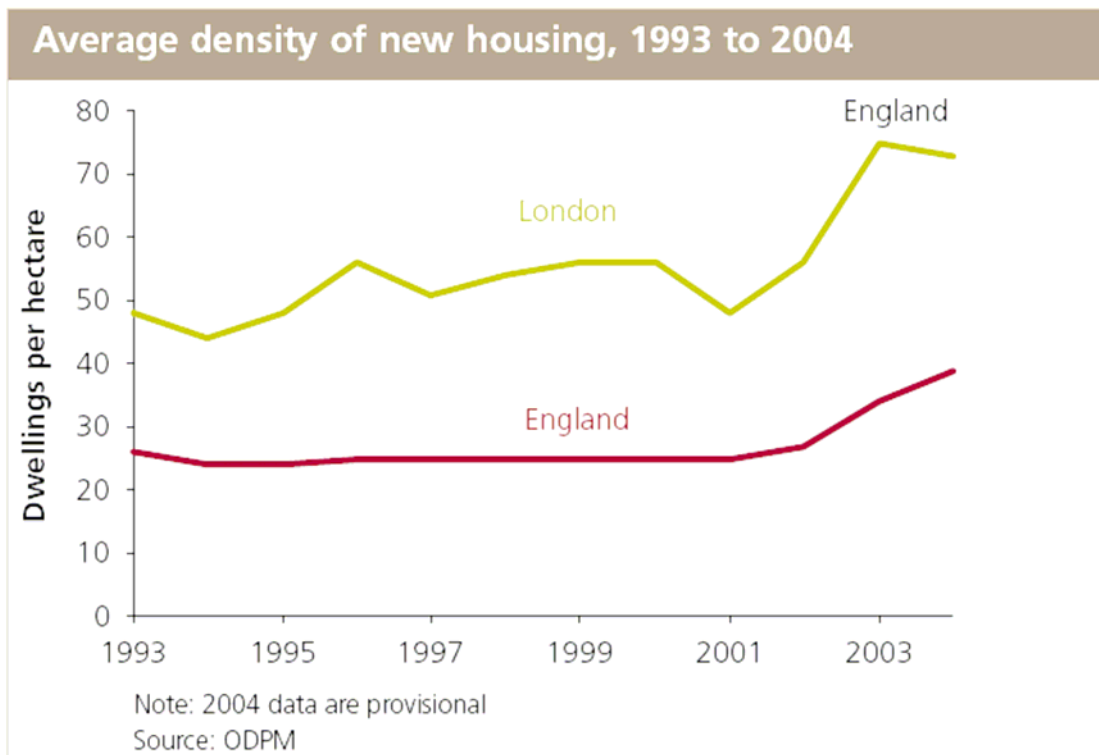
Planning policy now includes a target for 60 per cent of residential development to take place on brownfield land, defined as previously developed land. The graph in Figure 2.3 shows that this target is currently being met. However, this still leaves 40 per cent of residential development taking place on agricultural or other undeveloped land which is likely to be located in rural areas (small sites) and on the edge of urban areas (large sites). Even brownfield sites may make some contribution to ecosystems while they remain undeveloped.



**Figure 2.3: Development on previously developed land**  
 Source: Defra (2005)

The percentage of new dwellings arising from building on previously developed land or through the conversion of existing buildings increased from 54 per cent in 1990 to 67 per cent in 2004 (provisional estimate). The percentage of all new development (not just residential) occurring on previously developed land (measured by land area) also increased: from 46 per cent in 1990 to 58 per cent in 2001.

Government policy, as outlined in the consultation on Planning Policy Statement No. 3: Housing (ODPM, 2005), places considerable emphasis on increased density of development. Low densities are considered to be a waste of a scarce resource (land). Figure 2.4 shows the change in average densities since 1993.



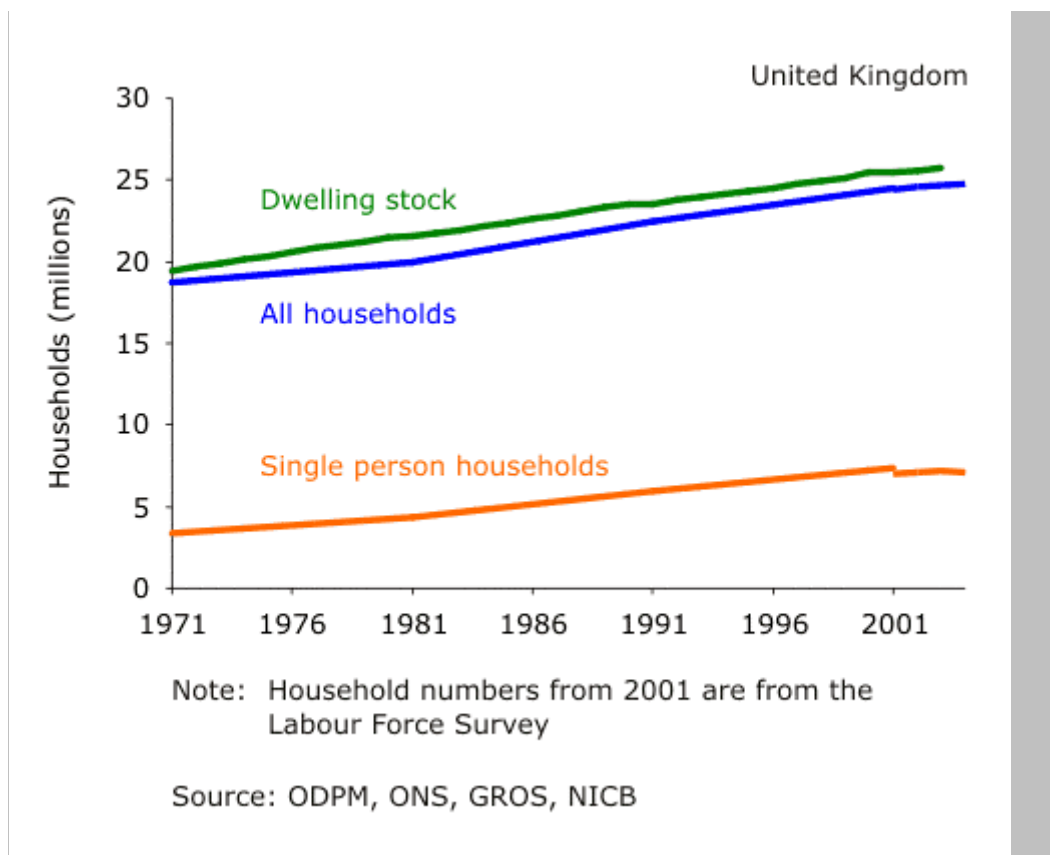
**Figure 2.4: Average density of new housing, 1993 to 2004**  
Source: Defra (2005)

The density of newly-built dwellings in England remained fairly constant between 1993 and 2001, at an average of 25 new dwellings per hectare. Recently, however, density has increased and, in 2004, the figure was 39 new dwellings per hectare (provisional estimate), representing a third more new dwellings per hectare.

There is some debate about high densities and whether they necessarily imply small units. There appears to be an important difference between density in terms of persons per room and planning density in terms of dwellings per hectare. High numbers of dwellings per hectare can be associated with low numbers of persons per room. Persons per hectare is another measure which could be used. While current policies are associated with the decline in household size and the consequent increase in demand for new housing units, it might appear to be misguided to be developing smaller units during a period of economic growth and increased real incomes as demand for space tends to rise with income. The outcome of such a policy would be rapid price increases of larger dwellings relative to small.

Figure 2.5 shows the increase in the number of households and in the dwelling stock up to 2004. The increase in household numbers provides a strong explanation for the recent house price boom. The number of dwellings exceeds the number of households and this is explained by vacancies and second homes. Many local governments with high vacancies and/or second homes have policies to reduce them, yet by European standards vacancy rates in the UK are very low – the Barker Review (Barker, 2004) argues that they are already too low to allow the housing market to function efficiently.





**Figure 2.5: Households, single person households and dwelling stock, 1971 to 2004**  
Source: Defra (2005)

The number of UK households increased by 5.7 million between 1971 and 2001, from 18.7 to 24.5 million. Almost 70 per cent of the increase was due to an increase in the number of single person households, from 3.4 million in 1971 (18 per cent of households) to 7.4 million in 2001 (30 per cent of households).

The latest population and household projections have been updated for Shelter by Alan Holmans to take account of discrepancies with the 2001 Census and used to provide an estimate of future dwelling requirements and particularly future need for affordable housing (Holmans et al., 2005). This suggests that an additional 203,000 new homes will be required each year during the period 2001 to 2021 to meet projected household growth. Of these, 48,000 should be social housing for rent, an extra 18,000 a year above what is currently planned. New social housing is needed in every region, but to match demand, 70 percent should be in London and the South East.

Table 2.3 gives the household projections to 2026 based on the work for Shelter which used the draft 2003-based population projections, but scaled down to match the Shelter projection for 2011-2021. (It would be very difficult to project to 2030 and of course the projection is less accurate the further into the future it goes).

**Table 2.3: Projections of household numbers**

Year	Households
2001	20,619,000
2011	22,372,000
2021	24,148,000
2026	24,900,000

Source: Holmans et al (2005)

These projections still need to be translated into dwelling requirements.

In the UK, unlike most of Europe, people overwhelmingly aspire to home ownership. Until recently they also aspired to suburban living, at low densities in houses with gardens. These preferences mitigate against increasing densities. However, there has been a recent increase in inner city 'loft' living, particularly by younger, middle class professionals. It is not yet clear whether this is a permanent preference change, or whether delays in parenthood means that such people will seek to move to the suburbs at a later stage in their life.

At the same time, there is considerable support for planning policies that protect the countryside, including from inner city residents who may not appear to benefit particularly from such policies.

## 2.3 Agriculture

Given the long production cycle in forestry, predictions of timber outputs to 2030 are much less uncertain than is the case for the other land uses. However, there is a similar degree of uncertainty as to the areas of land that will be taken for afforestation or replanted following clear felling. Given the declining importance of timber, these decisions will be most influenced by government policies.

Timber prices dropped by 70 per cent in the late 1990s and early 2000s to a point where, for many categories of produce, market prices were lower in *nominal* terms than they had been forty years earlier. The main reasons appear to be increased supply on the global market (largely from former Soviet bloc countries), relatively slow growth in demand with a sluggish global economy and, for home producers, a greater emphasis on recycling and the strength of sterling. Given the relative insignificance of home production in the global context, the different scenarios for the UK are unlikely to have a large influence on world prices.

It appears that timber prices have now begun to recover but, for the next 25 years, softwood markets are not likely to experience a continuous upward trend if Russia continues to exploit the Siberian and European forests. While exports to the UK from the Baltic States may decline well before 2030, supplies from North America and Scandinavia are likely to remain strong. UK softwood production is expected to peak at around 2020 and then decline somewhat, before rising again towards the middle of the century.

The hardwood market is much more diverse, based on quality as well as quantity. Assuming producers meet the Forestry Stewardship Council criteria of sustainability, the market for quality produce is likely to strengthen over time. Home production will remain relatively small, and of variable quality, but the best butts should command a reasonable price.

Expansion of the market for wood fuel as a renewable energy source could transform the outlook for thinnings and low grade produce from traditional forests, as well as stimulating short rotation coppice production, but substantial growth in this market is uncertain.

Government forestry policy, while allowing for some independence to develop forestry strategies for England, Scotland and Wales, is essentially set to pursue multiple public benefits from existing woods, with continuing modest expansion of the national forest estate – now 70 per cent privately owned. Building up a substantial reserve of home-grown timber for strategic reasons, which dominated policy for much of the twentieth century, has almost entirely disappeared. Socio-economic development, regeneration (including landscape restoration), recreation and biodiversity are now the main elements in policy.

Significant support is given to the private sector. Commercial forestry is free from income and capital taxation and, in recent years, around £18-20 million per annum has been allocated to grants for the private sector. The main emphasis has been on new planting, but more support for management may be given in coming decades as part of a more integrated approach to countryside management and conservation. Additional financial assistance has been given for land switched from intensive farming to forestry use, in recognition of the loss of income for many years.

In current market conditions, management of state-owned forests is loss-making. In the absence of a strategic imperative, what is the justification for retaining a quarter of the national forest in public ownership? The government is currently responding to growing demands from a largely urban population for the countryside to be available for informal recreation, for visual enjoyment and as a haven for wildlife. These same goals have been pursued for far longer by much of the rural population, including a large number of landowners and forest managers. Sustainability has been familiar to foresters since at least medieval times and the eighteenth century was marked by extensive improvements in the landscape, including ‘amenity’ tree planting. In landscape terms, there is a strong tendency for the public to wish to retain what is familiar or to return to an image of a bygone era, and there is considerable resistance to change. Many private forest owners, while content to deliver public benefits as a by-product of their land management, seek viable markets for wood as an essential basis for maintaining multi-purpose forests.

## 2.4 Biodiversity and ecosystem services

Biodiversity is of immense value to society, supporting a wide range of ecosystem functions essential to humankind as well as contributing to security, resilience, social relations, health, and freedom of choices and actions. Ecosystems services of particular value in the UK include:

- fisheries;
- timber production;
- freshwater (retention and purification);
- climate regulation (especially carbon sequestration, for example in forests and soils);
- soil formation, maintenance and erosion control;

- pollination;
- flood attenuation and alleviation;
- cultural values;
- promotion of health and wellbeing.

In broad terms, the main factors likely to influence the impacts of the four scenarios on biodiversity and ecosystem services are:

- ecosystem/habitat extent;
- ecosystem/habitat quality (that is the degree to which the ecosystem or habitat supports desired processes, functions and features, such as important species);
- external exploitation (such as harvesting, hunting and fishing) and control (such as culling).

These factors are affected by farm, forestry and other land use changes, which are in turn driven by markets and prices, government policies and social preference. Thus to a certain extent, biodiversity impacts are at 'the end of the line' and are particularly difficult to predict. Biodiversity impacts may also cause feedback impacts on land use and policies, for example where severe soil damage from inappropriate farming may lead to abandonment.

An important consideration when assessing the likely impacts on biodiversity is the location of areas of high biodiversity importance. As a result of the expansion and intensification of agriculture, urban development and the loss of ancient woodlands, the area of semi-natural habitat of high biodiversity value has been greatly reduced in the UK. Now the vast majority of such habitats are concentrated in coastal and upland areas, particularly in the North and West UK. Thus, biodiversity impacts under each scenario will depend more on land use changes in the uplands and marginal coastal areas, than on changes in intensive farmland and developed areas of the South-East. However, there is considerable uncertainty over how land use will change in upland and coastal areas.

Biodiversity is also increasingly regulated by international, EU and national policies and legislation. Nature conservation in the UK has traditionally focussed on the protection of sites and selected species; this has been strengthened in recent decades by international legislation. Thus, it is likely that relatively strong UK biodiversity conservation legislation will remain in place for at least the near future, and this may be further strengthened by increasing awareness of the importance of biodiversity. Some revisions may broaden conservation goals in response to the Millennium Development agenda, the Convention on Biological Diversity's 'Ecosystem Approach' and requirements to adapt to climate change. Longer-term policies may be influenced by the socio-economic and governance changes outlined in the scenarios.

There has been a widely-documented increase in environmental awareness in the UK over the last fifty years or so, with an increasing appreciation of the value of the natural environment and the threats to it. This in turn has resulted in demands and support for increased environmental legislation and spending. Nevertheless, environmentally 'demanding' citizens probably remain in the minority. Furthermore, recent events such as the fuel protests indicate that environmental considerations are usually secondary to personal economic considerations. Demands for nature conservation depend on comfortable standards of living amongst a significant proportion of the population.

Some impacts on biodiversity will depend on the timing of changes in each scenario and some may not be revealed within the scenario's timescale even though they may have a profound impact on the future. This can arise because many habitat changes are slow. For

example, even if all grazing on uplands ceased tomorrow, with the absence of a viable seed bank and with harsh colonisation and growth conditions, natural reforestation of moorland would take many centuries. Thus, consideration of scenario impacts by 2030 may overlook some potentially significant long-term impacts.

Predicted climate change impacts are taken into account and are consistent across the scenarios. However, the impacts of climate change on biodiversity may be mitigated by adaptation measures. Although identifying the required measures is at an early stage, it is generally agreed that one action will be to minimise non-climate related threats to biodiversity, to maximise resilience to change. For example, by creating a near optimal habitat for a species, it is less likely that the loss of an important food source as a result of climate change will lead to starvation and extinction. Another adaptation strategy will be to maximise the connectivity of habitats to allow species to move naturally and colonise new areas with suitable climates. Thus, the impacts of the scenarios may have synergistic effects if they increase or decrease adaptive capacity to climate change.

# 3 Implications of the scenarios

Having reviewed some of the drivers of land use change, we now consider the implications of the scenarios for land uses in 2030. Summary narratives for the four scenarios are included as Appendix 1. In this section of the report, we provide a brief outline of each scenario before turning to the implications for each of the individual land uses.

## 3.1 Restoration

Continuing growth in developing economies between the years 2005 and 2020 is a cause of global environmental damage and significant migration flows around the world. This triggers a global environmental consciousness and a far-sighted UK government intervenes to make business and consumers aware of the full cost of their consumption patterns. A better-informed population is more aware of resource constraints and this provides political support for a reduction of the world's environmental footprint. This in turn promotes a shift in lifestyle choices and purchasing behaviour and a segment of the UK population is now actively and voluntarily reducing their consumption.

Government has made significant investments in public transport. Demand-side management has reduced the demand for energy and there has been extensive investment in renewable energy. Planning guidance has taken a much longer-term view of resource implications and there has been major expansion of housing and related infrastructure in North England. New developments have to meet tougher environmental standards and new properties are much more resource-efficient. Similarly, water infrastructure has been much improved. Government and non-governmental organisations (NGOs) are encouraging more sustainable forms of consumption. There is a growing recognition by the lower quartile of society that living communally is both cheaper and more environmentally sustainable.

The economy has moved towards the service sector, with a growth of repair services over the purchase of new items. There has been a growth of private long-term investment, but the steady decline in consumer expenditure has slowed the economy and new consumption now comes largely from the public rather than the private sector.

### 3.1.1 Land for development

Environmental protection and sustainable development policies have ensured that much of the countryside remains intact. The planning system puts additional housing and infrastructure in the North, mainly in low demand areas, in order to balance the previous growth in the South.

The overall public support for 'small is beautiful' and 'local is global' has also led to more communal living and better use of the existing housing stock. The land taken from farming for housing has stabilised at less than 30 per cent of the total area developed. There is a mixed pattern of change in housing density. The renewed focus on family suggests an expanded demand for family homes, leaving the smaller high-density development of the earlier 21<sup>st</sup> century as less attractive. The expansion of communal living leads to a new form of higher-density living.

New housing meets high environmental standards, substantially reducing resource requirements, along with a new emphasis to improve the resource efficiency of the existing

housing stock. With the success of new developments in the North, the level of new build in the South has fallen considerably. Planning now considers the long-term environmental implications of development, avoiding coastal areas and floodplains that could be at risk. Greater environmental consciousness is reflected in the layout of new settlements, with green space protected for amenity, recreation and biodiversity. There is more emphasis on promoting mixed development in both new and regeneration schemes.

The population enjoys a massively improved public transport system as well as incentives to reduce car travel, which is now very expensive. People are keen to acquire houses closer to their places of work, and businesses concentrate staff within a central locality where their work requires their physical presence on site or they need to have face-to-face contact. Strong governance has resulted in widespread public support for policies which mitigate environmental damage, especially in the development of a skills-based economy, with its emphasis on 'repair' rather than 'replace'. This has produced new employment in all regions since repair is ubiquitous. Given that the manufacturing sector had already moved overseas, the impact of this shift for other sectors is modest.

Despite a more effective planning system, increased development in the North places the environment under greater pressure, although extensive use is made of brownfield and recycled land with substantial levels of investment in environmental enhancement and restoration. Developments in the science of ecological restoration have enabled such restorations to achieve a higher environmental standard much more quickly than was possible in the past.

### **3.1.2 Agriculture**

International trade in food continues while carbon-based energy is relatively scarce and expensive, stimulating a growth in renewable energy production. Large areas of land may be devoted to biofuels, although the government has introduced energy demand management and there will be competition from other renewable sources. Biomass offers a source fuel for transport. Although the total demand for transport fuel is considerably reduced, given fuel efficient engines and greater public transport, energy crops still use a significant amount of farmland.

The long-term view taken by government and strong environmental preferences encourage a larger public sector. Agricultural subsidies may be lower, but agri-environmental support may be stronger. It is not entirely clear to what extent the land remains intensively farmed, but the introduction of green taxes, potentially on fertilisers and pesticides, reduces the more damaging impacts of production. Food security does not appear to be an overriding concern. Relatively high energy costs may affect the use of fertilisers and pesticides, leading to the development of new farming methods. One would expect greater use of integrated pest management, but increased demand for local products may force a shift back to mixed farming systems. It is unclear whether the new systems will use genetically modified organisms (GMOs), although an environmentally-conscious population may continue to resist GM technologies. On the other hand, greater understanding and better science may pave the way for their adoption in support of environmental protection, for example for greater crop resistance requiring fewer agro-chemicals. Continuing production over much of the land is thus likely, rather more extensive than at present but with reduced environmental impacts.

The most obvious implications of environmental awareness will be changes in the type of food demanded, with more local supply chains or activities for conservation organisations. Demand from more environmentally-aware consumers may shift towards products generated by more environmentally-sensitive production systems under strict quality assurance

schemes. This may stimulate local food production and markets, although the economic influences are complex. A more even population spread across the country means that local production may be more widely distributed across UK farmland.

The wealth of NGOs, coupled with heightened environmental consciousness, may boost land acquisition by Conservation, Amenity and Recreation Trusts (CARTs), especially for sensitive ecosystems and valued landscapes. With a slower economy and stable private income levels, this reflects collective rather than individual action. At the same time, the interest in communal living may stimulate more social land ownership by community trusts, perhaps in combination with CARTs.

### **3.1.3 Forestry**

Increased emphasis on environmental protection and sustainability leads to greater recognition of the importance of forest management, backed by government aid, and to support for widespread adoption of continuous cover silvicultural systems. Softwood production at home has peaked and few additional coniferous forests have been established in the past twenty-five years, with a modest amount of new planting of mixed species with a high proportion of native broadleaves. However, supplies of softwood from slow growth forests in the northern regions of Russia and Scandinavia face limits and there is renewed interest in softwood forests on land that competes with farm products.

The New National Forest and the Community Forests established near conurbations in the early 1990s are now contributing to the landscape (including some urban fringe areas and former derelict mining areas) and are providing welcome recreation opportunities. Government support is forthcoming for more city-orientated forests.

Community energy schemes include a small number based on wood fuel, supplied partly from short rotation coppice and partly from hardwood thinnings. Hardwood growers continue to have problems disposing of small category produce, because of the relatively small quantities of any particular specification from individual woodland estates. Overall, there is a modest increase in forest area, mostly on land released from farm production. Ownership of woodland by CARTS has increased.

### **3.1.4 Biodiversity and ecosystem services**

Biodiversity and ecosystem services are likely to benefit more under this scenario than any other.

Land use changes under the restoration scenario are modest, but the most significant change for biodiversity is the reduction in intense farming. This results in fewer pesticide impacts within farming ecosystems and less pollution of water courses and adjacent habitats. Green taxes may reduce the use of artificial fertilisers, thereby reducing diffuse pollution of watercourses and aquifers. Lower phosphate levels will benefit biodiversity in many rivers, whilst lower nitrate levels will help reverse the degradation of drinking water supplies.

A wider spread of livestock production will also bring benefits to biodiversity and ecosystems. A decrease in stocking densities will reduce water pollution, poaching, soil erosion and run-off of nutrient-rich manure. A return to permanent pasture and less use of highly fertilised temporary silage will also reduce water pollution and provide better habitats for wildlife. Extensive grazing in the uplands will maintain semi-natural habitats of high conservation and



landscape value. However, there may be more pressure on upland habitats if demands for arable products and forestry lead to an increase in stocking densities.

There may also be greater demand for organic produce and meat from environmentally-assured livestock. Assurance schemes may extend beyond the control of production to embrace wider environmental criteria. This may play a major role in supporting semi-natural habitats of high biodiversity value, especially in the lowlands where extensive livestock farming has become increasingly unprofitable.

If there is some abandonment of agriculture, particularly in the uplands, this could provide good opportunities to restore natural habitats such as forests, heaths and blanket bogs (though this may be constrained by climate change).

Extensive and well-funded agri-environment schemes are likely to be in place, to maintain and restore landscapes, habitats, species and historical features in the farmed landscape. With high levels of environmental awareness, strong membership of CARTs and comfortable standards of living, there may be a large increase in land under conservation management. These organisations will be well placed to take advantage of opportunities provided by land abandonment. In particular, large reserves of near natural habitat could be created to support landscape-scale ecological patterns, processes and functions (such as flood attenuation and storage). This could bring possible problems of fragmentation, although a far-sighted government could overcome these.

Many of these changes will help to increase the resilience of biodiversity to climate change. If planned carefully, habitat restoration will create better interconnected networks of habitat. This, together with a general improvement in habitat quality, will boost the potential for plants and animals to survive climate changes and, if necessary, disperse through the landscape to new areas with suitable microclimates.

The only likely detrimental impact from this scenario will result from the need to reduce greenhouse gas emissions. Although the growing of energy crops and biofuels may help to reduce CO<sub>2</sub> emissions, crops tend to be grown as intensive monocultures and therefore support little biodiversity. Pollution from intense fertiliser use may also be a problem. If energy crops cover large areas of the farmed landscape, they will have significant impacts on biodiversity, especially if grown on set-aside land. This may present a challenge to an environmentally-oriented government in that strong environmental constraints on production might make domestic production uncompetitive in world markets and make it cheaper to import rather than to produce domestically. This might then be used as an argument for the reintroduction of trade barriers, on the grounds that domestic protection could reduce environmental damage overseas.

## 3.2 The Krypton Factor

The UK is benefiting from aggressive investment in new technologies for economic development and the environment, supported by strong environmental regulation. This arises as a response to concerns about the security of international energy supplies and international competition. Investment has kept the UK economy ahead of competition and international trade is vibrant. The South East remains a focus for economic growth, but in the context of environmental planning and high environmental standards, which entail high costs of flood defence and desalination plants. Nuclear power stations have been constructed across the country, and wind turbines have been installed offshore. Traffic congestion has been addressed by a road building programme.

There are, however, problems with managing waste and concerns about whether high environmental standards could hinder further growth. Pressures on local environments, especially in the South East, are a source of social tension, particularly where different areas have different levels of employment, health and environmental quality.

The environment is not high on the government's agenda, and the threat of climate change has not developed in the way feared. However, a minority claim that there is profound environmental degradation 'beneath the surface' and that resource constraints and climate change issues will resurface within the next 10-20 years.

### **3.2.1 Land for development**

Heavy investment in new infrastructure requires a substantial area of land for roads and power generation.

Those able to afford it can increase their living space as their incomes rise. As a result, the development of farmland for housing continues because this meets people's needs. Low-density living in a more 'pepper-potted' rural landscape is the norm (more like Italian countryside than traditional English). Ground-breaking architecture produces housing considered to be much more attractive than previous 'Wimpy' homes on estates. High levels of landscaping with trees have increased this perception. Wild landscapes have been created for leisure purposes on previous brownfield land, and protecting the countryside from development is not seen as a priority because the landscape with houses is considered attractive. Development is resource-efficient and, while reliance on the private car remains strong with more roads, cars are more environmentally-friendly and fuel-efficient, using alternative fuel sources such that the dependence on oil is dramatically reduced and energy prices have dropped.

Big issues remain, such as how far society can 'build its way out of it'. Despite sophisticated technology, some environmental targets have still to be met. There is tension between the desire for home ownership and quality of life. However, as with the Restoration scenario, there is an increase in eco-friendly housing, and possibly increased sharing because high house prices may encourage this for longer. Urban/rural differences are likely, such as greater remote working in rural areas. But here too there are concerns as to where the limit lies; at what point does long-distance commuting become uneconomic? The growth of small satellite centres may result, and government policy may drive a 'South East versus the rest' approach which could be detrimental. It is unclear whether a high-tech society reduces regulation and planning or whether in the long-term, the government reinforces these.

### **3.2.2 Agriculture**

The economy is experiencing a long period of growth with a high level of international trading. This generates a high level of individual wealth and purchasing power. Population density in the South East continues to rise, causing local environmental damage.

"The proportion of rural land given over to intensive agriculture has increased slightly with the development of crops such as biofuels...", incentivised by government support. However, in an open economy, one might expect an end to farm subsidies and high levels of agricultural imports to displace domestic food production. Similarly, in the face of energy prices predicted to be at their lowest for five years, it is difficult to envisage substantial domestic production of biofuels. The scenario thus implies either a protectionist model or a

freer trade alternative based on a “vibrant” international trade. The way in which this develops will have a major impact on land uses and prices.

A potential saviour for the agricultural sector may lie in branded and functional foods. It may be possible to adapt new technologies, quite possibly making use of genetic modifications for new products. The relative lack of concern for the environment combined with a preference for high-tech solutions may lead to the widespread adoption of GMOs. In this respect, the UK may become internationally competitive, although the late start in GMO science implies a degree of catching up.

Damaged local environments in the heavily-populated South East may reinvigorate a counter-urbanisation movement, with more wealthy individuals acquiring land away from congested areas for landscape enjoyment, keeping horses and so on. Similarly, if farming becomes uncompetitive, there may be a shift towards land used for leisure purposes or acquired for environmental protection, for example by water companies.

Less interest in environmental issues suggests less activity by conservation trusts that rely on collective support and donations, leaving the provision of countryside goods reliant on agri-environment schemes and private owners. Agri-environment schemes may be quite extensive from a government taking a long-term perspective, although lower public priority for the environment may make this politically unattractive.

In short, many forces are pulling in different directions, raising the question of whether government would provide support for the agricultural sector in the face of international competition, and agri-environment schemes if the environment were not at the top of people’s agenda.

### **3.2.3 Forestry**

Substantial areas of short-rotation coppice are established between 2010 and 2025 with strong government support, but continued emphasis on technological development leads to more efficient renewable energy sources and the outlook for coppice production is gloomy.

Some areas are converted to more traditional forest management with the introduction of different species. The buoyancy of the global economy results in real growth in timber prices in the 2020s, while supply from less developed countries drops as stocks diminish and domestic economies strengthen to the point where conservation of remaining forests becomes feasible. Improved returns for home producers lead to improvements in forest management, with a return to fully-productive woodlands neglected for several decades.

Forest area expands modestly, with new plantations in high-density urban areas in the South East, and wealthy individuals planting more trees around their country residences. There are opportunities for new commercial leisure activities in forests, based on the CenterParks model, although the total area covered may not be large. However, expansion may be more substantial if farm subsidies end, leading to a collapse of agricultural land prices. Planning now puts more emphasis on trees, the greening of urban space and a partially-wooded environment for new settlements.

### **3.2.4 Biodiversity and ecosystem services**

The impacts on biodiversity and ecosystem services are difficult to predict, because the likely land use changes are uncertain. In particular, it is unclear whether farm practices will

remain intensive and over similar areas of land. The fate of livestock farming in the uplands is especially unclear.

If significant abandonment takes place, this will create opportunities for habitat restoration. However, with less public appreciation of the value of nature conservation, these opportunities may not be taken up and instead the land may be used for energy crops, although this would be deterred by lower energy prices. Should a large-scale increase in energy cropping arise, it will be highly detrimental to farmland wildlife and may lead to further impacts from, for example, pesticide and fertilizer use. If intensive farming is maintained (whether with current crop types or new energy crops), these may be mitigated by agri-environment schemes. However, it is by no means certain that the schemes will be retained or be sufficient to lessen the impacts..

There will undoubtedly be detrimental impacts on biodiversity, including the growth in land for housing, commercial and tourism development and associated infrastructure (especially roads), increased demand for water (and thus increased abstraction from rivers and wetlands) and the increase in intensive management of forests and planting of new commercial forest plantations. Investments in flood defences to protect continued expansion in the South East will bring substantial costs and impacts on coastal ecosystems.

However, a long period of economic growth might be expected to engender more positive attitudes towards the environment than is suggested in the scenario's supporting narrative (see Appendix 1).

### 3.3 Survivor

A global economic crisis in 2013 is the cause of a major economic recession after 2015. International organisations fail to adequately address problems and fall into disrepute. By 2030 there is a shift in values towards the local, with greater awareness of the value of land. The UK economy has slowed and most of the population is less wealthy, in real terms, compared to 2005. Only the relatively affluent can afford a car and people travel less. Possessions are kept longer and people care more about the quality of goods. While technical goods remain available from developing economies, people at the lower end of society mend things more than they used to. In consequence, small professional repair shops open with a re-emergence of traditional trades and skills. Shortages of key resources remain and prices, particularly of energy, remain high. The UK is less dependent on trade and imports and has started to grow more food locally and develop higher cost substitutes. There is little concern for international issues but labour and goods can be traded within the UK. Goods move around less due to high freight costs.

The emphasis is now on local communities with low-tech innovation and local governance. With a slowly decaying infrastructure, older urban developments are particularly vulnerable with low levels of water and high pollution. Consumption is less resource intensive and there is less packaging.

People are more frugal and there has been a 'green value shift'. Along with more social contact, people are thought to be healthier. Government is relatively ineffective and there is social unrest in poorer areas, with a growing underclass. The previous boom in single households has dissipated and people are more likely to share with others to spread the costs. With more multi-person households, the number of households is similar to 2005 and developers are beginning to convert properties for shared housing.

### 3.3.1 Land for development

Sustained economic recession has led a relatively impoverished population to accept higher-density living conditions. Environmental damage has led to many older housing estates being abandoned as unsafe or permanently flooded. Infrastructure is lacking and what is there is decayed, but there is public support for recycling and less waste is being produced. There is no longer the need for so much housing because household size has increased, and this helps to solve resource cost problems such as heating and light. People walk and cycle more because fuel for cars is so expensive and the roads are full of holes. However, crime has increased and there are social problems in the poorest areas. The area of land taken from agricultural for residential use is low because the new housebuilding industry has virtually collapsed, and there is a new emphasis on 'living off the land', helping to retain farming. Consumption is generally low and people eat more seasonal, local foods. International migration has fallen, as has demand for new housing.

Because this is a short-term governance scenario, there is likely to be an increase in unplanned developments and ad hoc solutions to development issues. But this will depend on the strength of local governance, where some better-off regions may have maintained strong controls while others have largely given up. Migration from rural to urban areas may increase, especially young people moving to the city in order to avoid the need for transport. The lack of employment is bad news for market towns. There is considerable spatial variation in resources, and trading may be needed, especially for regional resources such as water. There may be limits to the capacity of urban land to meet needs.

### 3.3.2 Agriculture

Economic collapse has undermined the economy and the majority are less wealthy than at the start of the 21<sup>st</sup> century. Consumption and behaviour are constrained, but there is greater environmental awareness and interest in wild places. An atmosphere of 'back to the land' is based on more localised living, closer to subsistence and nature. However, the impact of these changes depends on the depth of the collapse and the extent to which the economy and social institutions have diminished. One possible interpretation is of a 'post-apocalypse' society where living standards and the quality of life are substantially diminished. However, the likely scenario is considerably less dramatic, where the economy and national trading continue, albeit at a lower level than had been reached by the mid-2010s. Less international trade requires higher levels of domestic food production and land is used for food crops with products sold through localised marketing chains. There is much less packaging and processing. Energy is also provided on a more localised basis such as Combined Heat and Power (CHP) systems, some sourced from energy crops sufficient to fuel a much smaller transport sector, with other energy sources meeting other requirements.

The degree of change depends considerably on energy costs and the extent to which regional trading is feasible. For example, a national trading system may emerge, with regions developing specialist production based on their comparative advantage in natural resources. With a requirement for a high degree of self sufficiency in food, lowland areas may concentrate on arable production, leaving livestock to the less productive uplands. Agricultural systems will become less reliant on energy, using less fertiliser and pesticides, and may even substitute labour for machinery. Limits on imports will restrict access to international sources of protein for animal feed, with a substantially increased reliance on grass for meat production. Again, this may increase pressures on upland farming areas.

Alternatively, with very high energy costs and severe constraints on transport, land in regions beyond intensively farmed areas, especially in the uplands, may be used extensively by

widely-scattered farmers or else abandoned completely. This may lead to a major change in upland landscapes, with different types of landscapes and habitats developing over a longer period of time.

Strong local community governance exists in wealthier areas, and regulation of rural land uses protects semi-natural environments and provides space and public access. Local people are actively involved in voluntary conservation work. But in areas with lower incomes, the quality of the landscape degenerates in the absence of active management.

This scenario hangs on energy prices and the extent to which higher transport costs override the disadvantages of a small-scale localised system for food production and distribution. Energy costs would need to be high to trigger this response.

### **3.3.3 Forestry**

An emphasis on 'back to the land' in a sustained economic depression has increased interest in wood as a fuel at a local level, giving a modest boost to demand for hardwood thinnings and low-grade produce within some local communities and stimulating new areas of short rotation coppice. Transport costs, however, prevent the development of a national market for wood fuel.

At the same time, depression in the main timber markets leads to widespread neglect of forests in most parts of the country and some public benefits such as recreation are lost. The quality of timber expected to be harvested in the second half of the century is jeopardised. Virtually no new planting has taken place for several years, partly because of the increased demand for land for food production. The overall environmental effect of these trends in forestry is negative. Within more densely-populated areas, problems of trespass and vandalism in woodlands, including theft of wood, fencing and gates, have become much more serious for landowners.

However, new demands for timber may arise. Sustainable construction may create a demand for softwoods not available overseas. There may be renewed demand for charcoal, and pyrolysis may offer a competitive source of energy for transport. Coupled with an increased demand for wood fuel and the impact of climate change allowing planting of faster-growing species, there may even be a renaissance in forestry competing with agriculture for land, especially in the uplands.

### **3.3.4 Biodiversity and ecosystem services**

Land use and socio-economic changes produce a mix of biodiversity benefits and detrimental impacts. The general decline in the economy and reduced investment in infrastructure, such as roads, and the decline in demand for land for housing will reduce the pressure on habitats and ecosystems, for example through reduced demand for water. On the other hand, reduced investment in water and sewerage systems may lead to declines in water quality, reversing improvements in recent decades.

Agriculture will have mixed impacts on biodiversity. With the demand for more domestic food production, set-aside and other marginal land previously abandoned or restored to semi-natural habitats may revert to agricultural use. Most lowland farmland will be managed intensively and it seems unlikely that there will be significant funding (or public or farmer support) for agri-environment schemes to mitigate agricultural impacts. However, the high

costs of energy might limit the cost-effectiveness of pesticide and artificial fertiliser use, thereby reducing pollution impacts.

The situation in the uplands is uncertain, because there may be both farming and abandonment. The proportion of each will depend on domestic demand and market forces. Extensive livestock farming will help maintain existing semi-natural habitats. If these systems use a mix of hardy breeds of sheep and cattle with appropriate seasonal densities, much of the currently degraded heather moorland will be improved, leading to a boost in biodiversity, less erosion and better water quality. However, livestock rearing will probably be abandoned in more remote and harsh upland areas. With a weak economy there will be less demand for grouse moors and without a strong conservation sector, most abandoned areas will probably be left unmanaged. This will provide substantial water quality benefits if extensive areas are abandoned. But biodiversity impacts will be mixed, with upland forest species benefiting at the expense of open moorland habitats and species, though such effects will take many decades.

Forestry impacts on biodiversity will probably be relatively modest under this scenario. The absence of new planting will prevent further losses of heathlands and upland habitats, but there will be little scope for woodland habitat re-creation in the lowlands. Most forests will remain unmanaged, and although this might be beneficial to near-natural ancient woodlands, management neglect more often leads to a loss of biodiversity in the short-term. Some areas of coppice woodland will be returned to management and this will help support some species of conservation importance. But a large-scale switch to short rotation coppice with substantial conversion of high forest-managed woodland will be highly detrimental.

While a lack of investment in infrastructure will generally have negative consequences, there may be significant benefits to the environment, especially if a lack of flood defence systems leads to inundation of recreation areas and a return to coastal habitats. But this could be at the expense of high-quality farmland.

### 3.4 Strike it rich

Global political and economic powers remain much as they have done for the previous 40 years and global resource scarcity has not yet had a major impact on the economies of the developed world. Social and political conflicts in China and India have slowed their economic development but they continue to supply cheap goods to the rest of the world. While there have been serious environmental impacts in other parts of the world, most western countries have seen little environmental damage in their own countries. In consequence, there is little awareness of the environment and few changes to behaviour.

The UK economy has prospered and domestic policy focuses on continuing economic growth. However, this prosperity is not shared by all members of society and large parts of the population are no better off than 25 years ago. This polarisation has negative implications, with increasing social conflict in some urban communities and a rise in gated communities. The population has been growing with economic immigration, increasing congestion and demand for housing in and around urban areas.

The dominant environmental issues are local responses to global concerns and issues such as urban regeneration, environmental deprivation and exclusion, contaminated land, waste and pollution control and traffic management. However, there is little government effort to curb consumption patterns or to take action to deal with long-term environmental and infrastructure problems. Thus water quality is lower, especially in deprived urban areas,

while wealthier areas introduce micro-filtration facilities to serve their communities or make use of bottled water supplies. Attempts to address environmental and energy problems are driven by private interests rather than by government, for example with private generators and wind power in the home.

### 3.4.1 Land for development

High patterns of consumption mean economic growth. Thus, the UK is not as impoverished as in the Survivor scenario, though there is increased social polarisation. Gated communities are on the rise, especially for the rich who can afford their own power generators, desalination plants and so on. There is a loss of green belt land and greater urban development driven by the need for transport and housing. The urban fringe is over-developed as people try to live close to work, resulting in congestion. Regional differences increase, with brownfield development in the North but greenfield in the South. Planning is piecemeal because of the lack of strategic oversight.

Population growth is accommodated by low-quality construction in areas that already suffer from low environmental standards. The planning system is lax here, while NIMBY attitudes prevent development in wealthier areas with stronger governance and higher environmental standards.

Building practices may change with less environmentally-sound, poorer-quality building and spatial dispersion. Land remediation may increase, to prepare land for more intensive use. Even high-quality land will be under pressure.

### 3.4.2 Agriculture

Despite an extended period of stable economic growth, not all have enjoyed the same benefits and the environment remains of secondary concern. In the absence of government support for the environment, and in a polarised society, those with environmental interests seek to make private provision. The increase in conflict, allied with declining infrastructure in urban areas from a lack of public investment, prompts the move of wealthy individuals to secure estates in the countryside. These cover quite substantial areas of land but this is not farmed, being used for recreation or keeping horses or simply as a *cordon sanitaire* ensuring privacy for the residents on the estate. Environmental quality becomes a private good.

There is little support for domestic agricultural production or for agri-environment schemes. Agriculture is dominated by large farming businesses that operate across land under a number of different ownerships, based on a variety of contractual arrangements. In the absence of a close connection between the farm operator and ownership of the land, and in the absence of an effective agri-environment scheme, operators have little interest in environmental management. This is damaging for farmed habitats and landscape quality. However, operating at relatively low world commodity price levels, arable production uses modern technology to minimise input, incorporating fallows into rotations and leaving less-productive areas uncultivated. Diffuse pollution is relatively low. Livestock production is at much larger scales and concentrations with lax regulation on pollution, with serious risks to the environment.

Food production and supply continues on long marketing chains, with large volumes of imports and national supermarket chains. Energy prices are relatively low so that land is not taken for the production of energy crops. Farmers remain under pressure to minimise production costs in order to sell to the dominant supermarkets. This is associated with the increased scale of production and the standardisation of products.



While incomes are relatively high, limited environmental interest means that it is difficult for conservation trusts to raise funds and so the sector fails to develop. The absence of government intervention means that areas in which agricultural production cannot compete at world market prices experience significant decline in agricultural activity. This particularly affects the uplands, where production turns to extensive ranching or is abandoned altogether, entailing the loss of characteristic landscapes.

One question with this scenario is whether a period of stable economic growth with relatively high incomes would not itself stimulate a greater priority for some environmental issues and a greater growth of consumer-led environmental improvements, such as through higher quality foods, more powerful conservation organisations and privately-maintained landed estates. It might also translate into votes for political parties that are prepared to do more for the environment.

### **3.4.3 Forestry**

With an abundance of global natural resources, timber supplies coming onto world markets are sufficient to satisfy demand, apart from the highest quality hardwood products, the scarcity of which has resulted in large price increases. Woodland owners fortunate enough to have good quality hardwood are now able to sell profitably and there is a tendency to revert to clear-felling in larger forests, with negative environmental consequences. Expansion of the forest area is limited by the competition from agri-businesses, and largely confined to small areas which serve only amenity purposes rather than long-term timber production.

Demand for exclusive leisure activities in an attractive rural setting has enabled some rural landowners to diversify successfully. Traditional rural estates which derived most of their income from farming, often for centuries, are breaking up under competition from larger-scale farming operations, and the woodlands are mostly preserved by the wealthy purchasers of country houses and shooting enthusiasts. Most upland plantations established by the Forestry Commission and private investors in the second half of the last century have been bought by multinational wood processing firms, but the outlook for softwood markets does not encourage replanting after harvesting. The exceptions are on the lower slopes, where climate change permits replacement of conifers with broadleaves, and in areas accessible by road where leisure demand is anticipated.

Most government support for private forestry has ceased. In general, leisure pursuits, wildlife protection, creation of green spaces and remediation of environmentally-damaged land have superseded wood production and economic development in national forest policy, while felling controls have been relaxed in the context of abundant global timber supplies. The majority of private woodland owners are pursuing multiple goals which coincide to some extent with public aspirations. The main differences are that public access is now denied in many cases where people used to be able to wander, and woodland management is once again subsidized from other sources of private wealth, as in the late-18<sup>th</sup> Century and, to some extent, the mid- to late-20<sup>th</sup> Century.

### **3.4.4 Biodiversity and ecosystem services**

Biodiversity impacts will be mixed under this scenario, though there is considerable uncertainty over impacts resulting from land use changes. With little support for agri-environment schemes and agriculture largely following market forces, it is likely that farming will have a greater impact on biodiversity. However, commercial pressures may be sufficient

to minimise costly operations (for example favouring minimum tillage over ploughing) and inputs (such as fertilizers and pesticides). Soil conditions and pests will be controlled to some extent by retaining fallow land in rotational cropping systems. These practices will help maintain important habitats for farmland wildlife as well as reducing pesticides and fertilizer pollution of water courses. The absence of large areas of energy crops will also be beneficial.

In contrast, livestock production will probably be concentrated in optimal areas (though these might be restricted by climate change), leading to further polarisation of farming systems with further losses of mixed farming landscapes. This will increase water pollution, with higher volumes of nutrients entering watercourses from nutrient-rich run-off and point source pollution from stockyards.

Widespread farm abandonment is expected in the uplands as a result of market forces and the absence of a funded agri-environment scheme supporting rural livelihoods. But some ranching may continue to be profitable, keeping some areas under land management. As with the Krypton factor and Survivor scenarios, without a strong conservation sector much of the abandoned upland will be left unmanaged and habitat will not be restored. However, some lower slopes may be planted with broadleaved woods (facilitated by climate change) which may provide some biodiversity benefits if sensitively carried out.

A predicted tendency to revert to clear felling of large forest areas will undoubtedly affect biodiversity, especially as good quality hardwoods typically found in semi-natural woodlands will be most in demand. A small expansion of woodland may provide some biodiversity benefits, but these will be constrained by the area being largely managed for amenity purposes.

Under this scenario a weak government conservation sector is predicted, but with a large number of wealthy individuals with a strong desire to conserve wildlife and landscapes. Some may be able to create private wildlife parks, perhaps restoring semi-natural or natural habitats (such as on abandoned areas of upland habitat). But the emphasis will be on private leisure and enjoyment rather than on a more scientific approach to nature conservation, and it is unlikely that these will amount to significant areas. However, if carefully planned, habitats of considerable biodiversity could be created and connected to build large landscape-scale reserves. In contrast, isolated and uncoordinated initiatives will probably be of little value and will be constrained by the surrounding landscape. In the worst cases, unregulated private initiatives may create conservation problems, for example via inappropriate reintroduction schemes or the release of alien species (as has been recently carried out with antelope on ranches in the USA).

## 4 Key biodiversity and ecosystem service impacts

A summary of the predicted key impacts on biodiversity and 'ecosystem services' (vital processes such as water purification provided by functioning ecosystems) under each scenario is provided in the table below. This draws on the predicted impacts on agriculture and forestry and related socio-economic impacts.

**Table 4.1: Summary of key biodiversity and ecosystem impacts under each scenario**

Impact	Restoration	The Krypton factor	Survivor	Strike it rich
<b>Highly detrimental</b>		Substantial short-rotation coppice. Increased agricultural intensification (?) Increased demand for water resources.	Substantially reduced agri-env and CART conservation management.	Substantially reduced agri-env conservation management. Clear felling of some forests.
<b>Moderately detrimental</b>	Increase in short-rotation coppice and other energy-crops and biofuels.	Intensive forest production and some new commercial plantations Increased land for housing, roads and airports. Reduced conservation management. Increased water pollution from arable (and livestock).	Management neglect in most woods. Small increase in agricultural area.	Intensive productive management in some forests. Increased eutrophication of water bodies from livestock production. Reduced CART conservation management.
<b>Moderately beneficial</b>	Small increase in forest on former farmland. Reductions in pesticide impacts and diffuse pollution of water bodies from arable farming. Increase in extensive livestock grazing. Retention of green space around towns.	Improved management in some neglected forests. Possible opportunities for habitat restoration in abandoned areas.	Increases in local environmental concern. Opportunities for habitat restoration in some abandoned areas, but benefits may be constrained by limited planning/management. Reintroduction of short-rotation coppice - beneficial if in small areas of previously coppiced woodland.	Increases in private conservation management. Reductions in pesticide impacts and diffuse pollution from arable. Habitat restoration in abandoned areas, but benefits constrained by limited planning and management.
<b>Highly</b>	High conservation			

<b>beneficial</b>	management through agri-environment schemes and CARTs. Habitat restoration in abandoned areas. Reductions in atmospheric pollution.			
<b>Notes</b>		High uncertainty in this scenario.		

## 5 Possible scenario impact indicators

Possible indicators were suggested in the February 2006 workshop, as illustrated in Table 5.1. These are broadly grouped into land use drivers, environmental conditions and policy responses. However, given the wide range of issues considered at the workshop, relatively little time was devoted to a detailed assessment of specific indicators. It proved difficult to focus attention at the workshop or to reach a clear consensus on the specific indicators. This could be the focus for a subsequent workshop, once the more general land use implications have been considered. Some methods use more formal, computer-based approaches to rank support for variables or viewpoints. However, while this can generate clear ranking, it tends to lose much of the richness of the debate and may not offer any guidance as to the extent to which an outcome reflects a genuine consensus rather than a forced numerical ranking based on what may be rather casual judgements.

**Table 5.1: Possible scenario impact indicators**

	<b>Land for development</b>	<b>Agriculture</b>	<b>Forestry</b>	<b>Biodiversity and ecosystem services</b>
<b>Land use drivers</b>	Population numbers Household size Transport demand Demand for space	World commodity prices Energy prices Exchange rates Imports/exports	World timber prices Exchange rates Domestic timber demand Imports/exports	Water resource use (SDS) Water stress (SDS) Agriculture- fertiliser input (SDS) Land use (SDS) Opinion polls
<b>Environmental conditions</b>	House and land prices Development densities Construction standards Development in flood plains Travel miles	Land uses Stocking densities Diffuse pollution emissions Land in fallow and so on Energy crop area	Forest management Forest species New planting Harvest methods	UK bird populations (SDS) Priority habitat status (SDS) Fish stocks (SDS) Carbon sequestration Soil maintenance and erosion control Water quality Flood storage capacity
<b>Policy response</b>	Targets for brownfield development Protected land Planning guidelines	Cross-compliance Environmental regulation Producer Subsidy Equivalents Agri-environment area Agri-environment expenditure Product assurance schemes	Forestry Commission land Forestry grants Tax relief Timber product certification	Farming and environmental stewardship (SDS) Environmental legislation Protected land Nature conservation budget Membership environmental NGOs Land owned by CARTs

Indicators with SDS are national sustainable development indicators listed in the UK government 2005 Sustainable Development Strategy – Securing the Future (<http://www.sustainable-development.gov.uk/progress/index.htm#>) (last accessed 15 May 2006).

# 6 Reviews of the scenarios and their land use implications

This section offers a commentary on the review of the scenarios and their implications that took place in the second part of the workshop. It does not seek simply to report on the discussion, but rather to reflect on the issues raised and to explore some of their implications.

One general response was to question the aggregate nature of the scenarios. Inevitably, and as has been fully recognised in the process of their development, outcomes will vary between different localities, across different population groups and for different environmental elements or resources. It is not simply that the future is likely to be some composite or intermediate outcome of the various strands explored in the scenarios; these differences will play out in different ways in different contexts simultaneously. Many alternatives were raised in the course of the discussions at the workshop.

Discussion focused on three, sometimes overlapping, broad themes:

- environmental and resource qualities, capacities and limits;
- public preferences and responses to the scenarios;
- political processes and decision-making.

## 6.1 Environmental and resource qualities, capacities and limits

The scenarios imply different approaches towards environmental constraints and resource limits. The Restoration scenario was generally seen to be 'good', with longer-term planning and action taken by government and the public to address environmental and resources issues using a full range of approaches to conservation, such as eco-friendly housing or agri-environment schemes. In contrast, the Krypton factor scenario seeks technical fixes, providing short cuts to solving environmental problems. These seem to work adequately in several respects, but there is evidence of problems emerging and the fear is that other more fundamental problems are postponed rather than avoided. The scenario narrative refers to "profound invisible environmental degradation" (see Appendix 1). The techno-fix approach might include functional foods, genetically modified crops, or personal provision of a decent environment by means of maintaining a distance from damaged ones. It was felt that the costs of environmental damage would have to be paid in the end. Other scenarios fell somewhere between these extremes.

Environmental limits must exist, but economists might argue that the emphasis should be on trade-offs rather than on absolute limits. However, limits are apparent in each of the narratives and these tend to frame the scenarios and need to be addressed. There was a view that limits must be managed or the consequences would be felt more severely in the longer term, and that responses, especially to climate change, must include both mitigation and adaptation. This suggests a need for planning, and a strong view was that the Restoration approach was preferred to the Krypton factor one. However, this requires firm

government action and long-term investment and this in turn, in a democracy, requires public sanction and support. So it becomes important to understand the ways in which public attitudes are formed and how these translate into private behaviour and political positions.

The scenarios also recognise that these issues must be addressed globally rather than from a more narrow national or local perspective. It will not be sufficient or even possible to isolate the UK from the wider global environment. While domestic policies and actions are critical, there are profound international factors relating to the direct effects of a changing environment and indirect consequences of social and economic change at the international level. The UK contribution to global change is probably not in itself significant. Relatively, economic growth across developing countries is likely to have a much greater impact on the global environment, especially on climate change, and this in turn will affect the UK. However, other countries will also bear the brunt of these changes, and the capacity for countries to adapt will depend on their economic wealth and ability to invest in new infrastructure, support disadvantaged groups and buy commodities on world markets. Education levels will also be crucial. These impacts will be transferred to the UK via various mechanisms, as they may disrupt world commodity markets, promote mass migration flows or lead to military interventions and conflict. There is thus a high degree of self-interest in adopting an international perspective, but this also requires a longer-term view.

Energy was regarded as a critical issue for all scenarios. Biofuel is of particular relevance for future farmland use, but is itself determined by the wider energy market and by decisions taken by government. It was argued that biofuel is not necessarily carbon neutral or sustainable, and this highlights the more general issue of conflicts and trade-offs between different environmental concerns. It is no longer simply the case of pro- versus anti-environment. Energy production offers a variety of examples: the detrimental impact of energy crops on diffuse pollution or on biodiversity, the aesthetic impacts of wind power that are perceived as being damaging to sensitive landscapes, or the environmental gains and risks associated with nuclear power. In some cases, an approach appears to offer a techno-fix of questionable long-term sustainability, such as the argument for nuclear power to mitigate climate change rather than more fundamental efforts to manage the underlying demand for energy. One could argue that it is unrealistic to aim to achieve sufficient reductions in energy demand to resolve these environmental problems. The scenarios do not provide answers to these issues but they do offer the contexts within which these ideas can be discussed.

The high degree of uncertainty in how much farmland will be needed for food and energy production means that care should be taken against the irreversible loss of critical land resources. Threats to food security may arise from the potential disruption to production associated with climate change and its many potential consequences<sup>1</sup>, from threats to international trading arrangements, and from new demands for land for non-food products. In contrast, the planning system is giving less weight to farmland classification based on agricultural production potential. However, given changes in the nature of farm production, land availability and food (and energy) security should be reassessed. There may be a need for a new type of land classification based on long-term potential and criteria such as soil quality, water availability or sources of the necessary nutrient and energy inputs for farming. It was suggested that there is a greater threat to the productive capacity of Grade 1 agricultural land from farming itself rather than from urban development. This new approach should then feed into the town and country planning process to develop better targeted land

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<sup>1</sup> Pearce (2005) reports on research at the University of Illinois that climate change could do much more damage to food production than has been anticipated, due to high temperatures and droughts depressing crop yields.



use planning together with a more strategic approach. It might also feed into agri-environment schemes and cross-compliance requirements.

Concern for land as a resource is part of a wider concern for ecosystem services on which many economic and social processes rely. The importance of ecosystem services is beginning to be understood, but more needs to be done to define their scope and value, through a strong publicly-funded science base. This would help to identify the constraints and available options well in advance, build public understanding and buy time to develop more fundamental responses rather than rely on short-term techno-fixes. Public support will be needed for longer-term planning and to ensure that sufficient recognition is given to ecosystem services.

Despite the qualitative nature of the scenarios, there is an inevitable tendency to concentrate on quantitative changes and indicators. It is difficult to be specific about issues that cannot be quantified, but this does not mean that they are not important, such as the presence of tranquil areas within the countryside. Noise and light pollution can drastically alter the character of a local area, yet it is difficult to measure their impact in a rigorous way. The analysis of the threats to environmental quality needs to take all aspects into account and methods need to be developed with this in mind.

## 6.2 Public preferences and responses to the scenarios

The scenarios sketched out different ways in which public appreciation of environmental issues might develop. Public concerns are a critical driver for policy action, but personal choices and voluntary initiatives are also significant. Some uncertainty was expressed over the ways in which environmental attitudes might develop within the scenarios. What factors could promote positive action towards the environment in advance of direct evidence of severe environmental damage, by which time it may be too late?

Positive attitudes in the Restoration scenario appear to have emerged from a period in which there was "...visible evidence of the impact of climate change..." that became an increasing concern of both citizens and politicians, engendering a more far-sighted approach by the UK government. However, this may be somewhat optimistic. Notwithstanding the evidence of environmental damage, citizens and voters still face problems of open access and free rider incentives. There is evidence of environmental damage in the Strike it rich scenario and yet it is assumed to be insufficient to stimulate policy action. The majority of the population can often push environmental damage costs on to others in the form of externalities, whether they be others within the same community, other countries or future generations. This is the fundamental policy dilemma. Most environmental regulation imposes economic costs on certain groups and they will tend to take political action to prevent regulation, even if they appreciate the environmental benefits that may accrue elsewhere and to others. This may make the Krypton factor scenario seem more plausible, with some positive attitudes towards the environment, but little government action. Thus the determinants of consumer attitudes towards the environmental impact of their actions become an issue for study and analysis. In a democracy, in the absence of state coercive power against a majority interest, policy has to flow from what citizens generally agree to be right.

Environmental quality is often assumed to be a luxury good, in the sense that demand tends to rise in periods of sustained economic growth. Empirical evidence for a greater commitment to environmental policies is difficult to attain because the market offers those with greater incomes private means by which they can enhance their own environments. Individuals may take a more direct response to poor environmental standards by buying

better housing, food and private open space and spending time on holiday or at a second home in an attractive environment, rather than lobbying for changes in government policy. These are more direct ways of addressing concerns that our personal environment is degrading. It cannot be assumed that environmentally-aware individuals will press for public policies that generally enhance the environment. If they can make private provision to enhance their private environments, they may not welcome greater regulatory activity or higher taxes. The next question is what influences individuals to adopt pro-social behaviour, whether this takes the form of pressing for environmental policies even when personal benefits may be limited, of taking consumer decisions that benefit the environment in terms of what products to buy, and of voluntary actions such as making donations to charities or volunteering for projects?

When consumers do attempt to send signals via their purchasing decisions, how effectively are these transmitted to producers? If consumption is to become more sustainable, this will depend on consumers taking decisions based on personal preferences rather than being pressured by price changes and regulations. Pricing and regulation play a role but attitudes and preferences are equally important and there is a clear need for education. The information available to consumers is limited and the impacts of alternative product choices typically complex and subtle. When consumers demand higher quality products, this may or may not mean that production has less environmental impact. There are thus issues as to what information should be made available to consumers, how they will react to it and what incentives this creates for producers. The growth of product assurance and 'fair trade' schemes suggests there is scope for this type of influence, but more information is required on how such approaches may be best developed. Finally, the same arguments apply to the voluntary sector. Non-governmental conservation bodies are assumed to benefit the environment, but how close are their actions to those that would be sought by a well-informed and well-intentioned government? Are there aspects of the environment that are well served, such as historic parks, and others that are neglected, such as protection of inner urban environments or conservation of uncharismatic species?

Society should not be viewed as a single entity. Different groups have different concerns and priorities, such as between different income groups, age groups or regional groups. The views of young people in particular may be important in building positive attitudes for the future. However, given that attitudes may alter with age, it cannot be assumed that the attitudes of young people today will be the same when they become mature adults. It is difficult to judge and risky to attempt to generalise on the attitudes of particular groups. School curricula now include more material about environmental issues, but whether this translates into positive environmental attitudes and behaviour is unclear. These are complex issues and there may be a danger that the rehearsal of simple environmental prescriptions in schools could lead to greater levels of scepticism in later life.

## 6.3 Political processes and decision-making

Planning by governments and agencies will only be effective if there is the political will to use the available measures and instruments to bring them into reality. And this will only happen with sufficient support from the general public, or at least a belief that support can be garnered through political leadership. Where behavioural changes are sought, the latter case may be more common. There may be a need to build public appreciation of the environmental challenges faced and the means for their resolution, as well as for leadership prepared to press for novel policy approaches.

These changes need to be supported by public institutions within and outside of government. Well-respected organisations play an important role in influencing public debate and need to speak with authority from a well-informed position. There remains a need to understand better our resources, whether they will continue to be available and what constraints will act upon them. Clear arguments can then be set out for longer-term planning and policy implementation rather than simply reacting to shorter-term crises.

The scenarios are based on long- or short-term governance. In the narratives, government is described in terms of national policy making, with some references to international and local levels. But in practice there are many forms of governance that may adopt different approaches, and this may lead to tensions between different levels of government as different groups seek to influence the political agenda to achieve their desired outcomes.

There are no single mechanisms to resolve all environmental problems. It was suggested that it may be too late to benefit from market solutions but, in any case, some environmental constraints are not readily brought within the ambit of market incentives. Rather, it is a matter of applying the right combinations of mechanisms via markets, regulations and social change. This is clearly not a trivial task and full understanding may never be possible. The EU Water Framework Directive offers an interesting approach, where an ambitious objective is set out for the long term, with a systematic sequence of actions to meet the objective through a series of stages. The end point of the WFD process is close to the date used for the scenarios, illustrating the long time lag in policy implementation.

# 7 Conclusions

The Environment Agency's generic scenarios for 2030 outline the possible ways in which future events might unfold, with implications for the environment. The aim is not to identify one or the other as being most likely. Rather, the scenarios offer extreme ranges of circumstances to prompt debate and discussion.

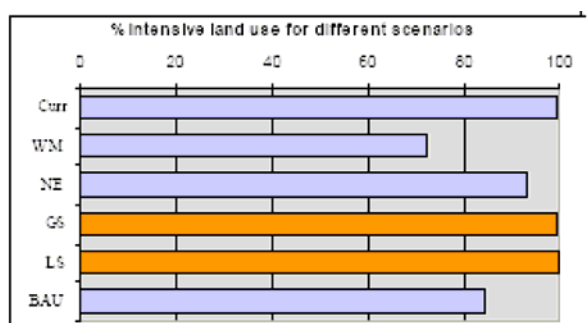
These scenarios cannot be validated and other approaches might have been adopted. Indeed, scenarios are being used in a variety of ways to explore issues for the future (such as the Countryside Agency, 2003; Leon et al., 2005; Penke and Wytrzens, 2005; Riordan, 2006). The methods and focuses adopted vary between studies and there is no generally accepted methodology, although there are clear similarities between different studies.

The Environment Agency scenarios have been designed to reflect broad social changes and their social and economic contexts. One of the objectives of this study was to assess whether these scenarios can help to develop thinking about land use. It is apparent that they have supported this thinking, although other variables that could have particular significance for land use have been identified outside of the scenarios' supporting prose narratives. One such issue might be the state of the economy and the scope to import commodities that would compete with domestically-produced ones, for example, the extent to which it would be possible to import temperate food products, timber or energy from the world market. This would depend on the state of world markets, exchange rates, terms of trade, and on the attitude of international organisations and domestic governments to trade protection. To clarify such issues might require global rather than nationally-focused scenarios, and would be beyond the remit of this exercise. A similar issue was raised at the workshop about environmental problems such as soil erosion in other countries, and the possible impacts that they could have on the availability of commodities on the world market. Scenarios developed to focus specifically upon future land uses would be more likely to recognise these aspects and make more explicit assumptions about such variables.

A more general issue was which potential drivers and variables were to be regarded as exogenous, that is, to be taken as given and outside the discussion at the workshop, and which were to be the focus of the debate. In general, it was assumed that the scenarios presented by the Henley Centre were to be accepted for the purposes of the discussion, and this worked reasonably well, although there was some review as the participants came to understand and appreciate their full implications.

In developing wide-ranging and qualitative narratives of this sort, it is difficult to exclude inconsistencies in the circumstances being described. Thus, some scenarios portray periods of sustained economic growth without the emergence of strong public environmental concerns. This seems surprising but could be possible, and could lead to private provision of environmental quality rather than a public debate. Similar uncertainty surrounds the question of whether governments in favour of free trade and open markets would at the same time offer protection to the agricultural sector. Again, this may not be inconsistent. Contemporary international debate about multifunctionality could allow governments to argue for support for public goods from agriculture while at the same time favouring free trade on world markets.

One means by which inconsistencies might be identified could be through quantitative accounting or a modelling framework. Quantifying the impacts might permit more explicit assumptions that would enable checks on internal consistency, such as production levels, yields and land uses. Morris et al. (2006) adopted a mixed approach using a combination of stakeholder views and economic modelling in a project for the Department for Environment Food and Rural Affairs (Defra). They looked at agricultural change over a 50 year period, and used stakeholder workshops and expert panels to develop quantitative parameters for the scenarios and crop and livestock yield estimates. These were then used to construct models of agricultural systems as they might have developed over that period. This type of modelling makes it possible to quantify land uses and environmental impacts that have been assessed in more qualitative terms in this study. For instance, Figure 7.1 shows the proportion of potentially suitable land for intensive farming under five scenarios, compared with the current position. A further advantage of the modelling approach is that it helps to increase internal consistency, although even here some internal inconsistencies remain. However, the reliability of these quantitative estimates is impossible to assess in the same way that the Environment Agency scenarios are impossible to validate.



Source: Morris et al. (2006)

**Figure 7.1: Percentage of intensive land use for the different scenarios**

In assessing the outcome of the workshop, it should be borne in mind that the participants do not represent a random selection of the population. Ray and Ward (2006) comment on their experience that a feature of involving stakeholders in the construction of scenarios was that 'futures of desire and of a relatively conservative nature' predominate. It is difficult to judge whether this was a feature of the Environment Agency's scenarios; although the method adopted in their development was designed to minimise this type of bias. But it was apparent that preferences across the scenarios and the interpretation of their implications reflected the predominant interests of the majority of participants. This may simply mean that the participants had a heightened knowledge, appreciation and sensitivity towards the environmental threats and their implications, or it might alternatively be interpreted as a type of bias in the way in which the discussion developed.

In conclusion, the scenarios offer a stimulating framework for exploring potential land uses and their environmental implications within a set of alternative futures. While uncertainty remains about some of the drivers of land use change, the scenarios frame the discussion within a coherent social and economic context. The complexity of the narratives and the multiplicity of drivers and processes involved make it difficult to test assumptions about land use indicators, and this may need to be done in a subsequent project or workshop focusing on indicators and quantification. The scenarios have helped to build an understanding of the major changes in land use that could develop. In some cases changes would appear to be beneficial to the environment, whilst in others there would be greater environmental damage.

Nevertheless, this understanding provided an aid to the more general implications for priorities for environmental planning and policy, and helped identify areas where outcomes are especially unclear.

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# Appendix 1: Henley Centre Headlight Vision Scenarios

The Environment Agency commissioned Henley Centre Headlight Vision to develop scenarios in response to the question: “Given the scale and diversity of social, economic, technological and other change over the next 25 years, what is the range of plausible futures that the UK environment might face in 2030?” (Environment Agency, 2006).

Around 50 drivers were identified through a review of existing scenario sets, other knowledge resources and a series of executive interviews with internal and external stakeholders. A workshop allowed over 30 participants to collaborate in the prioritisation of drivers. Following this, prioritised drivers (such as climate change, consumption culture and increasingly stressed infrastructure) were analysed, clustered and tested to develop two key axes which formed the basis of the scenarios. One axis focuses on UK societal attitudes and behaviour around consumption, ranging from material to dematerialised consumption. A second axis looks at UK governance systems, ranging from the short-term, focused on socio-economic concerns, and long-term governance, focused on sustainability. Further iterations focused on developing the scenarios and reviewing and validating a series of 30 indicators used to define the scenarios. These cover a range of key topics (such as water, transport, waste, socio-economics and biodiversity) and focus on the pressures on the environment.

The four resulting scenarios are:

- Restoration - long-term governance, dematerialised UK consumption;
- The Krypton factor - long-term governance, material consumption;
- Survivor - short-term governance, dematerialised consumption;
- Strike it rich - material consumption, short-term governance.

## Restoration (long-term governance, dematerialised consumption)

In the years between 2005 and 2020, China and India have continued to rise as powerful global economies, demonstrating an increasing ability to safeguard natural resources, principally oil, and to sustain their growth rate. However, continuing growth of developing economies has had a major impact on local, regional and longer-term global environments during this period. Increased carbon emissions and increasingly visible evidence of the impact of climate change have become a greater concern for both citizens and politicians.

A new global consciousness around environmental and social sustainability issues has emerged, pushing the political agenda at a global level. The Maldives 2020 accord has replaced all previous global agreements on the environment, such as Kyoto, Rio and so on.

A more far-sighted tendency in UK governments has been at the forefront of this movement, slowly introducing and increasing intervention (including consumption taxes) in some areas to make both business and consumers more aware of the full cost of their consumption

patterns. (Increasingly complex road charging arrangements, higher fuel taxes and household waste collection charges calculated by volume are but three examples).

The digitalisation of society and the intensification of global migration patterns have improved people's knowledge and concern about the environment. They are better educated about the reality of global resource constraints and the impact this has on developing countries in particular. In a world where significant proportions of the population are economic migrants from less developed countries, the political pressure to act to reduce the developed world's environmental footprint has increased.

This has particularly been the case in the ten years from 2010-2020. A number of well-reported floods and international extreme weather events (such as recurring heatwaves, storms, slowly rising sea levels and more widespread local flood incidents in the UK), along with growing evidence of the impact of climate change in higher latitudes, on parts of Sub-Saharan Africa, Southern Europe and the US wheat belt, have built a growing perception of a more fragile global environment among a greater proportion of the developed world.

The spectre of significant displacement of people has also fed the emergent ecological consciousness. The shift in lifestyle choices and purchasing behaviour (such as avoiding items which appear to have high 'product miles') has been a notable consequence of this efficient dissemination of information in the digital world. This wider global consciousness has also been advanced by the increasing displacement and migration of people across the globe, with economic migrants and other displaced communities becoming more vocal, and influential forces in the developed world placing a heightened culture pressure on political leaders in the developed world to act.

Partly as a result of new forms of regulation and taxation, and also a heightened concern about environmental impacts, a new socially driven environmental consciousness has been brought to bear, just as discussions of world poverty were highlighted at the end of the last century. A significant segment of UK and other western societies are now actively and voluntarily reducing their consumption levels, partly as an ethical response to environmental damage and social inequalities but also because the threat of individual carbon quotas looms on the political agenda. However this is not an uncontested view among all in society, it is a majority view that is spreading among the population at large.

Recognising the growing public awareness and new found 'fear' surrounding environmental impacts, as well as the increasing risk that resource constraints pose to the world economy, politicians, including those from the key economic powers, made strengthened commitments on the environment in the Maldives accord of 2020. Global emissions trading schemes are a key feature and all measures are governed by a newly strengthened UN and more interventionist EU. The social and environmental chapters in the latest draft of the EU's Stockholm treaty are more significant than ever before. Global governance is strong – and increasingly convergent in its view of future priorities, reflecting the concerns of society at large. Across the EU, environmental action has always been one of the areas for collective action that has been popular and understandable to national publics: this factor has helped generate support for more radical measures and for strengthening of international governance for the environment and sustainable development.

The UK government has welcomed these new measures. Quite apart from the public pressure, they were fearful that they would otherwise be unable to compete for increasingly scarce and expensive carbon-based energy reserves. The new measure should also help to stem the growth of India and China, both of whom have had significant negative impacts on UK economic growth for the last 10 years.

As a result, the government has made significant investments in improving certain types of infrastructure. Public transport is now much more efficient, and given the costs of energy, is the only real option for those who can't afford expensive petrol-fuelled vehicles or the latest hybrid models run from renewable energy sources, which are favoured by a growing segment of the population. The UK motor manufacturing industry has been largely replaced by a motor service industry, with a network of highly efficient service repair outlets replacing showrooms across the country (similar to the models seen in Belgium, Switzerland and Austria at the turn of the century). The overall capacity and environmental efficiency of the UK transport network has improved dramatically, rivalling the best in Europe in 2030.

The move towards renewable energy sources has been part of a strong and co-ordinated mitigation strategy in relation to resource constraints and climate change. Demand-side management measures have been combined with an intensive programme aimed at providing more renewable energy in the form of wind turbines, alongside some wave and some small increase in nuclear capability. New planning guidance has taken a much more long-term view of future developments and the impact of climate change. The latest plans for urban regeneration, following the success of the Northern Way programme of the first two decades of the 21st century, include major expansions of housing and related social infrastructure programmes in the North West, North East and Yorkshire, in an attempt to encourage a more balanced growth of the population across the UK and less resource intensive growth in London and surrounding areas in the East and South East of England.

Similarly UK water infrastructure has been drastically improved, with major replacement programmes taking place in the last 10 years thanks to significant levels of public investment, particularly in and around major cities. Fewer leakages occur. Universal water metering has been introduced across the UK, while local waste water recycling and dual reticulation schemes have been introduced in some parts of the country, especially in and around new urban developments. On a global scale a significant investment in the capital costs of desalination plants and associated management skills has been promised by the G12, part of the latest plans flowing from the Newcastle summit earlier this year.

Education and information campaigns effectively run in partnership between the government and environmental NGOs to encourage more sustainable forms of consumption in the home, have been successful in the UK, with resource efficiency seen as key. Individually, significant numbers of citizens are more responsible and respectful of natural resources. New developments, as well as renovations of older property, have to meet an increasing number of environmental standards before they can proceed, for example with regard to insulation. More houses are built with showers instead of baths, whilst commercial properties will often include a dedicated space for recycling. The hosing down of cars is viewed as an antisocial activity. A greater focus on conserving resources has also spurred greater availability and take-up of recycling at the local level. Overall resource efficiency has improved significantly in the last ten years.

The rise in single person households seen between 2000 and 2020 has begun to level off. In part this is on account of property prices and a renewed focus on the family, but it is also due to a growing recognition by the lower quartile of society that living communally is both cheaper and more environmentally sustainable. The number of multi-person households (with three or more unrelated people) has continued to rise as a result.

The structure of the economy has continued to move towards the service sector. Services are increasingly in demand in 2030 – including some of those which seemed to be disappearing at the end of the last century. The demand for more technical and skills-based work has been aided by a slight increase in the trend to repair electrical and other durable goods rather than purchasing new ones.

Another facet of the economic structure has been a move towards long-term investment income for many consumers. Overall however, the economy has slowed down with consistent year on year falls in consumer expenditure since 2025. People are choosing to save rather than spend. The UK savings ratio has seen rises in seven of the last ten years. Levels of disposable income have been pretty much at a standstill for the last five years, with wage pressure on the younger generation acting as a further break on their behaviour, and a significant proportion of new consumption now appears to come from the public, rather than the private sector.

## The Krypton Factor (long-term governance; material consumption)

In 2030 the UK is benefiting from an aggressive technology update programme followed during the first quarter of the century. This focused on driving international competitiveness in relation to new technologies such as genomics, informatics and nanotechnology, but also resulted in a major technology update in relation to environmental technologies as a result of government investment well over a decade ago.

The UK government has taken this course of action prompted by concerns about the impact of increasing competition from the economic growth of newly developing economies, in particular China. Not only are these high growth markets pushing up demand for, and prices of, energy resources, but they are also known to be investing in new environmental technologies and alternative sources of supply in an attempt to secure their own future growth. This caused concern for a long-sighted UK government and European Commission in 2012. The fear that the sheer volume of knowledge and skilled labour in China could allow them to seize the economic initiative if they developed a clean fuel prompted a foresighted response earlier than many had expected.

The UK is at the forefront of this new EU-sponsored initiative. Like other major European economies, it was prompted to take action to ensure the long-term sustainability of the UK economy. A wave of investment in a technology update programme has led to the construction of a new indigenous energy infrastructure, focused primarily on nuclear power with additional supply coming from a number of other sources including carbon sequestration, and some additional wind and wave power. Around the same time a raft of new environmental directives have been introduced to ensure that industry will move towards more sustainable business practices and processes designed to improve resource efficiency and environmental performance. Environmental and corporate social responsibility reporting is mandatory and large corporations are fined for underperformance in certain areas.

New models have emerged in parts of the construction industry. For example, a growing proportion of new developments in the South East, which remains the focus of UK economic and population growth, are being designed and built with solar panels and individual wind turbines, in order to improve their resource efficiency.

The measures introduced have been broadly successful. Although some experts were forecasting a slowing UK economy around 2020, the technology update programme and other regulatory measures appear to have eliminated concerns over potential resource constraints. This has enabled the economy to continue on a path of stable growth for the last ten years, whilst allowing consumer consumption to flourish unrestricted.

Dealing with the resulting waste has become a pressing issue however. The WEEE Directive has been continually extended and strengthened by the EU to cover other product categories. However, there is controversy over further regulation of industry, with many companies fed up with constantly having to adapt production processes and supply chains to

deal with both changing regulation and fragmented, ever-changing consumer needs and demands. They claim the earlier raft of regulation introduced was more than enough and that given continuing competitive pressure, a period of stability and deregulation would be more beneficial.

The basic structure of the UK economy has undergone some changes over the last 25 years, partly as a result of the new regulatory environment. Globally trade is vibrant. The high-tech and knowledge base sector have continued to grow rapidly, with new markets created in some areas where regulation has acted as a spur to innovation. Ownership of intellectual property is a key source of revenue for the organisations involved. There have been a number of notable successes, such as the launch of a series of expertly designed and engineered luxury vehicles running on new types of biofuels, all of which are designed in the UK or Germany and look set to breathe much needed life into the European motor industry. However with greater regulation of the supply chain, most mass manufacturing continues to be done in the developing world to maintain global competitiveness.

Nevertheless, with the scope and remit of the European Environment Agency increasing, along with multi-agency implementation of environmental regulation across the globe, most major manufacturing economies have been obliged to comply with the standards and regulation introduced in the UK. Initially, there was concern that this may not be possible but the intervention of multinationals, increasingly influential as both economic and political players, resolved the issue - accepting the need for more global standards to ensure a level playing field.

The UK landscape has undergone some changes. With a focus on sustainability at the national level, the quality of local environments frequently suffers, particularly around highly developed areas such as the South East of England, where a number of new desalination plants have been built and major new flood defences planned to protect new urban developments from the predicted impacts of climate change. The proportion of the rural land given over to intensive agriculture has increased slightly with the development of crops such as biofuels, incentivised through new tax breaks, grants and subsidies.

Developing a new domestic energy infrastructure has led to the construction of new nuclear power stations across the country and a huge series of wind turbines off the East Coast of England using local technologies and knowledge and creating new jobs as a result. In recognition of increasing problems with congestion on major roads, a new road building programme has been developed. There has been investment in public transport infrastructure in order to attract users, though this has not achieved any major changes in travel patterns or habits.

Responding to the trend towards smaller households, additional sustainable housing has been constructed following the successful example of the Thames Gateway initiative. In addition to these measures, climate change mitigation has resulted in the coastlines of the South East and East of England now being dominated by new flood defences and the odd wind or wave turbine.

UK consumers have become interested in travelling to destinations where there are able to experience completely unspoilt natural environments, where the surrounding society is

relatively safe to visit. It's much harder for the affluent majority to find these places, but the most popular holidays in recent years have included cruises in the Arctic circle, allowing individuals the chance to walk on the remaining stretches of the polar ice cap. Visitor numbers in areas such as Switzerland, Greenland and Canada are also increasing – boosted by a feeling that this may be the “last chance to see” many of these natural attractions.

International travel has continued to grow, though air travel is an area where major breakthroughs to improve performance have still to be made. Some are pushing for the launch of ‘green airline’ services but the industry has yet to develop a model with radically improved performance standard, having decided to focus initially on areas with the greatest potential for mass demand. A new market is developing in virtual experiences and travel, facilitated by advances in new technology which allow household TVs to offer 3D virtual projections that make the virtual experience seem real. Virtual dinner parties are the latest social trend, allowing friends to meet and eat with others across the globe while sat in the safety and comfort of their own home, and with less washing up!. The developed world seems very small and easily accessible for the affluent middle classes.

The UK has prospered in relative socio-economic terms compared to most other developed countries. Concerns over shortfall in the labour force as the result of an ageing population have gone with the increased productivity and efficiency made possible by technological advances and an influx of newly skilled economic migrants. However, social tensions have emerged on occasion as a result, particularly in relation to local issues, where different areas have different levels of employment, health and environmental quality. Overall though, income inequality has decreased as investments in education have paid off and an increasing proportion of individuals are able to access well-paid jobs in a fairly stable economy.

Overall then the environment is not top of people's agenda. The focus on growth has led new market solutions to emerge, often off the back of initial intervention by a government focused on long-term sustainability earlier than most. Nevertheless, with energy prices at their lowest for five years some parts of media are jokingly saying “remember when we all thought the world was at an end”. Stories of the growing impact of climate change across the globe still appear in the media from time to time, but do not generate great concern among the developed world. The solution is seen as simple by most citizens – reduce poverty in the less developed areas and provide technological solutions to mitigate the worst impacts of climate change where possible. However, a small minority still claim that, despite the measures that were introduced, there is profound invisible environmental degradation “beneath the surface” and the issues of resource constraints and climate change will resurface within the next 10-20 years.

## Survivor (short-term governance; dematerialised consumption)

The rapid growth of China and India in the late 20th century and early 21st century frightened political leaders in Europe and the United States, who were concerned that it would reduce the living standards of their own populations, with a resulting backlash.

Twenty years ago a lot of politicians could be heard echoing the Clinton phrase, “it’s the economy, stupid”. It was the economy. So they concentrated on increasing productivity and growth, with initiatives such as the revised Lisbon Agenda (focused on the transition to a new highly competitive knowledge and R&D based economy) a key focus of economic policy in the EU.

In a world where essential resources already appeared insufficient to meet rising demand, prices simply spiralled upwards – reaching \$30 for one litre of petrol as early as 2013. The Western economies buckled first, despite first trying to secure scarce resources through the use of military power. Many of them slumped into major recession after 2015. Once they’d gone, China and India lost their main markets, and their economies, too, went into sharp decline a few years later.

Organisations which might have helped manage these conflicts, such as the United Nations, World Trade Organisation and the International Monetary Fund, have long lost any influence or credibility they might have had for the way they’d consistently promoted the interests of the developed world at the expense of the developing countries. Looking back, there seems to be a little more equity about how the pain has been shared out between the developed and developing world. In spite of the self interest and the lack of political leadership at a global level, no one seems to be a major winner this time around.

In the world in 2030, the UK’s attitudes towards the environment have become curiously dualistic. On the one hand, land which can be used for crops generally is. As a result of a shift in values towards the local, our awareness of the value of land and its management has increased. At the same time, we have more interest in the wild places - and there are more of these now that some areas have largely been abandoned because of the recognition of future flood risk. With more people taking most of their holidays closer to home, they care more about the land on their doorstep and the local environment that surrounds them.

Many commentators now claim, looking back from 2030, that the planet “sleepwalked its way to disaster”. There was certainly a lack of longer-term planning and real action or recognition of the very real resource constraints that lay ahead. Governments around the world constantly claim that, even knowing what they know now in 2030, if they could do things differently with the benefit of hindsight, it’s not clear that events would turn out any differently. It seems everyone’s self interest was too strong during the period after the turn of the century. The latest statements from the government suggest that in 2030 they have decided to simply focus on the situation with which the UK is faced.

The UK economy has slowed in comparison with the consistent growth rates seen in the years between 2005 and 2014. The great majority of the population is significantly less



wealthy, in real terms, compared to 2005. Only the relatively affluent can afford their own car and the personal mobility it affords them. Even so, people can live comfortably enough if they are careful. People don't travel as much as they used to and there is less consumer spending across the economy than there was 30 years ago. People value possessions, but keep them longer. The convenience culture and disposability of material goods that existed 25 years ago has turned. People care more about the quality of goods, buy less cheap global produce (especially food and clothes). The most desirable material goods tend to be those that are good quality and long lasting, and tend to be made in Europe or the UK, not the developing economies in the Far East.

However, highly technical goods and most electronics are developed and produced in these developing economies, who have also found growth in niche markets by introducing new technologies into the developed economies of Europe, the US and Japan. However, those at the lower end of society mend things more than they used to. Small professional repair shops have popped up everywhere on the local high street, with traditional trades and skills reappearing in some areas (albeit among a younger generation of workers) and new highly specialised tech-repair shops appearing in other areas. People tend to reuse stuff when they can rather than pay the additional disposable costs that are now placed on goods at the point of disposal. For certain goods, an informal barter economy has arisen.

Shortages of key resources remain; the position since the Great Collapse of 2020, during which the global economy went into major recession, hasn't got much better. Prices remain high, particularly for energy, and producer nations have every interest in keeping hold of what they've got, and selling it slowly. In particular, energy costs are high. Oil is at around €200 - €250 a barrel.

When the great collapse arrived, it brought about a retrenchment with many countries turning in on themselves. The UK, like much of Western Europe, has been forced to become less dependent on trade and imports, and has instead started to grow more food locally, and develop higher cost substitutes for resources which had gone missing.

Despite growing evidence of climate change, there is little concern for international issues beyond self interest for the national and local economy. The EU has closed its external borders, shutting its doors on environmental refugees from elsewhere. However it continues to allow labour and goods to move internally, albeit with some restrictions in place. Goods move around less than in the free market days of the late 20th century, partly because freight costs are prohibitive for all but the lightest materials (sea-based trade flows are growing once again), but people continue to circulate. There is a live national debate about whether the pits in Durham and Nottinghamshire would function without the expertise of the Poles who moved here to help re-open them.

One of the more striking features of the UK in 2030 is the extent to which leadership is local. Although, at a national level, there has been little investment in infrastructure, some populist local leaders have engaged their communities and used local capacity to build CHP schemes and other projects to share resources across their areas.

There is some innovation, albeit of a fairly low-tech nature. Micro-generation units have flowered within local communities, largely as the result of strong local leadership and a

renewed sense of community leading to shared resource pools. Governance is much more local on issues of delivery of key resources. Each community has to live more within its means, according to centrally determined targets, but how they do so is very much left to them. The regular power cuts of the late 2010s are now mostly a thing of the past.. Household-based rainwater harvesting becomes relatively popular, while grey water schemes begin to be adopted in drier parts of the UK (such as the South East) particularly in blocks of flats where such initiatives are instituted on a collective basis. Solar panels and wind turbines can be seen across the country in many areas.

More generally the core infrastructure has recently been described by a leading commentator as “being in a high level of low level tatty-ness”. All over the country there is a slowly decaying infrastructure, including leaking pipes and decaying boilers. Older urban developments are particularly vulnerable to such decay, and generally have very low levels of water quality and high levels of local pollution as a result of the slowly decaying infrastructure. Additional desalination has been discounted as economically unviable due to the prohibitive energy costs.

Waste levels have fallen. Consumption is less resource intensive and more products are made to last longer. There's less waste from packaging. Larger retailers have had to change their business models in order to stay in business, given their previous dependence on oil. Supermarkets in most urban areas have large dispensers from which consumers can refill branded food containers, rather than endless rows of packaged goods. Wealthier retailers prefer to use other forms of non-plastics packaging for those consumers happy to pay the premium for the convenience of packaging.

Values have started to shift. People are more frugal than they used to be, and in this respect the economic shift was aligned with the so-called “green value shift” which had already been noticeable before 2015. There's more social contact in this world, partly because there is less traffic and people use the streets to get around more than they used to, but also an increase in virtual contact via the habitual use of video conferencing (rather than business travel). People look healthier and there's some (disputed) evidence that mental health has improved as a result. There is a segment of wealthy consumers who are unwilling to accept the compromises they must make on their quality of life and flee to other countries. These are often places rich in oil where it is possible to use one's affluence to purchase the lifestyle of one's choice.

Some people feel that the government should do more. Fuel rationing schemes and individual carbon quotas have been introduced intermittently in the UK and other parts of the EU, primarily to respond to short-term crises. There's social unrest in many poorer areas of the UK, with a growing underclass of socially excluded resource “have-nots” emerging, particularly in those areas without effective political leadership or without the necessary resources to invest in micro units or other relatively expensive technological solutions. The introduction of some protectionist economic policies (permitted under the so-called EU “compromise clause”) has pushed prices up, but kept more people in work than would otherwise be the case. The UK economy, has seen a slight resurgence in knowledge based manufacturing in the last five to ten years, just one result of such policies.

One predictable side-effect of the change in environmental and economic circumstance is that the previous boom in the number of single households has dissipated. People simply can't afford the energy or property costs involved in living on their own. Family breakdown rates are much as they were in the early 2000s, but people are now far more likely to share with others to spread costs. There are far more multi-person households than there used to be and the number of single person households has been in decline for the last five years. The overall result is that the number of households is about the same as it was in 2005. Press reports suggest a growing trend for developers to create new shared housing from houses that were converted into single person flats during the property boom of thirty years ago.

## Strike it rich (short-term governance; material consumption)

In the first 30 years of the 21st century, the global economy has seen a lot of turbulence. However, the key political and economic powers remain as they have done for the last 40 years. The global resource scarcity that was predicted and feared by many in relation to food, energy, water and so on has by and large not yet had a major impact on the economies of the developed world. As a result, the environment remains a secondary issue for most consumers and political leaders around the world.

The influence from China and India on the developed western economies that was anticipated at the turn of the century has not quite materialised. While these economies saw strong growth in the first five to ten years of the 21st century, political barriers to further growth, particularly in China, emerged quicker than many had predicted. The newly affluent middle classes, eager to hold onto their new found wealth, have found themselves at odds with demands from the poor and working classes, on whom so much of the growth had been founded. Social and political conflicts have emerged, and have yet to be fully resolved. Growth has slowed as industrial disputes begin to emerge, with the middle classes effectively putting a brake on growth. Despite rising labour costs, China continues to be a supplier of relatively cheap goods to the rest of the world, but has not threatened the developed world's position as the leader in the knowledge economy of the 21st century.

As a result western economies continue to thrive, based on increased, and in many parts of the world, intensified consumption. The global economy is increasingly based on highly technical, knowledge and service-based industries, and a constantly updated and improved range of products and services. Innovation is key.

At the global level world poverty remains an issue, with the gap between rich and poor nations intensifying over the last 30 years, despite regular, repeated pronouncements from the discredited G8. Despite regular vocal protests about the issues, there remains a lack of concerted action on issues relating to both poverty and wider sustainability issues (and there is certainly increasing evidence of environmental damage, including climate change impacts, in parts of Sub-Saharan Africa). International bodies such as the G8, UN and WTO are widely discredited, seen as ineffectual in dealing with these global issues. However, this general concern doesn't transform itself into changed behaviour or consumption patterns in the western economies that are responsible for a significant proportion of the global environmental impacts.

In fact for many in western society, there is no real perception of serious environmental damage that has resulted over the last 25 years. Certainly the widely predicted energy crises have never emerged, despite the odd rise in prices from time to time. This is largely due to investment in developing infrastructure and improving supply capacity in oil producing countries. And most western societies have seen very limited environmental damage in their own countries, which appear to have more resilient environments than other parts of the world. The political debates tend to be focused around the socio-economic problems of the poorer parts of the world, and there is little focus on the environmental damage in these

areas, despite reports of the social repercussions of climate change and water shortages in many of these areas.

The UK has prospered, with stable levels of growth over the last 15-20 years and continual rises in the level of consumer spending and disposable income. However, this story of increasing affluence, choice and prosperity is not shared by everyone in the country. The polarisation of UK society has increased since the turn of the century. Large parts of the population are little, if any, better off than there were 25 years ago. The relative gap between the bottom ten per cent of the UK population and those in the top ten per cent has increased on a wide range of indicators, including economic wealth, social indicators (such as health and indexes of social deprivation) as well as environmental and wider quality of life considerations. This has had negative implications in terms of increasing social conflict in some urban communities. A rise of gated communities has ensued, with affluent households increasingly ensuring that they have everything they need in-house, including water and energy supplies. With crime on the increase, regulation is focused on maintaining security, stability and the status quo. Security at a national as well as global level is key – certainly more important than any concern for the environment and wider concerns about social sustainability.

UK domestic policy is focused on continuing economic growth, and the national, and increasingly local management of environmental impacts. The dominant environmental issues that remain on the (diminished) public agenda are local responses to global concerns and issues, such as urban regeneration, environmental deprivation and exclusion, contaminated land, waste and pollution control and traffic management. Contingency plans for emergency global mitigation technologies (such as carbon sequestration, solar deflectors and so on) have been discussed for the last ten years, but are yet to be implemented because of continuing uncertainty about the risks involved.

There has been little sustained effort to curb consumption patterns over the long term, partly because the economy remains dependent on increased levels of consumer spending, particularly among the affluent middle classes. However, problems of congestion are increasing and much of the UK infrastructure that was creaking at the turn of the century is now in disrepair.

Short-term measures have been introduced and improvements made in some instances, for example in reaction to rising sewage treatment failures which caused public health concerns in many parts of the country in 2020. In most other cases, society has simply adapted its behaviour, as it did during the continuing power cuts of 2022, which resulted in a growing demand for private generators and solar and wind power in the home.

The rising population in the UK, much of it resulting from new forms of economic immigration, has led to increased congestion and an increased demand for housing in and around urban areas. There is a continuing desire for single person households, which has consequences in terms of increased resource consumption. There is less need for social interaction in this post-digital world, where technology enables face-to-face interaction via a screen at the touch of a button. Nevertheless the desire for personal mobility and foreign travel (particularly for leisure purposes) remains.

The regulatory framework has not moved on much for the last 25 years. At a European level, fears of competition from the developing economies of India and the Far East during the first ten years of the century, combined with a crisis of confidence in the EU project, and entry of additional member states, have combined to limit the ability or willingness of the EU Commission to intervene too strongly on social and environmental issues.

Europe has become very much a political and economic project. Agreement on longer-term social and environmental issues has been much harder to obtain in an enlarged EU, with many member states still struggling to put the necessary arrangements in place to bring their systems into line with the more basic EU requirements. The implementation of directives agreed at the turn of the century has also been patchy, with the Commission seemingly unable to enforce stringent penalties on member states.

As a result, there is a host of local environmental management issues. The socio-economic polarisation of society is also seen in relation to the relative quality of local environments. For example, while the creaking infrastructure means that UK water quality is lower than it was 25 years ago, there are very significant differences across the country, and between neighbouring localities. The lowest quality water can be found in deprived urban areas, while neighbouring affluent areas can afford micro filtration facilities to serve their community, or bottled water supplies (in which there is an ever increasing market). Similar patterns exist in relation to congestion levels and air pollution. In many cases there has been a privatisation of the response to environmental problems: air conditioning units, water storage and filtration units, housing insulation and solar and wind power generators are all growth markets, in many cases minor status symbols for the population at large.

NIMBYism reigns in many parts of the country, particularly in relation to waste management. Incineration and CHP plants are on the increase, but remain unseen by the affluent majority who boycott their location in their neighbourhoods. In fact this export of the environmental footprint can be seen throughout society at both a national and global level. After all, the UK has been exporting much of its waste as raw materials to other countries for the last 20 years, along with many of our other environmental problems

# Appendix 2: Workshop agenda and attendance

## Scenario based forecasts of land use and management change

**22<sup>nd</sup> February – One Great George Street, Westminster, London**

### **9.45 Arrival and coffee**

### **10.00 Introductions**

Hilary Aldridge and Mark Everard from the Environment Agency will open the event

### **10.10 Introduction to scenario development**

Henley Centre Headlight Vision will explain how the scenarios have been developed

### **10.30 Scenario immersion**

A short exercise to refresh participants of the four scenarios (following up the reading material)

### **10.50 Land use topics**

Cambridge University will introduce the four land use topics, giving indications of current trends and potential change under the scenarios

### **11.20 Refreshment break**

### **11.40 Breakout group exercise – Assessing the potential changes in land use and management**

Participants will be split into 4 groups with each group taking one of the scenarios and assessing the likely changes in land use and management within their scenario

## **1.00 Lunch**

### **1.45 Feedback and initial review**

Groups will feedback their conclusions from the morning exercise

### **2.25 Group discussion of the key changes in land use and management**

A plenary review of the group conclusions

### **2.55 Refreshment break**

### **3.15 Buzz group exercise – identifying implications**

Small groups will be asked to consider the key implications for land use and management arising from discussion of the four possible scenarios

### **3.35 Review of key implications**

Group discussion of the key implications identified during the buzz group exercise

### **4.20 Next steps**



## Attendance

### Environment Agency

Hilary Aldridge	Head of Environmental Quality
Clive Bates	Head of Environmental Policy
Paul Bryson	Representing Martin Griffiths and WFD
Mark Everard	Project Manager - Land Use Scenarios
John Fraser	Water Quality
Dave Griffiths	Diffuse Water Pollution Policy Manager
Richard Howell	Strategic Environment Planner in EA Wales
Bob Huggins	Horizon Scanning Manager
David Legg	Economist, Millbank
Jamie Letts	Agricultural Policy Adviser
Neil Preedy	Catchment Scale DST
Alison Richards	'Henley Centre' scenarios project
Glenn Watts	Water Resources
Neil Weatherley	Environmental Strategy Science Manager
Antony Williamson	Links to related land use projects

### Defra

Daryl Brown	Land Use and Planning
David Calpin	Sustainable Land Use
David Coleman	Sponsorship Landscape and Recreation Division
Jessica Ellis	Horizon Scanning
Fiona Lickorish	Horizon Scanning
Russell Todd	Water Quality

### Other Departments, Agencies and NGOs

Richard Allin	Cambridge University
Andrew Angus	Cranfield University
Liz Bingham	Countryside Agency
Lloyd Burdett	Henley Centre
Andrew Curry	Henley Centre
Ruth Davies	RSPB
Ian Hodge	Cambridge University
John Hopkins	English Nature
Rob Jarman	National Trust
Helen McKay	Forestry Commission
Sarah Monk	Cambridge University
Derek Nicholls	Cambridge University
Helen Pontier	Centre for Ecology and Hydrology
Graham Tucker	Ecological Solutions
Mark Walsingham	National Trust

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