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A framework for the future: green networks with multiple uses in and around towns and cities

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A framework for the future: green networks with multiple uses in and around towns and cities

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1. Introduction

The past few years have seen a lot of changes. Some of these affect how we do approach - and how we should approach - environmental issues. The Earth Summit of 1992 by following the Bruntland Commission [World Commission on Environment and Development, 1987] in insisting on sustainability, signalled the need to turn away from economically-led planning and towards environmentally-led planning where landscape function is as important, or more so, than landscape form. Part of the outcome of The Earth Summit has been the Biodiversity Convention, which sets global targets. From these come the Local Biodiversity Action Plans which are the building blocks for global action.

The change in emphasis in planning has taken place in Britain alongside restructuring the statutory agencies responsible for nature conservation, countryside recreation and amenity, pollution control and watercourse management; local government re-organisation and internal restructuring of most local authorities; setting up Regional Government Offices in England; and a considerable increase in public concern for the environment. Many traditional separations have been closed - and, no doubt, new ones opened.

Britain in general and England in particular shows in its landscape and natural habitats the all-pervading impact of human activity. Human settlements have spread to the extent that, in comparison with more remote parts of the earth, England is essentially an urban area with a good network of greenspace. In these circumstances it is indeed a challenge to conform with the Biodiversity Convention and Agenda 21.

There is a temptation against this background to look for some new Great Idea which will solve all problems. To do so risks ignoring all that was good in the past. There are many useful ideas and approaches from the past, many also tried and tested, which can be used in a slightly different way to give fresh impetus. There are new combinations to be made of old concepts. There may be concepts from the past which suddenly make sense in the new situation we find ourselves in - better sense perhaps than they did when first tried.

Multi-functional green networks can, I believe, play a positive role in achieving the functional targets of clean air, water and soil which environmental sustainability

demands. They hold in a green matrix the key nodes of the habitats on which Local Biodiversity Action Plans and Species Action Plans focus and in linking them are in line with the thinking behind the European Habitats Directive 92/43/EEC. By permeating the area they can ensure that social targets are attained of local greenspace accessible to all by foot, bicycle or public transport.

They can also provide a meeting place for influential national agencies and local authority planners and policy-makers who may be working in rather different ways or using rather different approaches to address the same problems. Beneath the surface runs an undercurrent of beliefs. Foremost among these is the notion that there is nothing inherently bad about cities as places in which to live. Most are, however, built and managed with too much emphasis on immediate economic return and with too little on how their natural elements can contribute to societal and individual wellbeing. Where better than in centres of human population to show how concern for the natural environment can improve the quality of life? Where better to give people abundant opportunity to take direct action individually or as a community? It is in these ways that the political and economic power-bases which urban areas hold can be harnessed to give effective support for environmental issues. This is essential if the changes are to take place and activities undertaken which together add up to sustainable existence of human society.

More specifically, human settlements and their immediate surroundings provide habitats for a rich variety of wild plants and animals. Many of these are significant in terms of local and national biodiversity. The new and evolving communities of plants and animals generated in built-up areas are not only interesting to scientists and potentially important in nature conservation, but also make up the natural elements of day-to-day landscapes for millions of people.

By planning for green networks, both people and wildlife will benefit from connectivity in the landscape and by more natural elements permeating the whole area.

This document reviews some of the background to the concept of multi-functional green networks; looks at the social and environmental benefits they can bring; and at the strategic framework they fit into. In so doing it marshalls ideas from a wide

literature in a form aimed to be useful to professionals in the agencies, Departments and authorities at the centre of current activity.

2. What are green networks and where do they come from?

2.1 Definition

Green networks are natural, or permanently vegetated, physically connected spaces situated in areas otherwise built up or used for intensive agriculture, industrial purposes or other intrusive human activities. They may include land to which there is no general access, such as private gardens and estates. They are, as Forman and Godron (1981) suggest, characteristic of landscapes "bearing the heavy imprint of human activity".

2.2 History and current relevance

The concept of green networks as the basis for a variety of recreational, land management and ecological purposes in and around settlements is far from new. It has also long been recognised, as ancient writings suggest, that vegetation is the key to making cities pleasant [Botkin and Beveridge, 1997]. Increasing pressures on land have, however, given a new lease of life to the idea of networks as cost-effective, multifunctional systems which it is possible to approach at strategic level on the one hand and, on the other, at a complete range of scales from regional to neighbourhood for practical purposes and for integrated programmes involving local communities. River catchments illustrate the possibilities well. The health of the whole system can be approached at a strategic level, examples being the Mersey Basin Campaign in NW England and the many Catchment Management Plans. It can also be taken down to the level of a single tributary catchment for local project purposes and, in ever-decreasing but logically connected steps, to single street surface drainage projects to which local residents contribute or encouraging individual gardeners to channel run-off from roofs into water butts or into ponds.

Green networks can connect urban, rural and natural landscapes and often have ecological foundations which recognise natural factors and the

connections between urban systems and their surroundings. In this, by interdigitating and connecting towns and cities with their hinterlands, they reflect the thinking behind Biosphere Reserves [UNESCO, 1974] which has been applied imaginatively to urban areas [UK-MAB Urban Forum, 1996].

However, in many ways this was pre-dated by, for example, Olmsted's linear park system for Boston and the later approaches in the USA which encouraged linking urban parks with rural areas [Little, 1990]. This approach brought urban planning closer to nature conservation and it was widely adopted in Europe. It remains an important part of national conservation programmes based on landscape ecology and of international projects such as the European Natura 2000 ecological network - the basic network of representative habitats demanded in Article 3 of the Habitats Directive [EEC, 1992]. In many countries in Europe nature conservation is very much a component in physical planning, with the ideas about safeguarding species and sites supplemented by the concept of networks which give spatial coherence [Jongman, 1995]. At the scale on which many ecological networks are being considered, multiple uses are almost inevitable, given the demand for land in Europe, especially around cities. The regional network in Noord Brabant in the Netherlands is an illustration of a multifunctional network and there are many examples in eastern Europe [Jongman, 1995].

2.3 Multiple uses

The same basic approach has been adopted in many countries. In the UK it is frequently developed from the concept of wildlife corridors which most nature conservation strategies and, hence, Development Plans identify and seek to protect [Salmon Widman & Associates, 1994]. This has led to over-emphasis of the potential conduit function linear open space systems have for wildlife [Barker, 1996], the actuality of which is open to question [Dawson, 1994]. For many species in so disturbed an environment as lowland Britain a close mosaic of stepping-stone habitat patches may be as effective as a continuous strip in allowing them to permeate the whole area. This has coloured approaches to reconstruction of the countryside so as to reduce habitat fragmentation [Kirby, 1995].

Protecting and developing green networks is important, but it is dangerous to place too much emphasis on one single aspect of their function - especially when the data do not give the copper-bottomed support which reliance on a single argument demands. Where green networks serve a variety of functions, the benefits of which are clearly understood and supported by evidence, they are readily defended if needs be. They are less likely to be challenged in any case because their value across a range of functions is more likely to be respected by a wide audience.

Green networks with multiple uses and values in urban areas go beyond the early ideas that they are important simply for recreation and for beauty. They address also the needs of wildlife, flood control, improved water quality, outdoor education, community cohesion, local transport and many other urban infrastructure needs [Council of Europe, 1989a; Countryside Commission *et al.*, 1991; Forman, 1991; Lyle and Quinn, 1991; Searns, 1995; Tapsell, 1995].

2.4 Connectivity

Underlying all the thinking, theoretical design and practical development and management of green networks is the concept that the landscape was highly connected before human intervention and therefore increased connectivity is good *per se* [Noss, 1987]. Whether the benefits described in the literature depend on physical continuity of a particular habitat, are the consequence of habitat stability, are products of reduced isolation of major blocks of habitat by providing stepping stones, are due to a generally less hostile matrix, or are due to any of the other reasons speculated upon, there do seem genuine ecological effects of benefit in nature conservation [Troumbis *et al.*, Undated; Nentwig, 1989; Saunders and Hobbs, 1991; Collinge, 1996]. It is possible that many of the broad benefits to wildlife recorded are due primarily to structural diversity in the landscape [e.g. Arnold, 1995] although connectivity, however this is understood and defined, is important [Harrison & Fahrig, 1995] and is enshrined in, for example, the concept of a European network of biogenetic reserves [Council of Europe, 1989c; EEC, 1992].

2.5 Relevance to people

It has been suggested that developing green networks is an adaptive response to urbanisation driven by basic human needs [Searns, 1995]. They certainly have public appeal in that they are seen as a common sense approach to a broad spectrum of problems, provide a wide range of opportunities, and are accessible locally. They appeal to non-specialists as well as to specialists. This being so they encourage public participation and support, and local and central government involvement in often innovative ways [Taylor *et al.*, 1995]. Further, since "...improving the urban environment is a pre-requisite for the proper protection of rural England", the development and sound management of urban and urban fringe networks will benefit rural areas and their inhabitants too. [Department of the Environment/Ministry of Agriculture, Fisheries and Food, 1995]. Support for this notion is expressed also by the CPRE and Green Alliance (1997).

The concept of green networks addresses complex problems which have their roots in an exploding human population and in urbanisation. Many problems show as conflicts between clearly defined user groups; between users and owners and occupiers; or between specific functions such as flood control, and broader social and/or nature conservation issues [Searns, 1995]. Such conflict, it has been argued, can be reduced or eliminated by careful design and, particularly, where issues such as nature conservation or landscape quality are perceived threatened by public access to and enjoyment of features [e.g. Shipp, 1993; Manning, 1997]. It is, however, the case that many studies show that passive recreation can bring about considerable changes to plant and animal communities, which may not be acceptable in some circumstances [eg. Council of Europe, 1989b; Matlack, 1993; Shipp, 1993; Miller, 1994; Anderson, 1995; Gómez-Limón and de Lucio, 1995]. Further, a consequence of fear of crime in natural landscapes is pressure for management [Burgess, 1995] which may induce changes which are often seen as undesirable to fauna and flora.

3. Societal aspects

3.1 Standards for providing accessible natural greenspaces

A number of studies have suggested that vegetation in the city reduces stress [eg Huang *et al.*, 1992]. This is one of the reasons leading Rohde and Kendle (1994) to suggest, "Human beings need to make contact with nature in the course of their normal daily lives, and no special effort (or journey) ought to be required for obtaining it". This thinking is reinforced by Box and Harrison (1993) and Harrison *et al.* (1995) who suggest minimum standards of provision for accessible natural greenspaces. The recommendations derived from these and adopted by English Nature [English Nature, 1996] are that people living in towns and cities should have:

- an accessible natural greenspace less than 300 metres (in a straight line) from home;

- statutory Local Nature Reserves provided at a minimum level of 1 hectare per thousand population;

- at least one accessible 20 hectare site within 2 kilometres of home; one accessible 100 hectare site within 5 kilometres of home; and one accessible 500 hectare site within 10 kilometres of home.

These spaces could be nodes on a green network and the network could itself give added value to society.

The City of Birmingham has formally adopted standards linked to these, but not identical to them [Birmingham City Council, 1997]. In doing so the City uses criteria based on size and distance; on an expansion criterion based on the existing situation; and a relationship criterion based on the ratio of space to numbers of people.

3.2 Range of uses

It is the case that seeing wildlife and expecting to see it, heightens people's awareness of their surroundings and adds value to landscapes [Hull and McCarthy, 1988], but this brings pressures on wildlife [Miller, 1994] which need better understanding of the conflicts and compatibilities to manage effectively [Strutin, 1991]. However, green networks with nodes of the kind mentioned give the chance of conserving wildlife and bringing people into contact with it and, it has been argued, without jeopardising it provided the design is good and ecological necessities recognised [Manning, 1997].

At the other end of the spectrum, green networks can provide for sports and other active pursuits. They are often important for agriculture and forestry, even inside urban areas where they may also hold allotment gardens. These productive areas may not be generally accessible, at least in part. Even less generally accessible are private gardens and private and institutional estates which may supplement accessible open space along its edges or may together or singly form significant secondary elements in a green network - albeit elements totally inaccessible to most people.

3.3 Values and evaluation

The elements going to make up any green mosaic or network within a town or city therefore vary in size, type and function. They are frequently put into hierarchical systems based on whether their function, for whatever purpose or purposes they are being evaluated, is seen as significant on the whole city (or wider) scale, district scale or purely local scale [eg Cape Town City Engineer's Dept, 1982; Greater London Council, 1985; Gobster, 1995]. While greater emphasis is invariably placed in plans and programmes on sites or strands of any network which have been identified as important on the whole-city scale, there are qualifications which need to be made, particularly where values to society are involved. The value small areas of natural accessible greenspace near home have for young people [eg Harrison *et al.*, 1995] and the value children place on small-scale landscape features [eg Jeavons and Hitchmough, 1994] are usually under-estimated in the hierarchical systems mentioned above - indeed children's perceptions and views are rarely sought even though they

are main users of many open spaces and hold valid and perceptive opinions [Tapsell, 1997]. Further, Gobster (1995) points out that it is the **local** trails which should be seen as the basic framework for a green web, attracting as they do very loyal users among local residents.

Underlying much of the demand from professionals for access for all to natural elements in the urban landscape is the fear that people will otherwise become alienated from nature. Were this to happen it would have considerable implications for the changes implied or specified in Agenda 21. For this reason the general and the formal value these elements have as a means of raising awareness of wild plants, animals and geology and for education is frequently stressed. It may also colour the concept that these natural elements can and should give a focus for community development and in young people a focus for personal and social development.

3.4 Public confidence: public ambivalence

Linked in with fears about alienation are concerns over public safety on natural sites, invasion of the privacy of landowners alongside linear parks and increased damage to private property and increased theft following green trails being opened up. That green spaces and trails are relatively safe places in the urban landscape [eg Mayhew and Maung, 1992] and that new trails do not increase crime [Ryan, 1993] is largely irrelevant if the contrary **perception** remains. Planners and managers must address public perceptions through information programmes and site design and management policies and practices. [Burgess, 1995]. Among effective approaches to increasing public confidence is involving local people in site design and in management planning; providing a ranger service; providing key social focal points; clearing litter; and encouraging use by providing informative newsletters, leaflets or notices [Millward and Mostyn, 1989].

In planning for natural/nature-like greenspaces it must be recognised that society is ambivalent about them. While nature may to some be spiritually good and to be cherished, to others it is 'anti-civilisation' and to be feared. [Rohde and Kendle, 1994]. These extremes can co-exist in any individual so that, for example, a feature esteemed during the daytime, may become feared

for a variety of reasons after dark. With such complexity in society's reaction, the need for variety in design and use of the open space network is clear. [Rohde and Kendle, 1994]. In an ideal situation everyone should have a wide range of choice, an ideal which is in practice constrained by lack of space itself. Within such space as is available there is a delicate balance to be struck between enough of a challenge to stimulate and intrigue but not so much as to raise levels of anxiety to a point where it becomes uncomfortable. However, as Millward and Mostyn (1989) point out, once people are used to a natural open space they do not want it to evolve into a conventional park.

A sense of wilderness can co-exist with feelings of safety but, as Rohde and Kendle (1994) say, the environmental cues which ensure this are not clear. They also point out that with psychological benefits accruing, even from brief contact with nature or just a view from the window, there is a good argument for a system of open spaces permeating the whole area even if the components are individually quite small.

4. Wildlife and natural features

4.1 Wildlife corridors

In many countries, and certainly in the UK, green networks have been designed and protected for their values to nature conservation. For example, virtually all the nature conservation strategies for urban areas in the UK set out policies to protect 'wildlife corridors'. Although the precise value and function these systems have in practice is less clear than we would wish [Adams and Dove, 1989; Dawson, 1994] much of this is attributable to the fact that most of the published studies on the topic have not been conducted with full scientific rigour [Nicholls and Margules, 1991; Dawson, 1994]. The weight of anecdotal evidence is sufficient [eg Spellerberg and Gaywood, 1993] and the need to observe the precautionary principle compelling enough for Dawson (1994) to recommend that:

- corridors should be preserved, enhanced and provided, where this can be cost-effective, as they do permit certain species to thrive where they otherwise would not;

- corridors should be as wide and continuous as possible; and

- their habitat should match the requirements of the target species.

This set of recommendations is significant when drawing up local Species Action Plans as part of the national Biodiversity Action Plan where the requirements of listed species which have significant populations in urban settings are being considered. It has very practical implications for habitat creation in developing new areas and in re-developing built-up areas. This can be linked to general environmental functions (see below) and the social aspects mentioned above to give a persuasive argument for multifunctional green networks. It should be mentioned here that although there appear to be many benefits from green networks there can be disadvantages too. Quite apart from channelling human access they may provide conduits for the spread of undesirable species as well as desirable ones, or favour predators as against prey species, and can actually act as barriers for some species [e.g. Forman, 1991].

Whatever the evidence for linear greenspace acting as a conduit for wildlife, and for rivers, streams and canals this evidence is very compelling [Umweltbundesamt, 1996], it is certainly the case that many species able to live in urban areas do not have to have seamless continuity in their preferred habitat to let them move from place to place. A close mosaic of habitats is enough to support a rich and varied wildlife in an urban setting [Sukopp and Werner, 1982] and to take into account many of the conclusions coming from metapopulation theory [Collinge, 1996]. However, for some species the fine detail of connecting areas is highly significant. For example, provision of walls of old tree stumps beneath motorway viaducts was found necessary to let small mammals move across the motorway corridor. The large expanse of bare sand was an effective barrier to them, although not to larger animals. Providing cover was the remedy [Nieuwland Advies, 1995]. The importance of detail under these circumstances is also underlined by Yanes *et al.* (1995) and Rodríguez *et al.* (1997).

The temptation to put a human perspective on linkages must be resisted, not only because essential details of this kind may be missed but also because it is

the case that some built-up areas are in fact more similar to natural habitats than many areas recognised as 'green' in plans. For example, built-up areas with detached houses with gardens, especially where they are big enough to hold wild areas, will act as important conduits for wildlife and may indeed act as donor sites of wildlife for the urban area generally. These areas are 'developed' in the eyes of the planner and not part of the green system, whereas close mown grass around flats or on playing fields, which supports only a small range of species, is seen as 'green' [Szacki *et al.*, 1994].

4.2 Mosaics

It is also the case that so far as urban habitat patches go, size - in the range normal for such places - is less significant than vegetation structure, small-scale topography and micro-habitat richness in determining species number. Taken together, and with social aspects in mind, a close mosaic of small (<2 ha) sites with good structural variety serves the main needs of a large number of species of plant and animal and of local residents, especially children [Harrison *et al.*, 1995]. If, however, this mosaic can be linked physically by means of strips of accessible natural greenspace its value to society will be increased and wildlife will benefit from additional habitat. Major spaces will form nodes in the network. The reticulate structure given by networks provides alternative routes for species moving across the landscape, minimising the damage caused by breakages, disturbance or concentrations of predators [Forman, 1983].

4.3 Geological interest

It is likely that a number of accessible natural greenspaces will also have geological interests which are usually compatible with other uses for the site. The main natural features on which substantial linear greenspaces are based (stream/river valleys and natural steep ridges) will usually have considerable geological interest. The networks will therefore serve some earth science conservation needs as well as those of wildlife conservation. They give often large-scale, very visible elements in the landscape on which programmes of interpretation can be based as well as smaller scale ones such as spring-lines in open spaces or natural or man-made outcrops of rock and it is the case that

non-specialists are interested in these features and the processes which brought them into being [Pounder, 1996; Larwood, 1997].

4.4 Essential core sites

Within green networks, key elements in terms of wildlife habitat and natural features can be identified and, particularly in the case of wildlife habitat, be earmarked as the essential core element of natural capital (Environmental Capital) which should not be eroded. Ideally, buffer zones should flank the core areas and the core sites should be joined by habitat corridors. This ecological approach to green networks underlies programmes such as the Durban Metropolitan Open Spaces System [Poynton and Roberts, 1985; Roberts, 1994], the strategy for conservation in Tucson [Shaw *et al.*, 1986] and that in Southern California [Lyle and Quinn, 1991]. It is implicit in the concept, which has been advanced, of Environmentally Sensitive Areas as landscape elements which should be interconnected to protect regional biodiversity [Ndubisi *et al.*, 1995] and in landscape ecological network approaches [Jongman, 1995; Linehan *et al.*, 1995; Collinge, 1996]. At the finer scale used in most UK urban areas the statutory Sites of Special Scientific Interest together with the non-statutory Sites of Interest for Nature Conservation should give the basis for selecting core, or potential core, areas. It is, however, essential that the dimensions and configuration of core areas are governed by ecological rather than economic, planning or political criteria [Troumbis *et al.*, Undated]. In the context of multifunctional networks it would be appropriate for these core areas to be acquired (where necessary) and managed as statutory Local Nature Reserves [Smyth, 1990; Barker, 1995]. To do so would go some way to counteracting the trend over the past 40 years towards smaller Local Nature Reserves in Britain suggested by Box (1991).

Local Biodiversity Action Plans will tend to focus on these core areas but the interconnecting green networks, even if only by making the general landscape matrix less hostile [Forman and Godron, 1981], will be significant in programmes to enhance habitats or expand the range of target species [Verboom *et al.*, 1991; Harrison & Fahrig, 1995]. Habitat creation/habitat expansion programmes will be concentrated in the green corridor areas [eg Clarkson, 1996] but redevelopment will give, in the long term, opportunities to

make the corridor connections currently missing. In order to achieve this, strategic plans for the area concerned must flag up the intention to do so and carry the policy forward from plan revision to plan revision. This approach would conform well with the concept of the EECONET [Bennett, 1991].

5. Multiple benefits and uses

5.1 Water management

Green networks in urban areas can, and often do, perform functions important at the whole city scale or present significant management benefits [Rabinovitch, 1992]. Of these the greatest potential is in river corridors where major flood prevention or control functions can be combined with many others [eg Lardner, 1991]. Land alongside rivers and streams is particularly significant here [Sukopp and Werner, 1987; Gilbert, 1989; Baschak and Brown, 1995; Schrader, 1995; Copas, 1997; House and Fordham, 1997; Penning-Rowsell and Burgess, 1997; Manning, 1997; Tapsell, 1997] and many non-specialists feel it to be so too. Returning river valleys to a more natural state is significant for long-term sustainability and in doing so the value of the natural drainage system as a green network will be enhanced [e.g. Tapsell, 1995; Copas, 1997].

Linked with flood prevention are the surface water run-off retention pools which are increasingly common as components of major new developments, such as business parks, where they serve aesthetic as well as water storage functions. If suitably located, these can add to the aquatic corridor system. So can the pools and reed beds being constructed and used to treat both surface water drainage and sewage. These structures, particularly where combined with other measures such as porous hard surfaces and swales [Scheuler, 1992; SEPA, 1996], not only reduce impacts on watercourses downstream of built-up areas but also help groundwater recharge, add wildlife habitat, give possibilities for fisheries and for water-based recreation. The inter-relationship between water-bodies and their immediate surrounds is an important one, recognised for example in the case of the Bielański woodlands in Warszawa, Poland [Bauma and Trojana, 1982], which largely determines the range of species an area supports. It is also crucial in terms of landscape and human use. It is true to say that in urban situations water needs high quality natural

greenspaces and green spaces need good quality water. Where drainage management and vulnerable aquifers are taken into account seriously in town design they can result in substantial greenspace corridors which have major landscape values in urban areas, as in the case of McHarg's design for Woodlands, Texas [McHarg and Sutton, 1975; Spirn, 1984].

5.2 Air hygiene

Within the urban fabric, wide green corridors or major open spaces can have appreciable effects in mitigating the urban heat island [Horbert *et al.*, 1982; von Stülpnagel *et al.*, 1990]. Corridors and especially those on ridges [Loessner, 1978] and those along river corridors [Nkemdirim, 1980] are important conduits for air. These air flows help flush pollutants from the urban system. Vegetation, and in particular trees, can reduce pollution by trapping airborne particulates. Woodland edges are especially effective and creating linear woodlands along roads is recommended as a means of reducing air pollution from them [Broadmeadow and Freer-Smith, 1996]. Such woodlands add, of course, high-profile landscape features and wildlife habitat as well. The money saved through city trees removing pollutants from the air and in providing shade and shelter to buildings has been calculated by several authors and the general benefits summarised by McPherson *et al.*, (1997) who quote $402 net value per planted tree.

5.3 Landscape

At both macro and micro scale, a green network has important landscape values [Walmsley, 1995]. Particularly where based on natural elements, it gives a structural foundation which goes with the grain of the landform [Spirn, 1984] and with which many people feel immediately at ease. This is recognised in the Far East in the basic philosophy (Feng-shui) of respecting natural landforms and forces in siting settlements [Skinner, 1982]. It underlies the reasoning of Arendt (1996) for landscape-led development.

5.4 Leisure routes

Particularly where they follow natural drainage systems [Manning, 1997] or the old transport systems of canals or redundant railways where gradients are gentle, green networks provide a framework for walkways and cycleways which will become increasingly important as sustainability is sought. The North American Greenways systems almost invariably include hiking and cycle trails [Gobster, 1995; Luymes and Tamminga, 1995; Searns, 1995; Zube, 1995]. In England, the Countryside Commission is currently undertaking reviews and studies to investigate multi-user routes for use on wheel, foot and horseback which link communities with places they wish to visit for leisure purposes or commuting to work or school without using roads jammed with cars and lorries [Countryside Commission, 1996; Stearn, 1997 pers. comm.]. Multiple use has all too often in the past given rise to conflict with deeply entrenched positions taken. This need not be the case and multi-functional green networks provide excellent opportunities for partnership with the partners arriving at an holistic view of sustainable multiple use.

5.5 Costs and benefits

Whether used for any form of public recreation; designed to channel surface water drainage; acting as effective air movement systems; or giving a sense of landscape integrity and aesthetic beauty, linear space systems have the advantage of having a long edge readily accessible to many people and permeating large areas. The long edge while having the potential to increase to local authorities the variable costs of management, such as fencing, entry points, notices etc, in practice rarely does so in urban areas where boundaries are frequently unfenced or fenced by adjoining private landowners to delineate and secure their properties. It might in any case be argued that by being accessible to more people than isolated sites the variable costs per person served would be less. Further, it has been shown for grassland and woodland that small isolated sites are relatively more expensive to maintain than large continuous sites [NUFU, in press]. A common network can certainly offer advantages in terms of promotional and interpretative literature, and makes it easier for local authority rangers to relate to the open space system and for users to expect and accept a uniform ranger service.

Many of the advantages of networks are founded in psychology! The financial benefits or disadvantages depend a great deal on individual circumstances and it is hard, and indeed probably dangerous, to generalise.

An agreed, defensible and stabilised green network, particularly around its key nodes of space, can have some economic benefits. Prices for adjoining properties rise and re-sale probability becomes high. This in turn can generate greater tax revenue. The areas alongside such networks become stabilised in an important urban political sense [Faraca, 1986].

6. Strategic planning issues

6.1 International and national guidance

The value which networks have for nature conservation has been stressed in Europe at continental level [Council of Europe, 1989c; Bennett, 1991; Jongman, 1995;]. The Council Directive on the conservation of natural habitats and of wild fauna and flora [EEC, 1992] in Article 3 demands that a coherent ecological network of special areas for conservation be set up under the title Natura 2000 and, in Article 10, that governments ensure that land-use planning and development policies are used to "encourage management of features of the natural landscape which are of major importance for wild fauna and flora. Such features are those which by virtue of their linear and continuous structure .... or their function as stepping stones .... are essential for the migration, dispersal and genetic exchange of wild species." The intention here is to ensure improved coherence where necessary in the Natura 2000 network. This thinking is expanded and reinforced by Troumbis *et al.* (Undated).

At national level in England, Planning Policy Guidance 9, Nature Conservation, [Department of the Environment, 1994], in paras 15 and 16 emphasises the importance of corridors and linkages and in paras 23 and 24 looks to policies for their protection.

Strategic guidance on nature conservation does therefore support the notion of green networks protected by international, national and local policies. What is

not made clear in guidance explicitly serving nature conservation is the range of other functions which ecological networks will serve.

6.2 Importance of a strategic approach

Any substantial green network in and around an urban area in the UK will have multiple uses, be in multiple ownership and involve a wide spectrum of interests. Management and the funding of management will be a cocktail, mixing resources from local and central government, the national lottery, the private sector, non-governmental associations and local residents. Setting up a green network on the ground will involve agreements, easements and purchases, some of which may have to be by compulsory purchase. The situation requires clear long-term objectives which will be readily understood and supported by the majority of people [House and Fordham, 1997] and be embodied in the statutory system of planning and management of public resources. A strategic approach is highly desirable in any urban greening work [GFA Consulting, 1996] but is essential in developing multifunctional green networks.

Strategic plans are usually based on hierarchical evaluations of different potential or actual uses which depend largely on whatever the primary interest or value of a particular place is thought to be. What is seen as the primary interest may change according to the fashion of the time - yesterday's derelict quarry may be today's nature reserve, heritage site or Site of Interest for Nature Conservation [Box *et al.*, 1996]. Within each set of uses or interests additional hierarchies exist and it is the case that places of very high significance for one use (eg playing fields) are of limited value to some other interests or uses (eg nature conservation) but of significance to others (eg air flow; flood control). Uses and interests may change with the seasons and over the years. Green networks need to be considered with a broad spectrum of interests and uses in mind. This will engage the largest possible number of people and marshall concerns for many important functions in defence of the network's essential feature - spatial continuity.

Multifunctional green networks are important components in making towns and cities sustainable. Very many of the schemes already undertaken are

centred on the natural drainage system. River corridors are important in many ways and changes in the industrial and transport base give the opportunity for radical restructuring (eg Tyneside; Barn Elms Reservoirs). This restructuring by no means always brings societal or environmental benefits, as public criticisms of actual and proposed developments along the river Thames in London remind us [eg Pepinster, 1997]. Smaller streams, while offering less spectacular opportunities, have the advantages of greater local focus and the chance to piece together many small-scale projects into something of wider significance [eg Tapsell, 1995; Clarkson, 1996].

River systems bring together a suite of opportunities which, if taken, add up to substantial improvements. Measures to decrease pollution contribute to the value rivers have for recreation. This may in turn lead to improved access which may generate demands for landscape improvements, further improvements in accessibility, and so on. As the system becomes clean, safe, green and used so the whole area becomes more attractive for inward investment [GFA Consulting, 1996].

A strategic overview can take advantage of operations such as valley gravel extraction. In the past it was by serendipity that wet gravel workings left major corridors in their wake useful for flood control, recreation and nature conservation. New features such as the Lee Valley Park in north and east London are often now planned from the outset. Planned changes on this scale gives ample opportunity to include features such as cycleways linking into regional/national networks.

6.3 Variety in major elements

Although river valleys are probably the most widespread and amenable landscape features on which to focus attention where the main elements of a green network are concerned there are other major but less widespread features. Steep-sided ridges are examples and, although the air hygiene corridors in Stuttgart are among the best known, many UK towns and cities hold major corridors based on them. These may be associated with rivers (eg Avon Gorge in Bristol) but are not always (eg Corstorphine Hill, Edinburgh). In many instances wedges of agricultural land run into built-up areas (eg

Sandwell Valley, West Bromwich). In Poole and Bournemouth relic Dorset heaths form significant networks, while behind the south coast seaside towns in Sussex run the South Downs, a major landscape, recreation and nature conservation feature. Finally, for any coastal town, the sea shore and associated features are major corridors which hold some of our most vulnerable and damaged habitats alongside some of the least accessible.

7. Where should this lead us?

7.1 Environmentally-led long-term restructuring

In the past, landscape considerations have rarely led development. As a result we have a legacy of poor and unco-ordinated open spaces many of which have appeared by default rather than by design. Looking now, as we are, in the context of development which is less demanding of the natural environment and is sustainable in the long term, we should be advocating 100-year strategies to restructure urban systems in ways which will redress the balance. This reflects the need for the kind of multi-faceted approach advocated by Kelcey (1978) and adopted, in theory at least, in integrated planning systems [Jongman, 1995]. The urban area is sufficiently dynamic to make this a reasonable time-span over which to plan quite radical structural reform based on a considered approach relying on opportunities as buildings and infrastructures reach the end of their useful lives. In spite of some uncertainties over detail, the technology is there now to develop new spaces of considerable ecological value and durability which will serve also many of the other functions mentioned. If it is the case that multifunctional green networks are important in developing sustainable systems and in improving the quality of life and health of a city as well as conserving nature, then they must be given high priority.

It is, of course, most cost-effective to improve and add to existing networks based on major natural features and on man-made features such as transport axes [Kistowski, 1994], but this may not always be possible in the short term. Spatial continuity is important and to achieve this, particularly in situations where this continuity is not there at present, there must be a long term strategy in place which is sufficiently strong to ensure that priority is given to the green

network in the presence of other demands. The implication must be that a carefully constructed landscape master plan should lead development, as was the intention in at least some of the UK New Towns eg Telford [Telford Development Corporation, 1973], rather than having to follow development. If it follows development then environmental sustainability is a very remote possibility, as most modern cities amply illustrate. Where development is proposed on landscapes retaining natural elements then the key natural (and cultural) resources and the need to keep these as viable, integrated systems, should determine the scale, configuration, design and management of the development [Arendt, 1996]. Had this been done in the past most of the problems addressed here would be insignificant now.

The main axes are key components of any network, supplemented and linked by smaller-scale linear features ranging from transport corridors to rows of gardens [eg Milton Keynes Wildlife Corridor Project, 1996]. For many functions these main axes are undoubtedly more useful than are the linking features. However, as Gobster (1995) suggests, for functions directly important on a day-to-day basis to local residents it is those features most easily accessible to them which are the most important. The implication here is that, for some purposes at least, the standard hierarchy of sites should be stood on its head with those serving a regional function being seen as less important than those serving local functions - unless both are served. It illustrates the flexibility needed to address the issues if what has been termed 'multifunctional and pluricultural open space' [European Foundation, 1996] is indeed to play a significant role in making towns and cities pleasant and sustainable places in which to live.

7.2 Infilling and the quality of life

The demands in response to pressures on green field rural sites for urban brown field sites to be used to satisfy the need for new houses [CPRE and Green Alliance, 1997; Llewelyn-Davies, 1997] make the landscape-led and sustainability-led strategic approach all the more necessary. The consequences of cities turning in on themselves to satisfy immediate needs for housing was shown very clearly during the Industrial Revolution. Nottingham, hemmed in by common land, which the commoners defended stoutly, was an extreme

case where, Hoskins (1955) noted, a city described a hundred years previously as one of the fairest in the land held some of the worst slums in Britain when examined by official Commissioners. Gardens and orchards had been converted into back-to-back housing for workers.

It is not to imply that precisely the same mistakes made then will be repeated now. However, history suggests that in the absence of a clear, environmentally sound strategy not only will the environment suffer but also the quality of life enjoyed by residents. To permit this flies in the face of everything which Agenda 21 stands for. Indeed it is an important part of Local Agenda 21 to consider how different parts of society and different activities affect each other, especially at local level. This needs professionals to use their skills to help local residents define their objectives and to achieve them, regardless of whether or not the final vision is what the professionals would themselves wish. This is fundamental to the thinking in this paper and to resolving, in partnership, the potential conflicts which multiple uses of open spaces bring. Resolution of conflict is important if the continuous and multiple use of space, seen by Deelstra *et al.* (1991) as one hall-mark of a good city, is to be achieved.

7.3 Public safety, responsible reporting and common-sense

Some of the conflicts we are experiencing now are of our own making. Fear of crime in natural and nature-like open spaces has led managers to clear away cover actually or potentially of great value to wildlife and to spend a great deal of time, effort and money making accessible spaces more open in the expectation that this will let users feel safe. There is no statistical basis for thinking green spaces particularly dangerous, indeed they seem relatively safe [Mayhew and Maung, 1992]. The widely held view to the contrary can be ascribed fairly and squarely to iterative and sensational treatment by the media of any instance of violent crime in naturalistic open space. [Burgess, 1995].

The same applies to the relatively few cases of serious or fatal accidents involving ponds, woodlands and other natural habitats. It is most unlikely that these places are particularly dangerous when compared with built

elements of the urban environment, constructed playgrounds and, of course, roads. Further, to remove them or to deny access to them encourages young people to seek adventure in genuinely dangerous places and often in ways which place others at risk as well as themselves. While reasonable standards of safety should be set, it is neither possible nor desirable to wrap society in the cotton-wool of absolute safety. There comes a point where the adverse consequences to society of applying stringent standards of safety outweigh the benefits. This point is reached, and in many instances passed, in accessible natural greenspaces in towns and cities.

7.4 Quality of life

One of the products of centuries assuming that human needs can be met in perpetuity by using natural resources in ways which disregard human impacts on them and the long term consequences of this on us, has been the modern city. However, as Botkin and Beveridge (1997) point out "In the more than 2000 years of city planning, those who have written about cities have agreed on three points: (1) cities are centres for innovation and creativity in civilization, an idea we do not hear much about any more; (2) the more pleasant a city is, the more likely it is that its residents will be innovative and creative; (3) vegetation is the key to making cities pleasant." Cities *per se* are economical of space for human habitation and present many economic advantages and potential management benefits. Living in large settlements presents many social advantages although Western attitudes, possibly rooted in Christian traditions of cities as centres of degradation and vice, are often negative. Such attitudes are not supported by any evidence for specifically urban problems affecting well-being and health and linked to settlement size [Fischer, 1976].

In cities the quality of life experienced by inhabitants is the product of a great many factors. One of these is the contribution which contact with nature has on psychological growth and fulfilment [Rohde and Kendle, 1994]. Another is the role natural greenspaces can have in reducing the stress generated by the high frequency of interaction with other people in densely populated cities and in the case of green multifunctional networks, even, paradoxically, in improving communications across the urban area. Difficulty of

communication is coupled with frequency of interaction as the major causes of stress which can cause social fragmentation [Fletcher, 1995]. When to this is added the environmental advantages multifunctional green networks hold, then their value as the foundation on which modern cities should be encouraged to evolve and to re-structure themselves is increased. However, a strong, integrated planning system is essential if any long term strategy founded on environmental sustainability, rather than on short-term economic gain, is to succeed. A 100-year strategy needs the anchor point a good planning system can provide to have any hope of success and, in spite of its complexity, a fully integrated planning system seems a prerequisite.

7.5 Coda

There has been the tendency in the past to design out natural landscapes from large settlements and then to put greenery back, in limited quantities, as an afterthought around buildings and in the form of highly simplified plant communities needing continual management to maintain them. The need now is for landscape-led designs which harness natural processes and features and which set the essential human elements humbly and carefully alongside them. Too many modern cities are, environmentally speaking, open sores which will take time and a lot of hard work and money to heal when they should be a triumph of human existence in harmony with the natural environment.

8. Conclusions

8.1 Networks of natural or nature-like greenspaces are characteristic of situations where the impact of human activity is as heavy as it is in Britain. They can be fleshed out into national networks serving a wide range of purposes which connect with the conservation of key target species, increased sustainability in landscape management and increased benefits to society in terms of the quality of day-to-day life.

8.2 The Earth Summit of 1992 gave impetus to environmentally-led planning. To focus on multifunctional green networks is a practical and pragmatic way to stimulate integrated planning. This is needed to lead towards making human

existence sustainable and in achieving functional targets of clean air, water and soil towards which good multifunctional green networks can contribute.

8.3 Multifunctional green networks fit with current notions of landscape connectivity in Europe which are seen as important in conserving the characteristic habitats and species of the continent. Connectivity is important in the conservation of biodiversity. The prime sites form core nodes in the network at all scales from continental to local.

8.4 People need day-to-day contact with nature for their psychological well-being. Networks of natural or nature-like greenspaces permeating settlements bring such contact within the compass of all. Networks make it easier to reach the minimum targets suggested for accessible natural greenspaces.

8.5 Physical connections between core nodes of accessible greenspace are important if people are to be able to move without much stress between them and on foot, horseback or bicycle.

8.6 By serving a wide variety of environmental, ecological and societal purposes multifunctional green networks are readily defensible.

8.7 Multifunctional green networks by their range of functions and widespread nature offer a focus for organisations to form new partnerships and for anyone to become involved in their locality in work linked to Local Agenda 21, to major sustainability issues and to Local Biodiversity Action Plans. In multifunctional green networks even small individual actions can contribute to major strategic goals.

8.8 To maintain and develop reasonable networks will need long term, fully integrated planning. 100-year strategies for redevelopment may be needed in some urban situations and these demand a strong environmentally-led planning system.

8.9 Maintaining and developing reasonable networks demands the understanding and support of local people. Professionals must recognise the ambivalence people have to natural landscapes. Professionals must use their skills to help

local people refine their ideas and to see them achieve their goals. The resolution of actual or potential conflict is essential in multifunctional open space systems.

8.10 By linking the rural hinterland with urban centres, multifunctional green networks help break down the urban/rural divide. This is essential if the issues of sustainable human existence are to be addressed. It is helpful in understanding and addressing the conservation of nature. It is helpful in improving the quality of life for people.

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