GREEN INFRASTRUCTURE IN-DEPTH CASE ANALYSIS

THEME 7: MAPPING FOR PLANNING

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1 Introduction

The use of mapping in green infrastructure planning processes is the focus of this in-depth analysis. Integrated spatial land planning and territorial coherence schemes at the municipal and regional levels can profit from the use of accurate ecological and socio-economic information in making more informed decisions. Various methods of mapping have been developed as tools to ensure the provision and application of such information in land-planning processes and to identify opportunities for developing Green Infrastructure.

The use of mapping techniques within this context evolved out of a previously inadequate system of coordination occurring between conceptual and planning activities and the resultant poor functioning of the existent systems of land-use planning, both ecologically and socio-economically (Attwell et al., 2005). The natural and already built-up areas of municipalities were often being inappropriately utilised, leading to risks for green spaces and features (e.g. uncontrolled suburbanisation, development on green fields, the creation and abandonment of areas devastated by industry etc.) (Attwell et al., 2005) and a lack of consideration for the requirements of ecosystem functioning and the needs of current and future inhabitants.

Since Green Infrastructure is a type of physical asset, geographic information system (GIS) mapping techniques can show its spatial distribution in a given area and provide a more informed and systematic way for considering the competing priorities of Green Infrastructure within spatial planning processes (Davies et al., 2006). Ireland's creation of a national map of Green Infrastructure assets[1] serves as a useful reference for the involved process, namely:

1. Determine Green Infrastructure elements (flood attenuation, recreation and biodiversity);
2. Import and structure relevant datasets to a GIS (including source data from local authorities, other organisations (e.g. Birdwatch, Biodiveristy Data Centre) and relevant government and state organisations);
3. Reclassify landcover, habitat, zonings etc. as Green Infrastructure elements map;
4. Create a baseline Green Infrastructure map from which additional Green Infrastructure maps (e.g. water quality and flood attenuation, recreation and life quality and biodiversity) can be derived.

These datasets can subsequently be complemented by additional datasets representing, for example, socio-economic features or more appropriate datasets such as habitat or land use planning, depending on the context for which the maps are being utilised. The resulting comprehensive information sets allow planning processes to ensure multi-functionality, extended user access, landscape enrichment, sustainable development, habitat connectivity and biodiversity

[1] Comhar (2010)

enhancement. Precise data on ecological and socio-economic conditions also enable the foreseen benefits of land management plans to be clearly communicated to policy-makers and the public at large.

Mapping tools thus aim to look at the various uses of Green Infrastructure features, analyse and integrate them in spatial plans and provide them with a sense of functionally and a strong political context (Attwell et al., 2005). A strong evidence base can ultimately facilitate the development of a series of recommendations for the management of regional Green Infrastructure assets for improving the functionality performed relative to the needs of the inhabitants and natural systems (North West GI Unit, 2009). Consequently, it becomes possible to value existing green areas and prevent their deterioration, improve the quality and diversity of these features to optimally serve local needs, strategically connect green areas for optimal functioning and account for all green areas under both private and public management in planning processes (Davies et al., 2006).

Three examples are discussed in detail in this analysis, having been selected to illustrate the utilisation of mapping tools in Green Infrastructure spatial planning processes. The main example explored, SITXELL, was selected for its representativeness of the measures considered most central to this theme. In particular, SITXELL utilises a GIS mapping scheme to support land planning processes at the Barcelona provincial government. The tool provides accurate ecological and socio-economical information and has resulted in the "greening" of public administration and companies involved in land planning and a more balanced territory in ecological, social and economic terms.

An additional two examples are also discussed, presenting alternative approaches to the utilisation of mapping in Green Infrastructure planning, while still pursuing the same overarching objectives. The first of these, the Cambridge Green Infrastructure Strategy and Green Vision (UK), uses mapping tools to identify the green space needs of the growing population and identify opportunities for Green Infrastructure in the region for the next 20 years, supporting economic growth and the preservation of natural features. Finally, France's Green and Blue Infrastructure initiative targets regional fragmentation and aims to include an ecological network supporting biodiversity needs in its territorial and urban planning schemes.

2 Overview of Initiatives

2.1. Lead Initiative: SITXELL project, Spain

SITXELL is a territorial information system started in 2001 by the Natural Areas Department of the Barcelona Provincial Council. The initiative is a territorial analysis structured through the different geographical information layers and aimed at studying and valuing non-building lands. SITXELL is also a tool to influence spatial land planning at the municipal and regional levels through the provision of accurate and rigorous ecological and socio-economical information and planning criteria to competent public administration.

Specifically, the objectives of the initiative are: to make use of a GIS scheme based on accurate multidisciplinary information and assessment, to support land planning processes at the Barcelona Provincial Government; to offer land-analysis information and technical support to the municipalities of the province of Barcelona to be applied at the municipal-planning level; to collaborate with the regional government of Catalonia to ensure that regional planning is based on precise data on open areas and that incorporate an ecological approach; and to communicate the benefits of integrated land planning and management to the diverse actors at different scales.

2.2. Secondary Initiative I: Cambridge Green Infrastructure Strategy and Green Vision, UK

Due to an expected population increase and the subsequent changes to the quality of life enjoyed by existing communities, the provision of Green Infrastructure was identified as a key priority for the successful implementation of the growth agenda. Therefore, a Green Infrastructure Forum was established in 2004 to develop projects which could be submitted for funding from the government's Growth Area Fund. The Green Infrastructure strategy was produced in 2006 as a result of a Green Infrastructure study identifying the green space needs of the growing population and identifying opportunities for Green Infrastructure within and adjacent to major development sites. The strategy is designed to be relevant within a long-term context and address the provision of large-scale Green Infrastructure for the Cambridge sub-region over the next 20 years in order to complement and support the significant growth in housing provision that is planned during this period. The main objectives include: connectivity of habitats, multi-functionality, extended access, landscape enhancement and biodiversity enhancement. While the lead example is primarily concerned with delivering opportunities for recreation and environmental education via the increased protection and health of ecosystems as benefits, this initiative focuses on achieving sustainable development and a high quality of life, including residents' health, as well as providing opportunities for climate-change mitigation and adaptation.

2.3. Secondary Initiative II: Green and Blue Infrastructure Initiative, France

In order to overcome the current fragmentation of the French territory, the Green and Blue Infrastructure initiative (*Trame verte et bleue*) was created in 2010. The initiative requires that sites previously identified for their importance for biodiversity are linked in the form of an ecological network in order to create territorial cohesion. More generally, the overall objective is to ensure that the preservation of biodiversity is taken into account in planning decisions, particularly in territorial coherence schemes (ScoTs) and local urban planning schemes (PLUs). The law introducing the Green and Blue Network relies heavily on existing tools and is in line with the subsidiarity principle. Management is carried out locally between the state and local authorities (primarily the

regions) and on a contractual basis in consultation with other local players in a coherent framework set by the state. This initiative focuses on ecosystem resilience and ecological connectivity.

3 SITXELL PROJECT

3.1. General Background Information

SITXELL (short for "Including natural values and ecosystem goods and benefits into integrated land planning" – *incluyendo los valores naturales y los bienes y servicios de los ecosistemas en la planificación del su*) is a territorial information system about the open areas in the province of Barcelona utilising the technology of geographical information systems (GIS). This section provides more detail about this project as well as an introduction to the method applied.

On the technical side, SITXELL is a project about territorial analysis that is structured around the different geographical information layers and aims to study and value non-building lands. On the political side, SITXELL is a tool to influence spatial land-planning processes at the municipal and regional levels by offering accurate and rigorous ecological and socio-economic information and planning criteria to public administrations. Thus, the project aims to change the current paradigm about natural areas as "not touch" sites or "empty" areas waiting to become building sites into a modern, dynamic, humanistic and strategic overall view of their natural and socio-economic values and their benefits for humans.

SITXELL started in 2001 as a project developed at the Natural Areas Department of the Barcelona Provincial Council. The project has been developed in close collaboration with several university departments, research centres, municipal and regional governments and specialised enterprises to cover all the different aspects of land analysis.

The process starts with the functional groups of fauna. For each functional group (forest birds, birds of open habitats, forest mammals etc.), a set of characteristic species for which adequate information is available is selected. For each set of species, an overall analysis is conducted looking at the species' core distribution within the given area. Subsequently, a degree of permeability for group travel for each type of land use (which is essentially a map of permeability) is established. Combining the location of the core areas of permeability to the movement within the whole territory, maps of ecological connectivity can be created for various functional groups. These maps (like the rest of the cartographic information on geology and hydrology, distribution of species and habitats, ecosystem structure, landscape ecology or socio-economic dynamics, for example) are used at various scales, and these elements are then included in urban planning processes. While this methodology is applied on a local and regional scale, the same techniques could theoretically be used with increased resources and time investments on a national scale and then combined across the EU for a more comprehensive overview.

The general objectives of the SITXELL project are:

- To provide knowledge about the ecological and socio-economic values of natural areas that is accurate, reliable and useful for assisting land use policies;
- To support spatial land planning by using a multidisciplinary analysis tool;
- To influence decision-makers and land planners at different political and territorial levels about the need for an integrated approach to land planning and management;
- To develop a public and private consensus and partnership to help raise social awareness of the importance of ecosystems and the goods and services they provide as well as the need to incorporate this idea in land policies.

3.2. Specific Objectives

The specific objectives of the SITXELL project are:

- To use and spread the GIS concept and scheme in land analysis and planning;
- To offer land-analysis information and technical support to the municipalities of the Barcelona province;
- To collaborate with the regional government of Catalonia to ensure that regional planning is based on precise data on open areas and incorporate an ecological approach;
- To communicate the benefits of integrated land planning and management to the diverse actors (public and private) and at the different scales (local, regional, state, European).

3.3. Green Infrastructure Elements

SITXELL correlates positively with the following elements of Green Infrastructure:

- Protected areas;
- Restoration zones;
- Sustainable use areas/ecosystem service areas;
- Elements of natural connectivity.

The above Green Infrastructure elements are addressed in the project both in terms of the information generated as well as in the resultant actions taken on the basis of this information (e.g. designating protected areas, restoring certain habitats etc.). More specifically, the information produced within the project falls within the framework of environmental modules (geology, hydrology, flora, vegetation and habitats, fauna, landscape ecology, cultural heritage and landscape) and land-use modules (socio-economic, sectoral rules and guidelines, planning, transport infrastructure and technical services).[2]

3.4. Implementation Costs

Between 2001 and 2010, the cost of SITXELL has been around €3,285,000, averaging to approximately €330,000/yr (Castell, 2011). These costs are largely comprised of the contracts and agreements with research centres, universities and private specialists (€1,950,000 for the 10 year period) to develop the SITXELL information system, requiring specific land analyses and natural values assessments of open areas in the province of Barcelona. Additional costs are incurred from human resource costs, one-off hardware/software purchases and the provision of general support services. Please see the following two tables more details about these costs; however, please note that these figures have been specified to the highest level of detail possible based on the information currently available from and provided by the project contact.

[2] http://www.diba.cat/parcsn/parcs/plana.asp?parc=18&m=237.

Table 3.4.1: Overview costs (total & per Green Infrastructure element) / Cost associated with the implementation of the initiative.

	Total (Local Currency)	Core areas	Restoration areas	Sustainable use / ecosystem service zones	Green urban and peri-urban areas	Natural connectivity	Artificial connectivity features	Comments
Total Costs	€3,285,000							– Includes one-off costs of the contracts with research centres, universities, private specialists etc. to develop land analysis and natural value assessments as well as one-off hardware and software costs. Also included are ongoing costs of human resources (c.a. €130,000/year) and informatics support and general working €4,500/year) (Castell, 2011).
Time covered by total costs (years)	2001–2010							
Annualised costs	Ca. €330,000							
Area covered [ha]	2,280 km^2							– Figure represents the designation of protected areas within the Barcelona Regional Plan (which was proposed after the SITXELL analysis), representing 70.5% of the total area of the region.
Cost per hectare	€145							– While the designation of protected areas within the regional planning scheme has been one tangible outcome of this project, there have been many additional uptake outcomes as well (i.e. usage of the tool, website visits, course and workshops, additional designations of protected areas etc.) which are not accounted for in the provided per ha figure.
Financial Costs (list any details e.g. establishing management bodies)	€2,000,000 €134,500/yr							– Contracts and agreements with research centres, universities, private specialists to develop specific land analysis and natural values assessments and hardware, software, other specific needs for the 10-year period (Castell, 2011). – Cost per year of human resources (two specialist full-time and other part-time experts dedicated to the project and informatics support and general working (Castell, 2011).
Opportunity costs (uncompensated)								

Table 3.4.2: Detailed costs.

FINANCIAL COSTS		
	Cost	**Comments**
<u>One-Off Costs</u>		
Administrative, management and information costs	€1,950,000 €50,000	Contracts and agreements with research centres, universities, private specialists for GIS setting-up and information acquisition (developing specific land analysis and natural values assessments) for the 10 year period. Costs to establish a network of computers, data servers, data stores, plotters and other informatics devices fully dedicated to SITXELL project.
• Establishing management bodies		
• Surveys		
• Research		
• Consultation		
• Management plans		
• Land purchase:		
• Restoring GI:		
Costs of green infrastructure provision	Not relevant.	SITXELL project refers only to land analysis and planning and does not develop direct tasks associated with land management.
• Land purchase		
• One-off compensation payments		
• Creation of green infrastructure elements		
• Restoration of green infrastructure		
<u>Ongoing Costs</u>		
Administrative, management and information costs		
• Running of administrative bodies	€130,000/yr	Cost of human resources (two specialists full-time and other part-time experts in land planning, forest and agricultural engineering and economists) dedicated to the project.
• Monitoring		
• Ongoing management planning		
• Communications	€4,500/yr	Informatics support and general working.
• Managing sites:		
Costs of green infrastructure provision		
• Maintenance of green infrastructure		
• Costs of management agreements		
• Costs of protective actions		

3.5. Observed and/or Projected Impacts

Biodiversity Benefits

The biodiversity benefits of SITXELL primarily stem from an improved functional connectivity of habitats and increases in ecosystem health via the designation of special protected areas. On a regional level, the Barcelona Metropolitan Territorial Plan[3] approved the special protection of 2,280 km^2 (70.5% of the region) proposed by the SITXELL analysis based on connectivity criteria and the role of the territorial matrix in the process of conservation of species and ecological processes. In addition, during the Strategic Environmental Assessment, 38 areas of special interest for connectivity and associated regulations and proposals were developed (Castell, 2011).

Additionally, since 2005, SITXELL information and its approach have been used in the elaboration and approval of the numerous protection plans and have been the basis to elaborate the Protected Areas Network Conservation Strategy. The protection plans include:

a. Montseny Natural Park and Biosphere Reserve (31,064 ha);

b. Foix Natural Park (2,900 ha);

c. Montnegre i Corredor Natural Park (15,010 ha; in hand);

d. Serralada Litoral Natural Park (4,053 ha; in hand).

At the municipal level, SITXELL information and analysis have been used by municipalities in developing their competences on spatial planning since 2006. Specifically, 14 municipalities have asked for specific analysis in order to establish protection regulations and/or management plans for their local areas of natural interest. As a result, five new protected areas at the municipal level have been approved in the period 2006–2010.

It is not possible to estimate the extent to which positive effects are due only to this tool and not to the overall territorial plan or management of protected areas that have contributed. For example, in the case of the Barcelona Metropolitan Territorial Plan, the system of open space generated through SITXELL allowed 70% of the territory to be protected. Additionally, these figures do not indicate the state of biodiversity connected with these designations. Monitoring activities would be useful to specify changes in population numbers and perhaps the conservation status of the addressed habitats more generally within each protected area.

Socio-Economic Benefits

Broadly, the results of the SITXELL project relate to a general change in the way spatial land planning and natural areas protection are approached on the part of experts, politicians and stakeholders. The direct effect of this conversion can be defined as a "greening" of public administration and companies involved in land planning, referring to their placing a greater weight on natural values in their decision-making processes. This has ultimately led to a more balanced territory in ecological, social and economic terms. As a result, positive impacts have been produced in terms of, for example, the prevention and mitigation of natural risks, support to agrarian activities (agriculture and forestry) and the establishment of areas for education and recreation (Castell, 2011).

[3] The Barcelona Metropolitan Territorial Plan was approved in2010.

Table 3.5.1: Overview of biodiversity, ecosystem service and socio-economic benefits

Biodiversity Benefits		
Species	**Habitats**	**Genetic Diversity**
An increased functional connectivity of the protected habitats enables improved ecosystem health and species movement.	The open area system proposed and included in the Barcelona Regional Plan protects 2,280 km^2 (70.5% of the region).	

Source: Castell (2011)

Ecosystem Service/Socio-Economic Benefits	
Provisioning	
Regulating	Prevention and mitigation of natural risks (natural hazards control).
Cultural	Establishment of areas for education and recreation. Increased access to protected areas and opportunities for nature tourism.
Supporting	Creation and maintenance of habitats, potentially leading to improved conservation statuses of habitats and species (particularly through connectivity features).
Wider socio-economic benefits (e.g. fuelling economic activity, job creation, health benefits**)**	Stimulation of a greener economy and cost saving to municipalities. Increased support to agrarian activities (agriculture, forestry). Health benefits by increased opportunities for recreational activities.

Source: Castell (2011)

3.6. Observed and/or Projected Economic Impacts

The economic impact of this project has not been estimated as a whole. However, given that SITXELL costs ca. €330,000 annually, the authors of this initiative emphasise that the impact of this low-cost project is very high when taking into account the number of local plans and regional projects that have benefited from the SITXELL. Specifically, the direct savings for municipalities has been estimated at €110,000 per year (Castell, 2011). The benefits for biodiversity via habitat conservation and improved functional connectivity must also be included in such estimates, though economic estimations are not currently available.

In addition to quantitative results in terms of spatial land plans, programes and projects that have used SITXELL data, its impact on the improvement of planning must be emphasised in terms of achieving strategic and integrated planning by planners, politicians and stakeholders.

3.7. Recent Developments and Outlook

Currently SITXELL is well known in Catalonia, Spain and in many other European countries. The large number of visits and downloads from the website are estimated indicators of SITXELL's high level of interest and usage. Specifically, there were 56,741 visits to SITXELL specific websites for

consultations on land information and analysis just between June 2009 and December 2010 (Castell, 2011). The main challenges for the near future are to update and expand information and analysis contained in SITXELL and to develop a more dynamic analysis of changes in land use.

3.8. Summary

GREEN INFRASTRUCTURE BENEFITS	
Ecosystem resilience	
Climate change adaptation	
Disaster prevention	✓
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
1. Conservation status of habitats and species	
2. Number of visitors to protected sites per year	
3. Total number of visits to sites specifically related to education or cultural reasons	

3.9. Contact Details

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4 Comparable Initiatives

1. **Policy Initiative**

   Cambridge Green Infrastructure Strategy and Green Vision.

2. **General Background Information**

   Over the next 20 years, the Cambridge sub-region's population is expected to grow by approximately 130,000 people from its current population of 425,000 (Cambridgeshire Horizons, 2006). This increase can be seen as either an opportunity or a threat to the quality of life enjoyed by existing communities. The housing developments will create pressures on the environment (e.g. in terms of habitat loss and fragmentation and disturbance), but at the same time will bring opportunities to enhance the amount and quality of regional Green Infrastructure features which could become part of a strategic network of green spaces. Much will depend on the extent to which the existing infrastructure, including Green Infrastructure, can be enhanced to support the scale of growth proposed.

   The provision of Green Infrastructure has therefore been identified as a key priority for the successful implementation of the growth agenda. A Green Infrastructure Forum was established by Cambridgeshire Horizons and Cambridgeshire County Council during 2004, which included representatives from all the local authorities, relevant national and regional agencies and active local amenity/biodiversity societies and organisations (e.g. National Trust, Wildlife Trusts, Natural England and the Environmental Agency), to develop projects which could be submitted for funding from the government's Growth Area Fund (Cambridgeshire Horizons, 2006).

   The Cambridgeshire and Peterborough Structure Plan includes policies for creating new Green Infrastructure and enhancing the existing landscape. In line with the green-space policies set out in the Structure Plan, Cambridgeshire County Council commissioned an audit of the Strategic Open Space in the County by W.S. Atkins in 2004. A number of other studies, such as the East of England Biodiversity Mapping Project, the 50-year biodiversity vision map produced by the Cambridgeshire and Peterborough Biodiversity Partnership and the Cambridgeshire Rights of Way Improvement Plan provide valuable background to the development of the Strategy.

   The Green Infrastructure Strategy was produced in 2006 as a result of a study that:

   - Brought together existing data on Green Infrastructure sites, and mapped out existing green space provision;
   - Identified future green space needs of the growing population, looking forward at least twenty years;
   - Identified opportunities for Green Infrastructure within and adjacent to major development sites, embracing and developing the work being carried out by the local planning authorities through their Local Development Frameworks;
   - Carried out a general analysis on the wider Cambridge sub-region identifying opportunities and future projects building on the W.S. Atkins report of 2004;
   - Built upon current and future initiatives and identified key issues, including those relating to biodiversity, landscape and rights of way;

- Proposed an implementation strategy and framework for the long-term management and maintenance of any future assets created.

This strategy was revised in 2010. It is envisaged that the new Green Infrastructure Strategy will provide Cambridgeshire Horizons and its partners with the long-term vision and structure required to direct the development of individual bids and projects to deliver the component parts of the proposed Green Infrastructure Network over the next 20–30 years. It identified general deficiencies and makes specific recommendations to inform Local Development Documents and other relevant local strategies prepared by the Local Authorities. Subsequently, the Cambridgeshire Green Vision[4] was produced to ensure that enough Green Infrastructure would be provided to support the significant growth in housing provision that is planned for the next 20 years.

3. Specific Objectives of this policy initiative (as far as possible, quantified):

The Green Infrastructure Strategy and Cambridgeshire Green Vision were conceived to provide large-scale Green Infrastructure for the Cambridge sub-region over the next 20 years to complement and support the significant growth in housing provision that is planned over this period.

According to Cambridge Horizons (2006), the 2006 vision was to "create a comprehensive and sustainable network of green corridors and sites that enhance the diversity of landscape character, connect and enrich biodiversity habitats and extend access and recreation opportunities for the benefit of the environment as well as current and future communities in the Cambridge sub-region." The revised 2010 strategy increases the focus on delivering a sustainable environment and high quality of life, as well as supporting a planning system by aiming to achieve the following objectives (Cambridgeshire Horizons, 2010):

1. **Reverse the decline in biodiversity** – conserve and enhance biodiversity and geo-diversity through the protection and enhancement of habitats and wildlife sites and linkage of key habitats at the landscape scale;

2. **Mitigate and adapt to climate change** – develop carbon neutral initiatives that reduce GHG emissions or actively take carbon dioxide out of the atmosphere and to promote alternative access via green routes;

3. **Promote sustainable growth and economic development** – create employment opportunities, protect and enhance cultural heritage and landscape character;

4. **Support healthy living and well-being** – build healthy and active communities through accessible open space and green routes; create community cohesion.

These objectives will in part be reached via 12 strategic projects which have been identified for delivery in the short term (up to 2020) as part of this strategy, and more specifically through the ecosystem service benefits delivered by the implemented Green Infrastructure elements (as outlined in the subsequent section). While additional projects will likely arise, the selected 12 will serve to secure additional Green Infrastructure investment and will benefit from focused guidance on Green Infrastructure as they are in an early project stage. These projects range from

[4] http://www.cambridgeshire.gov.uk/environment/natureconservation/delivering/greenvision/.

grey infrastructure (A14 green bridge construction) to wetland restoration, establishment of public parks, increasing habitat connectivity and safeguarding habitats and reserves.[5]

4. Green Infrastructure Elements

The initiative addresses core areas, restoration areas, sustainable use zones, green urban areas, natural connectivity features and artificial connectivity features in the form of three main Green Infrastructure components suggested by the Green Infrastructure Strategy. These elements are now being taken forward by the Green Vision and help to reach the objectives outlined above via the delivery of associated ecosystem service benefits. The first objective of biodiversity conservation, for example, is addressed through improved connectivity, greater habitat areas and the improved permeability of landscapes offered by the green corridors. The second objective, regarding climate change, is supported by the core area Green Infrastructure element (the "Big Six" landscape projects – see below), which helps, for example, to protect against floods. Finally, the last two objectives of the strategy are supported by the restoration and sustainable-use zones, respectively.

Green Corridors

At least 22 new Green Corridors are proposed, broadly addressing the Green Infrastructure elements of connectivity outlined within this study. These will be based on features such as footpaths, cycleways, bridleways, rivers, ditches, disused railways lines and hedges. A network of green corridors will provide opportunities for informal sport and leisure activities as well as connecting green spaces to allow movement of wildlife and people between different habitats.

Major New Green Spaces

There are over 20 new or enhanced major green spaces planned as part of the Green Vision, corresponding to the elements of sustainable use areas and, in part, green urban areas. The larger projects form "Green Hubs" or focal points in the green corridor network. Many of the new green spaces are related to proposed developments, ensuring that new residents of Cambridgeshire are served as well as existing residents.

The "Big Six" Landscape Projects

There are six big landscape projects promoted in the Green Vision, including for example large-scale wetland restoration projects. These aim to enhance the quality of the landscape and wildlife across large parts of Cambridgeshire, mainly in agricultural areas, and correlate with the Green Infrastructure elements restoration areas and core areas, as outlined in this study.

5. Implementation Costs

Funding is being provided by a variety of national and local government sources, public grants, planning condition-linked funding, charities and businesses. According to Cambridge Horizon (2006), capital funding in the order of £92 million is required for the initiative and related projects (spread over the 20-year time span of the Strategy), with a further 10% per annum revenue expenditure based on the number of the projects implemented at any time. While a more detailed cost breakdown of this sum is not available, cost estimates for several of the aforementioned 12 strategic projects are provided, as follows. More details about each initiative can be found in Cambridgeshire Horizons (2010).

[5] Additional information can be found Cambridgeshire Horizons (2010).

- Cambridge Green Wheel (develop and improve a series of linked circular routes around Cambridge) – capital costs: £791,000 (based on a four-year project, using 2009 operational and capital costs); operational: £104,000 (one project officer at £33,000/year; establishment cost would be £133,000 over four years).

- Fens Waterways Link (enhance river navigation by opening up 240 km of contiguous waterways) – £63.6 million in estimated construction costs (capital) for 105 km of waterways.

- Great Fen Project (joining of two nature reserves and safeguarding the relict habitats within, covering 3,700 ha) – capital costs for land purchase and visitor facilities £30,000,000; requirements in the next 5–10 years, including the visitor centre, estimated at £10,000,000.

It should be kept in mind that these provide only rough estimates of these select projects and do not by any means cover the breadth of actions included within the short explanatory descriptions. Socio-economic and environmental benefits correlating to these cost estimates are provided in the following section, under Section 6.

6. Observed and/or Projected Impacts

The 2006 strategy was successful in helping to secure Growth Area funding, raise the profile of Green Infrastructure in the sub-region and highlight its role in contributing to the delivery of successful, sustainable communities (Cambridgeshire Horizons, 2010). The revised version (2010) aims to expand on these achievements and explore the benefits of investing in Green Infrastructure for wildlife and new or existing communities throughout Cambridgeshire, as well as for other agendas (e.g. the effect it can have on sustainable economic growth, healthy communities and climate change adaptation and mitigation).

Although there is currently no template for measuring the relations between Green Infrastructure objectives, measures and targets, the revised Strategy is developing a Green Infrastructure Map and Scorecard tool by which to measure baseline conditions and quantify future achievements. Some aspects will include, for example, the area of land created in certified carbon-sink projects, average percentage quality rating of target habitat corridors, percentage uplift in land and property values in proximity to Green Infrastructure assets and percentage downstream flood-risk reduction as a result of Green Infrastructure projects (Cambridgeshire Horizons, 2010). Regarding the aforementioned cost estimate figures for select priority projects within the Cambridgeshire revised Green Infrastructure Strategy, there are naturally also associated benefits to be expected, summarised in brief below:

- Cambridge Green Wheel – improvement of ca. 100 km of public rights of way; improved path accessibility to increase community participation; improvement of biodiversity and visual amenity value of routes; increased ability of residents to travel sustainability for work and leisure purposes.

- Fens Waterways Link – opening of 240 km of contiguous waterway; improve access to landscape and cultural heritage of the Fens; link major wetland sites and create new habitats; improve and increase Green Infrastructure assets and give local communities a sense of ownership; restoration and enhancement of wildlife habitats; creation of over 1,700 full time jobs for constructing the link, with 80% from local communities; increasing countryside tourism.

- Great Fen Project – connection of 3,700 ha; increased flood protection, enhanced local access, tourism and climate change mitigation and adaptation; storage/capture of 325,000 tonnes CO_2 equivalent per year; restoration of 3,000 ha fenland habitat; 27 km of public footpaths and 34 km of cycle routes.

Again, these figures represent estimated effects to be expected within the outlined projects and should serve as a basis for orientation, but not as concrete outcomes as the projects are not yet fully implemented or complete.

7. Observed and/or Projected Economic Impacts

As noted above, it is too early in the implementation of the strategy to assess impacts due to the early stages of the Green Infrastructure Map and Scorecard, but progress in this area is expected to enable the comparison and quantification of Green Infrastructure impacts. That being said, the creation and maintenance of green spaces can among other benefits positively modify the environment and help citizens meet their recommended levels of physical activity. According to the updated Strategy, increasing exercise levels by 1% could reduce morbidity and mortality rates, delivering £1.5 billion in health care savings (Cambridgeshire Horizons, 2010: 283).

8. Recent Developments and Outlook

With support from Cambridgeshire Horizons, a review and update of the Green Infrastructure Strategy has begun. The revised strategy was released in 2010 and was opened for public and stakeholder consultation. The idea of the revisions was to build on the successes of and expand on the previous edition to cover the whole county of Cambridgeshire instead of just concentrating on the sub-region. The new strategy plans Green Infrastructure to 2031 and beyond and includes the development of a Green Infrastructure Scorecard and Map to help measure baseline conditions and quantify future impacts.

9. Summary

GREEN INFRASTRUCTURE BENEFITS	
Ecosystem resilience	
Climate change adaptation	✓
Disaster prevention	
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
1. Number of recreational users of green space	
2. Conservation status of habitats and species	
3. Net carbon exchange	

10. Contact Details

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1. Policy Initiative

The Green and Blue Infrastructure initiative (*Trame verte et bleue* – TVB) and, more specifically, the preparation of Regional Ecological Coherence Schemes (*Schéma régional de cohérence écologique*).

2. General Background Information

The Green and Blue Infrastructure, and in particular the Regional Ecological Coherence Schemes which are a key instrument for its implementation at the regional level, is a key spatial planning tool at the national scale. The core objective is to stop the decline of biodiversity by conserving and restoring ecological continuities to ensure the provision of ecosystem services.

The green and blue corridors have been officially created in the 2010 Grenelle II bill (Chapter II, Article 121, which adds a title VII in the 3rd book of the national environmental code), which requires linking sites identified for their importance for biodiversity conservation in order to overcome the current fragmentation of the French territory and contribute to improved overall ecological coherence. The notion of ecological coherence, which is rather recent, comes from the integration of landscape ecology and biogeography in strategic environmental assessment and land and country planning.

The Green and Blue Infrastructure is managed locally between the state and local authorities (primarily the regions) and in consultation with other local players, on a contractual basis, in a coherent framework established by the state. The representative of the central government in the region (*prefer de region*) sets the final plan after having consulted with the regional council (parliament).

At the national level, a framework document entitled *National directions for the preservation and enhancement of ecological continuities* (*Orientations nationales pour la preservation et la remise en bon etat des continuities ecologiques*) is prepared and updated by the competent authorities, together with a national Green and Blue Infrastructure Committee, whose members are, amongst others, representatives of local authorities, economic actors, national parks and environmental NGOs. At the regional level, an instrument is prepared which is entitled Regional Ecological Coherence Scheme (*Schema regional de coherence ecologique*); this tool implements the national-level framework at the regional level.

The Regional Ecological Coherence Scheme is particularly based on available scientific knowledge, the national inventory of natural assets and the local and regional inventories, expert opinions and the regional scientific council of the natural assets. The Regional Coherence Scheme includes:

(a) A non-technical summary;

(b) A presentation and analysis of the regional challenges with regard to the preservation and the restoring the good ecological state of the ecological continuities;

(c) An identification of the natural spaces, ecological corridors as well as relevant freshwater bodies (a list is provided);

(d) A map including the Green and Blue Infrastructure;

(e) The contractual measures which allow the preservation and, where necessary, restoration of the good ecological state of the ecological continuities;

(f) The measures foreseen to support the implementation of ecological continuities for the municipalities which are affected by the Regional Ecological Coherence Scheme.

Once prepared, the Regional Ecological Coherence Schemes are sent to the local authorities who then take it into consideration. In particular, the Regional Schemes are to be taken into account in local planning tools, especially as territorial coherence schemes (ScoTs) or local urban planning schemes (PLUs) are being developing or revised. The local planning tools have to specify the measures which will allow avoiding, reducing and, where applicable, compensating for the deterioration of "ecological continuities" foreseen to result from the implementation of land use or urban planning document measures.

Before a date is set by the representative of the state in the regions, the regional government and representatives of the state in the region assess the results obtained with regard to the conservation and enhancement of ecological continuities through the implementation of the scheme. Both decide whether the Regional Ecological Coherence Scheme needs to undergo revision (following the same procedure as for its development).

However, given that the TVB embodies what can be seen as a more flexible approach of highlighting considerations that should be "taken into consideration" by regional authorities, potential weaknesses of the initiative may consequently arise. The limited amount of enforcement within the core policy structure potentially leaves room for a lack of integration into local planning tools and therefore a reduction in the overall effectiveness regarding an achievement of the desired objectives.

3. Specific Objectives

The overall objective is to ensure that the preservation of biodiversity is taken into account in planning decisions, particularly in territorial coherence schemes (ScoTs) and local urban planning schemes (PLUs).

Green Infrastructure is seen as a tool whose purpose it is to create territorial cohesion through the creation of an ecological network throughout the country's territory.

4. Green Infrastructure Elements

Restoration zones, natural connectivity features and protected areas are included in the network and considered when mapping the priority areas for the creation of connectivity features in the landscape.

"Biodiversity reservoirs" are linked via "ecological corridors". On land areas, these are natural and semi-natural environments; part of the blue component are the water and wetland networks (rivers, streams, canals, ponds, wetlands etc.).

5. Implementation Costs

The law introducing the Green and Blue Infrastructure relies heavily on existing tools and is in line with the subsidiarity principle. According to the impact assessment of the Grenelle II law, additional costs to local authorities and the state cannot be avoided. The government will spend

€58 million over the period 2009–2014. The impact assessment, however, emphasises that these compare favourably when compared with the benefits linked to the preservation of the ecological services and in particular those linked to the regulation of ecosystems (without, however, providing an overall quantitative or monetary assessment).

According to the impact assessment, this measure has no major cost to companies or households, with the exception of operators of large linear infrastructures who will have to integrate the constraints related to the ecological continuity in the context of their impact assessments.

According to the impact assessment assessing the costs to the different administrations based on the evaluation of the costs in regions which had already piloted the establishment and management of such a green infrastructure (Alsace and Nord-Pas de Calais Regions and the Isère Department), the size of the annual budgets allocated for authorities involved in projects leading on the development of a Green Infrastructure is of approximately €600,000 for a regional authority and €200,000 for a district administration (*conseil general*). These estimates have been produced base on the data from authorities which have already implemented such a project and extrapolation calculations (MEEDDM, 2009).

6. Observed and/or Projected Impacts

Most directly, the public will have access to better preserved nature (MEEDDM, 2009). The on-the-ground implementation of the first pilot initiatives in a few above-mentioned regions would have to be investigated further with relevant stakeholders to get more specific information as the initiative is too recent at national level for such an ex-post assessment to have taken place.

More generally, the main benefits of this initiative are likely to be avoided impacts rather than measurable improvements. Hence, the overall impact might be a reduced rate of degradation of some Green Infrastructure elements and the preservation of natural resources via refined land and resource use decisions. The avoided "adverse impacts" will at least in part be achieved by the provisions foreseen in Article 121 of the 2010 Grenelle II law, which explicitly call for local authorities to take into account the strategic documents for the Green Infrastructure developed at regional level (i.e. *Schemas regional de coherence ecologique*) when developing or revising their territorial coherence schemes (ScoTs) or local urban planning schemes (PLUs).

The mapping, however, also foresees identifying areas where investment in restoration and creation of Green Infrastructure is needed, so in some cases it is expected to make a contribution to maintaining the overall coherence of the country's Green Infrastructure and to strengthen the populations of some plant and animal species.

While more details are not available for the projected quantified impacts of this policy specifically, indications from a study on marine spatial planning in the UK[6] can provide useful insights about potential benefits of integrated spatial planning regarding Green Infrastructure. Here, it was revealed that in addition to the aforementioned benefit of preserving natural resources via an optimised land and resource use, economic benefits could also include facilitating sector growth and reducing costs associated with information, regulation, planning and decision-making aspects (GHK, 2004).

An indication of specific effects which could be achieved from this imitative can also be provided by a pilot of the Green Infrastructure which was established in 2003 on the plain of Alsace,

[6] See GHK (2004).

following a feasibility study in 2001. After a positive assessment of the pilot study in 2006, the Regional Council decided to extend the network to the rest of Alsace. Between 2003 and 2009, the following results were achieved:

- 1,000 ha of ecological corridors have been created;
- 4,000 high stem fruit trees have been planted;
- 140 ha of the central nuclei of the network were restored;
- Several business parks and housing estates have implemented actions to enhance their ecological value;
- 15 km of wildlife passages have been created along the canal between the Marne and the Rhine rivers;
- 50 projects have been financially supported, led by communities, associations or environmentally aware farmers;
- 2 regional nature reserves have been created, covering 200 ha;
- An urban park was created, covering 12 ha.

7. Observed and/or Projected Economic Impacts

The creation of jobs in local authorities, in particular in the regions (at least 50 jobs) (MEEDDM, 2009).

Consultancies will have to provide support to the development of the regional coherence schemes territorial coherence schemes (ScoTs) (MEEDDM, 2009).

The farmers benefiting from agri-environmental measures will be strengthened in their choice of a more sustainable agriculture (MEEDDM, 2009).

For more precise information, the on-the-ground implementation of the first pilot initiatives in a few above mentioned regions would have to be investigated further with relevant stakeholders to get this information as the initiative is too recent at national level for such an ex-post assessment to have taken place.

8. Recent Developments and Outlook

The decrees to implement the laws creating the Green and Blue Infrastructure are currently under development. These are:

- Decree on the national committees for the Green and Blue Infrastructure;
- Decree on the regional committees for the Green and Blue Infrastructure;
- Decree on the national orientations for the preservation and the restoration of the ecological continuities.

9. Summary

GREEN INFRASTRUCTURE BENEFITS	
Ecosystem resilience	✓
Climate change adaptation	✓
Disaster prevention	
Ecosystem service provision	✓
Main indicators for measuring ecosystem service provision	
1. Number of species for which the Green Infrastructure element provides habitat	
2. Conservation status of habitats and species	
3. Number of recreational users of green space	

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5 Conclusions

5.1 Overview of the Initiatives

The three in-depth case studies explored in this analysis as well as many other examples currently being employed throughout Europe utilising mapping in integrated spatial planning processes provide support for the idea's utility and added value offered. The selected cases illustrate the varied applications of mapping, ranging from a lobbying and informative instrument in the case of SITXELL to a support tool for protecting ecological resources while accommodating regional growth in Cambridgeshire to a targeted mechanism for protecting biodiversity and increasing ecological coherence.

The diverse aspects explored via the use of GIS mapping tools offer a strong ecological and socio-economical information base for Green Infrastructure and integrated, multi-functional land-use planning. The potential of such techniques in planning processes and possible future directions within this theme, as illustrated in particular by the development of a Green Infrastructure Map and Scorecard toolkit as part of the Cambridgeshire Strategy, have valuable implications for more widespread implementation.

5.2 Achievements and Successful Measures

While each initiative offered different insights, one of the most marked attributes shared by the case studies was the central role of collaboration with a diversity of stakeholders from the inception through implementation and maintenance stages. Green Infrastructure maps offer a strategic framework that lends itself to complementary insights from various stakeholders regarding regional priorities and opportunities (Comhar, 2010), optimising the relevance of subsequent actions taken and the effectiveness in achieving the desired goals and objectives.

In the case of SITXELL, for example, university departments, research centres and specialised enterprises were consulted to address the varied aspects of land analyses. Additional experts from municipal and regional governments aided in the operational aspects of the land analysis and planning projects (Castell, 2011). Both the French and UK initiatives also integrated representatives from local and regional authorities, local amenity/biodiversity societies and additional local players on a contractual or advisory basis. The varied actors involved serve not only as contributors to the planning and implementation processes, but also aid in establishing community cohesion and a common discourse surrounding the value of Green Infrastructure attributes.

Potential for increased efficiency of Green Infrastructure projects in achieving their objectives is also offered by the groundwork currently being laid as part of the Cambridgeshire Strategy. Through the development of a Green Infrastructure Strategy Map and Scorecard, a performance management system is being created to "track a range of objectives and measures, enable performance problems to be anticipated, diagnosed and resolved, communicate the Strategy 'story' internally and externally and focus staff and external partners on the most important activities and resources" (Cambridgeshire Horizons, 2010: 112). To date, however, these tools have not yet been tried and tested.

5.3 Weaknesses of the Initiatives

As decision-makers and land planners at different political and territorial levels are the primary targets of Green Infrastructure mapping tools, it follows that convincing arguments about the value of incorporating Green Infrastructure assets within traditional planning processes are necessary.

However, largely absent data on the economic impacts of the explored initiatives hinder a straightforward comparison of costs and benefits and represent a key weakness of the aforementioned cases.

In the SITXELL project, for example, annual costs of around €330,000 seem insignificant when compared to the area of the region protected as a result (over 70%; 2,280 km^2) and the subsequent benefits for biodiversity via habitat conservation. Further, the number of local and regional plans that have profited from provided datasets are also difficult to quantify in purely economic terms. However, the direct savings for municipalities as a result of the project have only been estimated at €110,000 (Castell, 2011).

Furthermore, cost and benefit difficulties extend beyond that of quantifying benefits. Green Infrastructure strategies and spatial plans naturally have the potential for high costs due to their extensive reach and cross-sectoral scope (e.g. the €58 million projected to be spent on France's Green and Blue Infrastructure initiative). However, difficulties arise in distinguishing the added costs evoked via the consideration of Green Infrastructure and biodiversity benefits as compared to those that would have been incurred regardless in the implementation of traditional spatial plans.

5.4 Potential to Contribute to Green Infrastructure

Given that best practice in Europe supports strategic spatial planning which accounts for biodiversity considerations (Comhar, 2010), achieving sustainable development and responding to societal pressures such as population growth will require the integration of ecological considerations into a range of sectoral policies, such as agriculture, transport, tourism and recreation. The ability to select ecological, structural and socio-economic aspects of importance for particular development plans and combine these features in comprehensive GIS maps offers a versatile approach to spatial planning processes, in particular regarding the inclusion of current and potential Green Infrastructure features. The underlying methodological foundation of producing such maps has been supported for its multifaceted nature and the breadth of considerations which can be addressed. Development plans basing their decision-making processes on such maps have consequently had a greatly positive reaction by policy-makers, substantiating the feasibility and validity of incorporating Green Infrastructure into planning processes and concretely illustrating its potential for added value.

However, the high investment costs required of the explored initiatives and the anticipated tighter resource environment for Green Infrastructure investment in the coming years will likely demand more of a quantified delivery performance than was previously the case (Cambridgeshire Horizons, 2010). Therefore, the Cambridgeshire Strategy predicts that successful Green Infrastructure projects will need to control their associated costs in the future while still managing to produce a high quality product that can be maintained efficiently and deliver the desired ecological and socio-economic benefits.

5.5 Lessons for a Potential EU Green Infrastructure Strategy

While uptake has been well received within the explored initiatives as well as other similar European projects, further research is needed to assess the more specific value and functions of Green Infrastructure and refine the related mapping processes.[7] For example, there is a desire to develop a more dynamic analysis of changes in land use within SITXELL and the Cambridgeshire Strategy seeks to refine a Green Infrastructure Mapping and Scorecard tool.

[7] See e.g. http://www.designforlondon.gov.uk/what-we-do/all/east-london-green-grid/ for strategic mapping studies considering the multiple uses of Green Infrastructure, such as flood risk areas, ecologically sensitive areas, barriers to connectivity, transport corridors, future development areas and residential and employment zones.

Ultimately, a more standardised and accepted approach for delineating the added value provided by Green Infrastructure spatial plans, both in ecological and socio-economic terms, would also help to address current data gaps and streamline the integration of available data in order to realise a successful adoption of foreseen Green Infrastructure approaches (Comhar, 2010). An analysis of this sort has been conducted for marine spatial planning in the UK,[8], providing a useful foundation from which to expand such studies. Here, it was revealed that economic benefits include facilitating sector growth, optimising the use of the resource (in this case the sea) and reducing costs of information, regulation, planning and decision-making (GHK, 2004). Relevant to Green Infrastructure on a broader scale, these benefits arose through an integrated and cross-sectoral approach to strategic planning which helped facilitate sectoral development and reduce potential conflicts.

Here, the development and distribution of a European toolkit providing the means by which regional and national Green Infrastructure strategies could be developed and measured would be valuable and help to plan and implement Green Infrastructure projects more efficiently on various spatial levels. Taking the Green Infrastructure Map and Scorecard idea currently being developed as part of the Cambridgeshire Strategy as a basis, the EU could support the expansion and refinement of these tools through its potential Green Infrastructure strategy. This would not only improve the effectiveness of regional plans by enabling more targeted goal setting, but also create a platform by which concrete benefits and economic assessments could be conducted and compared.

[8] See GHK (2004).

6 References

Attwell, K, et al. (2005). *Report of COST Action C11 – Greenstructure and Urban Planning: Final Report*, www.greenstructureplanning.eu/COSTC11-book/pdfs/a-Intro.pdf.

Comhar (2010) *Creating Green Infrastructure for Ireland*, http://www.comharsdc.ie/_files/Comhar%20Green%20infrastructure%20report%20final.pdf.

Davies, C, et al. (2006) *Green Infrastructure Planning Guide Project: Final Report*.

GHK (2004) *Potential Benefits of Marine Spatial Planning to Economic Activity in the UK*, www.rspb.org.uk/Images/MSPUK_tcm9-132923.pdf).

North West GI Unit (2009) *A Green Infrastructure Mapping Method*, http://www.greeninfrastructurenw.co.uk/resources/A_Green_Infrastructure_Mapping_Method.pdf.

SITXELL Project, Spain

Castell, C. (2011) *SITXELL Input and Results*.Chapter in Report to EPSA 2011 Awards organised by the European Institute for Public Administration.

Europarc España (2009) *Conetividad ecológica y áreas protegidas. Herramientas y casos prácticos*. Monografías O2. Serie EUROPARC-España. Programa de Trabajo para las áreas protegidas 2009–2013.

Herrando, S (2005) *Mòdul ocells-indicadors. Implementació del SITXELL de la provincia de Barcelona*. Barcelona Diputació de Barcelona.

SITXELL website, http://www.diba.cat/parcsn/parcs/index.asp?Parc=18.

Cambridge Green Infrastructure Strategy and Green Vision, UK

Cambridgeshire Horizons (2006) *Green Infrastructure Strategy*. Cambridgeshire Horizons, Cambridge.

Cambridgeshire Horizons (2010) *Cambridgeshire Green Infrastructure Strategy: Second Edition Green Infrastructure Strategy – Draft for Public and Stakeholder Consultation*, http://www.cambridgeshire.gov.uk/environment/natureconservation/delivering/greenvision/.

Green and Blue Infrastructure Initiative, France

Alsace Nature (2008) *Rapport sur la mise en oeuvre de la Trame verte et bleue en Alsace*, www.alsacenature.org/content/view/330/273/lang,fr/.

Circulaire du 12/04/06 relative à l'évaluation de certains plans, schémas, programmes et autres documents de planification ayant une incidence notable sur l'environnement, http://www.ineris.fr/aida/?q=consult_doc/consultation/2.250.190.28.8.2839.

Ministère de l'Environnement, du développement durable et de la Mer (2009) *Etude d'impact: Projet de loi portant engagement national pour l'environnement*, http://www.legrenelle-environnement.fr/IMG/pdf/etude_impact_loi_environnement.pdf.

Ministère de l'Environnement, du développement durable et de la Mer (2011) *Présentation de la loi Grenelle II*, http://www.legrenelle-environnement.fr/-Loi-Grenelle-2-.html.

Ministère de l'Environnement, du développement durable et de la Mer (2009) *L'évaluation environnementale des PLU*, http://www.rdbrmc-travaux.com/spge/site_v2/IMG/Plaquette-PLU-2009_Web.pdf.

More information can be found at the following websites:

- www.region-alsace.eu/dn_guide-aides-milieux-naturels-paysages/creation-restauration-trame-verte.html;
- www.region-alsace.eu/dn_biodiversite-et-paysages/politique-trame-verte.html;
- www.region-alsace.eu/dn_biodiversite-et-paysages/politique-trame-verte.html;
- www.region-alsace.eu/dn_guide-aides-milieux-naturels-paysages/creation-restauration-trame-verte.html.