a toolkit for planning and evaluating urban GI – in bicester and beyond

Alison Smith, Pam Berry, Jenny Barker and Nicole Lazarus **explain how Cherwell District Council set about compiling a set of tools to help integrate green infrastructure into the planning process for development in Bicester**

Photos: Alison Smith

Fig. 1 Langford Meadows cycle path and 'Bicester Henge' – high-quality GI delivered through planning gain

Bicester is a rapidly expanding town in Oxfordshire – it will almost double in size from 2016 to 2031, as over 10,000 new homes are added in urban extensions around the town. Cherwell District Council has long-standing ambitions that this growth should be sustainable, with high-quality green infrastructure (GI) built into new developments. Bicester hosts the UK's only eco-town development, and it is also a Garden Town and a Healthy New Town.

In earlier phases of development, planning gains were used to secure high-quality green spaces in the heart of Bicester, including a wide strip of urban meadow alongside the Langford Brook, with SuDS (sustainable drainage system) ponds, sports pitches, playgrounds, cycle paths, and even a stone circle (see Fig. 1). Local people are enthusiastic about their green spaces,[1] and volunteers run a Green Gym and are restoring an overgrown orchard for community use.

Despite these ambitions for sustainable development, Bicester faces the same challenges as many towns in South East England: high housing delivery targets, a shortage of land for development, and intense pressure on local authority planning resources. A steady stream of development proposals,

driven by high housing prices, brings opportunities to create new high-quality GI but also threatens the integrity and connectivity of existing green spaces.

The need to protect and enhance GI is particularly urgent, as the Cambridge-Milton Keynes-Oxford growth arc could bring a million new homes to a region dominated by intensive farming, where semi-natural habitats are already scarce and highly fragmented. High-quality GI can help to cost effectively deliver a range of services that are essential to protect quality of life for the people who live and work in the area – providing attractive walking and cycling routes to improve health and reduce congestion; reducing flood risk; recharging groundwater supplies; buffering air, water and noise pollution; protecting biodiversity; and enhancing 'sense of place'.

There are many potential tools for planning and evaluating GI, but often they are not suitable for use by planners with limited time and resources. Cherwell District Council therefore approached the University of Oxford to help in identifying a set of simple and freely available tools that could be used to integrate GI into the planning process.

A toolkit for local planners

Working with a group of local stakeholders, with funding from NERC, we tested a range of tools for different applications: mapping existing GI assets, assessing site design (for example planning applications), identifying opportunities for new or improved GI, and valuing the costs and benefits of alternative GI options. We included GIS mapping and modelling tools, spreadsheet tools, and participatory mapping with local communities (see Fig. 2). However, the list of tools we tested is not exhaustive, and other tools are available or emerging.

Mapping existing assets

Working with local stakeholders, we identified a list of GI priorities for the Bicester area, in terms of the demand for different services that GI can provide ('ecosystem services'). Top priority was GI for recreation, followed by water quality regulation, flood protection, urban food, habitat for wildlife, aesthetic value, and a 'sense of place'.

The first step was to produce a base map of the existing GI. Good data sources were available: an open space survey and a Phase 1 habitat survey for

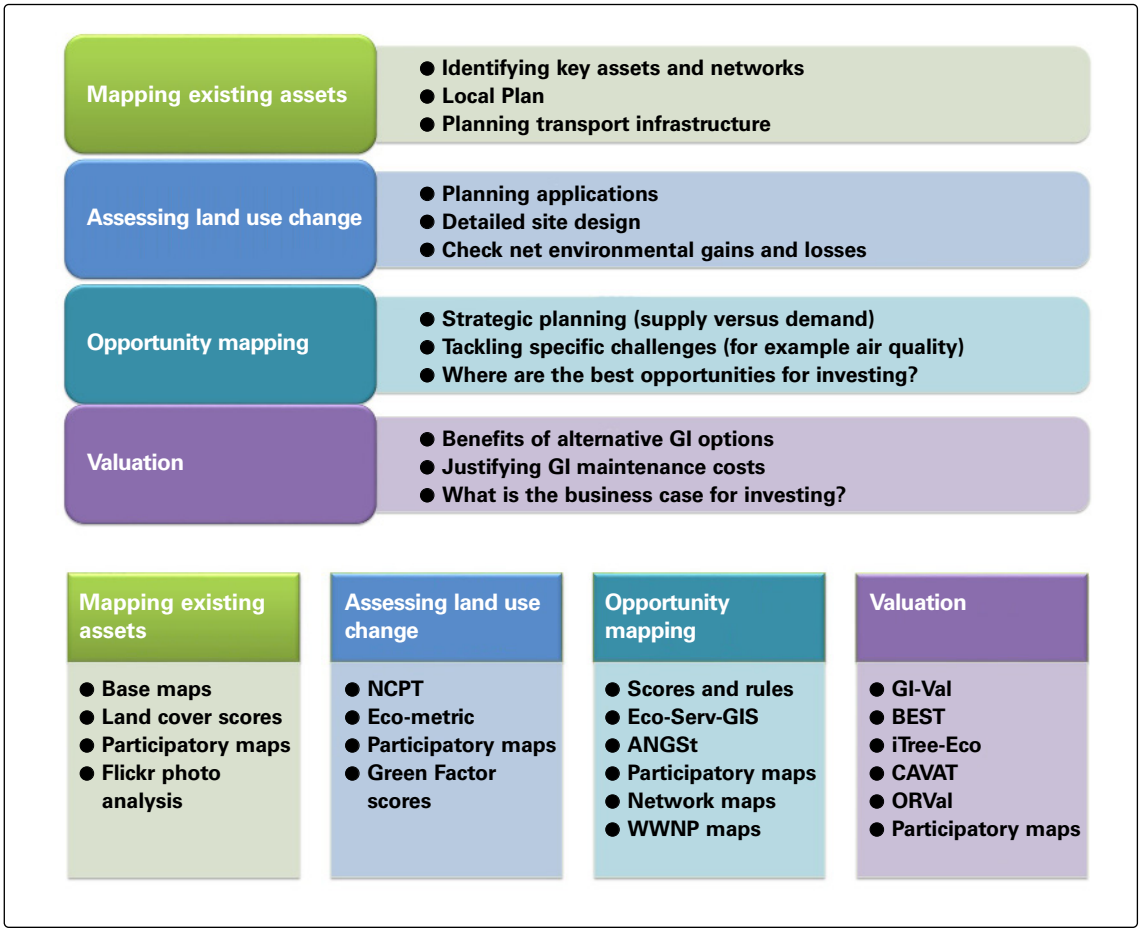

Fig. 2 A toolkit for planning green infrastructure

Fig. 3 High-value green infrastructure in and around Bicester, based on land cover scores

the whole district, and a detailed map of all the public green space and urban trees in Bicester. We combined these with OS MasterMap (useful to map gardens). The combined map was able to show all types of urban GI and how this links to habitats in the wider countryside.

We combined this base map with a matrix of scores for the ability of different types of land cover to deliver different ecosystem services.[2] The scores were initially derived by a group of expert stakeholders in Warwickshire, and subsequently refined using a major literature review of over 700 papers.[3] This is a relatively quick and simple method of mapping a wide range of ecosystem services, and requires only basic GIS capability. We produced maps for individual services, and also one showing the average score for all the cultural and regulating services in shades of green, with low-scoring areas omitted for clarity (see Fig. 3). This revealed that there are relatively few areas in and around Bicester that have good potential to deliver cultural services (such as recreation and sense of place) and regulating services (such as carbon storage and flood protection).

This map is practically the inverse of the map for the service of food production, as the arable fields and improved grassland surrounding Bicester have a maximum score for food production but a low score for most other services (again, see Fig. 3). However, while food products have a market value, the regulating and cultural services provided by GI are generally not valued. It is these 'invisible' services that need to be protected through the planning system. The maps show development areas outlined in purple, revealing that several of the remaining high-value areas are scheduled for development. This simple mapping exercise therefore highlights the need to be aware of the role of these areas in delivering services to people, so that any adverse impacts can be avoided or mitigated.

Adding local knowledge to the generic maps

While this mapping method is relatively simple to apply, it does rely on a generic matrix of scores. For example, all broadleaved semi-natural woodland will receive the same score, regardless of condition or location. It is therefore important to supplement this type of approach with local knowledge. Workshops with local stakeholders helped to refine and sense-check the maps. Planners felt that involving a wider group of stakeholders in deriving the scores and checking the maps added value to this method, compared with using 'black box' tools developed by external experts.

We also held a series of public participatory mapping events – at a street event (the Bicester Big Lunch), via an online survey, a drop-in session at the library, and a small focus group workshop. At these events we gathered data on what green spaces people use, what benefits they gain from these spaces, and what they would like to see improved.

Additional mapping layers can also be applied – for example we used a map of archaeological constraints to identify areas with additional cultural value. Mapping publicly available Flickr photos can help to show places where people take photos of nature or of attractive views, demonstrating delivery of 'aesthetic value', 'interaction with nature', and possibly 'sense of place'. In the Bicester area, for

example, there are hot-spots of nature-related photos along riverside paths and at the RSPB (Royal Society for the Protection of Birds) reserve at Otmoor.

Assessing site design

For assessing the impact of land use change at a specific site, we tested the Natural Capital Planning Tool (NCPT),[4] a freely available spreadsheet tool which uses a matrix of scores to estimate the impact of development on a range of ecosystem services. The scores are simply multiplied by the area of each habitat before and after development. Additional multipliers are applied to take account of certain local factors, such as whether the area is in a flood zone, and whether there is public access for recreation.

We applied the NCPT to the plans for the second phase of eco-town development at North West Bicester.[5] First we looked at a minimum GI case, where all the green space in the development was just amenity grassland. This showed a large loss in harvested products, as expected for a development on farmland, and losses in all the other services except for recreation, where there was a gain because previously there was no public access.

We compared this with the masterplan, which was carefully designed to deliver biodiversity net gain by preserving all the pre-existing hedgerows, with wide buffer strips of species-rich grassland, a country park with a mosaic of semi-natural grassland and shrubland, allotments, and a wetland area. The masterplan turned most of the ecosystem service losses into gains, demonstrating the value of investing in a high-quality design that delivers biodiversity net gain (see Fig. 4 on the next page). With a few further adjustments to the plans, it would be possible to deliver gains in all services except for harvested products.

Natural England is developing a similar 'Eco-metric' tool that is designed to be used as an add-on to the revised Defra (Department for Environment, Food and Rural Affairs) biodiversity metric, for exploring the wider benefits of biodiversity net gain projects.[6] This will include a wide range of multipliers to adjust for habitat condition and spatial location. It is currently being tested in a range of pilot projects.

A simpler approach for site assessment is to use a green factor scoring system, such as the new Urban Green Factor (UGF)[7] adopted by the City of London.[8] This generates a single score between 0 and 1, based on the surface area of each type of land cover, weighted by scores for the type of cover. Woodland, species-rich grassland or wetland areas score 1 and sealed surfaces score 0, with intermediate scores for other surfaces, such as green roofs and walls, amenity grass, or permeable paving. Local authorities can set their own targets – for example for a minimum score of 0.4. These simple systems are ideal for assessing small to medium-sized urban developments, and should encourage installation of options such as street trees and green roofs, with benefits for biodiversity, flood mitigation, and urban cooling.

Opportunity mapping

We did not find any simple and freely available tools that can automate the process of identifying opportunities for improving GI. We trialled the use of EcoServ-GIS, a tool developed by the Wildlife Trusts, but this is no longer supported and the software has become outdated so it is only suitable for use by experts.[9] Instead, we used participatory workshops to identify opportunities for investing in improved GI. For example, our participatory mapping exercise found that people would like more woodland areas and better links to footpaths in the countryside outside Bicester. Planners found that one of the strengths of this project lay in getting a range of relevant stakeholders round the table to discuss different options.

We also performed an ANGSt (Accessible Natural Green Space Standard) analysis, which showed that only 13% of properties in Bicester are within 300 metres of natural green space of over 2 hectares in area, and no properties are currently within 2 kilometres of a large (20 hectare+) natural green space. Although options for creating new green space in the town centre are limited, this highlighted both the need to protect and enhance existing small areas of green space and the benefits of a planned new community woodland to the south.

There are also some useful online opportunity maps. The Working with Natural Processes (WWNP) website[10] provides an interactive map that identifies good places for planting trees, reconnecting floodplains or installing run-off attenuation features, such as flood storage ponds or woody dams, in order to reduce flood risk. Several areas have developed opportunity maps that identify the best places to focus on habitat creation to support local species, usually led by the local Wildlife Trust or Local Nature Partnership, and Natural England is also developing a set of habitat network maps for England. Finally, tools such as SENCE and Viridian are available on a consultancy basis.[11]

Valuation

We tested a range of valuation tools, including two spreadsheet frameworks (GI-Val and BEST), iTree and ORVal. The spreadsheet tools are a very useful way of structuring a valuation assessment, although they do require the user to collect a lot of input data, which can be challenging. The iTree valuation, using data from the database of public trees, estimated that the value of the trees for air pollution regulation, carbon sequestration and avoided stormwater run-off treatment costs was around £26,000 per year,[12] considerably less than the cost of maintaining the trees. However, the GI-Val and

Development Impact Score
Average Per-Hectare

Ecosystem Service	Max Possible	Minimum GI	Min Possible	Masterplan
1. Harvested Products	+0.16	−2.59	−2.71	−2.10
2. Biodiversity	+4.42	−0.04	−0.58	+0.37
3. Aesthetic Values	+2.49	−0.75	−2.51	+0.11
4. Recreation	+4.99	+1.54	−0.01	+1.26
5. Water Quality Regulation	+3.07	−0.43	−4.39	−0.15
6. Flood Risk Regulation	+6.50	−0.48	−1.50	−0.21
7. Air Quality Regulation	+3.03	−0.06	−1.65	+0.39
8. Local Climate Regulation	+3.85	−0.59	−2.14	−0.13
9. Global Climate Regulation	+4.41	−0.15	−0.59	+0.00
10. Soil Contamination		+0.00		+0.00
Development Impact Score	+32.93	−3.54	−16.07	−0.46

Fig. 4 Output of the NCPT tool – changes in ecosystem service scores due to development, comparing a minimum-GI case with a high-quality GI masterplan (white figures show maximum and minimum possible changes in scores for each service; colour shading indicates potential for the score to be improved towards the maximum)

BEST analyses showed that this is only a small part of the total value of the trees and other GI in Bicester, with much higher benefits from the health impacts of increased walking and cycling, and the value of living close to a green space (as indicated through increased property prices).

The free online ORVal tool[13] for instantly assessing the recreational value of any green space in England showed that the green spaces in Bicester were worth around £2.6 million per year, based on the estimated number of visits and the time and cost of travelling to the sites. This tool is being expanded into a new tool called NEVO,[14] which will include additional ecosystem services.

The participatory mapping work demonstrated the wide range of benefits that local people receive from green spaces, including health and wellbeing benefits from recreation, interaction with wildlife, increased social cohesion, and a sense of local identity.[1] The local councils were surprised to find that people valued all types and sizes of green space, even small areas of amenity grass and trees outside houses.

Mainstreaming GI planning tools into practice

Each of the tools described above has different strengths and limitations. The generic scoring tools are fairly simple to apply and cover a wide range of ecosystem services, but the scores are based largely on literature values and expert opinion. Because scores for different services are not like for like, different services cannot be compared. Economic valuation allows different services to be compared, but comes with its own set of caveats and conceptual difficulties, such as how to place a value on a view of green space, or a life saved. Local knowledge is essential to sense-check and refine the outputs of tools like these. Applying a wide range of different tools will allow a more robust analysis, and will highlight areas of agreement or uncertainty.

However, this brings its own problems in terms of the resources needed for a multi-pronged approach. Even though local planners initiated this project and were keen to co-develop the toolkit, pressure on their time increased to the extent that they were not able to apply the tools themselves. Some tools have onerous data requirements, especially the spreadsheet valuation tools, and GIS expertise is often needed. To mainstream these tools into practice requires GI champions at councils with adequate time and resources to either apply tools themselves or commission third parties such as Local Environmental Record Centres or consultants who have the necessary mapping and modelling expertise.

Users are still often confused by the wide range of tools on offer. One issue is that research funding is geared towards developing new and innovative methods, rather than improving and consolidating existing tools. This has resulted in a confusing array of half-finished tools that are often not quite robust enough for widespread uptake, or tools that fall into disuse because there is no funding for maintenance. As well as more funding for maintenance and development of existing tools, better signposting is needed to help users find the right tool for each context. Many tools are profiled on the Ecosystems Knowledge Network's Tool Assessor webpages,[15] and there is good potential to add a signposting facility here.

Quick and simple online maps are an ideal resource to save time for planners. For example, it would be possible to use the land cover scoring method to develop national maps of high-value natural capital

assets and networks. The forthcoming NEVO tool[14] should be a useful addition to the online mapping toolkit.

Supporting regulation can drive wider uptake of tools. The recent consultation[16] and subsequent announcement in the Chancellor's Spring Statement[17] that biodiversity net gain would become mandatory for all development could encourage consideration of wider environmental gains via tools such as the NCPT or Natural England's Eco-metric. Similarly, strengthening the requirements for SuDS, or for a minimum percentage of accessible green space, will help to mainstream GI planning using tools such as the Urban Green Factor. Planners appreciated the clear standards for eco-towns that guided the North West Bicester masterplan, and similar quantitative standards would help to mainstream GI into other developments such as 'Garden Towns'.

Although tools such as the NCPT are excellent for assessing change at a single site, a more strategic approach is needed at district or county level. Planners would like to move away from viewing individual high-value green spaces as constraints, to start to identify opportunities to connect them into networks that deliver multiple health, economic and environmental benefits, providing attractive walking and cycling routes and wildlife corridors between towns to tackle traffic congestion, air pollution, climate change, and biodiversity loss.

Finally, this project identified a major gap around green space management, with even good-quality GI being undermined through incorrect management, such as cutting grass at the wrong time. The growing trend for new GI to be passed on to management companies can exacerbate this problem. However, the enthusiasm of local volunteers offers potential to improve management and monitoring, as well as increase the use of green space by local people. Tools to facilitate better co-ordination of GI management across an area (such as not cutting all the flower-rich meadows at the same time) and sharing of best practice could have major benefits.

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Notes

1 A Smith, H Mason, P Berry, J Thompson and R Dunford: *The Value of Green Space in Bicester to Local People*. Environmental Change Institute, University of Oxford, Jun. 2018. www.eci.ox.ac.uk/research/ecosystems/bio-clim-adaptation/downloads/bicester-public-value-green-space.pdf

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4 See the Natural Capital Planning Tool website, at http://ncptool.com; and O Hölzinger, J Sadler, A Scott, N Grayson and A Marsh: 'NCPT – managing environmental gains and losses'. *Town & Country Planning*, 2019, Vol. 88, May, 166-70

5 A Smith: *Testing the Natural Capital Planning Tool for NW Bicester Phase 2*. 2018. Available on request from Alison.smith@eci.ox.ac.uk

6 See C Warburton and A Smith: *Measuring Net Gain in Natural Capital and Ecosystem Services – the Eco-metric Approach*. Ecosystems Knowledge Network webinar, 15 Mar. 2018. https://vimeo.com/282518798 A further EKN webinar updating the foregoing will be released shortly

7 *Urban Greening Factor Study*. Green Infrastructure Consultancy, for the City of London, Jul. 2018. www.cityoflondon.gov.uk/services/environment-and-planning/planning/planning-policy/local-plan/Documents/urban-greening-factor-study.pdf

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9 See the Ecosystems Knowledge Network's Tool Assessor EcoServ-GIS profile, at https://ecosystemsknowledge.net/ecoserv-gis

10 The JBA Trust's Working with Natural Processes website is at http://naturalprocesses.jbahosting.com/#12/51.8962/-1.0897

11 See the Ecosystems Knowledge Network's Tool Assessor SENSE and Viridian profiles, at https://ecosystemsknowledge.net/sence-spatial-evidence-natural-capital-evaluation and https://ecosystemsknowledge.net/viridian, respectively

12 M Vaz Monteiro, P Handley, KJ Doick and A Smith: *i-Tree Eco Valuation of Public Trees in Bicester: A Provisional Analysis*. Forest Research, Feb. 2018. www.eci.ox.ac.uk/research/ecosystems/bio-clim-adaptation/downloads/bicester-iTree-report.pdf

13 The University of Exeter Land, Environment, Economics and Policy Institute's (LEEP's) ORVal (Outdoor Recreation Valuation) tool is available at www.leep.exeter.ac.uk/orval/

14 See B Day and N Owen: *Natural Environment Valuation Online: A Web-Based Tool for Natural Capital and the Sustainable Management of Natural Resources*. Ecosystems Knowledge Network webinar, 31 Oct. 2018. https://vimeo.com/300268123

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