

FINDINGS FROM A BIODIVERSITY AND CLIMATE ASSESSMENT OF THE NHS Lothian ESTATE

With 81 hectares of green space throughout its estate, NHS Lothian has recognised that it is responsible for significant natural capital that supports biodiversity and a wide range of benefits: regulating air quality, taking up carbon and increasing health and wellbeing. How significant are these assets, and how can they be managed to meet NHS Lothian's goals and commitments?

These are the questions that NHS Lothian asked with the commissioning of a natural capital assessment of the estate in 2020. NHS Lothian has recognised the role it can play in a green recovery from the COVID-19 pandemic, and is the first health board in Scotland to publish a detailed account of its green assets. This has happened as the pandemic, in itself, has led to a widespread re-appreciation of outdoor space and its many values.

This brief is a summary of the assessment report's thorough documentation of the estate as a community and health asset – public land that generates multiple public goods. The assessment built a spatial asset register of the entire estate as a window on biodiversity in green space, the ecosystem services flowing from it, and how these can help in pursuing action on climate change. The results reveal substantial opportunities to enrich the estate by:

- ✓ **Improving the quality and quantity of green space**
- ✓ **Connecting with surrounding green infrastructure**
- ✓ **Encouraging more nature-based health activities**
- ✓ **Developing a co-ordinated strategic approach to manage natural capital assets**

Conserving and increasing biodiversity on its estate can help NHS Lothian fulfil its duty as a public body under the **Nature Conservation (Scotland) Act**. Establishing a baseline for biodiversity, and using this to track increases or decreases, can enrich biodiversity reporting. Enhancing the capacity of green space to sequester carbon can also be an important step on the path to achieving net zero carbon emissions, along with policies to deliver emissions reduction. Such action is called for by the **Climate Change (Scotland) Act** and its ambitious target of net zero by 2045.

Further targets for the management of green space are set out in the **NHS Lothian Green Space and Health Strategy**, published in 2019 as the first health board-led strategy of its kind in Scotland. Its approach is reiterated in the **NHS Lothian**

Sustainable Development Framework, published in 2020; both documents put green space and biodiversity in focus and detail the potential of the NHS outdoor estate if managed as a health and environmental asset. The assessment summarised here is the first big step down that strategic path.

NATURAL CAPITAL MAP OF ELLEN'S GLEN HOUSE



- | | |
|--|---|
|  Amenity grassland |  Hedge |
|  Broadleaved woodland |  Introduced shrub |
|  Coniferous planting |  Parkland |
|  Freshwater stream |  Buildings and roads |
|  Gardens | |

What the estate's green space is made of – and what it can do

In the NHS Lothian estate's green space, growing plants (especially trees, hedges and scrub) capture carbon from the atmosphere, offsetting human emissions. They clean the air of pollution from nearby roads and car parks. The green landscape provides habitats for diverse species, and improves the lives of NHS patients and staff in a multitude of ways that can be measured in better health and wellbeing.

The chart below shows this green space as though it were one large park. The reality is more complex because it is spread across 94 sites – hospitals, community hospitals, health centres and care homes – where there may be rich woodland surroundings or just a single square of grass. The spatial arrangement has consequences for biodiversity and ecosystem services, and so do the choices made at NHS sites about what is planted and how it is maintained. Much of the green space (for instance, that square of grass) is low in biodiversity and natural capital value.

Present low quality in green space is a sign of significant opportunities to meet NHS Lothian's aims and

commitments. Improving quality, in biodiversity and carbon terms, can be a practical process. A patch of grass can be mowed less frequently and eventually transitioned into more species-rich grassland or wildflowers. Trees and hedges can be maintained and diversified with an eye to maintaining a continuous canopy.

While such actions have local benefits, they are also opportunities on a much larger scale: to help Scotland hit its national and international sustainable development targets, to respond to biodiversity loss and climate change, to contribute to a green recovery, and to reach a net zero future.

NHS Lothian has a chance to consider the strategic impact of green space on these goals and its integration into decision-making. It can carry forward the assessment's engagement with key stakeholders to pursue the opportunities observed. Through its estate, NHS Lothian has the potential to act and innovate in a time of ecological and climate emergency.

THE MOST PREVALENT HABITAT TYPES IN NHS LoTHIAN GREEN SPACE (APPROXIMATE HECTARES)



Components of the assessment

Spatial asset register

The first step in the assessment was to record the natural capital of the estate in a spatial asset register. A baseline asset map brought together information on habitat type, extent and condition at each of the 94 estate sites. This was a major task in itself, as no previously existing spatial database even recorded the boundaries of the entire estate. The work combined publicly available information, maps and planning applications with aerial photography, local knowledge and site survey data collected in the field.

Biodiversity assessment

With the spatial asset register in place, a biodiversity metric was used to quantify baseline levels across the estate. Applied to each area of habitat, the metric calculated "biodiversity units" based on its area, distinctiveness and condition. By itself, this is just a number; its significance lies in the comparisons that can be made when changes are implemented. Some habitat types, such as semi-natural habitats, can be valuable even at poor quality. Others, such as amenity grassland, will always be of low biodiversity value, and their metric can only be improved if they are replaced with a more diverse habitat.

HABITAT TYPES IN THE ROYAL EDINBURGH HOSPITAL



 Amenity grassland	 Hedge
 Broadleaved, coniferous and mixed planting	 Introduced shrub
 Broadleaved and mixed woodland	 Parkland
 Brownfield site	 Rough grassland
 Defunct hedge	 Scrub
 Disturbed ground	 Buildings and roads
 Gardens	

Carbon and air quality assessment

The spatial register also informed an assessment of carbon sequestration and air quality regulation services provided by each habitat, site, and the estate as a whole. These were quantified throughout the register and their monetary values estimated. The valuation of these ecosystem services is key to providing full cost-benefit analyses, most importantly of changes to the estate that may reduce or increase the habitat types that perform the services. The values can be affected by changes in the built environment on a site, or simply by new grounds maintenance practices such as reduced mowing.

Health and wellbeing benefits

Health and wellbeing are also ecosystem services, but valuing them is less straightforward. In addition to natural asset data, it takes local data on nature-based health interventions such as gardening and walking activities, and research on the changes these achieve in mental and physical health. There are no data on use of the estate's walking routes or individual small gardens, so instead the assessment applied two cost-benefit analyses to therapeutic gardening: a quality adjusted life year (QALY) approach and case studies of two individuals. These provided evidence of the potential benefits from new nature-based activities on the estate.

Spatial accounting tool

An end result of all the analyses is a spatial biodiversity and natural capital accounting tool, which will allow NHS Lothian to re-run assessments of biodiversity, carbon sequestration and air quality regulation based on planned or completed changes. This tool can calculate the effects as changes are made to the register, whether these are changes to the estate (such as when a new building is built or garden established) or future plans being modelled to determine their positive or negative consequences for natural capital. The tool can also calculate the net present values of planned investments over their lifetime, usually 50 years.

Results across the estate

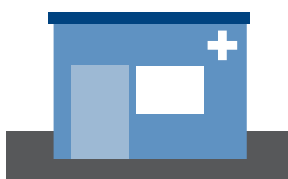
81 hectares of green space
= **46%**
174 hectares in the whole estate

Larger sites tend to have a greater range of habitats and significant areas of woodland and parkland



Smaller sites tend to be dominated by sealed surfaces, have less variety in habitats, and are more likely to comprise garden planting and introduced shrub

Several small GP surgeries and dentists have no green space



484

biodiversity units for the estate as a whole

629

biodiversity units suggested as a target for short-term improvements

Types of Habitat by Condition

GOOD CONDITION 0.2% OF HABITATS

- Well-managed community gardens containing a diversity of habitats
- Primarily gardens of the Royal Edinburgh and Midlothian Community Hospitals



MODERATE CONDITION 28.3% OF HABITATS

- Broadleaved woodland, parkland and planting
- Coniferous planting
- Hedges
- Rough grassland, scrub and tall herb
- Gardens with broadleaved trees, allotments, lawns and borders
- Brownfield with trees
- Streams



POOR CONDITION 71.5% OF HABITATS

- Coniferous woodland
- Parkland
- Introduced shrubs and hedges
- Amenity grassland
- Scrub
- Gardens
- Brownfield and disturbed ground
- Streams



282 tonnes

CO₂ equivalent sequestered per year



£1.14 million

present value (over 50 years)



1 tonne

PM2.5 air pollution absorbed per year

£8.36 million

present value (over 50 years)

COST-BENEFIT ANALYSIS OF TWO EXISTING GARDENING ACTIVITIES

350 participants annually

£4.65 million present value (over 50 years)

£2.00 in benefits to health for every **£1.00** spent

£508,700 annually in carbon sequestration, air quality regulation and health benefits

£14.15 million present value (over 50 years)

Other benefits such as flood alleviation, water quality and noise regulation are likely to increase the total value

Opportunities for increasing and improving natural capital

The estate needs more, better and better-connected green space to improve biodiversity value, take climate action and enhance air quality. It is essential to understand what activities will shift the baseline most, and in the right direction. Capital proposals need to consider what will help or hinder these efforts right from the start.

Improve the quality of green space

- Quickly and easily increase the biodiversity units across the estate from 484 to 629 by managing poor-condition woodland, parkland scrub, hedges and similar habitats to raise them to medium condition.
- Add at least 34 more units by replacing low-biodiversity habitats such as amenity grassland, common throughout the estate, with more valuable habitats. The quickest win is to identify lawns for more relaxed mowing regimes. Community gardens can also replace low-value habitats.
- Maximise continuous tree canopies within and across sites. Plant new trees and mixed hedges of species that are recommended for pest and disease resilience, biodiversity and carbon sequestration.
- Examine capacity of green roofs and walls to be planted with shrubs and vegetation.
- Carry out green space site management plans with local experts. Ensure that necessary skills (e.g. in arboriculture) are embedded into plan delivery and specified in management contracts.

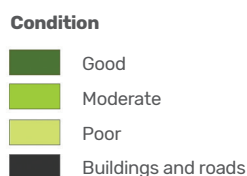
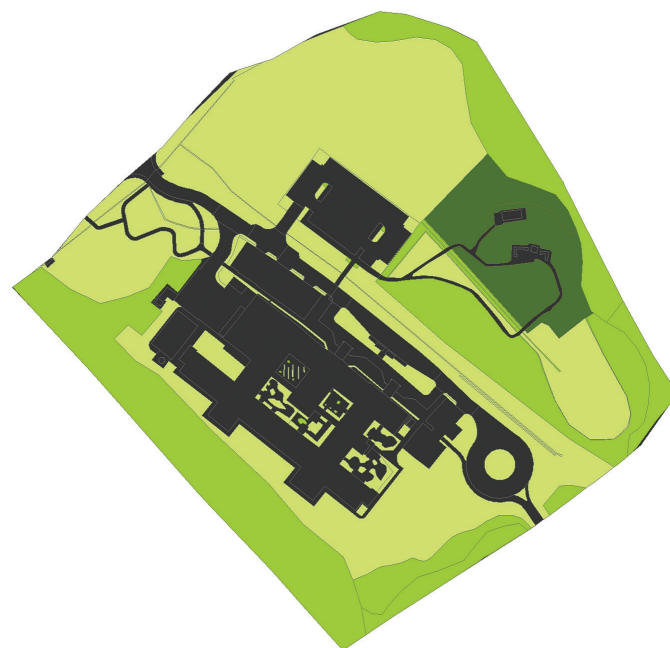
Increase the quantity of green space

- Pursue further gains in biodiversity and ecosystem services by increasing green space within the estate.
- Seek opportunities to reduce the area of sealed surfaces.
- Ensure that changes follow the principles of biodiversity net gain, so there is only ever an increase, and no net loss, of biodiversity across the estate.

Connect with surrounding green infrastructure

- Connect habitats and create networks, particularly to habitats of strategic importance, to increase biodiversity. Connecting woodland and providing more continuous tree cover will also be beneficial for carbon sequestration and air quality.
- Improve the connectedness of green space by working in partnership with neighbouring landowners and land managers to increase tree canopy cover in communities outside site boundaries.

CONDITION OF HABITATS AT THE MIDLOTHIAN COMMUNITY HOSPITAL



How to use the tools to model and monitor changes

The spatial register and accounting tool have the potential to be used in decision-making. They can be integrated into property/asset systems, reporting on biodiversity and net zero carbon, and estate acquisitions and disposals. The register can be edited in a GIS layer as changes to the estate occur, becoming part of a strategic approach to managing assets. This also allows what-if scenarios and masterplans to be evaluated; a user can model potential changes for a site or across the estate, and the accounting tool will tabulate the implications for biodiversity and ecosystem service provision and value.

This approach can become even more powerful as gaps in datasets are filled – through tree surveys, green space audits, site condition assessments and biennial biodiversity audits. Datasets could also be expanded by sharing data and expertise with partners like NHS Forest.

Opportunities for well-used, healthy green space

Expanding NHS Lothian's nature-based interventions is a cost-effective way to support the provision of considerable public health benefits.

Encourage more nature-based health activities

- Increase use of existing community gardens and social green prescribing. The analysis indicates that garden use could be increased by 50% with no detrimental impact on resourcing or staffing.
- Identify areas for future community gardens, allotments and growing spaces.
- Coordinate with local delivery partners to increase prescribed activities.

Promote the estate as a health asset

- Reinstate and update walking routes and maps, in coordination with local partners.
- Improve signage for walking opportunities, linking these to larger routes and adjacent green space.
- Work with local partners to organise and deliver staff wellbeing programmes.
- Publicise findings from the natural capital assessment, and regularly communicate potential uses of green space, with staff through wellbeing programmes.
- Promote community gardens that offer opportunities for social green prescribing through local delivery partners.

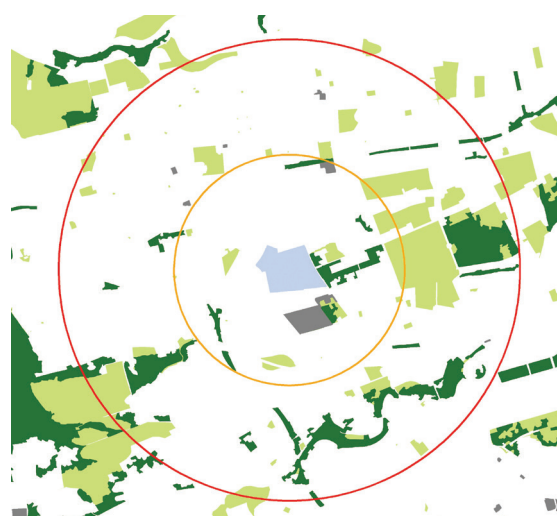
How to measure the benefits and make a case for interventions

There are many ways to measure the health and wellbeing benefits of therapeutic use of green space. The assessment used and evaluated two forms of cost-benefit analysis. One was the quality adjusted life year (QALY) and cost effectiveness analysis approach, which uses the change in participants' QALYs to derive estimates of the value of the health benefits resulting from the intervention. Another was a case study approach that equates the economic benefits of a therapeutic intervention to the estimated resulting avoided health costs. While the assessment focused on financial benefits directly to the NHS, other approaches can measure wider social and economic benefits.

Such analyses are important for exploring how activities are valued within the health and social care system. Because measurements are specific to activities and their contexts, it can be more useful to undertake focused analysis of a nature-based health intervention than to turn to broader research literature. The tools created for this assessment can help explore the impacts of creating or expanding an intervention; then, the spatial asset register can be used to find appropriate green space for it.

CONNECTIVITY OF WESTERN GENERAL HOSPITAL WITH WOODLAND AND PUBLIC GREEN SPACE

2km buffer 1km buffer Western General Hospital
Other NHS Lothian sites National forest inventory
OS open greenspace



CASE STUDY APPROACH: ECONOMIC BENEFITS FOR ONE PARTICIPANT IN THE NATURE-BASED CONSERVATION ACTIVITY PROGRAMME BRANCHING OUT

Avoided prescription costs	£32
Avoided psychiatric consultation costs	£111
Avoided use of community psychiatric nurse services	£2,392
Avoided use of support worker	£1,248
Net annual benefits	£3,783

Applying the tools at the site scale

St John's Hospital, Livingston

St John's Hospital covers 16.8 hectares, with extensive areas devoted to parking but also 6.6 hectares of natural habitats. The asset register shows the natural capital assets are dominated by amenity grassland, along with broadleaved parkland around the eastern edges and broadleaved woodland on the south-west and eastern edges. Historic maps show that some of this woodland has existed here since at least the 1850s. There is a large patch of rough grassland on the eastern edge of the site, where it backs on to Howden Park. There is no formal path along this edge or into the park, but desire lines (visible tracks through the grass) indicate that walkers cross it frequently. The rest of the natural areas are comprised of scrub, hedges and urban tree planting.

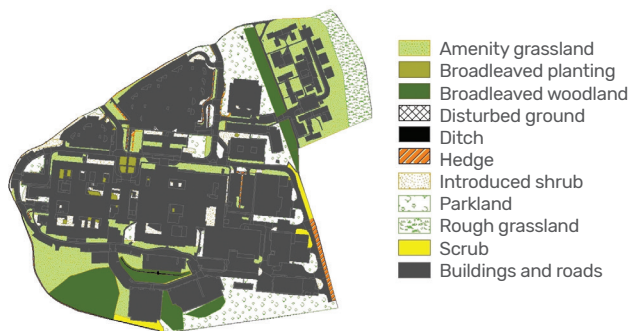
This green space adds up to 31.7 biodiversity units – a small total, since only 19% of the habitat was assessed as moderate condition. This share represents woodland, native hedgerows, scrub and rough grassland. The other 81% was assessed as poor condition, but here there are opportunities to improve the score. While the amenity grassland and introduced shrub habitats are of intrinsically low biodiversity value, the poor-condition parkland, hedges and tree plantings could be restored to higher value. This alone could raise the biodiversity score from 31.7 to 42.3 units.

The woodland, trees and hedges sequester 15.5 tonnes of CO₂ equivalent per year, with an annual value of £1,076 and a present value (over 50 years) of £58,944. The plants also absorb 0.04 tonnes of particulate matter per year, with an annual value of £6,441 and a present value of £233,389. The south-west woodland absorbs more carbon and particulate matter than the parkland habitats, hedges or individual tree plantings.

Opportunities identified by the assessment

- Reduce sealed surfaces and plant trees/hedges to connect with woodland outside the site.
- When annual planting needs replacing, plant perennial pollinator-attracting species.
- Introduce less intensive mowing regimes.
- Plant additional trees and mixed hedges and fill gaps in hedges.
- Create a community garden in the south of the site.
- Introduce a path into the existing south lawn and signposts routes to Howden Park and surroundings.
- Incorporate the community garden and walking routes into social prescribing and regularly communicate potential use of green space through staff wellbeing programmes.

HABITAT TYPES



HABITAT QUALITY



CARBON SEQUESTRATION



AIR QUALITY REGULATION



Where to go for more evidence

Biodiversity and Climate Change Assessment for the NHS Lothian Estate

NHS Lothian Sustainable Development Framework and Action Plan

2019 Green Space and Health Strategic Framework for Edinburgh & Lothians

NHS Scotland Sustainability Action

The NHS Green Space Demonstration Project

This project allowed for an exploration of interventions not well examined in existing literature, such as less intensive mowing regimes. It investigated not only physical interventions and activities but also curation, coordination and management.

Recommendations for tree and hedge species are given in the full assessment. These are based on the following sources:

Data on specific ecosystem services provided by tree species

Database detailing tree size, crown characteristics and potential in parks or gardens

Data on the i-Tree survey of trees in Edinburgh

Overview of plant species and cultivars used in urban hedges

National Biodiversity Network Atlas Scotland online database

Biodiversity net gain in Scotland

To make meaningful improvements in carbon sequestration and biodiversity, the debate is moving beyond ideas of offsetting and no net loss to the principle of biodiversity net gain.

Evidence reviews on the health and wellbeing benefits of urban green space:

On health and the natural environment

On improving access to green space

On green space benefits in urban planning, design and management

Green space design for health and wellbeing

Examines how specific characteristics of a site can maximise the contribution that green space can make to health and wellbeing outcomes and where potential improvements can be made.

Review of nature-based interventions for mental health care

An extensive review showing that social and therapeutic horticulture in settings such as allotments and community gardens is associated with significant mental health benefits.

Physical activity in parks and community engagement

Shows how the communication of physical interventions and activities in a green space can lead to increased use.

