Local Investment in Natural Capital (LINC) Project Natural capital baseline data report

Accessible version

Executive Summary

This natural capital baseline data report was produced by eftec for the West Midlands Combined Authority (WMCA) as part of the Local Investment in Natural Capital (LINC) programme. It provides **baseline natural capital information for the WMCA area** and illustrates examples of potential opportunities to enhance assets and benefits.

The approach to quantify natural capital assets and benefits is **based on Defra's Enabling a Natural Capital Approach (ENCA) guidance and aligned to HM Treasury (HMT) Green Book required methods**. Quantification of benefits includes using monetary valuation to express their economic value. The data sources used (Table 14, Appendix 3 and WMCA NCA data 170125.xlsx) provide coverage over the whole WMCA study area. Land use data is not consistent for the area, but progress on the Local Nature Recovery Strategy (LNRS) for WMCA is expected to improve the mapping of natural capital assets (e.g. data for new habitat, and urban features such as gardens, street trees, allotments). This will improve the ability to quantify, value and analyse benefits, and improve the understanding of natural capital in the WMCA area. In turn, **data on the size and value of benefits from natural capital can help support the case to implement the LNRS**.

The baseline assesses a range of benefits, covering provisioning, regulating and cultural ecosystem services provided by natural capital to people in the WMCA area. Those ecosystem services which can currently be measured and monetised can potentially **provide benefits with a present value[1] of £21bn over the next 60 years**. As not all benefits can be measures and valued, the total value of ecosystem services provided by the natural capital assets in the WMCA area will be significantly higher than this figure.

The largest benefits identified are benefits to wider society related to recreation and public health. Carbon sequestration, air pollutant removal and local climate regulation benefits are less significant but are still important benefits. The amount and value of benefits may change over time. They may increase due to factors such as population growth or decrease if natural capital assets deteriorate. Climate change makes these future trends uncertain, but also creates a need for long-term investment in natural capital assets that can ameliorate the probable environmental and socio-economic impacts of climate change. Resilience to climate change can be improved by increasing the quantity and condition of existing natural capital assets, such as trees and water bodies in urban areas, which can provide cooling and flood attenuation services.

This evidence makes a case for investment in natural capital in two ways: Firstly, realising this value over time requires sufficient investment to at least **maintain the natural capital assets** that provide them. Secondly, the distribution of values indicates areas where investment to **enhance natural capital assets** can provide greatest benefit to society. The case for investments may need more accurate baseline data to measure uplift against, but some opportunities are quantified in this report, relating to:

[1] Present value is calculated from the sum of discounted future benefits (see Table 1).

- The value of **urban tree cover**, and where to target increasing this, based on the distribution of urban tree cover and the benefits it provides and socio-economic data.

- The market to support mandatory **biodiversity net gain** requirements in land use developments. The scale of opportunity offered needs to be carefully assessed, as the outcomes of market processes have uncertainty.

- Enhancing **access to green space to reduce the incidence of mental ill-health**, with potential savings in associated treatment and lost productivity costs. Analysis of pipeline projects demonstrates that improved access to 1,164 ha of green space could avoid mental health care costs and lost workforce productivity worth approximately £1.7 million per year.

The baseline results are shown in Table 1 (asset values over 60 years) and Table 2 (annual values). The values to businesses shown in Table 2 are the private benefits that accrue to businesses and can be measured through market data. Benefits to wider society often also have some value to business (e.g. public health benefits support the workforce), but this cannot easily be distinguished with available data.

Monetary valuation does not capture all benefits from nature. However, they provide important insight to inform investment, and can be used to assess specific investment opportunities, and tradeoffs. For other benefits, relevant evidence to measure benefits for the WMCA area was not available for this report: examples include spatial data (e.g. of all tree cover and woodland in the WMCA area), quantification of benefits (e.g. for flood risk reduction from Sustainable Drainage Systems (SuDS) and other urban green space without trees), and unit monetary values (e.g. for biodiversity). Opportunities to enhance natural capital benefit evidence are identified in relation to flooding and water resources, biodiversity, and recreation and mental health.

Table 1 WMCA Detailed 2024 Natural Capital Balance (PV60 £m)

Produced at: August 2024	Valuation metric	Value to businesses £m	Value to the rest of society £m	Total £m (PV60[2])
Asset values (monetised)				
Agricultural output	Arable income	72		72
	Livestock Income	103		103
Carbon sequestration[3]	Gardens		674	674
	Built Environment		(32)	(32)
Air quality regulation[4]	Value of PM2.5 removal by woodland		911	911
Recreation	Adult recreation welfare value		10,508	10,508
Physical health	Avoided medical treatment costs		8,199	8,199
Flood management	Value of additional water storage capacity from tree cover		57	57
Temperature regulation	Avoided productivity losses from current habitat cover	378		378
Total gross asset value		553	20,349	20,902
Asset values (non-monetised)				
Biodiversity	Proportion of possible biodiversity achieved in the WMCA local authorities[5]	N/A	28-42%	
Water quality	Proportion of Water Framework Directive (WFD) river lengths categorised as moderate or good	N/A	66%	

[2] **Present value reflect the current value of an expected future flow of benefits and use discount rates to account for time preferences as the uncertainties of future benefit flows. A lower discount rate, as used for environmental benefit flows, places a greater value of benefits to future generations. The standard discount rate prescribed by HM Treasury Green Book is 3.5% for the years 0-30 and 3.0% for years 31-75 and is used for all benefits except air pollution and physical health. These use the health discount rate of 1.5% for years 0-30 and 1.29% for years 30-75. Present values also incorporate assumptions on expected trends in the quantity and /or value of the estimated benefit where available.**

[3] **Value of carbon emissions increase over time in line with (DESNZ, 2023).**

Figure 1 and Figure 2 illustrate the proportion of each benefit provided by natural capital assets in each Local Authority in the WMCA study area over a 60-year period. The benefits in each local authority are mainly driven by the greater number of beneficiaries (e.g. in Birmingham). Two wider society benefits are valued based on avoided medical treatment costs. The annual per capita values for these health benefits show some variation in benefits from physical activity – the highest benefits in Solihull (£84 /person/year) are nearly 50% higher than benefits in Wolverhampton (£58/person/ year). Health benefits from air pollution removal by trees are more evenly distributed across the local authorities (£9-11 /person/ year).

Table 2 Annual value of benefits WMCA

Produced at: August 2024	Valuation metric	Value to businesses £m	Value to the rest of society £m	Total £m
Asset values (monetised)				
Agricultural output	Arable income	2.7		2.7
	Livestock Income	3.9		3.9
Carbon sequestration[2]	Gardens		18.4	18.4
	Built Environment		(0.9)	(0.9)
Air quality regulation[3]	Value of PM2.5 removal by woodland		32	32
Recreation	Adult recreation welfare value		401	401
Physical health	Avoided medical treatment costs		203	203
Flood management	Value of additional water storage capacity from tree cover		2.2	2.2
Temperature regulation	Avoided productivity losses from current habitat cover	14.4		14.4
Total gross asset value		21	655	676

[4] **Underlying modelling factors in changes in population and pollution density (eftec and CEH, 2019)**

[5] **The proportions of expected maximum numbers of plant, invertebrate, bird, mammal, lichen and herptile species found in the WMCA study area were calculated for each local authority, from data sourced from NEVO.**

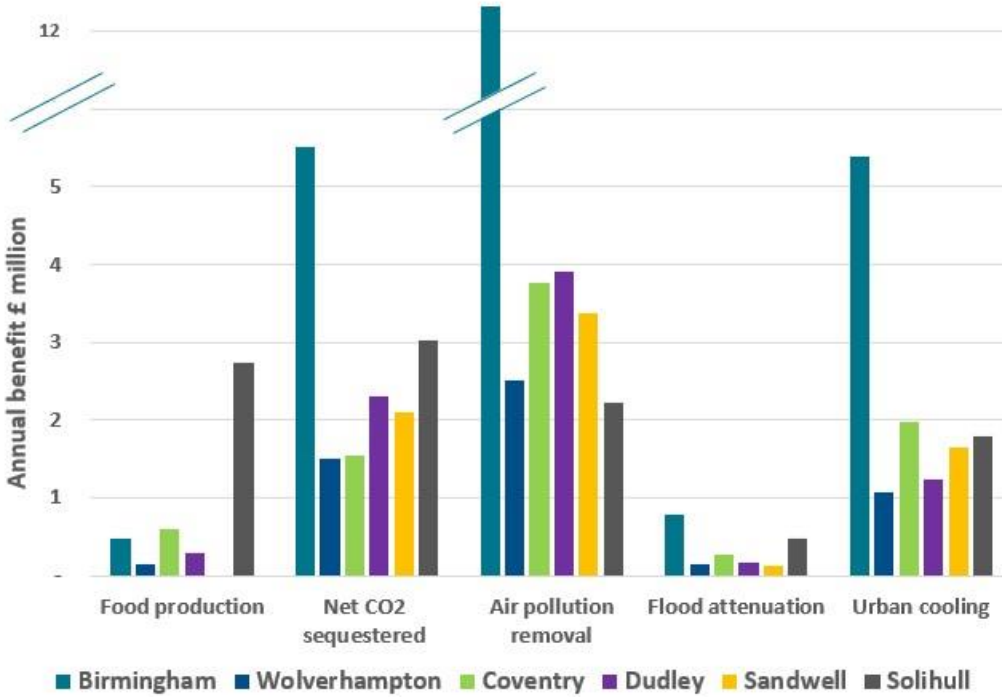

Figure 1 Value of benefits by local authority for 2023 (inflated to 2024 prices)

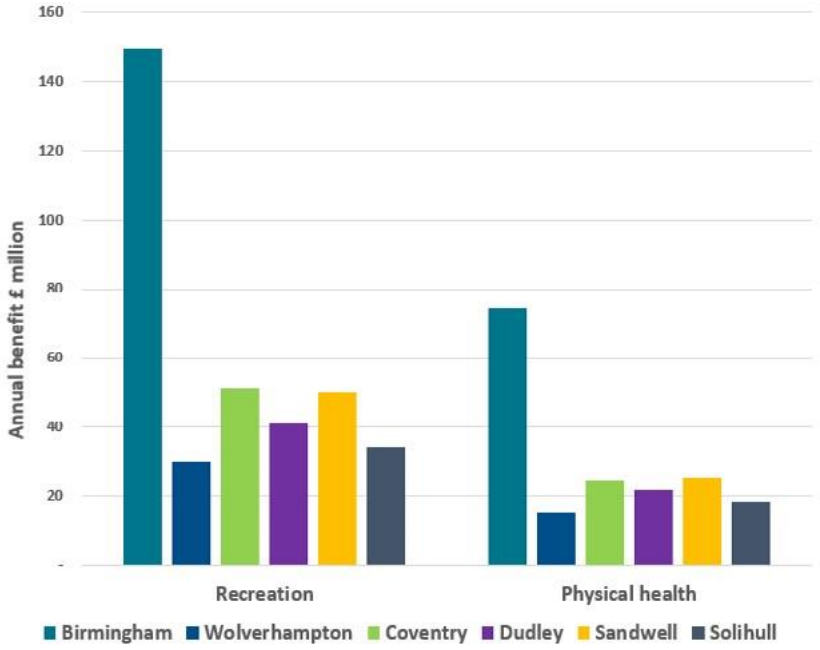

Figure 2 Value of recreation and physical health benefits by local authority for 2023 (inflated to 2024 prices)

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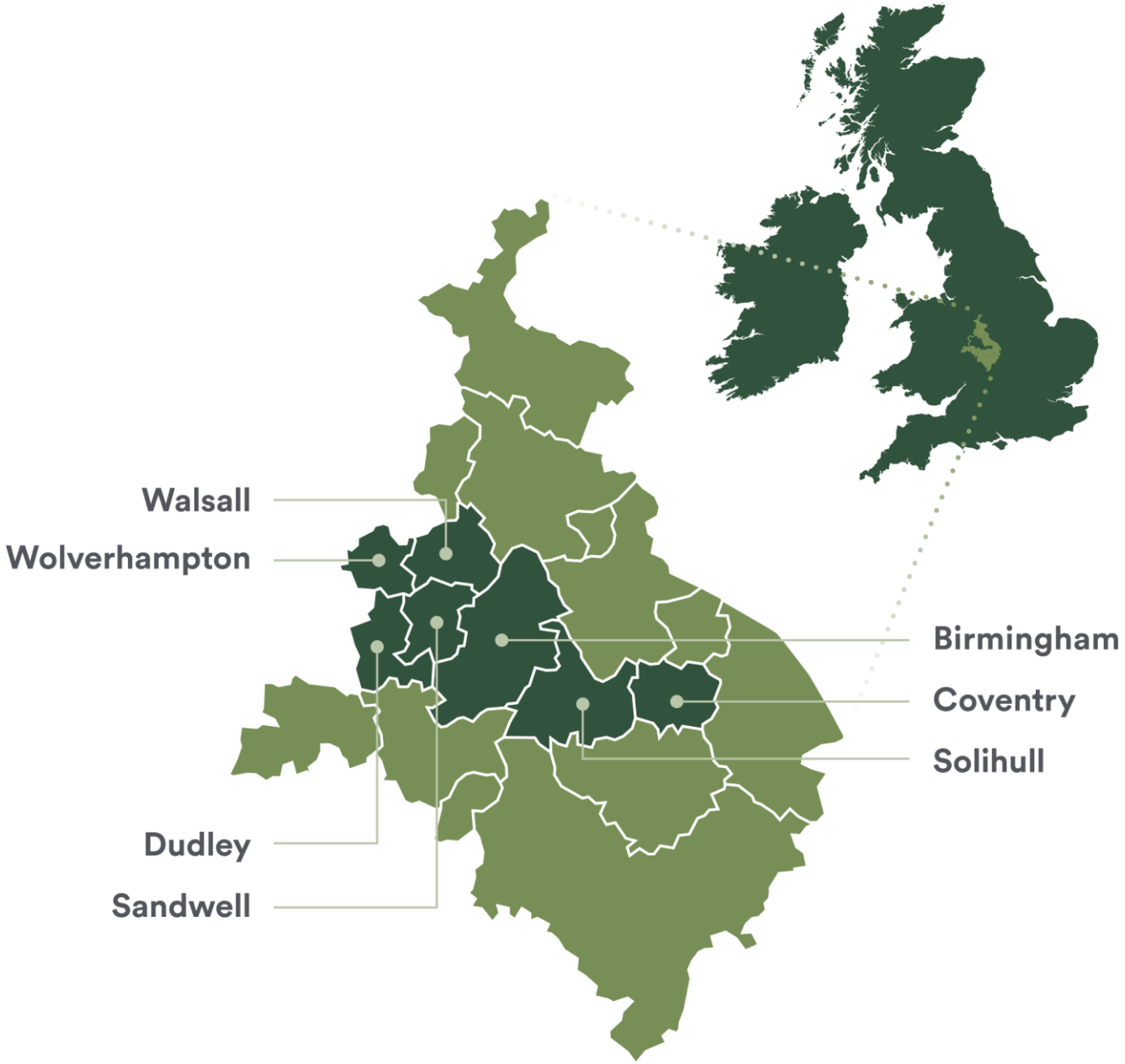
1. Introduction

1.1 Background

The West Midlands Combined Authority (WMCA) was set up in 2016. WMCA is made up of 18 local councils. With a population of 4.7 million people, the wider WMCA region has the largest economy of any combined authority area in the UK at £118 billion (2023). The core 7 constituent local authorities are home to 2.9 million people, one of the youngest and most ethnically diverse populations in Europe. The 2021 census for the 7 constituent authorities valued their gross domestic product (GDP) as £74.2bn. The geographic scope of this report is the 7 constituent local authorities.

Historical industrialisation has led to a highly urbanised environment, especially in Birmingham, Coventry and Wolverhampton, while subsequent deindustrialisation has resulted in significant inequality and economic disparity.

The 'Summary of Climate Change Impacts in the WMCA Area,' (WMCA, 2022a) demonstrated that issues such as extreme heat, flood risk and degradation to infrastructure are exacerbated by this urbanisation and have knock-on effects



urbanisation and have knock-on effects in terms of health and economic outcomes. Physical and mental health outcomes remain poor, with life expectancy below the national average.

The WMCA's Natural Environment Plan (WMCA, 2022b) showed insufficient and inequitable access to greenspace across the region. The plan sets out a clear and bold vision for nature but highlights the complex connections between environmental, social and economic issues and how these must be addressed in an integrated manner.

1.2 Programme objectives

This report aims to support the WMCA LINC programme, which has an overall aim to develop a funding ecosystem, model and strategy to support ecosystem service projects and to restore and enhance natural assets, reconnect communities with nature and support a 2041 net zero goal. Although attracting investment into traditional natural capital projects at scale in urban regions is challenging, due to population density and limited space, the additional economic and social value of green and blue assets in built up areas can be significant. The three main objectives of the WMCA Local Investment in Natural Capital (LINC) programme are to:

- xplore and demonstrate the potential for natural capital investment. This involved both supply-side and demand-side market research, analysis of potential market infrastructure and operating models, and the establishment of a regional scale natural capital project pipeline.

- Build the skills and capacity for effective governance arrangements and capability of local leaders and partner organisations. Support was provided for pilot projects towards investment readiness, addressing investment barriers restricting market growth by providing the technical support, materials and skills required to raise and manage investment.

- Develop local ecosystem markets and investment/delivery vehicles that support the green transition. This will provide the governance structure needed to attract investment at scale from across the public, private and philanthropic spheres. The vehicle will be able to identify and aggregate together projects and catalyse blended finance transactions to meet WMCA's Natural Environment Plan objectives and national targets in the Government's Environmental Improvement Plan. A market facing prospectus, highlighting the scale of the investment opportunity and capacity to deliver for nature will provide the cornerstone of a communications plan to launch the investment vehicle.

1.3 Natural capital baseline data report objectives

This natural capital baseline data report aims to help identify new revenue streams and accelerate the development of local natural capital markets. These include Biodiversity Net Gain (BNG), where a strategic regional approach could better support Local Planning Authorities (LPAs) in delivering place-based priorities. Large amounts of brownfield property and an unequitable distribution of tree cover in the region present further opportunity (e.g. through planting street trees and small areas of urban woodland), as well as using the Woodland Carbon Code to attract private investment for planting on the lower grade farmland within the 20% of the WMCA study area (see section 4.1) under agricultural production.

LINC - 1. Introduction

To support the WMCA LINC programme objectives, this report compiles data to provide a natural capital baseline assessment for the region, and support WMCA in identifying and prioritising investment opportunities. A stakeholder workshop on 17th June 2024 identified data sources to improve understanding of the natural capital baseline for the WMCA study area. These sources are covered in more detail in this report, analysing potential enhancements to natural capital value. Where data gaps exist or data do not cover the whole WMCA region (e.g. woodland area and tree cover), the best use of data for the baseline and to assess potential enhancements is investigated.

2. Natural capital approach

Natural capital is "the stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people"[6]. A natural capital approach can be defined as distinguishing between the natural capital stocks and the flows of benefits they provide and linking the extent and condition of assets to the benefits they can provide into the future. The intention is to ensure that investment decisions prioritise maintaining or enhancing the natural capital assets to provide the benefits, and not to maximise one of the benefits at the expense of others or the natural capital asset itself. Ecosystem services provide public and private benefits which can provide investment opportunities to local government and private investors (see Figure 2: The link between natural capital accounting and investment (Finance Earth)). Identification and quantification of these benefits can help inform both buyers and sellers of the potential investment opportunities.

The natural capital accounting process includes answering the following key questions:

1. What assets do we own and/or manage?
2. What benefits do they provide and to whom?
3. What are these benefits worth?
4. What is the value of the assets we own and/or manage?

These questions link to the steps shown in Table 2 on assets and ecosystem services (questions I and II) and revenues (III and IV). The valuation of benefits also involves identifying beneficiaries, which can help identify buyers. All these steps inform financing options. A full account will also consider the costs of maintaining natural capital assets, but such a costing exercise is outside the scope of this analysis. Nevertheless, the approach is useful to inform investment opportunities, through the information that is gathered to answer the above questions:

Natural capital asset register – which is a register of all natural capital assets within the boundary of the account. It forms the foundation of the account and records both the extent and condition of WMCA's land assets. The asset register is also the basis for the materiality assessment to determine the content of the benefit flows and liabilities account, and for scoping the natural capital risk register.

Materiality assessment – which records the benefits that are considered material, and which of these have been included in this account and which have not. The assessment also demonstrates whether benefits have been measured in biophysical units or valued in monetary terms.

6 Capitals Coalition (2016). Natural Capital Protocol. Available at: https://naturalcapitalcoalition.org/natural-capital-protocol/

Physical flow accounts – which quantifies the benefits that the assets deliver in physical terms. The changes in the quantity and/ or quality of the assets and their benefit provision over time are also shown.

Monetary flow accounts – which estimates the economic value of the benefits in monetary terms and discounts the projected future flow of these benefits to provide the present value for the assets. This uses data from actual markets and other (non-market) values. The physical and monetary values of benefits are calculated as annual values and used as the primary input for estimating present values[7]. To support this, assumptions on future trends and changes in physical and/or monetary values need to be made. A simple assumption is that physical and monetary flows remain constant into the future (i.e., the 2024 estimate is projected forward). Notable exceptions are for the monetary value for carbon sequestration and future flows (both physical and monetary) for air quality regulation, where source modelling (eftec and CEH, 2019; DESNZ, 2023) has captured an estimated trend.

The results are shown in the Natural Capital Balance Sheet. This reflects the value of natural capital assets within the WMCA study area if their ability to provide benefits can be maintained and the value of those benefits remains constant. In reality, factors affecting the monetary values of those benefits are expected to change over time. These factors include the extent and condition of natural capital assets which are expected to change due to environmental factors such as climate change and pressures from economic activities. They include changes to the beneficiaries (such as the resident population).

The monetary flow accounts distinguish private values for WMCA from external values to the rest of society. Where understanding and evidence allow, calculation of assets can take account of expected changes to future benefits of management, and external factors such as population growth or climate change. Otherwise, caution is needed when interpreting the bottom line of a Natural Capital Balance Sheet – as BS 8632[8] states, a positive net asset value is not necessarily an indication of sustainable asset management.

7 Sum of discounted annual flows over time.

8 **BS 8632 (2021) is the UK's National Standard for Natural Capital Accounting for Organizations. Available at: https://www.bsigroup.com/en-GB/topics/sustainable-resilience/net-zero/naturalcapital-accounting/**

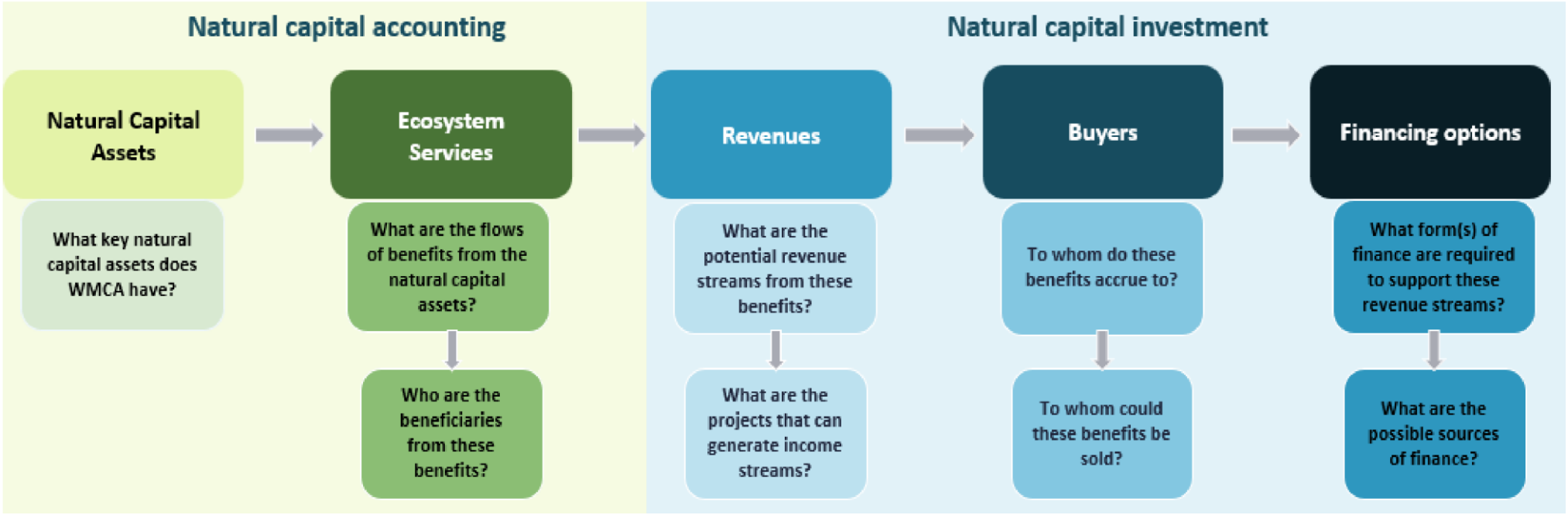


Figure 3 The link between natural capital accounting and investment (Finance Earth).

3. Summary of baseline account

This section describes the development of the baseline account using the available data.

3.1 Scope

The accounts use the latest available physical and monetary data for key natural capital assets that lie within the geography of the WMCA's seven constituent local authorities (LAs):

- Birmingham City Council (Birmingham)
- City of Wolverhampton Council (Wolverhampton)
- Coventry City Council (Coventry)
- Dudley Metropolitan Borough Council (Dudley)
- Sandwell Metropolitan Borough Council (Sandwell)
- Solihull Metropolitan Borough Council (Solihull)
- Walsall Metropolitan Council (Walsall)

Monetary values have been inflated using HM Treasury deflators to 2024 price year (H.M. Treasury, 2024). The asset values are separated into private benefits to businesses and benefits to wider society. Asset values are calculated by summing the expected future annual flow of benefits over 60 years, discounted according to HM Treasury Green Book Guidance (2020) to express in present value terms.

3.2 Asset register

The asset register records all natural capital assets within the boundary of the account. The WMCA area lacks complete and detailed baseline data on habitats and land uses. Therefore, a collection of data sets must be used to understand the baseline extent and condition of natural capital in the WMCA area.

The aim is to generate a consistently measured natural capital baseline for the WMCA area, in order to:

a. Support robust analysis of investment potential

b. Give confidence to investors (including external public sector spending) that the baseline has been measured accurately enough to be able to identify additionality of investments

The assets of the WMCA region are classified by broad land-use and habitat types and shown in Table 3. and Figure 3.1. The total area is approximately 90,164 hectares, of which the predominant land cover type is urban. Consistent data for the whole WMCA study area was not readily available for this natural capital baseline account for some important assets (e.g. distinguishing woodland and urban trees – see Section 3.2.1). This inhibits the accuracy of the extent account and the subsequent baseline calculations. The data available is expected to improve in consistency and detail through mapping to support the forthcoming local nature recovery strategy, which should provide an up-to-date land cover dataset.

With no single source of habitat data available for the WMCA, the asset register is derived from several publicly available data sources (WMCA NCA data 170125.xlsx). The differences between these are shown in Table 13.

All habitat data other than that for woodland and non-woodland land cover, was sourced from the Natural Environment Valuation Tool (NEVO) (University of Exeter, 2019). The urban area was then adjusted to take account of the differences in woodland and non-woodland extent from Centre for Ecology and Hydrology (CEH) and iTree.

Table 3 WMCA extent account 2024 (hectares)

Habitat	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA Total
Total woodland	4,017	1,150	1,144	1,665	1,550	2,336	1,130	12,992
Woodland	1,067	131	455	520	241	1,010	428	3,852
Non-woodland trees & shrubs	2,950	1,019	689	1,145	1,309	1,326	702	9,140
Cropland	1,392	403	1,380	668	213	4,821	1,364	10,241
Natural grassland	486	51	385	105	88	1,506	283	2,904
Modified Grassland	1,420	292	883	701	376	3,475	1,255	8,402
Urban	19,324	5,045	6,057	6,637	6,300	5,587	6,325	55,275
Freshwater	140	3	15	20	29	103	40	350
Total	26,779	6,944	9,864	9,796	8,556	17,828	10,397	90,164

Table 4 WMCA extent account 2024 Habitats as a percentage of total in each local authority

Habitat	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA Total
Total woodland	15%*	17%	12%	17%	18%	13%	11%	14%
Woodland	4%	2%	5%	5%	3%	6%	4%	4%
Non-woodland trees & shrubs	11%	15%	7%	12%	15%	7%	7%	10%
Cropland	5%	6%	14%	7%	2%	27%	13%	11%
Natural grassland	2%	1%	4%	1%	1%	8%	3%	3%
Modified Grassland	5%	4%	9%	7%	4%	19%	12%	9%
Urban	72%	73%	61%	68%	74%	31%	61%	61%
Freshwater	1%	<1%	<1%	<1%	<1%	1%	<1%	<1%

*Birmingham City Council have committed to using aerial imaging to determine canopy cover over time. This method differs in resolution and sample size to this study and will return different results.

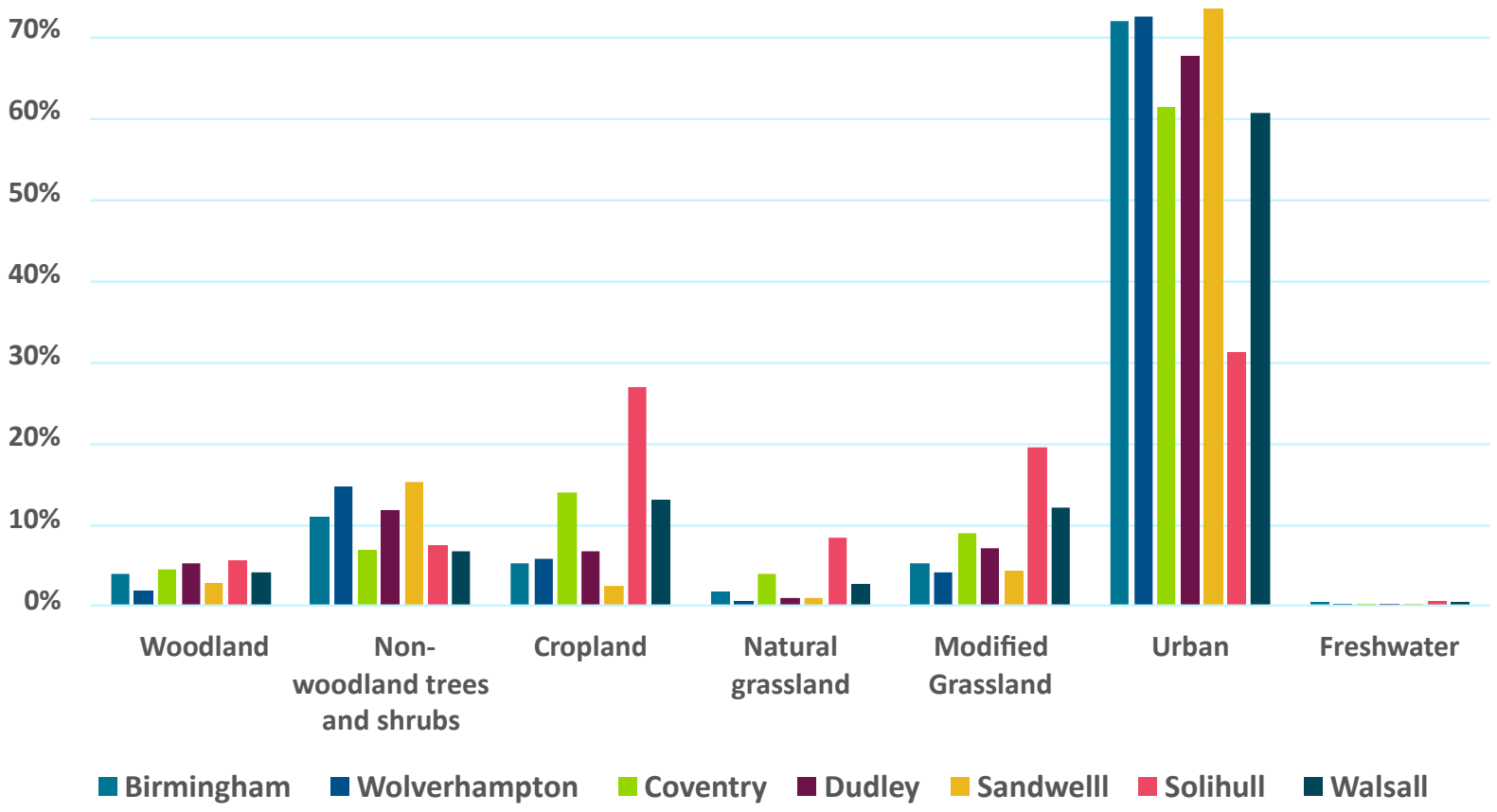


Figure 4 Percentage of land cover of each type by local authority in the WMCA study area

3.2.1. Tree cover

In the absence of an up-to-date land cover dataset of the WMCA area, different data sets need to be combined to help understand overall land cover for this report. There are conflicting estimates of tree cover (covering final woodland and non-woodland trees) in the WMCA areas from different publicly available data sources, so judgement was required to combine several data for the purposes of this work.

The Centre for Ecology and Hydrology (CEH) uses OS MasterMap to estimate urban and rural tree cover. It includes trees that are > 5m high when mature, and areas with tree cover >20%. This data source likely undermeasures non-woodland trees.

The difference between the CEH data and iTree canopy cover data is used to estimate non-woodland tree cover (i.e. street trees, small stands of trees). Other land cover areas are based on the University of Exeter's NEVO model (University of Exeter, 2019), adjusted to ensure correct total size of each LA through pro-rata adjustment of all non-woodland habitats. Where NEVO's woodland area is lower than that from CEH, the difference is allocated to 'urban' land cover.

Tree cover from ORVal (Day and Smith, 2018) was used only in the recreation and physical health analyses. This tool uses GIS and includes areas of open-access woodland, including both ancient, semi-natural, plantation forests and wood pasture.

The core woodland data was taken from the CEH's 2019 work on air pollution values, which is assumed to be spatially accurate. Nonwoodland trees and shrub data comes from iTree's random plot data within the account boundary (Treeconomics, 2022). Although the iTree data from each plot is analysed in finer detail than by the CEH data, with regard to species, age, size and condition, this is extrapolated to the wider area and so may have a lesser degree of confidence associated with it. Areas of trees and shrub canopy cover are also likely to overlap which may distort the areas (Styche and Forde, 2022).

Tree Equity data provides no publicly available tree cover data but offers a good breakdown of the regional inequality of access to trees. This is used to help assess opportunities to invest in urban trees, see Section 4.1.

3.3. Natural capital asset values

Asset values calculate the benefits that natural capital can potentially provide into the future to people in the WMCA area. See Section 3.2 for further details on the approach used.

3.3.1. Materiality assessment

A materiality[9] assessment is used to determine which benefits should be included in the account, given the natural capital assets in scope. All the individual benefits in Defra's ENCA guidance (Defra, 2021) were considered for inclusion in the account[10]. The assessment in the materiality matrix in Table 5 shows which benefits are considered material, and out of the material benefits which have been possible to include in this account and which have not. The assessment has been undertaken using a service-asset attribute matrix which aims to show which ecosystem services are material for each asset within the WMCA account boundary:

- Of these material ecosystem services, which benefits have been assessed and how; and
- Which have not been possible to measure in biophysical units or value in monetary terms and why.

The asset boundary of the WMCA is divided into seven local authorities (see section 3.1).

The following are recognised as material benefits from natural capital in the WMCA area, but currently cannot be reliably measured or valued at the regional scale. They can be recognised through relevant key performance indicators (KPIs) (e.g., site of special scientific interest (SSSI) condition) and listed as 'key non-monetised benefits' in the account summary.

- **Recreation (children visits):** The number of children recreational visits is included in the account, but it is not easy to establish the value of a child's time as a proxy for welfare benefits, and there are some risks of double counting with the value that has been attributed to adult visits. Hence this benefit has only been included as quantitative information (number of visits) within the account (i.e., non-monetised benefit).
- **Biodiversity**: The monetary valuation of wildlife and habitat is complex and, in many contexts, contentious. A portion of this value is indirectly captured in the biodiversity indicators presented in the account for SSSI condition, as well as through the value of other benefits to which biodiversity contributes (e.g. recreation).
- **Water resources**: the benefits of different land cover for the quality and quantity of water resources are determined by very context specific processes, which makes them difficult to measure and value. Analysis is also restricted by the boundaries of the study area, which are administrative, and therefore do not

9 This is defined in the Natural Capital Protocol as "an impact or dependency on natural capital is material if considering it, as part of the set of information used for decision making, has the potential to alter that decision" (Capitals Coalition, 2013).

10 Defra's ENCA (2021) also reflects 'bundled' benefits which include amenity, soil, landscape and non-use values. These are not considered for this account to avoid double-counting with the individual benefits already included (e.g., recreation).

align to catchment or waterbody boundaries. The data that is available can inform a basic qualitative analysis, but this benefit has not been valued here.

The following benefits are also considered material, but remain unquantified:

- **Education**: visits to nature can be valued based on the costs of providing outdoor learning activities (see ENCA (Defra, 2021) for further guidance). However, it is uncertain if data can be gathered on the total number of such visits by schoolchildren per year across the region. This would be better assessed specific to sites with nature-education facilities that encourage learning in the natural environment.

- **Volunteering**: Value of time (at average wage) can be used as a proxy to value the benefits of volunteer activities in nature (e.g., from Heritage Fund[11]). As with education, this would be difficult to capture at the regional level but may be more evident at the site-level.

- **Mental health benefits of engagement with nature**: While the evidence for mental health benefits from access to green space is improving in the UK, it is dependent on fine-scale data about access to green space and vulnerability to mental ill-health. The uncertainties in the asset register of land cover for the WMCA area mean that these methods cannot produce a reliable counterfactual of mental health levels if no accessible green space was available, nor a quantification of users of green space who are vulnerable to mental ill-health. Therefore, a calculation of mental health benefits across the whole WMCA area is not possible. However, an estimate of mental health benefits of increases in use of green space as a result of enhancing or increasing accessible areas can be calculated, as this marginal change is easier to quantify. This opportunity, as part of the case for addressing poor levels of access to green space, is analysed in Section 4.3. Following current ENCA guidance (Defra, 2021), physical health benefits are valued in this report.

11 Heritage Fund. (n.d.). How to calculate volunteer time. [online]. Available at: https://www.heritagefund.org.uk/discussions/how-calculate-volunteer-time

Table 5 Materiality matrix showing the ecosystem benefits in each local authority in the WMCA region and the extent to which they were assessed for the baseline account

Private & Public Benefits	Birmingham City Council	City of Wolverhampton Council	Coventry City Council	Dudley Metro-politan Borough Council	Sandwell Metro-politan Borough Council	Solihull Metro-politan Borough Council	Walsall Metropolitan Council	WMCA
Food provision	●	●	●	●	○	●	●	●
Timber	○	○	○	○	○	○	○	○
Water supply	○	○	○	○	○	○	○	○
Renewable energy	○	○	○	○	○	○	○	○
Minerals						○	○	○
Carbon sequestration	●	●	●	●	●	●	●	●
Air quality regulation	●	●	●	●	●	●	●	●
Flood risk management	●	●	●	●	●	●	●	●
Temperature regulation	●	●	●	●	●	●	●	●
Recreation	●	●	●	●	●	●	●	●
Physical health	●	●	●	●	●	●	●	●
Mental health	○	○	○	○	○	○	○	○
Tourism	○	○	○	○	○	○	○	○
Water quality	▲	▲	▲	▲	▲	▲	▲	▲
Biodiversity	▲	▲	▲	▲	▲	▲	▲	▲

Key	
Benefit estimated in quantitative and monetary terms	●
Benefit estimated in non-monetary terms	▲
Material but not assessed	○
No material service provision	

3.4. Physical and monetary accounts

The methods used to assess the benefits included in the baseline are aligned to ensure the results for each operating area can be compared. The methods applied reflect developments in natural capital measurement and valuation tools (e.g., updated ORVal (Day and Smith, 2018)) and evidence (e.g., latest carbon values (DESNZ, 2023)) in the UK, using the latest methods now reflected in guidance. The distribution of benefits between private benefits to business and benefits to wider society, is also noted, as this can be an important factor in determining investment approaches.

Note that the benefit approaches applied have also factored in potential for double counting between benefits. There is a risk of double counting between benefits, such as recreation and tourism, as well as recreation and water quality through the valuation method. This has been avoided by considering and adjusting for attribution to beneficiaries (e.g., distinction between recreation visit and tourism visit) as well as potential valuation overlap in the data sources used (e.g., ORVal and NWEBs (Environment Agency, 2012; eftec and CEH, 2019)) . There is also a risk of double counting if both values for flows of benefits (e.g. recreation) and values for assets (e.g. property prices) are used, since the asset values may reflect the ability to access the benefits. Therefore, property values are excluded from the baseline.

The physical and monetary estimates for each benefit are given a confidence rating which is described in Table 6. The estimated annual physical and monetary values are summarised in Table 7.

Table 6 Assessing data quality

Key	Symbol	Description
Low	L	Evidence is partial and significant assumptions are made so that the data provides only order of magnitude estimates of value to inform decisions and spending choices.
Medium	M	Science-based assumptions and published data are used but there is some uncertainty in combining them, resulting in reasonable confidence in using the data to guide decisions and spending choices.
High	H	Evidence is peer reviewed or based on published guidance so there is good confidence in using the data to support specific decisions and spending choices.
No colour		Not valued

Appendix 3 provides details on the methods used to measure and value the benefits included in the baseline account. The methods used ensure the results can be compared between each local authority areas, and over time as the data used to calculate them (which can be physical data like population numbers, or unit value data like valuation per tonne of CO^2e) change. The methods used are summarised here:

3.4.1. Food production

Agricultural output, both livestock and crops, plays only a small role in providing benefits within the WMCA area. Farmland assets may present an investment opportunity, either in relation to regenerative production methods that protect natural capital assets, or measures to improve ecosystem services (e.g. reducing nutrient runoff pressure on water bodies). These have not been prioritised to be included, due to the small spatial area, and the applicability of relevant farming techniques needing further research.

3.4.2. Carbon sequestration

In line with tree cover in the WMCA study area, this benefit is currently being delivered at a much higher rate in Birmingham and Solihull, but with the overall low extent of woodland and non-woodland trees in all seven local authorities, there is potential for investment in tree planting under the Woodland Carbon Code.

3.4.3. Air pollution removal

This benefit derives from the ability of trees to remove particulate matter (PM2.5) from the atmosphere. It has a greater value in areas of dense population, where pollution is worse and there are more beneficiaries. This is clearly demonstrated in Solihull where the sparser population results in a lower monetary benefit than in the other local authorities, particularly Birmingham, Coventry and Walsall where the air pollution benefits of trees are particularly beneficial to the denser population (see Section 4.1).

3.4.4. Recreation and physical health

By far the largest benefits come from recreation and physical health, with Birmingham being the largest provider within the WMCA due to its highest population density. Recreational value is derived from the local population's access to green and blue space. The extent of natural habitats, their proximity to local populations and accessibility through pathways and parks, are all taken into account by the Outdoor Recreation Valuation Tool (ORVal) to calculate visit numbers and the value of these visits. Physical health values are calculated using data on the number of recreational visits that are deemed active, and the value these have in reducing medical treatment costs, due to avoided ill-health. There is also some evidence that productivity increases where people work close to greenspace so there will be some investment value to local business.

3.4.5. Flood attenuation

The benefits of flood risk management are provided through the ability of trees to absorb rainfall. This not only slows the flow of water in severe weather events and reduces flooding cost damage to infrastructure, but also allows water treatment plants to avoid water treatment and storage costs. The spatial pattern in the WMCA again follows the distribution and numbers of trees in each local authority. The flood attenuation benefits may lack some accuracy as although the iTree methodology includes trees and shrubs, it does not include areas of grassland, gardens, or some green infrastructure such as SuDs. However, these may be balanced out by iTree's assumption that all trees and vegetation provide flood mitigation services, while in reality they only do so where there is a local risk of flooding.

3.4.6 Urban cooling

Although the local population will benefit from the cooling effects of natural habitats in urban areas, the value of this is difficult to estimate accurately. For this baseline we have only valued the costs to private businesses due to the avoided losses in productivity. Coventry is a particular beneficiary of the effects of urban cooling, reflecting the higher-than-average GVA in the local authority.

3.5. Key observations

Table 7 shows the wide range of benefits supported by natural capital assets in the WMCA study area, a summary of overall values and confidence levels. The total net annual benefit value for the WMCA accounting boundary for 2023 is approximately £676 million in 2024 prices. Note that the carbon sequestration values show both positive (i.e., carbon sequestration) and negative impacts (i.e., emissions).

Table 7 Final physical and monetary flows

Produced at August 2024	Physical flow quantity			Monetary value		
	Unit/ per year	2024	Confidence	Valuation metric (£m/yr)	2024	Confidence
Key monetised benefits						
Agricultural output	Arable food production (tonnes)	40,072	M	Arable income	3	M
	Livestock food production (tonnes)	24,604	M	Livestock Income	4	M
Carbon sequestration	CO_2e sequestered in habitats (tonnes)	62,591	M	Total value of CO_2e sequestered in habitats	18	M
	CO_2e emitted by habitats (tonnes)	-2,970	M	Total value of CO_2e emitted by habitats	(1)	M
Air quality regulation	PM2.5 removal by woodland (kg)	23,029	H	Avoided medical treatment costs	32	H
Recreation	Recreation visits under threehours (millions)	102	M	Adult recreation welfare value	401	M
Physical health	Number of active visits (millions)	53	M	Avoided medical treatment costs	203	M

Produced at	Physical flow quantity			Monetary value		
August 2024	Unit/ per year	2024	Confidence	Valuation metric (£m/yr)	2024	Confidence
Flood mitigation	Additional water storage capacity provided by trees (million m^3)	1.6	M	Value of annual average additional water storage capacity from tree cover	2	M
Temperature regulation	Cooling effects of habitats (0^C)	0.72	M	Avoided productivity losses from current habitat cover	14	L
				Total	676	
Key non-monetised benefits						
Biodiversity	Proportion of total possible biodiversity present					
Water quality	Length of WFD rivers in each condition category (km)					
Other material unquantified benefits: Education, Volunteering and Mental health						

Two wider society benefits are valued based on avoided medical treatment costs. These are influenced by the size of the resident population benefits, so annual per capita monetary values for these health benefits from air pollution removal and physical exercise in green spaces are shown in Figure 4. This reflects the proportion of the greenspace areas in each local authority and the populations (in 2022) in those areas.

The highest health benefits from physical activity in greenspace are in Solihull (£84 /person/year), which are nearly 50% higher than benefits in Wolverhampton (£58/person/ year). The recreation physical health benefits are significantly greater benefits than health benefits from air pollution removal by trees, which is more evenly distributed across the local authorities (£9-11 /person/ year). These figures are of a similar size to those identified in Manchester of £4884 per person in healthcare savings (in 2019, eftec et al 2019).

Figure 5 Annual health benefits per person in each local authority from existing green space

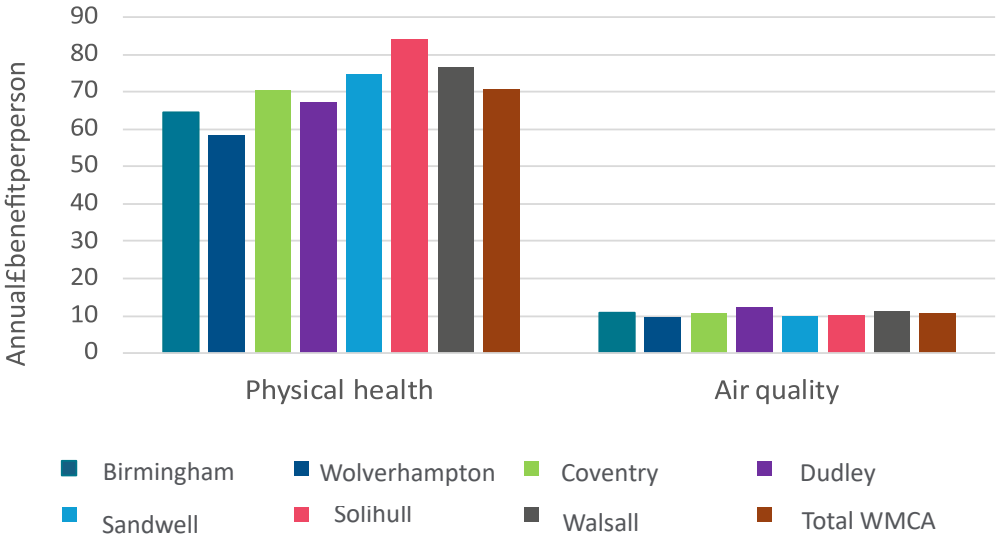


Table 8 shows the beneficiaries from the natural capital benefits quantified and values for the WMCA area in Table 7. It shows physical health benefits from access to green space are at least five times larger than health benefits related to air quality. The variations in physical health benefits likely reflect the provision of green space, and patterns of use by local residents. The data also shows very similar levels of air quality benefit per person across the Authorities. This is likely due to an inverse relationship between the amount of pollution removed by trees (which reduces the value), and worse air quality and higher numbers of people exposed to it (both of which increase the value).

3.5.1. Distribution of beneficiaries

The analysis helps identify the groups in society that benefit from natural capital, and therefore who will benefit from actions to maintain or enhance it. The breakdown of beneficiaries is shown in Table 8 below. While there are a range of beneficiaries at different spatial scales, and different time scales, the majority of the benefits are public goods that are realised locally within the WMCA area.

Table 8 Distribution of beneficiaries of the benefits provided from natural capital assets in the WMCA region

Produced at August 2024	Valuation metric	Total £m (PV60[1])	Beneficiaries
Asset values (monetised)			
Agricultural output	Arable income	72	Private income to farm businesses and rents to land owners
	Livestock Income	103	
Carbon sequestration	Total value of CO_2e sequestered in habitats	674	Global benefit of reducing net carbon emissions, including to future generations. Potential for private benefit if sequestration credits can be sold in carbon markets.
	Total value of CO_2e emitted by habitats	(32)	
Air quality regulation	Value of PM2.5 removal by woodland	911	All of local population in WMCA. Increased benefits in areas with higher air pollution, tree cover and/ or population. Higher benefits in more vulnerable groups (e.g. elderly, children). Employers benefit from healthier workforce.
Recreation	Adult recreation welfare value	10,508	All of local population in WMCA. Small benefit to visitors from outside the region.
Physical health	Avoided medical treatment costs	8,199	All of local population in WMCA, more benefit to those living closer to/ regularly using accessible green space. Employers benefit from healthier workforce.

Produced at August 2024	Valuation metric	Total £m (PV60[1])	Beneficiaries
Flood management	Value of additional water storage capacity from tree cover	57	Households and businesses owning property at risk of surface water flooding. All of local population in WMCA benefit from reduced disruption.
Temperature regulation	Avoided productivity losses from current habitat cover	378	Employers benefit from avoiding loss of workforce productivity.
Total gross asset value		20,869	
Asset values (non-monetised)			
Biodiversity	Proportion of possible biodiversity achieved in the WMCA local authorities4	28-42%	All of local population in WMCA, more benefit to those living closer to wildlife rich areas. Value of priority habitats to all of England population.
Water quality	Proportion of WFD river lengths categorised as moderate or good	66%	All of local population in WMCA, more benefit to those living closer to waterbodies. Water companies and other abstractors benefit from improved raw water quality.

4. Opportunities for enhancing natural capital value

The baseline results provide a basis for considering how investments to maintain and/or enhance natural capital in the WMCA area can provide value to society. Two opportunities for enhancement are considered in more detail in this section: urban trees and biodiversity net gain.

4.1. Urban trees

A significant proportion of benefits from natural capital in the WMCA area relate to trees. Although there are difficulties in fully mapping woodland and tree cover for the area (see Section 3.2.1), they are the main provider of carbon sequestration and air quality regulation benefits and play an important role in recreation and public health benefits. These health benefits include physical health, which is quantified in the baseline results, and mental health, which are not quantified in the baseline due to a lack of measurement and valuation approaches suitable for the whole WMCA area.

The asset register (Section 3.2) quantifies the tree cover in each local authority area with the WMCA. This area includes woodland, and also tree and shrub cover outside woodland. The latter makes up the majority of woodland cover, reflecting that street trees and other trees outside woodland are a key natural capital asset for the WMCA area. The quantification of these areas has a high level of uncertainty as this tree cover can be difficult to measure accurately, and this limits the ability to measure and value its benefits.

The provision of tree cover in Lower Super Output Areas (LSOA) is analysed in tree equity scores (TES), and this provides a useful basis for comparing provision of benefits across the WMCA area. TES UK covers over 34,000 urban neighbourhoods in the UK and is used to highlight inequitable access to trees. A score of 100 means an area has a sufficient number and distribution of trees. The lower the score, the greater the priority for tree planting in that neighbourhood. By assessing the existing tree canopy and the level of priority for access using measures of social deprivation and risk from environmental hazards (income, employment, age, heat severity and air pollution), the tool measures how well benefits are reaching disadvantaged communities. The scope combines tree canopy cover in LSOAs with a priority measure based on six equally weighted climate, health and socioeconomic variables.

Table 9 Tree Equity scores, canopy cover per person and % of LSOAs with a Tree Equity Score* (TES) below 75

Local Authority	Composite TES (minimum target 75)	Tree canopy cover m2 per person	% with TES of 100	% of LSOAs** below 75	Minimum LSOA TES score
Birmingham	83	45	13%	19%	38
Wolverhampton	82	44	7%	20%	50
Coventry	84	42	7%	12%	60
Dudley	85	55	15%	8%	60
Sandwell	81	40	8%	22%	47
Solihull	86	62	10%	7%	59
Walsall	82	44	10%	15%	58
Average WMCA	83	47		15%	

In Table 9, all the Local Authorities have similar overall equity scores, but for Sandwell, Birmingham, Walsall and Wolverhampton, distribution of tree cover within their LSOAs is less equitable -they have higher %s of LSOAs scoring below 75, despite having similar tree cover per person as Coventry.

The baseline data allows estimation of average values per tree. Physical values are shown in Table 10, and monetary values in Table 11. These averages represent significant variation in benefits on the ground, that will reflect location, tree species, local beneficiaries and other factors. However, they give an indication of the impact that investments in additional tree cover could deliver.

The LSOAs scoring below 75 in Table 9, indicate that there are local areas within authorities where investment in urban trees could have greatest benefits. Targeting investment in urban to these locations will bring extra costs, but this may be worthwhile given the value they generate is likely to be significantly higher than the averages identified in Table 10 and Table 11.

* see https://uk.treeequityscore.org/

** LSOA = Lower-layer Super Output Area, a local geographical statistical boundary in England and Wales with an average population of 1,500 people or 650 households.

Trees also contribute to the average cooling effect from green and blue space across the WMCA's urban areas of -0.72oC (eftec, 2018). This measure cannot readily be disaggregated to a local or per tree scale for Table 10, as it is generated by a mix of habitats. However, an average monetary value is estimated in Table 11. The monetary values also include recreation and physical health benefits which are associated with trees where they are part of accessible local green space.

4.2. Biodiversity Net Gain

A new statutory mechanism requiring actions to enhance nature is Biodiversity Net Gain (BNG). This policy requires compensation for losses of nature resulting from built development regulated by the Land-use Planning Act. Gains and losses are measured in biodiversity units (BUs)[12] based on the area, distinctiveness and condition of habitats affected. Developers in England must now replace losses to habitat they impact through development, and deliver, as a minimum, an additional 10% gain. The mitigation hierarchy dictates that measures should be taken to avoid, then minimise, loss of habitat on site, prioritise habitat creation and/ or enhancement on-site, and only compensate off-site if this is not possible. This compensation can be bought from a third party that takes action outside development sites, thus creating a potential market for investment. In 2021, eftec et al produced an analysis for Defra on the expected market that would form based on the proposed regulations.

Its modelling results, shown in Table 12 for the WMCA area, included the expected annual demand for biodiversity units based on trends in land use development over the last decade, and potential supply (from eftec et al 2021). This includes the mandatory 10% 'gain' to deliver BNG, and assumes 50% of compensation happens within development sites (this is shown on lines a. and b. of Table 12, respectively). Potential supply is modelled through habitat creation on land of low biodiversity value (e.g. intensively farmed grasslands). Supply data from Local Authority specific studies is also shown.
(Coventry City Council, 2022; Clarkson & Woods Ecological Consultants, 2023; Lepus Consulting, 2023)

As annual BU demand is being compared to the total stock of supply, the level of demand was multiplied by 10 (c. in Table 12) and compared to the supply (d. in Table 12) to calculate whether an authority was expected to have a surplus (or scarcity) of BUs (e. in Table 12) in its market. For three authorities, the potential supply of BUs is not significantly greater than expected demand, giving a risk of BU scarcity in the market. In particular, the results for Sandwell suggest demand for BU's will be approximately three times greater than supply over the next decade. The uncertainties in the model mean this should not be taken as a prediction of exact market size, but is an indicator of a significant risk of scarcity, which would increase market prices for BUs. This could lead to greater mitigation and compensation for biodiversity loss within developments and/or could restrict the level of development.

Some of the best sites identified for BU supply in Sandwell are estimated to be able to provide between 3 and 5 BUs per ha, which is higher than the potential supply per ha assumed likely by eftec et al in 2021. The higher

12 Biodiversity units are measured using a Defra metric: Statutory biodiversity metric tools and guides - GOV.UK

level of supply is feasible, but it may require a higher cost per BU, and/or a longer timeframe, to deliver.

The eftec 2021 model was also cautious in modelling market supply as only a limited number of habitats were considered eligible for enhancement. Not all broad habitat types can be compensated using enhancement of existing habitat, some can only be compensated through creation of new habitat (based on trading rules in biodiversity metric 2.0). Additional enhancement capacity may be available from changes in condition whilst remaining within the same habitat type, but this has not been explored further since condition values are all based on fixed assumptions.

Through the WMCA LINC BNG Accelerator programme, BU offset sites across the West Midlands have been mapped and BNG viability reviewed. Detailed assessment of these supply sites has shown a number of additional restrictions to supply. Green spaces in urban settings can be inappropriate for BNG due to existing amenity use incompatible with BNG delivery (e.g. sports fields), enrolment of land in existing funding programmes (e.g. Countryside Stewardship) or other hurdles (e.g. common land is not compatible with BNG). There is a significant level of work required to understand the suitability of any plot of land for BNG so a precise picture of supply remains a challenge.

The eftec 2021 model, based on recent development trends, did not factor in increased land use development that would be needed to meet Government housing targets. Local studies often take these potential developments into account. The Sandwell BNG report estimated BU demand from construction of 30,300 new dwellings between 2021 and 2041, with 9,500 of these are expected to be delivered in the Local Authority.

It is difficult to equate these dwellings to BU demand, as brownfield sites, density of development, and other factors could all influence the final level of demand. However, there is potential for increases in supply of housing to significantly increase the land used for development and the demand for BUs in Sandwell above the recent trend levels modelled by eftec et al in 2021.

In conclusion, the data for Sandwell suggest both supply and demand for BUs will be greater than the levels identified in the eftec et al study in 2021. This is mainly due to more specific assessments of supply potential, and considering demand driven by increases in housing construction. The impact on the relationship between supply and demand from these increases is indeterminate, so the data does not change the conclusion that there is a risk of scarcity of BU supply in Sandwell.

Table 10 Per tree benefits in each local authority:

Average annual physical per tree benefit	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA average
kg C02e sequestered	3.0	2.9	3.1	3.0	2.9	3.1	3.1	3.0
kg PM2.5 removal	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
m3 avoided surface water run-off	0.43	0.32	0.28	0.28	0.49	0.23	0.28	0.33

Table 11 Per tree £ values.

Average annual value per tree, £	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA average
C02e sequestered	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9
PM2.5 removal	7.4	12.0	5.2	4.7	8.7	1.4	4.7	6.3
Avoided surface water run-off	0.7	0.3	0.5	0.3	0.5	0.4	0.3	0.4
Avoided productivity losses from cooling	1.7	1.1	1.8	1.0	1.2	0.9	1.0	1.51
Recreation	16.0	18.8	18.9	16.8	20.7	14.0	12.2	16.8
Physical health	10.6	12.5	12.5	11.1	13.7	9.3	8.1	11.1
Total annual per tree value £	37	46	40	35	46	27	27	37
Present value per tree, £PV60	1,155	1,402	1,243	1,089	1,421	850	845	1,143

Table 12 BNG demand and supply in the WMCA region

BNG	Description	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA average
eftec et al (2021) model	a. Demand with 10% BNG (BU/year)	149	58	96	51	118	9	10	491
	b. Demand with 50% onsite mitigation (BU/year)	74	29	48	25	59	5	5	246
	c. Demand over 10 years (BU total)	744	292	480	253	589	47	49	2,456
	Supply (ha)	1,966	306	2,275	1,022	162	9,766	2,518	18,015
	d. Supply (total BUs)	901	596	5,360	2,393	187	14,309	5,093	28,839
	e. Surplus (total BUs)	157	303	4,880	2,140	- 402	14,262	5,044	26,383
Other BNG analyses:	Areas identified for BU Supply (ha)	46		65		295			
	Supply (BUs)	106				918			

4.2.1. WMCA market

The risk of scarcity in Sandwell, and to a lesser extent Birmingham and Wolverhampton, contrasts with the likely significant surplus of BU supply in other authorities in the WMCA area. This suggests that trading outside individual authorities' boundaries, for example across National Character Areas or through a strategic approach to support a WMCA-wide BU market, could be useful to alleviate scarcity of BUs within specific authorities.

The specific benefits of a regional collective approach to BNG (and indeed all natural capital markets) include:

- Enabling regional development that fulfils its BNG obligations without significant delay or additional cost.
- Supply from sites with a wider range of habitat types and/or larger size that are more resilient in supporting enhancement of nature.
- Shared infrastructure, learnings, template materials and economies of scale across multiple Local Planning Authorities (LPAs) to reduce cost burdens and share risk through a community of practice.
- A more consistent joined up approach for nature, including better alignment around the LNRS and strategic coherence across various placed based priorities /plans.
- A collaborative approach also offers key benefits to developers/ buyers operating across the region who would be able to engage at a centralised level and receive a clear and consistent market offering.

However, disadvantages can arise if compensation is delivered remotely from the areas where biodiversity is lost, leaving a depleted natural capital stock in the local area where development takes place.

Therefore, while there are advantages of supporting a regional market, the planning system should consider:

- Encouraging compensation for biodiversity loss close to development sites where feasible. Although this is incentivised by the Defra BU metric, economic incentives (e.g. local land prices) might incentivise delivery of compensation further from development locations.
- Maintaining levels of local benefits from green space (e.g. accessible semi-natural areas). Delivery of BNG does not ensure compensation for all benefits associated with losses of biodiversity. Planning authorities should consider the need to compensate for all benefits from green space that are lost to development. For example, this could be delivered by enhancing the recreation and health value of green space through better management[13].

4.3. Mental health benefits from improved access to green space

The draft pipeline of projects in the WMCA region (as of October 2024) includes projects that could provide 1,164 ha of new or enhanced accessible greenspace. Improved access to green space is associated with mental health benefits. The evidence to quantify and value this benefit cannot be calculated for the whole population, as the baseline level of mental health if there was no accessible green space is not known. However, the additional mental health value of improved access to green space from the pipeline projects can be estimated.

The enhanced access to green space identified from the pipeline, is estimated to result in 278 avoided mental health cases annually. Assuming the benefits from these cases persist for 3 years and are cumulative in the population, this results in 833 beneficiaries per year annually. The annual benefits from this in economic terms are a public saving of £787,641 in mental health care costs, and a saving to businesses of £959,866 in avoided losses to productivity. This translates to a combined overall benefit of over £65 million in combined avoided costs over 60 years.

The calculation steps are laid out in Table 13. These figures are based on the assumption that there is a two-year lag between the enhancement or creation of greenspace and the increase in visits.
Further details are in A3.6.

Table 13 Annual avoided MHC cases and their value to society and private businesses, over time.

Area	New area created (ha)	New visits per ha	Annual avoided MHC cases from visits to nature			Annual monetary benefit £		
			Year 2	Year 3	Year 4 onwards	Year 2	Year 3	Year 4 onwards
Birmingham	24	10,666	27	54	81	56,979	113,958	170,936
Wolverhampton	6	8,172	4	9	13	9,148	18,295	27,443
Coventry	676	903	54	107	161	112,408	224,815	337,223
Dudley	25	2,595	7	14	21	14,508	29,016	43,524
Sandwell	183	8,006	124	249	373	260,965	521,929	782,894
Solihull	172	2,862	53	106	158	110,728	221,456	332,184
Walsall	79	1,089	8	17	25	17,768	35,536	53,304
Total	1,164		278	555	833	582,503	1,165,005	1,747,508

5. Conclusions and recommendations

This section makes recommendations about using the accounting results for business planning and developing them in the future. The evidence makes a case for investment in natural capital in two ways. Firstly, realising this value over time requires sufficient investment to at least maintain the natural capital assets that provide them. Secondly, the distribution of values indicates areas where investment to enhance natural capital can provide greatest benefit to society.

This baseline data provides a basis for identifying natural capital investment opportunities across the WMCA area. Three opportunities for enhancing natural capital benefits are analysed in more detail in Section 4:

Urban trees, baseline data enables calculation of typical values of benefits per tree in the WMCA area. The figures indicate the scale of benefits that local tree planting, provided it is appropriately located (the right the right place) can deliver. Data on the distribution of tree cover within communities further helps target where benefits can be realised: some parts of the WMCA area have lower levels, and/or less evenly distributed tree cover, indicating there are locations where additional urban trees will have greatest benefit.

Biodiversity Net Gain, different local market analysis and national market modelling data are compared. Local data provides specific information about potential local markets and helps quantify potential local scarcity of supply and market opportunities. The national model gives context to individual local authorities' data by enabling consistent comparison between authorities. Overall, the WMCA region is not likely to face scarcity of biodiversity units (BU) supply, but enabling trading between authorities within the area would have market benefits. However, this could have consequences for the location of natural capital assets and the distribution of the benefits they provide between communities.

Mental health, which will be impacted where improved access to green space increases visits amongst a local population. This is modelled for proposals in the investment pipeline to enhance or create urban green space. It suggests 278 people benefiting annually, and assuming benefits to them persist for three years, a benefit of £1.7m per year.

5.1. Interpretation

The benefits from natural capital assets in the WMCA area that can be measured and valued are estimated at £21bn over the next 60 years. **There** are significant further benefits that cannot be measured and valued at present. Major benefits relate to public goods of recreation and resulting health benefits of physical activity. The annual benefit value for the WMCA area for 2023 is approximately £676 million in 2024 prices. Health benefits from pollution removal by trees are an order of magnitude lower, but are slightly larger than carbon sequestration benefits by habitats. These substantial benefits have economic implications, both in terms of costs of health services, and in maintaining an economically active workforce.

It should be borne in mind that these figures capture benefits that can be consistently measured for the whole WMCA area, given

available spatial data, avoiding double-counting, and aligning with UK Government guidance (i.e. ENCA and HMT Green Book). The accounting data provides metrics for supporting investment processes. The overall data shows not only the value of natural capital, but also its distribution across locations. Areas with lower benefits can be targeted for investment as locations with opportunities to create the greatest uplift.

This is illustrated by the tree cover data and valuations. Trees provide a wide range of benefits (including for local climate, carbon sequestration, surface water, air quality and aesthetics), and can be incorporated into the urban environment in smaller areas or as linear features. The available data enables estimates of the average benefits provided per tree in each local authority, as well as metrics to identify areas with lower provision where benefits would be expected to exceed these averages. The data can be used in the business case for natural capital investment:

- For the public sector, current benefit calculations provide approaches to estimate expected benefits to society from investments. This can feed into the business case needed to demonstrate that investment in natural capital is a good use of public resources (e.g. providing metrics for Defra's LINC nature projects data collection).

- For the private sector, many of the public goods values have more limited relevance. However, the health and productivity related values could be relevant to larger employers (or groups of employers) in specific parts of the WMCA area, where a significant proportion of the beneficiaries will be among their employees.

- The Biodiversity Net Gain data illustrates where supply of biodiversity units may be lower relative to market demand, indicating the potential for investment in supply to obtain faster sales and/or a higher price per unit.

5.2. Recommendations for improvement

The baseline data is the result of detailed modelling of natural capital assets and benefits for WMCA. The model's accuracy is dependent on inputs. The baseline data on land cover available for this report, (i.e. the extent and condition of habitats - a natural capital asset register), is undergoing improvements to provide a consistent dataset of land cover and land uses across the area and support the West Midlands Local Nature Recovery Strategy (LNRS). This improved data will support a more robust and consistent natural capital asset register, which in turn can provide improved evidence to strengthen the case to implementing the LNRS. It is recommended that the natural capital baseline data are updated once the LNRS baseline habitat data has been finalised.

The current data sets can, and improved future data sets will better, provide inputs to the business case for natural capital investment. With more consistent measurement of assets, more detailed breakdowns of benefits to local areas can be calculated with confidence.

Progress on the LNRS for WMCA is expected to improve the mapping of natural capital assets, and therefore the ability to quantify, value and analyse the benefits they provide. However, there will still be a task to connect this data to evidence on benefits. For example, mapping of green space for the LNRS could be compared to the mapping underlying the ORVal tool (which models the number and value of visits to green space across England). The ORVal mapping layers can be downloaded from the

tool website. This comparison will help understand which portion of natural capital assets within the WMCA the ORVal data layers relate to.

The ORVal tool provides a very cost-effective way to identify recreation benefits of the natural environment. However, like all models it can only reflect factors that can be consistently quantified. The quality of green space, and some cultural factors influencing visits to green space, are hard to quantify so not fully reflected in ORVal. As a consequence, its results for certain sites can be less accurate. However, these inaccuracies are likely to even out over multiple sites, and ORVal's prediction of total visits to the natural environment across a population reflect detailed survey data. Therefore, its results at a local authority scale are considered relatively robust and a valuable input for identifying public benefits from natural capital.

It should be borne in mind that ORVal is a modelling tool based on survey evidence of visitors' behaviour. It may reflect changes in visitor trends as new survey evidence is incorporated into the model. However, it is not a monitoring tool giving visit numbers for recent time periods. Other monitoring approaches will be needed to quantify changes in visits as a result of investments increasing the accessibility of green space.

The natural capital baseline calculations can also be updated in future as the investments take place. They provide a consistent framework to measure natural capital value over time, and so can contribute to monitoring. Natural capital value may change due to improvement (e.g. from investment) or deterioration of assets, but also a variety of other factors (e.g. changes to population size or preferences). The calculation of values is useful to understand the combined effects of these changes over time.

There are also a number of benefits across society that are considered to be important for the WMCA area, but are not able to be adequately measured and valued within this report. These include:

- Water resources and flooding: the benefits of different land cover for the quality and quantity of water resources, and mitigation of flood risk, are determined by very context specific processes. Unlike other benefits such as air quality, water quality and quantity benefit, and flood risk reduction benefits, from natural capital are not consistently modelled and quantified in the UK. This lack of quantification means detailed catchmentspecific modelling would be required to measure and value them. This data is not available in the WMCA area, and analysis is also restricted by the boundaries of the study area, which are administrative, and therefore do not align to catchment or waterbody boundaries. Therefore, these benefits have not been valued here.

- Mental health benefits from greenspace are highly important for the urban environments in the WMCA area (in 2019 a report for Birmingham City valued its benefit at £10m/yr (Holzinger et al, 2019)). However, quantifying their benefits requires finescale mapping of access to green space by the local population, which has not been possible within this report. This is due to the available mapping not being sufficiently accurate to determine the population in regular contact with urban green space (in particular in relation to features in the urban fabric such as street trees and green walls). Furthermore, while it is known that increased contact with green space over current levels can reduce mental ill-health, there is also a lack of evidence on the overall relationship between contact with green space and mental health outcomes.

Therefore, the overall effect of green space on mental health in WMCA cannot be quantified and valued. The potential positive impact on mental health from improving access to green space is analysed in Section 4.3. The inability to adequately value mental health benefits is currently a limitation in trying to develop natural capital finance related to health benefits. In future, research may enable a standardised local

- Extending dose-response relationships across a wider range of green space availability, so that the effects of not having accessible green space can be robustly quantified. OR,

- Establishing a relationship between mental health benefits and other widely measured variables such as visits to green space, or levels of urban greening) (which can be measured through canopy cover or indicators such as the urban greening factor).

measurement and valuation of mental health benefits from green space in England. This might be achieved by:

- Biodiversity is both part of natural capital assets and a benefit from natural capital. There is no single agreed measure of the stock of biodiversity, and therefore no single approach to value maintaining it. Therefore, it is not measured and valued as part of the baseline data in this report. Changes in biodiversity, measured through changes in species abundance, can be valued using a tool published by Defra[1]

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Appendices

Appendix 1. Natural capital accounting approach

Natural capital is “the stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people” . A natural capital approach can be defined as distinguishing between the natural capital stocks and the flows of benefits they provide, projecting benefits into the future and linking the provision of benefits to the extent and condition of assets. The intention is to ensure that business decisions prioritise maintaining the natural capital assets to maintain the benefits, and not to maximise one of the benefits at the expense of others or the natural capital asset itself.

Appendix 2. Asset register methodology

A comparison of woodland categories that are included in the different data sources are listed in Table 14.

Table 14 Comparison of data sources

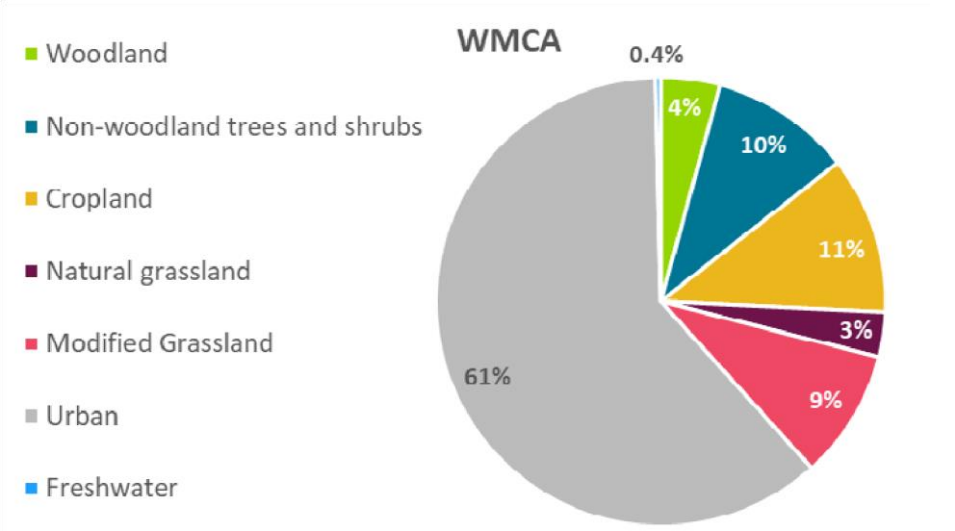
Reference source	Data collection used by source	Woodland definitions:
NEVO (University of Exeter, 2019)	GIS for base data (2km^2 grid reference). Predicts farmland use according to climate, soil quality, location and some farm level data.	
ORVal (Day and Smith, 2018)	GIS (2km^2 grid reference) for parks, paths and beaches with recreational value. For each recreation site, the data set records the nature of the greenspace provided, including the site's 'land cover and use' or more succinctly land cover	Areas of open-access woodland; including both ancient, semi-natural, plantation forests and wood pasture.
iTree:	Species diversity, age class, leaf area is measured in random plots of 0.04 ha (400 sq. m). This is extrapolated to estimate canopy cover.	All trees, in stands and individual street trees, as well as shrubs.
CEH & eftec (CEH and eftec, 2019)	OS MasterMap.	Woodland in rural and urban areas (based on LCM). Characterised by vegetation dominated by trees >5 m high when mature, with tree cover >20 %. Scrub (30 % for inclusion in this Broad Habitat).
DEFRA (DEFRA, 2024)	Farm level data	Used in Food provision account only, no woodland areas assessed.

The full asset register used to calculate the benefits of natural capital are shown in hectares in Table 15 followed by a pie chart (Figure 5) showing the distribution of habitats in the WMCA region.

Table 15 Asset register for the WMCA, showing breakdown by local authority, in hectares

Local authority	Birmingham	Wolverhampton	Coventry	Dudley	Sandwell	Solihull	Walsall	WMCA average
Total habitat	**26,779**	**6,944**	**9,864**	**9,796**	**8,556**	**17,828**	**10,397**	**90,164**
Total woodland	4,017	1,150	1,144	1,665	1,550	2,336	1,130	12,992
Woodland	1,067	131	455	520	241	1,010	428	3,852
Non-woodland trees and shrubs	2,950	1,019	689	1,145	1,309	1,326	702	9,140
Cropland	1,392	403	1,380	668	213	4,821	1,364	10,241
Natural grassland	486	51	385	105	88	1,506	283	2,904
Modified Grassland	1,420	292	883	701	376	3,475	1,255	8,402
Urban	19,324	5,045	6,057	6,637	6,300	5,587	6,325	55,275
Freshwater	140	3	15	20	29	103	40	350

Figure 6 Overall habitat cover in the WMCA



The asset register also has Water framework directive (WFD) overall status condition data for the rivers in the WMCA, provided by Environment Agency (Table 16). Many of the rivers flow through more than one of the local authorities in the WMCA and several will have varying condition levels at different points along their course.

Table 16 Number of stretches of rivers in each Water Framework Directive category for each local authority 2019

Status	Bad	Poor	Moderate	Good	Total
Birmingham		5	10	0	15
Wolverhampton		1	5	0	6
Coventry		4	6	0	10
Dudley		3	5	0	8
Sandwell		1	5	0	6
Solihull		6	8	0	14
Walsall	1	2	5	0	8
Total	1	22	44	0	67

Appendix 3. Natural capital benefit methodologies

This appendix describes the methods used to measure and value natural capital benefits in the baseline account. These methods are summarised in Table 17 below, and then described in more detail. Where relevant, method descriptions also note differences with other analyses in the study area that quantify the same benefits, but were not used due to incomplete coverage and/or methodological differences.

Table 17 Overview of benefits included in the asset values of the WMCA Natural Capital Balance Sheet

Benefit	Description	Annual Physical Flow Measure	Monetary Valuation Metric & Method	Beneficiary
Food provision	Estimated arable and livestock production per hectare of farmed land valued at market prices.	Area of land in agricultural production (ha); Number of livestock and tonnes of crops	Benefit calculated using farm profit (University of Exeter, 2019), adjusted to Defra areas of production (DEFRA, 2024)	Private Businesses
Carbon regulation	Estimated for woodland, using the average UK sequestration rate (tonnes CO^2 equivalent per hectare) and the non-traded value of carbon.	Carbon sequestered in habitat (tCO_2e/yr)	Non-traded central carbon value (DESNZ, 2023)[6] £/t/CO_2e	Global society
	Estimated for arable land using Natural England's 2021 rates (tonnes CO^2 equivalent per hectare) and the nontraded value of carbon.	Carbon emitted by peatland (tCO_2e/yr)		
Air quality regulation	Estimated for woodland using the average rate of PM2.5 removal for the local authorities covered by the account and avoided health risks and medical costs as a result.	PM2.5 removed by woodland (kg/yr)	Avoided cost (medical treatment and productivity) and welfare gain(£/ha) by eftec and CEH (2019)[7]	UK society

[6] DESNZ, 2023 Green Book supplementary guidance: valuation of energy use and greenhouse gas emission for appraisal. Available at: https://www.gov.uk/government/publications/valuation-of-energy-useand-greenhouse-gas-emissions-for-appraisal

[7] eftec and CEH (2019). Pollution removal by vegetation. Available at: https://shiny-apps.ceh.ac.uk/pollutionremoval/

Benefit	Description	Annual Physical Flow Measure	Monetary Valuation Metric & Method	Beneficiary
Recreation	Estimated in terms of number of visits to accessible greenspaces (that are less than three hours in duration), and the welfare value associated with these visits.	Recreational visits, less than 3-hours (visits/yr)	Benefit to visitors evaluated as total welfare value from (ORVal) tool[17]	Visitor population
Physical health	Estimated by the proportion of the visits that are active, the health benefits of active recreation (in terms of improvements in Quality Adjusted Life years – QALYs[18]) and the economic value of health improvement. Avoiding these costs is additional to the welfare from enjoying good health/recreation.	Total active visits	Avoided medical treatment costs per year, based on Claxton et al., (2015).[19]	Visitors
Flood risk management	Estimated by valuing the flood mitigation effects of avoided surface run-off provided by trees	Volume of water intercepted by tree canopy (m^3)	Avoided water treatment costs, based on iTree calculations (Styche and Forde, 2022)	Water companies
Temperature regulation	Estimated in terms of the avoided worker productivity losses from the cooling effects provided by urban blue and greenspace	Cooling effect of existing blue and greenspace (Bowler et al., 2010)	Avoided workforce productivity losses per year, based on (eftec, CEH and CEP, 2018) and (Costa et al., 2016)	Local businesses
Water quality	Estimated as the welfare gain from maintaining the Water Framework Directive (WFD) quality status of the waterbodies (Environment Agency, 2020) as reported in the natural capital asset register. The welfare gains from maintaining the WFD status makes use of the National Water Environment Benefit Survey (NWEBS) values for each river basin district in the accounting boundary.	Length (km) and area (km^2) of WFD waterbodies by status	Not evaluated in monetary terms	UK society

17 Day, B. H., and G. Smith (2018) Outdoor Recreation Valuation (ORVal) User Guide: Version 2.0, Land, Environment, Economics and Policy (LEEP) Institute, Business School, University of Exeter. https://www.leep.exeter.ac.uk/orval/

18 QALY is a health measurement used widely in health and health economics research. QALY of zero denotes death, and 1 denotes full health

19 Claxton K, Martin S, Soares M, Rice N, Spackman E, Hinde S, et al. (2015). Methods for the Estimation of the NICE Cost Effectiveness Threshold. Health Technology Assess. [online]. Available at: https://www.york.ac.uk/che/research/teehta/thresholds/

Benefit	Description	Annual Physical Flow Measure	Monetary Valuation Metric & Method	Beneficiary
Biodiversity	The valuation of biodiversity is complex and, in many contexts, contentious. A portion of this value is indirectly captured in the biodiversity indicators presented in the account for SSSI condition, as well as through the value of other benefits to which biodiversity contributes.	Species diversity in each local authority as a proportion of total possible diversity	Not evaluated in monetary terms	UK society

A3.1 Food provision

The areas farmed for crops and livestock in each local authority of the WMCA were sourced from the Department of Environment, Food, and Rural Affairs (DEFRA, 2024). Agricultural output in tonnes of crops and heads of livestock per hectare was sourced from the Natural Environment Valuation Online tool (NEVO) (University of Exeter, 2019). The areas cited for agricultural output in NEVO are larger than those in the DEFRA source so the yields per hectare were applied to the DEFRA area statistics to find the total output of livestock and crops in each local authority. The farm profit estimates per hectare from NEVO were applied in the same way to the DEFRA areas.

A3.2 Greenhouse Gases

Greenhouse gases benefit reflects carbon sequestration provided by woodland and greenhouse gas (GHG) and emissions from farming operations. The areas for both woodland and non-woodland trees and shrubs, as described in the asset register, were used to calculate sequestration. Natural England's sequestration rate of 5.7t CO_2e/ha (ONS, 2022) was applied to woodland areas, and based on expert judgement a rate 20% lower (4.3 tCO_2e/ha) was applied to nonwoodland trees and shrubs.

Emission calculations applied the Natural England estimate of 0.29 tCO_2e for arable land to the cropland areas estimated by NEVO (University of Exeter, 2019; ONS, 2022).

The amount of tCO_2e sequestered and emitted is then valued following the (DESNZ, 2023) guidance and inflated to 2024 prices (UK HM **Treasury,** 2024). The economic value of carbon sequestration in the account boundary is estimated using the non-traded central price, £294 per tonne of CO_2e in 2024. This is multiplied by the estimated tonnes of CO_2e sequestered.

Comparison to related methods

Carbon sequestration is also quantified in the baseline using the iTree approach. It uses sequestration rates between 11.69 and 25.5t CO_2e/ha, which are significantly higher than the average rates for UK woodland and trees (of around 5t CO_2e/ha). The iTree approach uses a different non-traded cost of carbon to value the sequestration, due to using different baseline years.

In addition, a study for Birmingham calculates carbon stock, but not sequestration rates.

A3.3 Air quality regulation

Air quality benefit included in the baseline natural capital account arises from the ability of different types of vegetation to remove pollutants from the air. This benefit is estimated by the amount of PM2.5 removed by woodland and the human health benefits of this removal.

Jones et al. (2017) modelled this benefit for the UK national accounts reflecting the variety of different levels of PM2.5 concentration, types and extent of vegetation and density of human population across the country (Jones et al., 2017). An update to this study produced estimates of PM2.5 removal per hectare of woodland by local authority across the UK. This has been updated annually since with this account using the latest (2023) estimates, inflated to 2024 values. The monetary benefit of removal is estimated as the avoided health care cost (eftec and CEH, 2019).

Comparison to related methods

An iTree study uses all tree canopy cover to quantify this benefit for a wider range of pollutants. However, the iTree study gives a lower monetary value as it uses an average UK social damage costs for pollutants, published in DEFRA guidance. The monetary values in the baseline are higher as they take into account the greater beneficiary population in the study area.

A3.4 Recreation

Recreational benefit is measured in terms of the number of visits to accessible greenspaces, and the average welfare value associated with these visits. This benefit is estimated by the number of visits and welfare value per visit. The online tool ORVal is used to for this purpose. The tool also breaks down the estimated number of visits and associated welfare value by socio-economic group. The physical flow (number of annual visits) and monetary value (welfare value) is assumed to remain constant over time.

It should be noted that the data from ORVal takes into account the location of the recreation asset, surrounding population, habitat type(s) and local alternatives, but makes the assumption that accessible green space is in average condition for its type. If the green space is in a better (worse) condition than average, this will likely have higher (lower) values for number and welfare value of visits. Similarly, as the model underlying ORVal is based on Monitor of Engagement with the Natural Environment (MENE) data, it does not take into account visits by children or overseas visitors to the UK.

Comparison to related methods

A study for Birmingham used MENE data from 2009/10 to 2013/14 to quantify the numbers of visits. Its approach to valuing recreation is the same as used in the baseline.

A3.5 Physical Health

In addition to providing recreational benefit to outdoor visitors, if people are active during their visits, recreation can also have measurable physical health benefits. This benefit is estimated by the proportion of the visits that are active, the health benefits of active recreation (in terms of improvements in Quality Adjusted Life years – QALYs) and the economic value of health improvement (in terms of the avoided health cost due to improvement in QALY).

Beale et al. (2007) analysed Health Survey for England data, estimates that 30 minutes a week of moderate-intense physical exercise, if undertaken 52 weeks a year, is associated with
0.0106768 QALYs per individual per year. Beale et al. (2007) assume this relationship between physical activity and QALYs is both cumulative and linear. White et al. (2016) estimates that 51.5% of recreation visits are ‘active’, where an ‘active visit’ is defined as those who had a moderate level of activity for 30 mins or more

Claxton et al. (2015) estimate a cost-effectiveness threshold of a QALY to be roughly £12,900/QALY in 2008 prices. This figure is used as a proxy for health costs, reflecting the avoided health costs when QALY is improved by one unit. Based on this information, the avoided health cost is estimated as £3.86 in 2024 prices. The monetary unit value is assumed to remain constant over time.

Comparison to related methods

A study for Birmingham used MENE data from 2009/10 to 2013/14 to quantify the numbers of active visits. Its approach to valuing recreation was based on a willingness to pay for a QALY, which gives a higher value than the cost-effectiveness valuation used in the baseline. However, as it is a welfare value, it may overlap with the recreation benefits value.

A3.6 Mental Health uplift

A3.6.1 Visits to new greenspace projects

A list of pipeline projects for the WMCA region was compiled by Accelar (Pipeline submissions combined xls). An extract of projects that detailed the area of greenspace creation or enhancement that would improve access, physical and mental health or social outcomes were filtered and used for this analysis.

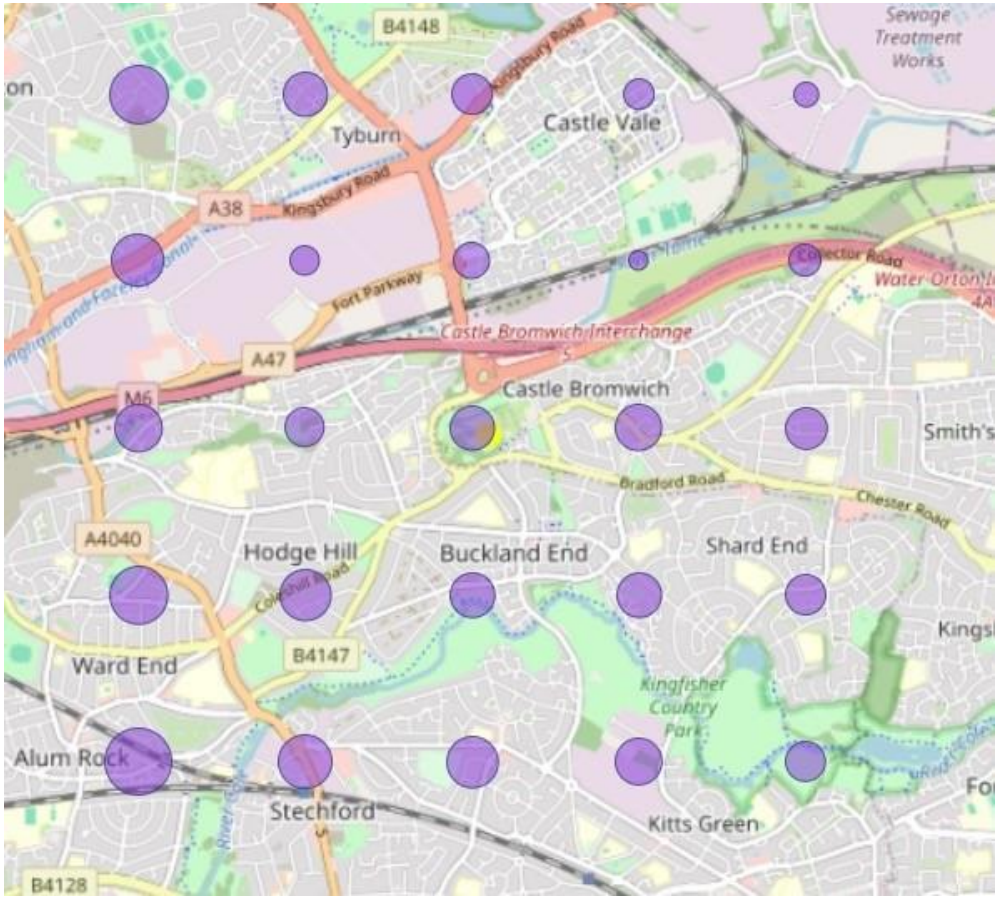
The Heat Map tool in ORVal was used to estimate the physical and monetary values of visits to these new areas outlined in the pipeline projects. This function gives a general indication of visits and welfare values for 25 sites that are generated within a 5km grid (roughly 1.6 km between each recreation site). The user can specify the area (in hectares) of the site.

In general, ORVal factors in habitat type and area into its model predictions, therefore when using the heat map function the user needs to specify the habitat type. For ease of calculation and owing to a lack of detail about many of the projects, this analysis was an iterative process where it was assumed that the projects would all involve greenspaces that were composed of 50% broadleaved woodland, 25% natural grassland and 25% managed grassland. In addition, 13.6km of riverside was added to ORVal habitat descriptions for the Sowe Valley project in Coventry.

The size of the dots represents the general magnitude of visits and welfare value, i.e. the larger the dot the greater the visit and welfare value is. The outputs of the model (including when using the heatmap function) are: the total number of visits, which should be regarded as an upper bound estimate; and an estimate of the number of new visits, which illustrates how many visits are predicted to visit the site that would not be made if the site was not there – a lower bound estimate. In order to report a conservative estimate of effects, the latter figure is used. As a result, the annual values reported are the welfare values for the new visits. These visits are valued on the basis of the average value of all visits, which is likely to be a slight underestimate of the value of new visits.

Some sites, such as Castle Bromwich were clearly within a defined area and of a defined size (Figure 6). In this case the physical and monetary values were taken directly from the dot overlying the site.

Figure 7 Example ORVal heat map output for the 16.1 ha site at Castle Bromwich



In other cases, where the site location is unknown, the average values of the 25 sites on the heatmap have been used to estimate the number of new visit and associated welfare values. For larger sites only those that are outside built-up areas are used in the analysis.

Where several small sites are proposed within the local authority boundary, the size of one site is used in ORVal to derive the visit and welfare estimates and this is then multiplied by the number of these sites. An example of this is the Birmingham pocket parks which are proposed to cover 8 ha. As a conservative estimate it is assumed there will be eight of these (although it is likely there will be more, smaller parks), so the heat map function is used in ORVal to find the average visit and welfare values in the local authority for a onehectare site. These are then multiplied by eight to find the total value to Birmingham Local Authority of creating eight one-hectare sites of greenspace.

A3.6.2 Incidence of mental health conditions (MHC) in the WMCA region

Visits to outdoor greenspace of 30 minutes or more per week are estimated to reduce the prevalence of MHCs by 7% (Shanahan et al., 2016). The proportion of visits to natural environments considered ‘active’ are those which last more than 30 minutes at least once per week, and have been estimated to account for 51.5% of all visits to nature (White et al., 2016). These have been applied across all greenspace habitats in the WMCA region.

The proportion of visitors with the three commonest MHCs (namely depression, anxiety, and CMD-NOS) are assumed to be the same as the proportion of the population with MHCs. According to ONS data, 3.3% of

been diagnosed with common mental health disorder not otherwise specified (CMD-NOS).

These proportions of prevalence of MHCs have been adjusted in two ways. Firstly, the numbers are adjusted to account for the higher or lower prevalence of each condition in each local authority compared to the national average. Secondly, it has been estimated that approximately 26% of mental health conditions co-occur, meaning that a single person may be diagnosed with multiple MHCs. The estimated number of MHC is therefore adjusted to account for this co-occurrence.

A3.6.3 Avoided MHC due to new or enhanced greenspace

The rates of each MHC treated per hectare in each local authority are multiplied by the number of estimated new visitors to greenspaces in each of those local authorities. The number of estimated new visitors to the created and enhanced greenspace with MHCs is then multiplied by the proportion of these people that are likely to benefit from visiting nature, which has been estimated to be 7% of MHC cases (Shanahan et al., 2016). This generates the number of MHC cases improved from visits to the proposed new greenspace. It has also been assumed that the mental health benefits of visits to greenspace will continue to persist for at least three years, so this figure has been tripled.

The value of treating these MHC cases through visits to greenspace is estimated based on the avoided treatment costs of MHCs (i.e. treatment-based costs) and the avoided productivity loss from a reduction in MHC cases in the workforce (i.e. employment related costs). Treatment-based and employment-based costs estimate the costs of treating a single MHC diagnosis in a single patient. They therefore need to account for the co-occurrence of MHC mentioned above (Saraev et al., 2021). Treatment-based costs have been adjusted by Saraev et al. (2021) based on the percentage of individuals with depression, anxiety, and CMD-NOS that actually seek and receive treatment for their MHCs. Treatment-based costs include the cost of visits to GPs, prescribed drugs, inpatient care, supported accommodation and social services, as well as contact with a range of professionals and other costs (Saraev et al., 2021). Employment-based costs are estimated according to the average annual working days lost from individuals with depression or anxiety (Saraev et al., 2021). The treatment-based and employment-based costs are added and multiplied by the number of reduced MHC cases to estimate the total avoided costs from visits to greenspace.

the population has been diagnosed with depression, 5.9% has been diagnosed with anxiety, and 7.8% has

A3.6.4 Method limitations

Exact locations and sizes of new green space creation in the WMCA area are not known, so this analysis was based on a scenario of new greenspace creation based on a draft proposed list of pipeline projects, provided by Accelar, that are projected to have health and well-being benefits. The uplift in mental health benefits is calculated using ORVal, employing assumptions on the size and location of the pipeline projects, as described in Appendix 2. Estimates of new visits and their welfare value are the lower bound

estimates associated with the projected greenspace from the chosen pipeline projects. This analysis comes with some caveats which may cause over- or underestimation of the values of mental health benefits:

- ORVal does not compute new visits for greenspace enhancement, only creation of new greenspace.

- There is no association between living within 1km of greener areas and better mental health outcomes, only between the frequency of actual visits to the greenspace (White et al, 2021).

  Saraev et al, 2021 assumed that the people visiting greenspace have the same proportion of mental health conditions as the general population, however, the proportion of people with poor mental health visiting greenspaces may be higher than the general population if they actively seek out greenspaces.

- The treatment costs of mental health disorders may be underestimated as they are based on publicly available data and many people may seek help privately or through employer schemes. Days lost through sickness may also be an underestimation due to the enduring stigma of disclosing mental health conditions in the workplace. (Saraev et al, 2021). Employment related costs are based on the national living wage in 2024 so is the lower bound of costs.

- The value of mental health and well-being benefits for those not suffering from or who would never suffer from a MHC, are unaccounted for (Saraev et al, 2021).

- The research only looked at walking – mental health benefits may increase for more vigorous exercise.

- The heat maps used to estimate new visit numbers and welfare values, in some cases, are based on assumptions of number and size of greenspaces to be created or enhanced in each pipeline project. ORVal can only estimate uplift to visit number and welfare values for created habitat, while many of the pipeline projects involve greenspace enhancement which generally results in fewer new visits.

- Treatment costs are taken adjusted to 2024 prices from a 2008 study (McCrone et al) so could have changed significantly. They are also adjusted based on the percentage of those suffering from MHCs that are assumed to seek treatment for these conditions (McManus et al, 2016), which may also have changed in the interim period.

- Persistence of the benefits of greenspace to mental health conditions is currently unknown.

- Not every demographic gets the same benefit and sense of place and cultural heritage are also important. The research found that those with non-White heritage had less mental health benefit than White British (White et al, 2019)

A3.7 Flood risk management

iTree have estimated the annual avoided surface run-off by calculating the volume of precipitation intercepted by leaves, to compare with and without vegetation. Using their canopy cover estimates for each local authority, they have calculated the avoided surface run-off from random plots in each area. The value of this is based on estimated or user-defined local values. These values include the cost of treating the water, but as this

is part of a combined sewage system the lower, national average externality value is reported and applied (Treeconomics, 2022, 2023).

Comparison to related methods

A study for Birmingham uses a benefit transfer approach, (based on the area of habitat that provides flood risk regulating services - including grassland, heathland, hedgerows and wetland areas).

A3.8 Temperature regulation

The calculations for this benefit were based on eftec's work on local climate regulation for DEFRA (eftec, 2018). In that study, the average per hectare cooling effect on the urban environment of different types of blue and greenspace was estimated for the West Midlands using previous research (Bowler et al., 2010; Volker et al., 2013). It is assumed that without these habitats, there would be a corresponding increase in temperature. The overall cooling effect of existing green and blue space in the West Midlands area was estimated in eftec's study to be 0.720^{c}.

Table 18 Cooling effect per hectare of habitat, by type (Bowler et al., 2010)

Habitat	Cooling effect (-0^{c})
Woodland <3ha	-3.5
Woodland >3ha	-3.5
Woodland buffer	-0.52
Parks/grass >200m^2	-0.95
Parks/grass buffer	-0.52
Gardens >200m^2	-0.95
Gardens buffer	-0.52
Rivers/canals >25m	-1.4
Rivers/canals buffer	-0.8
Lakes/ponds >700m^2	-0.1
Lakes/ponds buffer	-0.06

It is assumed that only certain economic sectors are affected by excessive temperatures. The benefits valued are the productivity losses avoided during hot weather events as a result of the cooling effect of the extant natural capital. The productivity loss functions from Costa et al. (2016) were applied to the GVA/day of each sector in each local authority (Office of National Statistics, 2018). These productivity loss functions identify productivity loss estimates (% less than "full work") for each sector (work intensity) affected under the different hot day temperature bands being used for the city being assessed (Costa et al., 2016).

Productivity losses without vegetation are calculated as a proportional increase towards the productivity losses at the next temperature band, based on the temperature change of the combined cooling effect of each city-region. The productivity loss averted at each temperature band due to urban vegetation is calculated by subtracting the productivity loss without urban cooling effect by productivity loss with urban cooling effect. The 5-year average of the number of days in the West Midlands area where a range of hot days were experienced (eftec, 2018), was used to estimate the annual value of productivity losses in each sector (Table 19).

Table 19 5-year average of the number of days in the West Midlands where a range of hot days were experienced

Habitat	Cooling effect (-0^{C})
Woodland <3ha	-3.5
Woodland >3ha	-3.5
Woodland buffer	-0.52
Parks/grass >200m^2	-0.95
Parks/grass buffer	-0.52
Gardens >200m^2	-0.95
Gardens buffer	-0.52
Rivers/canals >25m	-1.4
Rivers/canals buffer	-0.8
Lakes/ponds >700m^2	-0.1
Lakes/ponds buffer	-0.06

To determine the total productive days lost in each sector due to hot days, the productivity loss averted per temperature band is multiplied by the number of hot days at each temperature band (eftec, 2018). For each sector, the GVA per day is multiplied by the productive days lost due to hot days and the values summed.

Costa et al, 2016 estimate that adaptation measures (including behavioural changes and air-conditioning) will lessen the effect of productivity losses in workers from hot days. They estimate that the losses are reduced by 40% for outdoor workers and 85% for indoor workers, thus negating some of the avoided productivity losses provided by urban greenspace (Costa et al., 2016).

A3.9 Water quality

Overall condition of waterbodies in the river basins that lie within the WMCA area were provided by Environment Agency (DEFRA, 2023). As many of these waterbodies flow through multiple local authorities, the data cannot be precisely evaluated. Instead, the proportions of each condition (bad, poor, moderate and good) were calculated for each the waterbodies that were wholly or partly in each local authority. For the final output, only the proportions of those in moderate or good condition were shown in the final output. There was no monetary valuation estimated for water quality.

A3.10 Biodiversity and Biodiversity Net Gain

The proportion of plant diversity in each local authority as a percentage of the total possible diversity in that region were provided by NEVO (University of Exeter, 2019). No monetary value was applied.

The supply and demand of biodiversity units was calculated using eftec's 2021 model (eftec et al., 2021). Supply measures the potential Biodiversity Units (BUs) available in each LPA through habitat creation or enhancement. Annual demand is the estimated annual biodiversity loss to development multiplied by the biodiversity net gain requirement of 10% and the estimated off-site mitigation rate of 50%. It is assumed that not all potential biodiversity units will be made available for development so potential supply must be ten times that of demand for there to be no scarcity in each year.

A3.11 Tree Equity

The Tree Equity Score measures how well the benefits of trees are reaching communities living on low incomes and others disproportionately impacted by extreme heat, pollution and other environmental hazards. It is calculated using the Priority Index which prioritises the need for planting at ward level, to achieve Tree Equity based on six equally weighted climate, health and socioeconomic variables. This is integrated with the tree cover in each ward to calculate Tree Equity Score UK for that ward.