

# Natural Capital Account - Bristol

Prepared for Bristol City Council



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# **Bristol's Natural Capital Account: Executive Summary**

# Bristol's greenspaces provide services worth £385 million gross per year

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Bristol's greenspaces receive an estimated **17 million recreational visits per year**.

This results in **£385 million per year in gross benefits to local communities**.

**£361 million per year results from health benefits**, composed of improvements to mental wellbeing (61% of the gross value), and increases in the quantity and quality of life from physical activity (33% of gross value).

Health and wellbeing services deliver approximately **£22 per visit** on average.

Bristol's greenspaces help regulate the climate by **removing £0.3 million worth of carbon** every year and also provide **£24 million in benefits to property owners** through an annualised uplift in the value of residential properties

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# **Overview of Natural Capital Accounts: definition, purpose, methods**

# Why use Natural Capital Accounts ?

Natural Capital Accounts (NCA) present the estimated visits and annual monetary value of a place's publicly accessible greenspaces. They are an instrument for strategic planning and making the case for funding.

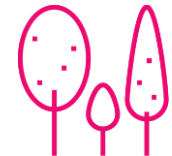
## Strategic greenspace planning

The NCA can highlight how different parks are performing in terms of the ecosystem services they create, providing policymakers with data for planning and future investment

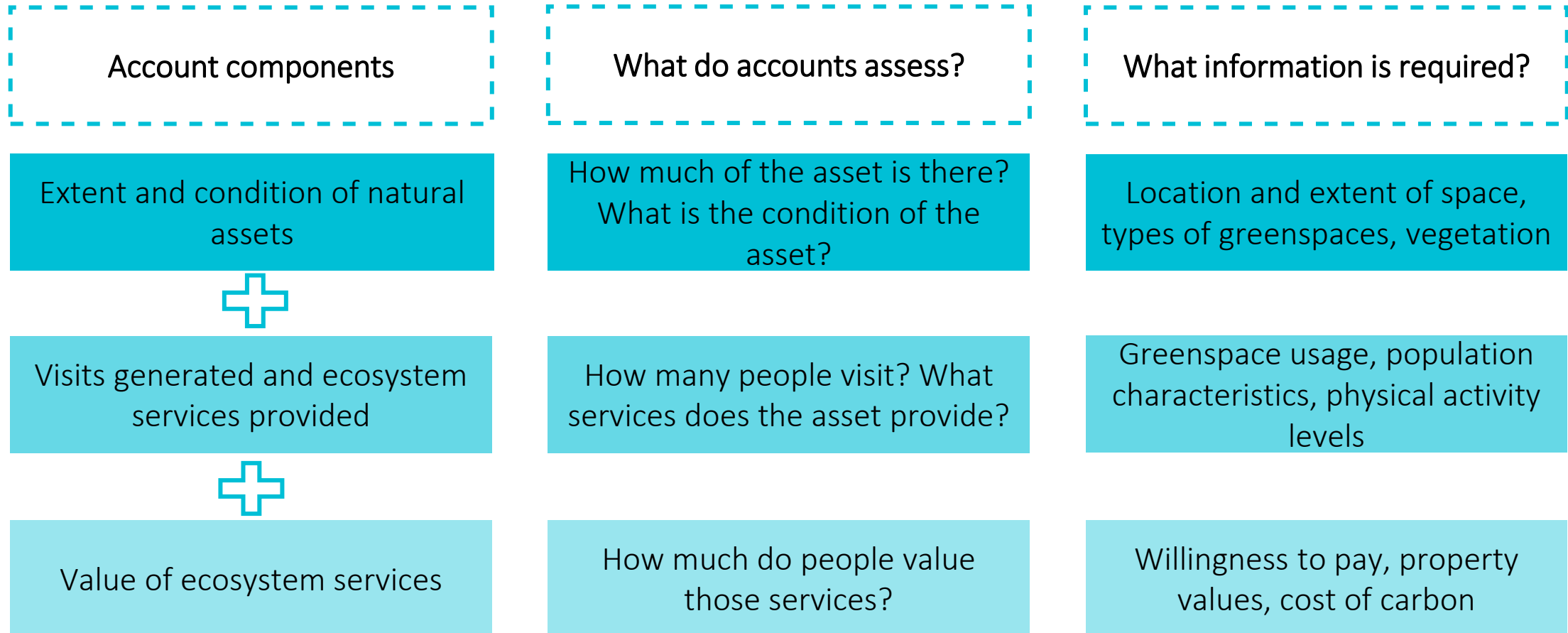


## Effective funding proposals

Better strategic planning leads to a stronger business case for additional funding or green space development.



# A Natural Capital Account (NCA) creates a clear framework for linking natural assets with the value of services they provide to people



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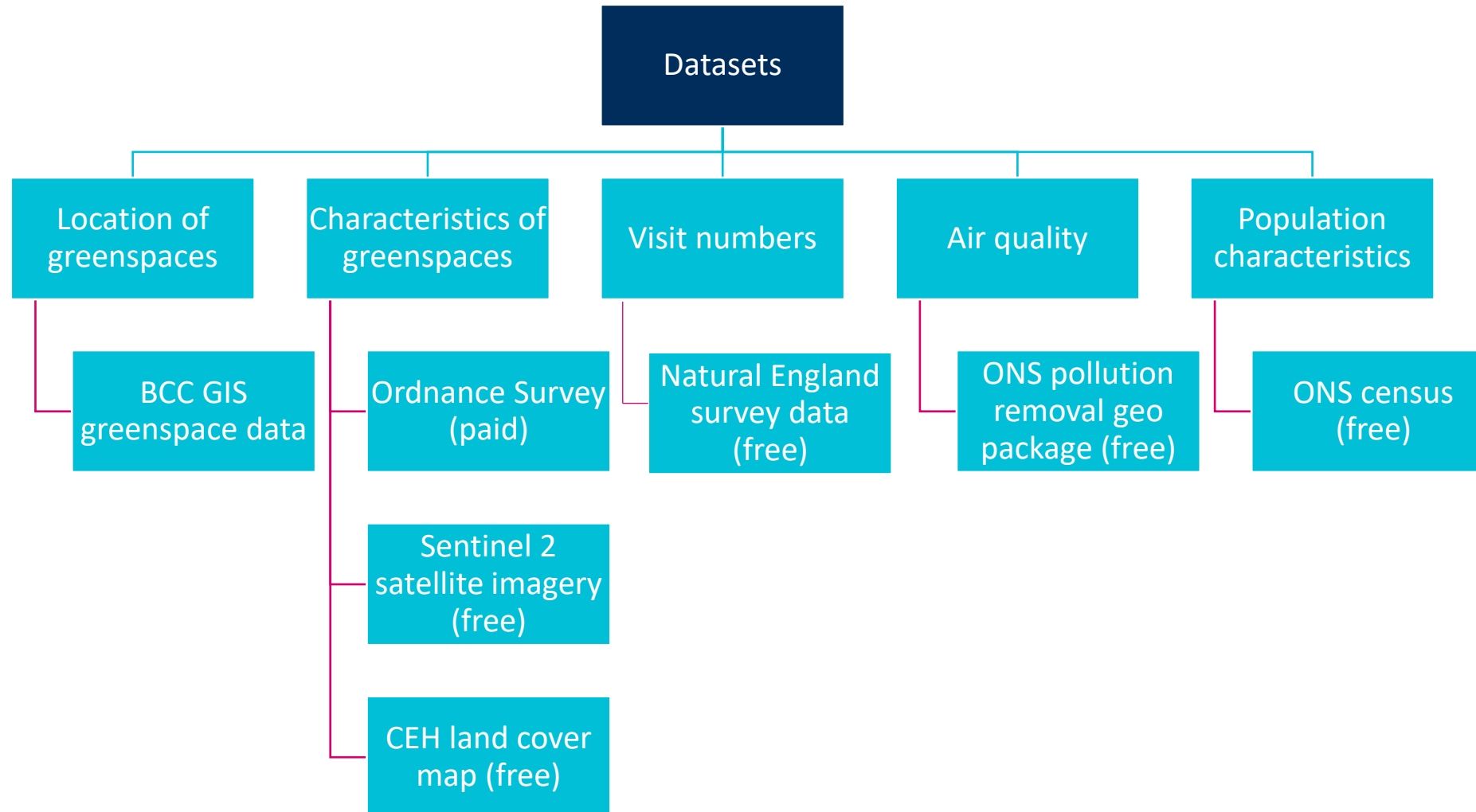
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# To provide robust NCAs, Greenkeeper creates a comprehensive and consistent database on UK greenspace assets



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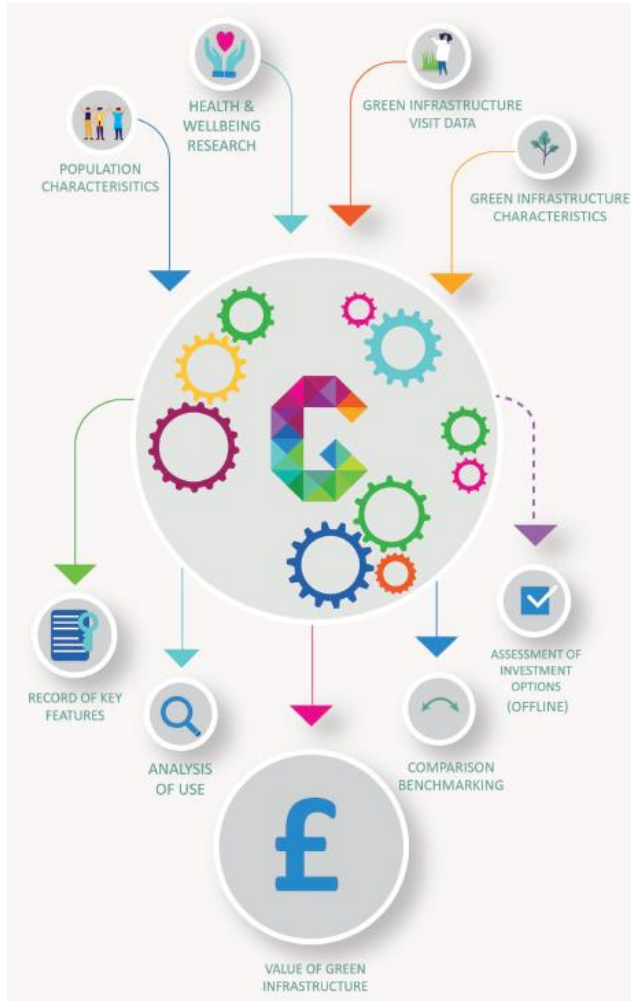
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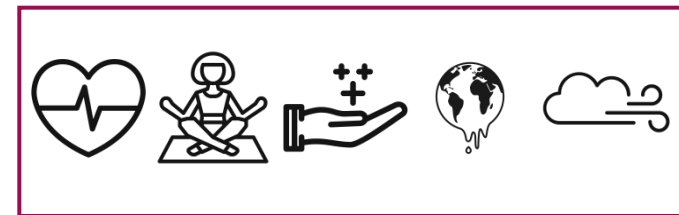
# Greenkeeper predicts how people use UK greenspaces and the benefits they receive.



## Step 1: predict visit numbers



## Step 2: value annual ecosystem services



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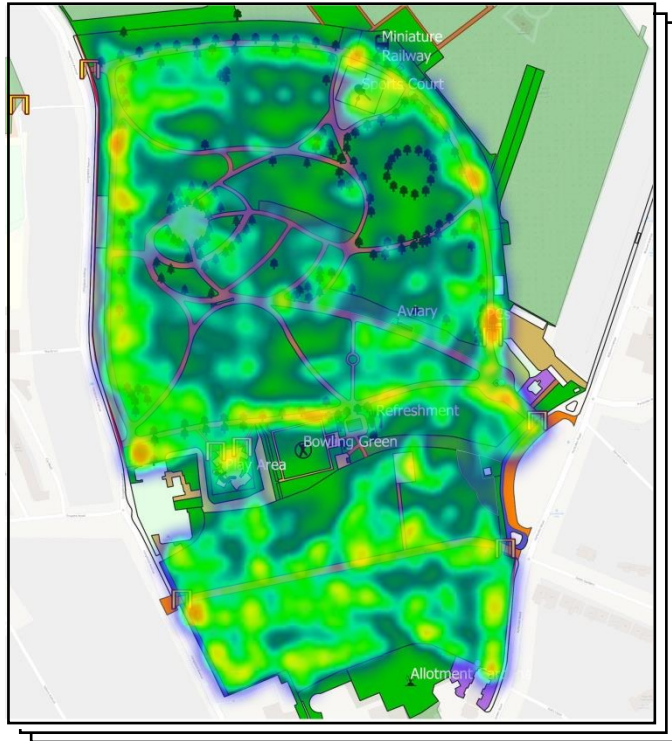
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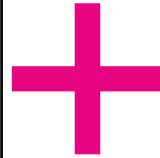
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# Visit numbers are estimated based on the location and characteristics of the greenspace and population

Observational data is used as an input to estimate greenspace visits:



Visit numbers for individual greenspaces



Location, characteristics of greenspaces and population

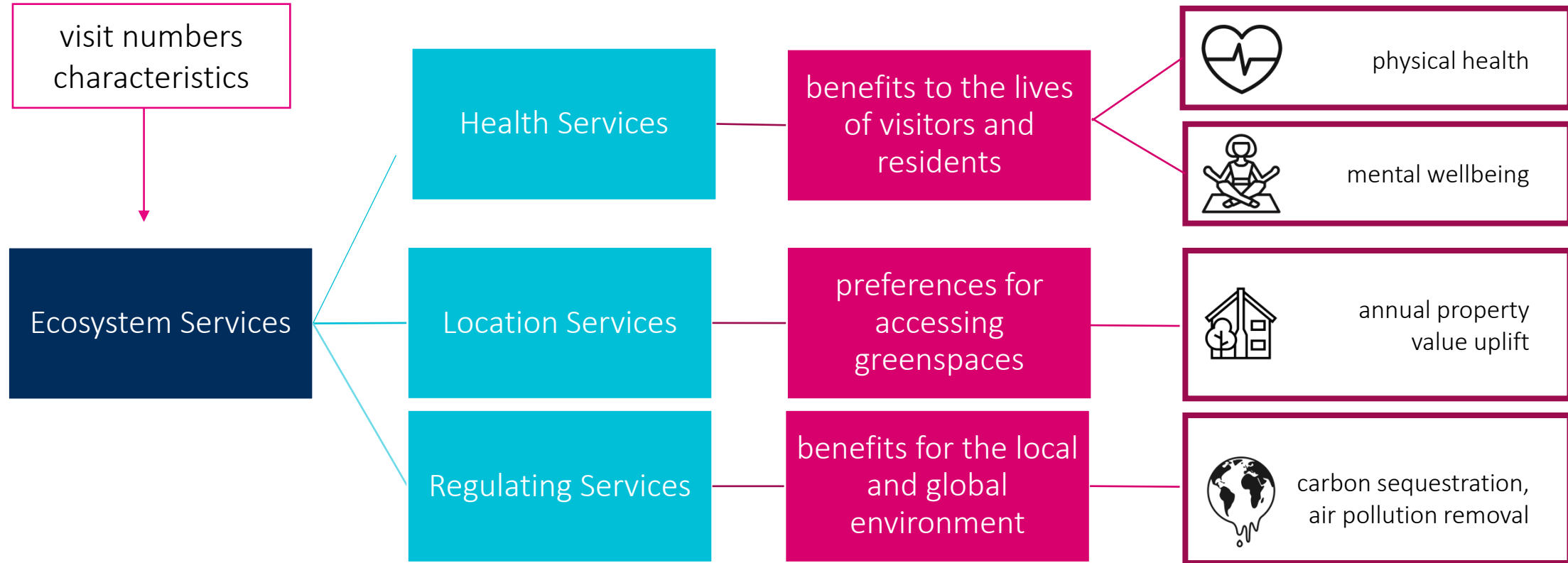


**Demand model:**  
statistical model that predicts visit numbers for more than 20,000 greenspaces in the UK based on location and characteristics

Visit numbers for any urban greenspace in the UK, as well as future developments

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## Based on visit numbers and characteristics, benefits are estimated and valued



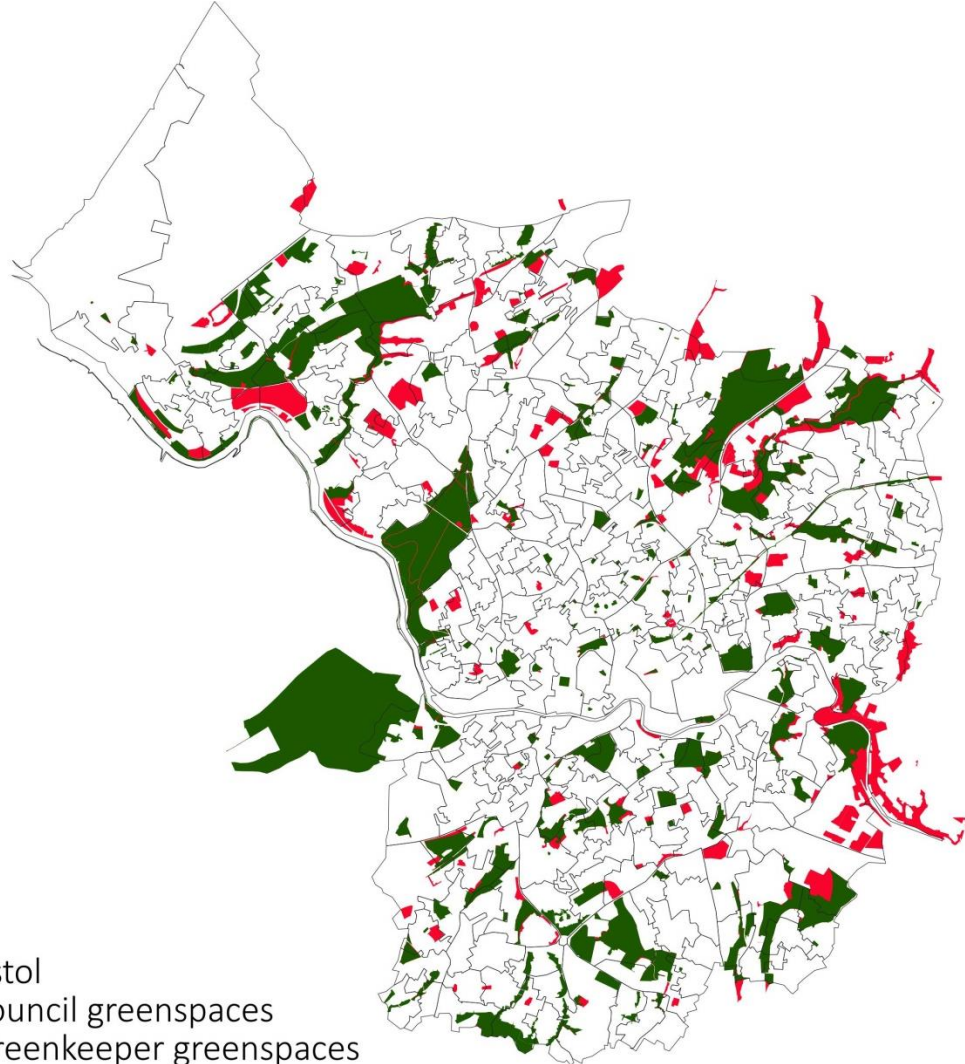
We measure ecosystem services as benefits that would be lost if a green space were removed or changed – or the benefits gained by providing a new greenspace. Other benefits not measured by Greenkeeper today include biodiversity, flood management, and education.

Note: Further details on ecosystem services and their valuation methods are provided on slide 21 and the appendix, respectively.

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# **Bristol City Council's natural assets**

## The new Bristol natural capital account is based on a comprehensive set of changes to the City's greenspace portfolio



In consultation with Bristol City Council, multiple changes to the City's greenspaces have been made, including:

- updated characteristics and features for every greenspace; and
- removal of non-council-owned greenspaces (shown in red) and the addition of new council-owned greenspaces

In total, our analysis covers 237 greenspaces – an additional 82 greenspaces from the previous natural capital account

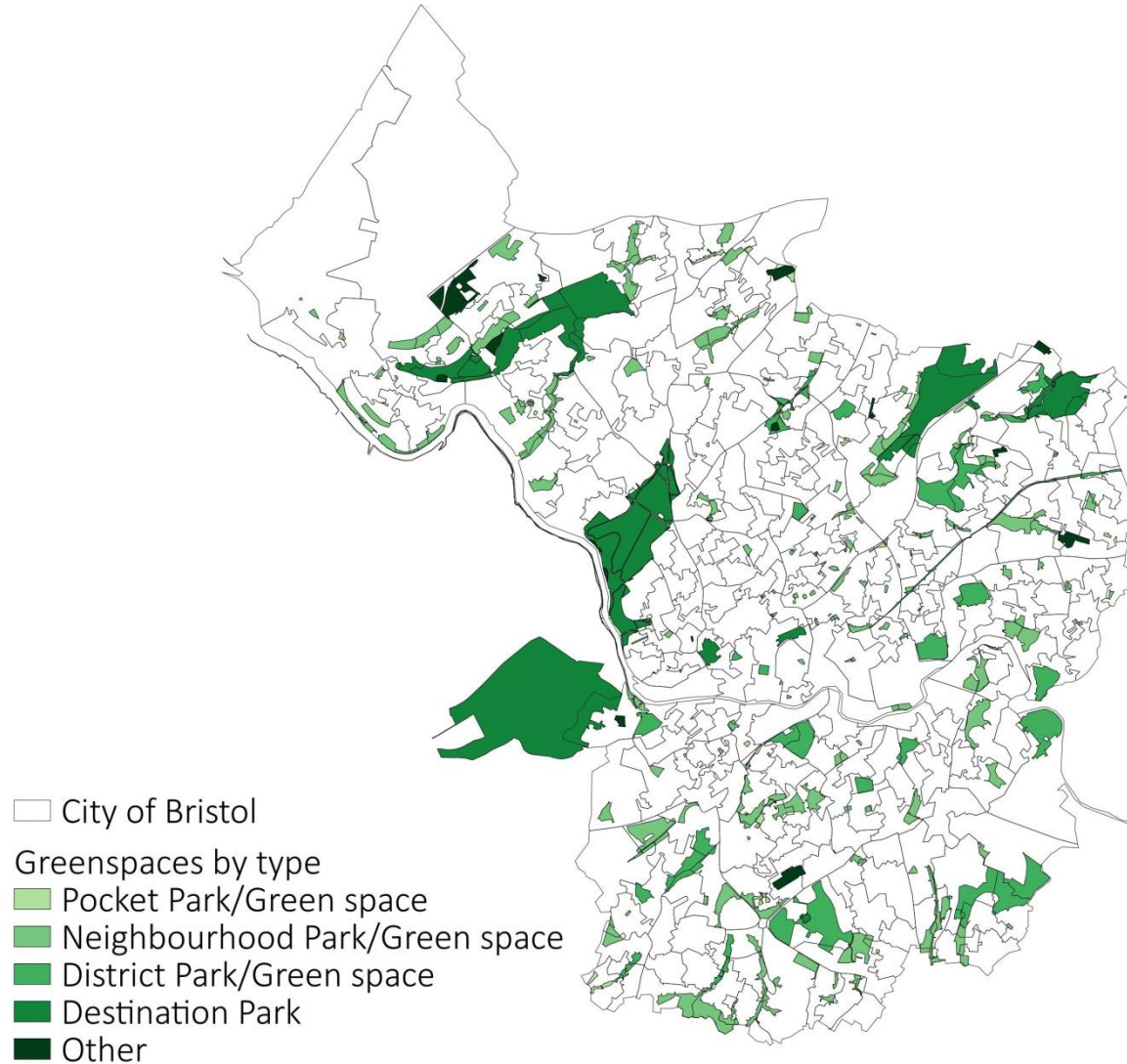
## Greenspaces are grouped into five categories based on Bristol City Council's greenspace classification

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Classification	Area in hectares	Number of parks
Pocket Park/ Greenspace	25	47
Neighbourhood Park/ Greenspace	499	138
District Park/ Greenspace	353	26
Destination Park	799	11
Other	64	15
<b>Total</b>	<b>1,741</b>	<b>237</b>

# Greenspaces are grouped into five categories based on Bristol City Council's greenspace classification

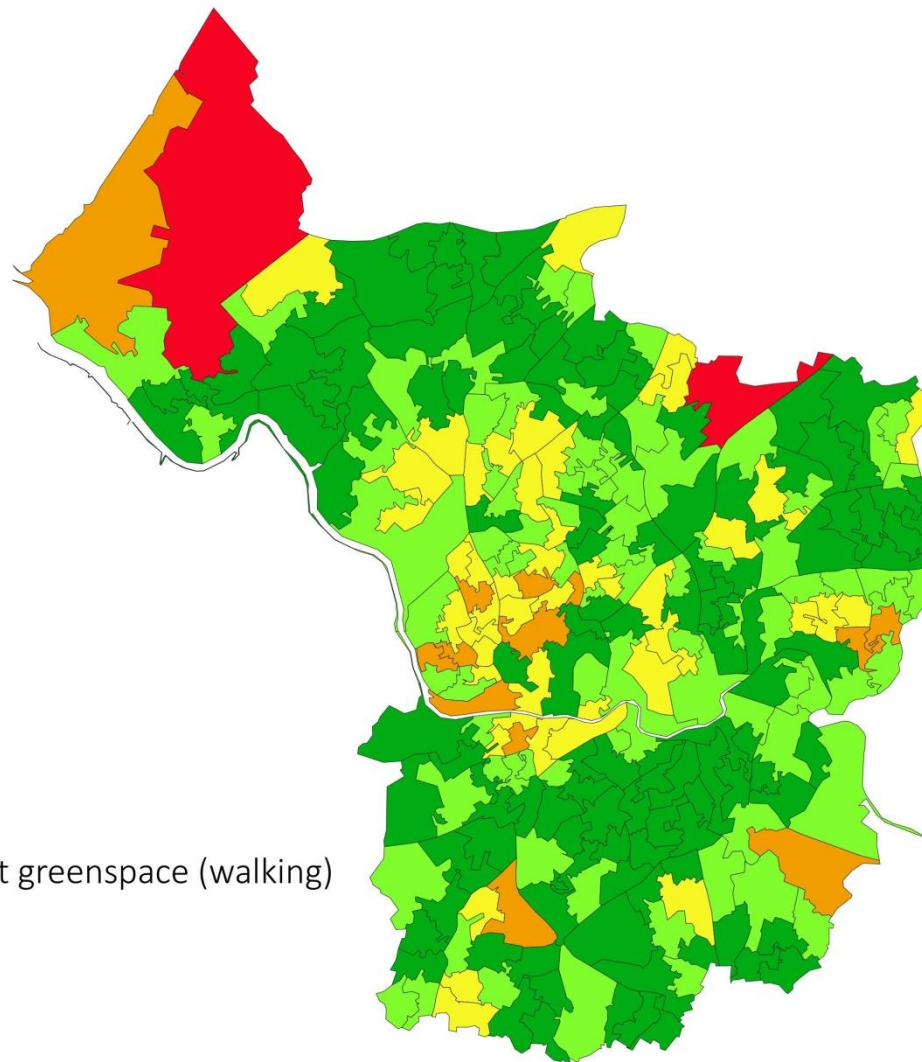
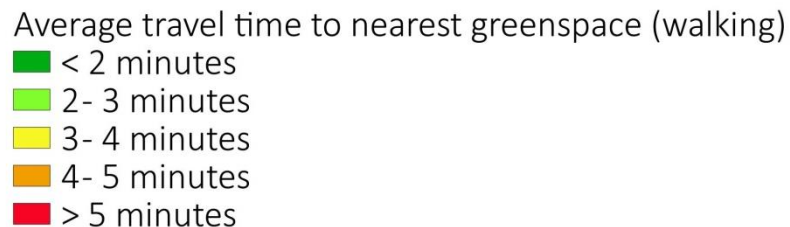
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# The average resident in Bristol typically lives within 5 minutes walking distance to a greenspace of at least two hectares in size

Greenkeeper calculates travel times to predict annual visits to greenspace. The travel time corresponds to the time spent walking on footpaths or driving on roads to a publicly accessible greenspace from each LSOA in Bristol.

Bristol is generally characterized by high accessibility to greenspaces. The average individual in Bristol typically spends less than five minutes on foot to reach a greenspaces that is 2 hectares in size or larger.



Note: Lower-level super output area (LSOA). Travel time to nearest greenspace is calculated as the time spent walking from a population-weighted centroid to the nearest greenspace that is 2 hectares in size or larger. See [Office for National Statistics Survey data](#) for more information.



# Visits to Bristol greenspaces

## Visit numbers are predicted using observational data taken from the Measuring Engagement with the Natural Environment survey

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Visit numbers are calculated based on a **recreational demand model**, which uses national survey data from the Measuring Engagement with the Natural Environment (MENE) survey to estimate visits to greenspaces based on local population characteristics.

The MENE survey captures how often individual's living in England visit greenspaces and, most importantly, **reveals which greenspaces are visited the most**, allowing us to infer relationships between the features and characteristics of a greenspace, and whether an individual is likely to visit that greenspace.

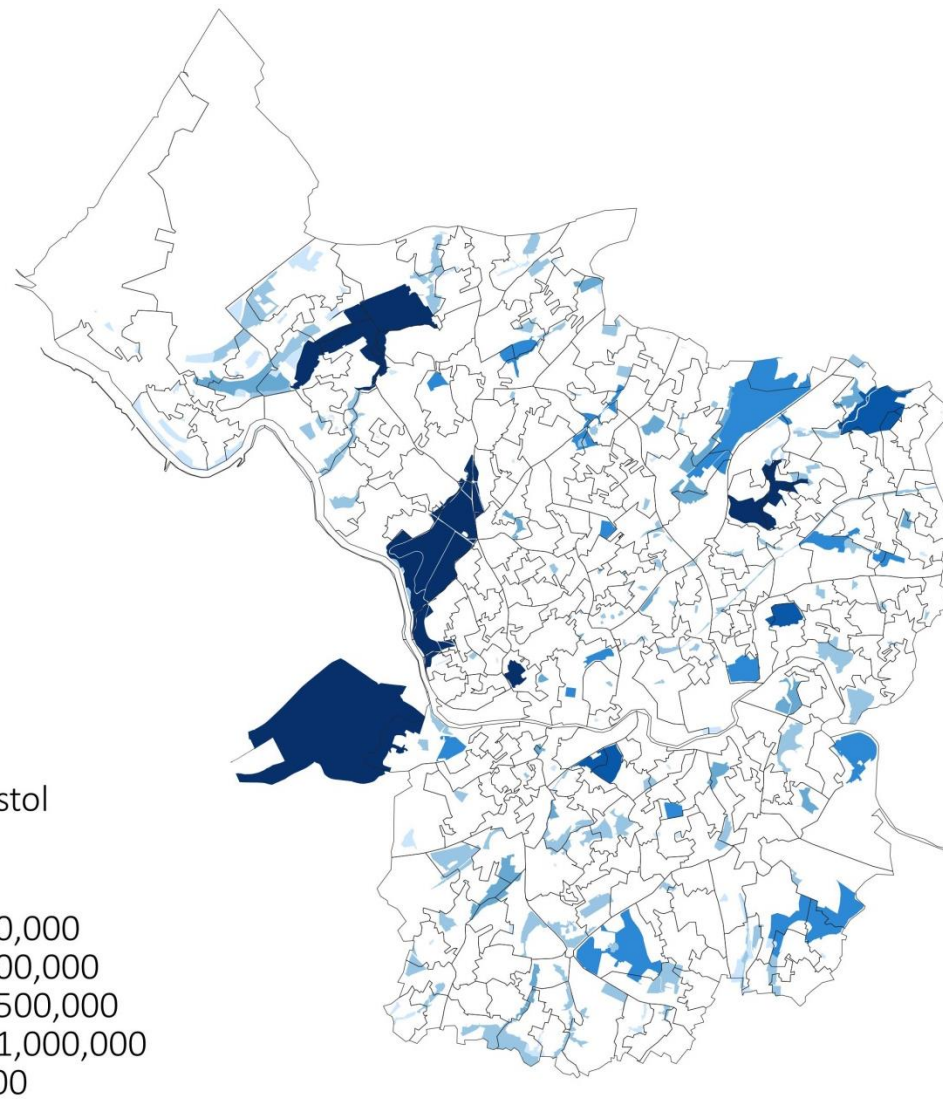
The MENE survey is limited to individuals aged 16 or older, meaning the visit numbers produced by Greenkeeper are predictions for adults only. **A visit to a greenspace can originate from any urban location in the UK**, so long as the time it would take them to travel to that greenspace is less than 60 minutes. A visit from a non-UK resident, such as a tourist from abroad, is not captured within our model.

## Greenkeeper uses detailed information on greenspace characteristics, accessibility and amenities in order to predict annual visits

Characteristics and accessibility	Cafes	Attractions	Play areas	Sports facilities	Toilets
Size	Cafes, snack bars and tea rooms	Archaeological sites	Playgrounds	Athletics facilities	Public toilets
Location	Fast food and takeaway outlets	Historic and ceremonial structures	Children’s activity centres	Bowling facilities	
Crime rates	Pubs, bars and inns	Historic buildings		Climbing facilities	
Accessibility to public transport	Restaurants	Museums		Golf ranges, courses and clubs	
Water cover and waterbody count		Designated scenic features		Sports ground, stadia and pitches	
Grey cover i.e. buildings, footpaths, etc.		Observatories and planetariums		Gymnasiums, sports halls and leisure centres	
Green flag awards				Swimming pools and tennis facilities	

Note: Greenkeeper only considers amenities located within greenspaces. Amenities located near or adjacent to greenspaces are not included.

# The model estimates that 17 million recreational visits are made to Bristol's greenspaces every year



Bristol receives 17 million visits to the city's greenspaces annually.

- on average, 323 thousand visits are made per week to Bristol greenspaces
- each hectare of greenspace in Bristol receives approximately 9 thousand visits annually

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# Large greenspaces that offer a variety of different amenities are typically the most visited in Bristol

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Amenities such as cafes, toilets, attractions and play areas are associated with more visits in Bristol

- the ten most visited greenspaces are home to 162 different local amenities, over 30% of all greenspace amenities

64% of all visits to greenspace in Bristol are made to ten parks, primarily due to:

- a greater number and variety of amenities; and
- larger total area, to accommodate for various forms of recreation and physical activity

However, the parks receiving the most visits per hectare of greenspace are smaller in size, suggesting that smaller parks can be more efficient at attracting visitors.

- when considering weekly visits per hectare of greenspace, the ten most frequented greenspaces are all less than 8 hectares in size

# **Ecosystem services of Bristol greenspaces**

# Ecosystem services are the benefits that humans derive, either directly or indirectly, from the natural environment

**Greenspaces are an essential source of ecosystem services for urban populations.** Individuals directly benefit from the recreational and cultural services that greenspaces provide, making themselves healthier and happier in turn. At the same time, these spaces provide us with indirect benefits such as climate regulation and the removal of local air pollution.

## Greenkeeper focusses on the value of four ecosystem services

- improvements to health from physical activity in greenspace
- improvements to mental wellbeing from time spent in greenspace
- increases in the value of properties for homeowners due to locations near greenspace
- removal of greenhouse gases from the atmosphere

## The four pillars of ecosystem services

Physical health benefits



Mental wellbeing benefits



Annual property value uplift



Carbon sequestration



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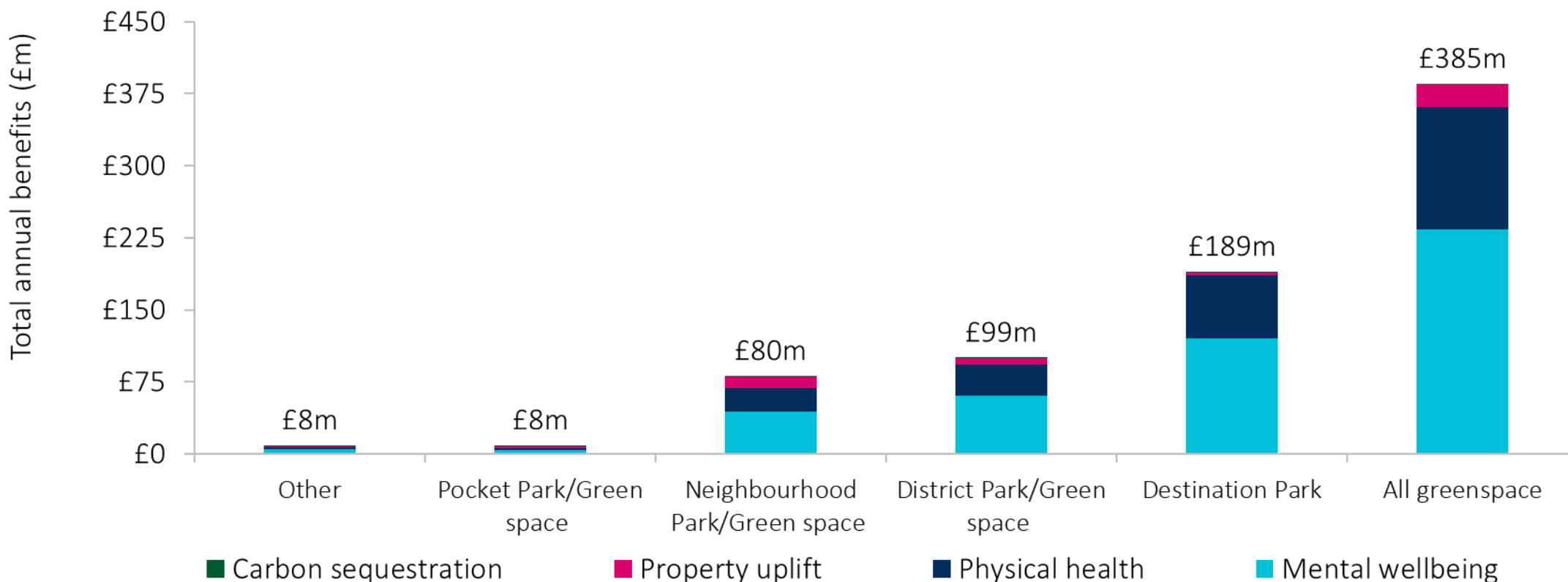
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# Bristol greenspaces provide services valued at £385 million per year, 75% of which is attributable to Neighbourhood and Destination Parks

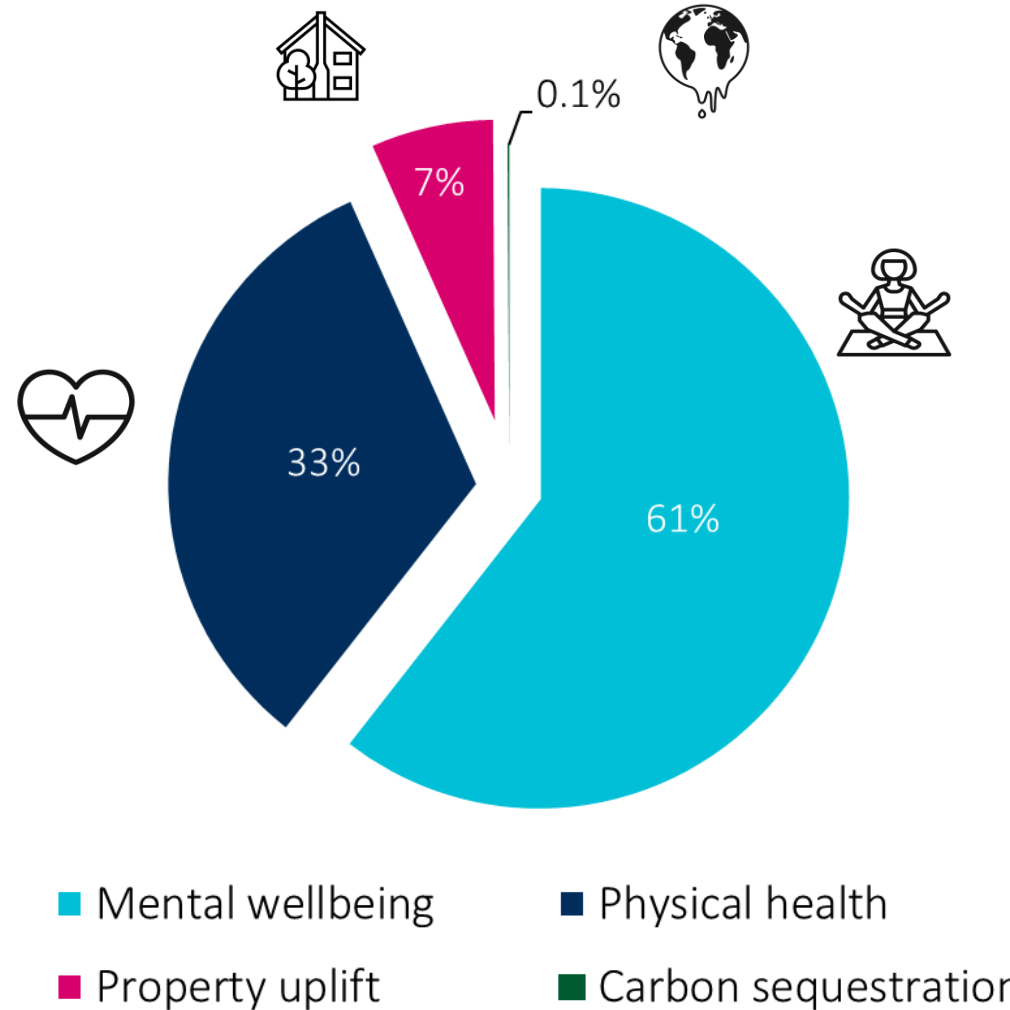
Neighbourhood Parks and Destination Parks occupy the most land cover and attract the most visits in Bristol. However, **Neighbourhood Parks** tends to be more accessible for local populations, attracting visits from nearby residents. **Destination Parks** typically attract visitors from across the city due to their size and the greater variety of amenities offered to visitors.



Note: Greenspaces ordered by total annual benefits from smallest to largest



## Mental and physical health account for 94% of greenspace benefits in Bristol



Improvements to mental wellbeing and physical health for greenspace visitors are valued at **£361 million per year**, accounting for to 94% of the total value of Bristol greenspace

Note: Benefits defined as the monetary value of the four ecosystem services



# Mental wellbeing benefits are valued at £234 million per year, approximately £14 per visit

Time spent in greenspace affects an individual's reported level of life satisfaction. More time spent in greenspace is associated with a higher level of life satisfaction according to studies comparing self-reported wellbeing with time spent outdoors.

We place a value on this increase in life satisfaction to calculate mental wellbeing improvements. The value is based on the amount of money a person would need to be compensated in order to achieve the same increase in life satisfaction gained from their time spent in greenspace.

Mental wellbeing benefits	Value
Mental wellbeing benefits	£234 million per year
Mental wellbeing benefits per visit	£14 per visit

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# Physical health benefits are valued at £127 million per year, approximately £8 per visit

Green space visitors achieve physical health benefits from undertaking activity in green spaces e.g. running, cycling, etc.

We measure health outcomes in terms of risk of mortality and quality-adjusted life years (QALYs). Physical activity reduces disease rates and improves quality of life.

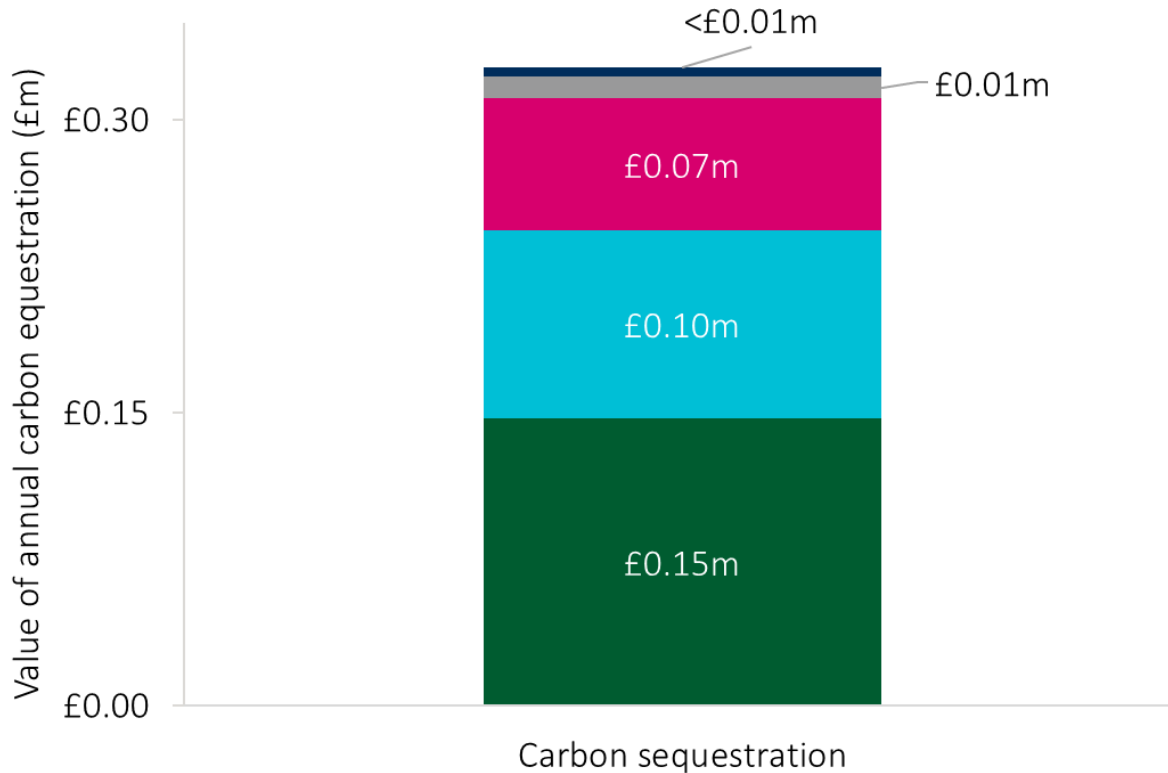
Physical health benefits	Value
Physical health benefits	£127 million per year
Physical health benefits per visit	£8 per visit

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Note: A QALY is unit of measuring life expectancy, weighted by quality of life.



# Greenspaces remove £0.3 million worth of CO<sub>2</sub> per year, with approximately 45% of removals occurring in Destination Parks



- Pocket Park/Green space
- District Park/Green space
- Destination Park
- Other
- Neighbourhood Park/Green space

Bristol greenspaces capture thousands of tonnes of CO<sub>2</sub> per year. Tree canopy cover within green spaces indicates the amount of carbon sequestered.

The largest share of CO<sub>2</sub> sequestration primarily occurs in destination parks, which contains 45% of greenspace tree cover in Bristol.

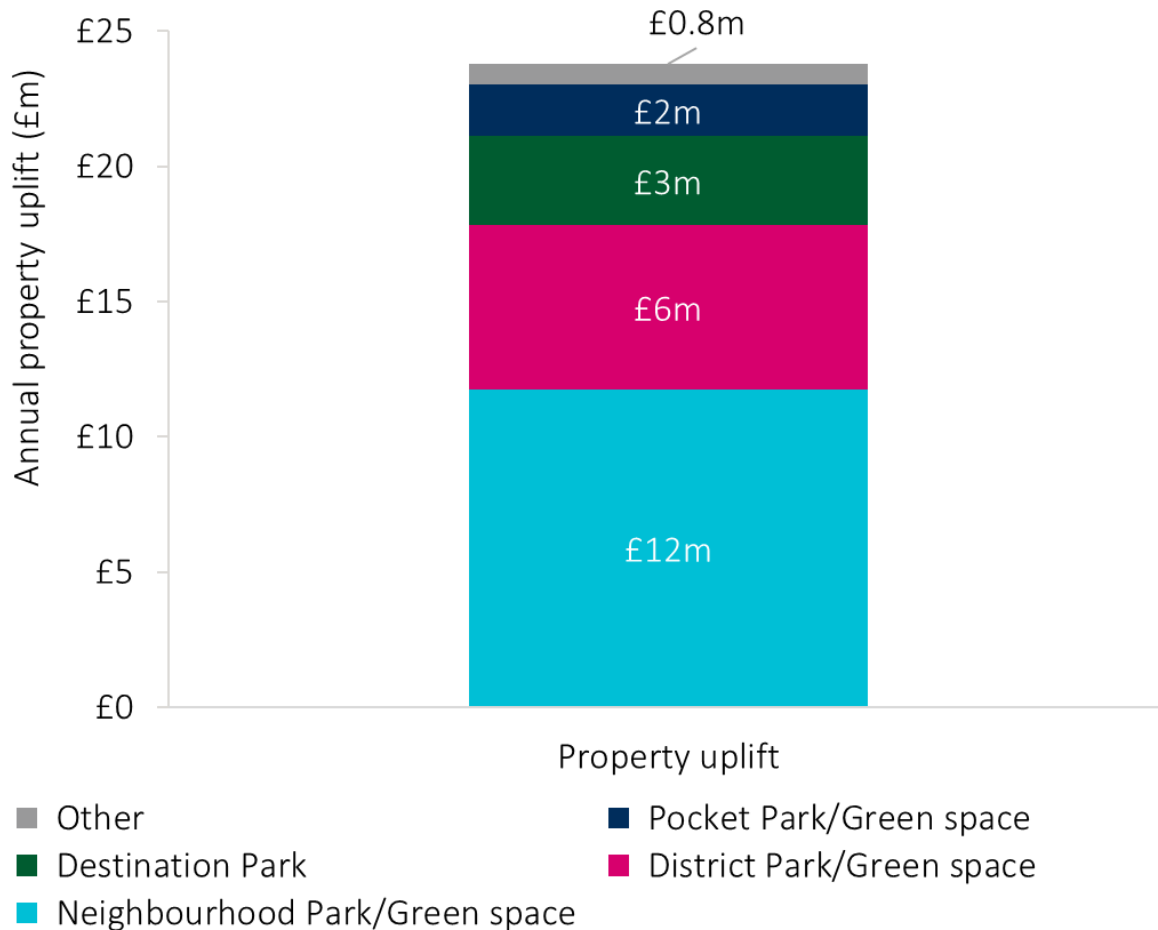
The value of carbon sequestration is £330 thousand per year, approximately £190 per hectare of greenspace. We value the reduction in atmospheric carbon using the UK government’s non-traded price of carbon.

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Note: Tree cover is calculated using 10m resolution optical imagery from the European Space Agency’s Sentinel 2 satellite during Summer 2018.



# Greenspaces provide £24 million in property uplift annually, representing 7% of the total value of Bristol's greenspaces



Annual property uplift measures people's preference for living near green spaces. This is reflected in higher property prices near greenspaces.

The uplift of house prices near greenspaces reflects its value to residents through their use of the space and also its contribution to the attractiveness of a residential area.

Properties near Neighbourhood Parks receive 50% of all property uplift in Bristol, partly due to location, but also due to the large number of local parks.

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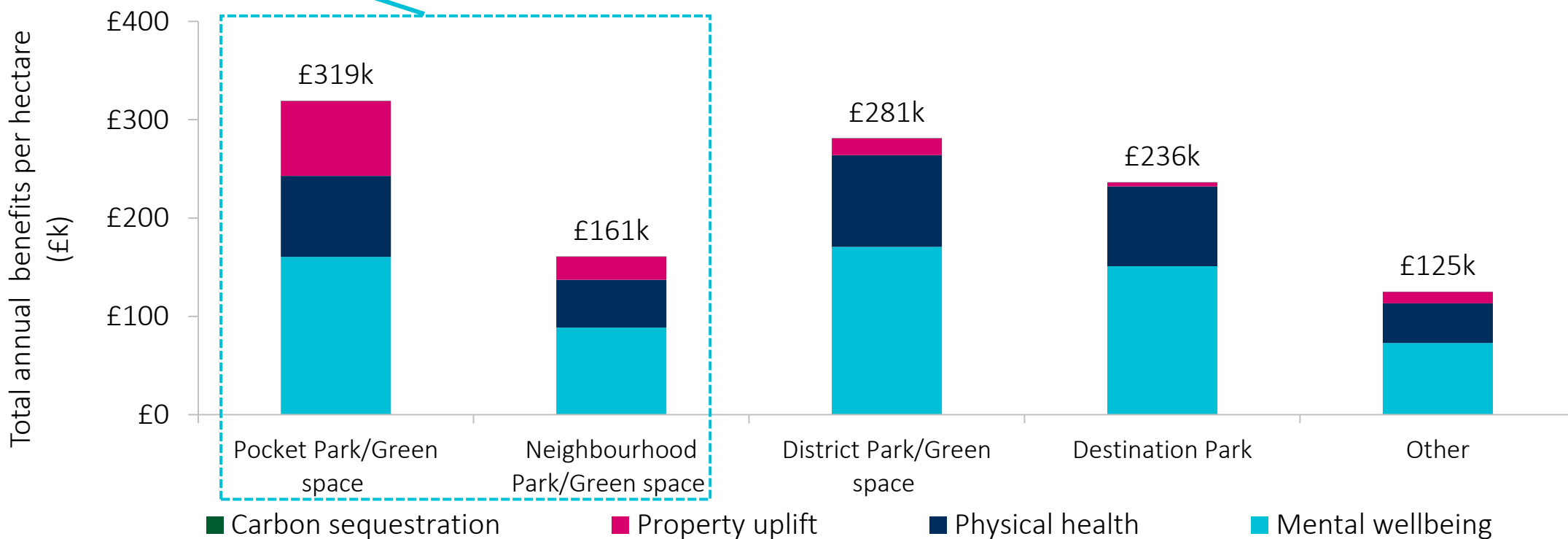
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## Smaller greenspaces derive a greater share of their value from property uplift due to locations in densely populated areas

The relative importance of annual property uplift among smaller parks is driven by their locations, typically in densely populated areas, which results in a higher number of residential properties receiving an annual property uplift. On the other hand, residential properties are less frequently located near destination parks, the value of which is typically driven by mental and physical health benefits from park visitors. This can be seen below, where the share of total value per hectare attributable to housing price uplift decreases with park size.



Note: Greenspaces ordered by size from smallest to largest. The 'other' category, which consists of greenspaces of different sizes, is placed at the end.

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## Recap: £385 million of gross value is created by the city's greenspaces, 94% resulting from improvements in health and wellbeing



Smaller greenspaces are better at delivering benefits to homeowners, owing to locations in densely populated area. However, larger parks deliver more health benefits by attracting greater footfall from across the city.



Visits to all greenspaces have significant benefits for mental wellbeing and physical health, valued at £361 million per year.



Going forward, increasing the frequency of visits to greenspaces and the level of physical activity in these spaces could unlock even greater value from existing parks. Similarly, new greenspace developments could target densely populated areas where accessibility is low.

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## Glossary of terms

Term	Description
LSOA	Lower-layer super output area. A small geographic area used for reporting localised statistics in the UK.
Ecosystem services	Ecosystem services are the benefits that humans derive, either directly or indirectly, from the natural environment.
Carbon sequestration	CO <sub>2</sub> captured from the atmosphere and stored within organic matter such as trees.
QALY	Quality-adjusted life year. A unit for measuring the quantity and quality of life. One QALY equals a year lived in perfect health.

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## Bristol's natural capital account

		Park Size					All Parks
		Other	Pocket Park	Neighbourhood Park	District Park	Destination Park	
Ecosystem Benefits (£m)	Carbon sequestration	<1	<1	<1	<1	<1	0.3
	Amenity value	1	2	12	6	3	24
	Physical health	3	2	24	33	65	127
	Mental wellbeing	5	4	44	60	121	234
	<b>Total Benefits</b>	<b>8</b>	<b>8</b>	<b>80</b>	<b>99</b>	<b>189</b>	<b>385</b>

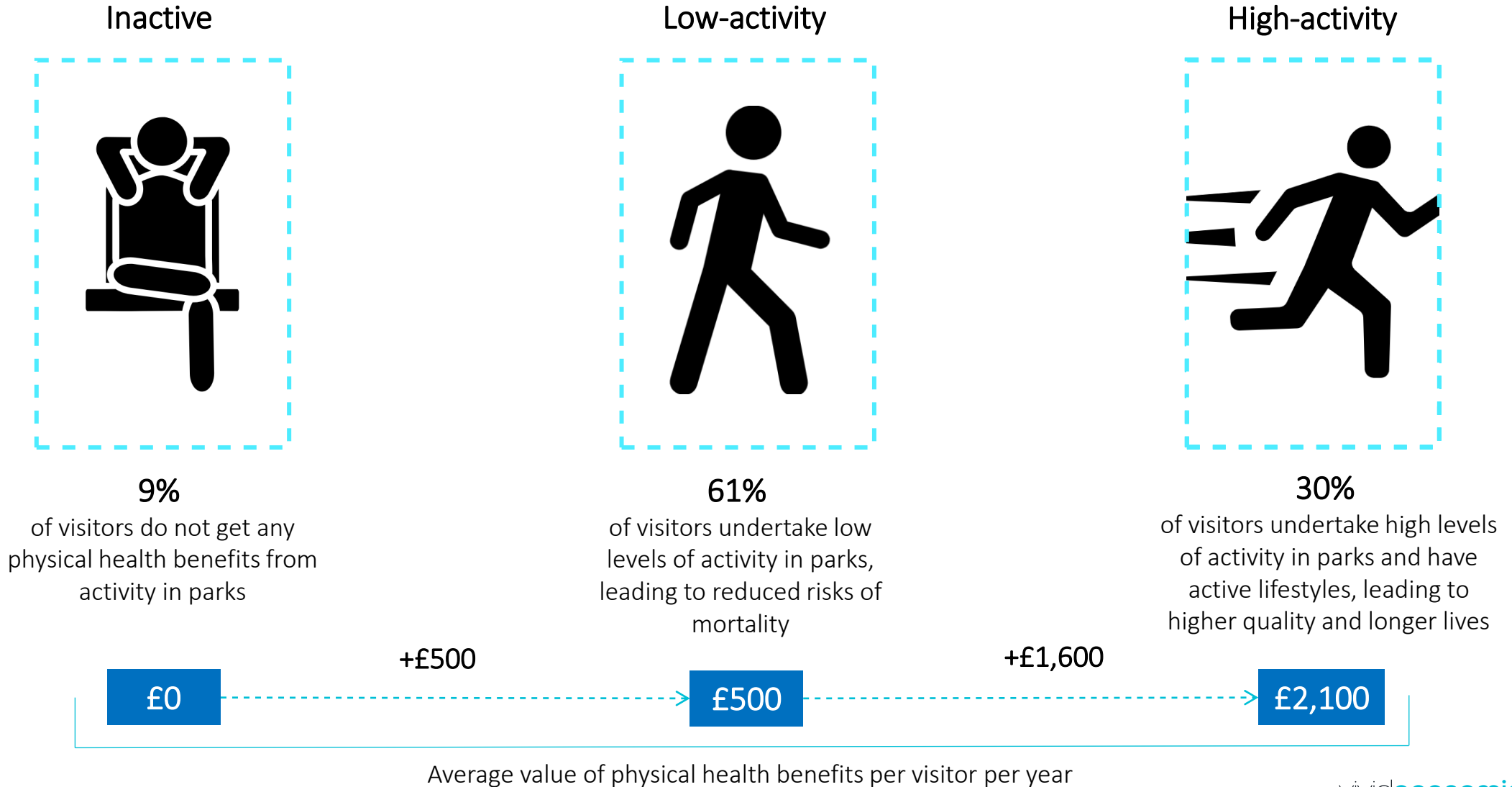
Note: total benefits may not sum up to the same number due to rounding

## There are nearly 500<sup>1</sup> amenities in Bristol's greenspaces

Types of greenspace	Tree cover (ha)	Blue cover (ha)	Grey cover (ha)	% tree cover	% blue cover	% grey Cover	# cafes	# attractions	# play areas	# sports facilities
Other	31	1	1	49%	1%	1%	0	1	2	33
Pocket Park	13	0	1	53%	1%	5%	0	1	25	2
Neighbourhood Park	264	3	14	53%	1%	3%	2	4	78	73
District Park	185	4	14	52%	1%	4%	3	6	30	83
Destination Park	405	3	9	51%	0%	1%	13	27	7	41
<b>TOTAL</b>	<b>898</b>	<b>11</b>	<b>40</b>	<b>52%</b>	<b>1%</b>	<b>2%</b>	<b>18</b>	<b>39</b>	<b>142</b>	<b>232</b>

Note: <sup>1</sup> Waterbodies and toilets not shown in the table.

# Most visitors to greenspaces undertake some physical activity but fail to meet NHS recommendations of 150 minutes of exercise per week



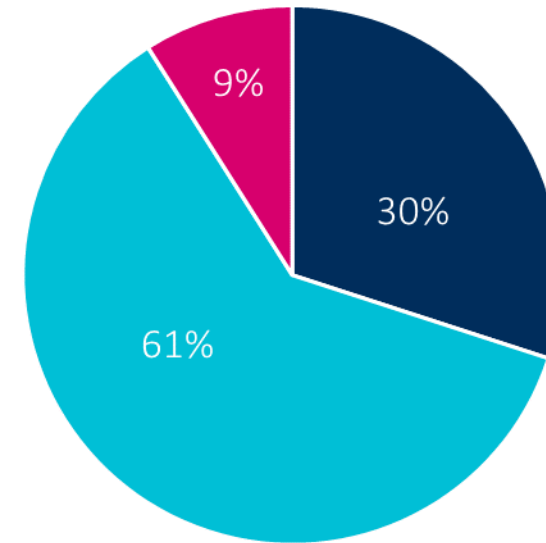
Note: Values in this slide reflect the average activity levels in medium sized parks. The average value of physical health benefits will vary in small and large

## Visitors with an active lifestyle, or those meeting NHS guidelines, are those who report being active for more than 30 minutes on 5 or more occasions per week

We estimate the share of visitors making active visits and exercising at least 150 minutes a week by identifying the share of respondents in the MENE survey who reported undertaking an activity during their visit with a 'Metabolic Equivalent of Task' (MET) of 3 or higher, and who also reported being active for more than 30 minutes on 5 or more occasions per week. Visitors who meet these criteria are classified as **high activity visitors**, and they represent **30% of greenspace visitors**.

A separate share of visitors are those who report undertaking exercise in greenspace with a MET of 3 or higher, but who do not meet the NHS guidelines of 30 minutes of activity on five or more occasions per week. These visitors are classified as **low activity visitors**, accounting for **61% of all greenspace visitors**.

The last share of greenspace visitors are those individuals that meet neither the criteria for high activity visitors or low activity visitors. In other words, these are visitors who do not undertake physical activity in greenspace with a MET of 3 or higher. These are **inactive visitors** who make up the remaining **9% of greenspace visitors**.



- High activity visitors
- Low activity visitors
- Inactive visitors

# 61% of visitors to greenspace do less than 150 minutes of physical activity per week

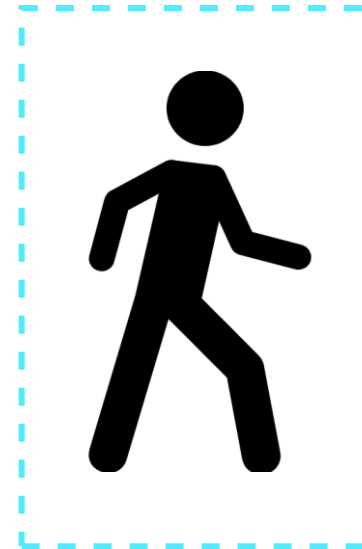
## What is a low-activity visitor?

A low activity visitor undertakes physical activity in greenspace at intensity levels that are beneficial for health, but for less than the NHS recommend 150 minutes per week. The proportion of low-activity visitors is calculated based on reported physical activities within greenspaces from MENE survey data.

## How do we measure the physical health benefits gained by these visitors?

- We estimate the reduction in risk of all-cause mortality as a result of physical activity in greenspaces
- Using this change in risk, we calculate the number of fatalities prevented among low activity users due to green space, and multiply total lives saved by the value of a prevented fatality (VPF = £2.2m)<sup>1</sup>

## Low-activity



61%

of visitors undertake low levels of activity in parks, leading to reduced risks of mortality<sup>2</sup>

Note: <sup>1</sup>VPF represents the value used in cost-benefit analysis to determine how much a public entity is willing to spend preventing a fatality. The VPF used by the UK Government is £2.2 million (HM Treasury, 2018); <sup>2</sup>values are indicative of activity levels in medium sized parks, and will vary for small and large parks

Sources: NHS (2011) Fact Sheet 4: Physical Activity Guidelines for Adults (19-64 years); World Health organization (WHO) Health Economic Assessment Tool (HEAT).

Accessible from: <https://www.heatwalkingcycling.org/#homepage>

## 30% of visits are made by high-activity people who do more than 150 minutes per week

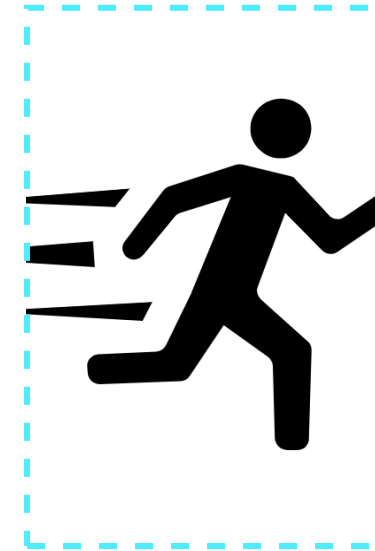
### What is a high-activity visitor?

A high activity visitor undertakes physical activity in greenspace at intensity levels that are beneficial for health for 150 minutes or more per week. The proportion of high-activity visitors is calculated based on reported physical activities within greenspaces from MENE survey data.

### How do we measure the physical health benefits achieved by these visitors?

- We estimate the number of Quality Adjusted Life Years (QALYs) <sup>1</sup> gained by high activity visitors each year
- We value improvements based on the HM Treasury Green Book guidance on the value of an additional QALY

### High-activity



30%

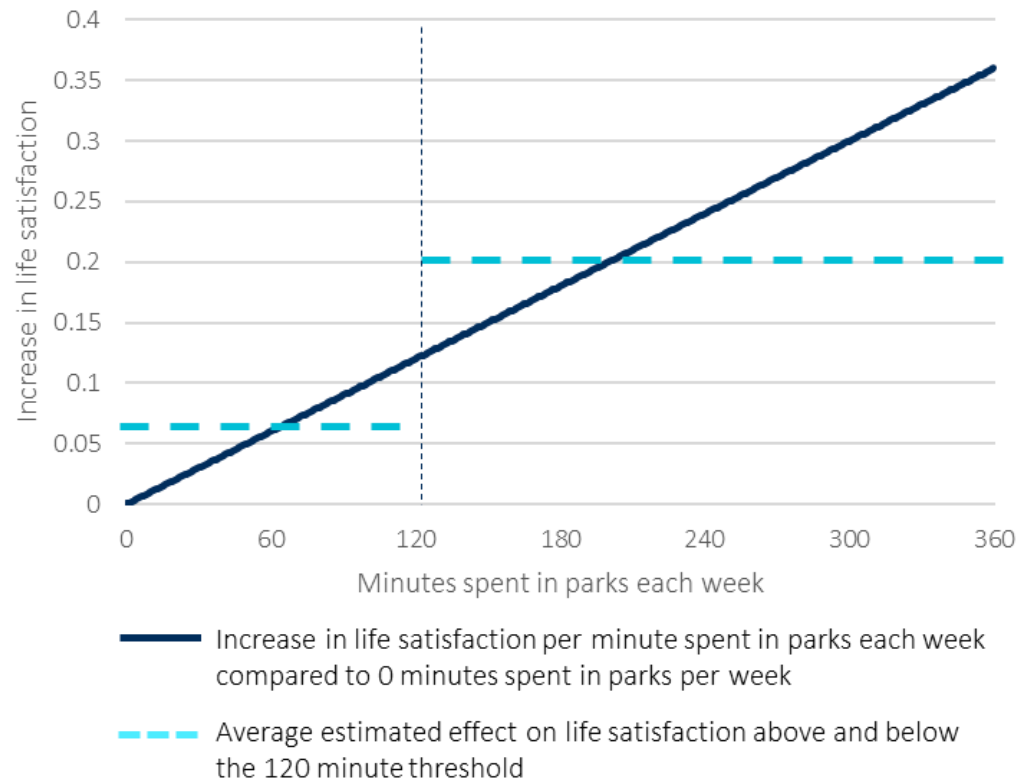
of visitors undertake high levels of activity in parks and have active lifestyles, leading to higher quality and longer lives<sup>2</sup>

Note: <sup>1</sup> A QALY is unit of measuring life expectancy, weighted by quality of life; <sup>2</sup> values are indicative of activity levels in medium sized parks, and will vary for small and large parks

Source: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/685903/The\\_Green\\_Book.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf).

# Regular visits to greenspaces improve wellbeing similarly to having full time employment or being married

University of Exeter and Vivid Economics have developed a new method to value the improvements in wellbeing based on the relationship between visit frequency and reported wellbeing. We use a recreation demand model to estimate the number of greenspace visits added by a park and the resulting quality of life improvements





# Amenity value measures the additional amount of money that people are willing to pay to live in a location close to greenspace

Amenity value measures people's preferences for living closer to green spaces, which is expressed by their willingness to pay in the housing market.

Research has shown that individuals are willing to pay more to live next to greenspace. As such, the value of residential properties located near greenspace receive an uplift in value that can be detected when looking at transactions in the property market.

The uplift value is estimated for properties within 200 metres of greenspaces. Uplift value coefficients are based on the hedonic pricing model from the ONS (shown to the right). Property uplift values are spread over 30 years as an annuity using a discount rate of 3.5% to calculate the annualised value of greenspace as a local amenity.

Park size	Property price uplift
Small	0.53%
Medium	0.60%
Large	1.07%
Extra Large	1.45%

Source: Uplift coefficients from [ONS \(2017\)](#) hedonic price model.

## Carbon sequestration is calculated using satellite data and average sequestration rates for tree in the UK



Tree canopy cover is found using 10 resolution optical imagery from the European Space Agency's Sentinel 2 satellite during the of Summer 2018. Using this imagery, we can calculate the hectares of tree cover found in each greenspace.

The monetary value of carbon sequestration is calculated by multiplying the value of carbon by the average sequestration rate for a single hectare of trees. In the UK, the average hectare of trees sequesters 5.4 tCO<sub>2</sub> annually. We use this sequestration rate and a value of £66/ tCO<sub>2</sub> to arrive at an annual value for carbon sequestration in greenspaces.

Greenkeeper does not take into account sequestration that occurs outside of greenspace. For example, sequestration may also occur on green streets or private gardens and properties.

# • Contact us

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The logo for Vivid Economics features a teal colon followed by the word "vivid" in a lowercase, sans-serif font, and "economics" in a larger, bold, lowercase, sans-serif font. Below this, the tagline "putting economics to good use" is written in a smaller, lowercase, sans-serif font.

:vivid**economics**  
putting economics to good use