latural Capital Account - Bristol

pared for Bristol City Council

ontents

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ristol’s Natural Capital Account:
xecutive Summary

istol's greenspaces provide services worth £385 million gross per ar

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

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

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

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

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

Overview of Natural Capital Accounts: definition, purpose, methods

hy use Natural Capital Accounts ?

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

rategic greenspace planning

e NCA can highlight how different parks are rforming in terms of the ecosystem services ey create, providing policymakers with data planning and future investment

Effective funding proposals

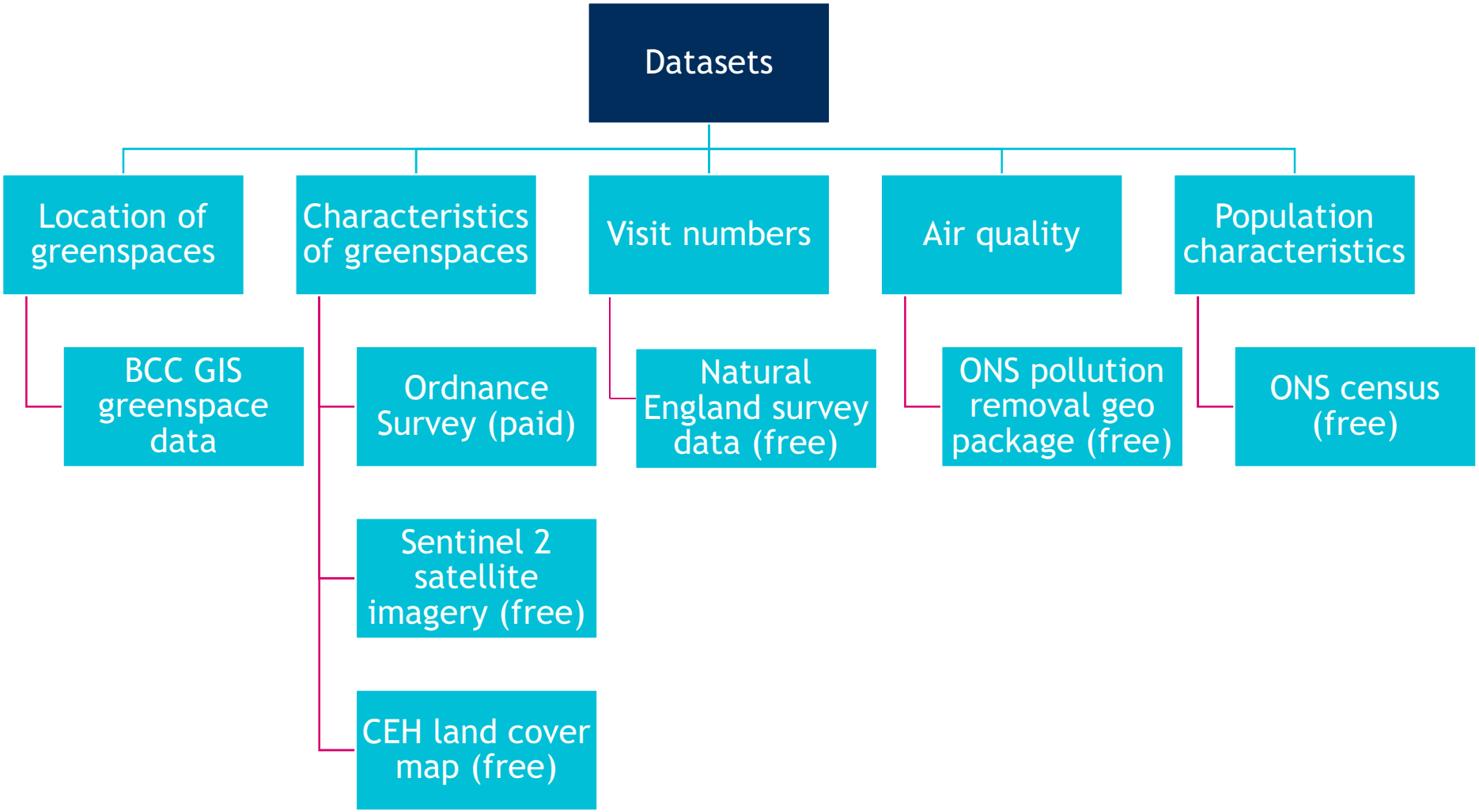
Better strategic planning leads to a stronger business case for additional funding or green space development.

Additional details on benefits valuation can be found in the methodological annex

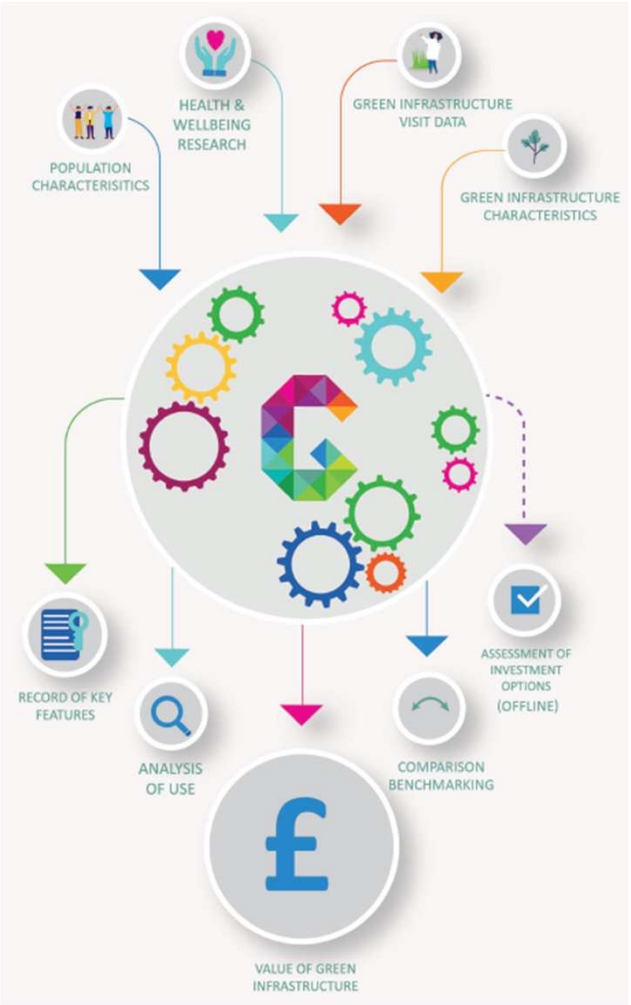
Natural Capital Account (NCA) creates a clear framework for linking tural assets with the value of services they provide to people

Account components	What do accounts assess?	What information is required?
xtent and condition of natural assets	How much of the asset is there? What is the condition of the asset?	Location and extent of space, types of greenspaces, vegetation
sits generated and ecosystem services provided	How many people visit? What services does the asset provide?	Greenspace usage, population characteristics, physical activity levels
Value of ecosystem services	How much do people value those services?	Willingness to pay, property values, cost of carbon

provide robust NCAs, Greenkeeper creates a comprehensive and nsistent database on UK greenspace assets



eenkeeper predicts how people use UK greenspaces d the benefits they receive.



Step 1: predict visit numbers

Population number and characteristics

Distance (accessibility)

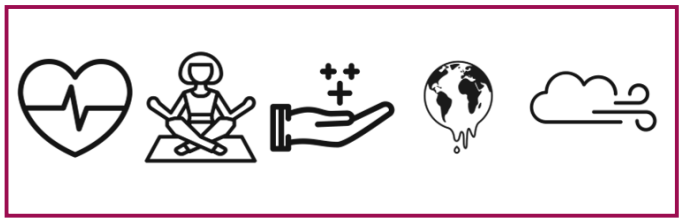
Greenspace characteristics

Size

estimate:

Number of visits

Step 2: value annual ecosystem services

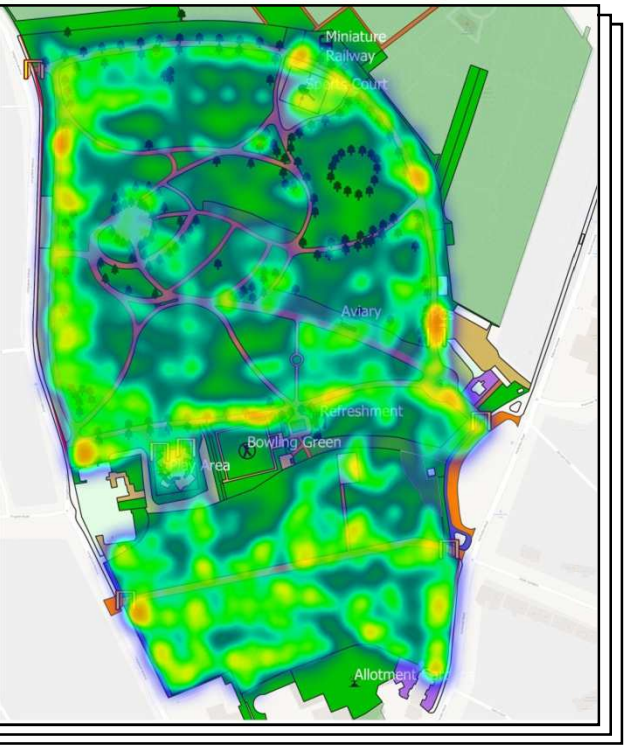


estimate:

Value of benefits

sit numbers are estimated based on the location and characteristics the greenspace and population

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



Visit numbers for individual greenspaces

+

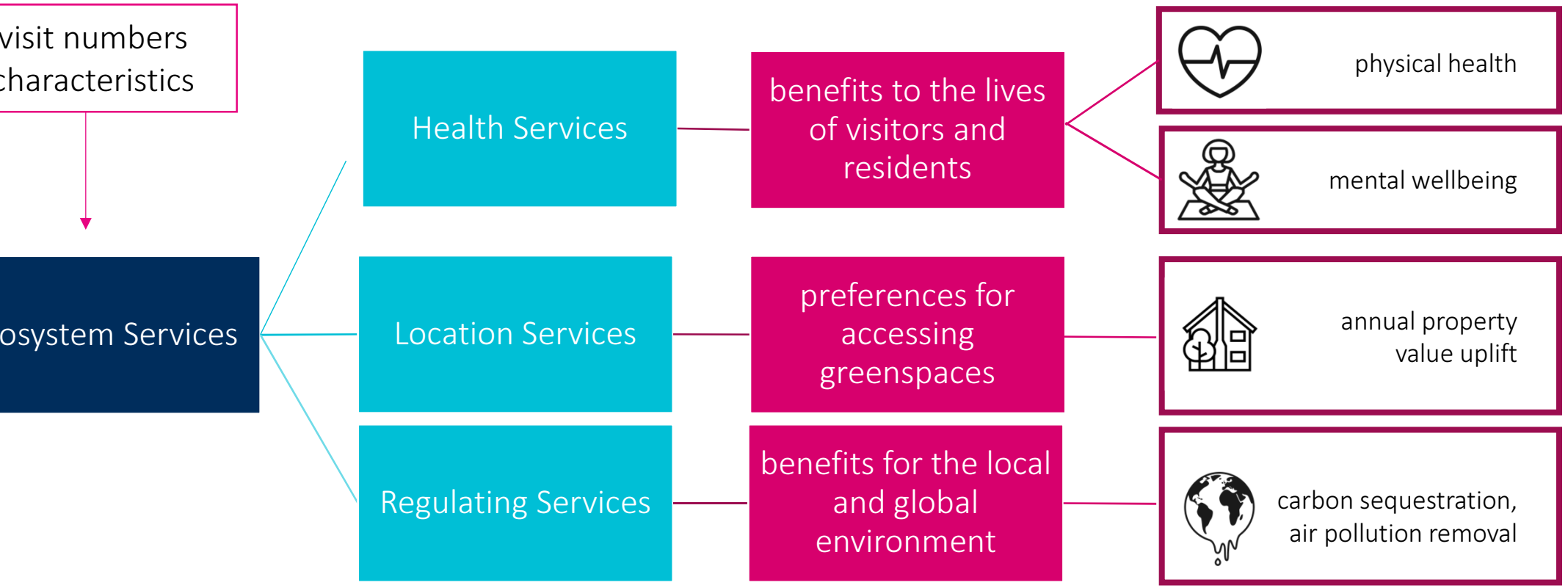
Location, characteristics of greenspaces and population

›

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

ased on visit numbers and characteristics, benefits are estimated and lued

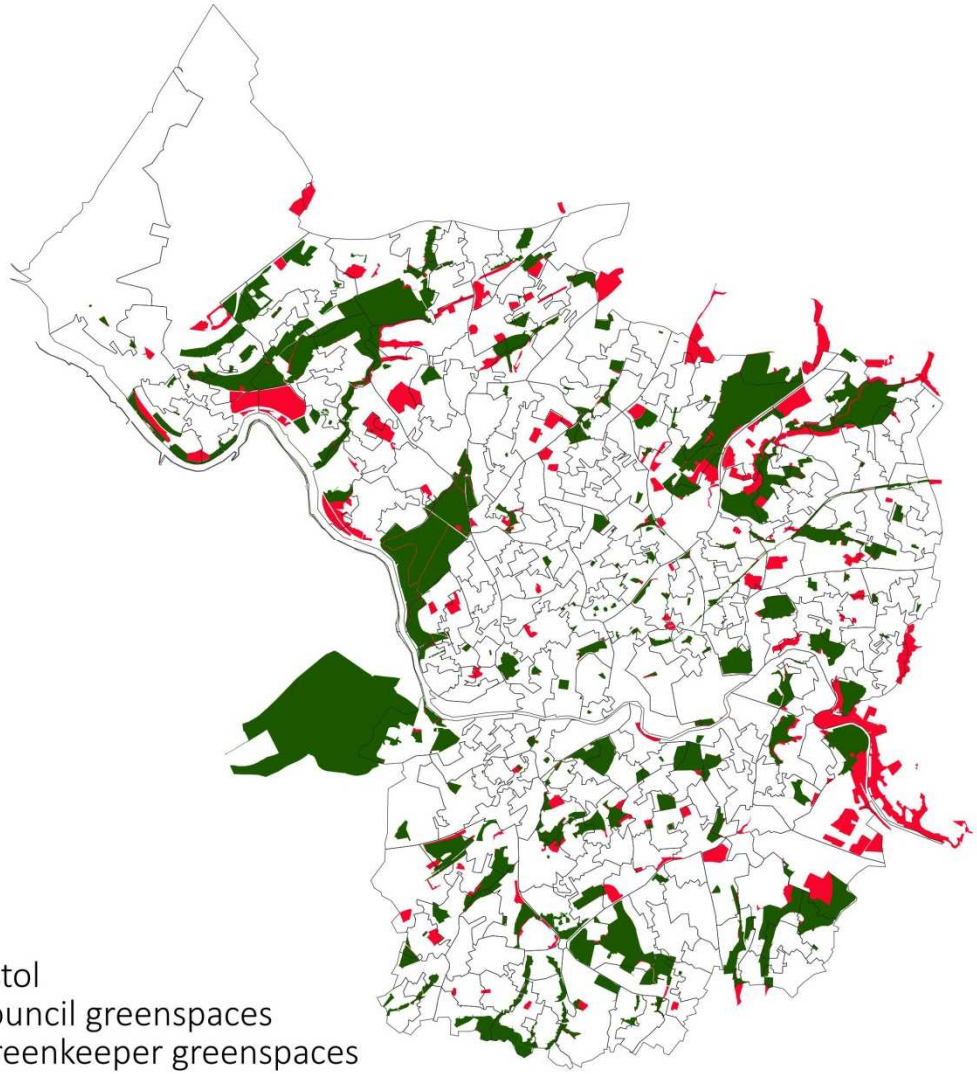


e measure ecosystem services as benefits that would be lost if a green space were removed or changed – or the nefits gained by providing a new greenspace. Other benefits not measured by Greenkeeper today include odiversity, flood management, and education.

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

ristol City Council’s natural assets

e new Bristol natural capital account is based on a comprehensive t of changes to the City's greenspace portfolio



ty of Bristol
evised Council greenspaces
riginal Greenkeeper greenspaces

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

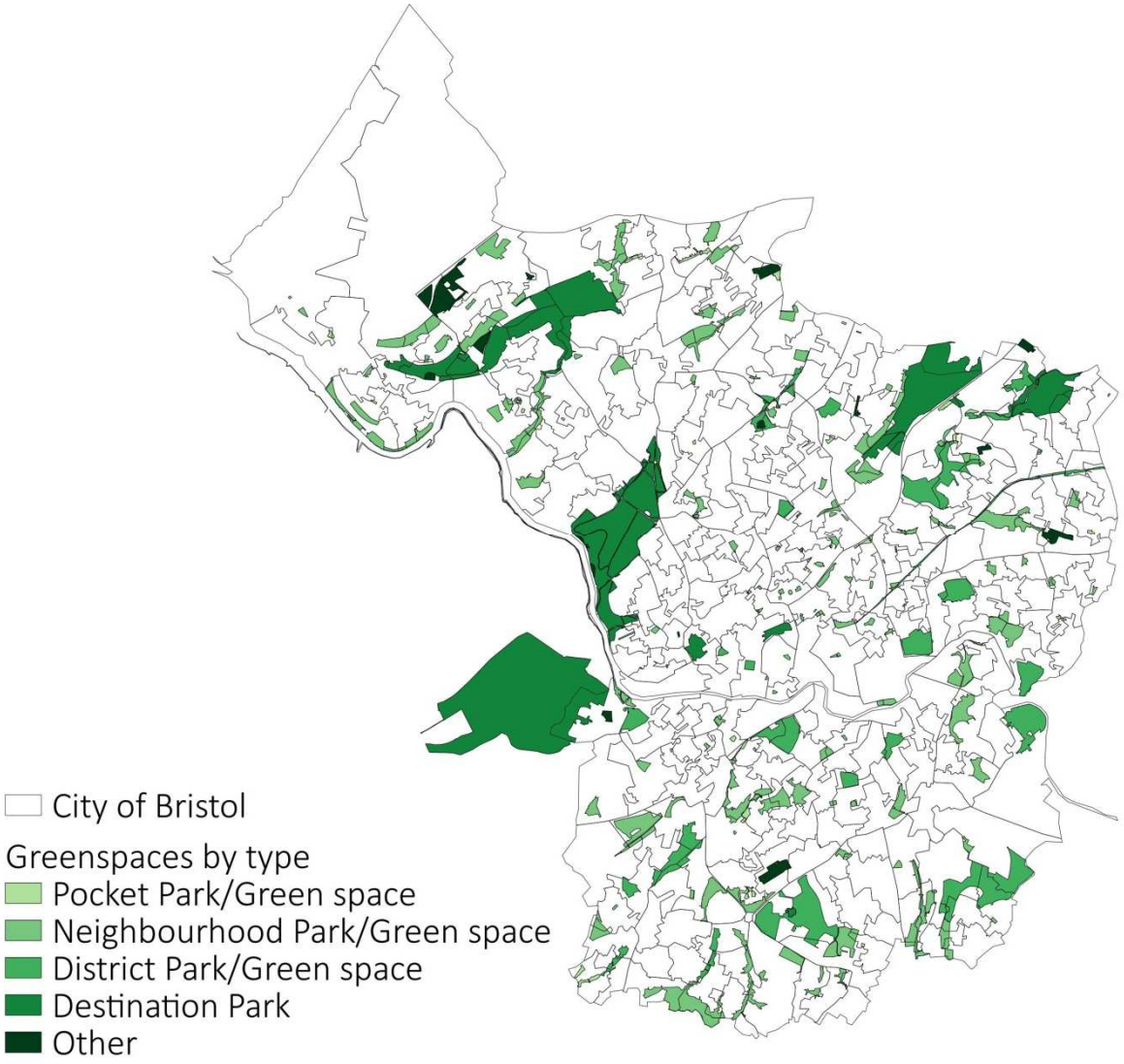
- updated characteristics and features for every greenspace; and
- removal of non-council-owned greenspaces (shown in red) and the addition of new council-owned greenspaces

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

eenspaces are grouped into five categories based on Bristol City ouncil's greenspace classification

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
Total	1,741	237

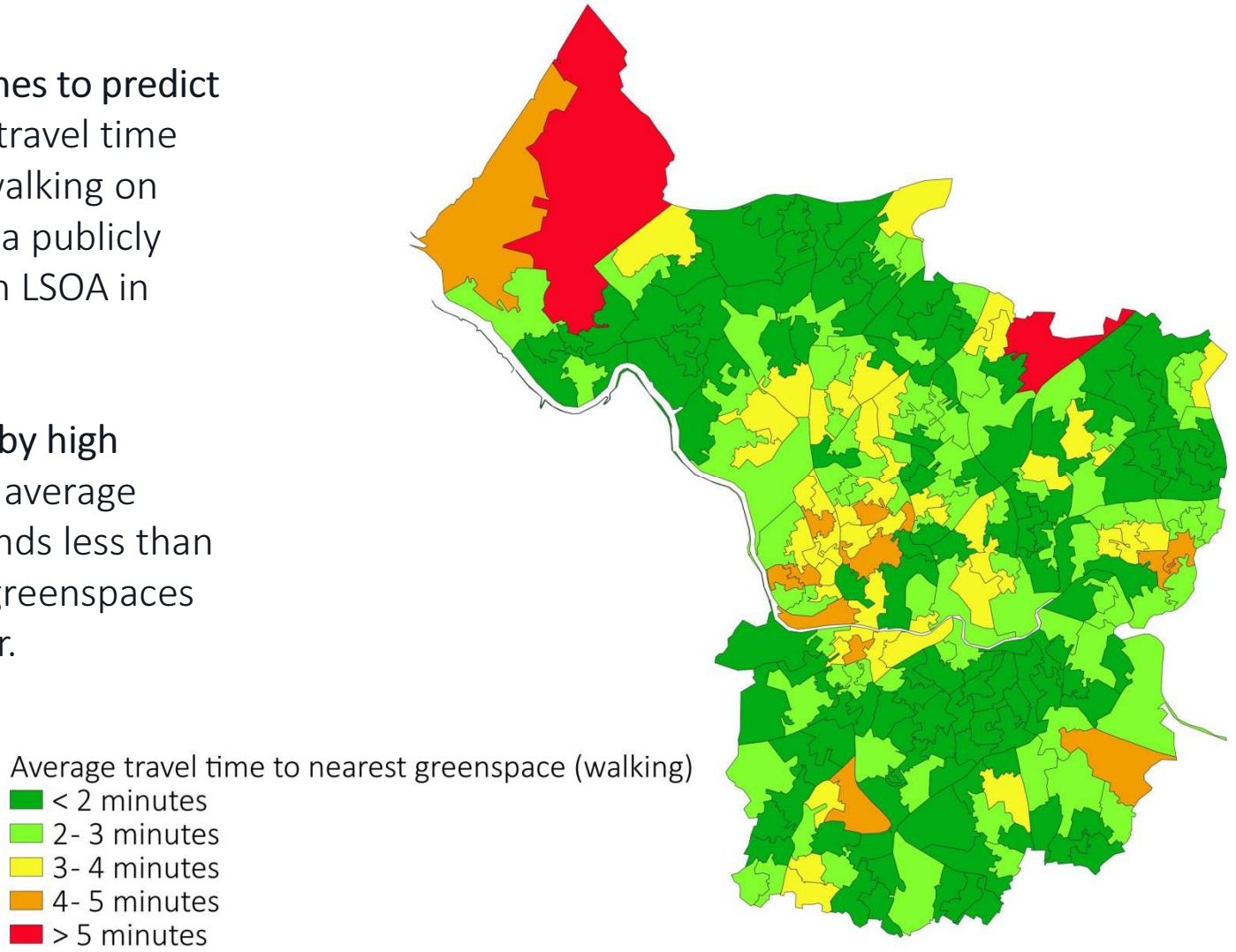
eenspaces are grouped into five categories based on Bristol City ouncil's greenspace classification



e average resident in Bristol typically lives within 5 minutes walking stance to a greenspace of at least two hectares in size

eenkeeper calculates travel times to predict **nual visits to greenspace.** The travel time rresponds to the time spent walking on otpaths or driving on roads to a publicly cessible greenspace from each LSOA in stol.

stol is generally characterized by high cessibility to greenspaces. The average lividual in Bristol typically spends less than e minutes on foot to reach a greenspaces at is 2 hectares in size or larger.



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

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isits to Bristol greenspaces

sit numbers are predicted using observational data taken from the easuring Engagement with the Natural Environment survey

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

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

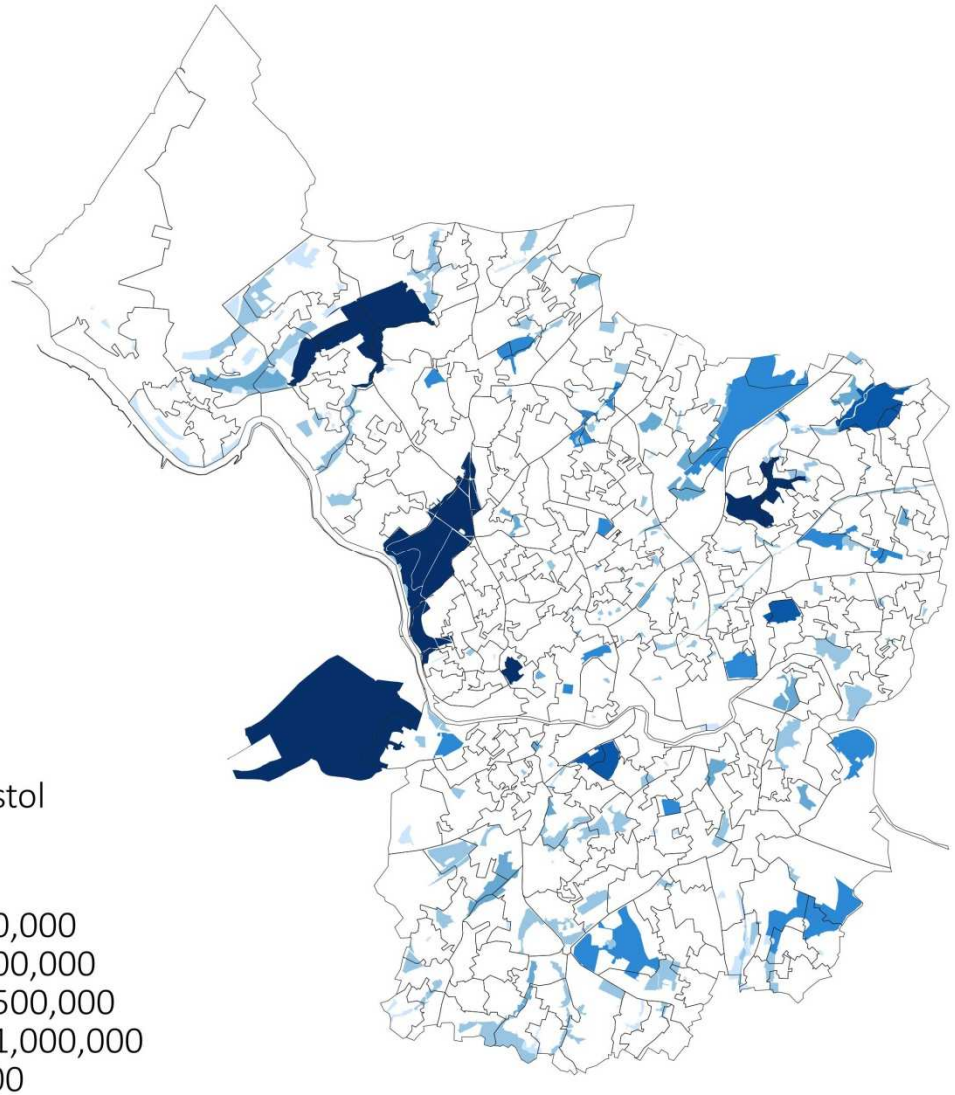
MENE survey is limited to individuals aged 16 or older, meaning the visit numbers produced by Greenkeeper predictions for adults only. **A visit to a greenspace can originate from any urban location in the UK**, so long as time it would take them to travel to that greenspace is less than 60 minutes.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

eenkeeper uses detailed information on greenspace characteristics, cessibility 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	
ccessibility to public transport	Restaurants	Museums		Golf ranges, courses and clubs	
Water cover and waterbody count		Designated scenic features		Sports ground, stadia and pitches	
ey cover i.e. buildings, footpaths, etc.		Observatories and planetariums		Gymnasiums, sports halls and leisure centres	
Green flag awards				Swimming pools and tennis facilities	

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

e model estimates that 17 million recreational visits are made to istol'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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rge greenspaces that offer a variety of different amenities are pically the most visited in Bristol

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

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

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

greater number and variety of amenities; and

rger total area, to accommodate for various forms of recreation and physical activity

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

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

: Table shows most visited parks in Bristol in descending order.

cosystem services of Bristol reenspaces

cosystem services are the benefits that humans derive, either directly indirectly, from the natural environment

enspaces are an essential source of ecosystem services for an populations. Individuals directly benefit from the reational and cultural services that greenspaces provide, king themselves healthier and happier in turn. At the same e, these spaces provide us with indirect benefits such as nate regulation and the removal of local air pollution.

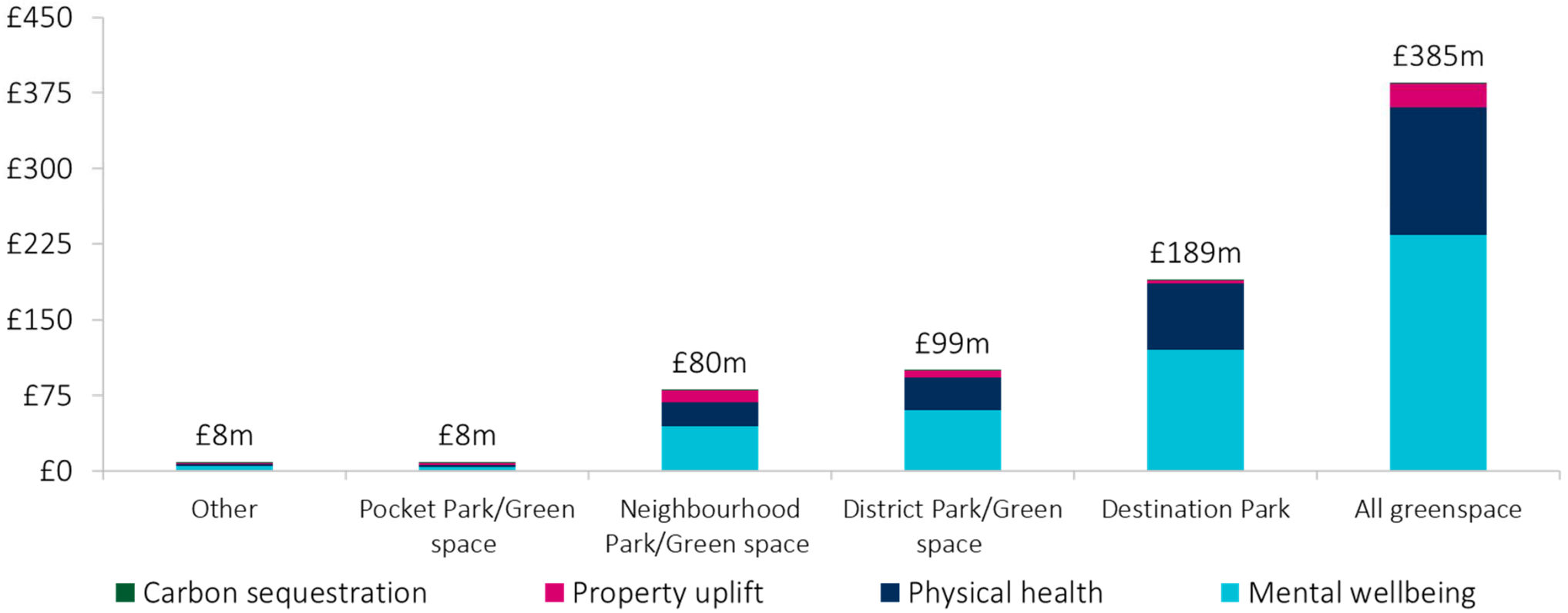
enkeeper focusses on the value of four ecosystem services

- mprovements to health from physical activity in greenspace
- mprovements to mental wellbeing from time spent in reenspace
- ncreases in the value of properties for homeowners due to ocations near greenspace
- emoval of greenhouse gases from the atmosphere

The four pillars of ecosystem services	
Physical health benefits	
Mental wellbeing benefits	
Annual property value uplift	
Carbon sequestration	

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

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



enspaces ordered by total annual benefits from smallest to largest

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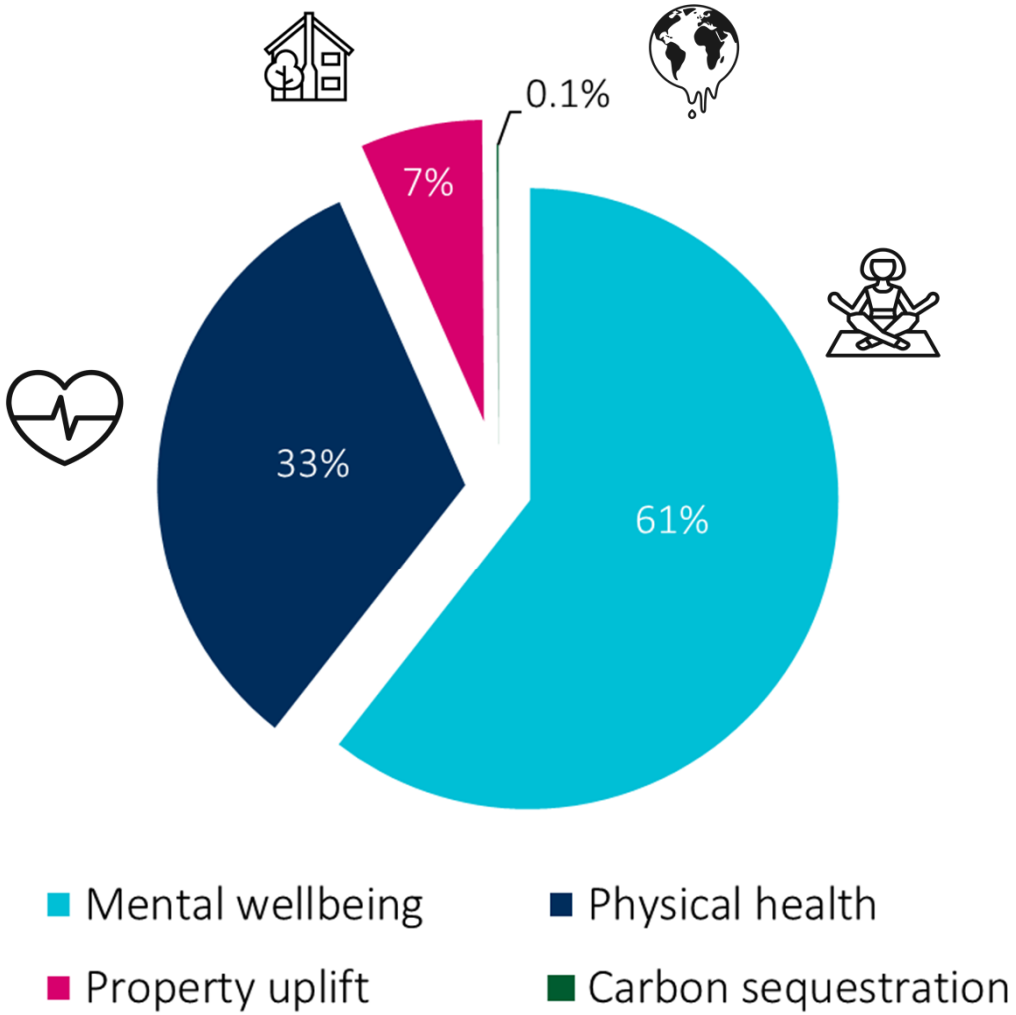
ental and physical health account for 94% of greenspace benefits in istol



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

: 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

e spent in greenspace affects an individual's reported el of life satisfaction. More time spent in greenspace is ociated with a higher level of life satisfaction according studies comparing self-reported wellbeing with time nt outdoors.

place a value on this increase in life satisfaction to culate mental wellbeing improvements. The value is ed on the amount of money a person would need to be mpensated in order to achieve the same increase in life sfaction 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

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

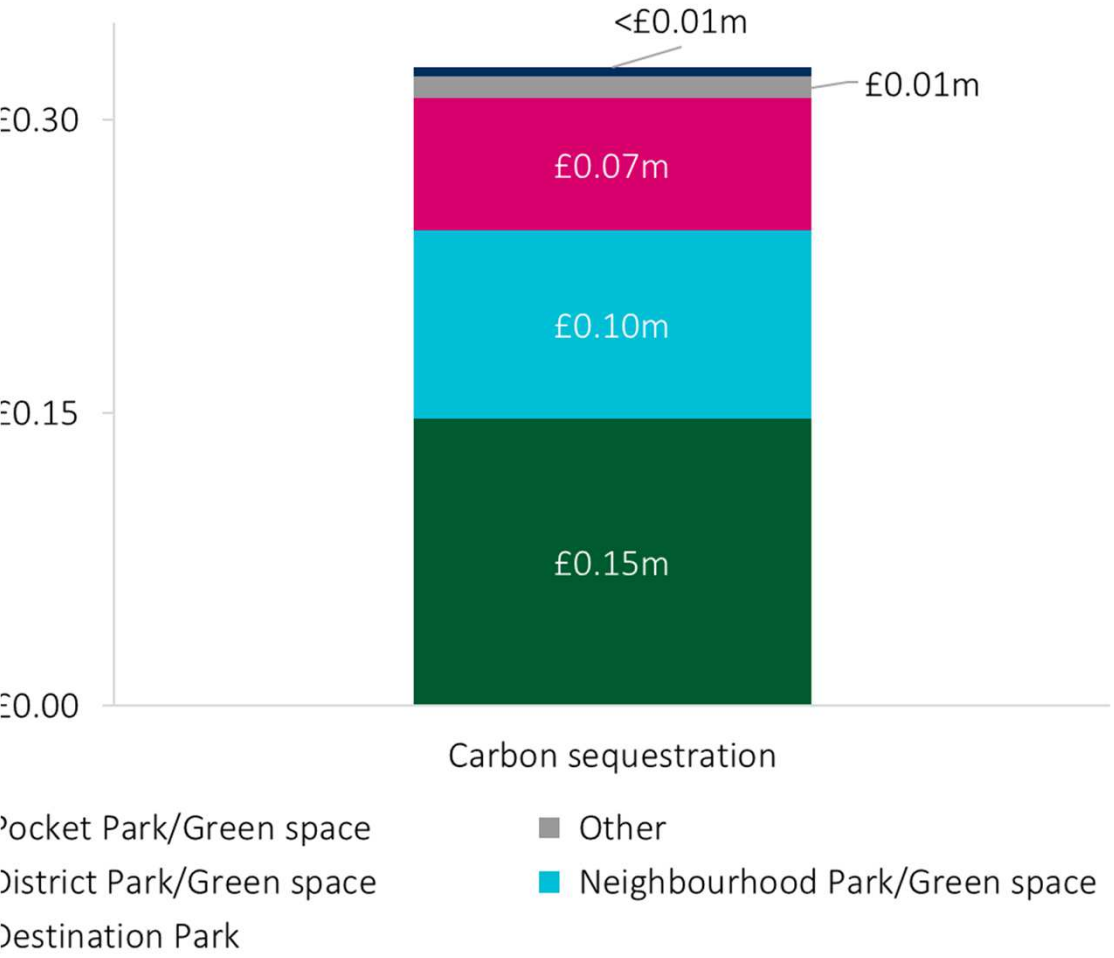
een space visitors achieve physical health benefits from dertaking activity in green spaces e.g. running, cycling, c.

e measure health outcomes in terms of risk of mortality d quality-adjusted life years (QALYs). Physical activity duces 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

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

Greenspaces remove £0.3 million worth of CO_2 per year, with approximately 45% of removals occurring in Destination Parks



Bristol greenspaces capture thousands of tonnes of CO_2 per year. Tree canopy cover within green spaces indicates the amount of carbon sequestered.

The largest share of CO_2 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.

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

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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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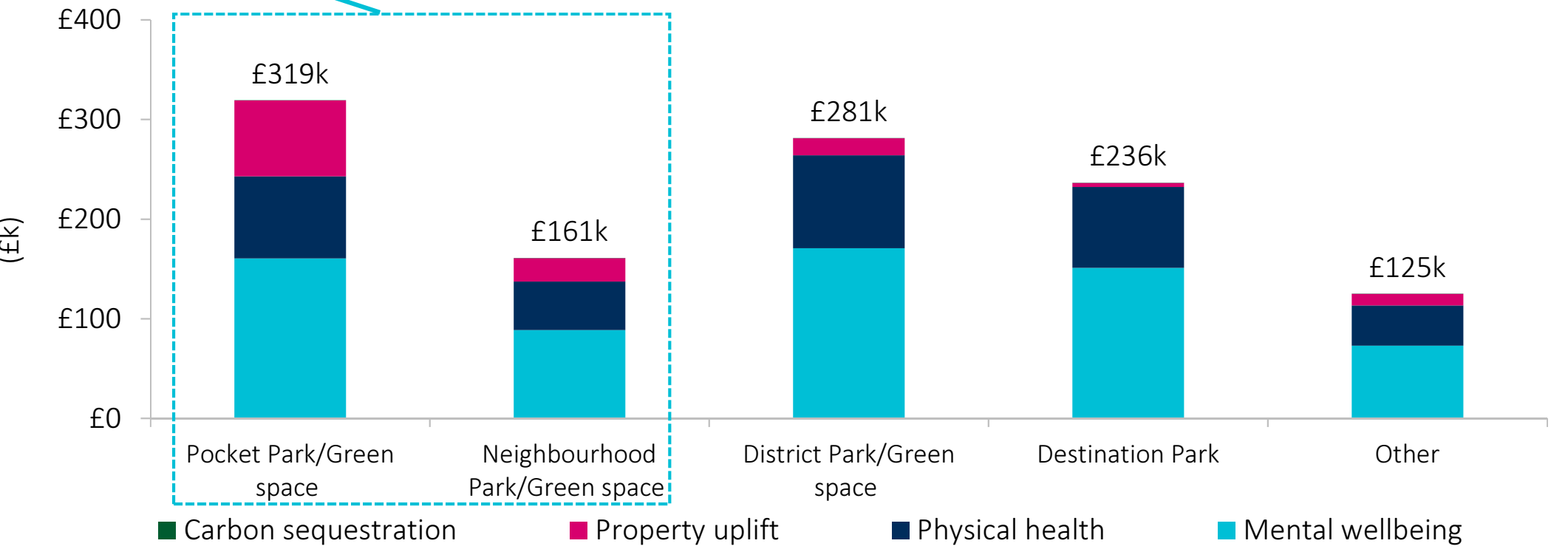
naller greenspaces derive a greater share of their value from property lift due to locations in denseley populated areas

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



enspaces 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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ecap: £385 million of gross value is created by the city's greenspaces, % 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.

ossary 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_2 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.

Appendix

istol's natural capital account

Ecosystem nefits (£m)

	Park Size					
	Other	Pocket Park	Neighbourhood Park	District Park	Destination Park	All Parks
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
Total Benefits	**8**	**8**	**80**	**99**	**189**	**385**

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

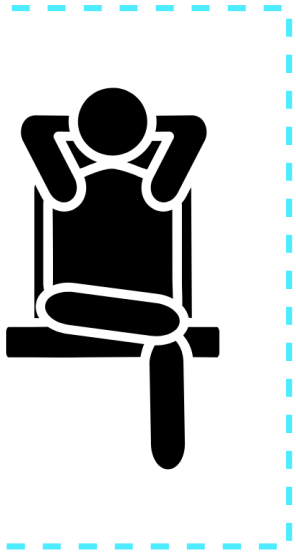
ere are nearly 500[1] amenities in Bristol's greenspaces

ypes of eenspace	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
cket Park	13	0	1	53%	1%	5%	0	1	25	2
hbourhood Park	264	3	14	53%	1%	3%	2	4	78	73
strict Park	185	4	14	52%	1%	4%	3	6	30	83
nation Park	405	3	9	51%	0%	1%	13	27	7	41
TOTAL	898	11	40	52%	1%	2%	18	39	142	232

: [1] Waterbodies and toilets not shown in the table.

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

Inactive



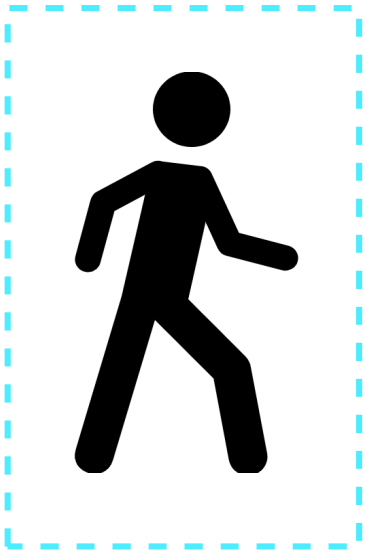
9%

of visitors do not get any physical health benefits from activity in parks

£0

+£500

Low-activity



61%

of visitors undertake low levels of activity in parks, leading to reduced risks of mortality

£500

+£1,600

High-activity

30%

of visitors undertake high levels of activity in parks and have active lifestyles, leading to higher quality and longer lives

£2,100

Average value of physical health benefits per visitor per year

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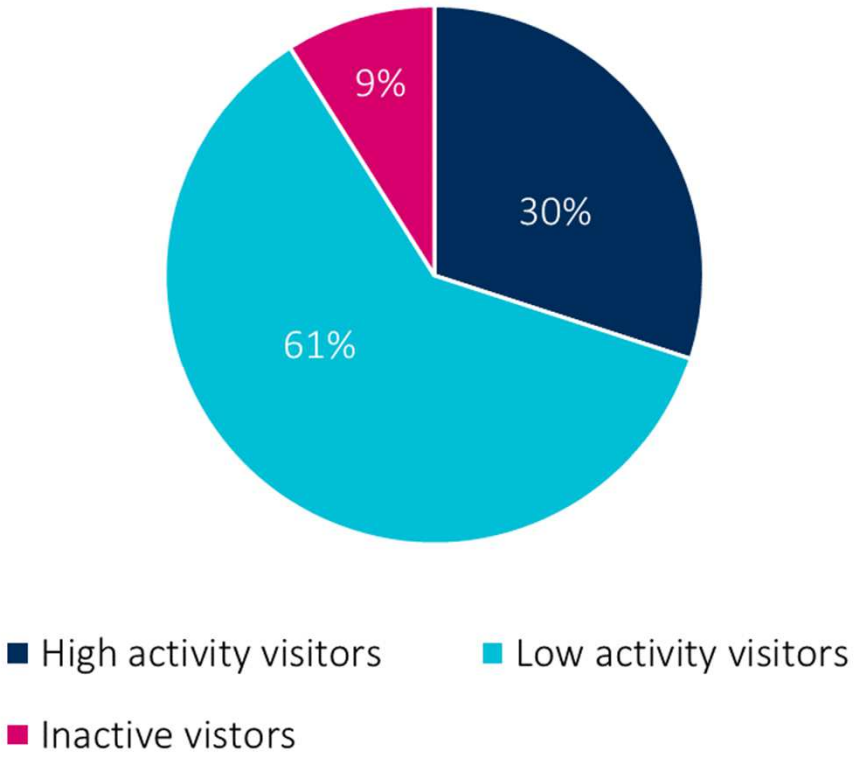
: Values in this slide reflect the average activity levels in medium sized parks. The average value of physical health benefits will vary in small and large

sitors with an active lifestyle, or those meeting NHS guidelines, are ose who report being active for more than 30 minutes on 5 or more casions per week

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

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

e last share of greenspace visitors are those individuals that meet ther the criteria for high activity visitors or low activity visitors. In er words, these are visitors who do not undertake physical activity greenspace with a MET of 3 or higher. These are **inactive visitors** who ke up the remaining **9% of greenspace visitors.**



% of visitors to greenspace do less than 150 minutes of physical tivity per week

What is a low-activity visitor?

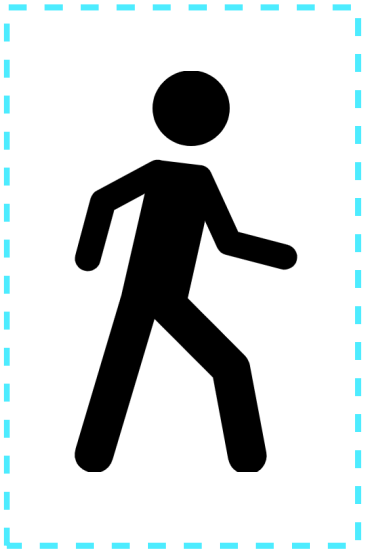
ow activity visitor undertakes physical activity in greenspace at intensity levels t are beneficial for health, but for less than the NHS recommend 150 minutes r week. The proportion of low-activity visitors is calculated based on reported ysical activities within greenspaces from MENE survey data.

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) [1]

Low-activity



61%

of visitors undertake low levels of activity in parks, leading to reduced risks of mortality[2]

[1] 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 nment is £2.2 million (HM Treasury, 2018); [2] values are indicative of activity levels in medium sized parks, and will vary for small and large parks es: NHS (2011) Fact Sheet 4: Physical Activity Guidelines for Adults (19-64 years); World Health organization (WHO) Health Economic Assessment Tool (HEAT). ible from: https://www.heatwalkingcycling.org/#homepage

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

What is a high-activity visitor?

igh activity visitor undertakes physical activity in greenspace at intensity levels at are beneficial for health for 150 minutes or more per week. The proportion high-activity visitors is calculated based on reported physical activities within eenspaces 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) [1] 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%

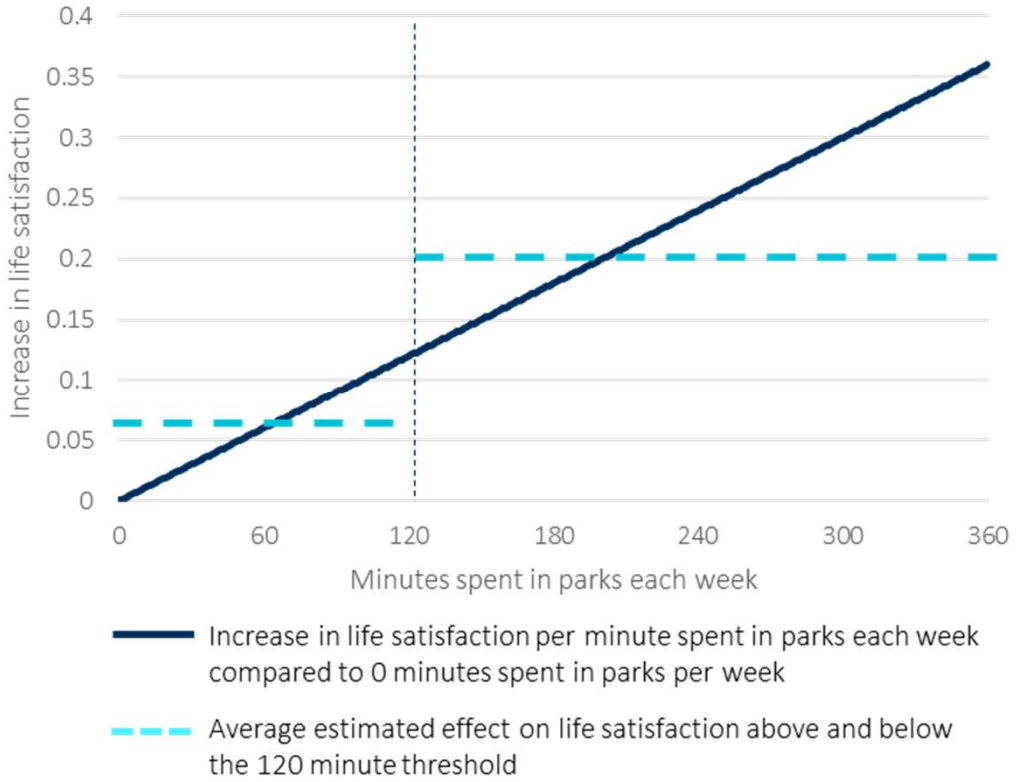
of visitors undertake high levels of activity in parks and have active lifestyles, leading to higher quality and longer lives[2]

[1] A QALY is unit of measuring life expectancy, weighted by quality of life; [2]values are indicative of activity levels in medium sized parks, and will vary for small and parks

e: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf.

gular visits to greenspaces improve wellbeing similarly to having full time nployment or being married

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



menity value measures the additional amount of money that people e willing to pay to live in a location close to greenspace

menity value measures people's preferences for ing closer to green spaces, which is expressed by eir willingness to pay in the housing market. search has shown that individuals are willing to pay ore to live next to greenspace. As such, the value of sidential properties located near greenspace ceive an uplift in value that can be detected when oking at transactions in the property market.

e uplift value is estimated for properties within 200 etres of greenspaces. Uplift value coefficients are sed on the hedonic pricing model from the ONS nown to the right). Property uplift values are spread er 30 years as an annuity using a discount rate of 5% to calculate the annualised value of greenspace 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.

rbon sequestration is calculated using satellite data and average questration 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_2 annually. We use this sequestration rate and a value of £66/ tCO_2 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.

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