Where can walking and cycling alleviate transport poverty?

A case study of Scotland - Technical report

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1 Introduction

The concept of transport poverty has been explored in several studies in recent years, (for example by Sustrans in 2016[1] and 2012[2]) and defined in a number of ways. In 2023, the Social Market Foundation[3] defined those in transport poverty as households that are driven below the poverty line due to their spending on public and private transport. In 2024, in their review of transport poverty[4], Public Health Scotland define transport poverty as "the lack of transport options that are available, reliable, affordable, accessible or safe that allow people to meet their daily needs and achieve a reasonable quality of life."

Cycling and walking are the cheapest forms of transport and as such they have great potential to alleviate transport poverty whilst also improving health and environmental outcomes. This report accompanies a tool that uses Public Health Scotland's definition of transport poverty to identify areas where policy or behaviour change interventions to promote walking and cycling could most easily alleviate transport poverty. These are areas that have high levels of income deprivation but the best existing conditions for walking and cycling. Furthermore, the tool can be used to identify those areas which have some of the worst existing conditions for walking and cycling and where investment could be directed to address this inequality, or where specific dimensions of transport poverty need addressing.

[1] Transport Poverty in Scotland, Sustrans 2016
[2] Locked Out - Transport poverty in England, Sustrans 2012
[3] Getting the measure of transport poverty: Understanding and responding to the UK's hidden crisis - Social Market Foundation
[4] Transport poverty: a public health issue - Transport poverty: a public health issue - Publications - Public Health Scotland

2 Methodology

2.1 Indicators, measures and data sources

To evaluate the potential for active travel to alleviate transport poverty we have based our indicators on the five aspects of transport poverty defined by Public Health Scotland (Table 1). Data sources for each indicator are described below. For the affordability indicator, we have used income deprivation, to suggest where populations may be more at risk of transport poverty. Walking and cycling are two of the most affordable forms of transport, so can be a suitable transport solution from an affordability aspect even where incomes are low.

The geographic unit used in this analysis is the 2011 Scottish data zone. Each of the 6,796 data zones had a 2011 population of between 500 and 1,000 residents. As data zones are defined by population size, geographic area varies substantially depending upon the type of area in which the data zone is located. Data zones were chosen as the geographic unit because it provides sufficient resolution to be useful for decision making within a local authority and makes the best use of available data[5].

[5] Some minor inconsistencies in attributed populations can be found when using data zones and comparing to other geographic units. Only the safety indicator in this tool uses population in its calculation and while no best-fitting has been applied in our calculations, for the affected datazones, Lerwick North - 03, Data Zone: S01012397 and Knapdale - 01, Data Zone: S01007320 the impact is expected to be negligible due to the location of collisions.

Table 1: Details of measures and data sources for each indicator

Indicator	Measure	Data source
Availability	Neighbourhood score, **described in more detail below**.	Sustrans analysis
Reliability	Assumed constant for walking and cycling	N/A
Affordability (Income Deprivation)	Percentage of population defined as income deprived by the Scottish Index of Multiple Deprivation[6]	Taken directly from the Scottish Index of Multiple Deprivation 2020[7]
Accessibility	Percentage of population with a long-term illness, disease or condition[8]	Scotland's census data 2022[9]
Safety	Number of traffic collisions in the past 10 years (2014 – 2023) involving at least one cyclist or pedestrian, per 1000 population. **Calculation described in more detail below**.	Department of Transport Road Safety Data releases (also known as STATS19)[10] and Scottish Index of Multiple Deprivation 2020 (for population)

[6] The Scottish Index of Multiple Deprivation Income Domain is calculated using the sum of the number of adults receiving Guaranteed Pension Credit, Income Support (IS), income-based Employment Support Allowance (ESA) or Job Seekers Allowance (JSA), the number of children in IS, JSA or ESA households, the number of people claiming Universal Credit (UC) and their dependent children (excluding those in the 'working with no requirements' conditionality group), and the number of adults and children in Tax Credit families on low incomes.

[7] Scottish Index of Multiple Deprivation 2020 - gov.scot

[8] Four data zones did not have data for this measure and were given a value of 21.9%, which is the average value for Scotland as a whole, to ensure their inclusion in the tool.

[9] Scotland's Census

[10] Road Safety Data - data.gov.uk

2.1.1 Additional detail on availability indicator

The availability indicator uses a set of criteria that have been created by Sustrans to assess areas on their suitability for active travel. It is based on the availability of a set of essential services and amenities needed for a good quality of life, within a comfortable 10-minute walk, based partly on the work of Badland et al., 2019[11].

2.1.1.1 Defining neighbourhoods

A new spatial unit termed "neighbourhoods" were created using the population weighted centroid of each output area[12] as the 'centre' point. The radius of each neighbourhood was defined by modelling the distance the local population can comfortably walk in 10 minutes based on the average gradient of an area and an estimate of the average fitness of the local population[13]. The mean neighbourhood radius was 565m.

2.1.1.2 Assigning neighbourhood scores

Fourteen criteria were set up and a 'pass mark' decided for each (Table 2 and Table 3). The values for each criteria in each neighbourhood was calculated in GIS software using the data sources given in (Table 2 and Table 3); neighbourhoods were awarded a point for each criteria pass mark they met and the total score for each neighbourhood summed. Since "neighbourhoods" are generally smaller than data zones, the value for each data zone was calculated by averaging the

[11] Badland H, Higgs C, Giles-Corti B. (2019). The Healthy Liveable Communities Urban Liveability Checklist. RMIT University, Melbourne.

[12] "Output Areas (OAs) are the key geography for dissemination of small area statistics from the Census…They are designed to have relatively small numbers of households (in the range of 25 to 89) and population (>=60), while nesting within Council areas." Scottish Government

[13] Macklon G, Philips I, Pearce M, Dallas M. (2019). *A spatial microsimulation approach to modelling capacity for active travel in Scotland*. Sustrans.

scores of the neighbourhoods which sit within it. This average score varied across Scotland from 0.6 to 12.

Table 2: Details of the 14 criteria against which neighbourhoods are assessed for the suitability for active travel.

Criteria	Pass mark	Data source
Households per primary school	Between 1 and 1,500	Scottish School Roll and Locations[14]
Households per secondary school	Between 1 and 6,500	Scottish School Roll and Locations[14]
Neighbourhood traffic volume exposure	≤50 metres of busy roads	Department for Transport road traffic estimates[15]
Large open spaces	≥1 areas larger than 1.5 hectares	Open Street Maps[16]
Local living destinations	≥5 different destination types (see Table 3)	Open Street Maps[1616] and Public Health Scotland[17]
Entertainment	≥3 different destination types (see Table 3)	Open Street Maps[16]
Supermarket access	≥1	Open Street Maps[16]
Bus stops and train stations	≥10	National Public Transport Access Nodes (NaPTAN) dataset[18]

[14] Scottish School Roll and Locations, Scottish Government.
[15] DfT Road traffic bulk downloads
[16] Open space polygons, local living destinations, entertainment and supermarket locations from OpenStreetMap via Geofabrik downloads
[17] GP locations, Public Health Scotland
[18] National Public Transport Access Nodes (NaPTAN) dataset

Criteria	Pass mark	Data source
Housing diversity	≥4 different types of housing each make up at least 10% of the total housing in the neighbourhood	Scotland's Census 2011[19]
Dwelling density	≥25 dwellings per hectare	Scotland's Census 2011[19]
Active travel	≥15% of the working population walk or cycle to work	Scotland's Census 2011[20]
Working from home	≥10% of the working population work from home	Scotland's Census 2011[20]
Distance to work	≥50% of the working population travel less than 5km to work	Scotland's Census 2011[21]
Traffic free NCN in neighbourhood	>0m of traffic free NCN	Sustrans internal sources[22]

[19] Scotland's Census 2011 - National Records of Scotland, table KS401SC
[20] Scotland's Census 2011 - National Records of Scotland, table QS701SC
[21] Scotland's Census 2011 - National Records of Scotland, table QS703SC
[22] Sustrans' National Cycle Network (NCN) Open Data Portal

Table 3: Destination types used for assessing Local living destinations and Entertainment criteria.

Local living destinations[23]	Entertainment destinations[23]
• Convenience shop (ie convenience store, newsagent, or petrol station) • Speciality food (ie fruit and vegetable, meat, fish, or poultry store) • Post office • Post box • Bank • Pharmacy • General practice / medical centre • Dentist • Community centre / hall • Early childhood education centre • Library	• Pitch • Swimming pool • Café • Pub • Bar • Fast food • Museum • Restaurant • Nightclub • Sports centre • Theatre • Cinema • Mall • Department store • Arts centre • Stadium • Zoo • Ice rink • Theme park • Food court

2.1.2 Additional detail on safety indicator

The safety indicator is based on the number of traffic collisions involving active travel users. Locations of all traffic collisions in the past 10 years (2014 – 2023) involving at least one cyclist or pedestrian were entered into GIS software to identify the number within each data zone. These values were combined with each data zone's 2017 population (from the Scottish Index of Multiple Deprivation 2020) to calculate the number of collisions per 1,000 population. One data zone was found to have no population data; a representative value from a nearby data zone was used to ensure its inclusion in the tool.

[23] Destination locations: OpenStreetMap via Geofabrik downloads, GP locations: Public Health Scotland

2.2 Categorisation & Scoring

2.2.1 Categorisation

Each measure was split into 5 categories (quintiles) to give data zones a score of between 1 and 5 for each indicator. The thresholds for each category were defined by the 0th, 20th, 40th, 60th, 80th, and 100th percentiles of the measure values[24]. Using this method, each category contains approximately 20% of the data zones, but as equal data points (such as the 0 values from the collisions dataset) must be in the same quintile, the actual percentage of data zones in each category varies from 14% to 26% (Table 4).

Table 4: Minimum, maximum, mean and median values of each metric used to develop the scores.

Measure (abbreviated)	Minimum value	Maximum value	Mean value	Median value
Neighbourhood score	0.6	12.0	5.4	5.1
% Income deprived	0.0%	59.0%	12.3%	10.0%
% Long-term illness/ disease/ condition	6.3%	52.8%	21.9%	22.2%
Number of road collisions per 1000	0	215.3	4.4	2.3

2.2.2 Scoring

Scoring was designed such that a high score for an individual measure (5) indicated that, considering that measure alone, the potential or ease of cycling and walking to alleviate transport poverty in that area is expected to be high. A low score for an individual measure (1) indicated that, considering that measure alone, the potential or ease for cycling and walking to alleviate transport poverty in that area is expected to be low. This does

[24] Percentiles define values below which a certain percentage of values fall. For example the 40% of values will fall below the 40th percentile.

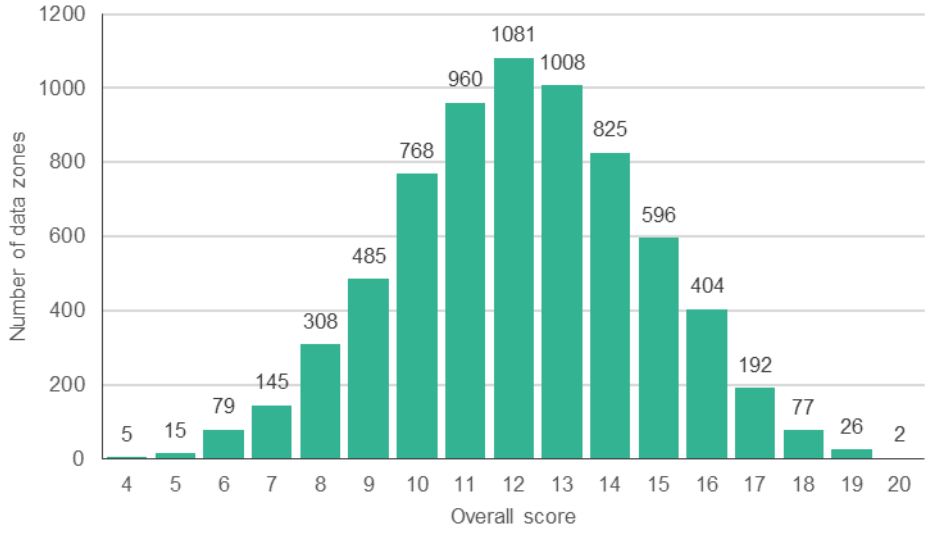
not mean that it is not possible to alleviate transport poverty through walking and cycling in areas with low scores, but that it is expected take more investment and effort.

- **Affordability**. *Areas with the highest percentage of households who are income deprived score 5.*
    - These are the areas which are more likely to be at risk from transport poverty and therefore there is the most potential for cycling and walking to alleviate this. These could also be considered to be areas where cycling and walking are most affordable in comparison to private car use.
- **Availability**. *Areas with the highest 20 minute neighbourhood scores score 5*.
    - These areas can be considered as having the best connections to services and amenities by active travel, and therefore the fewest existing barriers.
- **Accessibility**. *Areas with the lowest percentage of population with a long-term illness, disease or condition score 5*.
    - The population of these areas can be considered as having the least accessibility barriers to participation in active travel.
- **Safety**. *Areas with the lowest rates of involving at least one pedestrian or cyclist per 1,000 population score 5*.
    - These areas can be considered as being the safest for active travel and therefore the fewest existing barriers.

2.2.3 Overall score

An overall score for the potential for cycling and walking to alleviate transport poverty was calculated by summing each of the four individual measure scores, producing a potential maximum overall score of 20 and potential minimum score of 4. The distribution of these scores is shown in Figure 1.

Figure 1: Histogram of overall score values for Scotland

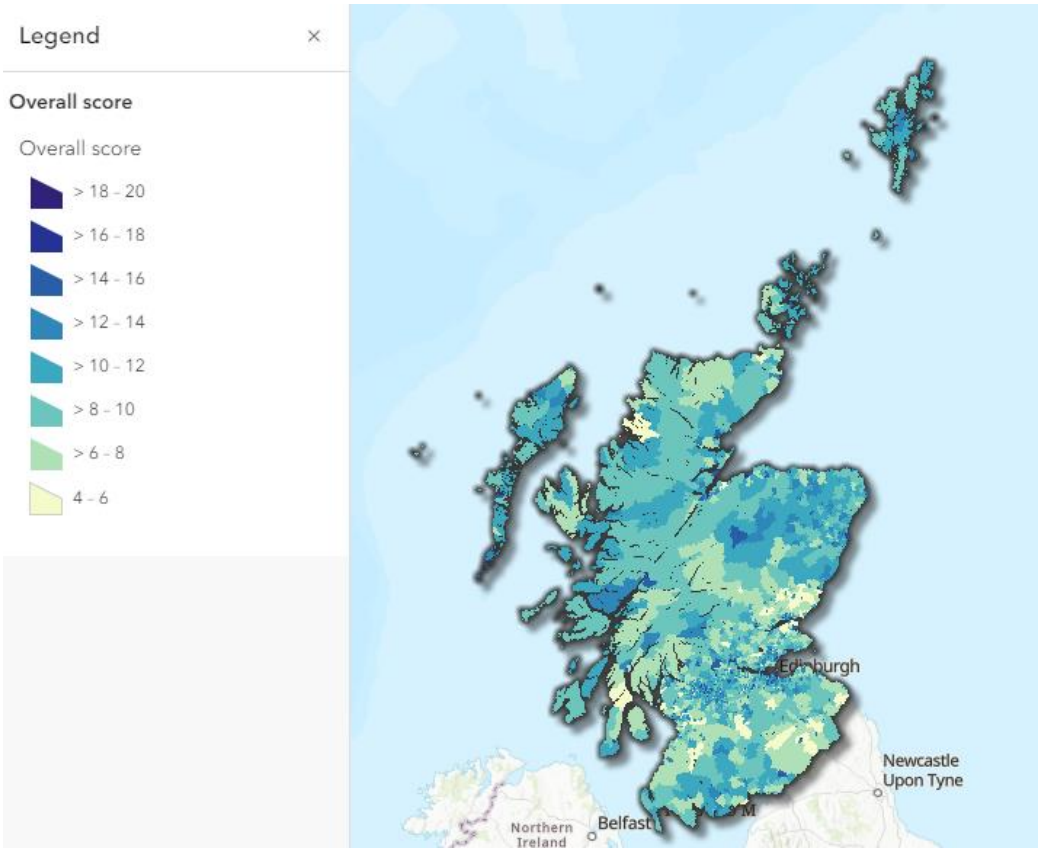


3 Overview and suggested usage

3.1 Distribution of highest and lowest scoring data zones

Figure 2 shows the geographic distribution of the overall values across Scotland.

Figure 2: Map showing the value of the overall score across Scotland, incidated by colour where dark blue shows a high score and pale yellow shows a low score



For the purpose of exploring the data in this technical report, “high-scoring” data zones have been defined as those with an overall score of 16 or more, representing 10.5% of all data zones. These are expected to be data zones where active travel has the most potential (or greatest ease) of alleviating transport poverty. Figure 3 shows these high-scoring data zones split by area type while Figure 4 shows them split by local authority.

Figure 3: Number of high-scoring data zones in each area type (columns) and the percentage of total data zones within each area type which are high-scoring (line). Data table available in the appendix.

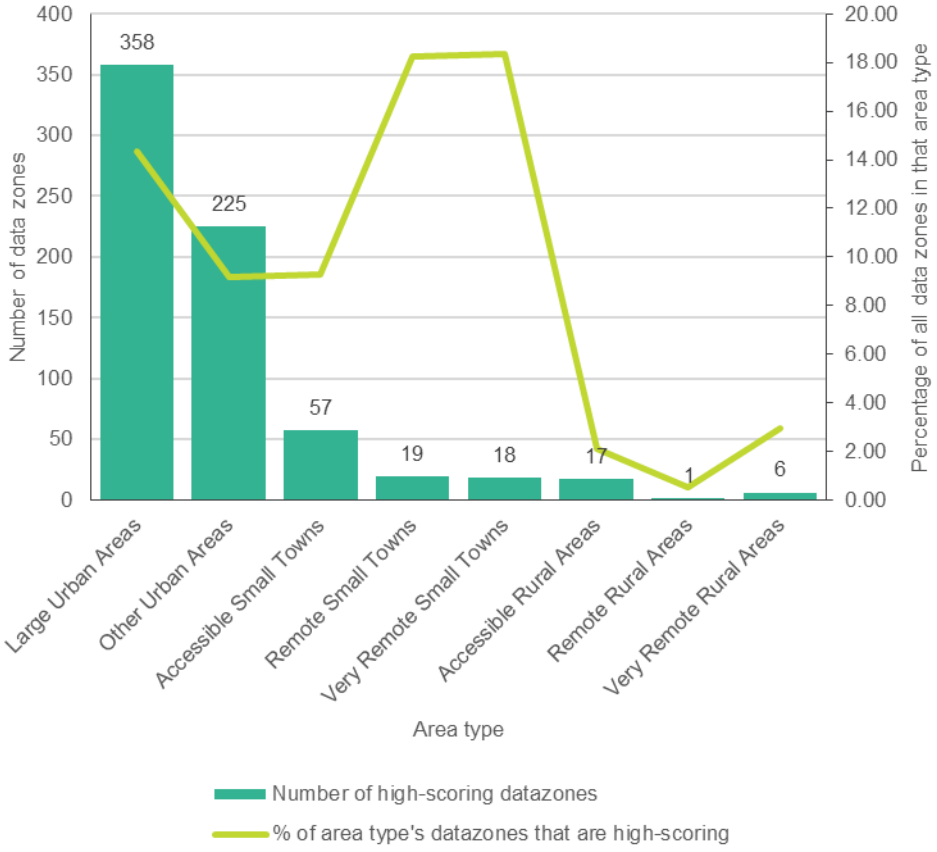
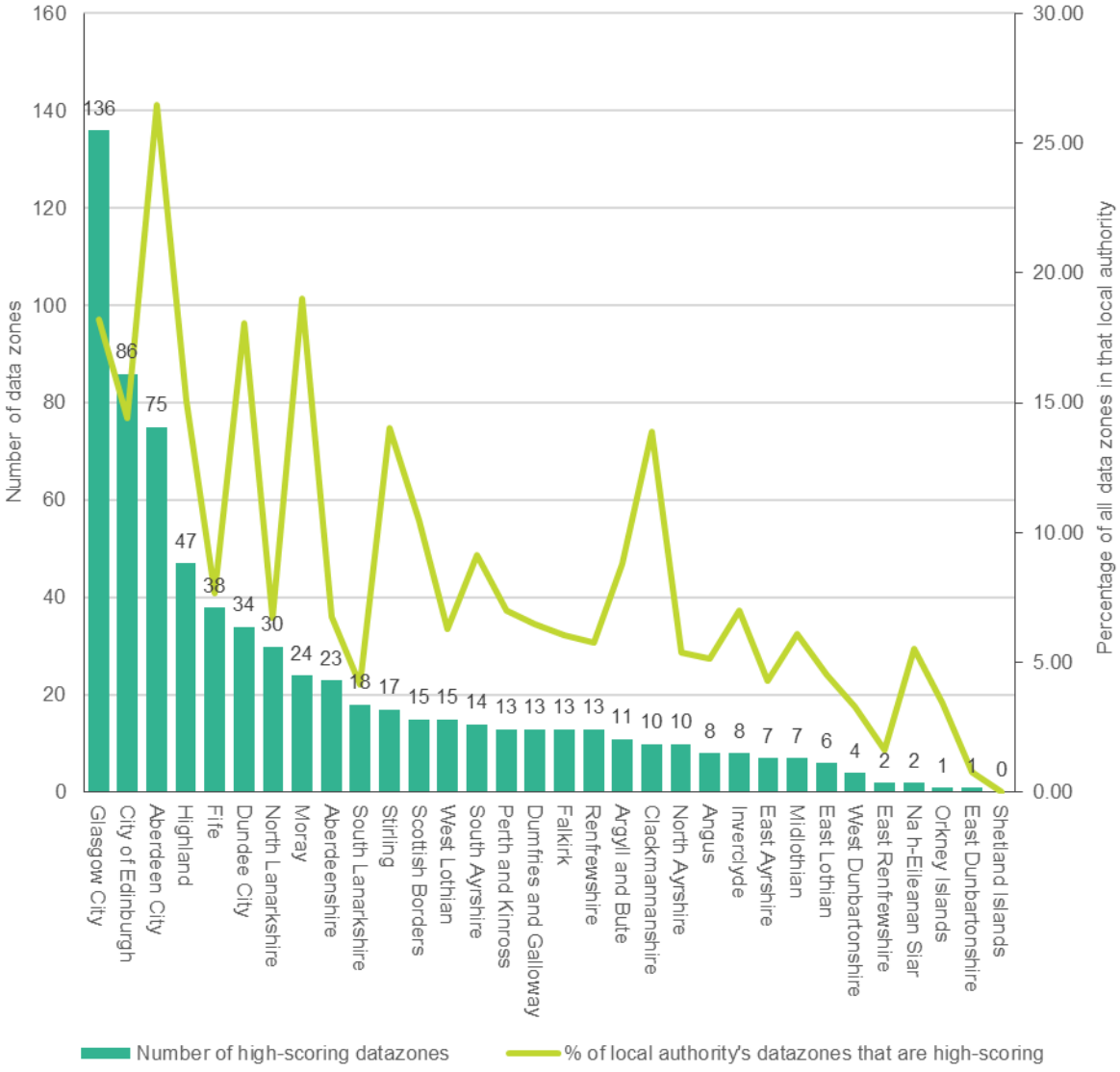


Figure 4: Number of high-scoring data zones in each local authority area (columns) and the percentage of total data zones within each local authority area which are high-scoring (line). Data table available in the appendix.



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The distribution by area type shows some consistent trends (Figure 3). In total there are far fewer small-town and rural type data zones across Scotland than there are urban type data zones, which largely explains why the less urban area types generally contain fewer high-scoring data zones than more urban areas. However, it can also be seen that high-scoring data zones also make up a lower percentage of the total data zones in each less urban area types compared to urban areas. The exception to this trend is remote small towns and very remote small towns, which both have 18% of their data zones in the high-scoring category, which is the highest value of any area type.

The local authority with the greatest number of high-scoring data zones is Glasgow City with 136, while the lowest is the Shetland Islands with zero. However, it can also be seen in Figure 4 that the percentage of data zones within each local authority that are high-scoring varies greatly. The local authority with the highest percentage of data zones scoring high is Aberdeen City, with 26.5% of their data zones being high-scoring. The local authority with the lowest non-zero percentage of data zones scoring high was East Dunbartonshire with 0.8%.

Table 7 and Table 8 in the appendix give details of the 28 data zones with the two highest (19 and 20) overall scores and 20 data zones with the two lowest (4 and 5) overall scores. The detail shown in Table 7: Data zones with the two highest overall scores, 19 and 20Table 7 and Table 8 reflect the trends already described above – the majority of the twenty eight top scoring data zones are in urban areas while many of the bottom 20 scoring zones are in more rural areas. It is notable that a large number of local authorities are represented in both lists, with the top 28 scoring data zones spread across 13 of the 32 local authorities in Scotland and the bottom 20 spread across 12 local authorities. The data zones in Table 8 can be considered those where conditions for cycling are poor, but income deprivation is also low, indicating that economic assistance with cycle ownership is unlikely to increase rates of walking and cycling and other interventions would be required.

3.2 Suggested usage

An interactive mapping tool showing scores for each individual measure and the overall score is available for users to interrogate the data to investigate a range of questions. The data can also be provided in excel format on request.

We suggest that these maps and data could be used to inform local authorities and to produce policy recommendations in the following ways.

The overall score can be used to identify areas where active travel has the potential to most easily alleviate transport poverty, for example with the provision of cycles or behaviour change projects to low income households or a scheme to make cycles more affordable to people on low incomes.

The overall score can also be used in conjunction with the individual measure scores to identify areas that score relatively highly overall but score poorly in one particular measure and

would benefit from a specific, targeted intervention. For example:

- In areas with low *availability* scores:
  - building new cycle and walking paths
  - improving integration of existing cycle / walking routes with places people want to go
  - designing places where everyday services such as supermarkets and schools are *available* through walking and cycling
  - ensuring secure cycle storage is *available* to all
- In areas with low *safety* scores:
  - upgrading existing or building new active travel routes to best-practice standards such as physically segregated cycle lanes
  - making improvements to urban infrastructure to prioritise the *safety* of active travel users
  - making policy decisions to prioritise the *safety* of active travel users such as reducing traffic speeds
- In areas with low *accessibility* scores:
  - improving enforcement of bans on pavement parking and parking in cycle lanes
  - better maintenance of pavements and cycle routes and removing physical barriers and pavement clutter
  - developing schemes to increase the use of e-bikes or adapted cycles, such as trials or help to buy schemes

3.3 Possible future work

Further time and funding would allow this tool to be developed further to create a more interactive web application enabling users to filter the maps as they wished to answer their own questions. For example, to highlight only high scoring data zones in a particular local authority, or all those data zones which score well overall but poorly for the safety indictor.

A more sophisticated safety indicator could also be developed incorporating a broader range of factors such as rates of bike theft, air pollution measures or crime rates affecting social safety.

Mapping of existing active travel routes could be included to speak further to the availability indicator.

Appendix

Table 5: Number of high-scoring data zones and the percentage of data zones which are high-scoring by area type

Area type	Number of high-scoring data zones	Percentage of data zones which are high-scoring
Large Urban Areas	358	14.34
Other Urban Areas	225	9.15
Accessible Small Towns	57	9.30
Remote Small Towns	19	18.27
Very Remote Small Towns	18	18.37
Accessible Rural Areas	17	2.11
Remote Rural Areas	1	0.51
Very Remote Rural Areas	6	2.94

Table 6: Number of high-scoring data zones and the percentage of data zones which are high-scoring by local authority

Local authority	Number of high-scoring data zones	Percentage of data zones which are high-scoring
Glasgow City	136	18.23
City of Edinburgh	86	14.41
Aberdeen City	75	26.50
Highland	47	15.06
Fife	38	7.69
Dundee City	34	18.09
North Lanarkshire	30	6.71
Moray	24	19.05
Aberdeenshire	23	6.76
South Lanarkshire	18	4.18
Stirling	17	14.05
Scottish Borders	15	10.49
West Lothian	15	6.28
South Ayrshire	14	9.15
Perth and Kinross	13	6.99
Dumfries and Galloway	13	6.47
Falkirk	13	6.07
Renfrewshire	13	5.78
Argyll and Bute	11	8.80
Clackmannanshire	10	13.89
North Ayrshire	10	5.38
Angus	8	5.16
Inverclyde	8	7.02
East Ayrshire	7	4.29
Midlothian	7	6.09
East Lothian	6	4.55
West Dunbartonshire	4	3.31
East Renfrewshire	2	1.64
Na h-Eileanan Siar	2	5.56
Orkney Islands	1	3.45
East Dunbartonshire	1	0.77
Shetland Islands	0	0.00

Table 7: Data zones with the two highest overall scores, 19 and 20

Data Zone Name	Data Zone Code	Local Authority	Urban-Rural Classification	Overall score	Afford ability Score	Availa bility Score	Acces sibility Score	Safety Score
Fort William South - 08	S01010523	Highland	Other Urban Areas	20	5	5	5	5
Great Junction Street - 03	S01008787	City of Edinburgh	Large Urban Areas	20	5	5	5	5
Lossiemouth West - 03	S01011138	Moray	Accessible Small Towns	19	4	5	5	5
Central and South Inch - 02	S01011939	Perth and Kinross	Other Urban Areas	19	5	5	4	5
Borestone - 04	S01013057	Stirling	Other Urban Areas	19	5	5	4	5
Cornton - 03	S01013078	Stirling	Other Urban Areas	19	5	5	4	5
Inverness Drummond - 03	S01010608	Highland	Other Urban Areas	19	5	5	4	5
Invergordon - 04	S01010743	Highland	Remote Small Towns	19	5	5	4	5
Alloa South and East - 04	S01007464	Clackmannanshire	Other Urban Areas	19	5	5	4	5
Stranraer West - 06	S01007486	Dumfries and Galloway	Other Urban Areas	19	5	5	5	4
Lockerbie - 03	S01007637	Dumfries and Galloway	Accessible Small Towns	19	4	5	5	5
Annan East - 07	S01007670	Dumfries and Galloway	Accessible Small Towns	19	5	5	4	5
Hawick - Burnfoot - North	S01012362	Scottish Borders	Other Urban Areas	19	5	5	5	4
Gracemount, Southhouse and Burdiehouse - 04	S01008556	City of Edinburgh	Large Urban Areas	19	5	5	4	5

Data Zone Name	Data Zone Code	Local Authority	Urban-Rural Classification	Overall score	Afford ability Score	Availa bility Score	Acces sibility Score	Safety Score
Paisley South East - 02	S01012109	Renfrewshire	Large Urban Areas	19	5	5	5	4
Burnhill and Bankhead North - 05	S01012869	South Lanarkshire	Large Urban Areas	19	5	5	4	5
Rosemount - 04	S01006567	Aberdeen City	Large Urban Areas	19	4	5	5	5
Torry East - 02	S01006632	Aberdeen City	Large Urban Areas	19	5	5	4	5
George Street - 03	S01006647	Aberdeen City	Large Urban Areas	19	4	5	5	5
Froghall, Powis and Sunnybank - 01	S01006658	Aberdeen City	Large Urban Areas	19	4	5	5	5
Old Aberdeen - 03	S01006673	Aberdeen City	Large Urban Areas	19	4	5	5	5
Tillydrone - 01	S01006675	Aberdeen City	Large Urban Areas	19	5	5	5	4
Tillydrone - 06	S01006680	Aberdeen City	Large Urban Areas	19	5	5	4	5
Woodside - 02	S01006682	Aberdeen City	Large Urban Areas	19	5	5	5	4
Govanhill East and Aikenhead - 02	S01009895	Glasgow City	Large Urban Areas	19	5	5	5	4
Cowlairs and Port Dundas - 01	S01010219	Glasgow City	Large Urban Areas	19	4	5	5	5
Wyndford - 03	S01010360	Glasgow City	Large Urban Areas	19	5	5	5	4
Balgay - 01	S01007834	Dundee City	Large Urban Areas	19	5	5	4	5

Table 8: Data zones with the two lowest overall scores, 4 and 5

Data Zone Name	Data Zone Code	Local Authority	Urban-Rural Classification	Overall score	Afford ability Score	Availa bility Score	Acces sibility Score	Safety Score
Fairmilehead - 06	S01008546	City of Edinburgh	Large Urban Areas	4	1	1	1	1
Crossgates South Knowe and Annfield	S01009405	Fife	Other Urban Areas	4	1	1	1	1
Whinnyknowe and Leslie Mains	S01009592	Fife	Other Urban Areas	4	1	1	1	1
Largs North - 05	S01011333	North Ayrshire	Other Urban Areas	4	1	1	1	1
Fairlie and Rural - 02	S01011308	North Ayrshire	Accessible Rural Areas	4	1	1	1	1
Muthill, Greenloaning and Gleneagles - 01	S01011847	Perth and Kinross	Accessible Rural Areas	5	1	1	2	1
South Angus - 04	S01007132	Angus	Accessible Rural Areas	5	1	1	1	2
Monikie - 08	S01007144	Angus	Accessible Rural Areas	5	2	1	1	1
Arbroath Landward - 03	S01007172	Angus	Accessible Rural Areas	5	2	1	1	1
Friockheim - 01	S01007226	Angus	Accessible Rural Areas	5	2	1	1	1
Letham and Glamis - 07	S01007246	Angus	Accessible Rural Areas	5	2	1	1	1

Data Zone Name	Data Zone Code	Local Authority	Urban-Rural Classification	Overall score	Affordability Score	Availability Score	Accessibility Score	Safety Score
New Abbey - 04	S01007596	Dumfries and Galloway	Accessible Rural Areas	5	2	1	1	1
Helensburgh North - 06	S01007392	Argyll and Bute	Other Urban Areas	5	1	1	1	2
Crookfur and Fruin - 06	S01008333	East Renfrewshire	Large Urban Areas	5	2	1	1	1
Ettrick Water and Bowhill Area	S01012378	Scottish Borders	Accessible Rural Areas	5	1	1	2	1
Earlston and Hurlford Rural - 07	S01007961	East Ayrshire	Accessible Rural Areas	5	2	1	1	1
Kilmany Rathillet and Logie	S01009746	Fife	Accessible Rural Areas	5	1	1	1	2
Renfrew West - 01	S01012159	Renfrewshire	Large Urban Areas	5	1	1	1	2
Calderbank and Brownsburn - 01	S01011613	North Lanarkshire	Other Urban Areas	5	1	1	1	2
Cairnhill - 01	S01011641	North Lanarkshire	Other Urban Areas	5	1	1	1	2