Access to Public Green Space in Eastleigh, Hampshire

1 Introduction

It is widely recognized that access to green space has benefits for urban populations (including improved physical health: Coombes et al., 2010; psychological wellbeing: Fuller et al., 2007; and biodiversity: Sandström et al., 2006) and as such regulatory bodies are interested in monitoring access to green space. This study will assess access to public green space in part of Eastleigh, Hampshire.

2 Review of guidelines

The key green space access guidelines which apply to Eastleigh are listed in Table 1. This project will focus on the ANGSt and Eastleigh Borough Council's (EBC) in-house standard.

3 Methods

3.1 Overview

Figure 1 shows an overview of the method for this project.

3.2 Study Area

The study area (Figure 2) covers part of Eastleigh, Hampshire, UK.

3.3 Data Sources

3.3.1 Ordnance Survey Data

The OS data sources listed below were used (acquired via Digimap, 2010):

- **MasterMap**: High resolution vector topographic map data.
- **CodePoint**: Geographic centroids of each unit postcode in the SO50 postcode
- **Integrated Transport Network (ITN)**: Road map data which was processed to form an ArcGIS Network Dataset

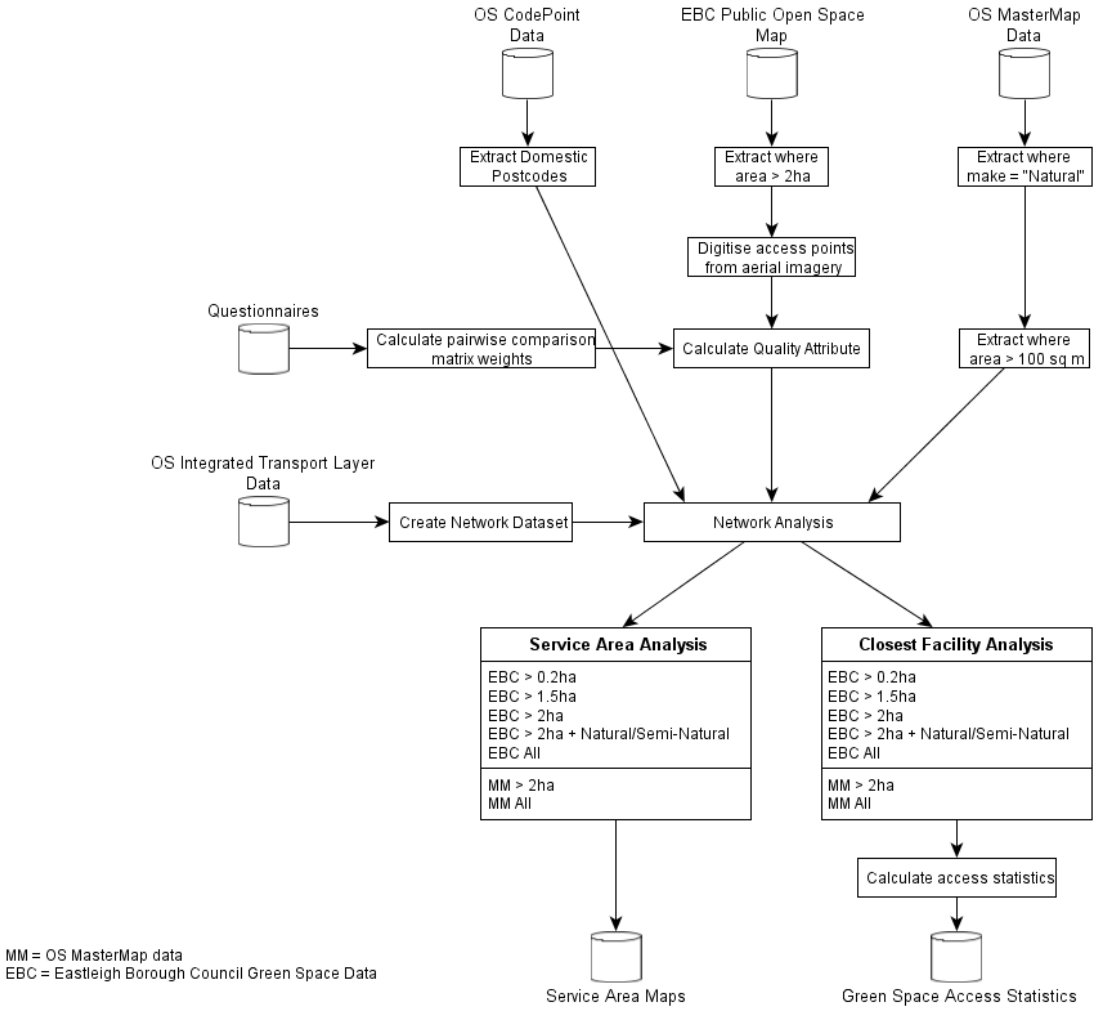

Figure 1 - Flowchart showing an overview of the method for this project

3.3.2 Eastleigh Borough Council Data

EBC provide online display of maps showing data from their Local Development Plan Review (Eastleigh Borough Council, 2006, 2010c), with a layer of areas identified as public open space. There is no facility to download GIS-ready data from the website, but an enquiry to EBC resulted in access to shapefiles of this data (Horn, N., personal communication, 26/04/2010).

3.3.3 Questionnaires

Most green space guidelines refer to “quality” green space. A literature review suggested that many factors combine to produce the “quality” of a green space. Van Herzele and Wiedemann (2003) suggest and define five factors which affect this quality: *space*, *nature, culture and history*, *quietness* and *facilities*.

Table 1 - Details of Public Green Space access guidelines relevant to Eastleigh

Guideline/Body	Terminology	Definition	Guidelines	References
Accessible Natural Green Space Standard (ANGSt)	"Natural Green Space"	"Land, water and geological features which have been naturally colonized by plants and animals and which are accessible on foot to large numbers of residents"	At least 2ha of natural green space within 300m of home	English Nature (1995)
National Playing Fields Association Six Acre Standard	"Open space"	"All open space in the public realm which offers opportunities for sport, recreation and tourism"	At least 2.4ha of open space available for every 1000 residents including 1.6ha for outdoor sport and recreation, and 0.8ha for children's play	Earley (1994) Fields in Trust (2010)
Eastleigh Borough Council	"Green Network" "Green space"	Urban parks and gardens; Amenity green spaces; Play areas; Playing fields and sports pitches; Green corridors; Country parks and natural/semi-natural land Undefined in the Local Plan Review document	At least 2.8ha of open space available for every 1000 residents. At least 0.2ha of good quality green space within 300m of home. At least 1.5ha of good quality green space within 600m of home. A natural/semi-natural wildlife site of at least 2ha within 600m of home. Access to a Country Park area of at least 20ha within 4km of home.	Eastleigh Borough Council (2006)

To establish a method of assessing quality, a sample of twenty people was asked one of two questionnaires (one simple, and one more complex, see Appendix 1) about their opinions on public green space. The questionnaires were asked on the University of Southampton's Highfield Campus, so the majority of respondents were students, although an effort was made to include older people. The simple questionnaire asked respondents to rank the factors in order of importance, whereas the complex questionnaire asked respondents to fill in a pair-wise comparison matrix (based on Saaty, 1977) using the factors.

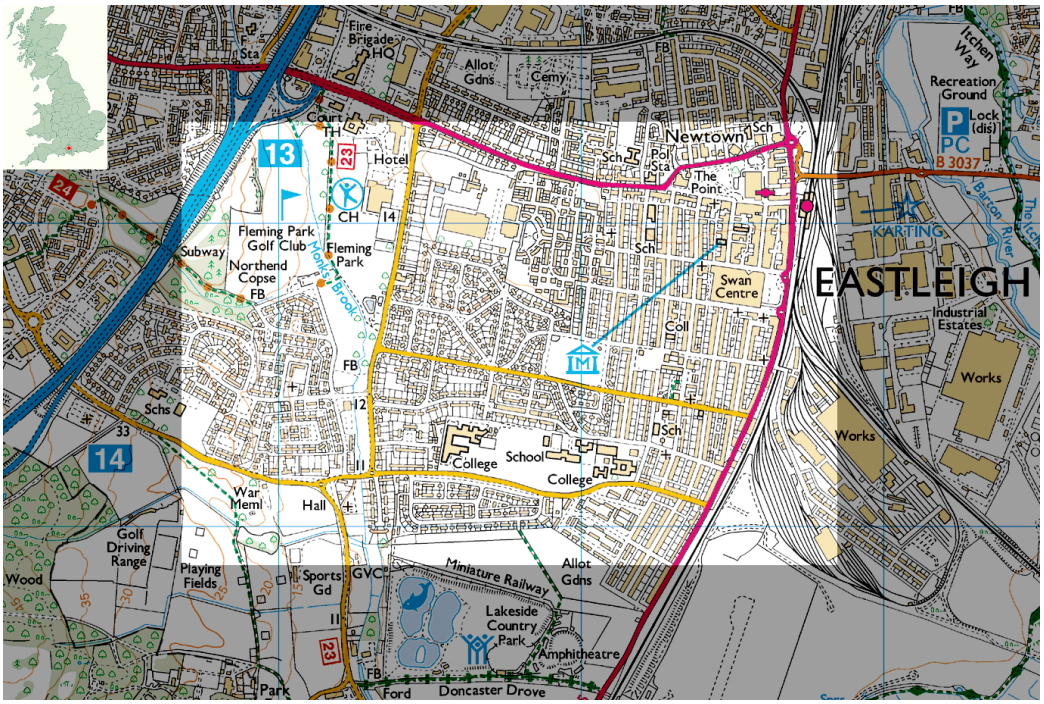

Figure 2 - Location and extent of the study area within Eastleigh, with inset showing location of Eastleigh within the UK

3.4 Mapping green space

Green space was mapped from OS MasterMap data as shown in Figure 1. Not all of these green spaces are necessarily accessible by the public, but they were included in this study as they may have influences on the biodiversity benefits of green space provision.

Although the all of the green spaces in the EBC data are accessible to the public, they are not always accessible at every point on their perimeter. Therefore, the access points for each green space polygon were digitised based upon aerial imagery (Google, 2010) and local knowledge.

3.5 Quality assessment

The results of each of the complex questionnaires were analysed using the *WEIGHTS* command in IDRISI (Clark Labs, 2006) to produce a weight for each category of factors from the pair-wise comparison matrix. Results with a consistency ratio over 0.5 were discarded as it was assumed that the respondent did not understand the instructions on the questionnaire. This threshold was chosen as it excluded the most inconsistent results, while still leaving a reasonable sample size. The mean weights from the questionnaires are shown in Table 2, with the mean rankings from the simple questionnaires. It can be seen that the order of importance of the factors is similar for both types of questionnaire (Table 3), with Facilities and Culture seen as the least important in both. The averaged weights from the complex questionnaire were chosen as these were thought to better reflect the subtleties of the prioritisation of the factors. Quality values on a scale of 1-10 were then calculated for each of the factors as shown in Table 4.

Table 2 - Weights for each factor from both the simple (ranking-based) and complex (pair-wise-comparison-based) questionnaires

Category	Pair-wise Comparison Weight	Simple Ranking Weight
Nature	0.35194	2.5454
Quietness	0.28466	2.7272
Space	0.25762	2.3636
Facilites	0.05752	3.3636
Culture	0.04816	4

Table 3 - Rankings for each factor from both the simple (ranking-based) and complex (pair-wise-comparison-based) questionnaires

Ranking from Pair-wise Comparison	Ranking from Simple Ranking
Nature	Space
Quietness	Nature
Space	Quietness
Facilites	Facilites
Culture	Culture

3.6 Network Analysis

Green space locations were subset into the categories shown in Figure 1. It was originally intended that only high-quality sites would be used in the analysis, but there were a number of issues with this (see Table 5), and they were not used.

Network analysis was carried out using the subset locations of green space as input *Facilities* and the postcode centres as *Incidents*. *Closest Facility* and *Service Area* analyses were performed.

Table 4 - Methods of calculation of individual factor quality scores, based on methods adopted by Van Herzele and Wiedemann (2003)

Factor Category	Method	Data Sources
Space	Analysis of fragmentation was attempted, using the method of Wiedemann (1996), but this appeared just to give higher values for larger spaces. Instead, the quality score was first calculated based on a scaling of the absolute size of the area, and then adjusted to take into account the 'feeling of spaciousness' caused by various landscape elements as observed from aerial imagery.	**Aerial imagery:** Google (2010)
Nature	The locations of water bodies were extracted from the OS MasterMap data and green spaces containing water were marked. The quality score was assigned qualitatively based upon the presence of water, and the variety of environment types present in the area, as observed from aerial imagery.	**Water bodies:** OS MasterMap **Aerial imagery:** Google (2010)
Culture and History	No information was available on the cultural and historical quality of green spaces in this area, therefore all green spaces were given a quality of 1 for this factor.	None
Quietness	Noise levels (in decibels) were assigned to each green space polygon as the highest noise level shown on the Defra map for that area. Areas which were not covered by the Defra map were assigned a noise level of 0. This was then scaled to a value from 1-10.	**Defra Noise Maps**: Defra (2006) including maps of industrial noise, road noise, rail noise and airport noise
Facilities	Scores were assigned qualitatively based upon a number of sources of information on facilities in green spaces. Children's play area locations (based on postcodes) were digitised, and assigned to the nearest green space. EBC's website lists green spaces with large numbers of facilities (such as Lakeside Country Park), and aerial imagery from Google Maps were used to identify other facilities.	**Play area data:** Eastleigh Borough Council (2010b) **Lakeside Country Park:** Eastleigh Borough Council (2010a) **Aerial Imagery**: Google (2010)

Table 5 - Problems with using the quality data from this study

Problem	Explanation
No definition of "good quality"	The term "good quality" was not defined in the EBC standard, making calculating and thresholding quality very difficult.
"Good quality" varies with green space size	It seems likely that the quality of a green space would vary between different sizes of green space. For example, a good quality 0.2ha space is likely to have very different characteristics to a good quality 20ha site. This made it very difficult to choose thresholds for a "good quality" site.

4 Results

4.1 Green Space Locations

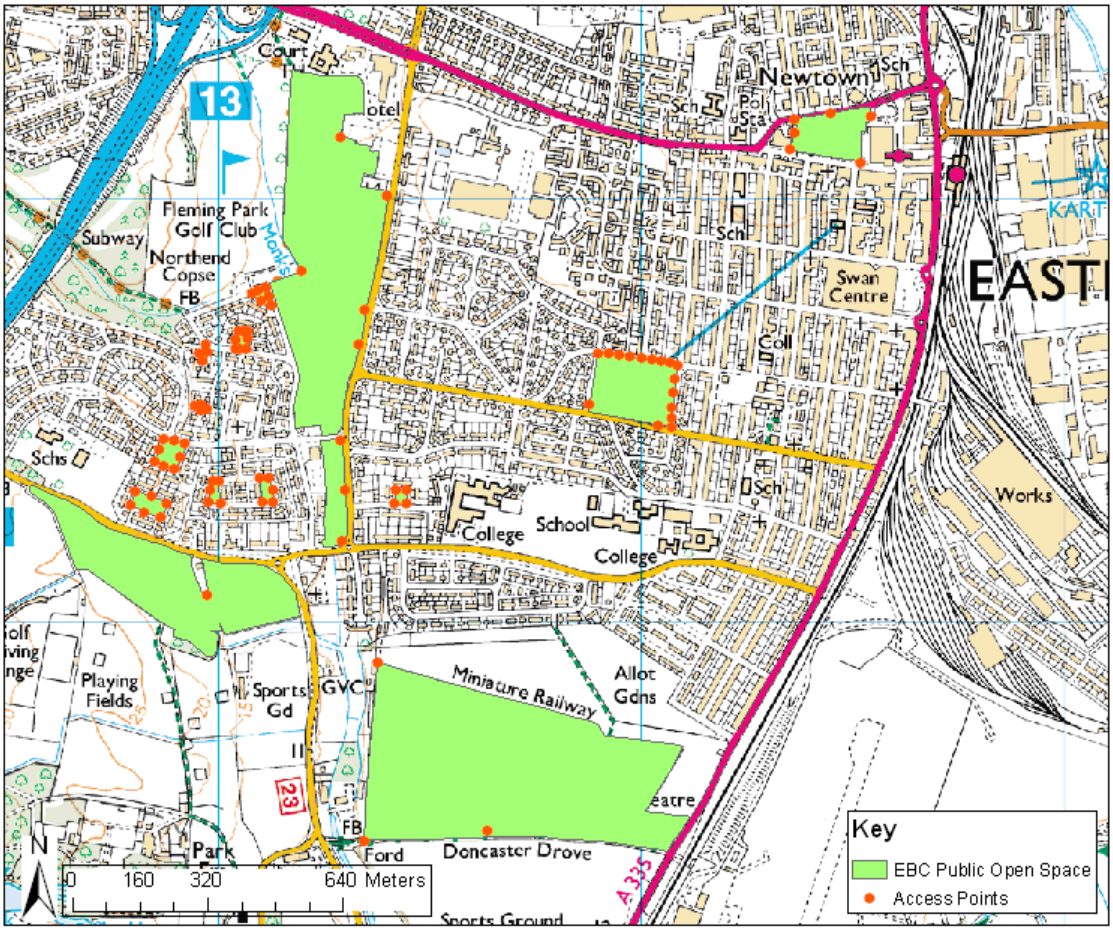

Figure 3 - Locations of the green space areas from the EBC data, showing manually digitised access points

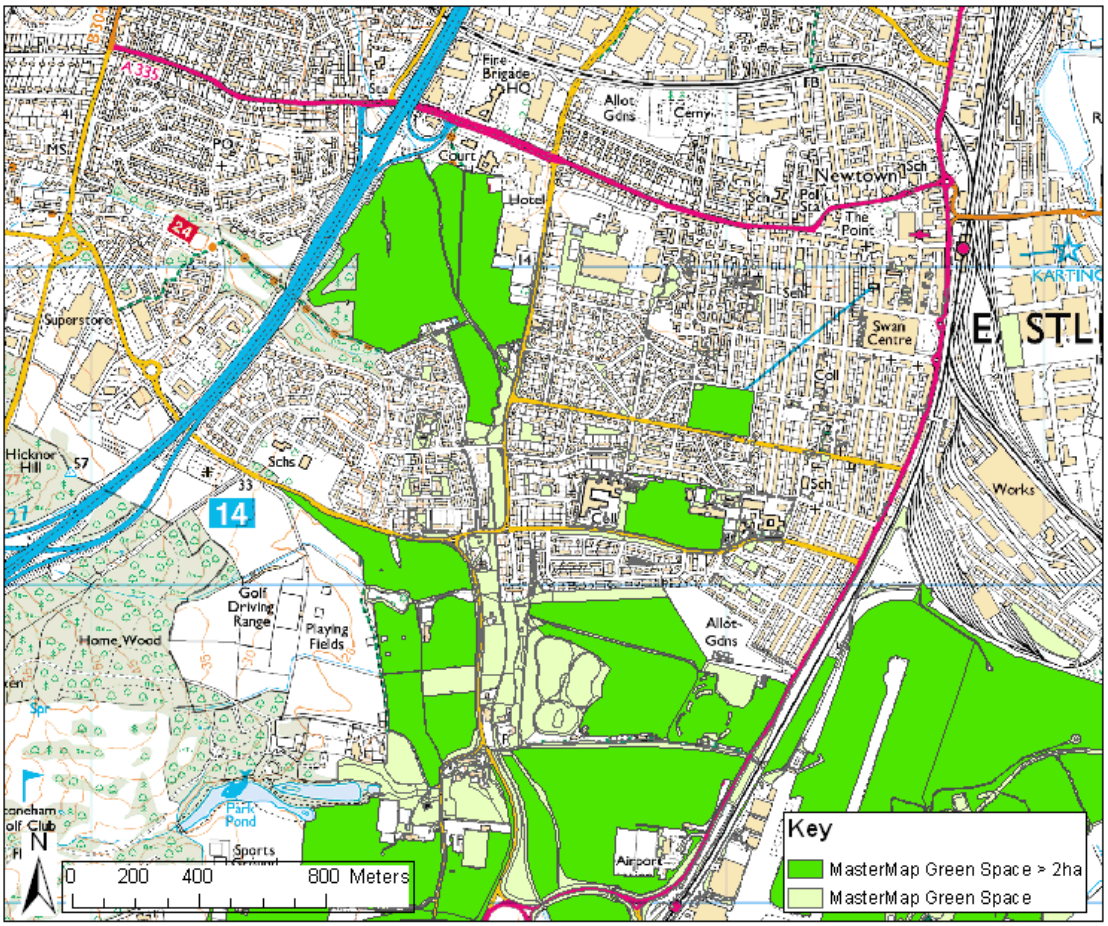

Figure 4 – Locations of the green space areas from the OS MasterMap data, distinguishing between areas > 2ha and areas < 2ha.

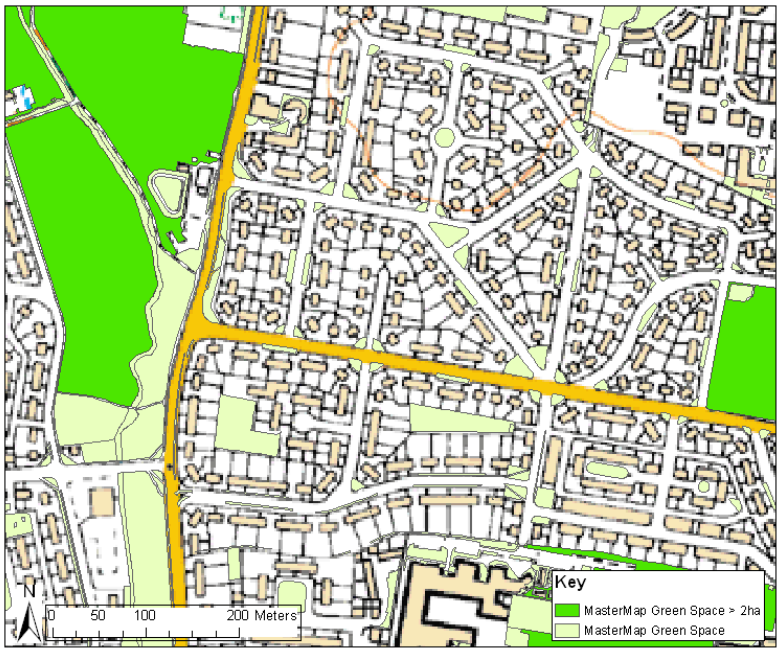

Figure 5 - Larger scale map showing the large number of small green spaces indentified in the OS MasterMap data

4.2 Eastleigh Borough Council Data Results

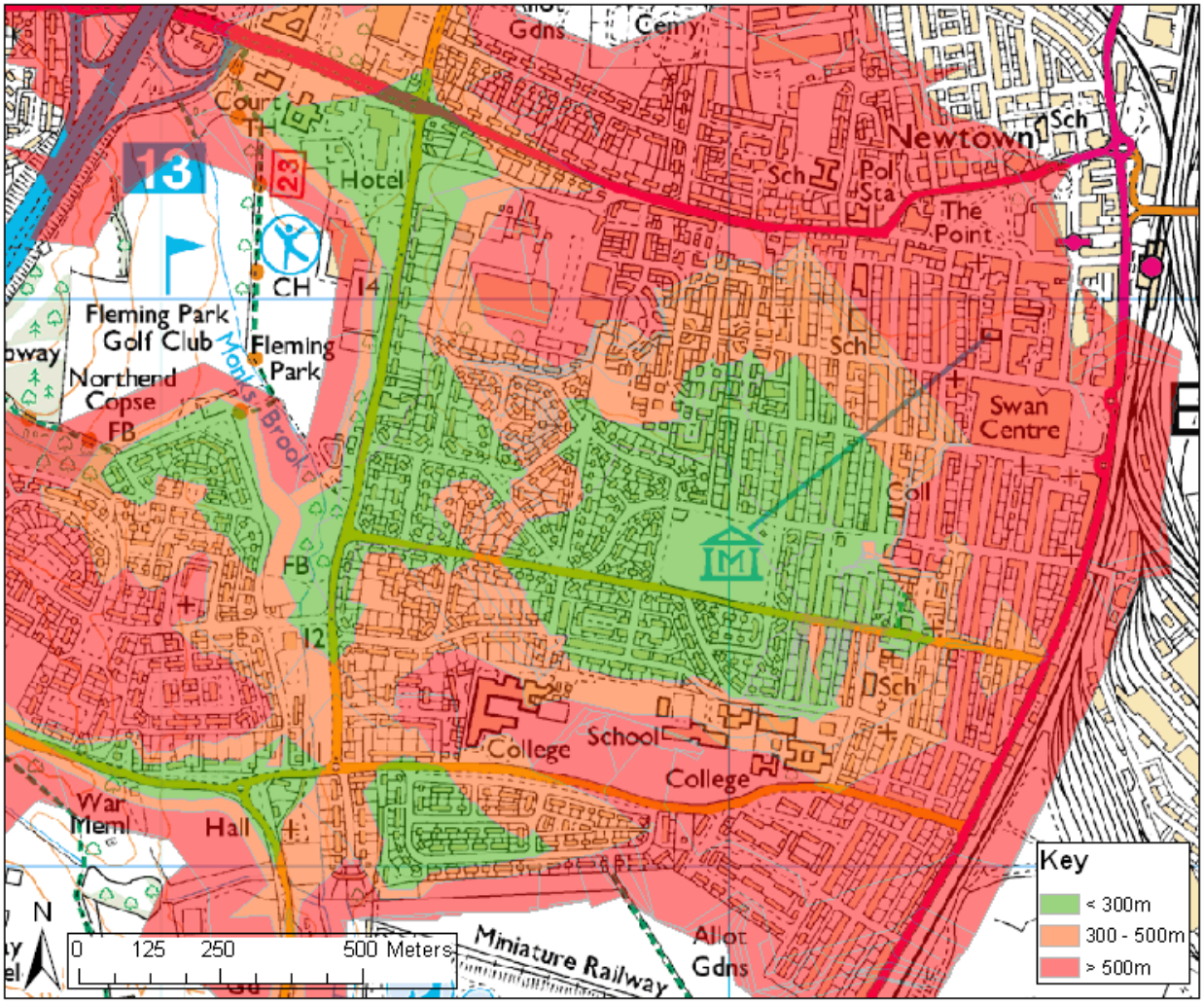

Figure 6 - Map showing areas which fulfill the ANGSt standard (at least 2ha of green space within 300m)

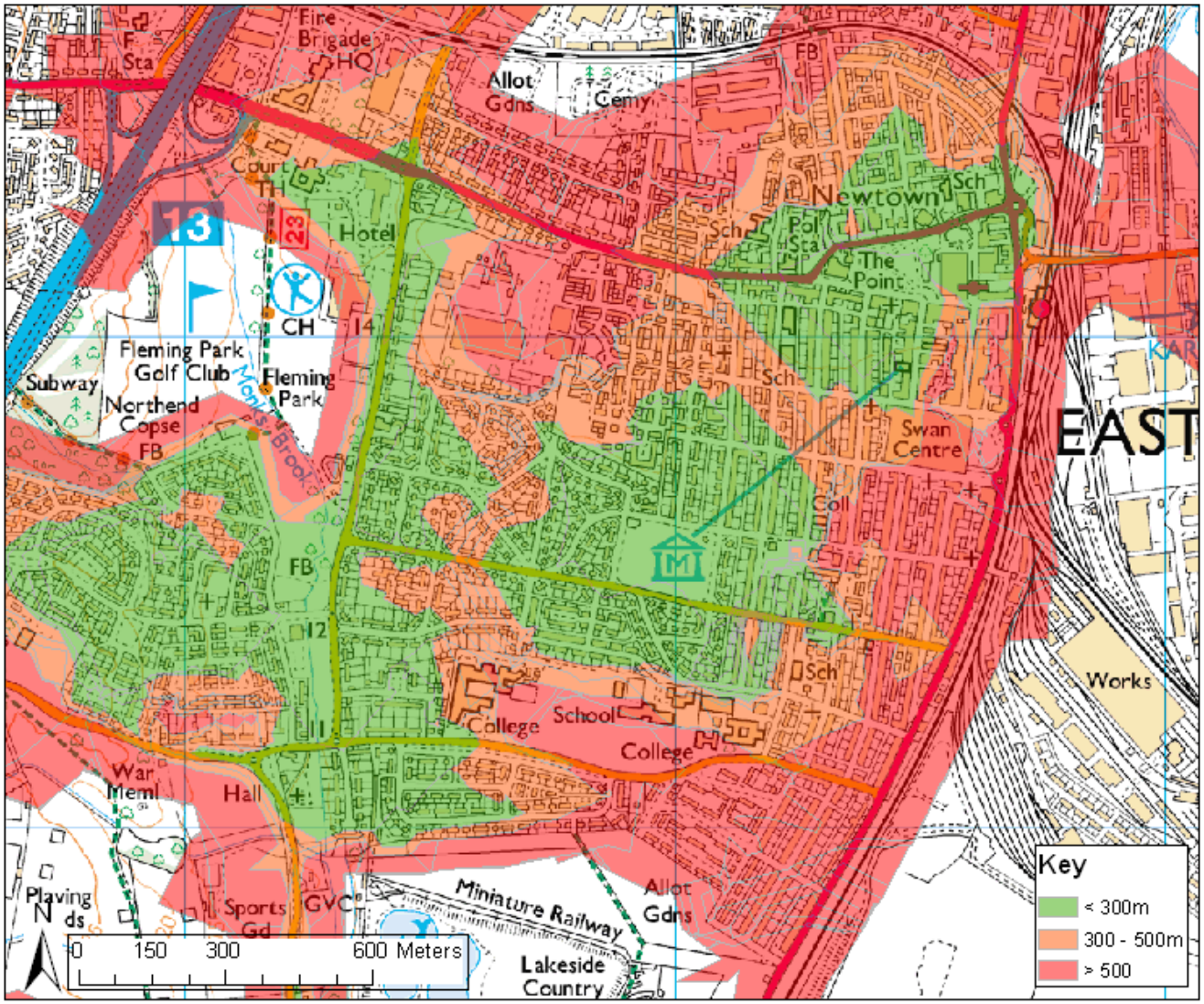

Figure 7 - Map showing areas which fulfill the EBC standard of 0.2ha of green space within 300m

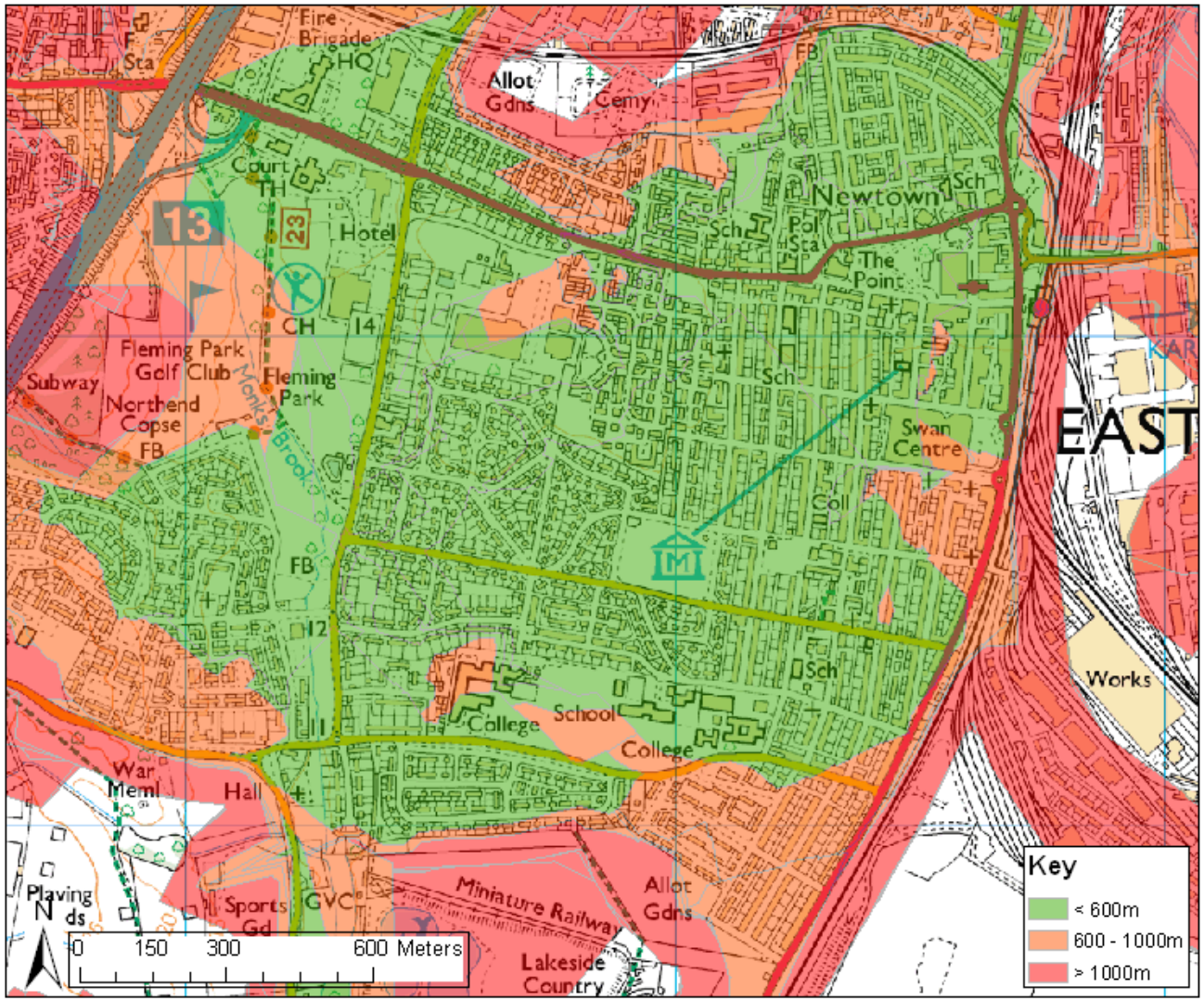

Figure 8 - Map showing areas which fulfill the EBC standard of 1.5ha of green space within 600m

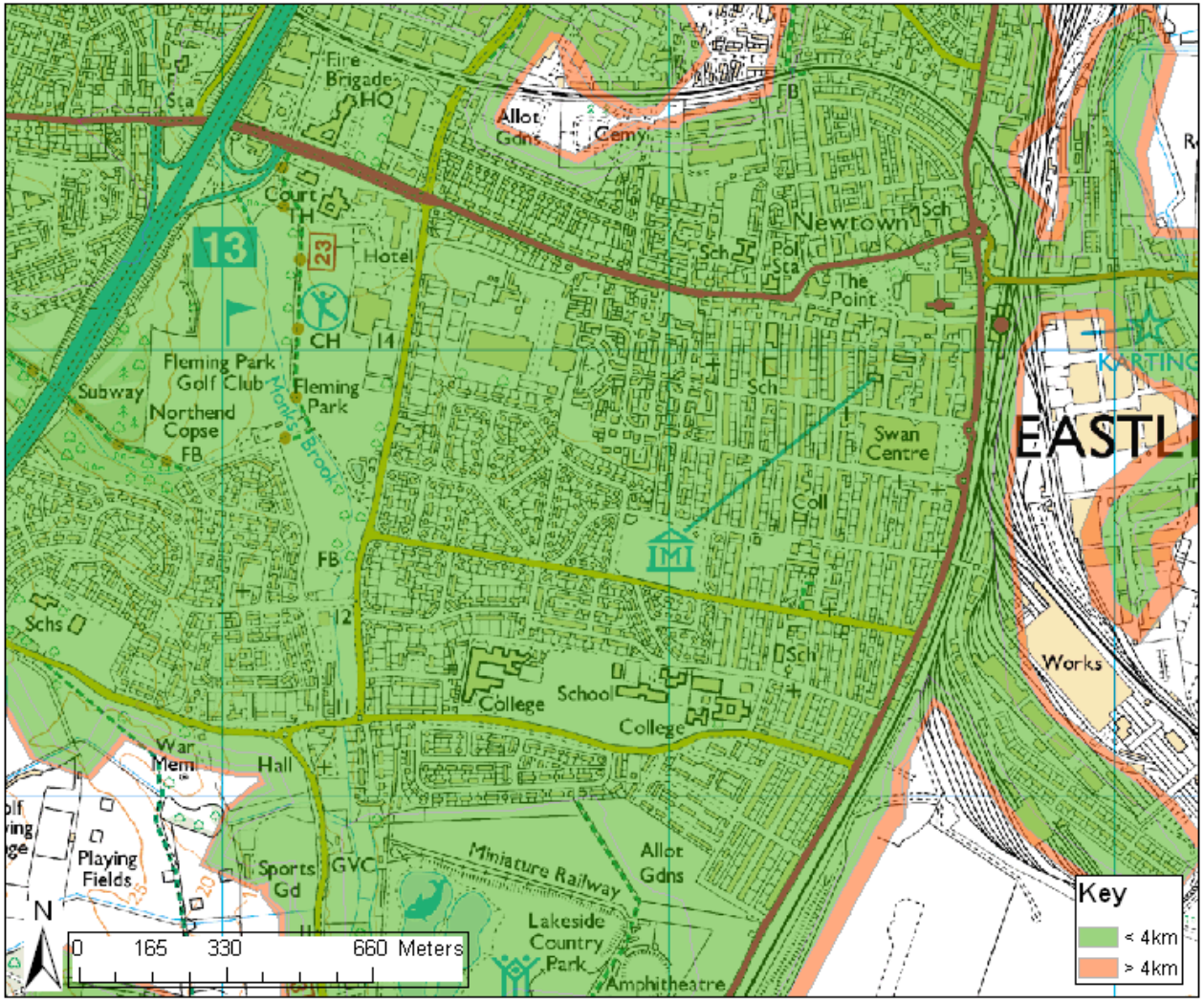

Figure 9 - Map showing areas which fulfill the EBC standard of 20ha of green space within 4km

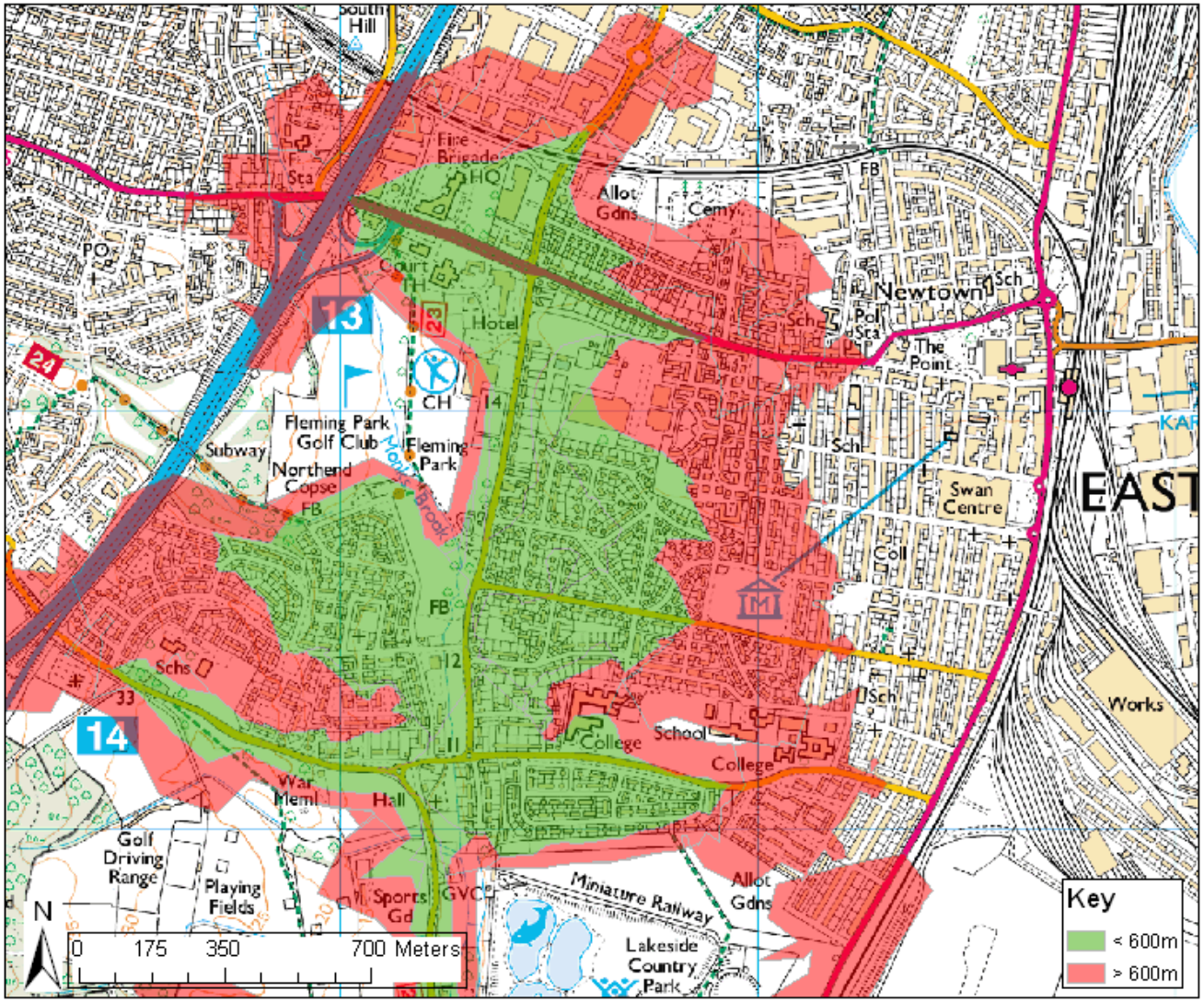

Figure 10 - Map showing areas which fulfill the EBC standard of a natural/semi-natural green space area of 2ha within 600m

4.3 OS MasterMap Data Results

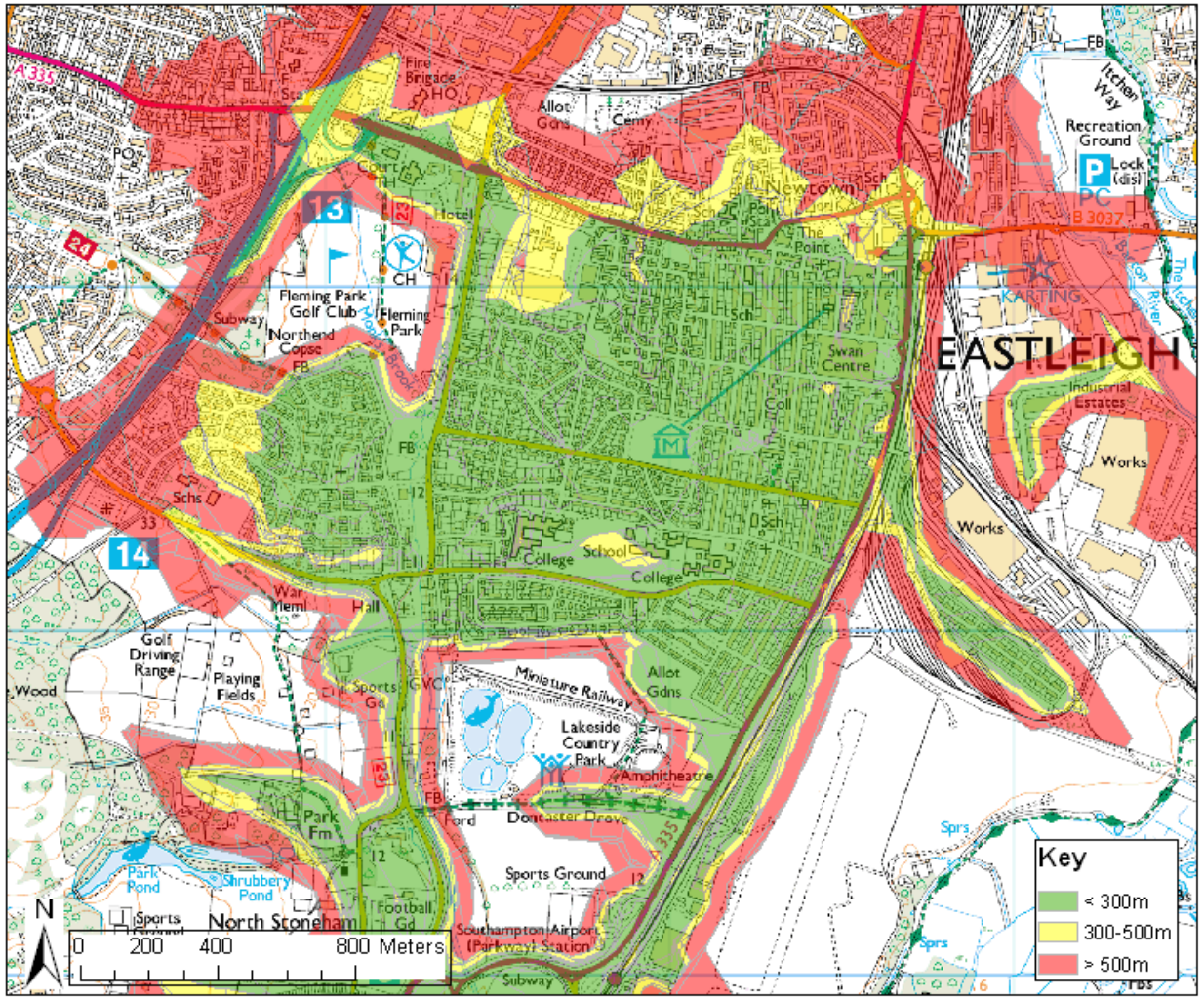

Figure 11 - Map showing areas which have a green space of any size accessible within 300m

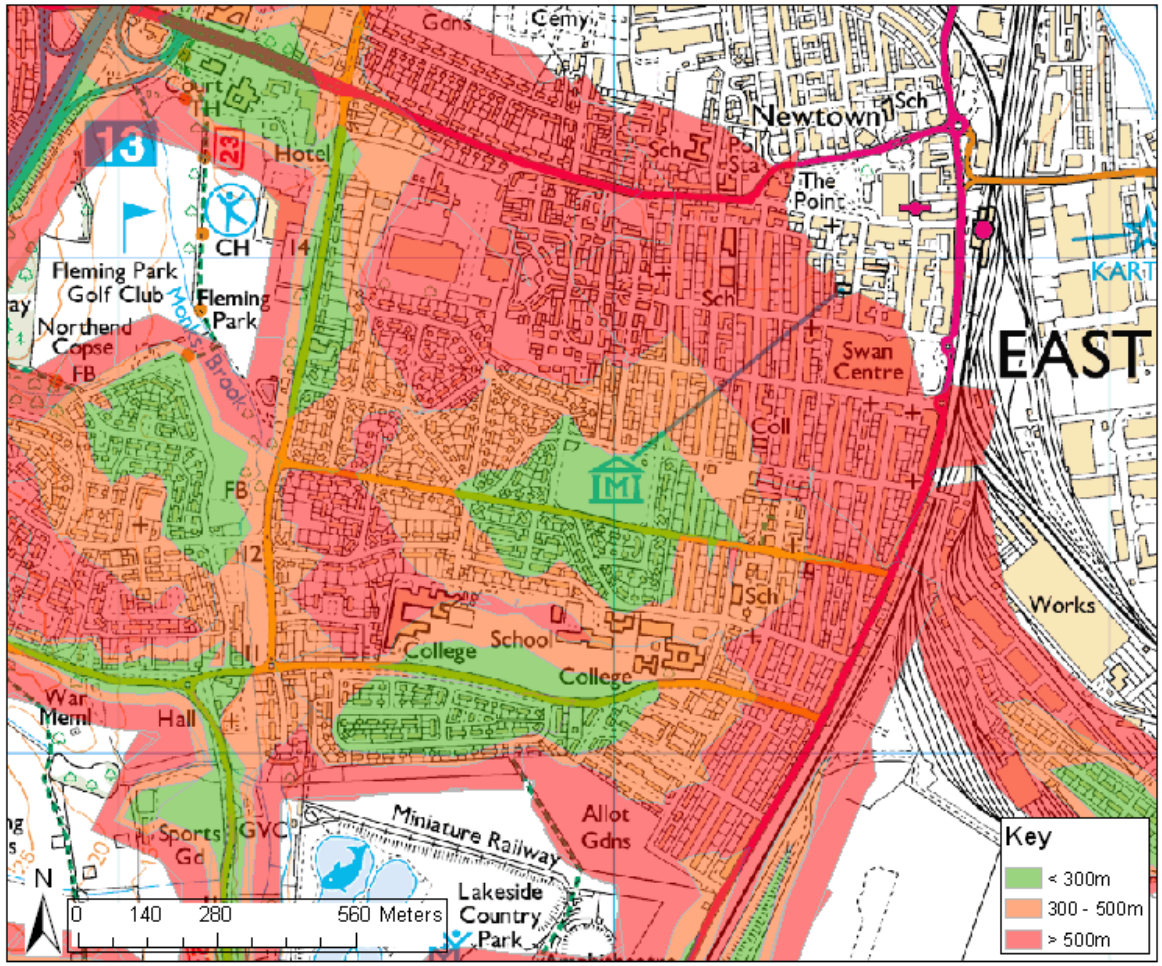

Figure 12 - Map showing areas which fulfill the ANGSt standard of 2ha of green space within 300m, based upon OS MasterMap green space data

4.4 Green Space Access Statistics

Table 6 – Percentage of domestic postcodes which fulfill each green space accessibility standard, for both EBC and OS MasterMap data

EBC Data			OS MasterMap Data		
Body	**Guideline**	**% Fulfill**	**Body**	**Guideline**	**% Fulfill**
ANGSt	2ha within 300m	32%	ANGSt	2ha within 300m	19%
EBC	0.2ha within 300m	42%	N/A	Any size within 300m	100%
EBC	1.5ha within 600m	84%			
EBC	2ha natural within 600m	31%			
EBC	20ha within 4km	100%			

4.5 Other questionnaire results

Table 7 - Results from the other questions on the questionnaire

Which is most important to you?				
Accessibility		**Attractiveness**		
35%		65%		
Do you have access to a 2ha green space within 300m				
Yes		**No**		
52%		48%		
How important is green space access to you?				
1	**2**	**3**	**4**	**5**
58%	17%	5%	17%	0%

5 Analysis

5.1 How well does Eastleigh fulfil green space access standards?

Less than a third of the domestic postcodes in the study area fulfil the 300m ANGSt standard, and that only rises to 42% for the 300m EBC standard. Wider-scale standards fare better, with all postcodes in the study having access to a 'country park' site within 4km, and 84% of postcodes having access to a 1.5ha area within 600m. Unfortunately there are limited natural/semi-natural green spaces in Eastleigh, so only 31% of postcodes have access to a local natural site.

All of the postcodes in this area have access to a green space (of any size) within 300m, but many of these green spaces are very small (75% of the green spaces selected from the OS MasterMap data are less than 0.05ha in area). Therefore, access to these green spaces is unlikely to prove beneficial for public health, but may have positive biodiversity benefits.

5.2 Spatial variations in green space accessibility

Certain parts of the study area have particularly bad access to green space. They are labelled in Figure 13, and the reasons for the bad access are explained in Table 8.

5.3 Comparison of EBC and OS MasterMap data sources

Table 6 shows that there are considerable differences between the calculated accessibility using EBC and OS MasterMap data. This is because access points were not digitised for the OS MasterMap data (due to the time constraints given the volume of the data), and therefore distances were calculated to polygon centroids.

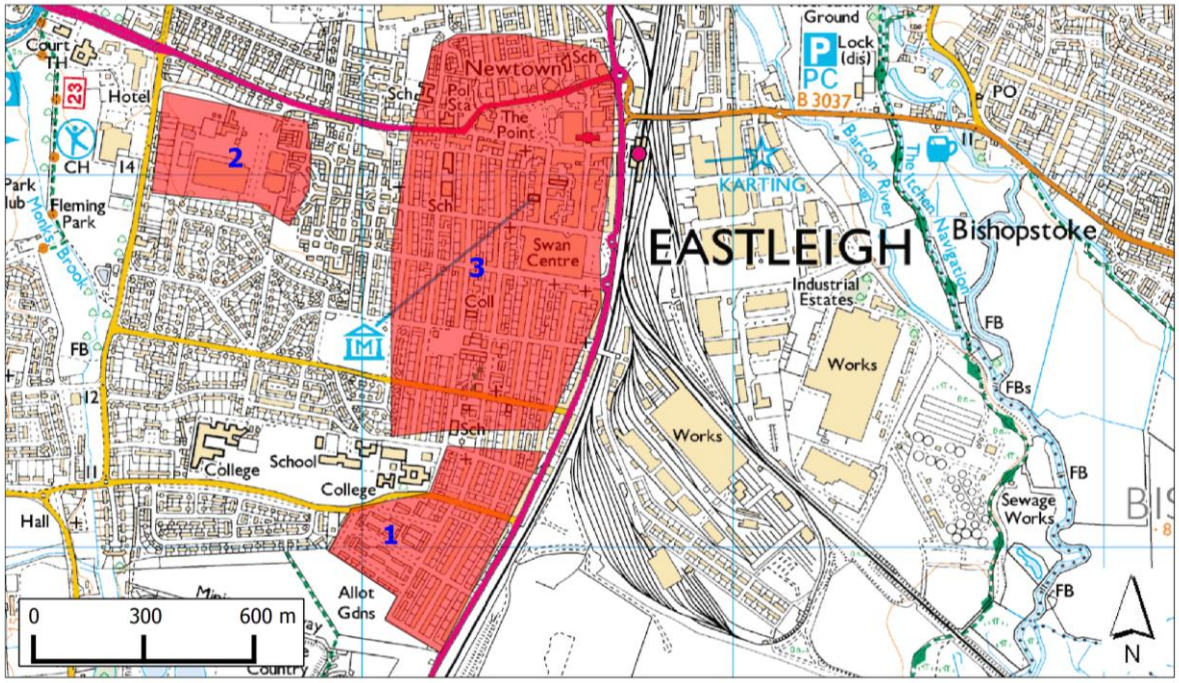

Figure 13 - Map showing areas with particularly bad access to green space, with labels used to refer to them in the text

Table 8 – Explanation of the poor accessibility of green space for the areas highlighted in Figure 13

Area	Explanation
1	The closest publically accessible green space to this area is Lakeside Country Park to the southwest, but there is no direct route available, as there are allotments in the way. Instead, the route involves walking down the A335, and then down to the Lakeside Country Park access road. The accessibility result for this area shows the importance of using network analysis with access points for green space polygons, as the Euclidean distance to the centroid of the green space polygon gives a value far smaller than the true value.
2	This area is displayed on the maps as having poor accessibility, yet it is just to the east of Fleming Park, a large area of green space. This shows one of the limitations of the network analysis approach. This area consists of a school and associated playing fields, and therefore has neither domestic postcodes nor publically accessible roads. This means that the area is treated as if it were a blank area of the map, and has correspondingly bad accessibility.
3	The whole of the eastern side of the study area has poor accessibility to natural/semi-natural green space. This is simply because the natural green space is concentrated on the western and southern edge of the study area. The eastern side consists of the central business district, railway station and industrial estates, leaving little space for natural green space.

5.4 Comparison with other studies

Other relevant studies are summarised in Table 9. It can be seen that Eastleigh has equivalent green space access to Sheffield, and considerably more than Leicester.

Table 9 - Results for other comparable green space access studies

Study area	Results	References
Leicester, UK	10% fulfil ANGSt 300m Variable access depending on ethnic group	Comber et al. (2008)
Sheffield, UK	36% fulfil ANGSt 300m Highest green space access for the most deprived areas	Barbosa et al. (2007)
Eastleigh, UK	32% fulfil ANGSt 300m	This study

6 Limitations and possible improvements

6.1 Limitations of the input data

The OS MasterMap data only includes high-level land-cover/land-use data in its attribute table, meaning that it was impossible to produce a specific query to identify publically accessible green space. Ordnance Survey are currently working on providing detailed land-cover information with the MasterMap product (D. Holland, personal communication), so this situation may improve in the future.

The Network Analysis was performed based on OS ITN data, but this data is designed for providing information and routes for vehicular transport, whereas most green space standards are based on access by foot. ITN data does not, for example, include alleyways or paths which may have a significant impact on the accessibility of certain green space areas.

The calculation of percentage fulfilment of the standards was based on routes calculated from unit postcode centres, as opposed to individual addresses. This means that the calculated percentage does not necessarily reflect the percentage of the population who fulfil the standard, as the population of unit postcodes varies.

The method of calculating the quality of each green space was based upon a limited sample of questionnaires. The respondents were also demographically skewed, consisting mostly of students who were not resident in Eastleigh. As discussed above, as all green spaces larger than 2ha were found to be of good quality, and the definition of “good quality” was debateable, it was decided not to use the quality data as a major part of the analysis. However, the questionnaires results showed that the quality of a green space is important to local populations (Table 7).

6.2 Limitations of the method

As mentioned in Table 8, areas with no domestic postcodes and no internal roads, such as the interior of large green spaces and privately owned estates (such as school or college

grounds) appear to the Network Analyst as blank areas of the map. These blank areas have a high resistance to travel, which results in erroneously large distances being calculated.

This study only assesses potential access to green space, but this may be very different to actual usage (Higgs, 2004), as the latter can be affected by a number of factors (Table 10).

Table 10 - A selection of factors which can affect actual usage of a green space

Factor	Explanation
Affordability	Although the green spaces in this study were all free to enter, transport costs (particularly to green spaces a considerable distance away) may affect actual usage.
Fear	This is often a particular issue for ethnic minorities, elderly people and women (Madge, 1997), although many people can be dissuaded from visiting a green space because of the fear of attack.
Cultural acceptability	In certain cities there are areas that are mostly inhabited by a certain cultural group, and other cultural groups would find it difficult to enter these areas. This is linked to the fear of attack, and is particularly noticeable in deprived inner-city areas

6.3 Limitations of the standards

The definitions of current green space accessibility standards (see Table 1) are frequently vague, and key terms (such as “good quality”, or even “green space”) are often undefined. This makes analysing the fulfilment of these standards very difficult.

6.4 Further work

Table 11 lists a number of possible extensions to this study.

7 Conclusions

The study area does not fulfil the national ANGSt guideline of 2ha of green space within 300m of every house. When comparing the results of this study to EBCs in-house standards, it can be seen that this area fulfils the large-scale standards, but struggles to fulfil the smaller-scale standards. There are a number of issues with the methodology of this study (particularly the calculation and use of green space quality data) but many of these could be improved with further work.

Table 11 - Possible extensions to this study

Extension	Details
Larger study area	The study area for this project was only part of Eastleigh. For the results of this project to be useful to EBC then the whole of Eastleigh, and preferably the whole of Eastleigh Borough, should be covered.
Improve the calculation of quality	This could be achieved through field surveys of each site, or questionnaires carried out at selected green spaces. Questionnaires similar to those used in this project would still be needed, but the sample size should be increased, and the questionnaires should be asked in Eastleigh. If possible, a threshold to represent a "good quality" green space should be established, and then used to subset the data before analysis.
Include path data	Before conversion to a Network Dataset, the OS ITN data could be extended by adding path data (either digitised manually, or from another source such as OpenStreetMap: Open Street Map, 2010), as this may have a considerable effect on the route distances calculated.

8 References

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9 Appendix 1

The following pages contain the simple questionnaire followed by the complex questionnaire.

SIMPLE QUESTIONNAIRE HERE

COMPLEX Q HERE

COMPLEX Q HERE

10 Appendix 2

The raw data from the questionnaires is shown below. Questionnaires which were only partially completed were excluded, leaving a total sample size of 18.

Table 12 - Weights calculated from the pair-wise comparison matrices from the complex questionnaire, including averages

Survey ID	Consistency	Space	Nature	Culture	Quietness	Facilites
1	0.68	0.2305	0.1949	0.1746	0.3682	0.0318
2	0.07	0.1422	0.4595	0.0375	0.3247	0.036
3	1.68	0.2253	0.164	0.1664	0.2723	0.1719
4	0.15	0.449	0.1753	0.0435	0.2468	0.0854
5	0.24	0.1484	0.446	0.0738	0.3039	0.0279
6	0.04	0.3685	0.1995	0.058	0.2916	0.0823
7	0.13	0.18	0.4794	0.028	0.2563	0.056
Average		0.26065	0.2732	0.0923	0.30125	0.07255

Table 13 – Raw and averaged rankings from the simple questionnaire

Survey ID	Space	Nature	Culture	Quietness	Facilites
8	3	5	1	4	2
9	1	2	4	3	5
10	2	3	4	1	5
11	4	1	2	3	5
12	1	3	5	2	4
13	4	3	5	2	1
14	4	3	5	2	1
15	3	1	4	5	2
16	1	2	4	3	5
17	2	1	5	3	4
18	1	4	5	2	3
Average	2.363636364	2.545455	4	2.7272727	3.3636364