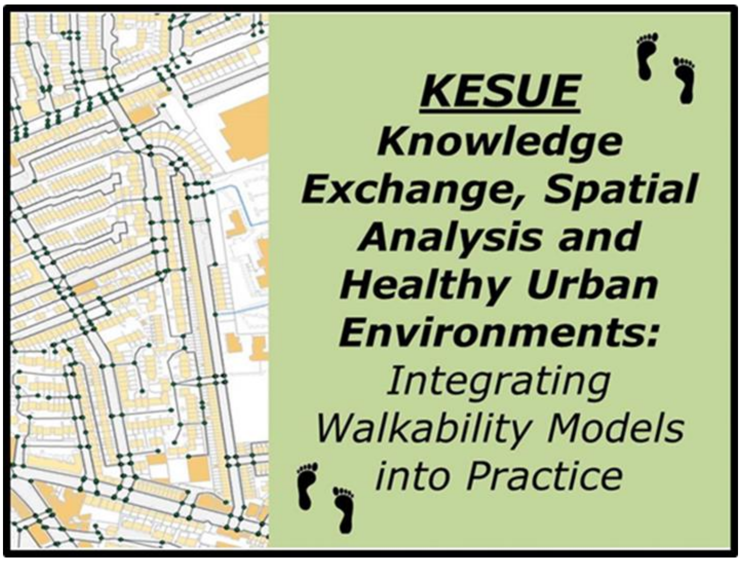

Knowledge Exchange, Spatial Analysis & Healthy Urban Environments (KESUE): PROJECT REPORT

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Project Partners:

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This project was also funded under the Economic and Social Research Council Knowledge Exchange Programme, (ref. ES/J010588/1)

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Summary

The Knowledge Exchange, Spatial Analysis and Healthy Urban Environments (KESUE) project has extended work previously undertaken by a QUB team of inter-disciplinary researchers engaged with the Physical Activity in the Regeneration of Connswater (PARC) project (Tully et al, 2013). The PARC project focussed on parts of East Belfast to assess the health impact of the Connswater Community Greenway. The KESUE project has aimed to extend some of the tools used initially in East Belfast so that they have data coverage of all of Belfast and Derry-Londonderry. The purpose of this has been to enable the development of evidence and policy tools that link features of the built environment with physical activity in these two cities. The project has used this data to help shape policy decisions in areas such as physical activity, park management, public transport and planning.

Working with a range of local partners who part-funded the project (City Councils in Belfast and Derry-Londonderry, Public Health Agency, Belfast Healthy Cities and Department of Regional Development), this project has mapped all the footpaths in the two cities (covering 37% of the NI population) and employed this to develop evidence used in strategies related to healthy urban planning. Using Geographic Information Systems (GIS), the footpath network has been used as a basis for a wide range of policy-relevant analyses including pedestrian accessibility to public facilities, site options for new infrastructure and assessing how vulnerable groups can access services such as pharmacies. Key outputs have been Accessibility Atlases and maps showing how walkability of the built environment varies across the two cities.

In addition to generating this useful data, the project included intense engagement with potential users of the research, which has led to its continued uptake in a number of policies and strategies, creating a virtuous circle of research, implementation and feedback. The project has proved so valuable to Belfast City Council that they have now taken on one of the researchers to continue the work in-house.

Further details and an electronic copy of this report are available at:
http://www.qub.ac.uk/research-centres/KnowledgeExchangeSpatialAnalysisandHealthyUrbanEnvironments/

Acknowledgements

The project team are very grateful to the funders of this project, including the ESRC, DRD, Public Health Agency, Belfast City Council, Derry City Council and Belfast Healthy Cities. We would also like to acknowledge the individuals within these organisations, who have helped establish the project and offered continued assistance during its execution, including: Joan Devlin, Jonna Monaghan, Emer Boyle, Karen Anderson-Gillespie, Andrew Hassard, Seamus Mullan, Mary Black, John Meehan, Philip Doherty, Andy Bready, Keith Walsh, Tom Reid, Sharon McCullagh and Willie Burke.

A number of other organisations have also offered in kind assistance which has included provision of useful data, including staff at the Ordnance Survey NI, particularly Brian Galloway and a number of other statutory agencies.

We have also been grateful to the help and hospitality offered in connection to the various dissemination events that have been held across Ireland and the UK, which have provided a good opportunity to discuss the work with a varied and insightful range of professionals. We are indebted to SHINE (Bristol), Institute of Public Health Ireland, Public Health Manchester, Glasgow Centre for Population Health, City and Council of Swansea and Healthy Norwich. Many thanks to all the participants in our workshops.

Finally, we would like to thank our two research assistants, Mick Donnelly and Luke Kelleher who worked intensely throughout the project, mapping the footpaths and providing great skill to the various spatial analyses undertaken.

1. *Introduction and Background*

This paper reports the findings of the Knowledge Exchange, Spatial Analysis & Healthy Urban Environments (KESUE). This project was jointly-funded by the knowledge exchange programme of the UK's Economic and Social Research Council (ESRC, grant number ES/J010588/1) and local partners including Belfast and Derry City Councils, Northern Ireland's Public Health Agency, the Department of Regional Development and Belfast Healthy Cities.

The KESUE project evolved from a larger multi-disciplinary project that has been examining the health impact of a major new greenway in East Belfast; the *Physical Activity in the Regeneration of Connswater* project (PARC, see Tully el al 2013). This multi-disciplinary, five-year project, led by the UKCRC Centre of Excellence for Public Health at Queen's University, Belfast, was funded under the National Preventative Research Initiative (NPRI[3]). PARC aims to assess the health impacts of the Connswater Community Greenway (CCG[4]) using a range of economic, spatial and social tools. One of PARC's Working Groups was specifically aimed at understanding how changes in the local built environment could directly influence changes in levels of physical activity in the area, particularly walking. In order to do this, a Geographical Information System (GIS) model was developed for the area around the Greenway which allowed monitoring of the changing character of the built environment, which could then be related to surveys of the health and physical activity of the local population. The model was based on a detailed network of all the footpaths in the area, which had to be originally mapped in order to establish accurate factors for measuring pedestrian access.

The establishment of the footpath network within a GIS model enabled a cross-analysis of pedestrian accessibility with a range of other social and spatial data, such as that collected as part of the census or the distribution of local services in the area, including parks, health facilities and shops. In discussing the possibilities of this with local community and council officials, it soon became clear that it had relevance well beyond the specific objectives of PARC and would be of much wider value if it could be established for the entire Belfast Council Area.

As a result of this, discussions were held with a variety of potential local partners in Belfast and Derry-Londonderry, the result of which was a successful bid to the ESRC knowledge exchange programme in June 2011. The project ran from May 2012 to the end of July 2013, with two research assistants, Luke Kelleher and Mick Donnelly, employed for a 12-month period between May 2012 -April 2013.

The core aim of the project was to establish an evidence base for healthy urban planning in Belfast and Derry-Londonderry and to use this to support policy initiatives by key local project partners. It was also anticipated that this would improve researcher understanding of the needs of decision-makers, to improve future research and potentially stimulate long term policy-research partnerships.

Specific objectives of the project were to:

1. Develop the Real Walkability Network (RWN) as a policy-support tool for increasing physical activity across the cities of Belfast and Derry-Londonderry.
2. Develop the analytical functions of the network to meet the needs of project partners on initiatives such as improved park management, increased connectivity, promoting "shared space" and prioritising infrastructure investment for physical activity;
3. Develop an evidence base of built environment attributes in Derry-Londonderry and Belfast that can contribute directly to the delivery of key strategies and policies;

[3] http://www.mrc.ac.uk/Ourresearch/ResearchInitiatives/NPRI/index.htm
[4] http://www.communitygreenway.co.uk/

4. Provide direct training to local government officers in Belfast and Derry-Londonderry so they are able to integrate project outputs into future initiatives;
5. Identify further opportunities for implementing the walkability tool in other settlements across Northern Ireland;
6. Disseminate the use of GIS-based walkability tools in other UK cities as a decision-support tool for promoting physical activity.

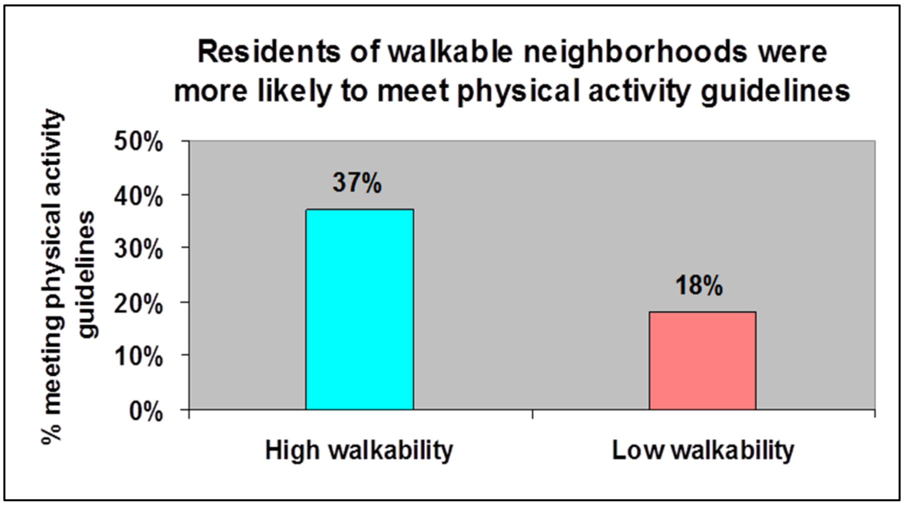
This report briefly outlines the academic background to the project, describes activities undertaken during the project and identifies the key findings.

2. Summary of Research Context

Physical inactivity has recently been described as a 'pandemic'1 with 6–10% of all deaths from non-communicable diseases worldwide attributable to physical inactivity.2 Current recommendations on the subject in the UK3 have once again underlined the problems caused by inactive lifestyles and the degree of change needed in the population to meet the minimum guidelines for PA. Given the modest effect of previous initiatives,4, 5 more innovative approaches are required to halt the global rise in physical inactivity if these recommendations are to be realised. Public health specialists have adopted a broader approach that recognises the role of supportive environments, for example the workplace, which have the potential to make healthy choices easier.

There is increasing research interest in how we can most effectively intervene in the built environment to change behaviours such as physical activity and improve health, typified by the Healthy Urban Planning movement (Barton and Tsourou 2000, Corburn 2009). This is linked to a broader integrated approach for tackling problems associated with increased sedentary ways of life and growing levels of obesity. This is based on the notion that human settlements, particularly those in the global north, have developed as obesogenic environments (Townshend and Lake 2009), which discourage levels of physical activity that could bring important health and sustainability benefits. There is growing evidence of the influence of the built environment on a number of aspects of health, such as a study of 357 adults in Atlanta in the USA (Frank et al, 2005) which used accelerometers to discover that those who live in walkable neighbourhoods are more likely to meet recommended daily levels of physical activity, as shown in Figure 1.

Figure1: Links between physical activity and built environment



(Source: Frank et al, 2005)

A range of disciplines have been engaged in research on increasing physical activity, each offering its own distinct contribution (Sallis 2009). Of particular interest here is the contribution of the planning profession, which Sallis identifies as centring on the concept of 'walkability' and the spatial analysis of land use and other influences, which can help develop indicators of how conducive an urban environment may be for physical activity. Owen et al (2004), note that walking is the most common forms of physical activity and noted in Ogilvie et al (2007) as being "near perfect exercise" (p. 1204) as it is popular, convenient, free and carbon neutral. The benefits of walking have been noted as including reduced likelihood of coronary heart disease, improvements in cholesterol profile, control of hypertension, a slowing of osteoporosis, great body strength and rehabilitation after illness (Rippe et al 1988, Morris et al 1997).

This has prompted a substantial increase in research that explores the relationships between the form of the built environment and levels of physical activity (estimated at over 200 studies in the last decade by Bull at al 2010). These have examined the influence of different attributes of the built environment, such as connectivity, accessibility, residential density the spatial unit of assessment (Saelens et al 2003, Frank et al 2010). There appears to be an emerging consensus on which features of the built environment are likely to have the greatest impact on physical activity, Southworth (2005, p. 249) noting that an area will encourage walking if it has the following attributes as:

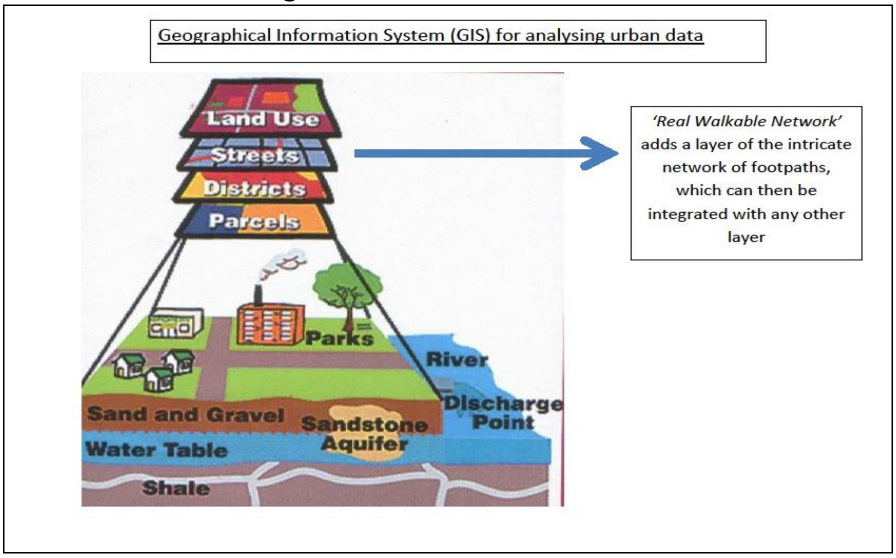
- Connectivity of a network of footpaths;
- Linkage with public transport;
- Fine grained mix of land uses, especially those supporting local services;
- Safety (from crime and road accidents);
- Environmental quality of the paths;
- Path context within the broader urban design, such as visual interest and street design.

Clearly, the relationship between individual physical activity and the built environment is not a simple one with a high degree of variance between actual types of physical activity, temporal variations and differential impacts according to age and other demographic categories (e.g. Panter et al 2011, Astell-Burt et al 2013). Despite this, research has provided important insights into how we may begin to use the concept of walkability to make positive interventions in the built environment to promote healthier approaches to urban planning, although the ways this can be adapted into practice through tools or decision-support instruments is still under-explored. A key challenge has been to identify the ways in which walkability can best be evaluated and a number of approaches have been suggested, including: self-reported environmental measures, in which local people rate the quality and walkability of their own area (such as the Neighbourhood Environment Walkability Scale, NEWS[5]); environmental audits that provide more objective criteria for comparing a number of urban areas (such as the Systematic Pedestrian and Cycling Environmental Scan Instrument, SPACES, [6]); and those based on GIS measures (Brownson et al 2009). GIS is a computer based mapping system that allows a variety of spatial phenomena to be jointly assessed and graphically portrayed, as shown in Fig 2 below, with walkability measures drawing on a number of the different layers (such as land use or footpath network) to provide an overall assessment of how conducive an area may be to walking.

[5] http://activelivingresearch.org/node/10649;
http://www.heartfoundation.org.au/SiteCollectionDocuments/HFW-Walkability-Checklist.pdf

[6] http://activelivingresearch.org/node/10617

Figure 2: Basic Elements of GIS



An example of how these different layers can be used to inform policy and decision-making is the development of robust, verifiable and reproducible indicators, such as the Walkability Index (Leslie et al 2007, Frank et al 2010). This Index draws on normative and measured interactions between walking behaviour and the built environment to combine four key attributes, based on data commonly collected by municipal authorities:

- Residential Density;
- Retail Floor Area Ratio, representing the retail building floor area divided by the retail land floor area, which indicates the likely area devoted to car parking with retail sites and this acts as a broad proxy for land dedicated to cars;
- Land use mix, based on five categories (residential, retail, entertainment, office and institutional) and calculated using a entropy equation whose normalised outcome was between 0 (single use) and 1 (complete even distribution of land use categories);
- Street Connectivity, calculated using Intersection Density, the ratio between the number of intersections of three of more legs and the land area.

To calculate the Index each of the above attributes are calculated and then normalised using a z-score. The z-scores are then combined to produce a single index[7], with street connectivity given a double weighting based on the strong influence of walking distance on non-motorised travel choice. Frank et al (2010) initially calculated the walkability index for individual census blocks in King County Seattle and then Baltimore-Washington DC region, with the index tested against walking data from travel to work surveys and verified by field visits.

While the Walkability Index provides a useful and relatively simple means of broadly capturing the features that seem to influence physical activity for utility journeys in different urban areas, it does have a number of drawbacks. This includes the fact that, as noted by Bull (2010), the Index has been developed and deployed in a North American and Australian context, which have distinct urban morphologies, dominated by car dependency, so there is a need to refine and further test such tools in more diverse urban environments, such as those that exist in Europe. Although most of the data components of the Index are readily available from transport or census authorities, this is not always the case (e.g. that related to retail floor areas). The use of such indicators are also prone to distortion, according to the unit of geographical scales used (Learnihan et al 2011). We must also remember that

[7] This is calculated using the expression Walkability = [(2xz-intersection density)+(z-net residential density)+(z-retail floor area ration)+(z-land use mix)

the Index is a measure of relative, not absolute, walkability and tends to indicate factors that may encourage or facilitate walking behaviour but does not identify the main causal links in any particular area, nor account for the wide range of demographic and cultural influences on walking.

However, it has been suggested by Lin and Moudon (2010), that 'objective' measures, such as GIS measures have stronger association with walking for health when compared to 'subjective' (i.e. self-reported) measures. GIS-based walkability indices have a number of other advantages, such as widespread availability of data. While offering substantial potential for the integration of health and planning objectives, GIS approaches have faced two challenges. The first is a technical one related to the accuracy of walkability indices arising from data availability issues forcing the use of road centre lines as a proxy for footpath networks. The second is a lack of integration of such decision-support tools in the key areas of practice - such as development control, transport planning or business planning for the delivery of local services – that can have most influence over the initiatives that can most influence increased physical activity.

A key reason for this has been that standard models for transport planning and accessibility are based on networks of road infrastructure, which provides a weak basis for modelling pedestrian accessibility. This problem of "missing pedestrian data" (Chin et al (2008) was overcome in the PARC project by digitising footpaths in the East Belfast area, resulting in a very fine grained network (Figure 3), which became known as the "Real Walkable Network" (RWN). This has the potential to be combined with a range of other spatial and statistical data to provide a powerful analytical tool for measuring accessibility, community profiles and a wide range of other functions.

Figure 3: Detail from the Real Walkable Network

Drawing on this theoretical background, a multi-disciplinary team from Queen's University Belfast, from the School of Planning, Architecture and Civil Engineering and UKCRC Centre of Excellence for Public Health came together to explore these issues in the KESUE project, described in more detail below.

3. ***Methodological Approach***

The specific objectives listed at the end of section 1 can be translated into three key strategic aims for the project: i) extending the functionality of the RWN and Walkability model across the entire local authority areas of Belfast and Derry-Londonderry; ii) engaging with user communities to disseminate the use and value of the walkability assessments to help improve policy and decision-making in a range of areas, including public health, active travel and regeneration; and iii) to help develop longer term partnerships that would promote a the future interaction of research and practice in this field.

These aims were translated into three key phases of the project, as follows:

- *Model consolidation and validation* (May 2012 - November 2012). This involved the mapping and extension of the footpath network initially developed for East Belfast under the auspices of the PARC Study, so that it now has operational coverage of both the Belfast (population c. 580,000) and Derry City Council areas (c. 90,000), thus covering over 37% of the total NI population and the area with the greatest concentration of deprivation in the region. The mapping was primarily a desk-based study using aerial photographs and other online sources, as discussed in section 4. During this time the Research Assistants interacted with staff of project partners, thus developing an understanding of the extent, form and availability of spatial data and the information needs of different partners, including potential links to regional strategies on obesity, active travel and physical activity. In the application, it was envisaged that the research assistants would be permanently based within the two councils during the project, but it was agreed with partners that the work would be more effectively discharged if they were jointly-based within the university, with up to one day a week based within Councils.

- *Project integration and sustainability* (November 2012 - May 2013). This involved integrating walkability models and other elements of spatial analysis into the existing programmes of the partner organisations to improve their effectiveness, efficiency and accuracy. This stage of the project also involved some capacity development of project partners to ensure they understood the purpose and potential of the data and GIS model. This was an interactive process, with researchers initially suggesting specific types of analysis, such as the development of Accessibility Atlases for the two cities, which indicated the walkable service areas of a wide range of public services, as discussed in section 5. These suggestions invariably led to partners recognising the potential of such analyses and offering further requests for other analytical exercises, with over 20 separate tasks being completed during the project.

- *Knowledge dissemination and engagement with wider practitioner communities* (from March 2013 and ongoing). This involved an extensive programme of dedicated workshops and presentations in Northern Ireland, Republic of Ireland and Great Britain that disseminated the experience of the project. Presentations were also made at three international conferences. The project has stimulated a lot of interest amongst policy communities in Northern Ireland and the project team continue to share the results at a range of seminars and policy forums. Further events focussed on sharing and extending the use of the RWN are planned for the future. We have also established a permanent website for the project to aid in dissemination of the project findings, see: http://www.qub.ac.uk/research-centres/KnowledgeExchangeSpatialAnalysisandHealthyUrbanEnvironments/ .

The core activity upon which much of the project is based is the mapping of the footpath network in Belfast and Derry-Londonderry and this is described in more detail in the next section.

4. *The Real Walkable Network*

The mapping of the comprehensive footpath network across the two local authority area was the most intensive element of the research. This was digitised using the existing map base provided to the project by the Ordnance Survey of Northern Ireland (OSNI) and cross checked with aerial photographs and limited field survey. The two research assistants took approximately six months full-time to digitise the network as there was no consolidated data for urban paths for Northern Ireland. Other areas may have some existing data that would considerably speed up this process, such as the "urban paths layer"[8] available in other parts of the UK. The accuracy of the data included in the RWN was quality controlled through peer-checking samples of the completed network and by the use of typology rules which eradicated digitising errors such as dangles, undershoots and spurious polygons.

Each path was classified into one of seven categories:

- Footpaths;
- Road Crossings;
- Shared;
- Back Access;
- Bridges;
- Tracks;
- Subways.

This provides additional functionality, for example allowing more sophisticated modelling of movement through the network adjusted by suitable impedance values for different types of path. As shown in Figure 3 above, it was assumed that pedestrians are most likely to follow direct desire lines across the urban landscape and not necessarily only cross at formalised road crossings. For this reason the footpath network was extended across the road at junctions to facilitate potential direct crossing.

The extent of the network, and the level of accuracy that can potentially be gained from it, can be inferred from Table 1 and Figure 4 below. This notes the intricacy of the network and its comparative complexity compared to the existing mapped network which involves the road centre line only; for example the Belfast RWN has over 114,000 elements, while the road network only has 17,000.

Table 1: Extent of the RWN compared to the road network

	Number of Super Output Areas	*RWN Network Length*	*RWN Network Elements*	*OSNI Road Network Length*	*OSNI Road Network Elements*	*% Difference Length*	*% Difference Elements*
Belfast	*150*	*2304 km*	*114491*	*1317 km*	*17415*	*+ 75%*	*+ 557%*
Derry	*69*	*1614 km*	*54012*	*1097 km*	*7381*	*+ 47%*	*+ 631%*

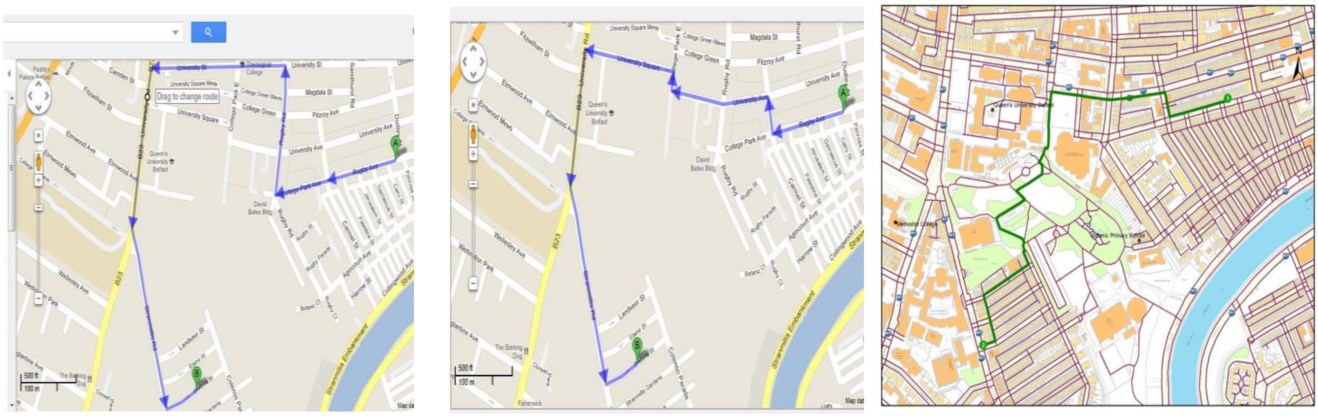
[8] http://www.ordnancesurvey.co.uk/oswebsite/products/os-mastermap/itn-layer/urban-paths.html

Figure 4: Level of detailed captured by use of the road network and the footpath network (RWN)

Road Network **Real Walkable Network**

An anecdotal illustration of how this provides improved results, can be shown by modelling short frequent journeys made around Queen's University Belfast; routes modelled using the RWN compared to the road network (which is used by Google maps for example) frequently come out 33% shorter and aligning with actual practice because the existing model – based on road centre lines - overlooks key desire lines through local parks and other as thorough fares that are segregated from motorised transport. This is shown in Figure 5. Given that the neighbourhood immediately around where people live has the greatest influence on people's physical activity, this greater level of accuracy could therefore offer a major step forward in increasing the relevancy and accuracy of walkability analyses.

Figure 5: Comparison of sample route using Google (road), Google (walk) and the Real Walkable Network



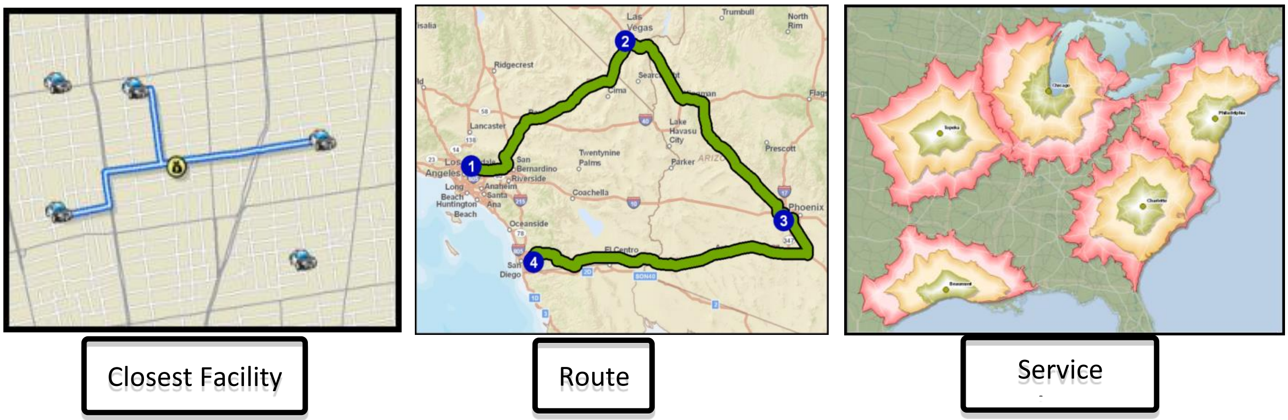
Google by Car: **1770m**

Google by Foot: **1448m**

RWN: **1181m**

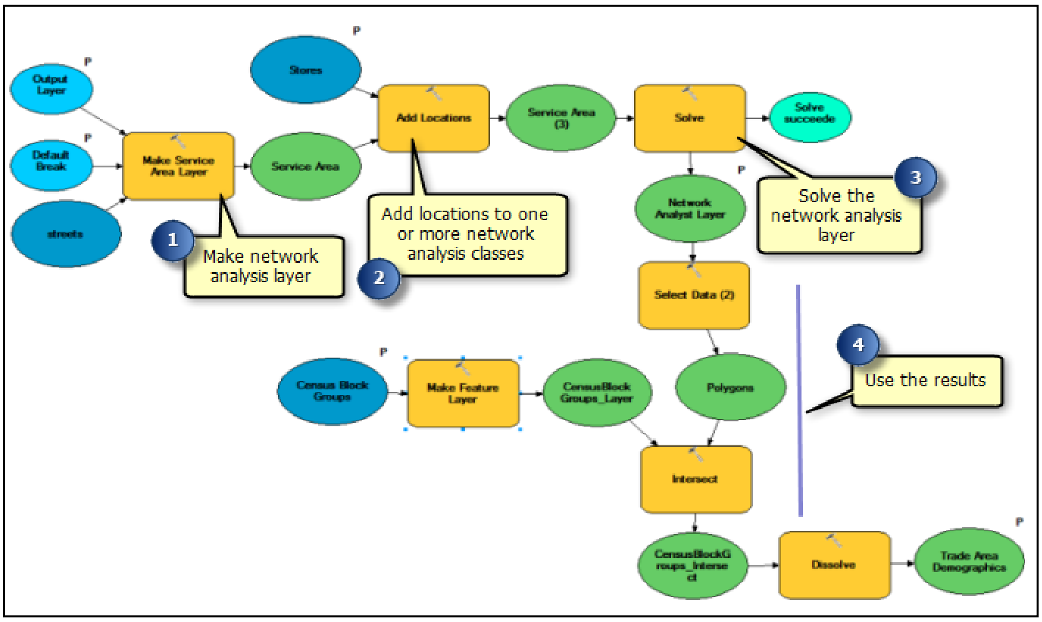
Once complete, the RWN is capable of facilitating a range of analytical tasks relatively easy, using network analysis tools found within ArcGIS. Software. The three most common are shown below in Figure 6. The 'Closest Facility' tool calculates the nearest named facility from any point of the footpath network; for example from a household address to the nearest public park. The 'Route' tool can be used to identify the shortest route between two points, taking into account intermediate destinations; for example the shortest route for someone to complete a daily commute, taking into account a child drop of or visit to a shop or public service. The 'Service Area' tool allows the identification of the area accessible around a particular point, using the footpath network; for example the area served with a 10 minute walk of a local school.

Figure 6: Common used network analyst tools used with RWN



These network analyst tools can then be used to run a more complex model bringing together a range of analyses for a map output – for example calculating the buffer areas around all households in a certain area, or identifying how many people live with 10 minutes walking catchment area of a facility such as a doctor's surgery. An example of the process of assembling such a model is shown in Figure 7.

Figure 7: Model Builder for automating iterative processes



5. Knowledge exchange and partner engagement

Although very labour intensive to develop, the RWN model has no value unless it can be put to practice by our local partners. Once established, the research team therefore engaged with project partners to identify the potential uses of using the RWN as a basis for generating evidence for policy making. This process began with a Steering Group meeting to agree key priorities and agreed on an initial 10 tasks.

In order to stimulate user awareness of the possibilities of this data, the first task was to provide an 'Accessibility Access' for the two cities (discussed below) followed by meetings with each partner to discuss how they could potentially use the RWN – this in turn generated a further list of tasks, some of which are listed below. These were subject to a process of iteration with spatial analysis tasks going through a number of stages before it met the needs of the partner. Unfortunately, researcher time was relatively limited and the task requests outstripped what was possible, although a workshop in February 2014 will discuss how this capacity can be expanded and continued.

A number of the analytical tasks completed by the project are described below, followed by illustrations of some of the outputs produced. Over 20 specific tasks undertaken, many of which have led to on-going work and further consolidated the relationship between the university and various policy communities.

i. *Accessibility Atlas - All Partners (*Figure 8)
The first major task involved the production of an *Accessibility Atlas* for both Belfast and Derry-Londonderry. This mapped over 30 public services for which spatial data was already available (including schools, health facilities, transport services etc.) and produced a graphic representation of the area, supported by statistical data by the number and profile of households within an accessible area determined by a suitable walkable hinterland (for example, a local doctor’s surgery at 800m and post primary school at 1600m), taken from adopted planning standards. Examples of these are shown in Figure 8. A number of hard copies of the Atlases were produced, which also included overlays showing the areas of highest and lowest deprivation in each of the cities to indicate the coincidence of poor accessibility with key socio-economic indicators. An electronic copy of the Atlas was provided for each partner allowing them to better understand the type of analysis the RWN could be used for and stimulated a range of new tasks requests. Electronic copies of the Atlases are available on request from the research team.

ii. *Support for an Age-Friendly City – Belfast City Council and Belfast Healthy Cities* (Figure 9)
The research team also discussed using the GIS model to help understand how Belfast could develop as a more Age-Friendly city. This included using census data to identify the areas of Belfast that could be ‘age-vulnerable’ (i.e. a concentration of older single person households with poor access to cars and long term health issues). These were examined in relation to access to key services for older people, such as pharmacies and in the case of Figure 9 below, also screened for potential access barriers such as slope. There is also potential to use location data on street lamps to simulate the walkways that are illuminated at night, to relate to safety issues of walking after dark.

iii. *Evaluating the road safety benefits and journey time savings – Derry City Council* (Figure 10)
This task evaluated the potential impact on Pedestrian Access and Public Safety of a number of proposed infrastructure projects in Derry-Londonderry for the City Council, including a number of proposed greenway projects. This involved calculating the differences in existing route to the city centre compared to that which would be possible if the greenway was in place and quantified the changes in travel time and identified the length of journey taken away from dangerous main roads etc.

iv. *Assessing the impact on pedestrian accessibility of the new Peace Bridge, Derry-Londonderry – Derry City Council (*Figure 11)
This task for the Ilex, the main regeneration agency in Derry-Londonderry quantified the access benefits brought about by the opening of the new Peace Bridge. Figure 11 shows the impact on the journey to the city centre for each of the postcodes in the city, quantified by reduction in walking times.

v. *Accessibility impacts of new Waterside Rail Station, Derry-Londonderry – Dept. Regional Development* (Figure 12)

There are current proposals to open a new rail terminal on the Waterside in Derry-Londonderry and the Department of Regional Development had proposed three potential locations for this. The RWN was used to calculate the differing accessibility impacts for each of these locations, thus indicating which location would be most accessible to the greatest number of residents and how this could be improved by adding in various infrastructure improvements such as footbridges. The analysis for one of the locations is shown in Figure 12.

vi. *Identifying sites for Community Gardens – Public Health Agency* (Figure 13)
This task was a response the Public Health Agency's proposal to use a number of vacant sites in inner Belfast for temporary use as a community gardens. Site selection criteria were developed with the PHA, including the number of people living within a 10 minute walk catchment and the level of deprivation of the catchment area. This was then used by the PHA to prioritise the sites to be included in the scheme.

vii. *Identifying distribution of fast-food outlets adjacent post-primary schools – Public Health Agency* (Figure 14)
The RWN has also been used to explore issues related to a child-friendly city. This has included assessing the location of fast-food outlets in relation to post-primary schools, to gauge whether they are concentrated within a 10-minute walk of the school gates. An example of this analysis is shown in Figure 14. The GIS model can also be used to identify barriers to walking to school.

viii. *Support for Community Physical Activity Programmes – East Belfast Partnership* (Figure 15)
Figure 15 shows how the research team responded to a request from a community health initiative in East Belfast who wanted to identify a number of short walks it could promote under its "Walking the Blues Away" programme.

ix. *Accessibility to City of Culture venues – Derry City Council* (Figure 16)
Derry-Londonderry is hosting a number of large scale events during 2013 as part of its City of Culture programme. Support was provided for this by identifying the walking distances from each of the event venues and walking routes from various car parks to these venues. An example, for the Verbal Arts Centre, is shown in Figure 16.

x. *Access benefits form new park management policies – Belfast City Council* (Figure 17)
This task was requested by Belfast City Council to evaluate the access benefits that would be gained by adopting a 24-hour access policy for the city parks that make up part of the Connswater Community Greenway in Belfast. Under the present policy, park gates are closed between dusk and dawn, thus limiting parks' value as thoroughfares for commuting. This analysis calculated the changes in travel times and the number of households that would be affected by the policy. This is shown in Figure 17.

xi. Multi-use pitch strategy – Belfast City Council (Figure 18)
This task, also for Belfast City Council, provided an evidence base for a city-wide strategy for providing multi-use pitches, for which there is strong demand from communities. This work developed a needs analysis and identified the areas served by existing pitches and those areas in greatest need. Figure 18 shows elements of the demand model and the resulting spatial output.

xii. *City-wide measures of Walkability - All Partners* (Figure 19)
As described in section 2, it is possible to combine key features of the built environment to produce a single walkability index, to highlight spatial variations in how likely different areas

support walking behaviour. City-wide walkability indices have been developed for Belfast and Derry-Londonderry (see Figure 19) and these will be used in the future as a basis for a variety of active travel strategies as well as research projects that will investigate the links between physical activity levels and the built environment.

Figure 8: Excerpt from the Accessibility Atlases showing area of city accessible by foot to General Practitioners and Pharmacies in Belfast and swimming pools in Derry-Londonderry

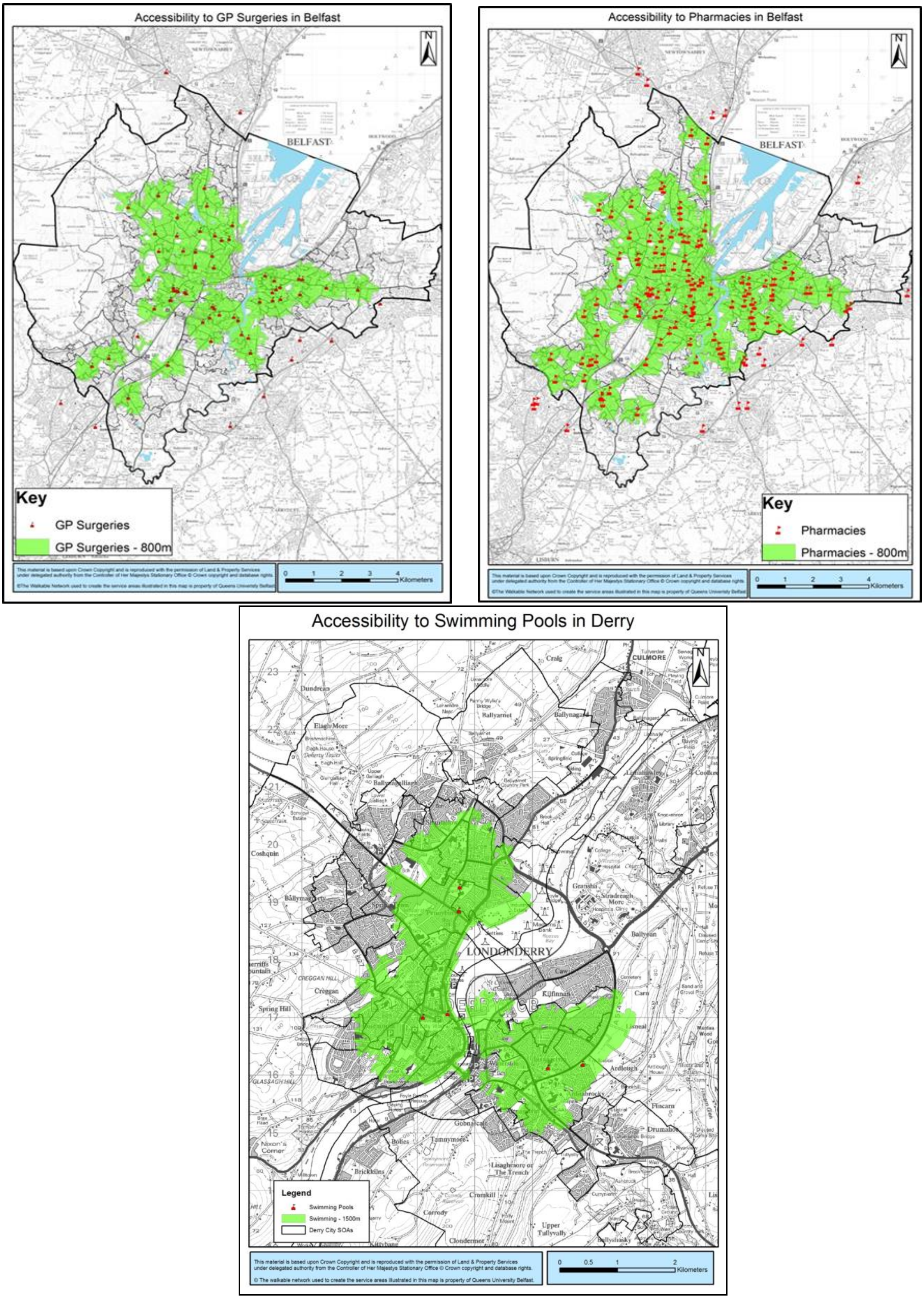


Figure 9: Support for an Age-Friendly City: Areas accessible to Pharmacies in Belfast, with red area showing a gradient of more than 4%.

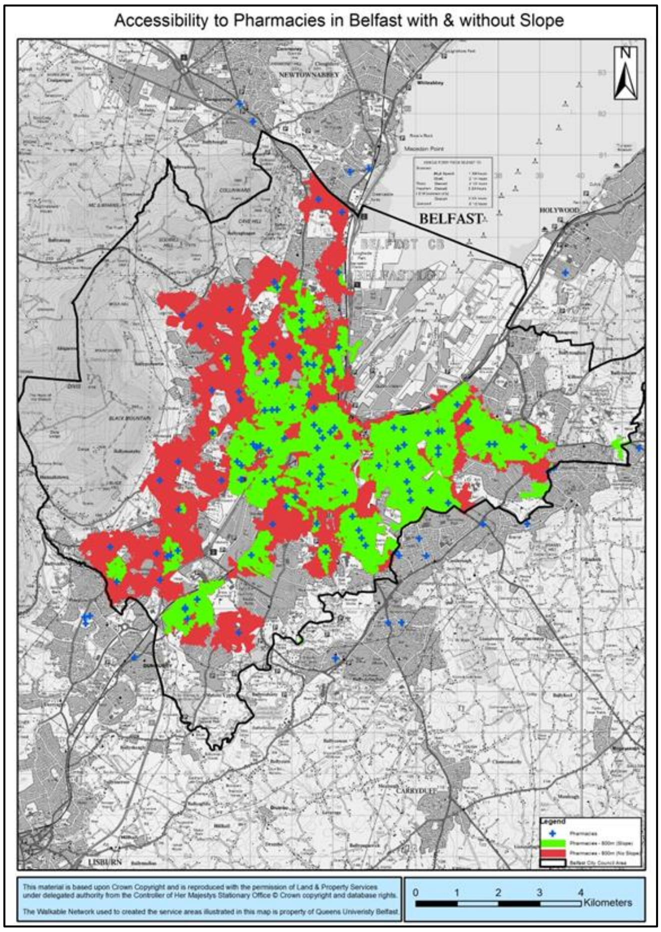


Figure 10: Evaluating the road safety benefits and journey time savings

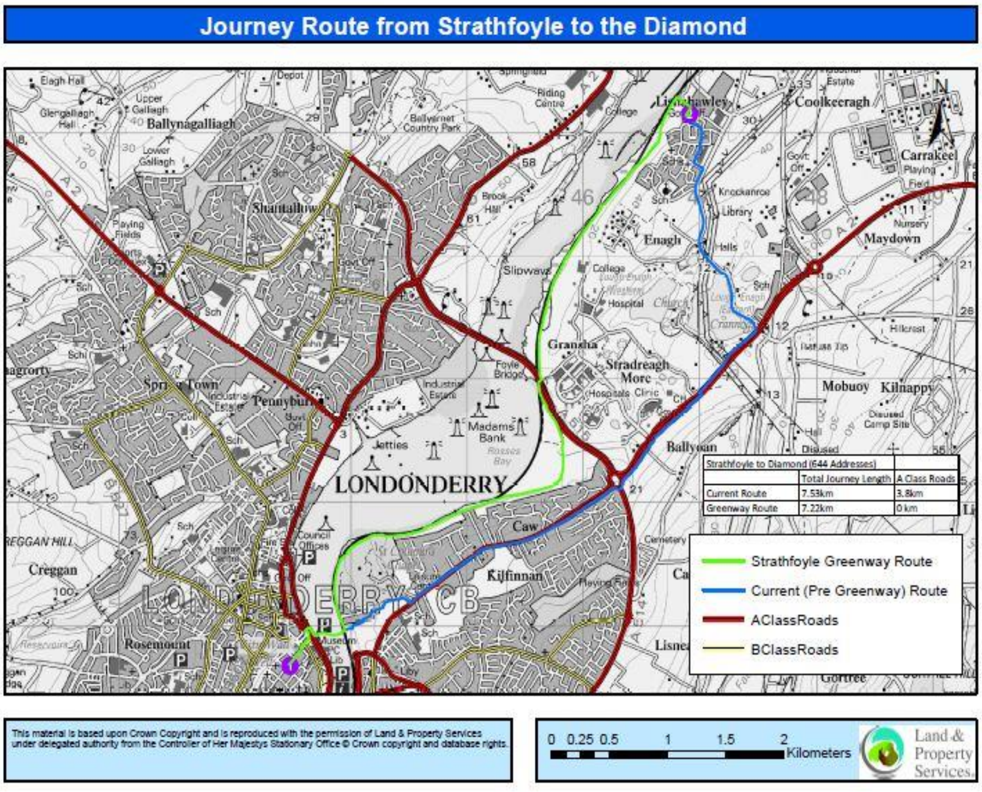


Figure 11: Assessing the impact on pedestrian accessibility of the new Peace Bridge, Derry-Londonderry

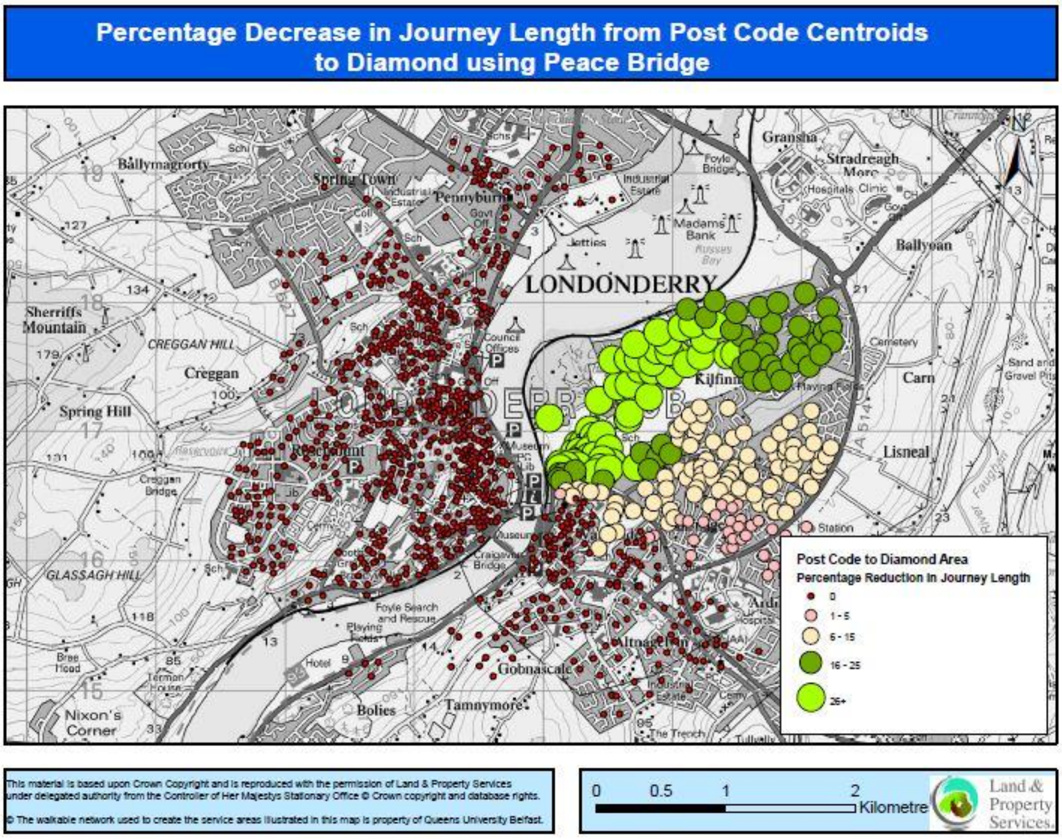


Figure 12: Accessibility impacts of new Waterside Rail Station, Derry-Londonderry

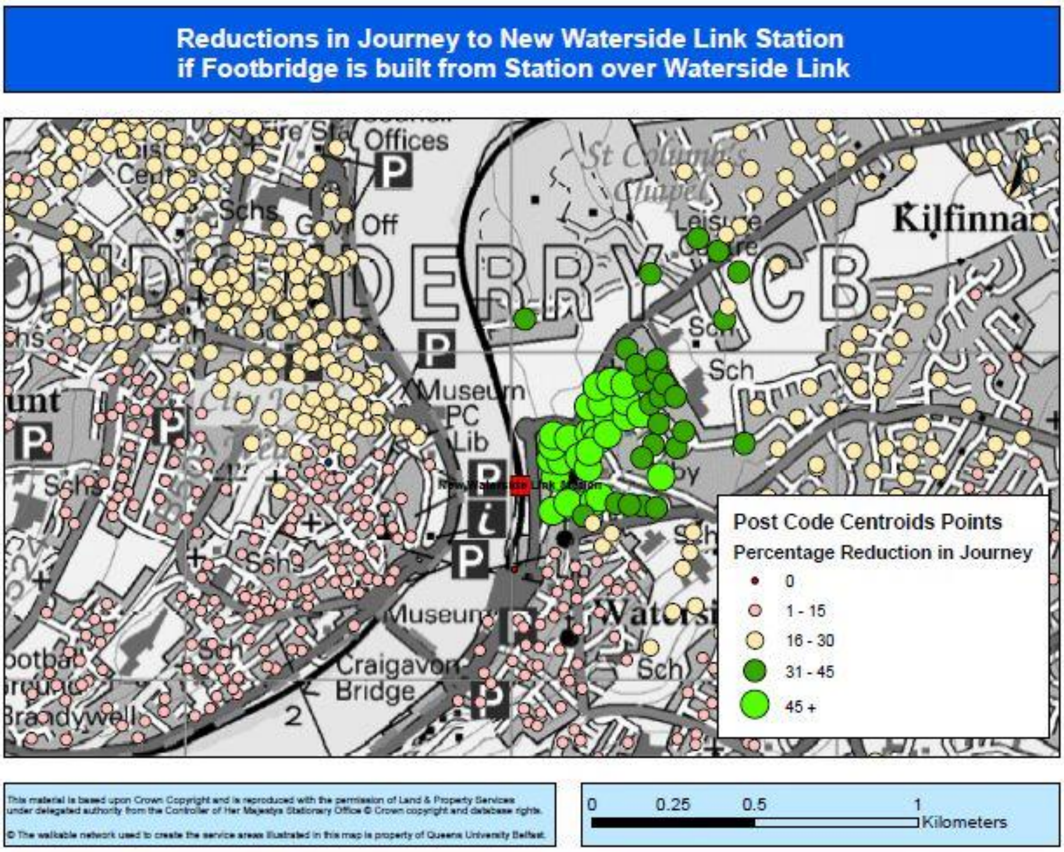


Figure 13: Identifying sites for Community Gardens

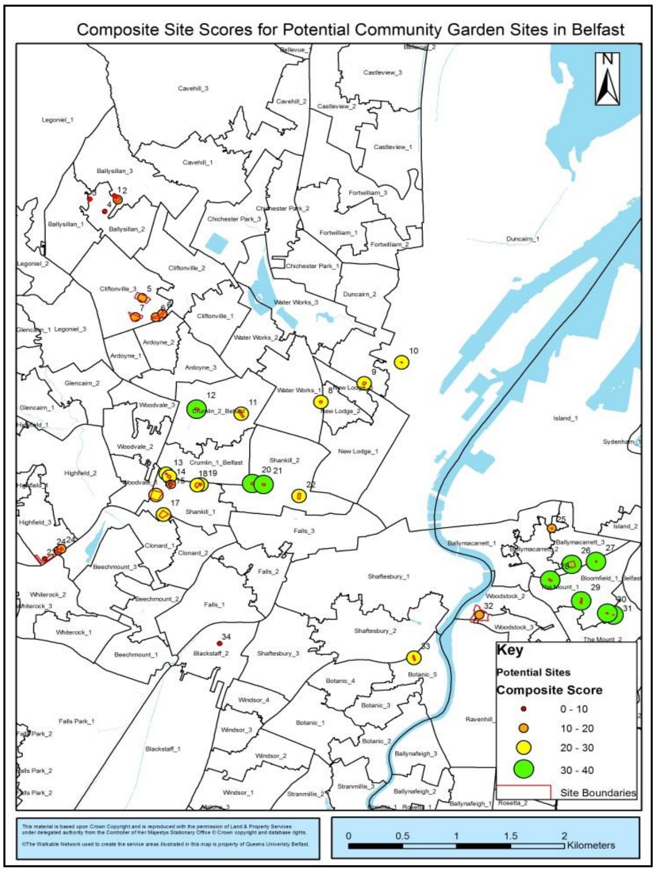


Figure 14: Identifying distribution of fast-food outlets adjacent post-primary schools

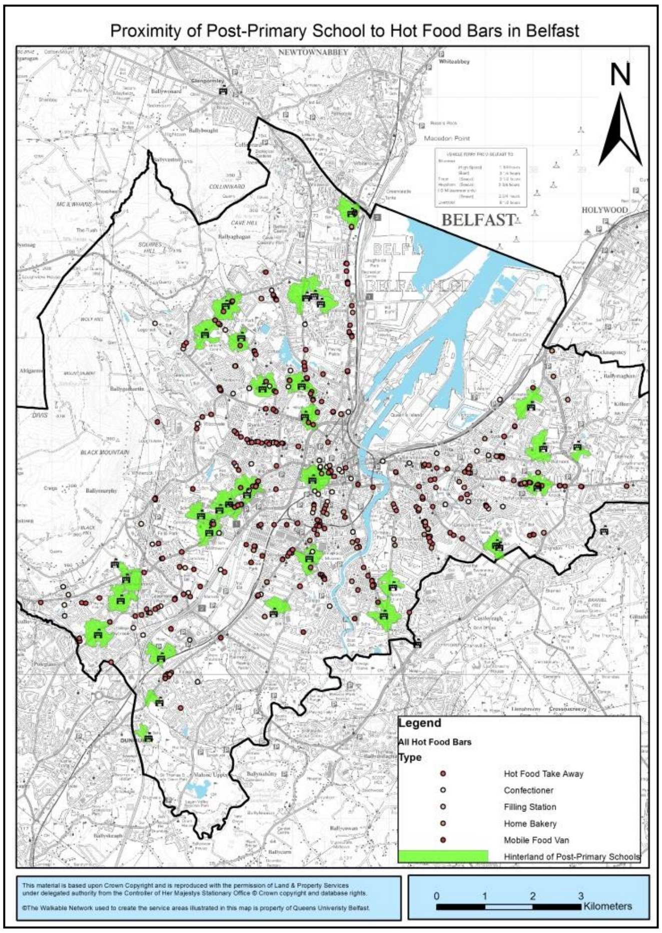


Figure 15: Support for Community Physical Activity Programmes

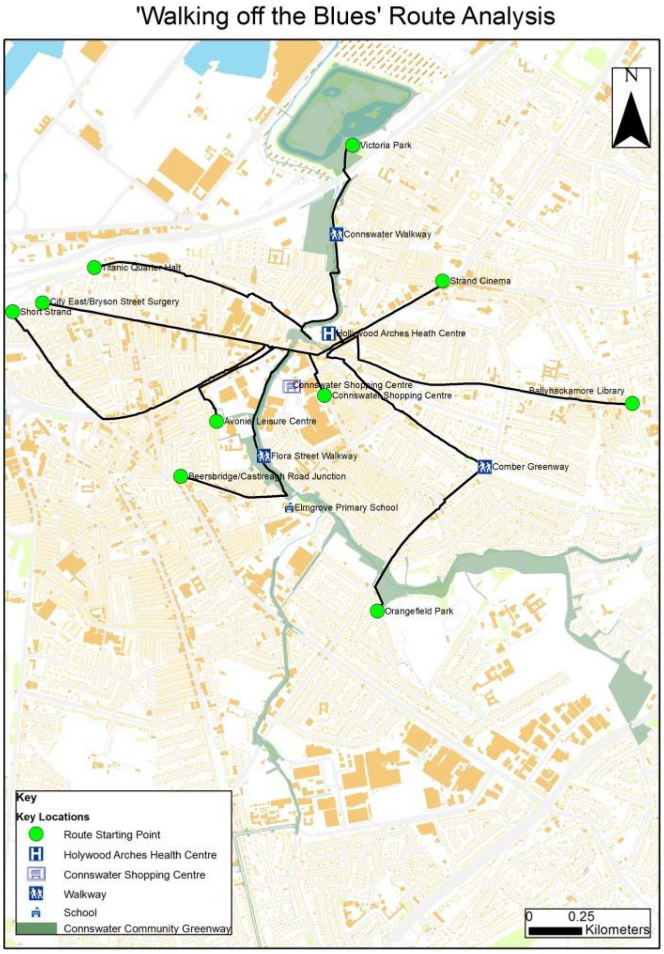


Figure 16: Accessibility to City of Culture venues

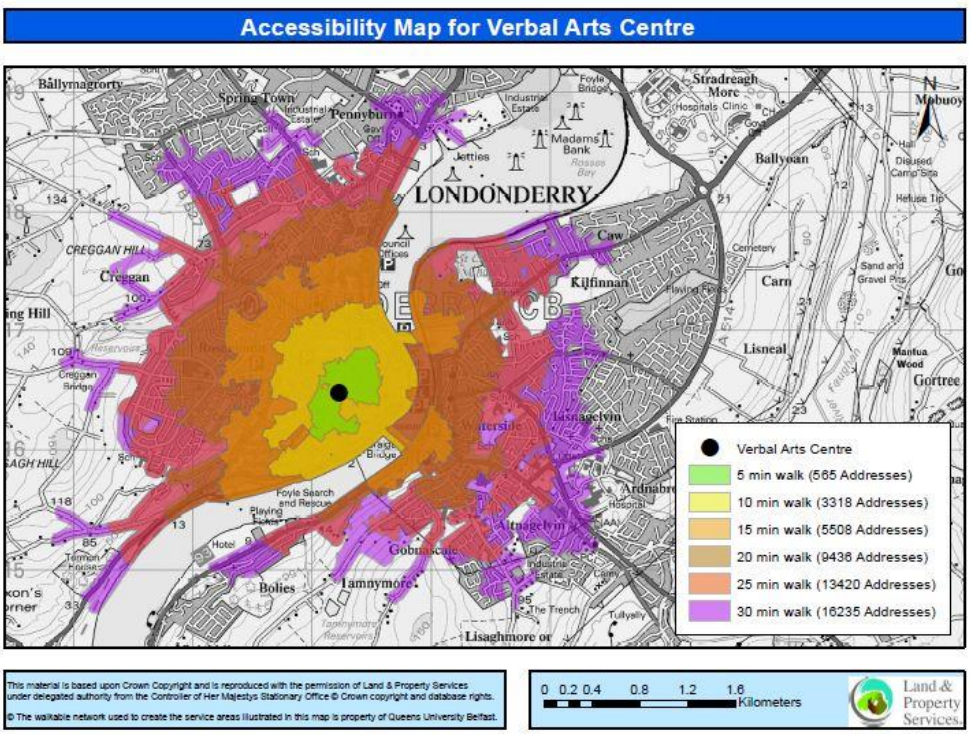


Figure 17: Access benefits form new park management policies

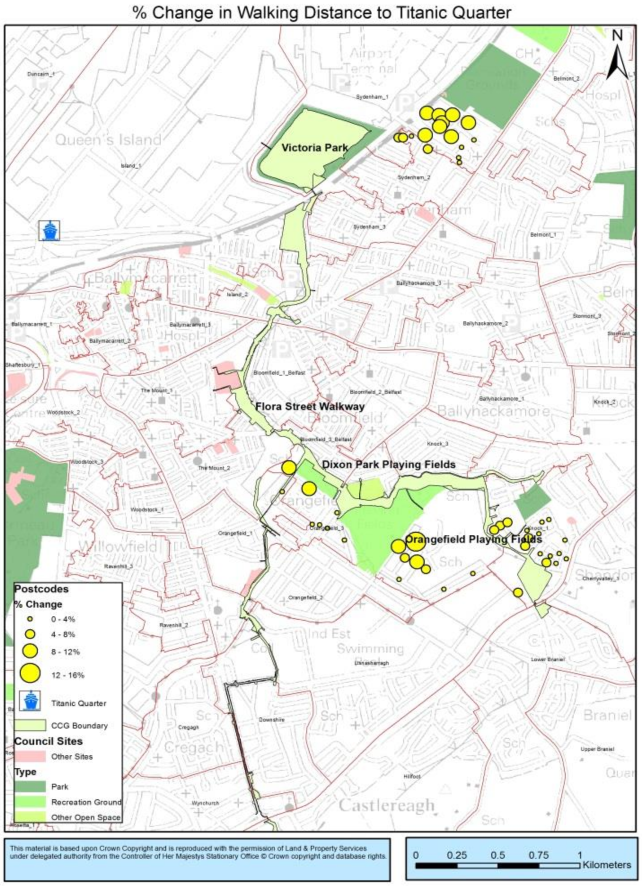


Figure 18: Supporting Belfast City Council's multi-use pitch strategy

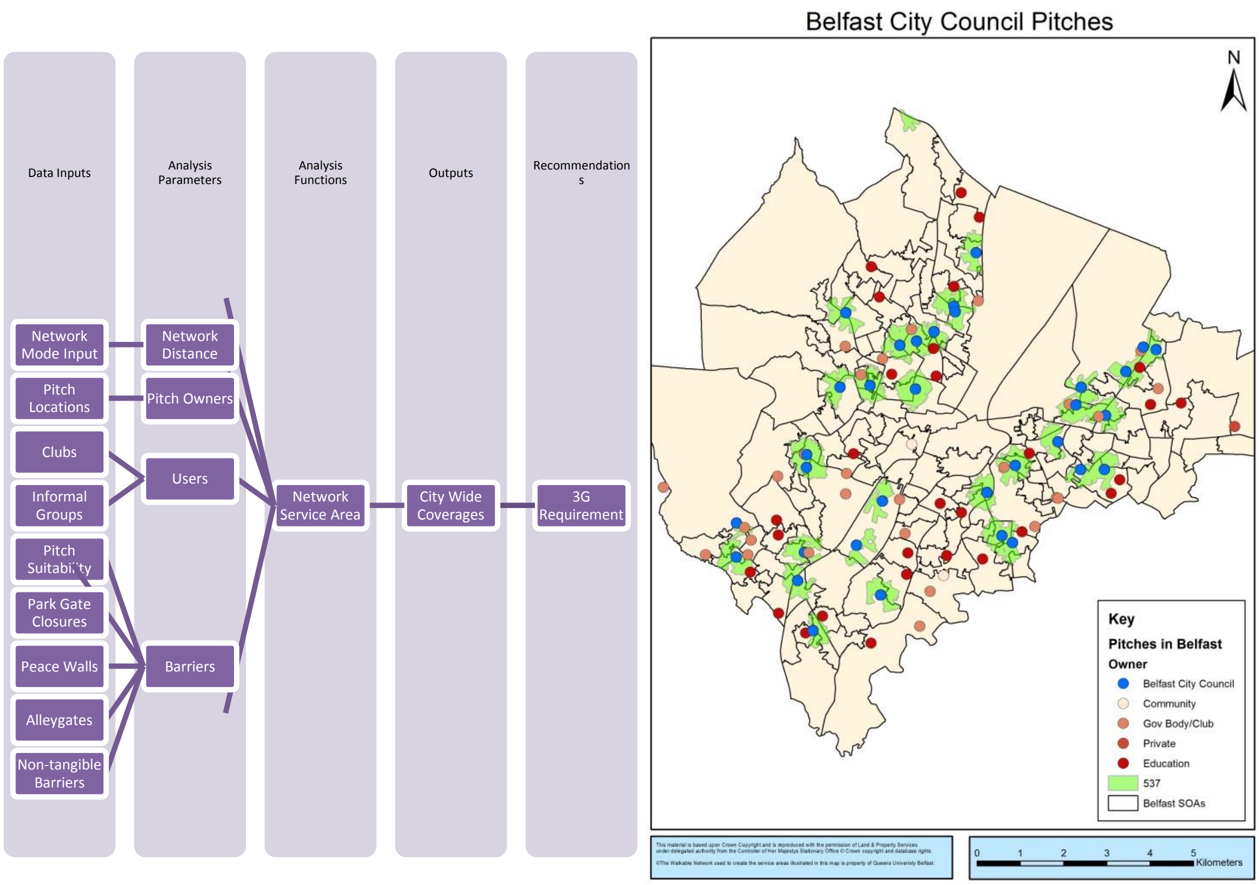
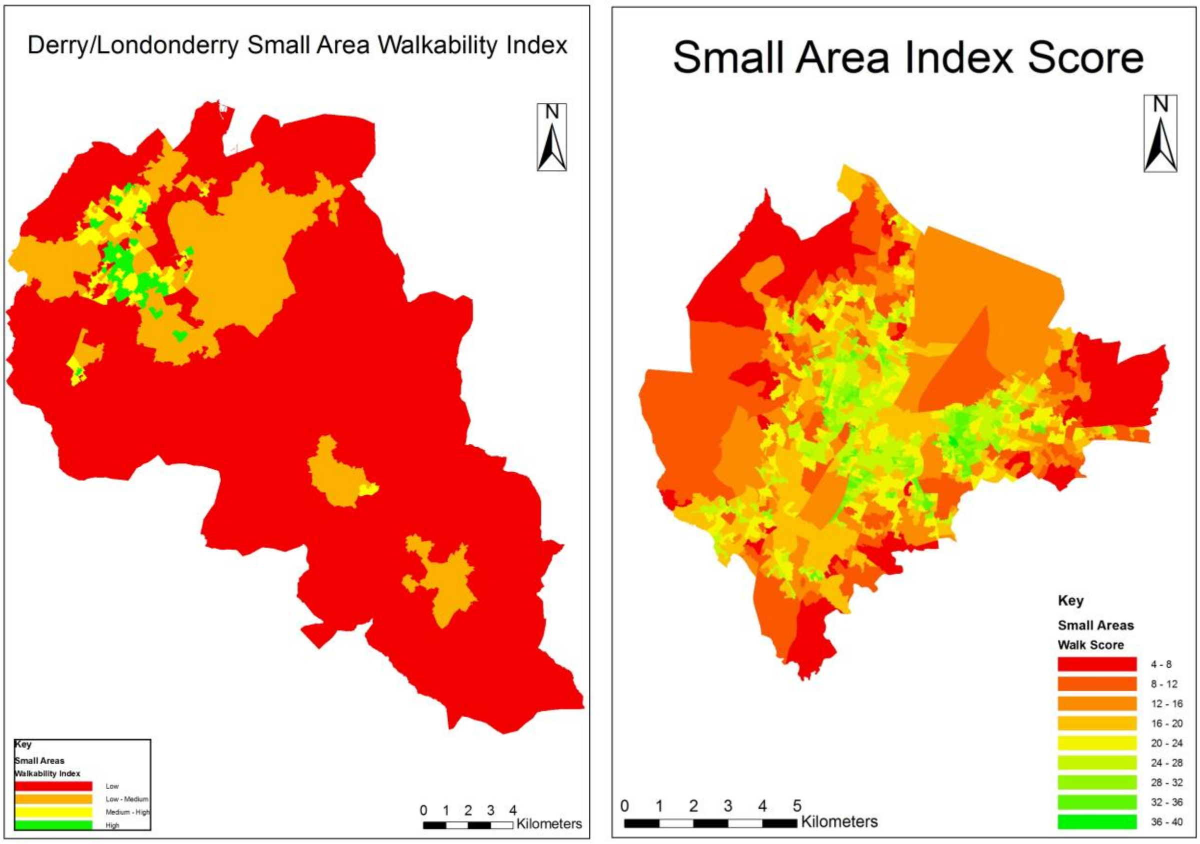


Figure 19: City-wide measures of Walkability



6. Dissemination and engagement activities

The third phase of the project was a process of dissemination of the project activities and findings to user communities in Northern Ireland, the Republic of Ireland and other parts of the UK. This included over 40 unilateral and joint meetings between the research team and project partners to discuss the walkability data and how it can be implemented in their work, which resulted in the various activities discussed above. These meetings are ongoing, as more organisations hear about the capabilities of the model and recognise its value to providing an evidence base to policy.

These dissemination activities took on a number of formats, including a series of dedicated half-day workshops organised in conjunction with partners in UK cities, as well as making presentations to practice workshops and key note talks at local conferences. A list of the presentations and workshops made up to early November 2013 are listed below.

Presentations s and Workshops (as at 21/11/13)

- 10th October 2012: Prof. Geraint Ellis and Joan Devlin (Belfast Healthy Cities, provided evidence to the Northern Ireland Assembly Department of Regional Development Committee on ‘Evidence on Healthy Urban Planning’. 14 participants.
- 26th November 2012; Presentation to Belfast Healthy Cities Regeneration and Healthy Urban Environment Working Group on ‘Integrating Walkability Models into Practice’. 18 participants.
- 21st March: Half-Day KESUE Walkability Workshop organised in conjunction with Glasgow Centre of Population Health. 20 participants
- 22nd March 2013: Half-Day KESUE Walkability Workshop organised in conjunction with Brighton and Hove City Council. 25 participants.

- 25th March 2013: Half-Day KESUE Walkability Workshop organised in conjunction with City and County of Swansea. 20 participants.
- 15th April 2013: Workshop on 'Mapping Neighbourhood Walkability for Planning and Health', Bristol. Key note talk by Prof. Geraint Ellis on 'Knowledge Exchange, Spatial Analysis and Healthy Urban Environments'. 30 participants.
- 22nd April 2013: Prof. Geraint Ellis presentation to the NI Transport and Higher Education Research Working Group on the KESUE Project. 15 participants
- 24th April 2013: Half Day Healthy Norwich Workshop, Prof. Geraint Ellis Key note speaker on ' Knowledge Exchange, Spatial Analysis and Healthy Urban Environments (KESUE) project. 70 participants.
- 20th May 2013: Half-Day KESUE Walkability Workshop organised in conjunction with Manchester Public Health. 20 participants
- 10th June 2013: Half Day Conference IPH, CoEfPH (NI) and HRB CHDR, Cork, Ireland on 'Supporting physical activity in urban communities: lessons from recent Irish and international walkability studies '. Including presentations by Prof Geraint Ellis ('A new walkability index and its application to local government planning in Northern Ireland') and Dr. Mark Tully ('The relationship between physical activity and walkability'). Audio files and slides available at http://www.ucc.ie/en/hrbc/news/fullstory-296681-en.html 50 participants
- 26th September 2013: EcCoWell City Cork conference, Prof. Geraint Ellis workshop facilitator on 'Walkability in Cities'. 260 participants
- 9th October 2013: Networks Involving Communities in Health Improvement Annual Conference 2013, Ballymena, Prof Geraint Ellis as a Key Note Speaker on 'Effective Planning for Healthy Communities'. 60 participants
- 5th November 2013: Glasgow City Health Conference 2013, Prof Geraint Ellis as an invited speaker on 'Accessibility and Health: The KESUE project'. 120 participants.
- 20th November 2013: Public Health Law Seminar, Belfast. Prof Geraint Ellis as a Key Note Speaker on "Planning, Physical Activity and Healthy Communities". 40 international participants

These activities have therefore directly interacted with nearly 800 practitioners, policy-makers and decision-makers. In addition a number of the events also attracted coverage in the media and therefore some of the findings were further disseminated to a wider audience. An example is the coverage attracted by the IPH Walkability Workshop in Cork on 10th June, which was covered by:

Newspapers:

- Irish Times Health Supplement 25/06/13
- Irish Medical Times 21/06/13
- Irish Medical News 17/06/13
- The Examiner 11/06/13
- Belfast Newsletter 11/06/13
- The Irish Mirror 11/06/13
- The Irish Independent 11/06/13

Online Media:

- The Journal.ie: http://www.thejournal.ie/irish-people-walking-levels-944492-Jun2013
- Irish Health.com: http://www.irishhealth.com/article.html?id=22220&artid=22220

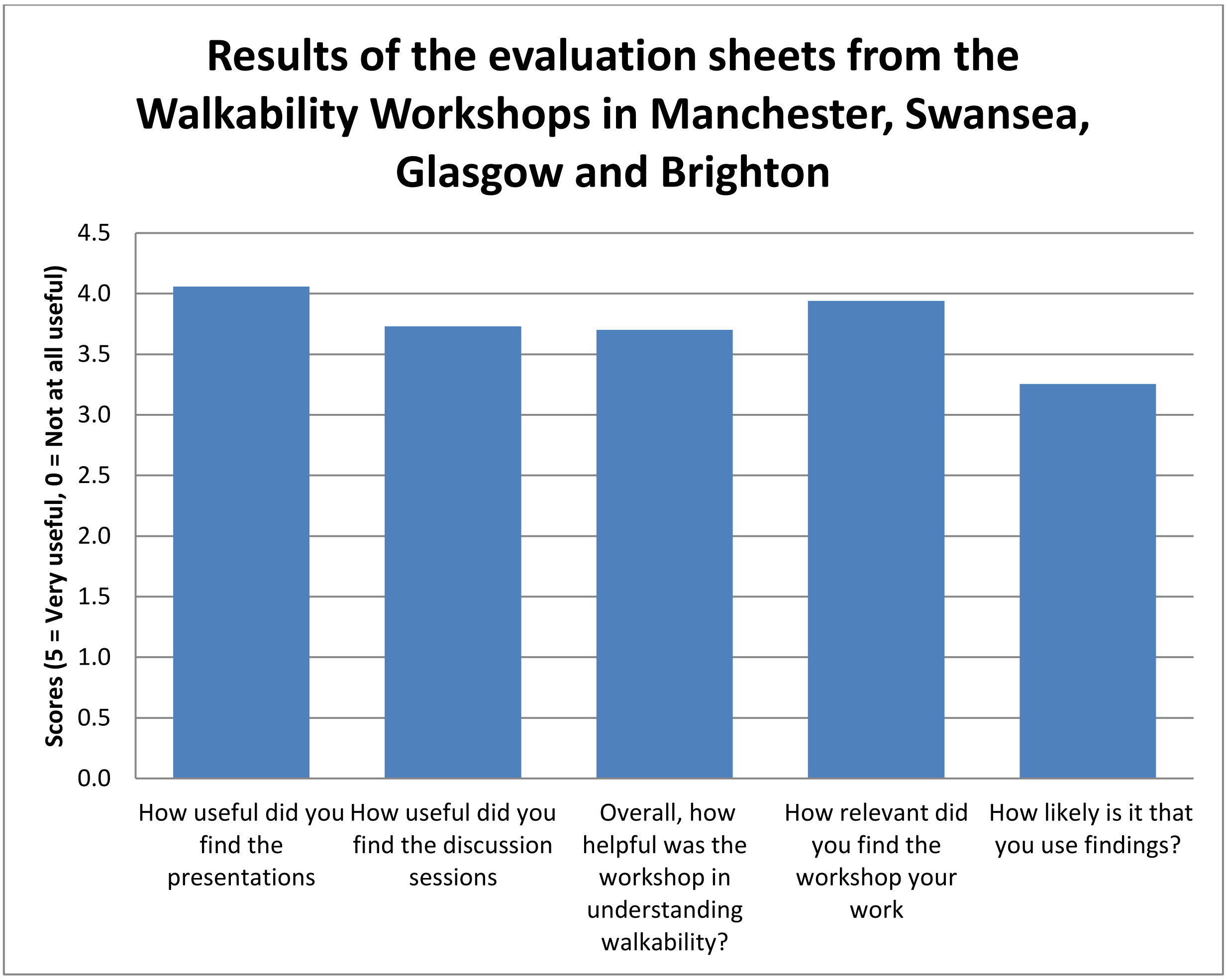
Broadcast Media:

- Red FM (Cork)
- Spin 103.8
- WLR FM

- BBC Radio Ulster

In the case of the workshops focussed entirely on the project and co-organised with UK city partners (i.e. in Brighton, Glasgow, Swansea and Manchester), an event evaluation was undertaken with those attending and the results of this are summarised in the graph below, showing a very high satisfaction in the way the events were delivered and great interest in the potential of undertaking similar activities in their cities. Further to this, participants made a range of comments on the workshops, including: '*… excellent to hear how others use the road and path networks*'; '*… really informative and interesting*'; '*… could be taken forward with more thought from our end*'; '*… eye opening about the breadth of areas walkability knowledge can be put to*'; '*...could deliver significant benefit to our area*'; and '*excellent presentations and inspiring discussion*'. :

Figure 20: Summary of participant evaluation of KESUE workshops



The findings have also been presented at three major national and international conferences, noted below, chosen because they involved the international planning research community, the UK public health research community and the WHO European Network of Healthy Cities, which includes politicians and policy makers from 54 countries. The WHO conference in Turkey was initially scheduled for June 2013 but was postponed due to civil unrest and rescheduled for September, when members of the project team were unavailable, so the paper was kindly presented by representatives of Belfast Healthy Cities who were attending the conference.

Conference papers:

- AESOP-ACSP Joint Congress , Dublin 15-19 July 2013, Conference Paper on "*Accessibility and Health: Towards Walkability Tools for Planning Practice*"
- UKCRC Public Health Research Centres of Excellence Annual Conference, Cardiff. 9-10th July 2013 Conference Paper on *"The KESUE Project: Developing Walkability Tools for Practice".*
- 2013 WHO European Healthy Cities Networks Annual Business and Technical Conference, 20-22 September 2013, Izmir, Turkey. Paper discussing Belfast Healthy City Case Study on "*KESUE Project: Developing Walkability Tools for Practice*"

A final element of the dissemination and engagement process has been to provide long-term management of the data and GIS model. Some discussion has been undertaken with local partners over how this could be done and this will be one of the items to be discussed in a final Belfast-based workshop on the project which will take place in February 2014.

7. Conclusion and Key Findings

This paper has described the activities that have taken place, and continue to take place, under the KESUE project, centred on the development of the Real Walkable Network and the integration of the concept of walkability into a range of areas of health, planning and other areas of policy in Derry-Londonderry and Belfast. By working with a range of local partners, the tool has been used for a range of tasks, including assessment of competing sites, relative impact of new infrastructure and providing evident to support alternative policy options. The use of the tool has enabled, for the first time, to orientate policies and services around the concept of walkability and pedestrian access allowing it to become a key criteria in a range of policy contexts. It has also highlights the value of close, integrated partnerships between knowledge producers, such as universities, with knowledge users, such as local authorities, communities and other stakeholders and how such knowledge exchange projects can provide valuable insights for the further development of healthy cities.

There are six main findings that flow from the project:

- There is substantial value in developing footpath networks in UK cities as these significantly improve the accuracy of accessibility analyses. In the case of Belfast, the network is 75% more extensive than the default road network and has 557% more individual elements. Given that the greatest influence on physical activity appears to be the immediate vicinity (i.e. ten minutes' walk) of the home, such improvements in accuracy could lead to far more robust research on environment-behaviour interactions.

- The GIS platform of the RWN provides enhanced value as it allows pedestrian data to be combined with a range of other existing information. For example, it has been combined with data on land use and density to provide an assessment of overall walkability. It has also been combined with socio-economic and census data to help identify those groups that could differentially benefit from access improvements. There is potential for combining the network data with a range of other data sources (e.g. environmental health licensing of fast food outlets) to provide a range of powerful analyses that can make policy interventions more targeted and effective. The use of the tool has enabled us, for the first time, to orientate policies and services around the concept of walkability and pedestrian access.

- There are, however, outstanding issues on how the data and models established by this project can be managed in the long-term to provide an ongoing and publicly-available resource, which is an area that we are continuing to work on with our project partners.

- The development of the RWN was very time and resource intensive and may therefore not be replicable in every city. However, there is a growing number of data sources, including those held by Great Britain's Ordnance Survey and open access map data that are being released that would form a substantial basis for such a network.

- As a knowledge exchange project, KESUE has highlighted the great benefits that can be derived from extending and adapting university research projects into a policy-relevant resource. This appears to have been to the mutual benefit of both external partners and the researchers themselves, who are now better placed to undertake impact-related research in the future. The project has also highlighted the value of close, integrated partnerships between knowledge producers and knowledge users, such as local authorities and other statutory agencies, coming together to promote healthy cities

- In addition to the policy-related outcomes, the project has facilitated a number of research insights that are being developed through papers for peer-reviewed journals and which contribute to our understanding of how best to measure connectivity in cities; the appropriate geographic scales for analysing built-environment-behaviour interactions; and the development of more accurate measures of walkability.

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