PROJECT BASED LEARNING: A CASE STUDY IN MAPPING THE GREEN INFRASTRUCTURE IN ADELAIDE

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Abstract
In Autumn 2014, the UniSA Environmental Informatics master's course took on the project of mapping Green Infrastructure in Adelaide. This was a natural progression from the report on the Evidence Base for Green Infrastructure in South Australia which was presented last year and the interactive companion version launched in June 2014. The question raised by the students was: "Where is the Green Infrastructure?" This was a logical question in light of the evidence presented in the report that demonstrated how important Green Infrastructure is to the economy, human well-being, and the environment. This presentation summarizes the process of creating a Green Infrastructure map of the Adelaide metropolitan area.

Introduction
Universities are under fire for failing to prepare students for life after university (Arum, R and Josipa R 2011). This has prompted a number of innovative teaching styles and research on the effectiveness of different pedagogies. The University of South Australia has embraced this challenge by encouraging faculty to explore alternative teaching methods. In the Masters of Natural Resource Management and Sustainability at UniSA we have adopted project based learning (PBL) for the Environmental Informatics course (ENVT5024). PBL is a teaching method that incorporates knowing and doing (Markham 2011). Blumenfeld & Krajcik (2006) cite numerous studies demonstrating that students applying their knowledge to real world problems have better outcomes than students who are taught using traditional methods.

In 2014, the problem selected for the course was "Mapping Green Infrastructure for the Adelaide Greater Capital City Statistical Area"(figure 1). Sheryn Pitman, Green Infrastructure & Sustainable Landscapes Project Officer at the Botanic Gardens of Adelaide, presented information to the students summarizing the work on the Green Infrastructure Evidence Base project. Students who reviewed the report which provided evidence demonstrating the benefits of Green Infrastructure raised the following questions: 1)Where is it? 2)What are the best methods of quantifying the areal extent of the Green Infrastructure? and 3) How might one go about mapping Green Infrastructure? The Green Infrastructure Project's Working Group recognized that mapping Green Infrastructure in all of its diversity would be highly desirable for characterizing, publicizing, improving and sustaining Green Infrastructure in Adelaide. With the support of the Green Infrastructure Working Group, this real world problem was presented for the class to solve.

Project: Mapping the Green Infrastructure of Adelaide Greater Capital City Statistical Area (GCCSA).

Background
The aim of this course is to explore, evaluate, and appreciate sources of environmental information and measurement. This was certain to be covered in the course given that mapping Green Infrastructure entails identifying, assessing, and acquiring multiple sets of geographic information pertaining to the environment. However, answering the question "What is Green Infrastructure?" was a new challenge for this particular course.

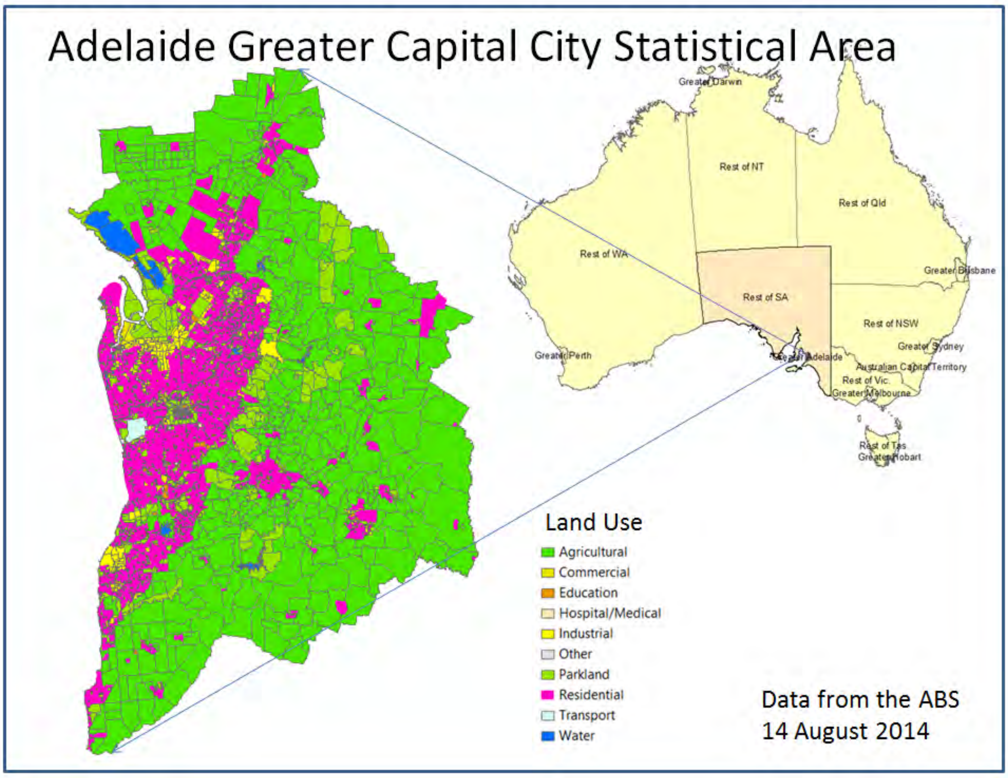

Figure 1: Overview map of land use in the Adelaide GCCSA

One of the issues with PBL is the lack of knowledge surrounding the selected problem, thus during the first few weeks of the course the students undertook a literature review which included reading the evidence base report, "Green Infrastructure: Life support for human habitats" by Ely and Pitman (2012). In addition, they expanded their GIS skills in preparation for solving the problem. This groundwork provided students with the awareness of the importance of mapping Green Infrastructure. The class accepted and used the definition of Green Infrastructure in the evidence based report. This is perhaps more expansive than some others and is provided below:

> *Green Infrastructure is the network of green spaces and water systems that delivers multiple environmental, social, and economic values and services to urban communities. This network includes parks and reserves, backyards and gardens, waterways and wetlands, streets and transport corridors, pathways and greenways, farms and orchards, squares and plazas, roof gardens and living walls, sports fields and cemeteries.*

A search of the 'Web of Science' (a comprehensive interdisciplinary and bibliographic database), for 'Green Infrastructure' returns 1,359 articles yet 'mapping Green Infrastructure' returns only 53 articles. In Google Scholar, the search for 'Green Infrastructure' alone returned about 1,060,000 results and for'mapping Green Infrastructure' reduced it to about 117,000 results. Although these are not extensive searches, they do provide perspective on the need for research and application development in the area of identifying, quantifying and mapping Green Infrastructure.

A consensus approach was developed through individual research, class discussions, and group work to proceed using a modified methodology based on the Liverpool and Mersey Forest reports. For an extensive explanation, please see Appendix A in the Liverpool Green Infrastructure Technical Document (Home link: http://www.merseyforest.org.uk/our-work/green-infrastructure/liverpool-city-region-green-infrastructure-framework/).

Mapping Methodology

The two methods adopted from the Liverpool report for the mapping were typology and functionality. Typology is an exercise in classification to get the standardized surface types (type of land cover, or land use, or both) for Adelaide GCCSA (most of these data were acquired from South Australian Government Data

Directory (data.sa.gov.au)). The functionality of Green Infrastructure is the nature of the services or values provided by the Green Infrastructure which can be a function of spatial context, land cover type, proximity to population, or other factors. We elected to use the most accessible datasets due to the time constraints of a one semester course. The new and interesting part of the mapping project was to decide on and create six functional surfaces appropriate to the Adelaide area. We used the 28 functional surfaces of the Mersey Forest research to generate our six; however, not all of the Mersey surfaces were appropriate for the Adelaide area (e.g. Biofuels production). We created six novel Adelaide specific functional surfaces. The functional surfaces selected by the student groups were: Water Recreation, Flood Mitigation, Native Bird Habitat, Non-Motorized Transport, Social Events, and Community Gardening. A discussion of the importance of each of the function follows.

Water Recreation

Water recreation is part of Green Infrastructure because water is an incredibly important physical and aesthetic landscape element (Völker & Kistemann 2011). Water is one of the essential ingredients to life, and has features and qualities that associate with health, wellbeing, leisure and tourism. These qualities are consistent with the project's definition of Green Infrastructure in that a space needs to be 'beneficial to its inhabitants'. Water recreation is beneficial to its inhabitants because water recreation areas encourage popular activities such as swimming, boating, nature study, walking, and picnicking by water bodies (Collins & Osmanski 1986). Recent studies have found that natural scenes that include lakes and creeks can have a higher restorative effect than grey urban environments. It has also been documented that nature scenes with water can have a positive influence on the psycho-physiological state as well as a positive impact on emotional states (Velarde, Fry &Tveit 2007).

Flood Mitigation (Water Ways for Flood Mitigation)

Even though Adelaide experiences relatively low rain fall flood events do occur and many people who live in Adelaide are often unaware of the risks of flooding. Flooding in Adelaide generally occurs during storm events and mostly around creek and former creek areas. Many creeks and watercourses in Adelaide are treated and have been altered to be used as storm water drains rather than as carriers of floodwaters (Wright 2010). The flood mitigation surface is essential to the mapping of Green Infrastructure in Adelaide because it identifies vegetated waterways that have the potential for flood mitigation. Councils can monitor these water bodies and their performances during flooding events. Vegetated waterways also have other benefits that include ecological benefits and aesthetic values which can be substantial when compared to concrete lined channels or other grey infrastructure.

Native Bird Habitat

Wildlife habitat is an important part of Green Infrastructure as it forms the basis for understanding the networks of natural greenspace in the urban environment and its environmental, social and economic value. In Adelaide, natural greenspace is made up of small parks and reserves, Conservation and Recreation Parks, as well as 'greenways' made up of rivers and creek systems (Ely & Pitman 2012). The native vegetation cover of Adelaide is an indicator of biodiversity health and reveals potential habitat sources for native birds and mammals in the urban environment. Important water systems including; the Barker Inlet- St Kilda Wetlands and the Onkaparinga Estuary are important environments for a variety of native and migratory bird species found in the metropolitan region of Adelaide. To further understand the biodiversity and conservation value of greenspaces and for the protection and planning of corridors and wildlife linkages between these spaces, bird habitat is an essential functional surface to include when mapping the Green Infrastructure of Adelaide.

Non-Motorised Transport

Non-motorised transport is an important part of the Green Infrastructure of Adelaide as it provides an alternative to the traditional reliance on motorised transport. The positive consequences of this are a range of environmental and human benefits including: increased physical activity and improved health and wellbeing; increased use of public and natural spaces; livelier and more pleasant suburbs and cities; reductions in greenhouse gas emissions; and reductions in noise, air and water pollution. Motor vehicle use results in air, noise and water pollution which can harm people and the natural environment (Chester and Horvath, 2008). Many pollutants, such as noise, carbon monoxide, and oxides of nitrogen and sulphur have local impacts, while others such as ozone, hydrocarbons, methane and carbon dioxide have regional and global impacts (Litman, 2009). Walking and cycling produces relatively no pollution.

Non-motorised transport promotes physical activity, which is incredibly important in Australia due to increasing rates of sedentary lifestyles and chronic disease (Paffenbarger et al, 1986). Walking and cycling are among the most practical and effective ways to incorporate regular exercise in peoples' lives (Rabl and Nazelle, 2012). We defined non-motorised transport as purpose-built and repurposed routes reserved for cyclists and pedestrians. This definition does not include normal footpaths or roads with or without bike lanes, unless they include specialist cyclist infrastructure.

Social Events

The parklands and gardens of Adelaide provide space for social events and represent vital aspects of the Green Infrastructure. The majority of social events in Adelaide are held on or adjacent to parks, reserves or gardens. This direct link is irrefutable evidence of the relationship between social events and Green Infrastructure along with why they are relevant to this project. We included our social event functional surface to areas that support the following: Leisure day, Carnival Spring Regatta, Carols by Candlelight, Gorgeous Festival, Schutzenfest, Harvest Festival, Australia Day Parade, Brighton Jetty classic, WOMADelaide, Willunga Almond Blossom Festival, Blues in the Barossa, St. Peter's Fair, Prospect Fair, French Market, Cheesefest, Beachside Food & Wine Festival, Glendi Greek Festival, Semaphore Greek Cultural Festival, Garden of Unearthly Delights, Tomato Festival, Town Picnic, Latin American Fiesta, and Indofest. The benefits of these greenspaces that host these events meet the definition of Green Infrastructure and provide tangible economic benefits with many of these "festivals generating income and contributing to sustainable local economic development" (O'Sullivan & Jackson, 2010).

Community Gardening

Community Gardens hold many of the key components of Green Infrastructure, from human collaboration with the environment, to investments into increased environmental sustainability and increased resilience in the form of increased food security. It is because of these major issues that community gardens are such vital parts of Adelaide's Green Infrastructure. Community gardens have the potential to reduce our need for processed food and our carbon footprint, as well as providing aesthetically pleasing environment which also hold key benefits for education and social collaboration. Community gardens are greenspaces which produce healthy fresh food and provide a model for improving food security, human health, local ecology, and social capital, along with creating opportunities for community development through education, skills and training (Wakefield, 2007).

Conclusion

This project was an excellent experience for the students and myself. Engaging students with the community in ways to serve the public good is exactly what UniSA hopes to continue to achieve. These spatial data sets comprise the proto type for the Green Infrastructure Geodatabase of the Adelaide greater capital city statistical area. The GCCSA is a useful regional concept developed by the Australian Census Bureau. However, at the local level this region is comprised of numerous independent local councils which could benefit from a larger regional and comprehensive geographic information system. A spatial database of this nature would enable a more holistic approach to many social, economic, and environmental initiatives that serve the public good.

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