

Living Roofs and Ecosystem Services[©]

Zoë Cooper

Living Roofs Ltd, The Kitchen, 14-16 Maidstone St, Ponsonby, Auckland 1021,
New Zealand

Email: zoe@livingroofs.org.nz

INTRODUCTION

Living roofs are no longer the intellectual property of the sandal brigade and environmental education centers. Amid concerns regarding climate change adaptation and our ability to achieve sustainable development, we are focusing on pursuing solutions that present real economic, environmental, and social benefits.

Living roofs are simply, intentionally vegetated roofs. They are nothing new, but the approach and initiative required to secure them is. We have a number of landscape, architectural, and engineering professionals in Aotearoa (New Zealand) who are aware of the benefits of living roofs and as such are eager to promote their use.

Living roofs have numerous benefits from helping us adapt to climate change, providing a sanctuary for our wildlife, alleviating flash flooding, reducing diffuse stormwater pollution, enhancing biodiversity, providing public and resident amenity space, and reducing the urban heat island effect of our cities.

TYPES OF LIVING ROOFS

There are different types of living roofs including extensive, semi-extensive and intensive, which simply refers to the depth of substrate and as such the type of plants or trees suitable. All of these will have different loading implications on a structure where the saturated weight must be used to calculate the structural load. The following values (Table 1) from the website <http://www.livingroofs.org> give an indication of the different elements on a roof and the structural loading implications.

Table 1. The load values are for saturated weights.

Gravel surface	90-150 kg·m ⁻²
Paving slabs	160-220 kg·m ⁻²
Vehicle surface	from 550 kg·m ⁻²
Extensive living roof	60-150 kg·m ⁻²
Intensive living roof	200-500 kg·m ⁻²

It is interesting to note that many inverted roofs are covered in paving slabs (hard landscaping) in order to ballast out the insulation. The use of an extensive living roof system would have a negligible effect on the structural load in this instance.

ENVIRONMENTAL AND ECONOMIC BENEFITS

Insulation Benefits

Insulation benefits of living roofs have been realised for many years in Scandinavia, mainland Europe, and Africa. Living-roof systems provide an opportunity to achieve living buildings whilst at the same time increasing returns on investments. They protect the roof membrane from UV and weather damage and can extend the roof life by as much as 2 or 3 times. The incorporation of living roofs can add to property values by providing additional living space and, as such, more marketable floor space. It is also possible to reuse materials on site, such as aggregates for the living roof substrate saving on some of the development costs. Moreover, using these systems can increase your New Zealand Green Building Council (Green Star) environmental building ratings score and support growth of new environmental industry.

Studies at the University of Toronto show that buildings with living roofs can save a significant amount of energy through reducing heating and cooling bills by insulating the building, therefore reducing energy expenditure and carbon emissions (Ryerson University, 2004).

With global temperatures changing, these systems also offer a cheap way of reducing the urban heat island effect. This is the effect of a metropolitan area being significantly warmer than its surrounding rural areas due to urban development and waste heat generated by energy usage. Living roofs can reduce noise levels entering and leaving the building by up to 18 decibels (dB) and reflective noise by 3 dB or more. They filter dust and pollution from the air and water, which is something we could all appreciate in our cities.

Delivering Sustainable Drainage Systems

Historically we have designed stormwater systems to remove rainwater as quickly as possible from individual sites. As development has increased this approach to managing stormwater has caused problems with flooding and diffuse pollution.

Living roofs are a form of sustainable drainage, replicating natural drainage patterns, reducing stormwater runoff, and flash flooding. Auckland University's living roof has attenuated on average 68% of all flows over 13 months of continuous data. This can have a big impact on reducing flooding as stormwater is soaked up by the soil and vegetation, and gradually released back into the atmosphere and drainage system. They also have environmental benefits, as the roofs help reduce the effects of stormwater runoff flushing oils, debris, and other contaminants into urban rivers and streams. Some New Zealand Regional Council planning policies highlight the importance of "at source" sustainable drainage systems like living roofs (Auckland Regional Council, Technical Publication 10, 2003).

Increased Ecological Value

Urban areas are important for biodiversity yet preserving and enhancing our cities' ecology is a significant challenge we face as professionals. The regeneration of brownfield land can result in loss of an important habitat for a range of plant and animal species. By building "living" schemes the resulting development can replicate high value urban habitats.

We recently installed a living roof for Whangarei District Council at the start of a Department of Conservation walk at Urquarts Bay. Living Roofs alongside Renee Davies of Unitec and Blake Cameron of Greenscene Limited helped design and install the biodiversity living roof which was planted in natives found locally at Breem Head. We got a little worried on one visit to find the prostrate manuka dying back, only to find it blossoming with bees enjoying the flowers on our next visit. The roof embeds the development into the surrounding landscape, mitigates the adverse effects of the new structure on the environment and stimulates interest, educating the community and tourists in terms of living roofs, our specific environment and biodiversity. The following species were chosen as they are all found locally in the park:

Apium prostratum

Coprosma acerosa

Disphyma australe

Muehlenbeckia complexa

Pimelea prostrata

prostrate manuka

Selliera radicans

We need to recognise that opportunities should be provided for wildlife habitat enhancement through appropriate management of existing habitats and through the creation of new or enlarged habitats.

SOCIAL BENEFITS

Alongside the environmental and economic benefits, living roofs also provide social benefits to communities. They provide valuable public amenity for local residents and workers and can even provide recreational space for sporting activities. Another important advantage in New Zealand's cities is that they can improve views from surrounding buildings by providing aesthetic green space. Importantly for developers, they raise a company's green credentials and are a fantastic way to show corporate social responsibility. Both living roofs and sustainable drainage systems reduce the urban heat island effect by lowering the temperature around buildings through evapotranspiration that in turn lowers smog production. They also contribute to adapting to climate change.

LIVING ROOF LEGISLATION

Germany, Switzerland, Linz, Vienna, Toronto, Portland, and London all have legislation requiring the installation of living roofs on certain developments. However, New Zealand as an innovative and environmentally-aware country should be embracing this technology. Living roofs could be promoted by plant specialists and landscape architects to reduce the impact a development has on its local environment, improving biodiversity, and helping us adapt to the effects of climate change.

SELECTING PLANTS FOR ECOSYSTEM SERVICES

I have been working as an environmental planner for over 13 years providing developers, architects, landscape architects, and landowners with advice on developments, policy issues and obtaining required permissions. Previously, I worked for the Environment Agency in London as a major projects officer. My role was to provide developers with a single point of contact and project manage advice on large developments. This involved liaising closely with developers and local authorities to secure environmental protection and enhancement. I recommended the installation of a number of living roofs in London, and our team secured over 22 ha of living roofs south of the River Thames through planning permissions in a year. We were part of the advisory committee for the living roofs and walls technical report that supported the London plan living roof policy [4A11], which is the first and only direct living roofs policy in the United Kingdom. Whilst the policy expected developers to use living roofs it was limited in its guidance on how these living roofs should be delivered. As a statutory body we, the Environment Agency, felt our work in articulating the policy needed qualified guidance to steer developers in terms of how living roofs should be delivered.

So we sought internal funding for the development of a Green Roof Toolkit (2012). This was pre-application guidance to ensure that developers were fully aware of our expectations in terms of biodiversity provision in addition to stormwater issues. The guidance starts from the type of vegetation and substrate needed as opposed to starting from the conventional engineering approach. This toolkit, prepared by LivingRoofs.org and the Green Roof Consultancy has recently received a Climate Change Award Commendation from The Royal Town Planning Institute.

The toolkit, whilst focusing on the quality of living roofs in terms of vegetation and substrate characteristics, also provides clear and concise practical advice on the design of living roofs and promotes the contributions they can make in meeting the challenges of climate change.

The preparation of the toolkit included visits and reviews of the Basel and Karlsruhe models, stakeholder engagement of both the public and the private sector, and of construction industry professionals.

I am very proud to have been able to instigate a tool that is now actively used by developers, local authorities not only in the London, Thames region but now, I am told, nationally.

Over the last few years in London a number of developers have realised the environmental, social, and economic benefits of incorporating such forward thinking initiatives into schemes. I regularly negotiated with developers to incorporate living roofs

to mitigate adverse environmental effects and as a mechanism of ecological enhancement. There is no requirement for the provision of living roofs in New Zealand. However, as seen overseas, the economic benefits will ensure the installation of living roofs continues to grow.

Living roofs need to be designed for their locality, as a local solution for the local environment. Within London there are great examples already in existence, such as Barclays head office in Canary Wharf, and at 160 m it represents the highest living roof in Europe. The London Zoo, Laban Dance Centre in Deptford, Inn The Park Café in St James' Park, and the Jubilee Gardens in Canary Wharf are other excellent examples of living roof designs creating small havens for people and wildlife in the centre of a thriving city.

In New Zealand, LivingRoofs.org.nz is now established as an independent organisation that is promoting the uptake of living roofs and walls. LivingRoofs.org.nz is a living roof portal supported by the main living roof players in New Zealand including both industry and the Auckland Council.

Literature Cited

- Auckland Regional Council. 2003. Design guideline manual, stormwater treatment devices. Technical Publication 10, Chapter 12 <<http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/reports/technicalpublications/Pages/technicalpublications1-50.aspx>>
- Ryerson University. 2004. Report on the environmental benefits and costs of green roof technology for the city of Toronto <<http://www.toronto.ca/greenroofs/findings.htm>>
- The Green Roof Toolkit. 2012. <<http://www.environment-agency.gov.uk/business/sectors/91967.aspx>>