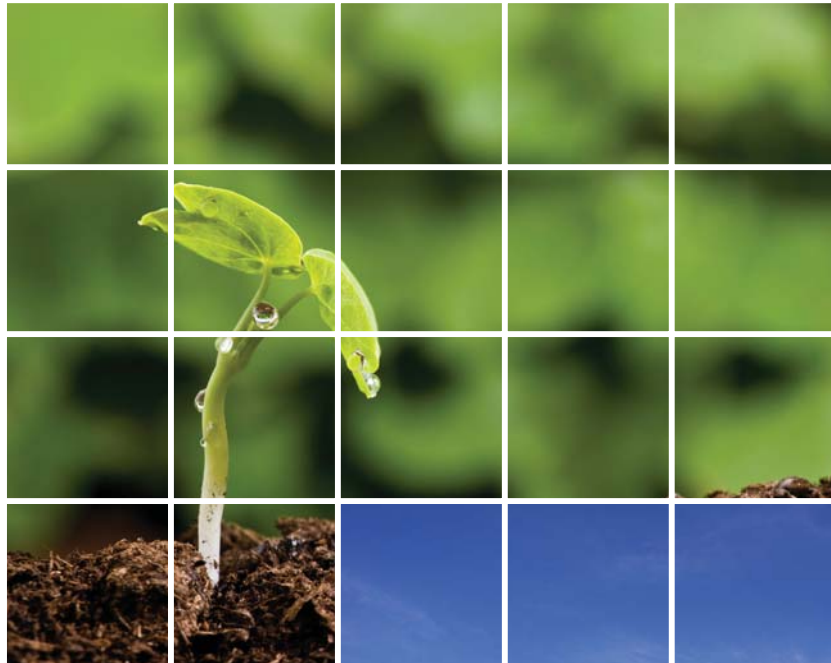


Discovery 09

December 2009 << Issue 29

**LOW
IMPACT**



**URBAN
DESIGN**

&



DEVELOPMENT



Landcare Research
Manaaki Whenua

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Editor: Tom Fraser

Designer: Caroline Miller

Thanks to: Christine Bezar

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PO Box 40, Lincoln 764 New Zealand

Ph + 64 3 321 9999

Fax + 64 3 321 9997

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CITIES AS COMPETITIVE ECONOMIC HUBS

Cities play a distinctive and important role in the economy and life of a nation – consider London, Paris, New York and Shanghai as magnets for financial investment, tourism and innovation.

New Zealand's cities too are distinctive, reflecting their cultural heritage, regional economies and civic leadership. From an ASEAN perspective, though, their futures have to be weighed alongside the likes of Sydney, Melbourne, Brisbane, Perth and Singapore, all of which compete for investment capital, firms, top talent and tourists. All have comparative strengths geographically and different infrastructural and environmental challenges. All host leading universities and research institutes and thus are hubs for new knowledge generation and innovation. Most have reinvented and rebranded themselves over the past decade, notably Brisbane and Singapore.

It is within this broader economic development context that research to support growth of our cities must be considered – and Auckland's future is especially significant for New Zealand.

Urban research globally has developed rapidly over the past decade from a modest, fragmented base, and in New Zealand Landcare Research and its collaborators have been at the forefront of bringing new thinking about cities. You can see applications in most of our cities of the research we and others have done – development with a lower environmental footprint; 'nature' brought in through alternative



subdivision design, use of swales and indigenous plantings; and construction that makes more use of renewable materials and energy and generates less waste than conventional designs. Because these innovations contribute to a better quality of life and well-being, and are generally also cost-competitive, demand for them continues to grow.

But this poses the question: 'Are we doing enough to ensure New Zealand cities are globally competitive, provide positive impressions on international visitors, contribute their share to greenhouse gas reductions, and provide an environment that attracts (and retains) the talent essential to improving their (and the nation's) productivity?' I have been reflecting on this as I write on a flight back from Brisbane; that city's development highlights the earnest challenge before us. Your thoughts on this matter would be most welcome.

A handwritten signature in black ink that reads "Warren Parker".

Warren Parker
Chief Executive

WHAT ON EARTH IS LIUDD?

>> LOW IMPACT URBAN DESIGN AND DEVELOPMENT (LIUDD) LOOKS AT HOW DEVELOPMENT IMPACTS ON THE ENVIRONMENT, RECOGNISING THAT ECOSYSTEMS HAVE LIMITATIONS THAT HUMANS MUST WORK WITHIN TO ENSURE SUSTAINABILITY.

LIUDD's premise is to enhance the performance and competitiveness of cities by improving the integration between human activities and natural processes. Water, soil, animal and plant life provide a diverse range of services – from local climate and water regulation to recreation, amenity and mental well-being, and their health warn us when the impacts of our activities exceed safe levels. LIUDD refers to ideas, methods and practices that ensure our urban development activities utilise rather than damage or destroy natural processes.

Landcare Research and the University of Auckland led the LIUDD programme, which was funded by the Foundation for Research, Science and Technology between 2003 and 2009.

Research leader Michael Krausse says 'low-impact', 'water-sensitive', and 'energy-efficient' urban design and development have been rapidly evolving in New Zealand since the late 1990s and underlying these is the common goal of working with the local environment – in terms of location, topography, hydrology, soil characteristics, and biodiversity – to reduce the impact of urban development.

'So, in the case of stormwater, this translates to exploring at design stage the potential for reducing impervious areas and site disturbance, maintaining infiltration and vegetative cover in strategic areas, and incorporating storage and reuse to manage peak flow and water quality,' Mr Krausse says.

'In residential redevelopment it means exploring the opportunities for increasing density close to key services, facilities and transport routes; maintaining strong links between landscape and the social context and character of the community; providing a mix of urban form and housing types to provide for a diverse community; facilitating walking access to and use of high quality public spaces; and designing energy, water-use and waste-disposal efficiencies into the infrastructure.'

LIUDD is a combined responsibility of developers, policy, planning and regulatory agencies, service providers, builders and residents for the benefit of the community as a whole. It requires collaboration by all these parties to be effective in all senses – outcome, cost, maintainability, and capacity to adapt.

It can include strategies to prevent environmental damage (development setbacks, source control of pollutants), reduce impervious surfaces

(clustered housing, narrowed streets) incorporate green infrastructure (rain gardens, swales, green roofs), reduce reliance on imported services (water reuse, energy generation, waste minimisation) and protect and restore natural features (stream channels and margins, bush fragments).

The emergence of LIUDD for medium-density urban expansion and redevelopment is a recent phenomenon driven by rapid urban growth in both metropolitan and regional centres. This has created significant demand for new housing and infrastructure at a time when local government resources have been stretched by delegated responsibility from central government, the need to replace failing or overstretched first-generation infrastructure, and resistance to increased property rating.

Development of LIUDD in New Zealand has been led by local authorities (notably the Auckland Regional Council, city councils at Auckland, North Shore, Manukau, Waitakere and Christchurch, and Kapiti Coast District Council), particular developers and their consultants, industry, and researchers.

Their work is reflected in the establishment of demonstration sites; support for visits from international specialists; publication of concepts, principles, and design guidelines; development of policies and plans; and teaching content in university planning, engineering, and landscape architecture degrees.

More information is available on our website and publications, including 'Low Impact Urban Design and Development: the big picture', are available from Manaaki Whenua Press.

CONTACT

Michael Krausse
Landcare Research, Auckland
kraussem@landcareresearch.co.nz



LIUDD AND THE COMMUNITY

>> LIUDD PROMOTES LOCALISED FORMS OF ENVIRONMENTAL MANAGEMENT AND THEREFORE EXTENDS RESPONSIBILITY FOR ENVIRONMENTAL MANAGEMENT BEYOND THE DOMAIN OF 'EXPERTS'.

That means landowners, community-based groups and the development industry, as well as a broader range of departments within local authorities, have an integral part to play.

Residents and community organisations become key stakeholders and need to be engaged in the processes of research, planning and monitoring. Active community involvement in the design and implementation of low-impact approaches can lead to improved ecological and social outcomes.

Kathryn Scott investigated the benefits and principles of community engagement in urban environmental management and found community engagement in LIUDD can occur at a range of scales, from adoption of on-site low-impact approaches, to participation in neighbourhood- and catchment-based environmental projects, and influencing policy and practices to support improved environmental and social outcomes.

She says there are many benefits of including communities in urban environmental management.

'Local-level partnerships encourage community ownership and solutions, and paths for civic

participation. Community-based groups often have energy, skills, and detailed local knowledge relating to the natural environment and social history. Such groups also know the local networks and key players and, most importantly, locally specific ways of engaging local residents.

'They often have the strongest capacity for networking to support local environmental management and there is evidence of community engagement leading to the preparation of better plans as well as enhanced community support for the implementation of the plans.'

Local community-based restoration groups found that people were motivated to become involved by a wide range of factors such as interest in conservation, local history or the arts, 'giving something back', and socialising with neighbours. Engagement approaches such as 'Adopt a site' provided regular opportunities for residents to connect with and become involved in caring for their local area. Such locally specific engagement is also more likely to result in changes in environmental practices than the 'moral high ground' approach often used by social marketing campaigns, Ms Scott says.

Community engagement in neighbourhood site planning can lead to better plans, as shown in Talbot Park, a 5-hectare, medium-density state housing redevelopment in Glen Innes, Auckland. LIUDD included rain gardens within public roads, rain tanks, permeable paving, extensive landscaping, and protection of mature trees and overland flowpaths.

Dialogue with the community in the early stages of the planning process allowed the integration of LIUDD with other solutions to issues raised by the community. Ongoing research by Ms Scott shows the vast majority of residents enjoy living in Talbot Park and are proud of the community and its LIUDD principles.



CONTACT

Kathryn Scott

Landcare Research, Auckland
scotkm@landcareresearch.co.nz

COSTnz

COSTnz (Cost of Stormwater Treatment in New Zealand) was developed by Landcare Research as part of the LIUDD programme. It was clear that for local authorities to determine the most appropriate stormwater treatment they needed to understand both the short- and long-term costs incurred as a result of construction and maintenance.

'COSTnz allows users to identify and combine acquisition, routine and corrective maintenance, and decommissioning costs to determine the full life cycle cost,' says Landcare Research environmental economist Eva Vesely.

Modules are available for ponds, rain gardens, wetlands, swales, filter strips, rain tanks, sand filters and infiltration trenches, plus a generic module enables the same analysis for various proprietary devices. In each case, users can select from a range of default values for each cost element, or input data from their own suppliers or historical information.

COSTnz uses a unit costing approach based on locally collected data, supplemented with statistical relationships for the total acquisition costs. It includes the option for discounting so that the present value of future costs can be estimated at the base year.

The set-up of the modules allows sensitivity analysis for a range of assumptions, such as lifespan of the device, different maintenance regimes, unit costs and a range of real discount rates.

Dr Vesely says COSTnz will improve understanding of long-term investment requirements and assist

>>A NEW WEB APPLICATION TO COMPARE THE 'WHOLE-OF-LIFE' COSTS OF ALTERNATIVE LOW IMPACT STORMWATER TREATMENT DEVICES COULD LEAD TO INCREASED USE OF MORE ENVIRONMENTALLY FRIENDLY STORMWATER MANAGEMENT IN YOUR NEIGHBOURHOOD.

www.costnz.co.nz

local authorities in their budgeting, reporting and auditing processes.

'It will also help low impact urban design and development decision-makers make more cost-effective choices at the project scoping phase and provide a platform for negotiations between councils and developers regarding financial contributions,' she says.

Now commercially available, COSTnz is targeted at asset managers, consultants, developers, designers and regulators. The Web application (www.costnz.co.nz) follows a logical approach with consistent layout, and is designed to be flexible and easy to use. Results are delivered in a PDF report format or as an Excel spreadsheet that enables users to develop the costing of a full treatment-train or input data into other systems.

**COSTNZ
ALLOWS
USERS TO
IDENTIFY AND
COMBINE
ACQUISITION,
ROUTINE AND
CORRECTIVE
MAINTENANCE,
AND
DECOMMISSIONING
COSTS TO
DETERMINE
THE FULL
LIFE CYCLE
COST**

”

CONTACT

Christine Harper
Landcare Research, Auckland
harperc@landcareresearch.co.nz

>> WITH NEARLY 2,000 ENDEMIC
PLANT, BIRD, REPTILE AND
FROG SPECIES, NEW ZEALAND
IS A UNIQUE COUNTRY AND
BIODIVERSITY HOTSPOT

PEOPLE, NATURE, AND LIUDD



LIUDD research and application has shown that biodiversity is 'alive' and can be protected, enhanced and experienced, even in busy urban centres. Nature doesn't have to be available only to hardened trampers, laden down with heavy packs, grinding up remote mountain tracks.

Habitat can be protected or restored in cities and, if green space is well designed and managed, will provide for threatened and endemic biota, and allow large numbers of people to experience nature in their own back yards. Internationally, efforts are being made to recognise and harness the potential of urban environments as centres for biodiversity protection.

Ecologist Colin Meurk says there are ways to develop cities that can minimise impacts on our natural resources (plants, wildlife and services), while improving our quality of life. Natural habitats provide interconnected

ecological/environmental benefits through the provision of supporting and regulating services to the wider environment (such as stormwater); social benefits such as national identity, public health, amenity, well-being and learning; and economic benefits through protecting downstream environments, providing for active recreation, enhancing property values and increasing attractiveness and consequent commercial productivity and competitiveness. Delivering these benefits are key principles of LIUDD.

There is an important distinction to be made between 'environment' and 'biodiversity', Dr Meurk said.

'It is generally assumed that what is good for one is good for the other, but whereas reducing river or air pollution may induce recovery of indigenous fish or moths, as in celebrated European cases, in New Zealand it will often be exotic indicator species in terrestrial or wetland



habitats that are most competitive and the main beneficiaries of cleaner air and water.

‘Another frequent misunderstanding is the difference between ‘biodiversity’ and ‘species richness’. Merely packing more (exotic) species into an area increases species richness but generally diminishes the number of indigenous species and therefore each place’s unique contribution to global biodiversity.’

Researchers have proposed a link between experience of nature and identification with it. Survival of biodiversity depends not only on applied ecology but also on community will. If indigenous nature becomes invisible, it is also likely to become irrelevant, as identity or support for it dwindles. So LIUDD emphasises connecting with nature (not just for direct utilitarian purposes) and raising the profile of biodiversity for its intrinsic worth and beauty. And it provides tools for its reintegration into cities and the wider cultural landscape.

Our research has identified opportunities and designs for urban plant communities and landscaping to include a greater number and diversity of indigenous species. We have developed structural solutions and plant choices for a range of niches in cities – catchment treatment trains, habitat patches, corridors and private gardens,’ Dr Meurk says. This information is attractively presented online at http://www.mwpress.co.nz/store/downloads/LRSS35_nature_neighbourhoods.pdf.

This understanding has also been incorporated into a continuing education programme (available through Landcare Research) that guides planners and developers through the development process – pre-construction (design), construction, and post-construction – and describes measures that maximise biodiversity outcomes. Leadership by local government in developing models, and increased availability of suitable plant material from nurseries, will continue to help raise awareness and uptake of these concepts.

Attracting wildlife into cities is also an LIUDD goal, Dr Meurk says.

‘Generally, native fauna and plants are co-adapted so we emphasise indigenous plants in urban vegetation. Some exotic plants do provide food sources for native birdlife (red-flowering gums, proteas, berry-bearing woody plants) but many of these are also serious biosecurity risks. There is supporting work on wildlife – including birds, bats and lizards – in cities in a number of research projects. It is all a matter of balance.’

After a long period of pushing our biodiversity into a corner, our cultural landscapes are now steadily evolving towards an optimal mix of indigenous and introduced elements that ensure our economic performance while maintaining quality of life and celebrating our point of difference nationally and regionally. The LIUDD programme has contributed information, ideas and tools towards achieving that balance, but there is still more to learn and apply.

CONTACT

Dr Colin Meurk
Landcare Research, Lincoln
meurkc@landcareresearch.co.nz

>>WATER SUPPLY AND STORMWATER MANAGEMENT
ARE TWO SIGNIFICANT ISSUES FOR BUILT
ENVIRONMENTS, ESPECIALLY AS OUR CITIES GROW.

INNOVATIVE INFRASTRUCTURE

Municipal reticulated water supplies are very costly and as houses grow larger and sections grow relatively smaller the resulting increase in impervious areas means the volume and speed of stormwater entering streams is often increased. More environmentally sensitive and cost-effective options are needed to minimise impacts of this stormwater runoff.

Integrated urban water management – linking the management of urban water supply, stormwater runoff, and wastewater with the management of natural urban waterways and water bodies – embodies the principles of LIUDD.

Rain tanks

People have relied on rainwater for household, landscape and agricultural water uses for centuries. As communities have become larger and more centralised, community water treatment and distribution systems have gradually replaced the collection of rainwater as our primary water supply. As we have begun to understand the need for sustainable use of water worldwide there has been a renewed interest in collecting rainwater.

The central functions of rain tanks are to reduce stormwater flows, thereby protect natural urban waters and/or reducing demand on the reticulated water supply.

The LIUDD programme found that Auckland's climate can provide enough water to meet needs in commercial and residential buildings.

A commercial building can meet its full needs, if the rainwater tank overflow, combined with uncollected roof water, exceeds the demand from reticulated services.

In a typical Auckland house, which currently needs approximately 240 m³ per year of reticulated water, a rainwater tank can collect 180 m³ per year on average. Simple demand management technologies such as low-flow fixtures, along with accounting for reduced leakage in rainwater tanks (relative to a reticulated system), can make up the difference.

There is also evidence that rainwater tanks provide educational benefits to the community on the availability of water. Residents using rainwater tanks report increased awareness of water consumption, and, if supply is low, can change their behaviour to reduce demand. Besides water quantity, users of rainwater tanks are also concerned with the health impacts of rainwater consumption. While there have been relatively few disease outbreaks linked to contaminated roof rainwater, research found that following best-practice system design and best-practice maintenance schedules will reduce the level of pathogens and other contaminants entering rainwater tanks.

Our research has provided more insights into the life-cycle costing of rain tanks when compared with reticulated supply. A life-cycle costing study that included the benefit of foregone investment in upgrading existing stormwater infrastructure to cope with increased development found that conventional and

LIUDD approaches were similar, but found the LIUDD approach also represented an investment in innovation.

A study that looked only at water-supply benefits showed that continued investment in reticulated water supply LIUDD (including an increased level of demand management) can be up to 80% more costly than investment in rain tanks for supply if the ongoing benefits of water savings are included. Not all infrastructural costs are financial. Energy and greenhouse gas emission costs have also been studied using life-cycle analysis.

Over a 100-year period, concrete rainwater tanks consume the least amount of energy, while reticulated supply (with demand management technology) emits the fewest greenhouse gas emissions. This demonstrates the complex trade-offs that must be considered when planning infrastructure, especially as the most expensive, most energy consuming, and highest greenhouse gas emissions were calculated in the hybrid scenario where investment is made in both reticulated supply and rainwater harvesting.

Vegetated swales

Swales – or biofilters – are vegetated areas used in place of kerbs or paved gutters to transport stormwater runoff and which can also temporarily hold small quantities of runoff and allow it to infiltrate into the soil.



Vegetated swales can serve as part of a stormwater drainage system and can replace kerbs, gutters and stormwater systems. Swales are best suited for residential, industrial, and commercial areas with low flow.

Swales reduce peak flows, remove pollutants, and promote runoff infiltration, and they tend to have lower capital costs. While swales are generally used for stand-alone stormwater management, they are most effective when used in conjunction with wet ponds, infiltration strips, and wetlands.

Rain gardens

Rain gardens, preferably planted with native plants, are strategically located to collect, infiltrate and filter rain that falls on hard surfaces like roofs, driveways, alleys, or streets to minimise the negative impacts of excessive runoff from these surfaces on lakes and streams.

Rain gardens – also known as a bioretention device – are designed to take the place of a stormwater system and soak up and filter the water that comes off a roof or paved area.

There is no standard size for a rain garden. One formula provides that the bioretention area should be 5% to 7% of the drainage area that the rain garden is intended to accommodate. A rain garden should be placed near impervious surfaces so that rainwater will drain into the dip or depression. Locate the rain garden strategically near to impervious surfaces, such as alleys, sidewalks, driveways, and under

downspouts or gutters, to capture the rain as close as possible to the point where it falls.

Green roofs

Green (or living) roofs are increasingly being legislated for and promoted around the world.

They are effectively a thin planted layer on top of a building or house to achieve maximum stormwater and energy benefits while keeping additional structural costs to a minimum.

New Zealand has very few thin green roofs, but local lightweight substrates, suitable plants, and the benefits for stormwater and biodiversity have been quantified as part of the LIUDD programme.

Using roof space for growing plants has the major benefit of not competing with highly valuable ground-space, while adding value to underutilised space that generates most of the stormwater, reflected heat, and ugly views in a city.

Green roofs are very popular in North America, Asia and Europe to enhance city environments and reduce building energy demands.

Green walls

Green walls, vertical gardens and living building facades, whether free-standing or fixed to a wall, reclaim often disregarded and neglected city spaces (walls and fences) with minimal

adverse effect on ground-level usable area. They supply large areas of cooling, insulating and filtering surfaces for a negligible building footprint. This technology has rapidly grown over the last five years with the development of cable and modular trellis systems, and lower maintenance.

CONTACT

Dr Robyn Simcock

Landcare Research, Auckland
simcockr@landcareresearch.co.nz

