

Low Impact Urban Design and Development: scope, founding principles and collaborative learning

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Abstract

The paper presents an overview of a nationwide research and implementation programme in New Zealand entitled ‘Low impact urban design and development: making it mainstream’ and reports on two aspects of the research underway. The purpose of the programme is to facilitate the uptake and implementation of low impact urban design and development (LIUDD) practices. The paper briefly outlines the scope and methodology of the programme and then reports on progress in respect of two aspects of the investigation. First, key principles and methods for the practice of LIUDD are presented. Second, the development of learning networks as a tool for adaptive collaborative learning is also outlined.

LIUDD principles can inform decision-makers and planners in the preparation of plans and policies for urban and rural development, thus representing a significant contribution towards influencing future urban form. The development of learning networks has significant potential as tools for sharing knowledge between stakeholders and researchers, and, in the longer term, facilitating the uptake of LIUDD practices. Both the development of the LIUDD principles and learning networks are important means for integrating the multi-disciplinary and multi-dimensional objectives and outcomes of the research programme.

Keywords:

LIUDD, LID, collaborative learning, learning networks, principles

INTRODUCTION

The Low Impact Urban Design and Development programme (LIUDD) is a nationwide research and implementation programme underway in New Zealand. The six-year programme (2003-2009) is funded by the New Zealand Foundation for Research, Science and Technology, a government agency responsible for funding public good science research. Landcare Research Ltd, a crown research institute, is the lead provider while other institutions (such as the University of Auckland and private consultants) are involved as subcontractors. The purpose of the programme is to facilitate the uptake and implementation of low impact design policies and practices. The paper gives a brief overview of the programme, then reports on progress with respect to two strands of the research. These strands draw on different disciplinary perspectives, which demonstrate both the multi-disciplinary nature of the programme as well as the breadth of investigations. First we present the LIUDD principles that underpin the research programme. Second, in recognition of the strong focus of the programme on stakeholder “buy-in”, we report on our approach for enhancing multi-stakeholder engagement and collaborative learning that are considered essential for ensuring uptake and implementation of LIUDD practices.

OVERVIEW OF THE RESEARCH PROGRAMME: SCOPE AND METHODOLOGY

The activities of the research programme focus on metropolitan Auckland with additional sites in Taupo, a rural and tourist town, and in Christchurch City. The context ranges from development sites (single building or neighbourhood) to catchments and includes both greenfield and brownfield applications. We have established case study sites in six urban and rural districts with varying spatial scales that we are drawing on to develop and apply concepts, techniques and processes. The

large inter-institutional research team encompasses researchers with expertise in environmental sciences, engineering, social sciences, economics and urban planning. We also interact with a significant number of stakeholders in councils, the private sector, iwi (Maori tribal) and other organizations through our various research tasks. This collaboration assists the education of researchers as well as stakeholders.

The programme has several features that we consider constitute a multi-dimensional approach to the research. First, it draws on a range of disciplines beyond those traditionally involved in this field to examine how the uptake of LIUDD can be enhanced and increased. Second, it is collaborative in that we work alongside partners in the public and private sectors over a period of some years. In turn, this collaboration assists to disseminate knowledge of the programme and its findings. Third, the programme is oriented through participatory research and the use of demonstration projects, towards building capacity for ongoing cross-sectoral learning and integrated adaptive management. The researchers have a strong commitment to the integration of knowledge and practice across stakeholders, disciplines and sectors and are exploring ways to ensure the results of the research are developed and presented in forms that are appropriate for residents as well as practitioners. A national task force of leading practitioners has been established to work with the research team to assist in the changing of practices at local levels, such as modifying and aligning various types of council plans and development practices.

The programme has four key themes, implemented through five objectives each with specified tasks and outcomes. These address the human and social dimensions of 'buy-in', integration of natural features and treatment processes through the application of innovative science and design, development of new economic tools and implementation of LIUDD. The paper reports on work undertaken under two of these themes: 'getting buy-in' and 'changing plans and practices'. These two strands are closely connected. Changing behaviour through social learning is critical to achieving more sustainable practices at varying spatial and social scales ranging from the management of catchments through to the way domestic households operate. To this end, the researchers are adopting a collaborative learning approach and working with stakeholders through learning networks to explore a variety of topics, such as how progress towards achieving LIUDD goals is concretely measured. The fourth theme recognises that uptake of LIUDD at a local level is directly influenced by a raft of local government planning instruments (Taylor and Weber, 2004).

LIUDD PRINCIPLES: A FRAMEWORK FOR CHANGING PLANS AND PRACTICES

The development of LIUDD in New Zealand has drawn on earlier initiatives such as Low Impact Development (LID, Shaver 2000) an alternative approach to stormwater management in North America. LID has much in common with Water Sensitive Urban Design (WSUD) in Australia (Lloyd *et al.*, 2001). It deliberately embraces LID as well as other elements. A strong driver has been the need to enhance sustainability of the built environment through an integrated approach to urban design and development (Eason, *et al.*, 2004; van Roon, 2005). LIUDD aims to avoid a wide range of adverse effects of a physiochemical, biodiversity, social, economic and amenity nature, resulting from conventional urban development and, at the same time, protecting aquatic and terrestrial ecological integrity (van Roon and Knight, 2004). With appropriate planning, funding and management, it is possible to have different patterns of development and intensities of development, whilst still meeting environmental standards and economic aspirations.

In order to advance the concept of LIUDD beyond its more confined origins, it is necessary to define key principles and implementation methods (van Roon and van Roon, 2005). A significant inclusion has been the incorporation of the values and practices of Maori, the indigenous people of New Zealand. The hierarchy of principles and sub-principles is demonstrated in Figure 1. Note that

in this figure, box outlines are differentiated to demonstrate the core focus of the LIUDD programme, which is shown in bold text. Complementary tertiary principles and sub-principles, that are outside the LIUDD programme brief, are boxed-in by broken lines.

Methods for implementation of every principle and sub-principle have been outlined elsewhere (van Roon and van Roon, 2005). These methods are alternative rather than traditional and will be continually amended and updated as the LIUDD team and stakeholders explore their economic, social and regulatory implications. Many of the principles are mutually reinforcing or overarching. There will be instances in implementation where trade-offs will be required and where more weight will have to be given to one principle over another. The process of negotiating between principles is key to integrated adaptive management practice and can be assisted by collaborative learning processes as discussed further on in this paper.

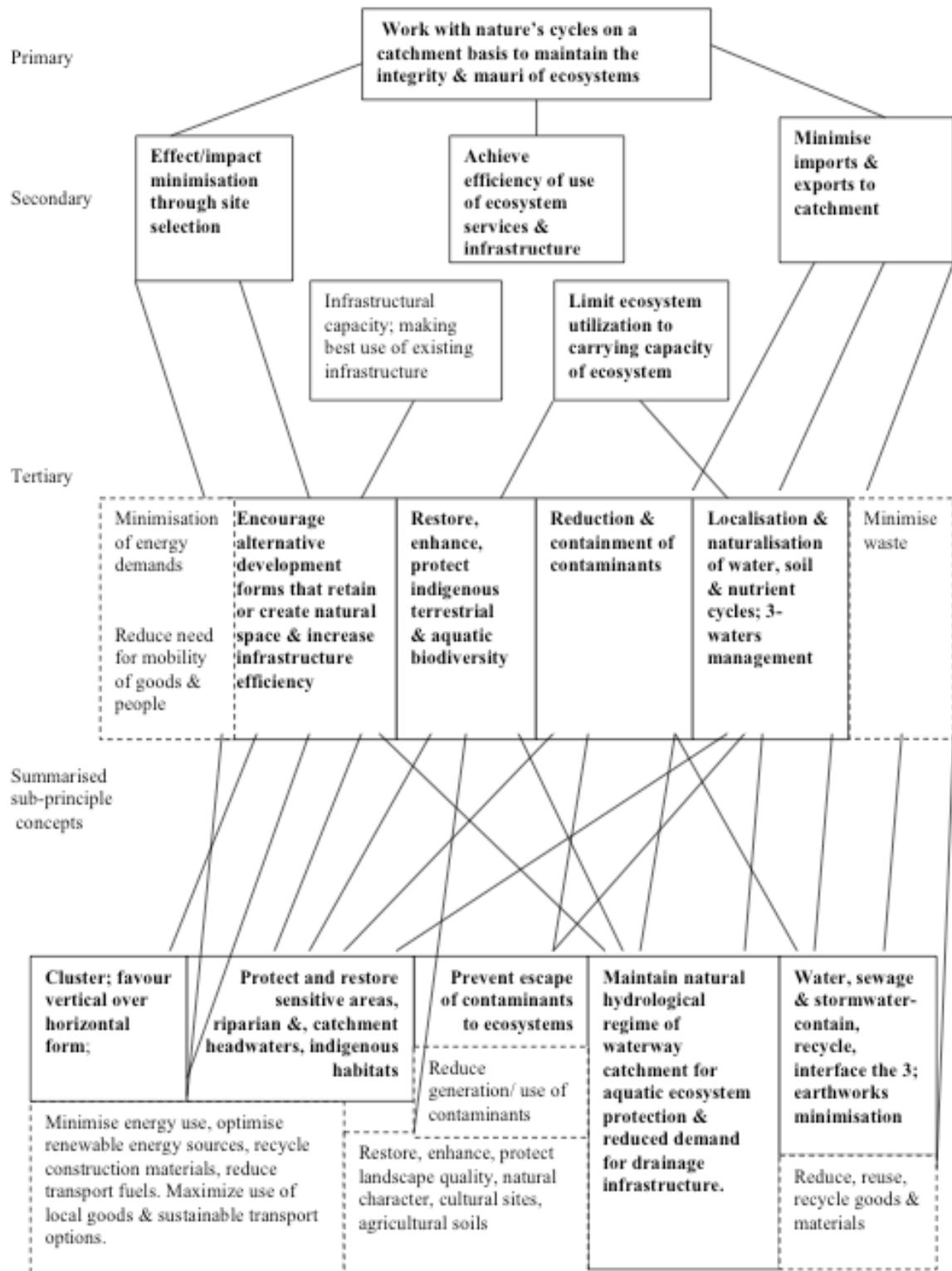
The principles form a hierarchy of importance. The single primary principle seeks recognition that human activity should respect and operate within natural cycles (van Roon and Knight, 2004) in order to minimize negative effects and optimize catchment internalisation of materials, contaminants and energy. This principle is embedded in all other principles in Figure 1. The catchment is promoted as the most desirable spatial unit for urban design and management. The ecological carrying capacity concept, as part of resilient natural cycles in a catchment context, is central to the LIUDD approach.

The secondary principle concerned with site selection emphasises the fact that the greatest achievements in LIUDD are derived from choosing the optimum location within a region for urban development (van Roon and Knight, 2004, 92). Without this essential step, even if the tertiary principles are applied consistently, there are unlikely to be acceptable outcomes. Another secondary principle is concerned with the efficient use of infrastructure and ecosystem services. The overarching secondary principle concerning minimisation of imports and exports to a catchment, is generic to almost all tertiary principles.

The justification for inclusion of tertiary principles and their implementation is supported by an array of publications from this LIUDD programme and parallel or complementary programmes in LID (Shaver, 2000) and WSUD. Although the increasing complexity of interactions with distance down Figure 1 has been demonstrated, there are numerous horizontal interactions at the tertiary and sub-principle levels that are not readily illustrated. One of the tertiary principles encourages alternative development forms that retain open space and enhance infrastructure efficiency. The term 'clustering' is typically used to describe the grouping together of structures in specific locations on a common site. This works well in residential and rural-residential catchments. However, clustering is not the only means of implementing this principle. For example, the concentration of titles (residential, commercial or industrial) within multi-level buildings, instead of spread across a site, can free-up open space between buildings that will then need to be protected from construction as well as re-vegetated. Such a change in site layout has as one of its primary objectives support for natural processes and biodiversity. This contrasts with the usual objective of maximizing human use, and proliferating impervious surfaces on the site by covering it in buildings and car-parks. Clustering has major implications for the implementation of LIUDD principles on all greenfield and redevelopment sites.

Another tertiary principle addresses the localisation and naturalisation of water, soil and nutrient cycles. The stormwater sub-principles and their implementation are the traditional focus of low impact approaches. The need to ensure hydrological neutrality within a catchment (van Roon, 2005), and methods (North Shore City Council, 2002) to achieve less than 15% 'effective'

Figure 1: Hierarchy of Principles of LIUDD. Principles in bold are the dominant focus of this LIUDD, FRST funded, programme. Principles in dashed boxes have minor focus in this programme. Figure 1 is a partial representation of Table 1 (van Roon and van Roon, 2005)



imperviousness is a major challenge for all stakeholders to meet. This is particularly so for those involved in redevelopment of brownfield sites.

These LIUDD principles have been developed primarily by the researchers in the LIUDD programme based on work undertaken with stakeholders and years of experience and research in the field. The principles form an essential part of a suite of planning tools and instruments that comprise a planning and policy framework to support the uptake of LIUDD. They represent an important first step in the development of this framework. For the principles to become embedded in peoples' daily lives, however, some level of organisational and personal buy-in will be needed. This requires the principles to be relevant and applicable to the varied political and spatial scales and diverse contexts in which people will attempt to use them. Learning networks provide a means to explore how these principles, along with other planning tools, fit with those that underpin peoples' daily practices. They also identify opportunities for shifting current assumptions by which urban design and development presently occurs.

BUILDING LIUDD KNOWLEDGE AND PRACTICE THROUGH COLLABORATIVE LEARNING

Awareness of the size, complexity and interconnectivity of environmental problems has increased use of multi-stakeholder processes in problem solving and decision-making. Adaptive management is increasingly used as a means for enabling a shift towards more integrated approaches to management that address environmental problems comprehensively and, importantly, incorporate flexible provisions for managing change (Marcotullio and Boyle, 2003, 18). The implementation strategy that underpins LIUDD recognises that the willing participation of stakeholders is critical in harnessing commitment to and support for the adoption of new management approaches (Lane and McDonald, 2005). As part of this strategy, researchers within the LIUDD team have developed a collaborative learning tool that they are now able to offer as a starting point for dialogue within and across learning networks that are being created through the research programme. By stimulating dialogue about the fundamental assumptions that lie behind current practices for addressing urban development problems opposing perspectives can be explored and unpacked, thereby contributing to the transformation of urban development and design practices. The success of the transformation rests on the extent to which low impact approaches and practices are taken up.

Learning networks rest on the principle that the development of an organisational process can engender the necessary participation to resolve an issue as well as the collective development of technical knowledge. Thus adaptive management approaches to urban development involve both 'process' and 'substantive' learning (Lane and McDonald, 2005). Ideally they involve moving through a cycle of problem identification (which includes attempting to find a common way of understanding and articulating the problem); action planning, modelling the system as a whole (which may include social elements as well as physical and economic); monitoring, management and experiment; redefining of the problem; attempting new actions and so on, repetitively through the cycle. Once experienced with this model of environmental management, participants no longer frame problem solving in terms of attaining a definitive end point, but as a step in the ongoing process of learning about the physical environment and exploring management options (Allen, *et al.*, 1998). In this way, the group's understanding of the breadth and complexity of environmental problems is strengthened and the work of the group becomes longer term (Lane and McDonald, 2005).

Collaborative double loop learning

Two examples of types of learning are illustrative of what can occur in response to the identification of environmental problems where unintended consequences have arisen from actions

undertaken (Argyris et al, 1985, 84-85). For example, on the one hand, a local council may try out a different downstream stormwater treatment system if receiving water quality is unacceptable. This strategy is termed single loop learning. Another possibility, on the other hand, is to change the governing variables themselves. For example, the local council may choose, as part of a brownfield redevelopment, to create open space for at-source reduction of stormwater by reducing building-footprints through clustering or by an emphasis on vertical rather than horizontal building forms (see tertiary principle in Figure 1). This is called double-loop learning, and involves more fundamental shifts in people's understanding of the underlying assumptions that drive their actions.

Developing double-loop problem solving techniques is thus a critical part of changing people's actions in respect to the environment. However, it also requires the action researcher to deal with the defences of individuals and organisations, which is no small undertaking. In many cases this will mean having to address situations in which participants may feel embarrassed or threatened (Allen and Kilvington, 1999). However, as Grudens-Schuck (1998, 61) points out, research and policy development programs require specific processes for confronting people about unworkable theories and organisational defences. Without these processes, the ability to negotiate between knowledge areas and opposing interpretations of events is severely limited, thus limiting opportunities for integrated and adaptive urban development. Learning processes such as these can tease out often culturally embedded assumptions and facilitate stakeholders away from the defence of subjective positions towards a more common understanding of the problem at hand (Meppem and Gill, 1998).

Collaborative learning for LIUDD

The LIUDD programme fosters an approach of learning with stakeholders so as to enable a shift away from conventional urban environmental management practices toward more sustainable approaches. We are in the early stages of developing learning networks in New Zealand. The aim is to bring people together so that they can share their experiences and knowledge so as to learn about the conditions under which LIUDD strategies work, or do not work, or can be modified and supported. The basic assumption is that by developing some common learning frameworks, collecting an agreed set of data and information, sharing stories and taking the time to reflect and analyse across experiences, members of the learning networks can more efficiently learn about the strategies they are using, improve their capacity to manage these strategies, and ultimately implement more effective projects or management efforts. Adopting a collaborative learning methodology shifts the emphasis from observing then describing the situation after events have happened, to action oriented participatory methods. The aim is to facilitate learning that will result in longer-term transformative change. By adopting an action learning approach the researchers are attempting to use action reflection cycles that enable people to move through a process of diagnosing, designing, doing and developing (Keen *et al*, 2005, 9).

In addition to the location-specific learning networks, we are also facilitating networks across locations. A network of researchers is looking at how Maori perspectives and values shape the development of LIUDD techniques for urban environmental management. Another group is looking at how household rain-tanks perform (socially, economically, and technically) as a stormwater management device, as well as an additional source of household water. A third network is interested in learning about the practices councils and infrastructure providers can utilise to manage the transition towards using more low impact approaches to urban development. Finally, there is a group of people interested to learn together about making links between the objectives of LIUDD policies and programmes and the complex outcomes that they could be associated with (van Roon *et al.*, 2005); not unsurprisingly stakeholders have already been enquiring how the researchers and other organisations can measure progress towards the adoption of more low impact approaches.

Preliminary feedback from the group exploring the performance of rain-tanks confirms the utility of bringing a diverse group of stakeholders together in order to explore a range of assumptions about and attitudes towards the adoption of rain-tanks. A small group was formed comprising two regulators, a health professional and researchers (with economics, planning and community development skills) to lead a process of inquiry about the use of rain-tanks in Auckland, New Zealand. The inquiry began with a workshop attended by regulators, asset managers, stormwater engineers, health professionals, infrastructure providers, rain-tank installers, consultants and developers. The working group came together to analyse the findings from the workshop and to plan the next steps of joint research. The workshop revealed both concerns about and support for rain-tanks. On the one hand, health concerns, the need to educate householders on use and maintenance of rain-tanks and whether costs of installation should be borne by councils, developers and homeowners were identified as major barriers to their increased uptake. On the other hand, there was general support for rain-tanks as a useful means of stormwater control¹ and for the reuse of water for activities such as washing clothes and flushing toilets. What also emerged was the challenge of working across disciplines and the need to ensure that different perspectives could be respected and accommodated in order to make progress on this issue (Meppem and Gill, 1998; Williams, 2002). The requirement for a specialist portfolio of skills and competencies in order to work across professional, organisational and jurisdictional boundaries in these situations is also noted by Williams (2002).

CONCLUSION

The development of LIUDD principles and the creation of learning networks for collaborative learning have been two significant advances in the research programme. The usefulness of these contributions lies in their ability to be used at both strategic levels and applied aspects of the programme. First, the principles provide a platform that can underpin the preparation of statutory and non-statutory local government plans and strategies, in turn shaping more sustainable urban form. Second, the collaborative learning process offers a means by which the principles and assumptions that underlie current urban development practices can be explored in order for more integrated and adaptive practices to be embedded. Learning networks will become an important means of building knowledge and practice across the research team and stakeholders as the research progresses and as its lessons are taken up and implemented by stakeholders, beyond the lifetime of the programme.

REFERENCES

- Allen, W.J., Bosch, O.J.H., Gibson, R.G. and Jopp, A.J. (1998). Co-learning Our Way to Sustainability: An Integrated and Community-based Research Approach to Support Natural Resource Management Decision Making. In: *Multiple Objective Decision Making for Land, Water and Environmental Management*, S.A. El-Swaify and D.S. Yakowitz,(eds), Lewis Publishers, Boston. 51-59.
- Allen, W.J. and Kilvington, M.J. (1999). Why involving people is important: The forgotten part of environmental information system management. Paper presented at *2nd International Conference on Multiple Objective Decision Support Systems (MODSS '99) for Land, Water and Environmental Management*, Brisbane, Australia, 1-6 August 1999.
- Argyris, C., Putnam, R. and Smith, D.M. (1985). *Action science*. San Francisco, USA, Jossey-Bass.
- Eason, C., Dixon, J. and van Roon, M. (in press). A transdisciplinary research approach providing a platform for improved urban design, quality of life and biodiverse urban ecosystems. In: *The*

¹ A forth-coming paper by Pandey, S. and Greenaway, A. is anticipated in mid-2006 on the use of rain-tanks as stormwater management devices in Auckland.

- Ecology of Cities and Towns: A Comparative Approach*, M. J. McDonnell., J. Breuste and A. K. Hahs (eds.), Cambridge University Press, Cambridge.
- Grudens-Schuck, N. (1998). *When Farmers Design Curriculum: Participatory Education for Sustainable Agriculture in Ontario, Canada*. Unpublished doctoral dissertation, Cornell University, Ithaca.
- Keen, M., Brown, V. and Dyall, R. (eds.) (2005). *Social Learning in environmental management: building a sustainable future*. Earthscan, London.
- Lane, M.B. and McDonald, G. (2005). Community-based Environmental Planning: Operational Dilemmas, Planning Principles and Possible Remedies, *Journal of Environmental Planning and Management*, 48(5), 709-731.
- Lloyd, S., Wong, T. H. F. and Chesterfield, C. J. (2001). Opportunities and impediments to water sensitive urban design in Australia. In: *Proceedings of The Second South Pacific Stormwater Conference: rain the forgotten resource*, 27 - 29 June, Auckland, New Zealand, 302 – 309.
- Marcotullio, P. and Boyle, G. (eds.) (2003). *Defining an Ecosystem Approach to Urban Management and Policy Development*. United Nations University/Institute of Advanced Studies, Tokyo.
- Meppem, T. and Gill, R. (1998). Planning for sustainability as a learning concept, *Ecological Economics*, 26, 121-137.
- Michael, D.N. (1995). Barriers and bridges to learning in a turbulent human ecology. In: *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. L. H. Gunderson, C.S. Holling, C.S. and S.S. Light (eds.), Columbia University Press, New York, 461-485.
- North Shore City Council (2002). *Long Bay is Worth Protecting*. North Shore City Council, Takapuna, New Zealand.
- Shaver, E. (2000). *Low Impact Design Manual for the Auckland Region*. Technical Publication 124, Auckland Regional Council, Auckland, New Zealand.
- Taylor, A.N. and Weber, T. (2004). Using Effective Policy Frameworks to Drive Water Sensitive Urban Design. Paper presented at the International Water Sensitive Urban Design Conference, 21-25 November, Adelaide.
- van Roon, M.R. and Knight, S.J. (2004). *Ecological Context of Development: New Zealand Perspectives*. Oxford University Press, Melbourne.
- van Roon, M. R., Dixon, J. and van Roon, H. (2005). Reformulating Planning Tools to promote Low Impact Urban Design and Development. In: *Proceedings of the Fourth South Pacific Stormwater and Aquatic Resource Protection Conference*, 4 - 6 May, Auckland, New Zealand.
- van Roon, M. R. (2005). Emerging Approaches to Urban Ecosystem Management: the Potential of Low Impact Urban Design and Development Principles, *Journal of Environmental Assessment, Policy and Management*, 7 (1), 1-24.
- van Roon, M. R. and van Roon, H. T. (2005). *Low Impact Urban Design and Development Principles for Assessment of Planning, Policy and Development Outcomes*, Working Paper 051 of the Centre for Urban Ecosystem Sustainability, a partnership between Landcare Research Ltd and the University of Auckland, New Zealand.
- Williams, P.M. (2002). Community Strategies: Mainstreaming Sustainable Development and Strategic Planning? *Sustainable Development*, 10, 197-205.