Low Impact Urban Design and Development Principles for Assessment of Planning, Policy and Development Outcomes

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Low Impact Urban Design and Development Principles for Assessment of Planning, Policy and Development Outcomes

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Note: Figure 1 and Table 1 are in a separate pdf document.

Abstract

Every set of practices that is given a label requires clear definition including acknowledgement of inclusions and exclusions. Low Impact Urban Design and Development (LIUDD) is no exception. This paper provides a coded listing of principles, sub-principles and implementation actions that together define good LIUDD practice. It constitutes a coherent tool by which stakeholder groups can assess the relevance and uptake of LIUDD principles in plans, policies and practice. The paper is intended to differentiate this major New Zealand research and implementation programme, from other complementary programmes in the cluster of New Zealand 'Sustainable Cities' projects funded by the New Zealand Foundation for Research Science and Technology.

Acronyms

CUES	Centre for Urban Ecosystems Sustainability
LID	Low impact development
LIUDD	Low impact urban design and development
LIRRD	Low impact rural residential design and development
WSUD	Water sensitive urban design
FRST`	Foundation for Research, Science and Technology

Introduction

In late 2003, the Centre for Urban Ecosystem Sustainability (CUES) obtained almost six years of funding from the Foundation for Research, Science and Technology (FRST), on a competitive bid basis, to make Low Impact Urban Design and Development (LIUDD) mainstream practice throughout New Zealand. (CUES is a partnership between the University of Auckland and Landcare Research New Zealand Ltd.) An essential element of achieving this outcome is providing clarity to all stakeholders on what the principles of LIUDD are and the methods that can be used to implement those principles.

This paper has three main objectives. The first objective is to define what LIUDD is and what it is not, by defining principles and sub-principles (Table 1). The second objective is to show the relationship between the principles and implementation actions. The third objective is to code principles and implementation actions, thereby

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enabling a stakeholder to create a checklist of implementation achievements using these codes. Stakeholders will thereby be able to assess the degree to which their planning documents, policies, guidelines, codes of practice, and actual practices incorporate LIUDD. The paper elaborates on Table 1, which is the primary tool to do this, but it should not however be used in isolation. The application of LIUDD principles will require the reformulating of planning tools to promote and implement those principles (van Roon *et al*, 2005).

The evolution of LIUDD

LIUDD is a term unique to New Zealand and this FRST programme. Contributing philosophies, principles and practices are, however, common to many countries and cluster in various combinations under diverse labels.

Much has been written about sustainability, sustainable urban development and the need for different urban forms (e.g. Freeman and Thompson-Fawcett, 2003; de Roo and Millar, 2000; Duary and Plater-Zyberk, 1994; Jenks *et al,* 1996; PCE, 1998). While mostly at a general and conceptual level, various dimensions of sustainability are addressed, including environmental, economic, physical design, and social. The LIUDD approach uses ecological carrying capacity in a cyclical context as a starting point.

LIUDD evolved from its origins in 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, Lloyd *et al*, 2001) in Australia. LID utilises natural drainage features in the landscape rather than piped systems for stormwater management and incorporates natural design features into erosion and sediment control during urban development (Shaver, 2000). WSUD, in addition, strongly emphasises 'integrated three waters management' to achieve reductions in water demand and sewage effluent discharges.

In New Zealand (Eason *et al*, 2004; van Roon, 2005) these concepts and practices, have been evolving since the late 1990s, and are reaching beyond alternative stormwater management to an integrated urban design and development process now termed LIUDD, which deliberately embraces LID as well as other elements. LIUDD aims to avoid a wide range of adverse effects of a physiochemical, biodiversity, social, economic and amenity nature, resulting from conventional urban development, protecting aquatic and terrestrial ecological integrity (van Roon and Knight, 2004) while allowing urbanisation at all densities.

The LIUDD team has drawn together sound New Zealand ecological principles for development (van Roon and Knight, 2004), New Zealand experience in green architecture (Vale and Vale, 2000), environmental economics (Krausse *et al.* 2001), alternative wastewater system design, and 'integrated three waters management'. ecovillage construction lessons (Gibellini, 2001), tikanga and maatauranga Maori (Harmsworth et al, 2002; Rolleston, 2005) urban/regional environmental planning knowledge, landscape restoration experience (Scott, 2003) and research into the design, management and maintenance of alternative stormwater management

technologies (Pandey *et al*, 2003). This convergence and integration of disciplines, and their application to case studies nationwide, continues to stimulate the evolution of LIUDD.

Not all of the Programme's work begins with the urban environment. Case studies in New Zealand locations particularly under pressure for peri-urban growth, for example Taupo, Manukau and Waiheke, have provided stimulus for development of Low Impact Rural Residential Design and Development (LIRRDD) principles and practices, some of which are reported in the appendix to the Proposed Taupo West Rural Structure Plan (TDC, 2004 Appendix 4).

The LIUDD approach is evolving rapidly and as research results become available and the nature of interactive systems are better understood, the emphasis in the Programme, articulated principles and means of implementation are adjusted. LIUDD and LIRRDD planning processes are seen as educational, to highlight the externalities which have tended to be ignored or under-rated in the process of design and development. 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 the past the concept of externalities has often been down played with the result that development has been subsidised by the environment to its detriment.

Principles of LIUDD

The principles, sub-principles and implementation tasks that we consider central to LIUDD (and LIRRDD) are summarized in Table 1 (Columns 1, 2 and 4 respectively). A detailed description of and rationale for each principle is presented in column 3 of the Table. The numerical codes, which follow implementation alternatives in the far-right column of Table 1, are provided to enable ease of reference to these tasks in future publications and checklists of LIUDD achievement. The inter-relationship of principles and sub-principles is also 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.

Table 1 includes some principles, which for the sake of completeness have been included, even though their implementation is beyond what we consider should be the scope of this LIUDD, FRST-funded programme. By including these extraneous sub-principles (XX) in the table we wish to convey the fact that we have not overlooked their importance in achieving objectives that arise from these principles. Instead we are acknowledging that their implementation belongs in other FRST funded 'Sustainable Cities' programmes (or in the existing statutory responsibilities of government agencies). In order to achieve a reasonably compact table, references have been minimised.

Maori values and practices have been incorporated throughout Table 1 as a first step in reframing development to create more sustainable forms of design from an indigenous/New Zealand perspective.

Note many of the principles can be mutually reinforcing or overarching. Each can be elaborated on in various ways and the implementation of one has spillover effects on the others. These spillover effects can be both positive and negative. There will be instances in implementation situations where trade offs will be required and where more weight will have to be given to one principle over another.

Table 1 is a work in progress and is expected to change as the LIUDD Programme progresses. Change is expected to be least in the main principles. However, the implementation alternatives listed are the beginning of an evolving task and will be continually amended and updated. Also it is our intention in the next phase of the Programme to provide greater detail on all implementation alternatives and to explore their economic, social and regulatory implications.

Primary Principle

The principles in the left column of Table 1 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 Table 1. The ecological carrying capacity concept, as part of resilient natural cycles, is central to the LIUDD approach.

Secondary Principles

Principle 2.1, concerning site selection, emphasises the fact that the greatest achievements in LIUDD and LIRRDD are derived from choosing the optimum location within a region for urban development (van Roon and Knight, 2004, p92). Without this essential step, even if the tertiary principles are applied consistently, there are unlikely to be acceptable outcomes. All principles in Table 1 provide useful guidance to this fundamental strategic planning approach. Sub-principle 2.1B articulates the 'least-regrets' approach as a component of site selection. The underlying philosophy of this sub-principle is to keep options open and avoid actions which pre-empt alternatives or which incur major costs.

Sub-principles 2.1X to 2.1XXX are critical components of site selection for development and hence are included in the table for completeness even though they fall outside the scope of this programme. As landscape quality and natural character are strongly influenced by natural cycles sub-principle 2.1X falls naturally in the hierarchy beneath the primary principle.

Principle 2.2 recognises past infrastructural investment and seeks to optimize return on this. It also addresses the services provided to society by healthy functional ecosystems and the need to ensure their ongoing capacity. The overarching secondary principle 2.3, concerning minimisation of imports and exports to a catchment, is generic to almost all tertiary principles.

Tertiary Principles

The justification for, and implementation of, tertiary principles in Table 1 are supported by an array of publications from this LIUDD programme and from parallel or complementary programmes in LID (Shaver, 2000) and WSUD. The hierarchical links between secondary principles, tertiary principles and sub-principles is demonstrated by Figure 1. Note that although we have demonstrated the increasing complexity of interactions with distance down the figure, there are numerous horizontal interactions at the tertiary and sub-principle levels that are not readily illustrated.

Principle 3.1 encourages alternative development forms so as to retain open space and enhance infrastructure efficiency. The term clustering, introduced in sub-principle 3.1A, 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. Clustering is not the only means of implementing Principle 3.1. 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 and re-vegetated to implement principles in Table 1. 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 impervious surfaces on the site by covering it in buildings and car-parks. This approach has major implications for the implementation of LIUDD principles on all greenfield and redevelopment sites. Understanding and implementation of Principle 3.1 may be aided by similar approaches termed conservation subdivision implemented by Arendt (2004) in 23 states of the United States of America.

The stormwater sub-principles 3.2A to 3.2D inclusive and their implementation are the traditional focus of low impact approaches. Conviction of the need for (van Roon *et al*, 2004), and methods (NSCC, 2002) to achieve less than 15% 'effective' imperviousness, to ensure hydrological neutrality within a catchment, is a major challenge for all stakeholders but particularly those involved in redevelopment. Revegetation of riparian corridors is becoming mainstream practice but there is less awareness of the particular need to protect complementary terrestrial and stream ecosystems in catchment headwaters so that these can function as a reservoir of stream biota for re-colonisation of streams that become inadvertently degraded downstream (van Roon and Moore, 2004).

With regard to principle 3.2 we would like to emphasise the importance of 'integrated three (or four) waters management'. Linear once-through systems are minimized when water supply, wastewater and stormwater systems are designed and costed simultaneously to maximize opportunities for water recycling and the minimisation of natural water takings and effluent discharges. Such integration is similar to the principles of 'industrial ecology' whereby complementary industries co-locate so that the waste outputs of one industry become the raw material inputs of the next.

A caution here, is that, the main centre of toxin accumulation that currently occurs in the aquatic receiving environment may move to the terrestrial environment. This LIUDD programme is limited in its influence upon contaminant generation. Through naturalization of the water cycle and support for green construction, the Programme aims to contribute to the reduced use, mobility and ecosystem availability of contaminants.

The Programme (Principle 3.4) contributes to fulfillment of the objectives of New Zealand's Biodiversity Strategy (DoC and MfE, 2000) by encouraging optimum protection and re-vegetation of both urban and rural-residential areas (TDC 2004) and by reducing hydrological and aquatic biological changes (van Roon and Moore, 2004) brought about by urbanization. Direct habitat management that is embodied in tertiary principle 3.4 is just a minor component of the all-encompassing ecological objective encapsulated in LIUDD. The Programme as a whole addresses the optimum functioning of ecosystem processes and cycles upon which all life depends.

Transport management at the regional scale (Principle 3.5X) and waste minimisation are beyond the scope of this Programme. However transport management is acknowledged as a primary driver for site selection for urban use (Principle 2). Transport planning and management at the neighbourhood or catchment scale can comfortably be aligned with achievement of stormwater, biodiversity and neighbourhood containment objectives. Also aligned with these are energy conservation actions (Principle 3.6) implemented at neighbourhood and individual site scales.

In developing Table 1 we have been mindful of the need to provide balance in the provision of principles and methods relevant to brownfield as well as greenfield developments. Adoption of these methods for greenfield sites is relatively easier and faster than for brownfields. The retrofitting of existing New Zealand urban areas has typically only been achieved over many decades as individual sites have been redeveloped and infrastructure has required replacement.

Conclusions

We have attempted to define the principles and actions that make possible the implementation of LIUDD as defined by the Centre for Urban Ecosystem Sustainability, New Zealand. We have therefore created the means, by which all stakeholders involved in development processes can generate checklists using the codes we have provided, to document implementation achievements. It is hoped that this will bring greater clarity to stakeholders wishing to introduce LIUDD into everyday practice.

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