CONSIDERATIONS FOR SUSTAINABILITY ASSESSMENTS OF URBAN DEVELOPMENTS

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1 FORWARD

This paper is being submitted to the House of Representatives Standing Committee on Environment and Heritage, Inquiry into Sustainable Cities. The paper has been prepared as a discussion on the issues relating to assessment or verification of sustainable developments. The paper addresses the final term of reference for the inquiry, being:

- Mechanisms for the Commonwealth to bring about urban development reform and promote ecologically sustainable patterns of development.

The paper predominately discusses issues relating to new developments. However, assessing the sustainability of existing developments and the ongoing urban consolidation, which occurs and increases pressures on existing resources, is equally important. The issues raised in this paper could be extended to include existing developments and urban consolidation.

The paper does not outline what should be considered as a sustainable city or discuss the benchmarks for such a city. These issues are not included as it is considered that the system in which the development occurs will dictate what is sustainable for that system. Therefore, a process to assess the sustainability of a development is more important than determining benchmarks at this time.

2 INTRODUCTION

There is an increasing awareness and acceptance of the need to change traditional planning and design of urban developments in Australia to incorporate the concept of sustainability. The number of developments in Australia that claim to be 'sustainable', 'eco-efficient' or 'incorporate environmentally sensitive features' is increasing. However, at present there is no consistent assessment process to validate or assess the adequacy of developments making this claim.

Processes exist for the assessment of sustainability. These processes are based on varying interpretations of sustainability, having been designed for different purposes and results are

not comparable. Many processes focus on environmental issues rather than incorporating all aspects of sustainability. Incorporating environmental issues is essential and a good step, but should not be considered adequate to demonstrate sustainability.

Researchers at The University of Adelaide have been investigating the concept of sustainability and alternative approaches to the assessment of sustainability for a number of years. Recently, research has focused on developing an assessment process that uses a system's approach and is applicable at all levels of society including: government, corporate, project and household levels.

This paper discusses the researchers' view of sustainability, compares the available assessment techniques at the urban development level, demonstrates the usefulness of these techniques and highlights issues that need to be addressed by the urban development sector.

3 SUSTAINABILITY

To make an assessment of the sustainability of an urban development, an understanding of what sustainability is, and what its objectives are, is required. There are many definitions for the term sustainability and four are discussed here:

The Oxford Concise Dictionary, 1997 defines sustainable as: "1. *ecol.* (esp. of development) which conserves an ecological balance by avoiding depletion of natural resources, 2. that can be sustained". Where sustain is defined as "… 4. endure, stand; bear up against, … 8. maintain or keep going continuously".

This lexical definition has been expanded by others to include: Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987); Sustainable water resource systems are those designed and managed to fully contribute to the objectives of society, now and in the future, while maintaining their ecological, environmental, and hydrological integrity (Loucks & Gladwell, 1999); and sustainability refers to the ability of a society, ecosystem, or any such on-going system to continue functioning into the indefinite future without being forced into decline through exhaustion or overloading of key resources on which that system depends (Gilman, 1992).

The dictionary definition is generic while the next two definitions relate to the specific systems of human society and water resources. This paper adopts the Gilman definition as the most appropriate platform to describe sustainability and enable the assessment of sustainability. This definition is:

- robust;
- defines sustainability as a characteristic of a system; and
- identifies the appropriate management of key resources over time as one objective.

4 SUSTAINABILITY OF A SYSTEM

Accepting that sustainability is a characteristic of a system, an understanding of the system being considered is required, prior to discussions relating to whether or not a system is sustainable. After this understanding is obtained a system can be considered sustainable if the following conditions are met (Foley et al, 2003).

- Resource levels available to the system are sufficient to meet the requirements of the system;
- Resource levels within the system are maintained at levels that do not exhaust or overload the resources; and
- Resources that are imported to or exported from the system do not compromise the ability of adjacent systems to be sustainable.

Resources are considered to be any component of a system that is important to the functioning of that system. A resource level refers to the quality or quantity of the resource under consideration. These resources include not only the natural resources but also human resources, financial resources and the manufactured or man-made resources, such as physical infrastructure and manufactured goods.

The inclusion of human and financial resources, in addition to the natural resources, is generally accepted in studies of sustainability. On the other hand, manufactured goods and infrastructure are usually ignored, although they play a central role in the functioning of the system.

Manufactured resources exist in all human systems and play an essential role in the processing of resources within that system. The water supply system for a township treats and distributes water and relies on the infrastructure within the system. If the infrastructure were to fail, it would affect the ability of both the water supply system and the township to continue to function satisfactorily.

It is important to recognise that the resources available to a system are unique to that system. Each system will require different levels of resources and each system will have different resources available to it. Resources available to a system can either be sourced from within the system or from adjacent systems. If the system relies on significant resources from adjacent systems, the sustainability of the adjacent systems must be considered.

The input into the system from adjacent systems must not overload the resources within the system under consideration. In addition, they must not exhaust the resources within the adjacent system such that the ability of that system to be sustainable is compromised. If the sustainability of the adjacent system is compromised the adjacent system may not then be able to continue to provide the amount of resource it once did. Determining whether the resource imported compromises the sustainability of adjacent systems is complicated when the adjacent systems share their resources among a number of systems that compete for the same resource.

Similarly, outputs from the system, in the form of exports or losses, must not compromise the ability of adjacent systems to be sustainable. Although the sustainability of the system under

consideration would not be directly affected, it may be indirectly affected through interconnected adjacent systems. Greenhouse gas emissions from a system is one example. This has a domino effect with subsequent systems and subsystems. Resources can only continue to be transferred between systems if the sustainability of the systems within the chain is not compromised.

5 ASSESSING THE SUSTAINABILITY OF URBAN DEVELOPMENTS

An urban development is a system consisting of many components and sub-systems including: individual houses, infrastructure networks and the water cycle. An urban development is also a subsystem of the larger system in which the development is located for example in a catchment, city, region or state. Therefore, prior to assessing the sustainability of an urban development, it is important to identify the system that is under consideration. A decision must be made as to whether the assessment is to include the impact that the development has on the sustainability of adjacent or larger systems. Such systems dictated by location are transport, service industries and recreational systems to name a few.

The potential for an urban development to be sustainable is a function of its planning, design and construction. In addition, the ability of the urban development to remain sustainable over time is a function of the management and maintenance of all resources within the development and importantly the behaviour, expectations and values of the residents within the development.

The planning and design of a system impacts on the resource demands of a system. Systems that are developed today have the opportunity to be planned and designed with regard to the system's sustainability. The demand on the system's resources can be reduced by: the use of efficient technologies; optimising the use of resources that exist within the system, reducing the dependence on adjacent systems; maximising the ability of the system to adapt to changing resource levels over time; and the use of cyclical processes that maximise the reuse of resources within the system. Systems that are not designed to transform and process resources efficiently may have a higher dependency on resources from adjacent systems. Therefore, the ability of the system to remain sustainable over time is more reliant upon the sustainability of adjacent systems.

In some instances the planning and design of developments with regard to sustainability can be restricted by regulations. Health regulations such as water quality requirements for potable purposes exist to minimise the risk of contamination and result in a constraint to how water can be reused within a development.

The ongoing management and maintenance of the development will impact on the ability of the system to continue to process resources efficiently. Urban developments with ongoing high maintenance requirements will require resources to be continually sought. For example, an urban development with open space landscaping will require high maintenance and high levels of irrigation, unless it is designed to cope with the natural variation of climate.

The consumption behaviour of residents within any development has the potential to have a greater impact on the sustainability of the development than the planning and design, although a good design will restrict unsustainable practices. Treloar et al (2000) assessed the lifecycle of a house using embodied energy and found that the largest contribution to energy use over a

30 year lifecycle was occupant consumables. Harmaajärvi (2000) considered CO_2 produced; also finding the greatest savings can be made in operational energy, which is essentially dependent on occupant behaviour. Treloar et al (2000) supported by Mendue (2001) and Thormark (2002) affirm that behavioural characteristics of occupants are a significant, if not the primary, factor in the environmental impact of a house.

The transportation requirements of residents is yet another characteristic of an urban development that can impact on sustainability. A development located outside of the metropolitan area without a public transportation system in close proximity will require residents that do not work in the immediate area to travel by private transport. Depending on the travel distance, number of people in the car and type of car significant resources may be required. Fuel and emissions are obvious resources that are impacted with the capacity and maintenance of the local transport infrastructure being less obvious impacted resources.

In summary, a number of considerations relating to what will be incorporated in a sustainability assessment of an urban development must be made prior to undertaking the assessment. These include:

- What aspects of the development will be considered in the assessment?
  - planning, design, construction materials/methods;
  - impact on sustainability of adjacent/larger systems;
  - ongoing management and maintenance requirements; and
  - likely resident behaviour (consumption, transport).
- Is the assessment to be predominately an environmental assessment or will it include social, economic and infrastructure aspects?
- Is there the need to be able to compare developments or is the assessment to be based upon the resources available to the system in which the development is to occur? and
- What is the purpose of carrying out the assessment?

6 THE PURPOSE OF AN ASSESSMENT

The purpose of an assessment will dictate the nature and extent of the assessment process used for urban development. The intended purpose will also affect who conducts the assessment and how it is carried out. There are various reasons why an assessment may be carried out, including:

- legislative requirement that development is to be sustainable;
- approval process requirement (local council or state);
- industry expectations or requirement;
- consumer expectations;
- marketing and public relations exposure for developer;
- commercial advantage (for consumers in longer term);
- developments are of a higher standard;

- developers want to do the 'right thing' and be able to demonstrate it; and
- it is good for business.

When an assessment is undertaken as a legislative or approval process requirement, it is likely that the developer will need to demonstrate compliance and this would then be confirmed or reviewed by the approving body. In such cases, the approving body could have proformas or checklists to assess the development. Such an assessment would be undertaken prior to construction of the development.

When an assessment is undertaken for exposure purposes, a standard assessment result or process is probably warranted. Brands or stamps such as AAA water fixtures, the six star energy rating scheme or even certification to an Industry Standard such as ISO 9001 are examples of brands in various sectors. Given the complexity and subjective nature of sustainability, a third party assessment of the development would add more credibility to the 'sustainable development' claim, on the proviso that the third party had a process with integrity. An assessment of this nature could be undertaken pre or post construction.

Finally, if the assessment was to be undertaken to maximise the sustainability potential of the development because the developer believed in the validity of the concept, a number of assessments carried out during the planning and design phase would be recommended to optimise the outcome. Rather than an assessment process, it would be used as a design process that could compare design alternatives within a development with a set of predefined sustainability objectives for the development. These objectives would be selected based on core sustainability objectives and the resources available to the system in which the development was to occur. The developer could facilitate the process or engage specialist consultants to undertake the role. Results from this type of assessment could feed into the other assessment processes described above.

Ideally, a single assessment process should be developed that could be used throughout the life of the project. At present, a process does not exist that could serve this purpose.

7 EXISTING TOOLS

Tools for the assessment and integration of sustainability vary in validity, purpose and structure. They include policy documents, design guidelines, case studies, assessment tools and performance ratings for specific products.

Governments and industry groups have developed various policy documents and guidelines to assist the integration of sustainability principles into developments. Examples include: the National Strategy of Ecologically Sustainable Development (Commonwealth of Australia, 1992) at the national level; Towards Sustainable Engineering Practice (Greene, 1992) that outlines how engineers can integrate sustainability in practice; the Queensland governments Guidelines Toward A More Sustainable Subdivision (Apelt, 2003); and the Urban Development Institute of Australia (Queensland) Sustainable Urban Development Criteria (UDIA, 2003). These are only a few of the many available documents that exist in Australia, a greater number of similar documents can be found internationally. Documents of this nature are at a higher level than assessment tools and don't necessarily provide specific details as to what is a sustainable project. They are based on the interpretation of sustainability relevant to the organisation that is responsible for them, generally focus on environmental issues and are

difficult to measure performance against. Each of these documents have merits when taken in the context for which they were developed.

At a more practical level, manuals such as the Home Technical Manual (Institute for Sustainable Futures, 2001) prepared for the Australian Greenhouse Office provides advice to improve the design of housing. Case studies demonstrate how these principles can, and have been used in practice. This type of document focuses on the household level and individual building envelope of the house. It does not take into consideration the adjacent systems that the house interacts with. The document is a good practical guide, especially for the homeowner, but does not have an associated assessment process. Therefore, it is difficult to assess whether houses using these design principles are sustainable or not.

Sustainability assessment tools are in their infancy and are becoming more common. It has only been in the last five to ten years that serious attempts have been made to measure sustainability. A summary of assessment techniques that have been applied at the household or development level are outlined in Table 1. The table is not exhaustive of all processes but is indicative of the type of assessment processes that exist.

Table 1: Sustainability/Environmental assessment tools for buildings and developments (after Evans et al, 2003)

System	Region	Applicable to	Factors included	Form of results	Other
Green building tool Cole and Larsson (1999) Crawley and Aho (1999)	Global	Multi unit buildings	Social, Water, Waste, Resources Transport, Economic	Total score - Uses current standard as benchmark	Region specific. Requires expert opinion
Comment	Most comprehensive, complex to use due to detail options				
Arup SPeAR® Paris and Wilson	Global	Project / Corporate	Societal, Environment, Economic, Natural Resources	Satisfaction wheel of results – uses colour for interpretation.	Weights all factors equally.
Comment	Output not appropriate for comparison. Subjective benchmark				
Ecobalance Harmaajärvi (2000)	Finland	Multi house projects	Water, Waste, Resources, Economic, Social, Transport	Tonnes CO_2 and surveys	Not necessary
Comment	Data intensive and not easily understood.				
Matrix Evaluation for Sustainability Assessment (MESA) Fleming (1999)	Australia	Development	Social, Economic, Resources, Environmental, Infrastructure	Matrix output. Incorporates fuzzy set theory.	Selects best alternative for developments. Using predefined criteria with weights
Comment	Includes community and expert opinions				
City of Melbourne – TBL assessment (City of Melbourne, 2002)	Australia	Development, Planning approval	Social, Economic, Environmental	Checklist	Subjective assessment of impacts
Comment	Used as part of Council approval process, developed in conjunction with ICLEI				

System	Region	Applicable to	Factors included	Form of results	Other
Green Business Council of Australia – Green star rating (GBCA, 2003)	Australia	Building	Management, Health, Water, Energy, Land, Transport, Materials, Pollution	Six star performance rating	For different phases of the building life cycle (design, operation)
Comment	Developed in conjunction with Sinclair Knight Merz – Based on similar international tools				
ENER-RATE Soebarto and Williamson (2001)	Australia	House	Resources, Social, Economic.	Matrix output. Uses reference building	User defined weights and factors
Comment	Not appropriate for comparison. Lacking environmental detail				
National Australian Building Environmental Rating System (NABERS) Vale et al (2001)	Australia	House	Resources, Social, Transport, Waste, Water	% of maximum available score	Weights all factors equally.
Comment	No economic assessment. Some indictors questionable				
Nationwide House Energy Rating Scheme (NatHERS) Williamson et al (2001), Bennetts (1999), Menadue (2001), O' Shea (2001)	Australia	House	Resources.	Number of stars - based on energy use thresholds	
Comment	Readily available. Not satisfactory for sustainability assessment				

A range of other tools exist including life cycle assessment, cost benefit analysis and ecological economic techniques. Life cycle assessments are considered more appropriate at an individual component level while economic techniques require the transformation of qualitative data into a monetary value and therefore are even more subjective than other tools.

In addition to the tools discussed, tools or processes that measure the sustainability of a community such as the Compass Index of Sustainability (AtKisson + Associates, 2001) and ecological footprints (Chambers et al, 2000) can also be relevant to developments.

A critique of each assessment tool listed is not provided in this paper. Recognising that there are exceptions to all generalisations a list of deficiencies with the tools presented in Table 1 is provided below.

- the resources available to the system in which the house, building or development is located is rarely considered;
- the impact on the sustainability of adjacent systems is generally not included;
- there is an emphasis on environmental issues such as energy;
- they do not necessarily consider construction materials or infrastructure;
- the criteria for assessment purposes vary and are rarely compared to core sustainability objectives and goals;
- aggregation methods for results are generally mechanistic and do not allow for the complexity associated with sustainability;
- where weightings are included in the aggregation technique, the process for selecting the weightings vary;

- there is not a recognition that the goals associated with sustainability may change over time and that sustainability is a dynamic concept; and
- assessment processes are not consistent with assessment processes that are used by communities, corporations or governments, although they are all attempting to demonstrate similar objectives.

8 NEED FOR FURTHER RESEARCH

Further research is required if an appropriate assessment process is to be developed to assess urban developments. There are various groups that are developing assessment processes. These groups include organisations that are further developing existing tools, for example Redefining Progress with the Ecological Footprint (Chambers et al, 2000), consultants who are developing new products to sell and research organisations such as The University of Adelaide.

For an assessment process to be considered appropriate, it must:

- be based on an acceptable definition of sustainability;
- have a clear assessment purpose;
- be flexible to cater for different development types;
- recognise the resources that are available to the development under consideration;
- have a transparent aggregation method to allow a better understanding of the results;
- be consistent, or in alignment, with the processes and goals that are applied to adjacent and larger systems (for example the local council or state government); and
- is part of a continuous improvement process to recognise the dynamic nature of sustainability.

The authors of this paper are currently developing a process to address these issues. The work is based on developing a consistent assessment process that can be used at all levels of society. The content and detail of assessments at each level will obviously be different; however, the process to arrive at the outcome need not be different. The process has been tested at a corporate level with further work required to ensure that it is practical at other levels of society.

9 CONCLUSIONS

Sustainability is an issue that society has accepted and is willing to address. Although, there is a need to demonstrate how the issue is being addressed by all sectors of society. The urban development sector has an important role in ensuring that development integrates the principles of sustainability. If this sector is to demonstrate performance, a number of key questions need to be answered, including:

- What is meant by a sustainable development?
- What is the purpose of carrying out an assessment?
- What aspect of the development is to be assessed?
- What assessment process is to be used? and
- Are existing assessment processes suitable for use?

Assessment processes do exist for assessing sustainability. These processes have varying purposes, criteria and aggregation techniques. Given deficiencies in the existing processes there is a need to further research.

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