INTEGRATION OF LID, URBAN DESIGN AND URBAN FORM PRINCIPLES.

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ABSTRACT

A Technical Report, 'The Integration of Low Impact Design (LID), Urban Design and Urban Form', was commissioned by the Auckland Regional Council (ARC) to assist planners, consent staff, developers and consultants in exploring the interaction of the two broad disciplines of LID and urban design. This paper identifies the synergies and conflicts between the two disciplines and potential mechanisms to achieve their integration.

This paper discusses the following steps to examine this subject:

1. Comparison of accepted principles for LID and Urban Design (ARC's TP124 and the MfE Urban Design Protocol).
2. A methodology or 'Toolkit' to inform integrated planning and design at a variety of scales and urban typologies.

The 'Toolkit', investigates complementary scales of environmental and social orders, the 'region' (municipality), 'catchment' (community), and the 'site' (neighbourhood) providing for: 1) Comprehensive planning frameworks based on scale-specific assessment and analysis. 2) Integrated design responses based on urban and environmental transitions.

KEYWORDS

Low Impact Design, Technical Publication 124, New Zealand Urban Design Protocol, Auckland Sustainability Framework, Auckland.

PRESENTER PROFILE

Hayden Easton is currently the Acting Team Leader of the Stormwater Action Team at the Auckland Regional Council. His activities include project management, working with territorial authorities and the development of Integrated Catchment Management Plans (ICMP's). He is also involved in the education about and promotion of Low Impact Design (LID).

1 INTRODUCTION

Low Impact Design (LID) is promoted within the Auckland region as a development approach that utilises natural systems and processes to manage erosion and stormwater (Shaver et al., 2000). In 2000, the Auckland Regional Council (ARC) released Technical Publication 124 'Low Impact Design Manual for the Auckland Region' (hereon referred to as TP 124). TP 124 provides guiding principles of LID and discusses methods that supplement these principles.

In 2005, the Ministry for the Environment (MfE) released the 'New Zealand Urban Design Protocol' (Mfe, 2005). The New Zealand Urban Design Protocol is a central government initiative to improve the quality of the urban environment. To facilitate quality outcomes for urban design, the New Zealand Urban Design Protocol sets out seven essential design qualities, known as the seven C's.
All Auckland councils are signatories to the New Zealand Urban Design Protocol.
In Auckland, all councils are also signatories to a document called 'The Auckland Sustainability Framework'. The Auckland Sustainability Framework (Regional Growth Forum, 2007) calls for LID

to achieve ‘a unique and outstanding environment’ (one of eight goals defined by the Auckland Sustainability Framework).

For this reason and to provide guidance to urban intensification projects utilizing LID approaches in the region, the ARC instigated the preparation of a Technical Report to inform the integration of LID and Urban Design ARC TR 2009-83 (Lewis et al., in press, Integration of LID, Urban Design, and Urban Form Principles) provides this discussion to assist planners, consent staff, developers, and consultants.

2 DISCUSSION

ARC TR 2009-83 (Lewis et al., in press) was commissioned by the ARC Stormwater Action Team to provide an analytical comparison between the two design processes of LID and urban design.

The ARC Stormwater Action Team provides proactive support to developers and industry to enable increased awareness and uptake of LID within the Auckland region. By enabling the comparison of the two design processes, the Stormwater Action Team aims to provide another potential mechanism to achieve and increase awareness and implementation of LID.

2.1 LOW IMPACT DESIGN PRINCIPLES

Common to all of the approaches and methods comprising LID, are five basic principles stated within ARC TP 124 (Shaver et al., 2000). These five basic principles are:

1. Achieve Multiple Objectives: Address peak rate and volume control as well as water quality control and temperature maintenance. Ideally provide for simple yet comprehensive options that cater for complex problems.

2. Integrate stormwater management and design early in the site planning process: Investigate stormwater issues during site assessment to inform land use typologies, and integrate stormwater management with development concepts.

3. Prevent rather than mitigate: a paradigm shift for site planning that provides for stormwater management at-source and during conveyance rather than at the bottom of the catchment. This also relates to the construction process, by reducing land disturbance and therefore potential entrainment of sediment.

4. Manage stormwater close to the point of origin as possible; minimises collection and conveyance: Minimise the concentration of stormwater in pipes by maintaining natural hydrology and thereby reducing the impact of flow volumes, contaminants and flow velocities on the receiving environment.

5. Rely on natural processes within the soil mantle and plant community: Utilise physical processing (i.e. filtration), biological processing (e.g. microbial action), and chemical processing (e.g. cation exchange capacity) to reduce contaminants in stormwater.

Further to the above five principles, other repeated directives captured in TP 124 (2000) include:

- Protection of the receiving environment and its habitats from potential cumulative stormwater effects.
- Clustering of development form to protect sensitive environments.
- Reduction in impervious surfaces.
- Protection of natural character and landscape amenity values.
- Provision of passive recreation in stormwater management areas.

2.2 NEW ZEALAND URBAN DESIGN PROTOCOL AND THE SEVEN C'S

The New Zealand Urban Design Protocol (2005) defines 'urban design' as:

> 'Urban design is concerned with the design of buildings, places, spaces and networks that make up our towns and cities, and the ways people use them. It ranges in scale from a metropolitan region, city or town down to a street, public space, or even a single building. Urban design is not concerned just with appearances and built form but with the environmental, economic, social and cultural consequences of design. It is an approach that draws together many different sectors and professionals, and it includes both the process of decision making as well as the outcomes of design' (MfE, 2005).

The above definition would suggest that urban design is a holistic design approach, with a broad interest in environmental, economic, socio-cultural outcomes for the urban environments.
Through the New Zealand Urban Design Protocol (2005), MfE have set out seven essential design qualities known as the seven C's. The seven C's and their interpretation are provided below:

1. Context: Seeing buildings, places and spaces as part of whole towns and cities.
2. Character: Reflecting and enhancing the distinctive character, heritage and identity of the urban environment.
3. Choice: Ensuring diversity and choice for people.
4. Connections: Enhancing how different networks link together for people.
5. Creativity: Encouraging innovation and imaginative solutions.
6. Collaboration: Communicating and sharing knowledge across sectors, professions and with communities.
7. Custodianship: Ensuring design is environmentally sustainable, safe and healthy.

2.3 SYNERGIES AND CONFLICTS

To enable a comparative analysis of the two design processes, an alignment of the LID principles and seven C's has been undertaken. TR 2009-83 (Lewis et al., in press) provides detailed discussion on the alignment of each LID principle and the Seven C's, but for the purposes of this paper, a brief summation of identified synergies and conflicts is provided. Mechanisms to resolve potential conflict are also provided (The toolkit).

2.3.1 SYNERGIES

The comparative analysis of the two design processes revealed some very strong synergies, particularly:

- Multidisciplinary teams: Both design processes advocate the use of multidisciplinary teams to provide for a comprehensive integrated design process.
- Protection of environmental resources: Through intensification of built form and the accommodation of transit and mixed use commercial centres.
- Design innovation: LID and urban design both promote the use of innovation. This can be attributed to the requirement for multidisciplinary teams.
- Future values: Design that is responsive to future potential environmental and social values.

- Adherence to sustainability models: Specifically, the optimization of resources to achieve multiple outcomes.

- Flexible planning provisions: Both design processes are proponents for flexible planning provisions to allow for responsive design outcomes.

- Interconnected goals: Quality of life and quality of environments as interconnected goals.

- Social and environmental infrastructure: Both design processes set out to achieve social and environmental infrastructure within legible and connected frameworks.

2.3.2 CONFLICTS

Contrasting to the above synergies, the comparative analysis of the two design processes identified some conflicts, these were:

Dendritic patterns vs Urban Grid: There is a creative tension between the dendritic pattern of a natural stream system and the connective street patterns (or grid) that urban design promotes for connectivity.

A mechanism to reconcile these conflicting patterns occurs at the fundamental level of movement within the site. It is a matter of integrating natural and built elements in the most appropriate ways to optimise the objectives for each design pattern. Some potential responses include:

- Adapt the urban grid in response to existing topography and landform.

- Convey water along streets, or within streetscapes as water features.

- Allow flexible width for carriage ways and riparian buffers.

- Favour pedestrian crossings in strategic locations based on travel distances.

- Provide for ‘shared surface’ streets which integrate with riparian open spaces.

- Mitigate road crossings of streams by enhancing stream habitats elsewhere.

- At road crossings provide for extended stream corridors to accommodate bridge abutments, landscape transitions, and enhance habitat above and below culverts.

- Continue landscape connections using green elements within the built environment (e.g. green walls, green roofs, and raingardens).

Urban Intensification: Another potential challenge to the integration of LID and urban design approaches is achieving urban intensification while preserving environmental resources. These seemingly divergent objectives may be reconciled in the following ways:

- Plan for urban frameworks, patterns of infrastructure, and natural systems at appropriate representative scales (region, catchment, and site) to achieve “the right thing in the right place”.

- Utilise LID treatments (appropriate to specific urban typologies) to attenuate and treat stormwater prior to reticulated systems. Disconnection from reticulated systems is more important than reducing the level of imperviousness in terms of potential effects on the receiving environment.

- Where habitat is lost, seek to achieve ecological connections, landscape amenity, environmental services, and interpretation of natural elements.

- Adapt environmental systems to account for urban constraints.

2.4 TR 2009-83 TOOLKIT

A toolkit is presented in TR 2009-83 as a method to integrate LID and urban design at complementary scales, and across representative urban and environmental gradients. Figure 1 diagrammatically represents the framework of the TR 2009-83 toolkit.

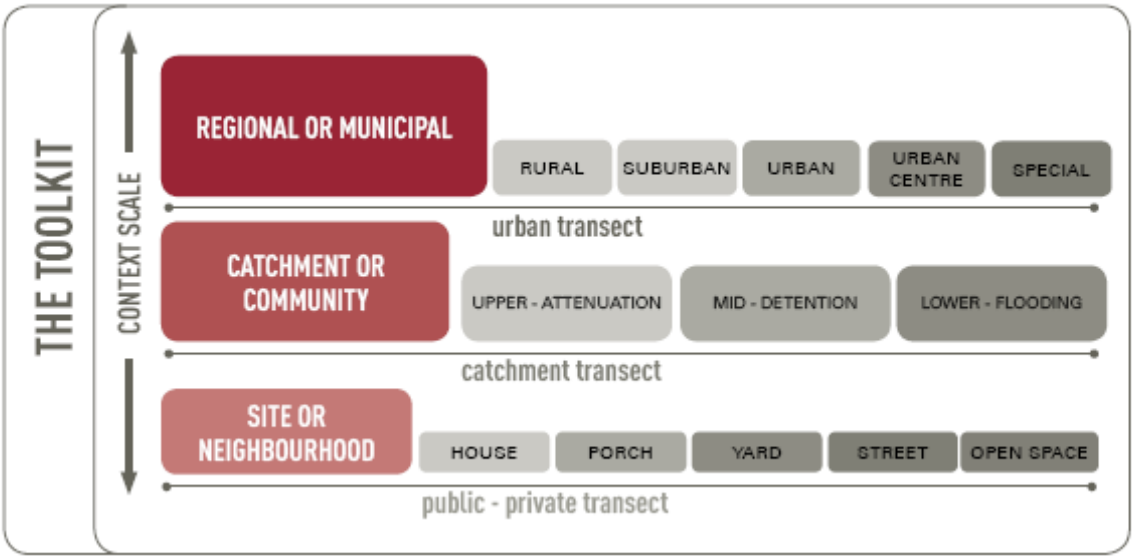

Figure 1. "The Toolkit" framework illustrating the three focus scales (region, catchment, and site) with associated environmental and urban transitions (the transects).

Complementary scales relate to environmental and social orders such as the 'region' (municipality or super-city), the 'catchment' (or community), and the 'site' (or neighbourhood) scale (figure 2). For each of the three scales of region, catchment, and site, the toolkit recommends a methodology for: 1. Comprehensive planning frameworks based on scale-specific assessment and analysis. 2. Integrated design responses based on urban and environmental transitions. Discussion for each complementary scale is provided below.

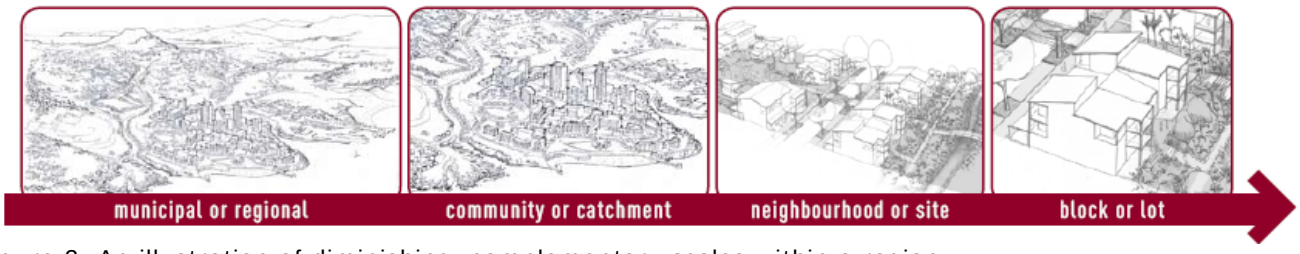

Figure 2. An illustration of diminishing, complementary scales within a region.

2.4.1 REGIONAL SCALE

TR 2009-83 (Lewis et al., in press) utilises discussion captured in the Auckland Governance Royal Commission recommendations to outline a potential regional planning process. The Auckland Governance Royal Commission called for robust, considered, and consistent planning to support the region's ongoing growth and development. LID and urban design benefit this process by inter-relating environmental and social infrastructure in terms of spatial planning and prioritization. Figure 3 below represents a potential planning process to facilitate the integration of LID and urban design perspectives in a regional model.

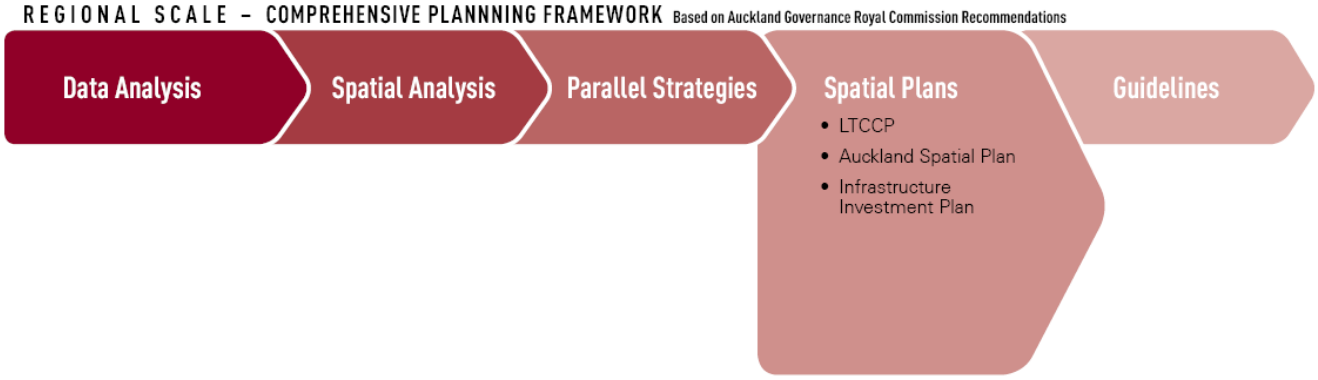

Figure 3. A potential planning framework for the regional scale to incorporate LID and urban design objectives

Data analysis: To accurately inform the planning process, it is necessary to work with comprehensive, compatible, and accurate data, which combines modelling and ground-truthing.

Spatial Analysis: Present information, or let it be extracted in such a way as to reveal relationships between patterns and elements of Auckland's environment.

Parallel Strategies: Priorities for urban growth, open space, and infrastructure in the region can be examined in parallel through multi criteria analyses. This identifies shared objectives, parallel timeframes, combined budgets, and the optimization of existing resources.

Spatial Plans: A long-term council community plan, and a spatial plan for the region, coordinates plans for growth, economic, and social development, and an infrastructure investment plan to guide growth management and public works investment.
A spatial plan is the ideal platform to recognise synchronicity between urban patterns of built form, landscape and ecology, infrastructure services, transport, and open space.

Guidelines: This allows for context specific planning provisions with flexibility, discretion and specialized zoning that relates to site-specific values and constraints.

2.4.1.1. INTEGRATED DESIGN RESPONSE

At the regional scale, urban design and LID are primarily concerned with social and environmental systems, such as community boundaries, transport grids, ecosystems, and stream patterns. However, to comprehensively address the urban landscape and its variation, LID approaches must consider the impacts of population density and land use change across the region, from the rural hinterland to the urban core.

Ideally LID responses will find synergies with urban design objectives specific to these urban areas and assist in their transition from one to the other. An ideal transect for stream and stormwater through the urban area may follow the following pattern:

- Catchment and stream protection, and reinforced ecological transitions in the rural environment.
- Generous open space buffers and natural systems interpretation in suburban areas.
- Environmental buffers to protect streams in urban environments.
- Functional and often linear integration of open water within the industrial grid.
- The harvest and reuse, and appearance and disappearance of water as an element within the urban centre.

2.4.2 CATCHMENT SCALE

At the catchment scale, complementary planning frameworks can be achieved through the strong alignment between urban design and LID outcomes through the preparation of integrated

catchment management plans (ICMP) and structure plans at the same extent (the stormwater catchment).

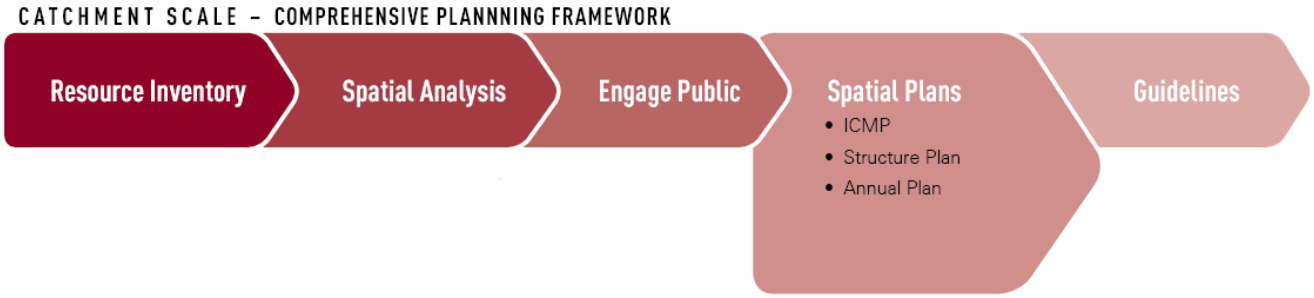

Figure 4. A potential planning framework for the catchment scale to incorporate LID and urban design objectives

Resource Inventory: An inventory of the catchment requires a combination of modelling and ground-truthing sufficient for validation of data e.g. stream walks, topographic analysis.

Spatial Analysis: Interpretation of data, through multi-criteria analysis. Interpretation of datasets is optimised by using inter-disciplinary teams. This will reveal issues and opportunities in the landscape that are relevant to all disciplines.

Engage Public: The process of engaging with the public can awaken the community to the value of their forgotten streams. Changes in the catchment over time are important considerations for forward planning. This information can be sought by those who have lived in an area for a long time.

Spatial Plans: The potential impact of development on the catchment, and the appropriate form of development contribution or otherwise can be determined through the parallel planning process of ICMP's and structure plans. These will inform the LTCCP and annual plans and prioritise existing and potential future catchment issues.

Guidelines: Guidelines such as management plans, development plans, practice notes and codes of practice are important tools for non-point source pollution, pollution prevention, and decentralised LID stormwater approaches. It can ascribe appropriate land management and/or urban design responses to stream management areas, upper catchment sources, and floodplain and coastal areas.

2.4.2.1 INTEGRATED DESIGN RESPONSE

At the catchment scale the synergy between LID and urban design can be based on the hydrological cycle in terms of rainfall collection and conveyance. The catchment can be broadly divided into three system-based areas, the upper, middle, and lower catchment.

Upper Catchment: The upper catchment represents a significant proportion of Auckland stormwater generation due to the prevalence of low order streams and ephemeral gullies within the primarily volcanic region. The upper catchment is therefore (from an LID perspective) focused on source control and infiltration to groundwater. Stormwater can also be attenuated through bioretention devices, infiltration fields, and/or the capture and re-use of rainwater. Slope protection and erosion control is also important in headwaters and can be managed through reserving bush and forestry, and applying appropriate pastoral regimes.

Middle Catchment: The mid-catchment is generally associated with detention or conveyance as stormwater combines to form streams and wetland areas. An appropriate urban response is to protect these systems with suitable buffers of native vegetation or open space, which often leads to ribbon-like fingers of green through the mid slopes and upper valleys of cities.

The integration of LID and urban design at the mid catchment is primarily a function of interlaced urban and environmental patterns such as the urban grid and natural drainage patterns.

Lower Catchment: LID approaches for the lower catchment are primarily concerned with protection of coastal and estuarine environments, and the prevention of flooding impacts. In terms of urban form, lowland environments are usually undulating to flat areas, which provide optimal site conditions for large scale, dense, and specialised urban typologies such as commercial centres, ports, and industrial zones. The resulting land use pattern is a dichotomy between built and natural landscapes, with wide open spaces in association with floodplains, estuaries, and recreational open space, side-by-side with dense development of high rise, civic spaces, and specialised zoning.

2.4.3 SITE SCALE

At the site scale, objectives for LID and urban design can be tailored to specific outcomes, such as enhancing identity and character values for a site, providing a marketing advantage for 'sustainable design', achieving low cost options to environmental services, efficient use of the site, and achieving multiple objectives to reduce operational costs. Figure 5 has been developed from conclusions obtained from ARC TR 2008-20 (Seyb and Lewis, 2008, Application of Low Impact Design to Brownfield Sites).

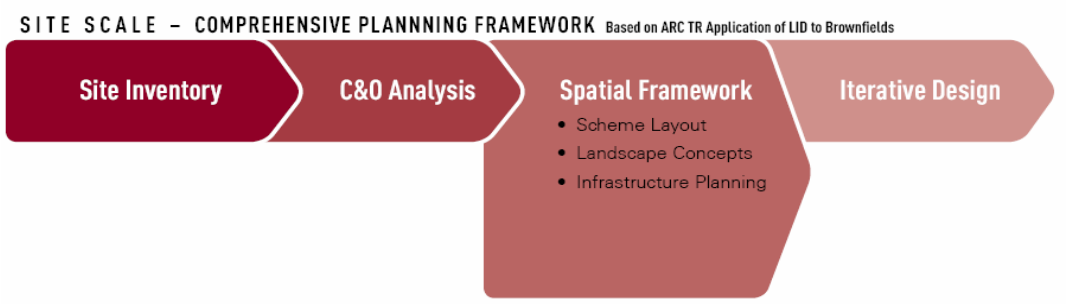

Figure 5. A potential planning framework for the site scale to incorporate LID and urban design objectives

Site Inventory: A site is generally assessed for three focus areas namely, environmental, social, and regulatory. The purpose of the site inventory is to enable an understanding of the site conditions and to pre-empt any foreseeable issues or concerns.

Constraints & Opportunity Analysis: Constraints and opportunity analysis identifies absolute constraints (such as protected watercourses), areas appropriate for specific land use, and areas that can be utilised for infrastructure.

Spatial Development Framework: The process for developing a spatial framework includes the following steps:

- Identify dominant features that determine development form. Dominant features are those that define and/or connect various elements of a site, such as landform, drainage patterns, aspect, and slope.

- Determine relative density and building coverage from SWOT analysis. The SWOT analysis determines optimal areas for development and potential constraints to be remedied or avoided.

- Integrate the site through an environmental enhancement framework. Areas that represent neither optimal development nor absolute constraints may represent opportunities for both social and environmental infrastructure.

Iterative Design: Through design re-iterations the proposed development, environmental enhancement framework, and transitions between different areas within the site can be tested. An investment in project coordination meetings will ensure that multiple objectives are

considered in design decisions. In this way resources of the site will be utilised to their fullest potential, with overlapping benefits for urban design and LID.

2.4.3.1 INTEGRATED DESIGN RESPONSE

The development framework for a site can be divided into open space, built form, and transitional areas. These can be arranged in a transect through a site, and may range from private buildings to public open space, including transitional areas such as porches, yards, and the street. Some of the key aspects of the public-private transect include:

- Public-Private transitions: Distinctions between public and private spaces can be blurred or strengthened as appropriate. LID methods can provide structural elements in these transitions with specific stormwater management devices as appropriate.

- Architectural responses: Architecture can provide a specific design response to environmental constraints. Responsive architecture can also reduce impervious surfaces and capture stormwater for re-use as appropriate.

- Street typologies: the street not only acts as a transport corridor, but also provides public open space, landscape amenity, and environmental services. The use of reduced street carriageways such as 'home zones', lane ways etc provides greater opportunities for LID interface within streetscapes.

- Open space connections: The quality and accessibility of open space is significant to urban design outcomes. Open space alignment with streams also provides for a linear park system that connects communities along a recognisable feature in the landscape.

- Site layout flexibility: Lot layout is often the most enduring legacy for a design. Flexible planning provisions provide opportunities to achieve dense community character around transport and commercial areas, reduce impacts on natural resources, and increase open space areas for the balance of the site.

- Mixed use facilities: Multi-faceted communities allow residents to be close to work and shops, and ultimately reduce the need for transportation infrastructure and its associated effects on the receiving environments.

3 CONCLUSION

TR 2009-83 (Lewis et al., in press) was commissioned to examine the two broad disciplines of LID and urban design. The document has identified both synergy and conflict between the two unique design principles. Key synergies identified were in relation to the multidisciplinary design teams, protection of environmental resources, design innovation, addressing future values, adherence to sustainability models, and the provision of flexible planning, interconnected goals and the drive for social and environmental infrastructure.

The document also identifies potential conflicts between the two design approaches. One potential conflict is between the preservation of the natural dendritic stream patterns driven by LID, and achieving the connective urban grid pattern favoured by urban design. Another source of conflict is urban intensification and its potential effects on environmental resources and the receiving environment. This can be reconciled through comprehensive planning for urban form and environmental systems across complementary scales, applying the appropriate low impact design response to the urban typology, and adapting environmental systems to account for urban constraints.

Through the application of a toolbox, TR 2009-83 (Lewis et al., in press) provides a means to reconcile potential conflicts of the two design approaches through a range of complementary scales.

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