LOW IMPACT DESIGN

The emerging experience in Dunedin

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ABSTRACT

It appears that there are limited drivers for requiring, constructing and maintaining Low Impact Design (LID) infrastructure in Dunedin. While there have been some recent situations where low impact design has been required through resource consents for development, there still seems to be a lack of certainty and confidence in its actual viability. This situation could be perceived to be due to a lack of policy, legal framework as well as limited Dunedin-specific manuals, guidelines and other regional regulatory requirements (compared to other local authorities in New Zealand).

However, the recent adoption of the 3 Waters Strategic Direction Statement (2010-2060) encourages further advancement of such approaches and the revised Code of Subdivision and Development supports further consideration, but offers no further guidance on options or implementation. Coupled with recent advances in network modelling and development of integration stormwater catchment management plans, further insight has been gained into the support for, and viability of, low impact design in Dunedin City.

This paper presents perceived and real barriers for LID in Dunedin and contemplates what recent findings may mean for future LID opportunities in Dunedin.

KEYWORDS

Low Impact Design, Integrated Catchment Management, Affordability, Challenges

PRESENTER PROFILE

Born in the UK with an education background in Oceanography. Moved to New Zealand in 2008 and took the role of AMP and Strategy Analyst for DCC Water and Waste Services. Currently seconded to the role of Asset Strategy Team Leader until February 2012.

1 INTRODUCTION

The general intent of Low Impact Design (LID) is to use natural drainage features in the landscape, rather than piped systems for stormwater management; and incorporate such features into designs for erosion and sediment control to minimise and mitigate adverse impacts on receiving environments. In Dunedin, however, conventional land development and traditional engineering approaches for collecting and conveying stormwater are dominant. Anecdotal evidence suggests that this is because there have not been any local 'tried and true' examples that would help promote or justify preference for low impact approaches.

While it appears there may be some emerging changes to this situation in Dunedin, the multi-stakeholder nature of stormwater management does not lend itself to clearly defined or well understood roles and responsibilities for either traditional development/engineering or low impact approaches. In conjunction with strong external and internal drivers, understanding the merits and associated life-cycle costs of these alternatives is key to enable or initiate any shift in Dunedin's preference. This paper discusses whether

developing and implementing LID approaches in Dunedin could be realised in the near future. It does not contain detailed financial analysis, but focuses on the potential of emerging business processes and frameworks to enable these approaches.

1.1 BACKGROUND

There are various tools available to manage stormwater in Dunedin (including the Dunedin City District Plan, the Code of Subdivision and Development, the Trade Waste Bylaw, the Building Act and Building Code). Within the Dunedin City Council (DCC), responsibilities for ensuring appropriate/regulated development, adequate drainage design and flood protection spread across City Planning, Building Control and Water and Waste Services (WWS); responsibilities for catch-pit maintenance rest with Transportation Operations; the Corporate Policy team is responsible for coordinating Dunedin's climate change adaptation plan; while Community and Recreation Services (CARS) has a vested interest in stormwater management with respect to stormwater run-off and flood mitigation for parks, playing fields and reserves.

Activities carried out by each department can greatly influence how well stormwater is managed. For WWS, tension arises when catch-pits are not regularly cleared or emptied by Transportation Operations, as this impacts on the ability to collect and convey stormwater away from properties and roads and therefore the ability to achieve network performance targets. In other cases, land ownership becomes an inter-departmental issue when considering areas that could be temporarily used for stormwater quality management or run-off storage. It has been suggested that such areas should ultimately be owned and maintained by CARS, however CARS have a strong mandate to prevent playing fields, reserves and other recreational areas from being inundated and are therefore less inclined to agree with low impact design principles and approaches.

City Planning try to balance these differing requirements. However, with no clear mandate on stormwater management across DCC, it is difficult to maintain a consistent approach to decision making. A recent example of this is demonstrated in a decision for a 118 residential lot subdivision development site, proposing multiple adjacent small-scale stormwater attenuation areas along a strip of reserve, leading to a larger drainage reserve area, covering approximately 4370m^2. Ultimately these areas are to be vested with DCC as a Local Purpose Utility Reserve; however clarification within DCC was still being worked through at the consent hearing stage in order to agree which department would be responsible for ongoing operational and maintenance requirements.

1.1.1 PLANS, POLICIES, AND SERVICE OBJECTIVES

Otago Regional Council (ORC) directives on stormwater management are outlined in several plans and policies. The Otago Regional Policy Statement gives general guidance to any stormwater management initiatives by identifying anticipated environmental outcomes. The Otago Regional Plan: Coast addresses the discharge of contaminants to the Coastal Marine Area (CMA) and seeks 'to maintain existing water quality within Otago's coastal marine area; and to achieve water quality that, a minimum, is suitable for contact recreation and the eating of shellfish' (by 2011). Policies also state that where water quality already exceeds these standards, water quality should not be degraded beyond the limits of a mixing zone associated with each discharge (ORC, 2001).

Policies within the Otago Regional Plan: Water address stormwater systems directly, identifying required outcomes for new systems and requiring the progressive upgrade of older systems. These policies provide both general and specific guidance for any stormwater system or associated discharge and play a role in determining the suitability and priority of any management option chosen by the DCC, with the related rules determining consent requirements.

The policies contained within the Dunedin City District Plan (the District Plan) address the effects of land use on water quality such as through the consideration of matters such as stormwater runoff from subdivisions. The District Plan also uses zoning as a method of regulating activities under the DCC

jurisdiction. These land uses play an integral part in determining the quantity and quality of any stormwater runoff. Section 18.6 of the District Plan outlines Assessment Matters for all Subdivision Activities. Examples of this for stormwater disposal state that the Council will have regard to:

- any adverse effects of the proposed subdivision on drainage on or from adjoining properties, and mitigation measures proposed to control any adverse affects
- the practicality of retaining open natural water body systems for stormwater disposal in preference to piped or canal systems and any impacts of stormwater disposal on existing water bodies.

In terms of service provision, the main objective for DCC is to protect public health and safety by providing clean, safe and reliable stormwater services to every customer connected to the network with minimal impact on the environment and at an acceptable financial cost. The stormwater activity is particularly focused on providing protection from flooding and erosion, and controlling and reducing the levels of pollution and silt in stormwater discharge to waterways and the sea (Dunedin City Council, 2010).

However, grey areas arise when these objectives are considered alongside ORC rules and responsibilities, such as management of watercourses, erosion and sediment control, flood mitigation, contaminated land liabilities, as well as point source and diffuse discharges to receiving environments. Unlike some other parts of New Zealand, however, the ORC does not currently take a strong regulatory approach to stormwater management requirements for the various types of land use and development. Requirements to mitigate quality and quantity issues from site development predominantly come from the DCC. Where ORC input is sought, a generic 'best practice' principle is advised, but collating detailed information, guidance and analysis for design is the applicant's responsibility. Whether the final solution is actually the 'best practicable option' is not always assured.

Within the last five years, there has been a drive by the DCC to ensure that site management plans are provided with subdivision applications. For example, requirements for Environmental Management Plans were initiated in 2006 in order to address both stormwater quantity and quality issues. The intent of this requirement was to ensure that post-development peak flow discharge from a subject site would not be significantly different from pre-development and that stormwater runoff during earthworks, construction and vegetation clearance was managed appropriately. However, the subsequent provision of plans and level of detail provided by applicants varied. More recently, Erosion and Sediment Control Plans are a requirement of consent conditions; however these are not mandatory to every resource consent and usually dependent on the scale of the proposal.

In 2010, an updated Code of Subdivision and Development for Dunedin was adopted. This code states that, under normal circumstances, design and construction of stormwater systems shall be undertaken in accordance with the requirements of NZS 4404:2004 Part 4: Stormwater, but DCC will also consider alternative stormwater systems, including reduced pavement areas, permeable pavements, wetlands, ponds, swales, soak pits and attenuating devices in order to minimise environmental concerns and maintenance expenditure. Specifically, when assessing proposals for subdivision and development the code outlines that DCC will look to:

- Encourage stormwater management methods that mimic natural runoff patterns;
- Protect and enhance riparian vegetation;
- Maintain sufficient water flows for healthy aquatic life;
- Restore any degraded or piped channelled streams;
- Encourage the use of swales within road reserves;
- Promote the use of low impact design for development;
- Consider on site disposal where practicable;
- Encourage the fencing off of stock from water bodies and their margins;
- Promote the use of soft engineering or bioengineering solutions; and
- Avoid straightening of streams.

While it appears that DCC is open to considering the utilisation and enhancement of natural systems for stormwater treatment, further guidance on design and implementation is not currently included in the code. It is yet to be seen whether this will encourage further consideration of LID in the future. However, there are a handful of examples where a low impact approach has been attempted in the recent past, on both brownfield and greenfield sites. Two recent greenfield examples are outlined in the following section and provide an insight into some of the challenges and issues faced in Dunedin.

1.1.2 EXAMPLES

Example 1: Grandvista – Grandvista is a four-stage subdivision development of 174 lots on a greenfield site (approximately 21ha in area). The development of this site was enabled through a private plan change process which changed the land use zone from Rural to Residential 6 (Figure 1). The lower part of the site has an open stream running through it, part of which has been developed into a reserve/recreation area that can also act as a stormwater detention pond and/or artificial wetland (Figure 2).

Initially there was resistance from the developer to improve the quality of reserve planting and adequately plant-out the stream banks with appropriate vegetation. Lack of budget was the main issue as some of the planting was considered to be over and above minimum requirements. However, DCC saw this as an opportunity to both incentivise and encourage integrated management of this area. WWS worked with CARS to advise and assist the developer with this and contributed funds for enabling this part of the site to be developed as per CARS requirements.

WWS also took the opportunity to use this site as a pilot study to monitor the effectiveness of planting to control stormwater quality and quantity; and represent a Dunedin-specific 'flagship' site for an integrated and sustainable approach to stormwater management; and be used as an example in future promotional material. A sign is currently being designed to erect at the site to heighten awareness and education within the local community. The sign will outline the purpose of the collaborative approach and demonstrate how the design and vegetation is intended to assist with stormwater management.

Figure 1: Grandvista Site

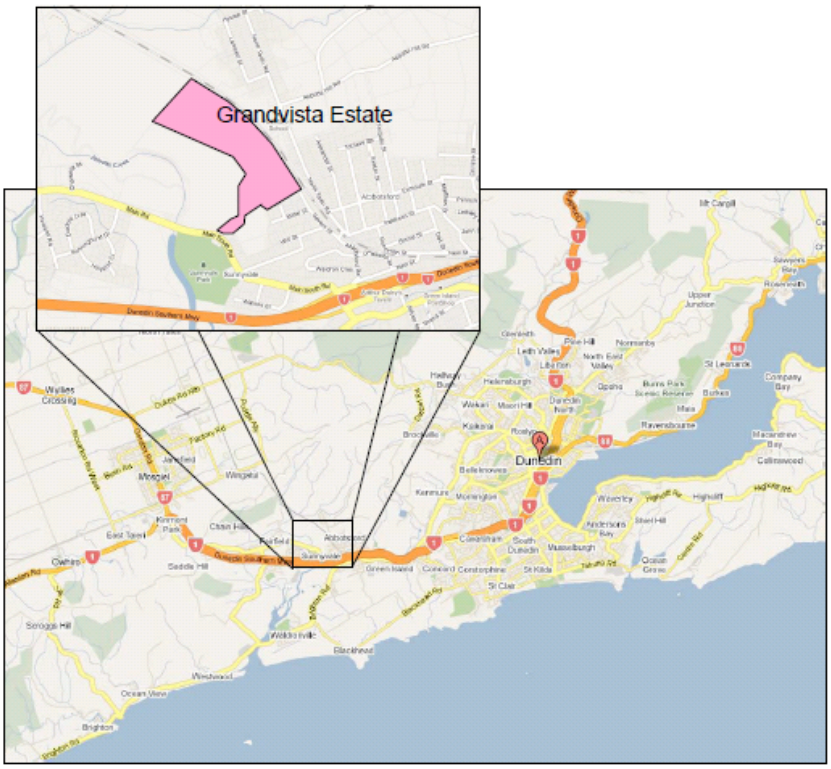

Figure 2: Planted Stormwater Retention Area

Example 2: Silver Springs – Silver Springs is a three stage subdivision development on a greenfield site (totalling approximately 61ha) (Figure 3). This development was enabled through a plan change process initiated by DCC, which changed the zoning of land in this area (known as the Mosgiel East Area) from Rural to Residential 1. The area being developed is on flat land with an underlying geology predominantly consisting of gravels. It is located adjacent to a significant watercourse in Dunedin known as the Silver Stream, in an area where there are historic flooding issues. The proposal for Stage 1 comprised of approximately 47 residential lots ranging in size from 717m^2 to 1010m^2 (Figure 3).

Figure 3: Silver Springs site

The Mosgiel East Structure Plan was developed for this area and was one of the first Structure Plans completed in Dunedin. With any subdivision proposal for this site, the District Plan directs DCC to consider the extent to which the subdivision is consistent with the Structure Plan. With respect to stormwater, the Structure Plan outlines both requirements and recommendations for design and management. The

'recommended' design elements allow for some flexibility in design, while ensuring that subdivision contributes to the efficient development and amenity of the Structure Plan area. An example of the stormwater quantity and quality requirements applicable to Silver Springs is as follows:

- *Local stormwater reticulation systems shall be designed for a 1 in 10 average recurrence interval event (as per existing design standards)*

- *The Structure Plan recognises that the development of Mosgiel East will increase stormwater runoff and requires developments at Mosgiel East to retain stormwater on-site for later discharge when the Silverstream's capacity permits*

- *Stormwater retention/detention measures shall be provided on-site as part of the overall development. The rate of stormwater discharge to the Silverstream shall remain equal to or less than that of pre-development up to the 1 in 100 average recurrence interval event.*

- *The discharge of stormwater shall not degrade the quality of the receiving environment. Stormwater is required to meet the Regional Plan: Water for Otago permitted activity discharge requirements.*

The Structure Plan also states that subdivision and land use applications should include information outlining:

- *the techniques to be used to manage stormwater and the extent to which these techniques are accommodated on site; and*
- *how the integrity of the stormwater mitigation and management measures will not be compromised during and after subdivision; and*
- *actions to be taken to ensure the on-going management and maintenance of on-site mitigation measures and the responsibilities for this; and*
- *design details highlighting the adequacy of the proposed measures and identifying areas of greatest risk.*

Although not a requirement, the Structure Plan recommends that stormwater management could include the use of techniques such as swales, rain gardens, permeable paving, and retention/detention areas. Subsequently, the applicant's proposal to manage stormwater for Silver Springs differs from the usual practice for residential development, whereby all stormwater will be directed to groundwater by infiltration via on-site stormwater devices. Extensive investigations by the applicant and consultants were carried out to determine the viability of such an approach. These investigations demonstrated that several lots have stormwater managed in this way, subject to DCC's approval. Consent for this was granted in 2008, with clear requirements for the developer to ensure that information is available to each individual lot owner regarding the ownership and maintenance requirements for the on-site stormwater devices. Opinion is still varied on whether this set-up will be successfully maintained over the long-term.

Further to this, the applicant challenged the requirement to pay development contributions given that the stormwater from the subdivision is to be managed via on-site soakage systems, with no connection being made to the available stormwater network outlined in the DCC Development Contributions Policy. An assessment verified that no development contribution was applicable because the developer is providing the required infrastructure through an alternative stormwater management system. Given that this situation is provided for in the Policy, it was determined that the Council need not require the relevant contribution. This, however, was not necessarily an ideal outcome given that DCC had recently invested in stormwater infrastructure upgrades with the justification and intention of seeking contributions from such developments.

1.2 GROWTH AND AFFORDABILITY

Although the examples above are from greenfield sites, there have also been attempts to apply low impact principles to infill development. Overall, however, the approach has been fairly adhoc in terms of implementation and success. With a lack of over-arching policy and a truly coordinated approach to

stormwater management across Dunedin, it could be perceived that staff and the development community are not yet well prepared or resourced for truly low impact approaches to become a serious alternative to traditional solutions. But are they actually viable in Dunedin anyway?

Dunedin's early history of rapid growth means that, without careful management and forward planning, large amounts of infrastructure will require renewal in a small amount of time. However, historic underfunding of depreciation has left the need for considerable capital investment in water, wastewater and stormwater over the next 20 years. As Dunedin currently faces relatively slow population growth over the next 50 years, there is a moderate to high risk that level of service will be compromised in order to maintain current affordability.

With a forecast for slow population growth, most of Dunedin's future development is likely to be infill/intensification. Sunk infrastructure costs and imminent affordability issues suggest that utilising existing network capacity is an obvious priority. This situation does not lend itself particularly well to justifying the construction of new low impact design solutions in brownfield areas. Where there are system capacity issues, investigations have shown that there do not appear to be any 'quick wins' in many areas and further work is required to determine the most cost effective way to alleviate capacity problems. Subsequently, there is no immediate incentive to encourage actions such as wide-scale stormwater harvesting to solve system capacity issues.

Greenfield development has largely been provided for by stormwater network upgrades funded partly through development contributions, with no real incentive for engineering design to incorporate alternative approaches. Similarly it could be argued that there is no justified need for low impact design when the scale of development in Dunedin is relatively small and the costs are perceived to outweigh the benefits, which are currently perceived amongst several stakeholders in Dunedin to be unproven. It is apparent that any such initiatives would need to be carefully balanced against the social and economic aspects of sustainability. Understanding whole of life costs for low impact design solutions is fundamental to this and equally so for valuation, renewals forecasting and future funding provisions.

Overall, the current situation in Dunedin does not appear to generate a strong driver for low impact design solutions. From both a quantity and quality management perspective, LID is not currently actively encouraged, or sought, as a serious alternative to traditional solutions. However, it is worth noting here that development of the 'next generation' of Otago's Regional Plan for Water is gradually gaining momentum. Coupled with recent and extensive work undertaken to understand the receiving environment (and more specifically the CMA), there appears to be an underlying suggestion that this will change. While the rate and form of development do not seem to generate a strong driver or capacity for LID, the next section shows that Dunedin's social and cultural characteristics appear to encourage it, with expectations for improvements in stormwater management.

2 THE EMERGING SITUATION

2.1 STRATEGIC DIRECTION

Approximately four years ago a proposal was progressed within DCC WWS which saw the start of some significant changes in the approach to planning and delivery of water, wastewater, stormwater services; as well as the team and staffing structure required to enable such changes. The intention of the proposal was to establish a framework that supported an integrated approach to the management and delivery of the three-waters services. A comprehensive 3 Waters Strategy Project commenced in conjunction with project partners Opus and URS. This involved three phases:

Phase 1 - Development of strategic level hydraulic models for water and wastewater to allow the identification of capital and operational investment needs at a macro level.

Phase 2 - Further development of the hydraulic models to determine capital and operational needs at a catchment or zonal level. A linked 1 and 2-dimensional hydrological and hydraulic model of each stormwater catchment and network was developed.

Phase 3 - Implementation of capital and operational works programmes to realise the required level of service improvements.

At the same time, a short-fall in strategic planning capabilities was recognised and it became apparent that DCC needed to develop a set of guiding principles and priorities for use in operational, tactical and strategic decision making. It was this realisation that initiated the development of the 3 Waters Strategic Direction Statement (2010-2060). Adopted in 2010, the 3 Waters Strategic Direction Statement (3WSDS) outlines the principles, priorities and planning assumptions that will underpin decisions regarding three-waters infrastructure planning and service delivery in Dunedin for the next 50 years.

Through the 3WSDS development process, a comprehensive stakeholder engagement exercise was carried out via a series of workshops, involving a variety of stakeholders to help identify areas of concern and relative priorities from a community perspective, as well as within the DCC. The principles identified as being important foundations to future decision-making for stormwater management included: Flexibility, encouraging desired behaviour change, using all the resources in the system, universal responsibility, integration, and consultation.

There was a general recognition that stormwater requirements and standards will need to increase in terms of both quality and volume management. A coordinated approach to stormwater management between ORC and DCC was also desired; with the responsibilities for each organisation being clarified. Increasing the sustainability and efficiency of the network long-term was also a key objective considered necessary by all stakeholders. The main views expressed through the consultation specific to stormwater management are outlined below:

Views Relating to Quality

- High awareness that stormwater contains many contaminants, and thus its management is not just a matter of transportation to the coast.
- That quality involves household drains and farm run-off as well as road run-off and sewage contamination.
- Recognition that the stormwater system includes recreational areas, which underlines the need for better quality stormwater.
- Improving quality of disposed stormwater is a key issue – the higher the quality, the better.

Views Relating to Volume

- Recognition that climate change may result in more frequent storm events, thus putting a greater episodic demand on the system; and thus likely to require increased capacity. This may be compounded by decreases in permeable land resulting from increased property development in certain areas.
- That managing volumes (which is partially related to quality) requires a more encompassing view of the system and its management.

Outputs from community consultation provided a strong message on the expectations for future stormwater management in Dunedin; and that this could be realised through various avenues:

- **Legislative changes** e.g. changing planning or building consents standards to further reduce the impact of new developments on stormwater;
- **Passive changes** e.g. increasing the use of swales and soak holes to better manage storm events, using landscaping to reduce the visual pollution of outfalls;
- **Active changes** e.g. increasing outfall pipe numbers to reduce the impact in any given area; increasing treatment standards; installing low-flow regulators; Doing more than simply increasing pipe capacity – i.e. review requirements for new property developments, in order to reduce run-off volumes and minimise the loss of permeable land;

- **Consideration of sustainable options** e.g. stormwater captured and used by households; implementing alternative energy sources for pump stations (such as wind turbines or micro hydro-electricity generators). In rural areas, capture stormwater in detention ponds, in order to slow flows and prevent flooding, but also to balance with demand for other water-use activities e.g. irrigation.

Through the 3WSDS, DCC now has clear commitments to improving stormwater management. Wherever possible DCC is committed to resolving stormwater problems at source through educating the community on problem contaminants, and working across Council departments to target catch pit maintenance programs and promote urban planning that incorporates lower impact design and materials. Where stormwater quality is an issue, but control at source is unlikely to be effective, DCC will consider sustainable stormwater treatment.

2.2 INTEGRATED CATCHMENT MANAGEMENT

Through the 3WSDS, DCC is also committed to adopting an integrated approach to management of the three waters and embracing the concept of kaitiakitaka (guardianship, care and wise management). This places emphasis on five key areas:

- Considering activities in the context of the wider water cycle and recognising the inter-relationships between drinking water, wastewater and stormwater.
- Working more closely with other water users to understand potential conflicts and opportunities to make more efficient use of water resources.
- Looking for opportunities to implement strategic 'landscape-scale' sustainable drainage schemes as well as encouraging smaller schemes that service particular homes or developments.
- Working with other stakeholders to simplify management of the three waters activities whilst developing and maintaining an integrated approach.
- Working more effectively across Council departments to align spatial and water planning processes, so that decisions on the type, design and location of new housing can be made with a good understanding of the requirements for new infrastructure.

In conjunction with the above, the technical/modelling outputs from the 3 Waters Strategy Project have provided significant technical input and a good platform for the development of Integrated Catchment Management Plans (ICMPs). The development of such plans has primarily been driven by stormwater discharge consent conditions. There are ten ICMPs in total and each contains a detailed analysis of issues for the development of catchment-specific stormwater management options. Depending on the catchment, there could be several options, which are further evaluated and shortlisted based on a Quadruple Bottom Line criteria matrix. Within the 'environmental' component of this matrix are assessment criteria specific to the use of source control/LID. Viable options are then progressed through to recommendations and categorised into a prioritised programme of capital work options, planning options, further study or operation and maintenance tasks for each catchment. Issues that have been prioritised may include both structural and non-structural options for stormwater management. For example, options range from pipe upgrades, redesigning environment monitoring regimes, development of emergency management plans, compiling inventories of stormwater structures, or simply identifying priority areas for more frequent cleaning and maintenance.

The level of detail specific to low impact options, however, is still very generic. It is clear that there is still a reasonable degree of uncertainty associated with the actual impacts of stormwater discharge quality and what the most cost effective way is to alleviate flooding. As such, many of the recommendations provide only a general directive to, for example: consider the cost/benefit of stormwater quality treatment as part of flood mitigation works where practicable, or: require source control of stormwater contaminants in new development of high contaminant generating land uses.

The detail in approach and subsequent design will be gained through further consultation and input from a variety of stakeholders (internal and external to DCC). WWS staff are currently mapping the next steps for

implementation and further communication with other staff and stakeholders. The current implementation plan recognises the collaborative approach required to give effect to the stormwater management principles and priorities by setting out various key tasks for staff to:

- Use recommendations from ICMPs to develop detailed approach to next steps for managing catchment issues – may include business process, operational, capital requirements and/or identification of further investigations.

- Review existing design standards/code of subdivision to understand current situation for acceptance and implementation of green engineering solutions.

- Review Dunedin context (or specific areas where the opportunity arises) for implementing, managing and maintain low impact/green engineering solutions – includes cost benefit of potential options and identification of barriers to success and/or opportunities for improvements – and prioritisation.

- Assess feasibility of green engineering solutions as part of capital request proposals for storm-water management. Identify opportunities for landscape solutions and sustainable drainage schemes.

- Develop and implement communications plans:

    - to promote awareness of green engineering solutions to those involved in capital project appraisal, design, construction and operations/maintenance (via workshops, training etc).

    - meet with key DCC management/staff to ensure awareness of plans and obtain support for integrated management approach; establish inter-departmental working groups to develop & implement actions where necessary.

    - initiate discussions with ORC & other stakeholders (internal & external to DCC). Recommend establishing a working party for investigations & research & development of DCC Policy/approach to LID/Green Engineering.

    - meet with key stakeholders (includingTe Runaka Otakou representatives) to discuss approach and future requirements regarding consultation and implementation.

- Develop Dunedin-specific resources for the community – may include guidelines and standards.

2.2.1 WILLINGNESS

Seeking a better understanding of the community's willingness to pay is integral to future planning. Through the 3WSDS, DCC is committed to prioritising investment based on the community's willingness to pay for improvements and what they are willing to sacrifice as a result. Stormwater discharges were identified as a particular priority for the public (amongst others) and planned improvements will therefore progress in this area.

However, with the increasing costs to maintain existing service levels, and the potential costs associated with meeting the strategic challenges, trade offs will need to be made to limit the costs to ratepayers. DCC plan to conduct comprehensive consultation on customer's willingness to pay for further service improvements in these and other areas, as well as looking for areas where customers may accept lower service levels to manage cost increases. Scenarios will be analysed and presented, comparing different investment decisions and level of service impacts across all three waters; including low impact solutions versus traditional approaches. Once completed, the feedback from this consultation will also be used to prioritise investment accordingly.

There are several areas where support from the Regional Council for a co-ordinated approach to stormwater management would benefit the community; as indeed would a co-ordinated approach within the Dunedin City Council. This has started to gain some momentum more recently, with DCC WWS staff liaising with the ORC on developing and implementing a sediment and erosion control training programme in Dunedin. While still early days (at the time of writing), there is definite support for ensuring a coordinated approach between Councils.

Other emerging changes within the DCC are also starting to provide momentum for an integrated approach. A recent restructure of the planning department resulted in an Urban Design team being integrated with planning and policy teams to comprise the City Development department. Staff within this department have recently commenced the development of a Spatial Plan for Dunedin. The Spatial Plan will set the strategic direction for Dunedin's growth and development for the next 30 years by outlining a broad set of principles and objectives and visually illustrating how the City may develop in the future. It is intended that the Spatial Plan will be used to guide land use planning in the city, alongside how future infrastructure and services may be provided. Findings from the 3 Waters Strategy Project and guidance from the 3WSDS and ICMPs will be integral to the development of the Spatial Plan.

2.2.2 WHAT ARE THE CHALLENGES?

While it seems there may be some change slowly beginning to take place in Dunedin, there are still several challenges that need to be worked through. Examples of these are outlined below:

External & Internal Drivers - It appears that there are limited drivers for requiring, constructing and maintaining low impact design infrastructure in Dunedin. Dunedin's limited projected growth does not naturally provide economic drivers to promote low impact/environmental initiatives that reduce demand on stormwater services. Using existing piped network capacity should therefore be a preference. Greenfield areas have the potential to incorporate LID solutions, but regulatory and other internal drivers are not currently strong, which creates uncertainty for how Council as a whole intends to approach the development, design, ownership and maintenance aspects of such solutions.

Affordability - Questions remain as to the benefits versus the upfront and ongoing costs to clearly justify or support implementation of LID approaches. A true understanding of net present value and life-cycle analysis is required to clearly determine the long-term asset management needs. While there are examples of costs and benefits throughout New Zealand, there is yet to be a detailed analysis carried out that uses Dunedin-specific case studies. Uncertainty in the benefits, coupled with current economic and financial limitations, seems to discourage acceptance of this approach as a viable option for consideration. Understanding the merits and associated life-cycle costs of these alternatives is required and this is perhaps the next step in Dunedin's journey.

Staff buy-in - The above understanding also needs to occur in conjunction with an underlying interest (and driver) before any wide-scale shift in preference occurs. The current limitations apparent in organisational and departmental drivers have arguably influenced staff perspectives and acceptance of LID options.

Status Quo preference - Traditional engineering approaches to collecting and conveying stormwater remain dominant in Dunedin but anecdotal evidence suggests that this is because there has not been any local 'tried and tested' examples that would help promote or justify preference for other low impact approaches.

Resources – capabilities and expertise: while there are numerous sources of process and design information now available on the internet, there does not currently exist any Dunedin-specific material that can be provided to staff, developers, surveyors and the like. The current challenges with growth, affordability and staff buy-in also mean that the focus on staff training on LID approaches is not a priority, hence staff awareness, expertise and capacity is not currently provided for to enable a sustained approach to LID alternatives for stormwater management.

A need for integration - The well reported silo mentality of local authorities can also be perceived as a limiting factor to a coordinated approach across the DCC. WWS recognise the importance of taking a more pro-active approach to ensure that ongoing liaison across the Council is maintained to enable informed and integrated decisions to be made. Who (or which department) should actually take the lead for the DCC, remains undecided.

3 CONCLUSIONS

Developing and implementing LID approaches in Dunedin could potentially be realised in the near future. Emerging approaches to integrated planning within the DCC, coupled with community expectations, are providing momentum for more focus to be placed on the consideration of LID approaches to land development and stormwater management. However, the immediate gap that needs to be filled is that of an over-arching policy to provide guidance to decision-making and the framework for a coordinated approach. Costs, benefits and affordability remain the key areas where there are currently more questions than answers and further understanding of this seems necessary before any long-term approach to LID is established and adopted.

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