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## Beacon Pathway Submission to the Christchurch City Council District Plan Review

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### What is Beacon?

Beacon Pathway Incorporated aims to transform New Zealand's homes and neighbourhoods to be high performing, adaptable, resilient and affordable. Beacon has extensive experience in demonstration projects, a sound base of robust research and a collaborative approach to creating change. A number of Beacon's tools, developed through earlier research and projects, have the potential to contribute to the redevelopment of Christchurch.

In the post Canterbury rebuild, Beacon has been active in:

- **demonstrating the opportunity to rebuild and repair Christchurch housing to a higher level of performance with two projects.**
  - Build Back Smarter. Beacon (with support from Council along with CAFE, EECA, Fletcher Building and the Ministry for Science and Innovation) initiated a project to demonstrate that performance upgrades can and should be included alongside earthquake repairs. Upgrades include: insulation in walls, ceiling and underfloor, efficient space and water heating, energy efficient lighting, double glazed windows, rainwater collection and re-use. Build Back Smarter has effectively demonstrated that such improvements can be carried out at same time as repairs and they do not delay the repair process. We are now working with key agencies and industry to see this model adopted.
  - The High Performance House at HIVE. Beacon project managed the design, construction and demonstration of an innovative show home at the HIVE Home Innovation Village. The house showcases a new technology, Warmframe, which allows speedy accurate offsite construction and very high performance, and is a collaborative project from five industry partners (NZ Steel, Fletcher Aluminium, Frametek-RFS, InsulPro and Resene). It was awarded an 8 star design rating by Homestar.
- **advocating for wall insulation at time of repair.** Beacon strongly advocated alongside EECA, Council and MBIE for EQC to change their repair policy and allow homeowners to retrofit wall insulation at time of repair. Beacon prepared a fact bank on wall insulation and provided evidence to support wall insulation retrofit.
- **Demonstrating that in the rebuild programme that the residential construction sector can deliver high performance smaller houses for Canterbury residents via off site manufacture.** At only 100m<sup>2</sup>, the HIVE High Performance House was built off-site in 10

weeks and demonstrated that there are realistic, attractive alternatives to the current market model.

- **initiating projects which will deliver to meet 21st century housing needs in Christchurch.** Beacon, along with Christchurch City Council and MBIE, facilitated the scoping of the ‘Breathe – a New Urban Village’ project, contributed to the technical working group and assisted in securing industry funding for stage 2 of the competition.
- **actively participating in the Canterbury Sustainable Homes Working party.** Beacon has been working with this group to advocate for regulatory interventions in the Land Use Recovery Plan which will result in more resilient housing which meets future needs.

Beacon’s Members include: Christchurch City Council, EECA, New Zealand Steel, Fletcher Aluminium, Certified Builders, Resene and InsulPro Manufacturing.

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## Contents

What is Beacon?.....	1
1. Beacon’s perspective on the draft District Plan Chapters.....	3
2. Beacon’s comments on the draft District Plan Chapters .....	5
2.1 Draft Strategic Directions Chapter .....	5
2.2 Draft Transport Chapter.....	6
2.3 Draft Subdivision and Development Chapter .....	7
2.4 Draft Residential Chapter .....	8
3. Beacon Resources .....	17
3.1 Neighbourhoods.....	17
3.2 Homes .....	18
3.3 Expertise .....	19
Appendix Two: Covenants affecting affordability.....	20
Appendix Three: Regulating for supplementary water supply in Christchurch.....	21

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## 1. Beacon's perspective on the draft District Plan Chapters

Beacon congratulates Christchurch City Council on updating its first tranche of reviewed District Plan chapters. Beacon acknowledges the scale of the task ahead rebuilding Christchurch but also recognises that this is likely to be New Zealand's only opportunity to **create a truly 21st century city**. The District Plan is a critical tool in the reshaping of the City. It must direct the step changes required to deliver on the vision for the City

### ***1.1 Step change needed to achieve vision - there are smarter way of doing things than just fixing up the existing***

A 21st century Christchurch cannot be delivered by just fixing existing infrastructure and delivering business as usual. Climate change strategies, a move to a low carbon future, improved community resilience and other aspects of 21st century sustainability, backed by a range of innovative strategic and policy approaches, actions and delivery must underpin the District Plan. This needs to include not only a demand management approach to the management of natural resources but also opportunities for diversity of supply - water, energy and localised waste management.

The challenge is large - it's not just about rebuilding the city, it is about building the 21st century Christchurch that is resilient in the face of challenges of natural disasters, climate change and reducing resource availability. The challenge to build resilient cities that are great places to live work and play, is a national challenge - Christchurch City needs to show leadership, but so too must central government, the financial and insurance sectors and the building and construction sector. Beacon will continue to support Christchurch City in these endeavours by working collaboratively across the sector to raise issues and facilitate pathways to address the challenges. A key component of achieving this vision is improving Christchurch's housing stock and developing high performing neighbourhoods.

### ***1.2 Quality, well-designed homes and neighbourhoods underpin Christchurch's pathway to a more liveable city***

Beacon supports the realisation of a quality compact city with intensification around transport hubs. This will require an urban design framework with a strong emphasis on resilience, low impact design, demand management and diversity of infrastructure supply. In Beacon's view, quality, sustainable and affordable housing and neighbourhoods are fundamental to a world class city.

Council has a key role in building strong, resilient communities where residents feel a sense of belonging to their neighbourhoods and take pride in their region. Beacon believes Council must work closely with communities to ensure the design and function of local places (dwellings, neighbourhoods and connecting infrastructure such as roads and parks) meets the needs of local communities.

Beacon proposes its Neighbourhood Sustainability Framework and Assessment Kit as a robust evidence-based tool for Christchurch City Council to use in developing more sustainable neighbourhoods. See [Appendix One: Beacon Resources](#).

Beacon has identified a number of areas where Christchurch City Council could successfully encourage the upgrade of existing housing stock to be better performing:

- Employment of two Eco Design Advisors to provide independent, whole of house advice on retrofit options available to people. We consider this to be a high priority and urgent action as homeowners in Christchurch are in desperate need of high quality independent advice on how to improve the performance of their homes.
- New high performing homes and neighbourhoods need to be built, not more of the same poor performing new build homes and developments. To do this, Council needs to encourage medium density development in the CBD rather than the current unsustainable growth on the urban fringe. Breathe – the New Urban Village project is a fabulous initiative to stimulate development of inner city homes and neighbourhoods. Where it is necessary to build on the urban fringe, Council must take steps to facilitate the development of more sustainable housing by:
  - Ensuring all subdivisions orientate sites for maximum solar gain.
  - Incentivising developers to remove covenants which:
    - restrict the use of off-site house manufacture and limit the re-use of modern houses from within the red zone
    - require minimum house sizes which effectively block many red zone homeowners from being able to afford to rebuild in many parts of Christchurch. We refer you to the research that has been done on this significant problem by the Canterbury Sustainable Homes Working Party attached at [Appendix Two: Covenants affecting affordability](#).
- Incentivising developers to include rainwater capture/re-use, lowering the demand on Christchurch's already stressed water infrastructure and making better use of what nature provides.
- Aligning Council infrastructure policies and practices to better support on site supplementary water supply systems. We refer you to the value case for supplementary rainwater supply developed by the Canterbury Sustainable Homes Working Party attached at [Appendix Three: Regulating for supplementary water supply in Christchurch](#).

### **1.3 Council is a key player determining Christchurch's housing outcomes**

Beacon's research shows that councils that want to successfully promote more sustainable homes can make it easier for homeowners to build and retrofit more sustainable homes. In partnership with councils, Beacon has developed a Resource Manual to support improved housing outcomes (see [Appendix One: Beacon Resources](#)) and has expertise in this area. In particular:

- Council can take a leadership role in providing demonstrations of high performing neighbourhoods and homes.
- Infrastructure is a major cost to Council. Council must focus on demand management, resilience, and creating an enabling environment for innovative solutions including localised and diverse networks for all infrastructure – roading, waters, energy. Involving communities in such design and decision making can also help to change behaviour.
- Council strategies, policies and plans particularly influence the design of neighbourhood and need to take full account of climate change, reducing reliance on fossil fuels and other aspects of resilience and sustainability such as demand management, local sourcing and local initiatives.

#### **1.4 Importance of demonstration projects**

There is a need for simple, free and independent whole of house advice early in people's build/rebuild planning, and exemplars of best-practice neighbourhoods and high performing new homes. Exemplars are needed as quickly as possible, to demonstrate what can and should be being achieved. Beacon congratulates Christchurch City Council for its involvement in a number of projects including those listed below; however, more is needed.

- Breathe - a design competition leading to an exemplar inner city medium density neighbourhood development
- Build Back Smarter – examples of how to improve the performance of homes as part of the repair of earthquake damage
- Development of a high performing exemplar house on the HIVE site.

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## **2. Beacon's comments on the draft District Plan Chapters**

Beacon supports the general direction of Christchurch City Council's reviewed District Plan Chapters. The District Plan is a key component in delivering high performing, affordable homes and neighbourhoods, within the Council's goal of a compact urban form.

### **2.1 Draft Strategic Directions Chapter**

Beacon supports the general direction of the Strategic Directions Chapter and makes the following specific comments:

#### **Section 3.4 Key issues and opportunities**

- **3.4.1.1 Housing.** Beacon submits that, in addition to being *affordable, warm, dry and secure*, housing must be high performing. Affordability must be considered in its broadest sense - housing performance cannot be disassociated from other household costs such as

transport, health and economic wellbeing. Less expensive areas for housing, for example, tend to be on the city fringe where household costs most often include significant transport prices in order to generate income to pay for housing and other household costs.

- **3.4.1.5 Infrastructure.** Beacon supports the recognition that *The pattern of urban development can have a significant effect on the costs of providing and operating infrastructure such as water reticulation, waste water collection, stormwater systems and the transport network.* Planning for urban development must address opportunities for localised systems and methods of reducing the load on existing systems e.g. use of rainwater tanks.
- **3.4.3 - Improving the quality of the urban environment.** Beacon supports an emphasis on good urban design.
- **3.4.4.1 Water supply** - Beacon supports the sustainable management of the City's drinking water supplies. This must include the use of localised water capture for non-potable uses.

### **Section 3.5 Strategic directions for the district**

- **3.5.2 Providing for recovery and growth** - Beacon supports the general provisions of the Land Use Recovery Plan and Chapter 6 to the Canterbury Regional Policy Statement including:
  - Focussing development on the existing urban areas (3.5.2.1) including increasing residential density, particularly in the central city and around other key centres
  - Reconfirming Christchurch's strong central city (3.5.2.2) alongside a network of complementary suburban centres
  - Ensuring the district has a range and choice of housing (3.5.2.3) providing for the diverse housing needs of residents including opportunities for mixed-use developments and redevelopment of brownfield sites in suitable locations. This must allow for households with a range of incomes and lifestyles to live in each area, thus increasing local vitality economically as well as environmentally and socially.

## **2.2 Draft Transport Chapter**

As part of developing a compact, sustainable urban form, Beacon supports the following parts of the draft Transport Chapter.

### **Key objectives:**

- To reduce dependency on private motor vehicles and promote the use of public and active transport.
- To minimise the adverse effects on the environment from the transport network.

### **Options**

- Actions to reduce dependency on private motor vehicles including promoting safe walking, cycling and use of public transport

- Removing minimum carparking requirements from local and neighbourhood centres; and reducing the minimum car parking requirements for some activities, including residential units.
- Increasing provision for cycling and cyclists as part of developments
- Introducing the need for new District Centres to provide public transport facilities / infrastructure.

## 2.3 Draft Subdivision and Development Chapter

Where it is necessary to build on the urban fringe, Council must take steps to facilitate the development of more sustainable subdivisions and housing. If the layout of the subdivision is sub-optimal, no manner of retrofit will fully address the issues. Beacon supports *policy 8.1.2.3 - sustainable design* (below), however this policy must be more strongly drawn through the District Plan rules.

### *8.1.2.3 Policy - Sustainable design*

*Enable resource efficiency, use of renewable energy, and community safety and development, by:*

- 1. ensuring that the streets and lots are orientated for solar gain. □*
- 2. incorporating public spaces that provide opportunities for formal and informal social interaction.*
- 3. accords with Crime Prevention Through Environmental Design principles.*

Beacon submits more sustainable homes and neighbourhoods can be created through, for example:

- Ensuring all subdivisions orientate sites for maximum solar gain.
- Incentivising developers to remove covenants which:
  - restrict the use of off-site house manufacture and limit the re-use of modern houses from within the red zone
  - require minimum house sizes which effectively block many red zone homeowners from being able to afford to rebuild in many parts of Christchurch.
- Aligning Council infrastructure policies and practices to better support on site supplementary water supply systems.



## 2.4 Draft Residential Chapter

### 2.4.1 *High performing homes (both new and existing) are needed*

Much of New Zealand's housing is cold, damp and unhealthy which leads to poor social and health outcomes. In addition, some of the housing built over the past twenty years is poor performing and, at times, not weathertight. It is critical that all new homes built are high performing and that existing homes are brought up to standard. The District Plan has a key role to play in this.

Actions in the District Plan to increase the performance of new homes, including built form standards requiring new residential unit to meet minimum Homestar and Lifemark standards (*14.2.3.14, 14.3.3.11, 14.4.3.7, 14.5.3.8, 14.9.3.17*) are supported. Specifically, Beacon also supports:

- The requirement to meet these standards on all developments from one unit or more
- The development standard process for Homestar and Lifemark provided in Appendix A. This mechanism will help achieve the Homestar and Lifemark outcomes desired by the Council whilst not proving onerous to the development community. Beacon offers support in working through the process of implementing Homestar and Lifemark standards and believes that this may be a useful process to assist other local authorities in implementing Homestar and Lifemark through their District Plans.

Well designed, high performing homes can be achieved with small footprints and Beacon draws the Council's attention to Hobsonville Point Small Home Test Lab ([www.axisseries.co.nz/lab/](http://www.axisseries.co.nz/lab/)) recently launched by the Minister for Housing. The three homes - a 40m<sup>2</sup> 1 bedroom home on an 111m<sup>2</sup> site, a 87m<sup>2</sup> 2 bedroom home (including garage) on a 152m<sup>2</sup> site and a 89m<sup>2</sup> 3 bedroom home on an 185m<sup>2</sup> site - all provide a high degree of indoor and outdoor amenity. Beacon submits that the minimum net floor areas in *14.3.3.13 (Residential Medium Density Zone)* and *14.9.3.16 (New Neighbourhood Zone)* (studio 35m<sup>2</sup>, 1 Bedroom 45m<sup>2</sup>, 2 Bedroom 70m<sup>2</sup>, 3 or more Bedrooms 90m<sup>2</sup>) are unnecessarily large.

In Beacon's view, quality, sustainable and affordable housing and neighbourhoods can underpin much of the progress required to achieve the vision for Christchurch.

### 2.4.2 *Support for compact urban form*

Future development must be well planned and provide high performing neighbourhoods - places where people can work, shop, socialise and live locally, supported by improved public transport and cycle/walkways. A failure to deliver this will mean Cantabrians continue to spend more unproductive, costly time in their motor cars, rather than living close to where they work and leading healthier, happier lives.



Achieving a better urban form will require integrating land use planning with economic development and transport planning, with the land use planning driving the transport planning, not the other way around.

Beacon's research has identified medium density mixed-use as a sustainable neighbourhood form which brings significant benefits to New Zealand cities. The realisation of a quality compact city with intensification around transport hubs will require an urban design framework with a strong emphasis on resilience, low impact design, demand management and diversity of infrastructure supply. Unfortunately, to date, New Zealand has not specifically designed dwellings and neighbourhoods to achieve these benefits. Therefore it is likely that much of the concern raised by residents in relation to increased densities is based on experience of poor design and construction. The opportunity now is to plan, design and retrofit neighbourhoods to realise the liveable city vision. Beacon's Neighbourhood Sustainability Framework and Assessment Kit is a robust evidence-based tool that can usefully guide decision making by Council and others towards achieving improved liveability at the neighbourhood level.

Beacon supports the compact urban form and submits that:

- Actions be undertaken to ensure uptake of brownfields redevelopment.
- Actions be taken to encourage 'refill' development within existing properties, such as secondary suites, secondary dwellings and pocket neighbourhoods, in ways that enable a level of invisible densification and which do not compromise the character and amenity value of existing neighbourhoods. For example, backyards could be amalgamated for development of smaller dwellings along co-housing principles.

Council's needs to take a multi-faceted approach to achieving a compact urban form, both regulatory ensuring the District Plan supports quality and innovation; and in its locality planning, as a repository of best practice information and through demonstrating best practice in partnership with others.

Beacon supports objectives to increase residential densities in Christchurch such as 14.1.3 (a) *Increased density of residential development in and around commercial centres where there is ready access to a wide range of facilities, services, public transport and parks and open spaces;* and (d) *Medium density residential development in suitable brownfield areas and on larger suburban residential sites where external impacts on the surrounding areas can be mitigated.*

Beacon believes that there are a number of objectives and policies which are counter to developing a compact urban form which require revision such as 14.1.3 (b) *Limited additional infill housing in other existing suburban areas to maintain a low density, open and landscaped environment;* These suburbs are likely to better served with amenities for increased densities than development on the periphery of the city.

14.1.1.1 Policy 1 *Ensure: (c) Low and medium density residential development in greenfield neighbourhoods that achieves a net density of 15 households per hectare*; - Beacon submits this is a very low density and will lead to more unnecessary urban sprawl

### **2.4.3 Increasing supply of housing**

The District Plan focuses on increasing housing supply by providing both brownfields and new greenfields development. Beacon has raised the importance of brownfields development as a source of land for new housing, and draws Christchurch City Council's attention to overseas development examples providing additional homes (both rental and home ownership), as detailed below. In some cases these are already being enabled in the draft District Plan.

- Beacon supports *14.2.2.1 Permitted Activities - Residential Suburban Zone - P13 Conversion of a residential unit within or as an extension to a residential unit into two* as a way of providing affordable housing and, in some cases, to cater for changing needs of households. Similar conversion for both rental and home ownership are being encouraged in other cities with successful outcome, for example

- the City of Langford, Canada

<http://www.cityoflangford.ca/EN/meta/departments/building-department/secondary-suites.html>

- the City of Victoria, Canada

<http://www.victoria.ca/EN/main/departments/planning-development/development-services/zoning.html>.

As an example, the house (right), in Victoria, Canada, has been converted to strata title with three homes, yet remains unchanged from a street perspective.



***Conversion of home into three homes with strata title, City of Victoria, Canada***

- *14.2.2.1 Permitted Activities - Residential Suburban Zone P15* allows a minor residential unit where the minor unit is a detached building. This provision must be extended to allow for secondary units adjacent to existing dwellings or above garages. The development of minor residential units has been achieved successfully in Portland as the site plan below shows.



***Site Plan for second unit, Portland, Oregon.***

- Beacon also supports the redevelopment of existing buildings for mixed use purposes that also provide for increased residences. In downtown Victoria, Canada, Victorian buildings have been seismically strengthened and redeveloped for residential purposes. In some cases, penthouse suites have been added unobtrusively, set back from the road (see below).



***Redevelopment of downtown building for residential, Victoria, Canada***



- Beacon supports the subdivision of larger sites in order to provide additional dwellings with smaller footprints. In the inner suburbs of Victoria, larger sites have been rezoned for 2 smaller dwellings that are built in a form in keeping with the existing neighbourhood as the photograph below shows.



***Development of smaller dwellings in keeping with existing neighbourhood, Victoria, Canada***

Beacon submits that the Christchurch City Council investigate statutory and non-statutory methods to encourage such developments so that density is increased less visibly, local businesses and services benefit from higher concentrations of people and the city's foot print does not extend.

#### **2.4.4 Support diversity of development opportunities**

Beacon supports 14.1.1 *An increased supply and wide range of housing types, sizes, and densities, to meet the diverse needs of the community.* These houses need to be high performing and be affordable in terms of ongoing living costs such as transportation and running costs.

A key aspect of this is integrating a mixture of scale. Rules such as 14.3.3.13 and 14.9.3.16 are a critical way of achieving diversity in terms of size *Where 6 or more residential units are proposed as part of a multi-unit residential complex, there shall be a mix of at least two unit size types ranging across 1, 2, 3 or more bedrooms. No unit size type shall account for more than two thirds of the overall number of units on a site.*

Examples of where diverse developments have been successfully implemented are shown in the following photographs.



***Integration of a mix of scale - West Hills, City of Langford, Canada***

***Integration of a mix of scale - Dockside Green, Victoria, BC***



#### **2.4.5 Support high performing neighbourhoods**

For communities to become stronger, more resilient, and better able to meet their needs, so that Christchurch becomes a better place to live, work and play, Council and communities must work together to ensure the design and function of local places (dwellings, neighbourhoods and connecting infrastructure such as roads and parks) meets the needs of local communities. The Council also has the opportunity to be an enabler of quality and affordable housing and neighbourhoods, creating exemplar, mixed-use, medium density developments as part of the redevelopment of council-owned facilities. Beacon submits that:

- Planning for neighbourhoods needs to take a bottom up, community-led approach. It must be collaborative, including people from all walks of life. Seattle's Department of Neighbourhoods (<http://www.seattle.gov/neighborhoods/npa/>) provides a useful model for neighbourhood planning. The inclusion of communities at the neighbourhood level is often left out of development aspirations, planning and delivery when the local lived experience offers significant insights as to what might be most effective in achieving a high level of liveability in each particular place.
- In new developments, much of the infrastructure needs to be provided prior to new population growth, rather than after people have come. In many cases, there is an existing population in these areas and their lived experience and aspirations can be useful in determining local priorities and effective additions to social amenities. Processes of bottom up planning such as those developed in the US for example (<http://www.theatlanticcities.com/neighborhoods/2012/12/how-hud-went-hyper-local/4074/> and spoken about by Jim Diers on recent tours to NZ) illustrate the value of actively including existing residents in greenfield, brownfield and infill/refill development. Bottom up neighbourhood plans identify neighbourhood assets, opportunities and needs so great places to live, work and play are developed. More locally, Hobsonville Point provides an example of where provision of infrastructure has led population growth (<http://www.hobsonvillepoint.co.nz/>)



High performing neighbourhoods must be supported by appropriate non-residential activities e.g. childcare, schools, medical, places of worship. In several places, residential activities are co-located with community facilities such as the Delridge library and Delridge Arts and Cultural Center, both in Seattle, for example.

***Co-location of community activities and residential, Delridge Library, Seattle***

More policy direction is needed on neighbourhoods offering choices for households on low to moderate incomes e.g. how the mix will be provided; otherwise, the current trend towards exclusion of lower cost housing will continue.



**2.4.6 Provide for affordable housing**

The lack of affordable housing is already having a range of adverse environmental, economic and social outcomes. This includes overcrowding of housing, reduced home ownership; uncertainty in rental occupation; increased community instability; long-term costs associated with housing needs post retirement, people having to live further from work, activities increasing transport costs; and increased costs of living flowing into higher costs for businesses. Housing affordability must be addressed within neighbourhoods, not just across the region. There needs to be a broader range of housing types and costs within suburbs.

Beacon proposes that Christchurch City Council looks to successful models of US Pacific Rim cities where cities have developed funding mechanisms to leverage the development of affordable housing either through the proposed value capture mechanism above, or a targeted rate of all households for a period of ten years to build up an affordable housing fund.

**2.4.7 Sustainability and sustainable design**

Infrastructure is a major cost to Council. The District Plan must enable and encourage demand management, resilience, and creating an enabling environment for innovative solutions including localised and diverse networks for all infrastructure – roading, waters, energy. Involving communities in such design and decision making can also help to change user behaviour to impact positively on the effectiveness of hard infrastructure at both a neighbourhood and regional level.

Beacon recognises that the Christchurch District Plan builds on other Council and Christchurch policy, which details sustainability; however, Beacon recommends that issues of sustainability be strengthened in the District plan, for example:



- Encouraging local energy generation, water capture and stormwater/wastewater disposal, either at an individual property or neighbourhood level. For example, a neighbourhood energy utility system provides space heating and hot water to new buildings in Southeast False Creek, Vancouver <http://vancouver.ca/home-property-development/neighbourhood-energy-utility.aspx>
- That policies and related rules be strengthened to include avoiding the adverse effects of climate change.
- Mitigating the adverse effects of climate change by waste minimisation initiatives to reduce the amount of waste going to landfills and energy consumption associated with transport of waste. This must focus on minimising the amount of waste created, not just waste going to landfill. Waste minimisation must be considered as part of development and well as in the ongoing use of buildings.
- Water - the capture and reuse of rainwater must be supported by objectives, policies and rules in the District Plan, other than just in Banks Peninsula (14.1.7). Currently there appears to be little allowing people to have a supplementary water supply with rainwater tanks. Beacon has done extensive work on the benefits to local government of demand management – including cost benefits and value analysis. Beacon draws Christchurch City Council’s attention to the reports *Slowing The Flow – A Comprehensive Demand Management Framework for Reticulated Water Supply*; and *Water Demand Management: An Economic Framework to Value* [www.beaconpathway.co.nz/further-research/article/reports\\_and\\_presentations\\_water](http://www.beaconpathway.co.nz/further-research/article/reports_and_presentations_water) ) as sources of information around best practice demand management approaches.
- Mechanisms should be included in the District Plan to ensure that a greater level of sustainability e.g. provision for their own energy, heat, cooling and water needs is integrated within all new and existing developments, either at a house and neighbourhood level. One way of achieving this is through a renewable energy policy requiring a certain percentage of any new developments to offset their carbon footprint through renewable energy provision on site (following the Merton Rule example from the UK<sup>1</sup>).
- Sustainable design is also about enabling community and neighbourhood involvement with a bottom up planning process. Beacon recommends that the Council work through key neighbourhoods in further developing the draft District Plan.

#### **2.4.8 Support for Maori development including papakāinga housing**

Beacon supports activities to enable the development of papakāinga within the Canterbury area. An enabling process must be developed for papakāinga housing, which takes a holistic approach including:

- Where appropriate, allowing activities that enable people to support themselves financially.

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*1 For more information please see ‘The Merton Rule, A review of the practical, environmental and economic effects’ available from [www.nhbcfoundation.org](http://www.nhbcfoundation.org)*

- Providing for communal facilities and activities where planned by whānau e.g. meeting spaces, communal provision of facilities such as laundry, kitchen, bathroom rather than individual provision in homes.
- Encouraging and enabling sustainable design such as local water and waste water systems and energy generation.
- Allowing densities to meet the need of whānau within sustainable design principles.

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### 3. Beacon Resources

A summary of the key programmes of work undertaken by Beacon which could assist Christchurch City Council is provided in this section. Further details are available free of charge on the Beacon website [www.beaconpathway.co.nz](http://www.beaconpathway.co.nz) or through contacting Beacon directly.

#### 3.1 Neighbourhoods

##### ***Neighbourhood Sustainability Framework and Assessment Kit***

Neighbourhoods are important because the way they are laid out and organised has significant impacts on how a home performs and on the direct, as well as indirect, costs to households.

Beacon's Neighbourhood research team has developed a framework and tools to measure the sustainability of New Zealand neighbourhoods - *The Neighbourhood Sustainability Framework and Assessment Kit*.

This research indicates that the neighbourhood scale presents opportunities for:

- House retrofit
- New design and construction awareness/desirability
- Distributed reticulation systems – electricity and water
- Improved stormwater management
- Improved connectivity and mixed use
- Reduced transport costs
- Community inclusion and leadership, including bottom-up planning.

The Kit is available free to help planners, designers, neighbourhood managers and developers identify, discuss and prioritise changes to improve the sustainability of both new and existing neighbourhoods. This is currently being updated. Please contact Beacon for further details.

##### ***The value of neighbourhoods***

Beacon's research has identified that low density non-mixed use (e.g. neighbourhood that are almost entirely residential) generate net costs rather than net benefits for a city. As a corollary, mixed use, medium density neighbourhoods are of value to cities, socially, economically and environmentally. Research which awarded monetary values to different neighbourhoods

showed that a sustainable neighbourhood is worth \$1,362 per household compared to a negative value of \$595 per household for NZ's least sustainable neighbourhoods.

Find out more at

[www.beaconpathway.co.nz/images/uploads/Final\\_Report\\_NH3112\(2\)\\_Valuing\\_neighbourhoods.pdf](http://www.beaconpathway.co.nz/images/uploads/Final_Report_NH3112(2)_Valuing_neighbourhoods.pdf)

## 3.2 Homes

### ***HSS High Standard of Sustainability®***

New Zealand homes can and should perform better. Homes that perform well have benefits that go beyond direct financial savings; they benefit the whole economy, local council budgets, and, most importantly, families.

A sustainable home is the sum of its parts. Beacon's focus is on whole-of-house sustainability - encompassing energy, water, indoor environment, waste and material/product selection. This focus is reflected in our work on a set of performance benchmarks to achieve a sustainable home - the HSS High Standard of Sustainability®.

See

[www.beaconpathway.co.nz/being-homesmart/article/beacons\\_hss\\_high\\_standard\\_of\\_sustainability](http://www.beaconpathway.co.nz/being-homesmart/article/beacons_hss_high_standard_of_sustainability)

### ***Policy Options for Sustainable Homes – A resource manual for local government***

Beacon Pathway has conducted research into the council-induced barriers to building and renovating homes to a high standard of sustainability. The research found that policy and regulatory barriers to sustainable building choices exist in:

- administering the Building Act and Building Code
- inflexible conventional infrastructure standards (particularly for water)
- District Plan provisions that provide no allowance for sustainable designs such as passive solar orientation or features such as rainwater tanks (e.g. traditional development controls for height, yards, and height-in-relation-to-boundary).

Beacon research has shown that councils throughout New Zealand have developed a range of initiatives to encourage people to make more sustainable choices in their homes and neighbourhoods, and are seeing some good results. The resource manual of policy options for councils provides an overview of the range of tools available to councils, and gives detailed examples of policies and practices already in place in New Zealand.

Download the Manual from

[www.beaconpathway.co.nz/further-research/article/a\\_resource\\_manual\\_for\\_local\\_government](http://www.beaconpathway.co.nz/further-research/article/a_resource_manual_for_local_government)

### **National Value Case**

Beacon's *National Value Case for Sustainable Housing Innovations* showed that there were clear national benefits to encouraging housing improvements on a wider scale. In particular, it showed the economic value to New Zealand of:

- A direct private economic gain to households of 1% GDP (\$2 billion in 2007 \$ terms).
- Savings in household energy consumption of 22PJ/year with reduction of CO<sub>2</sub> emissions of 3600kt/year.
- Direct water savings of 130 million m<sup>3</sup>/year.

### **Renovation and job creation**

Beacon research, supplied to the Job Summit 2009, established the value to the nation of large-scale home renovation by illustrating that housing is a critical part of urban infrastructure and that renovation is a viable source of job creation. *Large scale renovation is BIG on job creation* showed that for every 1,000 houses retrofitted to perform to Beacon's HSS®, a total of 392 full time equivalent jobs are required.

See [www.beaconpathway.co.nz/further-research/article/large\\_scale\\_renovation\\_creates\\_jobs](http://www.beaconpathway.co.nz/further-research/article/large_scale_renovation_creates_jobs)

### **Water demand management**

Beacon's water research has demonstrated the value of a demand management approach and provided a framework for councils considering instituting it. *Slowing the Flow: A Demand Management Framework* is a guide to the development of water demand management strategies and policies for all those working in reticulated water supply.

Beacon's research has also developed a comprehensive approach to valuing council implementation of water demand management. A case study of Tauranga City Council's demand management measures showed that the Council delayed the implementation of the next major water supply infrastructure by approximately 10 years with a net benefit to the community of \$53.3 million in 2009 terms.

See [www.beaconpathway.co.nz/further-research/article/reports\\_and\\_presentations\\_water](http://www.beaconpathway.co.nz/further-research/article/reports_and_presentations_water)

## **3.3 Expertise**

Beacon Pathway has considerable expertise and networks in the sustainability of New Zealand homes and neighbourhoods, has viewed best practice overseas, and has worked extensively with local councils. We welcome the opportunity to further discuss how we can help Christchurch City Council.

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## Appendix Two: Covenants affecting affordability



# COVENANTS AFFECTING AFFORDABILITY

**Although there is demand for affordable housing, it's getting harder to find a site to build a modest home. In Christchurch, for example, restrictions by developers on house size are leaving some red zone residents unable to afford replacement housing.**

By Lois Easton, Beacon Pathway, Tricia Austin, The University of Auckland, and David Hattam, Selwyn District Council

**A**s a result of the Canterbury earthquakes, over 10,000 dwellings are being demolished, with 5,100 homeowners from the red zone areas alone potentially seeking new land to build their replacement home on.

Many affected homeowners are from the lower property value eastern suburbs of Christchurch or lower property value areas such as Kaiapoi. Alongside the lower property values, many of the affected households are on low or fixed incomes, meaning that affordability of replacement housing is a critical issue.

## Older houses more modest

A range of factors affect the affordability of housing, many of them canvassed in the Productivity Commission's *Housing Affordability Inquiry, March 2012 Report*. However, a fundamental factor not considered in any detail by the Commission is dwelling size.

The Department of Building and Housing advises that the average cost per square metre of new house construction in Christchurch is between \$1618/m<sup>2</sup> and \$1778/m<sup>2</sup>. Based on their estimates, a house of 150 m<sup>2</sup> will cost an average estimated \$266,700 to build, and a 200 m<sup>2</sup> house will cost \$323,600 to build.

The floor area of most houses in the worst-affected areas of Christchurch is considerably smaller than many of today's new homes. Many households are receiving payouts for their homes and land around \$300,000.

Inevitably, affected homeowners will be looking to rebuild on land they can afford, with a more modest dwelling size than usually found in many new subdivisions today. With an average cost of \$160,000 for a section in Rolleston and using one of the cheaper home builders, it would be possible to build a smaller – for example, 110 m<sup>2</sup> – house in Rolleston, with a \$300,000 payout.

## Developers imposing larger houses

New house sizes have increased substantially over the past few decades, increasing by 50% in the last 25 years from 134 m<sup>2</sup> to 209 m<sup>2</sup>.

There is a range of reasons for this, but a significant contributor is the increasingly common use by land developers of minimum house size covenants on lots created during subdivision.

Research recently undertaken by David Hattam of Selwyn District Council and John Raven of Lincoln University looked at the prevalence of restrictive covenants in the Canterbury township of Rolleston. They found that 75% of new house sites created in the township had a restrictive



Affordability and covenants are issues as homeowners in Christchurch with damaged modest older houses look to new subdivisions to rebuild.

covenant requiring a minimum house size of at least 160 m<sup>2</sup>, with a typical requirement being 180 m<sup>2</sup>, and 25% of sections had a requirement of a minimum house size of 200 m<sup>2</sup>.

Even for the 25% of sections where there were no explicit size controls, almost all required house designs to be approved by the developer – with houses greater than 180 m<sup>2</sup> predominating in these subdivisions. Only 3% of sections created since 1990 had no minimum size covenants.

## Affordable options not possible

Terraced houses and medium-density development are often proposed as a mechanism to provide for more affordable housing and better housing choice – with smaller sites and smaller footprints available for development. In Christchurch, Hattam and Raven noted that what has resulted instead are 200 m<sup>2</sup> 2-storey houses with very small gardens because developers have squeezed the same sized house on a smaller section.

Just as significantly, where small lots of around 350 m<sup>2</sup> were created, the minimum house size was often 160 m<sup>2</sup>, showing that reducing section size does not necessarily provide new housing choices.



An alternative response for addressing housing construction costs is to design more flexible housing, starting with a relatively small central unit, enabling the owner to add additional rooms if needed and as resources allow. While this might be beneficial to households in Christchurch, it would also be impossible if a covenant required a minimum dwelling size.

It's worth noting that the cost of raw land is typically less than 20% of the cost of a section, so reductions in section size – without reductions in house size – do not result in significant increases in affordability. For instance, in Rolleston, the cost of a half-size 350 m<sup>2</sup> section is usually only around \$20,000 less than that of a full-size section.

### Covenants are a nationwide issue

Some researchers have recognised the use of restrictive covenants by developers as a widespread problem across New Zealand. It hasn't been dealt with because:

- regulation of covenants has been considered too difficult by many councils since they are imposed after the council has signed off the titles
- under the Resource Management Act, there is no mechanism available for councils to address this issue
- conditions on a subdivision consent could specify no covenants, but this would have to be put on a consent notice at the time of issue of title and the covenants would be put on at the same time.
- developers can put in place agreements with land purchasers – a group builder, for example – separate to the title.

### Local planning legislation needed to over-ride covenants

As with many affordability issues, the problem is a well recognised one overseas. In Australia and the United States, most states and territories have addressed this issue specifically in local planning legislation.

In New South Wales, for example, the Environmental Planning and Assessment Act 1979 specifically enables environmental planning instruments to over-ride restrictive covenants. This is the kind of mechanism needed by, but not currently available to New Zealand local governments working under the Resource Management Act.

The best way to provide houses that are more affordable is to make them cheaper to build, and the easiest way to do this is to make them smaller. The prevalent development paradigm denies people the choice to build a house that would suit their needs.

### Action needed in Christchurch

The government has acted to free up land, ostensibly to make sure that houses are provided for the people of Christchurch. Yet the developers of that land continue to impose covenants that allow only very large houses to be built, which will not address the needs of many of the people displaced from their homes.

While reforming the Resource Management Act to enable district plans to over-ride covenants might be something for the long term, the rebuild of Christchurch may require more immediate action. Special powers enabling the district plan to over-ride residential covenants could enable local Cantabrians to remain living in the region, without destroying the residential amenity that no doubt covenants were put in place to protect. ■

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## **Appendix Three: Regulating for supplementary water supply in Christchurch**

## Canterbury Sustainable Homes Working Party – Regulation

### Regulating for supplementary water supply (rainwater tanks) in new and rebuilt homes in greater Christchurch

#### Goal

The goal is to have greater resilience, reduced water demand in summer and mitigation of storm water runoff during rain events through the installation of rainwater tanks in all new homes and rebuilds following the earthquakes in greater Christchurch.

#### Method

The preferred method is through using s27<sup>1</sup> of the CER Act 2011 to instigate Plan Changes in the CCC, SDC and WDC District Plans.

Plan change 75 for the Kapiti Coast District Plan provides guidance for this process.<sup>2</sup>

#### Rationale

The Canterbury earthquakes disrupted the reticulated supply of water through damage to reservoirs, pumping stations and pipes. Some residents were without water for many weeks, and were reliant on bottled water, tanker supplies or neighbour's private wells

While more than eighty percent of the Christchurch water supply was restored within two weeks of the February earthquake, boil-water notices remained in place citywide until April 2011, due to the risk of cross-contamination from broken pipe works. Shortly after the 22 February earthquake, chlorine was introduced to the water supply to address potential contamination issues, and remained until December 2011.

Experience in Christchurch suggests that current UN-based recommendations of 3 litres of water per person per day, to meet water needs in a disaster situation, may fall well below the actual needs of an urban population. The CDEM Wellington Emergency Preparedness guide (December 2010) suggests 3 litres per person to meet daily drinking needs, and more for cooking, hygiene and pet care<sup>3</sup>.

In Christchurch City in summer 2011/12 level 3 restrictions were imposed because of the reduced storage in the water supply system.

If more homes had rainwater tanks they would have had access to an emergency supply, particularly for non-potable purposes such as clothes washing or garden watering, and there would have been reduced demand on the Councils' supplies.

Significant construction cost savings (up to 50%) can be realised by installing the rainwater tank and dual plumbing systems in new 'greenfield' developments (and new homes) compared to retrofitting existing 'brownfield' areas<sup>4</sup> (or retrofitting in existing homes).

Ministry of Health guidelines indicate that only about five litres per person per day (l/p/d) needs to be biologically and chemically safe. Average domestic water use is about 300-350 l/p/d – all of which is currently cleaned to a potable standard. Clothes and cars are washed, toilets flushed and gardens watered with high quality drinking water. Using rainwater for some of these activities would reduce the demand on potable water.

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<sup>1</sup> S27 (1) The Minister may, by public notice, suspend, amend, or revoke the whole or any part of the following, so far as they relate to any area within greater Christchurch: (a) an RMA document

<sup>2</sup> <http://www.kapiticoast.govt.nz/Documents/Downloads/District%20Plan%20Changes/Plan-change-75-Commissioners-Report.pdf>

<sup>3</sup> Moore, R.M. and Abbott, S 2011. *Benefits of Rainwater Tanks in the Event of Damage to Centralised Water Supplies in the Wellington Region*. Report to the Institute of Geological & Nuclear Sciences Ltd. (Contract No: C05X0907)

<sup>4</sup> Kettle, D. March 2010. Barriers to Water Demand Management: health, infrastructure and maintenance. Report WA7060/6 for Beacon Pathway Limited.

Putting in place legislation requiring rainwater tanks homes being built or rebuilt will incorporate resilience for the future.

- This is already signalled in the Christchurch City Council's Water Supply Strategy as Action 12, scheduled for 2014/15<sup>5</sup>.
- In the Waimakariri District Council Water Conservation Strategy<sup>6</sup> rainwater collection and reuse is recognised as a way to reduce peak water demand, but regulatory measures will be reviewed in the 2013 review of the strategy.
- Selwyn District Council has no specific reference to domestic rainwater collection in their five-water strategy.

### Definition

Rainwater harvesting involves the collection, storage and distribution of rainwater from the roof, for use inside and outside the home. Rainwater collected from the roof via gutters and pipes flows through screening devices to remove dirt and debris, and is then stored in tanks outside the house for use in the garden, toilet and laundry. The reticulated supply would still be used for drinking, cooking and other potable purposes.

Each rain tank can save a home about 50% in terms of their water usage when rainwater is re-used for the laundry use and toilet.<sup>7</sup>



### Benefits

- An invaluable alternative water supply when a disaster damages the reticulated system
- Reduces the demand for water from the main water supply
  - Reduces the extraction from groundwater
  - Reduces householders dependence on mains water
  - Offers more resilience when water restrictions are in place
- Reduces costs in the delivery of reticulated water supply, e.g. pipe size, reservoirs, energy costs
  - Avoids oversizing of water supply network and associated costs inefficiencies
  - Can delay capital works
  - Reduced energy costs in embodied energy of infrastructure, operational costs of treatment and pumping,
  - Lower households water bills (if water is charged for by volume)
- Reduced storm water runoff
  - Prevents the impact of storm water run-off on the local environment
  - Reduces peak flow in storm water system
- Education and awareness
  - On site systems give timely feedback to the householder on water consumption increasing awareness about the limits of water availability and cost of infrastructure/maintenance<sup>8</sup>
  - Householders have increased control over their water source
  - Rain tanks are part of a broader societal shift towards more eco-friendly behaviour and tanks facilitate a transition to more sustainable values and behaviours.

<sup>5</sup> Action 12 in <http://resources.ccc.govt.nz/files/WaterSupplyStrategy2009Full.pdf>

<sup>6</sup> [http://www.waimakariri.govt.nz/Libraries/Public\\_Documents/Water\\_Conervation\\_Strategy\\_-\\_June\\_2010\\_-\\_Final.sflb.ashx](http://www.waimakariri.govt.nz/Libraries/Public_Documents/Water_Conervation_Strategy_-_June_2010_-_Final.sflb.ashx)

<sup>7</sup> <http://www.waitakere.govt.nz/AbtCnl/to/pdf/brochure-rainwatertanksintheurbanarea.pdf>

<sup>8</sup> Presentation - Sustainable water supply for Auckland – Craig Brown Consulting – 5 February 2010  
[www.thesustainabilitysociety.org.nz/docs/Forum-20-Brown.ppt](http://www.thesustainabilitysociety.org.nz/docs/Forum-20-Brown.ppt)

If the councils introduced a volumetric charge on domestic water supply the financial benefits would be higher.

### Costs

- Costs vary with the amount of rainwater to be stored and its intended uses.
- Tank prices plus the cost of installation and additional fittings

Rainwater tanks as a water efficiency mechanism are frequently cited as being high cost for the benefits compared with other technology – these calculations need to be checked that operational costs and life cycle benefits are included; benefits to storm water/wastewater systems are accounted for; and assumptions on treatment standards/equipment are realistic and practical.

### Barriers

Some health regulators believe that health risks are manageable for rainwater use as a non-potable water use. In New Zealand, at present, some health authorities believe that if water tanks are properly installed, labelled and maintained, they are safe to use for non-potable use - flushing toilets, laundry and garden use<sup>9</sup>.

### Regulatory Mechanisms

- The Resource Management Act 1991 (RMA)
  - Regional Policy Statement (RPS) - identify that District Plans of Territorial Authorities should make provision for the mandatory inclusion of rain tanks as a 'rule'. A Section 32 cost benefit analysis and public notification would be required with a public consultation process under the RMA.
  - Regional Plans – the Canterbury Land and Water Plan (replacing the NRRP)
  - District Plan - Plan Change to include policies and a rule around the requirement for rainwater tanks. This process would require a Section 32 cost-benefit analysis to be undertaken.
- The Local Government Act 2002
  - A territorial authority must, from time to time, assess the provision within its district of water services and other sanitary services. An assessment may be included in the territorial authority's long-term plan, but, if it is not, the territorial authority must adopt the assessment using the special consultative procedure
  - If this assessment signals the need for water conservation to avoid or push out further infrastructure development then such measures can be considered under the Long Term Plan (LTP) and considerably shorten the public consultation process required for inclusion in the District Plan.
  - A council can pass a bylaw requiring a supplementary water supply for new houses

The preferred method is through using s27<sup>10</sup> of the CER Act 2011 to instigate Plan Changes in the CCC, SDC and WDC District Plans.

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<sup>9</sup> Kettle, D. March 2010. Barriers to Water Demand Management: health, infrastructure and maintenance. Report WA7060/6 for Beacon Pathway Limited.

<sup>10</sup> S27 (1) The Minister may, by public notice, suspend, amend, or revoke the whole or any part of the following, so far as they relate to any area within greater Christchurch: (a) an RMA document

## Appendix 1: Key regulatory processes to influence uptake of rain tanks<sup>11</sup>

Process	Scale of Influence	Likely Timeline	Priority	Likelihood of success
<b>District Plan Changes</b>	Local	2-3 years but would benefit from RPS or other policy work to set the scene	High	Success would require education and good consultation
<b>Regional Policy Statement</b>	Canterbury Region	Would take several years to be given effect to and filter through to implementation	Medium	Medium to high, needs good collaboration with ECan
<b>Regional Plans – NRRP and Land and Water Regional Plan</b>	Canterbury Region	Planning process just beginning	Low	Medium to high, needs good collaboration with ECan
<b>Building Code</b>	National	12+ months	Low	High but entirely dependent on involvement in code review and degree of interaction with DBH.
<b>Bylaw</b>	Local	6 month process	Medium	Medium – needs support from council to recognise a problem and begin bylaw-making process.

## Appendix 2: Rainwater tanks as part of integrated water management

The increasing cost and decreasing availability of water supply will require a more efficient and conservation-oriented supply and management approach if New Zealand is to achieve widespread household sustainability. Rainwater tanks need to be considered as part of a larger water management system:

- **Reduce** water use: demand management
  - Cheapest, but not sufficient in context of increasing population
  - Cost savings (energy and infrastructure)
  - Delays upgrading and renewing water supply and wastewater collection/treatment infrastructure
- **Reuse** water with minimal treatment, locally
  - Greywater recycling
    - Reduces base wastewater flow
    - Wastewater concentration increases
  - On-site wastewater irrigation
- **Rainwater:** a new source without knock-on infrastructure upgrades
  - Integrated Urban Water Management
- **Recycle:** collect and highly process water before using it again
  - Effectively it is another product

The benefits of an integrated water management system are:

- savings in operational (including electricity) and capital costs required for water supply and wastewater treatment
- increased awareness for consumers of water consumption
- increased provision of indirect use values through the reduction of water taken from ecosystems

<sup>11</sup> Adapted from Lawton M., Birchfield D. and Kettle, D. (2007) - Making policy and regulation rain tanks friendly. Report PR 205 for Beacon Pathway Limited.  
[http://www.beaconpathway.co.nz/images/uploads/Final\\_Report\\_PR205\\_Making\\_PolicyRegulations\\_Raintank\\_Friendly.pdf](http://www.beaconpathway.co.nz/images/uploads/Final_Report_PR205_Making_PolicyRegulations_Raintank_Friendly.pdf)

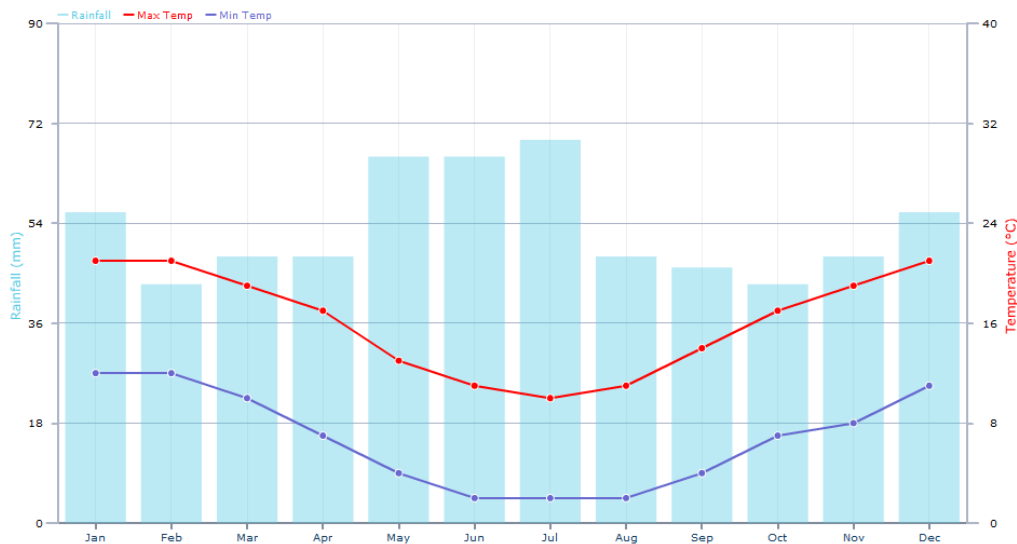
- reduced emissions of greenhouse gases.

### Appendix 3: Example - Kapiti Coast District Council

Kapiti Coast District Council (KCDC) has introduced the mandatory requirement for rain tanks for water conservation as a rule in their District Plan. They did this through their Long Term Council Community Plan (LTCCP), a Section 32 analysis, and a Plan Change notification and consultation process. The rule is triggered when there is an application for land use change or sub-division. In making their case for a plan change the council primarily considered resiliency of their system, especially in the light of climate shocks and water use efficiency, using non-potable water where appropriate. Current water supply can meet potable and hygiene requirements but cannot always supply outdoor needs.

### Appendix 4 : Rainfall and tank sizing

*Figure 1: Christchurch Rainfall*



Total rainfall per year (average) = 637mm

Rainfall varies across the city – wetter in the west, dryer in the east.

Volume available from a 200m<sup>2</sup> roof

$$= 200 \text{ m}^2 \times 0.637 \text{ m}$$

$$= 127.4 \text{ m}^3$$

$$= 127,400 \text{ litres}$$

$$\text{Less } 20\% \approx 100,000 \text{ litres}$$

In Christchurch the water abstraction rate for public supply averages between 430 and 450 l/p/d, with a median of 435 l/p/d. The daily peak in winter is mid-morning, whereas in summer it is in the evening because of garden watering.

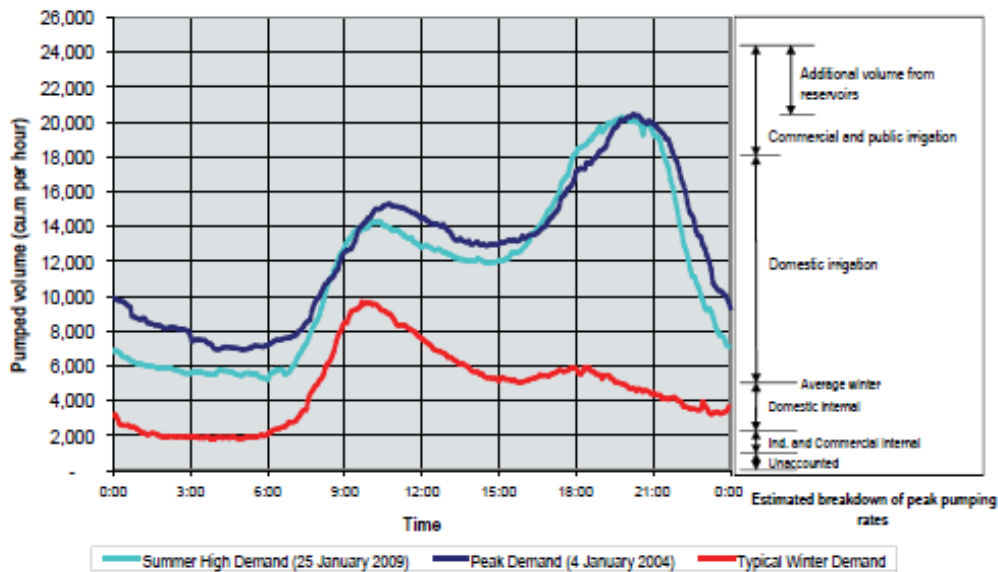


Table 2: Tank sizing

<b>1 Main Building area</b>		
Building width (metres)	10	
Building depth (metres)	8	
Rain Collection Area 1 (square metres)		80
<b>2 Extension/conservatory/porch/garage/shed etc</b>		
width (metres)		
Depth (metres)		
Rain Collection Area 2 (square metres)		0
<b>3 Calculate the area of any remaining useful roofs as a figure</b>		
In square metres and enter directly in the yellow box to the right		
<b>4 TOTAL of collectable roof areas (square metres)</b>		80
<b>5 Rainfall per year in your area (mms)</b>		1251
<b>6 Collectable rainwater per annum (In litres - discounted by 20% to account for water loss) (YIELD)</b>		80,064
<b>7 Use of water in the building</b>		
<i>Washing machine and toilet flushing are the main usage for rain water in domestic systems. Add an allowance for daily garden use</i>		
Number of people in the house	5 people	
Number of clothes washing cycles per day (50 litres each)	1.25	63
Number of toilet flushes per day (4.42 flushes per person, average 3 litres each)	22	66
Outdoor use per day (min 5 litres per person per day)	or adjust till F39 = F29 more or less	
		35
<b>8 Amount of water you require every day</b>		164
Amount of water you require every year (DEMAND)		59,787
<b>9 How many days drought protection do you need? Enter a number in the box to the right, typically 28</b>		28
<b>10 Capacity of water storage in litres required for drought protection</b>		4,586
The lesser of YIELD (6) or DEMAND (8) per annum		59,787
Therefore, volume of rainwater storage required (litres)		4,586