SUMMARY

Purpose of report

This report is written for CERA, other decision-makers and the Christchurch community at large. It is designed to address the urgent need for timely, research-based ideas and policy suggestions to inform pragmatic action steps to regenerate Christchurch. The report is based on the ideas developed by approximately 100 researchers, scientists and policy advisers at a workshop held on 28 April 2011 in Christchurch.

Key recommendations for consideration and action

1 *Articulate a fresh, shared vision – a regenerated Christchurch as a carbon-neutral, sustainable city.* While the need to get Christchurch fully operating is pressing, all cities face significant risks posed by climate change and oil vulnerability. To make Christchurch resilient to natural and economic shocks, we recommend that CERA articulate the vision and benefits for regenerating Christchurch as a model carbon-neutral and sustainable city; and develop a set of core design principles for redevelopment based upon this aim.

2 *Develop an alliance between researchers, planners and practitioners* to provide leading edge advice and technical input for Christchurch planning, using New Zealand-based, globally-informed research. This could include a multi-disciplinary review group to work alongside, but independent of, CERA, to provide scientific expertise and assist in providing resources for planning and informed community engagement.[1]

Key principles for regenerating Christchurch

1. Plan and manage Christchurch as an urban system, which includes integrated social, economic, cultural and ecological systems.
2. Focus on building social cohesion and engagement. The process through which the city is rebuilt, as much as the outcome of that rebuilding, can enhance or undermine the level and kinds of social cohesion of the Christchurch community. In turn, social cohesion will heavily influence the success of regeneration.
3. Ensure population health has a central focus in redevelopment. Redevelopment could incorporate the six principles for a Healthy City.
4. Work with tāngata whenua to incorporate mātauranga Māori principles of urban design, and actively acknowledge the historical landscape and historical living patterns.
5. Adopt low impact urban design and development (LIUDD) principles[2] to increase green-blue infrastructure resilience, reduce flooding and environmental pollution and provide multifunctional green spaces in the city.
6. Prioritise public and active transport investment, and redevelop suburbs and centres at critical transport and activity nodes and along public transport routes.
7. Ensure new development is resilient against sea level rise and tsunami risk.
8. Because of impacts on harder-hit suburbs, give special consideration to provision of affordable housing to provide security and stability from which the vulnerable can rebuild their lives.

1 Professor Philippa Howden-Chapman, Director, NZ Centre for Sustainable Cities, has agreed to be the first point of contact [philippa.howden-chapman@otago.ac.nz; 027 220 1620].

2 LIUDD is a design approach that utilises natural features and resources in partnership with built infrastructure to enhance the efficiency and effectiveness of, and co-benefits from, core services (power, water, waste, open space, urban form).

Key opportunities

1. There is incomplete or partial New Zealand based experience or information in some areas. However international support would be beneficial and is available through the NZ Centre for Sustainable Cities.
2. 'New' approaches require public buy-in. A well-planned information and facilitation strategy incorporating public discussion and input is vital.
3. Reconstruction can strengthen the reputation of Christchurch as an innovative city. Specifically, Christchurch has an opportunity to provide support for (a) start-up businesses, wherever located within the city (we see no case for an 'innovation' zone); (b) a stimulating, attractive living environment that reinforces the development of a thriving, innovative business sector. The adoption of LIUDD and related future-focused approaches would contribute to this reputation.
4. Energy security is now widely seen as critical for sustainability. Transport investments affect energy use, carbon emissions, lifestyles and health Strategic choices such as to invest in a public transport system or a motorway have enormous and often 'locked in" impacts over time. Christchurch has the window of opportunity to transform its transport and urban form systems to reduce carbon emissions and increase energy security.
5. It is crucial that Christchurch revitalizes the CBD to create a critical density of retail, commercial activities as well as cultural amenities. To encourage a variety of people to live in the city it is important to have a variety of housing types. Multi-unit residential redevelopment could achieve desirable density levels without resorting to high-rise apartments.
6. The opportunity for major re-building provides a unique opportunity for installing decentralised energy, local co-generation and micro-generation, and dispersed infrastructure through networked resources of power, water and sewerage. Decentralised infrastructure would be more resilient and more appropriate for a low carbon future.
7. Christchurch's wastewater system, based on a linear system with heavy, deep infrastructure and a single central processing facility has not performed well during the earthquakes[3]. LIUDD provides a framework for greater decentralisation, lighter infrastructure, and built-in redundancy.

3 New Zealand has not traditionally been in the forefront of wastewater innovation given our low population density, generous water resources and multiple potential receiving environments. This is changing e.g., WETOX (www.viclink.co.nz/success_stories/6), thermal oxidation (www.scionresearch.com/research/sustainable-design/environmental-technologies/biowastes/waste-2-gold) although these technologies still involve centralised systems. Innovation in decentralised systems is stronger in water scarce countries like Australia e.g. Biolytix (http://www.biolytix.com/residential/home/).

BACKGROUND

In response to the November and February earthquakes in Christchurch, the New Zealand Centre for Sustainable Cities and Landcare Research, one of its partner organisations, contacted researchers and scientists with knowledge of urban systems. An agenda for a workshop was set by a well subscribed web-based exercise that ran for a week and was then summarised into ten themes. These themes formed the basis for a 28 April workshop in Christchurch, which was attended by about a 100 people, mainly researchers and scientists, but also Christchurch policy makers (see appendix for list of participants).

The workshop was addressed by several eminent speakers,[4] and participants worked in groups to summarise the knowledge in the agreed themes. Rapporteurs in each group sketched the discussions, which were integrated into this report. This report is designed to help address the urgent need for timely, research-based ideas and policy suggestions to inform pragmatic action steps to regenerate Christchurch. Participants were given an opportunity to provide feedback on the draft report.

The workshop participants stressed the importance of seeing Christchurch as an urban system, which includes integrated social, economic, cultural and ecological systems.[5] They also emphasised the importance of democratic governance, including local democratic accountability and scrutiny, so that local solutions are privileged alongside 'top-down' planning, and can orientate the regeneration process. Reconstruction offers an opportunity to retrofit at lower marginal cost than would otherwise have been the case, as a consequence of major works (e.g. demolition, excavation) being required, regardless of the design option being selected for the replacement infrastructure. However, undertaking the redesign that accompanies a retrofit is a major challenge.

The participants also stressed that as a general planning principle it is important to leave space in networks for improved infrastructure, and we give prominence in this document to the advantages of low-impact urban design and development (LIUDD).[6] Clearly, one of the main contingencies here is the impact of the earthquake after-shocks and the uncertainties of land use, due to liquefaction and the raised water table in Christchurch, but this was not the main area of expertise of scientists gathered at the workshop.[7]

Research regarding the level of impact and disruptions to organisations in the Canterbury region has been ongoing following the 4 September Darfield earthquake. High amounts of liquefaction forced many organisations to close for a significant period of time. Changes in the water table proved to have minor effects for the agricultural sectors, partly due to the timing of the event. However, organisations located within the Red Zone following the 22 February earthquake have been forced to endure extended periods of closure. Meetings between these organisations and the Canterbury Earthquake Recovery Authority (CERA) are being held as part of a consultative approach to recovery.[8]

4 Podcasts by Ian Athfield, architect, Rod Oram, political commentator, Dr Anna Stevenson, public health specialist in Christchurch City Council are available on the NZ Centre for Sustainable Cities website www.sustainablecities.org.nz.

5 See International Council of Science Unions, Asia and Pacific, *Healthy Urban Environments*, 2011 for an exposition of urban systems approach.

6 This point is also made by Dr Arthur Grimes in "Looking forward after the quake", *Motu Economic and Public Policy Research*, 2011, 20, 4-5.

7 Workshop participants identified a number of questions however that needed answers in relation to future land use and infrastructure selection:
- Do infiltration based storm water systems exacerbate risks associated with liquefaction?
- Does further urban development to the west on less confined aquifers carry risks associated with future groundwater quality?
- Do we have adequate geotechnical and groundwater hydrological information to understand the impact of the earthquake on land stability and the confined aquifers and provide a guide for land use and infrastructure selection decisions?
- Do we have adequate coverage of local flood risk modelling and maps i.e. for all relevant water bodies, or just the major ones?

8 Preliminary research results can be found at http://resorgs.org.nz/pubs.shtml

Structure of, and audience for, this report

This report is structured around three high level themes: current knowledge about Christchurch city; decision making and governance; and addressing key issues of the day such as climate change, sustainable urban form, and low impact design and development.

The approach taken includes some references to the relevant literature, but is mainly a summary of knowledge based on expert opinion. The report is written to integrate and summarise the workshop discussions, making use of the wealth of available research identified and information generated by the workshop and subsequent process, so that it is more accessible for CERA and other decision-makers.

The scientists/researchers attending the workshop, including those meeting under the auspices of the New Zealand Centre for Sustainable Cities, see a potential to offer assistance and scientific advice and input into preliminary master plans for the redevelopment of the Christchurch CBD and eastern suburbs, which are due in November 2011.

The workshop considered the possibility of a review group alongside, but outside, the CERA structure. The multi-disciplinary review group would be able to provide scientific expertise and look for ways to provide resources for planning and to improve lines of communication.

MAKING GOOD USE OF RESEARCH KNOWLEDGE

Knowledge about Christchurch and urban sustainability relevant to the 're-creation' process

Christchurch reflects New Zealanders' urban settlement patterns, which are shaped by traditional preferences for personal space, and a tendency to small households and individual living. There were some indications, prior to the earthquake, that this appears to be changing towards a pattern where more urban lifestyles are popular for those without children; higher-density inner city living has strong attractions for some.[9,10,11,12] For these latter groups, the renaissance of Christchurch city is likely to be driven by cultural/artistic and creative developments, as well as employment potential.[13]

Christchurch is currently ranked outside the top 20 innovation cities (www.innovation-cities.com) in the Asia Oceania region (Wellington is 9th, Auckland 10th) despite a recognised cluster of expertise in the electronics industry. Christchurch has good business leadership in high technology, tourism, education and the dairy industry. The Council is financially underpinned by a number of valuable assets including Orion, the local lines company.

Christchurch also has the largest social housing stock in New Zealand, which has been generally well-maintained and enables both local and national government to prioritise equity to promote social inclusion. The earthquakes have most severely affected the eastern suburbs, where there are large numbers of socially disadvantaged people. If the differential effect of the earthquake is not responded to appropriately, there is potential for severe public discord.

There are already a number of pertinent reports on Christchurch. Information on vulnerability of people in Christchurch and socio-economic patterns are available in *The Vulnerability Report*[14] and the 2010 Healthy Christchurch Survey and the City Health Plan.[15] In the past the principle of *Health in all Policies* has been discussed, but the principle has not been central to the planning process; the rebuilding needs to have population health as a more central focus.

Christchurch also has an existing urban development strategy and a city plan, both of which highlight the use of waterways, transport and land-use. Given the impact of liquefaction, there is a need to reconsider the validity of the urban development strategy and the CITY Plan in some areas. Historic pathways and maps may be useful in these decisions.

It is also clear that patterns of development to date have been heavily influenced by rail and road investment, and investment (or lack of it) in walking and cycling facilities. Christchurch still has a high proportion, relative to other New Zealand cities, of cyclists,[16] and – given the advantages of this mode – investment to build on this is warranted. Investment in development at critical transport and activity nodes and along public transport corridors will help to attract economic activity and at the same time is less likely to be stranded in the future by rising oil prices and/or carbon pricing, than investment in highly decentralised locations. Business opportunities need to be identified for more sustainable solutions.

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9 Dixon, J., & Dupuis, A. (2003). Urban intensification in Auckland, New Zealand: A challenge for new urbanism. *Housing Studies*, 18(3), 353-368.

10 Perkins, H., & Thorns, D. (2001). A decade on: reflections on the Resource Management Act 1991 and the practice of urban planning in New Zealand. *Environment and Planning B: Planning and Design, 28*(639-654).

11 Preval, N., Chapman, R., & Howden-Chapman, P. (2010). For whom the city? Housing and locational preferences in New Zealand: Chapter 2. In P. Howden-Chapman, K. Stuart & R. Chapman (Eds.), *Sizing up the City: Urban form and transport in New Zealand*. Wellington: Steele Roberts.

12 Thorns, D. H. (2000). Housing policy in the 1990s -New Zealand a decade of change. *Housing Studies*, 15(1), 129-138.

13 A recent survey of younger people in New Zealand cities found some indications of dislike of apartment living if it had limited access to the outdoors, but the sample was a small, self-selected university-oriented. United Nations Environment Programme. Visions for Change: Country Papers. Paris, UNEP Division of Technology, Industry and Economics, 2011.

14 http://www.nzccss.org.nz/site/page.php?page_id=260

15 *Health in All Policies* has been a work stream for two years. One example of this work, which has been jointly funded by Environment Canterbury, the CCC Partnership and Canterbury District Health Board has involved undertaking health impact assessment (HIA) on regional policies. There are 14 domains in the HIA, which have been the focus of this work and could feed into CERA's work. Further detail will be available on the website http://www.healthychristchurch.org.nz/.

16 Statistics New Zealand. (2008). *Car, bus, bike or train: What were the main means of travel to work?* Wellington: Statistics New Zealand.

A key issue in Christchurch is the changing value of the land and the role of major land holders and developers such as Ngai Tahu, who have been developing greenfield sites such as the 'Wigram Skies' block. This substantial suburban development may meet short-term needs, but is potentially at the expense of a longer-term sustainable urban form for Christchurch. Given what we know about the sustainability of urban form, it is also not clear that other suburban developments around Christchurch have been well planned in terms of longer-term energy use, sea level rise and tsunami risk.

The early estimates of people leaving cities significantly affected by earthquakes tend to be exaggerated – for example, one estimate is that likely population change may be of the order of 1-2%, taking into account Kobe and New Orleans experience.[17] However, the number of after-shocks in Christchurch means than any such estimates may be unreliable.

Lessons from the past and current exemplars

Urban historians have written about the influences, such as "distraction", that lead to the erasure of memories of particular communities and what they have contributed to a vibrant city life.[18] There is a considerable anxiety among Christchurch residents about the loss of familiar community land-marks and in some suburbs, the loss of collective memories as their neighbours are forced to leave. History can also teach us valuable lessons about how to do things better and how to not make the same mistakes when faced with rebuilding or 're-creating' a city following a major disaster.

Although it is logical that one should learn from the way things were done in the past, in practice this is not always so. The September earthquake is an interesting case in point. Following that earthquake, there was initial euphoria ('no casualties'), followed by the need to get practicalities going again (e.g. water, gas, electricity, sewerage). Pretty soon, things seemed to be going back to normal. There was an element of forgetting and also of underestimating the risks of it happening again (e.g. quite a few people only started assembling earthquake emergency kits after the second quake).

How can evidence from the past motivate change? How can it affect people's action preparedness and risk assessments? In general, people's assessments of risks are not always accurate. Especially situations that are extremely rare (as is the case with the occurrence of earthquakes) are more readily susceptible to misperceptions, or cognitive biases, which influence individuals' judgments and decision-making.[19] For instance, individuals have a tendency to think that compared to other people, they are more likely to experience positive events and less likely to experience negative events; this is known as optimism bias.[20,21] Research indicates that people display optimism bias for a range of environmental risks, meaning that adverse consequences from for instance earthquakes, acid rain, and air pollution are considered more likely to happen to other people than to themselves.

To learn from past mistakes, it is important to describe these mistakes. Following the September earthquake, there appeared to be a drive to return to what things were like before the earthquake without a recognition of the potential risks and consequences of future earthquakes. Also, there is not always a clear cut-off point between the 'past' and the 'future', in the sense that the changes that are now happening as a result of the earthquake take place within existing patterns and lifestyles. There can be a tension between a desire for continuity (e.g. wanting to stay in the same neighbourhood) and change of direction (e.g. needing to move away because of liquefaction).

17 Love, T. (2011). *Population movement after natural disasters: a literature review and assessment of Christchurch data.* Wellington: Sapere Research Group.
18 Klein, N.M: *The History of Forgetting: Los Angeles and the erasure of memory.* London, Verso; 2008.
19 Haselton, M. G., Bryant, G. A., Wilke, A., Frederick, D. A., Galperin, A., Frankenhuis, W. E., & Moore, T. (2009). Adaptive rationality: An evolutionary perspective on cognitive bias. *Social Cognition*, 27, 733-763.
20 Harris, P. (1996). Sufficient grounds for optimism?: The relationship between perceived controllability and optimistic bias. *Journal of Social and Clinical Psychology*, 15, 9-52.
21 Pahl, S., Harris, P. R., Todd, H. A., & Rutter, D. R. (2005). Comparative optimism for environmental risks. *Journal of Environmental Psychology*, 25, 1-11.

The important question remains how can knowledge from past experiences be translated into future learnings, and what kind of knowledge is necessary? It is important to look at translational knowledge, and learn from national (e.g., the rebuild of Napier) and international examples (e.g., the rebuilding of San Francisco after the last earth-quake and Toronto's response to disastrous flooding –changing areas prone to flooding to parks). Christchurch can be the model for other NZ cities to change towards a more resilient model in order to withstand natural disasters, which will increase with the increased energy in the system due to climate change.

There are crucial questions of timing. Reconstruction of Christchurch's infrastructure and replacement / re-creation of buildings provides an opportunity to set an international example for disaster recovery, as well as a model for a sustainable city.[22] While the continuing after-shocks provide large uncertainties, the pattern of effects is becoming clearer. Moreover Christchurch has some natural advantages. Apart from a wealth of social capital, the city has the largest stock of social housing in New Zealand. A key decision needed from local and national government is to make use of this stock and prioritise equity to ensure those on low incomes are able to afford to live in the city centre.

There are important opportunities here, in terms of shaping Christchurch in a more resilient and sustainable way. There is a window of opportunity to focus on a more sustainable way of living – people are now talking about sustainability, particularly in the sense of community well-being, much more than before the earthquakes.

Key health and sustainability issues for the future

We know what is required for a healthy city.[23] What is less clear is how we can reconstruct an existing city to achieve those principles.

Key Principles for a Healthy Built Environment[24]

A healthy city has:

- CLEAN WATER: a city-wide supply of potable water and sanitation infrastructure for sewage disposal
- CLEAN AIR: pollution control to bring air quality to WHO standards across the city
- CLEAN LAND: effective decontamination of polluted land in the city and safe waste disposal practices
- SAFE HOMES: housing for all that provides shelter from cold and heat, is adequately ventilated and is supplied with safe appliances for cooking and heating
- CAR-INDEPENDENCE: planning that centres the city around frequent, affordable and accessible public transport and provision for safe walking and cycling
- GREEN AND BLUE SPACES: a city-wide infrastructure of greenery and water features that provide spaces for active mobility, urban climate control, local food supply and mental relief.

However, while health overlaps with and is central to sustainability, building a sustainable Christchurch demands that we take a high-level view of all the key dimensions of sustainability. Towns and cities are crucial sites for addressing climate change, the key environmental issue of our age. Energy security is now also widely seen as critical for sustainability: the International Energy Agency's chief economist has explicitly stated that we are past peak conventional oil[25] and planning for a future city needs to build in energy resilience for economic security. New economic configurations are needed based on a higher value, lower energy economy.

22 One idea discussed at the workshop was the idea of an international design competition to create a general development concept, which could be followed by a competition for the CBD and other zones.
23 Spatial Planning & Health Group, *Steps to Healthy Planning: Proposals for Action*. London: SPHG; 2011.
24 These key principles are highlighted in Rydin, Y. et al. Healthy Cities, *The Lancet*, in press.
25 Birol, F. (2011). *Extended Interview: Dr Fatih Birol; May 2011*: ABC Television.

Cities produce less carbon per person than suburban areas and have the potential to be the generators of "smart growth".[26,27] Of all measures that can be taken to reduce carbon emissions, changes in the built environment usually takes the longest to realise, even in New Zealand, where most building materials are only required to last for 15 years. Green infrastructure systems can bring efficiencies in land use, add amenity benefits, generate public support, and change attitudes to public space by combining functionality and aesthetics. Utilising combinations of existing and new green infrastructure, they can make use of local resources and natural assets and bring a series of co-benefits, including water conservation and improved human and ecosystem health, which need to be taken into account in investment decisions.

Addressing these long-term issues provides a major opportunity to plan Christchurch for the next century. While long-term planning obviously introduces many uncertainties, such as the need to allow for obsolescence as well as innovation, it has the advantages of providing a planning horizon, rather than only short-term direction. It requires a long-term framework of around 50 years, as well as shorter-term objectives and immediate responses. During this time the effects of rising energy prices and climate change will become even more evident. This dual-term focus is a major challenge – to focus on immediate urgent needs, without losing sight of long-term planning.

Ongoing red-zoning of the central business district (CBD) has encouraged the growth of suburban centres, but it is crucial that Christchurch revitalizes the CBD, so that it has a critical density of retail, commercial activities as well as cultural amenities. To encourage a variety of people and populations to live in the city rather than the suburbs, it is important to have a variety of housing types. Christchurch needs more intensive housing, but not necessarily high-rise apartments. Multi-unit residential redevelopment could achieve desirable density levels. Overseas there are good examples of denser housing integrated with greenspace, so that natural systems are woven into the city, creating a "garden city" which generates food within the city and provides place for play. A carbon-neutral city can build in green and productive landscape as well as areas with a compact built form.

Christchurch needs good examples of quality medium density housing, which includes younger and older people.[28] A city of villages could emerge, complementing the more intensively developed central area. It is important to consider framing and language used, e.g. "densification" may not appeal.

It is essential that non-renewable energy is used much more economically, through use of renewable energy and energy efficiency. The opportunity for major re-building provides a unique opportunity for installing decentralised energy, local co-generation and micro-generation, and dispersed infrastructure through networked resources of not only power, but also heat, water and sewerage. Decentralised infrastructure would be more resilient and more appropriate for a low carbon future.

Improving the public transport system is a key way to reduce carbon dioxide emissions and pollution. An improved network that incorporates an integrated transport system is crucial to guide investment. It is also important to promote active modes of travel, which have many health co-benefits, such as less air pollution and less obesity in the population. These are some of the co-benefits of moving to a low carbon economy.

The regenerated Christchurch could be a model, carbon-neutral city.[29] The earthquake recovery provides an opportunity to set a national and international example for disaster recovery, and the creation of a model sustainable city.

26 Howden-Chapman P, Stuart K, Chapman R. (Eds.): *Sizing up the City: urban form and transport in New Zealand*. Wellington: Steele Roberts Publishers; 2010.

27 Calthorpe, P. (2011). *Urbanism in the Age of Climate Change*. Washington, D.C.: Island Press.

28 Perkins, H. *Improving the design, quality and affordability of residential intensification in New Zealand*, forthcoming. (http://www.chranz.co.nz/wip/project35.htm)

29 The term carbon neutral" is used here since cities generally present most opportunities to reduce carbon emissions, but reduction of other emissions such as methane from landfills, and opportunities for carbon removal through tree planting are also valuable.

CURRENT KNOWLEDGE ABOUT LOW-IMPACT URBAN DESIGN AND DEVELOPMENT

Low Impact Urban Design and Development (LIUDD)[30] in New Zealand has been developed to its greatest level of sophistication in urban water management.[31] Christchurch has some of the early leading examples of the approach at different scales – SW Christchurch Area Plan, Papanui stream renewal, Anzac Drive. LIUDD provides another way of thinking about how we accommodate growth, provide infrastructure, develop land, and manage the interaction between the built and natural environments. It provides an integrating framework for design that recognises the value and constraints provided by natural processes and the role they can play in providing multiple outcomes for urban development. At an institutional level it recognises and requires that a range of professional expertise from across traditional divides (roading, water and waste water, storm water, parks, public health etc) is required to inform efficient development and deliver sustainable urban development solutions.

Benefits of a LIUDD approach to Christchurch's recovery planning for built infrastructure are that it would:

- Extend Christchurch's international reputation as a centre of innovation where cutting edge technology is developed and implemented
- Cost-effectively incorporate resilience into Christchurch's infrastructure system through the use of integrated design and complementary network, local and household systems incorporating redundancy or back up capacity.
- Enhance Christchurch's high quality living environment with vibrant, attractive multi-use public spaces
- Develop infrastructure that addresses key dimensions of community health and wellbeing.

Incorporating resilience into Christchurch's infrastructure system

Christchurch's water supply is highly redundant with many wells, a web of interactions and light, shallow infrastructure. It has performed remarkably well in the aftermath of the earthquake. Similarly the electricity supply system has significant redundancy and was able to be reinstated in a temporary form relatively quickly. The wastewater system, on the other hand, is based on a linear system with heavy, deep infrastructure focused on a single central processing facility and has performed rather less well.[32] LIUDD promotes and offers a framework in which to consider options with greater decentralisation, lighter infrastructure, and built-in redundancy using complementary technologies at different scales (at source i.e. household / business, local area, centralized treatment).[33] The use of integrated design and complementary network, local and at-source systems incorporating redundancy (back up) capacity can significantly enhance the resilience of Christchurch's infrastructure systems.

30 LIUDD is both a design approach and a range of structural techniques for urban development that utilises natural features and resources in partnership with built infrastructure to enhance the efficiency and effectiveness of, and co-benefits from, core services (power, water, waste, open space, urban form). LIUDD design emphasizes integration with the local landscape and minimisation of the demand on imported resources. Structural techniques use solar radiation, vegetation, soil, natural drainage and biophysical processes to support the provision of utility services (heating and ventilation, power, water, wastewater management etc), add value through enhancing amenity, habitat, and biodiversity, and minimise the impact of waste and pollutant emissions on receiving environments.

31 Case study portal (http://cs.synergine.com/) developed by Landcare Research, University of Auckland, Auckland Regional Council and Ministry for the Environment. New Zealand LIUDD research resources: Portal to LIUDD research (http://www.landcareresearch.co.nz/research/built/liudd/policy.asp).

32 New Zealand has not traditionally been in the forefront of wastewater innovation given our low population density, generous water resources and multiple potential receiving environments. This is changing e.g., WETOX (www.viclink.co.nz/success_stories/6), thermal oxidation (www.scionresearch.com/research/sustainable-design/environmental-technologies/biowastes/waste-2-gold) although these technologies still involve centralised systems. Innovation in decentralised systems is stronger in water scarce countries like Australia e.g. Biolytix (http://www.biolytix.com/residential/home/) .

33 New Zealand LIUDD planning tools: CCALM – a subcatchment based integrated storm water treatment planning model developed by NIWA and Landcare Research (contact j.moores@niwa.co.nz); CostNZ (http://www.costnz.co.nz) – a web based costing tool based on NZ data to enable comparisons of LIUDD storm water options with conventional options.

Cost-effectively enhancing Christchurch's high quality living environment

Early New Zealand research indicated that consideration of low impact approaches to investment decision making was hindered by the perception that such approaches were 'expensive'. Infrastructure investment analysis is often based on cost effectiveness for a given level of service, but fails to recognize the multiple benefits generated by alternative approaches[34], e.g., increased ground water recharge, improved air quality, enhanced aesthetics, recreation and habitat provision. Optimal investment decisions need to be taken from a 'whole of society, whole of life' perspective.

International[35] and New Zealand research shows (i) that costs of LIUDD approaches can be less than those of conventional approaches in specific contexts and often require less earth works and result in less impervious surface area[36], (ii) that life-cycle costs are sensitive to assumptions about design, life expectancy, maintenance regimes, and discount rate[37], and (iii) the potential for high costs associated with adopting new technologies in design, project management and consultation, although these costs can decline rapidly with experience, revisions of standards and policies, and development of associated support systems and businesses[38]. Recent NZ LIUDD research has developed web-based tools (www.costnz.landcareresearch.co.nz) to assist the evaluation of the cost-effectiveness of LIUDD storm water management approaches.

Developing infrastructure that addresses key dimensions of community health and wellbeing

Reliance on financial analysis of costs and market return generally favours conventional approaches to infrastructure by disregarding environmental externalities. A low-impact approach can result in a range of other benefits – enhanced walkability, improved building performance, reduced flooding, improved water quality, increased ground water recharge, improved air quality, and enhanced aesthetics, recreation and habitat provision. Valuation of these benefits is constrained by attribution and measurement difficulties, as well as by the current relatively low level of adoption; however international studies[39] and data from Auckland, Manukau and North Shore Cities showed positive willingness to pay for environmental amenities[40] and the avoidance of environmental dis-amenities[41]. The economic case for LIUDD is therefore complex. To determine net benefits accurately requires a whole of society, whole of life approach or a range of benefits and costs remain unaccounted for. In New Zealand, tools to support more integrated analysis and decision making have been developed for storm-water and potable water management. Preliminary work has been done on extending these approaches to energy supply, open space and transport infrastructure.

34 Powel LM, Rohr ES, Canes ME, Cornet JL, Dzuray EJ, McDougle LM September 2005. Low-impact development strategies and tools for local governments – Building a business case. LMI Report LID50T1. Available at www.lowimpactdevelopment.org/

35 lidphase2/pubs/LMI%20LID%20Report.pdf [3Feb09].
International LID research resources: US (www.lowimpactdevelopment.org; www.lid-stormwater.net); Australia (www.wsud.org; wsud.melbournewater.com.au);UK (www.ciria.org.uk/suds);Tom Liptan, Bureau of Environmental Services, Portland, Oregon (TomL@bes.ci.portland.or.us).

36 MacMullan, E. and Reich, S. November 2007. The Economics of Low-Impact Development: A Literature Review. Report prepared by ECONorthwest. Available at www.econw.com/reports/ECONorthwest_Low-Impact-Development-Economics-Literature-Review.pdf [3Feb09].

37 Vesely, E-T 2006. Life cycle costing: Addison Development Northern Block. Landcare Research contract report LC0607/059 prepared for Papakura District Council. 45 pp.

38 Vesely E-T, Heijs J, Stumbles C, Kettle D 2005. The economics of low impact stormwater management in practice: Glencourt Place. 4th South Pacific Stormwater Conference on Stormwater and Aquatic Resource Protection NZ Water and Wastes Association, 4–6 May 2005, Auckland. [CDROM].

39 USEPA (United States Environmental Protection Agency, Northeast-Midwest Institute & the Delta Institute) December 2008. Removing market barriers to green development. Available at www.nemw.org/RemovingMarketBarriers2GreenDevReport.pdf [3Feb09].

40 Kerr GN, Sharp BMH 2003. Community mitigation preferences: a choice modelling study of Auckland streams. Research Report No. 256, Agribusiness and Economics Research Unit, Lincoln University.

41 Samarshinge O, Sharp B 2006. Analysing spatial effects in hedonic house price models. Auckland, Department of Economics Working Paper, University of Auckland, 35 p.

Extending Christchurch's international reputation as a centre of innovation

Research is increasingly focusing on a range of 'new' attributes that will determine the success of cities – human and social capital, clusters of related expertise, international connectivity, environmental performance, provision of amenities that hold talented people. The vision of a successful future needs to be built on being a "world class" city. This will include demonstrating cutting edge innovation, vibrant and attractive public spaces and high quality sustainable living environments that attract new technology businesses, capital, and the "creative classes".

Reconstruction capital needs to not just replace what has been lost but also add value to the local economy and community. Specifically Christchurch needs a) a concentration of firms in key commercial area(s) of innovation and b) a stimulating, attractive living environment that reinforces the development of the innovation sector. Reconstruction investment can be used to strengthen the experience and reputation of Christchurch as an innovation city. The adoption of LIUDD and related future-focused approaches to redevelopment will signal that commitment and, when combined with research to evaluate and evolve those approaches, create international interest and profile for the city.

Key LIUDD challenges

A LIUDD approach, given its innovativeness and limited New Zealand experience or information in some areas, would require:

1. Strong collaboration between recovery planners, leading engineering consultancies and researchers (both New Zealand and international). Development of an alliance between recovery planners, researchers, designers, consultants, and international practitioners to provide leading edge advice, technical solutions and support to Christchurch using New Zealand research and case studies complemented by leading international examples would be essential and is feasible (informal offers of international support have already been received) but would need positive, intentional steps to be taken.
2. Consulting on whether LIUDD is an appropriate tool for supporting some of the core principles for redevelopment. Effective communication and advocacy for "new" approaches like LIUDD need a well-planned information and facilitation strategy incorporating public discussion and input. Public interest appears to be supportive (www.shareanidea.org.nz).

GOVERNANCE

The importance of active local democracy & accountability

The workshop noted that when governance arrangements are not clear, there are risks of insufficient transparency, local scrutiny or accountability of decision making, and historical evidence from various jurisdictions suggests that this can be a recipe for non-durable and poor quality decision making.

A critical element in good governance is accountability. This raises questions about how the relationships between CERA and the Minister and the Christchurch city council are to be managed. At present, there is a sense that decision making is disconnected, and overly centralised, and this contributes to the lack of clarity about how the community can best contribute to their own recovery. One participant noted that the only agent required to report to Parliament is the head of CERA; the Minister may be asked questions in the House, but there is no other formal opportunity for scrutiny and accountability. To the extent that City Council are now effectively employees of CERA, and council meetings are often not held in public and have a limited role, there are real risks of poor accountability practice. The recent history of governance in Canterbury reinforces this concern.

Transitional planning issues

While there is a clear recognition of the need to respond quickly, the importance of transparent planning processes and immediate consultation in language that citizens can understand were stressed at the workshop. There is already a considerable amount of activity initiated by the citizens; at the time of the workshop. The Christchurch Earthquake Activity Inventory details 92 communications and initiatives underway in relation to earthquake recovery and rebuilding; many of these were citizen initiated consultation groups and exercises.[42] However, the links with the decision-making structure and CERA are unclear. Previously, the community boards reported directly to the Minister for Christchurch, Gerry Brownlee, but Council staff have been reporting to Civil Defence. There was a strong call for a central repository of information and a communication plan. Council and Community and Regional Health staff have developed an Integrated Recovery Guide, which has a checklist to help with the transition planning process.[43]

It was noted that the knowledge generated by the research and science community, with the exception of geologists and geophysicists, had been largely absent in planning efforts to date. There is an urgent need to identify other areas of specialist knowledge, including the social sciences, so that undesirable trajectories are not locked in. Regular links are needed to maintain communication between research organisations and between research organisations and decision makers at the level both of CERA and local communities. The challenge is to coordinate a process that seriously involves the community in helping to design both a new central city and resilient suburbs. The media have a role to play in communicating progress and outstanding issues.

Sustainable development, taking account of social, environmental, economic and cultural concerns needs to be balanced. A key planning concern should be to take into account the current vulnerability of the population, but also to build on locational and neighbourhood resilience. The ongoing stability of the land is one of the great uncertainties; patterns of land-ownership are crucial.

Planning gain is a relevant concept used in Dutch, Swedish, German models to achieve collective benefit from desired change. This and other tax incentives are frequently used to advance sustainable performance, but given our different institutional environments, this European experience may not be directly transferable. We need to adapt our current policy framework – the Resource Management Act, Building Code, and the broader regulatory environment – but monitor the effects carefully. Property rights currently tend to drive outcomes, but property rights cannot be absolute, as government intervention to declare the unsuitability of

42 Fitt, H. 2011. *Christchurch earthquake activity inventory.* Landcare Research Contract Report LC213, prepared for Landcare Research. http://www.landcareresearch.co.nz/publications/researchpubs/ChristchurchEarthquakeActivityInventory.pdf. See also Magnetic South online futures game as part of the public consultation of the redevelopment of Christchurch see http://foresight.magneticsouth.net.nz/

43 http://www.cph.co.nz/Files/IntegratedRecoveryGuideV2-Jun11.pdf

certain property for ongoing habitation makes clear. We need to work out the possibilities for land-pooling,[44] particularly when ongoing shocks and liquefaction are leading to changing land values across the city. There is considerable interest in land-pooling from indigenous,[45] historical[46] and business perspectives.

The Council's income rating base has also been shattered, which raises the crucial question of who will pay for the building? One possible way is to give land owners shares in new structures or in energy micro-generation and use, so property owners have a greater stake in the new city and get value out of re-development. There is a need to plan now for easements and pathways for future infrastructure and access.

Another consideration is to plan for different population groups in the city. Children and young people want access to outdoors as well as cultural amenities. Older people who may want to come and live in the cities to reduce property maintenance and for security, may also want to be able to bring their pets. It is the quality of life, rather than just material goals that attract high technology people and people with wealth. If Christchurch is to continue as a high technology centre, it is crucial to plan for this infrastructure and the capacity for data-sharing.

Governance and decision-making

Redevelopment in Christchurch requires coordination and positive connections between all levels of governance, from neighbourhood groups, through to the city and regional councils and the central government. There are currently a lot of consultations and conversations happening, but it is unclear how pathways are being established into the institutional structures. Representation between levels and across levels is not guaranteed and the process is reliant on networking and skills in a very stressful situation. Underlying all aspects of process needs to be a respect for identity, respect for the citizen role, wellbeing and the agency of people and groups such as tenants' associations.

CERA, the approved structure, looks like a unitary planning authority/urban development corporation. Unitary planning authorities have been successfully used overseas to deal quickly with significant rebuilds. However, the role of such an organisation is less to facilitate and network, than to drive and implement policies. This makes it susceptible to being captured by vested interests, particularly those who will be paying for a significant proportion of the rebuild.

In recent years Christchurch has significantly reduced the number of democratic representatives at Council and Community Board levels. This has moved Christchurch away from a participatory democratic model. This, combined with centralised aspects, heightens the chances of people becoming disconnected and dissatisfied. Already there is significant dissonance between macro- and micro- levels of thinking and organising. Concerns were also raised that if this model does manage to achieve a rapid rebuild then it may be considered as a model for replacing more democratic structures in times of crisis or when dealing with particularly complex problems.

Internationally, there is a move away from using unitary authorities and urban development authorities. Currently even some of the largest corporations are trying to become more democratic as they recognize the value of engagement and widening the contributors to decision-making. There is a need to be clear about the fundamental models being used. There are other development models besides entrepreneurial and public-private partnership investment models, which tend to give dominant voice to investor stakeholders; different models have different strengths. In general, there is a need for social consequences of investment to be fully taken into account when investments are being appraised – rather than economic dimensions being over-weighted. Moreover, the 'entrepreneurial city' can also be 'the people's city', with high levels of local and place-based input. The tension between models is seen within Ngai Tahu, i.e. the development arm and governance arm, as well as between (and within) layers of government.

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44 http://urban.wikia.com/wiki/Land_pooling

45 Livesey B. Do urban growth strategies support the development of Māori freehold land? In: Stuart K, Thompson-Fawcett M, editors. *Tāone Tupu Ora Indigenous knowledge & sustainable urban design*. Wellington: Steele Roberts Ltd, 2010.

46 In Hong Kong, there is nearly complete government ownership of the underlying land base. The land "business model" is for the government to sell development rights on a long-term lease basis with both up-front and ongoing revenue streams. This model of development has existed in Hong Kong relatively intact, with only some modification to the length of lease terms, since the mid-1800s under British colonialism.

In terms of democratic consultation, (still) required by the Local Government Act, new methods of public consultation can be explored, e.g. new social media and on-line tools can assist in working with the community in suburbs such as Aranui and Lyttleton.

A Genuine Progress Indicator (GPI) approach can help in emphasising and measuring community values and well-being, rather than continuing to privilege one narrow economic dimension, Gross Domestic Product. It has proved a useful and practical tool elsewhere for challenging the dominance of conventional economic concerns.[47] Other recent alternative measurement systems include the OECD's Better Life Index a non-aggregated index system. [48]There are a number of on-line tools and, potentially, an ability for crowd sourcing to contribute. In the Wellington region, a draft GPI report has recently been released which gives a useful view of a range of social and environmental indicators alongside economic indicators, and positive and negative trends across these indicators.[49]

Role of tangata whenua

There was an important discussion at the workshop about the degree to which urban Māori have an active role to play in the rebuild of Christchurch city based on the Treaty of Waitangi principle of partnership. There was a recognition that values are developed in many ways, by sharing both Māori values and western values such as sustainability, biodiversity and ecological restoration.

It is important to find common ground, which makes complex decisions easier to comprehend. It is not about imposing one's values on others, rather it is about respecting and acknowledging each other's values. It is also important to recognise and actively acknowledge the historical landscape, historical living patterns and to remember the lessons from history. This process should be based on a set of underlying principles, preferably a shared set of values.

There is an existing relationship between Christchurch City Council and Mahaanui Kura Taiao. Tangata Whenua is already involved in a Phase One report of the Southwest Area Plan.[50] In addition, there are a number of forthcoming FRST-funded case studies of kaitiakitanga of Urban Settlements research project, which includes Pegasus town, Wigram Development, Lincoln Development and the House of Tahu.

In addition to the Southwest Area Plan, there are a number of Māori planning documents which are available to help guide rebuilding processes.[51]

47 Packard, A., & Chapman, R. (2011). Rethinking Progress: An evaluation of the Wellington Regional Genuine Progress Index. In J. Boston (Ed.), *Ethics and Public Policy: Contemporary Issues*. Wellington: Victoria University Press.

48 OECD Better Life www.oecdbetterlifeindex.org

49 http://www.wrs.govt.nz/genuine_progress_index_9gpi0/index.htm and http://www.stuff.co.nz/dominion-post/news/5199259/A-decade-of-change

50 http://www.ccc.govt.nz/thecouncil/policiesreportsstrategies/areaplans/southwest/whataretheissues/tangatawhenuavalues.aspx

51 Te Aranga Māori Cultural Landscape Strategy; Taone Tupu Ora; Ngā Hua Papakāinga – Papakāinga Design Principles; Tu Tū Whare Ora – Building Capacity for Māori Driven Design in Sustainable Settlement Development; He Rārangi Pukapuka Papakāinga - A Papakāinga Bibliography; Orakei Papakainga; Papakainga Development Guide; Te Keteparaha mo nga Papakāinga - The Māori Housing Toolkit; He Rārangi Pukapuka Papakāinga - A Papakāinga Bibliography; The role of Māori values in Low-impact Urban Design and Development; The Mauri Model; Ki te Hau Kainga: New Perspectives on Maori Housing Solutions. A Design Guide Prepared for Housing New Zealand Corporation.

INNOVATION TO ADDRESS CENTRAL ISSUES

Social Cohesion

Social cohesion is about people and their relationships with each other at all levels: familial, neighbourhood, city wide and national. Existing patterns of social connection, from church groups to neighbourhood associations, together with those that have subsequently emerged, have already provided resources for responding to the September, February and subsequent earthquakes. The process through which the city is rebuilt – as much as the outcome of that rebuilding – can enhance or undermine the level and kinds of social cohesion of the Christchurch community.

There have already been new forms of social media emerging, which have strengthened the response of communities. Groups such as students and farmers have mobilised to assist the worst hit communities. It is important that in future, the urban design process is open to indigenous as well as lay knowledge, and to innovative processes to build social cohesion.

Social inequality is disruptive of social cohesion. Christchurch before the earthquakes was marked by lines of socio-economic difference. The September earthquake struck hardest in the poorer eastern suburbs. The February earthquake further disrupted these suburbs, but also the better off, hill-side suburbs and the central city. The combined results have disrupted the housing, neighbourhoods, jobs and livelihoods of many people throughout the Christchurch urban area.

In terms of rebuilding Christchurch, the focus needs to be first of all on people, attending to their individual and collective voices and meeting their needs. Buildings and city plans are means and not ends. The core issue is how to support the people of Christchurch, at neighbourhood and city level, to work together to plan and implement the reconstruction of their city. So far, working together has built on existing community networks and given rise to new ones, often utilising web sites and other media of communication (although not everyone has ready access to broadband or to newspapers and other media). Crucially, there is a lack of connection between formal and informal citizen networks and those formally charged with overseeing the rebuilding of the city. Community voices need to have a central place in the process of planning and implementing the rebuilding of Christchurch. This has yet to happen.

In the re-generation of Christchurch there is a need to give more detailed consideration of supporting communities, as well people who are at different stages of their life cycle and particularly those on low incomes with little wealth or assets. There is an urgent need to provide residents with security and stability from which to rebuild their lives.

Children are particularly vulnerable and the closure of a number of schools and the disruption to the school year has been upsetting for many of them. The important role of local public amenities, particularly schools, is often evident through school closure and the community resistance sparked to school closures. Indicatively, schools have also been an avenue through which communities in other parts of New Zealand have offered support to Christchurch and a number of school-to-school relationships have been set up. Research has shown that school closure can have a greater effect parents in more economically deprived areas, where schools are more the focus of social cohesion, than in economically advantaged areas, where middle-class parents are more likely to have diverse social networks.[52]

Kaiapoi, which was heavily disrupted by the September earthquake, provides a model of good practice. The local authority has developed an integrated model of consultation with their community. They have utilised a wide range of community networks to consult with people about what they value about Kaiapoi, about what they want to retain and what they want to change in the process of rebuilding the town.

Research from elsewhere is useful, but there is a crucial gap in research pertaining to Christchurch. In general, research reveals the corrosive effect of marked inequality on social cohesion and the importance of employment and good jobs for social cohesion.[53]

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52 Witten K, Kearns R, McCreanor T. The Place of Schools in Parents' Community Belonging, *The New Zealand Geographer*, 2007, Vol 63, p141-148.
Witten, K., Kearns, R., Lewis, N., Coster, H. & McCreanor, T. Educational restructuring from a community viewpoint: a case study from Invercargill, New Zealand, Environment and Planning C: Government and Policy, 2003, 21, 203-223.
Witten, K., McCreanor, T. and Kearns R. The place of neighbourhood in social cohesion: Insights from Massey, West Auckland, Urban Policy and Research, 2003, 21, 4, 321-338.

53 Wilkinson, R & Pickett, K: *The Spirit Level: why more equal societies almost always do better*. London: Allen Lane; 2009.

For Christchurch there is a lot of useful data, for example on unemployment and emergency benefits, that is routinely collected, but often not collated and integrated at the city or neighbourhood level, where it is most needed to develop effective responses. Also useful information is collected by NGOs such as Citizens Advice Bureaus and other agencies like schools but cannot be readily pooled and made available to inform action.

Because many people left Christchurch (particularly after the February earthquake), there is also a need for information on what happened to these displaced people. Their displacement not only affects Christchurch but also the places they have moved to; for example, in the demand for social housing in areas as different as South Auckland, Wellington and Timaru.

Because its focus is people and their relationships with each other, the theme of social cohesion is central to all the other themes and their common point of connection. The Workshop group which focused on this topic represented this with a diagram showing a circle with 'people/social cohesion' at its centre with the other themes arranged around the circle's circumference, each theme connected by a line to 'people' at the centre.

Improving the sustainability of buildings

The scale of the rebuilding is still uncertain, but the number of buildings needing to be demolished continues to grow. The implementation issues are daunting, but do provide an exceptional opportunity to build healthy, energy efficient buildings.[54] There is some level of uncertainty about what successful outcomes would look like in Christchurch and how they should be monitored and measured. Compared to Europe,[55] there is currently an absence of exemplars of the positive impacts of policies, codes and innovative designs in the built environment.

Some research has been done in New Zealand on barriers to sustainable building. There is considerable opportunity for building more innovative, sustainable buildings and rebuilding better building envelope if the current Building Code is seen as providing minimum standards. If buildings are well insulated, energy demand is reduced and communal energy systems work to provide hot water/rain-water and power on basis of co-generation and use. Traditional stand-alone houses create many technical and social barriers to change, for example, it is easier for two shoulder-to-shoulder houses sharing water and power. Building more apartments in the inner city would provide greater opportunities for economies of infrastructure scale.

The current national Building Code, which applies to new buildings only, does not recognise the need to measure the carbon content of buildings. Yet, the embodied carbon in existing buildings needs to be taken into account in the decisions that are being taken to demolish or rebuild existing buildings. Unlike the EU, New Zealand does not require the use of any on-site renewable energy.[56] Although ECAN's Clean Heat Project has been disestablished, the Warm-Up NZ Programme continues to offer subsidies to encourage the retrofitting of both insulation and sustainable non-polluting heaters into homes built before 2000. There is only a limited scheme to encourage the installation of solar hot water heaters or photovoltaics. More widespread application would require modification to district plans to guarantee solar access.[57]

54 World Health Organization, *Health in the green economy: Housing, climate change mitigation and health co-benefits*. Geneva: World Health Organization; 2011.

55 Austin T: Planning more sustainable urban districts: Lessons from Europe. In *Growth Misconduct? Avoiding sprawl and improving urban intensification in New Zealand*. Edited by Witten K, Abrahamse W, Stuart K. Wellington: Steele Roberts Ltd; 2011:33-45.

56 By contrast with NZ the EU-27 countries promote renewable energy sources for heating and cooling through policies such as subsidies, tax incentives, financial support and feed-in tariffs; the initial three policies are widely used, mainly in new buildings, but also in retrofitted buildings in order to reduce carbon emissions and primary energy dependency.
One example from the UK is the 'Merton Rule' developed by Merton Council, which requires the use of 10% renewable energy onsite to reduce annual carbon dioxide (CO2) emissions in the built environment. Merton developed the rule and adopted it in 2003, subsequently London and many other councils have also implemented it; it has also become part of national planning guidance. Over the past few years, Merton has been working closely with other authorities, professions and industry to embed the Merton Rule. The Rule aims to reduce carbon emissions and is designed to help create an industry that can respond to the needs for affordable renewable energy: see Cansino JM, Pablo-Romero M, Roman R, Yniguez R: Promoting renewable energy sources for heating and cooling in EU-27 countries. *Energy Policy* 2011, 39:3803-3812. Also, see http://www.merton.gov.uk/environment/planning/planningpolicy/mertonrule.htm

57 Trenouth, C. & D. Mead. Barriers and Incentives for Sustainable Residential Development. Auckland, Hill Young Cooper Ltd, 2007. http://www.cmsl.co.nz/assets/sm/2247/61/016-TRENOUTHChloe.pdf

There are a number of rating schemes designed to measure the energy efficiency and performance of buildings (Healthy Housing Index,[58] NZ Green Building Rating Scheme, Beacon Pathways), which could be used in the re-build of Christchurch.

As part of viewing Christchurch city as a system, it is crucial to see housing and transport as an integrated system. Cheaper housing in outer suburbs or green-field sites is less likely to be a cheaper option overall, if there is no reliable public transport and occupants have to use their own cars to get to work, which leads to higher fuel costs and carbon emissions.[59]

Sustainable urban form, green blue infrastructure and transport systems

Clearly, 'getting there' matters in any city, but transport infrastructure is more significant than this – it fundamentally shapes a city's land use and form, over time, just as land use shapes transport needs and developments. Thus, strategic choices such as to invest in a public transport system or a motorway have enormous impacts over time, and those effects become 'locked in' – the configuration of a city is path-dependent.[60,61,62,63] More specifically, transport investments affect energy use, carbon emissions, lifestyles and health (a car-dependent, obesogenic environment affects the incidence of obesity, diabetes, and so on). In this sense, such investments have a deep and long-term impact.

Once a city is built, it is difficult to transform its design and form, and reshape transport system configuration, although significant changes are possible over a period of decades.[64] The Christchurch rebuild provides an opportunity to invest in patterns that are more sustainable. Importantly, the 'constraining hand' of existing land use is temporarily lifted, and it is possible to reshape transportation investment to equip Christchurch significantly better than it would have been and deal with the current and emerging realities of peak oil and climate change.

The central city will undoubtedly retain a significant role. It seems highly unlikely that Christchurch might be significantly decentralised as a result of the earthquake; there will always be a critical role for the city centre in terms of cultural amenities and the economic benefits of agglomeration.[65] New Zealand's current orientation towards urban road investment appears outdated, given the OECD emphasis on green growth: for example, the Secretary General of the OECD recently stated that "Particular caution should be observed when considering measures such as …investment in new roads…Short-term efforts must not come at a long-term cost to the environment."[66]

The need to relocate housing, construction of more sustainable built form and questions over the viability of land remediation, all highlight the need for research insights into the most effective planning and design strategies for the green blue infrastructure of greater Christchurch.[67] These need to inform decisions about the short-term recovery, and the longer-term adaption of the city to challenges of climate change and rising sea

58 Keall M, Baker M, Howden-Chapman P, Cunningham M, Ormandy D: Assessing health-related aspects of housing quality. *Journal of Epidemiology and Community Health* 2010, 64(9):765-771.

59 Viggers, H., Howden-Chapman, P. Urban form, public transport and mortgagee sales. In *Growth Misconduct? Avoiding sprawl and improving urban intensification in New Zealand*. Edited by Witten K, Abrahamse W, Stuart K. Wellington: Steele Roberts Ltd; 2011:159-178.

60 Banister, D., & Hickman, R. How to design a more sustainable and fairer built environment: transport and communications. IEEE: Proceedings of the Intelligent Transport System, 2006, 153(4), 276-291.

61 Goodwin, P. Solving Congestion: Inaugural lecture for the Professorship of Transport Policy, University College London, 23 October 1997. from http://www2.cege.ucl.ac.uk/cts/tsu/pbginau.htm.

62 Kahn-Ribeiro, S., Kobayashi, S., Beuthe, M., Gasca, J., Greene, D., Lee, D. S., et al. Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)]. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press, 2007.

63 Ward, M., Dixon, J., Sadler, B., & Wilson, J. Integrating land use and transport planning: Land Transport New Zealand Research Report 333. Wellington: Land Transport New Zealand, 2007.

64 Chapman, R. Transitioning to low-carbon urban form and transport in New Zealand. *Political Science*, 2008, 60(June), 89-98.

65 Andersson, F., Burgess, S., & Lane, J. I. Cities, matching and the productivity gains of agglomeration. *Journal of Urban Economics,* 2007, 61(1), 112-128.

66 Gurria, A. *From Grim to Green: towards a low-carbon future*. Paper presented at the 2009 International Economic Forum of the Americas (Conference of Montreal) from http://www.oecd.org/documentprint/0,3455,en_2649_34487_43031674_1_1_1_1,00.html.

67 Swaffield, S, Theory in Landscape Architecture: a reader. Philadelphia, University of Pennsylvania, 2002.

levels.

The issue of translating research findings into action is crucial.[68] Research findings need to be clear and accessible (which is not always the case). The language of research can be convoluted, and findings are not necessarily accessible to the decision makers (e.g., via easy access to journals). Further, research and policy are not always 'in synch' as they operate on different timescales. If specific research is to inform policy decisions, research would ideally need to happen in such a way that it can directly inform the problems and issues at hand. It is important for the research community to understand the issues being faced by Christchurch and to be willing to respond appropriately so that decisions can be informed by the research. There is also some level of uncertainty around some key issues – for instance what exactly successful outcomes look like, and how they should be monitored and measured.

There are various ways in which the research community can contribute to the discussions around the rebuild of Christchurch. It can provide descriptive information: what the city should look like to meet resilience and sustainability needs and how these needs can be achieved. It can also provide scenarios, presenting several possible answers to problems. For example, a "sustainable" city can take a number of forms, each with its own advantages and disadvantages.

Within the urban research community, interdisciplinary collaboration is needed. Partnerships between different research groups (e.g. urban planners and environmental scientists) can be formed which help provide a broader understanding of the complex issues involved in rebuilding Christchurch. Partnerships between the research community and the city council are also essential to ensure that the research will be able to inform the rebuild of Christchurch, and do so in a timely manner. From the point-of-view of the policy-makers, this would require a mandate that provides resources and creates the opportunities for input from the urban research community. From the point-of-view of the research community, this would require engagement and responsiveness to issues of the rebuild via a coordinated voice that provides clear practical solutions, whilst recognising the limitations and uncertainties research findings can have. Conversations (such as in this workshop), collaborations and effective partnerships are therefore essential in rebuilding a sustainable and resilient Christchurch.

Supporting the people of Christchurch in their efforts to re-create their city

The general view of the urban researchers at the workshop was that the research community can contribute ideas about how to create the forums and connectivity to ensure that community voices are gathered, heard and attended to in the process of re-creating the city. They can also contribute to the pool of ideas – everything from the overall design of a sustainable city to the uses of the healthy housing index in the design of residential buildings – which Christchurch citizens can draw on in deliberating about how their city should be re-created and rebuilt. Finally, the research community can contribute to the monitoring of the process and its emerging outcomes.

There is a range of research that social, physical and public health scientists can contribute; including work on alternative transport and land use scenarios, surveying of the Christchurch public as to transport and land use preferences (potentially framed as scenarios), underpinning data collection to describe socio-economic correlates, and analysis and interpretation of the findings of urban sustainability research from other jurisdictions. Two-way communication with community groups, local government and CERA, in order to negotiate research framings that meet needs, as well as the needs of social research, is important.

68 Davis P, Howden-Chapman P. Translating research findings into health policy. *Social Science and Medicine* 1996, 43(5):865-872.

CONCLUSION

Coming from the web-based exercise and workshop, there was a clear recognition of the critical importance of democratic engagement, leadership to guide implementation, and the need for a long-term strategy to inform short-term decisions. There is a great deal of skill and expertise and information available, but the challenge is to approach things differently and implement these innovative approaches. The extent of the physical damage and psychological shock caused by the earthquakes requires fundamental reconsideration of desired outcomes, including both social and economic values, and this reconsideration should be premised on community engagement.

This report is the result of efforts to channel the positive desire of researchers, the policy community and academics to assist the recovery efforts by engaging with the process and adding a vision of the possibilities that may arise from the re-creating of a resilient Christchurch. It is a step in building alliances with politicians, the community and the media. The next steps in this process will require some active advocacy and the provision of persuasive information, e.g. case studies of real implementation, and analyses of actual developments. There are important opportunities for partnerships with tertiary institutions to mobilise research capacity, including student projects.

We recognise that the recovery is urgent. There is a tight time frame and risks that temporary replacements may become permanent. All these considerations take place in the anxiety-provoking context of ongoing after-shocks. Investment in reconstructing infrastructure is likely to be constrained by fiscal realities and insurance issues, and may be further constrained by capital flight. It is not yet clear how the distribution of risks, costs and benefits will be borne across developers, owners, tenants, residents, infrastructure service providers, and society as a whole. In such a context, researchers and policy makers will have to, at one and the same time, proceed with all haste to develop creative ideas and practical plans where possible, while staying open to new ideas and innovative approaches based around a long-term vision of a sustainable and dynamic Christchurch.

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Professor Larry Murphy, Professor, Department of Property, University of Auckland

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Rod Oram, Economic Commentator

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