Expanding the conversational terrain: Using a Choice Experiment to assess community preferences for post-disaster redevelopment options

Abstract

The Canterbury region of New Zealand was rocked by major earthquakes on the 4th September 2010 and 22nd February 2011. The quakes caused extensive land, infrastructure and building damage particularly in the Eastern suburbs of Christchurch city. Almost 450 hectares of residential and public land was designated as a 'Red Zone' unsuitable for residential redevelopment because damage was significant and extensive, engineering solutions were uncertain, and repairs would be protracted. Subsequent demolition of all housing and infrastructure has left a blank canvass of land stretching along the Avon River corridor from the CBD to the sea.

Initially the official - and enormously controversial - position was that this land would 'lie fallow' until engineering solutions could be found. This paper presents an application of a choice experiment (CE) that identified and assessed Christchurch residents' preferences for different land use options of this Red Zone. Results demonstrated strong public support for the development of a recreational reserve comprising a unique natural environment with native fauna and flora, healthy wetlands and rivers, and recreational opportunities that align with this vision. By highlighting the value of this expanded range of alternatives, the CE provided a platform for public participation and expanded the conversational terrain upon which redevelopment policy took place. We conclude the method has value for land use decision-making beyond the disaster recovery context.

Keywords: Disaster recovery, land use redevelopment, choice experiment

1. Introduction

In September 2010 and February 2011, New Zealand's second largest city of Christchurch was shaken by two devastating earthquakes that caused substantial loss of life and widespread destruction to infrastructure, housing and municipal services. Severe aftershocks persisted in hampering recovery efforts and two more significant earthquakes in June 2011 impelled the government to change their strategy for the worst-affected areas of the city from 'repair' to 'retreat'. One of these areas - the Avon River Residential Red Zone (ARRRZ) - comprised approximately 450 ha of mostly of residential housing, stretching almost from the CBD to the coast. This large tract of land has subsequently been cleared of all housing, infrastructure and services; it is effectively a blank canvass. Initially the official - and enormously controversial - position on the Red Zone's future was that this land would 'lie fallow' until engineering solutions for land remediation could be found. This paper presents an application of a choice experiment (CE) that identified and assessed Christchurch residents' preferences for alternative land use options.

Communities' roles in disaster recovery

Disaster scholarship has recently witnessed a 'seismic shift' from a focus on expert-driven 'reconstruction' to more holistic 'recovery' processes that include social, economic and cultural dimensions. Consequently, it is now widely acknowledged that communities also have an important role to play (OECD, 2013), both in recovery activities and recovery decision-making (Vallance and Carlton, 2015). With regard to the latter, utilising local knowledge can improve outcomes and enhance legitimacy of decisions (Vanclay and Esteves, 2011). Community engagement in post-disaster redevelopment should aim to encourage and enable affected communities to become involved in decision making processes (Dare et al 2011). Engagement with affected communities reinforces collaborative governance within the context of disaster recovery by involving both private and public entities in collective and consensus-orientated decision making in response to disaster effects (Kapucu, 2014). Allowing broader participation in disaster recovery decisions has been recognised as an opportunity to enable communities to develop assets that might have been overlooked previously, and to rebuild and redevelop in more resilient and sustainable ways (Comfort et al. 2010).

While disaster scholarship demonstrates increasing levels of consensus around community involvement in decision-making, recovery practice is more varied and community consultation is often token or insubstantial (Shaw, 2014; Vallance, 2014). While the possibility of turning disaster into opportunity is alluring, the reality is that robust recovery depends greatly on a number of factors related to governance, with failure to engage the community and neglect of community needs undermining success (Salazar and Jigyasu, 2010; Flynn, 2011). Failures in post-disaster reconstruction can often be traced back to the centralizing approaches typically employed (Lyons, 2008).

This raises interesting questions around how communities might better participate in land use redevelopment decisions, both after disaster and in the face of any large scale change. Community surveys are one technique used to facilitate exchange of viewpoints by informing and consulting the public (Lenhian, 2008); however, respondents are often asked to provide their opinions on a pre-selected range of alternatives and the trade-offs between different options are not easily captured. CEs, on the other hand, are suited to valuing individual characteristics of redevelopment projects and provide economically consistent measures of relative preferences across these outcomes. In a limited applied literature, choice experiments have been employed to assess individual preferences for disaster risk reduction *prior* to earthquakes (Azimi and Asgary, 2013; Zhai and Suzuki, 2008; Keller et al. 2004) wildfires (Wibbenmeyer et al. 2013) and flooding (Zhai et al. 2006; Zhai and Saburo, 2006). Applications assessing affected community preferences *post*-disaster are scarce. Exceptions include preferences for types of aid closely following the Haitian earthquake (Andre and Lusk, 2011) and post-Katrina rebuild in New Orleans (Landry et al. 2011).

The broad aim of this study was to explore Christchurch residents' preferences for different redevelopment options in the ARRRZ encompassing potential for commercial businesses, residential housing, recreation, social and environmental services. Our two more specific objectives were, first, to identify the set of redevelopment options that were most important to Christchurch residents and, second, to estimate the monetary value of welfare gains from providing these options to residents. We also sought to assess the potential contribution CEs might make to post-disaster land use decision making processes more generally.

2. Background

On the 4th September 2010, the Canterbury region of New Zealand was rocked by an earthquake measuring 7.1 on the Richter scale. Though the epicentre was located some 50km away in Darfield, the quake and its immediate aftershocks caused extensive land, infrastructure and building damage in the Eastern suburbs of Christchurch city and in the smaller settlement of Kaiapoi in the neighbouring Waimakariri District. The damage was caused by lateral spread (where the ground essentially splits apart) along the faultline and/or areas adjacent to river banks, or liquefaction. Initially, it was thought that this was a 1:200 year event, and that the likelihood of existing residents and infrastructure suffering another earthquake was remote. There is some debate as to whether the February 22nd quake was an 'aftershock' or an earthquake in its own right given it was on a different faultline. At magnitude 6.3, this event was technically smaller but shallower, with a much higher Peak Ground Acceleration of up to 2.2g and an epicentre located almost directly under the city of Christchurch. According to Professor Yeats, Professor Emeritus of Geology at Oregon State University in Corvallis, USA, this would have 'flattened' most world cities (Anderson, 2011). As it was, there were 181 immediate fatalities (most of these in two building collapses in Christchurch's CBD), and further liquefaction in the Eastern suburbs of Christchurch.

There would have been far more fatalities were it not for New Zealand's strict building codes which require a building with a 50-year design life to withstand predicted loads of a 1 in 500-year event. Though the force of the February earthquake was statistically unlikely to occur more than once in 1000 years, most buildings retained enough integrity to allow those inside to escape. A far greater number required extensive repairs, some of which were estimated to exceed the cost of a complete rebuild. As the situation became more complex in terms of reinsurance, apportionment, geotechnical expertise and geographic spread, in March 2011 a new Government Department was established - the Canterbury Earthquake Recovery Authority (CERA) - to replace the Canterbury Earthquake Recovery Commission (CERC).

On the 13th June the region was rocked by another two earthquakes of 5.5 and 6 magnitude. The likelihood of repeat events, combined with the social and economic costs of remediation, repair and rebuild, meant 'retreat' rather than rebuilding was now considered to be the best option. On 23rd June the Minister for Earthquake recovery 'Red Zoned' residential land along the Avon River corridor creating the Avon River Residential Red Zone (ARRRZ) (see Figure 1 below), and it was this particular piece of land that formed the focus of this study. The criteria for Red Zoning were that there was significant and extensive area wide land damage; the success of engineering solutions was uncertain in terms of design, success and possible commencement given the ongoing seismic activity; and any repair would be disruptive and protracted for landowners. The Red Zoning decision was accompanied by several buy-out options of the over 6,000 residential properties with the vast majority of home owners selling their property to the Crown who, through CERA, coordinated the process of demolition and land clearance. Initially the official - and enormously controversial - position was that this land

would ‘lie fallow’ until engineering solutions could be found. This paper presents an application of a choice experiment (CE) that identified and assessed Christchurch residents’ preferences for different land use options of this Red Zone.

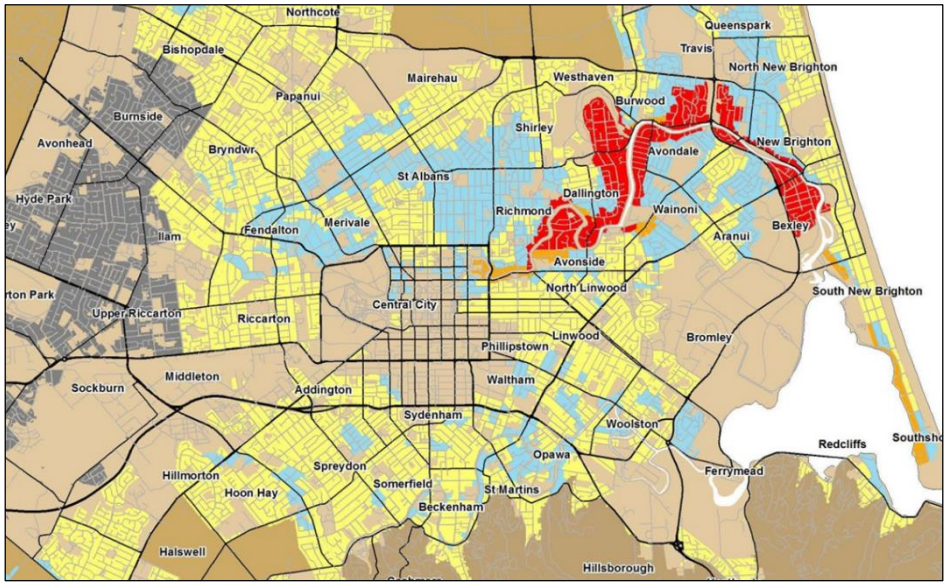

Figure 1. Christchurch’s post-quake land zoning. Avon River Residential Red Zone (red); TC3 (blue); TC2 (yellow); TC1 (grey). Available at http://maps.cera.govt.nz/maps (Canterbury Earthquake Recovery Map provided under Creative Commons Attribution 3.0 New Zealand licence).

3. Method

To explore community preferences for redevelopment options for the ARRRZ the methodology for this research sought to combine primary data gathered using both qualitative (in-depth community group interviews) and quantitative methods (choice experiment survey). In March, 2013, 14 one to two hour semi-structured interviews were conducted with representatives of Christchurch-based community groups, research institutes, and retail/commercial interests who had publicly promoted alternative land use options for the red-zone area. This stage of the research provided a ‘rich picture’ of potential futures for the ARRRZ. Thematic analysis identified contradictions, complementary activities, other studies, potential problems and benefits. These themes then contributed to the development of a web-based scoping survey issued in May, 2013 that enabled the researchers to cross-validate and prioritise the different proposals. This informed the subsequent selection of redevelopment options incorporated into the choice experiment survey and enabled us to establish a dollar value for non-market goods.

3.1 Community group interviews

The interviews with representatives of 14 different community groups or advocates of particular ideas were conducted in March 2013. The results, analysed thematically, included a broad spectrum of social, environmental, economic and cultural values. A number of those interviewed for this research were promoting the value of various ecosystem services including flood mitigation, storm water management, water quality improvements and bio-diversity preservation and enhancement. Most highlighted the ways in which the inclusion of these ecosystem services in the ARRRZ was compatible with activities proposed by other interviewees and would, in most cases, add value by enhancing the overall setting.

Flood management has become a more critical issue post-quakes as the number of properties vulnerable to a 50 year rainfall event had increased significantly due to ground settling. Interviewees described ways of combining flood management with development of an eco-sensitive recreation reserve, primarily through the incorporation of a man-made lake and wetlands. Developing a lake could meet international rowing event requirements, as well as serving local water sports communities including kayaking, dragon boating, rowing, canoeing, and waka. Combined with a series of smaller lakes, swales and wetlands - would also act as a repository for floodwaters from the Avon River, mitigate flood damage and manage storm water from surrounding suburbs. These wet areas could augment or replace expensive mechanically pumped and piped storm water mechanisms.

Other benefits of wetlands were also important to interviewees including aesthetics, supporting threatened native biodiversity, and enhancing water quality in the Avon River. Only one third of water flowing into the estuary from the Avon is able to sustain life. Wetland development was seen as an opportunity to achieve goals outlined in numerous policy documents including the Canterbury Regional Policy Statement which calls for improvement of natural character values where they have been degraded to unacceptable levels.

The opportunity to develop eco-sanctuaries or restore native habitats in an urban location was considered a potentially important way of raising awareness and enhancing people's understanding and appreciation of our unique native flora and fauna. Consistent with this view, there was significant support for a permeable predominantly native forested park promoting ecological restoration and biodiversity.

As outlined in the Canterbury Earthquake Recovery Authority's Recovery Strategy for Greater Christchurch (2012) sport is considered a key element of cultural recovery which, in turn, contributes to a vital, functional and liveable city. There was general consensus among active recreation interviewees that a continuous, traffic-free, pedestrian/cycle track along the river corridor from city to sea was important. Such a setting could provide the ideal for a range of individual, collective and on-going activities, as well as special events. As a diverse range of active leisure and recreation pursuits can be co-located, positive synergies can be created around the provision and sharing of facilities. This development would also have potential to encourage active transport modes such as cycling and walking to work or school that can generate health benefits, and benefits to the environment from reduced automobile emissions.

The interviews revealed strong support for devoting a portion of the ARRRZ to 'light' (i.e. not-for-profit) community-based urban agriculture and the preservation of key food producing heritage gardens in the ARRRZ. These exemplify historical gardening practices where maximum production is considered less important than, resistance to disease, good storage characteristics, and longevity of harvest. Advocates also highlighted the benefits of community gardens, not just as a food source, but also in terms of the health benefits of active recreation, good nutrition and the building of social capital.

Heritage protection was also important to interviewees broadly. The ARRRZ hosts a rich sample of early Maori and colonial heritage. Local Waitaha, Ngati Mamoe and Ngai Tahu used the river for mahinga kai (food gathering) and three Ngai Tahu pou stand on the sacred site of Tautahi. The ARRRZ contains many of the city's first European settler's homes exemplifying not just a housing type, but a way of thinking. As one example, Englefield Lodge is thought to be the oldest house in Christchurch, built in 1852 by William Guise-Britten who arrived on the First Four Ships from England. Nearby are a number of workers' cottages prefabricated in England and brought to Christchurch from 1865-80. Some of the other homes and gardens in the area epitomise the kind of suburban development advocated by urban planners such as Ebenezar Howard, considered radical at the time, and Truby King (founder of Plunket) who were both concerned about the crowded and unsanitary conditions of industrialised cities in the United Kingdom.

Interviews revealed a high level of concern for remaining Eastern suburbs whose livelihoods have been affected. Pre-quake, Eastern areas were suffering economic decline. The establishment of a 'city to sea' green/pedestrian corridor and recreation reserve was seen as a way of restoring the economic viability and general attractiveness of the Eastern suburbs. Such a corridor would help serve to make Eastern areas a destination for locals and tourists, facilitating the recovery of local business. Consistent with this, interviewees proposed various small-scale commercial and boutique retail activities for the ARRRZ, including boat shed cafes along the river, artisan and craft market sites, and tourist focused businesses.

3.2 Choice experiment survey

To elicit Christchurch residents' preferences for redevelopment options of the ARRRZ this research utilised the choice experiment method. Choice experiments have been applied within an earthquake disaster context (Azimi and Asgary, 2013; Zhai and Suzuki, 2008; Keller et al. 2004) and to estimate environmental, recreational and social values of urban development green space (Arnberger and Eder, 2011; Bullock, 2008; Koo et al. 2013; Lanz and Provins, 2013).

As opposed to revealed preference methods such as using direct or indirect market prices, this survey based approach facilitates valuation of goods and services whose value may not be directly observable in markets such as the public goods explored in the current paper. The ability of this method to identify which individual redevelopment options are more important in residents' choices and to estimate marginal willingness to pay (WTP) for these options has seen this approach to valuation become increasingly favoured by researchers. In the current context the method presents residents with competing redevelopment scenarios, each made up of different redevelopment options. This is achieved by designing an experiment in which redevelopment options are systematically and independently varied and combined to produce multiple choice scenarios by employing an experimental design. Respondents are then asked to indicate their preferred redevelopment scenario.

To determine the set of redevelopment options to be included in the choice experiment, community group interview findings were summarised into main themes and outcomes that formed the basis of a web-based scoping survey of Christchurch residents. The survey was delivered in an online format in May 2013 using social media advertisement to recruit respondents in a non-probabilistic snowball sampling approach. Rather than forming statistical population inference, this process aimed at allowing us to cross-validate interview findings with a broader set of residents and perspectives in a relatively resource efficient manner. The scoping survey achieved a sample size of 549 respondents with distributions of gender, age, and occupation consistent with the general Christchurch population. Importantly, the overall results were consistent with interview findings and, allowed us to narrow the focus of definitions and specific redevelopment options within broader thematic categories to be used

in the choice experiment. The final set of redevelopment options to be used in the choice experiment is given in Table 1.

Table 1: Redevelopment options used in choice experiment survey

Avon-River-Residential-Red-Zone Redevelopment Options	
Recreational Spaces	Cycle/walking/jogging paths
	Water based opportunities
	Sports fields
	Children's playgrounds
	Open grassed areas
Environmental Enhancement	Improved river water and habitat quality
	Mostly native plants and habitat
	Restoration of wetlands
Heritage Protection	Preservation of heritage gardens including flowers and fruit
	Preservation of important Māori food gathering sites
Eastern Suburbs Connection & Rejuvenation	Paths connecting CBD to Brighton
	Paths connecting CBD to Brighton, South Shore and Bottle Lake
Commercial Activities	Cafes
	Tourist focussed businesses
Percentage of Red Zone used for Park	60 per cent in Park/40% housing
	80 per cent in Park/20% housing
	100 per cent in Park
Enhanced Community Engagement	Regular festivals and markets
	Community food gardens
	Community meeting places
Annual Rates cost to Christchurch households (20, 30, 40, 80 $NZ 2013)	

The observed choices of scenarios that respondents make and associated redevelopment options of each scenario (chosen and non-chosen) are modelled in a probabilistic econometric framework using Random Utility Models (RUM) underpinned by the theory of individual choice behaviour known as Random Utility Theory (McFadden, 1974; Ben-Akiva and Lerman, 1985). In this way, choice experiments provide a utility theoretic measure of preferences over various redevelopment characteristics. Random Utility Theory postulates that individuals associate some utility (a latent measure of preference) with each set of redevelopment options that they consider. Residents try to maximise their utility by choosing the redevelopment scenario that they think is best for them, subject to what they know about competing options and whatever constraints, such as income, are operating on their choices. The concept of randomness in the RUM context does not imply that people make their choices randomly, but that there is a random component associated with an individual's choices that is a consequence of factors unobserved by the researcher, that are influencing choice. The RUM can be made operational by formulising the relationship of an individual's utility function as:

$$U_{ni} = \beta_{0,n} + \sum \beta_k x_{ni} + \varepsilon_{ni} \quad (1)$$

Where, U_{ni} is the measure of utility from alternative *i* for individual *n* and is a function of constant variable β_0, the sum of the utilities for each *k* redevelopment option where β_k is the utility weight to be estimated and *x* is a vector of observed parameters, ε_{ni} is an unobserved error term which is randomly distributed. The random component allows analysts to express choice in probabilistic terms that enables the underlying preferences for redevelopment options to be extracted:

$$P_{(ni|A)} = \text{Prob}(\text{U}_{\text{ni}} > \text{U}_{\text{nj}}) \quad i, j \in A \text{ and } i \neq j \quad (2)$$

Where the probability of choosing alternative *i* in choice set *A* ($P_{(ni|A)}$) is commensurate with the probability that the utility U_{ni} is greater than the utility of the other alternatives U_{nj} in *A*. Assuming that the error term is distributed independently and identically (IID) with extreme value type I, results in the multinomial logit (MNL) model (McFadden, 1974), the most commonly used form of discrete choice model. Under these circumstances the probability of selecting alternative *i* has a simple closed form solution which assumes homogenous preferences of attributes for all residents in the sample (i.e. the β_k is the same for all individuals). However the restrictive assumptions of this model inherent in the error term formulation are often not satisfied in the empirical data (Train, 2009). In this paper we employ an alternative more flexible model, the Random Parameter Logit (RPL) model which represents a full relaxation of the IID assumption, accommodates correlations among panel observations and accounts for uncontrolled heterogeneity in tastes across respondents (Train, 2009). Preference heterogeneity is introduced in the individual specific random parameters for attributes (Greene and Hensher, 2007). The parameter vector is expressed as the population mean β and the individual specific deviation η_n from a specified continuous distribution (Train, 2009). Hence the utility function can be rewritten as:

$$U_n = \beta X_n + \eta_n X_n + \varepsilon_n \tag{3}$$

The stochastic part of utility may now be correlated among alternatives and across the sequence of choices via the common influence of η_n (Greene and Hensher, 2007). We include an error components specification that allows for correlation patterns between the unobserved portions of the utility of alternatives. In order to take into account the degree of heterogeneity whilst obtaining meaningful WTP estimates, we specify triangular distributed random parameters for all attributes including price, with the spread of the price coefficient constrained to be equal to its mean. The choice probability resulting from this specification does not have a closed form solution and requires estimation by simulated Maximum Likelihood (ML). The ML algorithm searches for a solution by simulating draws from distributions with given means and standard deviations. Probabilities can then be calculated by integrating the joint simulated distribution (the mixture distribution of the IID distribution of ε_n and the specified distribution for η_n). One thousand shuffled Halton draws were used in maximising the log-likelihood function. Simulated unconditional estimates of WTP for attribute *j* by individual *i* are calculated as the ratio of the estimated model parameters accommodating the influence of the random component (Cicia etal. 2013) as:

$$WTP_i^j = -\left(\frac{\beta_j + \varepsilon_{ij}}{\beta_{price} + \varepsilon_{ip}} \right) \tag{4}$$

The experimental design employed here consisted of fourteen choice sets each made up of two alternatives employing a D-efficient fractional factorial experimental approach generated using NGene™ (ChoiceMetrics, 2014). The design was blocked into two with each respondent facing seven choice sets and each set included the ability of respondents to opt-out of making a choice.

3.3 Choice experiment survey administration

The sample of Christchurch residents to be surveyed was drawn from the Electoral Roll which contains all citizens registered to vote in public elections. As registration is mandatory for everyone aged 18 and over, this roll represents a high quality sampling frame. A random-stratified sample was drawn to reflect the distributions of age and geographical location of the Christchurch population with the final sample containing 1500 names and postal addresses. The survey was administered using a mixed-mode design consisting of posting a paper survey to all 1500 members of the sample that included a link to an on-line version of the survey. This meant that respondents could fill out and mail back the paper version of the survey in the free-post reply envelope provided, or they could use the link to complete the survey on-line. The majority of respondents chose to complete and return the paper version of the survey (85 per cent).

4. Results

The surveying process yielded an effective response rate of 20 per cent with 291 usable responses. A typical mail-out-mail-back self-administered survey response rate is less than 25 per cent in NZ. The greater level of cognitive burden that is required in choice experiment surveys means that these surveys tend to have response rates around 20 per cent. Other forms of survey administration, such as in-person (face-to-face) surveying tend to have higher response rates but incur considerably higher expenses beyond the resources available in this study.

4.1 Sample characteristics

The sample demographics (Table 2) reveal that although the sample contains proportionally higher income and educated residents than the general Christchurch population, representativeness overall can be considered reasonable. To ameliorate the income and education bias effect on results interpretation we weight the data prior to the statistical modelling reported in section 4.2.

Table 2. Sample characteristics (%)

		Sample	Census[1]
Gender (0.42)[2]	Female	55	51
Age (0.11)	18 – 29	12	19
	30 – 59	62	63
	60 ≤	24	18
Education (0.00)	High School	25	65
	Trade/technical qualification or similar	20	22
	Undergraduate diploma/certificate/degree	31	9
	Post-graduate degree	21	4
Location (0.68)	South-East Christchurch	20	18
	North-East Christchurch	30	26
	South-West Christchurch	22	24
	North-West Christchurch	28	32
Household size (0.00)	One occupant	16	24
	Two occupants	57	34
	More than two occupants	27	42
Household Income (0.00)	< $20,000	6	20
	$20,001 - $70,000	37	57
	$70,001 ≤	57	23
Employment Status (0.68)	Unemployed	1	2
	Paid employment	69	66
	Not in labour force	30	32

[1] Distributions from Statistics New Zealand Census 2013. [2] Values in brackets are P-values for Pearson's Chi-square test of the null hypothesis that the frequency distribution of the observed sample demographic variable is consistent with the population distribution provided by Statistics New Zealand Census 2013 data. A p-value less than 0.01 indicates a statistically significant difference between the two distributions at the one percent level.

4.2 Statistical modelling

Statistical analysis was conducted using econometric software Limdep v.9™ and Nlogit v.4.3™. Alternative model specifications including an attribute non-attendance model yielded no qualitative improvement over parameter estimates presented in Table 3. We also tested for survey mode affects by including a dummy variable indicating respondents who completed the online version of the survey with no statistical evidence found. These factors alongside the Akaike Information Criterion (AIC), Log-likelihood function value (LL) and McFadden Pseudo-R^2 form the basis for a test of relative model fit. The Pseudo-R^2 value indicates that the model has an acceptable level of explanatory power. An important finding is that parameter estimates for sports fields, children's playgrounds and open grassed spaces are not statistically significant, meaning that residents derive no utility from provision of these types of recreational spaces. This finding is consistent with the observation that many of these facilities are already currently available and are generally highly substitutable. Furthermore, as the standard deviations of these parameters were not found to be statistical significant, parameters were assumed constant meaning respondent preferences were homogenous for these outcomes. All redevelopment options that provide environmental enhancement had a positive influence on

respondents' likely choices. Interestingly, respondents did not want tourist focused businesses but preferred cafes, suggesting a preference for commercial activities that were able to service local communities rather than aimed at attracting tourists. Examining the standard deviation of each parameter estimate reveals that the greatest degree of preference heterogeneity is for the percentage of the ARRRZ that is allocated for redevelopment options other than residential housing. This is perhaps understandable given that this issue is a crucial determinant in the range and magnitude of redevelopment options that could be achieved. The finding of negative preferences for preservation of important Māori food gathering sites is an unexpected result. Qualitative data suggests that at the time the survey was administered, bad press concerning sewage discharge and contamination in the Avon River may have lead respondents to consider the ARRRZ and the Avon River as not suitable food gathering sites.

Table 3. Random parameter logit model estimates

Avon-River-Residential-Red-Zone Development Options	**Parameter Mean**		**Standard Deviation**	
Recreational Spaces				
Cycle/walking/jogging paths	0.669***	(0.13)	1.37***	(0.47)
Sports fields	0.094	(0.09)	NR [c]	
Water based opportunities	0.331***	(0.12)	1.02*	(0.55)
Children's playground	0.632	(0.13)	NR	
Open grassed areas	-0.091	(0.14)	NR	
Environmental Enhancement				
Improved river water and habitat quality	0.374***	(0.11)	0.97*	(0.57)
Mostly native plants and habitat	0.604***	(0.12)	NR	
Restoration of wetlands	0.243*	(0.13)	1.11**	(0.51)
Heritage Protection				
Preservation of heritage gardens	0.643***	(0.12)	NR	
Preservation of important Māori food gathering sites	-0.231**	(0.10)	1.33***	(0.49)
Paths connecting CBD with Eastern Suburbs				
CBD to Brighton	0.119	(0.26)	NR	
CBD to Brighton, South Shore and Bottle Lake	0.399***	(0.15)	1.27***	(0.39)
Commercial Activities				
Tourist focused businesses	0.094	(0.09)	NR	
Cafes	0.249***	(0.11)	1.53***	(0.46)
Percentage of Red Zone used for Park vs. Residential Housing				
80 per cent in Park	0.427***	(0.16)	3.95***	(0.60)
100 per cent in Park	0.536***	(0.12)	4.33***	(0.51)
Enhanced Community Engagement				
Regular festivals and markets	0.461***	(0.12)	1.56***	(0.42)
Community food gardens	0.205**	(0.10)	NR	
Community meeting places	0.13	(0.09)	NR	
Cost of Redevelopment				
Annual Rates Cost to Christchurch Households	-0.022***	(0.01)	0.022**	(0.01)
Number of obs.	2037			
LL [a]	-1049			
AIC [b]	2154			
McFadden Pseudo-R^2	0.31			

***, **, * denotes statistical significance at 1%, 5%, and 10% level respectively

Standard errors in brackets

[a] LL: Value of Log Likelihood function

[b] AIC: Akaike Information Criterion

[c] NR: Non-random parameters

4.2.1 Welfare estimates for redevelopment options

From the parameter estimates in Table 3, we estimate WTP for each of the redevelopment options by applying equation 4. We report medians, and upper and lower quartiles of the simulated unconditional distribution of WTP for each statistically significant redevelopment option (Table 4). These results reveal that respondents have the highest WTP for redevelopment options that provide heritage protection closely followed by those that provide environmental enhancement and recreational spaces. These estimates are constructed as per household measures and can be used to form aggregate estimates of value to the Christchurch population. Applying a multiplier of the total number of households in the survey sampling frame (150,000) to the median marginal WTP values forms a rudimentary total welfare estimate of approximately $24.6 million per year. This estimate provides an indication of the magnitude of total value that could help guide the scope and design of redevelopment options when compared with the costs of provision of each.

Table 4. Estimated marginal WTP values

Avon-Red-Zone Redevelopment Options		**Annual WTP $NZ (2013)**
Recreational Spaces	Cycle/walking/jogging paths	24.4 (6.6, 53)
	Water based opportunities	10.6 (-1.3, 30.6)
Environmental Enhancement	Improved river water and habitat quality	13.5 (1, 35.1)
	Mostly native plants and habitat	26.1 (18.8, 38.7)
	Restoration of wetlands	6.6 (-5.2, 29.4)
Heritage Protection	Preservation of heritage gardens including flowers and fruit	27.8 (20, 41.2)
Connection	Paths connecting CBD to Brighton, South Shore and Bottle Lake	12.7 (-1.7, 36.4)
Commercial Activities	Cafes	6.1 (-9.9, 31.6)
Percentage of Red Zone used for Park	80 per cent in Park	3.8 (-30.7, 59.3)
	100 per cent in Park	8.2 (-24.3, 62.3)
Enhanced Community Engagement	Regular festivals and markets	14.5 (-2.7, 45.9)
	Community food gardens	9.5 (6.9, 13.6)

Median simulated unconditional WTP; Lower and upper quartiles in brackets.

5. Conclusions

Encouraging more effective community participation in post-disaster decision-making requires finding ways in which to identify their preferences for land use redevelopment options. Centralised top-down approaches to determining land use redevelopment risks neglecting or foreclosing opportunities that may be more desirable, ignoring localised relevant information, and jeopardising the legitimacy and long-term sustainability of redevelopment choices. The CE methodology used here counters some of these weaknesses and vastly expands the conversational terrain that serves as a platform for land use decisions.

In this case, the initial decision to let the land 'lie fallow' was expedient but did not meet the needs and aspirations of a traumatised population. In the post-disaster context, the CE worked well in that a fuller range of alternatives was able to be considered, without demanding too much from participants already struggling with the death of loved ones, damaged infrastructure, job losses and general trauma. Forming monetary estimates of community preferences for public goods such as environmental enhancement and heritage protection necessitates application of economic non-market valuation methodology such as the CE approach applied in this study. The ability of the CE approach to establish public good values for redevelopment outcomes that provide an economic theoretic consistent narrative, strengthens community's participation in redevelopment resource allocation decisions that compete with direct-market values such as commercial enterprise. This methodological advantage provides measures of community preferences and values that are not able to be captured in more typical survey based questionnaires such as those employing simple likert scales and ranking exercises. Consequently, we conclude that the mixed method qualitative research and CE methodology outlined here clearly has the potential to make an important contribution to any recovery authority 'engagement' toolbox, particularly for those who wish to balance meeting community needs and aspirations with tight fiscal constraints and timelines.

In Christchurch, this research suggested community preferences were strongest for a unique 'recreation reserve' with native fauna and flora, healthy wetlands and rivers, and recreational opportunities that align with this vision, such as walking, cycling and water-based sporting and leisure activities. The research also showed support for a reserve that promotes and enables community interaction and wellbeing, as was evident in respondents' desires for community gardens, regular festivals and markets, and the physical linking of the CBD with eastern suburbs through a green corridor. Clearly apparent in the results was the lack of support for options that could be considered as more typical of an urban park development such as sports fields, children's playgrounds or open grassed areas. Importantly, this research showed that the recreation reserve option was actually cost-effective and met a much broader range of 'holistic recovery' needs than letting the land lie fallow.

Although a comprehensive cost-benefit analysis is beyond the scope of this study, welfare estimates given here provided valuable information for rebuild stakeholders as they analysed redevelopment projects for the Christchurch ARRRZ. The conversational terrain for redevelopment was expanded beyond the initial 'lie fallow' option, to include and consider a range of other alternatives. We conclude that the CE's ability to expand the conversational terrain to embrace other alternatives has implications beyond disaster recovery, and could usefully be applied whenever major land use changes are proposed where costs and benefits need to be assessed more broadly.

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