

Temporary Housing Issues following the 22nd Christchurch Earthquake, NZ

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ABSTRACT: The 22nd February 2011 Christchurch Earthquake damaged or destroyed over 6,000 residential properties forcing thousands to leave their homes. The Natural Hazard Research Platform, NHRP of New Zealand funded a short-term project aiming to inform the Department of Building and Housing, DBH, and the Christchurch Earthquake Response Centre and Recovery Management, CERA, on best practices and methods adopted at international level, to assess and respond to temporary housing needs. Further than this, the project team collaborated with the Council and Statistic NZ on estimating the internal and external population migration caused by the earthquake and its impact on the needs for temporary homes. This paper aims to briefly summarise how the aforementioned agencies responded to the temporary housing needs following the Christchurch earthquake and discuss the successes and issues encountered by the NHRP project to fulfil the overall objective of the project. The lesson learnt to support the planning for temporary housing needs in the occurrence of future events are finally discussed.

1 INTRODUCTION

Following the 4 September and 22 February earthquakes in Canterbury, New Zealand, the Natural Hazard Research Platform (NHRP) of New Zealand funded different projects to support and inform the decision making process during the recovery phase.

The Temporary Housing Project was a short-term effort designed to provide on-the-ground support to the decision making process. The project aimed to assist assessments and responses to temporary housing needs. As part of the project, the end-users, decision makers and housing professionals, were informed on the international research and experiential knowledge from previous disasters gathered by researchers involved in this project. Furthermore assistance was provided to the stakeholders in their attempts to estimate the displaced population and population migration following the disaster.

Canterbury Earthquake Recovery Authority (CERA), Canterbury Earthquake Temporary Accommodation Service (CETAS), Environment Canterbury (ECan), Christchurch City Council (CCC), and Department of Building and Housing (DBH) were the intended end-users and clients for the NHRP “Temporary Housing Issues” project.

This paper offers insights into the current understandings of post-earthquake temporary housing issues faced internationally and in Canterbury, following the Darfield and Christchurch earthquakes. The authors have discussed how housing needs have been estimated following major disasters in the past, provided examples from previous disaster studies, and reviewed the considerations and information that are required for estimating temporary housing needs. This paper outlines the way in which the researchers involved in this NHRP project engaged with key stakeholders to aid decision-making. The report aims to serve as a record of both the decision-making processes and steps taken to assess and meet the temporary housing needs following the Canterbury earthquakes. Lessons learned are critical to both the improvement processes in Canterbury as the population continues to face housing

challenges, and to mitigate challenges and improve processes throughout New Zealand before and after future disasters. These issues are discussed throughout the paper, and recommendations for improvement are made in the conclusions. Section 2 gives a broad overview of emergency sheltering and temporary housing solutions provided by local, regional, and national government following the earthquakes. This section also discusses the legislation and government assistance made available to address the temporary housing need between September 2010 and December 2011. Section 3 provides a description of the management of temporary housing following the 2009 L'Aquila earthquake in Italy. Section 4 shortly outlines the collaborative efforts (and encountered difficulties) of stakeholders decision makers and researchers to: assess temporary housing needs; estimate population migration; and plan for in-migration to other regional councils in NZ. This section includes a discussion of the application and suggested improvements of the Canterbury-Darfield Earthquake Household Displacement Model. Section 4 also shortly addresses the challenges to effective collaboration and data sharing observed by researchers involved in this project. The conclusive section includes a preliminary discussion on the lesson that need to be learned from the Canterbury experience aiming to improve the post-disaster temporary housing management in NZ.

2. POST-DISASTER TEMPORARY HOUSING IN CANTERBURY: OVERVIEW

This summary represents the broad strokes of the progression of accommodation for earthquake-displaced people following the 4th September 2010 and 22nd February 2011 earthquakes. While there have been non-governmental organisations (NGOs), faith-based organisations, and private individuals helping manage the temporary housing needs of Canterbury residents, this summary will focus on the governmental response.

2.1 Post-disaster temporary housing following the 4 September 2010 Darfield Earthquake

Following the 4 September earthquake, emergency shelter was provided to those who required accommodation in the immediate aftermath of the event. Shelters opened at welfare centres at Linwood High School, Cowles Stadium, Burnside Welfare Centre and Addington Raceway Centre, and Kaiapoi Rugby Football clubrooms. On the night of 5 September 2010 an estimated 200 people stayed overnight in emergency shelters (The Press, 2011). The welfare centres closed within approximately two weeks of the event, although other non-sheltering assistance centres remained open throughout Canterbury. According to media reports, most displaced people were staying either with friends and family or in motels and hotels following the September earthquake. Parliamentary reports indicated that private insurance was the primary funding mechanism for displaced individuals requiring temporary accommodation in rental properties while their homes were repaired (Brownlee, 2011). Some grants and assistance were made available through Housing New Zealand, Red Cross, and other organisations. There was little movement on larger-scale and longer-term solutions until mid-February of 2011, over 5 months after the September earthquake. On 18 February 2011 just three days before the ultimately more damaging Christchurch earthquake, the Government announced that it was setting aside a fund to pay for accommodation for displaced people as their insurance coverage for temporary accommodation ran out (Brownlee, 2011). The Government also announced that it was establishing the Canterbury Earthquake Temporary Accommodation Service (CETAS), a joint effort of the Ministry of Social Development (MSD) and the Department of Building and Housing (DBH) (Brownlee, 2011).

On 21 February 2011 CETAS began operating in Christchurch and Government funded temporary accommodation financial assistance became available. Financial assistance consisted of \$180 a week for a one-person household, \$275 a week for a two-person household and \$330 a week for households of three or more people to cover rental costs for those who are displaced from their homes due to earthquake damage. The assistance was “universal and would not be subject to any income or asset testing” (Brownlee 2011).

2.2 Post-disaster temporary housing following the 22nd February 2011 Christchurch Earthquake

The M_w 6.3 earthquake on 22 February 2011 disrupted the launch of CETAS as well as causing much wider housing damage and increasing the demand for temporary accommodation solutions. On the

night of the February earthquake an estimated 700 people spent the night at the main welfare centre at Burnside High School (Figure 1a) and another 250 stayed at Hagley Park in Christchurch's central city (ONE News, 2011).

Welfare centres were again opened in several locations throughout Canterbury including Pioneer Stadium in Spreydon, Cowles Stadium in Aranui, a Baptist church in Rangiora, and Burnside High School and several did not close until mid-March. The week of the February earthquake Housing New Zealand Corporation reinitiated a programme used following the September event to find longer-term solutions for people requiring temporary accommodation. Housing New Zealand utilised the Housing Emergency Lease Programme (HELP), a telephone line and website service designed to provide temporary housing support to people whose homes were uninhabitable after the earthquakes. The accommodation provided by HELP consisted primarily of vacant homes (including holiday homes and batches) leased from private property owners in Canterbury and rented to people requiring accommodation (Environment Canterbury, 2011a).



Figure 1. Temporary shelter following Chch earthquake: a) Welfare Centre at Burnside High School gymnasium - 23rd Feb 2011 - (Photo Credit: Sarah Ivey); b) 24th August 2011 - Temporary houses village at Linwood Park (Photo Credit: Geoff Sloan)

The week following the February earthquake (28 February – 4 March, 2011) a working group was established to respond to short-term (from 2–3 weeks) to medium-term (up to 3 – 6 months) temporary housing issues. The working group was comprised of representatives from DBH, Civil Defence and Emergency Management (CDEM), and CCC. The working group's main initiatives were: 1) to develop and activate a plan for providing transportable, self-contained accommodation for households displaced by the Canterbury Earthquake on the 22 February 2011; 2) to explore options for emergency and medium-term temporary accommodation.

In March 2011 the Canterbury Earthquake (Resource Management Act Permitted Activities) Order 2011 was approved to enable the CCC to permit temporary accommodation for displaced people and businesses that would otherwise not comply with the City and District Plans. The expiry date was originally set at 31 March 2011 but the Government extended it to 19 April 2011 (Christchurch City Council, 2011a). Along with this Order, the DBH issued a request for proposals on providing up to 2500 modular or portable dwellings (DBH, 2011b).

In April the DBH made arrangements for several hundred campervans to be used as a temporary accommodation option at the Canterbury Agricultural Park, at a cost of \$190 per week for two people, \$271 for four, and \$337 for six, plus power expenses (NZPA, 2011). Most of the campervans were released soon after they were acquired, but of the 65 campervans retained only one was occupied by tenants as of August 2011 (Heather, 2011).

The campervans were meant to provide a relatively short-term solution to the perceived demand for temporary accommodation. In April 2011 contracts were awarded to preferred suppliers to provide portable dwellings as a longer-term accommodation (up to two years) for people whose homes were badly damaged as a result of the Canterbury earthquakes. Three providers (a consortium of

Hawkins/Spanbild/Fulton Hogan; Jennian Homes; and New Zealand Transportable Units) were chosen as the housing suppliers (DBH, 2011a).

Also in April 2011, CETAS was able to remobilise and officially take over from Housing New Zealand, arranging temporary housing for the earthquake affected public. CETAS is responsible for managing temporary accommodation matching, social services coordination and financial assistance for housing (Environment Canterbury, 2011b). By May CETAS reported that they had supported more than 50 people into private rental accommodation and by August 200 people had been assisted into rental accommodation (Bach, 2011b, Bach, 2011a).

In May the DBH announced that three sites for villages of portable homes were confirmed. These were Linwood Park (Figure 1b), Rawhiti Domain, and Kaiapoi Domain. They were also continuing to explore options of a fourth site in the Burwood area (Bach, 2011b). In July of 2011 the Kaiapoi Domain village opened, by August only seven of the 22 temporary units were occupied at the village. However, it is currently understood that the majority of the units are filled as of November 2011, and the Waimakariri District Council is exploring options for further temporary housing for Kaiapoi residents. The first tenants moved into the Linwood Park village in late August. However, due to the lack of demand, plans for the Rawhiti and Burwood villages were on hold at the time of writing (December 2011) (Christchurch City Council, 2011b). Similarly, another multimillion dollar Government plan to put temporary houses onto earthquake-damaged Christchurch properties has been cancelled after just two portable homes were installed.

3. MANAGEMENT OF TEMPORARY HOUSING ISSUES FOLLOWING THE L'AQUILA EARTHQUAKE, ITALY

On April 6, 2009 at approximately 3:30 AM, an earthquake with magnitude (M_w) 6.3 struck the region of L'Aquila, Italy. Significant damage occurred in the city of L'Aquila and more than twenty neighbouring towns killing 305 people and injuring at least 1500 (Camata et al. 2009; Rossetto et al. 2009). An estimated 15,000 buildings were damaged or destroyed, leading to the temporary evacuation of 70,000 to 80,000 and leaving about 30,000 people homeless (Rossetto et al. 2009, Bazzurro et al. 2009). Temporary Housing and reconstruction issues were administered by the central government, with control ceded to the regional government in February 1, 2010 (10 months after the quake). The governmental commissioner, until January 31, 2010, was the chief of the Civil Protection Department, Dr. Guido Bertolaso. Distinct from previous emergency events in Italy (Figure 2), the Civil Protection Agency and national government leaders decided NOT to provide temporary homes, such as trailers, campervans, portacomos. The sequence of major reconstruction and recovery events in L'Aquila can be summarized as follows:

- Immediately after the earthquake, the Civil Protection Agency established tent communities and set up housing for displaced peoples in hotels along the Adriatic Coast;
- End of April 2009, the resolution was made to construct permanent structures intended to outlast the recovery timeframe, the so-called "C.A.S.E", "Complessi Abitativi Antisismici ed Ecosostenibili Housing" - Earthquake-resistant Eco-sustainable Housing Complexes (Figure 3a) and "M.A.P." projects (Moduli Abitativi Provvisori - Temporary Housing Unit) (Figure 3b);
- 15th December 2009 (8 months following the quake), C.A.S.E. project apartment were delivered for 12,000 displaced people (Figure 1) and M.A.P. houses for 6,000 people.

The "C.A.S.E" project consists of 185 seismically isolated, sustainable and environmentally friendly buildings with 4,600 apartments for 12,000 displaced people. The 185 C.A.S.E. buildings were separated into 19 different areas within L'Aquila in order to avoid creating a "new town" and to maintain the identity of the city (Figure 3a). Total cost of the "C.A.S.E" project: € 819,320,194 (Bertolaso 2010).

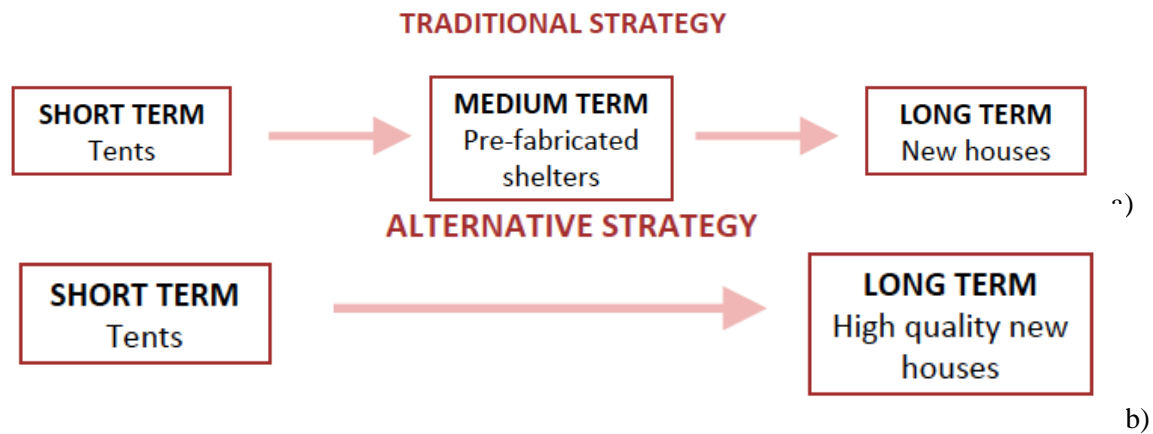


Figure 2. Strategy adopted in Italy to respond to post-disaster temporary housing needs: a) traditional; and b) new strategy post L’Aquila Earthquake (from Bertolaso 2010)

The “M.A.P” project addressed temporary housing needs for 6,000 people of rural villages or former municipalities of L’Aquila Region (Figure 3b). The “M.A.P.” Project consists of small groups of houses (3,113 in total) in 57 rural areas aiming to let people remaining the areas where they used to live and to which they feel they belong to. The M.A.P. houses were built to be highly earthquake resistant and safe. The M.A.P. houses were available in different sizes depending on the needs of the family hosted and of the characteristics of their geographical area. Various techniques and materials were used for their construction. Total cost of the “M.A.P.” Project: € 85,096,000 (Bertolaso 2010).



Figure 3. Post-Earthquake Housing Solution, in L’Aquila, Italy: a) C.A.S.E. project, some of the buildings b) M.A.P. project, some modules (photo credit Calvi and Spaziante, 2010).

The justification and guiding principles of the “C.A.S.E.” and “M.A.P.” projects can be easily found in the answers to the following questions:

- “What is the time difference that distinguishes a temporary or provisional home from a permanent or final?”.
- “Would it be possible to build temporary houses with environmental characteristics and safety levels similar to that required for permanent ones with cost per unit similar to provisional ones?”

The first question was discussed in the days directly following the 6 April 2009 Aquila earthquake. However it was clear that: 1) “temporary housing” built in Italy, following disastrous events, with the objective to last for months, or for a maximum of few years, ended up lasting for decades (Calvi and Spaziante, 2010) and far beyond their intended use; 2) the burden that such enduring settlements, planned to be temporary, imposed on the Italian Government and on the hosting communities from a social, economic, environmental and sustainable perspectives led officials to reconsider the prospect of

offering such temporary housing in the future (Johnson, 2007).

The answer to the second question was “YES”. The logical conclusion was therefore to propose the construction of provisional houses with similar (or possibly higher) characteristics and quality standards of the permanent ones (Calvi and Spaziente 2009). The costs of such a choiches (Table 1) were comparable, lower (M.A.P. versus Container) or completely justifiable in the long-term cost-benefit perspective.

Table 1. Comparing the average cost per square meter for C.A.S.E. and M.A.P. projects with portacom solution (from Bertolaso 2010)

Solution	Eruro/m2	Description
Container (portacom)	1070	Includes air conditioning, and basic furniture. <u>Costs for thermal insulation and electricity, sewerage system and road facilities not included.</u>
M.A.P.	1210	All inclusive
C.A.S.E.	2428	All inclusive + seismic isolation

4 ASSESSING HOUSING NEEDS, MIGRATION AND ACCOMMODATION TRENDS

Following the combined impacts of the 4 September 2010, 22 February and 13 June 2011 earthquakes there was a clear need to understand the temporary housing demand and supply in Canterbury, and at what point during the recovery process temporary housing would be required and made available. Further than determining the number of people that needed temporary accommodation, there was a significant need for the stakeholders involved in reconstruction planning activities in the Christchurch area to better understand population migration dynamics (Table 2) and by local and regional councils, and social agencies elsewhere who were attempting to manage or plan for in-migration from affected areas expressed similar needs and concerns (Table 3).

Table 2. Questions on temporary housing needs and population migration discussed with CCC as part of the NHRP short term project “Temporary Housing Issues”

Temporary Housing Needs and Population Migration: Pressing Questions

What is the current population baseline in Christchurch?
 How different is the population baseline from what was expected following the February earthquake?
 Is migration starting to settle?
 Will/should temporary accommodation be provided by public or private sector?
 Where do people go when they leaves their homes?
 Are people planning on coming back?
 If they are planning on coming back, when will this be?
 Where will temporary accommodation be located and who will go there?
 Plans to supply temporary accommodation are known, but what will the demand be?

Table 3. Priority Information Identified by Nelson City Council on population in-migration from affected areas (discussed with NCC as part of the NHRP “Temporary Housng Issues”).

Population in-migration from affected areas: Pressing Questions

How are population numbers being monitored after the earthquakes?
 What are the factors that might catalyse movement?
 Where are people moving to and what are the implications for the provision of public services in the Nelson-Tasman region?
 What additional pressures might be placed on local public resources and services such as health, education and housing? For example, how permanent are school reenrolments from Christchurch to Nelson? Will they continue to fluctuate as some people return to Christchurch?
 What additional services can be planned to support earthquake-related children, family and community needs?

The data sharing and data analysis involved a wide range of agencies, including representatives from CCC, Interagency Housing Group, CETAS, CERA, DBH, and Statistics NZ. The University of Canterbury assisted the development of appropriate assessments of the temporary housing needs and population migration. This process of determining the gaps in information and uncertainties faced by stakeholders raised the need to identify the factors that could prompt additional out-migration from Christchurch.

4.1 Canterbury-Darfield Earthquake Household Displacement Modelling, C-D EHDM

Following the 4 September Darfield Earthquake and in response to a request from the Earthquake Commission, EQC, and the CCC (under the auspices of the Housing Sub-Committee of the Christchurch Recovery, Social and Environmental Task Group, SETG), the Canterbury-Darfield Earthquake Household Displacement Model, C-D EHDM was created to determine the number of people that were likely to be displaced from their homes. An attempt was made to implement the same model to assess the number of people requiring temporary housing following the 22 February earthquake.

The model uses EQC data and damage categories to calculate the number of temporary-houses needed over time. The model output identifies, at an area unit level, the total displacement of household units, over time, based solely on the household rebuild and repair requirements. The model accounts for the following additional factors: the housing demand created by contractors and their employees moving into the area from elsewhere; demands for housing to meet infrastructure and commercial labour requirements; and the response of other agencies that can impact on the ultimate demand for temporary housing; actions by individuals regarding their own needs.

Of course, the temporary housing estimates from the C-D EHDM do not directly translate into temporary housing demand. The displacement numbers derived from the modelling can and have to be regarded as an upper bound estimate of future demand from the household sector and as a guide for gauging potential housing demand.

Two main criticalities were identified in the use of the C-D EHDM model to inform the management and recovery phases: 1) difficulties in promptly obtaining EQC data; 2) lack of a refined geographic separation of the damaged property data (aiming to reach the mesh block level or the single property level), particularly related to forward remediation programs.

The following modifications of the model and recommendation were discussed with the creators of the model and interested stakeholders as part of the Temporary Housing Issues, NHRP project:

- Explore the possibility of using, the “Building Safety Evaluation Data” that are promptly collected following the emergency as an alternative input for the model. These data should provide a stronger relationship with the displacement status for the residents than EQC claim data, as results from international research confirm (FEMA 2003).
- Link the model to a geographical information system, to allow for a geographical representation of the data.
- Integrate the know-how available internationally for the assessment of post-disaster temporary housing needs into the model, including the possibility for displaced population to volunteer information on their needs and preferences.

4.2 Alternative approaches to assess temporary housing needs and population migration

An alternative approach to the C-D EHDM model was considered, as part of the NHRP project, to estimate population in need of temporary housing. The concept was to use the rapidly assessed building safety evaluation (BSE) data as the input instead of EQC data. Past research on the 1994 Northridge Earthquake referred to in the HAZUS-MH technical manual (FEMA, 2003, p14-4) found a stronger relationship between red/yellow tags (indicating safety entry to buildings) and perceived habitability, than for levels of damage and perceived habitability. Perceived habitability is a critical component of displacement. Furthermore the idea was to include in the method an estimate of neighbourhood liveability, drawing on the framework model proposed by Wright and Johnston (2010)

for estimating evacuation numbers and sheltering requirements in NZ. The following research areas were explored:

1. Assessment of people in need for temporary housing based on household liveability: The building safety assessment BSE data, made available to the project by CCC, were used to indicate loss of habitable buildings. BSE data were combined with demographic data to assess potential displaced population due to the uninhabitability of their homes. Two methods were considered to process the data, namely: 1) A modified algorithm from the HAZUS-MH shelter model (FEMA 2003); 2) An ad-hoc algorithm, defined by the researchers, that establishes household liveability as a function of the both the tag colour and the usability status established as part of the post 22 February Earthquake building safety assessments. The results contained a number of sources of uncertainty, however, provided the researchers with valuable insight into possible methodologies for calculating displacement.

Not all displaced residents would require temporary housing, therefore, the population eligible for temporary housing was also estimated. The resulting numbers were adjusted to account for: 1) land zoning announcements; 2) population known to have migrated permanently outside of Christchurch based on NZ Post forwarding data. Power, water and wastewater outages were considered to account for the impact of service outages on household liveability.

2. Neighbourhood liveability: A method using GIS to evaluate access to neighbourhood amenities as an indicator of neighbourhood liveability was explored. Neighbourhood liveability or habitability as described by Wright and Johnson (2010) refers to individual and community factors which could influence decisions to leave or to stay such as disruption to education, employment, businesses or public services. Data was collected on businesses such as major supermarkets, banks and schools. The concept was to create a coarse “neighbourhood liveability index” and to use the index as an indicator of displacement potential, for the population not already displaced by the lack of household liveability. It was theorised that the same variables and index may be used, conversely, to assess possible attractive migration and pull factors. The data collected on neighbourhood liveability in the course of the research is incomplete due to time constraints and/or some data not being accessible to researchers at the level of enquiry (meshblock level).

3. Repair times: Time taken to repair or reconstruct residential dwellings was explored as a factor critical to establishing the timing of potential demand for temporary accommodation. Return times were estimated using repair/reconstruction time coefficients from two sources, namely: HAZUS-MH (FEMA, 2003); and coefficients developed for Wellington in an unpublished paper shared from GNS based researchers. The approaches were difficult to implement without introducing great uncertainty due to differences in the categorisation and geographic level of the BSE data.

4. Population Dynamics and real Demand for temporary housing: StatisticNZ embarked in a valuable and innovative work to assess the baseline population in Christchurch and to analyse post-earthquake population migration. Databases acquired and/or in the process to be acquired by Statistics NZ to assess and analyses population movements and to provide an answer to decision makers questions included, among others: NZ Post change of address data; EQC assessments; and earthquake-related financial grants; eftpos transactions; electricity consumption at the individual connection level (using Smartmeters to relay information); electricity disconnections and reconnections; cell phone usage data; births and death registrations (monitoring net growth), and; international arrival and departure cards.

Unfortunately researchers, and stakeholders in some cases, needed to ask for (and in many cases could not obtain) duplicate data directly from the data providers, because Statistics NZ were unable to share the information they had obtained from the same providers. As an example, Statistics NZ was able to obtain several forms of data including mobile phone usage and electricity usage, thanks to CERA, that, however, could not be shared with the researchers on ethical and commercial sensitivity grounds. Statistics NZ had found it impossible to obtain insurance claim data at the time of the discussion undertaken as part of NHRP project (August 2011).

5 CONCLUSIONS

UNDRO (1982) states that accelerated reconstruction of permanent housing is preferable to the use of temporary housing. International experiences (e.g. pre-1980, post-earthquake temporary housing management in Italy) have demonstrated that temporary settlements, conceived for medium-term use (6 months to 2 years), used to last for decades with negative social consequences for the displaced population and negative economic, social and environmental consequences for the hosting communities.

The international trend (at least what has been observed following the L'Aquila earthquake) for the management of temporary housing is therefore a two phases approach: from the short-term emergency response (tents, welfare centres) to the long-term response (high quality housing, conceived with the standard of permanent houses), escaping the medium term phase (low-quality short/medium-term temporary solutions).

A four-step approach has been observed following the 22nd February earthquake, including: 1) welfare centres; 2) campervans; 3) medium-term temporary housing; and 4) repair/reconstruction of permanent housing. Displaced persons following Christchurch earthquake did not seem to “accept” short-term solution (campervans) and to some extent the medium-term one (e.g. temporary housing at Linwood Park). People/communities have shown a great adaptive capacity and resilience choosing either to share accommodation with other families or to stay in their damaged house, adapting to the lack/reduced availability of lifelines services.

The planning for temporary housing for future events in NZ, should account for what observed in Christchurch. A two-phase approach that goes from the welfare centres, provision of alternative accommodation (e.g. motel/hotel/available apartments) directly to the repair/reconstruction is envisaged for NZ.

Internationally (e.g. L'Aquila) the provision of temporary housing to displaced populations is completely subsidised by the Government. The influence of the costs applied to the use of the temporary housing following the Christchurch earthquake on the apparent lack of demand for temporary housing should be further investigated.

A reliable estimate of displaced populations in need for temporary housing is a MUST for post-disaster temporary housing planning.

Any “Earthquake Household Displacement Modelling” in NZ should: 1) use the results of the building safety assessment, BSE as an input; 2) allow for a geographical representation of the results at a mesh-block level; 3) should account for international available knowledge and tools (e.g. Figure 4).

Seismic risk and scenario analysis at territorial authority scale should be run during ‘business-as-usual’ (before a disaster), to estimate the expected damage to the built-environment and the likely demand for temporary housing following an earthquake event. Data on the building vulnerability and the level of damage observed following the Canterbury events, and on the behaviour of the displaced population should be thoroughly collected and analysed. Calibration of models/tolls available for seismic risk analysis available nationally (e.g. RiskScape) and internationally (e.g. MAEviz) on the Canterbury data is recommended.

Databases on the location and availability of resources for temporary housing can and should be collected and maintained during ‘business-as-usual’ (before a disaster), to ease data collection demand post-crisis. Local authorities can carry out scoping projects any time prior to a disaster to determine areas that may be suitable for temporary housing and assess the infrastructure requirements for building on these areas. Identify potential suppliers for short-term sheltering solutions (tents, caravan, etc) prior to a disaster and maintain a database with contact details and estimated supply available.

Decision makers, practitioners, and researchers involved in the management of temporary housing issues should become aware of who they will need to work with following a disaster and strive to establish and maintain those relationships during ‘business-as-usual’, through collaborative planning, training, and exercising.

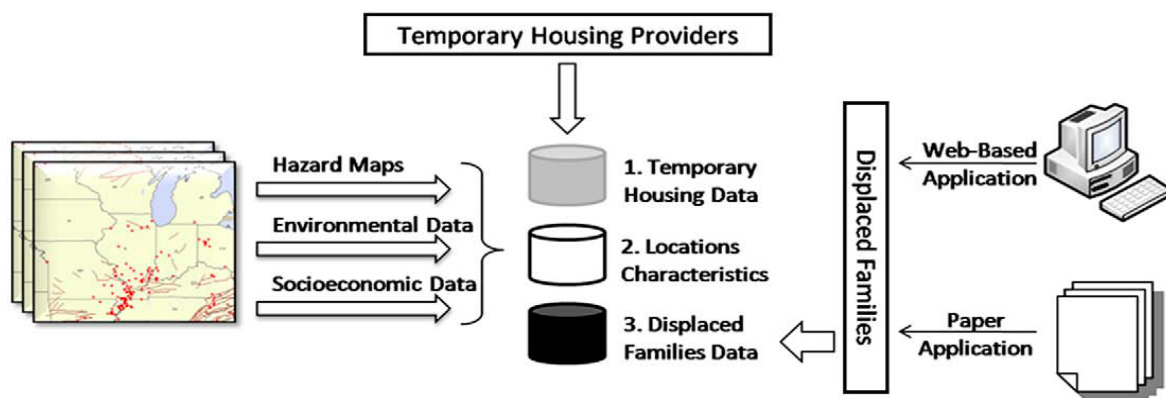


Figure 4: MAEviz, Temporary Housing automated optimisation model: Input data (from El-Anwar et al. 2009).

Data needs to be gathered efficiently and shared appropriately to ensure timely and well-informed decisions about temporary housing: the interactions undertaken as part of the NHRP short-term project “Temporary Housing” highlighted the importance of establishing trust based networks for effective data sharing, transparency, and avoiding duplicate analyses. There are persistent calls for greater collaboration between researchers, practitioners, and decision makers post-disaster. Significant efforts have been made following the Canterbury earthquakes to initiate and build these collaborations, however, data sharing and trust are issues that create barriers to optimal, efficient and accurate analyses which can inform decisions on a number of issues.

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