Christchurch City Council

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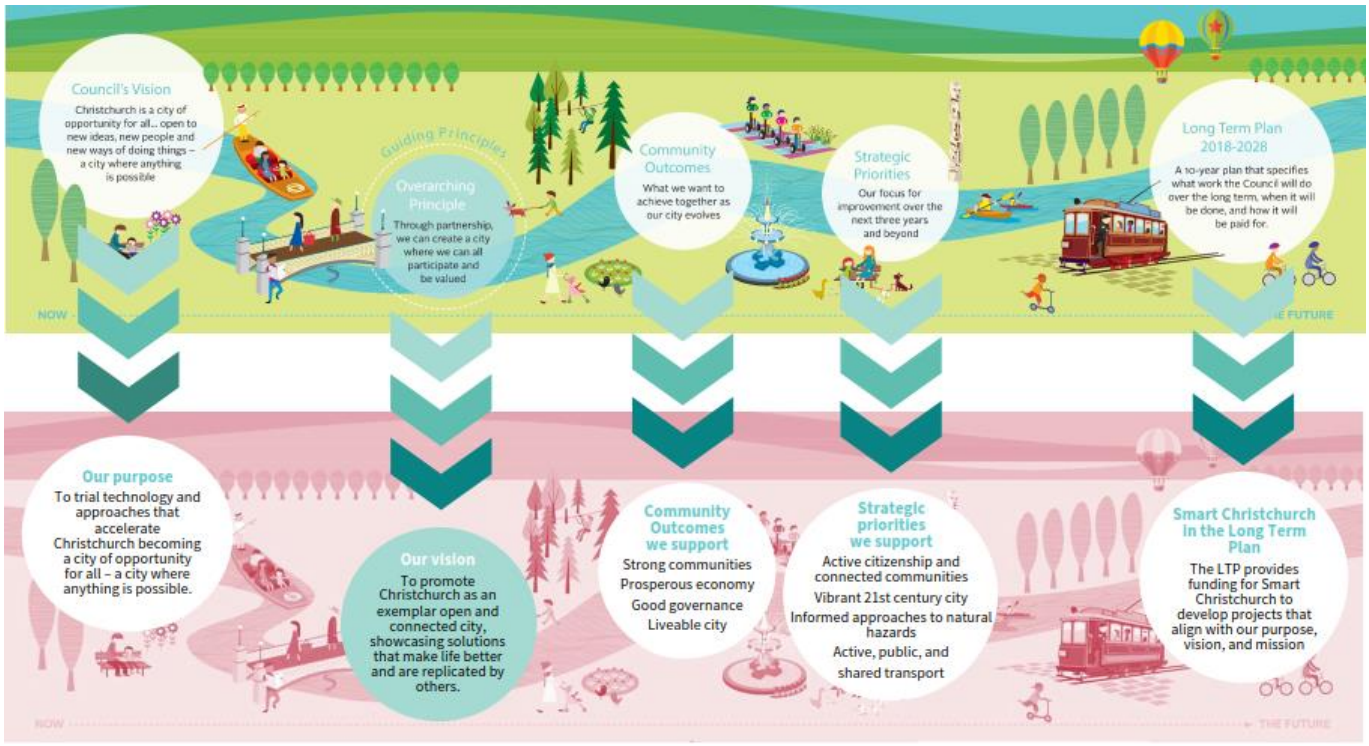


Seismic Resilience as a Service

Getting the best performance from our assets

Christchurch City Council

Contents

1 Project summary

In July 2018, the Smart Christchurch programme at Christchurch City Council (CCC) initiated a three year trial of the earthquake response network, EQRNet, with local company Canterbury Seismic Instruments (CSI). EQRNet is a dense network of more than 150 ground-based accelerometers which allows Council to manage its earthquake response in real-time; safeguarding communities, staff, and assets above and below ground.

This trial was initiated on the back of a 10-sensor pilot in the Christchurch CBD which demonstrated significant variations in ground-shaking over distances as small as 100m. This proved that a much greater level of monitoring is required than currently exists through GeoNet instrumentation.

Using EQRNet, we instantly compare localised shaking to every building's design intent and NZ Building Code Limit States using best-practice spectral analysis techniques. The network's output provides defendable real-time information to building managers, emergency teams, and the public, allowing better management of response during seismic events.

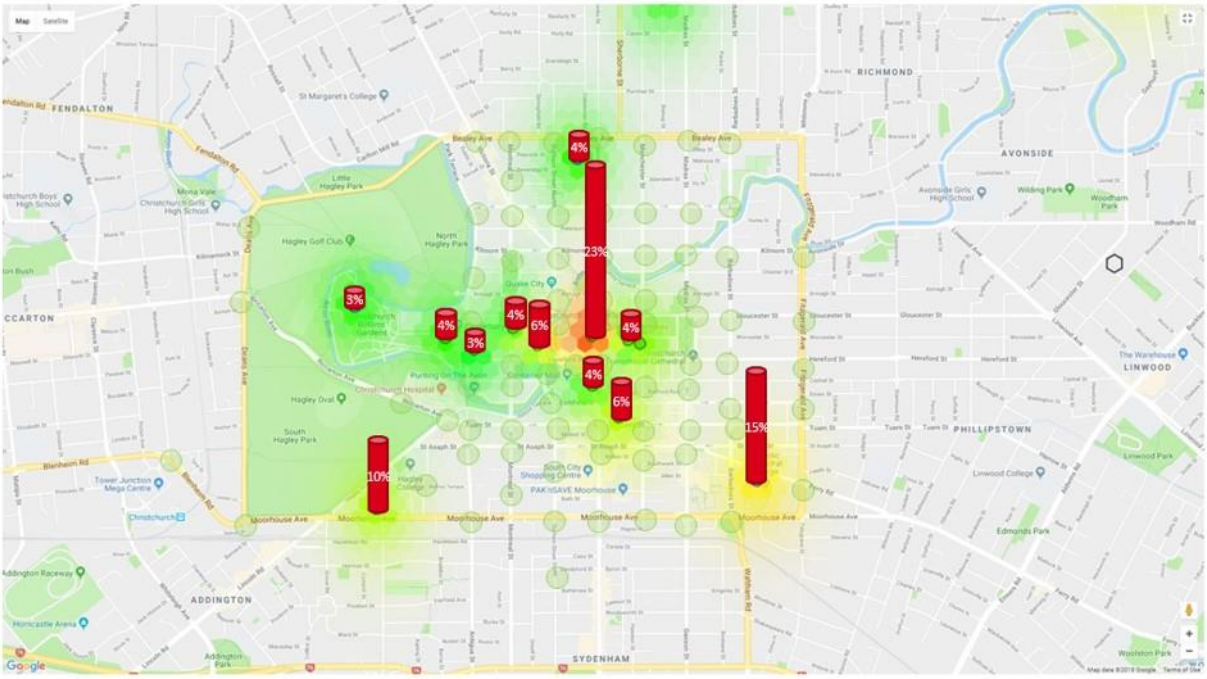
2 Strategic context

The earthquakes in Canterbury, Marlborough, and Wellington caused major loss of life and financial losses over $50B demonstrating the consequences of an earthquake event are severe and long lasting. Christchurch experienced red-zoning across the entire central city causing major economic and societal disruptions.

GeoNet has been Council's principal source of information when managing immediate and longer-term earthquake response actions. However, there are less than 25 GeoNet sensors in Christchurch, only 4 on the outskirts of the central city, and none in the CBD itself.

January 20 2018 M4.0 5 km SE of Christchurch, shaking relative to NZ Building Code Ultimate Limit State (ULS).

Our 10-sensor pilot in 2017 demonstrated significant variations in ground-shaking over distances as small as 100m within the CBD proving that sparse data is not suitable for site-by-site shaking variability or understanding ground shaking for an individual building.



January 20 2018 M4.0 5 km SE of Christchurch, shaking relative to NZ Building Code Ultimate Limit State (ULS).

Seismic Resilience as a Service(EQRNet) was conceived a to mitigate these risks whilst ensuring data is available for emergency response purposes.

This project aligns with:

- Greater Christchurch Resilience Plan
- Vision for Christchurch.
- Council's Strategic Framework:
  - Active citizenship and connected communities
  - Informed approaches to natural hazards

Risk	Mitigation
Buy-in from Council stakeholders: • Elected members • Staff: – Building inspectors – Facility managers – Finance / Procurement team – Major Facilities project managers – Executive Leadership Team.	10-sensor 'free' pilot demonstrated the effectiveness of the solution with no costs incurred. Workshops to discuss: • Facility managers • Building inspection team • Major Facilities project managers • Capital programme
Engineering community acceptance.	Mitigated by: • Using best-practice engineering techniques. • Giving them better data to do their jobs. • Using local and trusted supplier. • Involving in the pilot.
Funding of 150 sensor trial.	Using Smart Christchurch funding which has the mandate for trying new innovative technology and approaches.
Operational funding (post trial).	Having a 3 year trial allows funding to be allocated in the LTP and identifying opportunities for the service to self-fund through insurance premium rebates.

3 Project management

A joint project structure has been established between CCC and CSI, where CSI takes the lead for delivering and installing instrumentation, and delivery of the EQRNet service, whilst Council's role is to ensure its successful implementation across Council assets and processes and ensuring that EQRNet deliverables are fit for purpose not only for Christchurch City Council but for Councils and CDEM teams across NZ.

The Council has established an effective partnership with CSI and both parties are jointly responsible for creating an effective and affordable solution that can be replicated across New Zealand.

The EQRNet solution is not an off the shelf package, it is a bespoke solution for the NZ market, therefore it requires feedback and multiple iterations to make it fit-for-purpose. Some of things we have improved throughout the implementation of this project include:

- Revising the design of the sensors so that they can be fitted in traffic signal cabinets and be weatherproof. This resulted in utilising existing infrastructure instead of having to procure infrastructure solely for these sensors.

- Notification emails and text were revised based on the feedback of the current recipients of the alerts. This ensures that EQRNet output is easily understood.
- Participants in the EQRNet workshop provided feedback on the proposed changes on the Emergency Response procedure taking into account the implementation of EQRNet. This will continue to develop as we work with various stakeholders.
- We are currently engaging a contractor to work on user experience design of EQRNet heatmap to ensure the ease of use, and meaningful visualisation of data.

4 Relationship management

A key factor in the success of EQRNet, is the ability to integrate with Council regulatory and CDEM processes to directly inform the EQRNet service to become an effective Seismic Resilience as a Service for New Zealand as a whole. We recognise that effective engagement across a wide range of parties across multiple areas of responsibility and differing levels within the organisation, our local government colleagues as well as central government stakeholders such as Ministry of Business Innovation and Employment (MBIE) and GeoNet is vital to the success of the project.

The Project has engaged with those parties most affected by the new service: building wardens and local/regional emergency response personnel. We have undertaken multiple stakeholder workshops to introduce the concept, and then to understand the solution in more detail.

Draft changes to our existing earthquake response procedures have been prepared. Next steps involve earthquake event simulation and testing of the new response procedures. We expect this to result in changes to both the service outputs and the response procedures themselves. This iterative development both minimises risk (not too much change all at once) and ensures our stakeholders are get the opportunity to directly drive outcomes of value to them.

Externally, various stakeholders from GeoNet, CDEM, MBIE, engineering firms, tertiary institutions, etc. have also briefed and updated on the progress of the EQRNet project.

5 Continuous improvement

Support of Seismic Resilience as a Service, or EQRNet itself, is a demonstration of Council's commitment to continuous improvement. Our determination to learn from our earthquake experience ensures Council, our city, and colleagues and communities throughout NZ, are better prepared and respond more effectively in future earthquake events.

Adoption of the EQRNet service significantly improves performance in key areas of Council responsibility:

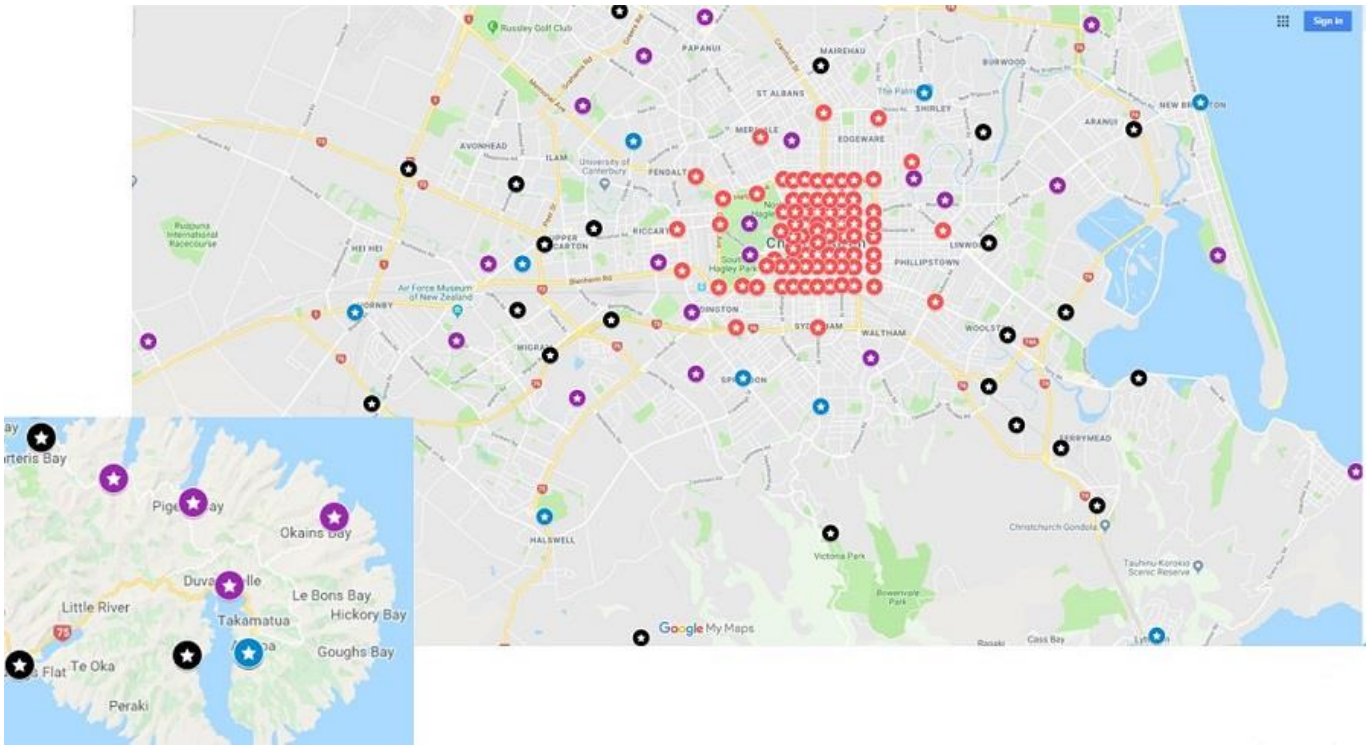
- Safe & healthy communities; Council is committed to providing safe and healthy workplaces for staff and providing a safe environment for citizens and takes all practical measures to achieve this.
- Informed and proactive approaches to natural hazards; good governance demands that Council takes steps to improve management of future quakes. The Council is relied upon to manage a coordinated priority response for the city through data-driven defendable decision-making.
- Modern and robust city infrastructure and community facilities; Given the significant investment in the rebuild of Christchurch from New Zealand tax payers and Christchurch rate payers, the Council is committed to implementing measures that will ensure that the maximum benefit is gained from this investment and that infrastructure has appropriate protections.

- Great place for people, business and investment; Christchurch cannot afford to shut down such a large portion of the CBD for so long again and therefore must take the necessary steps to avoid this if possible.
- Legislative requirements; Health & Safety legislation states that uncertainty and risk inherent in Council's current approach cannot be ignored once the shortfalls have been identified.
- Cost efficiencies; reduced risk and uncertainty gives Council the opportunity to negotiate with its insurance broker substantial discounts in Business Interruption and Material Damage premiums.

An End of Trial report will be written that contains the outcomes of the trial, lessons learned and recommendations for adoption as a Council service.

6 Project success

EQRNet delivers the most detailed ground shaking coverage of any city in the world; a true global first (see graphic below). If an earthquake occurred tomorrow, we have timely, relevant and better quality information with which to work. This will only improve with time: protecting our people and assets, improving citywide emergency response and providing better decisions, more transparency and vital reassurance to the community.



The Council will optimise the risk and cost balance with defendable real-time information. Its facility managers will benefit from instant, real-time alert information to manage earthquake response at each of its many assets, both above and below ground.

Private building owners and infrastructure companies who participate in the network will also receive real-time alert information to manage their earthquake response at their assets; both above and below ground.

Regional emergency management will benefit from an instant 'birds-eye' view of potential damage across the city (at a building-by-building level), allowing instant triage of the most affected areas and prioritisation of resource and response.

Christchurch citizens will benefit from EQRNet; raising seismic resilience awareness and providing useful and easily understood earthquake effects summary information within seconds of a quake.

EQRNet is capable of comparing local shaking to every building's design intent and NZ Building Code Limit States. The EQRNet's benefits:

- Minimises negative financial impacts
- Eliminates unnecessary evacuations and downtime costs
- Provides a defendable basis for potentially costly/difficult decisions
- Better coordination and information sharing between response agencies
- Better initial information for rapid building assessment teams
- Deliver improved risk estimation information to drive reduced insurance costs
- Improved public knowledge and confidence in Council's earthquake response action plans

Before: seismic sensors as a capital cost with silo-ed benefits	After: seismic resilience as a service for public good
Traditional seismic sensor solutions are seen as very expensive and delivered by major engineering firms with a profit incentive. Our experience with the Christchurch rebuild showed that seismic sensors in buildings were often de-scoped during cost-cutting exercises during construction. These silo-ed implementations do not have a public-good imperative and therefore do not typically make their data available for emergency response purposes or for the public to make individual quake response decisions. In addition, there were also several instances where seismic sensors had been implemented but then were not working during seismic events so effectively useless.	In order to mitigate these issues, we have changed the model from a one-off capex cost to a monthly operational cost that is committed to providing data for emergency response purposes and which leverages both public and private sensors for the network. Each additional sensor (whether public or private) provides exponential benefit for emergency response and informed decision-making for the network users.

6.1 The EQRNet solution

EQRNet is a subscription service that empowers city authorities, building owners, tenants, first responders and the general public to best manage their response to earthquakes by dramatically increasing the quantity, quality and relevance of information about the state of their buildings and city in real time. The more users that adopt the EQRNet service, the more data is gathered, and the more likely the cost will go down. There will also be opportunities where the reduction in insurance premiums and/or excess payments offset EQRNet costs by providing data that improves improved risk estimation.

Council being an Anchor User of the EQRNet service, assisted in the creation of a service that both Council and any other stakeholders (private or public) can participate in the future. Through this, the Council demonstrates leadership and credibility, removing barriers to access in the adoption of this critical city service by other building owners and infrastructure providers, as well as Greater Christchurch partners and cities and private sector throughout New Zealand.

It is easy for public organisations or private companies to be a part of the EQRNet network.

- Sensors can be installed in existing infrastructure.
- The installation of the sensor takes about 30 minutes.
- Power and relatively dry conditions are all that is required.
- There are innovative areas to house sensors such as traffic signal cabinets

6.2 An innovative approach for success

Choosing to deliver EQRNet as a three year trial is also innovative because this approach demonstrates its value to stakeholders and makes it easy to adopt by private and public agencies in Christchurch and across New Zealand. Benefits of the trial approach include:

- The Smart Christchurch Programme has a mandate to use funding for innovative technology and approaches.
- The Council receives full EQRNet benefit immediately.
- The three-year period allows for gradual integration of EQRNet services with Council operations, whilst not impacting operational budgets in this period.
- Sufficient time is provided to investigate opportunities where the reduction in insurance premiums and / or excess payments offset EQRNet costs.
- CSI and Council mitigate the risk should the Council wish to discontinue the EQRNet service.
- This allows other Councils and private entities around NZ to observe the network and choose to take advantage.

This project delivery model is strongly endorsed by both CSI and Smart Christchurch as an exemplar for other cities in New Zealand and around the world. Interest has come from across NZ, both public and private sector.

To date, EQRNet services have been adopted by Waimakariri District Council and Fire and Emergency NZ (nationwide), along with strong engagement from other city, district and regional councils across NZ and discussions with MBIE show interest in a national roll-out of EQRNet services.