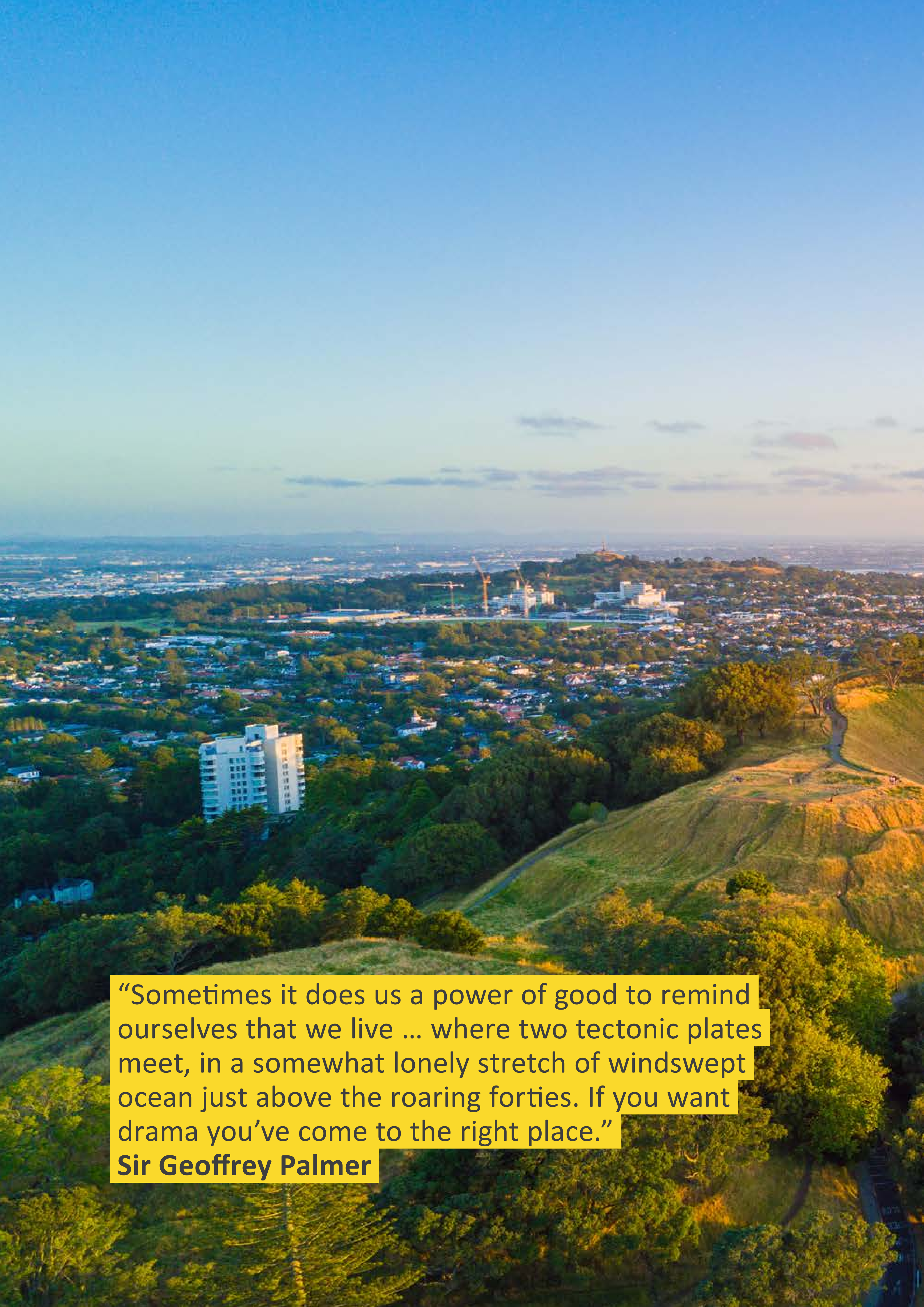
2020 EQC RESEARCH AND RESILIENCE UPDATE

EQC
EARTHQUAKE COMMISSION
Kōmihana Rūwhenua



“Sometimes it does us a power of good to remind ourselves that we live … where two tectonic plates meet, in a somewhat lonely stretch of windswept ocean just above the roaring forties. If you want drama you’ve come to the right place.”
Sir Geoffrey Palmer

OUR RESILIENCE VISION:
THAT NATURAL HAZARDS RESILIENCE BECOMES EMBEDDED IN ALL ASPECTS OF DECISION MAKING FOR OUR HOMES, TOWNS AND CITIES

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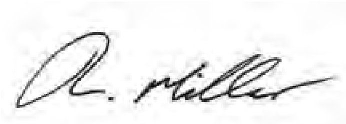
WELCOME TO THE 2020 EQC RESEARCH AND RESILIENCE UPDATE

Sid Miller, Chief Executive

2020 has certainly been quite a year, with Covid-19 affecting nearly everything we do at work and at home. EQC has been determined to stay on track with our work on risk reduction and resilience, knowing that natural hazards remain one of New Zealand's biggest everyday risks.

In April, Dame Silvia Cartwright's report of the Public Inquiry into the Earthquake Commission was released. The report contained a considerable number of recommendations relating to how EQC can play a greater role in building resilience to natural hazards. I'm pleased to say that work is already underway on many of these recommendations as we pursue our mission to reduce the impact on people and property when natural disasters occur. Others, we will be incorporating into next year's work programme.

I hope you find this update on some of our key areas of work over 2020 a useful insight into how we are contributing to a more resilient New Zealand.



Sid Miller
Chief Executive

Dr Jo Horrocks, Chief Resilience and Research Officer

It’s been just over a year since we launched our *Resilience Strategy for Natural Hazard Risk Reduction* setting out how we will work to reduce natural hazard risk and increase resilience in New Zealand over the 10 years to 2029.

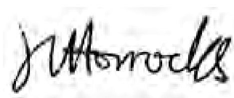
During 2020, we have focused and streamlined our data and research funding to drive our goal of stronger homes, on better land, served by resilient infrastructure. And we have continued to support EQC’s critical role of accessing international reinsurance.

We have also had a strong focus on making new knowledge accessible, and getting it into the hands of people making decisions that can increase the resilience of our homes, towns and cities.

During the year, many of us had the chance to pause (briefly!) and reflect on how science has advanced since the Darfield earthquake on 4 September 2010, while acknowledging that there is still so much more to learn and do.

We know that reducing risk and building resilience in New Zealand is a team effort across a huge number of people and organisations, and we are proud to be contributors to that effort.

This report gives a snapshot of some our work over the past year. As always, if there is something you want to know more about, or are keen to work on together, please don’t hesitate to get in touch at jhorrocks@eqc.govt.nz.



Dr Jo Horrocks
Chief Resilience and Research Officer

INTRODUCTION

If you live in New Zealand, natural hazards come with the territory. But that doesn't mean disasters have to.

Disasters come with the decisions we make about where people live and work, the buildings they are in, and the infrastructure connecting those buildings into communities, towns and cities. Disasters may seem inevitable and intractable, but there is much we can do to reduce the chance that hazards will affect us, and much we can do to lessen the impacts if and when they do.

Our vision is that natural hazards resilience becomes embedded in all aspects of decision making for our homes, towns and cities.

This report provides an update on some of EQC's research and resilience activity over the past year to help New Zealanders reduce natural hazard risk and build resilience.

HAZARDS EQC COVERS

EQC provides natural hazards insurance for damage to homes and land from **earthquakes**, **volcanic activity**, **landslips**, **tsunami** and **hydrothermal activity**—and residential land damage from **storms and flood**.

EQC'S RESILIENCE GOAL

Our resilience goal is to inform, enable and influence the choices and decisions that reduce vulnerability and the exposure of New Zealand's built environment to natural hazard events. In simple terms, the result we want to see is stronger homes, built on better land, served by resilient infrastructure, supported by affordable risk capital.

To do this, we fund research to develop scientific evidence for decision making; we put this into forms that decision makers can easily use; and we help get that evidence into the hands of the people who can make a difference.

Four focus areas

We pursue four key things to help reduce risk and build resilience in New Zealand.

A better understanding of New Zealand's natural hazard risks

Creating a more resilient built environment

Photo: University of Canterbury

Reducing current risks to our built environment

Smarter land-use planning

BUILDING THE EVIDENCE BASE

EQC invested more than $16 million in the 2019/2020 financial year into science, research and data to help understand our natural hazard risks and ways of preventing or reducing those risks.

We think of this as *building the evidence for change*. The more layers of evidence established through scientific insights, empirical research and corroborating data, the greater the case for change —for best practice, policy change or investment in resilience.

GeoNet

Our largest investment, at $13.7 million in 2019/2020 is GeoNet, New Zealand's natural hazard monitoring system. With more than 700 sensors nationwide, GeoNet monitors land and sea for movement and activity relating to earthquakes, large landslides, volcanoes and tsunami.

The data generated by GeoNet are used by response agencies for alerts, warnings, and situational awareness; by the public for hazard awareness; and by science and research organisations as the basis for natural hazards science. Because of GeoNet, New Zealand has some of the best knowledge of natural hazards across its land of any country worldwide.

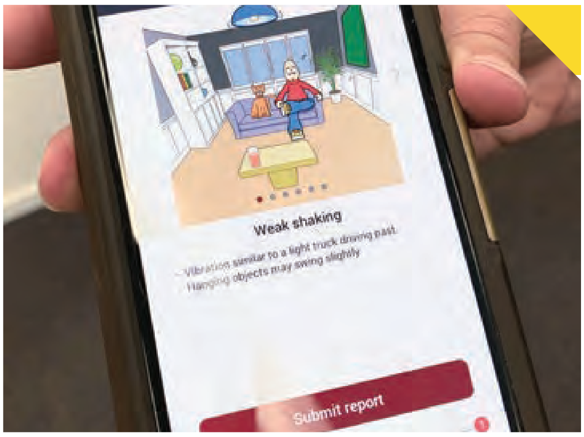
Data from GeoNet sensors are available, free of charge, to all. These data provide the base for natural hazards science on New Zealand.

24/7 monitoring and analysis

GeoNet data are analysed in near-real time at the National Geohazards Monitoring Centre to provide fast information on natural hazard events to people managing emergency responses.

Public information

Automated GeoNet algorithms translate data into New Zealand geohazard information available to all through the phone app or the GeoNet website.



Anyone can find out where earthquakes happened, what volcanoes are doing and how other hazards are tracking, and can contribute to New Zealand's understanding of geohazards by submitting "felt" reports about their earthquake experiences.

Investing in science and research

In 2019, EQC reviewed where and how our research funding could make the biggest difference to building New Zealand's resilience. The result was our *Research Investment Priorities Statement,* which guided decisions on awarding research funding in 2020.

Successful winners of Biennial Grants were announced at the beginning of 2020, and in mid-2020 we also announced funding of eight three-year university research programmes on key areas for building New Zealand's resilience.

At any given time, EQC is funding more than 30 research projects looking at everything from deep and long-term geological studies, to construction lab tests delivering results that can be used by builders within months.

Understanding natural hazard risks

Reducing risk and building resilience starts with an understanding of the nature of the risk, the drivers of risk, and how hazards could impact us now and in the future. This helps identify where the greatest opportunities are to make a difference.

There are many formal and informal ways of identifying, assessing and evaluating hazards and risks. Some will be informed by local and traditional knowledge, others through a more technical or scientific approach.

EQC aims to increase our collective understanding of natural hazard risks by investing in science, research and data and building capability in risk and loss modelling.

Measuring the strength greywacke rock

"Ugly, unloved and under-researched" is how Dr Carolyn Boulton describes the subject of her research—greywacke rock. Based at Victoria University of Wellington, Dr Boulton is sampling and testing greywacke rock to discover how greywacke responds to tectonic forces, particularly in "hosting" large magnitude and multi-fault earthquakes.

The strength of a fault, and how much stress it can withstand, fundamentally affects where earthquakes are generated and how they radiate energy.

Although many of New Zealand's recent earthquakes have been in faults in greywacke rock (e.g. Edgecumbe, Christchurch, Eketāhuna and Kaikōura) to date there has not been detailed study of what happens in the rock itself during and after an earthquake and what this could mean for future earthquakes.

As part of her project, Dr Boulton is collecting samples of greywacke rock in and near faults. She will then analyse their strength and stability. This will include subjecting the rock samples to simulated earthquake processes in laboratory experiments. These experiments will be performed at temperatures up to 450°C and pressures equivalent to those at depths between 10 and 15 km below the Earth's surface.

Results from the research will be used by other fault researchers and earthquake modellers to provide better estimates of New Zealand's earthquake risk and help answer the question of why New Zealand has so many multi-fault earthquakes.

Dr. Carolyn Boulton in greywacke country

Low seismicity, not low risk

New Zealanders in some parts of the country tend to think that living in a "low seismicity" area means they are safer from earthquakes. But research underway shows that this may not be the case.

Professor Mark Stirling at the University of Otago is leading research on faults in Southland, and GNS Science's Dr Pilar Villamor is investigating a newly discovered fault near Morrinsville in the Waikato which has the potential to generate a moderate to large earthquake.

In each case, the perception of "low seismicity" has meant that buildings and people in the area are less prepared for an earthquake than in high seismicity areas such as Wellington.

Earlier research has shown that faults in low seismicity areas have an irregular pattern of rupture. They may be quiet for many thousands of years and then produce earthquakes and significant aftershocks for a long period of time (decades).

Prof. Mark Stirling at the Hyde Fault. Photo: Guy Frederick

The current projects will build a record of pre-1840 earthquakes on the faults, and this in turn will help provide an estimate of the likelihood and magnitude of future earthquakes on a fault.

Working alongside Professor Stirling is Dr Caroline Orchiston from the University of Otago Centre for Sustainability. She is looking at some of the challenges decision makers face in making their communities more prepared for earthquakes. In particular how the Building Act has been implemented in low seismicity areas.

Bringing the geological and social science points of view together will give a fuller picture of what is needed to build community resilience and provide a case study that can be used to help other “low seismicity” areas like Auckland and Waikato be more prepared.

Different soil, same liquefaction effect

Before the 2016 Kaikōura earthquake, it was generally understood that sandy soil has high liquefaction potential. The 2016 quake, however, also triggered liquefaction in gravelly soil areas around Blenheim and Wellington’s waterfront.

Dr Gabrielle Chiaro, from the University of Canterbury, is leading research to understand how gravelly soil liquefies and what can be done to mitigate the risk.

The team has been drilling 15 metres below the ground surface in locations around Blenheim. They are using specially developed Cone Penetration Test equipment (CPT) which can push a large steel cone into the ground and measure the soil resistance it meets.

Dr Gabriele Chiaro drilling gravelly soil in Blenheim

Soil samples are also being taken back to the lab so that the team can determine the exact size and shape of particles in the liquefaction-prone soil, along with what the mix is of gravel, sand and silt.

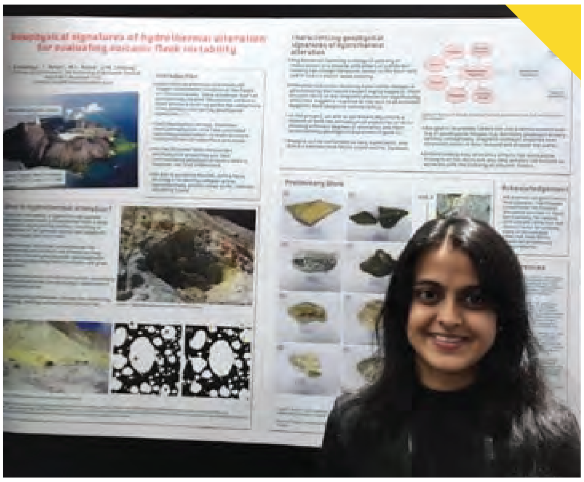
In the second phase of the research, the soil samples will be placed into a custom-made laboratory testing apparatus at the University of Canterbury where the team will replicate the type of earthquake load that can cause liquefaction.

The research will apply to other areas around New Zealand where there are either natural or reclaimed soils with the same makeup (e.g. Wellington's waterfront which is reclaimed gravelly soil).

Results from the research will be used for improving local hazard maps. The research will also be used to build a database of gravelly soil susceptible to liquefaction that councils, planners and developers can use to identify locations that might be at high liquefaction risk, and to make better-informed decisions about building on this type of land.

Plug or flow? How hydrothermal fluids change the plumbing of a volcano

Hydrothermal fluids (hot water and gases) circulating inside a volcano change the physical properties of rocks. As a result, volcanic rocks experience complex processes, such as dissolving and forming new minerals, which ultimately control the flow of fluids through them. If these fluids can easily circulate within the volcano, subsurface pressures are mostly released at volcano vents, crater lakes and fumaroles. However, if flow pathways get plugged due to the precipitation of minerals, fluid pressures build up and are later released in explosive eruptions.



Shreya Kanakiya with information on her study of fluids in volcanoes

In parallel, hydrothermal rock alteration also changes the strength of the rocks, which can result in volcano flank collapse as debris avalanches.

To probe the inside of a volcano and image this hydrothermal alteration, seismic waves and the magnetic properties of rocks are used; to date, however, these data cannot be directly associated with the physical changes of rocks. Geophysical, geological and geochemical laboratory studies are needed that link the rock hydrothermal alteration to geophysical signatures.

Shreya Kanakiya, a PhD researcher at the University of Auckland's School of Environment, is analysing datasets on hydrothermally altered rocks from Whakaari and Taranaki Maunga volcanoes. She is analysing “fresh” and altered rocks in the lab at pressure conditions resembling those within the volcano.

Ms Kanakiya is deciphering how mineral dissolution and precipitation due to hydrothermal alteration changes porosity, permeability and geophysical properties at great depths in volcanoes.

Her analysis will help transform geophysical images into rock physical properties of a volcano's plumbing system. It will also help geoscience researchers and hazard modellers improve volcanic activity monitoring, forecasting pressure buildup and mapping possible dome collapse areas.

Reducing current risks to our built environment

The resilience of our built environment— homes, buildings and infrastructure—is a key component of overall community resilience.

Buildings that cannot stand severe events tend to be the greatest source of loss of life and injury and the greatest source of cost in disasters. Damage or disruption to critical infrastructure can have flow-on effects to all parts of society, causing economic and wellbeing impacts.

While many disaster risk reduction efforts are focused on reducing future risks— through risk-informed land-use planning, smarter development and improved engineering techniques – it is important to address risk that already exists in our building stock and infrastructure.

This can involve techniques like seismic strengthening, retrofitting and other measures designed to increase the safety of buildings and infrastructure.

For EQC this means assessing and analysing risk levels, investing in research on strengthening solutions and raising the awareness of stakeholders and homeowners about measures they can take to protect their property and whānau.

Making old walls stronger walls

Wellington's CBD alone has more than 100 pre-1982 multi-storey buildings, including apartment buildings, that are potentially at risk from earthquake damage.

Walls in multi-storey buildings built in the 70s and early 80s can be at risk of buckling or bowing horizontally through the cross section under seismic loads. This is due to how they resist axial compression loads combined with the thinness of walls from this era. Dr Enrique del Rey Castillo from the University of Auckland is leading a research project to investigate the use of Carbon Fibre Reinforced Polymer (CFRP) to strengthen reinforced concrete walls.

Currently there are no New Zealand or international guidelines for how the walls can best be strengthened, meaning that owners need to find a separate engineering solution for each building. This adds cost and leads to inconsistency in how things are done.

Dr del Rey Castillo and his team are currently running tests on smaller sections of concrete that simulate the critical edges of the walls.

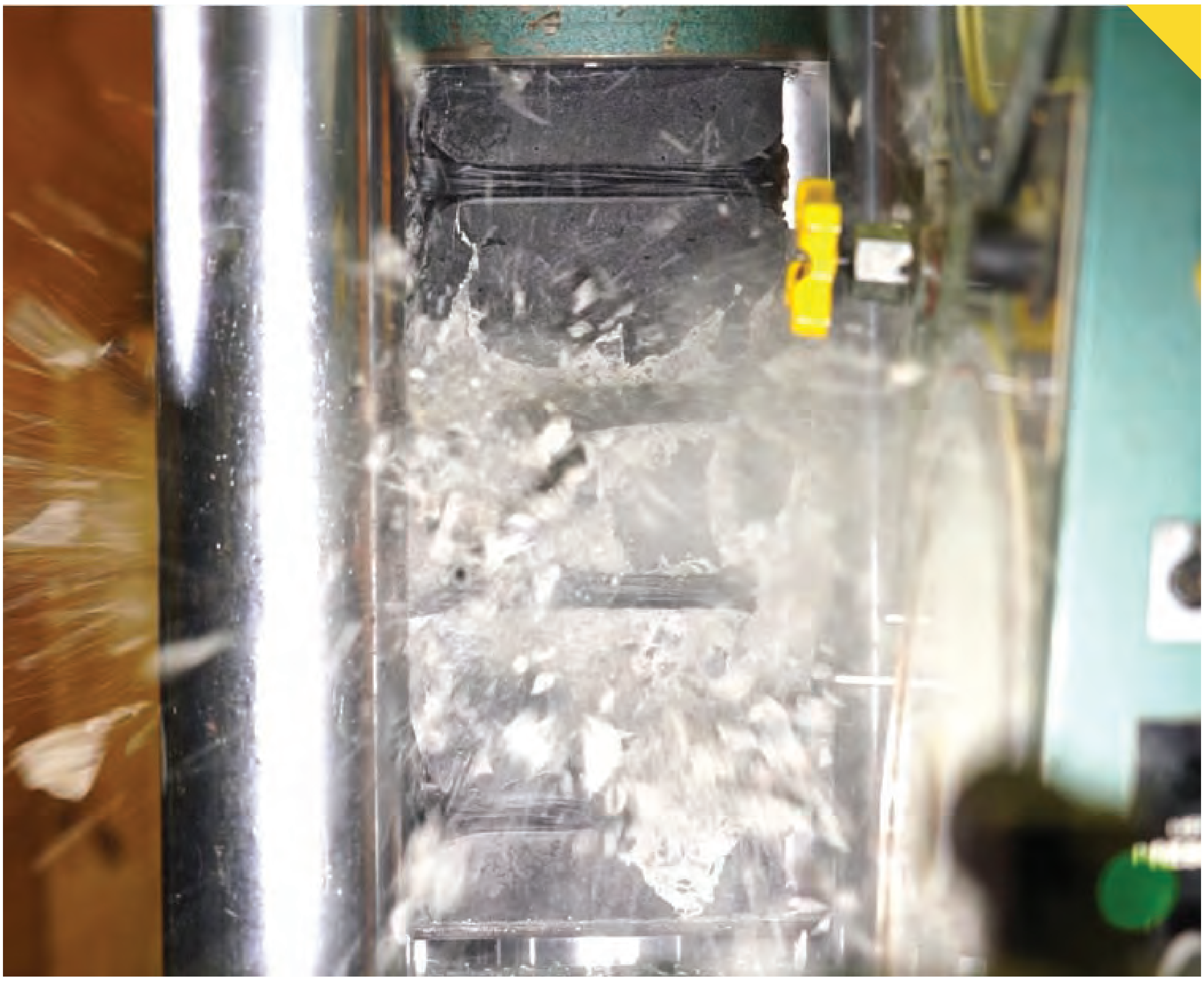
They will then move to building four-metre high walls typical of the era.

These walls will be tested to simulate the multi-storey loading levels and the seismic action on the walls, using different combinations of CFRP strengthening.

Once a successful strengthening system is established, results will be used to develop a design methodology that engineers can easily and reliably use to design the appropriate strengthening solution for each situation.

This research is also being supported by Mapei New Zealand, Sika, Holmes Consulting Group, Allied Concrete NZ and Concrete New Zealand.

Dr del Rey Castillo (left) with PhD researcher Victor Li in the lab are testing ways of making walls stronger. Photo: Victor Li

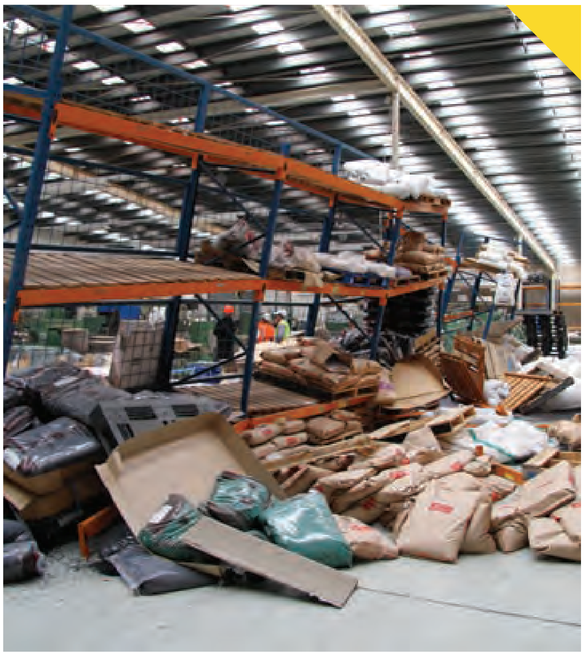


Lab testing of reinforced concrete

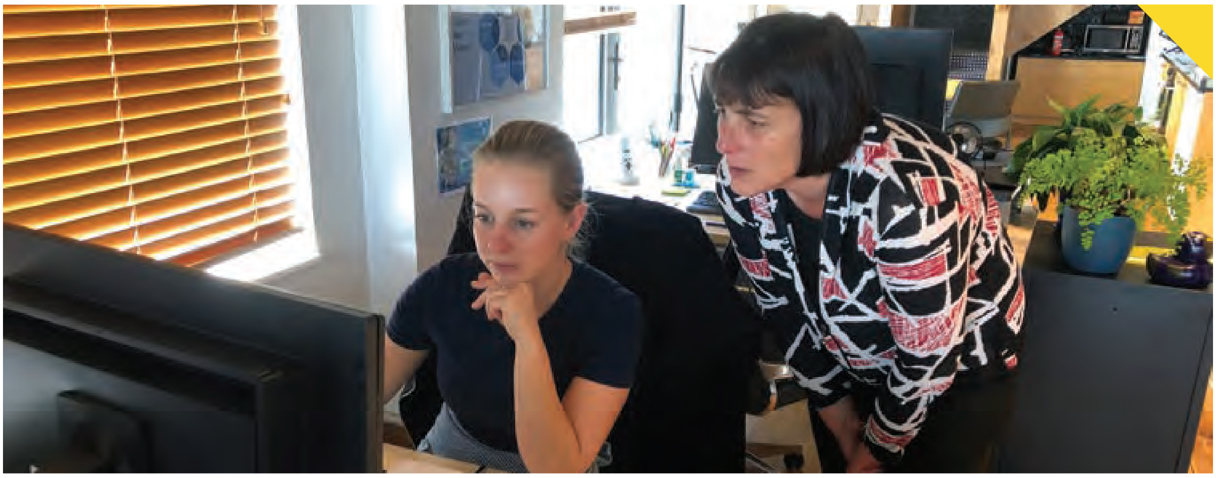
Reducing earthquake hazard in workplaces

Much has been done to reduce the structural risks of buildings for business and their customers over the ten years since the Darfield earthquake, but much less is known about what businesses have done to reduce other earthquake risks.

Researchers Dr Tracy Hatton and Sophie Horsfall from Resilient Organisations and Dr Toni Collins, University of Canterbury, are talking to businesses nationwide. They want to discover how much of a priority earthquake risk reduction is, and what has been done to improve seismic safety.



Warehouse workplace damage during the Christchurch earthquake sequence



Researchers Dr Tracy Hatton (right) and Sophie Horsfall are surveying businesses about earthquake safety

Fixing cabinets and other heavy furniture to walls and securing equipment (such as air conditioning units in ceilings and light fittings) are among some of the improvements that have emerged in the early round of qualitative interviews.

The team is also running a nationwide survey of businesses to find out what has worked and what the key challenges are for improving seismic health and safety. The team is particularly keen to understand if, and how, businesses see reducing earthquake risk as part of their overall Health and Safety obligation.

The research team will use the survey results to produce a *Best Practice* booklet, sharing what has worked, which will be freely available to all participants.

Bridge piles get a strength test

Destructive testing on the decommissioned Whirokino bridge and trestle has given Dr Lucas Hogan and his University of Auckland research team detailed data on the performance of bridge piles still common across the country.

The 90-year-old bridge and trestle on State Highway 1 south of Foxton was replaced earlier this year by Waka Kotahi NZ Transport Agency. A wider $70m structure was built over the Manawatū River and Moutoa floodplain, offering an unprecedented opportunity for real-life earthquake testing.

Dr Lucas Hogan (left) on site at Whikorkino Bridge with PhD researcher Pavan Chigullapally

Bridge piles ready to test

As well as extracting the bridge columns and shipping them to the University of Auckland Structures Lab for testing, the team has been pulling the exposed foundation piles back and forth to simulate earthquake movements. So far the foundations have held up well under the huge deformations.

The research, co-funded by EQC and QuakeCoRE, is being carried out in cooperation with Waka Kotahi, as the owner of the bridge. Sub-contractors Jurgens Demolition are working alongside the lead contractor, Fletcher Construction, who have fine-tuned the deconstruction programme to fit with the scientific needs of the University of Auckland team.

Once the field work is completed, Dr Hogan and team will create a computer model to assess the vulnerability of other bridges around the country and help prepare for future earthquakes.

There are still many bridges with these types of piles in the country, especially over braided rivers in the South Island in areas potentially affected by the Alpine Fault. Knowing the strength and vulnerabilities of these types of bridges will help assess what an earthquake could mean for transport on these bridges and the communication or sewerage services that may be running along them.

Engineers and infrastructure owners in New Zealand and internationally are keenly waiting for the results, due in late 2020, given the unique opportunity to gather data from pushing real bridge piles to their limits rather than using models in labs.

Creating a more resilient built environment

Reducing risks to the current building stock is critical for reducing impacts and losses from natural hazards in the immediate future.

However, the cheapest and easiest time to minimise risk is to build resilience in the planning, design and development phase.

This is particularly the case with new buildings and infrastructure and in land-use planning. Building resilient homes and infrastructure in low-risk locations, means new risks are not created, and costly “retrofitting” or other risk treatment options will not be needed in the future.

Faster construction, high quality, and just as strong?

Testing is underway at BRANZ to make sure that structural insulated panels (SIPs), a relatively new building system in New Zealand that can increase construction speed and potentially reduce cost for homes and low-rise buildings, perform well under New Zealand's seismic conditions.

Dr David Carradine checks SIPs panel performance after a test round

Structural Insulated Panels

SIPs, sandwich panels made of two face layers (like timber, metal or cement) and an insulating rigid foam core, have been widely used overseas for walls, roofs and floors for several decades, but are only now moving into wider use in New Zealand.

The panels can be prefabricated and assembled quickly on site, providing structural bracing and insulation in one system.

Dr David Carradine is leading the structural testing workstream as part of a wider BRANZ project looking at how the panels stand up to climate, fire and earthquakes.

Lab testing includes subjecting the panels to simulated earthquake and strong wind loads as part of standard New Zealand engineering tests to evaluate in-plane strength, stiffness and how the panels dissipate shaking energy.

Accelerated aging tests on typical SIP connections are also underway to ensure the system will continue to perform in the long term.

Dr Carradine says that, so far, things are looking good with SIPs able to resist the simulated earthquake loading, but not failing globally, while also dissipating energy.

Next, the SIPs will be tested in combination with other common New Zealand wall bracing systems such as timber and plasterboard. This will ensure that potential failure has not simply moved to another part of a building and allow a better understanding of the interactions among different wall systems.

As well as providing data on performance, the research aims to address the consenting challenge of SIPs. SIPs are currently considered an “alternative solution”, so owners often need to get an engineer’s assessment of compliance with the New Zealand Building Code, adding time and cost to a project.

Once results are analysed and reported (expected to be March 2021) manufacturers, council consenting teams and designers/engineers should be able to follow a simpler and more commonly understood process for compliance, knowing that SIPs have been tested against New Zealand’s Building Code.

Connecting cross-laminated timber walls for high performance

Cross Laminated Timber (CLT) makes it possible to build multi-storey timber buildings that are as strong as reinforced concrete buildings, but lighter and more environmentally sustainable.

Dr Minghao Li (right) and PhD researcher Ben Moerman are testing CLT wall connections

At the University of Canterbury, Dr Minghao Li and PhD researcher Ben Moerman are putting CLT structural walls and wall connections through their paces to see how they would stand up to shaking from earthquakes or wind loads.

CLT is made of structural timber boards glued together—essentially a much thicker version of plywood. Previous research has shown that CLT walls are strong and stiff, but the common connections between walls and to the foundation are not strong or stiff enough.

The team will develop and test new anchoring and connection systems, including the use of long (up to 1000mm) self-tapping screws on three-story CLT walls scaled to 2/3. Data from extensive lab testing will be used to create and validate models, which can then evaluate the performance of different building sizes.

Currently there are no New Zealand standards or guidelines for using CLT, although there are believed to be around 100 buildings under construction using CLT. Final results from the research will be used to write detailed guides on the most effective CLT anchoring and connection systems and how to design and build using them.

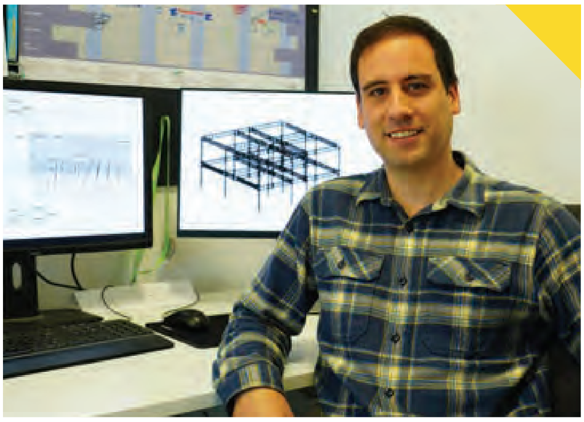
How much more would stronger buildings cost?

Building damage and demolition that occurred as a result of the Christchurch earthquakes and Kaikōura earthquakes, has prompted new thinking on ways to encourage developers and owners to build stronger than New Zealand's current "life safety"- based building code.

In Wellington, after the Kaikōura earthquake, several major nearly-new buildings were damaged beyond repair and had to be demolished, in spite of being built "to code".

The main reason given for not designing buildings less likely to be damaged is the additional cost, but to date there is very little data on how much that cost would be.

Research underway by Dr Enrique del Rey Castillo at the University of Auckland aims to quantify the extra cost of building reinforced concrete buildings to higher levels of earthquake performance. Concrete New Zealand is co-funding the research.



Dr del Rey Castillo

Dr del Rey Castillo is developing an extensive database of "model" buildings that have been created using the Building Modelling System. His focus will be on model buildings with reinforced concrete moment resisting frames and shear walls. These buildings will be used to create a costing database, including factors such as greater quantities of concrete and steel, the additional time and labour required and various construction methods. The database will be linked to buildings with different levels of seismic strength to enable an analysis of how much additional cost is involved in each case.

Once the model has been tested, Dr del Rey Castillo will develop a tool that will allow designers, developers, builders and policy makers to then easily compute the additional build cost for a given increase in a building's seismic strength. They can then make cost-effective decisions on buildings that are less likely to be damaged in an earthquake.

Smarter land-use planning

Where homes are built is a critical factor in creating or reducing natural hazard risk for our homes, towns and cities.

We can see houses around the country that are built too close to the edge of cliffs in the face of coastal erosion; are on flood area plains subject to repeated flooding; at sea-level on the coast subject to repeated inundation by storm surge; or are built on unstable or "creeping" land rapidly becoming degraded. Other than the life safety issues these can cause for individuals and communities, these sorts of planning decisions present a contingent liability that can often—and in very short order—become insurance claims.

EQC supports research and data collection to understand how land is affected by natural hazards, and to develop ways of mitigating natural hazard risk. These include techniques for strengthening land or planning that avoids development on the highest risk land.

Reading variations in the Earth's gravity field in Wellington's CBD

With some parts of the Wellington CBD affected significantly more than others in the 2016 Kaikōura earthquake, University of Victoria at Wellington Professor Tim Stern and masters degree student Alistair Stronach decided to take close look at variations in the thickness of the sedimentary rock Wellington is built on to see if that could provide an explanation.

To do so, they are using a high-precision gravity meter to measure small changes in the Earth's gravity field that are due to variations in the thickness of low-density sediments below the surface.

This will give them an indication of how the amplitude of seismic waves is modulated in Wellington CBD, and what this could mean for the level of shaking felt on the surface.

Alistair Stronach (left) and Professor Tim Stern on site in Wellington CBD measuring gravity changes

The gravity surveying work will feed into a study at GNS Science. The study uses computer modelling of how waves could travel through the Wellington sedimentary basin, which sits between the Wellington Fault and the postulated Aotea Fault, thought to be aligned with Kent Terrace.

Part of the research is to determine the exact position of the Aotea Fault. With two faults on either side of the city, seismic waves, particularly from a distant earthquake, are thought to be amplified as they reflect and become trapped in the soft sedimentary rock between the faults.

A close look at Gisborne landslides

As EQC claims data demonstrates, landslides are a major source of damage for homes. Matt Cook, PhD researcher from Auckland University's School of Environment, says that Gisborne brings together a "perfect combination" of conditions for landslides.

Tropical cyclones and severe rainfall, combined with the relatively young, soft rock and soil much of the city is built on, has already resulted in landslide damage to houses, with some demolished.

Mr Cook is working closely with the Gisborne District Council to map the extent and rate of slope movement in the city, and to gather data on historic landslides—some under existing buildings—to understand what could cause them to move again and identify other locations with similar conditions.

Initially, his research will use remote sensing technologies such as LiDAR (Light Detection and Ranging), which uses light transmitted from a laser mounted on an airplane to map elevation change and InSAR (Interferometric Synthetic Aperture Radar), which emits microwaves from a sensor mounted on a satellite. These imaging tools are used to measure ground movement to see both historic landslides and areas where the ground is now moving slowly, potentially as a precursor to a sudden major landslide.

Matt Cook is investigating landslides in Gisborne

The Gisborne/Tairawhiti region is fortunate to have full LiDAR coverage, acquired during the past two years, which allows for the difference from earlier urban LiDAR to be used as part of the assessment.

With Gisborne City having a history of urban landslides, Gisborne District Council is fully supporting the new research, which will allow potential landslide risks to be mapped in detail, giving a more precise assessment of landslide risk affecting dwellings. At present, hilly areas of the city are part of a blanket landslide risk zone, but this does not provide certainty to landowners about potential risks on their site. A key result of this project will be the ability to make property-level assessments of risk.

Shedding light on liquefaction

With liquefaction firmly established as a major risk to homes and communities following the Christchurch earthquake sequence, New Zealand has become a "natural laboratory" for understanding liquefaction risk, and ways of strengthening land and buildings against it.

Professor Misko Cubrinovski of the University of Canterbury has been an international leader in liquefaction research since the Canterbury earthquakes, and has received multiple awards on his work.

Over the next three years, with funding from EQC's University Research Programme, Professor Cubrinovski will lead research targeting ways of improving engineering assessments of soils and structures to better identify locations and buildings, which are vulnerable to liquefaction.

Along with identifying vulnerability, the research will deliver methodologies and tools for designers, engineers and local councils to support them in decision making that will increase earthquake resilience.

The research will involve detailed analysis of soils and how they behave under earthquake shaking: This will be simulated in the purpose built UC Geotechnical Engineering lab. Target areas for soil investigation will be 55 sites in Christchurch and reclaimed land under Wellington's port.

Professor Misko Cubrinovski (front right) observing damage on Wellington's waterfront

Funding for Professor Cubrinovski's research also provides support for student researchers to work alongside him, gaining experience and learning skills and approaches for their own future research.

Championing better land-use planning

Land-use planning has a major impact on New Zealand's resilience through both natural hazard risk management and climate change adaptation.

EQC is co-funding a programme, hosted by GNS Science, to support long-term land-use decision making that balances risk and development.

EQC's investment will focus on work to support local authorities' understanding and use of the Resource Management Act, increasing planning profession engagement in better management of natural hazards, and raising awareness of natural hazards planning within university courses.

As a first step, all councils will be surveyed about capability and capacity issues. Results from the survey will be used to understand what Continuing Professional Development courses could be developed to encourage better management of natural hazards. The survey will also identify what resources would best assist councils in their decision making.

EQC is funding the programme for three years.

Rockfalls on cliffs, Redcliffs following Christchurch earthquakes 2011. Photo: Graham Hancox

Building research talent

New Zealand's position as second-riskiest country in the world for natural hazard events (according to Lloyd's of London) has helped produce many world-leading natural hazard and risk reduction scientists. EQC is committed to helping nurture the next generation of scientists, who will continue the drive to understand our natural hazard risks and ways to reduce them.

Virtual science visits from school

2020 saw the delivery of our twelfth LEARNZ virtual fieldtrip in partnership with CORE Education.

The Alpine Fault: when AF8 goes big! will take Year 6 -8 students across Kā Tiritiri o te Moana/the Southern Alps to discover the incredible powers, which created the South Island landscape and still pose a threat to our communities.

Linking in with experts from the AF8 [Alpine Fault magnitude 8] programme, the field trip will visit a school close to the Alpine Fault to see how they have prepared themselves for natural hazards. Students will also learn practical measures to increase the preparedness of buildings to ensure personal safety. And it all happens from the comfort of their classrooms.

Further virtual field trips are planned for both 2021 and 2022.

Alpine fault view along the west side of Red Hills. Photo: Lloyd Homer

EQC University Research Programme

July 2020 saw the start of the revised EQC University Research Programme supporting visionary science leaders to oversee research into different aspects of natural hazard risk and risk reduction. Over the next three years, EQC will fund eight university programmes at five universities at $125,000 a year each, to help build New Zealand's resilience.

The funding supports research in fields ranging from paleoseismology, geology and engineering to economics and applying Mātauranga Māori to disaster risk reduction.

Along with delivering advances in science, each of the lead scientists will bring New Zealand's next generation of natural hazards scientists with them, offering guidance and experience to students on programme projects that will ultimately help them establish their own research careers.

Disastrous Doctorates

Each year, EQC is the key funder of Disastrous Doctorates—a three day forum for PhD students to share knowledge and skills, which is organised and run by students themselves.

In February this year, more than 40 students from a wide range of disciplines, all dedicated to reducing the impact of natural hazards, met at the 2020 Disastrous Doctorates in Dunedin. Over the three days they shared their research on everything from deep volcano science to specialist lifejackets for flood rescue workers, shared experiences of being a researcher, and heard from people established in science careers.

PhD student Amanda Wallis at Disastrous Doctorates

This year, EQC's Chief Resilience and Research Officer was invited to talk to the group about how EQC works to move research results into policy and practice. Members of the EQC communications team also ran a session giving tips on planning effective science communication and dealing with the media.

At Disastrous Doctorates

Fulbright-EQC Graduate Award in Natural Disaster Research

2020's Fulbright-EQC Graduate Award winner, Jesse Kearse, is planning to head to the NASA Jet Propulsion Laboratory (JPL) in California to gain expertise in using satellite data—though Covid-19 is making it a delayed start due to travel restrictions.

The Fulbright-EQC award gives young researchers the opportunity to either do part of their graduate degrees at a university in the USA or spend time as a visiting researcher at a centre of excellence there.

Mr Kearse aims to spend nine months with the world experts on INSAR (Interferometric Synthetic Aperture Radar—a technology that JPL has helped to develop) learning the latest analysis techniques. He will use his experience at JPL to analyse data from Sentinel-1 satellites to measure very small changes in vertical movement of New Zealand's land due to tectonic plate action when he returns to New Zealand.

This information will help him identify where in New Zealand is likely to be more at risk of sea level rise, with some areas lifting and some sinking towards the sea by millimetres each year. Along with providing detailed data on tectonic movement, the information is critical to his PhD research at Victoria University of Wellington looking at the localised effect of climate change and identifying areas that could be most at risk.

Jesse Kearse being presented with his award at Parliament by the Rt Hon Winston Peters, former Minister of Foreign Affairs

MAKING SCIENTIFIC EVIDENCE EASY TO USE

During our research review in 2019, it became clear that EQC, along with other natural hazards science funders, supports many researchers delivering excellent research, but that the research results do not always have the influence they could on decisions and actions. Researchers also told us that they want their research to have more effect on natural hazards resilience for New Zealanders.

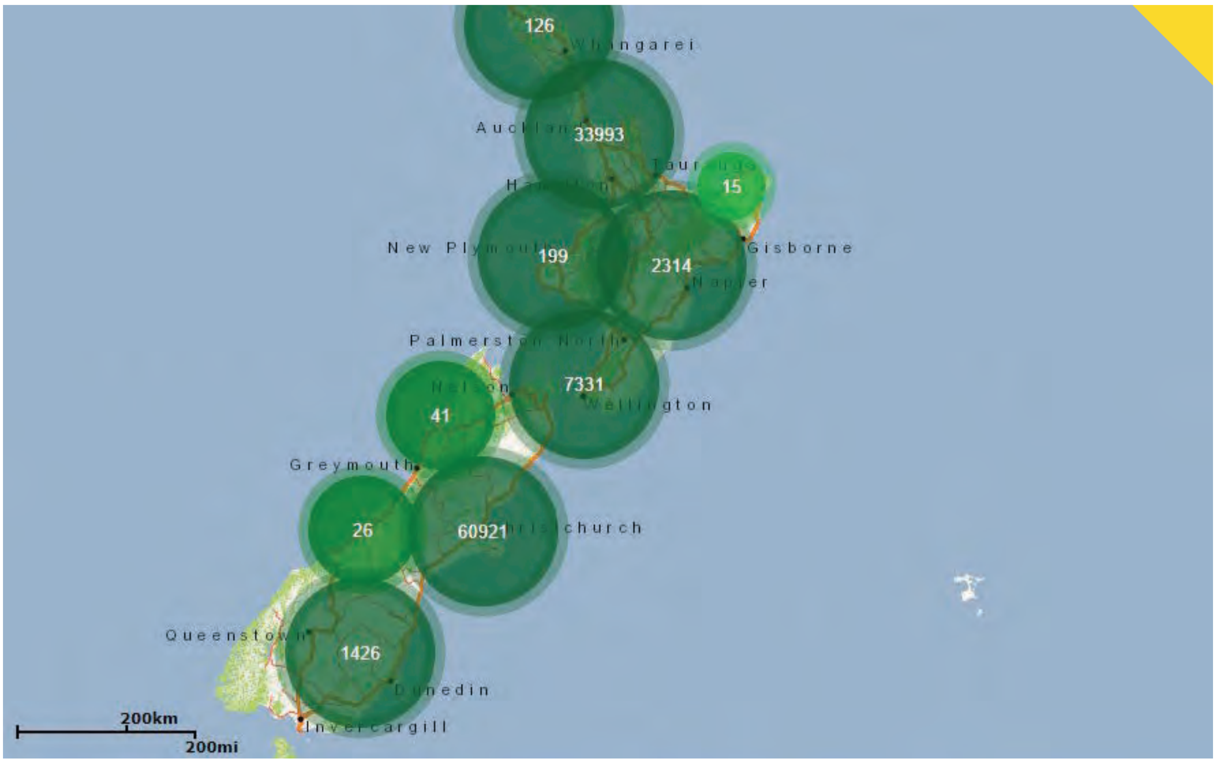
A key step in this pathway is to translate and operationalise scientific evidence into knowledge that decision makers, who are often not scientists, can use.

This year we are focusing a great deal of our effort on improving modelling, building scenarios, and bringing together data in accessible ways to help ensure that decision makers have sound science evidence in formats they can use.

Databases

Good data is the foundation of good decisions. Intensive research over the last decade has generated huge amounts of data, but organising that data and making it accessible has been a challenge.

EQC has been deeply involved in supporting two key databases to ensure that good data relating to land is freely accessible to people making decisions.



New Zealand Geotecnical Database datapoint clusters

Multiplying the power of geotechnical data

The New Zealand Geotechnical Database (NZGD) is a public/private resource that allows data from geotechnical tests to be uploaded once and shared many times. This public and private sharing of geotechnical data is thought to be internationally unique.

In 2020, EQC took over full funding of the NZGD for three years while a future strategy for the database is developed with stakeholders and users.

The NZGD now has more than 7,000 users, and is conservatively estimated to hold test data worth over $500 million. Users of the database include researchers, councils, engineers and developers—all able to access tests that have already been done, rather than needing to commission their own.

Providing easy and free access to geotechnical data has many benefits, including supporting hazard mapping and land-use planning for local councils. The NZGD is also being used in the development of nationwide liquefaction modelling.

Putting the landslide picture together

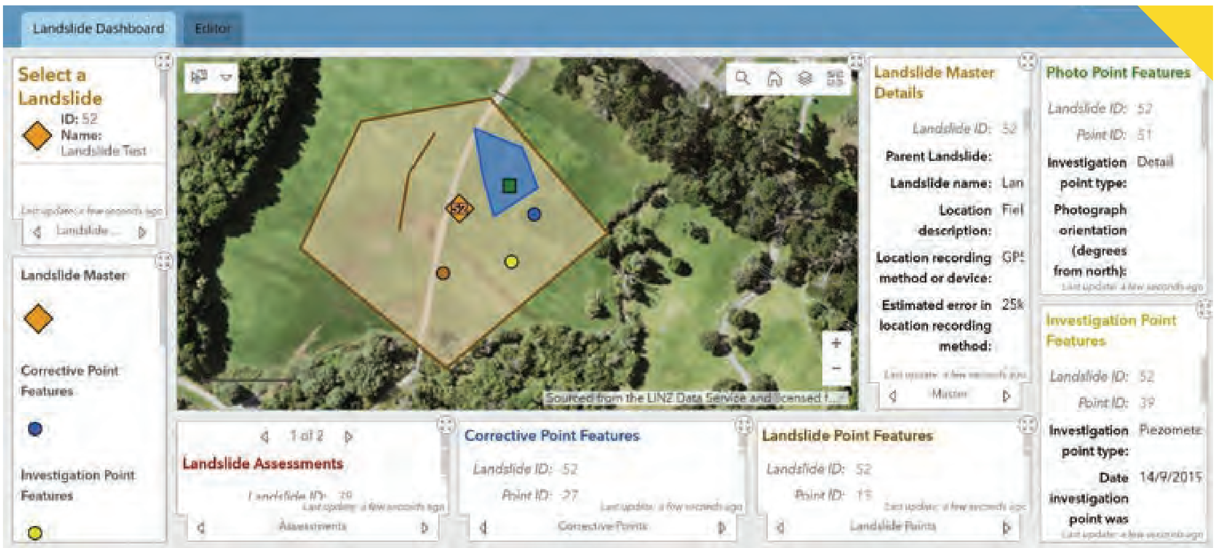
EQC is working closely with the Auckland Council, GNS Science, NZTA, KiwiRail and others to develop a National Landslide Database that will capture all current and future landslide information from local and regional councils, Crown entities and geotechnical consultants.

The database will make it easier to identify and assess landslide hazard across New Zealand.

So far, a successful pilot has been developed and work is now underway to deliver a full working database. The database will include an online map of known landslides, along with information on the magnitude, type and impacts of landslides.

Modelling impacts

Computer models are increasingly being used as the key tool to understand natural hazard risk, with advances in both science and computer technology driving further capability in the speed and scope of what can be incorporated into a model.

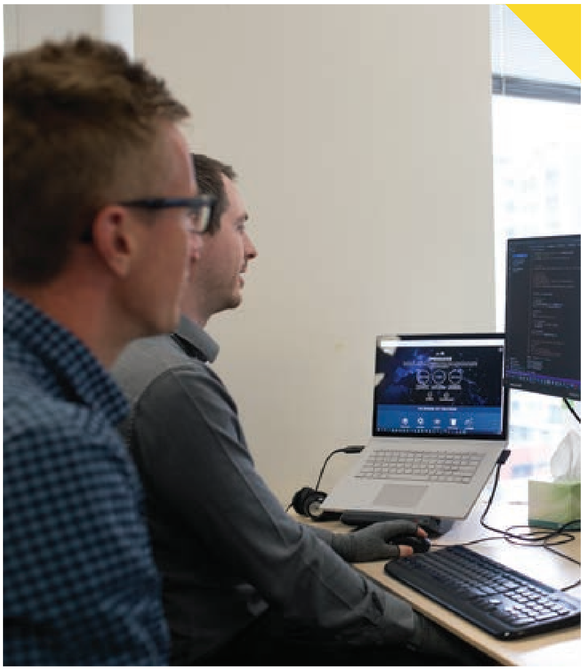


An output from the landslide database

As well as providing essential information for risk reduction decisions and action, loss modelling provides information to reinsurers to help them assess their risk in New Zealand and to EQC for planning its response to events.

During 2020, EQC has continued to invest in New Zealand risk modelling technology and science, including a range of smaller science projects looking at specific hazards.

RiskScape



EQC's Geoff Spurr and GNS Science's Nick Horspool working together on ensuring a smooth and accurate transition from Minerva to RiskScape. Photo: Sam Blyth

A key investment for EQC is our new loss modelling suite, 'PRUE' (Portfolio of Residential Underwritten Exposure), which is based on the RiskScape loss modelling engine developed by GNS Science and NIWA. RiskScape performs the calculations to estimate the impact from natural hazards. EQC's contribution, both financially and strategically, will help expand the functionality of the model, as well as the science it can incorporate.

EQC expects to replace its own inhouse model—Minerva—with PRUE in the near future. A critical element of the transition is ensuring that Minerva and our new model are fully reconciled in terms of the outputs they are delivering.

Once EQC's modelling is powered by the RiskScape engine, the new functionality will mean that EQC can more easily add other hazards to its modelling, and undertake more complex modelling such as compound and cascading events—such as landslides following an earthquake. This will give a fuller picture of the potential impact of natural hazards.

National Seismic Hazard Model

EQC has joined with MBIE and GNS Science to update the National Seismic Hazard Model (NSHM). The NSHM estimates the likelihood and strength of earthquake shaking in different parts of New Zealand and is widely used by government, industry, reinsurers and insurers to help estimate earthquake risk in New Zealand.

The update will be the first full revision of the model since 2002 and will bring in advances in scientific research and knowledge, including what has been learned from the Christchurch earthquake sequence, and the 2016 Kaikōura earthquake.

Estimations from the NSHM provide critical information for people making decisions about how buildings are built, road and rail infrastructure, insurance and civil defence planning.

Results from many research projects funded by EQC will form part of the new knowledge incorporated into the update.

The update is expected to be complete in mid-2022.

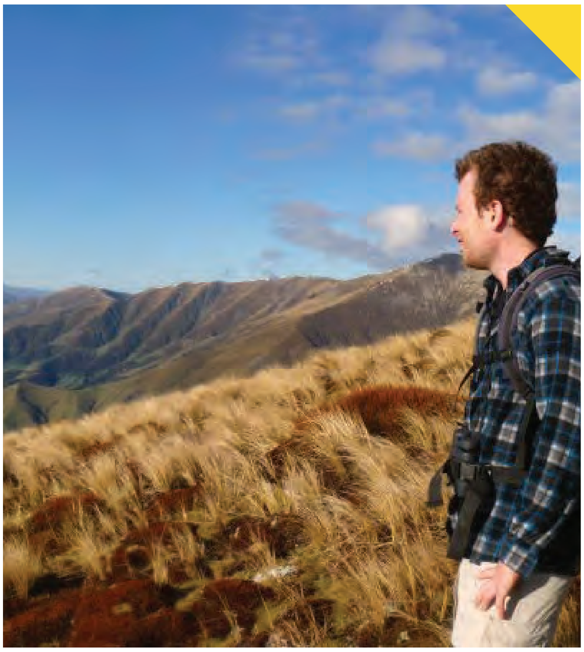
Developing a model for multi-fault earthquakes

Mapping from historical earthquakes is a critical part of developing a "fuzzy logic" model, which may help with forecasting which faults might set each other off in future in multi-fault earthquakes.

Using the Uniform California Earthquake Rupture Forecast as a starting point, Dr Tim Stahl is developing a model, which takes the particulars of New Zealand geology into account.

The new model will bring together the range of factors that lead to multi-fault earthquakes, such as the distances between fault lines, the orientations of angles between them, and the presence of minor faults that might link up the more active segments.

Similar modelling of multi-fault earthquakes to date has been based on black or white filters for the different factors. Dr Stahl's model introduces fuzzy logic to put all the relevant factors together and deliver a range of scenarios of what could happen. The scenarios will be tested against real-world data from past multi-fault earthquakes in New Zealand.



Dr Tim Stahl on fieldwork

The model will also aim to deliver an answer to the critical question of what the maximum credible earthquake could be in a particular location.

In developing the model, Dr Stahl is focusing on an area between Waiau and Blenheim, where one of the most complex multi-fault earthquakes ever recorded happened—the 2016 Kaikōura earthquake.

Tsunami and volcanic loss modelling

Starting in 2020, EQC is funding impact and loss modelling projects for tsunami and volcanic hazards in New Zealand—two hazards that are typically not well quantified and 'costed' worldwide.

The tsunami project will be led by scientists from GNS Science and the University of Canterbury and will use the Hawke's Bay region as a case study.

Results will be used for readiness, planning and insurance purposes, and have widespread applicability to other tsunami-prone coastal areas of New Zealand.

The volcano loss modelling project will leverage 10 years of volcanic hazard and impact research by DEVORA (Determining Volcanic Risk in Auckland) to undertake observational research and geospatial modelling to understand and assess potential volcanic impacts to the built environment. Its aim is to develop a suite of scenario-based impact and loss assessments, which will provide credible estimations of the likely impact of different eruptions on people and property in Auckland.

Developing scenarios

A key programme of work for EQC in 2020 and beyond is the development of a suite of nationally-consistent, credible hazard scenarios that will improve our ability to understand impact and loss from natural hazard events. This will also test and advance EQC's readiness, event response, and business continuity arrangements.

An agreed set of hazard scenarios, used effectively, will provide a common understanding of New Zealand's risks. These scenarios will also provide a consistent basis for mitigation actions, preparedness and planning for both EQC and external stakeholders.

Each scenario will be described: the likelihood and probability of the scenario occurring; likely impact and loss data across social, economic, environmental and built assets; capacity and capability to respond; strategic considerations; and any gaps or issues.

Our goal is to work with our loss modelling (science) investments; broaden our hazard base; and develop scenarios of varying magnitudes and locations, to deliver depth and breadth of hazard type, magnitude, location, probability, and damage.

A fictional volcanic eruption scenario from exercise Rūaumoko (MCDEM, 2008)

GETTING THE EVIDENCE TO THE RIGHT PEOPLE

New Zealand's natural hazard risk is reduced—or increased—by the many people making decisions about where and how New Zealanders build homes, towns, cities and infrastructure.

This year, we have put an increased focus on connecting and engaging with people involved in policy and practice to bring them the evidence in an accessible way.

We have continued to develop our relationship with central government policy makers, local government planning and consent officials, designers, engineers, architects and builders, and, through our Public Education programme, with homeowners.

We have also been successful in engaging media to take our science stories directly to the New Zealand public.

EQC Science-to-Policy Forum

Bringing science and decision makers together

EQC engages with policy makers and decision makers on a range of subjects, from building performance regulation to resource management planning to economic policy.

At the end of 2019, we hosted an inaugural EQC Science-to-Policy Forum. The programme included 20 speakers from the Resilience to Nature's Challenges and Deep South Natural Science Challenges, Crown Research Institutes, universities and consultancies, with nearly 60 policy practitioners from central and local government in attendance. We had positive feedback on the forum from the policy and science communities, and further forums have been requested. We believe such forums are useful for disseminating research to policy makers and practitioners; as a vehicle for explaining policy needs to researchers; and a 'safe space' for testing policy approaches with a diverse audience.

DEVORA—All about Auckland volcanoes

Auckland's DEVORA programme—Determining Volcanic Risk in Auckland—brings together scientists with emergency managers, planners and infrastructure providers to work together on reducing the impact of volcanoes in the city.

Dr Sophia Tsang (left) and Alec Wild present volcano simulations at the 13th annual DEVORA research forum

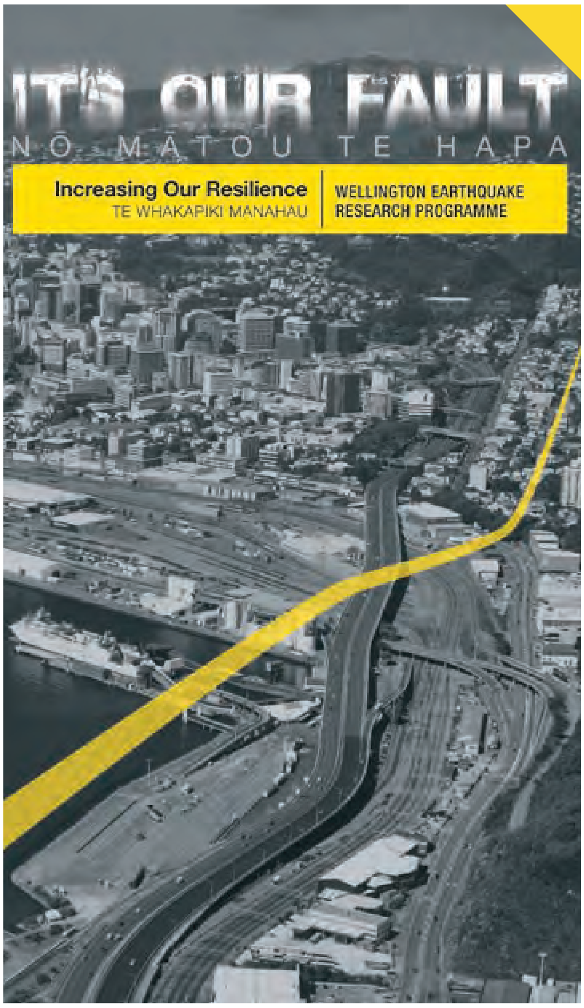
EQC is a founding partner in DEVORA and continues to be a major funder. With Auckland built on a potentially active volcanic field, and vulnerable to ashfall from other North Island volcanoes, a good understanding of the likely risks and impacts is important not just for the city, but the rest of New Zealand.

Through DEVORA, scientists look to understand key questions such as how often and how fast magma rises to the surface in the Auckland Volcanic Field, what patterns there have been in previous eruptions, and what the likely impacts of different eruptions could be in the future.

Science-based scenarios are developed to help planners and decision makers work out what they can do to reduce the impact of a future eruption.

It's Our Fault—All about Wellington earthquake risk

EQC is a founding partner in It's Our Fault, a collaborative science and users-of-science group looking at faults in the Wellington region, the potential impacts of fault ruptures on the people and property around them, and how those impacts could be reduced.



Along with earthquake hazard, the programme looks at the Wellington region's tsunami hazard, hazard from landslides and rockfall triggered by an earthquake, and liquefaction and fire following earthquake. The programme also has a very strong science-to-policy component to enable uptake of the latest science into policy and planning.

It's Our Fault has supported a significant number of research projects, from active fault studies to post-earthquake water supply restoration times to land-use planning for natural hazards.

Science is shared with local communities, iwi, councils and government to help the Wellington region be more prepared and do what it can to reduce risk ahead of hazards occurring.

Supporting resilient infrastructure

EQC is a key supporter of the New Zealand Lifelines Council (NZLC) and annual National Lifelines Forum, which brings together researchers, policymakers, and infrastructure providers.

Lifelines groups offer the platform for providers of essential infrastructure and services such as water, wastewater, electricity, gas, telecommunications and transportation networks to work together on projects to understand ways to reduce the impacts of hazards on lifelines infrastructure.

In 2020 EQC supported a significant update to the *National Vulnerability Assessment* report. The report provides a summary of information on the vulnerability of New Zealand's critical lifelines infrastructure to hazards, including those resulting from events such as volcanic activity, earthquakes, and flooding.

The report is intended to stimulate awareness of government, local authorities, utility providers, researchers and communities. It provides a unique strategic perspective on infrastructure services in

New Zealand, highlighting, in particular, the interdependencies of key infrastructure. Ultimately, the report aims to drive a change in the approach to prioritising resilience investment and to increase the resilience of infrastructure to meet community needs.

Partnering with councils on science and data

Councils are critical decision makers for their communities. Each year we work with councils around New Zealand to help generate science and data they need for hazard risk management decision making, including spatial and land-use planning.

This year, for example, we provided advice and funding to Tauranga City Council to support the development of its latest liquefaction hazard maps, funding and specialist expertise for the Marlborough District Council liquefaction hazard map project, and seed funding to the Waikato Regional Council to support LiDAR data collection.

These projects all aim to provide a precise, up-to-date view of land in their areas so that they can better manage natural hazard risk

Partnering with industry

Professional bodies play a key role in delivering the latest knowledge to their members. In 2020 we have worked closely with organisations such as Engineering New Zealand and the New Zealand Society for Earthquake Engineering (NZSEE) on working groups, strategies and projects for resilience.

Conferences, workshops and sponsorships

Each year EQC supports key science, research and risk conferences, workshops and seminars. Some of these, such as the Geoscience Society of New Zealand or the New Zealand Geotechnical Society conferences, encourage researchers to share findings and build alliances between them. Others such as the QuakeCoRE Annual Meeting or the New Zealand Society for Earthquake Engineering conference provide a platform for new knowledge to be presented and discussed directly with practitioners and decision makers.

In 2020 many of these gatherings had to be postponed or cancelled due to Covid-19. Others moved online, in many cases very successfully, reaching audiences far exceeding what they would have had with an in-person meeting.

One example of this was NZSEE's annual conference. Originally scheduled for April 2020, the NZSEE turned the conference into a series of webinars, each featuring two to three keynote speakers.

EQC continued to sponsor the webinar series, including hosting a special session on Low Damage Design. For this we invited an American structural engineer, David Mar, to share his experience on a highly successful and cost-effective, low damage design project in San Francisco.

David Mar

Low damage affordable housing project, Casa Adelante

The affordable housing project, Casa Adelante, delivered a low-damage, high-performance building for almost no additional cost over the original, conventional design.

The perceived cost of building to a higher standard is known to be a major barrier to more low damage buildings in New Zealand and overseas. Mr Mar's design showed that it is possible, and he was able to demonstrate how he achieved this to the nearly 600 participants from the engineering and construction sector on the webinar.

Taking it to the public

Natural hazard risks affect all New Zealanders, and everyone can play a part in reducing those risks. During 2020, EQC made a deliberate effort to take more of our research and resilience stories directly to the public through mainstream media, social media, public exhibitions and advertising.

Media attend an on-site briefing about EQC-funded BRANZ research on house foundations

Proactive media

Working with researchers funded through EQC, we delivered a steady stream of stories, which were enthusiastically picked up by print, online and TV channels, showing that New Zealanders are interested in knowing more about natural hazard risk and how to reduce it.

An additional aim of the media work was to give our researchers support and confidence to engage with media and tell their research story effectively to lay audiences.

Social media gets the message through

EQC continued to work with local partners throughout the year to connect Kiwis with the hazard messaging most relevant to them.

"A Lot On Our Plates" was an online campaign funded by EQC and developed by education programmes AF8 (Alpine Fault magnitude 8) and ECLAB (East Coast Life at the Boundary). To kick off the campaign, New Zealanders were invited to submit the questions they most wanted answered.

Over several weeks the campaign then provided interesting facts on natural hazards, risk and preparedness, which included direct access to subject matter experts through a Facebook Live Q&A session. The campaign rounded out with a quiz on all the topics covered.

Tying in with the campaign was the development of the *What's On Our Plates?* interactive learning modules. While they are based on NZ curriculum levels 4-6, the modules allow anyone to explore Aotearoa's active plate boundary, encouraging them to delve into the fascinating world of earth science and grow their knowledge of natural hazards.

Museums help grow hazard-aware Kiwis

The first step in preparing for natural hazards is being aware of them. Helping young New Zealanders understand the natural forces that have shaped our land is a vital aspect of EQC's Public Education programme.

EQC has strong and long-standing relationships with a number of partners that allow us to connect with young people across Aotearoa. Even with the challenges of Covid-19, the past year has seen thousands of visitors to four EQC-sponsored museum exhibitions with a natural hazards focus, including the redeveloped *Te Taiao | Nature* exhibit at Te Papa Tongarewa in Wellington.

Helping homeowners take risk reduction action

EQC continues to run campaigns encouraging homeowners to take risk reduction action.

Our "Love a home, check it first" campaign for homebuyers has been established as one of our "always on" activities, with the goal of getting Kiwis to consider the impact of natural hazards when choosing a new home.

Our most prominent campaign for 2020 rolled out amidst the unprecedented Covid-19 lockdown.

Featuring EQC's previously used "Teddy" character, the campaign built on the fact that nearly every New Zealander was getting to know their home well

In 2020 EQC videos aimed at homeowners and homebuyers each passed one million views on YouTube.

LOOKING AHEAD

Clarifying EQC's role

The 10-year anniversary of the Darfield earthquake on 4 September 2020 was a reminder of the urgency needed to reduce natural hazard risk for New Zealanders. EQC has a strong role to play as an insurer of homes, a key source of reinsurance, and a determined driver of greater resilience for our homes and communities.

We're confident that our 2019 *Resilience Strategy for Natural Hazard Risk Reduction* has set us on an effective path, though we also know that we still have a lot of work to do as we refine and develop our plans over the next years.

In early 2020, we commissioned Research First to ask stakeholders about our effectiveness in driving resilience. Though the feedback overall was that we are going in the right direction—delivering highly useful science and data and making a valuable contribution across the sector—there was a perceived lack of clarity over the role that EQC could or should play.

Over the coming year, we will be looking closely at where and how we can best play a role to build a more resilient New Zealand. This will include considerations from the Public Inquiry recommendations and also from the review of the Earthquake Commission Act, which is now underway.

We are very motivated to play a greater leadership role in hazard risk management, and will be consulting with stakeholders and community representatives as we consider how we could do this. We welcome direct feedback at any time.

Building our role in risk reduction

EQC is committed to playing an increasing role in building a more resilient New Zealand through effective natural hazard risk reduction.

Risk reduction is a complex aspect of hazard risk management due to the policy, regulations, practices and behavioural incentives required to support and deliver the reduction of risk.

During 2020 we have significantly increased the capability in our Resilience and Research team, and we are integrating risk reduction and resilience principles and knowledge into teams across the organisation.

EQC wants to support a collective, systemic approach to reducing natural hazard vulnerability and exposure in New Zealand. To do this we are building a comprehensive programme of work that allows us to leverage our investment in research and data, to influence, advocate for, and support evidence-informed risk reduction best practice.

Over the past 12 months we have increased EQC's capability and capacity to ensure information, knowledge, and data generated through EQC's research, risk modelling, damage assessment and claims management functions are used by other government and non-government agencies. This increased capacity will enable us to inform the development of efficient and effective policies, regulations, standards, guidelines and practices relevant to managing natural hazard risk. Ultimately, this will help manage Crown risk, and contingent liabilities associated with that risk.

Developing action plans to drive implementation of our Resilience Strategy

The EQC Resilience Strategy has, at its heart, a goal to inform, enable and influence the choices and decisions that reduce vulnerability and the exposure of New Zealand's built environment to natural hazard events. In simple terms, the result we want to see is stronger homes, built on better land, served by resilient infrastructure, and affordable risk capital.

In order to make deliberate progress on these aspirations, EQC is developing two action plans to guide our activities and help drive action.

Stronger Homes and Buildings Action Plan

The *Stronger Homes and Buildings Action Plan* aims to increase the resilience of New Zealand's built environment. The resilience of the current and future residential building stock is key to EQC's risk exposure. The resilience of the wider built environment, both vertical (buildings) and horizontal (infrastructure), is also a key component of overall community resilience.

EQC already participates in various activities across the built environment, including funding engineering science projects and programmes and supporting key professional associations. We are also keen to strategically target action to key areas of risk or need in the future.

A first draft of the *Stronger Homes and Buildings Action Plan* was developed in 2020. We intend to refine the plan through stakeholder and community engagement during 2021.

Better Land Action Plan

The *Better Land Action Plan* is aimed at influencing the system for land-use planning in New Zealand. Effective land-use planning contributes to both natural hazard risk management and climate change adaptation and holds the most promise for meaningful long-term decisions that balance risk and development.

We know from the Canterbury earthquake sequence that the biggest determinant of loss was not so much how a structure was built, but where it was built. Properties sited on land subject to the highest cumulative hazard (usually ground shaking plus liquefaction, or ground shaking plus topographic amplification) suffered the highest losses. To reduce future losses, it is important to be more discerning—and risk informed—in decision making on where and how land is developed. A first draft of the *Better Land Action Plan* was developed in 2020. We intend to refine the plan through stakeholder and community engagement during 2021.

Refining our research priorities

At the end of 2021 we will once again be asking for applications to our Biennial Grants research programme. Before that, we intend to review the research that is already underway and review how our Resilience Strategy is tracking towards our stated goals and objectives. We will also engage with a range of stakeholders to understand their knowledge needs and how we can best target our research investment to identified gaps.

These priorities will be published as a *Research Investment Priorities Statement*—something we aim to do every two years to drive the research landscape in ways that support the Resilience Strategy and our goal of *stronger homes, built on better land, served by resilient infrastructure*. We intend to make this a collaborative process that we hope all interested stakeholders will play a part in.

MEET THE TEAM

Dr Jo Horrocks
Chief Resilience and Research Officer

Sarah-Jayne McCurrach
Manager Risk Reduction and Resilience

Dr Wendy Saunders
Principal Advisor Risk Reduction and Resilience

Dr Alistair Davies
Senior Advisor Risk Reduction and Resilience

Caleb Dunne
Advisor Risk Reduction and Resilience

Dr Natalie Balfour
Manager Research

Janette Merlo
Research Advisor

Nicola Little
Senior Advisor Science Communication

Hamish Armstrong
Public Education Manager

EQC
EARTHQUAKE COMMISSION
Kōmihana Rūwhenua

The contingent liability associated with natural hazard risks means EQC has a critical financial and social interest in reducing risk and building resilience to natural hazards.

EQC PURSUES FOUR THINGS FOR A MORE RESILIENT NEW ZEALAND:

A better understanding of **natural hazard risk,** the drivers of risk, and the losses we could have.

A proactive approach to **reducing our current risks.**

Building for resilience and repairability – stronger homes, buildings, and infrastructure.

A risk-informed approach to **land-use planning** and to avoid building on the highest hazard land.

HOW WE DO IT:

We invest in **evidence** –science, research, data, and modelling–to build the case for change.

We aim to **translate** and **operationalise** this evidence into forms that people can use and act on.

We then aim to put the evidence **into the hands** of people who can make a difference:

- Central govt policy makers
- Local govt planners
- Engineers, developers & builders
- Home-owners
- The public

WHAT WE DO:

Research & Sponsorships

- GeoNet
- University Research Programmes
- Biennial Grants
- NZ Geotechnical and National Landslides Databases
- Loss modelling science and data*
- National Seismic Hazard Model; new residential fragility functions*

Risk Reduction & Resilience

- Coordination and collaboration in hazard risk management
- National Hazard Scenario Database*
- 'Stronger Homes' and 'Better Land' action plans*
- Resilience Portal
- Science to policy and practice

Public Education & Outreach

- Fix. Fasten. Don't Forget.
- Museum partnerships
- Public education partnerships
- Proactive media and social media

* Priorities in 20/21

VALUE ADD OPPORTUNITIES:

Sharing more of our data, risk information and modelling, and promoting **a greater risk-informed approach**

Participating more in the development of policy, regulations, standards, and guidelines to **ensure the effective management of risk**

Taking a greater role in the coordination and governance of natural hazard risk management to **ensure the system is working optimally**

OUR MISSION:
TO REDUCE THE IMPACT ON PEOPLE AND PROPERTY WHEN NATURAL DISASTERS OCCUR

EARTHQUAKE COMMISSION

Kōmihana Rūwhenua

November 2020

Cover photo shows Associate Professor Liam Wotherspoon lending his assistance to Dr Lucas Hogan's research on bridge piles. Photo by Pavan Chigullapally.