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Update on the 'It's Our Fault' project

1. Purpose

To inform the CDEM Group of progress to date on the 'It's Our Fault' project and request the CDEM Group consider and approve further financial support to the Institute of Geological and Nuclear Sciences (GNS Science) for the project's duration.

2. Background

"It's Our Fault" is the most comprehensive study of Wellington's earthquake risk to date. Its objective is to position Wellington as a more resilient city with a deeper understanding of the likelihood, nature and possible impacts of its earthquakes. Findings from the last 6 years have already contributed to a more accurate estimation of the real risk, which have been used for better city and civil defence emergency management planning, as well as influencing negative perceptions that have a flow on effect to investment and insurance premiums.

3. Project duration

The project has been running since 2006 and at least another four years of work is required to complete critical areas of the initial work. This work is formulated under and governed by the terms and conditions of the It's Our Fault Research Programme Agreement dated July 2006 between Earthquake Commission, GNS Science and Accident Compensation Corporation (as acceded to by Wellington City Council and Wellington Civil Defence and Emergency Management Group) (Research Programme Agreement).

4. Results to date

Findings to date are challenging long held assumptions about the behaviour of fault lines in the Wellington region and highlight the need to revise the basis of Wellington's planning and preparedness for earthquake.

The latest results indicate the chance of having a large (magnitude ~7.5) earthquake on the Wellington fault is significantly lower than previously thought, with the probability of rupture being ~10% in the next 100 years. This reduced probability provides greater opportunity for emergency management, engineering and other measures to be properly implemented, which would significantly enhance the resilience of Wellington in the coming decades. However, the findings do mean that more frequent moderate sized earthquakes (magnitude 6 to 7) or larger distant earthquakes now have, potentially, more relevance in terms of planning and preparedness in Wellington.

5. Benefits to date

These include:

- Reduced probability of a movement on the Wellington fault, the frequency of occurrence and a better estimation of when the last event occurred. This enables the insurance industry to have a better understanding of the risks. Hence, premiums can be priced more accurately

- 3-dimensional models of central Wellington and Lower Hutt and accompanying seismic shaking information now enables engineers to design structures for each locality more accurately. The area has been categorised into five subsoil class categories according to the New Zealand Structural Design Standard (i.e. the Building Code).

- Mapping of active faults in Cook Strait. This information will be used in future tsunami hazard assessments of the region and could impact on coastal land use planning

6. Tasks for 2012/13

Tasks for the 2012 – 2013 year and the potential areas of study post 2012 – 2013 are included as **Attachment 1**.

These include but are not limited to:

- Communicating findings to the public

- Producing data sets for affected parties

- Estimating the losses and casualties for large earthquakes

- Determining the potential impact of after shocks

- Better defining size and recurrence of potential subduction zone rupture.

7. Funding

At present, the direct annual budget for "It's Our Fault" is approximately $450,000 with funding as follows. (**Note** these are not exact figures)

Earthquake Commission – 56% (to a maximum of $250,000)

Wellington City Council – 22% (to a maximum of $100,000)

Accident Compensation Corporation – 11% (to a maximum of $50,000)

Wellington Region CDEM Group – 11% (to a maximum of $50,000)

Each CDEM Group member currently contributes annually as follows:

	No additional contribution by WCC	
Greater Wellington	40.1%	$20,050
Kapiti Coast District Council	10.4%	$5,200
Porirua City Council	10.8%	$5,400
Wellington City Council	0	0
Hutt City Council	21.7%	$10,850
Upper Hutt City Council	8.5%	$4,250
Masterton District Council	5.0%	$2,500
Carterton District Council	1.5%	$750
South Wairarapa District Council	2.0%	$1,000
Total		$50,000

8. CEG meeting

At its meeting on 26 October 2012 CEG noted that:

- Wellington City Council has had a good return on its investment with GNS and the presentations by GNS to the Wellington community have been over-subscribed.

- Kapiti Coast District Council's experience demonstrates a council must have strategies in place to manage the information coming from GNS.

9. Recommendations

That the CDEM Group:

1. ***Receives*** *the report.*

2. ***Notes*** *the contents.*

3. ***Considers*** *the Wellington Region CDEM Group's support for the continuance of the 'It's Our Fault' project to the sum of $50,000 for each of the financial years 2013/14 and 2014/15.*

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Attachment 1: Summary of current tasks and potential study areas

Attachment 1

Summary of current tasks and potential study areas

Over the 2012-13 financial year, the It's Our Fault Effects and Impacts phases continued, and a new Likelihood Phase II embarked on. The underlying goal of the Effects Phase is better definition of earthquake ground shaking and liquefaction hazard in the Wellington region. These results will provide input to the Impacts Phase, during which the earthquake loss, recovery time and social ramifications will be evaluated. Also within the Impacts Phase, the Task aimed at accounting for aftershock hazard in Wellington will continue. The new Likelihood Phase II will be focused on further characterising the rupture hazard posed by the subduction interface under Wellington, and the potential hazard posed by active faulting in Wellington Harbour.

Tasks undertaken this financial year

A draft summary findings brochure circulated to the Steering Committee for review and final approval

- Actively disseminated project information to key stakeholders, end-users and other interested parties, via It's Our Fault presentations to a range of audiences, publication of results in peer-reviewed journals and industry-sector conference proceedings, and update of the It's Our Fault web page

- It's Our Fault has generated a number of earthquake hazard related maps and geological models. There are an increasing number of requests for these maps and models in digital formats from TAs, consulting engineering and geotechnical firms, the insurance industry, etc. These datasets have been standardized for public release.

- Finalised the completion report (including maps) that provides base-level earthquake shaking subsoil classification for the Greater Wellington region (outside of Wellington CBD and Lower Hutt)

- Simulation of ground motions resulting from plausible Wellington subduction zone rupture scenarios. Development of engineering type ground motion assessments based on these simulated ground motions.

- The aim of this work is to firstly identify if there are any potential deficiencies in the currently used Wellington earthquake design spectra with regards to possible ground motions resulting from subduction zone rupture. Secondly, form an input to the Impacts Phase loss modelling.

- Liquefaction hazard characterisation coverage of other geographic areas (i.e. outside central Wellington and the Hutt Valley), needed for

the regional estimation of risk, loss and recovery time in the Impacts Phase. This work along with ground shaking hazard maps will also facilitate improved vulnerability and loss estimations.

- Estimation of losses and casualties from a selection of large earthquake sources in the region, not just the Wellington Fault, and identification of the infrastructure elements (e.g. classes of building) and ground classes likely to result in the worst losses and casualties. We will also investigate potential positive impacts that could accrue if specific vulnerable building and ground classes were to be improved.

  It is hoped that this will allow the most important, and cost effective, mitigation measures to be identified and focused on.

- Completion of the planning and policy review, and discussion of what the implications for land use planning are from the new knowledge gained from "It's Our Fault" and the Canterbury earthquakes.

New areas of research that will form part of the work plan include:

- Determining the potential impact of aftershocks and varying levels of moderate-size seismicity on the hazard estimation in Wellington

- Better defining the size and recurrence of the potential subduction zone ruptures underneath Wellington

- Probabilistic landslide hazard assessment.

Potential areas of study post 2012/13

Some of the critical elements that are likely to be addressed as part of the "It's Our Fault" project include:

- Development of engineering-type response spectrum attenuation expressions for subduction interface rupture using the database of simulated strong-motions developed previously. One of the potential causes of large earthquake losses in the Wellington region is a large magnitude (perhaps 8+) earthquake on the subduction interface between the Pacific and Australian plates, which is presently locked at a depth of approximately 23 km beneath the Wellington region. Paucity of data from plate interface earthquakes in general, let alone those of magnitude 8 or greater, means that the current estimates of ground motions from such an event are uncertain.

- The on-going Canterbury earthquake sequence has highlighted the debilitating impacts that liquefaction can have on the built environment. Losses in parts of Christchurch that experienced liquefaction are substantially greater than losses in areas that experienced strong ground shaking alone. The overall objective of this task is to characterise the

liquefaction hazard throughout the Greater Wellington region, with specific attention given to the Wellington CBD and Lower Hutt areas where data density is greatest, and to finalise liquefaction hazard maps (including supporting completion report) based on previous milestones

- The influence of topography and other local site effects on ground motion amplification and landslide triggering during earthquakes has been reported in many studies. However, evaluating these effects has been difficult through lack of high-resolution data, especially the lack of local instrumental ground motion recordings. In the Port Hills of Christchurch, as a result of the Canterbury earthquake sequence, there are now high resolution temporal and spatial data, including subsurface geotechnical information that allows quantification of the ground motion amplification relationships between topography, near surface geology, and seismic inputs. The objective is to use the information from Christchurch to determine possible effects in the Wellington hill suburbs and then develop topographic-shape classes that can be used to account for ground motion amplification due to topographic and ground condition effects in hill-slope environments

- Estimates of earthquake loss, casualties and social ramifications will be made for the region. The results of this work, when combined with the other streams of investigations, will allow the identification of specific interventions that could have the greatest impact to increase the region's resilience to a major earthquake event. These will include:

    - Estimate restoration times for water supply to Wellington City following a major Wellington Fault earthquake and for earthquake shaking less strong than from the Wellington Fault event

    - Identify the classes of buildings in Wellington likely to cause the worst losses and casualties, and estimate the potential impacts of upgrading these buildings to various levels of improved performance

    - Estimate the losses and casualties from a selection of large earthquake sources of importance to the Wellington region, including the losses that could be expected from "linked" sequences of earthquakes in the region

- Building on the milestones already completed, the Social Science Task will embrace three themes: post-earthquake sheltering needs; policy and planning; and risk communication.

    - Post-earthquake sheltering and evacuation needs - assessing the impacts of subduction zone ruptures is considered a priority due to the potential issues faced by emergency managers in identifying public shelter outside inundation zones, planning evacuation, and the potential loss of many shelter-at-home options for coastal

communities. Shaking and tsunami damage will be modelled for the Wellington region for two scenario ruptures, as will the resulting population displacement due to structural and non-structural factors which influence evacuation decision making

- Policy and Planning - compile a report for land-use planners, on the implications of the Technical Advisory Group (TAG) RMA recommendations for managing natural hazards

- Compile a report that assists land-use planners to determine the level of priority that liquefaction hazard/risk should be given in the planning process

- Compile a report that provides a "good practice" example of how a natural hazards chapter from a district plan could be drafted, incorporating TAG RMA recommendations, the risk-based approach to land-use planning, and cross-boundary hazard issues

- Risk Communication - A key issue emerging from the Canterbury earthquake sequence is the need to better understand how people interpret risks and how they respond based on their interpretations. This understanding is vital to any strategy for disaster reduction, building safety, and defining acceptable risk. Recent research has shown that lack of access to and/or framing of risk information have contributed to much of the misunderstanding around issues such as seismic risk and rock fall hazards.

- Aftershock Hazard in Wellington - This Task is aimed at addressing the potential impact of aftershocks on hazard estimation in Wellington. The recent Canterbury earthquakes have demonstrated what crippling effects earthquake aftershocks can have on a region, yet it is noteworthy to point out that the current New Zealand National Seismic Hazard Model explicitly excludes aftershocks in the hazard estimations. The primary motivation for this task is to assess whether or not there are any potential deficiencies in the currently-used probabilistic Wellington earthquake design spectra due to the absence of aftershock activity in the hazard estimations, both for long-term estimates and for estimates in the decades following the occurrence of a major fault rupture that are affected by the ensuing aftershock sequence. Also, because there is currently no accepted way to include aftershocks into such modelling prior to the occurrence of a main shock, various methods will be investigated for doing so

- Likelihood Phase II -In 2006, the Likelihood Phase of It's Our Fault was the first phase of work to be commissioned. Now, new data and interpretations have come to light regarding some of the region's active faults, and it is an opportune time to embark on a new Likelihood Phase II. It will see attention focussed on further characterising the rupture hazard posed by the subduction interface under Wellington and the potential

hazard posed by as yet poorly understood offshore active faulting in Wellington Harbour

- Current State of Locking & Timing of Recent Rupture of the Subduction Zone - An earthquake on the Hikurangi subduction interface underlying the southern North Island is potentially one of the greatest earthquake hazards facing the Wellington region, but also one of the least well understood

- Characterisation of Wellington's second-order active faults - Previous active fault investigations within the It's Our Fault programme have focused on the primary faults in the Wellington Region (e.g. Wellington, Wairarapa, Ohariu, subduction interface). The region is also cut by a number of less active second-order faults (e.g. Whitemans Valley, Evans Bay). Though these faults are known to have relatively low rates of earthquake activity, accurate characterisation of this is hampered by erosion rates along these faults often exceeding their rate of activity. In the marine environment however, where deposition (instead of erosion) may predominate, there is potential to gain a more complete record of fault activity and, accordingly, hazard characterisation. Recently acquired multibeam bathymetric data, high resolution seismic reflection profiles and sedimentary cores from Wellington Harbour have revealed a previously undiscovered active fault beneath the inner reaches of the Harbour. In this two-year task to be undertaken by NIWA, additional seismic reflection data will be acquired and integrated with the existing datasets, to constrain the structural geometry and recent displacement history of this fault