



30 April 2021

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Seismic Hazard at Hawke's Bay Regional Hospital

1000.NZ

Dear Megan,

As discussed, please find below an outline of new information regarding re-evaluation of New Zealand's Seismic Hazard Model, likely impacts on Hawke's Bay Hospital, and an outline of the way forward. Specifically, we make reference to the Radiology Refurbishment project, and have included comment on the wider site.

Background

The Hawkes Bay region has a high seismicity, slightly lower than Wellington. Hastings has a seismic hazard identified in NZS1170.5 of $Z = 0.39$. For the purpose of illustration; an IL4 building in Hastings with a period of 0.5 seconds and Deep Soil, is required to be designed for a ULS spectral acceleration of 2.1g. [NZS1170.5:2004, 3.1(1)]

For the Hawkes Bay Hospital site, a Probabilistic Seismic Hazard Assessment (PSHA) was carried out by GNS in September 2012. This comprehensive assessment derived a seismic acceleration for the site based on site-specific geology, such as underlying soil, proximity to faultlines, recurrence intervals, and magnitude of events able to be generated. This work was based on the Seismic Hazard Model at the time and included consideration of a magnitude M_w 7.8 event similar to the Napier 1931 event.

The GNS assessment identified a ULS spectral acceleration of 1.45g for an IL4 building with a period of 0.5 seconds – significantly lower than the corresponding NZS1170.5-derived value of 2.1g. This assessment enabled a more accurate understanding of the seismic demand at the site to translate to a reduction in the demand for structures designed and assessed.

Under the Building Act, NZS1170.5:2004, Section 1.4 permits the use of a special study to determine the site-specific seismic demand. Reference to special studies is also found in NZS1170.0:2002. Using special studies for determining seismic hazard is considered good practice for IL4 structures and/or complex structures.

Over the last few years, Detailed Seismic Assessments (DSA's) have been carried out on various buildings at the Hospital site using the GNS seismic hazard, and %NBS values reported relate to this demand. Current strengthening to the Theatre Block (in construction) is based on the GNS seismic demand. Strengthening to the Radiology building and Clinical Services building (currently in design) is also based on this seismic demand. Other consultants have also used the GNS information.

Re-evaluation of seismic hazard

A re-evaluation of the New Zealand Seismic Hazard Model has been commissioned, funded by MBIE, EQC and Waka Kotahi (NZTA). This work has come about from an improved understanding of the Hikurangi Subduction zone off the east coast of the North Island, based on a separate research programme of data collection and interpretation by GNS over the period (2016-2021).

We do stress that this is an early advisory of this work and the findings have yet to be officially released.

Project Status

The status of the re-evaluation project is as follows:

- The main body of work is understood to be complete, and the work is now undergoing review.
- Initial findings of this project have been communicated to the industry at the New Zealand Society of Earthquake Engineering Conference last month.

It is noted that this work has an impact on current PSHA's from now on, but NZS1170.5 still provides the Building Code requirement, and this remains current, and the default reference. If any changes are to be made to NZS1170, it will be some time before these are legislated, and the changes may not be significant.

Relevant project findings

The re-evaluation has carried out PSHA's for a number of locations across New Zealand and compared the results to NZS1170.5 derived accelerations. This included Napier and the assessment gave a seismic hazard at this location just over the NZS1170.5 value.

It is noted that Napier and Hastings are close together, but the underlying geology does vary, which is expected to result in some variance in seismic hazard between the two sites.

Regardless of this difference, the re-evaluation findings clearly indicate that the seismic hazard for sites in Hawkes Bay is likely to be close to NZS1170; significantly higher than the existing GNS PSHA values.

Relevance to Hawkes Bay Hospital

The implication of the re-evaluation is that a previous PSHA derived acceleration for the Hawkes Bay Region that is significantly lower than NZS1170.5 can no longer be considered reliable. Upon release of the re-evaluation paper, the seismic hazard interpretation results are expected to be used for interim guidance.

WSP have contacted GNS regarding the currency of the 2012 GNS PSHA, and they have recommended a new assessment be carried out.

The Peer Reviewer for the Radiology Refurbishment design has also questioned the relevance of the 2012 GNS PSHA in light of the re-evaluation findings described in this letter.

It is noted that any increase in the seismic hazard requires a review of the vulnerability to liquefaction potential for the site, as the current liquefaction assessment is also based on the GNS 2012 PSHA.

Regarding buildings at the Hawke's Bay Hospital site, the way forward, including options where relevant, is outlined as follows:

Existing DSA's

- It is recommended that no action is taken on existing DSA's at this point in time. Any decisions should be made following a new PSHA, and any change in geotechnical understanding.

DSA's currently being carried out

- Any DSA currently being carried out should reference NZS1170.5 seismic demand. Results using the 2012 GNS PSHA can be reported in parallel.

Recent new buildings

- Regarding any recent new buildings that have used the 2012 GNS PSHA, it is recommended that HBDHB approach the designer for comment.

AAU Building strengthening (IL3)

- The AAU building has had two of three seismic strengthening stages completed. The third stage (foundations) is currently on hold. It is recommended to keep the project on hold for now, until a clearer course of action can be determined.

Theatre Block strengthening

The Theatre Block is understood to be under construction currently. Design was based on the 2012 GNS PSHA.

1. No action is required, as this already has Building Consent, and at the time of Consent it complied with the Building Act, however;
2. There is an opportunity to review the capacity to NZS1170.5, and assess what change would need to be made to increase capacity.
3. It may be that some actions can be taken at reasonable cost to improve capacity.

Angio upgrade (Radiology)

- The design for this work by WSP has been submitted this week, based on NZS1170.5 seismic demands. No further action required.

Radiology Refurbishment Project

The Radiology Refurbishment is in the final stages of detailed design by WSP and is in the process of being Peer Reviewed by Dunning Thornton.

1. *Proceeding with no change – this is not recommended.* Based on the re-evaluation information, and confirmation from GNS that the existing 2012 GNS PSHA should be revised, we cannot justifiably use the 2012 GNS PSHA to determine loadings going

forward. Based on feedback received, the Peer Reviewer would exclude the loadings from their review, and the Council would most likely deny the Consent application.

2. *Revise the design for seismic loads increased to 1170.5 values.* This meets the Building Code. This will require re-design and more strengthening but minimises delay to the project.
3. *Await the results of a new PSHA, then revise the design for the new seismic loads.* This will meet the Building Code and provide better certainty regarding seismicity but will result in a longer delay to the project.

We do not recommend Option 1 and recommend Option 2, as a minimum, be undertaken to expedite the programmed works with the least delay.

The current geotechnical liquefaction assessment for the site also references the GNS 2012 PSHA. This needs to be re-assessed to NZS1170/NZTA Bridge Manual to inform the Radiology re-design as it forms part of the compliance requirement for Building Consent.

It is also advisable to commission a new PSHA to determine the extent of change in seismicity for the campus regardless of the options noted above as this will inform decision-making for the site going forward.

We consider either Tonkin and Taylor, or WSP through their recent takeover of Golder Associates Ltd are well placed to carry out a new PSHA.

Conclusion & Recommendations

Based on recent re-evaluation of the seismic hazard model for New Zealand, the Probabilistic Seismic Hazard Assessment or PSHA, carried out by GNS is no longer able to be relied upon for deriving seismic demands at the Hawke's Bay Hospital site. In the absence of a PSHA that can be relied upon, the default Code Compliant approach is to use the higher loadings in NZS1170.5. This impacts structural design and seismic rating of all buildings on the Hospital site.

The recommended actions are as follows:

1. Existing DSA's - No action recommended at this time, until further guidance from MBIE is provided.
2. Current and Future DSA's - Use NZS1170.5 seismic demands, or a new PSHA if available.
3. AAU strengthening - No action recommended at this time until there is further clarity on the way forward.
4. Theatre Block Strengthening - review the design against NZS1170.5 demands and consider strengthening at the discretion of HBDHB.
5. Angio Replacement - No action required, as NZS1170.5 has been used.
6. Radiology Refurbishment - Re-design proposed to NZS1170.5 seismic demands to meet Building Consent requirements. This includes a geotechnical review of liquefaction at the site.



7. The site – Commission a new Probabilistic Seismic Hazard Assessment or PSHA. This can be used in lieu of NZS1170.5 for seismic demands, and will address any uncertainty. Should a higher seismicity be advised, a review of the site vulnerability to liquefaction may be required.

We realise this has significant impacts for the current projects, and ramifications for the whole Hospital site. We will work with you to minimise impacts as much as we can.

We suggest once the immediate concerns have been addressed, that a site-wide desktop review of building capacities is carried out to understand any wider implications, and to inform forward planning.

If you have any questions, please don't hesitate to get in touch.

Yours Faithfully

WSP NZ Ltd

A handwritten signature in blue ink that reads "Jamie Lester".

Jamie Lester
Technical Principal - Building Structures

encl. HBDHB Radiology Refurbishment – Structural Re-design Proposal for Change in Seismic Hazard, dated 30 April 2021

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