Streamlining Engineering Judgement in Emergency Scenarios

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ABSTRACT

ENGEO have been assisting Wellington City Council (WCC) with private land assessments of geological hazards, mainly landslides. WCC have used our recommendations to assist in the difficult decision of issuing danger notices when home occupants are at risk.

This paper outlines the three-zone classification system we are using on these projects to assist with making engineering judgement decisions on-site. The Red Zone is for Restricted Access, Yellow Zone for Controlled Access and Green Zone for No Controls. This classification system lays out clear parameters to be put in place that allow, in most cases, for occupants to continue living in the properties in a restricted manner. This both minimises disruption to the lives of those living on the property and mitigates risk of life safety in potential future events.

ENGEO have also used a cloud-based application to set up a template for future assessment projects. The template allows for reporting to be created quickly once key site features and the zones have been classified. This streamlines several processes and allows for fast communication between engineer, council entities, homeowners and home occupants.

The discussed process allows for the engineering judgement and assessment of short-term danger to be brought to the forefront of the project. It assists in changing the mindset of the engineer away from the typical design approach and towards assessing immediate life safety risk.

Keywords: Emergency, Classification System, Efficiency, Slope Instability

1 INTRODUCTION

ENGEO has been working with Wellington City Council in doing land assessments of geological hazards on private land. The role is to provide a fast and informative opinion on whether homeowners or tenants are safe to access the dwelling or property following a geological event occurring. WCC use this to issue danger notices where required, to inform the residents of the danger and require them to mitigate or reduce the hazard. These projects require important engineering judgement decisions to be made within hours with limited information.

We have created a three-zone classification system and report template for these projects. This allows for key decisions and reports to be mostly compiled on-site within a couple of minutes and relayed to WCC within hours.

2 BACKGROUND

2.1 Wellington City Slope Instability History

Wellington City is located in Central New Zealand and has a population of approximately 215,000. The city is well known for its hilly landscape and the majority of the suburban houses are founded on these steep slopes. The ground in the region is primarily in-situ Greywacke Sandstone, overlain by colluvial soils. Wellington also receives an average rainfall of 1250 mm per year, leading to a large number of landslides. According to Wellington City Council's Chief Infrastructure Officer Siobhan Proctor, Wellington typically records around 1,100 landslides annually.

2.2 Role of Councils

Geological Hazards that occur are the responsibility of private landowners. However, Section 124 of the Building Act states that if a territorial authority is satisfied that a building is dangerous, they may issue a danger notice. This can include any or all of the following:

- Putting up hoarding or fencing preventing people from approaching the building nearer than is safe.
- Attach a notice to the building that warns people not to approach the building.
- Issue a notice that requires the private owner to undertake work to be carried out to reduce or remove danger.
- Issue a notice restricting entry to the building for particular purposes or restricting entry to particular person or groups of persons.

The key word in the above is danger. It is our role to advise councils on whether we consider the geohazard to pose significant immediate danger to people present on the property. The council can then use our recommendations to decide whether any of the above actions are appropriate.

3 EMERGENCY CLASSIFICATION SYSTEM

The classification system works by assigning areas of the property into one of three hazard zones. The three hazard zones represent three different tiers of risk that the hazard poses to the land in this area. These locations of each of these zones are drawn on a site plan and represented by the colours Red, Yellow and Green.

Table 1 below outlines the three different hazard zone categories. This table contains the description of the geohazard risk each zone and our recommendations for appropriate controls to be placed on each zone while the risk is still present.

Table 1: Hazard Zone Description

Hazard Zone	Description	Recommendation
Restricted Access (Red)	This includes the geological hazard area and the potential areas, which could comprise future progressive failures. Immediate risk of endangering life is present.	Access to this zone should be restricted due to the likely risk of endangering life by ground loss or crushing from failing debris.
Controlled Access (Yellow)	The immediate risk of endangering life is considered to be low for these areas.	Precaution is required by not sleeping in these areas (should be always alert and conscious) and spend minimal time there.
No Controls or Restrictions (Green)	There are no current concerns for these areas.	These areas can continue to be used as intended.

The levels of controls range from recommending no access to the land or assets in this area to recommending that the areas can continue to be used as intended.

4 EXAMPLE GEOHAZARDS

Figure 1 below shows three examples of geological hazard sites where we have applied the three-zone hazard zone framework for emergency geological hazard assessments.

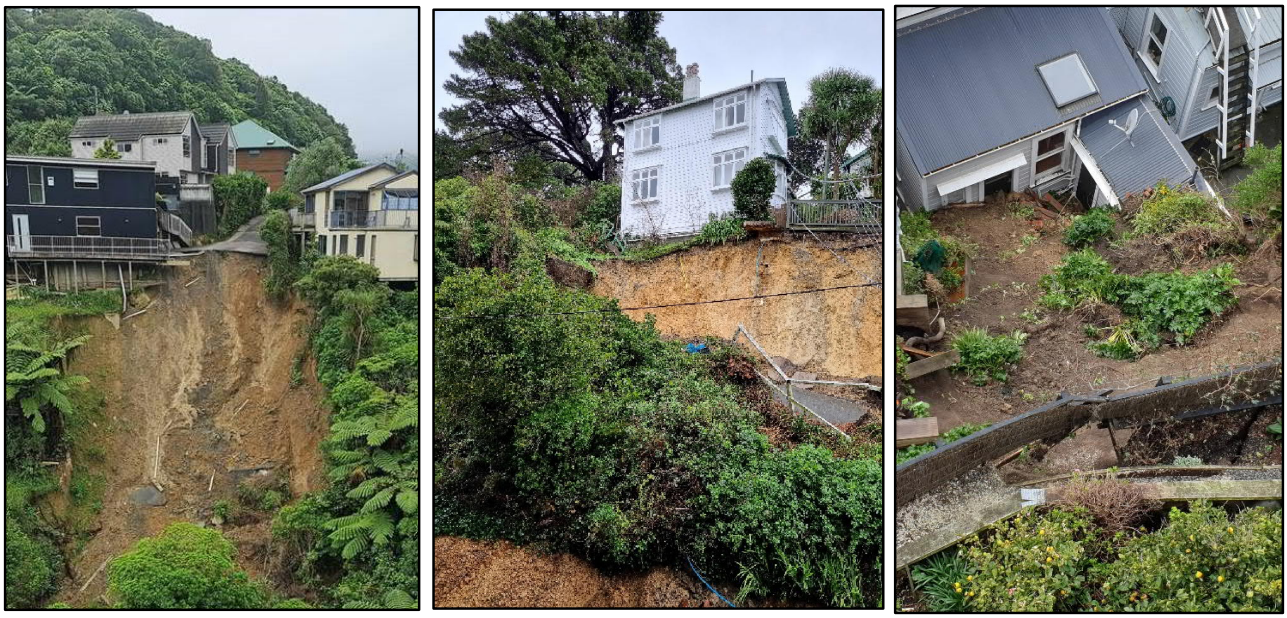

Figure 1: Example landslide sites (Wellington)

5 PRACTICAL APPLICATION AND PROCESS

5.1 Site Visit

The most crucial aspect of making different judgement decisions within a short timeframe is the process of gaining a clear understanding of the hazard and the associated risk. This is done most effectively by visiting the site. Key aspects that we assess on site include distance from hazard to houses and other assets, the material type and slope angles of surrounding ground and evidence of potential ground movement in other locations surrounding the hazard. It is also commonplace and recommended to meet with council representatives on site who further provide context and background site information.

For one landslide site we had, key aspects to consider were the distance from the crest of the landslide to the deck and house piles and evidence of instability of surrounding ground. During the first visit to this site we noted separation in the driveway concrete, which indicated a possible future failure extent. This turned out to be the location of the regressed landslide crest after the further slippage.

Figure 2 below shows photos taken at the driveway of this site. These photos show the progression of the landslide within a five-month period, from the edge of the driveway to behind the garage door.

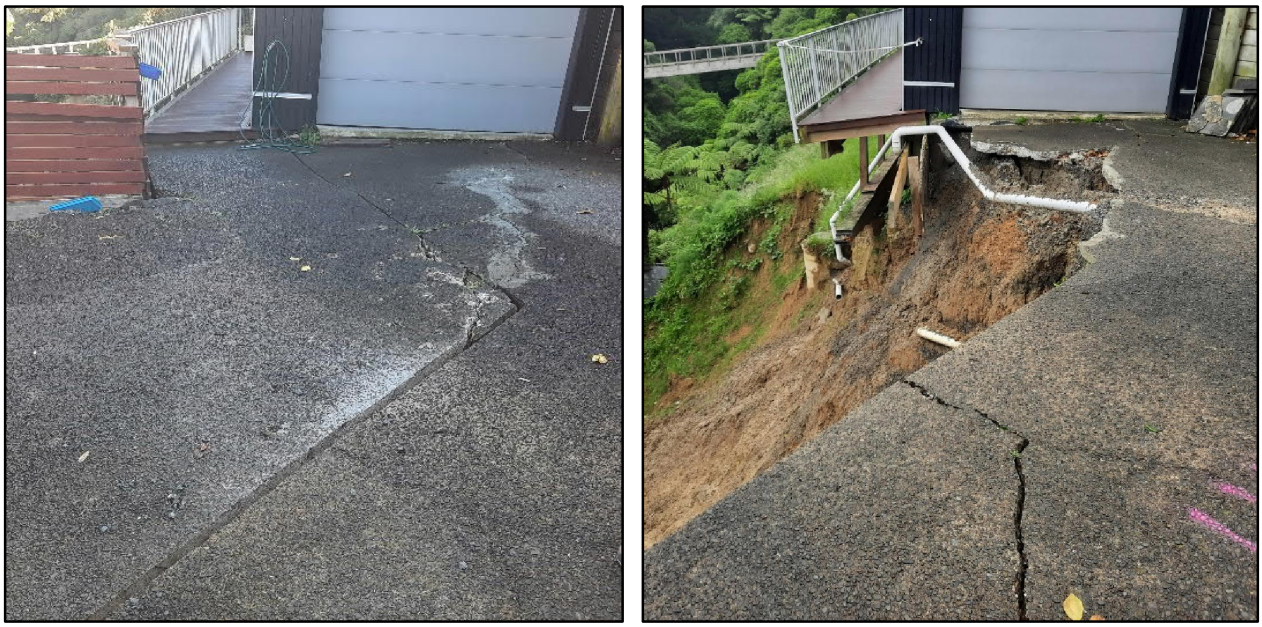

Figure 2: Regression Landslide Crest Observed (two photos taken five months apart)

5.2 Site Plan

To produce the plan on which the hazard zones are outlined, ENGEO have utilised the software Datanest. Datanest is a commercially available, flexible tool for tailoring information input and reporting output for a wide range of environmental and geotechnical projects. This software allows for a GIS overlay map be made while out on site, using a tablet. The site plans show the different hazard zones relative to the hazard location, property boundaries and different assets, using the colour coordinated three-zone classification system. Datanest uses Nearmaps for background satellite images and simplified GIS tools to make the creation of the plans clear and efficient.

The plans created provide a clear outline to the council and homeowners to follow regarding the risk assessed on site.

Figure 3 below shows the examples of site plans from a site where the hazard zones changed as the crest of the landslide regressed.

5.3 Reporting

Datanest is also used to create a report that we issue for each site. The core elements of text that are the same for each site, such as the inclusion of Table 1 above, are programmed into an automated template.

Site specific details, such as on-site observations, photographs, and measurements, can be added to the Gather function on Datanest by using a table while still out of the office. Once back in the office, an automated Microsoft word document can be exported, which contains both the site-specific data and the core text elements that are the same for all sites. Once this has been done there is limited additional text that needs to be added to each memo before it is reviewed and issued to the client.

For each assessment the council receives the memo report and the site plan, both of which are mostly curated from Datanest. These products provide council with clearly communicated information to use for their own records, decision making and to provide to landowners if required.

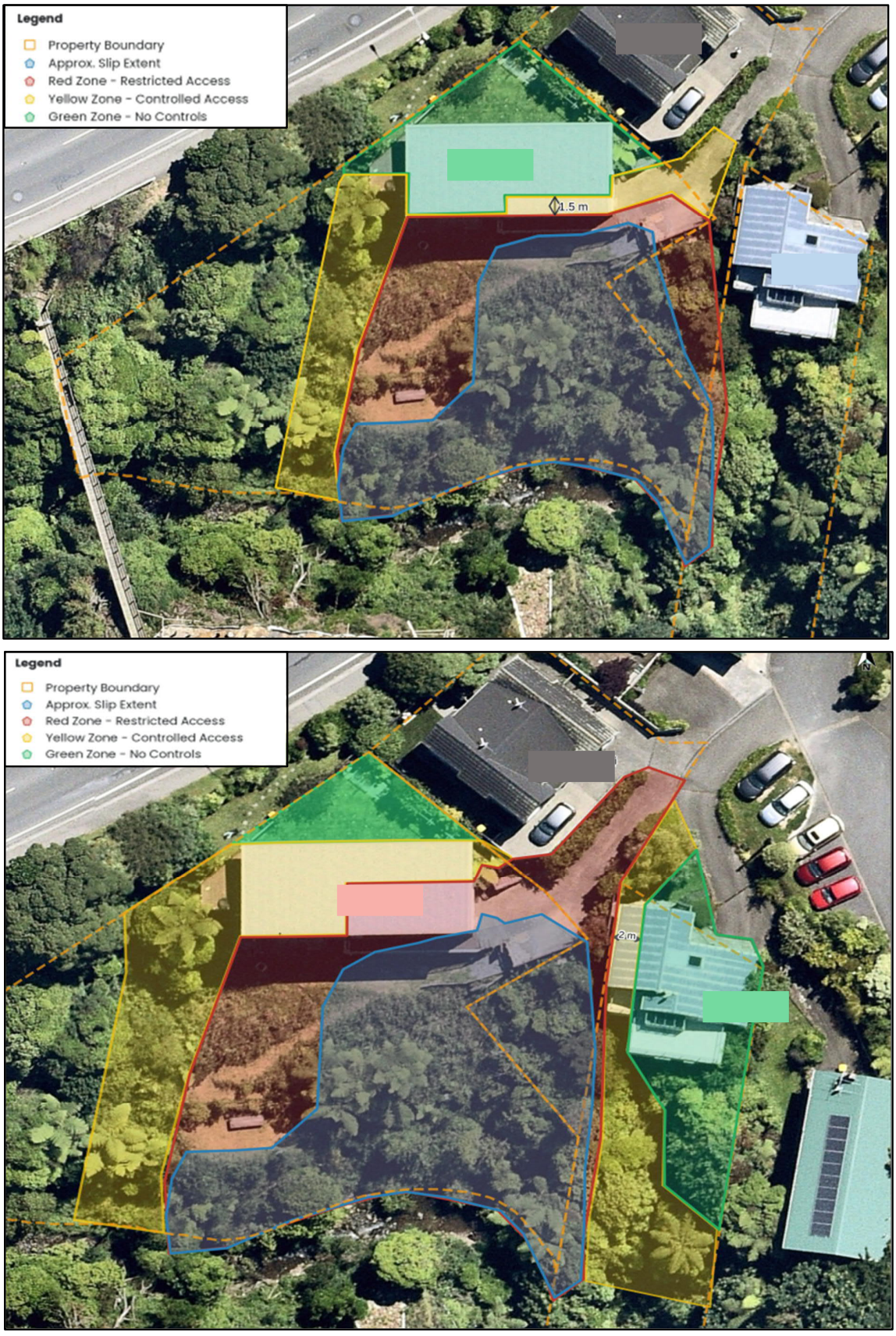

Figure 3: Hazard Zone Site Plans
(Examples showing geological hazard regression and reassessment)

6 ANALYSIS OF METHOD

6.1 Benefits

The main benefit of the three-zone classification system is that it provides a clear framework to communicate the risks of complex hazards. This is useful to both councils as it helps with their decision of whether or not to place certain restrictions on properties and landowners as it outlines the conditions of the restrictions simply.

The hazard zone boundaries can be easily changed overtime as the risk of a hazard changes, either for the better or the worse. Even if the zone boundaries move, the recommendations for each hazard zone category remain the same. This has the benefit of minimising confusion for council and landowners.

Using Datanest for both on site recording and reporting has the following benefits:

- All site data is stored together and is easily accessible with internet access.
- Outputs that the client receives have consistent recommendations and guidelines.
- Ability to record information on site without using paper.
- Fast transition from site visit to issued report.

6.2 Potential Additions to Process

For future projects we are looking to increase the amount of information that can be added to Datanest, both on site and in the automated memo template. The goal is to eventually be able to issue the site plan and memo to the client from site using Datanest from a tablet.

6.3 Potential Future Application

We have started using both the three-zone hazard classification system and the automation of site memos using Datanest on other types of projects. These tools have the potential to assist with efficient and informative assessment of all types of geological hazards, on both private and public land.

7 CONCLUSION

We consider the three-zone classification system to be effective at clearly relaying engineering judgement decisions in emergency scenarios. Feedback from WCC and homeowners has been positive, and we look forward to using this system on more projects in the future.

8 ACKNOWLEDGEMENTS

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