

# Fire and Emergency NZ

Accident investigation into fatal landslide incident at Muriwai  
on 13 February 2023

Incident Number F3667912

Investigation team  
Paul McGill and Andy Evans

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# Executive Summary

## Incident

On 13 February 2023 a crew of three Muriwai firefighters went to a house in Motutara Rd to investigate flooding damage. They were there for less than seven minutes when a large landslide demolished the house and trapped two of the three firefighters. One was rescued but died three days later in hospital. The other firefighter's body was recovered 35 hours after the landslide.

## Investigation

Fire and Emergency New Zealand (FENZ) appointed a two-person investigation team to identify all the factors that contributed to the two fatalities, using the Incident Cause Analysis Method (ICAM). The ICAM determines the immediate causes of incidents and their contributory factors. This method is based on the theory that accidents are usually not solely due to individual error but originate in wider systemic organisational factors.

## Conclusions

The ICAM based investigation found that FENZ's risk management systems did not identify landslides as a hazard that could harm its firefighters. This resulted in a lack of landslide related procedures and training for firefighters. The Muriwai firefighters knew about Muriwai's general susceptibility to landslides but did not recognise the warning signs that indicated an imminent landslide threat.

The search and rescue operation for the trapped firefighters was mobilised quickly and was well-resourced with specialist personnel and equipment. The investigation concluded that everything practicable was done to rescue the firefighters in very arduous conditions.

## Recommendations

The report includes the following recommendations for FENZ:

1. Review policy, procedures, and training programmes to lift firefighter awareness of the hazards associated with landslides and in particular the warning signs of an imminent landslide.
2. Consider including a local landslide susceptibility risk profile in station risk planning activities.
3. Review the FENZ risk management standard and align it to ISO 31000:2018. Then consider incorporating SA/SNZ HB 205 as the approach for managing safety risks. This will provide a consistent approach to managing both safety and non-safety risks.
4. Review the FENZ critical risk management programme, within the context of the FENZ risk management standard and FENZ's approach to managing safety risk. This includes developing a clear and robust definition of a critical risk, drawing upon recognised guidelines, standards, and best practice in the fields of critical risk and critical control management.

# 1. Introduction

## 1.1 Scope

See full terms of reference for this level 2 investigation in Appendix A.

In summary, the purpose of this investigation is to identify all the factors that contributed to the fatalities of two firefighters, while responding to a flooding issue at a property in Muriwai during Cyclone Gabrielle.

The investigation incorporates the requirement to review the content and application of best practice, operational procedures, and training. It also incorporates the requirement to evaluate the extent to which FENZ prepared the local brigade to safely respond to such a severe weather-related event, and the brigade's capacity and capability to respond. This requirement is to allow for FENZ to meet its commitment to continuous improvement to minimise the risk of such catastrophic harm being repeated in the future.

It is not the purpose of this investigation to attribute fault, blame or liability.

Specific terms of reference

- Identify all causal factors that contributed to the firefighter fatalities.
- Describe the context of the event; including the circumstances leading to the FENZ response, the nature of the FENZ response, the circumstances in which the harm was incurred, and the immediate post event emergency response.
- Identify any new or significant hazards that contributed to the injuries and fatalities.
- Identify all policies, standard operating procedures, instructions, guidelines and training modules that have relevance to the event.
- Identify any deviations from relevant policies, standard operating procedures, instructions, guidelines and training modules that may have occurred, and why.
- Evaluate the adequacy of all policies, standard operating procedures instructions, guidelines and training modules that have relevance to the event.
- Evaluate the extent to which FENZ prepared the local brigade to safely respond to such a severe weather-related event, and the brigade's capacity and capability to respond.
- Identify any inadequacy of hazard control.
- Recommend actions to address identified causal factors.

## 1.2 Relationship to other inquiries and evidence collection

This FENZ sponsored level 2 accident investigation is one of three concurrent inquiries and investigations into the cause and management of the incident.

New Zealand Police is collecting evidence for the coroner's inquiry under the Coroners Act 2006 and WorkSafe New Zealand is undertaking an investigation under the Health and Safety at Work Act 2015.

There is also some interface with FENZ's broad operational review of the Auckland Floods and Cyclone Gabrielle. The investigation team will share relevant information with this operational review team, while maintaining its confidentiality commitments and the independence and integrity of its investigation.

The extent of investigative powers varies. For example, WorkSafe NZ has a power to require production of information for its investigation, and there is also a statutory duty on employers to assist it. The coroner also has powers to require information and summon witnesses.

In the case of this FENZ sponsored investigation, it had no powers to compel anyone to produce information. The investigation team had full cooperation from FENZ and most other parties, however, several first responders declined to be interviewed. Therefore, the team is aware that NZ Police and WorkSafe may obtain some evidence that is not available to others at this stage.

The investigation team has completed this report on the available evidence within the time for reporting set by FENZ. This time frame was set with a view to providing timely advice to FENZ on matters it might need to address with some urgency. Within the given time constraints and restrictions on availability of certain evidence, the team is confident that its findings are robust and reflect a good understanding of what happened before, during, and after the incident. However, if material evidence emerges later, of which the investigation team had not been aware, it would review its findings at FENZ's request.

### 1.3 Methodology

This investigation has been conducted using the Incident Cause Analysis Method (ICAM)<sup>1</sup>.

The ICAM method determines the immediate causes of incidents, (absent/failed defences, and individual and team actions), and contributory factors (task and environmental conditions, and organisational factors). This method is based on the theory that incidents are usually not solely due to individual error (active failures) but originate in wider systemic organisational factors (latent conditions).

The method provides a checklist on the information that must be collected during the investigation. This includes relevant information on people, the work environment, equipment, procedures, and systems. The method then requires immediate causes and contributory factors to be determined. Finally, recommendations are made that address both immediate causes and contributory factors.

This investigation followed the above methodology with:

- A site visit
- Interviews with relevant witnesses
- Reading witness statements
- Document, video, and photo examination
- Formal analysis.

This report presents the background to the incident, including an overview of the geology and history of the location. The next section covers the management of risk at FENZ.

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<sup>1</sup> [http://www.safetywise.com/sng\\_e\\_post/2016/02/24/The\\_Benefits\\_of\\_the\\_ICAM\\_Incident\\_Investigation\\_Process](http://www.safetywise.com/sng_e_post/2016/02/24/The_Benefits_of_the_ICAM_Incident_Investigation_Process)

This is followed by a detailed description of the incident that includes information on the people, the work environment, equipment, procedures, and systems.

The report then describes the absent or failed risk controls and the actions of the fatally injured workers. It assesses environmental, task and organisational factors that contributed to the failed risk controls. It provides recommendations for further improvement of health and safety management at FENZ.

## 2. Background

### 2.1 Landslide risk in NZ

New Zealand is generally susceptible to landslides, and they present a significant risk to life and property.

In its 19 November 2020 media release, the Earthquake Commission (EQC) announced it had established a new national database for landslides. EQC's Chief Resilience and Research Officer Jo Horrocks pointed out *"that GNS Science has identified around 1800 fatalities from landslides over the past 160 years, which is significantly more than earthquake casualties over the same period... landslides cost the country an average of \$250-\$300 million each year...Landslips are a major risk to people and property in New Zealand, which we need to understand and manage"*

The Auckland Council is one of the contributors to this landslide database and the investigation team was informed that the Council is starting work to develop landslide susceptibility and hazard mapping.

### 2.2 Muriwai geology and history

The Auckland Council issued a "Community newsletter, Muriwai Beach cyclone recovery" on 8 March 2023. In this newsletter, pages 2-9, the Council's geotechnical and natural hazards specialist Ross Roberts provides an overview of Muriwai's geology.

In the background section he states:

*"Much of Muriwai, like other parts of Auckland's west coast, is underlain by Kaihu Group sands. The sands are weak and are poorly cemented, or completely uncemented, meaning grains of sand are not well stuck together. During rainfall, water starts to fill the air spaces between grains. Initially, this has a suction effect where the water pulls the sand grains together, increasing strength. As water content increases, this suction drops and the sands fail and flow. A good analogy is sand on a beach. If a little water is added, a steep-sided sandcastle can be built. But if too much water is added, the castle collapses rapidly as a debris flow. In Muriwai we have experienced debris avalanches (which included rocks and trees) which turned into debris flows (mostly sand) as they travelled down the slope."*

In the section on Muriwai's history of instability, Ross Roberts states:

*"In August 1965, following heavy rainfall, landslides occurred on consecutive days at the south-east end of Domain Crescent, completely destroying two houses and killing two people."*

*At the time of the 1965 landslides, Rodney County engineers declared that no houses would ever again be allowed to be built in the path of these landslides. In 1981 the Local Government Amendment Act (section 641A) allowed councils to issue building permits for houses on unstable land prone to erosion, subsidence, slippage or inundation. Councils were also absolved of any civil liability. This opened up the ability for landowners to overturn the previous council decisions, and house building re-commenced on the site of the 1965 landslide.*

*This isn't the only evidence we have of past landslides in Muriwai. A prominent feature of Muriwai is the escarpment that forms the crenulated ridgeline immediately west of Oaia Road. These crenulations, or "embayments", represent the headscarps (or source areas) of landslides...*

*Domain Crescent and Motutara Road are built on a talus (debris) slope at the base of the escarpment. The presence of this debris illustrates that over the years a significant quantity of material has fallen from the escarpment in the form of landslides."*

Martin Brook, associate professor of applied geology at the University of Auckland, wrote an article on landslides and the law in the science section of The Spinoff on 22 February 2023. In this article he stated:

*"The Earthquake Commission (EQC) Act in 1993 was an important step forward for natural disaster insurance. But it stipulated that compensation can be refused if a house was constructed on unstable land. In the 1990s and early 2000s, the Rodney District (which includes Muriwai) was ranked first nationally in having EQC claims rejected on the basis that houses had been built on existing unstable ground."*

### 2.3 Relevant industry guidelines

Best practice risk assessment and management is reflected in the requirements of the Health and Safety at Work Act 2015 (HSWA) and its regulations. These provide direction on the meaning of "reasonably practicable", noting that this must take account of the availability and suitability of ways to eliminate or minimise risks. They require the application of a hierarchy of controls, that is prioritising the elimination of hazards, above substitution, isolation, and engineering controls, which in turn should be prioritised above administrative controls and PPE.

These regulations are supported by additional guidelines and standards including:

- ISO 31000:2018 - Risk management - Guidelines
- ISO 45001:2018 – Occupational health and safety management systems
- WorkSafe NZ - How to manage work risks.

Organisations should use a recognised approach to the management of safety risks within the plan-do-check-act approach to assess, manage and monitor work risks. This approach is equally appropriate in strategic, operational, and dynamic risk management situations.

In many cases further guidance is made available to organisations, detailing how the generic requirements detailed above can be applied in more specific circumstances and situations. While these are widely available for many of the hazards that firefighters may be exposed to, guidance related to



the risks posed by landslides is not available from the regulators in New Zealand, Australia, the UK, or Canada.

The National Emergency Management Agency (NEMA) provides information on the risk of landslides<sup>2</sup>, but this is directed at the public and is not intended to detail how safety requirements can be met in specific circumstances by emergency responders.

In the absence of specific detailed guidance on the management of risks associated with identified hazards, organisations are expected to return to the generic process detailed in regulations and take it upon themselves to follow their prescribed hazard identification and risk management process to ensure that risks are eliminated or minimised so far as is reasonably practicable.

### 3. FENZ and safety management

#### 3.1 FENZ health and safety management system

The FENZ safety health and wellbeing strategy 2017 “Our safety, health, and wellbeing policy commitment, He Waka Eke Noa” contains the sentence “*Nothing is more important than our people*”. This is a clear indication of the intent of the FENZ executive in relation to the management of safety, health, and wellbeing in the organisation.

The policy commitment also contains an overview of the key duties that different roles in the organisation have, while at the same time highlighting that safety, health, and wellbeing is also everyone’s responsibility.

The FENZ safety health and wellbeing strategy 2017 to 2022 has the following principles that guide the way its people work together across the organisation.

- *Everyone goes home safely every time* – everyone, no matter what they do, has a right to go home safe and well after working for FENZ.
- *Everyone has a part to play* – all personnel within the organisation need to participate and take responsibility for making our workplaces and work practices safer and healthier.
- *Working collaboratively is best* – we will enable and encourage participation and engagement from all parts of the organisation and from unions and associations representing personnel.
- *Fair access to support for everyone* – based on safety, health and wellbeing risks and needs, irrespective of roles and geographic locations.
- *Risks managed as closely as possible to where they occur* – respecting the people who do the work and know the risks and learning from them.
- *Visible, effective leaders* – creating leaders who are responsible for their people, who engage and learn from what their people do well in managing the risks they face.
- *Acknowledged importance of training* – recognising the essential place of training and information in minimising incident ground and workplace risk.

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<sup>2</sup> [Lands des Get Ready Emergency preparedness n New Zea and](#)

- *Building a learning culture* – where people feel safe and supported to examine and learn from where things go well and where we need to improve.
- *Good work is good for us* – a vibrant, positive workplace culture can enhance physical and psychological health and wellbeing.

The FENZ safety, health and wellbeing manual is a key element of the safety, health and wellbeing strategy. Published in August 2022, it is a comprehensive document of over 120 pages that outlines how FENZ systematically manages safety, health and wellbeing across the organisation. The document does not refer to, or explicitly reference a recognised safety management system standard. FENZ is not required to meet such a standard, but its safety, health and wellbeing manual does broadly reflect the structure and elements of:

- AS/NZS 4801 Occupational health and safety systems
- ISO 45001:2018 - Occupational health and safety management systems
- ACC partnership programme audit criteria.

Individual sections of the manual provide detail relating to all elements of a functioning and comprehensive health and safety management system.

The manual is widely available, and, as indicated above, provides a good level and structure to assist in the management of safety, health and wellbeing across the organisation.

### 3.2 Risk management at FENZ

The FENZ risk management standard (2019) is the overarching document that provides an overview of how all risks to the organisation are to be managed. Safety, health and wellbeing is just one of twelve categories of risk that are included in the scope of the document. The standard prescribes the eight-stage process to be followed when managing any risks within these categories. The prescribed process reflects that contained in ISO 31000:2009 Risk Management – Principles and guidelines, and this is referenced within the standard.

### 3.3 Safety risk management at FENZ

Section 6 of the FENZ safety, health and wellbeing manual prescribes a six-stage process to be followed when managing safety, health and wellbeing risks. The six-stage process is structured differently to that detailed in the FENZ risk management standard and uses quite different language. While this process is not referenced, it broadly aligns with processes communicated by WorkSafe NZ. It is also indicated in section 6, that all identified risks should be recorded in the station's risk register. This aligns with the strategic goal of having risks managed as closely as possible to where they occur.

In addition to the process detailed above, FENZ commenced developing a critical risk management programme in 2017. This alternative approach to safety risk management was being actively promoted by both WorkSafe and the Government Health and Safety Lead (GHSL) at the time. Section 6 provides some detail on this approach and provides the following unreferenced definition of critical risk: "Critical risks are risks that could result in serious injury, illness or death."

During 2018 the top 10 FENZ critical risks were identified through: *“Analysis of injury and illness data, discussions with the NZFS National Safety, Health and Wellbeing Committee and operational leaders in urban and rural fire services and the examination of the HSWA expectations and guidance.”*<sup>3</sup>

In 2020 FENZ engaged a consultancy to review FENZ’s critical risk process. Amongst several findings, the consultants recommended that Covid-19, electricity and noise be added to the identified critical risks, to give a top 13. The FENZ safety, health, and wellbeing manual 2022 lists FENZ’s top 13 critical risks to be:

- 1) Working in and around moving vehicles
- 2) Working in and around fire and explosive materials
- 3) Working with hazardous materials
- 4) Working at heights
- 5) Working in and around water and hazardous weather conditions
- 6) Working in and around unstable underfoot and overhead objects and structures
- 7) Respirable and absorbable carcinogens and pathogens
- 8) Acute and post-traumatic psychological stress and illness
- 9) Cardiovascular disease
- 10) Fatigue
- 11) Pandemic – Covid 19
- 12) Electricity
- 13) Noise

The consultants also recommended that if the critical risk programme was to continue, it should follow a structured process broadly based on the International Council on Mining and Metals (ICMM) health and safety critical control management guidelines.<sup>4</sup> It is understood that FENZ has broadly adopted the recommendations made in the report and the programme is ongoing.

### 3.4 Dynamic risk assessment

Much of the work that FENZ firefighters undertake is presented in dynamic and often novel situations. Managing risks in these circumstances is much more challenging than in static familiar situations and it places a high level of reliance upon good decision-making in real-time.

The process of dynamic risk assessment is the primary control used by firefighters when attending incidents. It involves:

*“The continuous process of identifying hazards, assessing risk, taking action to eliminate or reduce risk, monitoring, and reviewing, in the rapidly changing circumstances of an operational incident.”*<sup>5</sup>

Firefighters are expected to conduct dynamic risk assessments, both prior to commencing an activity at an incident and during the ongoing response to the incident. This informs firefighters to decide if the

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<sup>3</sup> FENZ SHW Strategy Review July 2018

<sup>4</sup> ICMM Critical Control Management: Good Practice Guide

<sup>5</sup> Dynamic Risk Assessment: Making Risk Based Decisions. Asbury, S & Jacobs, E. (2014)

risks being taken are commensurate with the potential benefits of the outcome of the activity. To assist in this process, the “safe person concept” is applied. This concept guides firefighters as follows:

*In a highly considered way, firefighters:*

- *Will take some risk to save saveable lives.*
- *May take some risk to save saveable property.*
- *Will not take any risk at all to try and save lives or properties that are already lost.*

The application of these principles is the primary way in which the safety of firefighters is managed when attending incidents. The significance and criticality of this process is well known, and significant amounts of ongoing training and reinforcement have become embedded within the organisation.

### 3.5 Training workers

Training of firefighters is clearly an essential element of the job. Not only does this training require them to be competent using the tools, equipment and procedures for their work, but also in the application of knowledge to make good decisions in real time, as detailed in the dynamic risk assessment process detailed in section 3.4.

To ensure firefighters have the appropriate training to complete their role and responsibilities FENZ provides training in two broad categories: progression training (Training and progression system (TAPS)) and operational skills maintenance (OSM).

Progression training involves structured programmes to teach new skills. This usually includes theoretical and practical learning to achieve a particular qualification or role (e.g., Qualified Firefighter, Station Officer, emergency response driver, line rescue). Trainees are formally assessed before they receive a qualification. FENZ records this training in its national “Learning Station” system.

Operational skills maintenance (OSM) is refresher training to ensure firefighters maintain safe and effective operational practice. OSM works on the basis that firefighters have been previously trained in the skills that are being refreshed. The national OSM computer program uses a traffic light system to track each person’s currency with maintaining their assigned core and specialist skills.

FENZ does not provide its general frontline firefighters with information or training on landslides. This includes any information or training to enable firefighters to recognise the warning signs of an imminent landslide.

FENZ manages a specialist search and rescue function called Urban Search and Rescue (USAR). USAR teams consist of selected FENZ firefighters trained to be USAR technicians, along with medics, logisticians, engineers and search dog handlers. All are trained to international USAR standards.

USAR technicians do receive landslide/slip awareness and safety training. Their training relates to landslides impacting buildings and this is incorporated into their training on structural collapse and rescue. Geotechnical engineers, who are part of the USAR team capability, bring extensive knowledge on the risk and behaviours of landslides. These geotechnical engineers advise the incident managers and USAR personnel on managing the risks when operating at a landslide related incident.

The USAR teams also carry landslide and building monitoring equipment for the safety of the responders.

There are fewer than 200 FENZ firefighters trained as specialist USAR personnel out of more than 10,000 FENZ firefighters overall. The Muriwai firefighters were not USAR personnel and therefore had not received FENZ training on landslides.

### 3.6 Communicating and supervising risk controls

FENZ does not hold a centrally held safety hazard and risk register. Rather, hazard and risk registers are held at a brigade/station level. This allows brigades/stations to “own” the risks and controls and manage them in a manner they deem appropriate.

The hazard and risk registers should hold a list of all the hazards that brigade personnel could be exposed to and provide details of the appropriate controls to be used to mitigate the hazard from causing harm.

Brigades are supported in this process by their safety, health and wellbeing team and elected safety health and wellbeing representatives.

Safety notifications and learnings from events are also presented or made available to brigades to allow them to update their hazard and risk register. This information includes national safety alerts and notices and district notices. Brigades participate in debriefs and after-action reviews of incidents they attended. They can also access a “Continuous improvement: Operational lessons learned” section on the FENZ intranet (with case studies, operational reviews, research papers and international resources and guidance).

Brigades are required to review their hazard and risk register annually and this forms part of the operational audit and review process.

### 3.7 Summary of health and safety management

The FENZ health and safety management system (HSMS) does reflect the basic principles and elements of both ASNZS 4801 and ISO 45001. FENZ also belongs to the ACC partnership programme that requires regular independent reviews of the organisation’s HSMS to be conducted.

The FENZ risk management standard details how risk should be managed across the organisation and is based on ISO 31000:2009 Risk management – Principles and guidelines. The FENZ safety, health and wellbeing manual prescribes a process for managing risk, which varies significantly from the process detailed in its standard. The critical risk management process and dynamic risk management are not referenced in the standard, and neither process references the standard.

## 4 The Incident

### 4.1 Introduction

Cyclone Gabrielle was a severe tropical cyclone that reached the top of the North Island of New Zealand on 12 February 2023. It moved down the North Island over the next two days causing widespread devastation. On 14 February the country declared a national state of emergency for only the third time in its history.

The Cyclone struck Auckland on 13 February, only 17 days after the Anniversary Weekend floods in Auckland. 27 January was Auckland's wettest day on record and January was Auckland's wettest month ever. The previous high rainfall, resulting in saturated ground and high water-table levels, magnified the effects of the cyclone on Auckland.

FENZ firefighters and its specialist Urban Search and Rescue (USAR) teams responded to a landslide impacting a house (27 January, Shore Road, Auckland) resulting in one fatality, and a landslide destroying a house (1 February, Orua Bay, Auckland) resulting in serious injuries.

### 4.2 Events leading up to the incident.

Auckland declared a local state of emergency on 27 January for the Anniversary Weekend floods and this was still in place when Cyclone Gabrielle approached. This local state of emergency only ended on 14 February when a state of national emergency was declared in its place.

FENZ preparations for the cyclone in the Auckland area included:

- Activating its Te Hiku Regional Coordination Centre (RCC) in Auckland at 0700 hours on Monday 13 February. However, the RCC began planning for the cyclone a week beforehand and was still in a readiness mode following the Anniversary Weekend floods.
- Establishing Staging Areas at West Harbour, Silverdale, Auckland City and Papatoetoe. Assistant Commanders were assigned to each Staging Area, resourced with rescue equipment, ambulances, Surf Life Saving personnel and watercraft, generators, etc.
- Partnering with contractors to have excavators positioned in the west Auckland suburb of Westgate. This enabled them to respond their excavators quickly to vulnerable areas in West Auckland and the west coast, with its steep hillsides prone to landslides.
- Positioning specialist USAR personnel and resources in Auckland. Assigning fulltime staffing to the Papatoetoe based Technical Rescue Tender. These resources were stood up in readiness to undertake rescues from landslides and collapsed buildings.
- Issuing National Safety Notices to its operational personnel on 10 and 13 February, on "Important information to keep yourself safe around floodwaters" and "Staying safe in flood waters and high winds" respectively. The FENZ Waitemata District, which covers Muriwai, issued a notice to its personnel on 10 February on "Ex Tropical Cyclone Gabrielle". This

included advice on operational considerations and crew welfare. (These notices did not refer to landslide risk).

As emergency call numbers increased, FENZ implemented its Multiple Incident Procedure (MIPs) at 16:47 hours on 13 February. (This procedure is used at times when its communications centre receives more calls than can be managed under normal circumstances. For example, during severe weather or civil defence emergencies).

The Muriwai volunteer fire brigade was experiencing the full impacts of the cyclone as it intensified into the evening of Monday 13 February. Monday is the brigade's usual meeting and training night, so most of the members were on station. The brigade responded to a call to a tree blocking a road at 20:51 hours.

After that, the Muriwai brigade's two appliances (a Pump with callsign 871 and a "Smoke Chaser" with callsign 8725) drove around the local community in torrential rain to assess the damage and provide assistance.

When they got to the elevated part of Muriwai they realised how intense the storm was. They saw slips happening on Domain Crescent and evacuated the residents as they knew it was an area known for slips previously. They described these slips as mud coming down the hill, rather than landslides.

871 returned to Muriwai station at 22:12 hours, while 8725 remained out in the community.

Muriwai 8725 is a Ford Ranger, double-cab utility vehicle, purpose built as a fire appliance. It was crewed by the Chief Fire Officer (CFO) who was the driver, a Station Officer (SO) riding in the front left side and a Qualified Firefighter (QF) riding in the left rear. This was an experienced volunteer crew, with the CFO having 19 years' service, the SO eight years' service and the QF five years' service. The CFO was providing the newly promoted SO with the opportunity to ride in charge of the appliance to build his experience as an officer.

#### 4.3 Muriwai 8725 crew actions before the landslide

During the evening of 13 February, the occupants of a two-storey house ("house") on Motutara Road, Muriwai, noticed mud flowing around their house and water flowing into the ground floor. Their house was at the bottom of a steep hill, which was approximately 60 metres high (see Appendix B, Figure 6, p.33, for photograph of this house before the landslide). The hillside was heavily covered in bush and large trees. At the top of the hill is Oaia Road, where properties line the hilltop with commanding views of Muriwai beach and the west coast. Across the road from the house is Muriwai Lodge, with a café, accommodation, and a large parking area.

At that time 8725 was parked on Motutara Road, just a short distance north of the house. The crew had stopped to check on some flooding and to assist people to move a caravan.

The firefighters went to investigate, arriving at the house at 22:33 hours, less than four minutes after the occupants evacuated. As the firefighters did not consider it to be an emergency incident, they did not contact the communication centre and they remained available to respond to an emergency call.

On arrival, the SO and QF immediately got out and walked up the steep 30 metre driveway to the house. The three crew members were all wearing helmets, wet weather gear, boots, and had torches and personal radios.

Meanwhile the CFO reversed 8725 into a parking area across the road, with the vehicle facing the house. The vehicle was left running, with its flashing beacons operating and its spotlights directed up the driveway. Two minutes after 8725 arrived, the CFO walked up the house driveway to check on the SO and QF. The heavy rain continued and there was mud around the house with water flowing over it. Water was starting to flood into the ground floor of the two-storey house.

They decided to dig a trench to divert the water, so the QF went to 8725 to get a spade and then returned to the house.

The CFO texted one of the Muriwai officers back at the station at 22:38, asking for 871 and crew to come and give them a hand. The CFO then returned to 8725 to get a shovel. He was standing at the rear of 8725 when he heard a loud roar and looked up suddenly to see the hillside behind the house coming down towards him. The large landslide destroyed the house, driving it down onto the roadway in front of 8725. The firefighters were on scene for just six minutes 49 seconds before the landslide occurred.

#### 4.4 After the landslide

The CFO ran to the side of the nearby building for protection as the landslide came towards him. When the noise stopped, the CFO heard a person calling for help from the house next door to the one they had responded to. This house had also been destroyed by the landslide and the occupant was trapped under the roof (see Appendix B, Figures 7 and 8, p.34, for photographs of this house before and after the landslide). The CFO quickly assisted the occupant out of the house and into 8725 for safety.

The CFO then transmitted a priority message at 22:43:50 to the FENZ communication centre from the vehicle's radio. The message was *"two trapped in the house that has come down the hillside. Truck is wedged"*. As 8725 had self-responded to the house, the communication centre had no previous knowledge of 8725 actions or its specific location.

The communication centre mobilised the appropriate fire appliances and notified senior officers and other specialist personnel. The CFO's priority message was heard over the radio by several personnel across Auckland, including in the RCC, the West Harbour staging area and Papatoetoe 348, so a large response commenced immediately.

Meanwhile, the CFO asked a local resident to take the rescued person, who appeared to be uninjured, to a place of safety. The CFO then heard the QF calling for help from his incident ground radio. The QF's radio was jammed on, so the CFO could not reply to him or ascertain his location.



The Muriwai fire station was only 800 metres from the landslide and 871, with a crew of four, was on scene within five minutes of the priority message being sent. Under the command of the CFO, they started the search and rescue operation. Three other Muriwai brigade members followed shortly afterwards in private vehicles. Members of the public also started to turn up to assist.

They found the QF within a few minutes. He was heavily trapped under the roof section of the house in the middle of Motutara road, a few metres in front of 8725. There was no sign of the SO.

The conditions for the search and rescue operation were very arduous. There were severe gale force winds, torrential, horizontal rain and it was pitch dark. The landslide had caused a power outage for much of Muriwai.

These conditions made travelling to Muriwai very challenging. The high winds, surface flooding, and fallen trees and power lines, led many responders to describe it as the most frightening trip they had ever experienced. Many observed how the conditions deteriorated markedly as they travelled towards the west coast and Muriwai.

The CFO's priority message was sent at 22:43:50 and further resources arrived at the following approximate times:

- 23:01: Kumeu 861 and 867 with 10 personnel
- 23:12: Kumeu 8629 with four personnel
- 23:12: Waitemata Group Manager

They immediately supported the search and rescue operation. By this time, two Police personnel were also involved in the rescue, and one or two ambulance personnel.

The Waitemata Group Manager took over from the CFO as incident controller at 23:22.

The first specialist USAR resources arrived at 23:34, with the Papatoetoe 348 Technical Rescue Tender and its crew of four USAR personnel, led by a senior station officer (SSO).

At the same time, Henderson 348 arrived with an SSO and three personnel, along with the Te Atatu 6619 lighting truck. This set up powerful lights, which illuminated the scene and its surrounds. *(A firefighter's wrist was injured while pushing a lighting trolley that fell over. The firefighter was treated by ambulance on scene and later transported to hospital. This wrist strain injury will be subject to a FENZ Level 1 accident investigation).*

As senior officers and specialist rescue personnel continued to arrive, they gradually took over the search and rescue effort. The initial rescuers had worked tirelessly, in arduous and risky conditions, with the knowledge that their close colleagues and friends were trapped in the landslide. It was very cold, and some were showing signs of hypothermia when they were relieved.

The incident controller appointed an experienced operations manager. Safety officers were also appointed. The USAR manager arrived at 23:50 with a geotechnical engineer. The USAR manager set up a base inside the Lodge cafe next to the incident site. Three more USAR technicians arrived at 23:55.

The Incident Control Point (ICP) was moved to the Muriwai fire station as the incident ground became more structured and controlled. Only those directly involved in the rescue operation remained near the site, to ensure a well-structured search and rescue operation and to reduce the number of people exposed to the high-risk environment.

Several risk mitigation measures were put in place, including safety officers, geotechnical engineers, skilled and experienced rescue personnel, observers, illumination, evacuation signals, escape routes and safe assembly points. The geotechnical engineer advised rescue personnel that staying close to the original landslide site was the safest place to be, as it was relatively stable and another slip in the same place was unlikely. Therefore, the hazards were mainly to the side of the landslide. Overall, the safe person concept provided them with guidance on acceptable risk, i.e. "In a highly considered way firefighters will take some risk to save saveable lives."

It proved a difficult task to extricate the QF, who was heavily trapped from the neck down by a range of materials. He was conscious while medics treated him, and he was talking to his rescuers. Meanwhile, others continued searching for the SO.

The rescuers were very aware of the risk of further landslides, as they could hear them nearby. At around 00:10 on Tuesday 14<sup>th</sup> a small slip occurred 20 metres north of the rescue site, moving a house off its foundations.

At 00:14 a FENZ District Manager took over as incident controller, working from the command unit based at Muriwai station.

At 00:30 a major landslide occurred approximately 40 metres north of the rescue site (see Appendix B, Figure 3, p.32 and Appendix C, Figure 9, p.35). This landslide was as large as the rescue site landslide. The thundering roar of the landslide and the evacuation airhorn led rescuers to run to a safe area. In less than a minute, when the noise stopped, they resumed the rescue.

The QF was extricated at 01:57, 3 hours 13 minutes after the landslide. He was in a serious "Status 1" condition and transported to hospital by ambulance. The on-call excavators had cleared Muriwai Road of fallen trees and powerlines to provide an exit route.

With the QF rescued, the incident management team assigned all its resources to searching for the SO. All equipment was turned off to eliminate any noise and two "line and hale" searches were undertaken. One of these involved speaking into an incident ground radio and listening to hear anything being transmitted by a radio speaker underneath the landslide. Both the QF and SO were carrying personal radios before the landslide.

A USAR search dog had been used earlier, but it was used again, along with a Police disaster victim recovery dog.

Despite these efforts, there was no sign of the SO and no indication of his location in the landslide.

The incident management team met at approximately 03:00 to consider next steps. After their extensive search efforts, they determined there was no chance of survival in the search area, as there were no

survivable voids. Furthermore, the QF was hypothermic when rescued an hour earlier and the rain had worsened since.

The incident management team reluctantly decided to move from a “rescue” to a “recovery” operation. For safety reasons they ceased operations that night and resumed the recovery operation the next day during daylight hours. Again, the safe person concept provided them with guidance on acceptable risk, i.e., “*firefighters will not take any risk at all to try and save lives or properties that are already lost*”.

The SO was found on Wednesday 15 February at 10:00 hours, 35 hours after the landslide. He was found approximately 12 metres northeast of where the QF was rescued. When the SO’s body was recovered it was apparent that he died instantly when the landslide struck.

The QF died of his injuries in hospital on Thursday 16 February.

## 5. The ICAM analysis

The ICAM investigation method offers a clinical and structured framework that allows for the contributory factors to an incident to be clearly identified. The framework provides terms that are to be used to describe certain events and conditions and it is important that these terms are interpreted by the reader within this context (see Appendix D for more information on ICAM categories, descriptions and glossary).

The methodology allows for the following to be answered.

- What were absent or failed defences that directly led to the incident?
- What worker actions in terms of mistakes or rule violations occurred that directly led to the incident?
- Were there task or environmental factors that contributed to absent/failed defences and to any errors or violations?
- Were there any organisational factors that contributed to absent/failed defences and to any errors or violations?

### 5.1 Absent/Failed defences

Description of defence	ICAM category	Absent or failed
Dynamic risk assessment	Awareness	Failed

The defence that failed in its purpose, was the dynamic risk assessment, which included the application of the safe person concept.

The purpose of the dynamic risk assessment is to raise the awareness of the presence of risks and allows those that could be impacted to respond appropriately. It is classified as an awareness control in the application of ICAM. The dynamic risk assessment failed in its purpose as the firefighters became exposed to an imminent and catastrophic risk.

The investigation team reviewed the training records for the three firefighters crewing 8725.

These records showed that all three had undertaken the progression training programmes required for their roles. Their progression training courses included significant content on dynamic risk assessment and the safe person concept.

We reviewed their OSM records over the past three years (13/2/20 - 13/2/23). These showed they all maintained a high level of “green light” status for their assigned skills over that period. We particularly checked the OSM skills that were potentially relevant for this incident, including:

- Working during adverse natural events
- The safe person concept
- Working safely around water
- Operational safety.

They were all current/green lighted for these skills.

## 5.2 Individual and team actions

Description of action or decision	ICAM category
The firefighters on 8725 commenced a task without knowing they were exposing themselves to imminent and catastrophic risk.	Knowledge based mistake

The firefighters had not been informed or trained by FENZ to recognise the warning signs of an imminent landslide and they were unaware of the risk that they were exposing themselves to. The dynamic risk assessment process is highly dependent upon having knowledge of the hazards and risks that are present at the time.

Application of the ICAM methodology indicates this is a knowledge-based mistake (KBM).

## 5.3 Task and environmental factors

Description of action or decision precursors	ICAM category
FENZ had not formally identified landslides as a hazard that could cause harm to firefighters.	Hazards not identified. (Workplace factor)
The firefighters lacked awareness about the risk of a landslide occurring while conducting activities in the locations that they serve.	Hazards not identified. (Workplace factor)  Inadequate planning. (Workplace factor)
The firefighters lacked awareness about the warning signs and triggers that indicate the imminent increased risk of landslides occurring.	Inadequate training. (Workplace factor)

Controls and protocols not being developed to mitigate the risks associated with landslides.	Lack of procedures. (Workplace factor)
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The firefighters were trained in the concept and application of the dynamic risk assessment process. However, they did not have the knowledge to interpret the warning signs of the increased risk of a landslide that were present in the environment they were working in. This lack of knowledge was due to FENZ not formally identifying the risks that landslides posed to firefighters.

As the risks posed by landslides to firefighters were not identified, control measures and procedures were not developed to mitigate the harm that could be caused, and no appropriate training was developed and or delivered (ICAM: Hazards not identified, lack of planning, lack of procedures; inadequate training).

#### 5.4 Organisational factors

Description of organisational factor	ICAM category
Landslides had not been identified as a hazard that could pose a risk to firefighters while undertaking their work. This indicates a failure of risk management, specifically the critical initial steps; the identification of hazards, and assessment of risks.	Risk management (RM)

There was a failure of the FENZ risk management process, as the risk of a landslide causing harm to firefighters was not formally identified, and therefore appropriate mitigations were not put in place.

The principal document that pertains to risk management in FENZ is its risk management standard (July 2019). This standard is used to identify and manage all FENZ risks, including strategic, enterprise, operational, portfolio/project and safety health and wellbeing.

The standard states the following:

*“The Fire and Emergency New Zealand risk management framework is aligned with ISO 31000:2009 Risk management – Principles & guidelines and provides a systematic approach for making decisions about how to manage risks.”*

(Note: “ISO 31000:2009 Risk management – Principles & guidelines” was updated and replaced by “ISO 31000:2018 Risk management – Guidelines”).

The risk management process contained within ISO 31000:2009, (Figure 3 – Risk Management process, p.14) consists of seven elements, one of which is “Risk identification”. This standard provides further guidance on risk identification, stating that *“Comprehensive identification is critical, because a risk that is not identified at this stage will not be included in further analysis.”* (p.17).

The evidence presented indicates that the identification process for safety risks was not sufficiently comprehensive. This is supported by the details in the FENZ risk management standard:



*“Risk identification can occur at any time, whether as part of a risk review workshop, annual planning processes or during ‘business as usual’ activities. It occurs when something that has the potential to compromise the achievement of organisational objectives is identified.”*

*“Risk workshops are held quarterly for each Directorate, facilitated by the National Risk Manager. These workshops review existing risks, as well as identifying new or emerging risks. Outputs from the workshops are documented to ensure an audit trail on changes to the risk registers.”*

These risk workshops cover all organisational risks. The brevity and lack of prescription in these statements does not correspond to the importance of identifying critical safety risks at this stage of the risk management process.

The purpose of any organisational standard is to provide structure and certainty across the organisation as to how tasks or activities are to be undertaken. Subsequent documents and procedures should reflect the intent prescribed by the standard.

The FENZ safety, health, and wellbeing manual is one such subsequent document, that references both ISO 31000:2009 and the FENZ risk management standard. However, the risk management process detailed in Section 6 of the manual varies significantly from that prescribed in the risk management standard.

Despite these differences, there remains a requirement in section 6 of the manual to identify and record all hazards. Like the FENZ risk management standard, there is limited prescriptive detail on how this critically important stage should be conducted with the manual providing only the following guidance.

*“There are many ways of identifying hazards, including workplace inspections and audits, personnel engagement, and incident and near miss investigations.”*

The lack of a clear and structured approach to the identification of hazards is also apparent in the FENZ critical risk programme. A series of initial workshops and an independent review appeared to miss the landslide risk. The ICAM process shows that the root cause of this incident was FENZ failing to identify a hazard and to assess the risk that it posed to its firefighters. This failure appears to be due to the hazard identification and risk assessment elements not being sufficiently prescriptive or thorough in the three FENZ risk management process documents (safety, health and wellbeing manual, risk management standard and the critical risk programme).

In the ICAM categorisation the organisational factor here would be risk management (RM).

(See Appendix E for the ICAM chart that shows a summary of the analysis of this incident).

## 6. Conclusions

This section of the report summarises the investigation team's conclusions.

Conclusions on the ICAM analysis.

### 1. Absent/Failed defences.

- Dynamic risk assessment, which includes the application of the safe person concept, failed in its purpose as a risk control. It failed because the firefighters on 8725 were unaware of the hazards and risks associated with landslides. (*Failed – Awareness*)

### 2. Individual and team actions.

- The firefighters commenced a task without knowing they were exposing themselves to imminent and catastrophic risk. (*Knowledge-based mistake*).

### 3. Task and Environmental factors or conditions.

- FENZ had not formally identified landslides as a hazard that could harm its firefighters. (*Hazards not identified*).
- FENZ had not developed controls and protocols to mitigate the risks associated with landslides. (*Lack of procedures*).
- The firefighters lacked awareness about the risk of landslides in the location they serve. (*Inadequate planning*).
- The firefighters lacked awareness about the warning signs and triggers of an imminent landslide. (*Inadequate training*).

### 4. Organisational factors.

- FENZ's risk management systems did not identify landslides as a hazard that could harm its firefighters. (*Inadequate risk management*).

Conclusions on FENZ risk management processes.

### 5. Aspects of FENZ's risk management processes require reviewing as follows.

- The FENZ risk management standard (2019) references ISO 31000:2009, when this was superseded five years ago by ISO 31000:2018.
- The FENZ risk management standard (2019) is to be reviewed annually. It was last reviewed in July 2019. (*Note: FENZ subsequently reviewed its Risk Management Standard. See chapter 8. "FENZ actions since the incident"*).
- The FENZ safety, health and wellbeing manual, section 6, describes a risk management process that is significantly different to that prescribed in the FENZ risk management standard.

- The FENZ critical risk management programme is not referred to in the FENZ risk management standard and the specific purpose of the critical risk management programme is inadequately defined.

The risk management processes above do not provide detailed guidance on a structured process for identifying hazards, despite this being required in the ISO standards.

Conclusions on FENZ planning for landslide risk.

6. FENZ was prepared and resourced to respond to landslide incidents, after they occurred, and to conduct effective search and rescue operations for members of the public. However, FENZ did not adequately identify the risk of its own personnel being caught in a landslide in the first place. Because FENZ did not identify this risk, it had not developed any policies or procedures on landslides for its firefighters or provided them with awareness training.
7. The FENZ critical risk management programme has not identified landslides as one of its top 13 critical risks. The two landslide fatalities at Muriwai indicates the need for FENZ to review its risk identification process.
8. While the investigation did not review all FENZ risk planning documentation across the country, it appears its risk planning processes do not include landslide susceptibility at Region, District or station level. This is challenging for FENZ because Councils are only starting the work to develop landslide susceptibility and hazard mapping. Such mapping will provide significant assistance to FENZ to understand and manage landslide risk for its firefighters.

Conclusions on the actions of the 8725 crew

9. The 8725 crew went to the Motutara Road house without thinking they were placing themselves at any significant personal risk. They did not view it as an “emergency” activity, as they did not contact the communication centre and they remained available to respond to an emergency call. They knew the occupants had left, so they knew there was no life risk. Therefore, their only goal was to limit property damage due to flooding.
10. When responding to the Motutara Rd house the firefighters could only rely on their knowledge and training in dynamic risk assessment and the safe person concept. These failed because the crew lacked sufficient awareness of the imminent threat, warnings, and triggers of landslides. Although the crew was concerned about slips or mud coming down the hill on Domain Crescent earlier that night (refer to p.15), they did not show any awareness of the warning signs of an imminent landslide when working at the Motutara Road house.
11. Persons trained to recognise the warning signs of a landslide would likely have identified the significant risk conditions at the Motutara Road property. These warning indicators or signs included:
  - Initial mud slides
  - Heavy precipitation, increased groundwater levels/saturated soil
  - Water flowing over slopes and/or escaping from the ground



- Slope, elevation, angle, and length
  - Soil type
  - Erosion damage
  - Topography of immediate area.
12. The three crew members on 8725 were qualified for their operational roles. Two of them were officers. They were appropriately trained and up to date with their operational skills maintenance training requirements. However, they were not trained by FENZ to recognise the signs of an imminent landslide.
13. The three crew members were all wearing appropriate PPE for the activities they were undertaking on the night. They were all wearing helmets, wet weather gear, boots, and had torches and personal radios.

#### Conclusions on the search and rescue operation

14. FENZ planned well for Cyclone Gabrielle and prepositioned significant resources to enable it to respond quickly and effectively to emergency calls. This planning enabled an immediate response and a well-resourced operation to find and rescue the two Muriwai firefighters. Without this level of preplanning, it would have taken significantly longer to deploy such a high level of specialist rescue personnel and equipment.
15. The rescuers did everything practicable to find and rescue the firefighters. The first wave of rescuers were the local volunteer brigades and nearby Police and ambulance personnel, followed by specialist USAR teams, including geotechnical engineers, medics, and search dogs. The Investigation Team could not identify any changes to the rescue operation that would have made a material difference to the outcome.
16. The rescuers made dynamic risk assessments and managed the risks in accordance with the safe person concept, i.e. *“In a highly considered way, firefighters will take some risk to save saveable lives”*. Although the rescue site was a high-risk environment, the rescuers took a range of risk mitigations to reduce the risk to an acceptable level in the circumstances.
17. The rescuers acted in a highly commendable manner. They were undaunted by the very arduous working conditions and potential risks and displayed a relentless commitment to the rescue operation.

#### Conclusions on landslide risks for the community

18. The landslide risk awareness issue is not limited to FENZ. Communities are established in landslide susceptible locations. Residents are permitted to live there, with many seemingly unaware of the landslide threat, and in particular how this risk increases after heavy rainfall.
19. The geology of Muriwai makes areas of it susceptible to landslides and it has a history of instability. Two people were killed in a landslide in 1965 when two houses were destroyed, yet a house was built on the same site and destroyed during Cyclone Gabrielle. This occurred approximately 1.2 km

from the Motutara Rd house landslide. Most of the residents in similarly susceptible locations remained in place as the landslide risk escalated after record rainfall levels in late January, followed by Cyclone Gabrielle less than three weeks later. This hazardscape presented a very challenging operating environment for the Muriwai volunteer fire brigade members, who were both local residents and emergency responders.

## 7. Recommendations

The recommendations are listed under two sections:

### Section 1. Failed defence – Dynamic risk assessment.

1. Review policy, procedures, and training programmes to lift firefighter awareness of the hazards associated with landslides and in particular the warning signs of an imminent landslide.
2. Consider including a local landslide susceptibility risk profile in station risk planning activities.

### Section 2. Organisational factors – Risk management.

3. Review the FENZ risk management standard and align it to ISO 31000:2018. Then consider incorporating SA/SNZ HB 205 as the approach for managing safety risks. This will provide a consistent approach to managing both safety and non-safety risks.
4. Review the FENZ critical risk management programme, within the context of the FENZ risk management standard and FENZ's approach to managing safety risk. This includes developing a clear and robust definition of a critical risk, drawing upon recognised guidelines, standards, and best practice in the fields of critical risk and critical control management.

## 8. FENZ actions since the incident

FENZ informed the investigation team it has taken the following actions since the landslide incident occurred on 13 February 2023.

1. Completed a review of the FENZ Risk Management Standard, commenced in October 2022 and published (via the FENZ Portal) on 20 March 2023. This revised standard aligns with ISO 31000: 2018 Risk management – Guidelines.
2. Issued a national safety notice (028/2023) on “Safety around landslips and land subsidence” to all operational personnel on 5 May 2023. This notice included information on the warning signs of a landslide and operational considerations.
3. The FENZ learning development team and USAR subject matter experts have developed a learning package for slip awareness and considerations for responding to land slips. This is being developed into e-learning modules, ready for review in September 2023. This package reinforces the Safe Person Concept and will cover basic awareness training for all FENZ responders, plus in-depth safety considerations for all its officers.

4. FENZ is increasing its national USAR response capability by providing more training and equipment to districts/brigades in areas with greater potential for earthquakes and/or landslips associated with severe weather. Target date is August to December 2023.
5. FENZ has initiated a review of its approach to critical risk management. It recently recalibrated its critical risks and is in the process of further assessing its critical risk.

## Appendix A – Investigation terms of reference and investigation team

### Level 2 Investigation Terms of Reference Muriwai

#### Purpose

The purpose of this Level 2 investigation is to identify all the factors that contributed to the fatalities of two firefighters, and the injury of two others, while responding to a flood call during Cyclone Gabrielle. The investigation incorporates the requirement to review the content and application of best practice operational procedures and training, and to evaluate the extent to which Fire and Emergency New Zealand (FENZ) prepared the local brigade to safely respond to such a severe weather-related event, and the brigade's capacity and capability to respond. Above all, Fire and Emergency New Zealand is committed to continuous improvement to minimise the risk of such catastrophic harm being repeated in the future.

It is not the purpose of this investigation to attribute fault, blame or liability.

#### Background

In the late evening of Monday 13 February 2023, a crew from the Muriwai Volunteer Fire Brigade were investigating flooding in a house on Motutara Road in Muriwai. While they were at the property, a landslide occurred on the slope above, and the house collapsed.

Two firefighters were trapped. A full rescue operation was initiated as soon as the landslide occurred, involving 10 crews from seven brigades and including Urban Search and Rescue (USAR), Police and St John. Upon arrival of a specialist urban search and rescue team one Firefighter was rescued and transported to hospital in a critical condition. A third firefighter suffered an injured wrist and was transported to hospital for treatment.

On Wednesday morning, 15 February 2023 a Fire and Emergency Urban Search and Rescue Team was able to locate the body of the second missing firefighter in the landslide and the deceased was subsequently removed from the landslide.

On Thursday evening, 16 February 2023 the critically injured fire fighter passed away in hospital.

#### Context

This investigation is focused on the circumstances leading to the FENZ response in Muriwai that resulted in the death of two firefighters, and a non-fatal injury to one other firefighter. It is recognised that this particular response was part of a much broader emergency response to the impacts of Cyclone Gabrielle.

Cyclone Gabrielle was a severe weather event impacting significant portions of the North Island of New Zealand and followed an earlier severe weather event impacting many of the same geographic areas. In that regard, a separate operational review of the entirety of FENZ's emergency response to both the impacts of Cyclone Gabrielle and the prior severe weather event is also being conducted, separate to this investigation, but within the same timeframe.

At the same time that FENZ is conducting this investigation, to identify all causal factors that contributed to the firefighter fatalities and injuries suffered in Muriwai, FENZ has been advised that WorkSafe New Zealand will also be conducting an investigation into the fatalities.

Consideration will be given throughout the investigation on how best to manage any interfaces necessary between these various investigations whilst maintaining the independence and integrity of this investigation.

## Principles

This investigation will be undertaken in accordance with the Terms of Reference listed below. It will utilise the Incident Cause Analysis Method (ICAM) and will incorporate operational observations and findings.

The Chief Executive supports this investigation. This includes providing access to information held by Fire and Emergency, and access to any of its staff and operational personnel, for the purposes of obtaining information relevant to the Terms of Reference.

## Specific Terms of Reference

- Identify all causal factors that contributed to the firefighter fatalities.
- Describe the context of the event; including the circumstances leading to the FENZ response, the nature of the FENZ response, the circumstances in which the harm incurred, and the immediate post event emergency response.
- Identify any new or significant hazards that contributed to the injuries and fatalities.
- Identify all Policies, Standard Operating Procedures, Instructions, Guidelines and Training Modules that have relevance to the event.
- Identify any deviations from relevant Policies, Standard Operating Procedures, Guidelines and Training Modules that may have occurred, and why.
- Evaluate the adequacy of any policies, standard operating procedures instructions, guidelines and training modules that have direct relevance to the event.
- Evaluate the extent to which FENZ prepared the local brigade to safely respond to such a severe weather-related event, and the brigade's capacity and capability to respond.
- Identify any inadequacy of hazard control.
- Recommend actions to address identified causal factors.

## Process

Fire and Emergency New Zealand will provide the investigator, and any others assisting the investigator, with access to any relevant documentation or reports, as well as to staff and personnel for the purpose of interview, which is within scope of the investigation.

The investigation will be conducted in a manner consistent with the principles of natural justice and information protection.

The Chief Executive will have the opportunity to comment on the draft findings of the investigation, prior to a report being finalised.

## Confidentiality and disclosure

Investigators will receive and consider personal and confidential information while conducting this investigation. Accordingly, the investigation report will be prepared in a manner that anonymises individuals and maintains confidentiality to the extent possible.

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### Investigation team biographies

The investigation was conducted independently by Paul McGill, the lead investigator and Andy Evans a specialist ICAM (Incident Cause Analysis Method) health and safety investigator.

Paul McGill was with the New Zealand Fire Service and Fire and Emergency New Zealand for nearly 40 years, serving as a frontline firefighter then a range of senior roles, including Deputy National Commander, National Commander Urban and Acting Chief Executive.

Paul was appointed an Officer of the New Zealand Order of Merit for services to Fire and Emergency New Zealand in 2020. He has an MA in Management, is a Fellow (FIFireE) of the Institution of Fire Engineers, is a Member of the City and Guilds of London Institute for Fire Service Management and a graduate of the Brigade Command Course at the Fire Service College in the UK.

Andy Evans is a skilled and experienced independent health and safety investigator who has conducted many ICAM investigations into a wide range of incidents including in farming, power distribution, logistics, education, construction, and transport industries. Many of these were significant and high-profile.

Andy has a Master's Degree in occupational safety and health and has been a professional safety consultant for 10 years. He has developed and delivered ICAM training courses for three training organisations and trained more than 1,000 New Zealanders in ICAM.

## Appendix B – Photographs



**Figure 1** above. Several slips above Motutara Rd. Firefighter rescue site at bottom of centre slip. Oaia Road houses along top of hill. (NZ Herald)



**Figure 2** above. Rescue site in foreground where debris covers road. Lodge café is the large building in the centre past the rescue site. (USAR photo taken 14:00 hrs on 14 Feb)





**Figure 3** above. Rescue site in centre right where debris crosses the road. The landslide in foreground happened during the rescue approx. 1 hr 50 mins after the first landslide occurred. (USAR photo taken 14:00 hrs on 14 Feb)



**Figure 4** above. Close up of rescue site on roadway. (USAR photo taken 14:00 hrs on 14 Feb)





**Figure 5** above. Hillside above Motutara Rd with Oaia Rd houses at top of hill. The far slip is the first slip involving the firefighters with the second slip in foreground. (USAR photo taken 14:00 hrs on 14 Feb)



**Figure 6** above. Firefighters were working at the centre house indicated by the arrow before the landslide. (Real estate photo)





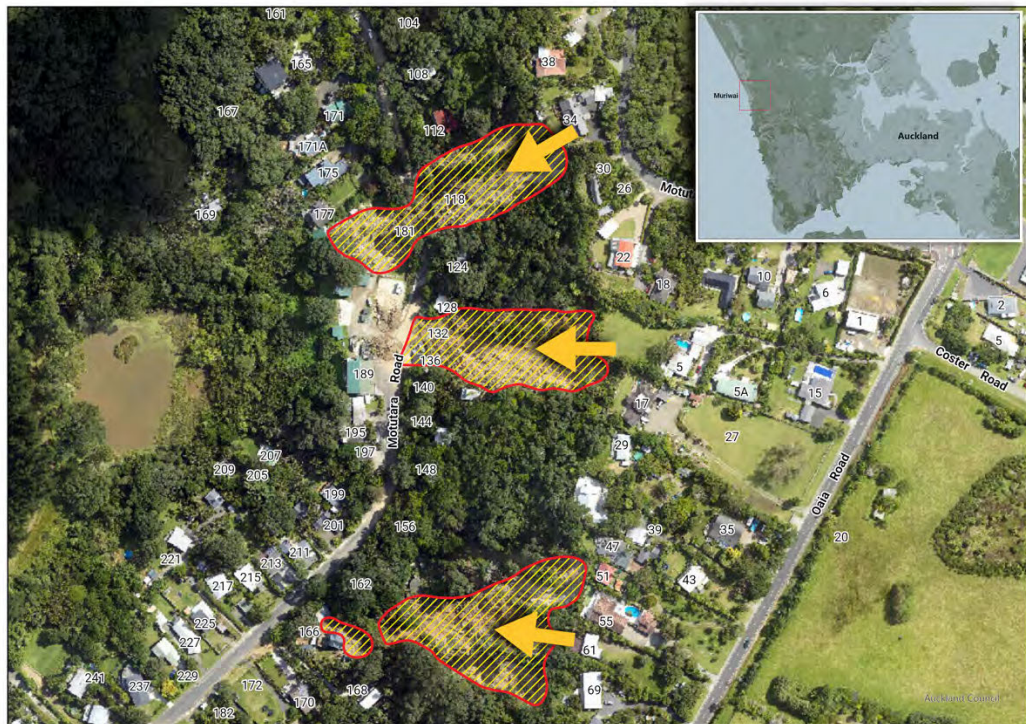
**Figure 7** above. Firefighters were working at centre rear house before the landslide. CFO rescued a person from roof section of centre front house shown after the landslide in figure 8 below. (Real estate photo)



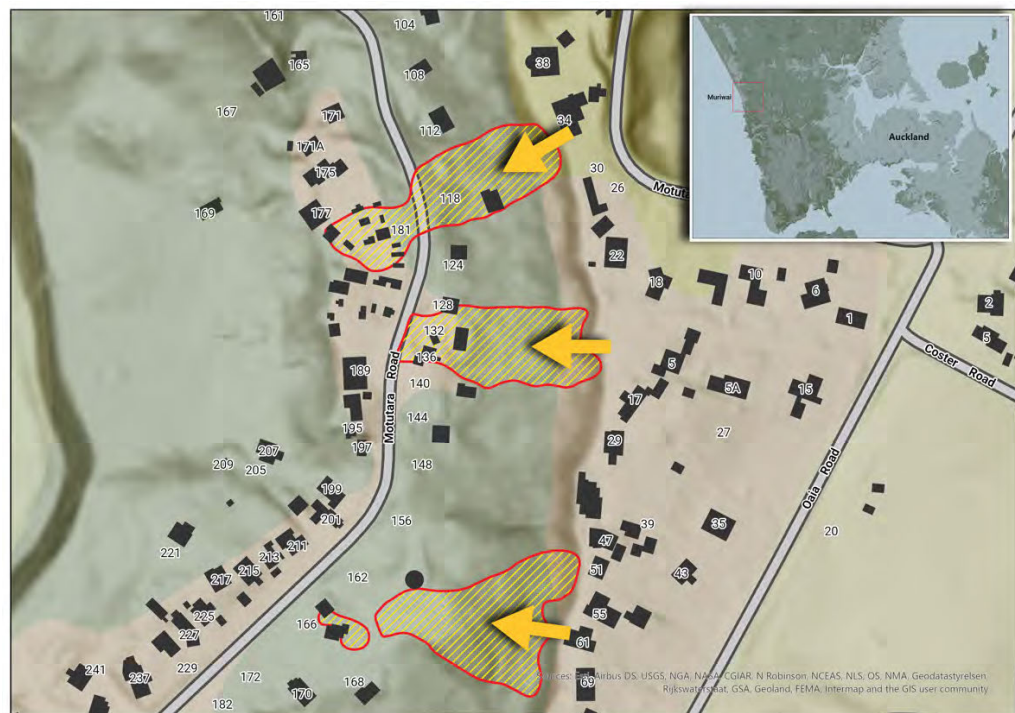
**Figure 8** above. CFO rescued a person from underneath the roof section shown above. This is the roof of the centre-front house shown in figure 7 above. (USAR Photo)



## Appendix C – Maps



**Figure 9** above. Satellite photo with landslides superimposed. The arrows indicate the direction of the landslides' travel. The rescue operation took place near the left edge of the centre landslide on Motutara Road. The top landslide occurred during the rescue operation approx. 1 hr 50 mins after the centre landslide occurred.



**Figure 10** above. Map showing houses that were destroyed in the path of the landslides.

## Appendix D – ICAM categories, description, and glossary

### Absent/Failed defences

These contributing factors result from inadequate or absent defences that failed to detect and protect the system against technical and human failures. These are the control measures that did not prevent the incident or limit its consequences.

Category	Meaning
Awareness	Appreciate the nature of the hazard and its associated risks.
Detection	Provide a clear warning of both the nature of any hazards and associated risks.
Control and interim recovery	Maintain safe systems or return to a safe state.
Protection and containment	Limit the severity of the outcome of the incident.
Escape and rescue	Get people away from potential sources of harm.

### Individual/Team actions

These are the errors or violations that led directly to the incident and are typically associated with personnel having direct contact with the equipment, such as operators or maintenance personnel.

Category	Meaning
Slip - Attention failure	Unintended deviation from a current plan of action.
Lapse - Memory failure	Omission/repetition of a planned action.
Mistake - Rule-based	Intended action inappropriate to the circumstances, a sound rule applied in inappropriate circumstances, or the application of an unsound rule.
Mistake - Knowledge-based	Erroneous judgment in a situation not covered by a rule, insufficient knowledge, experience, or immaturity.
Violation - Routine	Habitual deviation from required practice.
Violation - Situational	Rules are broken to overcome an operational difficulty.
Violation - Optimising	Rules are broken for the perceived benefit of either the organisation or the individual.
Violation - Exceptional	Ad hoc infringement of regulated practice.

### Task/Environmental conditions

These are the conditions in existence immediately prior to, or at the time of the incident that directly influence human and equipment performance in the workplace. These are the circumstances under which the errors and violations took place and can be embedded in task demands, the work environment, individual capabilities, and human factors.

Workplace factors (include)	Human factors (include)
Task Planning - sufficient	Complacency
Hazard analysis	Pressure
Work procedures - suitable	Lack of knowledge
Abnormal operation - deviation	Lack of communication
Tools and equipment - suitability	Peer pressure
Housekeeping	Physical/Mental capacities
Congestion/Restriction	Stress

### Organisational factors

These are the underlying organisational factors that produce the conditions that affect performance in the workplace. They may lie dormant or undetected for a long time within an organisation and only become apparent when they combine with other contributing factors that led to the incident. ICAM classifies the organisational factors into 14 organisational factor types:

ICAM organisational factor types		
Hardware	Maintenance management	Design
Organisational culture	Organisation	Procedures
Regulatory influence	Risk management	Training
Organisational learning	Management of change	Communication
Incompatible goals	Contractor management	



Appendix E – ICAM Chart, showing summary of the analysis

Organisational factors	Task and environmental conditions	Individual and team actions	Absent/Failed defences	Incident
<p>Landslides had not been identified as a hazard that could pose a risk to firefighters while undertaking their work. This indicates a failure of risk management, specifically the critical initial steps; the identification of hazards, and assessment of risks.</p> <p><b>(Risk management RM)</b></p>	<p>FENZ had not formally identified landslides as a hazard that could cause harm to firefighters.</p> <p><b>(Hazards not identified)</b></p> <p>Firefighters lacked awareness about the risk of a landslide occurring while conducting activities in the location that they serve.</p> <p><b>(Inadequate planning)</b></p> <p>Firefighters lacked awareness about the warning signs and triggers that indicate the imminent increased risk of landslides.</p> <p><b>(Inadequate training)</b></p> <p>Controls and protocols not being developed to mitigate the risks associated with landslides.</p> <p><b>(Lack of procedures)</b></p>	<p>Firefighters commenced a task without knowing they were exposing themselves to imminent and catastrophic risk.</p> <p><b>(Knowledge-based mistake)</b></p>	<p>Dynamic risk assessment and application of the safe person concept.</p> <p><b>Failed (Awareness)</b></p>	<p>A landslide led to the engulfment of two firefighters that resulted in them receiving fatal injuries</p>