Analysing government expenditure related to natural hazards

Contents

1 – Introduction

Purpose of our work

1   New Zealand faces a range of risks from natural disasters and other hazards. Although many of the risks can be easily identified, it is difficult to assess the likelihood associated with these risks. The threats posed by terrorism, climate change, and, recently, the Covid-19 pandemic highlight the need for public assurance about how well risks are managed.

2   Resilience has been defined as "the ability to anticipate and resist disruptive events, minimise adverse impacts, respond effectively, maintain or recover functionality, and adapt in a way that allows for learning and thriving".[1] It is about remaining effective across a range of future conditions. One of the focus areas for our Office's 2020/21 work programme is resilience.

3   The purpose of this document is to improve our understanding of government expenditure administered through appropriations[2] related to preparing for, or responding to, risks associated with natural hazards. Specifically, we want to know:

- How much government expenditure can we identify as related to natural hazards each year?
- What types of natural hazards does the expenditure relate to?
- What is the nature of the expenditure? How much is related to responding to hazard events compared with risk reduction?
- What votes incur the greatest expenditure?
- What trends can we observe in expenditure from the past 10 years?

4   This document describes our approach to answering these questions and the key findings from our analysis (including a discussion of the limitations). This work is intended to develop our understanding of government expenditure related to natural hazards as we consider further work on risk and resilience. It is not intended to be, and should not be used as, an estimate of total government expenditure related to natural hazards. Rather, it provides information that could assist in understanding how much government expenditure can be identified in publicly available appropriation data. We welcome feedback on this work.

5   Work that others have done indicates that government expenditure related to natural hazards is much higher than our numbers in this document. For example, government expenditure related to the 2010/11 Canterbury earthquakes alone

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1   Ministry of Civil Defence and Emergency Management (2019), *National Disaster Resilience Strategy*, page 7 at www.civildefence.govt.nz.

2   Both departmental and non-departmental expenditure (including capital expenditure).

has been estimated to be about $15 billion in analysis carried out by the Treasury.[3] Our analysis highlights the limits of appropriation data to provide a clear picture of total government expenditure related to natural hazards.

6   We wonder whether there are similar limitations in relation to other aspects of expenditure of public interest. If so, this has important implications for the Government in terms of its own ability to analyse expenditure and assist with long-term fiscal strategy and planning, as well as the degree to which it can be held accountable for the expenditure.

Scope

7   For the purposes of this analysis, we looked at only natural hazards that can be broadly categorised as geophysical. This includes geological, meteorological, and climate hazards.

8   We have not included biological natural hazards, and so have not looked at diseases, outbreaks, epidemics, pandemics, or other biosecurity hazards.

Limitations

9   Our analysis focused on government expenditure authorised through appropriations. We know that there are significant levels of expenditure in other parts of the public sector that are outside of the scope of this work. Our analysis does not include expenditure by local government and some Crown entities on insurance, risk financing, climate change adaptation, post-disaster recovery, or any other expenditure not provided through appropriations (such as Earthquake Commission spending that is funded by levies).

10   Our analysis provides information only about expenditure that can be identified in publicly available appropriation data. Relevant expenditure by government departments, for example on climate change mitigation, might not be separately identifiable in the appropriation data we used for this analysis. A full description of the limitations of our analysis is provided in paragraphs 38-40.

11   We identified some government expenditure related to most major natural geophysical hazards. We did not find explicit reference to droughts or drought-related natural hazards, which have been topical hazards in recent years. This is likely to be included in appropriations related to other areas of government expenditure (for example, adverse events or income equalisation)[4] that we have

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3   This estimate is taken from the *Financial Statements of the Government of New Zealand for the Year Ended 30 June 2017* at www.treasury.govt.nz. The last time estimates of Canterbury earthquake expenditure were included in the Government's financial statements was in 2017. However, it is worth noting that the Government's financial statements in 2018 and 2019 included a note that indicated total expenditure might actually have been less than previous estimates.

4   Inland Revenue, Income equalisation schemes at www.ird.govt.nz.

included in the analysis, but we cannot be confident of this. There is a need to look at a wider range of data sources to develop a more complete understanding of government expenditure related to natural hazards.

12   We have limited our analysis to two main categories of expenditure, "response and recovery" and "risk reduction". These categories draw on the concepts of the 4Rs (reduction, readiness, response, and recovery)[5] framework. However, because of the limitations of our analysis, we have combined readiness and reduction results under the "risk reduction" category and response and recovery results under the "response and recovery" category to minimise the risk of misrepresenting the focus of expenditure.

13   Our methodology does not attempt to align completely with the 4Rs, the risk management cycle set out in ISO 31000, or other risk management frameworks such as ACTA (avoid, control, transfer, and accept). Our analysis is intended to help us understand where the expenditure that we have been able to identify in the appropriation data is targeted.

14   Our analysis should not be used as an estimate of total government expenditure on civil-defence-related activities. It can only be considered as a contribution toward, or input into, any estimate. The limitations we set out in this document should be referenced if our analysis is going to be used in this way.

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5   Civil Defence National Emergency Management Agency. The 4Rs: Reduction, Readiness, Response, and Recovery at www.civildefence.govt.nz.

2 – Methodology

The data we used

15   Appropriations are the basis on which Parliament authorises executive government to incur expenses and capital expenditure. Every year, the Treasury publishes appropriation data on its website. This includes the budgeted expenditure for the next financial year, estimated actual expenditure for the current financial year, and actual expenditure against appropriations for the previous four financial years.[6]

16   We merged three appropriation data sets to form a 10-year view of actual expenditure by appropriations from 2009 to 2018. The data set includes departmental and non-departmental expenditure (including capital expenditure).[7] The data set we created contains almost 10,000 rows of data related to expenditure against individual appropriations for this period. We refer to this 10-year data set as "the appropriation data" in the rest of this document.

17   Each row of the appropriation data contains 17 items of information. The items we considered the most relevant for our analysis were:

- **Department**: name of the administering department of the appropriation.
- **Vote**: name of the Vote in which the relevant appropriations are reported.
- **Appropriation name**: name of the appropriation as reported in the Vote. This information, together with the "category name" and "current scope" information, describe what the appropriation is about.
- **Category name**: the category of appropriated expenditure within a broader multi-category appropriation.
- **Current scope**: a description of what types of expenditure (that is, expenditure on which activities) are permitted within the appropriation or category.
- **Portfolio**: ministerial portfolio responsible for specified appropriations, which also allows us to identify the Minister responsible for each appropriation.
- **Amount $000**: the value of appropriation.

18   One item of information in the appropriation data is "Amount type". There are several amount types, including actual, estimated actual, and main estimate. Our analysis uses only the actual amount, which represents actual expenditure by appropriation.

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6   An example from 2019/20 is available on the Treasury website. The Treasury, *B19-expenditure-data* at www.treasury.govt.nz.

7   Departmental expenditure is directly incurred by departments. Non-departmental expenditure is administered by departments but incurred on behalf of the Crown.

19   We excluded some items in the original data sets because they were not relevant to our analysis. Those items included:

- the "M Number" item, which gives the identification number of the responsible Minister; and

- the "App ID" item, which is used to uniquely identify each appropriation.

Our approach

20   To answer the questions we set out in paragraph 3, we:

- created the appropriation data set;

- identified significant events and key words relating to natural hazards and/ or disasters. This included obtaining input from the Department of Internal Affairs and the New Zealand Institute of Economic Research;[8]

- identified appropriations potentially related to natural hazards, risk reduction, or response expenditure by searching the appropriation data and using those key words;

- reviewed a sample of the results of each search to refine our criteria to minimise the risks of false positive results (that is, where a key word was present but the appropriation was unlikely to be relevant) and to pick up additional key words that were likely to result in identification of relevant expenditure;

- categorised these appropriations by the level of confidence we had in the relevance of the appropriation, the hazard type, the expenditure type, and the relevant event;

- validated our categorisation by manually checking samples of the data. More information about the quality assurance steps that we carried out is in paragraphs 41-46; and

- analysed the resulting data set (we refer to this data set enriched with the above categorisation as "the enriched appropriation data" in the rest of this document), summarised our key findings, and recorded the limitations of our analysis.

Key word search

21   We developed a list of key words to identify appropriations relevant to natural hazards. The list of key words we developed was based on information about previous emergencies[9] from the Civil Defence website, input from the Department of Internal Affairs and the New Zealand Institute of Economic Research, and our own research.

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8   The Department of Internal Affairs is also working with the New Zealand Institute of Economic Research to develop a better understanding of government department expenditure on response and risk reduction of natural hazards. We have consulted with both entities on our approach to this analysis.

9   Resources: Previous emergencies at www.civildefence.govt.nz.

22   The key words we used for each category initially were:

- **Types of natural hazards**: earthquake, tsunami, tornado, cyclone, flood, volcano, eruption, landslide, landslip, fire, snow, wind, rain, weather, climate or climatic, drought, and erosion.

- **Natural hazard events and where they occurred**: Christchurch, Canterbury, Hurunui, Kaikōura, Gita, Fehi, Nelson, Auckland, Taranaki, Tasman, Pam, and Lusi.

- **Response, recovery, or risk reduction expenditure**: response, enhancement, protection, demolition, rebuild, strengthening, awareness, severe, adverse, readiness, ex gratia, emergency, civil defence, disaster, hazard, and restoration.

23   We searched the appropriation data for key words within the "appropriation name", "category name", "vote", "portfolio", and "current scope" items.

24   We used key word searches to pick up whole words and partial words. After each search, we further refined our search criteria both to minimise false positives and to pick up additional key words we thought would identify relevant expenditure. In the end, we carried out more than 200 searches.

Enriching the appropriation data

25   We enriched the appropriation data to facilitate our analysis (see example in Figure 1). We decided to categorise the data into:

- our level of confidence in the appropriations relevance to natural hazards;

- type of expenditure;

- type of hazard; and

- the specific hazard event.

Figure 1
How we enriched the appropriation data

Two tables show how one appropriation was enriched with four additional columns after categorising.

Before

Appropriation	Year	Amount $million
Greater Christchurch Anchor Projects	2018	17.474

After

Appropriation	Year	Amount $million	Confidence level	Expenditure type	Hazard type	Event
Greater Christchurch Anchor Projects	2018	17.474	Medium	Response and recovery	Earthquake	2010/11 Canterbury earthquakes

Source: Categorised from appropriation data published on the Treasury's website.

26   The categories are explained further below.

Confidence levels

27   We categorised appropriations as high, medium, or low, depending on the level of confidence we had in their relevance (Figure 2).

Figure 2
Criteria for confidence levels and the key words that returned results

The table contains the criteria we used to assign the confidence levels and the key words that we found in the appropriation data.

Category	Criteria	Key words that returned results that were then categorised	Notes
High We have a high degree of confidence that an appropriation was related to natural hazards response or risk reduction expenditure.	Specific mention of natural hazard or disaster event from the Civil Defence website of previous emergencies.	2009 Victoria bushfire 2011 Australian flood 2011 Canterbury earthquake Canterbury rebuild Canterbury recovery Christchurch earthquake 2011 Japan earthquake/ tsunami 2016 Kaikōura earthquake 2017 Edgecumbe flood	
Medium We have a moderate degree of confidence that an appropriation was related to natural hazards response or risk reduction expenditure.	Contains key words associated with natural hazards or disasters, and includes a response or risk reduction key word.	Earthquake, flood, severe, weather, erosion, costs, arising, repair, recovery, strength, control, protect, relief, warning	

Category	Criteria	Key words that returned results that were then categorised	Notes
Medium We have a moderate degree of confidence that an appropriation was related to natural hazards response or risk reduction expenditure.	Special terms indirectly related to natural hazards response and reduction.	Civil Defence, Minister for Greater Christchurch Regeneration	All civil defence emergencies declared before 2020 have been related to natural disasters.* Christchurch regeneration is related to the 2010/11 Canterbury Earthquakes.
Low We think the appropriation might be related to natural hazard response or risk reduction expenditure, but when we manually reviewed the content it was not clear that the appropriation was about natural hazards.**	*Either* contains key words associated with natural hazards or disasters, *or* has key words associated with response and/ or risk reduction expenditure type.	Earthquake, climate or climatic (clima), hazard, post crisis, emergency services, disaster Protection, environmental awareness, rebuild, adverse event, emergency readiness, restoration Christchurch, reinstatement Christchurch	

* Civil Defence National Emergency Management Agency. Resources: Previous emergencies: Declared States of Emergency at www.civildefence.govt.nz.

** For example, the appropriation *Unwind of Discount Rate Used in the Present Value Calculation of Payment Under Crown Deed of Support with Southern Response Earthquake Services Ltd* is limited to the expense incurred in unwinding the discount rate used in the present value calculation of the liability as the liability nears settlement.
Note: There are two entries for medium because there were two different criteria that met medium.

28   The appropriation data was categorised from high to low. After an appropriation had been assigned a category, it was removed from the data search. This ensured that appropriations would not be assigned to more than one category. We also manually reviewed a sample of data from each category to check that the categorisation had been correctly assigned.

Type of expenditure

29   We have categorised the appropriations into three types of expenditure: "Risk reduction", "Response and recovery", and "Other civil defence" (Figure 3). If an appropriation did not fit under one of these three types of expenditure, we categorised it as "Unclear".

Figure 3
Criteria for each category and the key words that returned results

The table below outlines the criteria used for each category and the key words found in the appropriation data.

Category	Criteria	Key words that returned results that were then categorised	Notes
Response and recovery The wording of the appropriation was related to expenditure on a response to or recovery from an event that had happened.	Contains key words related to response and recovery, or a hazard event.	Costs arising, repair, recovery, relief, regeneration, rebuild, restoration Christchurch	
Risk reduction The wording of the appropriation indicates that the appropriation was related to reducing the risks associated with natural hazards.	Contains key words related to risk reduction.	Strength, control, protect, warning, environmental awareness, emergency readiness	
Other civil defence The wording of the appropriation indicates that the appropriation was related to civil defence expenditure, but we were not able to clearly identify a relationship to either risk reduction or response.	Contains the specific term civil defence.	Civil defence	The type of appropriations that we identified tended to be related to ongoing expenses associated with civil defence — for example, policy advice on matters relating to civil defence and emergency management and drafting ministerial correspondence and questions.

Type of hazard

30   We further analysed the appropriation data to understand the different types of natural hazards that were referenced. We initially searched for the following natural hazard key words: earthquake, tsunami, tornado, cyclone, flood, volcano, eruption, landslide, landslip, fire, snow, wind, rain, weather, climate or climatic, drought, and erosion. We reviewed a sample of our search results and refined our search criteria to also include the keyword "environmental".

Figure 4
Types of natural hazard found in the appropriation data

The table lists the hazard types we found in the appropriation data. If an appropriation did not contain a specific hazard type, we categorised it as "Unknown".

Type of natural hazard	Criteria	Notes
Bushfire	Contains the key word "bushfire".	
Climate change related	Contains the key words "climate" or "climatic".	This is an indirect association. Climate change is not necessarily related to a specific hazard but could lead to a natural hazard.
Earthquake	Contains the key word "earthquake".	
Earthquake and tsunami	Contains the key words "earthquake" and "tsunami".	Although a tsunami can also be caused by a volcanic eruption or an underwater landslide, we did not identify any references to these key words in the appropriation data.*
Environmental	Contains the key word "environmental".	This is an indirect association. Environmental does not necessarily indicate a hazard but might relate to hazard response or risk reduction.
Erosion	Contains the key word "erosion".	This is an indirect association. Landslips and landslides can be caused by erosion.
Flood	Contains the key word "flood".	
Weather	Contains the key word "weather".	This is an indirect association. Natural hazards can be caused by weather events.

* For more about tsunamis, see *Reference – Tsunamis* on the National Geographic website: www.nationalgeographic.com

Specific hazard event

31   We also categorised appropriations according to the specific natural hazard event (including the year when the event occurred) where this was possible (Figure 4). Where it was not possible to categorise an appropriation under a specific hazard event, it was categorised as "Unknown".

32   We included expenditure associated with international hazard events (Figure 5) because we thought it reasonable to assume that the financial assistance New Zealand provides to other countries would be reciprocated when major events occur here.

33   We expected to see a number of other hazard events specified in the appropriation data – for example, Taranaki and Auckland storms in 2019 and ex-tropical Cyclone Gita in 2018 – but we did not find them.

Figure 5
Criteria for events and the key words that returned results

The table outlines the criteria used for each category, and the events and key words found in the appropriation data.

Event	Criteria	Key words that returned results that were then categorised
2009 Victoria bushfires	Contains key words of the event.	Victoria and bushfire Australia and bushfire
2011 Queensland floods	Contains key words of the event.	Australia and flood
2010/11 Canterbury earthquakes	Contains key words of the event.	Canterbury and earthquake Canterbury and rebuild Christchurch and earthquake Canterbury and recovery
2011 Great East Japan earthquake	Contains key words of the event.	Japan and earthquake/tsunami
2016 Kaikōura earthquake	Contains key words of the event.	Kaikōura and earthquake
2017 Edgecumbe flood	Contains key words of the event.	Edgecumbe and flood

3 – Results

Analysing the appropriation data

The headlines

34   We analysed only the appropriations where we had high or medium confidence in their relevance to natural hazards. The main findings from our analysis of this data are as follows:

- We identified $11.4 billion of government expenditure related to natural hazards between 2009 and 2018, which is 1.36% ($11.4 billion out of $837.7 billion[10]) of the total government expenditure authorised through appropriations during these 10 years.

- We categorised $5.6 billion (49%) of the $11.4 billion expenditure identified as relating to hazard response and recovery, $2.8 billion (24%) was categorised as relating to risk reduction, and $3 billion (27%) was categorised as other civil defence.

- In 2011, after the Canterbury Earthquakes, we identified in the appropriation data a $2.5 billion expenditure related to natural hazards, the highest of the 10-year period.

- By types of hazard, "Earthquake" has the largest identifiable expenditure during the period, and then "Weather", "Flood", "Erosion", "Tsunami", and "Bushfire". The Insurance Council of New Zealand has earthquakes as the most costly type of natural hazard in New Zealand.[11]

- Risk reduction expenditure appears to follow a three-year cycle. We identified about $24 million for each year between 2012 and 2014. Between 2015 and 2017, this increased to about $600 million for each year, and then dropped back to about $24 million in 2018. This pattern is not consistent with the response and recovery expenditure, which has a more steady trend.

- In the last 10 years, 21 out of the 39 government departments incurred or administered some expenditure related to natural hazards. This might suggest that natural hazards result in, or require expenditure across, most government departments.

- The third highest expenditure that we identified in the appropriation data was incurred or administered by the Ministry of Social Development. This does not mean that it incurred the third most expenditure, but it does indicate that the appropriation data for the Ministry includes a larger number of specific references to natural hazards and response or risk reduction expenditure.

- Some government departments incurred or administered expenditure related to natural hazards consistently throughout the 10 years (for example, the Ministry of Social Development and the Ministry for Primary Industries), and

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10 This figure is the total actual expenditure from the appropriation data for the 10-year period.

11 Insurance Council of New Zealand. Cost of Natural Disasters at www.icnz.org.nz.

some government departments appear to have incurred or administered more one-off identifiable expenditure (for example, the New Zealand Defence Force and the Ministry of Justice).

- The proportion of identifiable natural hazard expenditure relative to total government expenditure authorised through appropriations has been relatively stable since 2011 (about 1-2%). Identifiable expenditure related to natural hazards before 2011 was significantly lower (less than 0.5% of total government expenditure authorised through appropriations).

35 It is worth noting that our searches returned no matches for the following key words:

- Types of natural hazards: tornado, cyclone, volcano, eruption, snow, wind, drought, and rain.
- Natural hazard events in New Zealand: Gita, Fehi, Pam, and Lusi.

36 This might indicate that the expenditure related to these natural hazards was not significant enough to need a specific appropriation, or to reference within the scope statement of another appropriation. Expenditure associated with these hazards might have been included within a broader appropriation.

Detailed findings

37 The following tables and graphs summarise identifiable expenditure by votes, administering departments, types of hazards, and types of focus throughout the 10-year period (Figures 6 to 16). The "Total value" fields below are the total identifiable expenditure against appropriations categorised with confidence level high and medium. Amounts for low confidence level are presented where possible as additional information.

By confidence level and type of expenditure

Figure 6
Breakdown of identifiable expenditure, by type of expenditure and confidence level

The table shows a breakdown of expenditure by type of expenditure and confidence level. Of the $11.4 billion expenditure, we categorised $5.6 billion (49%) as relating to response and recovery, $2.8 billion (24%) as relating to risk reduction, and $3 billion (27%) was categorised as "other civil defence".

Confidence level	Rounded total $million	Response and recovery $million	Risk reduction $million	Other civil defence $million	Unclear $million
High	4,872	4,871.9	–	–	–
Medium	6,513	682.9	2,791.0	3,039.2	–
Total value*	11,385	5,554.8	2,791.0	3,039.2	–
Low	3,455	576.5	41.6	–	2,836.5

* Total values do not include low-confidence level amounts.
Source: Analysed from the enriched appropriation data.

By vote

Figure 7

Breakdown of identifiable expenditure, by vote, administering department, and confidence level

The table shows a breakdown of expenditure in $millions by vote, administering department, and confidence level. The intention is to show the votes that had the most identifiable natural hazard expenditure. A vote is a collection of appropriations. Note that a department can administer multiple votes. We identified $3.3 billion for Vote Finance (for the Treasury), which is the biggest expenditure of all votes.

Vote	Administering department	Total value* $million	Confidence level		
			High $million	Medium $million	Low $million
Finance	The Treasury	3,273.7	62.2	3,211.5	69.1
Canterbury Earthquake Recovery	Department of the Prime Minister and Cabinet	3,151.5	3,151.5	–	–
Social Development	Ministry of Social Development	3,066.4	216.6	2,849.8	160.0
Canterbury Earthquake Recovery (old)	Department of the Prime Minister and Cabinet	567.4	567.4	–	–
Transport	Ministry of Transport	477.0	280.0	197.0	555.9
Tertiary Education	Ministry of Education	210.1	210.1	–	7.5
Prime Minister and Cabinet	Department of the Prime Minister and Cabinet	175.6	33.3	142.3	1.0
Emergency Management (old)	Department of Internal Affairs	134.6	89.2	45.4	–
Lands	Land Information New Zealand	102.2	102.2	–	–
Building and Housing	Ministry of Business, Innovation and Employment	73.9	70.9	3.0	0.8
Internal Affairs	Department of Internal Affairs	21.4	2.6	18.8	–
Defence Force	New Zealand Defence Force	16.2	16.2	–	–
Education	Ministry of Education	14.7	14.7	–	–
Conservation	Department of Conservation	14.5	14.5	–	35.0
Justice	Ministry of Justice	14.4	1.2	13.2	117.1

Vote	Administering department	Total value* $million	Confidence level		
			High $million	Medium $million	Low $million
Agriculture, Biosecurity, Fisheries and Food Safety	Ministry for Primary Industries	13.1	–	13.1	257.4
Agriculture and Forestry (old)	Ministry for Primary Industries	13.0	–	13.0	126.3
Arts, Culture and Heritage	Ministry for Culture and Heritage	11.8	10.0	1.8	140.1
Business, Science and Innovation	Ministry of Business, Innovation and Employment	10.2	10.2	–	198.1
Revenue	Inland Revenue Department	9.4	9.4	–	0.1
Foreign Affairs and Trade	Ministry of Foreign Affairs and Trade	5.5	5.5	–	–
Primary Industries and Food Safety	Ministry for Primary Industries	3.9	–	3.9	105.8
Statistics	Statistics New Zealand	1.7	1.7	–	–
Labour Market	Ministry of Business, Innovation and Employment	1.1	1.1	–	–
Defence	Ministry of Defence	1.1	1.1	–	–
Health	Ministry of Health	0.3	–	0.3	910.1
Parliamentary Service	Parliamentary Service	0.2	0.2	–	–
Ombudsmen	Office of the Ombudsman	0.1	0.1	–	–
Environment	Ministry for the Environment	–	–	–	359.3
Science and Innovation	Ministry of Business, Innovation and Employment	–	–	–	347.9
Climate Change	Ministry for the Environment	–	–	–	48.2
Māori Development	Te Puni Kōkiri	–	–	–	10.2
Energy	Ministry of Business, Innovation and Employment	–	–	–	4.7

* Total values do not include low-confidence-level amounts.

Source: Analysed from the enriched appropriation data.

By administering department

Figure 8
Breakdown of identifiable expenditure, by administering department and confidence level

The table shows a breakdown of expenditure in $millions by administering department and confidence level. The intention is to show the administering departments that had the most identifiable natural hazard expenditure. Three government departments – the Department of the Prime Minister and Cabinet, the Treasury, and the Ministry of Social Development – each administered more than $3 billion expenditure related to natural hazards, while the other government departments each administered less than $500 million expenditure related to natural hazards that we could identify.

Administering departments	Total value* $million	Confidence level		
		High $million	Medium $million	Low $million
Department of the Prime Minister and Cabinet	3,894.5	3,752.2	142.3	1.0
The Treasury	3,273.7	62.2	3,211.5	69.1
Ministry of Social Development	3,066.4	216.6	2,849.8	160.0
Ministry of Transport	477.0	280.0	197.0	555.9
Ministry of Education	224.8	224.8	–	7.5
Department of Internal Affairs	156.2	91.9	64.3	–
Land Information New Zealand	102.2	102.2	–	–
Ministry of Business, Innovation and Employment	79.8	76.8	3.0	551.6
Ministry for Primary Industries	30.0	–	30.0	489.5
New Zealand Defence Force	16.2	16.2	–	–
Ministry of Justice	14.5	14.5	–	35.0
Department of Conservation	14.4	1.2	13.2	117.1
Ministry for Culture and Heritage	11.8	10.0	1.8	140.1
Inland Revenue Department	9.4	9.4	–	0.1
Ministry of Foreign Affairs and Trade	5.5	5.5	–	–
Ministry of Economic Development (old)	5.4	5.4	–	–
Statistics New Zealand	1.7	1.7	–	–
Ministry of Defence	1.1	1.1	–	–
Ministry of Health	0.3	–	0.3	910.1
Parliamentary Service	0.2	0.2	–	–
Office of the Ombudsman	0.1	0.1	–	–
Ministry for the Environment	–	–	–	407.4
Te Puni Kōkiri	–	–	–	10.2
Rounded total	**11,385**	**4,872**	**6,513**	**3,455**

* Total values do not include low-confidence-level amounts.

Source: Analysed from the enriched appropriation data.

Figure 9
Proportion of identifiable expenditure related to natural hazards, by administering department

Across the 10-year period, the Department of the Prime Minister and Cabinet administered the most expenditure related to natural hazards. The top three government departments (the Department of the Prime Minister and Cabinet, the Treasury, and the Ministry of Social Development) are responsible for administering 90% of the identifiable expenditure related to natural hazards.
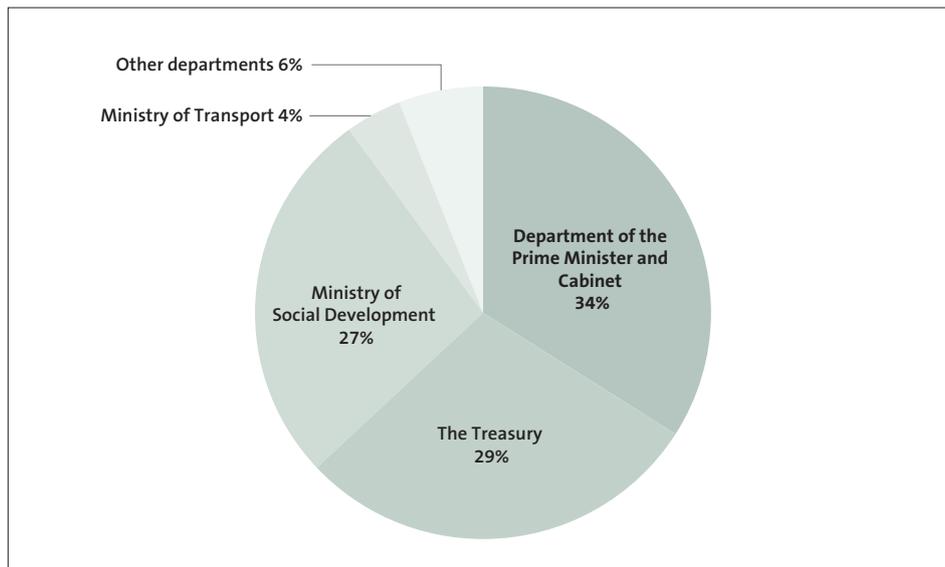
Source: Analysed from the enriched appropriation data.

By administering department and year

Figure 10
Breakdown of identifiable expenditure, by administering department and financial year

The table shows a breakdown of expenditure in $millions by administering department and year. The Department of the Prime Minister and Cabinet administered the most expenditure related to natural hazards in 2011 ($1 billion) and then the expenditure slowly decreased. Some government departments administered expenditure related to natural hazards consistently throughout the 10 years (for example, the Ministry of Social Development and the Ministry for Primary Industries), and some government departments appear to have more one-off identifiable expenditure (for example, the New Zealand Defence Force and the Ministry of Justice).

Administering department	2009 $m	2010 $m	2011 $m	2012 $m	2013 $m	2014 $m	2015 $m	2016 $m	2017 $m	2018 $m
Department of the Prime Minister and Cabinet	–	–	1,045.6	741.7	871.3	494.5	362.7	241.0	79.3	58.5
The Treasury	–	–	878.7	–	–	–	666.0	712.1	823.4	193.5
Ministry of Social Development	227.3	270.4	471.6	263.9	271.3	270.8	276.9	289.6	369.9	354.7
Ministry of Transport	17.5	18.6	18.6	63.6	44.8	50.8	30.6	36.2	32.9	163.4
Ministry of Education	–	–	14.7	0.1	–	10.0	100.0	85.0	15.0	–
Department of Internal Affairs	10.5	10.2	21.8	93.0	10.4	8.4	–	–	0.5	1.3
Land Information New Zealand	–	–	–	–	0.2	–	–	28.2	42.3	31.6
Ministry of Business, Innovation and Employment	–	–	8.1	21.6	15.4	14.4	6.5	3.0	6.2	4.4
Ministry for Primary Industries	3.5	4.2	3.3	2.1	2.2	1.7	2.1	2.1	5.8	3.1
New Zealand Defence Force	–	–	–	–	–	–	–	–	16.2	–
Ministry of Justice	–	–	14.5	–	–	–	–	–	–	–
Department of Conservation	0.2	0.9	7.1	6.2	–	0.1	–	–	–	–
Ministry for Culture and Heritage	–	1.5	2.3	4.9	0.5	2.4	–	–	–	0.3
Inland Revenue Department	–	–	3.2	6.2	–	–	–	–	–	–

Administering department	2009 $m	2010 $m	2011 $m	2012 $m	2013 $m	2014 $m	2015 $m	2016 $m	2017 $m	2018 $m
Ministry of Foreign Affairs and Trade	0.5	–	5.0	–	–	–	–	–	–	–
Ministry of Economic Development (old)	–	–	3.4	2.0	–	–	–	–	–	–
Statistics New Zealand	–	–	1.7	–	–	–	–	–	–	–
Ministry of Defence	–	–	–	–	–	–	–	–	1.1	–
Ministry of Health	–	–	–	0.3	–	–	–	–	–	–
Parliamentary Service	–	–	0.2	0.0	–	–	–	–	–	–
Office of the Ombudsman	–	–	0.1	–	–	–	–	–	–	–

Note: The darker shading indicates higher values of expenditure. Lighter shading indicates lower values of expenditure.

The cumulative totals across years may not match the totals in Figure 8 due to rounding.

Source: Analysed from the enriched appropriation data.

By type of expenditure and year

Figure 11
Breakdown of identifiable expenditure, by type of expenditure and year

The table shows a breakdown of expenditure in $millions by type of expenditure and year. Risk reduction expenditure appears to follow a three-year cycle. We identified about $24 million for each year between 2012 and 2014. Between 2015 and 2017, this increased to about $600 million for each year, and then dropped back to about $24 million in 2018. This pattern is not consistent with the response and recovery expenditure, which has a more steady trend.

Year ended 30 June	Risk reduction $million	Response and recovery $million	Other civil defence $million	Total natural hazards expenditure $million	Percentage of total appropriated expenditure
2009	17.7	4.0	237.9	259.6	0.27%
2010	20.9	4.2	280.6	305.7	0.42%
2011	862.8	1,352 .0	285.0	2,499.8	3.11%
2012	26.8	902.6	276.0	1,205.4	1.55%
2013	20.8	913.6	281.7	1,216.1	1.54%
2014	21.7	550.6	280.8	853.1	1.06%
2015	686.7	468.4	289.6	1,444.7	1.74%
2016	467.3	624.7	305.2	1,397.2	1.62%

Year ended 30 June	Risk reduction $million	Response and recovery $million	Other civil defence $million	Total natural hazards expenditure $million	Percentage of total appropriated expenditure
2017	640.0	340.7	411.8	1,393.5	1.56%
2018	26.3	393.9	390.5	810.7	0.88%
Rounded total	**2,791**	**5,555**	**3,039**	**11,385**	**1.36%**

Note: Percentage of total government department expenditure is the proportion of the total appropriated expenditure according to the appropriation data for that year.
Source: Analysed from the enriched appropriation data.

Figure 12
Proportion of identifiable expenditure, by type of expenditure

Of the total $11.4 billion expenditure, we categorised $5.6 billion (49%) as relating to hazard response, $2.8 billion (24%) as relating to risk reduction, and $3 billion (27%) as other civil defence.
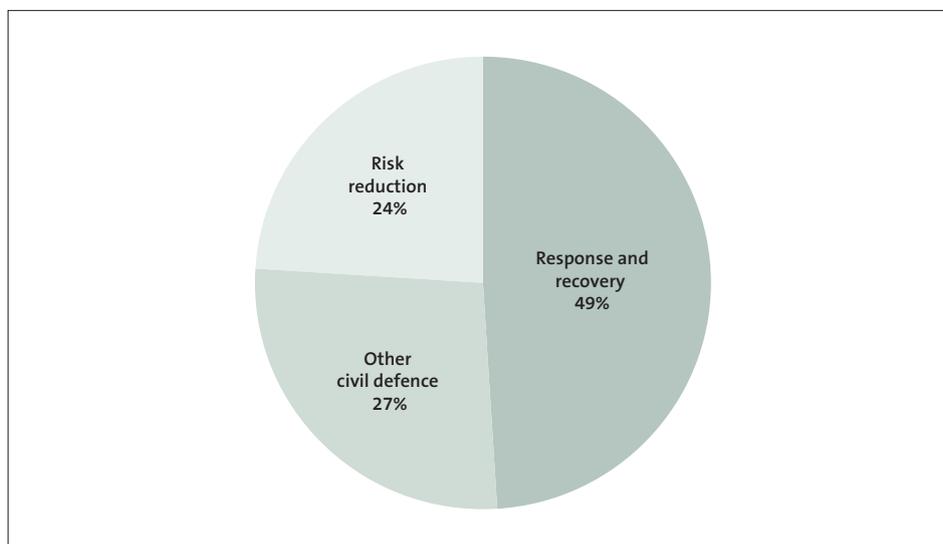
Source: Analysed from the enriched appropriation data.

Figure 13
Trend of identifiable expenditure, by type of expenditure and year

The bar graph below is a visual way to show the information in Figure 11. In 2011, after the Canterbury earthquakes, we identified $2.5 billion expenditure related to natural hazards, which is the highest of the 10-year period.
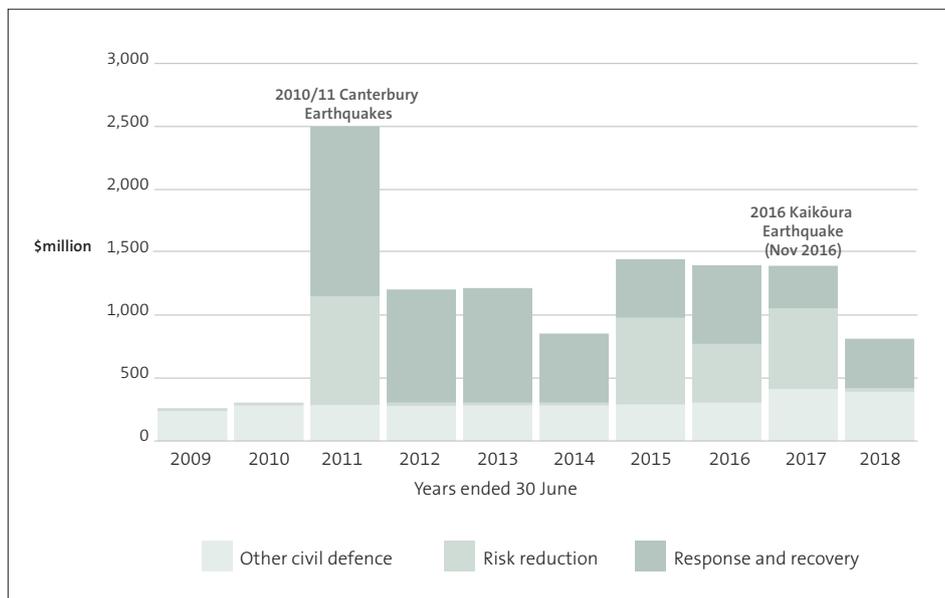
Source: Analysed from the enriched appropriation data.

By type of hazard and hazard event

Figure 14
Breakdown of identifiable expenditure, by type of hazard and hazard event

The table below shows a breakdown of expenditure in $millions by type of hazards and hazard events. By type of hazards, "Earthquake" has the largest identifiable expenditure during the period, and then "Weather", "Flood", "Erosion", "Tsunami", and "Bushfire".

Hazard event	Earthquake $m	Weather $m	Flood $m	Erosion $m	Earthquake, tsunami $m	Bushfire $m	Unknown $m	Total value $m
2009 Victoria bushfires	–	–	–	–	–	0.5	–	0.5
2011 Queensland floods	–	–	4.0	–	–	–	–	4.0
2010/11 Canterbury earthquakes	5,498.6	–	–	–	–	–	–	5,498.6
2011 Great East Japan earthquake	–	–	–	–	1.0	–	–	1.0
2016 Kaikōura earthquake	38.1	–	–	–	–	–	–	38.1
2017 Edgecumbe flood	–	–	0.3	–	–	–	–	0.3
Total for events specified	5,536.7	–	4.3	–	1.0	0.5	–	5,542.5
Unknown	2,567.4	197.0	20.9	18.0	–	–	3,039.2	5,842.5
Rounded total	**8,104**	**197**	**25**	**18**	**1**	**1**	**3,039**	**11,385**

Source: Analysed from the enriched appropriation data.

By type of hazard and year

Figure 15
Breakdown of identifiable expenditure, by type of hazard and year

Across the 10-year period, 2011 was the first year to show a significant expenditure related to natural hazards of which types of hazards are not in the category of "unknown". From 2011, "earthquake" remains the hazard type with the largest identifiable expenditure during the period.
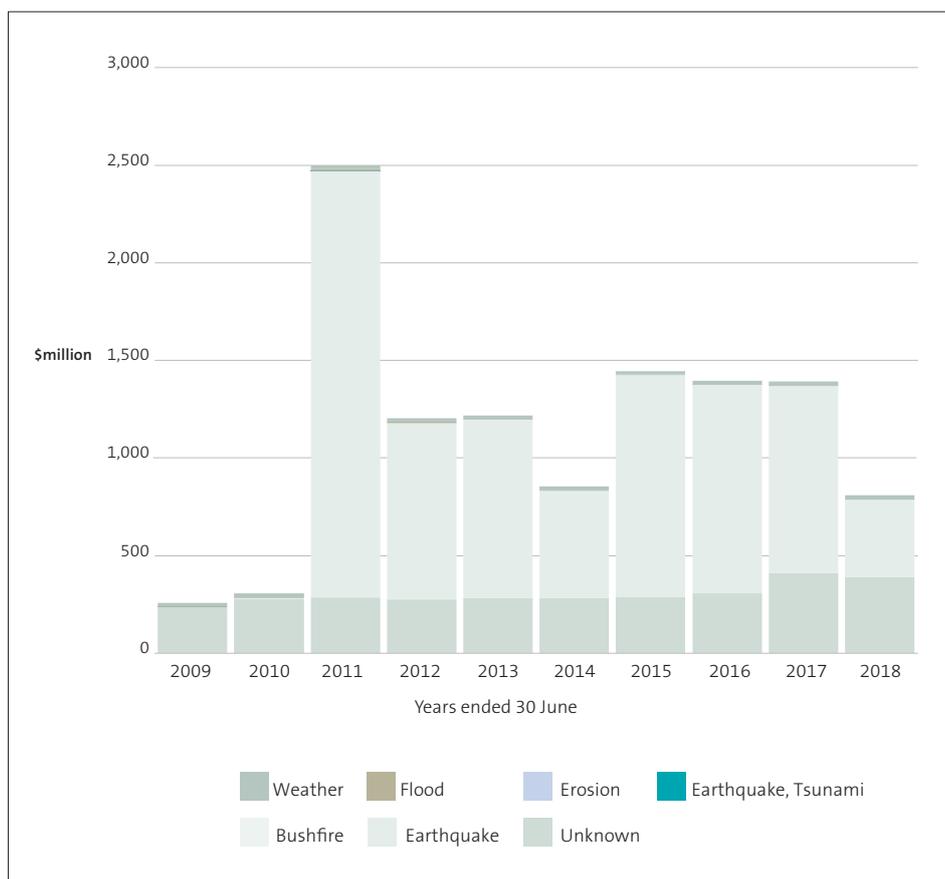
Source: Analysed from the enriched appropriation data.

Figure 16
Breakdown of identifiable expenditure, by type of hazard and year

The table below shows a breakdown of expenditure in millions by type of hazard and year. Expenditure related to earthquake has been significant since 2011, while the expenditure related to erosion and weather is consistent over the years at about $3 million and $20 million respectively.

Year ended 30 June	Earthquake $m	Bushfire $m	Earthquake, tsunami $m	Erosion $m	Flood $m	Weather $m	Unknown $m	Total value $m
2009	–	0.5	–	–	3.7	17.5	237.9	259.6
2010	1.5	–	–	–	5.0	18.6	280.6	305.7
2011	2,182.0	–	1.0	3.3	10.0	18.6	285.0	2,499.9
2012	902.6	–	–	2.1	6.2	18.6	276.0	1,205.5
2013	913.6	–	–	2.2	–	18.6	281.7	1,216.1
2014	550.6	–	–	1.7	–	20.0	280.8	853.1
2015	1,134.4	–	–	2.1	–	18.6	289.6	1,444.7
2016	1,068.7	–	–	2.1	–	21.2	305.2	1,397.2
2017	956.6	–	–	2.0	0.2	21.9	411.8	1,392.5
2018	394.1	–	–	2.6	0.2	23.4	390.5	810.8
Rounded total	**8,104**	**1**	**1**	**18**	**25**	**197**	**3,039**	**11,385**

Source: Analysed from the enriched appropriation data.

Limitations of our analysis

38   We know expenditure related to natural hazards will be greater than what we were able to identify from this data set for several reasons. These include:

- Our analysis was limited to only the information provided in the appropriation data set. This was sourced from Estimates data on the Treasury's website. We note that appropriation scope statements are required to be short and do not include performance information or results from the appropriation expenditure. As such, important supporting information and detail will not be derived from analysis of appropriation scope statements alone.

- Our methodology means that it is likely that we have mainly identified expenditure that is directly related to natural hazards. There are many other indirect costs that the Government incurs to manage and respond to the risks associated with natural hazards that we are unlikely to have identified in this analysis (for example, costs to the health sector associated with injury, or economic costs associated with loss of employment and tax revenue to the Crown). Where expenditure related to natural hazards as been incurred through an appropriation where the appropriation title or scope statement is broad or general, this expenditure might not have been identified as being hazard-related.

- Our methodology used "fuzzy" search techniques – that is, searches were not limited to the exact search term. Searches will pick up partial words in a search term and whole phrases that contain a search term. After each search, we also reviewed a sample of results to refine our key words and search criteria. This allowed us to minimise the risk of false positives and false negatives. Some risk remains, but we consider it unlikely to have significantly affected our analysis.

- We did not find specific mention of some natural hazards that we know happened in the last 10 years from the appropriation data (for example, Gita, Fehi, and Pam). Further research, such as examination of historical Cabinet papers or wider analysis of budget documents or other accountability documents, might identify expenditure related to these events.

- There are likely to be other relationships that we did not identify because of the limitations of our methodology. We have not carried out wider engagement with subject matter experts (for example, officials within the Treasury or the National Emergency Management Agency), which we consider would aid the development of this work. This document is exploratory work that we intend to use internally as we scope our planned work on risk and resilience. We welcome further feedback and might carry out further work that could include wider engagement with subject matter experts to improve the analysis.

- We acknowledge that large areas of expenditure and liabilities associated with the 2010/11 Canterbury Earthquakes (in particular, Earthquake Commission insurance claims[12]) have not been fully captured in this analysis. Expenditure we have identified in the appropriation data amounts to $5.5 billion. In 2017, the Government's financial statements had already identified $15 billion of expenditure.[13]

- We acknowledge that there is an international standard on risk management (ISO 31000[14]), and that the 4Rs framework is more widely used in New Zealand. We might align any future work more closely with these.

39 We could do further work to address the limitations set out above, such as:

- further review and analysis of the appropriation data where we have a low level of confidence to determine whether it should have been included – for example:

  – a similar search and analysis of Cabinet minutes in the past 10 years might identify relationships not visible in this data set – for example, if expenditure has been incurred under broad appropriations that were not picked up by key word searches; and

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12 The Treasury (2014), *Financial Statements of the Government of New Zealand for the Year Ended 30 June 2014*, Wellington, at www.treasury.govt.nz.

13 The Treasury (2017), *Financial Statements of the Government of New Zealand for the Year Ended 30 June 2017*, Wellington, at www.treasury.govt.nz.

14 ISO 31000 – Risk Management at www.iso.org.

- more in-depth analysis of government department annual reports might provide more information about the activities of government departments and insight as to whether expenditure related to natural hazards has occurred; and

- analysing information from other out-of-cycle funding mechanisms (such as between budget contingencies) and baseline updates might identify additional relevant expenditure.

40   The initial scope of our analysis was limited to expenditure information from the appropriation data. As well as the limitations already acknowledged for expenditure, we are aware that councils invest heavily in risk reduction and treatment, such as flooding and stormwater prevention. We might carry out additional work to examine their long-term plans and financial statements.

Quality assurance

41   The method we used went through several iterations of development and testing, and each iteration was internally reviewed by the Senior Data Analyst and the Director, Data and Analytics at the Office of the Auditor-General.

42   We had all the scripts developed to do searches and categorisations internally peer-reviewed to ensure that they reflected the criteria in the approaches.

43   Search and categorisation rules metadata have been captured for every successful search result and categorisation. This includes the rule and rule type that was used.

44   A sample of all search and categorisation results was manually reviewed for each key word or group of key words. This review was used to refine our search criteria and to minimise the risks of false negatives and false positives. Searches with no results and refinements to searches were also documented for transparency.

45   A random sample of 50 appropriations that were not in the search results were checked to confirm we had not missed any in our search criteria. The sample check did not find any more relevant appropriations.

46   A random sample of 10 appropriations were checked from our appropriation data set against relevant public organisations' annual reports to confirm that the information in the appropriation data set was consistent with the audited annual financial information. The sample check showed that the appropriation data always has the same information that is in the annual reports.