Ministry of Education

National Schools Weathertightness Survey

Report Version 1.1 | May 2012

MINISTRY OF EDUCATION

Te Tāhuhu o te Mātauranga

Document History

The National schools weathertightness survey report was first issued in April 2012. A revised issue (Version 1.1) was subsequently issued in May 2012 with the following list of amendments to ensure alignment with statistical data provided in a supporting workbook provided by KPMG. These are minor amendments that do not impact of the high level outcomes reported.

List of Amendments

Source	Details
Figures	1, 5, 8,13,14, 16,17, 31, 35, 36, 40, 42, 45, 49.
Pages	25 – Text above Figure 19 changed from 41% to 59%. 29 – Text above Figure 21, $730,448 changed to $730,659. 36 – Text above Figure 35 amended to reflect chart changes. 38 – Text above Figure 35 amended to reflect chart changes.

Executive summary

Purpose

The National Schools Weathertightness Survey (National Survey) was commissioned by the Ministry of Education (the Ministry) in May 2011 to help identify school buildings that may have weathertightness defects. This report provides **high-level findings**, based on **visual surveys** and data, gathered from 6,130 buildings at 1592 schools. The key objectives are to:

- profile post-1994 buildings (constructed or significantly modified) for weathertightness risk
- categorise buildings into priority ratings
- estimate the likely costs to repair.

The findings of this report are intended to assist the Ministry to develop a prioritised remediation plan in line with the objectives in the New Zealand School Property Strategy 2011-2021.

Context

Timber-framed buildings constructed from 1994-2004 are at significant risk from weathertightness failure.

In 2010, the Ministry undertook weathertightness surveys of 1,074 buildings from 199 Auckland schools that were the subject of work from 1994 onwards. A report titled *'Repair Cost of School Construction Defects'* (the Auckland 199 Survey) was issued on 14 April 2010. It concluded:

- Many of these buildings were in need of repairs, at a total estimated cost of $434m.
- By extrapolation, the estimated national cost of repair of permanent buildings is $1,200m, and repair of re-locatable buildings is $300m (**a total repair cost of $1,500m**).
- $175m is required within two years to repair the most urgent buildings.

The National Survey is based on analysis of data from surveyed buildings, the Ministry's Property Management Information System (PMIS), the Auckland 199 Survey, relevant statistical data and building industry knowledge.

Buildings have been categorised into four priority ratings based on weathertightness risk. They are Low, Low/Medium, Medium/High and High.

High-level findings

Scale

Repairs to all Buildings and Gross Repair Costs

- In terms of scale the report considers the buildings surveyed in the national survey, the Auckland buildings surveyed as part of the Auckland 199 survey and buildings already in the Ministry's Building Improvement Programme (BIP) but not captured by either of the former survey groups. If a worst-case scenario is assumed, the **total gross** repair or replacement of all post-1994 buildings would cost in the region of **$2,541m**, including professional fees and contingencies.

- The total gross repair cost is made up of $1,962m for the repair of 5,366 permanent buildings and $579m for the repair or replacement of 2,224 re-locatable buildings.

- The total number of post-1994 buildings is 7,590 made up of 6,130 buildings from the national survey, 1,074 buildings from the Auckland 199 survey and 386 buildings in the Ministry's BIP programme; with a total estimated area of 2,249,334 square metres (sqm), representing 39% of the Ministry's total property portfolio by sqm area.

- The total area of 2,249,334 is 648,831 sqm (29%) over that used for the Auckland 199 Survey extrapolation, which estimated a gross repair cost of $1,896m. If the extrapolation is extended to the larger sqm area, a revised repair cost would be $2,665m, which is more in line with the National Survey findings.

Predicted Outcomes

- The gross repair cost scenario is **unrealistic**. By applying risk profiling the predicted total repair cost is **$1,428m** including professional fees and contingencies, affecting an estimated 3,097 post-1994 buildings.

- The estimated sqm area is 1,157,855, which represents 18% of the Ministry's total property portfolio sqm area.

- Although it uses a different approach, the National Survey's predicted repair figure is within 5% of the Auckland 199 Survey which estimated the national cost at $1,500m ($1,200m for permanent buildings and $300m for re-locatable buildings).

Priority Ratings of Buildings (Repair Costs, Types and Location)

- There are an estimated 420 High priority buildings (excluding those already in the Ministry's BIP, as these have not been profiled against the national survey's assessment methodology). The estimated repair value for these buildings is $324m including professional fees and contingencies.

- The total number of high priority buildings is made up of 405 permanent buildings and 15 re-locatable buildings.

- The larger-area permanent buildings present the highest risk for weathertightness failure, typically sports halls and specialist buildings.

- The average High priority building gross repair estimate is $730,659 with an average sqm area of 494. By contrast, the average Low/Medium category gross repair cost is $273,585 with an average sqm area of 247.

- The Auckland district dominants the High priority building category, with a 30% overall contribution.

- Eighty-six percent of buildings in the lower South Island are in the Low and Low/Medium priority categories.

- There are 1,085 low priority buildings which are considered to have minimal weathertightness risk other than minor localized repairs at an estimated cost of $1.2m.

- 841 Low priority buildings have no associated repair cost.

- The balance of Low priority buildings that do have minor repair costs is 244 which equates to approximately $5,000 per building.

Permanent versus Re-locatable Buildings

- In terms of regional distribution and ratio the lower South Island has the lowest apportionment of post 1994 re-locatable buildings against permanent (11% vs. 89%) and the central North Island the highest (34% vs. 66%).
- Re-locatable buildings pose a different set of problems to permanent buildings in terms of required repairs for weathertightness and should potentially be identified and dealt with under a separate strategy that takes account of their current age, predicted economic life and usefulness to schools.

Permanent Buildings less than Ten Years Old

- Indicatively, 1,630 buildings, representing 38% of the total permanent buildings surveyed by the National Survey, are buildings that are ten years old or less, with a gross repair estimate of $579m.
- Buildings are distributed over 1,456 schools, which equates to 1.2 buildings per school.
- After approximately 3 years (from the present date) this group of buildings will reduce by around 57%.

Classroom versus Non-Classroom Buildings

- 64% of **permanent** buildings are non-classrooms (i.e. Halls, Administration buildings etc.).
- The ratio of **re-locatable** classrooms to **re-locatable** non-classroom buildings is 85% in favour of the former.
- Non-classroom buildings tend to be larger than classrooms to meet the needs of their designed purpose and present higher weathertightness risk.
- The non-classrooms in the high-priority category exceed classrooms by 115%.

The Impact of Climate

- There is little in the way of qualitative data available to influence a prioritised programme at this stage. However, information can be obtained by way of targeted investigations to improve understanding of the impacts of climate and assist a structured repair programme in the future.

Conclusions and Recommendations

- The National Survey provides high-level findings on the number of post-1994 buildings and provides an indication of both gross and predicted repair costs.
- The survey data establishes a foundation to allow a structured weathertightness investigation programme to proceed. In turn this will allow the establishment of a prioritised remediation programme in line with the Ministry's school property strategy.
- It is recommended that the structured investigation programme prioritise buildings in line with the priority ratings provided through the National Survey. This information is available via the data set used to support this report.
- The implementation of a structured feedback loop is recommended to affirm the assumptions made and bring improved understanding regarding weathertightness in school buildings and assist in improved property strategies going forwards.

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1 | Introduction

Scope and Purpose of Report

This report provides **high-level findings** based on **visual surveys** and data gathered from a total of 4,282 permanent buildings with an approximate (measured) gross floor area (GFA) of 1,273,079 square metres (sqm) and 1848 re-locatable buildings with an approximate GFA of 274,362 sqm. Total buildings surveyed are 6130 with a total area of 1,547,441 sqm.

The range of buildings surveyed is all post-1994 buildings[1] in schools nationally. The objectives of the visual survey are to provide high-level outcomes, based on profiling buildings for weathertightness risk and providing a priority rating and estimate of repair costs.

The survey and report has assessed buildings in terms of **weathertightness risk only** and **does not determine actual damage**.

The analysis within the report is intended to be used to support and inform the Ministry of Education (the Ministry) in their understanding of weathertightness issues that need addressing within the schools property portfolio. The findings of this report should allow the Ministry to develop a prioritised remediation strategy in line with the objectives in the New Zealand School Property Strategy 2011-2021 (the Property Strategy).

Overview of the Report

Topics covered by the chapters in this report are:

Background and Context

An overview of the issues related to weathertightness of buildings in New Zealand and how they relate to school buildings.

Findings and Analysis

Details on the visual survey findings and an analysis of the data measured against key criteria including scale of the problem, priority rating of buildings, regional implications, types and ages of buildings and climate. This section of the report has been presented to provide a concise summary of the relevant information. Qualifications and limitations are identified in the text or footnotes where relevant. The reader is referred to the appropriate methodology or background section of the report where further explanation is required.

Conclusions and Recommendations

Confirms any conclusions drawn from the analysis and makes a number of recommendations.

Appendix Section

Provides supporting information including methodology, qualifications and references.

[1] Includes all buildings built or significantly modified.

2 | Background and Context

Timber-framed Buildings

Timber-framed construction is a common building practice in New Zealand. It has a number of benefits over more heavyweight construction, including that it is:

- a renewable resource
- a relatively fast construction method
- more tolerant of the effects of seismic activity
- easy to modify.

The vast majority of buildings surveyed in the National Survey are of timber frame construction (approximately 95%).

Weathertightness History in New Zealand

During the mid- to late 1990s there was a growing awareness in the New Zealand building industry (the industry) regarding weathertightness failures of timber-framed buildings, resulting in significant decay damage to structural elements. In 2002 the Building Industry Authority (BIA) commissioned an inquiry and a report was issued on the weathertightness of buildings[2]. This report, often referred colloquially as the Hunn Report, had a residential property focus. It considered a broad range of issues and identified a systemic failure as being at the heart of the problem.

In July 2009 a report titled *'Weathertightness – Estimating the Cost'* was produced for the Department of Building and Housing (formerly the BIA) which estimated the repair cost at $11.3 billion for 42,000 homes. Subsequent commentary in the industry speculates the problem as much larger at $23 billion affecting 89,000 homes[3] (av. $258,500 per home).

What are the problems?

The extract opposite is taken from a Parliamentary briefing note advising on the outcomes of the Hunn report.[4]

> "Leaky buildings are those that both allow water to penetrate the building envelope or cladding system and that then hold the water in the wall cavity, where it may remain for some time. This results in the building's timber framing staying wet, raising its moisture content to levels that then allow fungal growth. It is fungal growth that literally eats away at the timber framing that creates the structural and health risks for the inhabitants".

Timber-framed buildings constructed from 1994-2004 are at significant risk from weathertightness failure. The period between 1995 and 2003 is of particular significance, as during this period New Zealand Standard 3,602[5] permitted the use of untreated *Pinus Radiata* timber framing, which was extensively adopted for timber frame construction. It was also normal within this period for claddings to be directly fixed to untreated framing without the benefit of a cavity to drain moisture. Without a cavity unplanned moisture entry (i.e. leaks) through the building envelope has serious consequences for untreated timber. The following comment is provided by Dr Robin Wakeling[6]:

> "Untreated Radiata pine timber commonly suffers loss of structural integrity within the first year of moisture entry into buildings due to fungal decay."

The already high-risk combination of untreated timber and direct fixed claddings was made worse during this period by other factors, including:

- A trend towards a more Mediterranean-style construction with monolithic claddings that lacked good weathertightness design principles.
- A decline in skills and knowledge in the industry, heightening the likelihood of defects being created and not being identified and addressed.

[2] Building Industry Authority Report of the Overview Group on the Weathertightness of Buildings to the Building Industry Authority.
[3] Source: http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10628820
[4] Background Note, Information Briefing Service for Members of Parliament, Leaky Buildings 2002.
[5] Timber and Wood-based Products for Use in Building.
[6] Dr Wakeling is a Bio-deterioration Consultant specialising in wood and building materials.

The New Zealand Building Code (the Building Code) sets a 50-year durability requirement in respect of structural elements. Buildings of this era were constructed in a way that means many will not achieve this requirement.

Unplanned moisture entry to buildings also brings the potential for the establishment and growth of potentially toxic mould contaminants that can be harmful to human health if not remediated.[7]

"Some moulds can produce adverse health effects such as allergies, aggravation of respiratory problems, eye and skin irritation, headaches, nausea and flu-like symptoms. At greatest risk are people with pre-existing asthma and those with weakened immune systems, as well as infants and the elderly. Most people who experience adverse effects associated with mouldy buildings fully recover following removal and clean-up of the mould contamination."
Source: Mould -Department of Building and Housing, May 2010

Weathertightness Issues in Schools

The construction methods for most school buildings during the same period were similar to the housing sector and school buildings are therefore similarly affected.

It was observed during the National Survey that many school buildings are designed with the objective of conveying a certain image. This could be due to cultural influence or the desire to give an impression of a modern or innovative environment. These aspirations for school buildings often do not align with good weathertightness principles.

In 2010 the Ministry undertook weathertightness surveys of 1,074 buildings from 199 Auckland schools that were the subject of work from 1994 onwards. A report titled *'Repair Cost of School Construction Defects'* (the Auckland 199 Survey) was issued on 14 April 2010[8]. It concluded that many of these buildings were in need of repairs, at a total estimated cost of $434m. By extrapolation the report estimated the national cost of repair of permanent buildings at $1.2bn[9], with $175m being required (to repair the most urgent buildings), within two years. A further $300m cost was advised for the repair or replacement of re-locatable buildings. The total cost to repair all buildings (re-locatable and permanent) was therefore estimated at $1.5bn[10].

"From a national perspective, the Ministry will continue to undertake programmes to ensure school property continues to support education in the years ahead. This will include carrying out remedial repairs on defective buildings to protect them against structural failure.

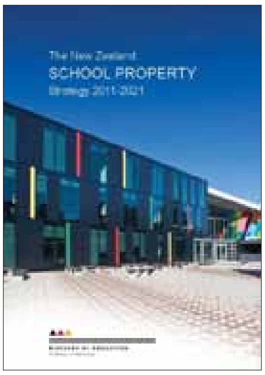
This remedial work is critical if these assets are to retain their value and be prevented from deteriorating further.

This programme has three key objectives:

- Identification of defective buildings through a national survey, to commence in early 2011
- Remediation and repair of defective school buildings; and
- Prevention of further defects through the introduction of new design and building standards for school property."

Source: The New Zealand School Property Strategy 2011-2021

The Ministry's state school property portfolio comprises approximately 2,300 state schools and 17,000 buildings which have an estimated total area of 6.5m sqm. The Property Strategy identifies a vision that school property provide a *"safe and inspiring learning environment"*. In achieving this vision a key strategic goal is that schools are *"fit for purpose"* and provide *"safe environments that empower teachers and students to succeed"*. The implementation of the National Survey forms part of this strategy and is intended to establish more robustly the assumptions made in the Auckland 199 Survey.



In May 2011, Hampton Jones Property Consultancy Ltd (Hampton Jones) was contracted by the Ministry to undertake a national survey of all school buildings constructed or significantly modified after 1994 and to provide a high-level report on the findings. The survey was completed in February 2012.

The Ministry already has a reactive investigation and remediation programme in place, with approximately 712 buildings currently in the system.[11]

[7] Source: DBH Mould Bulletin.

[8] Source: Ministry of Education.

[9] The extrapolation is based on an estimated m^2 area of 1,600,503 (table 4.1 *"Repair Cost of School Construction Defects"*) +/- 20% and Includes professional fees and 15% contingency, based on 2010 prices.

[10] The gross estimate for permanent buildings was discounted to take account of regional climatic variations, surplus stock and ownership. The gross estimate for permanent buildings was $1,9bn – source Auckland 199 Survey, table 4.2, page 23.

[11] Source – Ministry of Education.

The Nature of Repairs

The repair of buildings suffering from weathertightness failure deserves some consideration in the context of the National Survey. This is because repair choice impacts very significantly on the end estimated repair cost. The choices for repair are generally categorised into three main choices:

Targeted Repair	• Isolated minor repairs
Partial Re-clad	• Re-cladding of whole walls but not the entire building
Full Re-clad	• Re-cladding of the entire building

Re-cladding or partial re-cladding refers to the removal and subsequent replacement of the external building envelope fabric. It is also sometimes necessary to partially or fully replace roof coverings as part of a remedial design solution. Improving a buildings overall weathertightight design is often required and achieved by (for example) increasing roof pitches or introducing roof eaves etc.

Targeted Repairs

Useful guidance is provided in the Department of Building and Housing document *'Weathertightness: Guide to the Diagnosis of Leaky Buildings'* (May 2011) (DBH Weathertightness Guide):

> *A targeted or isolated repair may be appropriate for specific and localised shortcomings of the building envelope where the framing (including wall underlay, bolts and straps) in adjacent areas is unaffected. It may be appropriate in limited situations, such as for defective basement waterproofing, a faulty window and/or flashing installation, or leaking around a penetration.*

However, the advice goes on to warn:

> *Targeted repairs carry a high risk that further damage may be found during remedial repair work, necessitating a redesign and greater time and costs to complete the repair for the owner. The worst-case scenario is that a targeted repair may not fully identify or fix the problem and that leaking and decay continue undetected, with the remediation team considered liable. A recommendation for a targeted repair would need to be supported by a thorough inspection and investigation of the entire building on all elevations.*

Partial Re-clad

The DBH Weathertightness Guide states that:

A partial or limited reclad may be appropriate where:

- *the investigation demonstrates that defects and/or damage are clearly confined to a particular elevation (or possibly one particular storey), or to sections of cladding between corners (i.e. the evidence available and analysis show defects/damage are not systemic), and*
- *where resulting decay is confined to the framing in the immediate vicinity, and*
- *where the investigation has shown that adjacent areas of cladding and framing are free from defects and damage, and therefore from the potential for future damage.*

Partial repairs may be successfully carried out to direct-fixed cladding systems in some limited circumstances… With flush-panel (or 'face-sealed') monolithic systems, it is more difficult to avoid failure at the boundaries of the repairs, for example, without introducing complicated flashings or express joints.[12]

[12] This situation is most relevant where the wall cladding being replaced needs to be reinstalled over a cavity and has to integrate at the building corner with the existing cladding not on a cavity.

Full Re-clad

As a result of the shortcomings and risks associated with the first two options, fully re-cladding buildings affected by weathertightness failure is often the preferred choice of remediation experts.

Full recladding brings a number of benefits, including:

• The ability to conduct a thorough assessment of the timber frame and the positive identification of decay-affected timber.

• The opportunity to apply in-situ treatment of exposed timbers to improve future durability of the structural frame.

• The ability to introduce a cavity system to provide a moisture management capability through drainage and drying.

• Improving the long-term durability and life of the whole building.

• Ensuring full compliance with the Building Code requirements.

• Providing the opportunity of improving a buildings weathertight design features through design rationalisation.

Important considerations in terms of Building Code compliance are that structural elements (such as the timber frame) are required to last 50 years; however, external building claddings are only required to last 15 years in respect of their durability.

Weathertight Investigations

Weathertightness investigations can be put into two main categories, invasive and non-invasive.

Visual Survey

A number of non-invasive testing techniques exist but they provide limited indicative information. An experienced building surveyor can adequately assess a building from a visual perspective to determine the likely level of risk and identify key areas of concern. However, determining actual weathertightness failure and confirming its full extent requires invasive testing techniques.

Destructive Testing

"Destructive testing" is the name given to the invasive investigation of buildings. In terms of weathertightness investigations, this will generally include drilling the external wall claddings and inserting resistance moisture meter probes to test the wood moisture content. Cutting open sections of cladding to assess the condition of timber frame is usually necessary for a robust assessment. Removing sections of cladding also allows the opportunity to obtain samples of timber for specialist testing for the presence of preservative or decay. This information can be critical in making a proper and correct assessment of the building's weathertightness performance. The DBH Weathertightness Guide sets out the established methodology for this work by qualified professionals.

Drivers Influencing Repair Choice

A key difference between Ministry-owned school buildings and the residential property market is the issue of market value - i.e. how the value of a home for re-sale is affected once it is discovered to be a "leaky building". Opportunities are available to home owners to seek recovery via the Weathertight Homes Resolution Services Act 2006, or the courts. This is often a primary driver for the desire to fully remediate these buildings as the owner attempts to restore their loss in value against a home. Due to the reasons outlined in the previous section, The Nature of Repairs, this often favours full re-cladding as the only way to guarantee all issues are addressed and any future doubt removed.

The Ministry is impacted much less by this aspect, allowing a strategy to be developed based on the needs of schools and their communities rather than re-sale value. This means the Ministry is more likely to consider , options such as less extensive repairs to certain buildings or holding repairs where a building may not be required in the longer term as a result of, e.g. roll decline or re-zoning. In some instances demolition or re-build may be economically more viable options.

3 | Findings and Analysis

3.1 Approach

Priority Ratings

Central to the findings and analysis section of the report is the categorisation of buildings into priority ratings based on assessed weathertightness risk. Buildings assessed as part on the National Survey have been considered in terms of construction type, era, design and observed defects. The methodology behind this approach is explained in detail at Appendix B - Methodology on page 56. Buildings are categorised as Low, Low/Medium, Medium/High or High priority.

Repair Costs

The gross repair costs advised are a **worst-case scenario** and assume that all buildings in the Low/Medium, Medium/High or High priority categories will require either re-cladding (permanent buildings) or replacement (re-locatable buildings). Buildings in the Low priority either have no costs or low costs for minor repairs only.

Section (Risk Modelling of Buildings and Predicted Repair Costs) on page 19 goes on to consider the **predicted costs** as a comparison against **gross repair costs**.

For ease of reference, tables in this chapter are coloured **red** for combined analysis of permanent and re-locatable buildings, **yellow** for permanent and **orange** for re-locatable buildings.

3.2 Scale

Total Number of Buildings and Gross Repair Costs

The National Survey Findings

A total of 6130 buildings were surveyed at 1,592 schools nationally giving an approximate average of four buildings per school. The regional split of buildings and schools is set out below[13].

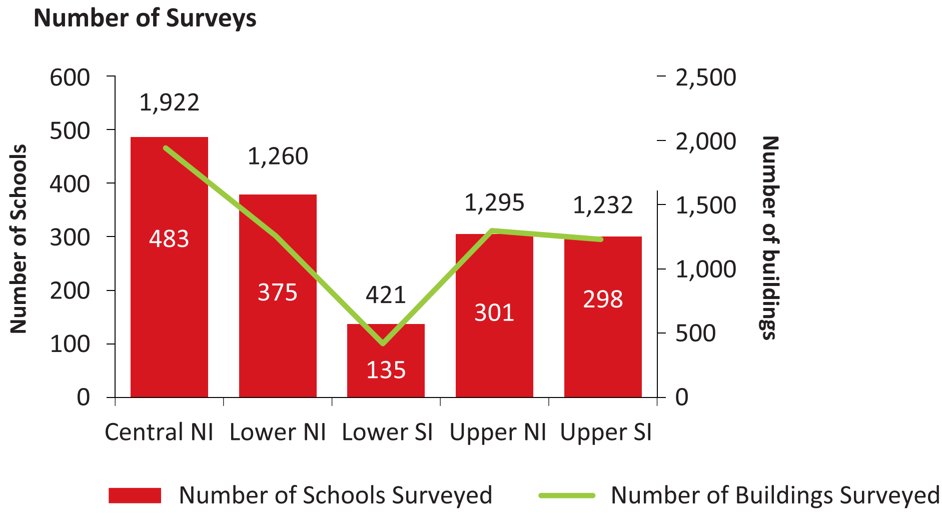


Figure 1: Schools and buildings surveyed (regional)

Buildings are separated into permanent buildings and re-locatable buildings[14] with the apportioned repair or replacement costs as follows:

Type	# buildings	Area (m²)	Repair cost ($m)	Av. ($/m²)
Permanent buildings	4,282	1,273,079	1,320	1,037
Re-locatable buildings	1,848	274,362	493	1,798
Total	**6,130**	**1,547,441**	**$1,813m**	**$1,172**

Figure 2: Building numbers surveyed and total repair costs

The gross repair costs are based on the assumption that the majority of at risk buildings (as determined by the National Survey priority profiling) will fail during their lifetime and require significant weathertightness repairs.[15]

[13] The number of schools and buildings in the upper North Island are inaccurate because 1,074 buildings were excluded as they were surveyed as part of the Auckland 199 Survey. These are considered later in the chapter.

[14] A re-locatable building is typically a 12 x 7 metre simple single storey pre-fabricated building, designed as a temporary facility, which can be moved from site to site. At many schools these buildings have been on site for prolonged periods.

[15] A building's lifetime is considered in terms of the Building Code durability requirement of 50 years for structural elements.

Additional Post-1994 Buildings Excluded from the National Survey

The Auckland 199 Survey

As noted previously, the National Survey is a follow-up to the Auckland 199 survey which took the findings from 1,074 buildings from 199 Auckland Schools and extrapolated the costs nationally. These (Auckland) buildings were excluded from the National Survey. The Auckland 199 Survey accounted for approximately 698 permanent buildings and 376 re-locatable buildings[16].

Buildings already in the Building Improvement Programme

It is estimated that there are 386 buildings with an approximate area of 283,048 sqm[17] already in the Ministry's Building Improvement Programme (BIP). The location of these buildings and the value of the works have not been determined. By applying the national average sqm repair cost of $1,037 (provided in the table at Figure 2), an estimated cost for these works is $294m.

Putting it all together

Source	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)
National Survey (Permanent)	4,282	1,273,079	1,320	1,037
Auckland 199 Survey (Permanent)	698	327,286	348	1,063
Buildings in the BIP	386	283,048	294	1,037
Sub total	***5,366***	***1,883,413***	***1,962m***	***1,042***
National Survey (re-locatable)	1,848	274,362	493	1,798
Auckland 199 Survey (re-locatable)	376	91,559	86	939
Sub total	***2,224***	***365,921***	***579m***	***1,582***
Total	**7,590**	**2,249,334**	**$2,541m**	**$1,130**

Figure 3: Consolidation of estimated repair costs of permanent and re-locatable buildings

The total estimated number of buildings is increased to 7590. The total sqm area of post-1994 school buildings is approximately **2,249,334 sqm**, represents approximately **39%** of the Ministry's total building portfolio, and is estimated at 6.5m[18]. As can be seen the total gross repair cost is **$2541m** to repair all buildings built or significantly modified post-1994.

Differences between the National Survey and the Auckland 199 Survey

The following table identifies the differences in the high-level outcomes between the Auckland 199 Survey and the National Survey.

Source	Area (m^2)	Gross repair ($m)	Av. ($/$m^2$)
Auckland 199 Survey	1,600,503	1,896	1,185
National Survey	2,249,334	2,541	1,130
Difference	**+648,831**	**+$645m**	**-$55**
Expressed as a percentage	**29%**	**25%**	**5%**

Figure 4: High-level outcome differences between the Auckland 199 Survey and the National Survey

[16] Source: MOE and Schools Building Defect Repair Cost, page 18 table 3.4 and page 22.
[17] Ministry of Education, area derived from PMIS. These buildings total 712 in number, of which 386 are not accounted for in either the Auckland 199 Survey or the National Survey.
[18] The New Zealand School Property Strategy 2011-2021.

The difference in total gross repair costs is significant, with the National Survey estimating an additional $645m.

The main reason for this cost difference is that the total sqm area of post-1994 buildings is significantly more than the total sqm area estimated in the Auckland 199 Survey, which based extrapolated costs on an assumed 1,600,503 sqm area[19]. The Auckland 199 Survey identified disparity between the areas of buildings measured and the records on PMIS and indicated a difference of 15% in favour of the former[20]. The National Survey estimates a difference of 29% between the two surveys with an additional 648,831 sqm of post-1994 sqm building area.

If the Auckland 199 Survey average gross repair rate is applied to the National Survey sqm area of 2,249,334, the two estimates come into reasonable alignment and are within 5% of each other (refer Figure 5).

	Area (m^2)	Gross repair ($m)	Av. ($/$m^2$)
Auckland 199 Survey	2,249,334	2,665	1,185
National Survey	2,249,334	2,541	1,130
Difference	**0**	**- $124m**	**-$55**
Expressed as a percentage	**0%**	**-5%**	**-5%**

Figure 5: Auckland 199 Survey and National Survey sqm areas aligned

[19] Repair Cost of School Construction Defects, page 23 table 4.1.

[20] Determined by comparing the measured areas of Auckland buildings against PMIS recorded areas. This difference was not accounted for in the cost extrapolation which relied on PMIS records.

Summary and Conclusions

- Assuming a worst-case scenario, the gross repair and replacement cost of all buildings is **$2,541m including professional fees and contingencies.**
- The estimated gross repair cost is made up of **$1,962m** to repair all permanent buildings and **$579m** to repair and replace all re-locatable buildings.
- The total number of built or modified post-1994 buildings is estimated at 7,590 with a total estimated area of 2,249,334 sqm, representing 39% of the Ministry's total property portfolio.
- On average, there is approximately four post-1994 built or substantially modified buildings per school nationally.
- The National Survey estimates a gross repair cost increase of $645m over that of the Auckland 199 Survey. The additional cost is a direct result of the actual sqm area being 29% over the figure used to extrapolate costs in the Auckland 199 Survey.
- When the National Survey sqm area is applied to the Auckland 199 Survey extrapolation for gross repair costs, the two estimates are **within 5% of each other.**

Qualifications

1. The repair costs advised for the National Survey are the **total gross repair costs** drawn from varying degrees of repair level or replacement[21], dependent on the building priority rating (Figure 61: Priority Ratings).
2. Repair costs for permanent buildings include a 20% allowance for professional fees and a 15% contingency.
3. Replacement costs for re-locatable buildings are estimated at $1,900 per sqm and include fabrication, transportation and delivery, and set-up costs but excludes disposal costs of the buildings to be replaced.
4. The average re-locatable repair cost (for the National Survey buildings) is a combination of isolated repairs to Low priority buildings[22] and replacement at $1,900 per sqm. This results in the dilution of the average repair/replace cost to $1,798 for the National Survey buildings as can be seen in the table at Figure 3.
5. The gross repair costs advised are a **worst-case scenario** and assume that the majority of permanent buildings will require the external envelope re-cladding and (to an extent) re-roofing, and the majority of re-locatable buildings will require replacement. This is an unlikely outcome and is discussed further in section 3.1.2.
6. The National Survey total sqm area is derived from actual site measurements of 6,130 buildings in the survey group, the stated measured area of 1,074 buildings that were the subject of the Auckland 199 Survey and an estimated area provided by the Ministry for buildings already in the BIP but not accounted for in either survey.
7. The exact nature of the required building repairs anticipated for the Auckland 199 Survey buildings is not fully known but re-cladding of these buildings has been assumed.
8. Repair costs are based on 2011 prices and take no account of the need for alternative accommodation, internal costs to the Ministry, regional price variations or price fluctuations over time.

[21] Replacement refers to re-locatable buildings only as these buildings are considered uneconomic to re-clad.
[22] An explanation on repair priorities is provided later at section 3.3.

Risk Modelling of Buildings and Predicted Repair Costs

Due to the complexities associated with the required repair approach of buildings suffering from weathertightness failure, outlined at page 12 (The Nature of Repairs), at-risk buildings have been assumed to require full re-cladding for estimating purposes **(total gross repair costs)** as detailed on page 15 (Total Number of Buildings and Gross Repair Costs).

At-risk buildings are determined by priority ratings that were devised for the National Survey, to categorise buildings for weathertightness risk[23]. Priority ratings provide a framework to determine which buildings should be investigated first. At-risk buildings fall into the following priority ratings: Low/Medium; Medium/High; and High. There is also a Low category for buildings that represent minimal risk that are unlikely to require any significant weathertightness repairs. Further detail is provided in the table below at Figure 6.

Priority rating	Points range	Meaning
Low	0-70	Buildings that are unlikely to have significant weathertightness failure and therefore are unlikely to require significant repairs such as re-cladding and re-roofing. These buildings are likely to meet the requirements of the Building Code and at most are anticipated to need only localised repairs. Buildings in this category have been priced for localised repairs in the region of $10k -$20k per building if deemed necessary by the surveyor who inspected the building.
Low/Medium	71-110	Buildings that profiled with increased risk over the Low category and may require significant weathertightness works in the form of re-cladding to meet the requirements of the Building Code. Invasive weathertightness investigation would be required to confirm. Buildings in this category have been priced for full re-cladding and roof repairs at the discretion of the building surveyor who undertook the assessment, but works to this extent may not be necessary.
Medium/ High	111-150	Buildings that profiled with increased risk over the Low/Medium category and potentially require significant weathertightness works in the form of re-cladding to meet the requirements of the Building Code. Invasive weathertightness investigation would be required to confirm. Buildings in this category have been priced for full re-cladding and roofing repairs at the discretion of the building surveyor who undertook the assessment. Works to this extent may not always be necessary but are still considered reasonably likely.
High	151-230	Buildings that profiled as highly likely to suffer from weathertightness failure based upon their size, complexity, era, type of construction and obvious defects. These buildings have in all instances been assumed to require re-cladding and full re-roofing for budget estimating purposes. However, as with the two medium categories, verification by way of invasive weathertightness testing would be required to confirm this conclusively.

Figure 6: Priority Ratings

From a visual survey alone it is not possible to determine which buildings are actually failing. This can only be achieved by physical (destructive) testing or removal of claddings as noted at page 13, Weathertight Investigations. The survey approach provides building risk profiling that will need to be verified by destructive investigation.

The following section outlines a forecasting model in an attempt to provide some rationale to the likely extent of buildings failing and their associated repair costs. The model provides a comparison of **predicted repair costs** against **gross repair costs**. The model is purely theoretical and will need to be verified over time by feeding back actual information from destructive investigation and repairs.

[23] Further details of the methodology used to assess buildings to develop the repair priority rating are provided in the methodology section at pages 56 - 70, Assessment Methodology.

The principles behind the forecasting model

Buildings with the lowest points score (0-70) present the lowest risk of failing and therefore are unlikely to require full re-cladding (0% risk). Beyond this point, as buildings are introduced to the survey group their points score will sit within a range of 71 and 150+. Buildings that score over 150 points are considered high-risk with a 90% chance of requiring re-cladding and re-roofing. The simple graph at Figure 7 below shows a straight line relationship drawn between these two values (0% and 90%) which bisect the Low/ Medium category at 30% and the Medium/High category at 60%.

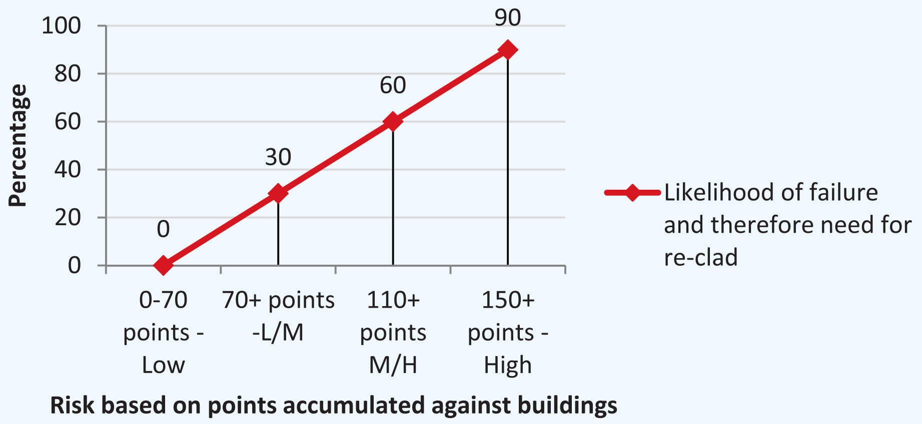


Figure 7: Decreasing risk of weathertightness failure model based on priority rating profiling

Range

The 90% cut-off for high-priority buildings is based on feedback from the Ministry that of the Auckland 199 Survey (urgent) buildings approximately 90% have progressed to invasive weathertightness testing and weathertightness failure has been confirmed.

Building types

Due to differences in construction, expected lifespan and repair approach, permanent and re-locatable buildings have been dealt with separately in the following analysis.

Permanent Buildings

The number of buildings from the National Survey is identified below at Figure 8. As can be seen, these buildings are separated into priority ratings and have a number of gross repair costs and sqm area outcomes.

National Survey Results

Priority rating	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)	Av. building size (m^2)	Av. per building ($)
Low	799	149,312	1	8	187	1,252
Low/Medium	1,908	471,361	522	1,107	247	273,585
Medium/High	1,226	479,935	542	1,130	391	442,088
High	349	172,471	255	1,478	494	730,659
Averages/Totals	**4,282**	**1,273,079**	**$1,320m**	**$1,037**	**297**	**$308,267**

Figure 8: National Survey data for permanent buildings

Factoring in the Auckland 199 Survey Buildings

Because the Auckland 199 Survey was undertaken with a different methodology it has been necessary for completeness to align the profiling of these buildings for priority rating and cost to those of the National Survey. The percentage split of buildings from the National Survey results per priority rating is shown below at Figure 9 for both number of buildings and cost contribution.

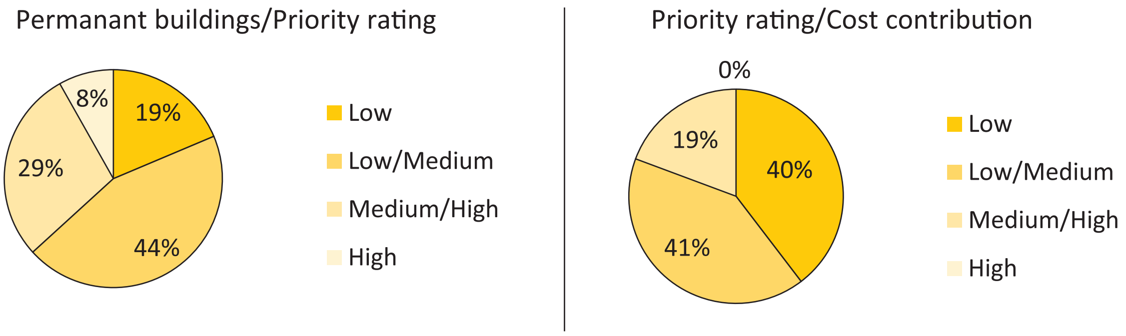


Figure 9: Priority rating and cost contribution percentage split of National Survey buildings

By taking the number of permanent buildings, the repair costs and overall sqm area from the Auckland 199 Survey[24] and applying them to the percentage splits shown in Figure 9 it is possible to apply an adjustment on a pro-rata basis as identified in the tables below.

Auckland 199 Survey Results (modelled against NSS outcomes)

Priority rating	# of Buildings est.	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)	Av. building size (m^2) est.	Av. per building ($)
Low	133	39,120	0.3	9	294	2,256
Low/Medium	307	119,826	139	1,159	390	452,769
Medium/High	202	124,749	143	1,144	618	707,921
High	56	43,591	66	1,517	778	1,178,571
Averages/Totals	**698**	**327,286**	**$348m**	**$1,064**	**469**	**$498,567**

Figure 10: Auckland 199 Survey data with assumptions modelled against National Survey outcomes

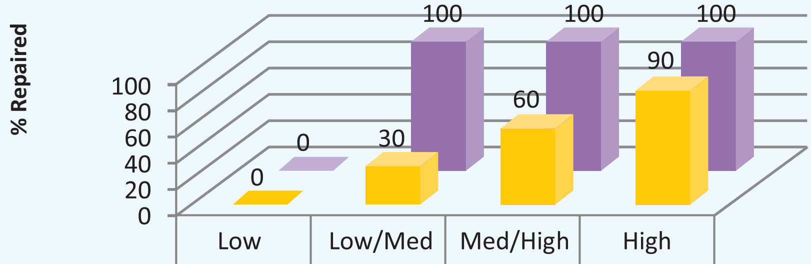
Combined Results

Priority rating	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)	Av building size (m^2)	Av. per building ($)
Low	932	188,432	1	7	202	1,395
Low/Medium	2,215	591,187	661	1,118	267	298,420
Medium/High	1,428	604,684	685	1,133	423	479,692
High	405	216,062	321	1,486	533	792,593
Averages/Totals	**4,980**	**1,600,365**	**$1,668m**	**$1,042**	**321**	**$335,000**

Figure 11: Combined National Survey and Auckland 199 Survey data

[24] Repair Cost of School Construction Defects, page 18, table 3.4 and page 22.

The table at Figure 11 above identifies 932 buildings in the Low category with $1m repair costs allocated. These costs are excluded from the forecasting model due to the differing nature of the works (i.e. targeted repairs as opposed to full external envelope re-cladding). The value of this work is estimated at around $1.2m.



	Low	Low/Med	Med/High	High
PREDICTED Likely extent of re-cladding repairs based on risk/priority	0	30	60	90
GROSS - Re-cladding repairs to all buildings (excluding Low)	0	100	100	100

Figure 12: Permanent buildings forecasting model

The graph at Figure 12 above is an expansion on that at Figure 7. The columns in purple indicate the worst-case scenario with all buildings (excluding those in the Low category) assumed to require full re-cladding repairs. The columns in yellow show the predicted assumptions based on a diminishing risk profile.

Priority rating		% of Full WT repairs	No. of buildings	Estimated repairs ($m)
Low	PREDICTED	0%	0	0
Low/Medium		30%	665	198
Medium/High		60%	857	411
High		90%	364	290
Total		-	**1,886**	**$899m**
Low	GROSS	0%	932	1
Low/Medium		100%	2,215	660
Medium/High		100%	1,428	685
High		100%	405	322
Total		-	**4,980**	**$1,667m**

Figure 13: Full Re-cladding repairs to all at risk buildings compared against predicted repairs and costs

The table at Figure 13 shows the split of buildings and associated repair costs for both predicted and gross repair options. The model shows an anticipated reduction of 46% from $1,688m to $898m.

Re-locatable Buildings

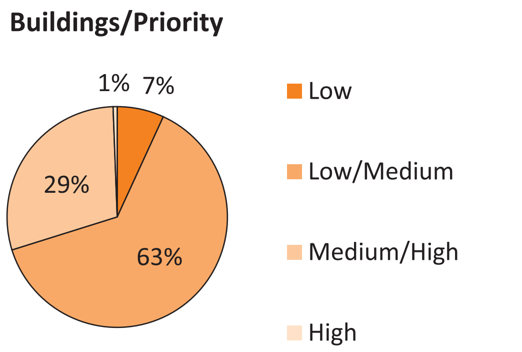
The principles applied to permanent buildings have been applied to the data on re-locatable buildings. This provides the following outcomes.

National Survey Results

Priority rating	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)	Av building size (m^2)	Av. per building ($)
Low	127	14,865	0.197	13	117	1,551
Low/Medium	1,170	167,444	318	1,900	143	271,795
Medium/High	540	90,270	172	1,900	167	318,519
High	11	1,783	3	1,900	162	272,727
Total	**1,848**	**274,362**	**$493m**	**$1,798**	**148**	**266,775**

Figure 14: National Survey data for re-locatable buildings

The percentage split of re-locatable buildings from the National Survey results (per priority rating) is shown below at Figure 15 for both number of buildings and cost contribution.



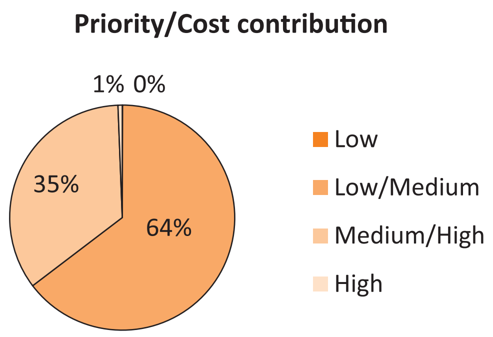


Figure 15: Priority rating and cost contribution percentage split of re-locatable National Survey buildings

The Auckland 199 Survey results for re-locatable buildings have been aligned with the National Survey priority rating and cost splits. These are provided in the table at Figure 16, and combined with the National Survey figures at Figure 17.

Auckland 199 Survey Results (modelled against NSS outcomes)

Priority rating	# of buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Av building size (m²)	Av. per building ($)
Low	26	6,159	0	0	237	0
Low/Medium	237	5,7828	55	952	244	232,236
Medium/High	109	26,596	30	1,228	244	276,147
High	4	976	0.86	881	244	215,000
Grand Total	**376**	**91,559**	**$86m**	**$939**	**244**	**$228,723**

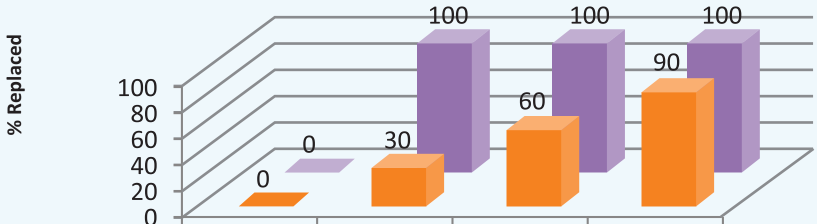
Figure 16: Auckland 199 Survey data with assumptions modelled against National Survey outcomes for re-locatable buildings

Combined Results

Priority rating	# of buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Av building size (m²)	Av. per building ($)
Low	153	21,024	0.197	9	137	1,288
Low/Medium	1,407	225,272	373	1,656	160	265,131
Medium/High	649	116,866	202	1,729	180	311,402
High	15	2,759	3	1,399	184	200,000
Grand Total	**2,224**	**365,921**	**$579m**	**$1,583**	**165**	**$260,430**

Figure 17: Combined National Survey and Auckland 199 Survey data for re-locatable buildings

The graph at Figure 18 replicates the principle applied to permanent buildings, with a diminishing risk profile applied to the orange columns. This provides a comparison between full repairs to all buildings and gross and predicted costs.



	Low	Low/Med	Med/High	High
PREDICTED Likely extent of re-locatble replacement based on risk/priority	0	30	60	90
GROSS - Replacement of all buildings (excluding Low)	0	100	100	100

Figure 18: Re-locatable buildings forecasting model

All re-locatable buildings have been estimated on the basis of replacement, with the exception of Low category buildings which have a repair allowance. As with permanent buildings, Low category buildings are excluded from the forecasting model due to the differing approach.

The table at Figure 19 shows the split of re-locatable buildings and associated replacement costs for both predicted and gross repair options. The model shows an anticipated reduction of 59% from $579m to $236m.

Priority rating		% of Full WT repairs	# buildings	Estimated repairs ($m)
Low	PREDICTED	0%	0	0
Low/Medium		30%	422	112
Medium/High		60%	389	121
High		90%	14	3
Total		-	**825**	**$236m**
Low	GROSS	0%	153	0
Low/Medium		100%	1,407	373
Medium/High		100%	649	202
High		100%	15	3
Total		-	**2,224**	**$579m**

Figure 19: Predicted level of repairs based on increasing risk profile of re-locatable buildings

General Comment

An interesting outcome is that the average size of re-locatable buildings is 165 sqm (as identified at in the table at Figure 17). Typically re-locatable buildings are 12 x 7 metres (84 sqm), which is a size that allows road transportation to sites and is versatile in terms of options to crane in to position and a number of other factors relating to prefabrication and storage. The average size identified by the National Survey suggests that re-locatable buildings are in fact multiple buildings combined. This was commonly observed during the National Survey with buildings placed end to end with an entrance door and cloakroom placed centrally. Although there is no cost implication due to replacement being estimated on a sqm basis the true number of re-locatable buildings is likely to be twice as many as recorded.

It was also observed through the National Survey that many re-locatable buildings have, over time, become more akin to permanent buildings as they have been added to, joined to other buildings and surrounded with other structures such as decks, steps and awnings. The proposed costs for simple replacement of these buildings will not be always be adequate for buildings that have morphed over time into more permanent structures, and this will need to be carefully considered if any replacement programme is to proceed in the future.

All Buildings with Predicted Repairs and Costs Applied

The table at Figure 20 provides a final summary of all buildings (permanent and re-locatable) and **total predicted repairs and costs.**

Priority rating	# of buildings	Area (m^2)	Predicted repair cost ($m)	Av. ($/$m^2$)	Av building size (m^2)	Av. per building cost ($)
Low (0%)	NA	NA	NA	NA	NA	NA
Low/Medium (30%)	1,087	244,938	310	1,266	225	285,478
Medium/High (60%)	1,246	432,930	532	1,229	347	427,058
High (90%)	378	196,939	291	1,481	521	771,429
Buildings in the BIP (100%)	386	283,048	294	1,039	733	761,658
Total	**3,097**	**1,157,855**	**$1,428m**	**1,233**	**374**	**$461,121**

Figure 20: Predicted repairs and costs applied to all buildings

The total predicted repair cost is $1,428m, affecting 3,097 buildings.

Comparison to the Auckland 199 Survey Findings

- The Auckland 199 Survey advised an estimated repair cost of approximately $1,200m to repair permanent buildings and $300m for re-locatable buildings with the total being $1,500m.
- This figure was reduced down from a gross estimate of $1,896m. The reasons for the reduction are allowances made in respect of non-Ministry-owned buildings, surplus stock and the impacts of climate on building degradation.
- The National Survey does not take into account these matters and to that extent there is potential for further cost reduction.
- Both surveys were undertaken with similar assessment methodology but different approaches to interpretation of the likely end repair costs. Despite this, estimates from both surveys are within 5% of each other.

Conclusions

- The forecasting model predicts the national repair cost of permanent and re-locatable buildings at **$1,428m**. This figure comprises $898m for permanent buildings, $236m for re-locatable buildings and $294m for buildings already in the BIP.
- The predicted repair scenario brings about a 44% reduction to the gross repair cost of $2541m.
- The affected sqm area reduces from 2,249,334 to 1,157,855, which represent approximately 18% of the Ministry's total property portfolio.
- The number of likely affected buildings reduces from 7,590 to 3,097 which represents approximately 41% of the total number of buildings.
- The number of re-locatable buildings is likely to be understated due to buildings being combined.
- The cost to replace some re-locatable buildings may be unrealistic for buildings that have become more permanent as they have been adapted and added to over the years.

Qualifications

1. Repair costs exclude alternative accommodation that may be required as part of any remediation programme, internal Ministry costs and the costs of destructive investigations.

2. Certainty of results is not possible with the type of high-level visual survey undertaken for the National Survey. Stage two (destructive testing) would determine more accurately the extent of affected buildings, and the results should be fed back into the assumption model.

3. Re-locatable buildings pose a different set of problems to permanent buildings in terms of required repairs for weathertightness and should be identified and dealt with under a separate strategy that takes account of their current age and predicted economic life and usefulness to schools. Further consideration of this issue is beyond the scope of this survey and report.

4. The level of accuracy in respect of interpretation of data taken from the Auckland 199 Survey cannot be guaranteed. The approach used to align with the National Survey approach was taken for completeness to give a better understanding of the scale of the issue. Improved accuracy would require assessment of these buildings through the National Survey assessment template.

5. The forecasting model is theoretical and therefore limited in terms of the accuracy of information it can provide at this stage. The model can be improved and verified over time as the results of prioritised investigation are fed back and outcomes are confirmed.

6. Repair costs for permanent buildings include a 20% allowance for professional fees and a 15% contingency.

7. Replacement costs for re-locatable buildings are estimated at $1,900 per sqm and include fabrication, transportation, delivery and set-up costs but exclude disposal.

8. The National Survey total sqm area is derived from actual site measurements of 6,130 buildings in the survey group, the stated measured area of 1,074 buildings that were the subject of the Auckland 199 Survey and an estimated area provided by the Ministry for buildings already in the BIP but not accounted for in either survey.

9. The exact nature of the intended building repairs anticipated for the Auckland 199 Survey buildings is not fully known but re-cladding of these buildings has been assumed.

10. Repair costs are based on 2011 prices and do not take account of the need for alternative accommodation, internal costs to the Ministry, or regional price variations or cost fluctuations over time.

Summary

The following is a summary of the scale of the National Survey and its high-level outcomes. As noted previously the gross repair outcome is a worst-case scenario and is an unrealistic expectation. This is considered further in the following section.

National Survey	Auckland 199 Survey	Gross Total	Refined Totals
• The total number of buildings surveyed is **6,130** • **4,282** Permanent • **1,848** Re-locatable • Total sqm surveyed is **1,547,441** • Estimated gross repair costs **$1813m**	• The total number buildings surveyed is **1,074** • **698** Permanent • **376** Re-locatable • All located in the Auckland region • Total sqm surveyed is **418,845** • Estimated gross repair costs **$434m**	• The total number of post-1994 buildings is **7,590** (inc est. 386 in the BIP) • **5,366** Permanent • **2,224** Re-locatable • The total post-1994 sqm area is **2,249,334** • Estimated total gross repair costs **$2,541m** • **$579m** for repair or replacement of re-locatables • **$1,961m** for all permanent buildings (inc those in current BIP est $294m)	• Total buildings **3,097** • **1,947** Permanent • **825** Re-locatable • The number of re-locatable buildings is likely to be understated due to buildings having been combined • Predicted total repair costs **$1,428m**

3.3 Priority Ratings, Repair Costs, Types and Locations of Buildings

High Priority Buildings

Permanent Buildings

The National Survey identified 349 High priority permanent buildings with a sqm area of 172,471 and a repair value of $255m. This represents approximately 8% of the permanent buildings surveyed. The average building size in this category is 494 sqm with an average per building repair cost of $730,659. The table at Figure 21 below separates these buildings into use type and provides size and repair cost comparisons.

Building use	High priority buildings	Area (m^2)	Av. (m^2)	Gross repair ($m)	Av. building repair ($)
Admin	91	40,936	450	60	664,611
Classroom	104	47,383	456	69	667,513
Library	21	5237	249	8	393,194
Other	16	6459	404	10	656,893
School hall	31	13,884	448	20	636,820
Specialist/science/music	56	36,221	647	52	929,865
Sports hall/gym	30	22,351	745	34	1,148,148
Totals	**349**	**172,471**	**494**	**$255m**	**$730,659**

Figure 21: High priority buildings by building use

The division of High priority buildings per building use is shown in the pie chart below at Figure 22. Classrooms and administration buildings contribute over 50% of the total number of High priority buildings.

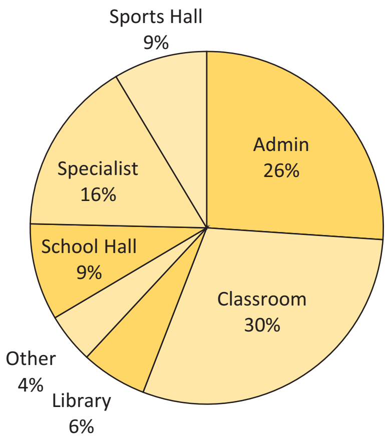
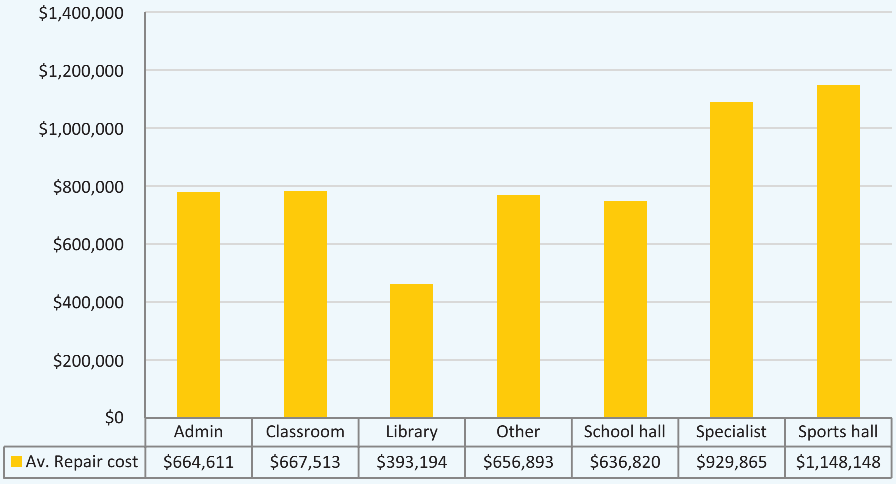


Figure 22: Division of High priority buildings per building use

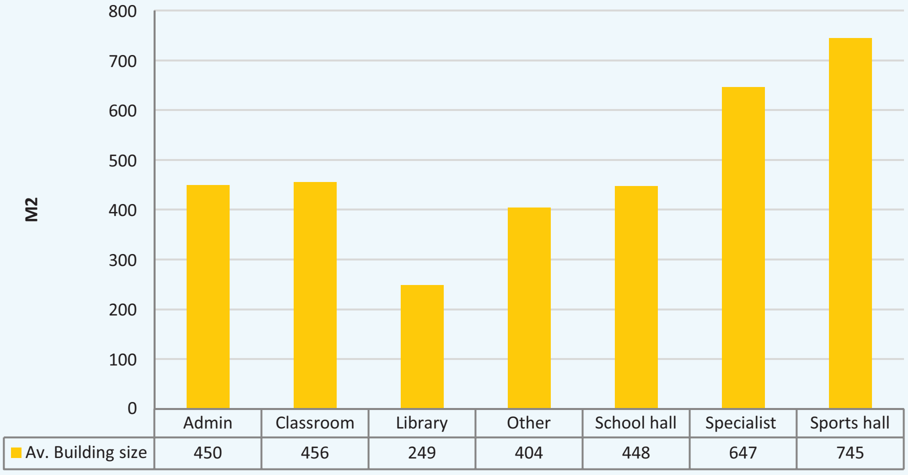
The most expensive buildings on average to repair are sports halls and gyms at approximately $1m and specialist buildings at $900,000. The lowest average cost per building to repair is library buildings.



	Admin	Classroom	Library	Other	School hall	Specialist	Sports hall
Av. Repair cost	$664,611	$667,513	$393,194	$656,893	$636,820	$929,865	$1,148,148

Figure 23: Average High priority building repair cost

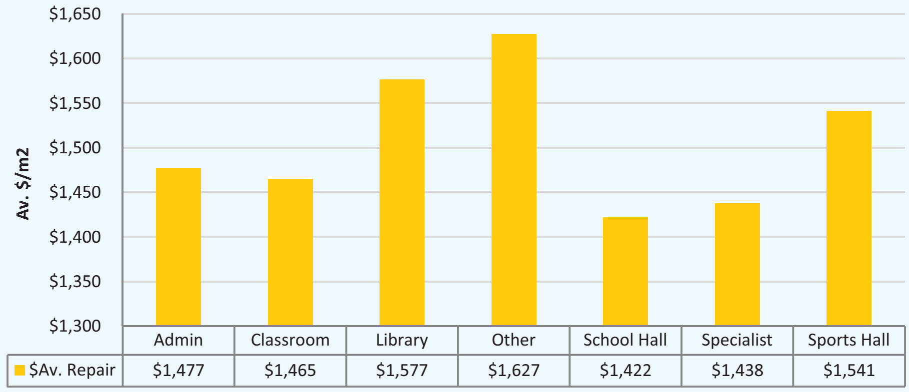
Unsurprisingly, as can be seen from the chart at Figure 24 below, there is a direct relationship between building size and cost, with sports halls and specialist buildings being significantly larger than other building use types.



	Admin	Classroom	Library	Other	School hall	Specialist	Sports hall
Av. Building size	450	456	249	404	448	647	745

Figure 24: Average High priority building by sqm

However, when comparing against the average sqm repair cost at Figure 25 it can be seen that the most expensive buildings to repair on an area basis are library buildings at $1,577 and other[25] at $1,627. These buildings have the smallest sqm area of the High priority building use group.



	Admin	Classroom	Library	Other	School Hall	Specialist	Sports Hall
$Av. Repair	$1,477	$1,465	$1,577	$1,627	$1,422	$1,438	$1,541

Figure 25: Chart showing the average m2 repair cost of high priority buildings per building use

[25] Other type buildings are a miscellaneous group that do not fall into the other categories, including toilets, staffrooms and changing rooms.

In comparing the split of High priority buildings against all priority ratings for buildings per building use, an understanding can be gained of which building types are the greatest high-risk contributors. Proportionally, Figure 26 shows that sports halls contribute the largest number of High priority buildings with 30 buildings from a total of 223 representing approximately 12% (rounded). Classrooms contribute the lowest with 104 buildings from 1,534 or 7% rounded.

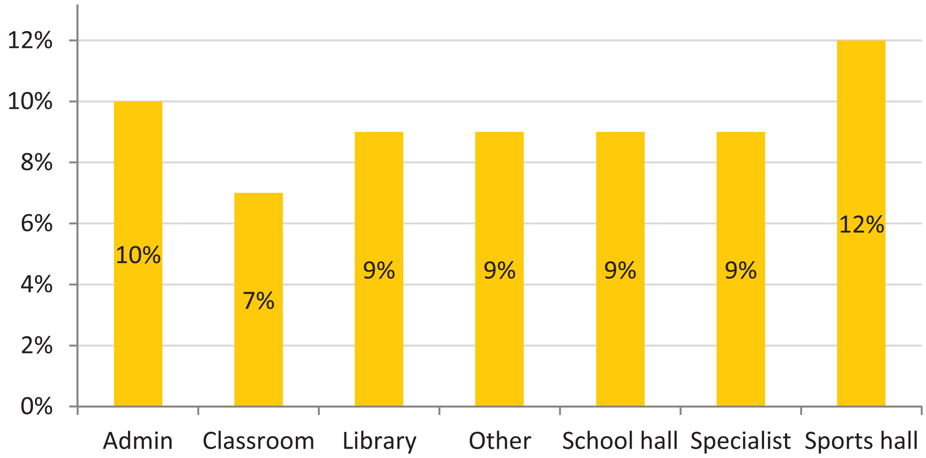


Figure 26: Percentage contribution of High priority buildings per building use

Larger permanent buildings present the highest risk as their size typically has a direct relationship to the level of complexity and weathertightness risk features (i.e. multiple levels, roof wall junctions, internal gutters, multiple cladding types etc). This is explored further latter in this report.

Re-locatable Buildings

Re-locatable buildings make up only a small proportion of the High priority building group. With the exception of one building all are classrooms.

Building use	Buildings	Area (m^2)	Gross repair ($)
Classroom	10	1,656	3,146,400
Specialist/science/music	1	127	241,300
Totals	**11**	**1,783**	**3,387,700**

Figure 27: High priority re-locatable buildings

Locations of all High Priority Buildings (Permanent and Re-locatable)

Regional Distribution

The central North Island has the largest population of high-priority buildings. However, the proportions are skewed by the fact that a large sample group of approximately 60 buildings is not included in the National Survey data. The lower South Island has the lowest incidences of High priority buildings.

Region	# buildings	Area (m^2)	Gross repair ($m)	Av. ($/$m^2$)
Central NI	122	59,615	88	1,469
Lower NI	98	50,800	77	1,514
Lower SI	14	4,746	6	1,336
Upper NI	69	38,178	55	1,428
Upper SI	57	20,915	33	1,576
Totals	**360**	**174,254**	**$258m**	**$1,482**

Figure 28: Regional locations of high priority permanent buildings

Number of High Priority Buildings by District

Further analysis identifies the level of High priority buildings at a district level. For completeness, the excluded Auckland buildings have been added in to the upper North Island analysis. An additional 60 buildings have been added for Auckland which is made of 56 permanent buildings and 4 re-locatable buildings as identified in the tables in figures 10 and 16.

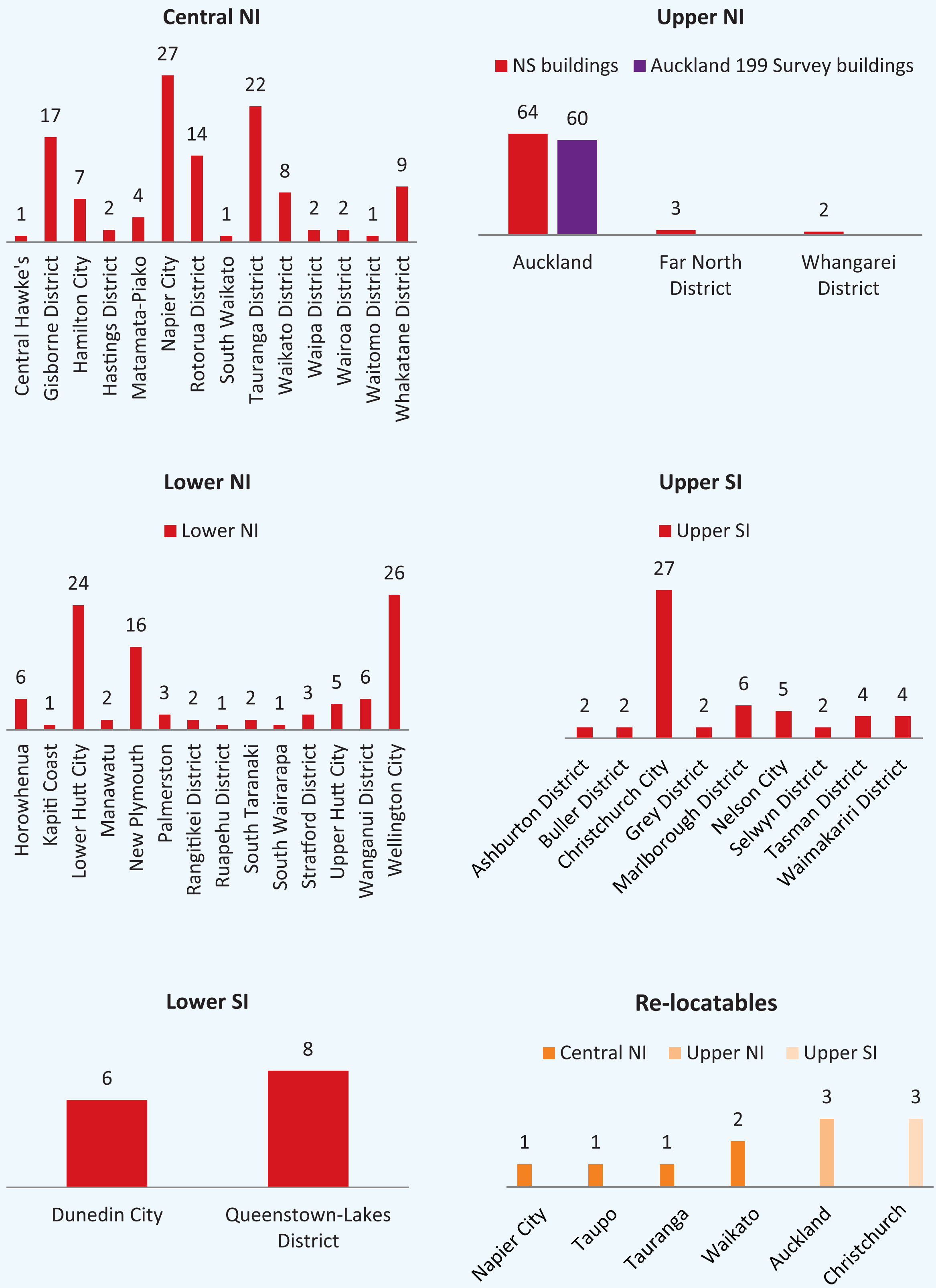


Figure 29: High priority buildings by district

The Auckland district dominates the High priority building category. With the Auckland 199 Survey buildings added, the total number of High priority buildings is 420 and the Auckland district contribution is approximately 30% of that number.

District	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. ($/$m^2$)
Auckland NS	64	36,181	51	1,417
Auckland 199	60	44,567	66	1,480
Total	**124**	**80,748**	**$117m**	**$1,448**

Figure 30: Estimated costs for Auckland High priority buildings

Summary and Conclusions

- There are 420 High priority buildings with a gross estimated repair value of $324m. These figures comprise of 360 buildings at $258m (national survey) and 60 buildings at $66m (Auckland 199 survey).
- The total number of High priority buildings is made up of 405 permanent buildings and 15 re-locatable buildings. Re-locatable buildings account for 4% of all high priority buildings.
- Applying this figure against the forecasting model would reduce this estimate by 10% to $292m.
- From the national survey group, the average High priority building gross repair estimate is $730,659.
- Proportionally, sports halls present the highest weathertightness risk, and classrooms the lowest.
- By virtue of their size, sports halls and specialist buildings are the most expensive High priority buildings to repair, but "other" category and library buildings are the most expensive buildings to repair per sqm.
- Re-locatable buildings do not impact significantly on the High priority building group.
- Tauranga, Napier and Gisborne are the predominant districts affected in the central North Island.
- Lower Hutt, New Plymouth and Wellington are the predominant districts affected in the lower North Island.
- Christchurch is the predominant district effected in the upper South Island.
- The Auckland district dominants the High priority building category with a 30% overall contribution by number of buildings.

Qualifications

1. The buildings in the Ministry's BIP are excluded from the analysis in this section because they have not been profiled priority rating through the national survey assessment methodology.
2. High priority re-locatable buildings are priced for replacement not repair.
3. The level of accuracy in respect of interpretation of data taken from the Auckland 199 Survey cannot be guaranteed. The approach used to align with the National Survey approach was taken for completeness to give a better understanding of the scale of the issue. Improved accuracy would require assessment of these buildings through the National Survey assessment template.
4. Repair costs for permanent buildings include a 20% allowance for professional fees and a 15% contingency.
5. Replacement costs for re-locatable buildings are estimated at $1,900 per sqm and include fabrication, transportation, delivery and set-up costs but exclude disposal.
6. Repair costs are based on 2011 prices and do not take account of the need for alternative accommodation, internal costs to the Ministry, or regional price variations or cost fluctuations over time.

All Priority Ratings

Permanent Buildings

Buildings have been profiled for risk and given a priority rating in accordance with the methodology set out at Figure 6: Priority Ratings.

The table at Figure 31 shows the relationship between the priority rating of buildings, their number, size and estimated remedial costs.

Permanent buildings priority rating	# of buildings	Area (m^2)	Gross repair cost ($m)	Av. building size (m^2)	Av. ($/$m^2$)	Av. per building cost ($)
Low	799	149,312	1	187	8	1,252
Low/Medium	1,908	471,361	522	247	1,107	273,585
Medium/High	1,226	479,935	542	391	1,130	442,088
High	349	172,471	255	494	1,478	730,659
Averages/Totals	**4,282**	**1,273,079**	**$1,320m**	**297**	**$1,037**	**$308,267**

Figure 31: Permanent building numbers surveyed per priority rating and costs

A trend exists between the size of permanent buildings and their priority ratings. The larger the building area the greater the risk profile and therefore priority rating.

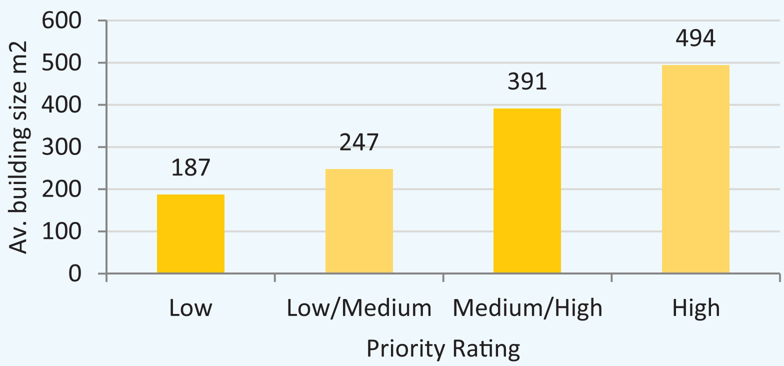


Figure 32: Relationship between permanent building size and risk/priority rating

The table at Figure 31 also shows that the average cost per sqm to repair increases as the priority rating goes up. This is not unexpected due to the methodology outlined at Appendix B, Assessment Methodology.

The combination of these factors (i.e. size and repair valuation) has a significant impact on the average repair cost per building/per priority rating as can be seen on the chart at Figure 5.

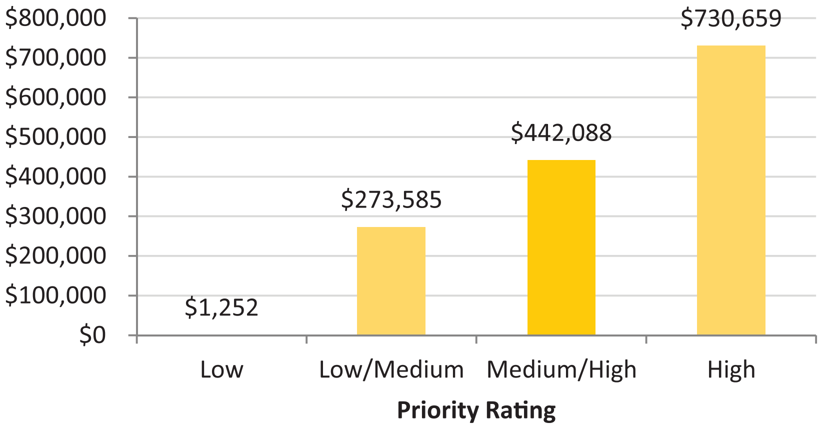


Figure 33: Average cost per permanent building per priority rating

With reference to Figure 34, combining these outcomes shows that the High priority buildings represent only 8% of the permanent buildings surveyed but contribute 19% to the overall repair costs, a multiple of approximately 2.4.

The same relationship against the Medium/High category compares 29% against 41% and produces a multiple of 1.4.

The buildings in the Low/Medium category have virtual parity at 44% and 40% with a multiple of 1.1.

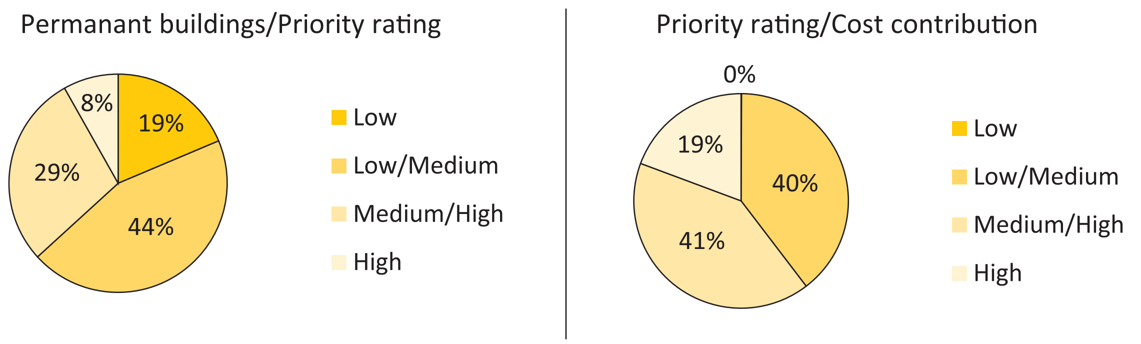


Figure 34: Percentage comparison of permanent buildings against priority rating and cost contribution

Zero-cost permanent buildings

The table at Figure 31 shows there are 799 Low priority buildings. Figure 35 shows that of these buildings 725 have no repair costs associated with them. The lower South Island reflects the most positive results in this regard with 163 permanent buildings with no cost against a total of 373 buildings surveyed, representing approximately 44% of buildings in that region. By contrast the central North Island has 184 buildings against a total of 1,269, representing approximately 14%.

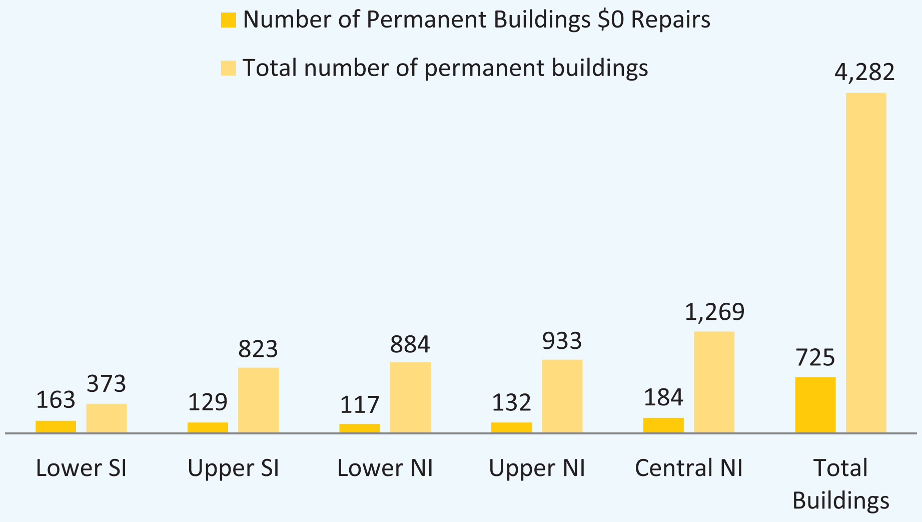


Figure 35: Zero-cost permanent buildings by region

Re-locatable Buildings

The relationships between the variables for re-locatable buildings are more straight forward, due to the fact that re-locatable buildings in the Low/Medium, Medium/High and High categories are priced for replacement at the same rate of $1,900 per sqm.

Re-locatable buildings priority rating	# of buildings	Area (m^2)	Gross repair/ replace cost ($m)	Av. building size (m^2)	Av. ($/$m^2$)	Av. per building cost ($)
Low	127	14,865	0.197	117	13	1,551
Low/Medium	1,170	167,444	318	143	1,900	271,918
Medium/High	540	90,270	172	167	1,900	317,617
High	11	1,783	3	162	1,900	307,973
Averages/Totals	**1,848**	**274,362**	**$493m**	**148**	**$1,798**	**$266,905**

Figure 36: Re-locatable building numbers surveyed per priority rating and costs

A similar trend exists between the size of buildings and their priority rating, with the exception of High priority buildings, which drop marginally below the Medium/High category but is still above Low/Medium. However, the small number of buildings in this category (11) may impact on the outcome.

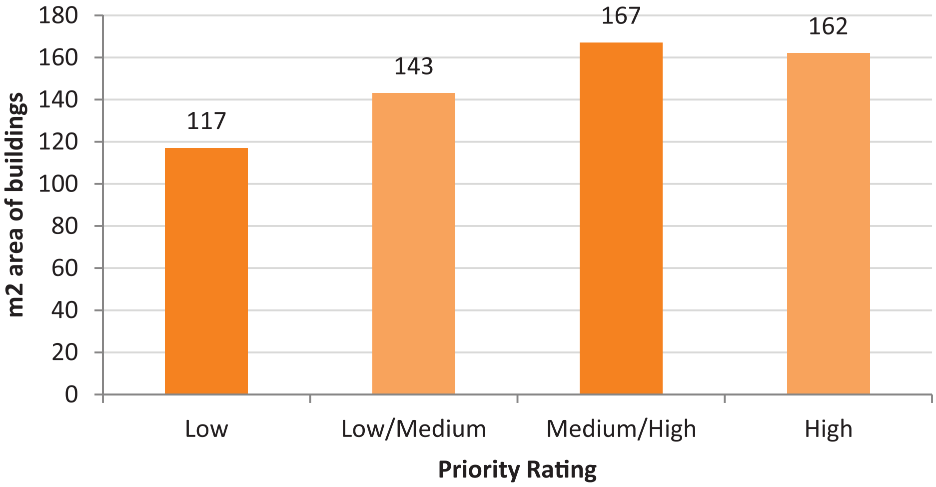


Figure 37: Relationship between re-locatable building size and risk/priority rating

Due to a standard rate applied for replacement, the cost for replacement of re-locatable buildings directly reflects the size of the building, as can be seen by comparing the charts in Figure 37 and Figure 38.

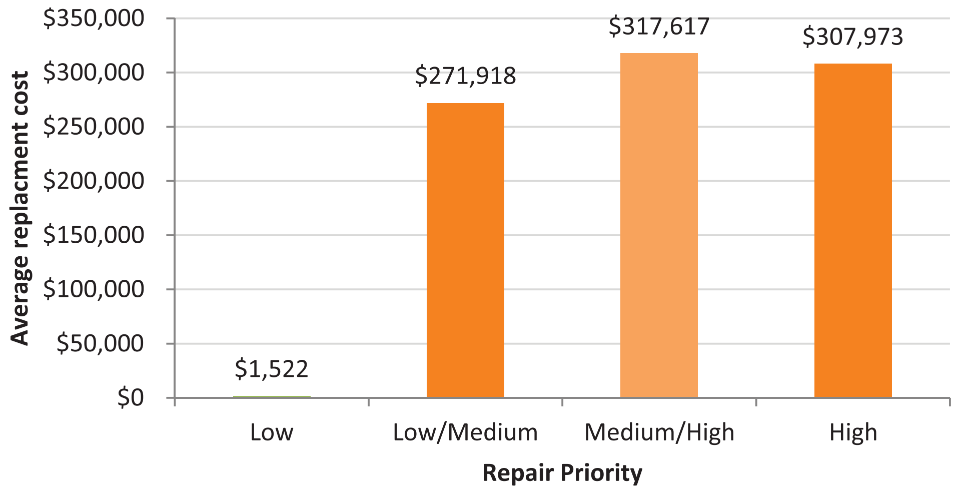


Figure 38: Average cost per re-locatable building per priority rating

The Medium/High category has the highest cost contribution in relation to amount of buildings in the same category, as can be seen at Figure 39.

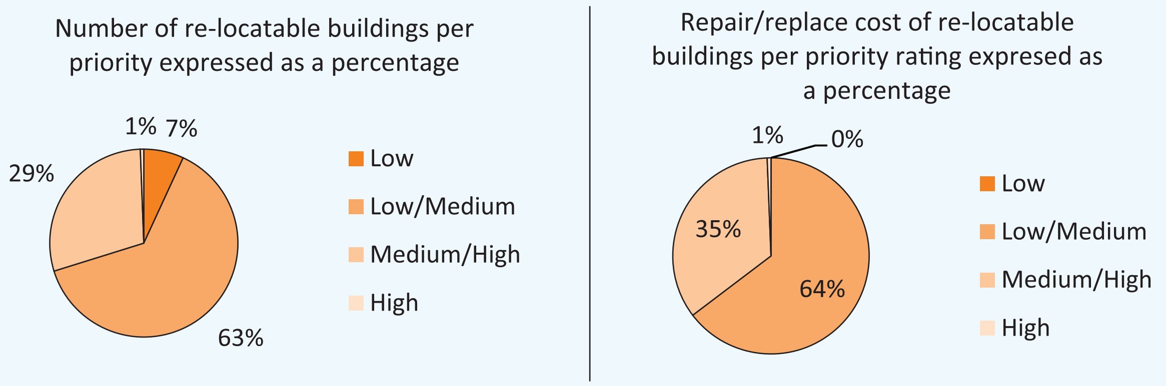


Figure 39: Percentage comparison of re-locatable buildings against cost contribution

Zero-cost re-locatable buildings

The table at Figure 36 shows there are 127 Low priority buildings. Figure 40 shows that of these buildings 116 have no repair costs associated with them. The lower South Island reflects the most positive results in this regard with no cost against 18 (37%). As with permanent buildings, by contrast the central North Island has 49 with no cost against a total of 653, only 8%.

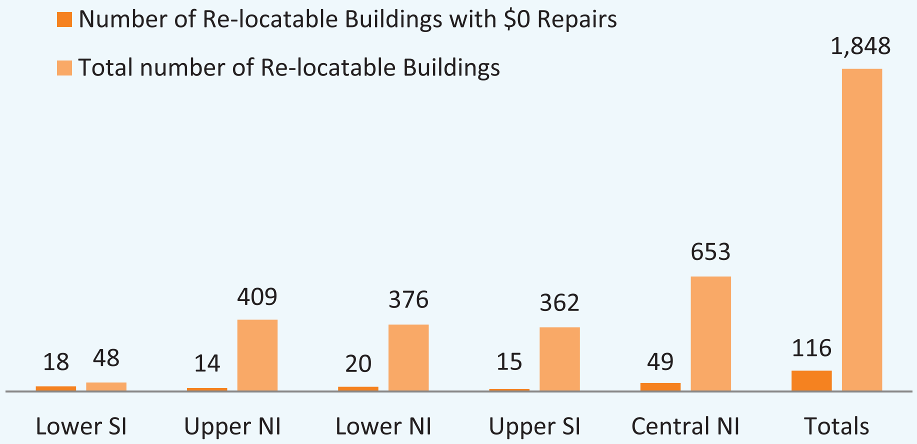


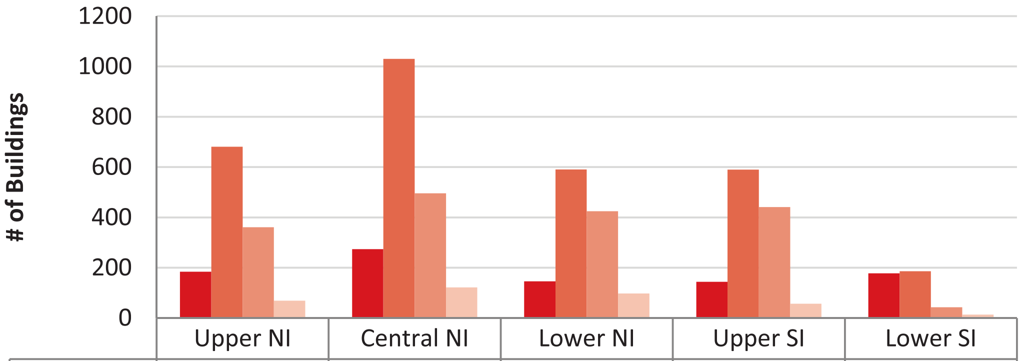
Figure 40: Zero cost re-locatable buildings by region

Low Priority Permanent and Re-locatable Buildings (sub-title)

- There are a total of 926 Low priority buildings in the national survey group made up of 799 permanent buildings and 127 re-locatable buildings.
- By alignment of the Auckland 199 surveyed buildings with the national survey priority rating outcomes there is an estimated additional 133 permanent buildings and 26 re-locatable buildings.
- The total number of buildings in the Low priority is therefore 1,085.
- Buildings in the Low priority category represent minimal weathertightness risk and are not considered to require significant weathertight repairs. An allowance for minor repairs to some buildings has been allowed for at approximately $1.2m.
- A total of 841 Low priority buildings have no repair costs.

Location of all Buildings (Permanent and Re-locatable) by Region and Priority Rating

The regional distribution of all buildings per priority rating is shown below in the chart at Figure 41 below.



	Upper NI	Central NI	Lower NI	Upper SI	Lower SI
Low	184	274	146	144	178
Low/Med	681	1,030	591	590	186
Med/High	361	496	425	441	43
High	69	122	98	57	14

Figure 41: Regional distribution of all buildings by priority

The following tables provide a breakdown of priority ratings per region with details of numbers of buildings, their area in sqm and repair costs. In line with the forecasting model outlined on page 22, a separate indicative predicted repair estimate is also provided per region[26].

Upper North Island

Priority rating	# buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Predicted repair cost ($m)
Low	184	50,809	0.530	10	0.528
Low/Medium	681	185,402	241	1,300	72
Medium/High	361	155,971	188	1,208	113
High	69	38,178	55	1,428	49
Grand Total	**1295**	**430,360**	**$485m**	**$1,126**	**$235m**

Figure 42: Upper North Island repair priority split

Central North Island

Priority rating	# buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Predicted repair cost ($m)
Low	274	46,931	0.568	12	0.568
Low/Medium	1,030	183,485	256	1,396	77
Medium/High	496	145,901	181	1,244	109
High	122	59,615	88	1,469	79
Total	**1,922**	**435,932**	**$526m**	**$1,206**	**$265m**

Figure 43: Central North Island repair priority split

[26] These figures differ from those in section 3.2 and are based on the gross repair costs of both permanent and re-locatable buildings. The figures also exclude the Auckland 199 Survey buildings and buildings already in the BIP.

Lower North Island

Priority rating	# buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Predicted repair cost ($m)
Low	146	23,075	0.178	8	0.179
Low/Medium	591	119,494	163	1,364	49
Medium/High	425	131,271	174	1,327	105
High	98	50,800	77	1,514	69
Total	**1,260**	**324,640**	**$414m**	**$1,276**	**$223m**

Figure 44: Lower North Island repair priority split

Upper South Island

Priority rating	# buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Predicted repair cost ($m)
Low	144	24,898	0.050	2	0.050
Low/Medium	590	109,181	142	1,296	43
Medium/High	441	120,941	154	1,273	92
High	57	20,915	33	1,576	30
Total	**1,232**	**275,935**	**$329m**	**$1,191**	**$165m**

Figure 45: Upper South Island repair priority split

Lower South Island

Priority rating	# buildings	Area (m²)	Gross repair cost ($m)	Av. ($/m²)	Predicted repair cost ($m)
Low	178	18,464	0	0	0
Low/Medium	186	41,243	39	935	12
Medium/High	43	16,121	16	962	9
High	14	4,746	6	1,336	6
Total	**421**	**80,574**	**$60m**	**$750**	**$27m**

Figure 46: Lower South Island repair priority split

The charts below assist in the assessment of proportion split of region and priority rating. Comparing a combination of Low and Low/Medium, the lower South Island presents the best result with 86% of buildings. The same comparison combining Medium/High to High indicates the lower North Island has the highest proportion of buildings at 42%.

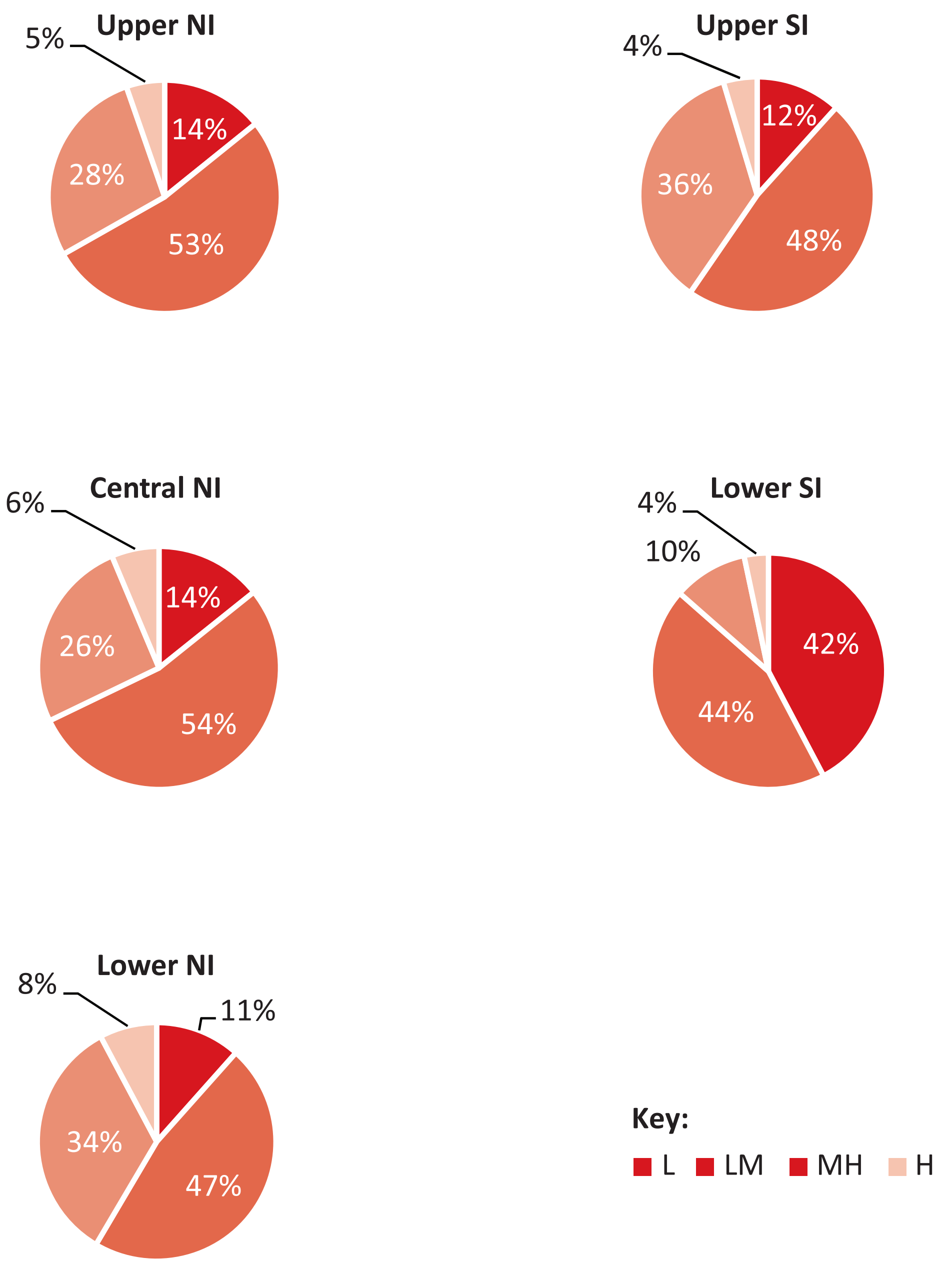


Figure 47: Regional percentage split of priority rating

Summary and Conclusions

Permanent Buildings

- Larger area permanent buildings present the highest risk for weathertightness failure determined by era, building type, design and the presence of defects[27].

- The lower South Island returned the best results in regard to buildings with no repair costs, which suggests smaller more simple buildings with less weathertightness risk.

Re-locatable Buildings

- Comparing the number of buildings per priority rating against contribution to repair cost as a percentage, it can be seen that the Medium/High category is contributing the largest cost per number of buildings. This is simply due to these buildings having the largest sqm area as the sqm replacement rate is constant at $1900m^2.

- The lower South Island has the largest proportion of re-locatable buildings with no cost.

Low Priority Buildings

- There are 1,085 low priority buildings which are considered to have minimal weathertightness risk other than minor localized repairs at an estimated cost of $1.2m.

- 841 Low priority buildings have no associated repair cost.

- The balance of Low priority buildings that do have minor repair costs is 244 which equates to approximately $5,000 per building.

All Buildings

- The central North Island has the largest number of buildings and the highest estimated repair cost as a result of the absence of the 1,074 Auckland 199 Survey buildings.

- The lower North Island proportionally has the highest percentage of Medium/High to High priority buildings.

- 86% of buildings in the lower South Island are in the Low to Low/Medium categories.

Qualifications

1. Re-locatable buildings are priced for replacement at a sqm value of $1,900 which includes all costs including delivery and set up, but excludes disposal costs.

2. The average re-locatable repair cost is a combination of isolated repairs to Low priority buildings and replacement at $1,900 per sqm. This results in the dilution of the average repair/replace cost to $1,798 as can be seen in the table at Figure 39.

3. Analysis in this section excludes buildings already in the Ministry's BIP.

4. The repair estimates and number of buildings for the upper North Island are skewed by the absence of the Auckland 199 Survey buildings which totalled 1,074.

5. The level of accuracy in respect of interpretation of data taken from the Auckland 199 Survey cannot be guaranteed. The approach used to align with the National Survey approach was taken for completeness to give a better understanding of the scale of the issue. Improved accuracy would require assessment of these buildings through the National Survey assessment template.

6. Repair costs for permanent buildings include a 20% allowance for professional fees and a 15% contingency.

7. Repair costs are based on 2011 prices and do not take account of the need for alternative accommodation, internal costs to the Ministry, or regional price variations or cost fluctuations over time.

[27] Refer Figure 60

3.4 Permanent Buildings versus Re-locatable Buildings

Re-locatable Buildings General

Re-locatable buildings are usually placed on school sites as a temporary facility. Permanent buildings are required under the Building Act 2004 to last for a minimum of 50 years. An intended term for re-locatable buildings would be more in the range of 15-20 years[28]. Re-locatable buildings are prefabricated off-site and delivered complete by a heavy goods vehicle, placed (usually) on timber pile foundations and connected to services. They do not pose the same scope of problems associated with permanent buildings suffering from weathertightness failure. Due to their temporary nature they lend themselves much more to holding type repairs to see them to the end of their economic life. Re-locatable buildings have been assessed under the National Survey under the same methodology as permanent buildings but they are priced for replacement rather than repair[29], for the reasons outlined above.

Building Type Proportional Split

The proportion of permanent buildings to re-locatable buildings from the National Survey is indicated below at Figure 48.

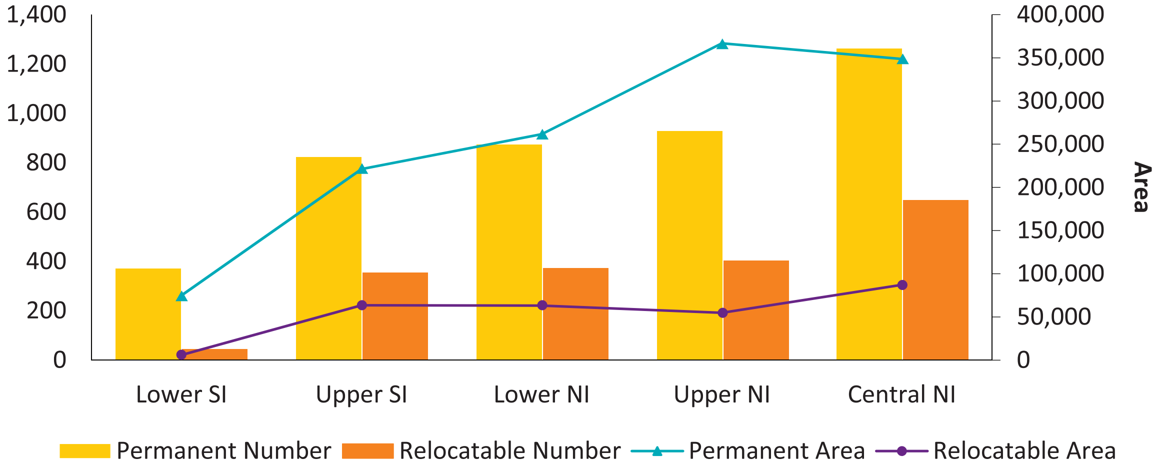


Figure 48: Permanent verses re-locatable building regional distribution

An analysis of the data confirmed the following percentage ratios between the two building type groups:

Region	Re-locatable % split	Permanent % split
Lower South Island	11%	89%
Upper South Island	33%	67%
Lower North Island	30%	70%
Upper North Island	28%	72%
Central North Island	34%	66%

Figure 49: Re-locatable and permanent building percentage comparison

The lower South Island has very few re-locatable buildings compared to permanent buildings. The central North Island has the highest proportion of re-locatable buildings compared to permanent buildings.

If the Auckland 199 Survey buildings are added to the upper North Island it makes little difference to the percentage split. Including the Auckland 199 Survey buildings there are 736 re-locatable buildings and 1631 permanent buildings with a 31/69 percentage ratio.

[28] Many re-locatable buildings placed on school sites extend beyond this timeframe.
[29] The exception is Low priority buildings which either have zero cost or a small sum for minor repairs.

Summary and Conclusions

- In terms of regional distribution and ratio the lower South Island has the lowest apportionment of re-locatable buildings against permanent and the central North Island the highest.
- As noted previously, re-locatable buildings pose a different set of problems to permanent buildings in terms of required repairs for weathertightness and should be potentially identified and dealt with under a separate strategy that takes account of their current age and predicted economic life and usefulness to schools.
- The comments under the 'General Comment' section page 25 are pertinent with regard to the fact that many re-locatable buildings have become more akin to permanent buildings, which will impact on any replacement programme strategy.

Qualifications

1. The analysis in this section excludes buildings in the current BIP.
2. The true age of re-locatable buildings is difficult to determine as many have been prefabricated prior to 1994. However the date taken for the purpose of the national survey is the date they were placed on site.

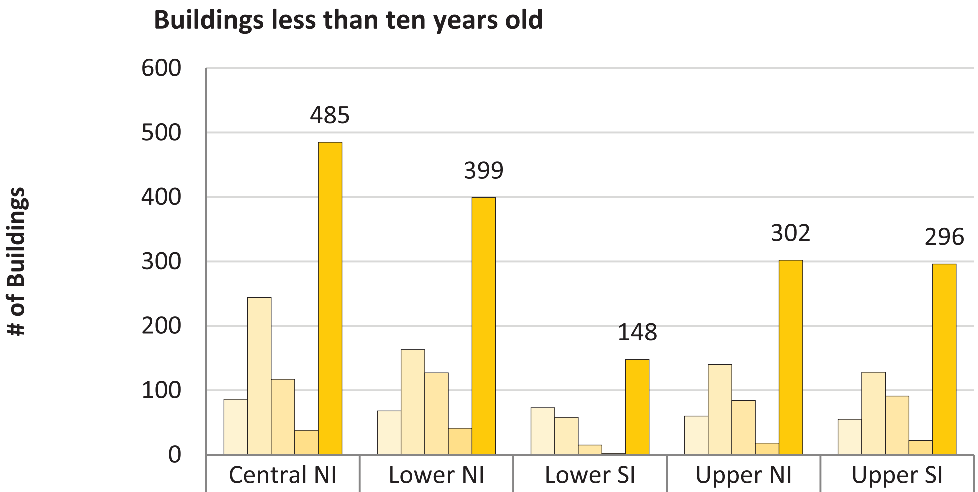
3.5 Permanent Buildings less than Ten Years Old

The data captured by the National Survey provided estimated building ages. This was obtained from school staff when known or determined by other means such as date plaques on buildings. In addition, PMIS data was referenced to obtain estimated ages of buildings[30].

In total there are 1,630 permanent buildings identified as being potentially ten years old or less, which equates to approximately 38% of the total number of permanent buildings surveyed (4,282)[31]. The buildings are distributed over 1,456 schools which equates to 1.2 buildings per school.

Figure 50 indicates the number of buildings per region by priority rating. As can be seen the lower North Island has the highest number of High and Medium/High buildings ten years old or less. The central North Island has the largest total number of buildings and the lower South Island the least.

The upper North Island results are skewed by the absence of the Auckland 199 Survey buildings, the ages of which have not been ascertained for the purpose of this analysis.



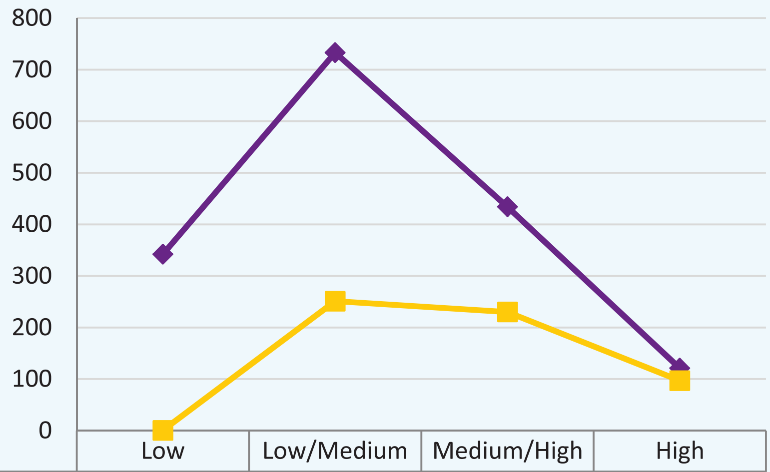
	Central NI	Lower NI	Lower SI	Upper NI	Upper SI
Low	86	68	73	60	55
Low/Med	244	163	58	140	128
Med/High	117	127	15	84	91
High	38	41	2	18	22
Total buildings	485	399	148	302	296

Figure 50: Buildings less than ten years old

[30] The accuracy of information received from schools or obtained through the PMIS cannot be verified and therefore the information in this section should be considered indicative only.

[31] Excludes the Auckland 199 Survey buildings and buildings already in the BIP.

The graph at Figure 51 shows the relationship between the number of buildings and the relative gross repair cost per priority rating. The total gross repair costs for all buildings potentially ten years old or less is $579m.



	Low	Low/Medium	Medium/High	High
# Buildings	342	733	434	121
Gross Cost ($m)	0.5	251	230	97

Figure 51: Potential number of buildings and gross repair costs per priority

The graph at Figure 52 shows the potential number of buildings per year that are ten years old or less, from one year old to ten years old. The figures are accumulated year on year (e.g. the 55 buildings that are potentially two years old include the five buildings that are one year old and so on). After approximately three years (from the present date) the data suggests that the group of buildings ten years old or less will have reduced by around 57%.

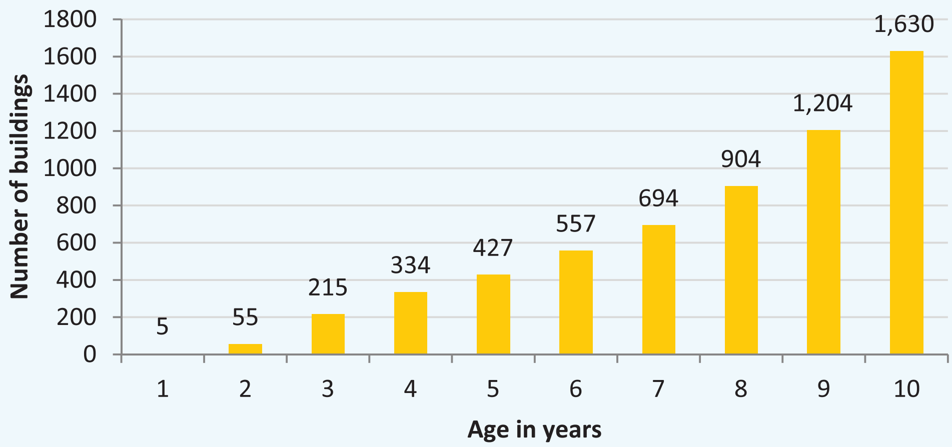


Figure 52: Potential number of buildings ten years old or less by year

Summary and Conclusions

- Indicatively, 1,630 buildings representing 38% of the total permanent buildings surveyed by the National Survey are buildings that are ten years old or less with a gross repair estimate of $579m.
- Buildings are distributed over 1,456 schools, which equates to 1.2 buildings per school.
- The central North Island has the highest number of buildings at 485.
- The lower North Island has the most buildings in the High and Medium/High categories, with 168 buildings.
- The lower South Island has the lowest total number of buildings at 148.
- After approximately three years (from the present date) this group of buildings will reduce by around 57%.

Qualifications

1. The date range considered is from 2002 to 2011. Therefore some buildings constructed in the first quarter of 2002 will already be older than ten years but are not included in the dataset.
2. The information sources are anecdotal or cannot be verified and therefore should be considered indicative only.
3. The buildings in the Ministry's current Building Improvement Programme and the Auckland 199 Survey are excluded from the analysis in this section.

3.6 Division of Classroom and Non-classroom Buildings

The following section considers the split of classroom buildings against non-classroom buildings (i.e. administration buildings, halls, gymnasiums etc.). The table at Figure 53 below shows there are significantly more permanent non-classroom buildings (64%) than classrooms (36%).

Permanent Buildings

Building use	# buildings	Area (m²)	Gross repair cost ($m)
Classroom	1,534	450,486	437
Non-classroom	2,748	822,593	883
Total	**4,282**	**1,273,079**	**$1,320m**

Figure 53: Division of classroom and non-classroom permanent buildings

The opposite is true when the same relationship is considered for re-locatable buildings as identified at Figure 54, with 85% of re-locatable buildings being classrooms.

Re-locatable Buildings

Building use	# buildings	Area (m²)	Gross repair cost ($m)
Classroom	1,569	242,457	441
Non-classroom	279	31,905	52
Total	**1,848**	**274,362**	**$493m**

Figure 54: Division of classroom and non-classroom re-locatable buildings

Combining both re-locatable and permanent buildings and applying the same analysis sees the two groups of buildings reach near parity.

All Buildings

Building use	# buildings	Area (m²)	Gross repair cost ($m)
Classroom	3,103	692,943	878
Non-Classroom	3,027	854,498	935
Total	**6,130**	**1,547,441**	**$1,813m**

Figure 55: Combined permanent and re-locatable classroom and non-classroom buildings

In comparing these buildings against priority ratings it can be seen that non-classroom buildings in the High priority category exceed the classroom buildings by 115%, but Medium/High numbers are nearly equal.

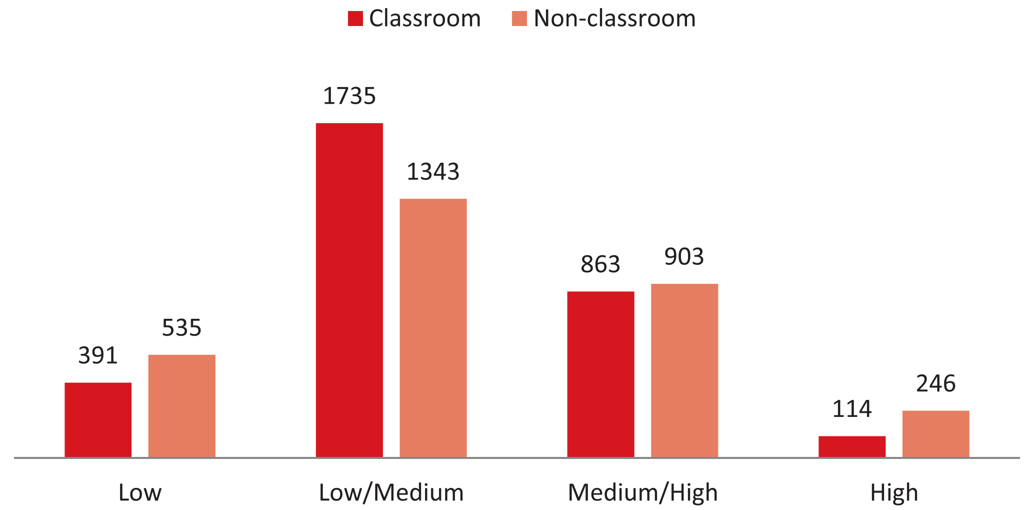
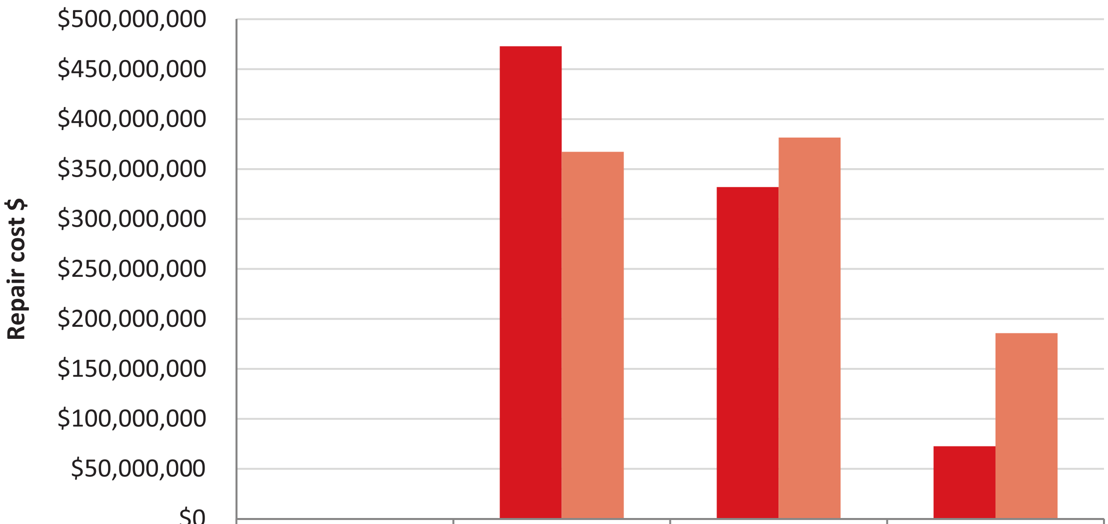


Figure 56: Number of classroom and non-classroom buildings by priority rating

An assessment of estimated gross repair costs of classroom to non-classroom buildings per priority rating provides the following outcomes at Figure 57.



	Low	Low/Medium	Medium/High	High
Classroom	$576,150	$472,960,742	$332,032,865	$72,567,773
Non-classroom	$751,770	$367,205,304	$381,591,416	$185,746,542

Figure 57: All buildings, classroom and non-classroom gross repair costs per priority rating

In terms of repair strategy, classroom buildings have greater flexibility on a per site basis as they are more likely to have surplus space, allowing classes to be combined temporarily whilst repairs to other classroom buildings are undertaken.

Repairs to non-classroom buildings, such as administration and specialist buildings, are likely to impact on a schools day to day running more significantly due to buildings being unavailable for the duration of the works. There is increased complications for providing temporary facilities for buildings of their nature in both size requirements and specialist services and equipment.

Summary and Conclusions

• 64% of permanent buildings are non-classrooms.

• Non-classroom building uses do not lend themselves to re-locatable building suitability, which explains the ratio of classroom to non-classroom re-locatable buildings (85% in favour of the latter).

• Non-classroom buildings tend to be larger than classrooms. The survey findings have identified that the larger buildings typically profile higher for weathertightness risk as identified on page 30.

• Non-classroom buildings in the High priority category exceed classrooms by 50%.

• The proportion of classroom to non-classroom buildings will impact on repair strategy as a result of how individual schools can be affected on an operational basis.

Qualifications

I. Excludes Auckland 199 Survey buildings and buildings already in the Ministry's BIP.

3.7 The Impact of Climate

In researching this aspect, the National School survey did not find any reliable quantitative research or theory relative to New Zealand regarding the relationship of weather and any regional climatic effects on the weathertightness performance of buildings. However, due to the direct relationship with the weather and in particular rain it is considered reasonable to consider which are the wettest areas across the country.

Highlighted below are the top five regions that featured at Figure 29 on page 32, affected by the most rainfall. A column has been added identifying the number of High and Medium/High priority buildings in these regions (National Survey buildings only).

District	Rainfall (mm)	Wet days > = 1mm	Wind km/h mean speed	Gale days 68km/h<	Relative humidity % (Yr)	# of high and high/medium priority buildings
MILFORD SOUND	6,749	186	9	9	91.8	-
MT COOK	4,293	161	10	5	76.3	-
HOKITIKA	2,875	171	11	2	84.1	-
WESTPORT	2,274	169	11	2	83.0	-
WHANGAREI	1,490	132	16	1	83.1	55
NEW PLYMOUTH	1,432	138	20	5	83.5	54
ROTORUA	1,401	117	13	1	79.0	62
KAITAIA	1,334	134	15	2	85.9	-
WELLINGTON	1,249	123	22	22	82.9	95
AUCKLAND	1,240	137	17	2	81.1	307[1]
TAURANGA	1,198	111	16	5	78.0	80
HAMILTON	1,190	129	12	2	83.6	-
MANAPOURI	1,164	129	10	NA	83.6	-
INVERCARGILL	1,112	158	18	18	83.7	5
TAUPO	1,102	116	13	2	80.8	17
GISBORNE	1,051	110	15	2	74.4	74
MASTERTON	979	130	11	1	73.9	15
NELSON	970	94	12	2	79.9	24
PALMERSTON NORTH	967	121	17	3	80.7	29
QUEENSTOWN	913	100	12	2	75.9	20
WANGANUI	882	115	18	5	78.7	-
CHATHAM ISLANDS	855	133	25	16	82.4	1
KAIKOURA	844	86	15	28	73.2	7
DUNEDIN	812	124	15	8	75.8	26
NAPIER	803	91	14	3	72.9	81
BLENHEIM	655	76	13	4	75.9	-
CHRISTCHURCH	648	85	15	3	79.6	209
LAKE TEKAPO	600	78	7	1	72.8	-
TIMARU	573	81	12	6	79.6	8
ALEXANDRA	360	66	6	3	78.1	-

Figure 58: New Zealand climate information summary from NIWA

Summary and Conclusions

There is little in the way of qualitative data available to influence a prioritised remediation programme at this stage. However, in developing a prioritised investigation and remediation programme an opportunity exists to gain feedback to improve the understanding of climate impact on timber-framed buildings. Consideration could be given to investigating a spread of Medium/High to High priority buildings. However, this data would still be limited due to the impact of many other variables that affect a building's weathertightness performance.

Qualifications

1. A building's weathertightness performance is impacted by many factors, including topography and exposure, regardless of the local level of rainfall. For this reason the buildings in the National Survey were all categorised as high wind zone in terms of the zoning provided in NZS 3,604 2011, which is the New Zealand Standard for light timber-framed buildings.

2. The information in the table at Figure 58 was obtained from New Zealand's National Institute of Water and Atmospheric Research (NIWA).

3. The New Zealand climate summary data are mean annual values for the 1971-2000 periods, for locations having at least five complete years of data.

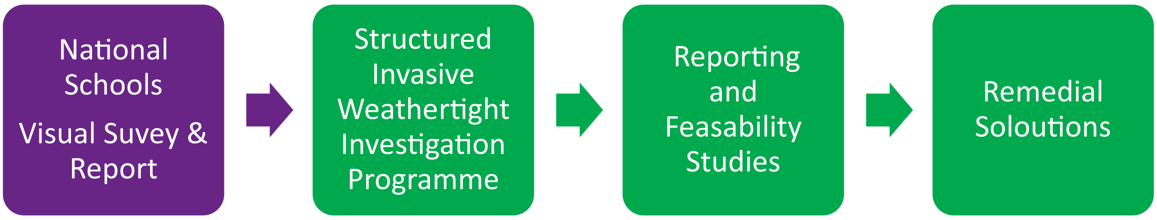
4 | Conclusions and Recommendations

4.1 Conclusions

The National Survey concludes that there are a total of 7,590 constructed or significantly modified post-1994 buildings with a total estimated area of 2,249,334 sqm. This represents approximately 39% of the Ministry's total property portfolio by sqm area.

The gross estimated repair costs to repair all buildings are in the region of $2,541m including professional fees and contingencies. The rationalised repair cost is predicted to be in the region of $1,428m affecting an anticipated 3,097 buildings with a sqm area of 1,157,855. There are 420 High priority buildings with an estimated repair value of $324m.

This report provides high-level outcomes based on visual site surveys, and as such requires future verification. The National Survey is the first stage in establishing a planned remediation programme in line with the objectives laid out in the Property Strategy. Stage two requires a structured weathertightness investigation programme to be implemented nationally on a priority basis.

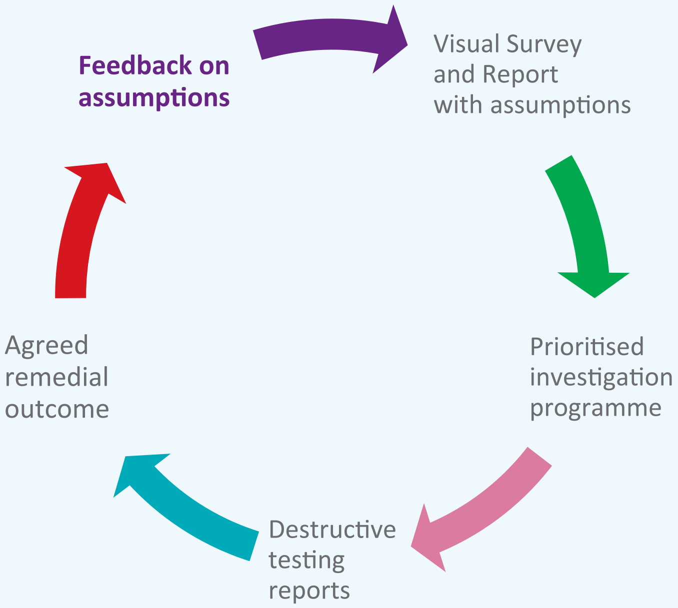


An extensive dataset has been obtained and compiled in support of this report, and this can be used as a foundation to assist this process.

4.2 Recommendations

It is recommended that a structured investigation programme is undertaken, using the National Survey priority rating of buildings as a guide.

It is also recommended that a robust and structured feedback procedure is put in place as indicated below.



The limitations of the prediction model should be remembered and the assumptions should be tested over time to crystallize actual outcomes. A well-considered feedback loop would provide verification of the assumptions made in this survey and quality feedback will allow adjustment and improved accuracy over time for the on-going benefit of any remediation programme. Clarity can also be gained on an array of issues including the following examples:

- Common (confirmed) causes of weathertightness failure
- Defect trends such as common defects geographically or associated with specific materials or products.
- Verification of the impact of climate
- Material related failures
- Workmanship issues
- Maintenance issues.

A better understanding of these issues can then be used to help drive improvements in:

- Design standards
- Defining durability requirements for building materials specific to school needs. For example the durability requirement under the current building code for claddings is 15 years, which is unlikely to align with life expectancy of school buildings and their claddings.
- An understanding of appropriate product choices and the compilation of a deleterious materials list.
- Better education of all school property stakeholders
- Consideration of lifecycle costing and the implications of premature failure or short term cost savings
- Designing with future maintenance and durability requirements in mind.

Appendix A – Glossary

Appendix A - Glossary

Term	Definition
Acceptable Solution	Produced by the Department of Building and Housing, provides prescriptive details to meet the requirements of the Building Code
Alternative solution	A colloquial term for any proposal to meet the provisions of the Building Code that is not an "Acceptable Solution"
BIA	Building Industry Authority
BIP	Building Improvement Programme (Ministry of Education)
Cavity	The term given to the gap between the inside face of the external wall cladding and the structural wall of a building
Chartered Surveyor	A qualified building surveyor with professional membership to the Royal Institution of Chartered Surveyors
Destructive Testing	The name given to the invasive investigation of buildings which in terms of weathertightness investigations includes drilling and cutting open of building envelope claddings or removal of the same
Eaves	The roof over-hang above an external wall of a building
GFA	Gross Floor Area
Gross Repair Costs	In terms of the National Schools Weathertightness Survey report, means the total costs to fully repair all at-risk buildings
Leaky Building	Timber-framed buildings that as a result of their design and construction allow unplanned moisture entry via the building envelope, resulting in wetting of the structural framing and subsequent damage from decay (often significant). Leaky buildings are typically buildings constructed from 1994–2004.
NIWA	National Institute of Water and Atmospheric Research
Permanent Building	A permanent building structure on a school site with a building code requirement to last for 50 years (for structural elements)
PMIS	Ministry of Education Property Management Information System
Predicted Repair Cost	In terms of the National Schools Weathertightness Survey report, means the likely costs to repair buildings suffering weathertightness failure.
Re-locatable Building	A temporary pre-fabricated school building designed to be re-located between sites

Appendix B – Methodology

The following is an overview of the methodology that was adopted for the assessment of school buildings in this survey.

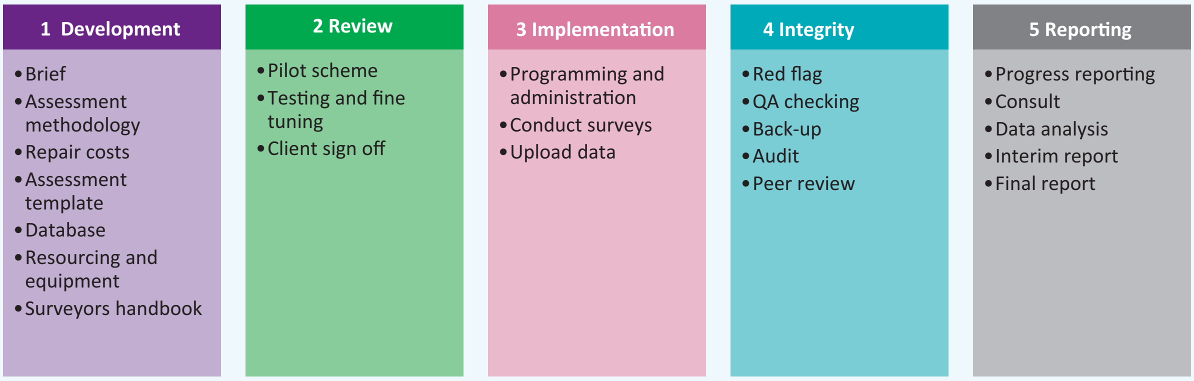


Figure 59: Methodology overview

1. Development

The development stage sought to clarify the project brief and develop the tools necessary for successful delivery of the project.

Brief

Upon engagement, consultation was undertaken with the project group to clarify the scope and brief and confirm the project parties' expectations[32]. The core brief was confirmed as follows:

> "A high level review, based on visual surveys of all post-1994 school buildings, profiled for weathertightness risk and catagorised for priority with estimated costs to repair."

Assessment Methodology

It was determined that buildings would be assessed by visual survey by a qualified Building Surveyor. A methodology was developed to profile buildings weathertightness risk against an accumulated points system. The principles of the Acceptable Solution to the Building Code E2/AS1 (3rd edition), 1 May 2008 (Risk Matrix) (the Acceptable Solution) and the DBH Weathertightness Guide have been used as a basis to develop the assessment values.

The assessment criteria fall into three main categories each that build a points-based outcome and end priority rating:

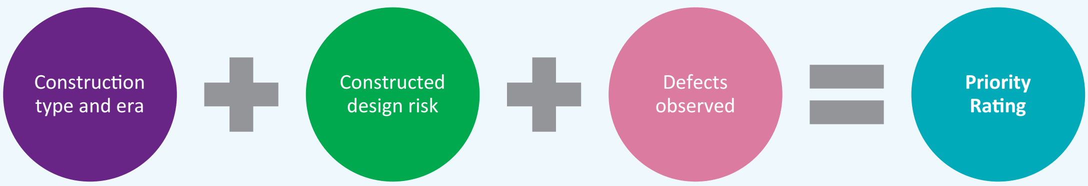


Figure 60: Building assessment methodology overview for priority rating

[32] The contract for services included provision to gather data for PMIS, Health and Safety, swimming pools and heating systems. This information has been excluded from this report on weathertightness.

The construction type and era considers the age of the building, cladding, roof and window types and the presence of a cavity or not.

Constructed design risk considers how the construction relates to current weathertightness design principles in broad alignment with the Acceptable Solution.

Defects observed included notable defects known to cause weathertightness failure of buildings as identified in the DBH Weathertightness Guide.

The accumulated points from each section contribute towards the end **priority rating** which are divided into four categories, as follows:

Priority rating	Points range	Meaning
Low	0-70	Buildings that are unlikely to have significant weathertightness failure and therefore are unlikely to require significant repairs such as re-cladding and re-roofing. These buildings are likely to meet the requirements of the Building Code and at most are anticipated to need only localised repairs. Buildings in this category have been priced for localised repairs in the region of $10k -$20k per building if deemed necessary by the surveyor who inspected the building.
Low/Medium	71-110	Buildings that profiled with increased risk over the Low category and may require significant weathertightness works in the form of re-cladding to meet the requirements of the Building Code. Invasive weathertightness investigation would be required to confirm. Buildings in this category have been priced for full re-cladding and roof repairs at the discretion of the building surveyor who undertook the assessment, but works to this extent may not be necessary.
Medium/ High	111-150	Buildings that profiled with increased risk over the Low/Medium category and potentially require significant weathertightness works in the form of re-cladding to meet the requirements of the Building Code. Invasive weathertightness investigation would be required to confirm. Buildings in this category have been priced for full re-cladding and roofing repairs at the discretion of the building surveyor who undertook the assessment. Works to this extent may not always be necessary but are still considered reasonably likely.
High	151-230	Buildings that profiled as highly likely to suffer from weathertightness failure based upon their size, complexity, era, type of construction and obvious defects. These buildings have in all instances been assumed to require re-cladding and full re-roofing for budget estimating purposes. However, as with the two medium categories, verification by way of invasive weathertightness testing would be required to confirm this conclusively.

Figure 61: Priority Ratings

The priority rating determines the order in which buildings should be investigated to confirm their weathertightness performance. The rating system is intended to provide the Ministry with a framework for planning and developing a prioritised investigation and remediation plan. There is no specific timeframe associated with these categories as it is not possible to determine any level of certainty or severity from a visual survey only.

Example of a **High priority** building. Typical atributes include a large floor area and a high level of complexiy. High risk weathertightness features are also present along with potential defects.

Example of a **Low/Medium priority** building. Typical attributes include, smaller floor area (compared to high priority buildings), simple design, low risk weathertightness features.

As noted at Figure 61, the end priority rating also determines specific outcomes for likely repair costs, as follows:

Building Score >70
- Low Priority
- Roofing or re-cladding repairs are not required
- Allowance for minor repairs up to $20,000 at surveyor's discretion

Building Score 71-110
- Low/Medium Priority
- Default repair estimate for full re-cladding based on % m² area entered
- Repair value adjusted for building type and 25% allowance for decayed timber replacement
- 30% predicted risk of repairs being required

Building Score 111-150
- Medium/High Priority
- Default repair estimate for full re-cladding based on % m² area entered
- Repair value adjusted for building type and 50% allowance for decayed timber replacement
- 60% predicted risk of repairs being required

Building Score 150+
- High Priority
- Repair estimate based on full re-cladding and full roof replacement
- Repair value adjusted for building type and 75% allowance for decayed timber replacement
- 90% predicted risk of repairs being required

Figure 62: Rules and outcomes

Likely Extent of Re-cladding Repairs

Due to the complexities associated with the required repair approach of buildings suffering from weathertightness failure (refer to The Nature of Repairs section), at-risk buildings have been assumed to require **full re-cladding for estimating purposes.** At-risk buildings are those that fall into the priority rating categories Low/Medium, Medium/High and High. Buildings in the Low category have no repairs or only minor (targeted) repairs allowed.

From a visual survey alone it is not possible to determine which buildings are actually failing. This can only be achieved by physical testing or removal of claddings. The survey approach provides building risk profiling that will need to be verified by destructive investigation.

Buildings with the lowest points score present the lowest risk of failing and therefore are unlikely to require full re-cladding (Low priority buildings are those with a points score below 70). Beyond this point as buildings are introduced to the survey group with a point score between 71 and 230 their risk and priority rating will be relative to their points score. In simple terms, a higher score means a higher risk of weathertightness failure and a higher the priority to investigate and repair. The line graph below demonstrates this principle:

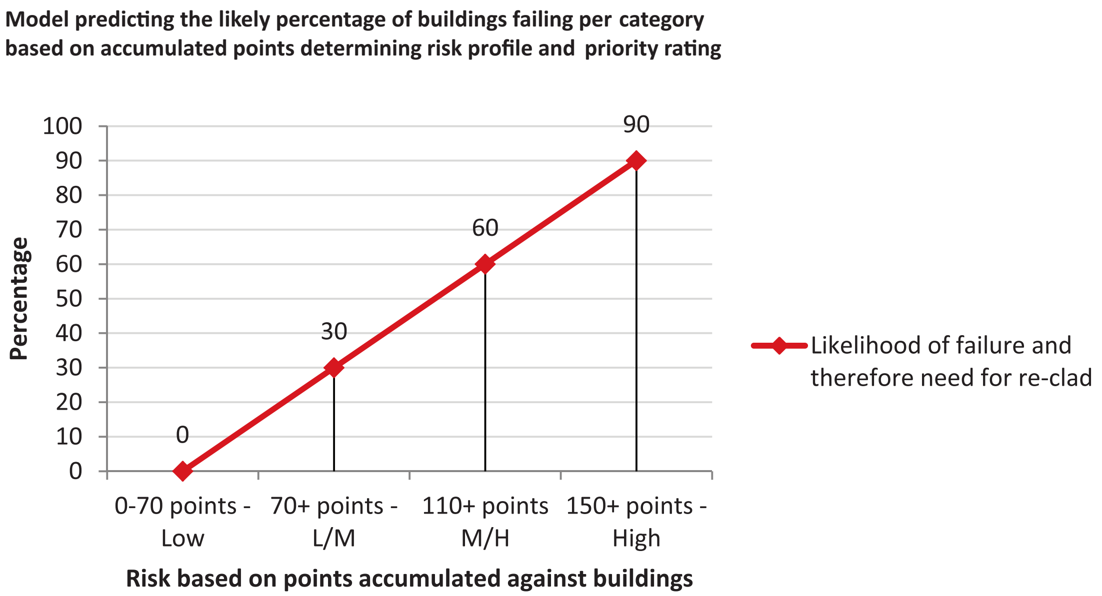


Figure 63: Model predicting the likely need for re-cladding based on risk

For High priority buildings, the maximum High priority category has been set at 90%. This is because even buildings in the High priority category have a reducing risk profile (points from 230 reducing to 151) and therefore in theory may not all be failing and require re-cladding. Anecdotal feedback from the Ministry based on buildings already in the BIP supports this assumption.

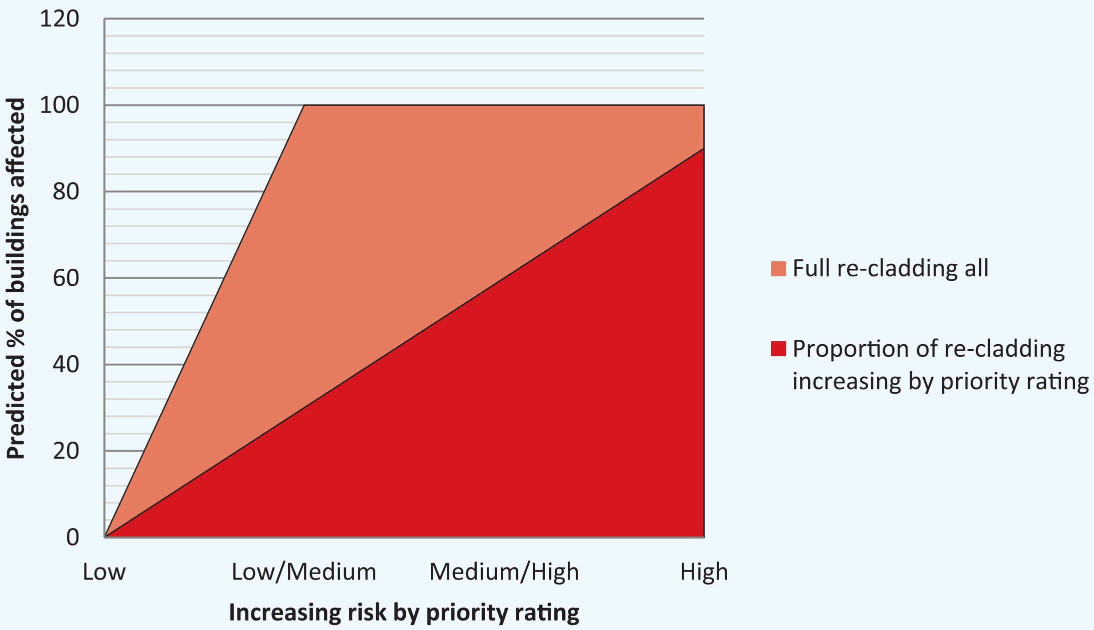


Figure 64: Model predicting the likely need for re-cladding against re-cladding of all buildings excluding Low priority

The above graph demonstrates how the reporting considers the worst-case scenario that all buildings will require re-cladding against a more likely outcome based on the risk profiling of the buildings.

Repair Costs

At the start of the project a number of sources were consulted to derive appropriate repair rates. These included internal expertise from Hampton Jones' Quantity Surveying team, an external Quantity Surveyor and industry rates from Rawlinson's price book 2010/11. The agreed rates were then incorporated into a pricing formula based on a gross floor area (GFA) approach. The rates cover labour and materials for the building work only and do not include professional fees, and, alternative accommodation and other similar costs[33].

[33] An allowance for professional fees of 20% and contingency of 15% was provided for in the data analysis.
[34] An adjustment to the re-cladding base rate based on building type e.g. a science block repair would typically have a higher cost than a basic classroom.
[35] Allowances of 25% of framing replaced for Low/Medium, 50% Medium/High and 75% High.

The agreed rates were integrated into formula as follows:

Re-cladding repair rate = [RC+BT+FR] x [GFA x P]

Value	Meaning
RC	Re-cladding Base Rate
BT	Building Type rate adjustment[34]
FR	Frame Remediation - Decayed timber frame replacement based on priority rating[35]
GFA	Gross Floor Area measured on site by surveyor
P	Percentage area of GFA applicable – see Fig. 13 below for example

Figure **65**: Re-cladding formula values

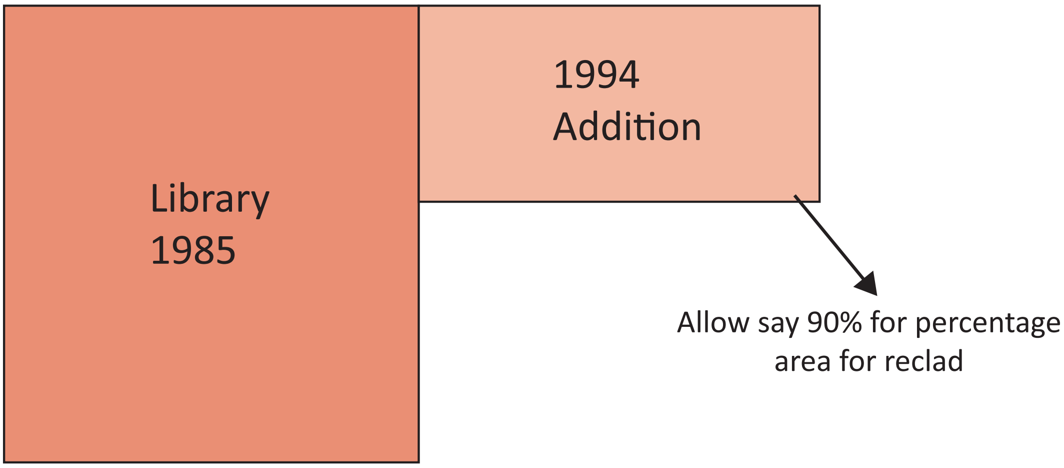


Figure 66: Example of percentage adjustment applied to a gross floor area measured on site

The example at figure 66 shows what approximate percentage of gross floor area would be entered for an extended building (addition), to take account of one elevation not requiring an external wall re-cladding.

For a stand alone building with all timber framed external walls the gross floor area entered would be 100%.

Re-roofing repair rate = [RT + A] x [P]

Value	Meaning
RT	Roof Type
A	Roof Type Rate Adjustment
P	Percentage of Roof Replacement

Figure 67: Re-roofing formula values

Assessment Template

The assessment template incorporates the assessment methodology referred to in Figure 60 and automatically provides a points-based outcome. The accumulated points determine the end priority rating referred to at Figure 61.

A repair estimate is automatically calculated through embedded formula based on a GFA calculation and adjusted for building type and priority rating as mapped in Figure 62.

Database

The database is a web-based intranet site which holds all of the information on the schools and their associated buildings.

The database provided the facility to store the original data from PMIS and organise and pre-populate survey templates on a by-school and by-building basis. The database also acted as an information portal for the project team to access information updates and documents (e.g. surveyor's handbook).

Survey data was uploaded directly from site via a touch screen tablet computer through a synchronisation process (mobile upload). Live updates to the Ministry were possible against key objectives such as number of buildings surveyed, repair priority and cost as the surveys progressed.

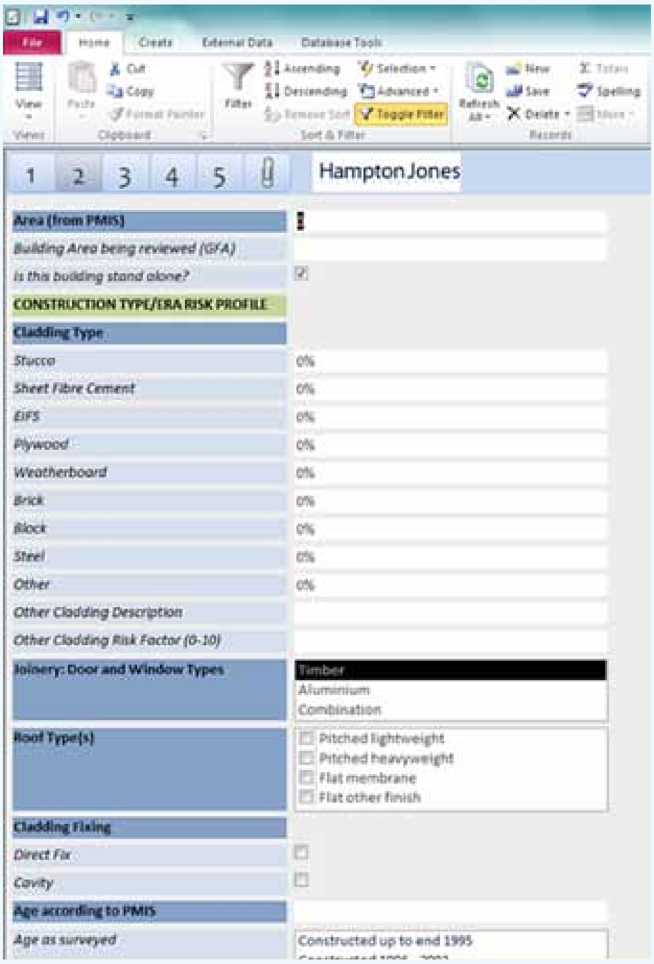


Figure 68: Example page from survey template

Figure 69: Example database web page

Resourcing and Equipment

A team of up to 14 Building Surveyors were engaged on the National Survey. This group were supported by a Project Director, Project Manager, in-house Quantity Surveyor and dedicated project administrator who formed the consultant project team.

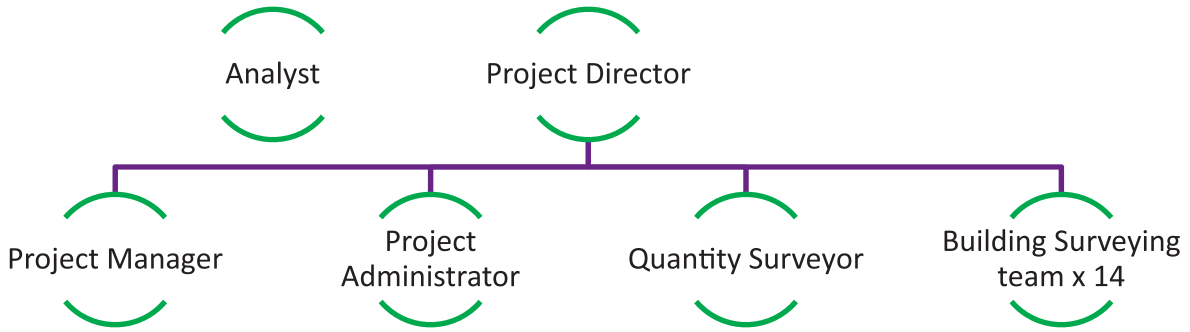


Figure 70: Consultant Project Team

The building surveying team were provided with a number of tools to undertake the surveys, including:

• Touch screen tablet computer

• Back-up device

• Camera

• Surveyors wheel

• Digital measuring device.

Surveyors Handbook

A surveyor's handbook was developed to brief the building surveying team on the project background and requirements. It was identified at an early stage that surveyor bias could have a significant effect on survey outcomes. Providing a clear document confirming the survey methodology and limitations has assisted in reducing this impact.

2. Review

Pilot Scheme

A pilot scheme was launched on 16 May 2011. Twenty-two buildings at eight schools in South Auckland were surveyed. The objective of the pilot was to develop the template and survey methodology to ensure correct capture of data to meet the primary objectives of the project. The pilot was completed prior to the main survey roll-out in June 2011.

Testing and Fine Tuning

The pilot survey data was processed through the prototype survey template, and the transfer of information to the database was reviewed. Some minor adjustments were made to cost formulas and points allocation against priority ratings prior to finalisation of the template and methodology.

Client Sign-off

A report detailing findings and recommending proceeding with the main survey was issued to the Ministry in May 2011.

3. Implementation

Implementation required commencement of the main survey of 6,108 buildings (excluding the 22 from the pilot) in an eight-month period, which was approximated to equate to 764 buildings per month.

Programming and Administration

In reality the number of buildings surveyed per month fluctuated as they were impacted by events including school holidays and staff leave or illness. These factors were accounted for in programming, to take account of known impacts such as school holidays and allow contingency for variable issues such as illness. Route planning to ensure efficiency was also a key consideration.

Schools were advised by letter from the Ministry of the planned visit and provided with a list of buildings requiring survey. The schools were subsequently contacted by the project administrator (Figure 70) to advise on a firm date and to obtain an up-to-date copy of the schools' site plan.

Conducting of Surveys

The following methodology was adopted by building surveyors when visiting a school site:

Consult	• Discuss the building history with the Principal/building manager and check against PMIS data already received
Inspect	• Undertake a visual inspection of the building exterior in accordance with the confirmed assesment methodology
Measure	• Measure the gross floor area of the post 1994 building
Record	• Take photographs of the building and record the gathered measurement and inspection data in the survey template • Save and upload to database

4. Integrity

The integrity of the survey process was dealt with in a number of ways.

Red Flag

A red flag option was provided on the survey assessment template for surveyors to tick to flag any concerns regarding the outcome of any assessment or to draw special attention to a certain building (e.g. a health and safety matter). These red flag surveys could then be easily identified in the database for review by the Project Manager or Project Director.

Quality Assurance Checking

Completed surveys were uploaded by building surveyors to the central database and held in a pending surveys list. Upon return to the office the same building surveyor who undertook the survey completed a Quality Assurance (QA) review to ensure correct transfer of information, completeness and integrity of data. Upon completion the surveyor would categorise as QA approved and the survey data would be transferred to a QA approved list. Preliminary statistical outputs regarding priority ratings and repair costs came from this list for progress reporting purposes.

Quality assurance was also delivered through in-house workshops for the project team lead by the Project Manager and/or Project Director and by communication via updates on the database intranet site and the surveyors handbook referred to at page 63.

Back-up

Survey data was backed up every 20 minutes to an offsite database server to allow immediate recovery. Encrypted transmissions with user and password log–ins were implemented.

Audit

Prior to final reporting, all data gathered against buildings was subject to audit to assess for completeness. Approximately 10% of surveys were subject to a detailed audit review by a senior member of the project management team to check for correct methodology and data integrity[36].

Prior to final data analysis a sanity check was undertaken of remedial re-cladding and re-roofing rates against actual recent concept estimated and tendered Ministry building repair projects. The analysis was compiled using the survey repair estimated costs for 15 buildings with a total value of $8,550,700, against the actual estimated and tendered value of $8,150,000, providing an approximate difference of +5% in favour of the survey estimates. Cost fluctuation was more pronounced on an individual building basis as anticipated and as such an accurate cost on a building-by-building basis should not be expected.

[36] This process was carried out concurrently as the surveys progressed.

Peer Review

In addition to the internal audit process an external peer review process was undertaken by a separate consultant in accordance with the following:

• Observe and audit the surveying of 100 buildings.

Region	Number of buildings
Upper North Island	15
Central North Island	25
Lower North Island	30
Upper South Island	20
Lower South Island	10

Figure 71: Peer review locations and building numbers

• Review 100 completed checklists.

• Peer review the central database, with remediation rates applied.

• Peer review of the final report.

5. Reporting

Reporting methodology is as follows.

Progress Reporting

During the surveying process, monthly reporting was provided to the Ministry to confirm the number of schools and buildings surveyed to date, priority ratings and estimated repair costs.

Consultation

Several workshops were conducted with the Ministry and the consultant project team to agree reporting objectives and scope for the interim and the final report.

Data Analysis

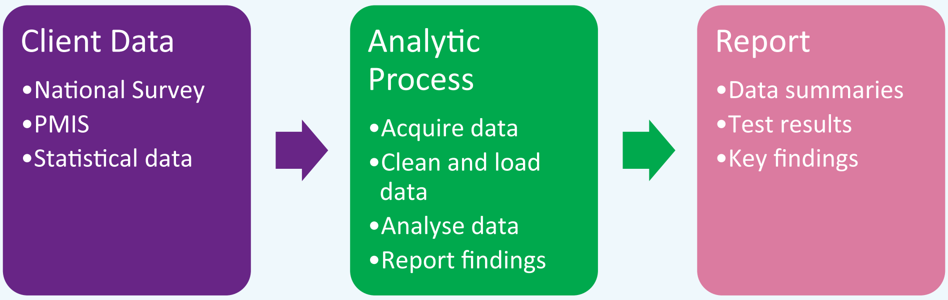
Data analysis and modelling was completed by KPMG for the Ministry under the direction of Hampton Jones.

KPMG has brought together the data anatomy relevant to the analysis of buildings within the National Survey and created a number of analyses:

- Descriptive summaries by various categories and analysis variables (For example: Estimated Repair Cost by Region).
- Segmentation: Statistically segment completed building assessments in the National Survey. (Using a progressive set of techniques which include Self Organised Map (SOM), Discussion Tree and Clustering)[38].
- Profiles: A descriptive understanding of the statistical segmentation.
- Geospatial: Analysis variables mapped to region.

Methodology

The following broad approach was adopted for the data analysis.



National Survey Data

The analysis and modelling was conducted on an analytic dataset created from source files received from the Ministry, Hampton Jones and external sources.

[38] Each technique builds a deeper understanding of the optimum segmentation.

Building Analytic Dataset

Outlined below are the data assets used as a source for all analyses.

Dataset	Source	Current
National Survey	Hampton Jones/Kinetics	04/10/2011
PMIS	Ministry	14/09/2011
Population Statistics	Statistics NZ	04/10/2011
Weather Data	Met service/NIWA	04/10/2011

Figure 72: Analytic dataset

Certainty of Results

Analysis and modelling have relied on the data above for insights used within the findings section. While all data sources have been through respective quality assurance processes, there is still the possibility of an error resulting from data quality. Through the analysis, results have also been through a quality assurance process and any abnormal metric investigated, ratified and/or corrected.

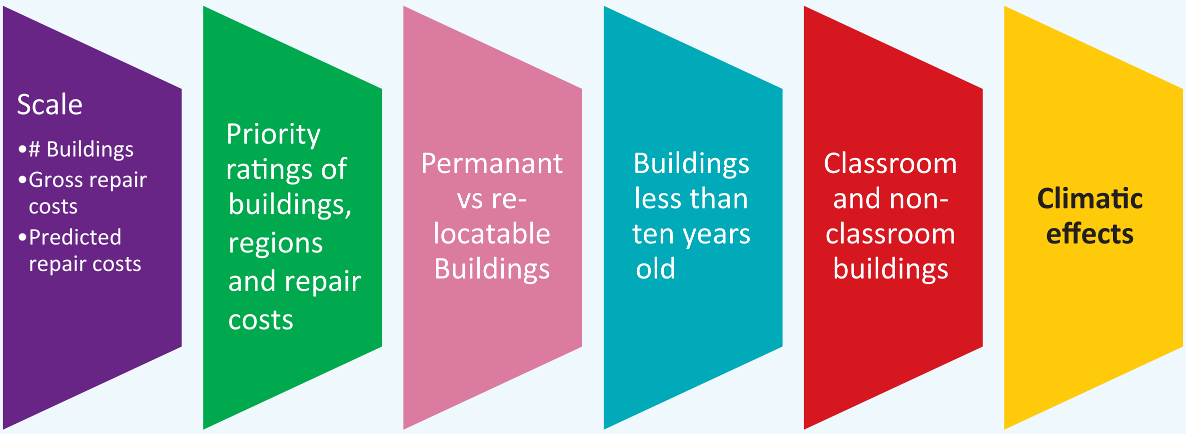
Interim Report

An interim report was compiled and issued in November 2011 upon completion of approximately 80% of the required building surveys. The purpose of the report was to provide the Ministry with an update on the current findings and an extrapolation of the likely final costs. The interim report was intended as a foundation document for the final report.

Final Report

The final report brings together the information and data analysis from the National Survey and a number of other sources to provide a comprehensive analysis.

The analysis and reporting has focused on the following key areas:



Appendix C – Limitations and Qualifications

1. This report has been prepared by Hampton Jones Property Consultancy Limited (Hampton Jones) for the Ministry of Education (the Ministry) to assist in developing a prioritised remediation programme to address weathertightness issues in state schools.
2. The report is provided in accordance with the "Agreement for Schools (Defective Buildings) Survey" signed on 17 May 2011
3. In preparing this report, Hampton Jones have relied upon, and assumed the accuracy and completeness of all information available to us from; persons we have directly consulted with, public sources or that provided directly to us by the Ministry.
4. Hampton Jones contracted KPMG to assist with qualitative and quantitative analysis of the procured data and to provide a supporting data-set of information in a supplementary workbook. Hampton Jones has evaluated that information but have not sought to verify the accuracy or completeness of the information or sought to have the information independently verified.
5. The information provided in this report is for the Ministry of Education only and Hampton Jones accept no responsibility or liability to third parties seeking to rely on its content unless prior permission is expressly granted, in writing by Hampton Jones.
6. Hampton Jones accept no responsibility for any reliance that may be placed on our report should it be used for any purpose other than that for which it is prepared.
7. This report must be read in its entirety. Individual sections of this report could be misleading if considered in isolation from each other.
8. This report has been prepared in good faith on the basis that all relevant information relied upon is true and accurate in all material aspects and not misleading by reason of omission or otherwise. Accordingly, Hampton Jones, its partners, employees or agents, accept no responsibility or liability for any such information being inaccurate, incomplete, unreliable or not soundly based.
9. We reserve the right, to revise or amend our report if any additional information becomes available which exists on the date of our report, but was not drawn to our attention during its preparation.
10. The report is based on a high-level review based on visual inspections. No destructive testing or internal inspections of concealed spaces have been undertaken to verify building conditions.
11. The gross floor area (GFA) repair rate estimate is a generic approach designed to be applied to the 6,130 buildings to provide an average cost. As such the repair costs attributed to individual buildings should not be relied upon as accurate.
12. Repair costs exclude allowances for alternative accommodation, disposal of re-locatable buildings, destructive testing, internal Ministry costs, legal fees and similar expenses not specifically identified.
13. GST is excluded.
14. It is assumed that all the buildings in the Low/Medium, Medium/High and High priority categories would potentially require re-cladding at some stage in the future to meet the 50-year structural durability requirement under the Building Code.
15. Buildings in the Low category are not anticipated to require re-cladding during their life.
16. Priority rating identifies which buildings should be prioritised for follow up invasive weathertightness investigation to confirm building weathertightness integrity and the need for repairs but also identify which buildings are most likely to fail (risk profiling).
17. Buildings in the High priority category are not confirmed as leaking buildings but rather buildings that are most likely to be at risk from weathertightness failure.
18. With regard to High priority rated buildings, the repair costs allow for full re-cladding and full re-roofing as a default outcome. This is because, in the experience of Hampton Jones, the types of buildings in this category often have roofs that are prone to leaking or already leak, or represent an unreasonable level of risk and require significant design rationalisation that often results in full roof replacement.
19. The survey includes buildings constructed after 1994 and includes additions to existing older buildings. Modifications to older buildings (e.g. older buildings that have been re-roofed) are not included.
20. Costs estimates are based on 2011 prices and no allowance has been made for future cost fluctuation or regional variations.
21. High level repair cost estimates are generally rounded to the nearest million dollars unless otherwise stated.
22. There is no specific time frame associated with priority ratings, because without physical testing it is not possible to determine any level of certainty or severity.
23. The criteria for post-1994 re-locatable buildings was taken from the date they were placed on the site, on the assumption that a building consent was required and the Building Code requirements of the time would apply. Many re-locatable buildings were in fact found to have been pre-fabricated much earlier.
24. Repair estimates are for weathertightness repairs only and do not take into account other potential works relating to; seismic upgrading, infrastructure or sub-structure works, specialist services or finishes or any other non-compliant building works not related to weathertightness.

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