aurecon

Bringing ideas to life

Homestar v5 Review

6 Homestar Specification

NZGBC

Reference: 522113

Revision: 5

2023-02-22

Document control record

Document prepared by:

Aurecon New Zealand Limited
Level 3, Air New Zealand Building
185 Fanshawe Street,
Wynyard Quarter 1010
PO Box 9762
Newmarket Auckland 1149
New Zealand

T +64 9 520 6019
E auckland@aurecongroup.com
W aurecongroup.com

A person using Aurecon documents or data accepts the risk of:

a) Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version.

b) Using the documents or data for any purpose not agreed to in writing by Aurecon.

Document control						
Report title	6 Homestar Specification					
Document code	522113-REP-BU-002		**Project number**		522113	
File path	Document1					
Client	NZGBC					
Client contact	Matthew Cutler Welsh		**Client reference**			
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
1	2022-08-30	Rev1	DW	KW		
2	2022-09-20	Rev2	DW	KW		
4	2022-12-20	Rev4	DW	KW		
5	2023-02-22	Rev5	DW	KW		
Current revision	**5**					

Approval			
Author signature		Approver signature	
Name	Dani Wijekoon	Name	Karl Wakelin
Title	Lead - Sustainability	Title	Associate - Sustainability

Contents

Appendices

Figures

Tables

Report prepared for

New Zealand Green Building Council – Te Kaunihera Hanganga TauTaiao

Costing by

Kwanto™

the how-much experts

1 Homestar Specification Review

1.1 Introduction

New Zealand Green Building Council (NZGBC) has engaged Aurecon to review the typical specifications required to achieve a 6 Homestar v5 rating and how this compares with specifications required to achieve NZ Building code (NZBC) Clause H1 compliance. The key metrics reviewed in this study are:

1. Improvements needed to move an H1 compliant design to meet 6 Homestar mandatory minimums in EF4 Energy Use , HC1 Winter Comfort and HC2 Summer Comfort.
2. The potential cost premium of building a 6 Homestar home compared to a similar design achieving only code compliance.

Clause H1 Fifth Edition AS1 is the current standard that dwellings must meet to satisfy building code requirements.

Due to the significant increase in overall insulation requirements compared to the previous edition of H1, minimum glazing R-values in AS1 are being increased via several intermediate stages from 3 November 2022 through to 3 November 2023 when it will take its final form. This has resulted in several sub-versions of the Fifth Edition.

This document focuses only on the final form of H1 Fifth Edition as it will be from 3 November 2023 (and 6 Homestar compliance). All references herein to H1 refers solely to this version unless specifically stated otherwise. The minimum schedule method R-values for H1 Fifth Edition for residential buildings are as follows (H1/AS1):

Table 1 H1 Fifth Edition R-value requirements (H1/AS1)

Climate Zone	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**
Roof/ Ceiling	6.6					
Wall	2					
Windows and Doors	0.46	0.46	0.46	0.46	0.5	0.5
Slab Floor	1.5	1.5	1.5	1.5	1.6	1.7
Other Floor Types	2.5	2.5	2.5	2.8	3	3

6 Homestar mandatory minimums for thermal performance in Homestar v5 are expressed as overall energy input and heating demand thresholds (in kWh/m^2 of conditioned floor area per year) as follows, as well as requiring the percentage of hours in the year when ambient temperature within the dwelling exceeds 25°C to be under 7% :

Table 2 6 Homestar Thermal Performance Thresholds

Climate Zone	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**
Space Heating Demand (kWh/m^2/yr)	40	50	60	70	80	90
Overall Input Energy (kWh/m^2/yr)	52	59	65	71	78	84

Note, that due to common building practices such as packing extra studs around corners and junctions, the timber ratios can be higher than expected. Studies by BRANZ have shown typical constructions contain 30-

34% timber fraction in walls, rather than around 20% as commonly assumed. Simplified calculations required for code compliance do not account for the additional thermal bridging at corners and joints, thus overestimating the thermal performance of the actual built thermal envelope.

For Homestar, a 30% timber fraction must be assumed unless steps are taken to reduce stud packing in corners. In this review, Aurecon considers both the H1 and Homestar designs to have a 30% timber fraction in walls, and 15% in ceilings to reflect reality. Reducing unnecessary timber framing elements are one of the most cost-effective ways to improve thermal performance, and may allow thermal performance thresholds to be met with less insulation elsewhere.

With the updates to Clause H1, new climate zones have been introduced (please see Appendix A), which are identical to Homestar v5 climate zones. This review considers specifications required to achieve required performance levels in four specific, representative locations, and the results are shown by these locations and not climate zones. The considered locations are:

- Auckland (Climate Zone 1)
- Wellington (Climate Zone 3)
- Christchurch (Climate Zone 5)
- Queenstown (Climate Zone 6)

Disclaimer:

As unique designs were reviewed in four locations, and as orientations were not varied in each location, this study cannot be considered exhaustive, or representative of all possible scenarios. It is only indicative, using two real world, reasonably representative home designs to provide an understanding of the likely improvements that may be needed and the likely ballpark cost premium of building a 6 Homestar home versus a minimum code compliant home. There are multiple variables at play in determining cost including supply issues, labour cost, features prioritised and the degree to which a specific design was optimised, and projects are not guaranteed to stay within the estimated costs presented in this report. Aurecon, Kwanto and NZGBC are not responsible where costs in a particular project differ to that shown in this report.

1.2 Home Designs

For this specification review two home plans were provided by NZGBC.

1.2.1 2 Bed Terrace

This is an end unit of a five-unit terrace. Given the larger external wall area present (compared to the middle unit), it is considered the worst case in terms of thermal performance and therefore likely to require the most insulation. The entire downstairs is a combined living – kitchen – dining area with two bedrooms and a central bathroom on the upper floor. This type of housing is typical of urban infill and regeneration projects as well as social housing.

Figure 1 2 Bed Terrace

The base design is assumed to be typical as follows:

- Concrete waffle slab floor (Firth Ribraft or similar)
- 90mm timber frame with studs at 400mm centres and dwangs at 800mm centres on both floors, with brick veneer cladding
- Intertenancy walls consisting of Metrapanel 130mm IT wall system
- Long run steel clad, pitched truss roof with 180mmm rafters at 900mm centres over flat ceiling
- 10mm Gib Plasterboard to interior wall and ceiling lining (Aqualine to wet areas and standard elsewhere)
- Internal doors MDF skin with solid core (Hume Doors 1980 x 760 x 35mm PCMSOL760 or similar); external doors solid with hardboard skin (Hume Doors 1980 x 810 x 40mm Ultimo XU2 or similar)
- Vinyl flooring for kitchen/dining area, entrance, upstairs bathroom and laundry; carpet elsewhere
- Insulation and glazing to meet H1 fourth edition minimums (hence requiring upgrade to meet current H1)

1.2.2 4 Bed Standalone

This is a single level, standalone family home with a large living area typical of current suburban and rural housing trends.

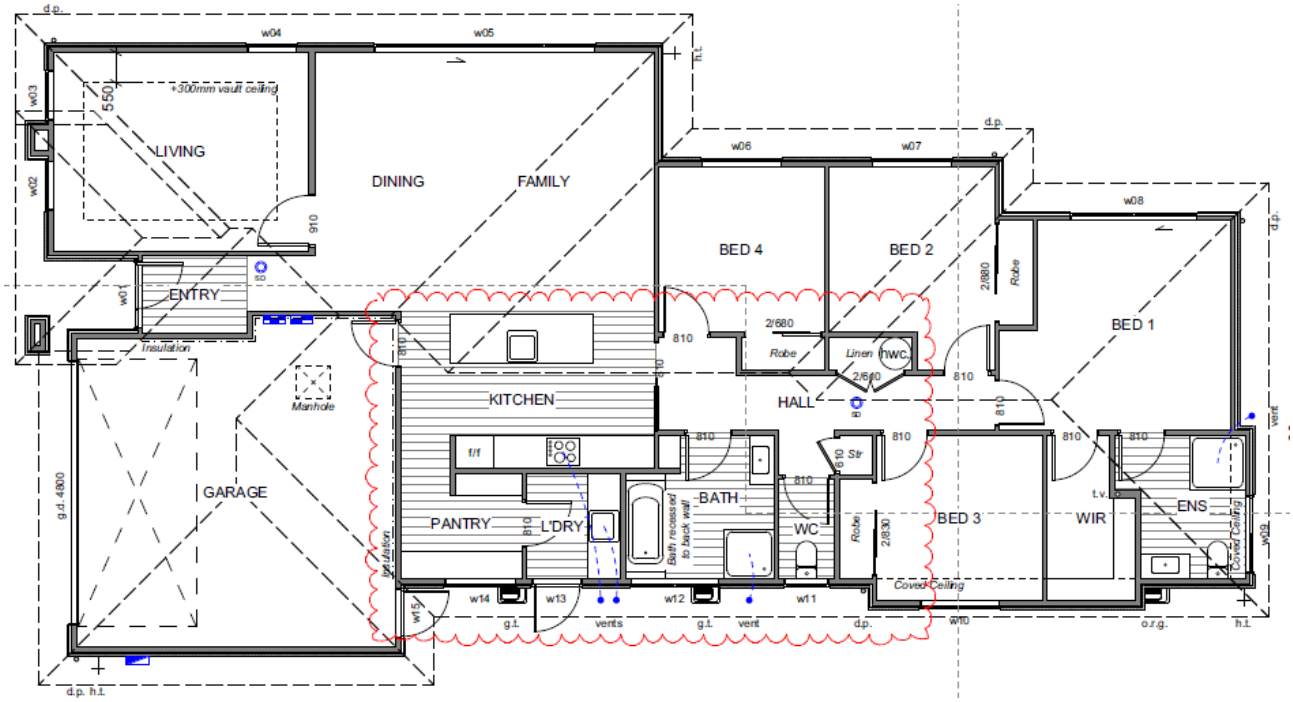


Figure 2 4 Bed Standalone

The house includes a large unconditioned garage, an open plan kitchen – dining – family area, a separate living area and multiple bathrooms as well as the four bedrooms. Living and bedroom areas include significant glazing which would help achieve points in the Homestar HC5 Natural Light credit but reduce thermal performance and increase the likelihood of overheating (without sufficient shading, ventilation, and orientation of glazing away from the West). While the actual construction of this specific house is non-standard (being a Passive House), we have assumed the base design as follows:

- Concrete waffle slab floor (Firth Ribraft or similar)
- 90mm frame wall with studs at 600mm centres and dwangs at 800mm centres, with shiplap weatherboard cladding
- Long run steel clad, pitched truss roof with 180mmm rafters at 900mm centres over flat ceiling
- 10mm GIB Plasterboard to interior wall and ceiling lining (Aqualine to wet areas and standard elsewhere)
- Internal doors MDF skin with solid core (Hume Doors 1980 x 760 x 35mm PCMSOL760 or similar); external doors solid with hardboard skin (Hume Doors 1980 x 810 x 40mm Ultimo XU2 or similar)
- Vinyl flooring to kitchen, bathrooms/toilet and entrance way; carpet elsewhere
- Insulation and glazing to meet H1 fourth edition minimums (hence requiring upgrade to meet current H1)

1.3 Specification Review methodology

The first stage of this review is to establish the H1 compliant specification for the two representative designs, and the improvement it requires to achieve 6 Homestar. H1 compliance is demonstrated through modelling as per H1/VM1. This specification will then be priced by a quantity surveyor (by NZGBC) to establish the likely cost uplift of achieving 6 Homestar.

The NZGBC ECCHO (Energy and Carbon Calculator for Homes) tool was used as the primary method of assessment for heating, overheating and energy performance given its use for Homestar and acceptance for H1/VM1. The Homestar calculator and the Homestar v5.02 Technical Manual were used to establish the rest of the specification and eligible points.

1.4 Estimated Cost

Quantity Surveyors Kwanto were engaged by NZGBC to estimate the construction cost of the specifications developed by Aurecon. The listed below exclude the following

- costs excluding GST,
- costs of purchasing lands,
- regulatory costs or
- fees associated with Homestar assessments

Table 3 Estimated Construction Cost of Specification

Plan	Location	Estimated Cost (H1)	Estimated Cost (6 Homestar)	Cost uptick (for 6 Homestar)	% Uptick
4 Bed Standalone	Auckland	$ 1,127,936	$ 1,133,407	$ 5,471	0.5%
	Wellington	$ 1,135,431	$ 1,140,766	$ 5,335	0.5%
	Christchurch	$ 1,163,346	$ 1,178,796	$ 15,450	1.3%
	Queenstown	$ 1,164,834	$ 1,166,511	$ 1,677	0.1%
2 Bed Terrace	Auckland	$ 508,626	$ 510,315	$ 1,689	0.3%
	Wellington	$ 511,598	$ 511,598	-	0.0%
	Christchurch	$ 522,311	$ 522,311	-	0.0%
	Queenstown	$ 529,749	$ 529,879	$ 130	0.02%

Please refer to Appendix E for a full breakdown of quantities for the 2-bed terrace design and Appendix F for a full breakdown of quantities for the 4-bed standalone design.

The costing data provided by Kwanto shows that the expected cost premium for building to a Homestar 6 Standard is no more than 1.3% above building to achieve minimum compliance under NZ Building Code Clause H1 Fifth edition in its final form as of November 2023. The data also shows that variance in cost can be expected based on location and type of the dwelling.

H1 compliance as well as a 6 Homestar Standard is achieved through the combined performance of multiple elements of a dwelling (in the case of Homestar, this goes beyond the thermal envelope). Therefore, the specification presented in this report is not the only way to achieve either threshold. Costs will also vary greatly depending on material and labour shortages, and inflation. The resulting general increase in the cost of construction may play some part in reducing the cost difference between minimum level and higher performing designs compared to what it would've been previously. The increasing adoption and resulting cost reduction of better performing building elements such as thermally broken glazing adds a further layer of complexity that impacts the premium of higher standards.

Ultimately, when faced with increasing capital costs, taking a total life approach to measuring costs/value is more prudent, than focusing only on minimising capital costs to realise minor savings while baking in additional operational costs, infrastructure burden and carbon impact over a 50 – 90 year average life of a home. However, total life costing is beyond the scope of this study.

While Aurecon has made a fair attempt to select a 6 Homestar specification requiring minimal further additions beyond H1 compliance, no claim is made that the lowest pathway is selected for every scenario. Hence, the results presented in this report should only be considered as an indication.

2 6 Homestar Specification

2.1 H1 and Homestar

The first goal of this review was to establish improvements required to move the two assessed designs from meeting H1 to achieving 6 Homestar mandatory minimums in EF4 Energy Use , HC1 Winter Comfort, and HC2 Summer Comfort.

All Homestar v5 ratings must have the following specific features that aren't strictly compulsory to meet building code:

- All glazing (windows, doors and skylights) must be in thermally broken framing)
- Slab floors must be edge insulated to levels specified in the HC4 Moisture Control credit
- Continuous mechanical extract is mandatory for a 6 Homestar rating, with balanced mechanical ventilation required at higher levels

For most locations, H1 complaint specifications for both designs required only minor improvements to reach 6 Homestar minimums beyond these mandatory features; typically, in the form of increased ceiling insulation or added wall /ceiling linings. Wellington and Christchurch 2 – Bed designs didn't require any further improvements to the thermal envelope as both edge insulation and thermally broken glazing was required to achieve H1.

Please refer to Table 5 through to Table 12 for the features required for each design at each location to achieve H1 (left column), and further improvements needed to meet 6 Homestar mandatory minimums in EF4, HC1, and HC2 (right column).

Given the comparative cost of various upgrades the following hierarchy was used as a pragmatic approach when identifying which element to upgrade to reach required performance:

- Ceiling construction R-value (limited by ceiling space).
- Wall cavity insulation, supported by additional linings where required, keeping to 90mm frame (max R2.8 cavity insulation).
- Thermally broken glazing (mandatory for Homestar, not mandatory for H1; and is expensive but getting cheaper) and low-e glazing with improved collar gain performance.
- Slab edge insulation (mandatory for Homestar, not mandatory for H1, generally unpopular due to implications for programme and potential to be damaged during works)
- Adding a 45-70mm service cavity (Will have implications for space availability, labour, co-ordination, and cost)
- Increasing to 140mm framing (last resort given cost and implications to available space as well as potentially significant programme impacts due to material availability).

In almost all locations, both designs performed better in cooling energy than the H1 reference building, while being slightly worse in heating energy. Once overheating was reduced to an extent through shading, glazing levels and ventilation, there were diminishing returns from further improvements to reduce heat gain. For 2 – Bed designs outside of Auckland, thermally broken glazing was prioritised over low-e non-thermally broken glazing to meet H1 because of this, as non-thermally broken low-e glazing (reducing heat gain) gave an overall worse result than clear thermally broken glazing (reducing heat loss).

Smaller terrace dwellings like the 2 – Bed case are generally thought to perform better from a heating perspective while being more susceptible to overheating. However, this can be mitigated by good design and orientation, and it may be the case for the designs used in this study, given that multiple orientations were not tested for each design.

2.2 ECCHO/Homestar Mandatory Minimums

ECCHO Calculations were carried out to firstly test the insulation specification required to achieve clause H1, and secondly to establish required specification improvements to achieve 6 Homestar mandatory minimums, including;

- EF4 Energy Use,
- HC1 Winter Comfort,
- HC2 Summer Comfort,
- HC3 Ventilation (continuous extract ventilation)
- HC4 Moisture Control – Minimising Condensation on Internal Surfaces (edge insulation on concrete floors).

2.2.1 Thermal and Energy Performance Results

ECCHO modelling provided the following results for each climate zone for the 6 Homestar specification outlined in this document:

Table 4 Energy and thermal performance points achieved

Location		EF4	HC1	HC2
Auckland	2 Bed	13	19	6
	4 Bed	13	15	6
Wellington	2 Bed	13	17	6
	4 Bed	12	15	6
Christchurch	2 Bed	13	16	6
	4 Bed	12	15	6
Queenstown	2 Bed	13	17	6
	4 Bed	12	15	6

To meet 6 Homestar mandatory minimums for HC3, the Homestar specification for both designs include a continuous extract ventilation system.

Similarly, edge insulation is specified to meet HC4 minimum requirements, even though ECCHO modelling showed that they weren't always required for all locations to achieve thermal performance minimums.

2.2.2 Insulation and glazing

Wall, floor and roof/ceiling insulation and glazing types required for H1 and any further improvements on top of this required to meet 6 Homestar minimums are outlined by design and location in the tables below. Where a change to the amount of glazing or shading was required, this has been indicated. Glazing only

includes windows and doors, as neither design include skylights. All thermal performance values are represented as R values in m^2k/W (units not shown in tables for clarity).

Table 5 Auckland – 2 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord (15% timber fraction) and 10mm plasterboard, R4 insulation layer on top.	None.
Wall	3mm Building paper, R2.6 wall insulation, 10mm plasterboard. 30% timber fraction assumed	None
Glazing	low-e double glazing with Argon fill (U_g = 1.9W/mk), non-thermally broken Aluminium frame	Thermally broken glazing is a minimum requirement for any Homestar rating for condensation prevention.as Clear double glazing (U_g = 2.63) in thermally broken Aluminium frame is sufficient for required thermal performance.
Floor	**Slab**: Raft slab with 50mm EPS (S grade) R1.6 insulation cover underneath. Some edge insulation required (20mm XPS) **Soffit:** Kooltherm soffit K10 board 40mm, 10mm plasterboard underneath (R2)	None

Table 6 Auckland – 4 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R6 Insulation in between truss bottom chord (15% timber fraction), 10mm plasterboard	R3.6 Insulation in between truss bottom chord (15% timber fraction) and 10mm plasterboard, R4 insulation layer on top.
Wall	3mm Building paper, R2.6 wall insulation, 10mm plasterboard. 30% timber fraction assumed	None
Glazing	Clear double glazing (U_g = 2.63W/mk), Thermally broken Aluminium frame	Low – e double glazing with Argon fill (U_g = 1.3W/mk), thermally broken Aluminium frame
Floor	Raft slab with 50mm EPS (S grade) R1.6 insulation cover underneath.	Add 20 mm XPS edge insulation (required for HC4)

Table 7 Wellington – 2 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R6 Insulation in between truss bottom chord (15% timber fraction), 13mm plasterboard	None
Wall	3mm Building paper, R2.6 wall insulation, 13mm plasterboard. 30% timber fraction assumed	None
Glazing	Clear double glazing (U_g = 2.63W/mk), thermally broken Aluminium frame.	None
Floor	**Slab**: Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath, 30mm XPS edge insulation **Sofit:** Kooltherm soffit K10 board 40mm, 10mm plasterboard underneath (R2)	None

Table 8 Wellington – 4 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord (15% timber fraction) and 10mm plasterboard, R4 insulation layer on top.	R3.6 Insulation in between truss bottom chord (15% timber fraction) and 10mm plasterboard, upgrade to R5 insulation layer on top.
Wall	3mm Building paper, R2.6 wall insulation, 13mm plasterboard. 30% timber fraction assumed	None
Glazing	Clear double glazing (U_g = 2.63W/mk), in thermally broken Aluminium frame.	Low – e double glazing with Argon fill (U_g = 1.3W/mk), thermally broken Aluminium frame
Floor	Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath	Add 30mm XPS edge insulation

Table 9 Christchurch – 2 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord(15% timber fraction), R4 insulation layer on top, 13mm plasterboard	None
Wall	6mm Ply, R2.6 wall insulation, 13mm plasterboard. 30% timber fraction assumed	None
Glazing	Clear double glazing (U_g = 2.63 W/mk), thermally broken Aluminium frame	None
Floor	**Slab**: Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath, 30mm XPS edge insulation **Sofit:** Kooltherm soffit K10 board 40mm, 10mm plasterboard underneath (R2)	None

Table 10 Christchurch – 4 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord(15% timber fraction), R4 insulation layer on top, 13mm plasterboard	R3.6 Insulation in between truss bottom chord(15% timber fraction), over 13mm plasterboard, upgrade to R5 insulation layer on top
Wall	6mm Ply, R2.6 wall insulation, 13mm plasterboard. 30% timber fraction assumed	12mm Ply, R2.8 wall insulation, two layers of 13mm plasterboard. 30% timber fraction assumed
Glazing	Low – e double glazing with Argon (U_g = 1.9W/mk) fil, thermally broken Aluminium frame	Low – e double glazing with Argon (U_g = 1.3W/mk) fil, thermally broken Aluminium frame
Floor	Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath	Add 30mm XPS edge insulation

Table 11 Queenstown – 2 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord(15% timber fraction), R4 insulation layer on top, two layers of 13mm plasterboard	None
Wall	12mm Ply, R2.8 wall insulation, two layers of 13mm plasterboard. 30% timber fraction assumed	None
Glazing	Clear double glazing (U_g = 2.63 W/mk), thermally broken Aluminium frame	None
Floor	**Slab**: Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath, 30mm XPS edge insulation **Sofit:** Kooltherm soffit K10 board 40mm, 10mm plasterboard underneath (R2)	Edge insulation to be increased to 40mm XPS or 50mm EPS to meet HC4 Homestar mandatory minimum R1.25.

Table 12 Queenstown – 4 Bed

Element	H1 Compliance requirement	Further improvement for 6 Homestar
Roof/Ceiling	R3.6 Insulation in between truss bottom chord(15% timber fraction), R4 insulation layer on top, 13mm plasterboard	None
Wall	12mm Ply, R2.2 wall insulation, 13mm plasterboard. 30% timber fraction assumed	None
Glazing	Low – e double glazing with Argon (U_g = 1.9W/mk) fil, thermally broken Aluminium frame	None
Floor	Raft slab with 95mm EPS (H grade) R2.8 insulation cover underneath, no edge insulation	Edge insulation to be 40mm XPS or 50mm EPS to meet HC4 Homestar mandatory minimum R1.25

2.2.3 Ventilation

Since only Homestar 6 is desired, both designs were assumed to be ventilated via a combination of openable windows and continuous exhaust ventilation (kitchen and bathroom) in all climate zones.

Table 13 Passive ventilation openings

Location		Window orientation 1	Window orientation 2
Auckland	2 Bed	7.4m x 0.1m	4m x 0.1m
	4 Bed	6.41m x 0.1m	3.98m x 0.1m
Wellington	2 Bed	7.4m x 0.1m	4m x 0.1m
	4 Bed	6.41m x 0.1m	3.98m x 0.1m
Christchurch	2 Bed	7.4m x 0.1m	4m x 0.1m
	4 Bed	6.41m x 0.1m	3.98m x 0.1m
Queenstown	2 Bed	7.4m x 0.1m	4m x 0.1m
	4 Bed	6.41m x 0.1m	3.98m x 0.1m

- Mechanical ventilation through system such as Vent-Axia Multivent system (single system for 2-bed, two for 4-bed) that includes a boost function for when the shower or kitchen hob is being used.
- It is assumed that a Manrose Puro Filtered Passive Vent Kit or similar is used to top up make-up air from opened windows
- Total leakage rate is 5 air changes per hour at 50 Pa.

2.2.4 Thermal Bridging

The BRANZ/PHINZ High Performance Construction Details (HPCD) Handbook was used to select the most appropriate corner construction, fRsi values and Psi value.

Slab to wall junction

- For both H1 and 6 Homestar compliant versions, the wall to floor junctions Psi values are assumed as follows where edge insulation is provided (0.571W/m.K where not included)

Table 14 Wall to slab junction assumed Psi values (from BRANZ/PHINZ HPCD Handbook), detail reference shown

Location		Ground perimeter thermal bridge Psi value (W/m.K)
Auckland	2 Bed	0.268 (90mm frame on waffle pod slab, current practice edge insulation, 20mm frame overhang) – HPCD detail 28
	4 Bed	0.268 (90mm frame on waffle pod slab, current practice edge insulation, 20mm frame overhang) – HPCD detail 28
Wellington	2 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HPCD detail 37
	4 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HCPD detail 37
Christchurch	2 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HPCD detail 37
	4 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HPCD detail 37
Queenstown	2 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HPCD detail 37
	4 Bed	0.143 (90mm frame on waffle pod slab, 30mm edge insulation) – HPCD detail 37

Roof to wall junction

- Not specially defined (not mandatory to be used for ECCHO).

External wall corners and internal wall/external wall junctions

- Not specially defined (not mandatory to be used for ECCHO). It was assumed that 30% timber fraction will be achieved as expected of current standard practice; this is reflected in the wall R-values

2.3 Remaining Credit Specifications to achieve 6 Homestar

Performance specifications for both homes were kept largely similar for water fixture efficiency, materials and their credentials, amenities and other features provided. Aside from this, the size and nature of the home dictated a difference. For an example, a bath and a larger washing machine has been allowed for within the 4-bed home given this is more likely to be a family home with children.

Urban Density or daylight points were not claimed for either home as these were not required. However, if a bigger points buffer is required, they can be investigated.

2.3.1 Resource Efficiency (EF1)

These points are achieved by virtue of building footprint and floor area , and there should not be an additional cost impact between the same footprint at a code minimum specification.

Table 15 Resource Efficiency points

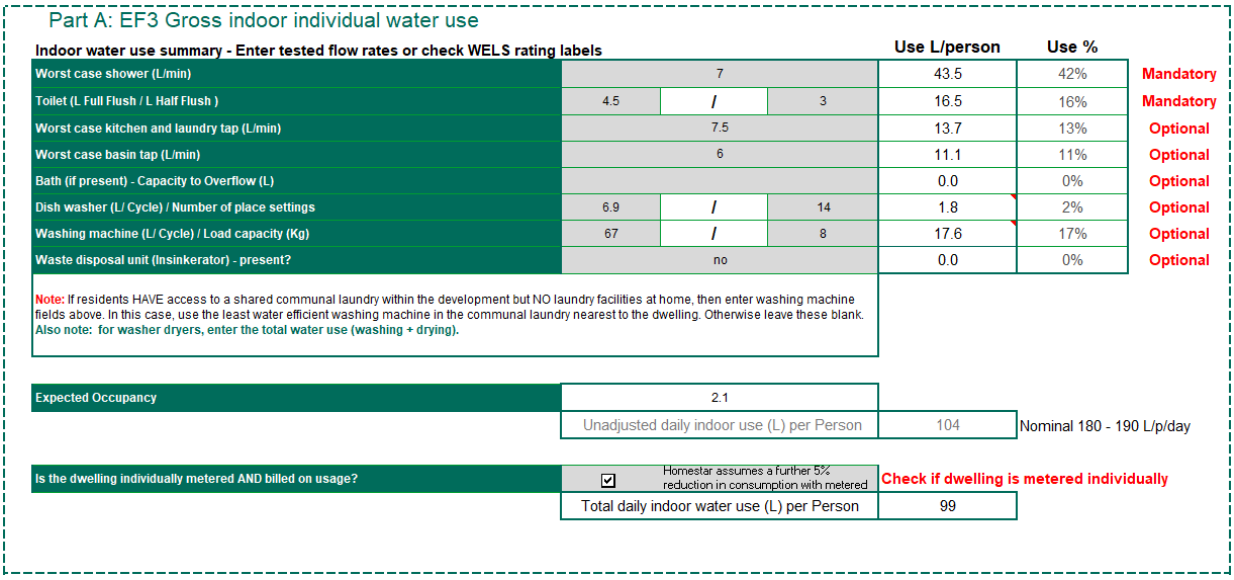
Design	**Conditioned Floor Area**	**EF1 Points**
2 Bed Terrace	86.12m^2	2.5
4 Bed Standalone	148.7m^2	2

2.3.2 Water (EF3)

Neither house is claiming points for stormwater detention or rainwater harvesting.

Table 16 Indoor water use points

Design	**Daily per person Water use**	**EF3 Points**
2 Bed Terrace	111 L/person/day	2.5
4 Bed Standalone	148.7m^2	2



Part A: EF3 Gross indoor individual water use

Indoor water use summary - Enter tested flow rates or check WELS rating labels				Use L/person	Use %	
Worst case shower (L/min)	7			43.5	42%	Mandatory
Toilet (L Full Flush / L Half Flush)	4.5	/	3	16.5	16%	Mandatory
Worst case kitchen and laundry tap (L/min)	7.5			13.7	13%	Optional
Worst case basin tap (L/min)	6			11.1	11%	Optional
Bath (if present) - Capacity to Overflow (L)				0.0	0%	Optional
Dish washer (L/ Cycle) / Number of place settings	6.9	/	14	1.8	2%	Optional
Washing machine (L/ Cycle) / Load capacity (Kg)	67	/	8	17.6	17%	Optional
Waste disposal unit (Insinkerator) - present?	no			0.0	0%	Optional

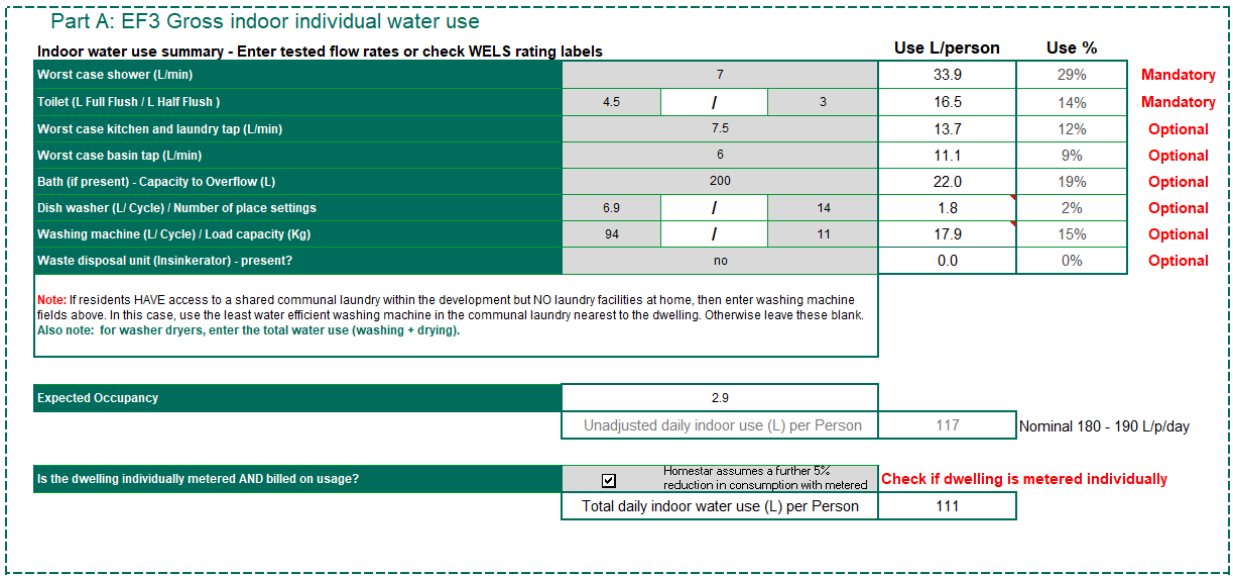
Note: If residents HAVE access to a shared communal laundry within the development but NO laundry facilities at home, then enter washing machine fields above. In this case, use the least water efficient washing machine in the communal laundry nearest to the dwelling. Otherwise leave these blank.
Also note: for washer dryers, enter the total water use (washing + drying).

Expected Occupancy	2.1		
	Unadjusted daily indoor use (L) per Person	104	Nominal 180 - 190 L/p/day
Is the dwelling individually metered AND billed on usage?	☑ Homestar assumes a further 5% reduction in consumption with metered		Check if dwelling is metered individually
	Total daily indoor water use (L) per Person	99	

Figure 3 2 Bed design water calculator output

The plans provided for the 2 bed-unit did not include a bath. In the 4-bed unit a bath is shown and a larger washing machine. Both designs have the same mid-sized dish washer, as well as showers, toilets, and taps as specified.

The specified fixtures, fittings, and appliances are indicative examples based on desired performance. There may be cheaper alternatives with similar performance that will also achieve the same points outcome, and we assume the quantity surveyor to estimate a reasonable average price.



Part A: EF3 Gross indoor individual water use

Indoor water use summary - Enter tested flow rates or check WELS rating labels				Use L/person	Use %	
Worst case shower (L/min)	7			33.9	29%	Mandatory
Toilet (L Full Flush / L Half Flush)	4.5	/	3	16.5	14%	Mandatory
Worst case kitchen and laundry tap (L/min)	7.5			13.7	12%	Optional
Worst case basin tap (L/min)	6			11.1	9%	Optional
Bath (if present) - Capacity to Overflow (L)	200			22.0	19%	Optional
Dish washer (L/ Cycle) / Number of place settings	6.9	/	14	1.8	2%	Optional
Washing machine (L/ Cycle) / Load capacity (Kg)	94	/	11	17.9	15%	Optional
Waste disposal unit (Insinkerator) - present?	no			0.0	0%	Optional

Note: If residents HAVE access to a shared communal laundry within the development but NO laundry facilities at home, then enter washing machine fields above. In this case, use the least water efficient washing machine in the communal laundry nearest to the dwelling. Otherwise leave these blank.
Also note: for washer dryers, enter the total water use (washing + drying).

Expected Occupancy	2.9		
	Unadjusted daily indoor use (L) per Person	117	Nominal 180 - 190 L/p/day
Is the dwelling individually metered AND billed on usage?	☑ Homestar assumes a further 5% reduction in consumption with metered		Check if dwelling is metered individually
	Total daily indoor water use (L) per Person	111	

Figure 4 4 Bed design water calculator output

Shower:

- LEVIVI ELBA shower system (7 L/min) with LEVIVI ELBA mixer

Toilet:

- LEVIVI MARBELLA back-to-wall toilet suite - 4 Star Wels (4.5L full flush/ 3L half flush)

Kitchen Mixer:

- LEVIVI ELBA sink mixer – 4 Star Wels (6.87-7.5L/min)

Handbasin tap:

- LEVIVI ELBA basin mixer – 5 Star Wels (6L/min)

Bath (4 Bed only):

- Stylus 1550mm White Origin Freestanding Bath (200L)

Dishwasher:

- Fisher and Paykel Double Dish Draw DD60DDFB9 (6.9L/cycle, 14 place settings)

Washing Machine:

- For 2 bed - Fisher and Paykel 8kg Front Loader washing machine WH8060J3 (67 L/cycle)
- For 4 bed - Fisher and Paykel 11kg Front Loader washing machine WH1160P3 (94/L cycle)

2.3.3 Materials

Points claimed for both designs in all locations as per below:

Table 17 Total materials points

Credit	Points	Comment
HC7 Healthy Materials	2	Claimed for Applied Coatings (paints) and Floor Coverings (as per the Level 1 Eco-Label credentials listed)
EN3 Sustainable Materials	10	Claimed for 7 material categories based on eco-label certification and EPDs

Alternative products to those listed below maybe used for pricing if the performance is identical.

Concrete:

- Targeting 1.25 points on the basis that both Allied concrete and Firth have Product Specific Environmental Product Declarations that cover plants from across the entire country

Structural Timber:

- Targeting 1.5 points based on all structural timber used on the Homestar designs being FSC certified, as most retailers and suppliers sell these in NZ. Assume that FSC certified timber is not especially specified for the H1 compliant home but will likely be used where available and is cost comparable with non-certified timber.

Insulation:

Targeting 1.5 points based on:

- Pink Batts R3.6 / R4 / R5 / R6 ceiling and R2.2 / R2.6 / R2.8 wall insulation with Environmental Choice Certification
- Mammoth R2 70mm Wall Sections (for 4 Bed design in Christchurch and Queenstown) without specific eco-label certification (but likely produced on the same line as the 90mm insulation that does)
- Expol Therma slab under slab insulation, no eco-certification
- 50mm Insulape pre-fix EPS edge insulation for Queenstown Homestar option and 30mm Expol X-edge slab edge insulation elsewhere (and Queenstown H1 option) neither have any recognised eco-label credentials

While not all products have a recognised eco – certification, Homestar Materials calculator shows at least 59% Eco Label A coverage (benchmark for points is 50%)

Wall and Ceiling Linings:

- Targeting 1.5 points based on GIB Plasterboard having Green Tag A certification

Floor Coverings

- Targeting 1.5 points based on Polyflor Affinity Harvest Oak (Green Tag A) for vinyl floor areas, and Bremworth Samurai wool carpet (ACCS ECS Level 4 Certified and low VOC) for carpeted areas

Applied Coatings:

- Targeting 1.5 points based on using Environmental Choice certified Resene paint

Long run roofing:

- Targeting 1.5 points based on NZ Steel Colorsteel roofing provided by a supplied accredited under NZ Steel Environmental Choice certification

2.3.4 Features to Encourage Sustainable Living

Both designs target 1.5 points in all climate zones by specifying these features.

Veggie Gardens (0.5 point in LV3):

- Planter box with 1m^2 planting area

Household Waste (no points without food waste collection, but good practice):

- Both designs will incorporate dedicated waste storage for rubbish, and recycling within the kitchen cabinetry (at least 20L capacity in each case) and an external space to store waste bins

Electric Vehicle Charging (1 point in LV4):

- Both designs have specified an EV Wall charger (EV Power 16/32 Amp Wall Charger, Single phase) to be mounted in the garage. Given Home charging does not need to be fast, we have assumed a 16Amp power supply on a dedicated circuit as per Homestar requirements. We consider this to be standard good practice for a new home in NZ given the move to make EVs more prevalent, rebates available etc.

2.3.5 Exclude from pricing

These are specified for Homestar points (2 points for both designs in all climate zones in total) but do not consider them to be an additional cost item.

Home User Guide (1 point in LV2):

- Assumed that the developer/ contractor will prepare a Home User Guide as per Homestar requirements. We do not consider this to have an additional pricing element as many new homes come with a manual, and aligning its template with Homestar requirements should not have a cost per project

Security lighting (0.5 point in LV3):

- PIR controlled security lighting is standard practice on entrances and garages

Indoor LED Lighting:

- LED lighting is industry standard for homes and will not differ between a 6 Homestar or code minimum design

Clearly visible street number (0.5 point in LV3):

- This could be on the front door or letter box. Standard good design practice

Appendix A: Homestar and H1 (Fifth Edition) Climate Zones)

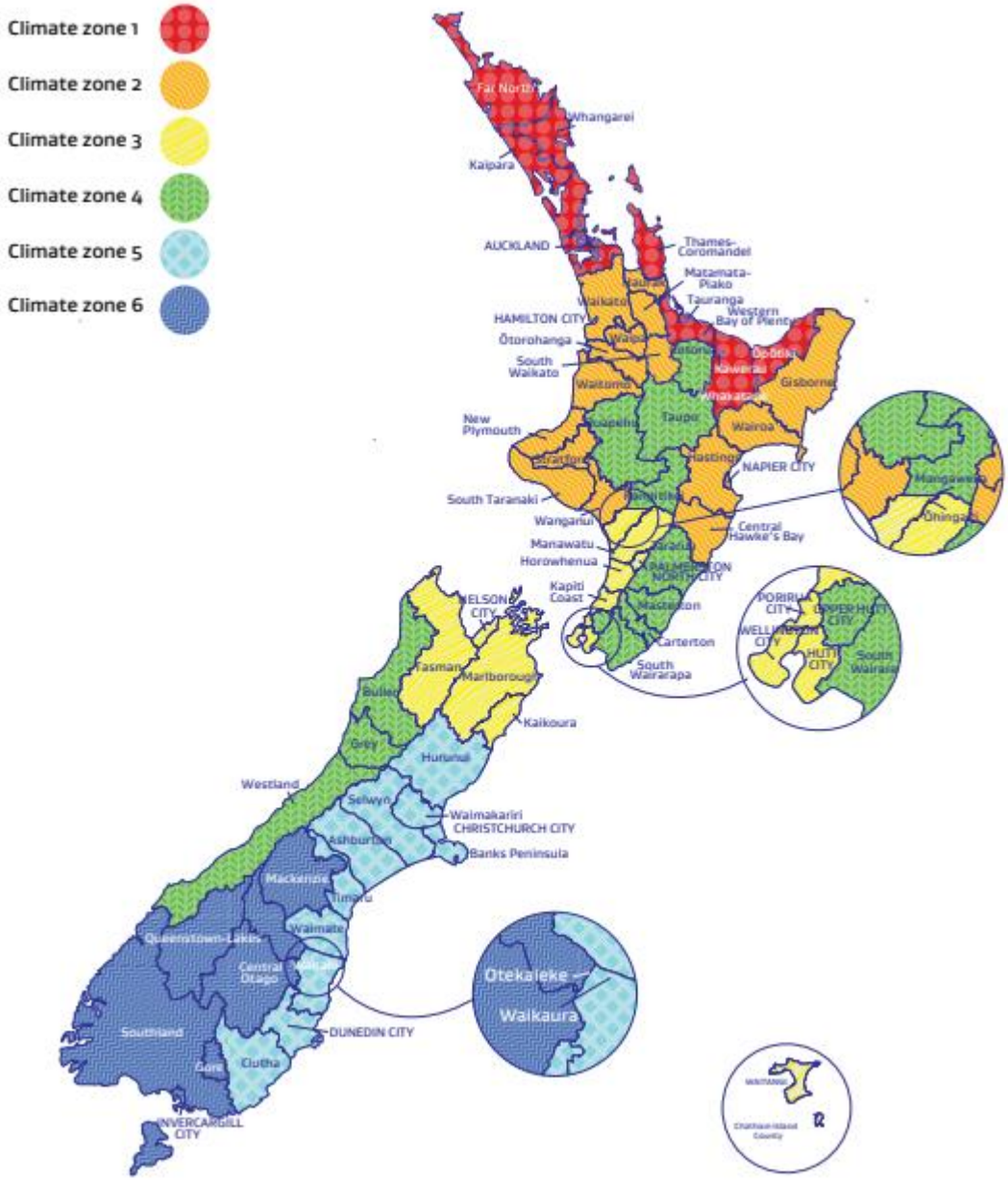


Figure 5 New Zealand Climate Zones (Reproduced from Clause H1, Appendix C)

Appendix B: Homestar Points – 2 Bed Design

Table 18 2 Bed Terrace - Homestar points summary

	2 Bed Terrace	Available	Auckland	Wellington	Christchurch	Queenstown
	Efficient					
EF1	**Resource Efficiency**	4	2.5	2.5	2.5	2.5
EF3	**Water use**	12				
	Indoor water use		10	10	10	10
EF4	**Energy use**	20	13	13	13	13
	Healthy and comfortable					
HC1	**Winter comfort**	22	19	17	16	17
HC2	**Summer comfort**	6	6	6	6	6
HC3	**Ventilation**	5				
	Moisture management through ventilation		2	2	2	2
HC4	**Moisture control**	6				
	Minimising condensation on internal surfaces		2	2	2	2
HC7	**Healthy materials**	4	2	2	2	2
	Liveable					
LV2	**Occupant amenities**	2	1	1	1	1
LV3	**Eco-friendly living**	2	2	2	2	2
LV4	**Sustainable transport**	4	1	1	1	1
	Environmentally Responsible					
EN2	**Embodied carbon**	6	1	1	1	1
EN3	**Sustainable materials**	10	10	10	10	10
	Total	**103**	**71.5**	**69.5**	**68.5**	**69.5**

Appendix C: Homestar Points – 4 Bed Design

Table 19 4 Bed Standalone - Homestar points summary

	2 Bed Terrace	Available	Auckland	Wellington	Christchurch	Queenstown
	Efficient					
EF1	**Resource Efficiency**	4	2	2	2	2
EF3	**Water use**	12				
	Indoor water use		8	8	8	8
EF4	**Energy use**	20	13	12	12	12
	Healthy and comfortable					
HC1	**Winter comfort**	22	15	15	15	15
HC2	**Summer comfort**	6	6	6	6	6
HC3	**Ventilation**	5				
	Moisture management through ventilation		2	2	2	2
HC4	**Moisture control**	6				
	Minimising condensation on internal surfaces		2	2	2	2
HC7	**Healthy materials**	4	2	2	2	2
	Liveable					
LV2	**Occupant amenities**	2	1	1	1	1
LV3	**Eco-friendly living**	2	2	2	2	2
LV4	**Sustainable transport**	4	1	1	1	1
	Environmentally Responsible					
EN2	**Embodied carbon**	6	1	1	1	1
EN3	**Sustainable materials**	10	10	10	10	10
	Total	**103**	**65**	**64**	**64**	**64**

Appendix D: ECCHO Outputs

In order:

Auckland

- 2 Bed H1
- 2 Bed Homestar
- 4 Bed H1
- 4 Bed Homestar

Wellington

- 2 Bed H1
- 2 Bed Homestar
- 4 Bed H1
- 4 Bed Homestar

Christchurch

- 2 Bed H1
- 2 Bed Homestar
- 4 Bed H1
- 4 Bed Homestar

Queenstown

- 2 Bed H1
- 2 Bed Homestar
- 4 Bed H1
- 4 Bed Homestar

Appendix E: Cost Estimates by Kwanto – 2 Bed Terrace

In order:

Auckland

- 2 Bed H1
- 2 Bed Homestar

Wellington

- 2 Bed H1
- 2 Bed Homestar

Christchurch

- 2 Bed H1
- 2 Bed Homestar

Queenstown

- 2 Bed H1
- 2 Bed Homestar

Appendix F: Cost Estimates by Kwanto – 4 Bed Standalone

In order:

Auckland

- 4 Bed H1
- 4 Bed Homestar

Wellington

- 4 Bed H1
- 4 Bed Homestar

Christchurch

- 4 Bed H1
- 4 Bed Homestar

Queenstown

- 4 Bed H1
- 4 Bed Homestar

.

Document prepared by

Aurecon New Zealand Limited
Level 3, Air New Zealand Building
185 Fanshawe Street,
Wynyard Quarter 1010
PO Box 9762
Newmarket Auckland 1149
New Zealand

T +64 9 520 6019
E auckland@aurecongroup.com
W aurecongroup.com