The Waitakere NOW Home

A case study in home performance

Beacon

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The Waitakere NOW Home:
Proving how to build higher performing homes

The Waitakere NOW Home was designed and built to show how a warmer, drier, healthier, more efficient home could be built, using materials and products available in 2005. The design used simple, proven concepts and technologies to improve the performance of the whole house – from its indoor warmth and humidity, to energy efficiency to water, and even to waste.

The house was extensively monitored in real life conditions. As the young family living in the house went about their day-to-day lives, the performance of the Waitakere NOW Home was remotely monitored.

Data was collected on energy use, water use, rainwater collection, temperature, indoor air quality, humidity and moisture levels. The family were interviewed to capture their experience of living in the home.

The data provided sound scientific proof of how well the house performed and the benefits of living in a healthy home.

Even now, the Waitakere NOW Home outperforms many newer homes - a BRANZ study found it had better thermal performance (warmer, more comfortable, requiring less heating) than 210 homes consented in 2016.

Whole of house performance

The Waitakere NOW Home's design focused on the whole of the house in order to fundamentally change how it performed.

The reason for this? Our houses are a web of interdependent features and building systems. We cannot fix one area only without compromises and under-performance in other aspects of the home. For example:

- We could use less energy by heating less, but this would mean unhealthy temperatures.
- We could install a heat pump to heat a home, but without sealing draughts and insulating ceiling, walls and floor, this would be like driving a car with the heater on and the windows open.
- We could have efficient heating, but if we don't get rid of the moisture that comes from showering and cooking, we will have to use our heater more often to warm the damper air.
- We could install a wonderful super-energy-efficient product, but if it has toxic by-products, we'd compromise our indoor environment.
- We could insulate and use energy efficient heating, appliances and lighting but if we still use a lot of hot water, overall energy use will still be high - approximately 30% of typical New Zealand household energy consumption is spent heating water.
- And even if a home's energy use was as efficient as possible, but we used a huge amount of reticulated water, we would have to consider the energy used to collect, purify, and transport that water to our door.

Thus, the design of the Waitakere NOW Home included careful thought to every aspect of the home:

Energy Warmth Dampness Water Waste

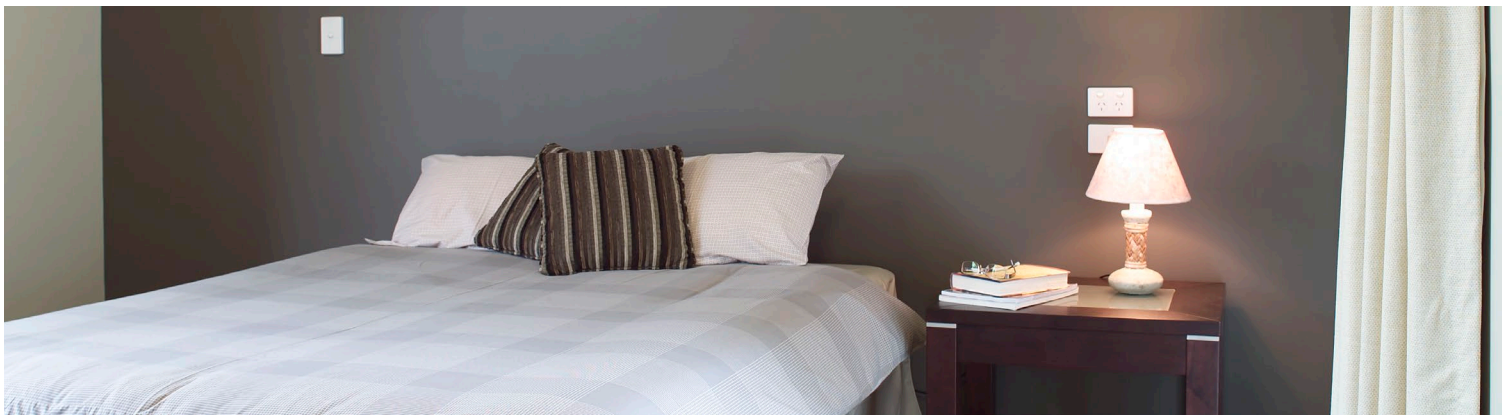
The Waitakere NOW Home at a glance

Its simple features included:

- A design which faces the north with lots of windows on the northern side
- Wide eaves to let the winter sun in but keep the summer sun out
- A concrete floor which absorbs heat from the sun and releases it when the air is cold
- High levels of ceiling, wall and floor insulation, much higher than in the Building Code
- Double glazed windows to keep the heat in and the noise out
- Solar water heating
- Water efficient taps, shower head, toilet and appliances
- A rainwater tank to collect and reuse rain
- Ventilation of moisture in the kitchen and bathrooms
- Passive ventilation to keep down moisture and avoid overheating
- Good natural light in all rooms, combined with efficient light fittings and bulbs.

The statistics

- The Waitakere NOW Home was a 3 bedroom, 2 bathroom, single storey dwelling, with attached garage.
- It had a total floor area of 146 m^2 (24m^2 of this is garage). Almost half of the total floor area was living and dining space
- The house had two living areas: the main open living area including the lounge, dining area and kitchen; and a second versatile living space off which the bedrooms open.
- It was built at a cost of $218,000 + GST, excluding landscaping and soft furnishings (2005 prices)



Layout and design

The Waitakere NOW Home was designed to have mainstream appeal. Yes, the designers wanted it to be energy and water efficient. Yes, they wanted it to be warm and healthy to live in. But, importantly, the house also had to appeal to residents of the area. It had to fit in with the type and size of houses in the neighbourhood. It had to look attractive, but ordinary.

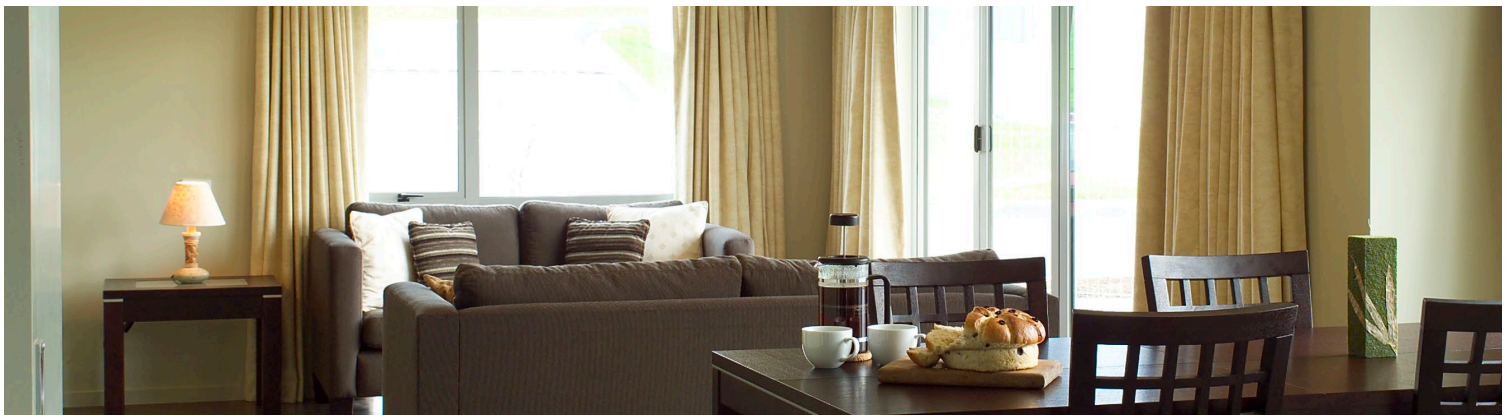
"Everything seems bigger"

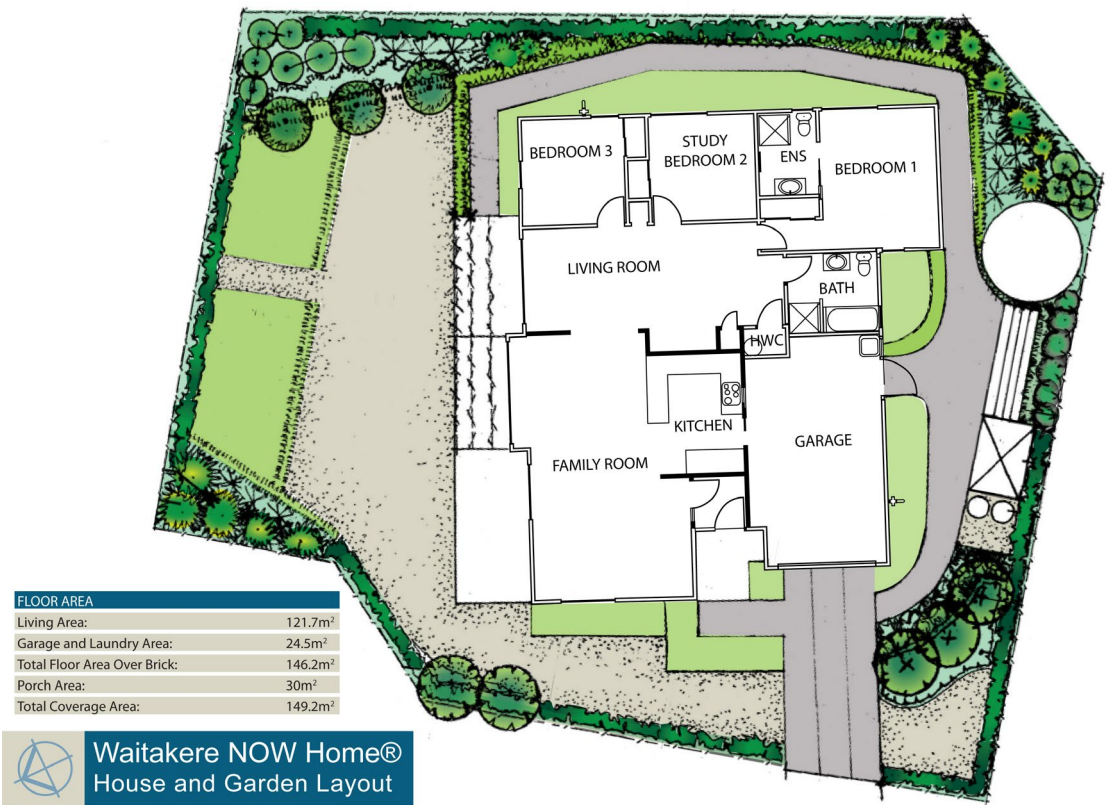
The family living in the home particularly enjoyed the layout of the rooms, the openness, absence of hallways or corridors, and clever use of spaces. This may seem surprising as the 'footprint' of the home is relatively small.

The house had no corridor or hallway space, and the laundry was part of the garage, close to the back door and clothesline. This enabled the architects to design two living areas: the main open living area including the lounge, dining area and kitchen; and a second living area off which the bedrooms open.

The second living area was versatile. Although designed with the idea that it could be used as a study or second lounge, the tenants used it for a children's play room (keeping toys separated from their main living areas), as a study, and as a home gym area.

For the family, "everything seems bigger". They appreciated how the spaces relate, the indoor-outdoor flow, and an overall sense of greater freedom of movement. They also liked the open plan design which they felt did not exclude people or separate children and adults. The indoor-outdoor flow was especially good for their family life





FLOOR AREA	
Living Area:	121.7m²
Garage and Laundry Area:	24.5m²
Total Floor Area Over Brick:	146.2m²
Porch Area:	30m²
Total Coverage Area:	149.2m²

Waitakere NOW Home®
House and Garden Layout

Comfort and appeal

- Comfortable and modern
- Bi-fold sliding doors to terrace provided indoor-outdoor flow
- Cathedral ceilings to living and dining areas gave a spacious, airy feel
- Bay window breakfast nook in dining area
- A modern kitchen
- Dedicated computer nook
- An airlock at the entry provided privacy to the main living space and reduced heat loss
- Large sliding doors and no corridors to make shifting furniture in, out and around the home easier
- Plenty of storage, with internal garage and three internal cupboards
- Easy access from laundry to the clothesline
- Designed to be barrier-free.

Healthy living indoors

Passive solar heating

The Waitakere NOW Home was designed for passive solar heating, making the most of the sun's warmth, and retaining that heat. The house was oriented north, with both living areas, the dining area and one bedroom on the northern face of the house. Large windows and doors admitted the maximum amount of sunlight during winter while overhanging eaves provided summer shade.

Thermal mass

A 100mm thick concrete slab and footings acted as a heat sink to store the sun's warmth and release it later in the day when the temperature drops. To prevent heat loss into the colder surrounding ground and air, the slab was insulated underneath and around its edges.

The concrete floor was left exposed in all the living areas to collect and store heat more effectively.

Laying the concrete slab over the insulation

Insulation

The Waitakere NOW Home had higher levels of insulation than was recommended in the New Zealand Building Code at the time. The ceiling insulation had an R value (a measure of its effectiveness) of R4.6, considerably more than the Code minimum in 2005 of R1.9. The wall insulation had an R value of R2.8, nearly twice that of the Code minimum in 2005, R1.5. These insulation values are also much higher than the new minimum standards introduced in 2008.

Preventing heat loss through windows

All glass in the house was double glazed, including the bi-fold doors. At night, heat loss through windows was prevented by using curtains with thermal linings. The curtain rail was mounted close to the wall to minimise heat loss.

Space heating

Designed for Auckland's warmer climate, the Waitakere NOW Home had no in-built space heating system. With extra insulation and passive solar heating, it was designed to be warm enough that extra heating would only be needed on the 10 coldest days of the year.

Getting rid of damp

High insulation levels and passive solar design in the Waitakere NOW Home created a warmer indoor environment, less prone to condensation. Cold air holds far less moisture than warm air. In cold temperatures the moisture naturally in the air settles on cold surfaces such as un-insulated walls, ceilings and windows as condensation. Double glazing keeps the inside glass surface warmer, so fogging and condensation (which can damage woodwork, furniture or upholstery) is much less of a problem.

A rangehood extracted moist air from the kitchen, and the laundry was sited in the larger, better ventilated space of the garage. The family was encouraged to dry clothes on the clothesline outside, or on a rack in the garage.

Solatube mechanical ventilation fans in the bathrooms were linked to the light switch being turned on, and run on a timer. These are particularly important in ensuites where extra moisture can affect the adjoining bedroom.

Passive ventilation

The Waitakere NOW Home used aluminium window frames with in-frame passive ventilation which allowed constant air circulation even with windows and doors closed.

The passive ventilation systems did not prove enough to cool the Waitakere NOW Home during the heat of summer. For greater cooling, security stays were fitted to some windows so they could be left open, and a Solar Star ventilation unit was installed in the kitchen. The Solar Star was solar powered but could be turned off when not needed.

Weathertightness

The Waitakere NOW Home met the challenge of creating a weathertight house with good design. The house had over-hanging eaves to keep wind-driven rain from the wall claddings. The roof had a more-than-adequate slope to shed water.

Flashings were installed wherever disparate materials meet. Joins in materials, and around windows, are often prime sites for moisture penetration into the linings of a home. Flashings were used:

- around all windows and doors
- around the concrete slab and insulation
- at wall cladding junctions
- on roof valley, junctions, barge, ridge and apron.

Kiln-dried boric-treated H1.2 radiata pine was used for wall and roof framing. This met the requirement for treated radiata to be used in external walls and moisture risk situations. Breathable paper wall and roof linings stopped moisture and dampness entering the home.

How the house performed

Humidity

Humidity levels were all in the acceptable range for human health (25-75%), a good result given that the humidity levels in Auckland frequently exceed 75%.

However, the family noticed condensation on the master bedroom window, next to the ensuite, in winter, and monitoring showed higher humidity levels in that room. Unfortunately, despite being on the plans, no extractor fans had been installed in the bathrooms. Extractor fans were quickly installed and in Year 2 there was a noticeable drop in humidity levels in the bathrooms and adjacent bedroom. This is a classic demonstration of the importance of bathroom ventilation in fighting mould and mildew. It especially holds true for ensuites, being so close to where householders are sleeping.

Temperatures

Designed to only need additional space heating on 10 days per year, the Waitakere NOW Home performed better with additional heating only required on two days per year.

The living room had an average winter temperature of 21.6ºC and the bedrooms had average night-time winter temperatures of 17.4ºC -17.7ºC. The winter mean temperatures all exceeded World Health Organisation minimum of 18ºC for living areas.

Room	Mean winter temperature	Overnight winter temperature	Mean summer temperature	Average relative humidity (dampness)
Family room	20.4ºC	19.1ºC	24.3ºC	53.0%
Living room	21.6ºC	20.8ºC	23.6ºC	54.4%
Main bedroom	18.4ºC	17.8ºC	22.9ºC	58.1%
Bedroom 2	18.5ºC	17.6ºC	25.1ºC	55.6%
Bedroom 3	18.6ºC	17.4ºC	23.8ºC	55.8%
Bathroom	16.0ºC	14.4ºC	21.7ºC	61.0%

At the height of summer (January/February), the house became too hot, particularly in the evening. All rooms experienced some overheating in summer and there was a significant amount of time spent above 25ºC over 24 hour periods in January and February, especially in the family room and northwest-facing bedroom.

The original design relied on an overhanging eave calculated to keep out the summer sun during the hottest part of the day and passive ventilation channels in the window frames. These did not prove adequate to prevent overheating, which is a common issue for today's air-tight homes. The need for more passive ventilation was addressed by installing a solar powered stack vent. Security stays - originally not used for fire safety reasons - were later installed to allow the windows to be left open at night and when the house was unoccupied.

What the family noticed

Despite constantly using their dehumidifier in their previous home, the family noticed how much drier the Waitakere NOW Home was. In fact, Joe and Hayley didn't unpack their dehumidifiers at all – there was no condensation and no mould. Good air flow eant they didn't need to air the house out. Their son's asthma improved rapidly and they were delighted to find after three months that he had hardly needed his nebuliser at all.

The family appreciated the evenness and stability of the temperature – even in winter all rooms were warm and comfortable and they only needed a fan heater and electric blankets on for a couple of days during the year. The concrete floor, used to store heat from the sun and release it when the air temperature dropped, worked extremely well, and even in winter was not cold to walk on. The family quickly learned the importance of pulling thermal curtains in winter to keep the heat in.

During summer, the family reported that the house could be uncomfortably warm at times, causing them to have trouble sleeping. With safety concerns, they did not like to leave their windows open at night or while they were away from the house. Security stays addressed this - night time airing of houses is an important way to stop them from overheating.

Energy efficiency

Using free energy

A solar water heating system was used in the Waitakere NOW Home to use the free energy from the sun and significantly reduce energy costs.

The solar water heater had collectors on the north-facing roof, and an electric boosted, mains pressure storage tank inside the house at ground level.

Heat loss from the water pipes and cylinders was minimised with a carefully designed plumbing plan. The hot water cylinder was situated inside and in the middle of the house, ensuring pipe runs to the most commonly used taps were as short as possible.

Using less energy

Appliances

Fisher & Paykel appliances with the best possible energy efficiency ratings available in 2005 were installed. More efficient models are now on the market.

- Dishwasher - 3 star energy rating with an energy consumption of 280 kWh per year.
- Fridge - a 4 star energy rating with an energy consumption of 454 kWh per year.
- Washing machine - a 2 star energy rating with an energy consumption of 57 kWh per year for cold washes, and 518 kWh per year for hot washes.

Lighting

Natural light was optimised with large windows in all rooms to reduce the need for artificial light between 9am-4pm all year round. A Solatube skylight was installed in the kitchen to improve natural light.

No recessed downlights were used as models available in 2005 required gaps in the ceiling insulation. Now, new IC and IC-R rated downlights allow ceiling insulation to cover downlight cans to ensure effective insulation that meets the new Code requirements.

In the main living area with its cathedral ceiling, pendant lights were used. Compact fluorescent lightbulbs were used where possible.

How the house performed

Overall energy savings

In their first year of living in the Waitakere NOW Home, the family used 7400 kWh per year or 33% less than a comparable 4 person household with school age children. This was also 45% less than the family's energy use in the house they occupied over the year prior to moving into the Waitakere NOW Home. The family were delighted with their lower energy bills which they noticed very early on.

In the second year, energy use rose to 8500 kWh over the year. While this was an increase over what was achieved in the first year, it was still 25% less than a comparable 4 person household with school age children.

Analysis shows that the family changed the way they used the house in response to its warmer, drier environment and lower energy bills.

- The house was increasingly used as a home office. The high running costs of computers/servers were offset by lower power bills.
- The family invested in more appliances. Lower energy bills mean more money in the pocket.
- Hot water use increased in the second year

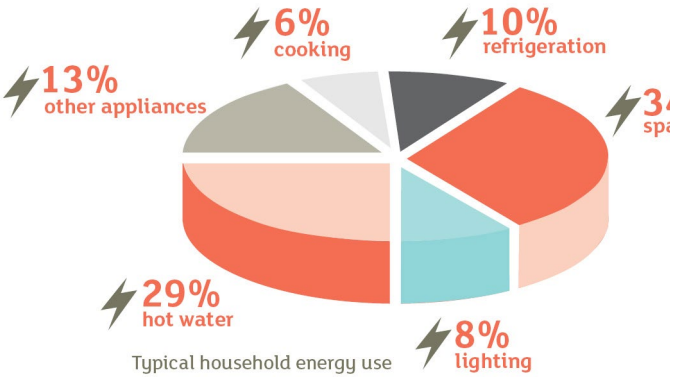
The lower running cost buffered the household against rising energy prices, and continued to provide more disposable income. The family still saved energy compared to similar households, while maintaining a high degree of comfort and expanding their use of the house.

Free energy

In the first year of monitoring, the solar water heater provided more than half (55%) of hot water needs. That's equivalent to a saving of 1620kWh (compared to similar houses in the area) or about $275 on water heating alone.

In the second year, the solar water heater provided 45% of hot water needs, 1880 kWh in total. Although the solar water heater provided more kWh in total, the increased hot water use by the household meant that a lower proportion was provided by solar.

It is worth noting that the two collector panels were at the same angle as the roof at only 20°. This low angle improved the summer time performance of the solar hot water system but reduced its winter time performance. Ideally, panels are on the same angle as the latitude of the site.



Surprising energy guzzlers

The energy use of appliances was more intensively monitored in the second year to see what part they play in household energy use. Appliance use was high; on average, the TV was on 40-45 hours per week, the stereo 30 hours per week, and the home computers 50 hours per week.

The home office, with several computers and a server, was a high energy user, forming 10% (847 kWh) of total energy use. When calculating the cost of a home office, it is important not to underestimate the associated energy costs.

Also of interest for many households was the high energy use of the large screen TV which used 5% (391 kWh) of total energy use, more than the oven and fridge.

What the family noticed

Right from the start, Joe and Hayley loved their new home. They had come from a cold, damp house where they needed dehumidifiers on 24/7 and which was hard to heat. What a change! Sun poured into the new house during the day, and at night, warmth radiated off the polished concrete floor. All the extra insulation and double glazing kept the warmth in. Joe and Hayley enjoyed the even heat through all the rooms – no cold back bedrooms. They only needed to get out a small fan heater and electric blanket for a couple of cold days in winter – the rest of the time they needed no extra heating. Joe and Hayley described themselves as the 'Pink Batts family' (after the TV advert), because they didn't want to leave the house when the weather was bad.

With all the natural light flooding in through the windows, the family noticed they didn't need to switch lights on as often.

Joe and Hayley loved the solar water heater which provided over half of the household's hot water. They always had plenty of hot water, and even better, they could see the savings on their power bills straight away. In water heating alone, they were saving approximately $367 per year.

In fact, with little space heating, their power bills dropped considerably. They were paying 45% less than in their previous home.

Most noticeably, Joe and Hayley changed the way they used the house in response to its warmer, drier environment and lower energy bills. The lower running cost buffered the household against rising energy prices, and provided more disposable income. The house was increasingly used as a home office, reflecting that it was a pleasant, warm and quiet place to work.

Water conservation

Using less water

The Waitakere NOW Home used low flow shower mixers and showerheads which restrict water flow to 9 litres per minute, compared to standard showerheads which can use up to 20 litres per minute. Taps with flow and temperature limiters restricted water flow to 7 litres per minute.

Dual flush toilets also reduced water consumption with a 6 litre full / 3 litre half flush, compared with the traditional 11 litre single flush cistern. This has the potential to reduce water used in toilet flushing by up to 67%. The toilets had an AAA Water Conservation rating.

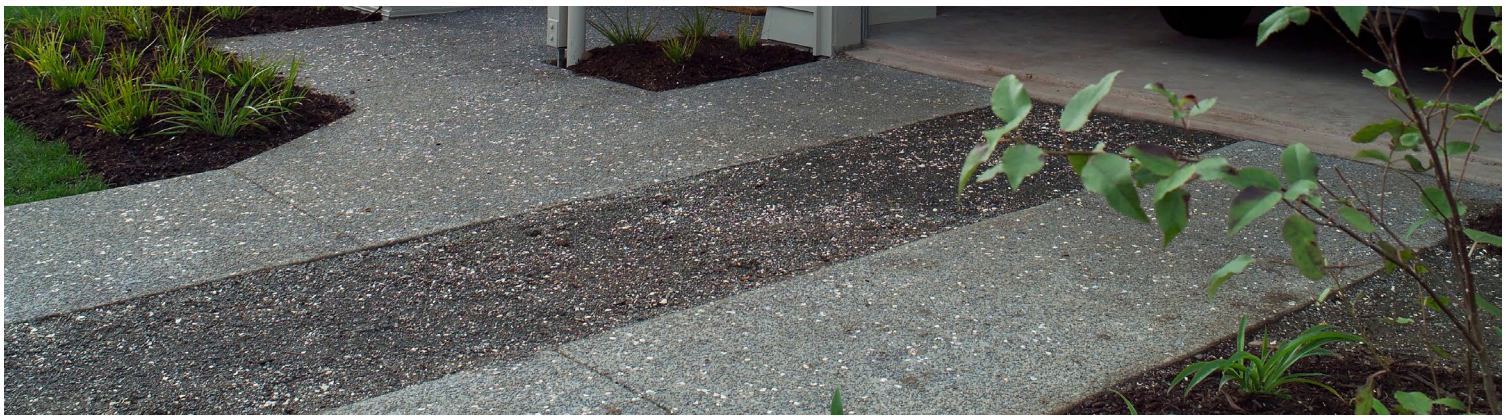
The dishwasher and washing machine in the Waitakere NOW Home were selected for water efficiency. The dishwasher had a water conservation rating of AAA. The washing machine automatically sensed the level of water required for a load, preventing unnecessary filling. It had a water conservation rating of AAAA. No in-sink waste disposal system was fitted to reduce water usage in the kitchen.

There was no inbuilt outdoor watering system. Instead the garden was landscaped with drought resistant native plants to reduce the need for watering.

Using free water

The most obvious water-saving device in the Waitakere NOW Home was the rainwater collection tank. All the water used in the NOW Home, except the cold water provided to the kitchen and bathroom, was drawn from this tank.

The Waitakere NOW Home rainwater tank was a 13,500 litre, 2.8m diameter tank, larger than recommendations at the time. The TankVac system siphoned dirty water from the bottom of the tank when tank overflowed, rather than the clean water from the top, and so maintained high quality water supply. The tank water was then pumped into the plumbing system where it supplied all hot water and non-drinking water.



Reducing the effects of stormwater

The overflow from the tank was the only water fed into Waitakere City Council stormwater system. With all the rainwater from the roof being collected by the tank, there was less chance of flooding.

The landscaping maximised permeable surfaces, with grass, garden and chip. Concreted areas were as small as possible, reducing run-off to a minimum.

How the house performed

Using less water

The use of low flow shower heads, flow restrictors on taps and low flow, dual flush toilets in the Waitakere NOW Home proved to be very water efficient. Total water use, including both reticulated water (from mains supply) and free water (from the rainwater tank), was 189 litres per person per day in the first year, dropping to 172 litres per person per day in the second year. A maturing garden requiring less watering of new plants led to the drop in water consumption.

Total water use was comparable to the Waitakere City Council average of 165 litres per person per day, and considerably better than averages from other parts of the country at the same time.

Hamilton City Council (unmetered water)	260 litres / person / day
Christchurch City Council (metered water)	280 litres / person / day
Porirua City Council (unmetered water)	327 litres / person / day
Hutt City Council (unmetered water)	381 litres / person / day
Wellington City Council (unmetered water)	451 litres / person / day

The most water in the house was used in the shower (280 l/p/d), followed by the laundry (132 l/p/d) and toilets (105 l/p/d). Simple measures, such as installing low flow shower heads, water efficient washing machines, and dual flush toilets, can reduce water bills in these major water use areas.

Free water means more savings

The Waitakere NOW Home's water conservation is even more impressive once the contribution of 'free' water from the rain tank is taken into account.

The 13,500L rain tank supplied 47% of the home's water needs in year 1, and 52% in year 2. The family used only an average 100 litres of reticulated water per person per day in Year 1, dropping to 85 litres per person per day in Year 2. As their water supply was metered, this represented a considerable savings on water bills. Overall, Waitakere NOW Home's reticulated water use in Year 1 was 40% less than the average in surrounding Waitakere City improving to 50% less in Year 2.

What the family noticed

Water in the Auckland region is metered and can be a big cost to households. The good news for Joe and Hayley was that their rainwater tank provided 47%-52% of their water needs, and the low flow taps and shower heads, dual flush toilets and water efficient washing machine reduced their water bills to half the average in surrounding Waitakere City.

After an initial glitch when the tank water ran out, a simple level indicator on the tank was enough to reassure Joe and Hayley about water levels. The family noticed no difference in using the low flow fittings on taps and showers – in fact, showering was the biggest user of water. Initially they used a lot of water on the garden and lawn, knowing that people would be looking at the garden during open homes, but admitted they weren't really gardeners. The low care garden planted with natives was ideal for them.

Reducing waste

Construction waste

Every effort was made to use careful design and accurate quantity surveying to minimise waste on the Waitakere NOW Home construction site. The room sizes in the Waitakere NOW Home were based on standard GIB® wall lining sizes to reduce plasterboard waste. Framing timbers were pre-nailed off-site to reduce timber off-cuts.

Off-cuts and other construction waste were sorted on site. Where possible, materials were re-used, or recycled, and only the remaining materials were sent to the landfill. Timber off-cuts were used for noggins, jack studs and blocking, and any untreated timber was used as firewood. Excess polystyrene insulation was delivered to a recycling company. Plastics (coded no. 1 and no. 2), and aluminium cans, were recycled using the local kerbside recycling scheme. Clear plastic wrap and ferrous metals were also separated for recycling.

Generating less waste from daily living

Recycling: Two-compartment, under-bench recycling/rubbish bins - each compartment of at least 15 litres - were provided in the kitchen to encourage sorting of household waste. Easy access to the garage and adequate space for non-organic recycling bins made recycling an easy option.

Composting: The Waitakere NOW Home kitchen had space for 5 litres of organic waste collection. It had no in-sink waste disposal system as these not only consume a great deal of water but discourage composting and overload the sewerage system. The rear garden in the Waitakere house, accessible from the kitchen through the garage, had space for two compost bins, handily placed next to the garden shed and at the back of the house.

Results

Construction waste generated

189 kg of waste materials – 8% of the total waste on site - were diverted from the local landfill using this sorting process. The relatively small percentage diverted reflects the difficulty in providing easy, practical landfill diversion solutions for many waste products, particularly plasterboard and concrete. Despite concerted efforts to make waste sorting and recycling easy, large amounts of waste were generated on site, including concrete from the roof, waste timber, packaging, and contractors' waste (drink bottles, lunch wrappers).

The total amount of waste generated on the Waitakere NOW Home site was 2448 kg. Expressed in terms of the overall floor area (146m^2), 16.8 kg/m^2 was generated. Domestic construction is believed to typically generate between 14.7 and 25.4 kg of waste per square metre, according to international studies reported in 'Residential Construction Waste Management: A Builder's Field Guide', published by the US NAHB Research Center.

What the family noticed

Joe and Hayley noticed that composting and recycling reduced their rubbish to one bag per week, a considerable reduction. They attributed this largely to composting, which they had not done before but found to be little effort.

The introduction of composting had another result - reduced vegetable purchases. Using the compost bin showed the family clearly how much fruit and vegetables were being thrown out uneaten each week.

"We are happy here, which flows through to everything else. Everything has been better since being here"

The benefits of living in a high performing home

While it is relatively easy to measure how much energy or water is used, and what the temperature is, we were also interested in how the family found living in the Waitakere NOW Home.

Our researchers interviewed Joe and Hayley regularly to get their feedback on how the house was performing. It has helped us identify problems not showing up in the monitoring data, and to address these.

Best of all, the family's experience demonstrates the greater health, social and family benefits of living in a home that performs well.

Health benefits

Joe and Hayley quickly noticed their family had fewer illnesses since being in the Waitakere NOW Home.

"We haven't had to be home with the kids sick since we've been here" reported Hayley after their first three months in the house.

One of the children suffered from asthma prior to moving into the house, and that showed improvement too, with less need for a nebuliser.

Hayley also praised the double glazing for blocking light and sound when she was recovering from migraines.

Good for the family

The family enjoyed more socialising in this house. They describe their former house as being cold, dark, damp and a place they didn't like to invite friends and families to. In contrast, their social life in the Waitakere NOW Home bloomed, they had more friends around and more people in their life.

"People want to come round," said Joe and Hayley. They attributed this to living in a quality house, which was comfortable, aesthetically pleasing, spacious, had indoor-outdoor flow, and was easy to clean.

The experience of our tenants indicates that warm dry homes are not only vital for health, they are important for mental health.

"You can't help but be positive, we don't get the winter blues" said Joe.

Joe and Hayley described the change as 'huge' in terms of a healthy state of mind and generally feeling happier, "We've realised the impact a house could have on the rest of life".

Best of all for the family was the increased confidence and happiness they noticed since moving into the NOW Home. Their boys were healthier and more confident. They felt connected as a family, especially working together to gardening and composting.

Their view: a good house positively contributes to strong family relationships.

A quieter home

An added advantage of the double glazing was the peace and quiet. Even though their house was near a busy road, the noise did not bother the family. In fact, the quiet was so noticeable, the family reported being surprised to find it was raining one day during a storm.

Changing their lives

The experience of living in the Waitakere NOW Home has had a lasting impact on the family's behaviour and awareness. Very early on, they noticed that they were using their dehumidifier, heaters and dryer less often, and they had started watching their energy use. A centameter installed in the second year gave them a real-time picture of the impact of various appliances on power consumption.

The family became more conscious of their waste, and learned not to overbuy or waste food. They became aware of environmental and sustainability issues through living in the house. Composting and recycling became second nature.

The family reported they now "look at things differently" and are more aware of what they're leaving behind. Hayley commented that "I am not conscious anymore, it's just how I am – I just do [more environmentally friendly] things, I don't think about them".

The family's next home

The family have now moved on to their own home. Their NOW Home experience made a big difference to what they looked for when house hunting.

Their new home had to be a sun trap with good natural light indoors, especially in the children's bedrooms. It had to face north for maximum sun. They looked for a home which was insulated and double glazed but also well ventilated. They had their new house checked for humidity and damp to ensure there were no hidden moisture problem.

Also important was the flow and layout of the house. It needed to be big enough for their growing family but with no wasted space – good design was a key criteria.
With insulation and double glazing already installed, the family have little need to renovate their new home. However, they did report that their first 'renovation' was to replace all the lightbulbs in the house with energy efficient compact fluorescent lightbulbs!

How does the Waitakere NOW Home compare to other new houses?

Even though it was built over ten years earlier, the Waitakere NOW Home still outperforms most new houses being built today.

BRANZ researcher Roman Jaques used the NOW Home as a benchmark to see how current new homes were performing. He randomly selected over 200 building consents from Auckland, Hamilton and Christchurch and modelled their performance using the submitted specifications. He compared this data to modelling of how the NOW Home would perform in the three locations.

Overall, he found that, compared to the NOW Home, the 2016 homes, with very rare exceptions, have:

1. **Considerably higher space heating and cooling-related CO_2 emissions (all three cities)**

   The Y2016 homes (with a few exceptions) have considerably higher space heating and cooling loads and therefore CO_2 emissions.

2. **Higher water heating-related CO_2 emissions (all three cities).**

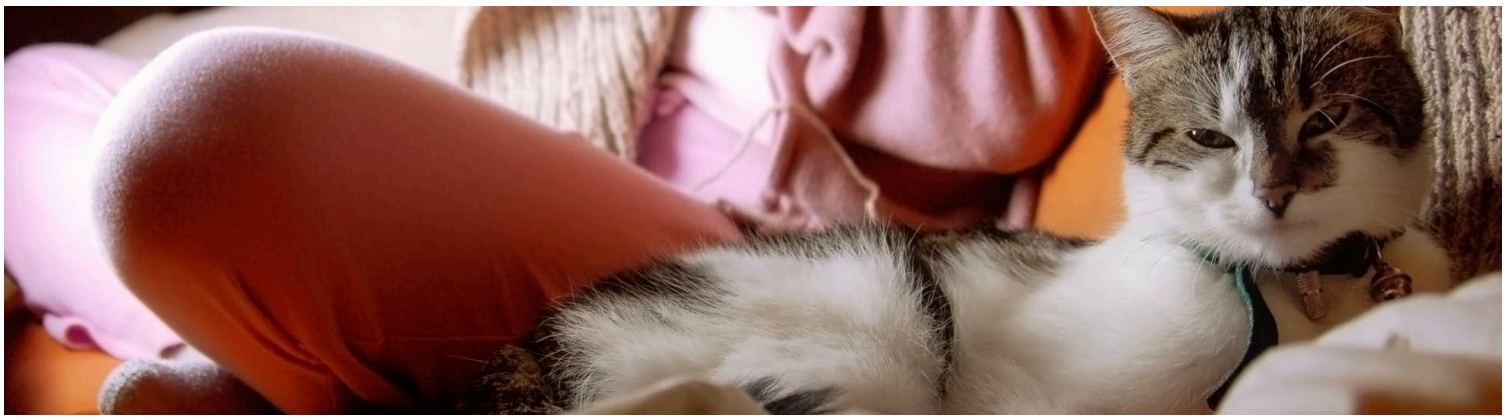
   There is a considerable gulf between a carbon-efficient water heating system and what is typically being installed. Comparing the mean figures, the Waitakere NOW Home has approximately 3.5x, 3.4x and 2.7x less carbon-intensive water heating requirements for Auckland, Hamilton and Christchurch respectively

3. **Lower whole-house resource efficiencies, by bedroom number (all three cities)**

   Resource efficiency is calculated by simply dividing the conditioned area of a house by the number of bedrooms. The lower the number, the more efficient the house is likely to be. The Waitakere NOW Home was designed specifically to address this issue; it forgoes hallways and has compact bedroom spaces.

4. **More energy-intensive space heating and cooling needs via active means (compared in Christchurch only)**

   The difference between what could easily be achieved through considered design (i.e. the Waitakere NOW Home) and what is currently being achieved (i.e. the randomly selected homes' median performer) in terms of the level of active heating and cooling required is considerable. This gulf in thermal performance is even more startling when only a handful of selected homes designed for the Christchurch climate thermally outperform the Waitakere NOW Home, which was designed for a considerably warmer climate.



5. **Less daytime thermal comfort in the main living area using passive heating or cooling (compared in Christchurch only)**

   Compared to the Waitakere NOW Home, the Y2016 consented homes, with very rare exceptions, are considerably less comfortable when only using passive heating or cooling (Christchurch result available only), having more extreme temperatures in the main living area.

6. **Fewer extreme temperatures in the main living area (compared in Christchurch only).**

   Compared to the Waitakere NOW Home, the random homes have considerably more overheating (defined as temperatures greater than 25°C) in a key area – the lounge. This suggests that randomly selected designs didn't consider shading in a meaningful way.

   The thermal performance of the Waitakere NOW Home is considerably better in terms of limiting both uncomfortably hot and unhealthily low temperatures when using the main living space as a proxy for the whole house.

While this 2019 report found some improvements over an earlier benchmarking report in 2015, it concludes that the underperformance of new homes needs urgent attention.

> "There is good evidence that newly built, detached New Zealand homes are far from well planned, based on those consented in 2016 in three key cities. This situation needs urgent remedying, especially if New Zealand wants significant progress in this area to meet its 2050 goals of being carbon neutral as well as generally improve new homes' comfort, health and affordability….
>
> The time for discussion is over."

For more information, go to www.branz.co.nz and look for this report:
Jaques, R. (2019). Measuring our sustainability progress: New Zealand's new detached residential housing stock (first update). BRANZ Study Report SR426.

Find out more about Beacon

Our website includes all the research undertaken in Beacon's original government research contract, and information on current research and projects.
www.beaconpathway.co.nz

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About this Report

Reference
Beacon Pathway (2020).The Waitakere NOW Home: A case study in home performance.