

Water, Water, Everywhere....

Quantifying Possible Domestic Water Demand Savings Through The Use of Rainwater Collection from Residential Roofs in Auckland, New Zealand

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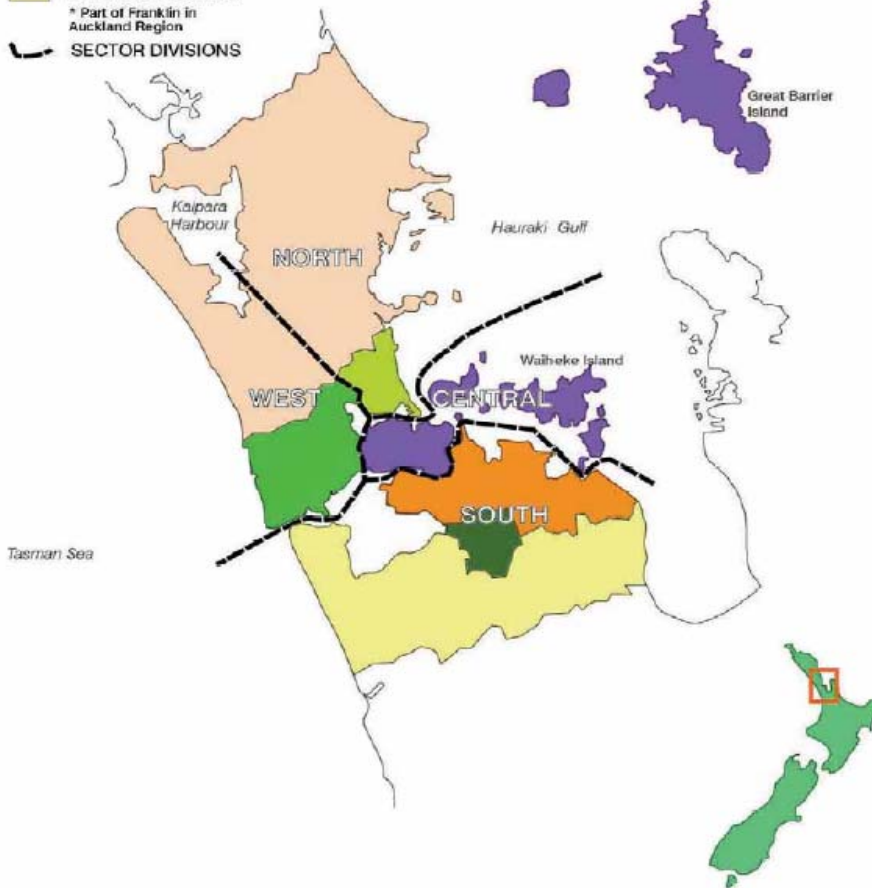
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AUCKLAND REGION

- RODNEY DISTRICT
- NORTH SHORE CITY
- WAITAKERE CITY
- AUCKLAND CITY
- MANUKAU CITY
- PAPAKURA DISTRICT
- FRANKLIN DISTRICT
- * Part of Franklin in Auckland Region
- SECTOR DIVISIONS



(Source: Auckland Regional Growth Strategy, 1999. p.31)

Auckland Region

Population: 1,158,891
(Statistics NZ, 2001)

Land Area: 16,140 km²

Four Cities:

Auckland City, North
Shore City, Waitakere City
and Manukau City

+

Three Districts:

Rodney District, Papakura
District and Franklin
District

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Household Water Use Breakdown (Waitakere City Council, 2005)

Water Use Categories	Percentage Breakdown	Water Use (litres per capita per day – averaged)
Kitchen	10%	17
Bathroom	25%	43
Laundry	20%	35
Toilets	25%	43
Garden	20%	35
TOTAL		173 (63 m³/ year/ capita)



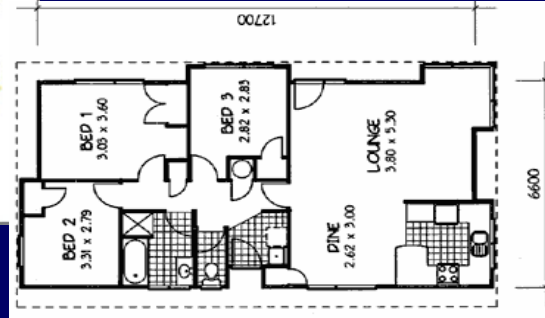
Total Water Collected from Roof (m³/annum) and Estimation of Potential Occupancy based on Rainwater Water Supply

Typical roof areas (m ²)	Total water collection from roof (m ³ /annum) = Roof area (m ²) X 0.9 X average annual rainfall (m)	Potential occupancy based on 63 m ³ /year/capita (no. of people)
100 m ²	112	1.8
150 m ²	168	2.7
200 m ²	224	3.6
250 m ²	280	4.4

Calculated Average Annual Rainfall for Auckland Region: **1244 mm**



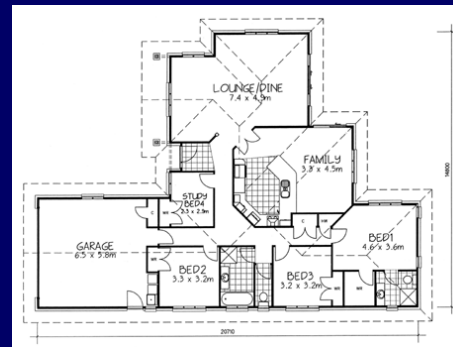
Keith Hay Homes



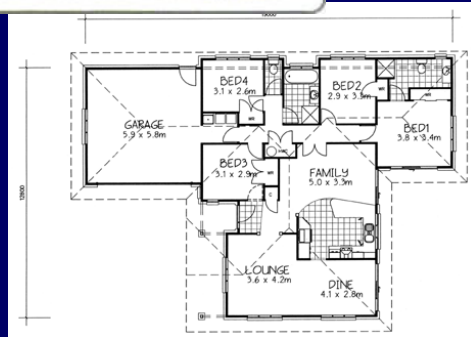
“Classic Collection”
Floor Area: 90 m²



“Classic Collection”
Floor Area: 138 m²



“Life Style”
Floor Area:
203 m²



“Life Style”
Floor Area:
177m²

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Interrelationship of Roof Areas, Number of Bedrooms and Water Supply

Typical roof areas (m ²)	Water collection from roof (m ³ /annum)	Potential occupancy based on available water (no. of people)	Assumed no. of bedrooms	Potential occupancy based on no. of bedrooms (no. of people)	Required water supply for occupancy @173 lcd (m ³ /annum)	Percentage of water supply that could be provided by rainwater
100 m ²	112	1.8	3	4	253	44%
150 m ²	168	2.7	4	5	316	53%
200 m ²	224	3.6	5	6	379	59%
250 m ²	280	4.4	6	7	442	63%



Household Water Use Scenarios

(Ref: I. Gunn, 2000, quoted in Parliamentary Commissioner for the Environment, 2001)

- **Standard water use facilities**  **73.0**
200 lit / capita /day
- **Standard water reduction fixtures**  **67.7**
180 lit / capita /day
- **Enhanced water reduction fixtures**  **51.1**
140 lit / capita /day
- **Full water reduction fixtures**  **32.9**
90 lit / capita /day

Per capita annual flow allowance (m³/ annum)



Water Self sufficiency of Houses – Roof Rain Water Collection

Typical roof areas (m ²)	Potential occupancy based on number of bedrooms (No. of people)	Water demand under Gunn's four demand-reduction scenarios (m ³ / annum)				Water collection from roof (m ³ / annum)
		1	2	3	4	
100 m ²	4	292	271	204	132	112
150 m ²	5	365	339	256	165	168
200 m ²	6	438	406	307	197	224
250 m ²	7	511	474	358	230	280



Example: Small House, Waiheke Island



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Example: Medium House, Waiheke Island



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Example: Medium- Large House, Waiheke Island



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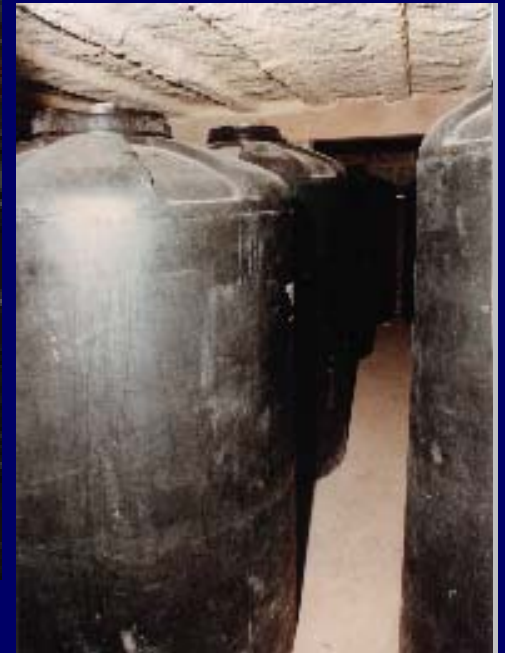
Example: Large House, Waiheke Island



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The Autonomous House, UK



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Autonomous House Water Use vs. Auckland Average

Water use categories	Percentage breakdown – conventional	Water use – conventional (litres per capita per day, averaged)	Percentage breakdown – conventional excluding toilets and garden	Water use – Autonomous House (litres per capita per day, averaged)	Percentage breakdown – Autonomous House
Kitchen	10%	17	18%	7	20%
Bathroom	5%	43	45%	21	62%
Laundry	20%	35	37%	6	18%
Toilets	25%	43		-nil	
Garden	20%	35		-nil	
TOTAL		173 (253 m ³ / year for 4 people)		34 (50 m ³ / year for 4 people)	
TOTAL excluding toilets and garden		95 (140 m ³ / year for 4 people)		34	



Costs of Reticulated Water Supply

1. Service charge \$30 per year
2. Wholesale charge \$0.515 per m³
3. Metrowater network charge \$0.66 per m³
4. A standard new water connection (20 mm) \$580

Network Upgrade Charge levied on each new dwelling is \$2126.25

(Ref: Metrowater, 2005, NZ)

Note: The costs considered in this paper do not address the cost of filtration, treatment systems and maintenance for rainwater use.



Cost of Typical Water Consumption from Reticulated and Rainwater Supply

Typical roof areas (m ²)	Potential occupancy and water demand (no. of people) (m ³ /annum)	Cost of water inc service charge and network upgrade charge (\$NZ per annum)	Net Present Value for a period of 75 years (\$NZ)	Net Present Value for a period of 7 years of property ownership (\$NZ)
100 m ²	4 (253 m ³)	\$327	\$6862	\$4,251
150 m ²	5 (316 m ³)	\$401	\$7845	\$4,643
200 m ²	6 (379 m ³)	\$475	\$8827	\$5,035
250 m ²	7 (442m ³)	\$501	\$9810	\$5,427
100 m ² (4 person household)	4 (112 m ³)	\$162	\$4663	\$3,373
25,000 litre Rainwater Tank	-	\$5 (electricity cost for pumping)	\$5901	\$5,392



Net Present Value (NPV) Comparisons

- For a period of 75 years, Rainwater Tanks appear financially attractive for four typical roof areas;
- For a short term of 7 years, only larger roof areas of, for example, 250 m², show financial advantages for the householder for rainwater tank investment;
- The four-person household with reduced demand (112 m³ per year) and 100 m² roof area could buy reticulated water at a lower cost compared to rainwater supply, at both 75-year and 7-year time frames.



Outcomes

- **Household rainwater collection could supply an adequate amount of water, at least in the Auckland Region.**
- **Possibly more long term Cost Benefits associated with Rain Water Supply compared to that of conventional water supply;**
- **Consideration of rainwater based domestic water supply systems for new developments while leaving the existing water system to supply existing dwellings.**
- **For a cost effective solution, rain water should supply all of a household's water demand;**
- **Duplication of reticulated water and rainwater systems will result in a consequent increase in costs;**
- **Further research is needed to ensure there are low-cost ways to allow rainwater systems to provide an effective and safe water supply for users;**



Water, water, everywhere
Nor any drop to drink

The ancient mariner stranded in the Sargasso sea
could not drink the salt water around him.....

..... but we have the opportunity to use the rain
water that falls **everywhere** on the roofs for
domestic supply in order to reach a more
sustainable water future.

Thank you.

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