



Ministry of Social Development

Baseline valuation of the social housing system

As at 30 June 2015

Appendices

APPENDIX A GUIDE TO APPENDICES

The Appendices provide much of the technical detail of our approach. The following table describes the various appendices supplied with the report.

#	Title	Description
A	Guide to Appendices	Describes appendices
B	Further background	Provides links to some background reading referred to in the report
C	Projection assumptions	Details on assumptions used, including inflation, discounting, unemployment rate, overpayment recovery and recoverable assistance
D	Data supplied	Describes the datasets provided by MSD and used in the valuation
E	Valuation scope	Details the various payment types and benefit codes valued
F	Details on modelling approach	Provides further detail on the types of models used in the valuation and their explicit parameterisation
G	Model Coefficients <i>[Separate Excel file]</i>	Excel file of parameters for each of the models
H	Sensitivity analysis	A segment level detailing of sensitivity to key models, rental growth, unemployment, discounting and inflation rates
I	Other one-way tables	Showing current client liability across a number of different dimensions
J	Projected number of clients and payments <i>[Separate Excel file]</i>	Tables detailing the projected number of people in each state and their corresponding payments, over the duration of the projection



APPENDIX B FURTHER BACKGROUND

B.1 Welfare valuations

The welfare valuation is referred to extensively in the report, Taylor Fry has been working in partnership with MSD and the Treasury since June 2011 to help develop the investment approach in the benefit system. Further detail is provided in our initial report on the feasibility of an investment approach, and in the five following valuations of the benefit system. All six reports are publicly available on MSD's website.

- » **Feasibility study:** <http://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/evaluation/taylor-fry-ia-feasibility/taylor-fry-feasibility-of-an-ia-for-welfare-report.pdf>
- » **2011 Welfare Valuation:** <http://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2012/valuation-report.html>
- » **2012 Welfare Valuation:** <https://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2013/taylor-fry-welfare-valuation.html>
- » **2013 Welfare Valuation:** <https://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2014/taylor-fry-welfare-valuation.html>
- » **2014 Welfare Valuation:** <http://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2015/reforms-succeed.html>
- » **2015 Welfare Valuation:** <https://www.msd.govt.nz/about-msd-and-our-work/newsroom/media-releases/2016/2015-valuation-of-the-benefit-system-for-working-age-adults.html>

The most recent valuation is particularly relevant; it covers the same valuation date as the housing valuation and the integrated nature of the models mean that many of the comments in that report are relevant to the housing valuation population.

B.2 Social housing and the Social Housing Reform Programme (SHRP)

The report forms part of the New Zealand Government's SHRP. Further background, including cabinet papers, is available at

<http://www.socialhousing.govt.nz/>

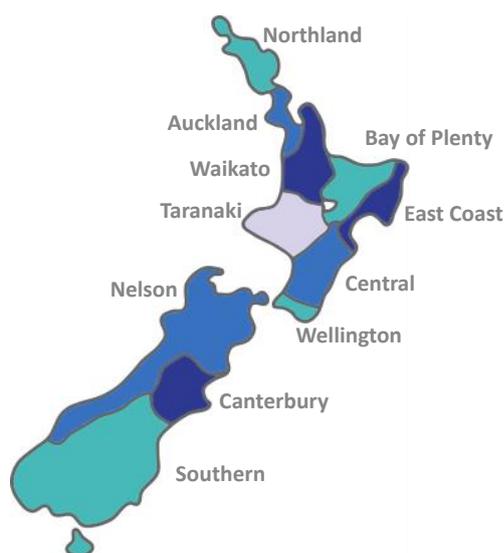
There are also a significant number of publications and statistics regarding the social housing system available at both the MSD and HNzc websites. Interested readers can visit:

- » <http://housing.msd.govt.nz/information-for-housing-providers/register/index.html>
- » <http://www.hnzc.co.nz/publications/>

B.3 Work and Income regions, and territorial local authorities

MSD has 11 regions that it uses to manage its services. These are summarised in the figure below.

Figure B.1 Work and income regions



To give a finer-grained view of location, this valuation models at a Territorial Local Authority (TLA) level (65 of them, excluding Auckland). Auckland is a single TLA, and we split this into the 20 local boards. These are all listed in the table below with their associated Work and Income region. Note that these groupings are not entirely exact; some TLAs straddle more than one Work and Income region.

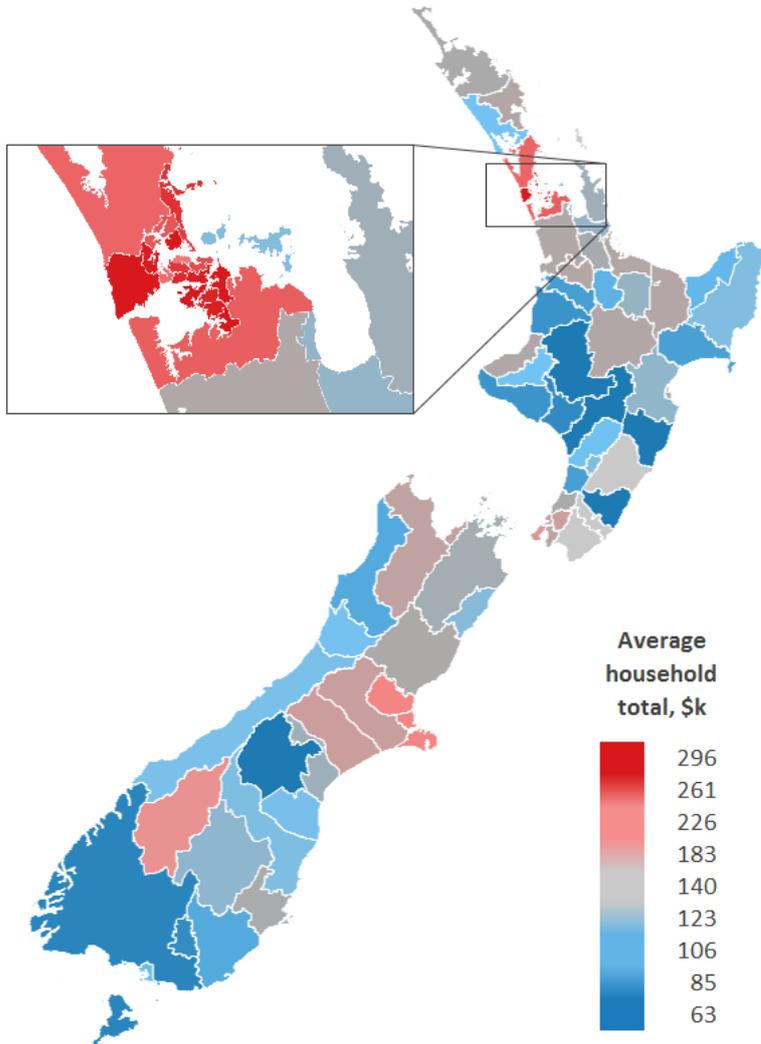
Table B.1 List of TLAs and Boards plus associated Work & Income region

Region	TLA/Board	Region	TLA/Board	Region	TLA/Board
Northland	Far North District	Central	Horowhenua District	Southern	Invercargill City
Northland	Kaipara District	Central	Kapiti Coast District	Southern	Mackenzie District
Northland	Whangarei District	Central	Manawatu District	Southern	Queenstown-Lakes District
Waikato	Hamilton City	Central	Masterton District	Southern	Southland District
Waikato	Hauraki District	Central	Palmerston North City	Southern	Timaru District
Waikato	Matamata-Piako District	Central	Rangitikei District	Southern	Waimate District
Waikato	Thames-Coromandel District	Central	Carterton District	Southern	Waitaki District
Waikato	Waikato District	Central	South Wairarapa District	Auckland	Albert-Eden Local Board Area
Waikato	Waipa District	Central	Tararua District	Auckland	Devonport-Takapuna Local Board Area
Bay of Plenty	Kawerau District	Wellington	Lower Hutt City	Auckland	Franklin Local Board Area
Bay of Plenty	Opotiki District	Wellington	Porirua City	Auckland	Henderson-Massey Local Board Area
Bay of Plenty	Rotorua District	Wellington	Upper Hutt City	Auckland	Hibiscus and Bays Local Board Area
Bay of Plenty	South Waikato District	Wellington	Wellington City	Auckland	Howick Local Board Area
Bay of Plenty	Taupo District	Nelson	Buller District	Auckland	Kaipatiki Local Board Area
Bay of Plenty	Tauranga City	Nelson	Grey District	Auckland	Mangere-Otahuhu Local Board Area
Bay of Plenty	Western Bay of Plenty District	Nelson	Kaikoura District	Auckland	Manurewa Local Board Area
Bay of Plenty	Whakatane District	Nelson	Marlborough District	Auckland	Maungakiekie-Tamaki Local Board Area
East Coast	Central Hawke's Bay District	Nelson	Nelson City	Auckland	Orakei Local Board Area
East Coast	Gisborne District	Nelson	Tasman District	Auckland	Otara-Papatoetoe Local Board Area
East Coast	Hastings District	Nelson	Westland District	Auckland	Papakura Local Board Area
East Coast	Napier City	Canterbury	Ashburton District	Auckland	Puketapapa Local Board Area
East Coast	Wairoa District	Canterbury	Christchurch City	Auckland	Rodney Local Board Area
Taranaki	New Plymouth District	Canterbury	Hurunui District	Auckland	Upper Harbour Local Board Area
Taranaki	Otorohanga District	Canterbury	Selwyn District	Auckland	Waiheke Local Board Area
Taranaki	Ruapehu District	Canterbury	Waimakariri District	Auckland	Waitakere Ranges Local Board Area
Taranaki	South Taranaki District	Southern	Central Otago District	Auckland	Waitemata Local Board Area
Taranaki	Stratford District	Southern	Clutha District	Auckland	Whau Local Board Area
Taranaki	Waitomo District	Southern	Dunedin City		
Taranaki	Wanganui District	Southern	Gore District		

The figure below shows the division of New Zealand into TLA and board.



Figure B.2 TLA and board boundaries, shading indicates average lifetime housing cost for those in social housing



APPENDIX C PROJECTION ASSUMPTIONS

C.1 Inflation assumptions

We model historical payments in June 2015 dollars. To do this, we inflate older payments to current levels using the historical Consumer Price Index (CPI) as show in Table C.1.1 below, this is consistent with benefit rate increases. We also apply inflation to our projected payments in line with Treasury forecasts, presented in Table C.1.2. Superannuation payments to those aged over 65 are currently pegged to changes in average weekly earnings (AWE). Tables C.1.1 and C.1.2 also show the historical and projected AWE increases presented relative to CPI. As discussed in Section 9.4.3 we have assumed that growth in rents will be faster than AWE growth in the short to medium term. The historical and projected rental growth assumptions are also presented (as a difference to CPI) in Tables C.1.1 and C.1.2.

Table C.1.1 Historic CPI, AWE and rental growth increases

Date	CPI Yearly increase	CPI Scale up factor to June 2015	AWE yearly increase	Rental growth yearly increase
Apr-95	4.0%	1.51	-1.6%	1.7%
Apr-96	2.2%	1.48	0.7%	3.2%
Apr-97	1.8%	1.46	2.1%	2.0%
Apr-98	1.3%	1.44	0.1%	-0.6%
Apr-99	-0.1%	1.44	2.1%	0.0%
Apr-00	1.5%	1.41	0.0%	-0.8%
Apr-01	3.1%	1.37	-0.7%	-2.0%
Apr-02	2.6%	1.33	3.1%	1.9%
Apr-03	2.5%	1.31	0.7%	4.5%
Apr-04	1.5%	1.28	2.0%	5.6%
Apr-05	2.8%	1.25	0.3%	2.6%
Apr-06	3.3%	1.20	1.2%	2.0%
Apr-07	2.5%	1.18	2.9%	4.5%
Apr-08	3.4%	1.13	1.3%	3.2%
Apr-09	3.0%	1.11	2.6%	-1.7%
Apr-10	2.0%	1.09	-1.3%	0.1%
Apr-11	4.5%	1.04	-0.4%	-1.2%
Apr-12	1.6%	1.03	2.1%	1.1%
Apr-13	0.9%	1.02	1.9%	2.2%
Apr-14	1.5%	1.00	1.8%	1.7%
Apr-15	0.3%	1.00	2.3%	2.7%

Notes:

- (a) Increases to CPI and AWE apply at the first of April each year, as done by Work and Income
- (b) Increases to rent are applied quarterly.



Table C.1.2 Projected CPI, AWE and rental growth

Date	CPI Yearly increase	CPI Scale up factor	AWE yearly increase relative to CPI	Rental growth yearly increase (National), relative to CPI
01-Apr-15		1.000		
01-Apr-16	1.63%	1.016	-0.44%	0.54%
01-Apr-17	1.63%	1.033	0.74%	1.64%
01-Apr-18	1.63%	1.050	0.99%	1.79%
01-Apr-19	1.63%	1.067	1.17%	1.87%
01-Apr-20	1.63%	1.084	1.42%	2.02%
01-Apr-21	1.63%	1.102	1.50%	1.99%
01-Apr-22	1.63%	1.120	1.50%	1.89%
01-Apr-23	1.63%	1.138	1.50%	1.79%
01-Apr-24	1.63%	1.157	1.50%	1.69%
01-Apr-25	1.63%	1.175	1.50%	1.59%
01-Apr-26	1.63%	1.195	1.50%	1.50%
01-Apr-27	1.63%	1.214	1.50%	1.50%
01-Apr-28	1.67%	1.234	1.46%	1.46%
01-Apr-29	1.72%	1.26	1.45%	1.45%
01-Apr-30	1.77%	1.28	1.45%	1.45%
01-Apr-31	1.81%	1.30	1.46%	1.46%
01-Apr-32	1.86%	1.33	1.45%	1.45%
01-Apr-33	1.91%	1.35	1.45%	1.45%
01-Apr-34	1.96%	1.38	1.45%	1.45%
01-Apr-35	2.00%	1.40	1.46%	1.46%
01-Apr-36	2.05%	1.43	1.45%	1.45%
01-Apr-37	2.10%	1.46	1.45%	1.45%
01-Apr-38	2.15%	1.49	1.45%	1.45%
01-Apr-39	2.19%	1.53	1.46%	1.46%
01-Apr-40	2.24%	1.56	1.45%	1.45%
01-Apr-41	2.29%	1.60	1.45%	1.45%
01-Apr-42	2.34%	1.63	1.45%	1.45%
01-Apr-43	2.38%	1.67	1.46%	1.46%
01-Apr-44	2.43%	1.71	1.45%	1.45%
01-Apr-45	2.48%	1.76	1.45%	1.45%
01-Apr-46	2.50%	1.80	1.48%	1.48%
01-Apr-47	2.50%	1.85	1.50%	1.50%
01-Apr-48	2.50%	1.89	1.50%	1.50%
01-Apr-49	2.50%	1.94	1.50%	1.50%
01-Apr-50	2.50%	1.99	1.50%	1.50%
01-Apr-51	2.50%	2.04	1.50%	1.50%
01-Apr-52	2.50%	2.09	1.50%	1.50%
01-Apr-53	2.50%	2.14	1.50%	1.50%
01-Apr-54	2.50%	2.19	1.50%	1.50%
01-Apr-55	2.50%	2.25	1.50%	1.50%
01-Apr-56	2.50%	2.31	1.50%	1.50%
Later	2.50%		1.50%	1.50%

Notes:

- (a) CPI and AWE increases assumed to apply at 1 April, consistent with current practice.
- (b) Rent increases applied quarterly.
- (c) CPI assumptions based on Treasury projections of CPI as at Jun-15, in provided spreadsheet *disc-rates-jun15.xls*



Table C.1.3 Historical regional rental growth rates (3 bedrooms) by region

Date	Yearly 3 bedroom rental growth rate					
	Northland	Auckland	Waikato	Bay of Plenty	East coast	Taranaki
30-Jun-94	11.0%	7.3%	3.7%	6.2%	2.6%	3.9%
30-Jun-95	4.9%	12.7%	8.8%	5.9%	5.8%	4.9%
30-Jun-96	3.6%	10.0%	5.0%	3.7%	4.7%	1.1%
30-Jun-97	8.4%	2.3%	7.0%	2.0%	8.4%	-0.3%
30-Jun-98	4.0%	-3.2%	-0.9%	2.8%	-1.1%	0.8%
30-Jun-99	-3.2%	-3.4%	-0.2%	-0.9%	-0.7%	-0.2%
30-Jun-00	0.4%	0.8%	-1.7%	0.7%	-0.6%	-1.6%
30-Jun-01	0.5%	0.2%	-0.2%	1.6%	0.4%	-0.6%
30-Jun-02	1.9%	7.1%	4.5%	2.8%	3.4%	4.9%
30-Jun-03	3.5%	7.3%	4.4%	1.3%	5.9%	8.1%
30-Jun-04	10.4%	4.7%	10.6%	12.4%	8.3%	6.9%
30-Jun-05	8.7%	2.1%	6.8%	6.7%	6.1%	9.4%
30-Jun-06	11.9%	1.3%	7.2%	8.1%	5.6%	8.8%
30-Jun-07	7.4%	5.5%	6.6%	7.3%	6.0%	7.5%
30-Jun-08	4.2%	5.5%	4.7%	4.2%	5.2%	8.8%
30-Jun-09	-0.9%	0.2%	0.5%	-0.2%	0.4%	2.5%
30-Jun-10	2.0%	3.6%	2.1%	4.6%	2.4%	1.7%
30-Jun-11	1.7%	5.4%	3.3%	2.0%	2.5%	1.9%
30-Jun-12	2.5%	4.1%	1.6%	0.9%	3.1%	3.2%
30-Jun-13	0.4%	3.6%	3.4%	1.5%	0.6%	2.2%
30-Jun-14	1.9%	5.2%	2.5%	2.2%	3.9%	1.0%
30-Jun-15	6.9%	5.2%	4.5%	1.3%	4.9%	4.1%

Date	Yearly 3 bedroom rental growth rate					
	Central	Wellington	Nelson	Canterbury	Southern	Total
30-Jun-94	3.3%	3.1%	7.0%	3.4%	4.8%	5.6%
30-Jun-95	2.5%	7.0%	3.8%	7.4%	8.5%	9.1%
30-Jun-96	2.9%	5.9%	1.7%	3.9%	-2.5%	7.2%
30-Jun-97	2.2%	4.3%	2.3%	3.9%	-3.5%	3.9%
30-Jun-98	2.0%	7.5%	3.9%	-0.4%	-0.5%	-0.1%
30-Jun-99	2.6%	2.5%	1.5%	-2.4%	4.4%	-1.1%
30-Jun-00	0.3%	0.6%	-1.4%	0.5%	0.7%	0.4%
30-Jun-01	2.2%	2.0%	4.8%	0.4%	6.3%	1.1%
30-Jun-02	2.6%	1.9%	6.2%	6.6%	7.3%	5.6%
30-Jun-03	4.8%	3.9%	12.2%	9.2%	9.5%	6.4%
30-Jun-04	4.0%	2.7%	6.0%	10.1%	14.0%	6.3%
30-Jun-05	2.8%	4.9%	4.6%	4.6%	4.0%	3.7%
30-Jun-06	8.5%	5.8%	4.1%	5.4%	2.8%	4.1%
30-Jun-07	6.8%	10.0%	7.9%	6.2%	4.5%	6.2%
30-Jun-08	8.5%	7.5%	5.2%	4.8%	8.8%	5.8%
30-Jun-09	1.7%	5.0%	1.7%	-1.3%	-0.8%	0.5%
30-Jun-10	2.7%	2.0%	3.3%	2.9%	3.6%	2.9%
30-Jun-11	3.6%	2.6%	2.0%	4.0%	3.8%	3.7%
30-Jun-12	2.0%	1.8%	2.4%	8.6%	1.9%	3.6%
30-Jun-13	0.1%	1.4%	2.5%	10.0%	3.4%	3.1%
30-Jun-14	3.7%	3.7%	1.3%	7.9%	5.4%	4.7%
30-Jun-15	3.5%	2.1%	2.2%	2.2%	6.0%	4.1%

Notes:

- (a) Historical rental increases based on MBIE data from <http://www.mbie.govt.nz/info-services/housing-property/sector-information-and-statistics/rental-bond-data>



Table C.1.4 Projected regional rental growth rates by region

Date	Quarterly rental growth rate					
	Northland	Auckland	Waikato	Bay of Plenty	East coast	Taranaki
30-Sep-15	0.54%	0.73%	0.34%	-0.06%	0.54%	0.12%
31-Dec-15	0.53%	0.70%	0.36%	0.00%	0.54%	0.17%
31-Mar-16	0.53%	0.67%	0.37%	0.06%	0.53%	0.21%
30-Jun-16	0.85%	0.98%	0.72%	0.46%	0.86%	0.58%
30-Sep-16	0.80%	0.90%	0.69%	0.48%	0.80%	0.58%
31-Dec-16	0.79%	0.87%	0.71%	0.55%	0.79%	0.63%
31-Mar-17	0.79%	0.84%	0.74%	0.63%	0.79%	0.68%
30-Jun-17	0.78%	0.81%	0.76%	0.70%	0.78%	0.73%
30-Sep-17	0.88%	0.88%	0.88%	0.88%	0.88%	0.88%
31-Dec-17	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
31-Mar-18	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
30-Jun-18	0.86%	0.86%	0.86%	0.86%	0.86%	0.86%
30-Sep-18	0.88%	0.88%	0.88%	0.88%	0.88%	0.88%
31-Dec-18	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
31-Mar-19	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
30-Jun-19	0.86%	0.86%	0.86%	0.86%	0.86%	0.86%
30-Sep-19	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%
31-Dec-19	0.92%	0.92%	0.92%	0.92%	0.92%	0.92%
31-Mar-20	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
30-Jun-20	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%

Date	Quarterly rental growth rate					
	Central	Wellington	Nelson	Canterbury	Southern	Total
30-Sep-15	0.37%	0.19%	-0.06%	0.69%	0.83%	0.55%
31-Dec-15	0.38%	0.23%	0.00%	0.67%	0.79%	0.54%
31-Mar-16	0.39%	0.26%	0.06%	0.65%	0.76%	0.54%
30-Jun-16	0.74%	0.62%	0.46%	0.95%	1.05%	0.86%
30-Sep-16	0.71%	0.61%	0.48%	0.88%	0.95%	0.80%
31-Dec-16	0.72%	0.66%	0.55%	0.85%	0.91%	0.80%
31-Mar-17	0.74%	0.70%	0.63%	0.83%	0.87%	0.79%
30-Jun-17	0.76%	0.74%	0.70%	0.80%	0.82%	0.79%
30-Sep-17	0.88%	0.88%	0.88%	0.88%	0.88%	0.88%
31-Dec-17	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
31-Mar-18	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
30-Jun-18	0.86%	0.86%	0.86%	0.86%	0.86%	0.86%
30-Sep-18	0.88%	0.88%	0.88%	0.88%	0.88%	0.88%
31-Dec-18	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
31-Mar-19	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
30-Jun-19	0.86%	0.86%	0.86%	0.86%	0.86%	0.86%
30-Sep-19	0.93%	0.93%	0.93%	0.93%	0.93%	0.93%
31-Dec-19	0.92%	0.92%	0.92%	0.92%	0.92%	0.92%
31-Mar-20	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%
30-Jun-20	0.91%	0.91%	0.91%	0.91%	0.91%	0.91%



C.2 Discounting

Future cash flows are discounted to present value using the risk-free rate. This is taken to be the New Zealand government bond rate, as published by Treasury.

Table C.2.1 Discounting assumptions

Date	Treasury (monthly) forward rate	Discount factor applied to cashflows
30-Jun-16	2.76%	97.5%
30-Jun-17	2.88%	94.8%
30-Jun-18	3.08%	92.1%
30-Jun-19	3.30%	89.3%
30-Jun-20	3.54%	86.3%
30-Jun-21	3.81%	83.3%
30-Jun-22	4.04%	80.2%
30-Jun-23	4.24%	77.0%
30-Jun-24	4.39%	73.8%
30-Jun-25	4.50%	70.7%
30-Jun-26	4.56%	67.6%
30-Jun-27	4.60%	64.7%
30-Jun-28	4.65%	61.8%
30-Jun-29	4.70%	59.0%
30-Jun-30	4.75%	56.4%
30-Jun-31	4.80%	53.8%
30-Jun-32	4.85%	51.3%
30-Jun-33	4.90%	49.0%
30-Jun-34	4.95%	46.7%
30-Jun-35	5.00%	44.5%
30-Jun-36	5.05%	42.3%
30-Jun-37	5.10%	40.3%
30-Jun-38	5.15%	38.3%
30-Jun-39	5.20%	36.4%
30-Jun-40	5.25%	34.6%
30-Jun-41	5.30%	32.9%
30-Jun-42	5.35%	31.2%
30-Jun-43	5.40%	29.7%
30-Jun-44	5.45%	28.1%
30-Jun-45	5.50%	26.7%
30-Jun-46	5.50%	25.3%
30-Jun-47	5.50%	24.0%
30-Jun-48	5.50%	22.7%
30-Jun-49	5.50%	21.5%
30-Jun-50	5.50%	20.4%
30-Jun-51	5.50%	19.3%
30-Jun-52	5.50%	18.3%
30-Jun-53	5.50%	17.4%
30-Jun-54	5.50%	16.5%
30-Jun-55	5.50%	15.6%
30-Jun-56	5.50%	14.8%
30-Jun-57	5.50%	14.0%

Notes:

- (a) Discounting assumptions apply to the middle of each quarter. Although the table only shows the discount factor for each June quarter, in practice, separate discount factors are calculated for each quarter.
- (b) Assumptions based on Treasury projections of monthly forward rates as at Jun-15, in spreadsheet titled *disc-rates-jun15.xls*. Forward rates are as provided Treasury.



C.3 Unemployment rate

The unemployment rate is built into the welfare state transition models, and thus influences the valuation result. We use the new definitions of unemployment adopted by Statistics New Zealand in June 2016. We apply rates at a regional level.

Table C.3.1 Historic national unemployment rate

Unemployment rate				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	9.8%	10.5%	11.2%	11.0%
1992	11.0%	10.4%	10.6%	10.6%
1993	10.1%	10.2%	9.6%	9.4%
1994	9.3%	8.5%	8.0%	7.6%
1995	6.8%	6.4%	6.3%	6.4%
1996	6.4%	6.1%	6.5%	6.2%
1997	6.7%	6.8%	7.0%	7.0%
1998	7.4%	7.9%	7.7%	8.0%
1999	7.5%	7.3%	7.0%	6.4%
2000	6.4%	6.3%	6.0%	5.8%
2001	5.5%	5.4%	5.4%	5.6%
2002	5.3%	5.3%	5.6%	5.0%
2003	5.0%	4.8%	4.5%	4.7%
2004	4.3%	4.2%	3.9%	3.7%
2005	3.9%	3.9%	3.8%	3.8%
2006	4.1%	3.7%	3.9%	3.8%
2007	3.9%	3.6%	3.6%	3.3%
2008	3.7%	3.8%	4.0%	4.4%
2009	5.0%	5.7%	6.1%	6.5%
2010	5.9%	6.5%	6.0%	6.2%
2011	6.0%	6.0%	5.9%	6.0%
2012	6.3%	6.4%	6.7%	6.3%
2013	5.7%	6.0%	5.7%	5.6%
2014	5.5%	5.3%	5.2%	5.5%
2015	5.4%	5.5%		

Notes:

(a) Rates supplied by Treasury, sourced from Infoshare, table reference HLF097AA. Figures are seasonally adjusted.

Table C.3.2 Projected national unemployment rate

Unemployment rate				
Year	31-Mar	30-Jun	30-Sep	31-Dec
2015			5.4%	5.3%
2016	5.2%	5.0%	4.9%	4.9%
2017	4.8%	4.7%	4.6%	4.5%
2018	4.4%	4.4%	4.3%	4.2%
2019	4.2%	4.2%	4.1%	4.1%
2020	4.1%	4.1%	4.1%	4.1%

Notes:

(a) Annual unemployment forecasts provided by Treasury in their BEFU 2015 economic forecasts to June 2019.

(b) (b) The number of years until reversion to full employment has been extended from March 2018 to March 2020 in recognition of the difference between the actual unemployment rate in the June 2015 quarter and Treasury forecast.



Table C.3.3.1 Historical regional unemployment rates in Northland

Unemployment rate in Northland				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	13.1%	13.6%	13.6%	14.8%
1992	16.3%	12.3%	12.7%	12.1%
1993	10.0%	16.0%	15.8%	14.3%
1994	12.7%	12.9%	14.8%	14.3%
1995	13.6%	10.0%	10.1%	11.7%
1996	12.0%	11.4%	9.2%	6.9%
1997	8.7%	10.4%	9.3%	10.1%
1998	12.7%	11.5%	11.5%	14.2%
1999	13.3%	14.1%	9.2%	9.7%
2000	9.7%	8.9%	9.2%	9.1%
2001	7.9%	6.9%	8.5%	9.6%
2002	11.1%	8.9%	8.8%	8.8%
2003	10.2%	7.6%	8.7%	7.2%
2004	4.4%	5.0%	5.4%	4.4%
2005	4.4%	7.4%	5.9%	5.0%
2006	5.7%	6.0%	5.7%	3.6%
2007	5.2%	3.5%	5.5%	2.7%
2008	4.7%	4.1%	7.1%	6.5%
2009	8.5%	7.7%	8.9%	9.0%
2010	8.8%	8.9%	7.8%	8.2%
2011	9.3%	7.2%	8.2%	7.8%
2012	8.1%	8.7%	9.0%	9.0%
2013	9.3%	6.8%	9.0%	8.2%
2014	7.5%	7.3%	8.3%	7.8%
2015	8.8%	7.4%		

Table C.3.3.2 Historical regional unemployment rates in Auckland

Unemployment rate in Auckland				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	10.9%	11.3%	12.3%	11.9%
1992	13.0%	12.0%	10.9%	10.9%
1993	10.8%	10.6%	9.9%	8.7%
1994	10.1%	8.0%	7.3%	6.7%
1995	5.9%	5.8%	5.4%	5.2%
1996	5.1%	5.3%	5.7%	5.1%
1997	6.4%	7.0%	7.3%	7.0%
1998	7.7%	7.8%	6.7%	6.7%
1999	7.0%	6.3%	6.3%	5.0%
2000	6.5%	6.0%	5.2%	5.1%
2001	5.4%	5.7%	4.3%	4.7%
2002	5.0%	5.2%	5.0%	4.1%
2003	4.6%	4.1%	3.5%	3.9%
2004	4.5%	3.9%	3.9%	3.4%
2005	4.3%	3.4%	3.5%	3.7%
2006	3.9%	3.2%	3.8%	3.9%
2007	4.6%	3.3%	3.6%	3.6%
2008	4.6%	4.1%	4.1%	5.0%
2009	6.3%	6.1%	6.2%	7.2%
2010	7.5%	8.1%	6.7%	6.9%
2011	7.0%	6.6%	6.2%	6.1%
2012	7.2%	6.8%	7.7%	6.4%
2013	6.7%	6.3%	5.9%	5.6%
2014	6.6%	5.8%	5.7%	5.6%
2015	6.5%	5.9%		

Table C.3.3.3 Historical regional unemployment rates in Waikato

Unemployment rate in Waikato				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	10.7%	10.8%	11.6%	10.9%
1992	12.1%	11.2%	11.0%	10.5%
1993	12.1%	12.1%	9.6%	9.7%
1994	9.8%	9.4%	7.7%	7.8%
1995	8.8%	6.8%	6.3%	6.6%
1996	8.2%	6.5%	7.5%	6.5%
1997	8.3%	7.5%	6.7%	7.4%
1998	8.3%	8.4%	8.4%	9.2%
1999	10.3%	8.7%	7.6%	6.4%
2000	7.9%	5.9%	6.2%	6.1%
2001	6.6%	6.0%	5.9%	6.3%
2002	6.3%	5.0%	5.6%	5.6%
2003	5.7%	5.2%	3.3%	4.4%
2004	4.0%	3.1%	2.9%	3.2%
2005	4.2%	4.9%	3.9%	4.2%
2006	4.5%	2.9%	3.7%	2.8%
2007	4.4%	3.7%	3.3%	3.3%
2008	4.1%	3.9%	4.3%	4.4%
2009	5.6%	6.5%	6.0%	5.7%
2010	5.2%	5.7%	6.5%	5.5%
2011	6.7%	5.7%	6.6%	6.0%
2012	8.0%	6.5%	5.8%	5.4%
2013	5.4%	5.4%	5.7%	6.3%
2014	6.2%	6.1%	5.6%	5.4%
2015	6.0%	4.6%		

Table C.3.3.4 Historical regional unemployment rates in Bay of Plenty

Unemployment rate in Bay of Plenty				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	13.5%	11.4%	12.9%	13.3%
1992	13.5%	12.8%	12.9%	12.6%
1993	13.5%	10.6%	9.6%	11.8%
1994	13.2%	10.7%	10.1%	9.7%
1995	10.1%	9.6%	7.0%	8.3%
1996	9.3%	6.6%	8.1%	9.2%
1997	10.6%	9.1%	8.3%	9.1%
1998	9.9%	12.2%	11.2%	11.7%
1999	11.9%	10.9%	9.2%	8.6%
2000	7.5%	8.9%	8.4%	6.7%
2001	9.0%	7.9%	8.6%	8.2%
2002	7.5%	8.3%	7.4%	6.9%
2003	7.9%	7.0%	5.3%	6.2%
2004	7.0%	5.3%	3.2%	4.5%
2005	4.7%	3.1%	4.3%	4.2%
2006	5.1%	3.9%	4.2%	3.6%
2007	4.0%	2.9%	3.4%	3.7%
2008	4.9%	3.8%	4.1%	4.3%
2009	5.9%	5.7%	7.6%	6.9%
2010	7.7%	7.7%	8.3%	6.8%
2011	7.1%	6.6%	7.3%	7.8%
2012	8.1%	5.8%	6.8%	8.2%
2013	7.7%	5.8%	6.8%	8.8%
2014	6.7%	5.4%	6.3%	5.4%
2015	7.5%	6.3%		

Table C.3.3.5 Historical regional unemployment rates in East Coast

Unemployment rate in East Coast				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	12.1%	12.5%	11.3%	9.7%
1992	11.4%	10.0%	11.3%	13.6%
1993	9.9%	11.8%	10.3%	12.8%
1994	12.7%	8.8%	8.9%	9.4%
1995	9.2%	7.1%	7.7%	6.3%
1996	7.0%	7.4%	9.1%	7.9%
1997	8.9%	8.1%	10.2%	8.2%
1998	9.3%	9.2%	10.7%	8.1%
1999	7.0%	7.4%	7.6%	9.3%
2000	7.3%	6.3%	7.7%	8.0%
2001	7.0%	6.6%	6.0%	7.3%
2002	4.9%	5.0%	5.2%	6.0%
2003	6.3%	4.3%	5.3%	5.7%
2004	6.1%	4.4%	5.5%	5.0%
2005	4.7%	4.8%	7.0%	4.9%
2006	3.9%	3.8%	4.9%	4.8%
2007	4.8%	5.0%	4.2%	4.7%
2008	5.8%	4.4%	6.7%	6.3%
2009	6.8%	7.2%	9.7%	8.2%
2010	6.5%	8.2%	7.0%	6.9%
2011	7.8%	6.8%	7.0%	6.7%
2012	7.8%	6.0%	8.7%	8.4%
2013	8.0%	7.3%	8.1%	7.1%
2014	7.9%	6.5%	6.8%	7.8%
2015	7.2%	7.7%		

Table C.3.3.6 Historical regional unemployment rates in Taranaki

Unemployment rate in Taranaki				
Year	31 Mar	30 Jun	30-Sep	31-Dec
1991	9.6%	11.4%	13.2%	14.6%
1992	13.6%	10.1%	10.3%	12.2%
1993	13.4%	8.6%	11.2%	10.0%
1994	10.0%	8.2%	8.1%	7.8%
1995	7.8%	6.3%	8.2%	6.5%
1996	7.6%	6.4%	8.1%	7.4%
1997	8.3%	7.0%	8.0%	6.5%
1998	6.6%	8.1%	6.9%	7.3%
1999	6.9%	6.2%	6.8%	8.9%
2000	10.2%	8.2%	6.3%	5.3%
2001	6.2%	4.8%	5.9%	6.1%
2002	5.1%	4.6%	5.8%	5.7%
2003	5.1%	5.6%	5.1%	4.5%
2004	5.3%	3.8%	4.3%	4.4%
2005	3.9%	2.9%	3.4%	4.2%
2006	5.1%	2.3%	3.6%	2.7%
2007	4.1%	4.0%	2.6%	2.6%
2008	3.5%	3.0%	3.3%	3.1%
2009	2.7%	4.3%	3.7%	5.9%
2010	4.8%	4.5%	4.8%	4.8%
2011	4.6%	5.1%	5.0%	3.5%
2012	4.5%	3.5%	4.4%	5.0%
2013	5.1%	5.1%	5.1%	5.6%
2014	6.3%	5.0%	4.4%	4.8%
2015	6.0%	7.3%		

Table C.3.3.7 Historical regional unemployment rates in Central

Unemployment rate in Central				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	11.8%	11.4%	11.8%	11.1%
1992	12.4%	10.4%	12.0%	13.0%
1993	12.1%	11.3%	9.3%	9.6%
1994	9.5%	8.9%	9.2%	8.7%
1995	6.0%	6.2%	8.2%	8.0%
1996	7.5%	6.3%	6.3%	6.1%
1997	6.0%	5.9%	5.5%	5.7%
1998	8.0%	6.9%	8.3%	5.6%
1999	7.5%	5.7%	7.3%	7.9%
2000	6.8%	6.8%	6.8%	5.5%
2001	6.7%	4.6%	4.3%	5.4%
2002	6.2%	5.4%	5.3%	4.0%
2003	4.8%	5.3%	5.4%	3.8%
2004	5.9%	4.3%	3.0%	4.3%
2005	4.8%	4.2%	4.5%	4.3%
2006	5.4%	4.8%	4.0%	4.4%
2007	5.0%	5.2%	5.1%	5.3%
2008	5.0%	4.4%	3.6%	3.7%
2009	4.7%	4.6%	5.4%	7.8%
2010	6.9%	6.8%	6.2%	6.5%
2011	6.5%	6.7%	6.1%	6.1%
2012	8.7%	6.9%	7.7%	8.0%
2013	7.0%	8.3%	7.1%	5.1%
2014	7.4%	6.7%	6.5%	8.8%
2015	7.2%	6.5%		

Table C.3.3.8 Historical regional unemployment rates in Wellington

Unemployment rate in Wellington				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	8.7%	8.4%	8.2%	8.3%
1992	10.1%	8.0%	9.6%	10.0%
1993	10.0%	8.9%	9.2%	9.5%
1994	9.3%	9.3%	8.0%	7.7%
1995	7.6%	6.4%	6.5%	6.9%
1996	7.6%	6.4%	5.4%	6.0%
1997	6.6%	5.3%	5.0%	5.8%
1998	5.8%	5.4%	5.7%	7.1%
1999	6.7%	6.7%	5.1%	4.2%
2000	6.4%	5.4%	5.1%	4.8%
2001	4.5%	3.3%	4.7%	4.8%
2002	5.9%	4.6%	4.9%	5.0%
2003	6.2%	4.9%	4.8%	5.6%
2004	4.8%	4.8%	4.0%	4.0%
2005	4.7%	4.2%	3.2%	3.1%
2006	5.8%	5.9%	3.7%	4.5%
2007	4.7%	3.4%	3.3%	2.4%
2008	5.0%	3.1%	3.4%	3.5%
2009	4.7%	5.3%	5.6%	6.0%
2010	5.1%	4.8%	4.5%	4.8%
2011	6.4%	4.8%	5.0%	6.6%
2012	5.6%	5.9%	6.4%	7.1%
2013	6.2%	5.8%	5.4%	6.0%
2014	5.1%	5.0%	5.2%	5.5%
2015	5.7%	5.1%		

Table C.3.3.9 Historical regional unemployment rates in Nelson

Unemployment rate in Nelson				
Year	31-Mar	30-Jun	30-Sep	31-Dec
1991	9.3%	8.0%	7.1%	9.7%
1992	9.4%	6.1%	7.3%	9.1%
1993	8.3%	9.4%	7.9%	9.4%
1994	9.9%	6.8%	6.0%	6.5%
1995	7.7%	4.2%	5.5%	4.2%
1996	4.9%	5.9%	6.1%	7.2%
1997	5.2%	5.9%	4.8%	4.8%
1998	5.5%	7.3%	5.9%	5.3%
1999	6.2%	5.7%	6.8%	6.3%
2000	4.9%	5.4%	4.6%	4.7%
2001	3.0%	2.5%	4.6%	4.1%
2002	3.5%	4.0%	2.3%	4.3%
2003	3.5%	3.0%	3.8%	3.6%
2004	2.8%	3.3%	1.9%	2.2%
2005	2.8%	2.4%	2.6%	3.3%
2006	4.2%	2.1%	3.2%	3.2%
2007	2.3%	3.4%	2.6%	2.6%
2008	3.3%	2.9%	3.2%	3.3%
2009	2.9%	3.2%	4.1%	4.4%
2010	4.7%	3.2%	3.7%	4.4%
2011	5.0%	4.0%	3.9%	4.6%
2012	5.5%	4.3%	4.5%	5.7%
2013	4.6%	4.0%	4.0%	4.1%
2014	4.9%	3.9%	3.5%	6.1%
2015	4.3%	4.4%		

Table C.3.3.10 Historical regional unemployment rates in Canterbury

Year	Unemployment rate in Canterbury			
	31-Mar	30-Jun	30-Sep	31-Dec
1991	8.7%	9.0%	9.8%	9.8%
1992	8.8%	9.3%	8.9%	8.5%
1993	9.7%	7.4%	6.6%	8.0%
1994	8.2%	7.2%	5.9%	6.5%
1995	6.0%	5.9%	5.2%	6.0%
1996	6.8%	6.0%	5.6%	6.3%
1997	7.2%	6.1%	6.8%	6.2%
1998	8.0%	7.6%	7.1%	8.5%
1999	7.8%	7.2%	7.1%	6.7%
2000	5.9%	6.2%	5.5%	5.4%
2001	6.0%	5.8%	5.2%	5.0%
2002	5.5%	4.7%	5.6%	4.2%
2003	4.4%	4.3%	4.4%	3.7%
2004	4.4%	4.0%	3.6%	3.1%
2005	4.0%	2.6%	3.0%	2.4%
2006	3.8%	2.7%	2.9%	2.9%
2007	3.3%	3.1%	2.7%	2.4%
2008	2.6%	3.1%	3.0%	3.3%
2009	4.5%	4.7%	5.2%	4.9%
2010	5.3%	4.5%	4.8%	5.4%
2011	4.9%	5.3%	4.9%	4.4%
2012	4.8%	6.0%	4.8%	4.4%
2013	4.0%	4.0%	3.9%	3.1%
2014	3.2%	2.7%	3.1%	3.4%
2015	2.8%	3.0%		

Table C.3.3.11 Historical regional unemployment rates in Southern region

Year	Unemployment rate in Southern			
	31-Mar	30-Jun	30-Sep	31-Dec
1991	7.2%	7.9%	9.6%	9.7%
1992	7.8%	8.6%	8.6%	7.6%
1993	7.2%	7.1%	8.0%	7.1%
1994	5.6%	6.5%	6.5%	6.0%
1995	4.9%	5.1%	3.8%	6.3%
1996	4.9%	5.5%	4.9%	4.7%
1997	4.8%	5.1%	5.4%	6.2%
1998	6.7%	6.6%	7.6%	7.3%
1999	7.1%	6.7%	6.5%	6.1%
2000	6.7%	5.8%	5.1%	5.7%
2001	4.5%	5.1%	5.4%	4.3%
2002	5.5%	4.7%	5.6%	4.9%
2003	5.1%	4.9%	4.9%	5.1%
2004	3.9%	3.9%	4.2%	3.4%
2005	4.2%	3.5%	2.6%	3.1%
2006	4.7%	2.9%	3.2%	3.2%
2007	3.2%	3.3%	2.9%	2.7%
2008	2.3%	3.6%	2.8%	2.8%
2009	3.6%	4.5%	4.7%	3.9%
2010	5.0%	4.3%	3.7%	4.6%
2011	4.0%	4.3%	4.2%	4.5%
2012	4.5%	4.1%	4.8%	4.1%
2013	3.9%	5.3%	4.8%	4.6%
2014	4.4%	3.1%	3.3%	3.6%
2015	3.5%	4.3%		

Notes:

- (a) Regional unemployment rates sourced from Statistics New Zealand. Figures are not seasonally adjusted.
- (b) Southern region rates are the population weighted average of two Statistics New Zealand regions; Southland and Otago.

C.4 Methodology for projecting regional unemployment rates

C.4.1 Regional unemployment rate approach – historical series

Our valuation models use a seasonally adjusted unemployment rate for New Zealand and its regions. Regional rates are only available in raw form, i.e. not seasonally adjusted. Therefore, for consistency in our modelling process, it is necessary to first produce seasonally-adjusted series of regional unemployment rates. We also remove some of the quarterly volatility via smoothing.

Our approach to producing adjusted regional unemployment rate series is as follows:

- » Source raw data from Statistics New Zealand
- » Calculate de-seasonalisation factors, taken as the average amount that quarter of year is above or below the average for a five-year moving window centred at that date. For example, the 1991Q2 de-seasonalisation factor is the average unemployment rate for Q2 in '89, '90, '91, '92, and '93 compared to the overall average in those five years
- » Centre the de-seasonalisation factors so that each rolling year of factors is centred at 100%
- » Use these centred de-seasonalisation factors to produce seasonally adjusted time series
- » Smooth the time series by using neighbouring quarters:

$$UE(t) = 0.25 UE(t - 1) + 0.5 UE(t) + 0.25 UE(t + 1)$$

C.4.2 Regional unemployment rate approach – projection series

The following approach is used to derive regional forecasts:

- » Find regional weights using the average total labour force over 2014/15.
- » Assume the quarters from 2005Q3 through to 2008Q2 represent a period of 'full employment', and calculate the average unemployment in each region over this period.
- » Calculate the difference between the regional average and national average over that period. These differentials are used in the regional long term rate assumption.
 - Currently Treasury uses 4.5% as the national long term unemployment rate. For example, a differential of +1.1% was calculated for Northland (over 2005-2008), so the Northland long term rate is 5.6%.
- » Mirror the Treasury projection shape for each region, taking the unemployment rate from the current level to the long-term average rate over 5 years.
 - Manual adjustment was made to the Canterbury projection; Canterbury's rate was judged to be lower than full employment, and a slow increase to 3.5% was assumed.
- » Add a correction factor to each future quarter, to ensure that the weighted average unemployment rate equals that used at the national level.

The forecast regional unemployment rates are shown below.



Table C.4.1 Projected regional unemployment rates

Date	Unemployment rate					
	Northland	Auckland	Waikato	Plenty	East coast	Taranaki
30-Sep-15	8.2%	5.9%	5.0%	7.2%	7.3%	6.4%
31-Dec-15	8.0%	5.7%	4.9%	6.9%	7.2%	6.2%
31-Mar-16	7.5%	5.5%	4.8%	6.6%	6.9%	5.9%
30-Jun-16	7.2%	5.3%	4.7%	6.3%	6.7%	5.7%
30-Sep-16	6.9%	5.2%	4.6%	6.1%	6.6%	5.5%
31-Dec-16	6.8%	5.1%	4.6%	6.0%	6.5%	5.4%
31-Mar-17	6.6%	5.1%	4.6%	5.9%	6.4%	5.3%
30-Jun-17	6.4%	4.9%	4.5%	5.7%	6.3%	5.2%
30-Sep-17	6.2%	4.8%	4.4%	5.5%	6.1%	5.0%
31-Dec-17	5.9%	4.7%	4.4%	5.3%	6.0%	4.8%
31-Mar-18	5.7%	4.6%	4.3%	5.1%	5.8%	4.7%
30-Jun-18	5.5%	4.4%	4.2%	4.9%	5.7%	4.5%
30-Sep-18	5.3%	4.3%	4.2%	4.8%	5.6%	4.4%
31-Dec-18	5.1%	4.3%	4.1%	4.7%	5.5%	4.3%
31-Mar-19	5.0%	4.2%	4.1%	4.6%	5.4%	4.2%
30-Jun-19	5.0%	4.2%	4.1%	4.5%	5.4%	4.2%
30-Sep-19	4.9%	4.2%	4.1%	4.5%	5.4%	4.1%
31-Dec-19	4.9%	4.1%	4.1%	4.5%	5.3%	4.1%
31-Mar-20	4.8%	4.1%	4.1%	4.4%	5.3%	4.1%
Later	4.8%	4.1%	4.1%	4.4%	5.3%	4.1%

Date	Unemployment rate					
	Central	Wellington	Nelson	Canterbury	Southern	Total
30-Sep-15	6.6%	5.4%	4.5%	3.0%	4.0%	5.4%
31-Dec-15	6.5%	5.3%	4.4%	3.1%	4.0%	5.3%
31-Mar-16	6.3%	5.2%	4.3%	3.1%	3.9%	5.2%
30-Jun-16	6.1%	5.1%	4.2%	3.1%	3.9%	5.0%
30-Sep-16	6.0%	5.0%	4.1%	3.1%	3.9%	4.9%
31-Dec-16	5.9%	5.0%	4.1%	3.1%	3.9%	4.9%
31-Mar-17	5.9%	4.9%	4.0%	3.1%	3.8%	4.8%
30-Jun-17	5.8%	4.9%	4.0%	3.2%	3.8%	4.7%
30-Sep-17	5.7%	4.8%	3.9%	3.2%	3.8%	4.6%
31-Dec-17	5.6%	4.7%	3.8%	3.2%	3.8%	4.5%
31-Mar-18	5.5%	4.7%	3.8%	3.2%	3.7%	4.5%
30-Jun-18	5.3%	4.6%	3.7%	3.2%	3.7%	4.4%
30-Sep-18	5.3%	4.6%	3.7%	3.2%	3.7%	4.3%
31-Dec-18	5.2%	4.5%	3.6%	3.3%	3.7%	4.2%
31-Mar-19	5.1%	4.5%	3.6%	3.3%	3.7%	4.2%
30-Jun-19	5.1%	4.5%	3.6%	3.3%	3.6%	4.2%
30-Sep-19	5.1%	4.5%	3.6%	3.3%	3.6%	4.1%
31-Dec-19	5.1%	4.4%	3.6%	3.3%	3.6%	4.1%
31-Mar-20	5.0%	4.4%	3.5%	3.3%	3.6%	4.1%
Later	5.0%	4.4%	3.5%	3.3%	3.6%	4.1%

Notes:

(a) The "Total" column in the table above represents the national unemployment rate, consistent with Appendix C.3.2



C.5 Expense rates

As discussed in Section 9.7 we have made a percentage loading to cover the cost of Administrative expenses incurred by MSD, Family support services and Payment integrity services. Table C.5.1 presents this as a percentage of all IRRS, AS and TAS paid to or on behalf of all clients in a year.

Table C.5.1 Projected expense rate

Year	Expense rate
2016	1.1%
2017	1.0%
2018	0.9%
2019	0.9%
2020	0.8%
2021	0.8%
2022	0.8%
2023	0.8%
2024	0.8%
2025	0.7%
2026	0.7%
2027	0.7%
2028	0.7%
2029	0.7%
2030	0.7%

Notes:

(a) Expense rate is expressed as a percentage of total future payments



APPENDIX D DATA SUPPLIED

D.1 Social Housing SAS datasets

The following social housing SAS datasets supplied by MSD were used to conduct the valuation. The valuation date is 30 June 2015 and all data is up to at least 31 August 2015 but extracted as at 30 September 2015.

- » **New_applications.sas7bdat:** File with one record per new application to the social housing register from outside the social housing system that contains:
 - Date of application
 - Analysis scores for affordability, adequacy, suitability, sustainability, accessibility and total
 - Main reason for application
 - Household size
 - Number of required bedrooms
 - Current location
 - Stated location preference
 - No particular location preference flag
 - Household type
 - Legacy system region code
 - Legacy and new system identification numbers for the application
 - Legacy and new system identification numbers for the primary applicant

The dataset covers applications from 16 July 2000 through to 31 August 2015.

- » **New_applications_household.sas7bdat:** File with one record per household member for each new application to the social housing register from outside the social housing system that contains:
 - Relationship to the primary applicant
 - Age
 - Gender
 - Ethnicity
 - Application signatory flag
 - MSD identification number for the household member
 - Legacy and new system identification numbers for the household member
 - Legacy and new system identification numbers for the application
 - Legacy and new system identification numbers for the primary applicant
- » **Transfer_applications.sas7bdat:** File with one record per transfer application to the social housing register from within the social housing system that contains:
 - Date of application
 - Business or tenant initiated transfer indicator
 - Analysis scores for affordability, adequacy, suitability, sustainability, accessibility and total
 - Main reason for application
 - Household size
 - Number of required bedrooms
 - Current location
 - Stated location preference
 - No particular location preference flag
 - Household type
 - Legacy system region code



- Legacy and new system identification numbers for the application
- Legacy and new system IDs for the primary applicant

The dataset covers applications from 16 July 2000 through to 31 August 2015.

- » **Transfer_applications_household.sas7bdat:** File with one record per household member for each transfer application to the social housing register from within the social housing system that contains:
 - Relationship to the primary applicant
 - Age
 - Gender
 - Ethnicity
 - Application signatory flag
 - MSD identification number for the household member
 - Legacy and new system identification numbers for the household member
 - Legacy and new system identification numbers for the application
 - Legacy and new system identification numbers for the primary applicant
- » **Register_snapshot.sas7bdat:** File with one record per application on the social housing register per end-of-month snapshot date that contains:
 - Snapshot date
 - Analysis scores for affordability, adequacy, suitability, sustainability, accessibility and total
 - Main reason for application
 - Household size
 - Number of required bedrooms
 - Current location
 - Stated location preference
 - No particular location preference flag
 - Household type
 - Legacy system region code
 - Legacy and new system identification numbers for the application
 - Legacy and new system identification numbers for the primary applicant

The dataset covers snapshots from 31 July 2000 through to 31 August 2015.

- » **Register_household_snapshot.sas7bdat:** File with one record per household member on the social housing register per end-of-month snapshot date that contains:
 - Snapshot date
 - Relationship to the primary applicant
 - Age
 - Gender
 - Ethnicity
 - Application signatory flag
 - MSD identification number for the household member
 - Legacy and new system identification numbers for the household member
 - Legacy and new system identification numbers for the application
 - Legacy and new system identification numbers for the primary applicant

The dataset covers snapshots from 31 July 2000 through to 31 August 2015.

- » **Register_exit.sas7bdat:** File with one record per exit from the social housing register that contains:
 - Exit date
 - Exit status (housed or other exit)
 - Exit reason



- Legacy and new system identification numbers for the application
- Legacy and new system identification numbers for the social house if applicable

The dataset covers exits from 17 July 2000 through to 31 August 2015.

- » **Houses_snapshot.sas7bdat:** File with one record per social house per end-of-month snapshot date that contains:
 - Snapshot date
 - Location details including meshblock ID, suburb and postcode
 - Number of bedrooms
 - Weekly market rent
 - Rent date
 - House characteristics including building year, bathroom status, carpeting, heating and parking
 - Occupancy status and status and expiry date of the current lease
 - Legacy and new system identification numbers for the social house

The dataset covers snapshots from 31 January 2000 through to 30 September 2015.

- » **Tenancy_snapshot.sas7bdat:** File with one record per social house tenancy per end-of-month snapshot date that contains:
 - Snapshot date
 - Household size
 - Household type
 - Social house entry date
 - Social housing entry date
 - Household weekly income
 - Income related rent
 - Income related rent subsidy
 - Market rent
 - Legacy and new system identification numbers for the household
 - Legacy and new system identification numbers for the primary applicant
 - Legacy and new system identification numbers for the social house

The dataset covers snapshots from 31 January 2001 through to 31 August 2015.

- » **Tenancy_household_snapshot.sas7bdat:** File with one record per household member in a social house tenancy per end-of-month snapshot date that contains:
 - Snapshot date
 - Relationship to the primary householder
 - Age
 - Gender
 - Ethnicity
 - Application signatory flag
 - MSD identification number for the household member
 - Legacy and new system identification numbers for the household member
 - Legacy and new system identification numbers for the household

The dataset covers snapshots from 31 January 2001 through to 31 August 2015.

- » **Tenancy_exit.sas7bdat:** File with one record per exit from a social house that contains:
 - Snapshot date of data extraction
 - Exit date
 - Exit status (exit all housing or transfer)
 - Exit reason



- Legacy and new system identification numbers for the household

The dataset covers exits from 1 January 1957 through to 9 October 2015 extracted as at 30 September 2015.

D.2 Social Welfare SAS datasets

The following social welfare SAS datasets supplied by MSD were used to conduct the valuation. All data is up to 30 June 2016 but extracted as at 31 July 2016:

- » **rate_period_20160630.sas7bdat:** Rate file with one record per client and benefit spell that contains:
 - Client identification number
 - Benefit type code (plus codes for supplementary benefits)
 - Gross and net payment amounts for primary benefit
 - Payment amounts for any supplementary benefits
 - Spell start and end dates

The dataset covered spells from March 1993 through to 30 June 2016. It also included Accommodation Supplement payments to pensioners.

- » **ahpy_lumpsum1_20160630.sas7bdat:** Lump sum file which covers those payment types recorded on system in a lump sum fashion (single date, rather than spell start and end dates). Fields include:
 - Client identification number
 - Benefit type code
 - Gross and net payment amounts
 - Input date
- » **ahpy_ccs_20160630.sas7bdat:** Similar to the ahpy_lumpsum1 file, except specific to the child care subsidy benefit, which was not included in the original lump sum file.
- » **rate_cda_20160630.sas7bdat:** Similar to the rate_period file, but specific to the child disability allowance benefit, which was not included in the original rate_period file.
- » **spel_20160630.sas7bdat:** File with one row per spell per client, containing a variety of fields related to the spell. The “oldcomdt” field contained the first payment date for the spell, which was used to overwrite spell commencement dates before the 1993 system change.
- » **swn_20160630.sas7bdat:** File with one row per client, with a range of static variables. This dataset was used to determine date of birth, gender, education level and ethnicity for each client.
- » **swns_with_dob_eth_20160630.sas7bdat:** File with one row per client, containing client ID and age for all clients. This data set was used to fill in this information for those clients where it was not included in swn_20160630.sas7bdat.
- » **chd_20160630.sas7bdat:** File containing one record for every ‘child spell’ per client. This effectively provides child records to attach to all benefit spells which depend on the age and number of children. Child age is also included.
- » **dist_20160630.sas7bdat:** File containing one record for every district per spell per client. This allows the assignment of each client spell to their district and region.
- » **dist_changes_20160801.sas7bdat:** File containing further records on districts by client and spell. Used to fill in information for client spells where it was not included in dist_20160630.sas7bdat.



- » **yp_ypp_regions_20160801.sas7bdat:** File similar in structure to the rate file, but only for clients in the new youth payment or young parent payment. An additional field indicates which of the two payments the client received.
- » **ptnr_20160630.sas7bdat:** File containing one record for every ‘partner spell’ per client. This allows the assignment of each client’s partner details on the historical data. The partner’s identification number is also included.
- » **incp_20160630.sas7bdat:** File containing one record for every ‘incapacity spell’ per client. This allows the assignment of incapacity details such as type and number of incapacities to JS-HCD and SLP-HCD clients.
- » **cyf_summary_20160630.sas7bdat:** File containing one record per client per child protection or youth justice spell. This allowed the calculation of CP and YJ related variables for each client including the age of first entry into the CP and YJ system and total number of CP and YJ events.
- » **mmc_period_20160630.sas7bdat:** File containing one record per client per corrections sentence served. This allowed the calculation of criminal history related variables for each client including the percentage of time spent in prison over the last year and the percentage of time serving sentences over the last ten years excluding those for driving offences.
- » **dmatch_id_20160921.sas7bdat:** File linking anonymous identities from different sources including children registered to parents while on benefits, corrections identities, CP/YJ identities and social housing identities. The matches in this file were used to attach CP/YJ, criminal history, intergenerational and social housing related variables to beneficiaries.

D.3 Benefit rates

Our analysis requires the conversion of historical payments to “current values”. A series of pdf documents **BenefitRateSummary_1999-04-01.pdf**, **BenefitRateSummary_2000-04-01.pdf** etc. has previously been provided showing all benefit rates whenever they were updated (typically 1 April, and occasionally 1 September, each year). A spreadsheet **Benefit Rates pre 1999.xls** has also previously been provided with values applicable before 1999. All but the most recent benefit rate information was carried across from the previous welfare valuation. The most recent information was provided in **benefit-rates-april-2015.pdf**.

D.4 Historical and forecast economic variables

- » **befu15-charts-data.xls:** Treasury fiscal strategy model, 2015 version. Excel spreadsheet containing historical quarterly values as well as Treasury forecasts for the next five years for each of:
 - Population
 - Employment and unemployment rates.
- » **disc-rates-jun15.xls:** Excel spreadsheet containing Treasury assumptions for government accounts for future discount and inflation rates for several dates, including June 2015.



D.5 Miscellaneous files

Several other files were either supplied or carried across from the prior valuations that aided investigation and interpretation, but did not directly feed into the valuation:

- » **benefit_cancellations.sas7bdat**: SAS dataset key containing identifiers for codes related to reasons why people leave benefit
- » **benefit_codes.sas7bdat**: SAS dataset with identifiers for different benefit codes
- » **district_codes.sas7bdat**: SAS dataset identifying district codes and corresponding regions

Various other summary files, file descriptors and overviews were also provided on an ad hoc basis.



APPENDIX E VALUATION SCOPE

The aggregate estimate of lifetime housing cost comprises of a number of different types of payments and costs. These are:

- » IRRS payments
- » AS payments
- » TAS payments
- » MSD expenses

Future IRRS payments related to households with CHPs are included in the above list, although we separate them out in our reporting. The table below gives further details on this categorisation, with much of the detail provided by MSD. In this table, we have attempted consistency with Treasury appropriations for 2014/15¹.

Multi-Category Expenses and Capital Expenditure	Allocation
<p>Social Housing Outcomes Support MCA The single overarching purpose of this appropriation is to operate the social housing register and associated interventions in such a way as to support more people with the greatest housing need into housing, and to move those who are capable of housing independence closer towards that.</p>	MSD expenses
<p>Emergency Housing Response This appropriation is limited to activities relating to the provision of emergency housing support for eligible families and individuals.</p>	MSD expenses
Non-Departmental Output Expenses	Allocation
<p>Part Payment of Rent to Social Housing Providers This appropriation is limited to the part purchase of social housing tenancies for individuals who have both been allocated a social house and had their income-related rent calculated by the social housing agency.</p>	IRRS payments
<p>Accommodation Assistance This appropriation is limited to the Accommodation Supplement, Special Transfer Allowance, and Away From Home Allowance to persons to cover accommodation costs, paid in accordance with the criteria set out in the Social Security Act 1964 and delegated legislation issued under that Act. Benefit codes 471, 470, 472, 473, 474 and 832.</p>	AS payments
<p>Temporary Additional Support This appropriation is limited to Temporary Additional Support to provide means-tested temporary financial assistance to persons with emergency or essential costs, paid in accordance with the criteria set out in the Social Security Act 1964 and delegated legislation issued under that Act. Benefit code 450.</p>	TAS payments

¹ <http://www.treasury.govt.nz/budget/2015/suppestimates/suppest15socdev.pdf>



APPENDIX F DETAILS ON MODELLING APPROACH

F.1 Generalised linear models

Most of the models used in the valuation are generalised linear models so we give a brief overview of the theory behind these models here.

F.1.1 Overview

A generalised linear model ('GLM') is a generalisation of ordinary least squares regression that can deal with non-normally distributed response variables. Given a response variable y and a set of independent variables or predictors x_1, x_2, \dots, x_n , a GLM models the dependency as:

$$y = h^{-1} \left(\sum_{i=1}^n \beta_i x_i \right) + \varepsilon_i \quad (\text{F.1})$$

And

$$E(y) = \mu = h^{-1} \left(\sum_{i=1}^n \beta_i x_i \right) \quad (\text{F.2})$$

Where

$h^{-1}()$ is the **link function**

β_i ($i=1, 2, \dots, n$) is the **parameter** corresponding to the dependent variable x_i

ε_i is an **error** term.

Note that

$$\eta = \sum_{i=1}^n \beta_i x_i \quad (\text{F.3})$$

is referred to as the **linear predictor** and that the GLM may be written as:

$$y = h^{-1}(\eta) + \varepsilon_i \quad (\text{F.4})$$

Thus, a GLM consists of three components:

- » A probability distribution
- » A link function
- » A linear predictor



F.1.2 Further detail

Probability distribution

In the equations (F.1) and (F.4) above, the error term ε_i is determined by the probability distribution of the response variable. Common distributions that may be used include:

- » Normal
- » Poisson
- » Gamma
- » Inverse Gaussian
- » Binomial

The choice of distribution is informed by the response variable. For example, counts are naturally modelled by a Poisson distribution while strictly positive continuous quantities may be appropriately handled by a Gamma or Inverse Gaussian distribution depending on the distribution of the response values. Probabilities may be modelled using a Binomial distribution.

Link function

The link function $h^{-1}()$ gives the relationship between the mean of the distribution and the linear predictor. There are many possibilities for the link function including (but not limited to):

- » Identity link: $h^{-1}(\eta) = \eta$
- » Log link: $h^{-1}(\eta) = \exp(\eta)$
- » Logit link: $h^{-1}(\eta) = \exp(\eta)/(1 + \exp(\eta))$

It is usually convenient to choose a link function which matches the domain of the link function to the range of the response variable's mean. In other words, if a response must be positive (for example, an average benefit payment), then a log link will ensure that the fitted value μ in equation (F.2) is positive. If the modelled quantity is a probability (for example, the probability of transitioning off benefit in the next quarter), then the logit link ensures that the fitted value lies between 0 and 1, as probabilities must.

Linear predictor

The linear predictor (equation F.3) is the quantity which incorporates the information about the independent variables into the model and is typically denoted by η . η is expressed as a linear combination of unknown parameters β_i and independent variables x_i ($i=1, 2, \dots$), which are known.

In all cases, once the probability distribution and the link function have been selected, the linear predictor (F.3) needs to be constructed. The steps to doing this include:

- » Identify the list of independent variables or predictors (x_i) to be considered.
- » Using data exploration, modelling techniques, statistical tests and prior knowledge, identify those x_i that are useful for predicting the response variable. Note that this may include functions of the predictors, rather than the raw predictors themselves.
- » Estimate the parameters β_i using GLM software.

The list of variables considered for the key benefits is given in Section F.5.

Functions of the predictors

The predictors or independent variables may be used as follows.

- » In their raw forms: For example, gender with two levels F and M.

- » As categorical groupings of the original variable: For example, age may be banded into a number of groups (<18, 18-29, 30-39 etc.).
- » As indicator functions depending on the value of the original variable where one condition is assigned the value 1 and the complementary position 0: For example, letting $I(\text{age} \geq 30)$ be 1 for age ≥ 30 and 0 otherwise would fit a step term at age 30.
- » As a spline for underlying raw predictors which are numeric or ordinal (e.g. age, benefit quarter, duration on benefit): The dependency of a linear predictor on duration could be modelled (if appropriate) by a combination of several line segments. For instance, if the linear predictor varied in a linear fashion with duration with one slope from duration 1 to 4, a different slope from 4 to 12 and a third slope from 12 onwards, then using three line pieces (1-4, 4-12 and 12+) would capture this dependency. The points 4 and 12 where the resulting fitted spline bends are referred to as knot points.
- » As interaction terms: All the above may be used as interaction terms. For example, a duration effect may be well fitted by one spline for those aged under 30 and another for those aged 30 and above. This could be accommodated by interacting the spline with the $I(\text{age} \geq 30)$ term.

F.1.3 Model fitting approach

Our typical approach to fitting a model includes the following:

- » First fit a saturated model including most, if not all, raw predictors as well as any known interactions. For continuous predictors like age, or categorical ordered predictors like duration, we would usually fit the predictor as a grouped version (e.g. for age which is in quarter years, we might fit it as integer years).
- » Simplify the model by:
 - Removing insignificant parameters
 - Grouping together related parameters with similar estimated values
 - Using splines where this is warranted
- » Using diagnostics check to see if there is evidence of poor fitting which may suggest the need for some interactions. Add additional terms as required until a satisfactory fit is obtained.

F.1.4 References

The following books give a complete introduction to GLMs:

- » McCullagh P. and Nelder J. (1989). Generalized linear models, second edition. Chapman and Hall, London UK.
- » Dobson A. J. (2002). An introduction to generalized linear models, second edition. Chapman & Hall/CRC, Florida USA.

For a discussion on the application of GLMs in contexts similar to the modelling of the MSD benefit liabilities (e.g. claim size and claim numbers modelling in insurance), the following papers provide some starting points.

- » England, P. D. and Verrall, R. J. (2002). Stochastic claims reserving in general insurance. British Actuarial Journal, 8 443-544.
- » Haberman, S. and Renshaw, A. E. (1996). Generalized linear models and actuarial science. The Statistician, 45 407-436.



- » Mulquiney, P. and Taylor, G. (2007). Modelling Mortgage Insurance as a multi-state process. Variance 1, 81-102.
- » Taylor, G. and McGuire, G (2004). Loss reserving with GLMs: a case study. Casualty Actuarial Society Discussion Paper Program 2004. Available at <http://www.casact.org/pubs/dpp/dpp04/04dpp327.pdf>

F.2 Transition models

The modelling involves producing probability estimates for:

- » transitioning from any given housing state to any other each quarter
- » transitioning from any given benefit state to any other each quarter
- » making a register application or moving off the register

In this context, 'housing state' refers to if a client is in a social house (SH), receiving Accommodation Supplement (AS) or neither (Nil). Transition probabilities will depend on a client's state as well as other modelling variables, listed in Section F.5. The transition models are fitted using generalised linear models; further detail on their exact parameterisations is given in Appendix G – Model coefficients.

The transition model approach focuses on understanding how people move through the system over time. It is worth mentioning here that alternatives to such an approach exist (see for instance, the snapshot based approaches used in Section 15 of the 2012 welfare valuation report for the segmentation analysis). However, we have chosen the transition approach for several reasons:

- » **Responsiveness:** Changes in movement behaviour observed in recent years can be correctly reflected in the models.
- » **Long range accuracy:** We are able to leverage the behaviour of clients at various stages of the housing system to make appropriate long range assumptions. For instance, the behaviour of older clients can be used to model the behaviour of the younger clients in the distant future.
- » **Intuitive appeal:** A focus on measures such as probability of entering/exiting housing is natural, and will allow easier drill down analysis.
- » **Consistency:** This approach is used and works well for the welfare valuations, a consistent approach is required to combine the two valuations. The significant overlap between these systems means that considerable insight will be gained by a combined approach.

The three housing states and nine benefit states are illustrated diagrammatically in Figure F.1. While there are 9 (3x3) housing transition types and 81 (9x9) different welfare transition types, it is worth noting that the most important transitions are:

- » A household staying unchanged in a social house
- » A primary householder leaving a social house and receiving AS the next quarter
- » A client moving from receiving AS into a social house the next quarter
- » A client remaining in their current benefit state
- » A client moving from benefits to no benefits (moving into the NOB state)
- » A client moving from no benefits back to benefits (moving out of the NOB state)

We also note that the valuation population is not equally distributed across the various states. The largest seven states are SH & NOB, AS & JS-WR, AS & JS-HCD, AS & SPS, AS & SLP-HCD, AS & SUP and Nil & NOB. Overall liability results will tend to be dominated by changes to these clients, by sheer weight of numbers.

Figure F.1 Housing states (left) and welfare states (right) in the valuation quarterly transition model

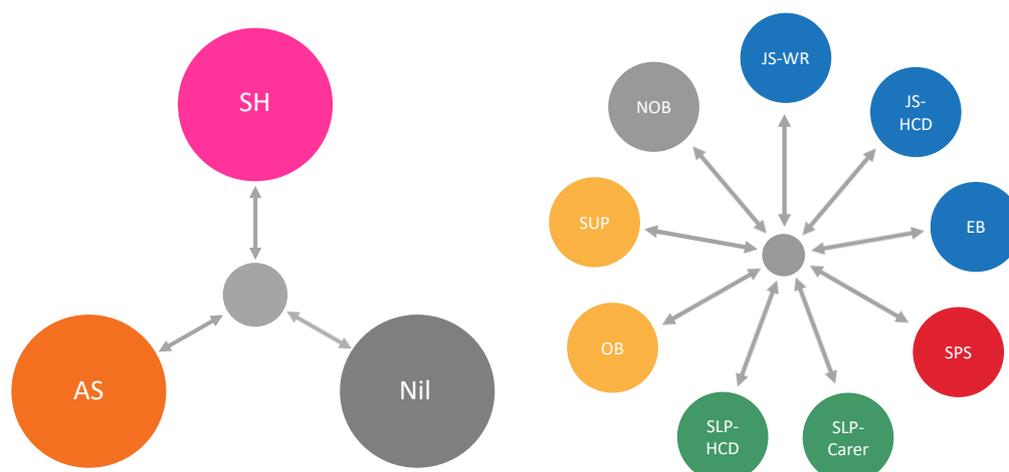


Table F.1 and Table F.2 show the models that have been fit to describe the transition behaviour in the social housing system and welfare system respectively. Detailed parameter values for these models are given in Appendix G, with a brief guide to these provided in Section F.8. All models were GLMs with the standard logistic link, apart from eight multinomial models. These multinomial models used the multinomial extension to logistic regression.

Table F.1 List of housing transition models used in valuation

Housing state	Type	Model ID	Description
SH	Logistic	hou_tra	Probability that a client in a social house and aged <65 remains in a social house the following quarter
SH	Logistic	hou_trap	Probability that a client in a social house and aged >64.75 remains in a social house the following quarter
SH	Logistic	hou_acc	Probability that a primary householder aged <65 and in a social house exits the social house and receives AS the following quarter
SH	Logistic	hou_accp	Probability that a primary householder aged >64.75 and in a social house exits the social house and receives AS the following quarter
SH	Logistic	hou_sec	Probability that a non-primary householder remains in a social house given the primary householder exits
SH	Logistic	hou_sec2	Probability that a non-primary householder remains in a social house given the primary householder remains
AS	Logistic	acc_nil	Probability that an AS client aged <65 does not receive AS in the next quarter, given the client does not move into a social house
AS	Logistic	acc_nilp	Probability that an AS client aged >64.75 does not receive AS in the next quarter, given the client does not move into a social house
Nil	Logistic	nil_acc	Probability a client aged <65 who is not 'Not on benefit' (NOB) receives AS in the next quarter, given they do not move into a social house

Housing state	Type	Model ID	Description
Nil	Logistic	nil_accp	Probability a client aged >64.75 who is not 'Not on benefit' (NOB) receives AS in the next quarter, given they do not move into a social house
AS or Nil	Logistic	reg_hou	Probability a client moves from the register to a social house
AS or Nil	Logistic	reg_oth	Probability a client exits the register not to a social house
SH	Logistic	tran1	Probability a client in a social house makes a register application in the quarter
AS or Nil	Logistic	reg1	Probability a client not in a social house makes a register application in the quarter
SH, AS or Nil	Logistic	a_dea	Probability a client aged >64.75 dies

Table F-2 List of welfare transition models used in valuation

Benefit state	Type	Model ID	Description
JS-WR	Logistic	jwr_tra	Probability that a client remains in JS-WR in the next quarter
JS-WR	Logistic	jwr_nob	Probability that a client moves from JS-WR to NOB, given that they leave JS-WR
JS-WR	Multinomial	jwr_mul	Multinomial Probability of moving to JS-HCD, SLP-HCD, SPS and OTH, conditional on leaving JS-WR and not entering NOB
JS-HCD	Logistic	jhd_tra	Probability that a client remains in JS-HCD in the next quarter
JS-HCD	Logistic	jhd_nob	Probability that a client moves from JS-HCD to NOB, given that they leave JS-HCD
JS-HCD	Multinomial	jhd_mul	Multinomial Probability of moving to JS-WR, SLP-HCD, SPS and OTH, conditional on leaving JS-HCD and not entering NOB
SPS	Logistic	sps_tra	Probability that a client remains in SPS in the next quarter
SPS	Logistic	sps_nob	Probability that a client moves from SPS to NOB, given that they leave SPS
SPS	Multinomial	sps_mul	Multinomial Probability of moving to JS-WR, SLP-HCD, JS-HCD and OTH, conditional on leaving SPS and not entering NOB
SLP-HCD	Logistic	slh_tra	Probability that a client remains in SLP-HCD in the next quarter
SLP-HCD	Logistic	slh_nob	Probability that a client moves from SLP-HCD to NOB, given that they leave SLP-HCD
SLP-HCD	Multinomial	slh_mul	Multinomial Probability of moving to JS-WR, JS-HCD, SPS and OTH, conditional on leaving SLP-HCD and not entering NOB
NOB	Logistic	nob_tra	Probability that a client remains in NOB in the next quarter



Benefit state	Type	Model ID	Description
NOB	Multinomial	nob_mul	Multinomial Probability of moving to JS-WR, JS-HCD, SPS, SLP-HCD and OTH, conditional on leaving NOB
Other –inwards	Logistic	oi_sup	Probability that someone entering OTH is entering SUP
Other - inwards	Multinomial	oi_mulm	Multinomial probability that someone entering OTH but not SUP enters EB, SLP-Carer or OB
Other	Logistic	o_tra	Probability that someone in OTH leaves their current state
Other	Logistic	o_nob	Probability that someone in OTH moves to NOB, given that they leave their current state
Other	Logistic	o_key	Probability that someone in OTH moves to one of JS-WR, JS-HCD, SPS or SLP-HCD, given that they leave their current state and do not move to NOB
Other	Multinomial	o_mulk	Multinomial probability of moving from OTH to each of JS-WR, JS-HCD, SPS and SLP-HCD, given that they move to one of these states
Other	Multinomial	o_mul2	Multinomial probability of moving within OTH to each of SUP, EB, SLP-Carer and OB, given that they move to one of these states

Notes:

(a) Other (OTH) in the table refers to benefits other than the main Tier 1 benefits, i.e. SUP, EB, SLP-Carer and OB

The structure is designed to place greater emphasis on the most important transitions; remaining in housing, remaining on the current benefit, moving out of housing, and moving out of the welfare system. Transitions where the client remains in the same state are handled by the models with “tra” suffixes. Transitions out of housing and welfare are handled by models with “nil” and “nob” suffixes respectively.

F.3 Combining the transition models

The transition models are combined to permit calculation of the probability of moving into any state. This is done on an individual level, but with consideration as to the transitions of others in the household. For example, the probability of a non-signatory exiting housing the next quarter is much higher in cases where the primary householder exits, but is still less than one – the individual transition models allow for this. The diagrams below show the steps involved in calculating these probabilities for:

- » A primary householder starting in a social house (SH) and a key benefit state (JS-WR/JS-HCD/SPS/SLP-HCD, here JS-WR)
- » A non-primary (signatory) householder starting in a social house (SH) and off benefits (NOB)



Figure F-2 Transition diagram for a primary householder aged < 65 starting in a key benefit - here JS-WR

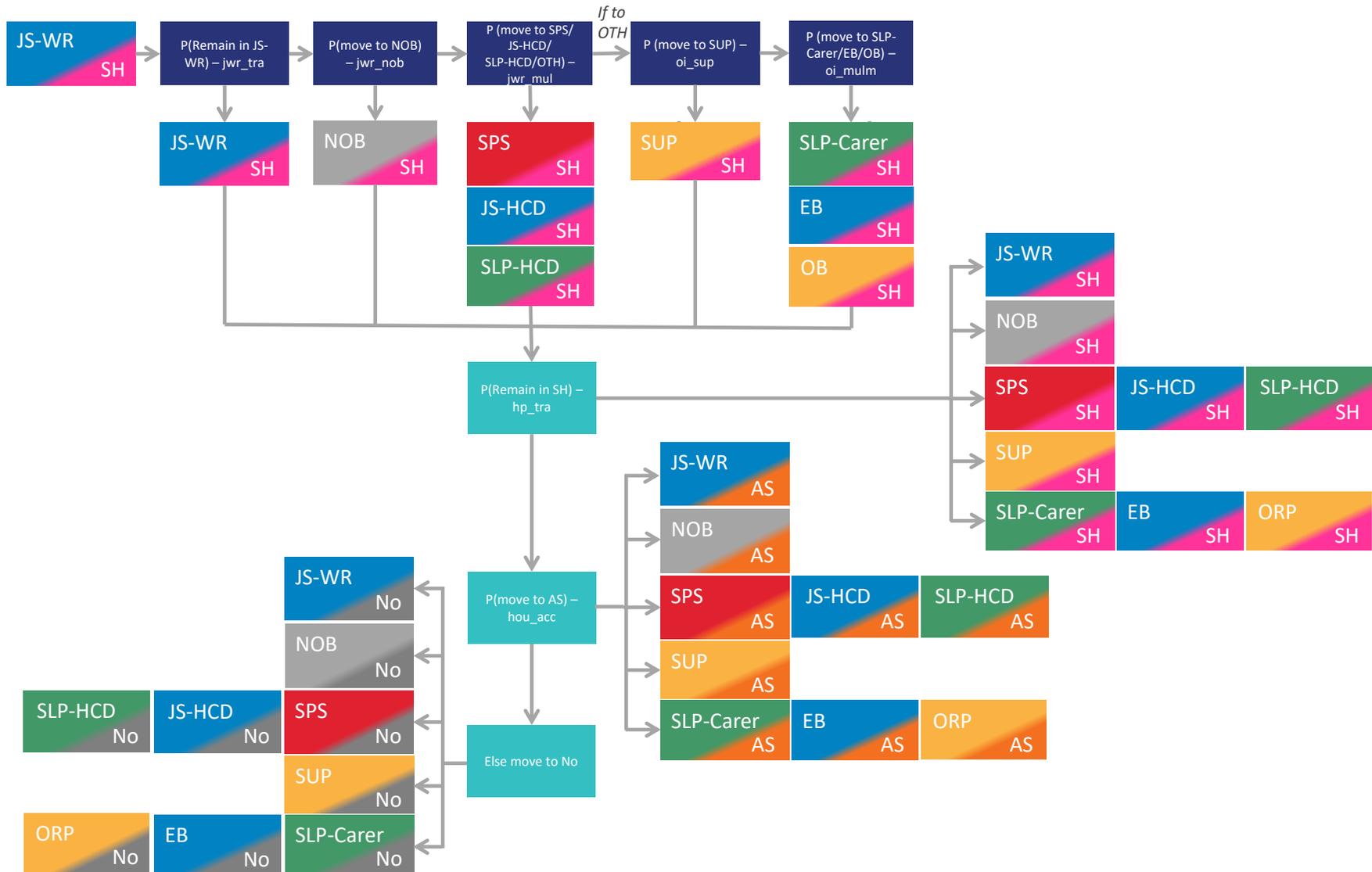
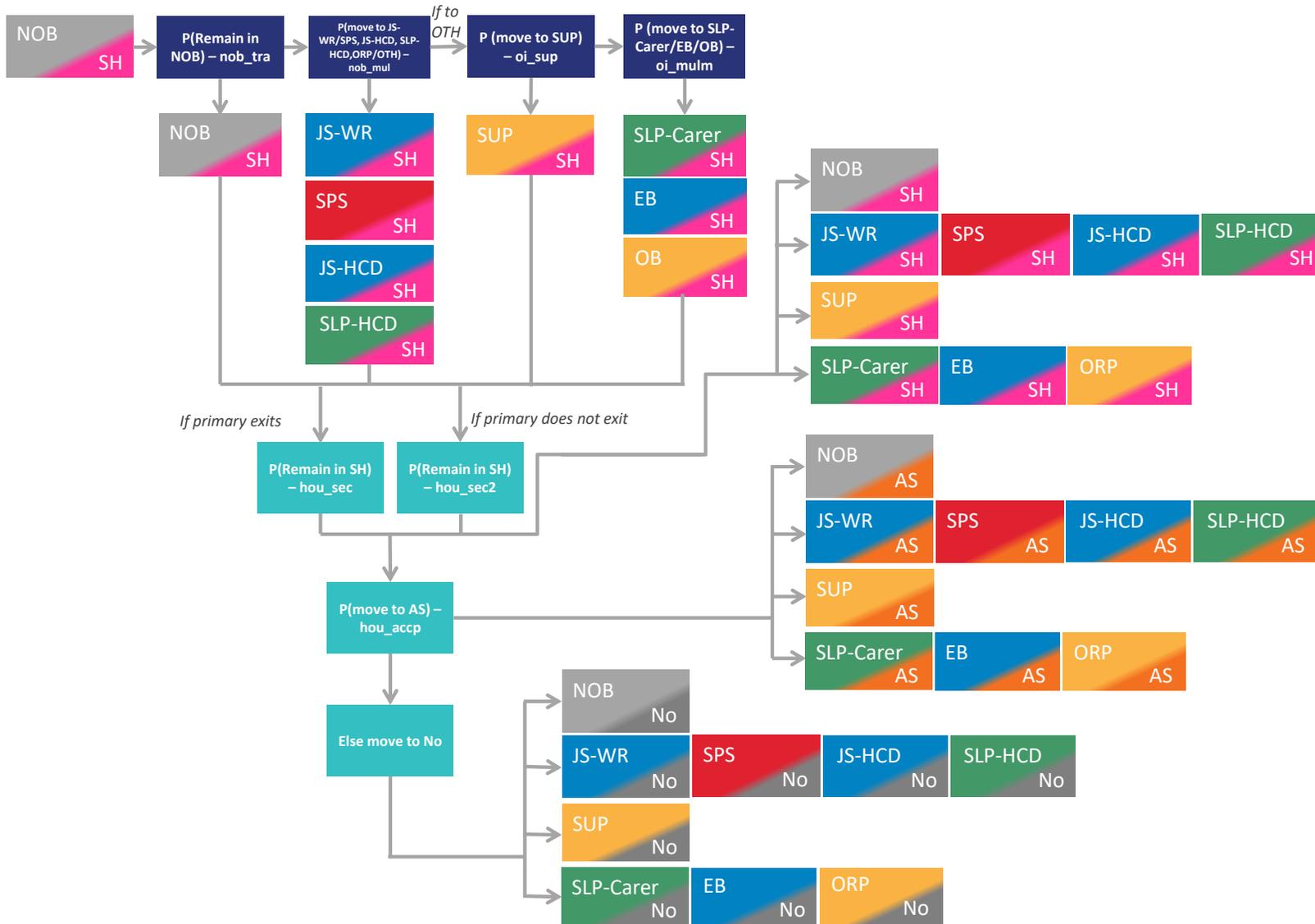


Figure F-3 Transition diagram for a non-primary (signatory) householder aged 65+ starting in a social house (SH) and off benefits (NOB)



F.4 Payment models

Clients in each state can receive a number of different payment types simultaneously:

- » Income related rent subsidy (IRRS)
- » Accommodation supplement (AS)
- » Their main Tier 1 payment
- » Orphans (or child living alone) Benefit (OB)
- » Disability allowance (DA)
- » Child disability allowance (CDA)
- » Childcare subsidy (CCS)
- » Hardship assistance (HS)
- » Employment intervention payments (EI)
- » Recoverable assistance (LOA in this section)

If we want to be able to distinguish between these various benefits, then separate models are required to estimate each. The models also need to be sensitive to the current state of a client, as well as all their other characteristics listed in Section F.5.

These models are summarised in Table F.2, which shows the payment models required for each of the states. Note that although it is impossible to receive AS while in a social house, it is possible to receive both in a quarter – hence the need to have both an IRRS and AS model for the Social housing states.

Table F.2 Payment models attributable to each state

Housing state	Benefit state	Payment Type										
		IRRS	AS	TAS	Main T1 (excl OB)	OB	DA	CDA	CCS	HS	EI	LOA
SH	SPS	●	●	●	●	●	●	●	●	●	●	●
SH	SLP-HCD	●	●	●	●	●	●	●	●	●	●	●
SH	JS-HCD	●	●	●	●	●	●	●	●	●	●	●
SH	JS-WR	●	●	●	●	●	●	●	●	●	●	●
SH	SLP-Carer	●	●	●	●	●	●	●	●	●	●	●
SH	EB	●	●	●	●	●	●	●	●	●	●	●
SH	OB	●	●	●	●	●	●	●	●	●	●	●
SH	SUP	●	●	●	●	●	●	●	●	●	●	●
SH	NOB	●	●	●	●	●	●	●	●	●	●	●
AS	SPS		●	●	●	●	●	●	●	●	●	●
AS	SLP-HCD		●	●	●	●	●	●	●	●	●	●
AS	JS-HCD		●	●	●	●	●	●	●	●	●	●
AS	JS-WR		●	●	●	●	●	●	●	●	●	●
AS	SLP-Carer		●	●	●	●	●	●	●	●	●	●
AS	EB		●	●	●	●	●	●	●	●	●	●
AS	OB		●	●	●	●	●	●	●	●	●	●
AS	SUP		●	●	●	●	●	●	●	●	●	●
AS	NOB		●	●	●	●	●	●	●	●	●	●
No	SPS			●	●	●	●	●	●	●	●	●
No	SLP-HCD			●	●	●	●	●	●	●	●	●
No	JS-HCD			●	●	●	●	●	●	●	●	●
No	JS-WR			●	●	●	●	●	●	●	●	●
No	SLP-Carer			●	●	●	●	●	●	●	●	●
No	EB			●	●	●	●	●	●	●	●	●
No	OB			●	●	●	●	●	●	●	●	●
No	SUP			●	●	●	●	●	●	●	●	●
No	NOB			●	●	●	●	●	●	●	●	●

While there are many payment models, we note that the relative significance of each differs greatly. IRRS payments make up over 90% of the payments in the social housing current liability and main benefits



plus accommodation support make up 90% of benefit payments in the welfare current client liability payments, so these payment types are modelled in greater detail.

It is therefore possible to rationalise the number of models by combining payments of a particular type across recipients in different benefit states. The models fitted are shown in Table F.3. The IRRS payment model and each of the main benefit models are fitted separately as are the larger components of Tier 2 payments (e.g. AS for JS-WR recipients, DA for JS-HCD and SLP-HCD recipients).

Table F.3 Payment models attributable to each state

Housing state	Benefit state	Payment Type										
		IRRS	AS	TAS	Main T1 (excl OB)	OB	DA	CDA	CCS	HS	EI	LOA
SH	SPS	hou_irrs2	hou_as	hou_tas	jwr_abp	jwr_orp	a_da	a_cda	a_ccs	jwr_hs	x_ei	jwr_loa
SH	SLP-HCD	hou_irrs2	hou_as	hou_tas	jhd_abp	jhd_orp	jhd_da	a_cda	a_ccs	jhd_hs	a_ei	jhd_loa
SH	JS-HCD	hou_irrs2	hou_as	hou_tas	sps_abp	sps_orp	sps_da	sps_cda	sps_ccs	sps_hs	x_ei	sps_loa
SH	JS-WR	hou_irrs2	hou_as	hou_tas	slh_abp	slh_orp	slh_da	a_cda	a_ccs	slp_hs	a_ei	slh_loa
SH	SLP-Carer	hou_irrs2	hou_as	hou_tas	emb_abp	a_orp	a_da	a_cda	a_ccs	a_hs	x_ei	a_loa
SH	EB	hou_irrs2	hou_as	hou_tas	slc_abp	a_orp	a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
SH	OB	hou_irrs2	hou_as	hou_tas	orp_abp		a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
SH	SUP	hou_irrs2	hou_as	hou_tas			z_da	z_cda	z_ccs	z_hs	a_ei	z_loa
SH	NOB	hou_irrs2	hou_as	hou_tas					nob_ccs	nob_hs	nob_ei	nob_loa
AS	SPS		acc_pmt	acc_tas	jwr_abp	jwr_orp	a_da	a_cda	a_ccs	jwr_hs	x_ei	jwr_loa
AS	SLP-HCD		acc_pmt	acc_tas	jhd_abp	jhd_orp	jhd_da	a_cda	a_ccs	jhd_hs	a_ei	jhd_loa
AS	JS-HCD		acc_pmt	acc_tas	sps_abp	sps_orp	sps_da	sps_cda	sps_ccs	sps_hs	x_ei	sps_loa
AS	JS-WR		acc_pmt	acc_tas	slh_abp	slh_orp	slh_da	a_cda	a_ccs	slp_hs	a_ei	slh_loa
AS	SLP-Carer		acc_pmt	acc_tas	emb_abp	a_orp	a_da	a_cda	a_ccs	a_hs	x_ei	a_loa
AS	EB		acc_pmt	acc_tas	slc_abp	a_orp	a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
AS	OB		acc_pmt	acc_tas	orp_abp		a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
AS	SUP		acc_pmt	acc_tas			z_da	z_cda	z_ccs	z_hs	a_ei	z_loa
AS	NOB		acc_pmt	acc_tas					nob_ccs	nob_hs	nob_ei	nob_loa
No	SPS			niltas	jwr_abp	jwr_orp	a_da	a_cda	a_ccs	jwr_hs	x_ei	jwr_loa
No	SLP-HCD			niltas	jhd_abp	jhd_orp	jhd_da	a_cda	a_ccs	jhd_hs	a_ei	jhd_loa
No	JS-HCD			niltas	sps_abp	sps_orp	sps_da	sps_cda	sps_ccs	sps_hs	x_ei	sps_loa
No	JS-WR			niltas	slh_abp	slh_orp	slh_da	a_cda	a_ccs	slp_hs	a_ei	slh_loa
No	SLP-Carer			niltas	emb_abp	a_orp	a_da	a_cda	a_ccs	a_hs	x_ei	a_loa
No	EB			niltas	slc_abp	a_orp	a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
No	OB			niltas	orp_abp		a_da	z_cda	z_ccs	a_hs	a_ei	a_loa
No	SUP			niltas			z_da	z_cda	z_ccs	z_hs	a_ei	z_loa
No	NOB			niltas					nob_ccs	nob_hs	nob_ei	nob_loa

Some detailed comments on the payment models follow:

- » Payments are allocated by client quarter, or proportionally in the event that payment spells span multiple quarters. Further, all payments are scaled to June 2015 benefit levels, using the CPI index applied to benefit payments over the past 22 years. We have used past increases in DPB/SPS payment levels to infer these CPI increases. Non-CPI increases (such as those seen for AS) come through as additional time series effects in the models. IRRS payments are modelled as a proportion of market rent, rather than as a dollar amount.
- » All models were Poisson with a log link, except the IRRS payment model, which uses a logit link. The choice of distribution was found to have a very minor effect on predictions in the payment models.
- » Table F.3 is a simplification in two ways:
 - It shows the housing payment models for clients up to age 65. For clients aged 65 and above a second model is used with the suffix 'p'. For example, for AS payments to clients aged 65 and above the model acc_pmt_p is used.
 - It shows one IRRS payment model for clients in social housing ('hou_irrs2'), there is in fact a second model used on the quarter of entry to social housing ('hou_irrs1').



- » As implied above, some payment models are ‘shared’ across states– for example, the accommodation supplement payments for all clients in the AS housing state use the ‘acc_pmt’ payment model. Similarly, the main payment model for clients on Jobseeker support is ‘jwr_abp’, this is used regardless of housing state. This sharing is done when the individual models are believed to share similarities to improve the efficiency of modelling. In these cases, the current state is also used as a predictor to ensure that any differences between states are still modelled.
- » It is possible to receive more than one Tier 1 benefit in a quarter. We have dealt with this by reallocating all Tier 1 payments to the current state; for example, if someone is allocated to JS-WR in a quarter but they receive both JS-WR and JS-HCD, all payments are summed and treated as JS-WR. The overall impact of this allocation is very small, since:
 - The amounts involved are generally small compared to a full quarter’s benefit
 - The allocations largely offset each other (e.g. for every client with a JS-HCD payment allocated to JS-WR there is another with a JS-WR payment allocated to JS-HCD)
 - The average number of quarters before transitions is high enough that such a reallocation occurs in a relatively small proportion of quarters.
- » NOB requires payment models for Childcare subsidy (CCS), Hardship benefit (HS) and Employment intervention (EI) because clients only in receipt of these benefits are assigned to the NOB state.
- » There is an important point to note regarding the non-main payment models (that is, every column of models except the first, second and fourth in Table F.3). These payments represent an **average** value across people in a given benefit state; thus, to take an example, the TAS model for those in the JS-WR state estimates the average TAS paid to clients receiving JS-WR, conditional on all their attributes like age, gender etc. However in reality some JS-WR clients receive TAS and some do not, so at an individual level these payment models are misleading since the actual AS payments will usually be much higher (if the client receives TAS) or much lower (if they do not). Thus, these payment levels are appropriate for the aggregate and segment level valuation, but must be interpreted carefully when inspected at an individual level. Distinguishing between the cases of receipt of supplementary payments at an individual level is beyond the scope of this valuation.

F.5 Model predictors

A list of independent variables or predictors used in the various GLM models includes:

- » Quarter
- » Client age
- » Gender
- » Number of quarters:
 - In current housing state
 - On current benefit
 - Since last in housing
 - Since last on the register for housing
 - Since first benefit
 - Spent in social housing
 - Spent in each of the various benefit states
- » Ethnicity
- » Region (Territorial Local Authority and Board in Auckland)
- » Regional unemployment rates
- » Education level
- » For those in social housing and/or the register:
 - Income level
 - IRRS level
 - Household size



- Number of quarters the household has been together
- Designation of primary and signatory
- SAS priority of application
- Market rent for the location
- » Youngest child age and number of registered children (for SPS clients)
- » Partner flag (SLP-HCD, JS-HCD, JS-WR and EB clients)
- » Incapacity type (SLP-HCD and JS-HCD clients)
- » Whether the incapacity belongs to the client's partner (SLP-HCD and JS-HCD clients)
- » Benefit last spell (if any)
- » Housing last spell (if any)
- » Family benefit history ('intergenerational') variables including match type with a parent beneficiary and intensity of the parent's benefit receipt while the client was aged 13-18 (note that this data is available only for those aged 25 or under)
- » Child, Youth and Family history variables which measure a client's exposure to CYF services as a child
- » Criminal conviction history variables which measure a client's convictions and related recent and longer-term exposure to correctional services
- » Relevant client characteristics which depend upon the benefit being received (e.g. Health condition or disability for JS-HCD or SLP-HCD, number and ages of children for SPS, partner information for a number of benefits etc.).

In theory, there are a very large number of variables that would impact on a client's lifetime social housing cost that do not feature in the list above (including health system information, employment history, family status etc.). The omission of a variable does not imply that it is unimportant. Rather, it indicates that our results should be considered as an average over that variable.

The variables may be separated into two categories:

- » **Static variables:** those that remain fixed at all points in time (for example gender).
- » **Dynamic variables:** those that change over time. These may be further subdivided into:
 - Those that vary in a known (deterministic manner). Examples include quarter, age, the various duration measures, and market rents (given our assumptions of a single set of forecasts for rental growth by future benefit quarter and region).
 - Those that vary in an unknown (stochastic manner). A client's region, the number of children and age of youngest child for SPS recipients and the incapacity type for HCD clients (JS and SLP) are examples of these predictors.

We generally refer to the last category as "semi-dynamic", recognising that while they change over time, changes are generally slow; the value does not change for most clients every quarter. For example, most clients remain in the same region in the subsequent quarter, but a small proportion move between regions.

A full list of the semi-dynamic variables is given here together with an overview of their updating method. Some detailed examples are then given.

F.5.1 List of semi-dynamic predictors

Register status

Information on any register applications active during the quarter is stored for all clients.

IRRS as a ratio of market rent

The IRRS payment level and the market rent of the house for the area is stored for all clients in social housing.



Region and TLA

The client's region is stored for every client on benefit. For clients in a social house this is at the Territorial Local Authority (and Board in Auckland) level. Information on the region when last on benefit is retained for those not on benefit.

Household

Household size, primary and signatory status can all evolve with time. For this valuation, we have not modelled this evolution (see section 10.3 of the main body of the report).

Children variables

The number of children (1, 2 or 3+) is stored for SPS recipients, as is the age of the youngest child.

Partner flag

This is stored for clients in EB, SLP-HCD, JS-HCD and JS-WR. It is not stored for all other benefit types.

Incapacity variables

The variables relating to incapacity group, the number of incapacities and a flag for whether the incapacity relates to a partner (for cases where the client has a partner) are stored for SLP-HCD and JS-HCD only.

Child, Youth and Family variables

Variables specifying whether the client as a child was involved in child protection or youth justice services (or both), the number of CYF events, days in child protection and age at first entry into the CYF system are stored for clients up to age 25. These can potentially change for clients up to age 18, but are fixed thereafter.

Criminal conviction history variables

We used for variables related to criminal conviction and related sentences, available for all clients. These were the percentage of time in prison over the last year, serving any sentence over the last year excluding those for driving offences, serving any sentence over the last ten years excluding driving offences, and in serving a sentence specifically related to theft over the last ten years.

F.5.2 Updating semi-dynamic predictors

This section discusses the updating methods for each of the semi-dynamic variables. Note that GLMs and probability tables referred to here are presented in the electronic appendices G and J.

Register status

The register status of clients is updated as follows:

Clients in social housing:

- » **On the transfer register:** A model is run to determine the probability the client moves into a different social house. All clients on the register are semi randomly sorted according to assessed need and the probability of moving into a house depends on an appropriately sized house being available in the desired TLA (or neighboring TLAs). The sorting is done in a way such that a client twice as likely to enter housing (according to the reg_hou model) is twice as likely to be higher in the



list. If the client does not move into social housing a second model is run to determine the probability they exit the register not to social housing.

- » **Not on the register:** A model is run to determine the probability that the client makes a new transfer application in the quarter. If so a second model is run to determine the priority of this application and the requested TLA is sampled from a table of probabilities.

Clients not in housing but on benefits:

- » **On the register:** A model is run to determine the probability the client moves into a social house. All clients on the register are semi randomly sorted according to assessed need and the probability of moving to a house depends on an appropriately sized house being available in the desired TLA (or neighboring TLAs). If the client does not move into social housing a second model is run to determine the probability they exit the register not to social housing.
- » **Not on the register:** A model is run to determine the probability that the client makes a new application in the quarter. If so a second model is run to determine the priority of this application and the requested TLA is sampled from a table of probabilities.

IRRS as a ratio of market rent

For clients entering social housing we simulate the market rent of the house (based on a distribution around first quartile rent levels) and then simulate the expected fraction of market rent that will be paid by IRRS.

For clients remaining in social housing IRRS level is first given a 'default' update:

$$\text{Default IRRS update} = (\text{Old rent} \times \text{rental growth inflation} - \text{old rent}) + \text{old IRRS}$$

The default update is slightly modified when the individuals are on NZ Super. These benefits are indexed to AWE, which we assume grows faster than CPI.

We have a series of models for IRRS updating each quarter:

- » Probability that IRRS level moves from zero to nonzero, or vice versa
- » If it toggles to nonzero, we have a probability table for expected IRRS level (as a fraction of market rent)
- » If IRRS remains nonzero, we have a probability model for whether the new IRRS equals the default update. If not, we apply a probability table for the new IRRS level.

Region – all benefits

Region is updated as follows:

Switching between benefits: A model is run to determine whether the region changes. If it changes, then the region is sampled from a table of probabilities. The new TLA is then sampled from a second table of probabilities. If the region does not change a second model is run to determine if the TLA changes. If it changes, then the new TLA is sampled from another table of probabilities.

Returning to benefit after being off benefit for at least one quarter: a binomial GLM gives the probability that a client's region (last updated when they were last on benefits) has changed while they were off benefit. In each simulation, if we sample that the region has changed and if so the new region is sampled from a table of probabilities. The new TLA is then sampled from a second table of probabilities. If the region has not changed a second model is run to determine if the TLA has changed. If it has, then the new TLA is sampled from another table of probabilities.

Leaving benefits: the region is not changed but the current value is stored.



Children variables - number of children and age of youngest child – SPS only

These variables are updated as follows:

Entering SPS: Values for the number of children are sampled from a table of probabilities based on the client's age. Values for the age of the youngest child are sampled from a zero-inflated beta model (**aye**).

Remaining in SPS: At each quarter

- » A GLM is run to calculate the probability of a new youngest child.
- » If no new youngest child, then the age of the youngest child increments by 0.25 years.
- » If there is a new youngest child, then the age of this child is sampled from a zero-inflated beta model. If the model returns 0 as the value, the age of the child is spread over 0, 0.25 and 0.5 years by the probabilities 0.2, 0.7 and 0.1 respectively.
- » For all SPS clients, the change in the total number of children is sampled from a multinomial GLM. Note probabilities are different depending on whether there is a new youngest child or not.

Leaving SPS: child variable information is forgotten.

Partner flag – EB, SLP-HCD, JS-HCD and JS-WR only

The partner flag variable is updated as follows:

Moving into any of EB/SLP-HCD/JS-HCD/JS-WR from one of the other benefits: a binomial GLM gives the probability that the client has a partner.

Remaining in any of EB/SLP-HCD/JS-HCD/JS-WR: a binomial GLM gives the probability that the partner flag switches (i.e. if the client has a partner they switch to having no partner and vice versa).

Leaving EB/SLP-HCD/JS-HCD/JS-WR and moving into one of the other benefits: partner information is dropped.

Incapacity variables – incapacity group, number of incapacities, incapacity relating to partner – JS-HCD and SLP-HCD only

The incapacity variables are updated as follows:

Entry into JS-HCD or SLP-HCD from other benefits: The incapacity group is sampled from a probability table. After that a second probability table is used to simulate the number of incapacities and (if the client has a partner) a third probability table is used to determine whether the incapacity relates to the partner or not.

There are different probability tables for each of the situations: entry into JS-HCD from all benefits apart from SLP-HCD, entry into SLP-HCD from all benefits apart from JS-HCD, switching from JS-HCD to SLP-HCD and switching from SLP-HCD to JS-HCD.

Leaving JS-HCD / SLP-HCD: incapacity variables are forgotten.

Child, Youth and Family variables

The Child, Youth and Family (CYF) variables are updated (for clients under age 18) as follows:

- » A binomial GLM is run for the probability of at least one CYF event occurring in the quarter. If yes:
 - A lookup table is used to update the type of interaction (i.e. child protection or youth justice).
 - Another lookup table is used to simulate the number of new events in the quarter (one or more).
 - If it is the first event for a person, the age of entry into CYF is recorded.



- » In both cases of the initial GLM, a binomial GLM is used to simulate the probability that the number of days in a CYF child protection placement changes in the quarter. This is always no if the CYF history does not include child protection.
 - If yes, then two lookup tables are used to simulate how many additional days in placement are applicable.

Criminal conviction history variables

The proportion of time in prison, non-prison theft sentences and other sentences are stored for the previous 40 quarters, making 120 variables in total. This is sufficient for calculating the four variables used in the transition and payment models. For each successive quarter, we delete the oldest of the 40 quarters and simulate the newest one:

- » If there **was no** sentence served in the previous quarter, a binomial GLM is used to simulate the probability that a new sentence is served in the quarter. The GLM uses a number of demographic characteristics of the individual.
 - If no, then the sentence served variables for the new quarter are set to zero.
 - If yes, then a table is used to allocate which type of sentence is served (prison, theft or other). A second lookup table is then used to allocate the proportion of the quarter served for each non-zero variable.
- » If there **was** a sentence served in the previous quarter, a binomial GLM is used to simulate the probability that a new sentence continues in the new quarter.
 - If no, then the sentence served variables for the new quarter are set to zero.
 - If yes, then an additional binomial GLM is used model the probability that the type of sentence being served changes. Lookup tables for the type and proportion are then used to simulate the new non-zero variables for that quarter.

This allows the 120 variables encoding sentence history to be updated for the new quarter. The four variables used in the models are then re-calculated before transition and payment models are applied.

F.6 Overlay models

Due to the housing and welfare state definitions of being in a housing state (SH say) or benefit (SPS say) in a quarter, additional information is needed for segment allocation to know if:

- » The client is in the same state at the end of the quarter and
- » The client has been on benefits continuously throughout the quarter.

We project this using models referred to as ‘overlay models,’ as they do not affect the main projection results, so they can be regarded as by-products of the simulation.

The overlay models include a full multinomial allocation of benefit type received by a client at the end of a benefit quarter. The process is:

- » Firstly, for welfare:
 - The benefit state for the current (“ben_now”) and next quarter (“ben_next”) are determined using the core transition models
 - If ben_now or ben_next are NOB (not on benefit), then end of quarter benefit status (“ben_end”) is set to NOB
 - If not, then if ben_now is NZ Super, then ben_end is set to NZ Super
 - If not, then a binomial GLM is used for the probability that ben_end is the same as either ben_now or ben_next. If yes, then a lookup table is used to allocate
 - If not, and either ben_now or ben_next are SUP, then ben_end is set to NOB
 - If not, then a binomial GLM is used for the probability that the end of quarter benefit is NOB. If yes, then ben_end is set to NOB



- If not and either ben_now or ben_next are ORP, then ben_end is set to ORP
- If not, then a binomial GLM is used for the probability that the end of quarter benefit is SUP. If yes, then ben_end is set to SUP
- If not, then a lookup table is used to simulate the remaining possibilities for ben_end
- » Then for housing:
 - The housing state for the current (“hou_now”) and next quarter (“hou_next”) are determined using the core transition models
 - If hou_now and hou_next are both SH then the housing end of quarter status (“hou_end”) is set to SH
 - If hou_now is SH but hou_next is AS then hou_end is set to AS
 - Similarly, if hou_now is AS but hou_next is SH then hou_end is set to AS
 - If hou_now and hou_next are both AS then a binomial GLM is used to predict if hou_end is AS or No
 - A person is on the register at the end of the quarter if they were on the register and failed to exit under the reg_hou or reg_exit binomial models (exit to social house and other exit respectively)

Once this chain of logic has been completed, we then update continuous duration. If ben_end is NOB, then the continuous duration is set to zero. Otherwise a binomial GLM is used to decide whether continuous duration is incremented by 1 (i.e. the client has had no 14 day breaks off benefits in the quarter) or reset to zero (i.e. they did have a 14-day break).

F.7 Number of new clients model

We allow for new individuals to be added to the projection, at the point at which they are part of a register application. This helps measure the lifetime housing cost of future applicants, but also models housing availability by plausibly estimating Numbers of individuals entering are thus a function of

- » The number of register applications each quarter
- » The number of individuals per application
- » The proportion of future applicants who are not part of the starting projection population, nor a register applicant in an earlier period.

We have each of these components. For entries beyond 10 years into the future, the last bullet requires extrapolation due to data limitations.

For each new client on the register we randomly sample client characteristics from the equivalent population of people entering the system in 2014/15. After entry, their pathway through housing and welfare is the same as other individuals in the projection.

F.8 Guide to electronic Appendix G

The file Appendix G.xlsx contains tables of the parameters for:

- » Each of the models listed in Table F.1 and Table F.3
- » The models for dynamic predictors described in Section F.5.2
- » The overlay models used for simulating continuous duration (Section F.6)
- » The number of future new clients (Section F.7).

Many of the parameters correspond to functions of the predictors rather than the raw predictors (see Section F.1.3); thus, each table is accompanied by the formulae giving the derivation of the predictor.

A number of models use offsets in their fitting, particularly for the welfare transition models. These help lock-in effects (for example, fixing the unemployment rate sensitivity to the same level as previously), as

well as encoding some of the projection assumptions described in Section 9.4 of the report. A description of these offsets is also included in Appendix G - Model Coefficients.



APPENDIX G MODEL COEFFICIENTS

Please see the separate spreadsheet for model parameterisations.



APPENDIX H SENSITIVITY ANALYSIS

H.1 Base results

H.1.1 Current client liability excluding loans and expenses

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)
In housing	13.28	1.17	14.45
Register	0.36	0.14	0.50
Recent exits	0.65	0.45	1.10
Total	14.28	1.76	16.05

H.2 Sensitivity to inflation and discount rate assumptions

H.2.1 Current client liability excluding loans and expenses, discount rates 1% lower

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	15.87	1.45	17.32	19.9%
Register	0.46	0.16	0.62	23.9%
Recent exits	0.86	0.53	1.40	27.0%
Total	17.19	2.15	19.33	20.5%

Notes:

(a) Assumes all forward rates are 1% lower than those given in Appendix C

H.2.2 Current client liability excluding loans and expenses, discount rates 1% higher

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	11.49	0.99	12.48	-13.6%
Register	0.30	0.13	0.43	-13.8%
Recent exits	0.51	0.40	0.91	-17.6%
Total	12.30	1.52	13.81	-13.9%

Notes:

(a) Assumes all forward rates are 1% higher than those given in Appendix C

H.2.3 Current client liability excluding loans and expenses, CPI and AWE rates 1% lower

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	14.88	1.09	15.98	10.6%
Register	0.42	0.13	0.55	10.1%
Recent exits	0.85	0.43	1.27	15.9%
Total	16.15	1.65	17.80	10.9%

Notes:

(a) Assumes all April inflation increases are 1% lower than those given in Appendix C

H.2.4 Current client liability excluding loans and expenses, CPI and AWE rates 1% higher

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	12.37	1.42	13.79	-4.6%
Register	0.35	0.15	0.50	0.5%
Recent exits	0.63	0.51	1.13	3.2%
Total	13.35	2.08	15.42	-3.9%

Notes:

(a) Assumes all April inflation increases are 1% higher than those given in Appendix C



H.3 Rental growth rate sensitivity

H.3.1 Table of national (quarterly) rental growth used in scenarios

Quarter	National rental growth rate above CPI		
	Adopted	1% increase	1% decrease
30-Sep-15	0.5%	0.7%	0.2%
31-Dec-15	0.5%	0.7%	0.2%
31-Mar-16	0.5%	0.7%	0.2%
30-Jun-16	0.5%	0.7%	0.2%
30-Sep-16	0.4%	0.6%	0.2%
31-Dec-16	0.4%	0.6%	0.1%
31-Mar-17	0.4%	0.6%	0.1%
30-Jun-17	0.4%	0.6%	0.1%
30-Sep-17	0.5%	0.7%	0.2%
31-Dec-17	0.5%	0.7%	0.2%
31-Mar-18	0.5%	0.7%	0.2%
30-Jun-18	0.5%	0.7%	0.2%
30-Sep-18	0.5%	0.7%	0.2%
31-Dec-18	0.5%	0.7%	0.2%
31-Mar-19	0.5%	0.7%	0.2%
30-Jun-19	0.5%	0.7%	0.2%
30-Sep-19	0.5%	0.8%	0.3%
31-Dec-19	0.5%	0.8%	0.3%
31-Mar-20	0.5%	0.8%	0.3%
30-Jun-20	0.5%	0.8%	0.3%
30-Sep-20	0.5%	0.7%	0.3%
31-Dec-20	0.5%	0.7%	0.2%
31-Mar-21	0.5%	0.7%	0.2%
30-Jun-21	0.5%	0.7%	0.2%
30-Sep-21	0.5%	0.7%	0.2%
31-Dec-21	0.5%	0.7%	0.2%
31-Mar-22	0.5%	0.7%	0.2%
30-Jun-22	0.5%	0.7%	0.2%
30-Sep-22	0.5%	0.7%	0.2%
31-Dec-22	0.4%	0.7%	0.2%
31-Mar-23	0.4%	0.7%	0.2%
30-Jun-23	0.4%	0.7%	0.2%
30-Sep-23	0.4%	0.7%	0.2%
31-Dec-23	0.4%	0.7%	0.2%
31-Mar-24	0.4%	0.7%	0.2%
30-Jun-24	0.4%	0.7%	0.2%
30-Sep-24	0.4%	0.6%	0.2%
31-Dec-24	0.4%	0.6%	0.1%
31-Mar-25	0.4%	0.6%	0.1%
Later	0.4%	0.6%	0.1%



H.3.2 Current client liability excluding loans and expenses, market rents 1% lower

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	10.63	1.12	11.75	-18.7%
Register	0.29	0.14	0.42	-16.0%
Recent exits	0.47	0.43	0.90	-18.1%
Total	11.38	1.68	13.07	-18.6%

Notes:

(a) Assumes all April inflation increases are 1% lower than those given in Appendix C

H.3.3 Current client liability excluding loans and expenses, market rents 1% higher

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	16.38	1.20	17.58	21.6%
Register	0.45	0.15	0.60	19.9%
Recent exits	0.88	0.46	1.34	21.9%
Total	17.71	1.81	19.52	21.6%

Notes:

(a) Assumes all April inflation increases are 1% higher than those given in Appendix C



H.4 Unemployment rate sensitivity

H.4.1 Table of national unemployment rates used in scenarios

Quarter	National unemployment rate	
	Adopted	Constant scenario
30-Sep-15	5.43%	5.50%
31-Dec-15	5.33%	5.50%
31-Mar-16	5.15%	5.50%
30-Jun-16	5.02%	5.50%
30-Sep-16	4.92%	5.50%
31-Dec-16	4.86%	5.50%
31-Mar-17	4.81%	5.50%
30-Jun-17	4.72%	5.50%
30-Sep-17	4.63%	5.50%
31-Dec-17	4.54%	5.50%
31-Mar-18	4.45%	5.50%
30-Jun-18	4.35%	5.50%
30-Sep-18	4.28%	5.50%
31-Dec-18	4.22%	5.50%
31-Mar-19	4.19%	5.50%
30-Jun-19	4.16%	5.50%
30-Sep-19	4.14%	5.50%
31-Dec-19	4.12%	5.50%
31-Mar-20	4.10%	5.50%
30-Jun-20	4.10%	5.50%
30-Sep-20	4.10%	5.50%
31-Dec-20	4.10%	5.50%
31-Mar-21	4.10%	5.50%
30-Jun-21	4.10%	5.50%
30-Sep-21 & beyond	4.10%	5.50%

To run this scenario, the national rate alternative considered above is converted into regional level forecasts in a similar fashion to the main projection.

H.4.2 Current client liability excluding loans and expenses, constant unemployment rate forecast at current rate of 5.9%

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	13.47	1.30	14.76	2.2%
Register	0.36	0.15	0.52	3.3%
Recent exits	0.68	0.49	1.17	6.8%
Total	14.51	1.94	16.45	2.5%

Notes:

(a) The national unemployment rates for this scenario are shown in column the second column of table H.5.1, with the regional rates adjusted accordingly

H.5 Sensitivity to transition model assumptions

H.5.1 Current client liability excluding loans and expenses, housing exit rates 5% higher

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	13.05	1.19	14.24	-1.5%
Register	0.35	0.14	0.49	-1.3%
Recent exits	0.65	0.45	1.11	0.6%
Total	14.06	1.78	15.84	-1.3%

Notes:

(a) For example, if 2% of clients transition out of housing, a 5% increase would change this to $2.0\% \times (1+0.05) = 2.1\%$

H.5.2 Current client liability excluding loans and expenses, housing exit rates 5% lower

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	13.51	1.14	14.65	1.4%
Register	0.36	0.14	0.50	0.4%
Recent exits	0.65	0.45	1.10	0.5%
Total	14.52	1.74	16.26	1.3%

Notes:

(a) For example, if 2% of clients transition out of housing, a 5% decrease would change this to 1.9%

H.5.3 Current client liability excluding loans and expenses, register application rates 5% higher

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	13.16	1.16	14.32	-0.9%
Register	0.35	0.14	0.50	-0.7%
Recent exits	0.65	0.45	1.10	0.1%
Total	14.17	1.75	15.92	-0.8%

Notes:

(a) For example, if 3% of clients make a register application, a 5% increase would change this to 3.15%

H.5.4 Current client liability excluding loans and expenses, register application rates 5% lower

Segment	IRRS payments (\$b)	AS + TAS payments (\$b)	Total liability (\$b)	Change on base
In housing	13.23	1.17	14.39	-0.4%
Register	0.36	0.14	0.50	-0.6%
Recent exits	0.66	0.45	1.11	0.6%
Total	14.24	1.76	16.00	-0.3%

Notes:

(a) For example, if 3% of clients make a register application, a 5% decrease would change this to 2.85%



APPENDIX I OTHER ONE-WAY TABLES

I.1 Current client liability by age at valuation date

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
16-19	243	21,023	650	193	23.6	867	3,568	41
20-24	2,388	18,467	934	268	34.6	1,236	518	67
25-29	4,330	13,602	1,105	230	31.6	1,366	315	100
30-34	5,134	11,127	1,246	183	27.2	1,455	283	131
35-39	5,702	10,585	1,404	151	24.5	1,579	277	149
40-44	7,075	11,989	1,729	143	25.1	1,898	268	158
45-49	8,399	13,041	1,964	126	22.4	2,112	252	162
50-54	8,141	12,413	1,735	99	16.8	1,851	227	149
55-59	6,779	10,115	1,271	62	9.6	1,343	198	133
60-64	5,939	8,667	897	41	5.0	943	159	109
65-75	8,277	11,697	967	35	3.7	1,005	121	86
75-85	4,191	5,952	333	9	1.0	343	82	58
85+	1,048	1,498	49	1	0.1	50	48	33
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

- (a) Number of households shows the number of households by group of the primary householder
- (b) Number of households excludes recent housing or register exits

I.2 Current client liability by current duration in housing state at valuation date

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
<1yr	5,954	26,330	1,480	395	59.1	1,935	325	73
1-2 yr	5,661	13,057	1,150	192	28.8	1,370	242	105
2-3 yr	4,219	10,589	934	140	20.5	1,095	260	103
3-4 yr	3,537	8,468	781	105	15.3	902	255	107
4-5 yr	3,363	7,641	720	86	12.6	819	243	107
5-6 yr	3,504	7,167	745	73	10.7	829	237	116
6-7 yr	3,296	6,528	703	66	9.8	779	236	119
7-8 yr	3,024	5,879	654	57	8.4	719	238	122
8-9 yr	2,876	5,639	639	48	7.1	695	242	123
9-10 yr	2,675	5,113	591	43	6.4	641	240	125
10-15 yr	28,291	43,308	5,458	238	35.5	5,732	203	132
15-20 yr	554	5,905	228	53	6.3	288	519	49
20-25 yr	302	2,581	101	27	3.4	131	434	51
25+ yr	390	1,971	98	14	1.6	113	291	58
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

- (a) Number of households shows the number of households by group of the primary householder
- (b) Number of households excludes recent housing or register exits



I.3 Current client liability by cumulative time in social housing

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
<1yr	4,367	14,145	740	260	38.4	1,038	238	73
1-2 yr	3,388	8,600	682	120	18.3	820	242	95
2-3 yr	3,393	8,151	718	106	16.1	840	248	103
3-4 yr	2,986	7,259	645	92	13.8	751	252	103
4-5 yr	3,139	7,277	684	85	12.7	782	249	107
5-6 yr	3,335	7,348	720	84	12.5	816	245	111
6-7 yr	3,483	7,423	764	80	12.1	857	246	115
7-8 yr	3,435	7,160	759	77	11.5	847	247	118
8-9 yr	3,266	6,998	745	71	10.6	827	253	118
9-10 yr	3,264	6,936	742	69	10.1	820	251	118
10-15 yr	31,912	54,433	6,425	359	52.9	6,837	214	126
15-20 yr	801	8,095	355	77	9.1	441	551	55
20-25 yr	395	3,581	167	36	4.2	207	525	58
25+ yr	482	2,770	139	23	2.7	165	343	60
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

- (a) Number of households shows the number of households by group of the primary householder
- (b) Number of households excludes recent housing or register exits

I.4 Current client liability by region

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
Northland	2,229	4,730	293	70	12.5	376	169	79
Waikato	4,151	8,670	669	102	17.8	789	190	91
East Coast	3,058	6,593	455	91	12.4	558	182	85
Bay of Plenty	4,153	8,188	478	100	16.7	594	143	73
Taranaki	1,965	3,648	198	42	6.8	247	126	68
Central	2,002	3,863	205	46	7.2	258	129	67
Wellington	8,257	16,855	1,329	155	23.0	1,507	183	89
Nelson	1,504	2,815	202	33	5.8	241	160	86
Canterbury	6,169	12,349	1,384	102	18.9	1,505	244	122
Southern	2,489	4,382	304	46	8.2	358	144	82
Auckland	31,669	78,073	8,766	752	95.9	9,615	304	123
Australia		10	0	0	0.0	0		30
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

- (a) The small number of adults in Australia are all recent housing exits
- (b) Number of households excludes recent housing or register exits.



I.5 Current client liability by local board (Auckland only)

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
Albert-Eden	1,765	3,729	472	34	4	511	289	137
Devonport-Takapuna	300	554	78	6	1	84	280	152
Franklin	341	837	86	12	2	100	292	119
Henderson-Massey	2,679	7,100	759	78	10	847	316	119
Hibiscus and Bays	113	287	31	5	1	36	320	126
Howick	631	1,658	198	17	2	217	344	131
Kaipatiki	1,002	2,402	286	26	3	315	314	131
Mangere-Otahuhu	4,329	12,475	1,304	101	12	1,417	327	114
Manurewa	3,246	8,512	915	93	12	1,021	315	120
Maungakiekie-Tamaki	5,060	11,563	1,422	97	12	1,532	303	132
Orakei	780	1,550	198	12	2	212	271	136
Otara-Papatoetoe	3,543	9,483	982	87	11	1,080	305	114
Papakura	1,408	3,420	396	44	6	445	316	130
Puketapapa	2,477	5,783	674	48	6	728	294	126
Rodney	62	188	16	3	0	19	306	101
Upper Harbour	51	105	13	2	0	14	282	137
Waiheke	17	17	2	0	0	2	116	116
Waitakere Ranges	523	1,561	156	19	2	178	341	114
Waitemata	1,349	2,238	313	24	3	340	252	152
Whau	1,993	4,611	466	45	6	517	259	112
All	31,669	78,073	8,766	752	96	9,615	304	123

Notes:

(a) Number of households excludes recent housing or register exits.

I.6 Current client liability by ethnicity

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
NZ EU	17,498	31,272	2,939	306	54	3,299	189	105
Māori	24,225	55,138	4,770	720	109	5,599	231	102
Pacific	16,815	44,083	4,603	330	37	4,970	296	113
Asian	3,463	7,611	806	75	8.41	889	257	117
Other	5,645	12,072	1,166	109	17.3	1,292	229	107
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

(a) Number of households shows the number of households by group of the primary householder

(b) Number of households excludes recent housing or register exits

I.7 Current client liability by household size, current households

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
1	18,160	18,855	2,359	108	19.5	2,487	137	132
2	13,493	23,217	2,322	198	31.3	2,551	189	110
3	10,317	21,544	2,292	215	31.4	2,538	246	118
4	8,362	20,261	2,106	194	27.3	2,328	278	115
5	5,796	15,988	1,630	144	19.4	1,793	309	112
6	3,684	11,608	1,146	96	12.5	1,255	341	108
7+	4,206	15,727	1,551	128	16.2	1,695	403	108
All	64,018	127,200	13,406	1,082	158	14,646	229	115

Notes:

(a) Excludes recent exits from social housing or the register

(b) Number of households excludes recent housing or register exits

I.8 Current client liability by benefit type

Group	Number of households	Number of adults	IRRS payments (\$m)	AS payments (\$m)	TAS payments (\$m)	Total liability (\$m)	Average HH liability (\$k)	Average individual liability (\$k)
SLP-Carer	1,449	2,415	412	36	5.5	454	313	188
SPS	11,485	15,898	2,737	371	55.7	3,164	276	199
JS-HCD	6,381	10,039	1,513	151	25.9	1,690	265	168
SLP-HCD	11,510	17,175	2,349	204	35.6	2,589	225	151
JS-WR	5,337	11,050	1,229	183	28.0	1,439	270	130
OB	292	396	55	3	0.5	58	199	147
SUP	1,484	3,508	316	49	6.3	371	250	106
EB	160	316	35	4	0.6	39	245	124
NZ Super	13,483	18,996	1,346	44	4.7	1,394	103	73
NOB	16,065	70,383	4,292	495	62.4	4,849	302	69
All	67,646	150,176	14,284	1,539	225	16,048	237	107

Notes:

- (a) Number of households shows the number of households by group of the primary householder
- (b) Number of households excludes recent housing or register exits



APPENDIX J PROJECTED NUMBER OF CLIENTS AND PAYMENTS

Projected numbers and payments are included as an electronic Appendix J.

