The NAIC solicits comments on this report. Comments should be sent to John Engelhardt, NAIC, at JEngelhardt@naic.org by April 6th, 2012.

Report from the joint American Academy of Actuaries/Society of Actuaries Payout Annuity Table Team, a joint subgroup of the Life Experience Subcommittee

2012 Individual Annuity Reserving Table

Presented to the National Association of Insurance Commissioners' Life Actuarial Task Force

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I - Background and Scope

The objective of the Payout Annuity Table Team (Team), as requested by the NAIC's Life Actuarial Task Force (LATF), was to produce a new annuity valuation mortality table, including projection scales and margins necessary to make the table suitable for standard valuation purposes for individual annuities. This report documents the data, assumptions and process the Team used to develop the 2012 Individual Annuity Reserve Table (2012 IAR Table). The Team began with data and information from the mortality experience analysis, as described in the Society of Actuaries 2000-2004 Individual Payout Annuity Experience Report, dated April 2009. From this, the Team developed a basic table (2012 IAM Table), projection scale (Scale G2). Lastly, the Team explored various approaches and levels of margin which were discussed and ultimately recommended by LATF. The IAR Table is comprised of these three components, which are discussed throughout this report. In addition, the Team recommended and LATF concluded it made sense to develop a generational mortality table through the use of projection factors. While this represents a departure from previous individual annuitant mortality tables, it overcomes the disadvantage of using a static table that can become dated more quickly than a generational table.

II - Table Development and Approach

The 2000-2004 Payout Annuity Mortality Experience Study includes experience for immediate annuities, annuitizations and life settlement options of individual life insurance and annuity death claims. The experience analyzed excluded substandard annuities, structured settlement annuities and variable payout annuities. The experience represented 16 companies over the exposure period. The aggregated annuitant data (male, female) provided for the periods 2000-2004 included death, exposure (initial exposed to risk) and amount of annual income for ages 50 to 113. The data presented some evidence of selection in the form of lower Actual-to-Expected ratios for non-refund (i.e., life only with no certain period) immediate annuities at higher annual income levels. However, the Team decided that due to the limited data at these higher income levels and the narrow scope of this finding (unique to immediate annuities), it would avoid unnecessary complexity and not seek to differentiate mortality by annual income level.

For the purpose of developing the 2002 experience table, the age range was subsequently limited to ages 50 to 99 due to lack of credible experience at younger and older ages. To account for differences in data (extract) periods by the contributing companies, the death, exposure and amount of annual income data were summed across the 2000-2004 period. This data was then smoothed using a graduation approach which is described in detail in this report. Mortality rates were then developed for ages younger than 50 and older than 95, and further adjustments were made to grade the rates for ages 50 to 65 up to the experience-based rates at age 65. The methods used to develop or extrapolate the mortality rates for ages under 50 and above 95, as well as other refinements and adjustments, are described within this report. See Section IV, Younger and Older Age Adjustments. The result of these efforts was a 2002 experience table.

The next step was to project this table with improvement factors to 2012 to create the 2012 Individual Annuity Mortality Basic Table (2012 IAM Basic Table). Once the decision was reached on the merits of creating a generational mortality table, the Team then proceeded with the development of an improvement scale to be used for years 2013 and beyond. Following the development of this scale, labelled projection Scale G2, a methodology to reflect mortality improvement between 2002 and 2012 was determined. Margin levels were then established and added to the 2012 IAM Basic Table to derive the 2012 IAM Period Table. The 2012 IAR Table consists of this 2012 IAM Period Table along with the use of Scale G2 to project future mortality improvements beyond 2012.

III - Graduation

The Team analyzed various graduation approaches to create a preliminary table and ultimately decided to create a preliminary table using confidence intervals by applying the P-Spline methodology. The Team chose the P-Spline method as it was a practical statistical package designed and used by actuaries for mortality data, the output of the package is a statistically robust fitted life ("best estimate") table and the output provides a measure of uncertainty of the fitted table in the form of confidence intervals.

The P-Spline method was used to fit the dataset and provide a graduated life table with the mortality rates (q_x) weighted by amount of annual income. Initially described by Eilers and Marx[1], P-Splines comprise a subset of a class

of (piecewise) polynomial functions. They combine the use of P-Splines and difference penalties (e.g., on the estimated coefficients of a generalized linear regression model) to smooth and provide projections of the data.

The P-Spline application used was made available through a spreadsheet-based modeling tool (CMI Mortality Projection Spreadsheet version 3.0) provided by the Continuous Mortality Investigation Bureau or CMIB (http://www.actuaries.org.uk/research-and-resources/pages/continuous-mortality-investigation).[2] Using the tool, values for q_x (males or females) weighted by amount of annual income were fitted for each age x of the dataset.[3] The surface fit was determined by a combination of the data and the penalty applied. Data smoothing was provided by means of the penalized splines and the log mean values of q_x within the fitted region generated.[4] Ninety-five percent confidence intervals (95% CI) were also calculated for q_x based upon the standard deviations (adjusted for increased uncertainty due to analysis by amount of annual income) of the log mean values of q_x generated by the tool.

This graduation approach resulted in mortality rates generally ranging between 99% and 101% of the best estimate mortality rates for key ages. However, the confidence intervals at the oldest and younger ages were wider, suggesting greater uncertainty. In addition, the resulting mortality rates at the older ages were higher than the Annuity 2000 Basic Table. The P-Spline application breaks down as data becomes limited and less credible, which was the case with the underlying younger and older age experience. Therefore, the Team explored additional methods to derive the mortally rates for the younger and older ages, as discussed in Section IV - Younger and Older Age Adjustments.

A comparison of the actual and smoothed mortality (q_x) values for males and females is provided in Figures 1 and 2, respectively.

Figure 1. Graduated Male Mortality Adjusted by Amount of Annual Income

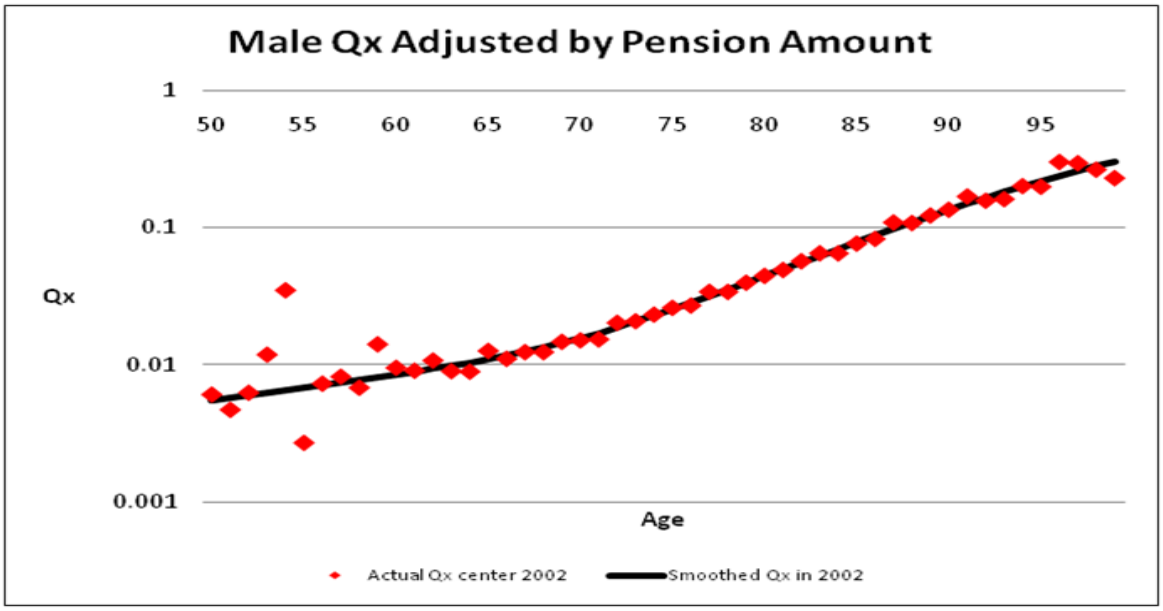
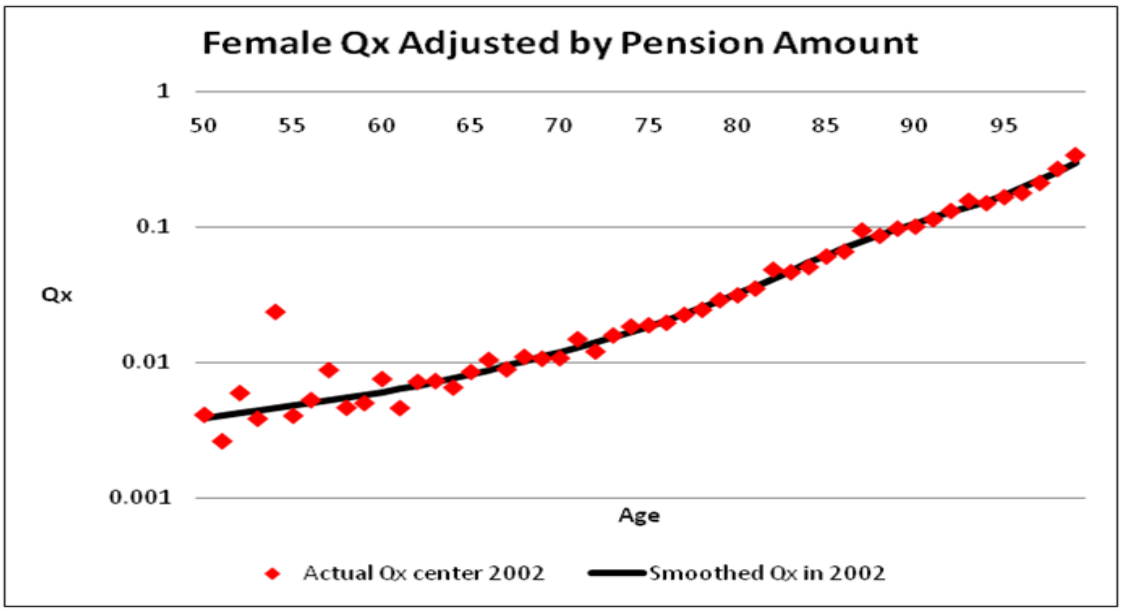


Figure 2. Graduated Female Mortality Adjusted by Amount of Annual Income



IV - Younger and Older Age Adjustments

The mortality experience at both the younger and older ages was limited. In analyzing the experience, the Team identified that the mortality rates at these ages had little impact on the final reserve. Therefore, the Team compared the results at specific ages to several existing industry tables, including: the 1994 Group Annuity Mortality Basic Table (GAM) projected with Scale AA to 2002 (the mid-point of the payout annuity experience period), the 2008 Valuation Basic RR100 Table (2008 VBT), the Annuity 2000 Basic Table (a2000 Table) and the 2006 U.S. Life Tables. Both the 1994 GAM and the a2000 Table had a reasonable fit for ages 20 and 35; however, the tables exhibited significant divergence from the underlying experience by age 50. In addition, the 1994 GAM was lower than the population mortality (2006 U.S. Life Tables) and the a2000 rates were significantly lower than both the population mortality rates and the more recent life experience table at the highest ages for the male risks.

IV.A - Younger Ages

The Team researched the development of the a2000 Table and predecessor tables and found that the a2000 Table rates, at the younger ages, could reasonably be described as being based on group annuity active life experience from 1939-1947, projected with various mortality improvement scales for almost 60 years.

For attained ages 50-59, the 2000-2004 experience shows ratios to the a2000 Table of 191% for males (245 deaths), and 231% for females (201 deaths). The Team considered that these high ratios might be caused by early retirements due to poor health. Past committees were not concerned about the actual experience for ages 50-59 being significantly higher than the valuation table. The Team attributed this lack of concern to the fact that there was not much payout annuity business at these ages, and the lack of material impact of mortality rates at these ages on the reserves. The lack of material impact at younger ages stems from the fact that annuity reserves are a function of probability of survival, which is near 1 at younger ages. For instance, using the a2000 table, using two times a mortality rate at age 20 (1.10 per 1,000 instead of 0.55 per 1,000) means the probability of survival (or receiving the next payment) would only decrease from 0.99945 to 0.99890, or a 0.055% reduction in actuarial value. In addition, there probably was a desire that the annuity valuation mortality appear consistent with other tables, e.g., life insurance and population life tables. Based on the report for the 1983 IAM Table, the a1983 Committee seemed to desire having the annuity mortality rates generally be lower than ultimate life insurance table mortality.

Table 1 below compares the mortality rates for ages 20, 35 and 50, for the following tables:

1. a2000 Table
2. 1994 GAM Basic projected to 2002 using Projection Scale AA
3. 2008 VBT, Nonsmoker, Ultimate
4. 2006 Social Security Administration (SSA) Experience

Table 1 - Comparison of Mortality Rates (1000qx) at Low Attained Ages

	Age 20		Age 35		Age 50	
Table	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
a2000 Table	0.55	0.28	0.79	0.52	3.33	1.71
1994 GAM Basic projected to 2002	0.47	0.27	0.88	0.47	2.40	1.34
2008 VBT, NS	0.88	0.31	1.02	0.50	2.48	1.77
2006 SSA	1.34	0.46	1.67	0.90	5.66	3.28

The 1994 GAM Table projected to year 2002 is reasonably close to the a2000 table for ages 20 and 35, and moderately lower at age 50.

The 1994 GAM rates were developed as follows:

- Ages 1-12 are from the 1990 Life Tables published in SSA 107.
- Ages 13-24 are graded up to the age 25 experience rate for the Civil Service Retirement System (CSRS) active life experience.
- Ages 25-50 are the CSRS active life experience.
- Ages 51-65 are weighted averages between CSRS active and retired life experience, with the weights for active lives grading down from age 51 to 65.
- Ages 66+ used group annuity actual experience. There was not a large disconnect between age 65 and 66, and later graduation smoothed the resulting table.
- All the experience rates were projected to 1994 prior to graduation.

After reviewing the various tables, the Team decided to use the 1994 GAM table, projected to 2002 using projection Scale AA for ages 1 through 45, and graded to the graduated (experience-based) rates at age 65. The grading was done such that the mortality rates have a constant percentage increase from age 50 to age 65. Age 0 was set equal to four times the age 1 rate, which was consistent with the approach taken for developing the age 0 mortality for the 2008 VBT.

Tables 2 and 3 below illustrate the development of the 2012 IAM Basic Table rates at younger ages for quinquennial ages for male and female risks, respectively.

Table 2 - Development of Mortality Rates for 2012 IAM Basic Table Male Risks - Select Younger Ages

Male Age	1994 GAM Basic 1000 Q_X	Projection Scale AA	1994 GAM Projected to 2002	Graduated Data	Graded Mortality
5	0.255	2.00%	0.217		0.217
10	0.212	2.00%	0.180		0.180
15	0.371	1.90%	0.318		0.318
20	0.545	1.90%	0.467		0.467
25	0.711	1.00%	0.656		0.656
30	0.862	0.50%	0.828		0.828
35	0.915	0.50%	0.879		0.879
40	1.153	0.80%	1.081		1.081
45	1.697	1.30%	1.528	3.445	1.528
50	2.773	1.80%	2.398	5.520	2.501
55	4.758	1.90%	4.081	6.836	4.092
60	8.576	1.60%	7.538	8.533	6.695
65	15.629	1.40%	13.962	10.955	10.955

Table 3 - Development of Mortality Rates for 2012 IAM Basic Table Female Risks - Select Younger Ages

Female Age	1994 GAM Basic 1000 Q_X	Projection Scale AA	GAM Projected to 2002	Graduated Data	Graded Mortality
5	0.188	2.00%	0.160		0.160
10	0.141	2.00%	0.120		0.120
15	0.233	1.60%	0.205		0.205
20	0.305	1.60%	0.268		0.268
25	0.313	1.40%	0.280		0.280
30	0.377	1.00%	0.348		0.348
35	0.514	1.10%	0.470		0.470
40	0.763	1.50%	0.676		0.676
45	1.046	1.60%	0.919	2.303	0.919
50	1.536	1.70%	1.339	3.899	1.588
55	2.466	0.80%	2.313	4.808	2.743
60	4.773	0.50%	4.585	6.007	4.738
65	9.286	0.50%	8.921	8.185	8.185

IV.B - Older Ages

Similar to the analysis for the younger ages, the Team researched the development of the a2000 Table and predecessor tables at the higher ages.

The a2000 Table mortality rates for the higher attained ages were developed as follows:

- As with the rates for the younger ages, the a2000 Table rates are the rates from the 1983 IAM Table projected 17 years using projection Scale G (100% for males and 50% for females). A cubic curve was fitted at the high ages, and rates were graded to 1.0 at age 115.
- The a1983 Table was based on the 1973 Experience Table, which was developed from the Society of Actuaries' 1971-76 experience study. At the older ages, the experience table was graduated with a formula that included a

cubic equation to grade to 1.0 by age 115. These rates were then projected 9.5 years to 1983, using 1.5% annual improvement. These rates were then re-graduated.

The level of improvement assumed in projecting the 1973 Experience Table to the a2000 Table was much higher than the observed mortality improvement in the US population over similar time periods. Table 4 below compares the assumed improvement used in the a1983 and a2000 Tables for select higher ages to the actual population improvement for similar periods of time.

Table 4 - Comparison of Annualized Improvement Rates in U.S Population, the a1983 and a2000 Tables for Select Higher Ages

	Male Age				Female Age			
Basis/Time Period	**82**	**87**	**92**	**97**	**82**	**87**	**92**	**97**
U.S. Life 1970-80	1.1%	1.0%	0.9%	0.5%	2.0%	1.8%	1.4%	0.9%
U.S. Life 1980-00	1.0%	0.7%	0.4%	0.2%	0.5%	0.4%	0.3%	0.2%
1973-1983 for a1983	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
1983-2000 for a2000	1.3%	1.3%	1.0%	1.0%	0.8%	0.8%	0.6%	0.6%

The Team noted that the actual to expected (A/E) ratios in the 2000-2004 experience study, where the expected basis was the a2000 Table, were relatively high. To understand why this might be, the Team analyzed the population improvement over the same time period versus that assumed in the a2000 Table. At the highest ages, the population improvement appears to have been less than assumed for the a2000 Table and the experience from the 2000-2004 experience study exhibited a similar relationship. For example, for attained ages 95-99, the 2000-2004 experience shows an A/E of 128% for males (1,477 deaths) and 108% for females (3,505 deaths). The Team did not have any other explanation for why the experience data mortality rates would be so much greater than the a2000 Table mortality rates. The Team did review preliminary experience data from 2005 through 2008 and noted a similar relationship to the a2000 Table. Therefore, the Team decided to continue this relationship in the final table.

For the higher ages in the 2012 IAM Table, the Team graduated the underlying experience data using individual age data up to age 99. The results of the graduation, compared to the a2000 Table, ranges from 120% to 130% for males (consistent with data), and 99% to 133% for females (consistent with data overall, but a very steep slope within the age range).

Table 5 below compares the graduated rates at ages 90, 95 and 99 to other predecessor mortality tables.

Table 5 - Comparison of Mortality Rates (1000qx) At High Attained Ages

	Age 90		Age 95		Age 99	
Table	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
2012 IAM Graduated Data	135.89	107.00	216.65	171.92	304.13	296.03
a2000 Table	124.61	112.76	180.24	174.49	233.37	233.03
1994 GAM Basic projected to 2002	159.25	122.05	247.20	197.05	321.39	273.83
2008 VBT, NS	139.33	104.24	227.67	159.48	306.99	240.15
2006 SSA	177.64	138.94	277.94	226.89	354.02	299.72

Table 6 below examines more closely the female A/E experience for ages 95 to 99. Upon further examination, it appeared that the female A/E ratios might have been skewed upward at and near age 99 by large amount claims. The Team decided the amount-based experience at these highest ages lacked sufficient credibility and did not make further adjustment to the underlying experience.

Table 6 - 2000-04 Experience for Ages 95 to 99

	Male			Female		
Age	A/E by Amount	A/E by Count	# of Deaths	A/E by Amount	A/E by Count	# of Deaths
95	110%	138%	511	95%	118%	1,036
96	156%	142%	385	95%	125%	886
97	144%	143%	268	107%	135%	733
98	121%	156%	203	128%	124%	487
99	99%	130%	112	152%	125%	363

The Team also desired to utilize a method that appropriately extrapolated the mortality for ages above age 99 and decided upon using Kannisto's formula. This formula is similar to the Gompertz formula (where the force of mortality increases by the same percentage amount at all ages), but Kannisto's formula is of the form X/(1+X), so that when mortality is low, the percentage increase in mortality by age is fairly constant, but as mortality becomes large, the increases get smaller. Kannisto's formula has been described as providing the best fit for data from ages 80-95 for a number of countries.[5]

Kannisto's formula was parameterized against the data for ages 80-95 and the rates for ages 96+ were used for the 2002 Experience Table. Table 7 below shows the results of the formula.

Table 7 - Results of Kannisto Extrapolation at Older Ages

	Male		Ratio:	Increase	Female		Ratio:	Increase	Ratio:
	Qx	Qx	Kannisto/	Kannisto	Qx	Qx	Kannisto/	Kannisto	Female/
Age	Actual	Kannisto	Actual	Qx	Actual	Kannisto	Actual	Qx	Male
80	0.04471	0.04487	100.4%	12.3%	0.03134	0.03357	107.1%	12.9%	74.8%
81	0.04932	0.05036	102.1%	12.2%	0.03514	0.03785	107.7%	12.8%	75.2%
82	0.05708	0.05646	98.9%	12.1%	0.04844	0.04265	88.1%	12.7%	75.5%
83	0.06524	0.06322	96.9%	12.0%	0.04645	0.04802	103.4%	12.6%	76.0%
84	0.06517	0.07069	108.5%	11.8%	0.05071	0.05399	106.5%	12.4%	76.4%
85	0.07673	0.07893	102.9%	11.7%	0.06059	0.06064	100.1%	12.3%	76.8%
86	0.08303	0.08799	106.0%	11.5%	0.06577	0.06801	103.4%	12.2%	77.3%
87	0.10939	0.09790	89.5%	11.3%	0.09433	0.07617	80.7%	12.0%	77.8%
88	0.10827	0.10872	100.4%	11.1%	0.08610	0.08516	98.9%	11.8%	78.3%
89	0.12294	0.12048	98.0%	10.8%	0.09739	0.09503	97.6%	11.6%	78.9%
90	0.13537	0.13320	98.4%	10.6%	0.10077	0.10584	105.0%	11.4%	79.5%
91	0.16907	0.14688	86.9%	10.3%	0.11384	0.11763	103.3%	11.1%	80.1%
92	0.15740	0.16153	102.6%	10.0%	0.13135	0.13040	99.3%	10.9%	80.7%
93	0.16175	0.17712	109.5%	9.7%	0.15632	0.14419	92.2%	10.6%	81.4%
94	0.20105	0.19362	96.3%	9.3%	0.14984	0.15900	106.1%	10.3%	82.1%
95	0.19895	0.21096	106.0%	9.0%	0.16614	0.17479	105.2%	9.9%	82.9%
96		0.22905		8.6%		0.19153		9.6%	83.6%
97		0.24781		8.2%		0.20916		9.2%	84.4%
98		0.26709		7.8%		0.22760		8.8%	85.2%
99		0.28678		7.4%		0.24673		8.4%	86.0%
100		0.30671		7.0%		0.26642		8.0%	86.9%
101		0.32673		6.5%		0.28654		7.6%	87.7%
102		0.34668		6.1%		0.30692		7.1%	88.5%
103		0.36639		5.7%		0.32739		6.7%	89.4%
104		0.38571		5.3%		0.34777		6.2%	90.2%
105		0.40450		4.9%		0.36790		5.8%	91.0%

Table 8 below compares the resulting graduated rates to the mortality rates for other predecessor tables for select ages 90, 95 and 99.

Table 8 - Comparison of Mortality Rates (1000qx) At High Attained Ages

	Age 90		Age 95		Age 99	
Table	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
2002 Experience Graduated Table	135.89	107.00	216.65	171.92	304.13	296.03
Kannisto Extrapolation	133.20	105.84	210.96	174.79	286.78	246.73
a2000	124.61	112.76	180.24	174.49	233.37	233.03
1994 GAM Basic projected to 2002	159.25	122.05	247.20	197.05	321.39	273.83
2008 VBT, NS	139.33	104.24	227.67	159.48	306.99	240.15
2006 SSA	177.64	138.94	277.94	226.89	354.02	299.72

The Team decided to use the graduated experience data rates up to age 95 and the Kannisto extrapolated rates for ages 96 and above.

Similar to the 2008 VBT Table, the Team decided to cap the mortality at the oldest ages, but decided upon a rate of 0.400 rather than the 0.450 used in the 2008 VBT. The decision to use 0.400 rather than 0.450 was based on information presented at the Society of Actuaries 2011 Living to 100 Symposium, which suggested there was some evidence that mortality did not end at 0.450 or 0.400 but that the process of aging could be slowed down, which would either increase a person's life span or reduce the impact of disease. Given that the difference in the ultimate mortality rate as these extreme ages has little bearing on the resulting reserve levels, the Team went with the lower level.

V - The 2012 Individual Annuity Mortality Basic Table

The previous sections within this report describe the development of the 2002 experience table. The next step was to project this with improvement factors to 2012 to create the 2012 Individual Annuity Mortality Basic Table (2012 IAM Basic Table). The Team also developed a set of improvement or projection factors to improve mortality beyond 2012.

The improvement factors for 2013 and beyond were developed first. The Team looked at population improvement rates over a number of historical periods. Different sources were considered (Social Security Administration, U.S. Life Tables developed by the Centers for Disease Control and Prevention, and data published by the Human Mortality Database), all of which showed similar results. In addition, the Team compared the historical improvement rates to existing improvement assumptions including Scale AA, Scale G and the recently published improvement rates from the Canadian Institute of Actuaries.[6] Historical improvement in annuity experience would have been preferred, but homogeneous data was not available. Tables 9 and 10 below show a comparison of the various improvement factors for male and female risks, respectively.

Table 9 - Comparison of Mortality Improvement for Various Sources - Male Risks

Male Age	Social Security Improvement Rates - 2010 Trustees Report Actual 1990-2000	Actual 2000-2006	Actual 1990-2006	Forecast 2010-2030	Average SSA 2002-2006	Scale AA	Scale G	CIA Proposal
25	2.9%	-2.0%	1.0%	0.9%	-2.0%			
30	4.2%	-1.3%	2.1%	1.1%	-1.1%			
35	3.8%	0.8%	2.7%	1.1%	1.4%			
40	1.8%	1.3%	1.6%	1.0%	2.0%			
45	0.6%	1.1%	0.8%	0.9%	1.6%			
50	1.3%	-0.6%	0.6%	1.0%	-0.1%	1.8%	1.8%	1.5%
55	1.9%	0.5%	1.4%	1.2%	0.5%	1.6%	1.6%	1.2%
60	2.2%	1.5%	1.9%	1.5%	1.7%	1.6%	1.5%	1.0%
65	1.9%	2.4%	2.1%	1.2%	2.6%	1.4%	1.5%	1.0%
70	1.5%	3.0%	2.0%	1.1%	3.2%	1.5%	1.4%	1.0%
75	1.4%	2.6%	1.9%	1.0%	2.9%	1.0%	1.2%	1.0%
80	1.1%	2.3%	1.5%	1.1%	2.5%	1.0%	1.2%	1.0%
85	0.2%	2.2%	1.0%	0.7%	2.6%	0.7%	1.2%	1.0%
90	-0.4%	1.4%	0.3%	0.5%	2.0%	0.4%	1.1%	1.0%
95	-0.8%	0.4%	-0.3%	0.4%	1.1%	0.3%	1.1%	0.5%

Table 10 - Comparison of Mortality Improvement for Various Sources - Female Risks

Female Age	Social Security Improvement Rates - 2010 Trustees Report Actual 1990-2000	Actual 2000-2006	Actual 1990-2006	Forecast 2010-2030	Average SSA 2002-2006	Scale AA	50% Scale G	CIA Proposal
25	1.6%	- 1.5%	0.5%	0.8%	- 1.8%			
30	1.8%	- 0.4%	1.0%	0.9%	- 0.5%			
35	0.6%	0.7%	0.7%	0.8%	1.4%			
40	- 0.6%	0.4%	- 0.2%	0.7%	1.4%			
45	0.1%	- 0.6%	- 0.1%	0.8%	0.4%			
50	1.2%	- 0.6%	0.5%	1.0%	- 0.4%	1.7%	1.0%	1.5%
55	1.2%	1.2%	1.2%	1.2%	1.3%	0.8%	0.9%	1.2%
60	1.1%	1.7%	1.3%	1.3%	1.7%	0.5%	0.9%	1.0%
65	0.5%	2.4%	1.2%	1.0%	2.5%	0.5%	0.9%	1.0%
70	0.3%	1.9%	0.9%	0.8%	2.2%	0.5%	0.9%	1.0%
75	0.2%	1.6%	0.7%	0.8%	2.0%	0.8%	0.8%	1.0%
80	- 0.1%	1.6%	0.6%	0.9%	2.1%	0.7%	0.8%	1.0%
85	- 0.4%	1.4%	0.3%	0.5%	1.9%	0.6%	0.8%	1.0%
90	- 0.7%	1.0%	- 0.1%	0.4%	1.5%	0.3%	0.7%	1.0%
95	- 0.9%	0.7%	- 0.3%	0.4%	1.1%	0.2%	0.6%	0.5%

In looking more closely at the historical SSA improvement for the 2000 to 2006 years, the Team identified there was both improvement and dis-improvement from year-to-year. Years 2004 and 2006 showed high improvement for most ages whereas the year 2003 showed dis-improvement. In determining the average mortality improvement, the improvement was not floored at zero, allowing for the dis-improvement to be considered. In addition, the Team discussed whether some of the recent improvement in mortality in the actual SSA data could be explained by cohorts of smokers and ex-smokers being replaced by cohorts of non-smokers. This theory raised several questions such as:

1. Whether the higher level of improvement should be used to adjust the base table to 2012?

2. The point at which to assume a steady state is reached?

3. Whether these higher improvement trends were applicable to annuitants, given that they have a lower starting level of mortality than the population? Also, should the fact that smokers are under-represented in annuity populations be considered in our adjustments?

An additional consideration of the Team was that recent group annuity experience from 1993 – 2002 exhibited mortality improvement in line with scale AA. The Team believed that group annuity mortality would be lower than population but would not have the same level of anti-selection as individual annuity mortality.

The Team determined to use the SSA data as its primary source. The SSA had three separate forecasts which represented a low-cost set (Alternative I), an intermediate set (Alternative II) and a high-cost set (Alternative III). The SSA figures reflected in Tables 9 and 10 above are from their intermediate forecast (Alternative II).

The Team considered the actual SSA improvement rates for the period 1990-2006, as well as the average improvement rates assumed by the SSA in their 2010 Trustees report for years 2012-2022, and developed a set of improvement factors that are equal to or slightly (0.1% to 0.4%) higher than the SSA 2012-2022 improvement factors for ages 50-95. (Note: Based upon clarification of approach from discussions with SSA actuaries and supported by various research and emerging experience, the Team determined the SSA improvement for ages 65+ to be too conservative (i.e., low) for an annuity valuation table.) Therefore, an additional improvement level of 0.4% for ages 65 to 82 and 0.2% for ages 87+ was added. The adjustment to the improvement was graded from 0.4% to 0.2% between ages 82 and 87. This adjustment was the same for males and females. For younger ages, a simple 1% assumption was made. For older ages, the improvement rates grade to zero at age 105. The Team has named the improvement Scale G2, as it replaces Scale G as the scale used for individual annuity valuation. Scale G2 is shown in Table 11, below. Table 12 compares the annualized improvement in Scale G2 to that of the U.S. Life Tables over various time periods.

Table 11 - Scale G2

	G2 Improvement	
Age	**Male**	**Female**
<50	1.0%	1.0%
50	1.0%	1.0%
60	1.5%	1.3%
80	1.5%	1.3%
90	0.7%	0.6%
100	0.2%	0.2%
105	0.0%	0.0%

Table 12 - Annualized Annual Improvement
Scale G2 Compared to U.S. Life Tables

	Male				Female			
Year	**62**	**72**	**82**	**92**	**62**	**72**	**82**	**92**
1960-70	0.1%	-0.1%	0.6%	1.3%	1.1%	1.1%	1.6%	2.6%
1970-80	2.2%	1.5%	1.1%	0.9%	1.4%	1.9%	2.1%	1.5%
1980-90	1.6%	1.4%	0.8%	0.0%	0.7%	0.6%	1.1%	0.3%
1990-00	1.9%	1.7%	1.3%	0.8%	0.8%	0.5%	0.0%	0.3%
2000-06	1.7%	2.7%	1.9%	1.1%	1.6%	1.9%	1.4%	0.8%
Scale G2	1.5%	1.5%	1.3%	0.6%	1.3%	1.3%	1.2%	0.5%

To create the 2012 IAM Basic Table, the Team projected the 2002 experience table for four years using actual SSA improvement from 2002 to 2006 (where 2002 is the mid-point of the underlying 2000-04 experience data, consistent with the experience study used to create the 2002 experience table). The Team looked at limited population data that indicated that population improvement rates from 2006 to 2009 were not inconsistent with Scale G2; therefore, the Team projected the rates from 2006-2012 (six years) using Scale G2. Tables 13 and 14 below show the actual SSA improvement rates for 1990 through 2006 and 2002 through 2006, and the SSA assumed improvement rates for 2012 through 2022, Scale G2, the 2002 experience table rates and the 2012 IAM Basic Table rates for male and female risks, respectively. Also, please see Exhibit I for the 2012 IAM Basic Table rates.

Table 13 - Scale G2 versus Population Improvement and Resulting IAM 2012 Basic Table, Male

Male													
	SSA 1990	SSA 2002	SSA 2012		2002 Exp.	2012 IAM		SSA 1990	SSA 2002	SSA 2012		2002 Exp.	2012 IAM
Age	-2006	-2006	-2022	Scale G2	Table	Table	Age	-2006	-2006	-2022	Scale G2	Table	Table
0	2.1%	0.7%	1.9%	**1.0%**	2.168	**1.783**	61	2.0%	1.7%	1.5%	**1.5%**	7.306	**6.237**
1	3.2%	3.3%	1.9%	**1.0%**	0.542	**0.446**	62	2.0%	1.8%	1.5%	**1.5%**	8.084	**6.854**
2	3.1%	2.9%	1.8%	**1.0%**	0.366	**0.306**	63	2.0%	2.1%	1.4%	**1.5%**	8.946	**7.510**
3	3.1%	2.9%	1.8%	**1.0%**	0.304	**0.254**	64	2.1%	2.4%	1.3%	**1.5%**	9.900	**8.220**
4	3.5%	3.5%	1.9%	**1.0%**	0.237	**0.193**	65	2.1%	2.6%	1.2%	**1.5%**	10.955	**9.007**
5	3.2%	2.3%	1.8%	**1.0%**	0.217	**0.186**	66	2.1%	2.8%	1.2%	**1.5%**	11.639	**9.497**
6	3.1%	1.5%	1.7%	**1.0%**	0.208	**0.184**	67	2.1%	2.9%	1.1%	**1.5%**	12.428	**10.085**
7	3.1%	1.5%	1.7%	**1.0%**	0.199	**0.177**	68	2.1%	3.0%	1.1%	**1.5%**	13.344	**10.787**
8	3.2%	2.1%	1.9%	**1.0%**	0.184	**0.159**	69	2.1%	3.1%	1.1%	**1.5%**	14.411	**11.625**
9	3.5%	3.8%	2.2%	**1.0%**	0.178	**0.143**	70	2.0%	3.1%	1.1%	**1.5%**	15.661	**12.619**
10	4.1%	7.2%	2.6%	**1.0%**	0.180	**0.126**	71	2.0%	3.1%	1.1%	**1.5%**	17.128	**13.798**
11	4.2%	8.9%	2.7%	**1.0%**	0.190	**0.123**	72	2.0%	3.1%	1.1%	**1.5%**	18.837	**15.195**
12	3.6%	6.8%	2.1%	**1.0%**	0.207	**0.147**	73	1.9%	3.0%	1.1%	**1.5%**	20.814	**16.834**
13	3.0%	3.9%	1.6%	**1.0%**	0.234	**0.188**	74	1.9%	2.9%	1.1%	**1.5%**	23.081	**18.733**
14	2.7%	2.2%	1.3%	**1.0%**	0.274	**0.236**	75	1.9%	2.8%	1.1%	**1.5%**	25.664	**20.905**
15	2.6%	1.5%	1.2%	**1.0%**	0.318	**0.282**	76	1.8%	2.7%	1.0%	**1.5%**	28.586	**23.367**
16	2.5%	1.1%	1.1%	**1.0%**	0.361	**0.325**	77	1.7%	2.6%	1.0%	**1.5%**	31.886	**26.155**
17	2.3%	0.6%	1.1%	**1.0%**	0.397	**0.364**	78	1.7%	2.6%	1.0%	**1.5%**	35.607	**29.306**
18	1.9%	0.0%	1.0%	**1.0%**	0.425	**0.399**	79	1.6%	2.5%	1.1%	**1.5%**	39.796	**32.858**
19	1.4%	-0.6%	0.9%	**1.0%**	0.447	**0.430**	80	1.5%	2.4%	1.1%	**1.5%**	44.505	**36.927**
20	0.9%	-1.1%	0.9%	**1.0%**	0.467	**0.459**	81	1.4%	2.3%	1.1%	**1.4%**	49.790	**41.703**
21	0.6%	-1.5%	0.8%	**1.0%**	0.493	**0.492**	82	1.3%	2.2%	1.0%	**1.3%**	55.722	**46.957**
22	0.5%	-1.7%	0.8%	**1.0%**	0.521	**0.526**	83	1.2%	2.3%	0.9%	**1.3%**	62.382	**52.713**
23	0.6%	-1.9%	0.8%	**1.0%**	0.561	**0.569**	84	1.1%	2.4%	0.8%	**1.2%**	69.863	**59.148**
24	0.8%	-2.0%	0.9%	**1.0%**	0.604	**0.616**	85	1.0%	2.4%	0.7%	**1.1%**	78.269	**66.505**
25	1.0%	-2.0%	0.9%	**1.0%**	0.656	**0.669**	86	0.8%	2.3%	0.6%	**1.0%**	87.702	**75.015**
26	1.3%	-2.0%	1.0%	**1.0%**	0.714	**0.728**	87	0.7%	2.2%	0.5%	**0.9%**	98.206	**84.823**
27	1.5%	-2.0%	1.0%	**1.0%**	0.751	**0.764**	88	0.5%	2.0%	0.5%	**0.9%**	109.777	**95.987**
28	1.8%	-1.8%	1.1%	**1.0%**	0.779	**0.789**	89	0.4%	1.8%	0.5%	**0.8%**	122.371	**108.482**
29	2.0%	-1.6%	1.1%	**1.0%**	0.805	**0.808**	90	0.3%	1.6%	0.5%	**0.7%**	135.888	**122.214**
30	2.1%	-1.4%	1.1%	**1.0%**	0.828	**0.824**	91	0.1%	1.4%	0.5%	**0.7%**	150.209	**136.799**
31	2.3%	-1.1%	1.1%	**1.0%**	0.848	**0.834**	92	0.0%	1.1%	0.5%	**0.6%**	165.349	**152.409**
32	2.4%	-0.7%	1.2%	**1.0%**	0.867	**0.838**	93	-0.1%	0.9%	0.4%	**0.5%**	181.387	**169.078**
33	2.6%	-0.1%	1.2%	**1.0%**	0.876	**0.828**	94	-0.2%	0.7%	0.4%	**0.5%**	198.436	**186.882**
34	2.6%	0.5%	1.2%	**1.0%**	0.877	**0.808**	95	-0.3%	0.6%	0.4%	**0.4%**	216.648	**205.844**
35	2.7%	1.2%	1.2%	**1.0%**	0.879	**0.789**	96	-0.4%	0.5%	0.4%	**0.4%**	229.053	**219.247**
36	2.7%	1.7%	1.2%	**1.0%**	0.891	**0.783**	97	-0.4%	0.4%	0.4%	**0.3%**	247.806	**238.612**
37	2.6%	2.0%	1.1%	**1.0%**	0.920	**0.800**	98	-0.5%	0.4%	0.4%	**0.3%**	267.095	**258.341**
38	2.3%	2.0%	1.1%	**1.0%**	0.963	**0.837**	99	-0.5%	0.4%	0.4%	**0.2%**	286.781	**278.219**
39	2.0%	1.8%	1.0%	**1.0%**	1.016	**0.889**	100	-0.5%	0.4%	0.4%	**0.2%**	306.714	**298.452**
40	1.6%	1.6%	1.0%	**1.0%**	1.081	**0.955**	101				**0.2%**	326.734	**323.610**
41	1.3%	1.4%	1.0%	**1.0%**	1.156	**1.029**	102				**0.1%**	346.679	**344.191**
42	1.1%	1.3%	1.0%	**1.0%**	1.242	**1.110**	103				**0.1%**	366.388	**364.633**
43	1.0%	1.3%	0.9%	**1.0%**	1.331	**1.188**	104				**0.0%**	385.708	**384.783**
44	0.9%	1.4%	0.9%	**1.0%**	1.424	**1.268**	105				**0.0%**	400.000	**400.000**
45	0.8%	1.5%	0.9%	**1.0%**	1.528	**1.355**	106					400.000	**400.000**
46	0.8%	1.5%	0.9%	**1.0%**	1.654	**1.464**	107					400.000	**400.000**
47	0.8%	1.3%	0.9%	**1.0%**	1.809	**1.615**	108					400.000	**400.000**
48	0.7%	0.8%	0.9%	**1.0%**	1.986	**1.808**	109					400.000	**400.000**
49	0.7%	0.3%	1.0%	**1.0%**	2.180	**2.032**	110					400.000	**400.000**
50	0.6%	-0.3%	1.0%	**1.0%**	2.398	**2.285**	111					400.000	**400.000**
51	0.6%	-0.7%	1.1%	**1.1%**	2.654	**2.557**	112					400.000	**400.000**
52	0.7%	-0.7%	1.1%	**1.1%**	2.936	**2.828**	113					400.000	**400.000**
53	0.9%	-0.5%	1.2%	**1.2%**	3.249	**3.088**	114					400.000	**400.000**
54	1.2%	0.0%	1.2%	**1.2%**	3.596	**3.345**	115					400.000	**400.000**
55	1.4%	0.5%	1.3%	**1.3%**	3.979	**3.616**	116					400.000	**400.000**
56	1.6%	0.9%	1.3%	**1.3%**	4.403	**3.922**	117					400.000	**400.000**
57	1.7%	1.2%	1.3%	**1.4%**	4.872	**4.272**	118					400.000	**400.000**
58	1.8%	1.4%	1.4%	**1.4%**	5.392	**4.681**	119					400.000	**400.000**
59	1.9%	1.5%	1.4%	**1.5%**	5.966	**5.146**	120					400.000	**400.000**
60	1.9%	1.6%	1.5%	**1.5%**	6.602	**5.662**							

Table 14 - Scale G2 versus Population Improvement and Resulting IAM 2012 Basic Table, Female Risks

Female													
	SSA	SSA	SSA		2002	2012		SSA	SSA	SSA		2002	2012
	1990	2002	2012	Scale	Exp.	IAM		1990	2002	2012	Scale	Exp.	IAM
Age	-2006	-2006	-2022	G2	Table	Table	Age	-2006	-2006	-2022	G2	Table	Table
0	1.9%	0.4%	1.8%	**1.0%**	1.943	**1.801**	61	1.3%	1.7%	1.3%	**1.3%**	5.051	**4.352**
1	2.6%	0.4%	1.9%	**1.0%**	0.486	**0.450**	62	1.3%	1.8%	1.2%	**1.3%**	5.699	**4.899**
2	2.0%	0.9%	1.9%	**1.0%**	0.316	**0.287**	63	1.2%	2.0%	1.2%	**1.3%**	6.430	**5.482**
3	3.1%	2.8%	1.9%	**1.0%**	0.237	**0.199**	64	1.2%	2.3%	1.1%	**1.3%**	7.254	**6.118**
4	2.8%	2.3%	1.9%	**1.0%**	0.177	**0.152**	65	1.2%	2.5%	1.0%	**1.3%**	8.185	**6.829**
5	2.6%	2.0%	1.8%	**1.0%**	0.160	**0.139**	66	1.2%	2.7%	0.9%	**1.3%**	8.780	**7.279**
6	2.5%	1.9%	1.7%	**1.0%**	0.150	**0.130**	67	1.1%	2.7%	0.9%	**1.3%**	9.438	**7.821**
7	2.5%	2.0%	1.7%	**1.0%**	0.140	**0.122**	68	1.1%	2.6%	0.9%	**1.3%**	10.168	**8.475**
8	2.6%	2.8%	1.7%	**1.0%**	0.125	**0.105**	69	1.0%	2.3%	0.8%	**1.3%**	10.979	**9.234**
9	2.8%	3.4%	1.8%	**1.0%**	0.119	**0.098**	70	0.9%	2.1%	0.8%	**1.3%**	11.882	**10.083**
10	3.1%	4.5%	1.9%	**1.0%**	0.120	**0.094**	71	0.8%	2.0%	0.8%	**1.3%**	12.892	**11.011**
11	3.2%	5.1%	1.9%	**1.0%**	0.126	**0.096**	72	0.8%	1.9%	0.8%	**1.3%**	14.028	**12.030**
12	3.0%	4.7%	1.8%	**1.0%**	0.135	**0.105**	73	0.7%	1.8%	0.8%	**1.3%**	15.315	**13.154**
13	2.6%	4.0%	1.4%	**1.0%**	0.151	**0.120**	74	0.7%	1.8%	0.8%	**1.3%**	16.782	**14.415**
14	2.1%	3.1%	1.1%	**1.0%**	0.176	**0.146**	75	0.7%	1.8%	0.8%	**1.3%**	18.466	**15.869**
15	1.9%	2.6%	1.0%	**1.0%**	0.205	**0.174**	76	0.7%	1.8%	0.8%	**1.3%**	20.413	**17.555**
16	1.7%	2.2%	0.9%	**1.0%**	0.231	**0.199**	77	0.7%	1.8%	0.8%	**1.3%**	22.676	**19.500**
17	1.5%	1.8%	0.9%	**1.0%**	0.251	**0.220**	78	0.6%	1.8%	0.8%	**1.3%**	25.324	**21.758**
18	1.2%	1.2%	0.9%	**1.0%**	0.262	**0.234**	79	0.6%	1.8%	0.8%	**1.3%**	28.440	**24.412**
19	0.9%	0.6%	0.8%	**1.0%**	0.267	**0.245**	80	0.6%	1.8%	0.9%	**1.3%**	32.131	**27.579**
20	0.5%	-0.1%	0.7%	**1.0%**	0.268	**0.253**	81	0.5%	1.8%	0.9%	**1.2%**	36.514	**31.501**
21	0.2%	-0.7%	0.7%	**1.0%**	0.269	**0.260**	82	0.5%	1.8%	0.8%	**1.2%**	41.655	**36.122**
22	0.1%	-1.1%	0.7%	**1.0%**	0.271	**0.266**	83	0.4%	1.8%	0.7%	**1.1%**	47.583	**41.477**
23	0.1%	-1.2%	0.7%	**1.0%**	0.275	**0.272**	84	0.3%	1.7%	0.6%	**1.0%**	54.293	**47.589**
24	0.3%	-1.3%	0.8%	**1.0%**	0.277	**0.275**	85	0.3%	1.7%	0.5%	**1.0%**	61.725	**54.441**
25	0.5%	-1.3%	0.8%	**1.0%**	0.280	**0.277**	86	0.2%	1.6%	0.5%	**0.9%**	69.775	**61.972**
26	0.6%	-1.3%	0.9%	**1.0%**	0.287	**0.284**	87	0.1%	1.5%	0.4%	**0.8%**	78.388	**70.155**
27	0.7%	-1.2%	0.9%	**1.0%**	0.294	**0.290**	88	0.1%	1.4%	0.4%	**0.7%**	87.512	**78.963**
28	0.8%	-1.0%	0.9%	**1.0%**	0.307	**0.300**	89	0.0%	1.3%	0.4%	**0.7%**	97.080	**88.336**
29	0.9%	-0.7%	0.9%	**1.0%**	0.323	**0.313**	90	-0.1%	1.2%	0.4%	**0.6%**	107.003	**98.197**
30	1.0%	-0.4%	0.9%	**1.0%**	0.348	**0.333**	91	-0.1%	1.1%	0.4%	**0.6%**	117.256	**108.323**
31	1.0%	-0.2%	0.9%	**1.0%**	0.376	**0.357**	92	-0.2%	1.0%	0.4%	**0.5%**	128.179	**119.188**
32	1.0%	0.1%	0.9%	**1.0%**	0.400	**0.375**	93	-0.3%	0.9%	0.4%	**0.5%**	140.355	**131.334**
33	0.9%	0.5%	0.9%	**1.0%**	0.422	**0.390**	94	-0.3%	0.8%	0.4%	**0.4%**	154.575	**145.521**
34	0.8%	0.8%	0.9%	**1.0%**	0.445	**0.405**	95	-0.3%	0.8%	0.4%	**0.4%**	171.923	**162.722**
35	0.7%	1.1%	0.8%	**1.0%**	0.470	**0.424**	96		0.7%	0.4%	**0.4%**	191.530	**182.120**
36	0.5%	1.3%	0.8%	**1.0%**	0.499	**0.447**	97		0.7%	0.4%	**0.3%**	209.161	**199.661**
37	0.4%	1.3%	0.8%	**1.0%**	0.534	**0.476**	98		0.7%	0.4%	**0.3%**	227.595	**217.946**
38	0.2%	1.3%	0.7%	**1.0%**	0.574	**0.514**	99		0.7%	0.4%	**0.2%**	246.726	**236.834**
39	0.0%	1.1%	0.7%	**1.0%**	0.621	**0.560**	100		0.7%	0.4%	**0.2%**	266.423	**256.357**
40	-0.2%	0.9%	0.7%	**1.0%**	0.676	**0.613**	101				**0.2%**	286.541	**283.802**
41	-0.4%	0.8%	0.7%	**1.0%**	0.732	**0.667**	102				**0.1%**	306.919	**304.716**
42	-0.4%	0.6%	0.7%	**1.0%**	0.787	**0.723**	103				**0.1%**	327.387	**325.819**
43	-0.4%	0.4%	0.7%	**1.0%**	0.836	**0.774**	104				**0.0%**	347.770	**346.936**
44	-0.3%	0.2%	0.7%	**1.0%**	0.879	**0.823**	105				**0.0%**	367.898	**367.898**
45	-0.1%	0.0%	0.8%	**1.0%**	0.919	**0.866**	106					387.607	**387.607**
46	0.0%	-0.1%	0.8%	**1.0%**	0.969	**0.917**	107					400.000	**400.000**
47	0.1%	-0.2%	0.8%	**1.0%**	1.034	**0.983**	108					400.000	**400.000**
48	0.2%	-0.4%	0.9%	**1.0%**	1.122	**1.072**	109					400.000	**400.000**
49	0.4%	-0.5%	0.9%	**1.0%**	1.218	**1.168**	110					400.000	**400.000**
50	0.5%	-0.6%	1.0%	**1.0%**	1.339	**1.290**	111					400.000	**400.000**
51	0.6%	-0.6%	1.1%	**1.0%**	1.511	**1.453**	112					400.000	**400.000**
52	0.8%	-0.4%	1.1%	**1.1%**	1.705	**1.622**	113					400.000	**400.000**
53	0.9%	0.1%	1.1%	**1.1%**	1.923	**1.792**	114					400.000	**400.000**
54	1.1%	0.7%	1.2%	**1.1%**	2.170	**1.972**	115					400.000	**400.000**
55	1.2%	1.3%	1.2%	**1.2%**	2.448	**2.166**	116					400.000	**400.000**
56	1.3%	1.8%	1.2%	**1.2%**	2.762	**2.393**	117					400.000	**400.000**
57	1.4%	2.1%	1.2%	**1.2%**	3.117	**2.666**	118					400.000	**400.000**
58	1.4%	2.1%	1.2%	**1.2%**	3.517	**3.000**	119					400.000	**400.000**
59	1.4%	2.0%	1.2%	**1.3%**	3.968	**3.393**	120					400.000	**400.000**
60	1.3%	1.8%	1.3%	**1.3%**	4.477	**3.844**							

Table 15 below contains the analysis for the 2012 IAM Table and the impact of the projection scale 40 years out, to 2052. The 2012 table results in mortality rates, which, at key ages, are significantly lower than those in the a2000 Table, even without future improvement. For example, male rates are 33% lower at age 75 and 18% lower at age 85.

Table 15 - Relationship of 2012 IAM Table with and without Projection to a2000 Table and Female to Male

	Projected Basic 1000qx as of:				Ratio to a2000 Table				Ratio: Female to Male	
	2012		2052		2012		2052			
Age	Male	Female	Male	Female	Male	Female	Male	Female	2012	2052
0	1.78	1.80	1.19	1.20	77.2%	100.4%	51.6%	67.2%	101.0%	101.0%
5	0.19	0.14	0.12	0.09	57.5%	73.6%	38.5%	49.3%	74.7%	74.7%
10	0.13	0.09	0.08	0.06	32.3%	67.2%	21.6%	44.9%	74.6%	74.6%
15	0.28	0.17	0.19	0.12	60.1%	88.1%	40.2%	58.9%	61.5%	61.5%
20	0.46	0.25	0.31	0.17	83.7%	91.5%	56.0%	61.2%	55.1%	55.1%
25	0.67	0.28	0.45	0.19	97.5%	75.6%	65.3%	50.6%	41.5%	41.5%
30	0.82	0.33	0.55	0.22	105.1%	74.0%	70.3%	49.5%	40.4%	40.4%
35	0.79	0.42	0.53	0.28	99.6%	82.3%	66.7%	55.1%	53.7%	53.7%
40	0.95	0.61	0.64	0.41	91.5%	90.5%	61.2%	60.6%	64.2%	64.2%
45	1.35	0.87	0.91	0.58	69.5%	83.1%	46.5%	55.6%	64.0%	64.0%
50	2.29	1.29	1.53	0.86	68.6%	75.4%	45.9%	50.5%	56.4%	56.4%
55	3.62	2.17	2.19	1.36	71.2%	78.9%	43.1%	49.7%	59.9%	62.4%
60	5.66	3.84	3.09	2.28	79.0%	89.9%	43.1%	53.3%	67.9%	73.6%
65	9.01	6.83	4.92	4.05	81.9%	97.3%	44.8%	57.7%	75.8%	82.2%
70	12.62	10.08	6.89	5.97	66.7%	90.3%	36.4%	53.5%	79.9%	86.7%
75	20.91	15.87	11.42	9.40	66.4%	81.2%	36.3%	48.1%	75.9%	82.3%
80	36.93	27.58	20.17	16.34	72.2%	77.5%	39.5%	45.9%	74.7%	81.0%
85	66.51	54.44	42.73	37.16	81.8%	85.2%	52.5%	58.2%	81.9%	87.0%
90	122.21	98.20	92.28	77.19	98.1%	87.1%	74.1%	68.5%	80.3%	83.6%
95	205.84	162.72	171.87	138.62	114.2%	93.3%	95.4%	79.4%	79.1%	80.7%
100	298.45	256.36	275.48	236.63	119.5%	108.1%	110.3%	99.8%	85.9%	85.9%
105	400.00	367.90	400.00	367.90	107.4%	105.9%	107.4%	105.9%	92.0%	92.0%

VI - The 2012 Individual Annuity Mortality Period Table

The 2012 IAM Period Table is the 2012 IAM Basic Table with the margins as determined by LATF, but without future projection. To develop the margins, the Team reviewed the approach taken for developing the margins used in the a2000 Table and discussed with LATF whether there was a need to vary the approach to determining the margin or the actual level of margin from that used in developing the a2000 Table, with a recommendation that the Team did not see a compelling reason to vary. LATF agreed no changes in the approach or level of margin were required. Thus, the resulting margin recommended by LATF is 10% for all ages up to and including 100. The margin then grades down 1% per year for ages 100 until the ultimate mortality cap of 0.40000 is invoked. This results in a margin of zero beginning at age 106 for males and 108 for females. The table omega is 120 where the mortality rate is set to 1.00000. The Team determined there was no need to smoothly grade from 0.40000 to 1.00000 as there was little difference on the impact of reserves. See Exhibit II for the 2012 IAM Period Table.

VII - The 2012 Individual Annuity Reserve Table and Projection Factors

To develop the 2012 Individual Annuity Reserve Table (2012 IAR Table), the Team concluded it made sense to create a generational mortality table through the use of projection factors. These projection factors are applied to the table each valuation year, rather than using a static table which can become dated more quickly. The Team used the same approach as for the improvement factors described in Section VI of this report. For future projection, the Team decided to use Scale G2, without further modification. An example of the development of a generational mortality table through application of projection factors is shown in Exhibit IV.

VIII - Validation of 2012 IAM Table

In order to test the overall fit of the resulting table to the underlying 2000-2004 experience, the Team back-tested the table by recalculating the A/E ratio where the expected basis was the 2012 IAM Table (i.e., without margin) adjusted to 2002, the mid-point of the underlying experience. The purpose of this test was to ensure that the resulting table, after the various adjustments, graduation and smoothing compared to the underlying experience as the Team intended. The Team observed the overall fit to be quite good at the core ages (i.e., 65 through 95) and somewhat less at other ages, where different data was used. The Team concluded this was appropriate and the results of the back-testing did not warrant additional modification to the table. Table 16 below shows the results of the back-testing.

Table 16 - Comparison of 2012 IAM Basic Table (Adjusted to 2002) to 2000-2004 Experience

Attained Age Group	Male A/E Ratio	Female A/E Ratio
60 - 64	111%	112%
65 - 69	100%	103%
70 - 74	100%	102%
75 - 79	100%	99%
80 - 84	100%	100%
85 - 89	100%	102%
90 - 94	101%	100%
95 - 99	107%	105%

In addition, the Team tested the 2012 IAM Table to the preliminary 2005-2008 experience data. The Team determined there was no evidence to suggest withholding the introduction of the 2012 Table in order to obtain more data. Table 17 shows the results of the testing against the 2005-2008 preliminary experience data. The Expected basis is the 2012 IAM table (i.e., without margin) adjusted to January 1, 2007, the mid-point of the underlying experience.

Table 17 - Comparison of 2012 IAM Basic Table (Adjusted to January 1, 2007) to Preliminary 2005 - 2008 Experience

Attained Age Group	Male A/E Ratio	Female A/E Ratio
60 - 64	110%	129%
65 - 69	94%	99%
70 - 74	105%	99%
75 - 79	102%	103%
80 - 84	104%	98%
85 - 89	102%	96%
90 - 94	107%	105%
95 - 99	99%	107%

IX - Impact to Reserves

The Team analyzed the impact of the 2012 Individual Annuity Reserve (2012 IAR) Table, which includes both the projection factors and margin, to the current a2000 Table, as well as to annuity reserves. Figures 3, 4, 5 and 6 below compare the mortality rates per 1,000 of the 2012 IAM Table, the 2012 IAR Table to the a2000 Table and a2000 Valuation Table.

Figure 3
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Male Risks, Ages 0-64

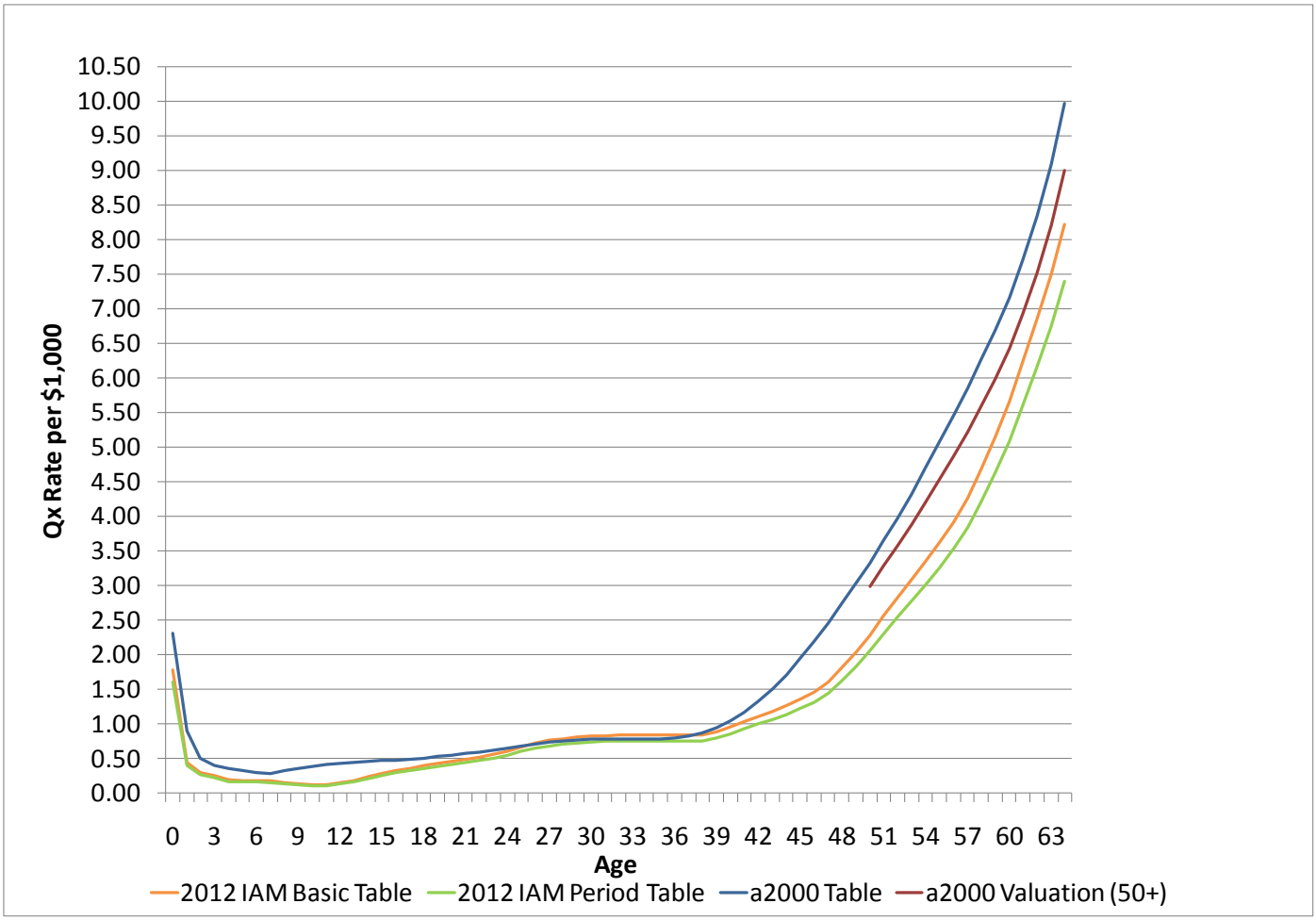


Figure 4
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Male Risks, Ages 65-90

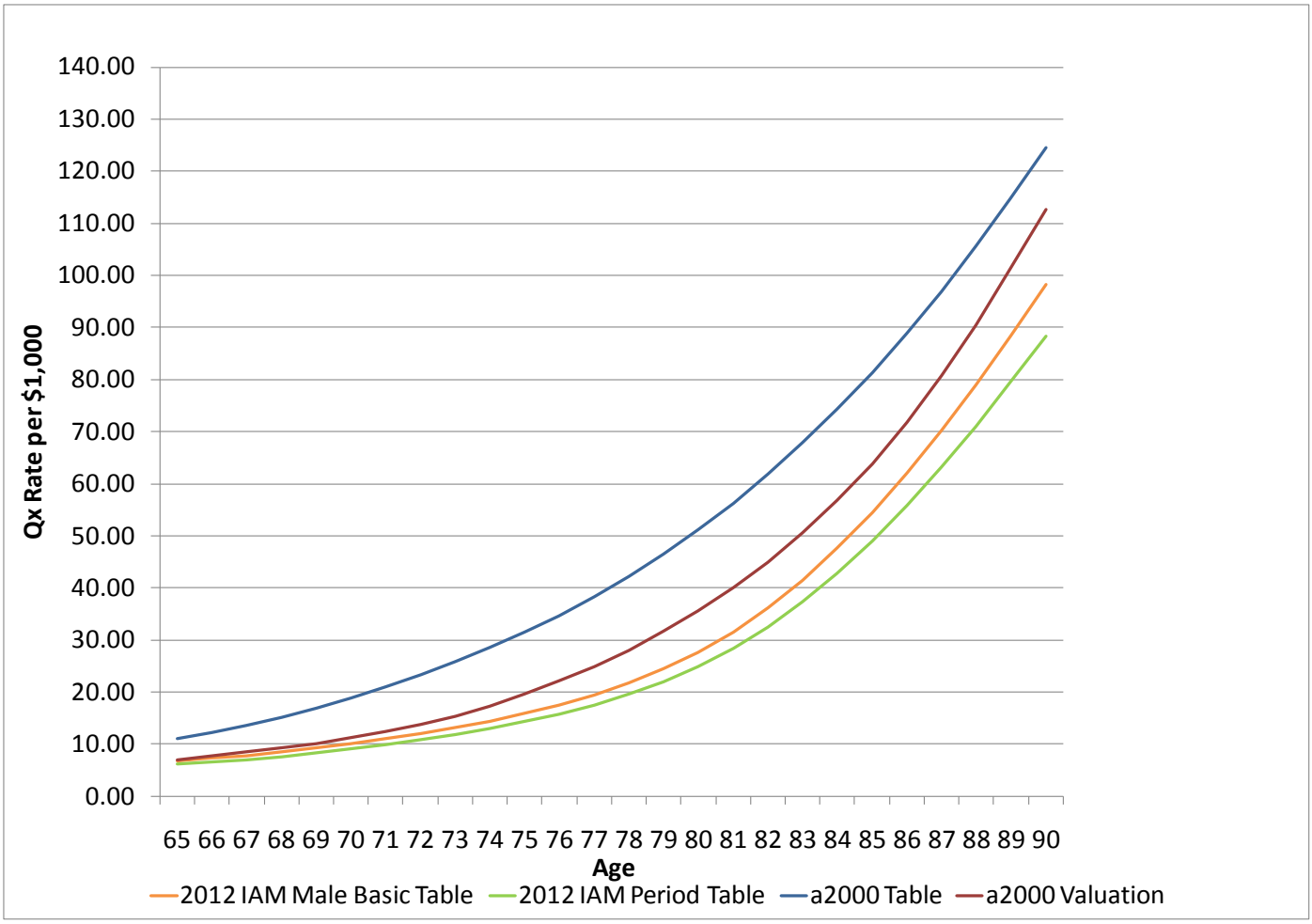


Figure 5
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Male Risks, Ages 91-115

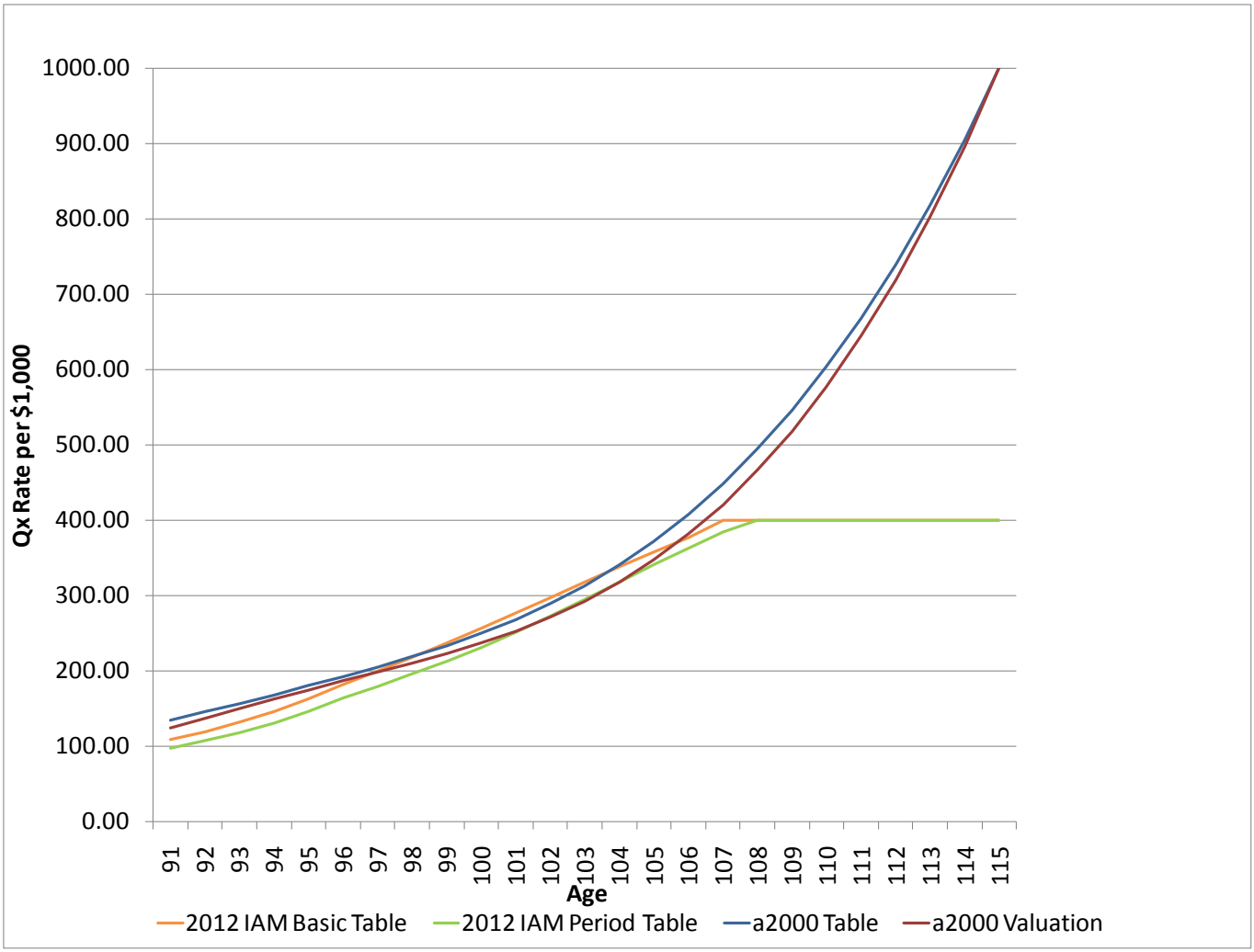


Figure 6
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Female Risks, Ages 0-64

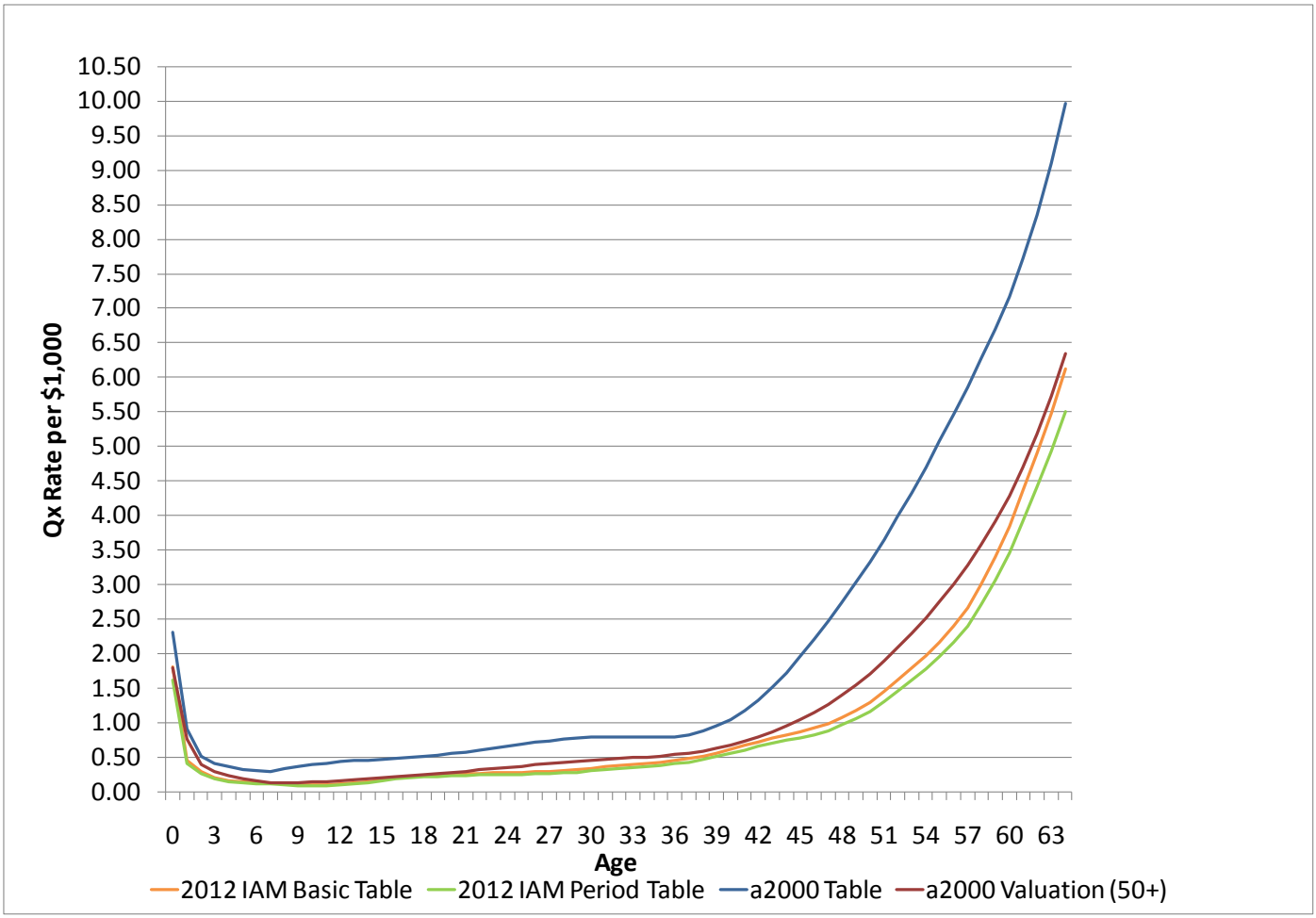


Figure 7
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Female Risks, Ages 65-90

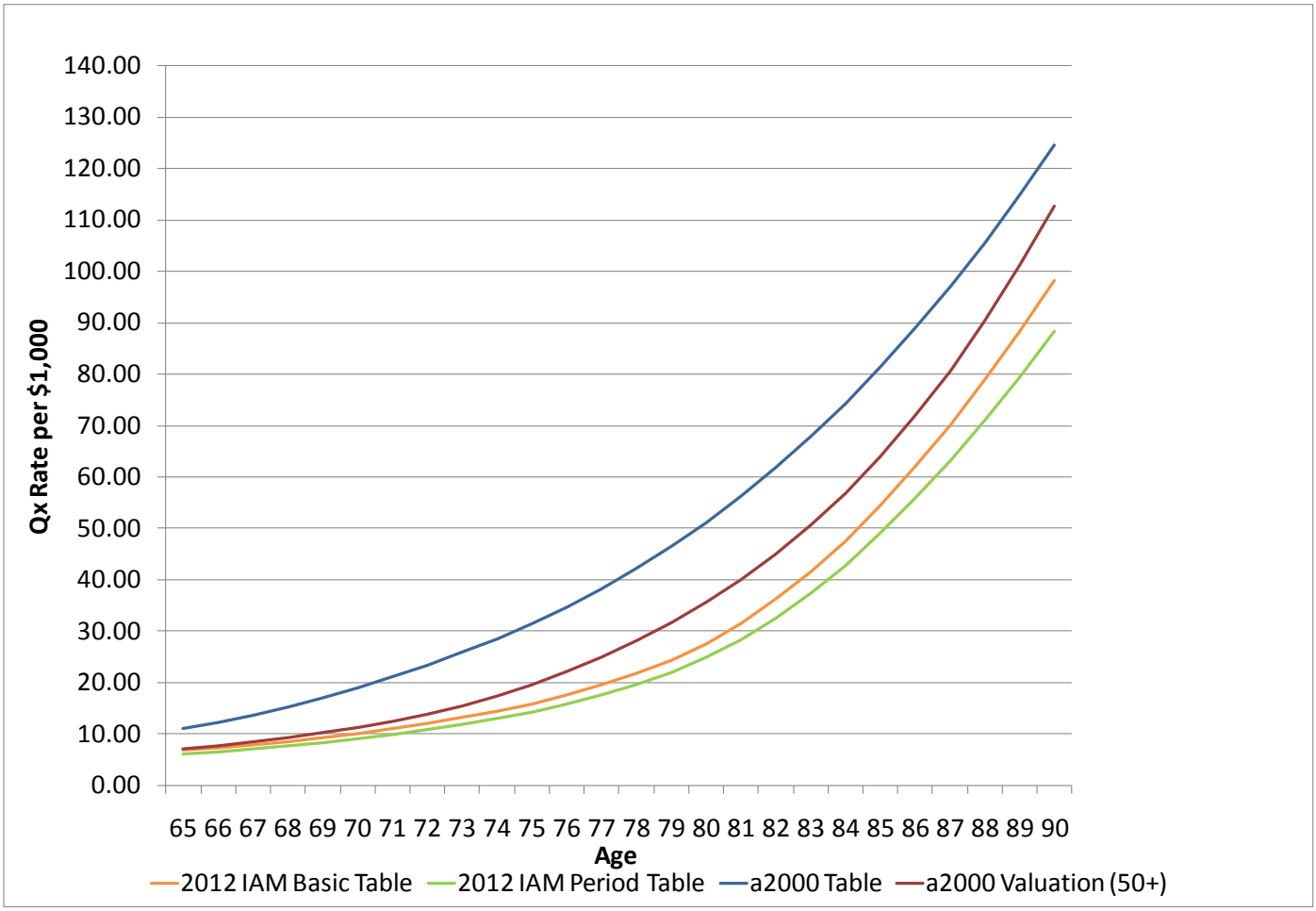
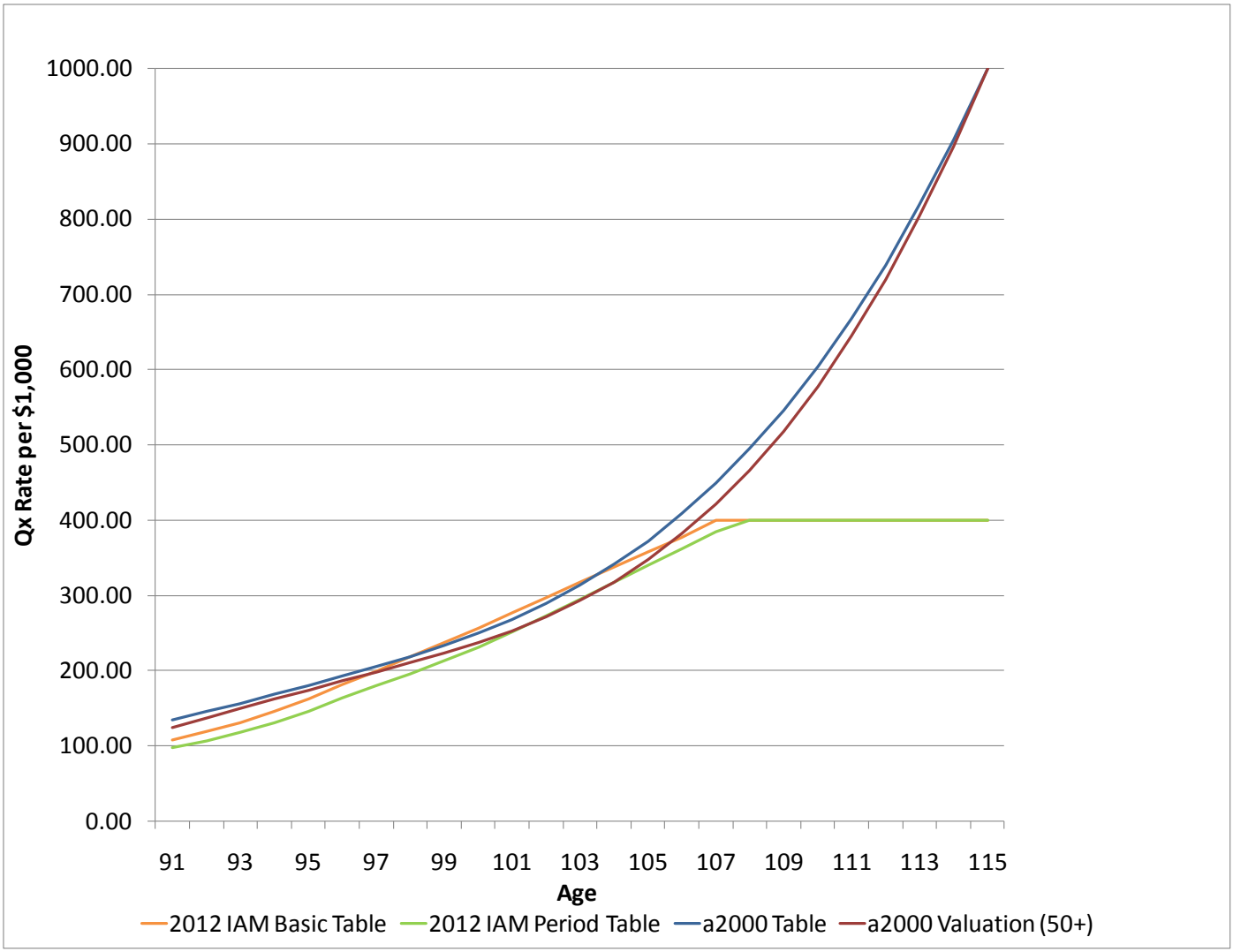


Figure 8
Mortality Rate per 1,000 Comparison
Proposed 2012 Table to a2000 Table
Female Risks, Ages 91-115



The Team also prepared sample reserve calculations using 5% interest and proposed mortality and compared them to reserves using a2000 table. In performing the review of the impact to reserves of the IAR Table, the Team compared initial reserves and reserves 10 years after issue for select ages as shown in Tables 18 and 19 below.

Table 18 - Comparison of Reserves at Issue

		Initial Reserves per $1,000 @ 5% Interest			Percentage Increase		
		a2000	2012 w/o Improvement	2012 with Improvement	2012 w/o Improvement	Adding Improvement	Total 2012
Life Annuity at Age 65	Male	11.60	12.37	12.76	6.6%	3.1%	9.9%
	Female	12.62	13.00	13.32	3.0%	2.4%	5.5%
Life Annuity at Age 75	Male	8.50	9.20	9.45	8.3%	2.7%	11.2%
	Female	9.41	9.95	10.16	5.7%	2.1%	8.0%
Life Annuity at Age 85	Male	5.50	5.63	5.72	2.3%	1.5%	3.9%
	Female	5.91	6.29	6.37	6.4%	1.3%	7.7%
20 Year C&L at Age 65	Male	14.54	14.58	14.79	0.3%	1.4%	1.7%
	Female	14.69	14.83	15.01	1.0%	1.2%	2.2%
20 Year C&L at Age 75	Male	13.67	13.53	13.59	- 1.1%	0.5%	- 0.6%
	Female	13.71	13.71	13.77	- 0.1%	0.5%	0.4%
Age 50 deferred to 80	Male	1.05	1.27	1.57	21.3%	23.3%	49.6%
	Female	1.36	1.51	1.76	11.0%	16.6%	29.4%
Age 60 deferred to 80	Male	1.78	2.14	2.46	19.8%	15.4%	38.2%
	Female	2.26	2.50	2.78	10.5%	11.1%	22.7%

Table 19 - Comparison of Reserves 10 Years after Issue

		Reserves per $1,000 10 Years After Issue @ 5% Interest			Percentage Increase		
		a2000	2012 w/o Improvement	2012 with Improvement	2012 w/o Improvement	Adding Improvement	Total 2012
Life Annuity at Age 65	Male	8.50	9.20	9.79	8.3%	6.3%	15.1%
	Female	9.41	9.95	10.43	5.7%	4.8%	10.8%
Life Annuity at Age 75	Male	5.50	5.63	5.95	2.3%	5.6%	8.1%
	Female	5.91	6.29	6.57	6.4%	4.5%	11.1%
Life Annuity at Age 85	Male	3.21	2.82	2.91	-12.1%	3.3%	- 9.2%
	Female	3.32	3.30	3.39	- 0.6%	2.8%	2.2%
20 Year C&L at Age 65	Male	11.10	11.18	11.51	0.7%	3.0%	3.7%
	Female	11.35	11.58	11.87	2.0%	2.5%	4.6%
20 Year C&L at Age 75	Male	9.69	9.45	9.56	- 2.5%	1.1%	- 1.4%
	Female	9.76	9.75	9.85	- 0.1%	1.1%	0.9%
Age 50 deferred to 80	Male	1.78	2.14	2.63	19.8%	23.1%	47.4%
	Female	2.26	2.50	2.91	10.5%	16.4%	28.6%
Age 60 deferred to 80	Male	3.21	3.76	4.31	17.0%	14.7%	34.2%
	Female	3.92	4.32	4.78	10.1%	10.7%	21.8%

EXHIBIT I

2012 Individual Annuity Mortality Table Basic Rates

EXHIBIT I

2012 IAM Basic Table
Male, Age Nearest Birthday

Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$
0	1.783	30	0.824	60	5.662	90	122.214
1	0.446	31	0.834	61	6.237	91	136.799
2	0.306	32	0.838	62	6.854	92	152.409
3	0.254	33	0.828	63	7.510	93	169.078
4	0.193	34	0.808	64	8.220	94	186.882
5	0.186	35	0.789	65	9.007	95	205.844
6	0.184	36	0.783	66	9.497	96	219.247
7	0.177	37	0.800	67	10.085	97	238.612
8	0.159	38	0.837	68	10.787	98	258.341
9	0.143	39	0.889	69	11.625	99	278.219
10	0.126	40	0.955	70	12.619	100	298.452
11	0.123	41	1.029	71	13.798	101	323.610
12	0.147	42	1.110	72	15.195	102	344.191
13	0.188	43	1.188	73	16.834	103	364.633
14	0.236	44	1.268	74	18.733	104	384.783
15	0.282	45	1.355	75	20.905	105	400.000
16	0.325	46	1.464	76	23.367	106	400.000
17	0.364	47	1.615	77	26.155	107	400.000
18	0.399	48	1.808	78	29.306	108	400.000
19	0.430	49	2.032	79	32.858	109	400.000
20	0.459	50	2.285	80	36.927	110	400.000
21	0.492	51	2.557	81	41.703	111	400.000
22	0.526	52	2.828	82	46.957	112	400.000
23	0.569	53	3.088	83	52.713	113	400.000
24	0.616	54	3.345	84	59.148	114	400.000
25	0.669	55	3.616	85	66.505	115	400.000
26	0.728	56	3.922	86	75.015	116	400.000
27	0.764	57	4.272	87	84.823	117	400.000
28	0.789	58	4.681	88	95.987	118	400.000
29	0.808	59	5.146	89	108.482	119	400.000
						120	400.000

EXHIBIT I

2012 IAM Basic Table
Female, Age Nearest Birthday

Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$
0	1.801	30	0.333	60	3.844	90	98.197
1	0.450	31	0.357	61	4.352	91	108.323
2	0.287	32	0.375	62	4.899	92	119.188
3	0.199	33	0.390	63	5.482	93	131.334
4	0.152	34	0.405	64	6.118	94	145.521
5	0.139	35	0.424	65	6.829	95	162.722
6	0.130	36	0.447	66	7.279	96	182.120
7	0.122	37	0.476	67	7.821	97	199.661
8	0.105	38	0.514	68	8.475	98	217.946
9	0.098	39	0.560	69	9.234	99	236.834
10	0.094	40	0.613	70	10.083	100	256.357
11	0.096	41	0.667	71	11.011	101	283.802
12	0.105	42	0.723	72	12.030	102	304.716
13	0.120	43	0.774	73	13.154	103	325.819
14	0.146	44	0.823	74	14.415	104	346.936
15	0.174	45	0.866	75	15.869	105	367.898
16	0.199	46	0.917	76	17.555	106	387.607
17	0.220	47	0.983	77	19.500	107	400.000
18	0.234	48	1.072	78	21.758	108	400.000
19	0.245	49	1.168	79	24.412	109	400.000
20	0.253	50	1.290	80	27.579	110	400.000
21	0.260	51	1.453	81	31.501	111	400.000
22	0.266	52	1.622	82	36.122	112	400.000
23	0.272	53	1.792	83	41.477	113	400.000
24	0.275	54	1.972	84	47.589	114	400.000
25	0.277	55	2.166	85	54.441	115	400.000
26	0.284	56	2.393	86	61.972	116	400.000
27	0.290	57	2.666	87	70.155	117	400.000
28	0.300	58	3.000	88	78.963	118	400.000
29	0.313	59	3.393	89	88.336	119	400.000
						120	400.000

EXHIBIT II

2012 Individual Annuity Mortality Period Table Rates

EXHIBIT II

2012 IAM Period Table
Male, Age Nearest Birthday

Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$
0	1.605	30	0.741	60	5.096	90	109.993
1	0.401	31	0.751	61	5.614	91	123.119
2	0.275	32	0.754	62	6.169	92	137.168
3	0.229	33	0.756	63	6.759	93	152.171
4	0.174	34	0.756	64	7.398	94	168.194
5	0.168	35	0.756	65	8.106	95	185.260
6	0.165	36	0.756	66	8.548	96	197.322
7	0.159	37	0.756	67	9.076	97	214.751
8	0.143	38	0.756	68	9.708	98	232.507
9	0.129	39	0.800	69	10.463	99	250.397
10	0.113	40	0.859	70	11.357	100	268.607
11	0.111	41	0.926	71	12.418	101	290.016
12	0.132	42	0.999	72	13.675	102	311.849
13	0.169	43	1.069	73	15.150	103	333.962
14	0.213	44	1.142	74	16.860	104	356.207
15	0.254	45	1.219	75	18.815	105	380.000
16	0.293	46	1.318	76	21.031	106	400.000
17	0.328	47	1.454	77	23.540	107	400.000
18	0.359	48	1.627	78	26.375	108	400.000
19	0.387	49	1.829	79	29.572	109	400.000
20	0.414	50	2.057	80	33.234	110	400.000
21	0.443	51	2.302	81	37.533	111	400.000
22	0.473	52	2.545	82	42.261	112	400.000
23	0.513	53	2.779	83	47.441	113	400.000
24	0.554	54	3.011	84	53.233	114	400.000
25	0.602	55	3.254	85	59.855	115	400.000
26	0.655	56	3.529	86	67.514	116	400.000
27	0.688	57	3.845	87	76.340	117	400.000
28	0.710	58	4.213	88	86.388	118	400.000
29	0.727	59	4.631	89	97.634	119	400.000
						120	1000.000

EXHIBIT II

2012 IAM Period Table
Female, Age Nearest Birthday

Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$	Age	$1000q_x2012$
0	1.621	30	0.300	60	3.460	90	88.377
1	0.405	31	0.321	61	3.916	91	97.491
2	0.259	32	0.338	62	4.409	92	107.269
3	0.179	33	0.351	63	4.933	93	118.201
4	0.137	34	0.365	64	5.507	94	130.969
5	0.125	35	0.381	65	6.146	95	146.449
6	0.117	36	0.402	66	6.551	96	163.908
7	0.110	37	0.429	67	7.039	97	179.695
8	0.095	38	0.463	68	7.628	98	196.151
9	0.088	39	0.504	69	8.311	99	213.150
10	0.085	40	0.552	70	9.074	100	230.722
11	0.086	41	0.600	71	9.910	101	251.505
12	0.094	42	0.650	72	10.827	102	273.007
13	0.108	43	0.697	73	11.839	103	295.086
14	0.131	44	0.740	74	12.974	104	317.591
15	0.156	45	0.780	75	14.282	105	340.362
16	0.179	46	0.825	76	15.799	106	362.371
17	0.198	47	0.885	77	17.550	107	384.113
18	0.211	48	0.964	78	19.582	108	400.000
19	0.221	49	1.051	79	21.970	109	400.000
20	0.228	50	1.161	80	24.821	110	400.000
21	0.234	51	1.308	81	28.351	111	400.000
22	0.240	52	1.460	82	32.509	112	400.000
23	0.245	53	1.613	83	37.329	113	400.000
24	0.247	54	1.774	84	42.830	114	400.000
25	0.250	55	1.950	85	48.997	115	400.000
26	0.256	56	2.154	86	55.774	116	400.000
27	0.261	57	2.399	87	63.140	117	400.000
28	0.270	58	2.700	88	71.066	118	400.000
29	0.281	59	3.054	89	79.502	119	400.000
						120	1000.000

EXHIBIT III

Projection Scale G2

EXHIBIT III

Projection Scale G2
Male, Age Nearest Birthday

Age	$G2_x$	Age	$G2_x$	Age	$G2_x$	Age	$G2_x$
0	0.010	30	0.010	60	0.015	90	0.007
1	0.010	31	0.010	61	0.015	91	0.007
2	0.010	32	0.010	62	0.015	92	0.006
3	0.010	33	0.010	63	0.015	93	0.005
4	0.010	34	0.010	64	0.015	94	0.005
5	0.010	35	0.010	65	0.015	95	0.004
6	0.010	36	0.010	66	0.015	96	0.004
7	0.010	37	0.010	67	0.015	97	0.003
8	0.010	38	0.010	68	0.015	98	0.003
9	0.010	39	0.010	69	0.015	99	0.002
10	0.010	40	0.010	70	0.015	100	0.002
11	0.010	41	0.010	71	0.015	101	0.002
12	0.010	42	0.010	72	0.015	102	0.001
13	0.010	43	0.010	73	0.015	103	0.001
14	0.010	44	0.010	74	0.015	104	0.000
15	0.010	45	0.010	75	0.015	105	0.000
16	0.010	46	0.010	76	0.015	106	0.000
17	0.010	47	0.010	77	0.015	107	0.000
18	0.010	48	0.010	78	0.015	108	0.000
19	0.010	49	0.010	79	0.015	109	0.000
20	0.010	50	0.010	80	0.015	110	0.000
21	0.010	51	0.011	81	0.014	111	0.000
22	0.010	52	0.011	82	0.013	112	0.000
23	0.010	53	0.012	83	0.013	113	0.000
24	0.010	54	0.012	84	0.012	114	0.000
25	0.010	55	0.013	85	0.011	115	0.000
26	0.010	56	0.013	86	0.010	116	0.000
27	0.010	57	0.014	87	0.009	117	0.000
28	0.010	58	0.014	88	0.009	118	0.000
29	0.010	59	0.015	89	0.008	119	0.000
						120	0.000

EXHIBIT III

Projection Scale G2
Female, Age Nearest Birthday

Age	$G2_x$	Age	$G2_x$	Age	$G2_x$	Age	$G2_x$
0	0.010	30	0.010	60	0.013	90	0.006
1	0.010	31	0.010	61	0.013	91	0.006
2	0.010	32	0.010	62	0.013	92	0.005
3	0.010	33	0.010	63	0.013	93	0.005
4	0.010	34	0.010	64	0.013	94	0.004
5	0.010	35	0.010	65	0.013	95	0.004
6	0.010	36	0.010	66	0.013	96	0.004
7	0.010	37	0.010	67	0.013	97	0.003
8	0.010	38	0.010	68	0.013	98	0.003
9	0.010	39	0.010	69	0.013	99	0.002
10	0.010	40	0.010	70	0.013	100	0.002
11	0.010	41	0.010	71	0.013	101	0.002
12	0.010	42	0.010	72	0.013	102	0.001
13	0.010	43	0.010	73	0.013	103	0.001
14	0.010	44	0.010	74	0.013	104	0.000
15	0.010	45	0.010	75	0.013	105	0.000
16	0.010	46	0.010	76	0.013	106	0.000
17	0.010	47	0.010	77	0.013	107	0.000
18	0.010	48	0.010	78	0.013	108	0.000
19	0.010	49	0.010	79	0.013	109	0.000
20	0.010	50	0.010	80	0.013	110	0.000
21	0.010	51	0.010	81	0.012	111	0.000
22	0.010	52	0.011	82	0.012	112	0.000
23	0.010	53	0.011	83	0.011	113	0.000
24	0.010	54	0.011	84	0.010	114	0.000
25	0.010	55	0.012	85	0.010	115	0.000
26	0.010	56	0.012	86	0.009	116	0.000
27	0.010	57	0.012	87	0.008	117	0.000
28	0.010	58	0.012	88	0.007	118	0.000
29	0.010	59	0.013	89	0.007	119	0.000
						120	0.000

EXHIBIT IV

Generational Mortality Table Development

EXHIBIT IV

Example of Generational Mortality Table and Use of Projection Factors

In order to develop generational mortality table rates, the mortality rate for a person age x in year (2012 + n) determined as follows:

$$q_x^{2012+n} = q_x^{2012} * (1 - G2_x)^n$$

where,

- G2x is annual rate of mortality improvement for age x
- q_x is the mortality rate from 2012 Individual Annuity Mortality Period Table

The following table illustrates the development of the 2012 IAR Mortality Table from the 2012 IAM Period Table

Illustration of Development of 2012 IAR Mortality Table, which is a Generation Mortality Table from the 2012 IAM Period Table

Age	2012	2013	2014	2015	2016	2017	2018	…	2070
65	q_{65}^{2012}	q_{65}^{2013}	q_{65}^{2014}	q_{65}^{2015}	q_{65}^{2016}	q_{65}^{2017}	q_{65}^{2018}	…	q_{65}^{2070}
66	q_{66}^{2012}	q_{66}^{2013}	q_{66}^{2014}	q_{66}^{2015}	q_{66}^{2016}	q_{66}^{2017}	q_{66}^{2018}	…	q_{66}^{2070}
67	q_{67}^{2012}	q_{67}^{2013}	q_{67}^{2014}	q_{67}^{2015}	q_{67}^{2016}	q_{67}^{2017}	q_{67}^{2018}	…	q_{67}^{2070}
68	q_{68}^{2012}	q_{68}^{2013}	q_{68}^{2014}	q_{68}^{2015}	q_{68}^{2016}	q_{68}^{2017}	q_{68}^{2018}	…	q_{68}^{2070}
69	q_{69}^{2012}	q_{69}^{2013}	q_{69}^{2014}	q_{69}^{2015}	q_{69}^{2016}	q_{69}^{2017}	q_{69}^{2018}	…	q_{69}^{2070}
…	…	…	…	…	…	…	…	…	…
120	q_{120}^{2012}	q_{120}^{2013}	q_{120}^{2014}	q_{120}^{2015}	q_{120}^{2016}	q_{120}^{2017}	q_{120}^{2018}	…	q_{120}^{2070}

The following is an example of the mortality table rates for years 2013 through 2018. The table is based on the 2012 IAM Period Table for Male risks, using Scale G2, for issue years 2013

			Values of 1000qx					
Age	**$1000q_x^{2012}$**	**$G2_x$**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
65	8.106	0.015	7.984	7.865	7.747	7.630	7.516	7.403
66	8.548	0.015	8.420	8.293	8.169	8.047	7.926	7.807
67	9.076	0.015	8.940	8.806	8.674	8.544	8.415	8.289
68	9.708	0.015	9.562	9.419	9.278	9.138	9.001	8.866
69	10.463	0.015	10.306	10.151	9.999	9.849	9.701	9.556

[1] Eilers, P.H.C., and Marx, B.D. 1996. "Flexible Smoothing with B-splines and Penalties." Statistical Science 11(2): 89-121.

[2] P-Spline formula denoted as $q(i)x,t = \exp\{\log(q(i)x,t) + Z \times \hat{S}x,t\}$ whereby $q(i)x,t$ is the force of mortality for each age x and for each year t. $\hat{S}x,t$ is the standard deviation of the log mean value of $q(i)x,t$. Z is a standard normal variable for use in generating scenarios. Further details on the P-Spline methodology and the Mortality Projection Spreadsheet v3.0 can be found in the Continuous Mortality Investigation Working Paper 15 (2005), pp. 12-15 and Revised Working Paper 20 produced by The Faculty of Actuaries and Institute of Actuaries.

[3] Continuous Mortality Investigation. 2005. "Working Paper 15. Projecting Future Mortality: Towards a Proposal for a Stochastic Methodology." and Continuous Mortality Investigation. 2007. "Revised Working Paper 20. Stochastic Projection Methodologies: further progress and P-Spline Model features, example results and implications." The Faculty of Actuaries and Institute of Actuaries.

[4] Currie, I.D., Durban, M., and Eilers, P.H.C. 2004. "Smoothing and Forecasting Mortality Rates." Statistical Modeling 4: 279-298

[5] Inference for Logistic-type Models for the Force of Mortality", Louis G. Doray, Living to 100 and Beyond Symposium, 2008

[6] Canadian Institute of Actuaries, "Mortality Improvement Research Paper," Committee of Life Insurance Financial Reporting, September 2010