★ Segal Consulting

Alameda County Employees' Retirement Association

ACTUARIAL EXPERIENCE STUDY

Analysis of Actuarial Experience
During the Period
December 1, 2013 through November 30, 2016

September 6, 2017

Board of Retirement
Alameda County Employees' Retirement Association
475 14th Street, Suite 1000
Oakland, California 94612-1900

Re: Review of Actuarial Assumptions for the December 31, 2017 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the Alameda
County Employees' Retirement Association. This study utilizes the census data for the period
December 1, 2013 to November 30, 2016 and provides the proposed actuarial assumptions, both
economic and demographic, to be used in the December 31, 2017 valuation.

We are members of the American Academy of Actuaries and we meet the Qualification Standards
of the American Academy of Actuaries to render the actuarial opinion herein.

We look forward to reviewing this report with you and answering any questions you may have.

Sincerely,

Andy Yeung, ASA, MAAA, FCA, EA   Eva Yum, FSA, MAAA, EA
Vice President and Actuary   Associate Actuary

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Table of Contents

Actuarial Experience Study
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I. Introduction, Summary, and Recommendations

To project the cost and liabilities of the Pension Fund, assumptions are made about all future events that could affect the amount and timing of the benefits to be paid and the assets to be accumulated. Each year actual experience is compared against the projected experience, and to the extent there are differences, the future contribution requirement is adjusted.

If assumptions are changed, contribution requirements are adjusted to take into account a change in the projected experience in all future years. There is a great difference in both philosophy and cost impact between recognizing the actuarial deviations as they occur annually and changing the actuarial assumptions. Taking into account one year's gains or losses without making a change in the assumptions in effect assumes that experience was temporary and that, over the long run, experience will return to what was originally assumed. Changing assumptions reflects a basic change in thinking about the future, and it has a much greater effect on the current contribution requirements than recognizing gains or losses as they occur.

The use of realistic actuarial assumptions is important to maintain adequate funding, while paying promised benefit amounts to participants already retired and to those near retirement. The actuarial assumptions used do not determine the "actual cost" of the plan. The actual cost is determined solely by the benefits and administrative expenses paid out, offset by investment income received. However, it is desirable to estimate as closely as possible what the actual cost will be so as to permit an orderly method for setting aside contributions today to provide benefits in the future, and to maintain equity among generations of participants and taxpayers.

This study was undertaken in order to develop assumptions for use in the December 31, 2017 and later actuarial valuations. It compares the actual experience during one three-year period, from December 1, 2013 through November 30, 2016, with that expected under the current assumptions.

The study was performed in accordance with Actuarial Standard of Practice (ASOP) No. 27, "Selection of Economic Assumptions for Measuring Pension Obligations" and ASOP No. 35, "Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations". These Standards of Practice put forth guidelines for the selection of the various actuarial assumptions utilized in a pension plan actuarial valuation. Based on the study's results and expected future experience, we are recommending various changes in the current actuarial assumptions.

We are recommending changes in the assumptions for inflation, investment return, merit and promotional salary increases, retirement from active employment, pre-retirement mortality, healthy life mortality, disabled life mortality, termination from active employment (vested and withdrawal of contributions), disability (service connected and non-service connected), retirement age for deferred vested members, salary increases for reciprocity members, spouse age difference, and conversion of unused sick leave at retirement.

Our recommendations for the major actuarial assumption categories are as follows:

Pg #	Actuarial Assumption Categories	Recommendation
7	**Inflation:** Future increases in the Consumer Price Index (CPI), which drives investment returns and active member salary increases, as well as cost-of-living adjustments (COLAs) increases for retirees.	Reduce the current 3.25% inflation rate to 3.00% per annum as discussed in Section III (A).
9	**Investment Return:** The estimated average future net rate of return on current and future assets of the Association as of the valuation date. This rate is used to discount liabilities.	Reduce the current investment return assumption from 7.60% per annum to 7.25% per annum as discussed in Section III (B).
16	**Individual Salary Increases:** Increases in the salary of a member between the date of the valuation to the date of separation from active service. This assumption has three components: • Inflationary salary increases • Real "across the board" salary increases • Merit and promotional increases **Terminal Pay:** Additional earnings that are expected to be received during the member's final average earnings period.	Reduce the current inflationary salary increase assumption from 3.25% to 3.00% per annum, consistent with our recommended general inflation assumption, and maintain the current real "across the board" salary increase assumption at 0.50%. This means that the combined inflationary and real "across the board" salary increases will decrease from 3.75% to 3.50% per annum. We recommend adjusting the current merit and promotional rates of salary increase (which are based on years of service) to those developed in Section III (C) to reflect past experience. We recommend reducing the terminal pay assumption for service retirement for Safety Tier 2 members (and, consequently, for Safety Tier 2C and Tier 2D members). The assumptions for the other tiers remain unchanged. No changes to the terminal pay assumptions for disability retirement are recommended.
24 54 32	**Retirement Rates:** The probability of retirement at each age at which participants are eligible to retire. **Other Retirement Related Assumptions including:** • Percent married and spousal age differences for members not yet retired • Retirement age for inactive vested members • Future reciprocal members and reciprocal salary increase	We recommend adjusting the retirement rates to those developed in Section IV (A). For active and inactive vested members, maintain the percent married at retirement assumption at 50% for females and 70% for males. Reduce the spouse age difference assumption from three years to two years for female members (female members are assumed to be two years younger than their male spouse beneficiaries). For deferred vested members, increase the assumed retirement age from 60 to 61 for General members and maintain the assumed retirement age at 56 for Safety members. Maintain the current reciprocity assumption for future terminated members at 30% for General members and 60% for Safety members. In addition, reduce the current reciprocal salary increase assumption from 4.15% to 3.90% for General members and from 4.45% to 4.30% for Safety members.

Pg #	Actuarial Assumption Categories	Recommendation
35	**Mortality Rates:** The probability of dying at each age. Mortality rates are used to project life expectancies.	For members who retire from service, we recommend adjusting the rates as developed in Section IV (B) for General and Safety members and all beneficiaries to reflect a generational approach for anticipating future mortality improvement.
43		The disabled member mortality rates for General and Safety members have also been adjusted as developed in Section IV (C).
		The recommended pre-retirement mortality assumptions for General and Safety members have been adjusted as developed in Section IV (B). In addition, we recommend maintaining the assumption that all pre-retirement deaths are assumed to be non-service connected deaths.
		For determining member contribution rates, and optional forms of benefit and reserves, we recommend changing the mortality rates to those developed in Section IV (B).
		These changes for healthy and disabled retirees generally reflect longer life expectancies.
46	**Termination Rates:** The probability of leaving employment at each age and receiving either a refund of contributions or a deferred vested retirement benefit.	We recommend adjusting the termination rates to those developed in Section IV (D) to reflect recent experience.
		We also recommend reducing the assumption for the percentage of members electing a refund of contributions for members with five or more years of service from 40% to 35% for both General and Safety members.
51	**Disability Incidence Rates:** The probability of becoming disabled at each age.	We recommend reducing the disability rates for General members and increasing the disability rates for Safety members to more closely reflect actual experience.
55	**Sick Leave Conversion:** The assumption for converting unused sick leave into service credit at retirement.	We recommend decreasing the sick leave conversion assumption from 0.005 to 0.003 years of additional service credit at retirement for each year of employment for General members, and increasing the assumption from 0.005 to 0.006 years for Safety members.

We have estimated the impact of the proposed assumption changes as if they were applied to the December 31, 2016 actuarial valuation.

Cost Impact of Recommended Assumptions		
<u>Change</u> in Costs	Contribution Rate	Estimated Annual Dollar Amount in Thousands*
Employer	3.46%	$34,547
Member	<u>0.64%</u>	<u>6,447</u>
Total	4.10%	$40,994

* Based on December 31, 2016 projected annual payrolls as determined under each set of assumptions.

Of the 4.10% of payroll rate impact, about 3.75% of payroll is due to the recommended investment return assumption, 1.08% of payroll is due to the recommended mortality assumption, and the rest (i.e., a decrease of 0.73% of payroll) is due to the other recommended economic and non-economic assumptions.

Section II provides some background on basic principles and the methodology used for the experience study. A detailed discussion of the experience and reasons for the proposed changes are found in Section III for the economic assumptions and Section IV for the demographic assumptions. The cost impact of the proposed changes is detailed in Section V.

II. Background and Methodology

In this report, we analyzed both economic and demographic (non-economic) assumptions. The primary economic assumptions reviewed are inflation, investment return, and salary increases. Demographic assumptions include the probabilities of certain events occurring in the population of members, referred to as "decrements," e.g., termination from service, disability retirement, service retirement, and death before and after retirement. In addition to decrements, other demographic assumptions reviewed in this study include the percentage of members with an eligible spouse or domestic partner, spousal age difference, percentage of members assumed to go on to work for a reciprocal system, reciprocal salary increases, terminal pay assumption and sick leave cashouts.

Economic Assumptions

Economic assumptions consist of:

> **Inflation:** Increases in the price of goods and services. The inflation assumption reflects the basic return that investors expect from securities markets. It also reflects the expected basic salary increase for active employees and drives increases in the allowances of retired members.

> **Investment Return:** Expected long-term rate of return on the Association's investments after expenses. This assumption has a significant impact on contribution rates.

> **Salary Increases:** In addition to inflationary increases, it is assumed that salaries will also grow by real "across the board" pay increases in excess of price inflation. It is also assumed that employees will receive raises above these average increases as they advance in their careers. These are commonly referred to as merit and promotional increases. Payments to amortize any unfunded actuarial accrued liability (UAAL) are assumed to increase each year by the price inflation rate plus any real "across the board" pay increases that are assumed.

The setting of these economic assumptions is described in Section III.

Demographic Assumptions

In order to determine the probability of an event occurring, we examine the "decrements" and "exposures" of that event. For example, taking termination from service, we compare the number of employees who actually terminate in a certain age and/or service category (i.e., the number of "decrements") with those who could have terminated (i.e., the number of "exposures"). For example, if there were 500 active employees in the 20-24 age group at the beginning of the year and 50 of them terminate during the year, we would say the probability of termination in that age group is 50 ÷ 500 or 10%.

The reliability of the resulting probability is highly dependent on both the number of decrements and the number of exposures. For example, if there are only a few people in a high age category at the beginning of the year (number of exposures), we would not lend as much credibility to the

probability of termination developed for that age category, especially if it is out of line with the pattern shown for the other age groups. Similarly, if we are considering the death decrement, there may be a large number of exposures in, say, the age 20-24 category, but very few decrements (actual deaths); therefore, we would not be able to rely heavily on the probability developed for that category.

One reason we use several years of experience for such a study is to have more exposures and decrements, and therefore more statistical reliability. Another reason for using several years of data is to smooth out fluctuations that may occur from one year to the next. However, we also calculate the rates on a year-to-year basis to check for any trend that may be developing in the later years.

III. Economic Assumptions

A. Inflation

Unless an investment grows at least as fast as prices increase, investors will experience a reduction in the inflation-adjusted value of their investment. There may be times when "riskless" investments return more or less than inflation, but over the long term, investment market forces will generally require an issuer of fixed income securities to maintain a minimum return which protects investors from inflation.

The inflation assumption is long term in nature, so our analysis included a review of historical information. Following is an analysis of 15 and 30-year moving averages of historical inflation rates:

HISTORICAL CONSUMER PRICE INDEX – 1930 TO 2016
(U.S. City Average - All Urban Consumers)

	25th Percentile	Median	75th Percentile
15-year moving averages	2.5%	3.4%	4.5%
30-year moving averages	3.1%	3.9%	4.8%

The average inflation rates have continued to decline gradually over the last several years due to the relatively low inflationary period over the past two decades. Also, the later of the 15-year averages during the period are lower as they do not include the high inflation years of the mid-1970s and early 1980s.

Based on information found in the Public Plans Data website, which is produced in partnership with the National Association of State Retirement Administrators (NASRA), the median inflation assumption used by 142 large public retirement funds in their 2015 fiscal year valuations was 3.00%. In California, San Mateo County uses an inflation assumption of 2.50%, CalPERS, CalSTRS, Contra Costa County, Los Angeles County, and two other 1937 Act CERL systems use an inflation assumption of 2.75%, San Joaquin County uses an inflation assumption of 2.90% while eleven other 1937 Act CERL systems use an inflation assumption of 3.00%.

ACERA's investment consultant, Verus, anticipates an annual inflation rate of 2.10%, while the average inflation assumption provided by Verus and seven other investment advisory firms retained by Segal's California public sector clients was 2.30%. Note that, in general, investment consultants use a time horizon for this assumption that is shorter than the time horizon we use for the actuarial valuation.

To find a forecast of inflation based on a longer time horizon, we referred to the 2017 report on the financial status of the Social Security program.[1] The projected average increase in the Consumer Price Index (CPI) over the next 75 years under the intermediate cost assumptions used in that report was 2.60%. (Besides projecting the results under the intermediate cost assumptions

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[1] Source: Social Security Administration – The 2017 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.

using an inflation of 2.60%, alternative projections were also made using a lower and a higher inflation assumption of 2.00% and 3.20%, respectively.)

We also compared the yields on the thirty-year inflation indexed U. S. Treasury bonds to comparable traditional U. S. Treasury bonds.[2] As of June 2017, the difference in yields is 1.87%, which provides a measure of market expectations of inflation.

Based on all of the above information, we recommend that the current 3.25% annual inflation assumption be reduced to 3.00% for the December 31, 2017 actuarial valuation.

The setting of the inflation assumption using the information outlined above is a somewhat subjective process, and Segal does not apply a specific weight to each of the metrics in determining our recommended inflation assumption. Based on a consideration of all these metrics, we have recently been recommending the same 3.00% inflation assumption in our experience studies for our California based public retirement system clients.

Retiree Cost of Living Increases

In our last review of the economic assumptions as of December 31, 2014, consistent with the 3.25% annual inflation assumption adopted by the Board for that valuation, the Board maintained the 3.00% retiree cost-of-living adjustment for Tiers 1 and 3, and the 2.00% retiree cost-of-living adjustment for Tiers 2[3] and 4.

We recommend that the current retiree cost-of-living assumptions (i.e., 3.00% per year for Tiers 1 and 3, and 2.00% per year for Tiers 2 and 4) be continued in the December 31, 2017 valuation.

In developing the COLA assumption, we also considered the results of a stochastic approach that would attempt to account for the possible impact of low inflation that could occur before COLA banks are able to be established for the member. Although the results of this type of analysis might justify the use of a lower COLA assumption, we are not recommending that at this time. The reasons for this conclusion include the following:

> The results of the stochastic modeling are significantly dependent on assuming that lower levels of inflation will persist in the early years of the projections. If this is not assumed, then the stochastic modeling will produce results similar to our proposed COLA assumption.

> Using a lower long-term COLA assumption based on a stochastic analysis would mean that an actuarial loss would occur even when the inflation assumption of 3.00% is met in a year. We question the reasonableness of this result.

We do not see the stochastic possibility of COLAs averaging less than those predicted by the assumed rate of inflation as a reliable source of cost savings that should be anticipated in our COLA assumption. Therefore, we continue to recommend setting the COLA assumption based on the long-term annual inflation assumption, as we have in prior years.

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[2] Source: Board of Governors of the Federal Reserve System.

[3] Including Safety Tier 2C and Tier 2D.

B. Investment Return

The investment return assumption is comprised of two primary components, inflation and real rate of investment return, with adjustments for investment expenses and risk.

Real Rate of Investment Return

This component represents the portfolio's incremental investment market returns over inflation. Theory has it that as an investor takes a greater investment risk, the return on the investment is expected to also be greater, at least in the long run. This additional return is expected to vary by asset class and empirical data supports that expectation. For that reason, the real rate of return assumptions are developed by asset class. Therefore, the real rate of return assumption for a retirement system's portfolio will vary with the Board's asset allocation among asset classes.

The following is the Association's current target asset allocation and assumed real rate of return assumptions by asset class. The first column of real rate of return assumptions are determined by reducing Verus' total or "nominal" return assumptions by their assumed 2.10% inflation rate. The second column of returns (except for Hedge Funds and Private Equity) represents the average of a sample of real rate of return expectations, where each firm's nominal returns have been reduced by that firm's assumed inflation rate. The sample includes the expected annual real rates of return provided to us by Verus and seven other investment advisory firms retained by Segal's California public sector retirement system clients. We believe these averages are a reasonable forecast of long-term future market returns.[4]

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[4] Note that, just as for the inflation assumption, in general the time horizon used by the investment consultants in determining the real rate of return assumption is shorter than the time horizon we used for the actuarial valuation.

ACERA'S TARGET ASSET ALLOCATION AND ASSUMED ARITHMETIC REAL RATE OF RETURN ASSUMPTIONS BY ASSET CLASS AND FOR THE PORTFOLIO

Asset Class	Percentage of Portfolio	Verus' Assumed Real Rate of Return[5]	Average Assumed Real Rate of Return from a Sample of Consultants to Segal's California Public Sector Clients[6]
Domestic Large Cap Equity	22.40%	4.90%	5.75%
Domestic Small Cap Equity	5.60%	4.90%	6.37%
Developed International Equity	19.50%	8.70%	6.89%
Emerging Markets Equity	6.50%	11.50%	9.54%
U.S. Core Fixed Income	11.25%	1.20%	1.03%
High Yield Bonds	1.50%	5.50%	3.99%
International Bonds	2.25%	0.80%	0.19%
TIPS	2.00%	0.80%	0.98%
Real Estate	8.00%	3.70%	4.47%
Commodities	3.00%	3.50%	3.78%
Hedge Funds	9.00%	4.30%	4.30%[7]
Private Equity	9.00%	7.60%	7.60%[7]
Total	**100.00%**	**5.54%**	**5.35%**

The above are representative of "indexed" returns and do not include any additional returns ("alpha") from active management. This is consistent with the Actuarial Standard of Practice (ASOP) No. 27, Section 3.8.3.d, which states:

> "Investment Manager Performance - Anticipating superior (or inferior) investment manager performance may be unduly optimistic (pessimistic). The actuary should not assume that superior or inferior returns will be achieved, net of investment expenses, from an active investment management strategy compared to a passive investment strategy unless the actuary believes, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the measurement period."

The following are some observations about the returns provided above:

1.   The investment consultants to our California public sector clients have each provided us with their expected real rates of return for each asset class, over various future periods of time. However, in general, the returns available from investment consultants are projected over time periods shorter than the durations of a retirement plan's liabilities.

2.   Using an average of expected real rates of return allows the Association's investment return assumption to include a broader range of capital market information and should help reduce year-to-year volatility in the Association's investment return assumption.

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[5]   Derived by reducing Verus' nominal rate of return assumptions by their assumed 2.10% inflation rate.

[6]   These are based on the projected arithmetic returns provided by Verus and seven other investment advisory firms serving ACERA and 16 other city and county retirement systems in California. Except for the hedge funds and private equity asset classes, these return assumptions are gross of any applicable investment expenses.

[7]   For these asset classes, Verus' assumption is applied in lieu of the average because there is a larger disparity in returns for these asset classes among the firms surveyed and using Verus' assumption should more closely reflect the underlying investments made specifically for ACERA. Note that the return assumptions provided by Verus for the hedge funds and private equity asset classes only are net of any applicable investment expenses.

3. Therefore, we recommend that the 5.35% portfolio real rate of return be used to determine the Association's investment return assumption. This is 0.19% lower than the real rate of return that was used three years ago to prepare the recommended investment return assumption for the December 31, 2014 valuation. This difference is due to changes in the Association's target asset allocation (+ 0.04%), change in the real rate of return assumptions provided to us by the investment advisory firms (- 0.18%) and the interaction effect between these changes (- 0.05%).

Association Expenses

For funding purposes, the real rate of return assumption for the portfolio needs to be adjusted for investment and administrative (or non-investment) expenses expected to be paid from investment income.

Based on information provided by the Association, we have shown in the following table the expenses in relation to the average market value of assets for the five years ending December 31, 2016. As noted earlier, the assumed rates of return for the hedge funds and private equity asset classes provided by Verus (and used by Segal in developing the recommended portfolio real rate of return to be used in determining the Association's investment return assumption) are net of any applicable investment expenses. In order to avoid double counting investment expenses for these asset classes in developing the expense component of the recommended investment return assumption, we have excluded from the Association's total investment expenses the amount of investment expenses related to hedge funds and private equity as provided by ACERA.

INVESTMENT AND NON-INVESTMENT EXPENSES
AS A PERCENTAGE OF AVERAGE MARKET VALUE OF ASSETS
(Dollars in 000's)

Year Ending December 31	Average Market Value of Assets	Investment Expenses[8]	Non-Investment Expenses[9]	Investment %	Non-Investment %	Total %
2012	$5,371,301	$35,440	$14,098	0.66	0.26	0.92
2013	6,154,250	40,466	14,728	0.66	0.24	0.90
2014	6,714,154	50,089	14,966	0.75	0.22	0.97
2015	6,714,319	37,234	15,403	0.55	0.23	0.78
2016	6,803,102	49,978	15,808	0.73	0.23	0.96
Average				0.67	0.24	0.91
Recommended Assumption				0.65	0.25	0.90

Based on this experience, we recommend that the Association's future expense assumption be maintained at 0.90%.

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[8] "Net fees & investment expenses, excluding interest expense from leverage on real estate," based on information from ACERA. Excludes hedge funds expenses and private equity expenses.

[9] Includes administrative, legal, technology, actuarial, and business continuity expenses. It is our understanding that these amounts have been included by the Association in establishing its budget for administrative expenses.

Note related to investment expenses paid to active managers – As cited above under Section 3.8.3.d of ASOP No. 27, the effect of an active investment management strategy should be considered "net of investment expenses…unless the actuary believes, based on relevant data, that such superior or inferior returns represent a reasonable expectation over the measurement period."

For ACERA, of the $50.0 million in net fees and investment expenses paid in 2016 (that excluded interest expense from leverage on real estate), about $47.4 million was associated with investment expenses, with the remaining $2.6 million associated with real estate related fees and expenses. Of the $47.4 million of investment expenses, about $6.5 million was paid for expenses associated with obtaining investment consulting and custodian services, and $0.1 million was associated with passively managed funds. That left $40.8 million (or 0.60% out of the total 0.73% in investment expenses in 2016) for expenses paid to active managers.

We have not performed a detailed analysis to measure how much of the investment expenses paid to active managers might have been offset by additional returns ("alpha") earned by that active management. However, we observed based on information provided in the Comprehensive Annual Financial Report (CAFR) that the total fund return on a net of investment expense basis was lower than the policy benchmark by about 0.6% over the last five years.[10] We will work with the Association's staff to determine whether future studies might potentially exclude the level of investment expenses for active managers that are expected to be offset by investment returns and the effect the recent decision to increase the exposure to passive investing might have on investment expenses. For now, we will continue to use the current approach that any "alpha" that may be identified would be treated as an increase in the risk adjustment and corresponding confidence level. For example, 0.25% of alpha would increase the confidence level by 3% (see discussions that follow on definitions of risk adjustment and confidence level).

Risk Adjustment

The real rate of return assumption for the portfolio generally is adjusted to reflect the potential risk of shortfalls in the return assumptions. The Association's asset allocation determines this portfolio risk, since risk levels are driven by the variability of returns for the various asset classes and the correlation of returns among those asset classes. This portfolio risk is incorporated into the real rate of return assumption through a risk adjustment.

The purpose of the risk adjustment (as measured by the corresponding confidence level) is to increase the likelihood of achieving the actuarial investment return assumption in the long term.[11] The 5.35% expected real rate of return developed earlier in this report was based on expected mean or average arithmetic returns. This means there is a 50% chance of the actual return in each year being at least as great as the expected return (assuming a symmetrical distribution of future returns). The risk adjustment is intended to increase that probability somewhat above the 50% level. This is consistent with our experience that retirement plan fiduciaries would generally prefer that returns exceed the assumed rate more often than not. Note that, based on the investment return assumptions recently adopted by systems that have been analyzed under this model, we observe a confidence level generally in the range of 50% to 60%.

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[10] Reference: page 80 of the CAFR for the year ended December 31, 2016.

[11] This type of risk adjustment is sometimes referred to as a "margin for adverse deviation."

In our model, the confidence level associated with a particular risk adjustment represents the likelihood that the actual average return would equal or exceed the assumed value over a 15-year period. For example, if we set our real rate of return assumption using a risk adjustment that produces a confidence level of 60%, then there would be a 60% chance (6 out of 10) that the average return over 15 years will be equal to or greater than the assumed value. The 15-year time horizon represents an approximation of the "duration" of the fund's liabilities, where the duration of a liability represents the sensitivity of that liability to interest rate variations.

Three years ago, the Board opted to lower the investment return assumption from 7.80% to 7.60%, which implied a risk adjustment of 0.29%. Together with an annual portfolio standard deviation of 14.40% (provided in 2014 by SIS, before they became part of Verus), this reflected a confidence level of about 53% that the actual return over 15 years would not be less than the assumed return, assuming that the distribution of returns over that period follows the normal statistical distribution.[12]

If we use the same 53% confidence level from the return assumption adopted for the December 31, 2014 valuation to set this year's risk adjustment, based on the current long-term portfolio standard deviation of 11.52% provided by Verus in 2017, the corresponding risk adjustment would be 0.23%. Together with the other investment return components, this would result in a preliminary investment return assumption of 7.22%. Based on our general practice of using one-quarter percentage point increments for economic actuarial assumptions, we have evaluated the effect on the confidence level of rounding this preliminary investment return assumption to 7.25%. A net investment return assumption of 7.25%, together with the other investment return components, would produce a risk adjustment of 0.20%, which corresponds to a confidence level of 53%.

The table below shows ACERA's historical investment return assumptions, risk adjustments and corresponding confidence levels for the current and prior studies, for the years when this analysis was performed.

HISTORICAL INVESTMENT RETURN ASSUMPTIONS, RISK ADJUSTMENTS AND CONFIDENCE LEVELS BASED ON ASSUMPTIONS ADOPTED BY THE BOARD

Year Ending December 31	Investment Return	Risk Adjustment	Corresponding Confidence Level
2005	7.90%	0.46%	56%
2006	8.00%	0.41%	56%
2007	8.00%	0.38%	56%
2009	7.90%	0.49%	56%
2011	7.80%	0.53%	56%
2014[13]	7.60%	0.29%	53%
2017 (recommended)	7.25%	0.20%	53%

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[12] Strictly speaking, future compounded long-term investment returns will tend to follow a log-normal distribution. However, we believe the Normal distribution assumption is reasonable for purposes of setting this type of risk adjustment.

[13] Based on the 7.60% investment return assumption adopted by the Board. Note that as part of the 2014 analysis, we had initially recommended a 7.50% investment return assumption that contained a risk adjustment of 0.39% and a confidence level of 54%.

As we have discussed in prior years, the risk adjustment model and associated confidence level is most useful as a means for comparing how the Association has positioned itself relative to risk over periods of time.[14] The use of a 53% confidence level should be considered in context with other factors, including:

➢ As noted above, the confidence level is more of a relative measure than an absolute measure, and so can be reevaluated and reset for future comparisons.

➢ The confidence level is based on the standard deviation of the portfolio that is determined and provided to us by Verus. The standard deviation is a statistical measure of the future volatility of the portfolio and so is itself based on assumptions about future portfolio volatility and can be considered somewhat of a "soft" number.

➢ A confidence level of 53% (associated with a 7.25% investment return assumption) is within the range of about 50% to 60% that corresponds to the risk adjustments used by most of Segal's other California public retirement system clients. Most public retirement systems that have recently reviewed their investment return assumptions have considered adopting more conservative investment return assumptions for their valuations, mainly to maintain the likelihood that future actual market return will meet or exceed the investment return assumption. While this may provide argument for considering a confidence level greater than 53%, we would also note that a 0.35% reduction in the investment return assumption is already a significant reduction in a long-term assumption.

➢ A lower level of inflation should reduce the overall risk of failing to meet the investment return assumption.

➢ As with any model, the results of the risk adjustment model should be evaluated for reasonableness and consistency. One measure of reasonableness is discussed below in the section that presents a comparison with assumptions adopted by similarly situated public sector retirement systems.

Recommended Investment Return Assumption

Taking into account the factors above, our recommendation is to reduce the net investment return assumption from 7.60% to 7.25%. As noted above, this return implies a risk adjustment of 0.20%, reflecting a confidence level of 53% that the actual average return over 15 years would not fall below the assumed return.

The following table provides the components of the investment return assumption developed in the previous discussion. For comparison purposes, we have included similar values from the prior three studies when this analysis was performed.

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[14] In particular, it would not be appropriate to use this type of risk adjustment as a measure of determining an investment return rate that is "risk-free."

CALCULATION OF INVESTMENT RETURN ASSUMPTION

Assumption Component	December 31, 2017 Recommended Value	December 31, 2014 Adopted Value	December 31, 2011 Adopted Value	December 31, 2009 Adopted Value
Inflation	3.00%	3.25%	3.50%	3.50%
Plus Portfolio Real Rate of Return	5.35%	5.54%	5.73%	5.79%
Minus Expense Adjustment	(0.90%)	(0.90%)	(0.90%)	(0.90%)
Minus Risk Adjustment	(0.20%)	(0.29%)	(0.53%)	(0.49%)
Total	**7.25%**	**7.60%**	**7.80%**	**7.90%**
Confidence Level	**53%**	**53%**	**56%**	**56%**

Based on this analysis, we recommend that the net investment return assumption be decreased from 7.60% to 7.25% per annum.

Impact of 50/50 Excess Earnings Allocation on Investment Return Assumption

Note that in developing the recommended investment return assumption in the past, we disclosed in our economic assumptions/experience study reports (and in our annual actuarial valuation reports) that the impact of the 50/50 allocation between the retirement and SRBR asset pools of the Article 5.5 "excess earnings" benefits had not been considered. This was based on our understanding that Article 5.5 of the Statute, which authorizes the allocation of 50% of excess earnings to the SRBR, does not allow for the use of a different investment return for funding than is used for interest crediting. This would appear in effect to preclude the prefunding of the SRBR through the use of an assumption lower than the market earnings assumption (which is currently 7.60%).

As required by the Actuarial Standard of Practice (ASOP) No. 4 ("Measuring Pension Obligations and Determining Pension Plan Costs or Contributions"), we performed a stochastic model in 2013 to estimate the impact of the 50% allocation of future excess earnings to the SRBR. The results of our model indicated that the 50/50 allocation of future excess earnings would have about the same impact as an "outflow" (i.e., assets not available to fund the benefits included in the valuation) that would average approximately 0.75% of assets over time. For informational purposes only, when we applied the results of our stochastic model to the most recent December 31, 2016 funding valuation, we included the estimated impact that such an annual outflow would have on the employer's contribution rate and on the actuarial accrued liability measured in that valuation, using the current 7.60% investment return assumption.

Using a simplified method compared to the one used in our 2013 study, we have estimated the impact of the 50% allocation of future excess earnings to the SRBR using the data and recommended results included in this study. Based on that analysis, we recommend that the 0.75% assumption be reduced to 0.60% in the December 31, 2017 valuation in preparing the informational purposes only disclosures.

Comparing with Other Public Retirement Associations

One final consideration related to the recommended investment return assumption is to compare it against those used by other public retirement systems, both in California and nationwide.

We note that a 7.25% investment return assumption is now the most common assumption, and is used by ten County employees' retirement systems. However, a 7.00% investment return assumption is becoming more common among California public sector retirement systems. In particular, five County employees' retirement systems (Contra Costa, Fresno, Mendocino, Sacramento, and Santa Barbara) use a 7.00% investment return assumption. Furthermore, the CalPERS Board has approved a reduction in the earnings assumption from 7.50% to 7.00% over the next three years. In addition, CalSTRS recently adopted a 7.25% earnings assumption for the 2016 valuation (down from 7.50%) and a 7.00% earnings assumption for the 2017 valuation.

The following table compares ACERA's recommended net investment return assumption against those of the nationwide public retirement systems that participated in the National Association of State Retirement Administrators (NASRA) 2016 Public Fund Survey for 142 large public retirement funds in their 2015 fiscal year valuations:

Assumption	ACERA	NASRA 2016 Public Fund Survey[15]		
		Low	Median	High
Net Investment Return	7.25%	4.29%	7.50%	8.50%

The detailed survey results show that more than one-half of the systems have an investment return assumption in the range of 6.75% to 7.75%, and over half of those systems have used an assumption of 7.50%. The survey also notes that several plans have reduced their investment return assumption during the last year. State systems outside of California tend to change their economic assumptions less frequently and so may lag behind emerging practices in this area.

In summary, we believe that both the risk adjustment model and other considerations indicate a lower earnings assumption. The recommended assumption of 7.25% provides for a risk margin within the risk adjustment model consistent with three years ago, and it is consistent with ACERA's current practice relative to other public systems.

C. Salary Increase

Salary increases impact plan costs in two ways: (i) by increasing members' benefits (since benefits are a function of the members' highest average pay) and future normal cost collections; and (ii) by increasing total active member payroll which in turn generates lower UAAL contribution rates. The components of the salary increase assumptions are discussed below.

As an employee progresses through his or her career, increases in pay are expected to come from three sources:

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[15] Public Plans Data website – Produced in partnership with NASRA.

1. **Inflation:** Unless pay grows at least as fast as consumer prices grow, employees will experience a reduction in their standard of living. There may be times when pay increases lag or exceed inflation, but over the long term, labor market forces may require an employer to maintain its employees' standards of living.

    As discussed earlier in this report, we are recommending that the assumed rate of inflation be reduced from 3.25% to 3.00% per annum. This inflation component is used as part of the salary increase assumption.

2. **Real "Across the Board" Pay Increases:** These increases are typically termed productivity increases since they are considered to be derived from the ability of an organization or an economy to produce goods and services in a more efficient manner. As that occurs, at least some portion of the value of these improvements can provide a source for pay increases. These increases are typically assumed to extend to all employees "across the board." The State and Local Government Workers Employment Cost Index produced by the Department of Labor provides evidence that real "across the board" pay increases above inflation have averaged about 0.6% - 0.9% annually during the last ten to twenty years.

    We also referred to the annual report on the financial status of the Social Security program published in July 2017. In that report, real "across the board" pay increases are forecast to be 1.2% per year under the intermediate assumptions.

    The real pay increase assumption is generally considered a more "macroeconomic" assumption that is not based on individual plan experience. We note that for ACERA the actual pay increases over the past five years were less than CPI increases, as shown below. However, this recent experience may not be a credible predictor of future experience.

Valuation Date	Actual Average Increase[16]	Actual Change in CPI[17]
December 31, 2012	0.85%	2.22%
December 31, 2013	0.42%	2.58%
December 31, 2014	2.11%	2.67%
December 31, 2015	1.76%	3.18%
December 31, 2016	3.15%	3.53%
Five-Year Average as of December 31, 2016[18]	**1.66%**	**2.84%**
Three-Year Average as of December 31, 2016	**2.34%**	**3.13%**

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[16] Reflects the increase in average salary for members at the beginning of the year versus those at the end of the year. It does not reflect the average salary increases received by members who worked the full year.

[17] Based on the change in the December CPI for the San Francisco-Oakland-San Jose area compared to the prior year.

[18] The five-year average covering the years 2007 through 2011 was 3.11% for the actual average increase in ACERA salaries and 2.18% for the actual change in CPI.

Even though the actual average salary increase was lower than the average change in the CPI over the last five-year period from 2012 to 2016, that difference has decreased in the last three years since the last experience study was performed for ACERA in 2014. Considering these factors, we recommend maintaining the real "across the board" assumption at 0.50% for the December 31, 2017 actuarial valuation. This means that the combined inflation and "across the board" salary increase assumption will decrease from 3.75% to 3.50%.

3. **Merit and Promotional Increases:** As the name implies, these increases come from an employee's career advances. This form of pay increase differs from the previous two, since it is specific to the individual. For ACERA, there are service-specific merit and promotional increases.

   The annual merit and promotional increases are determined by measuring the actual increases received by members over the experience study period, net of the inflationary and real "across the board" pay increases discussed above. Increases are measured separately for General and Safety members. This is accomplished by:

   › Measuring each continuing member's actual salary increase over each year of the experience study period;

   › Categorizing these increases according to member demographics;

   › Removing the wage inflation component from these increases (assumed to be equal to the increase in the members' average salary during the year for all members);

   › Averaging these annual increases over the three-year experience period; and

   › Modifying current assumptions to reflect some portion of these measured increases reflective of their "credibility."

   To be consistent with the other economic assumptions, these merit and promotional assumptions should be used in combination with the 3.50% assumed inflation and real "across the board" increases.

   The following table shows the average salary increases over the three-year experience study period (December 1, 2013 through November 30, 2016) before removing the inflationary component:

Years of Service	Average Actual Salary Increase (%)	
	General Members	Safety Members
0 – 1	7.26	10.68
1 – 2	9.57	14.30
2 – 3	7.11	11.86
3 – 4	5.33	8.81
4 – 5	4.58	6.86
5 – 6	4.46	5.03
6 – 7	4.09	4.59
7 – 8	3.73	4.33
8 – 9	3.56	4.96
9 – 10	3.58	5.13
10 – 11	3.20	4.85
11 or more	2.95	4.57

The annual increase in average salary for this three-year period was about 2.57% for General members and 3.41% for Safety members.

The following table shows the average actual merit and promotional increases for the current three-year period, after removing the increases in average salary in each service category, along with the current and proposed merit and promotional assumptions based on this recent experience.

Years of Service	Merit and Promotional Salary Increase (%)					
	General Members			Safety Members		
	Current	Actual	Proposed	Current	Actual	Proposed
0 – 1	3.70	4.71	4.80	6.70	7.11	7.80
1 – 2	3.70	7.00	4.80	6.70	10.76	7.80
2 – 3	3.20	4.53	3.90	5.90	8.05	7.00
3 – 4	2.10	2.67	2.40	3.80	4.97	4.40
4 – 5	1.70	2.04	1.90	3.30	3.61	3.50
5 – 6	1.40	1.84	1.60	2.50	2.14	2.30
6 – 7	1.30	1.67	1.50	1.40	1.88	1.60
7 – 8	1.10	1.16	1.10	0.90	1.10	1.00
8 – 9	0.70	0.96	0.80	0.80	1.22	1.00
9 – 10	0.60	0.95	0.80	0.80	1.17	0.90
10 – 11	0.50	0.51	0.50	0.70	0.99	0.80
11 or more	0.40	0.38	0.40	0.70	1.18	0.80

Based on this experience, we are proposing increases in the merit and promotional salary increase assumptions at the early years of an employee's career and decreases in the assumptions for the later years of service for General members, and slight overall increases for Safety members.

Charts 1 and 2 provide a graphical comparison of the current, actual, and proposed merit and promotional increases for General and Safety members, respectively.

Chart 1: Merit and Promotional Salary Increase Rates
General Members
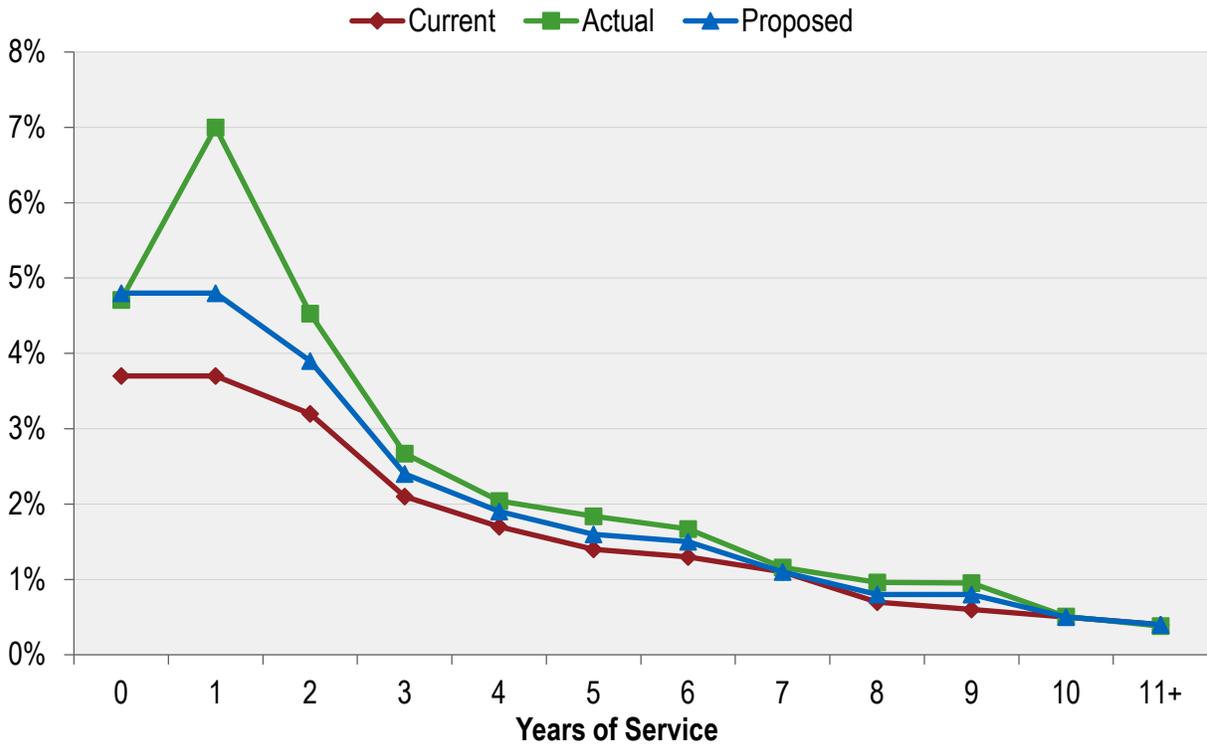
Chart 2: Merit and Promotional Salary Increase Rates
Safety Members
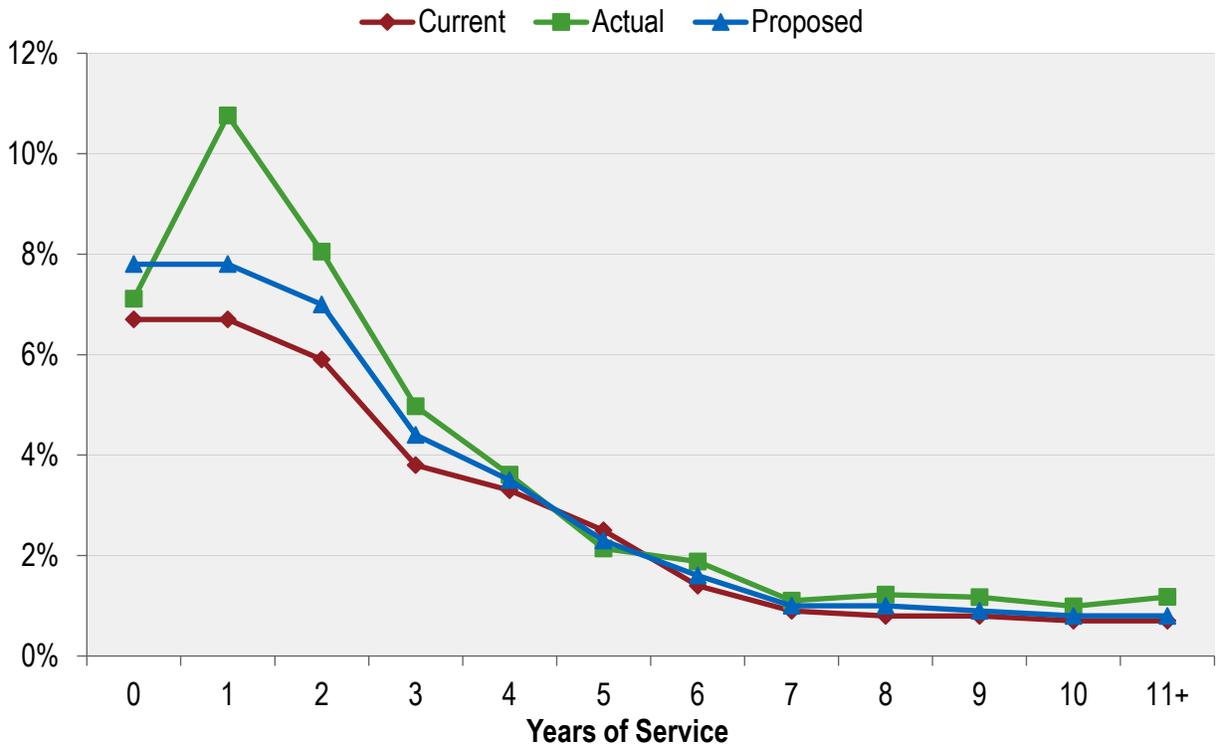
Active Member Payroll

Projected active member payrolls are used to develop the UAAL contribution rate. Future values are determined as a product of the number of employees in the workforce and the average pay for all employees. The average pay for all employees increases only by inflation and real "across the board" pay increases. The merit and promotional increases are not an influence, because this average pay is not specific to an individual.

We recommend that the active member payroll increase assumption be decreased from 3.75% to 3.50% per annum, consistent with the combined inflation and real "across the board" salary increase assumptions.

Terminal Pay

Under the Ventura Settlement, employers agreed to include several additional pay elements as Earnable Compensation for non-CalPEPRA members. There are two categories within which these additional pay elements fall:

> Ongoing Pay Elements – Those that are expected to be received relatively uniformly over a member's employment years; and

> Terminal Pay Elements – Those that are expected to be received only during the member's final average earnings pay period.

The first category is recognized in the actuarial calculations by virtue of being included in the current pay of active members. The second category requires an actuarial assumption to anticipate its impact on a member's retirement benefit.

Data has been collected since 1997 to estimate terminal pay for active members as a percentage of current pay. Because of the uncertainty associated with terminal pay (e.g., vacation accrual and sell off policies, maximum vacation carryover, vacation usage, etc.) a range of estimates was determined. An assumption was then recommended for terminal pay.

Service Retirements

In the following table, we have summarized the observed vacation and sick leave cash out from members who retired from service during December 2013 – November 2014, December 2014 – November 2015, and December 2015 – November 2016.[19] Note that there was no experience observed for General Tier 3, Safety Tier 2C, or Safety Tier 2D members (and this assumption does not apply to the CalPEPRA tiers, as noted above). In the current valuation, General Tier 3 shares the same terminal pay assumption as General Tier 1 because both of these Tiers use final 1-year average compensation. Similarly, Safety Tier 2C and Safety Tier 2D share the same terminal pay assumption as Safety Tier 2.

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[19] It is our understanding that sick leave cash out is no longer included in final average compensation effective July 12, 2014.

Observed Terminal Pay Percentages				
	December 2013 – November 2014		December 2014 – November 2015	
Membership Category	Number of Retirees	Terminal Pay*	Number of Retirees	Terminal Pay*
General Tier 1	64	8.9%	38	6.6%
General Tier 2	218	4.1%	228	3.1%
Safety Tier 1	0	0.0%	1	9.2%
Safety Tier 2	51	2.6%	24	2.1%

Observed Terminal Pay Percentages				
	December 2015 – November 2016		Three-Year Period Combined	
Membership Category	Number of Retirees	Terminal Pay*	Number of Retirees	Terminal Pay*
General Tier 1	44	6.9%	146	7.7%
General Tier 2	230	2.9%	676	3.3%
Safety Tier 1	1	9.4%	2	9.3%
Safety Tier 2	39	2.4%	114	2.4%

* *The total of vacation and sick leave cash out expressed as a percent of final average compensation before such cash out.*

On September 12, 2012, the Governor of California approved Assembly Bill (AB) 197 that, in part, excludes "various payments from the definition of compensation earnable" including "payments made at the termination of employment." We understand that action was taken by the Board to implement AB 197, which was subsequently challenged in a lawsuit. In the latest update we received on January 25, 2017, ACERA indicated that the status of AB 197 was not expected to change until the summer of 2017 and that ACERA was unable to predict any changes on the outcome of the appeal at that time. While the status of AB 197 is still not known at this time, we have recommended a slight reduction in the terminal pay assumption for Safety Tier 2 members (and, consequently, reductions in the terminal pay assumptions for Safety Tier 2C and Tier 2D members). The assumptions for the other tiers remain unchanged. Note that we will continue to monitor the terminal pay assumptions for all non-CalPEPRA tiers as more information on the status of AB 197 becomes available.

The current and recommended terminal pay assumptions for members who are expected to retire from service are as follows:

Terminal Pay Assumptions for Service Retirement		
Member Category	Current Assumptions	Proposed Assumptions
General Tier 1	8.0%	8.0%
General Tier 2	3.0%	3.0%
General Tier 3	8.0%	8.0%
Safety Tier 1	8.5%	8.5%
Safety Tier 2	4.0%	3.5%
Safety Tier 2C	4.0%	3.5%
Safety Tier 2D	4.0%	3.5%

Disability Retirements

We have also received data to analyze the terminal pay assumptions for disabled retirees. The results are as follows:

	Observed Terminal Pay Percentages – Three-Year Period Combined	
Member Category	**Number of Retirees**	**Terminal Pay***
General Tier 1	0	0.0%
General Tier 2	5	2.1%
Safety Tier 1	1	0.0%
Safety Tier 2	9	0.4%

* *The total of vacation and sick leave cash out expressed as a percent of final average compensation before such cash out.*

We are recommending no changes to the terminal pay assumptions for disability retirement, due, in part, to the minimal experience available over the three-year study period and to the uncertainty of the status of AB 197.

The current and recommended terminal pay assumptions for members who are expected to retire from disability are as follows:

	Terminal Pay Assumptions for Disability Retirement
Member Category	**Current and Proposed Assumptions**
General Tier 1	6.5%
General Tier 2	1.4%
General Tier 3	6.5%
Safety Tier 1	6.4%
Safety Tier 2	2.1%
Safety Tier 2C	2.1%
Safety Tier 2D	2.1%

IV. Demographic Assumptions

A. Retirement Rates

The age at which a member retires from service (i.e., not on a disability pension) will affect both the amount of the benefits that will be paid to that member as well as the period over which funding must take place.

General Tier 1 rates have been decreased overall to reflect later retirements. General Tier 2 rates have been increased at age 60 and lowered at ages 62-64 to more closely reflect recent actual experience. General Tier 3 rates remain unchanged due to limited experience over the three-year experience study period, and since the number of actual retirements for ages 55 to 62 (where about one-half of the eligible retirements could occur) closely matched expected experience.

Although there has been no retirement experience over the three-year experience study period for General Tier 4 members, we have adjusted several of the retirement rates under that tier. The reason for the adjustments to the Tier 4 rates is that the current rates were originally developed in comparison to the General Tier 2 rates in effect at that time, based on the benefit levels between the two tiers. As subsequent adjustments have been made to the General Tier 2 rates since then, we have adjusted the General Tier 4 rates for this study to maintain the original overall relationship between the General Tier 2 and Tier 4 retirement rates.

For all General tiers, we have also increased the age at which 100% retirement is assumed from age 70 to age 75.

Safety Tier 1 rates before age 60 have remained unchanged due to the very limited experience over the three-year experience study period. The rates for Safety Tier 2 (also used for Safety Tier 2D members) have been decreased at ages 56-59 to more closely reflect recent actual experience. In addition, we have introduced a retirement rate at age 49 for Safety Tier 2 as there have been several retirements prior to age 50 during the experience study period.

For Safety Tier 1, we have also increased the age at which 100% retirement is assumed from age 60 to age 65. For the remaining Safety tiers, we have increased that age from age 64 to age 65.

Aside from the age adjustments for 100% retirement noted above, no adjustments have been made to the Safety Tier 2C and Safety Tier 4 rates because no data is available for these tiers.

The table on the following page shows the observed service retirement rates for General Tier 1 members based on the actual experience over the past three years. The observed service retirement rates were determined by comparing those members who actually retired from service to those eligible to retire from service. This same methodology is followed throughout this report and was described in Section II. Also shown are the current rates assumed and the rates we propose:

General Tier 1

Age	Rate of Retirement (%)		
	Current Rate	Actual Rate	Proposed Rate
50	4.00	0.00	4.00
51	4.00	11.11	4.00
52	4.00	0.00	4.00
53	4.00	8.00	4.00
54	4.00	0.00	4.00
55	7.00	8.51	6.00
56	9.00	8.16	8.00
57	12.00	13.51	10.00
58	12.00	5.00	12.00
59	16.00	13.59	14.00
60	24.00	20.19	20.00
61	24.00	19.10	20.00
62	40.00	31.51	35.00
63	35.00	20.45	30.00
64	35.00	15.63	30.00
65	35.00	36.00	35.00
66	35.00	45.00	35.00
67	30.00	25.00	30.00
68	25.00	30.00	30.00
69	35.00	14.29	35.00
70	100.00	50.00	65.00
71	100.00	25.00	65.00
72	100.00	50.00	65.00
73	100.00	0.00	65.00
74	100.00	0.00	65.00
75 & Over	100.00	50.00	100.00

General Tier 2

Age	Rate of Retirement (%)		
	Current Rate	Actual Rate	Proposed Rate
50	2.00	1.41	2.00
51	2.00	1.09	2.00
52	2.00	2.09	2.00
53	2.00	1.94	2.00
54	2.00	1.54	2.00
55	2.00	2.53	2.00
56	3.00	2.10	3.00
57	4.00	4.01	4.00
58	4.00	4.08	4.00
59	5.00	5.39	5.00
60	6.00	8.20	7.00
61	9.00	9.92	9.00
62	18.00	13.65	15.00
63	18.00	14.65	16.00
64	20.00	14.24	18.00
65	25.00	26.91	25.00
66	25.00	30.48	25.00
67	25.00	21.14	25.00
68	30.00	32.00	30.00
69	35.00	26.32	35.00
70	100.00	27.63	50.00
71	100.00	20.00	50.00
72	100.00	13.64	50.00
73	100.00	18.75	50.00
74	100.00	12.00	50.00
75 & Over	100.00	23.53	100.00

General Tier 3

Age	Rate of Retirement (%)		
	Current Rate	Actual Rate	Proposed Rate
50	6.00	0.00	6.00
51	3.00	0.00	3.00
52	5.00	0.00	5.00
53	6.00	0.00	6.00
54	6.00	0.00	6.00
55	12.00	33.33	12.00
56	13.00	0.00	13.00
57	13.00	0.00	13.00
58	14.00	33.33	14.00
59	16.00	33.33	16.00
60	21.00	16.67	21.00
61	20.00	0.00	20.00
62	30.00	20.00	30.00
63	25.00	0.00	25.00
64	25.00	0.00	25.00
65	30.00	0.00	30.00
66	25.00	0.00	25.00
67	25.00	0.00	25.00
68	25.00	0.00	25.00
69	50.00	0.00	50.00
70	100.00	0.00	65.00
71	100.00	0.00	65.00
72	100.00	0.00	65.00
73	100.00	0.00	65.00
74	100.00	0.00	65.00
75 & Over	100.00	0.00	100.00

General Tier 4

For General members in Tier 4, the expected rates of retirement under the current and proposed assumptions are as follows (note: there was no actual experience):

Age	Rate of Retirement (%)	
	Current Rate	Proposed Rate
50	0.00	0.00
51	0.00	0.00
52	4.00	4.00
53	1.50	1.50
54	1.50	1.50
55	2.50	2.00
56	2.50	2.50
57	3.50	3.50
58	4.50	3.50
59	4.50	4.50
60	4.50	6.00
61	7.50	8.00
62	19.00	18.00
63	15.00	15.00
64	17.00	17.00
65	21.00	22.00
66	20.00	25.00
67	20.00	25.00
68	30.00	30.00
69	35.00	35.00
70	100.00	50.00
71	100.00	50.00
72	100.00	50.00
73	100.00	50.00
74	100.00	50.00
75 & Over	100.00	100.00

Safety Tier 1

Age	Rate of Retirement (%)		
	Current Rate[1]	Actual Rate[2]	Proposed Rate[1]
49	0.00	0.00	0.00
50	35.00	0.00	35.00
51	30.00	0.00	30.00
52	25.00	0.00	25.00
53	35.00	0.00	35.00
54	45.00	0.00	45.00
55	45.00	0.00	45.00
56	45.00	0.00	45.00
57	45.00	0.00	45.00
58	45.00	0.00	45.00
59	45.00	0.00	45.00
60	100.00	25.00	45.00
61	100.00	0.00	45.00
62	100.00	0.00	45.00
63	100.00	0.00	45.00
64	100.00	0.00	45.00
65 & Over	100.00	0.00	100.00

[1]   *Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.*

[2]   *Excluding members who have accrued a benefit of 100% of final average earnings.*

Safety Tier 2 (and Safety Tier 2D)

For Safety members in Tier 2, the actual rates of retirement compared to the expected rates for the last three years under the current and proposed assumptions are as shown below.

Currently the retirement rates for Safety Tier 2 members are also used for members in Safety Tier 2D. Note that we do not yet have any retirement experience for Tier 2D members, so we recommend utilizing the proposed Safety Tier 2 rates for Safety Tier 2D. We will monitor this assumption as experience develops for Tier 2D.

Age	Rate of Retirement (%)		
	Current Rate[1]	Actual Rate[2]	Proposed Rate[1]
49	0.00	23.53	10.00
50	15.00	10.34	15.00
51	15.00	19.15	15.00
52	15.00	17.57	15.00
53	15.00	12.28	15.00
54	15.00	16.67	15.00
55	15.00	9.30	15.00
56	20.00	10.53	15.00
57	25.00	0.00	15.00
58	25.00	15.00	20.00
59	25.00	12.50	20.00
60	30.00	30.77	30.00
61	30.00	33.33	30.00
62	30.00	28.57	30.00
63	30.00	0.00	30.00
64	100.00	0.00	50.00
65 & Over	100.00	29.41	100.00

[1] *Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.*

[2] *Excluding members who have accrued a benefit of 100% of final average earnings.*

Safety Tier 2C

For Safety members in Tier 2C, the expected rates of retirement under the current and proposed assumptions are as follows (note: there was no actual experience):

Age	Rate of Retirement (%)	
	Current Rate[1]	Proposed Rate[1]
49	0.00	0.00
50	4.00	4.00
51	2.00	2.00
52	2.00	2.00
53	3.00	3.00
54	6.00	6.00
55	10.00	10.00
56	12.00	12.00
57	20.00	20.00
58	10.00	10.00
59	15.00	15.00
60	60.00	60.00
61	60.00	60.00
62	60.00	60.00
63	60.00	60.00
64	100.00	60.00
65 & Over	100.00	100.00

[1]   *Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.*

Safety Tier 4

For Safety members in Tier 4, the expected rates of retirement under the current and proposed assumptions are as follows (note: there was no actual experience):

| Age	Rate of Retirement (%)	
	Current Rate	Proposed Rate
49	0.00	0.00
50	4.00	4.00
51	2.00	2.00
52	2.00	2.00
53	3.00	3.00
54	6.00	6.00
55	10.00	10.00
56	12.00	12.00
57	20.00	20.00
58	10.00	10.00
59	15.00	15.00
60	60.00	60.00
61	60.00	60.00
62	60.00	60.00
63	60.00	60.00
64	100.00	60.00
65 & Over	100.00	100.00

Chart 3 compares actual experience with the current and proposed rates of retirement for General Tier 1 members. Chart 4 displays the same data for General Tier 2 members; Chart 5 is for General Tier 3 members; Chart 6 is for Safety Tier 1 members; and Chart 7 is for Safety Tier 2 members.

Deferred Vested Members

In the prior valuation, deferred vested General and Safety members were assumed to retire at age 60 and 56, respectively. The average age at retirement over the three-year study period was 61.9 for General and 54.2 for Safety. We recommend increasing the General assumption to age 61 and maintaining the Safety assumption at age 56. No change was made to the Safety age after taking into consideration the overall experience for the past six years combined.

Please note that for members who terminate with less than five years of service and are not vested, we assume that they will retire at age 70 for both General and Safety if they decide to leave their contributions on deposit as permitted by §31629.5.
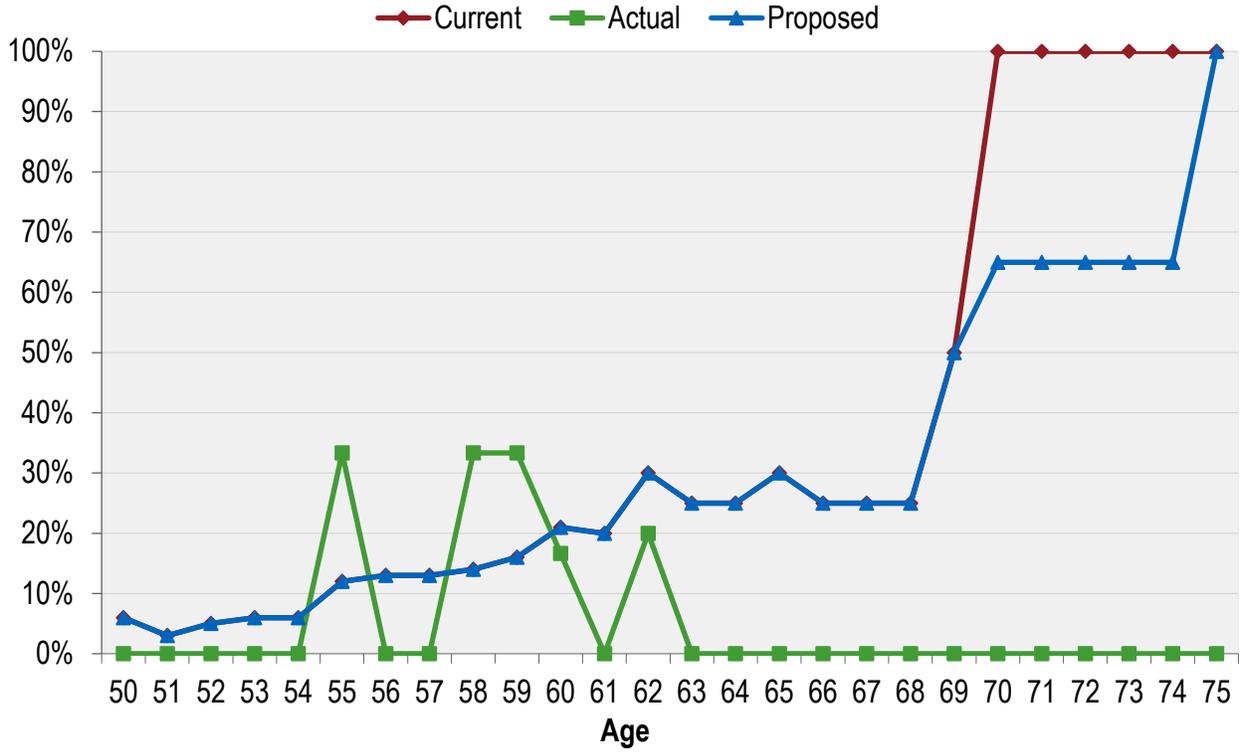
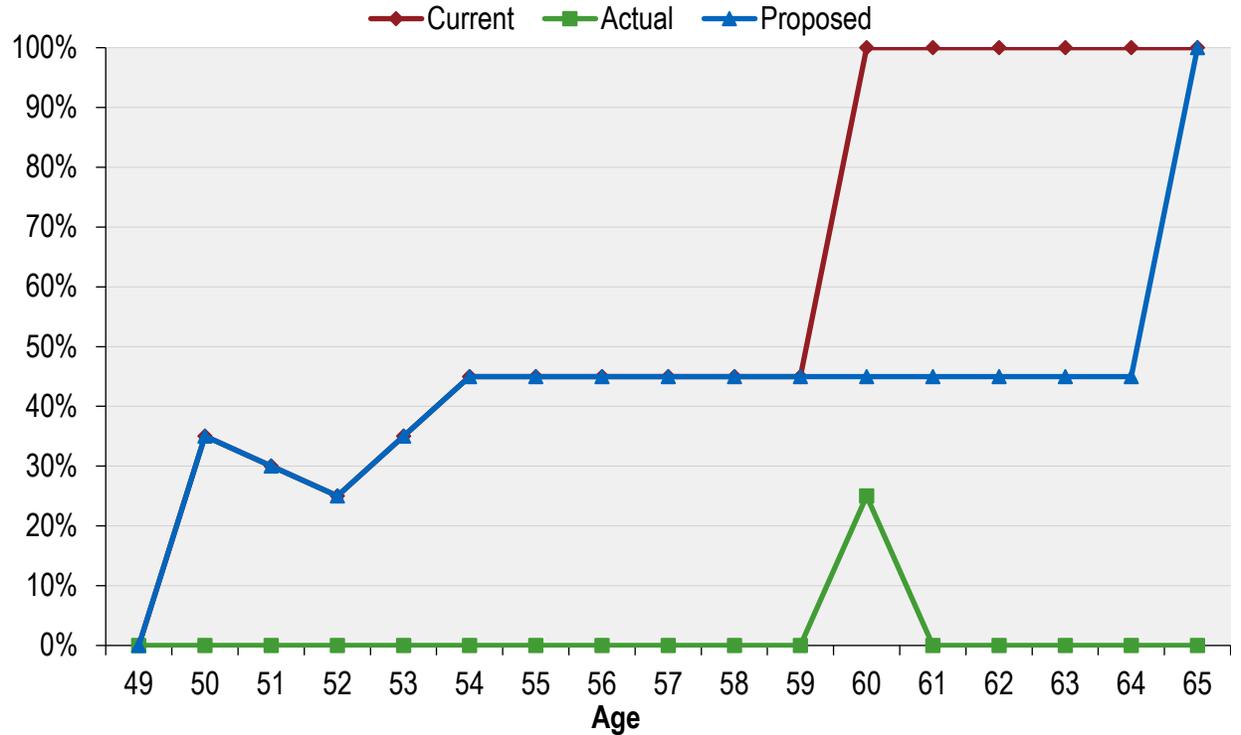# CHART 3: RETIREMENT RATES
GENERAL TIER 1 MEMBERS
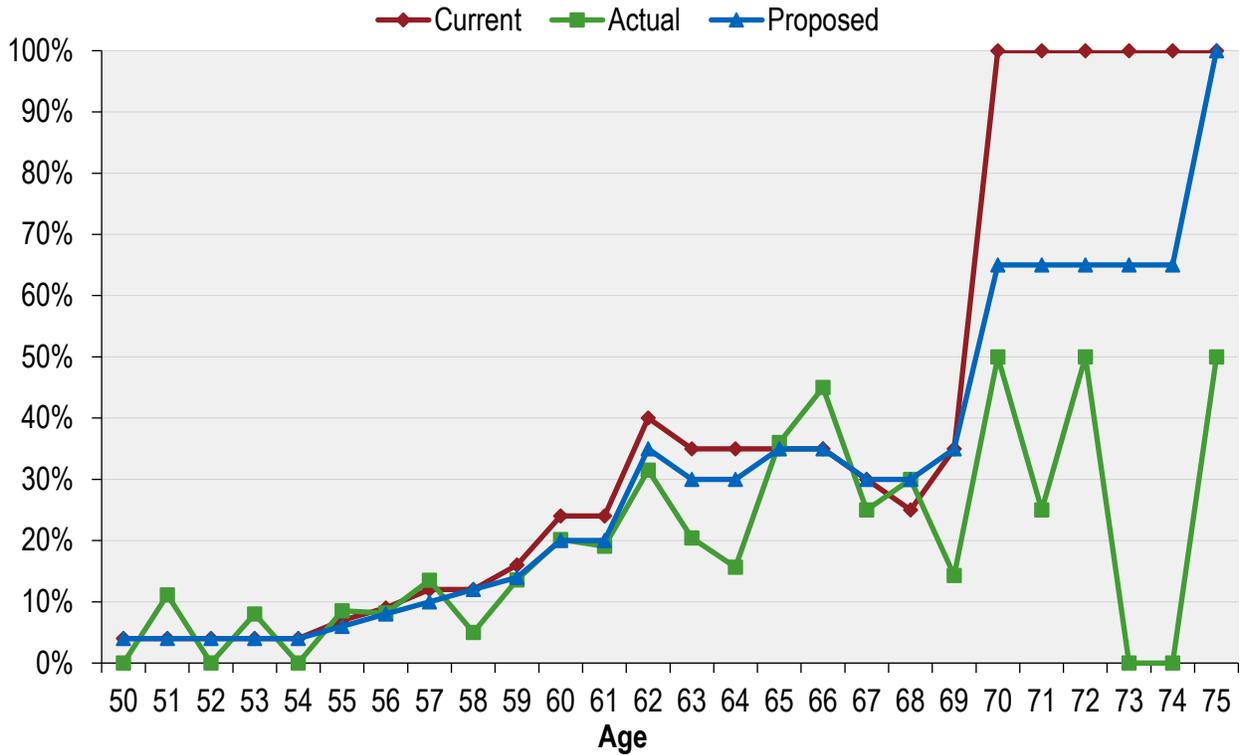
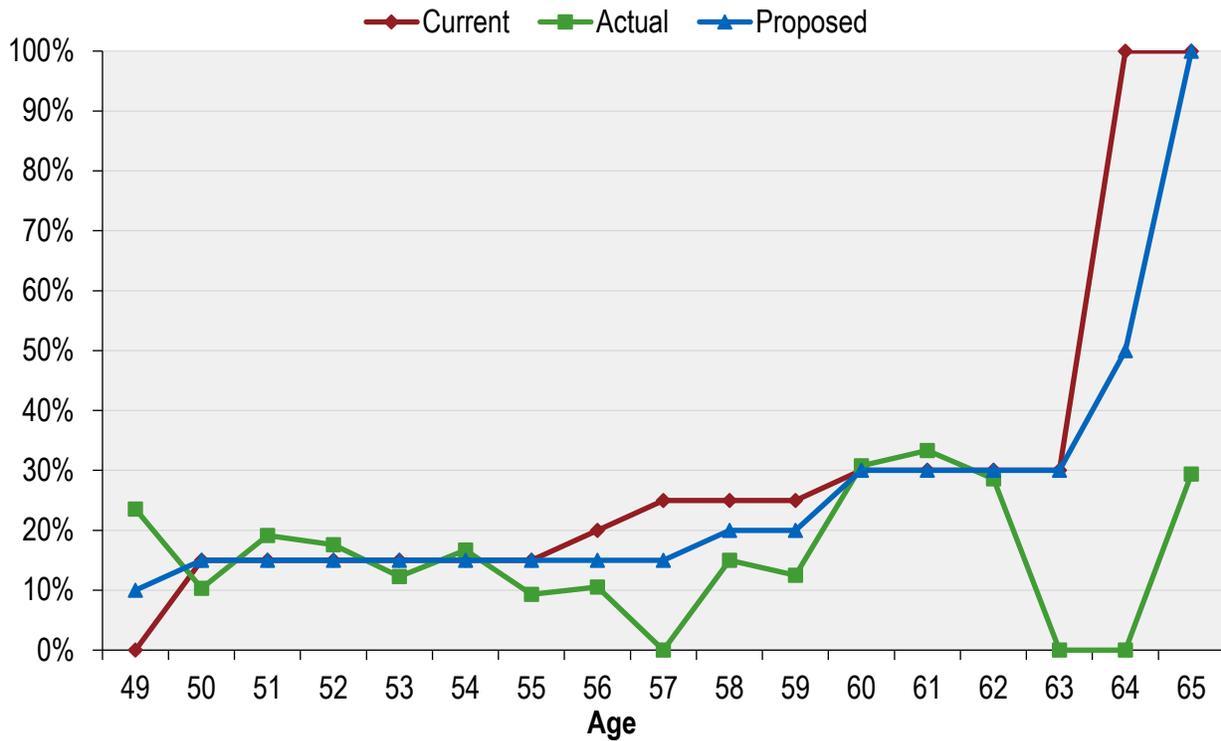# CHART 4: RETIREMENT RATES
GENERAL TIER 2 MEMBERS
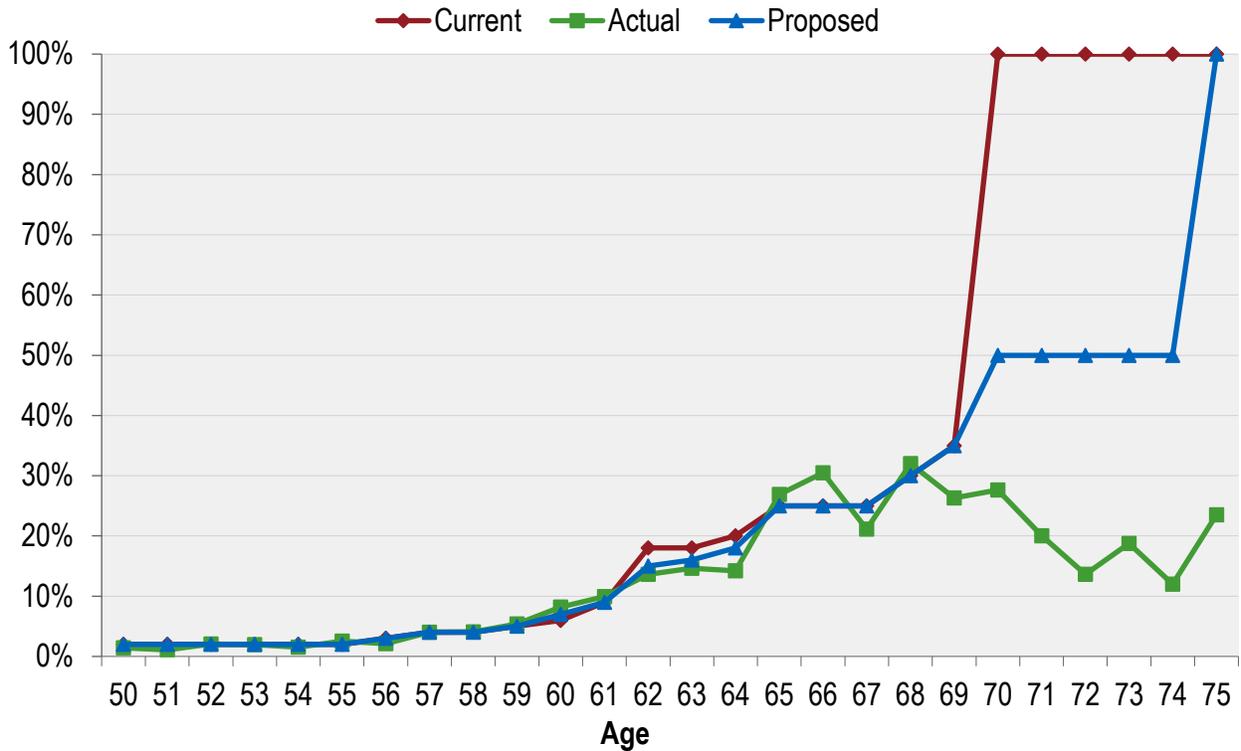
**CHART 5: RETIREMENT RATES
GENERAL TIER 3 MEMBERS**

**CHART 6: RETIREMENT RATES
SAFETY TIER 1 MEMBERS**

CHART 7: RETIREMENT RATES
SAFETY TIER 2 MEMBERS

B. Mortality Rates - Healthy

The "healthy" mortality rates project the life expectancy of a member who retires from service (i.e., who did not retire on a disability pension). Also, the "healthy" pre-retirement mortality rates project what proportion of members will die before retirement. For General members, the table currently being used for post-service retirement mortality rates is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2020, set back one year for males and females. For Safety members, the table currently being used for post-service retirement mortality rates is the RP-2000 Combined Healthy Mortality Table (separate tables for males and females) projected with Scale BB to 2020 with no setback for males and set back two years for females. All General and Safety beneficiaries are assumed to have the same mortality of a General member of the opposite sex who has taken a service (non-disabled) retirement.

The Society of Actuaries (SOA) has published the RP-2014 family of mortality tables and associated mortality improvement scales. Within that family of mortality tables, there are mortality rates developed for annuitants on a "headcount" weighted basis that weight all retirees at the same age the same way without regard to the level of benefits those annuitants are receiving from a retirement plan. Mortality rates are also developed for annuitants on a "benefit" weighted basis, with higher credibility assigned to experience from annuitants receiving larger benefits. The headcount-weighted basis is the more common practice currently and is the approach used by Segal in the past for its California public system clients (including ACERA) and by other public sector actuaries in California.

As for the mortality improvement scales, they can be applied in one of two ways. Historically, the more common application is to use a "static" approach to anticipate a fixed level of mortality improvement for all annuitants receiving benefits from a retirement plan. This is in contrast to a "generational" approach where each future year has its own mortality table that reflects the forecasted improvements, using the published improvement scales. While the static approach is still used by some of Segal's California public system clients, as well as CalPERS, the "generational" approach is the emerging practice within the actuarial profession.

A generational mortality table provides dynamic projections of mortality experience for each cohort of retirees. For example, the mortality rate for someone who is 65 next year will be slightly less than for someone who is 65 this year. In general, using generational mortality anticipates increases in the cost of the Plan over time as participants' life expectancies are projected to increase. This is in contrast to updating a static mortality assumption with each experience study as we have proposed in prior experience studies.

The SOA is in the process of collecting data from public sector plans so that they can develop mortality tables based on public sector experience comparable to the RP-2014 mortality tables developed using data collected from private and multi-employer plans. Furthermore, after publishing the two-dimensional MP-2014 mortality improvement scale, the SOA replaced it with the two-dimensional MP-2015 mortality improvement scales to remove some of the conservatism built into the MP-2014 scale and to better reflect the most recent data of mortality improvement from the Social Security Administration. We understand that the Retirement Plans Experience Committee of the Society of Actuaries (RPEC) intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2016 is the latest improvement scale available.

We recommend that given the trend in the retirement industry to move towards generational mortality, it would be reasonable for the Board to adopt the Headcount-Weighted RP-2014 mortality table (adjusted for ACERA experience), and project the mortality improvement generationally using the MP-2016 mortality improvement scale. Once the SOA has included data from public sector plans in developing the new tables, we will also include a discussion with the Board on whether to consider the benefit weighted mortality rates in a future experience study.

As an illustration of the relative effect of these approaches, we have provided in the table below the approximate change in the total employer and member contribution rates based on the different approaches to build in margin for future mortality improvements.

	Estimated Employer and Member Contribution Rate Impact Combined
Headcount-Weighted RP-2014 Family of Tables – Static Approach with Increased Margin*	**1.11% of payroll**
Benefit Weighted RP-2014 Family of Tables – Static Approach without Increased Margin	1.92% of payroll
Headcount-Weighted RP-2014 Family of Tables – Generational Approach	1.08% of payroll

Includes an increased margin of 20% to anticipate the move towards a "generational" approach.

In order to use more actual ACERA experience in our analysis, we have used experience for a six-year period from both the current (from December 1, 2013 to November 30, 2016) and the last (from December 1, 2010 to November 30, 2013) experience study periods to study this assumption. In addition, we have continued to examine the mortality experience with all beneficiaries included since combining healthy retirees and beneficiaries would provide more exposures and would lend more credence to the results.

Post- Retirement Mortality (Service Retirements and Beneficiaries)

Among all service retired members and beneficiaries, the actual deaths compared to the expected deaths under the current assumptions for the last six years is shown in the table below. We also show the deaths under proposed assumptions. In prior years we have generally set the mortality assumption using a static mortality projection so that actual deaths will be at least 10% greater than those assumed. As noted above, we are recommending the use of a generational mortality table rather than static mortality. A generational mortality table incorporates a more explicit assumption for future mortality improvement. Accordingly, the goal is to start with a mortality table that closely matches the current experience (without a margin for future mortality improvement), and then reflect mortality improvement by projecting lower mortality rates in future years. That is why the current actual to expected ratios shown in the table below for General (including all beneficiaries) and Safety are 97% and 95%, respectively. In future years these ratios should remain around 100%, as long as actual mortality improved at the same rates as anticipated in the generational mortality tables.

The actual deaths compared to the expected deaths under the current and proposed assumptions for the last six years are as follows:

	General Members – Healthy			All Beneficiaries – Healthy		
Gender	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	362	401	420	62	70	70
Female	504	555	583	210	248	242
Total	866	956	1,003	272	318	312
Actual / Expected	110%		95%	117%		102%

	General Members and All Beneficiaries- Healthy			Safety Members - Healthy		
Gender	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	424	471	490	79	87	91
Female	714	803	825	12	15	16
Total	1,138	1,274	1,315	91	102	107
Actual / Expected	112%		97%	112%		95%

For General service retirees and all beneficiaries, the ratio of actual to expected deaths was 112% during the six-year period under the current assumptions. We recommend updating the current table to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables (separate tables for males and females), with no setback for males or females. This will bring the actual to expected ratio to 97%. This table is then projected generationally with the two-dimensional mortality improvement scale MP-2016.

For Safety service retirees, the ratio of actual to expected deaths was 112% during the six-year period under the current assumptions. We recommend updating the current table to the RPH-2014 (Headcount-Weighted) Healthy Annuitant Mortality Tables (separate tables for males and females), with no setback for males or females. This will bring the actual to expected ratio to 95%. This table is then projected generationally with the two-dimensional mortality improvement scale MP-2016.

All of this is consistent with ASOP 35 as we anticipate future improvement in life expectancy using the generational approach.

Chart 8 compares actual to expected deaths for General members and all beneficiaries under the current and proposed assumptions over the last six years. Experience shows that there were more deaths than predicted by the current table over the last six years.

Chart 9 has the same comparison for Safety members. Experience shows that there were more deaths than predicted by the current table over the last six years.

Chart 10 shows the life expectancies under the current and the proposed tables for General members and all beneficiaries. Chart 11 has the same information for Safety members.

The expected deaths (Charts 8 and 9) and life expectancies (Charts 10 and 11) under the proposed generational mortality table are based on mortality rates from 2014, which is the base year of the table, with any applicable age adjustments. In practice, life expectancies will be assumed to increase after applying the mortality improvement scale.

Pre-Retirement Mortality

In prior experience studies, the pre-retirement rates for active members were set equal to the post-retirement mortality rates for retirees since the actual number of deaths among active members was not large enough to provide a statistically credible analysis. However, this approach is not compatible with our current proposal because the post-retirement RP-2014 Healthy Annuitant Mortality Table does not include mortality rates for ages below 50.

From the RP-2014 family of tables, we recommend that pre-retirement mortality follow the Headcount-Weighted RP-2014 (RPH-2014) Employee Mortality Tables times 80%, projected generationally with the two-dimensional MP-2016 projection scale for both General and Safety members. The 80% scaling factor is to account for the lower incidence of observed pre-retirement death on the combined General and Safety workforce relative to the standard table.

Currently, our assumption is that all pre-retirement deaths are non-service connected and we recommend maintaining that assumption since we have not observed any service connected deaths over the current three-year experience study period.

Mortality Table for Member Contributions, Optional Forms of Benefit and Reserves

There are administrative reasons why a generational mortality table is more difficult to implement for determining age-based member contribution rates, optional forms of payment and reserves. One emerging practice is to approximate the use of a generational mortality table by the use of a static table with projection of the mortality improvement over a period that is close to the duration of the benefit payments for active members. We would recommend the use of this approximation.

Member Contributions

We recommend that the mortality table used for determining contributions for General members be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, set back one year for males and females, weighted 30% male and 70% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 30% male and 70% female. This is based on the proposed mortality tables for General members and the actual sex distribution for the current active General members.

For Safety members, we recommend that the mortality table used for determining contributions be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, with no setback for males and set back two years for females, weighted 75% male and 25% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 75% male and 25% female. This is based on the proposed mortality tables for Safety members and the actual sex distribution for the current active Safety members.

Optional Forms of Benefit and Reserves – Service Retirement and All Beneficiaries

For General members, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, set back one year for males and females, weighted 30% male and 70% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 30% male and 70% female. This is based on the proposed mortality tables for General members and the actual sex distribution for the current active General members.

For General beneficiaries, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, set back one year for males and females, weighted 70% male and 30% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 70% male and 30% female. This is based on the proposed mortality tables for General beneficiaries and the assumption that beneficiaries are of the opposite sex to the member.

For Safety members, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, with no setback for males and set back two years for females, weighted 75% male and 25% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 75% male and 25% female. This is based on the proposed mortality tables for Safety members and the actual sex distribution for the current active Safety members.

For Safety beneficiaries, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, with no setback for males and set back two years for females, weighted 25% male and 75% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 25% male and 75% female. This is based on the proposed mortality tables for Safety beneficiaries and the assumption that beneficiaries are of the opposite sex to the member.

Optional Forms of Benefit and Reserves – Disability Retirement[20]
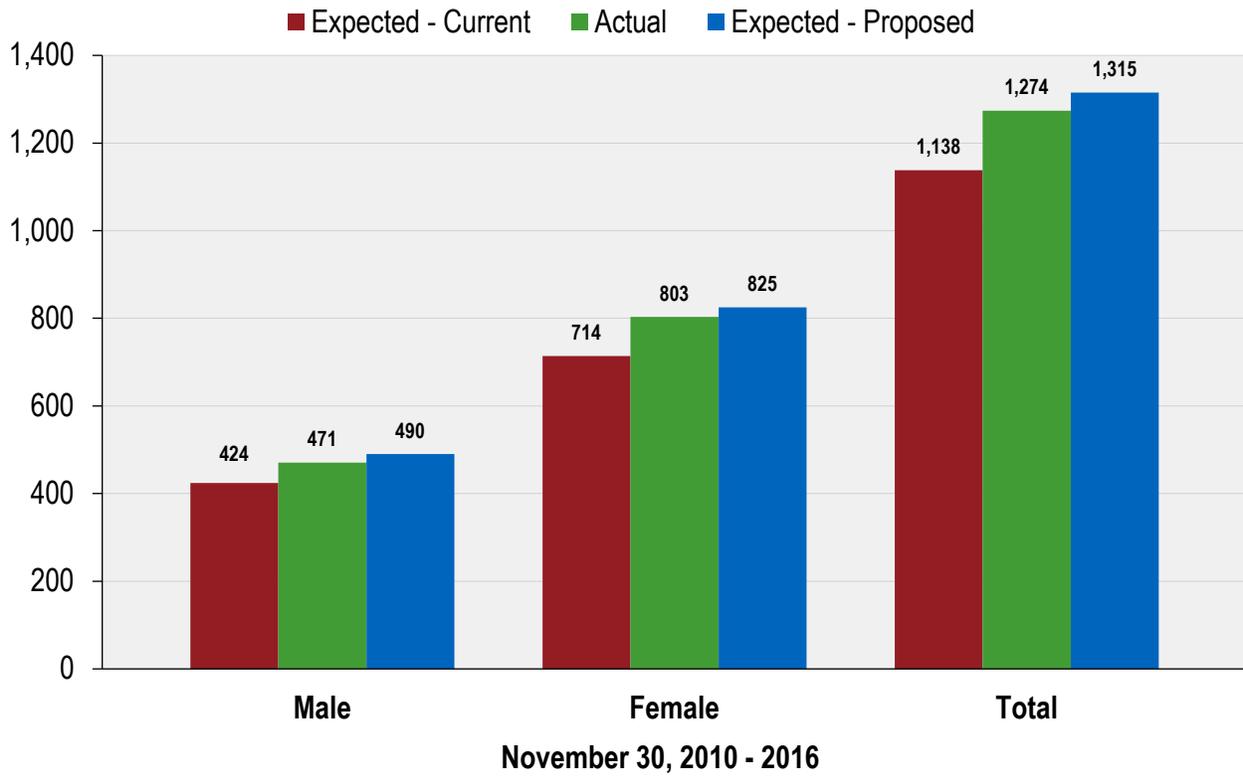
For General members, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, set forward seven years for males and set forward four years for females, weighted 30% male and 70% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, set forward seven years for males and set forward four years for females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 30% male and 70% female. This is based on the proposed mortality tables for General members and the actual sex distribution for the current active General members.

For Safety members, we recommend that the mortality table used for determining optional forms of benefit be changed from the RP-2000 Combined Healthy Mortality Tables projected with Scale BB to 2020, set forward six years for males and set forward three years for females, weighted 75% male and 25% female to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, set forward two years for males and with no set forward for females, projected 20 years with the two-dimensional improvement Scale MP-2016, weighted 75% male and 25% female. This is based on the proposed mortality tables for Safety members and the actual sex distribution for the current active Safety members.

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[20] See Subsection C for the development of the underlying mortality assumptions recommended for the disabled members.

CHART 8: POST-RETIREMENT DEATHS
GENERAL – NON-DISABLED MEMBERS (AND ALL BENEFICIARIES)

Legend: Expected - Current | Actual | Expected - Proposed

	Male	Female	Total
Expected - Current	424	714	1,138
Actual	471	803	1,274
Expected - Proposed	490	825	1,315

November 30, 2010 - 2016

CHART 9: POST-RETIREMENT DEATHS
SAFETY – NON-DISABLED MEMBERS

Legend: Expected - Current | Actual | Expected - Proposed

	Male	Female	Total
Expected - Current	79	12	91
Actual	87	15	102
Expected - Proposed	91	16	107

November 30, 2010 - 2016
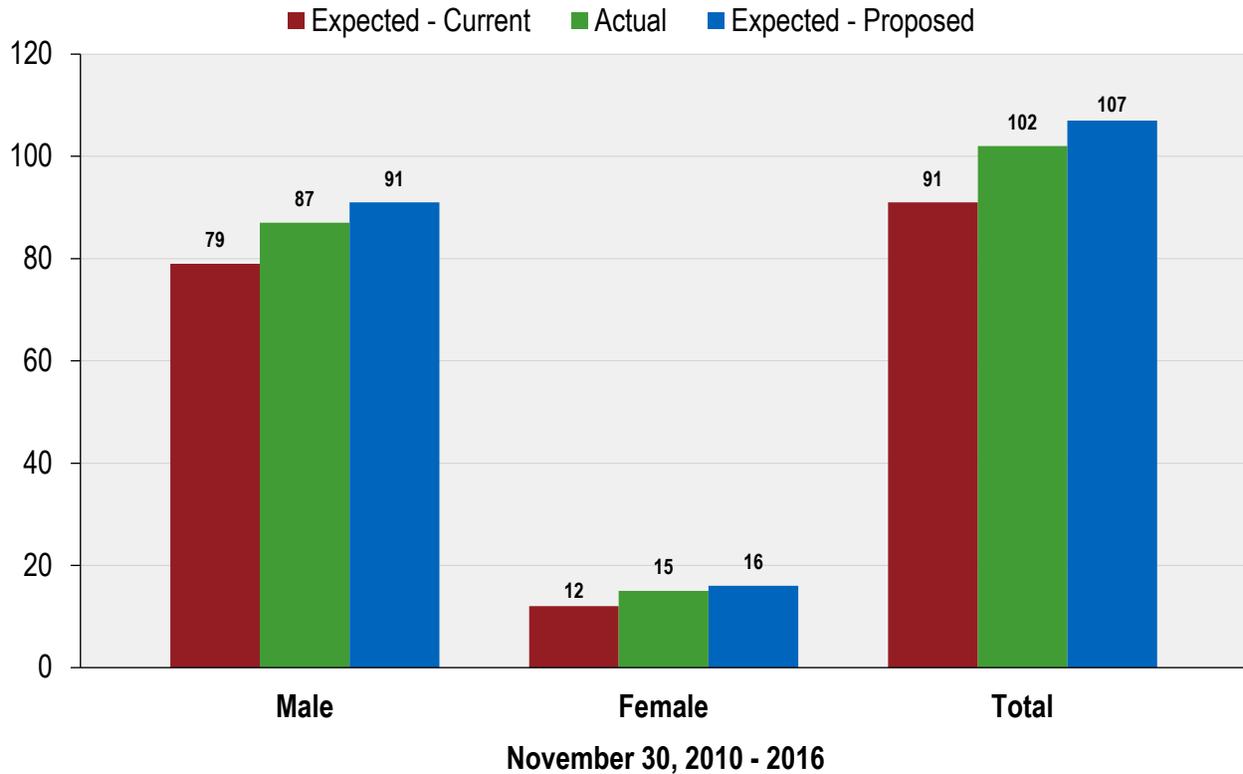
CHART 10: LIFE EXPECTANCIES
GENERAL – NON-DISABLED MEMBERS
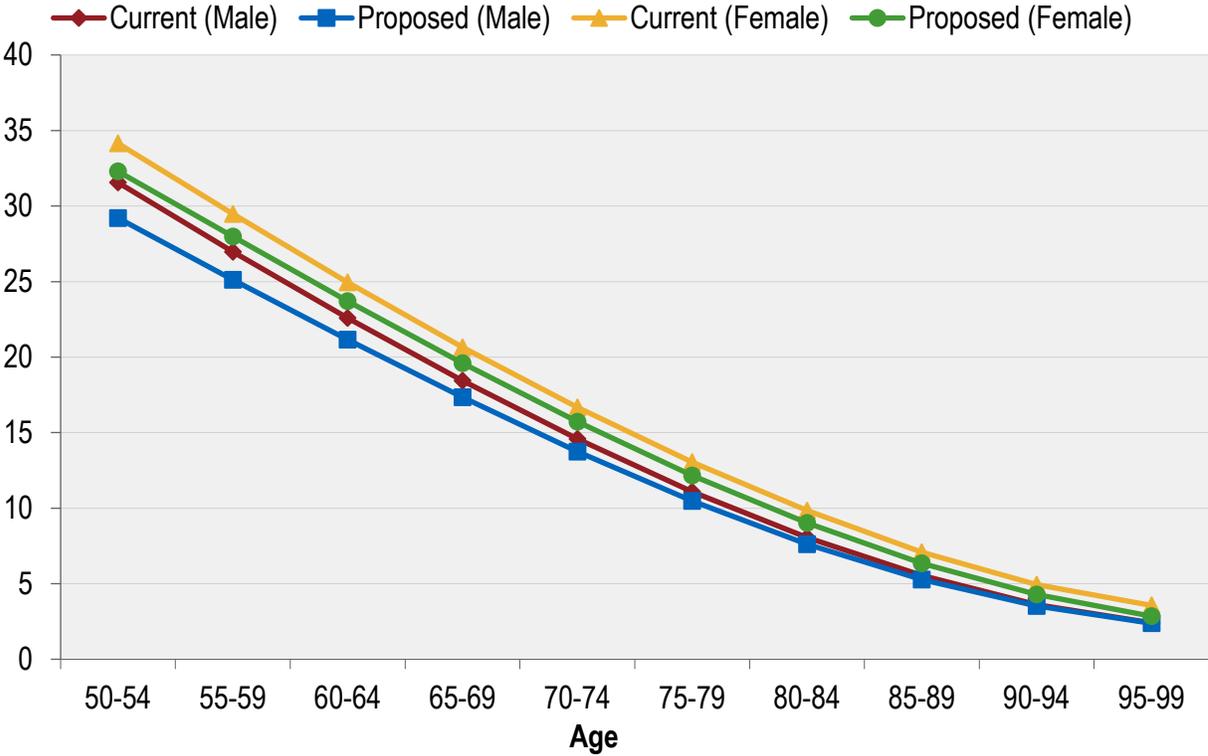
CHART 11: LIFE EXPECTANCIES
SAFETY – NON-DISABLED MEMBERS
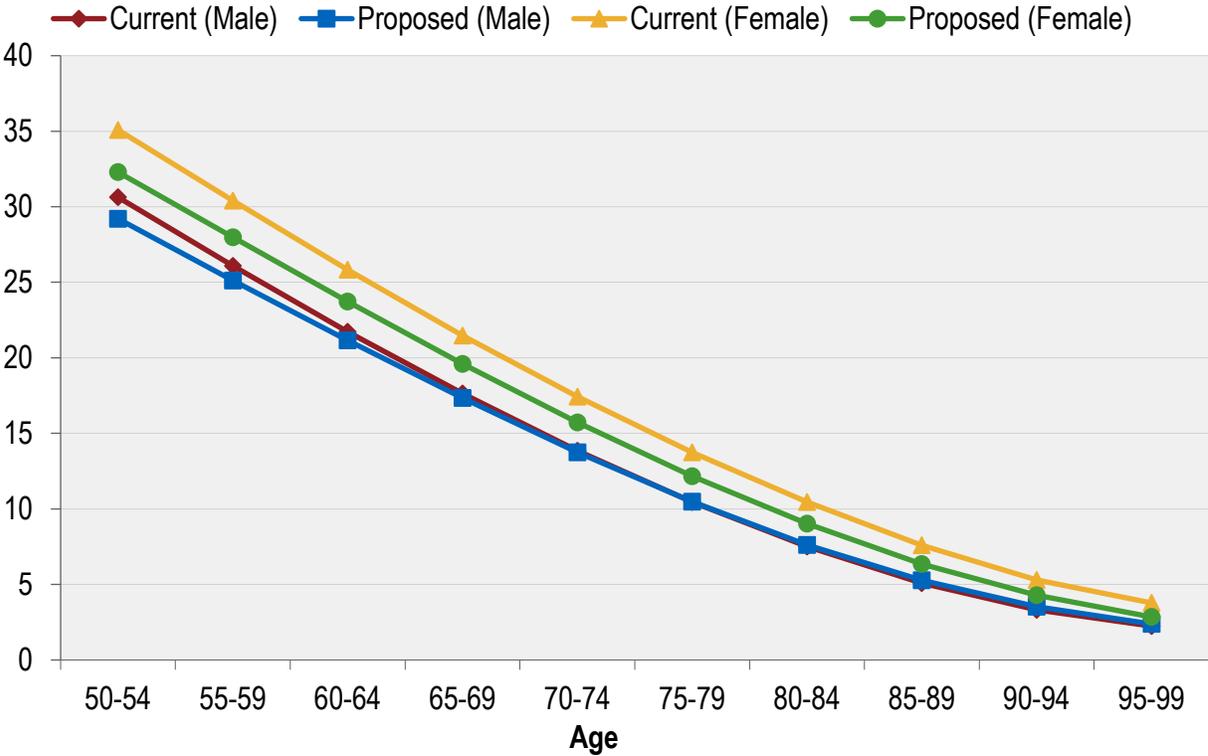
C. Mortality Rates - Disabled

Since mortality rates for disabled members can vary from those of healthy members, a different mortality assumption is often used. For General members, the table currently being used is the RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward seven years for males and set forward four years for females. For Safety members, the table currently being used is the RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward six years for males and set forward three years for females.

The number of actual deaths compared to the number expected under the current and proposed assumption for the last six years are as provided in the table below.

Gender	General - Disabled			Safety - Disabled		
	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	31	34	33	22	18	17
Female	51	54	54	3	2	3
Total	82	88	87	25	20[21]	20
Actual / Expected	107%		101%	80%		100%

Based on the actual experience from the last six years, we recommend changing the mortality table for General disabled members to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables (separate tables for males and females) set forward seven years for males and set forward four years for females. This will bring the actual to expected ratio to 101%. This table is then projected generationally with the two-dimensional mortality improvement scale MP-2016.

Likewise, based on the actual experience from the last six years, we recommend changing the mortality table for Safety disabled members to the Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables (separate tables for males and females), set forward two years for males and with no set forward for females. This will bring the actual to expected ratio to 100%. This table is then projected generationally with the two-dimensional mortality improvement scale MP-2016.

Chart 12 compares actual to expected deaths under both the current and proposed assumptions for disabled General members over the last six years. Experience shows that there were more General member deaths than predicted by the current table.

Chart 13 has the same comparison for Safety members. Experience shows that there were less Safety member death than predicted by the current table.

Charts 14 and 15 show the life expectancies under both the current and proposed tables for General and Safety members, respectively.

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[21] Of the 20 deaths from the last six years, 13 deaths occurred from December 1, 2010 – November 30, 2013 and 7 deaths occurred from December 1, 2013 – November 30, 2016.

CHART 12: POST-RETIREMENT DEATHS
GENERAL - DISABLED MEMBERS

November 30, 2010 - 2016
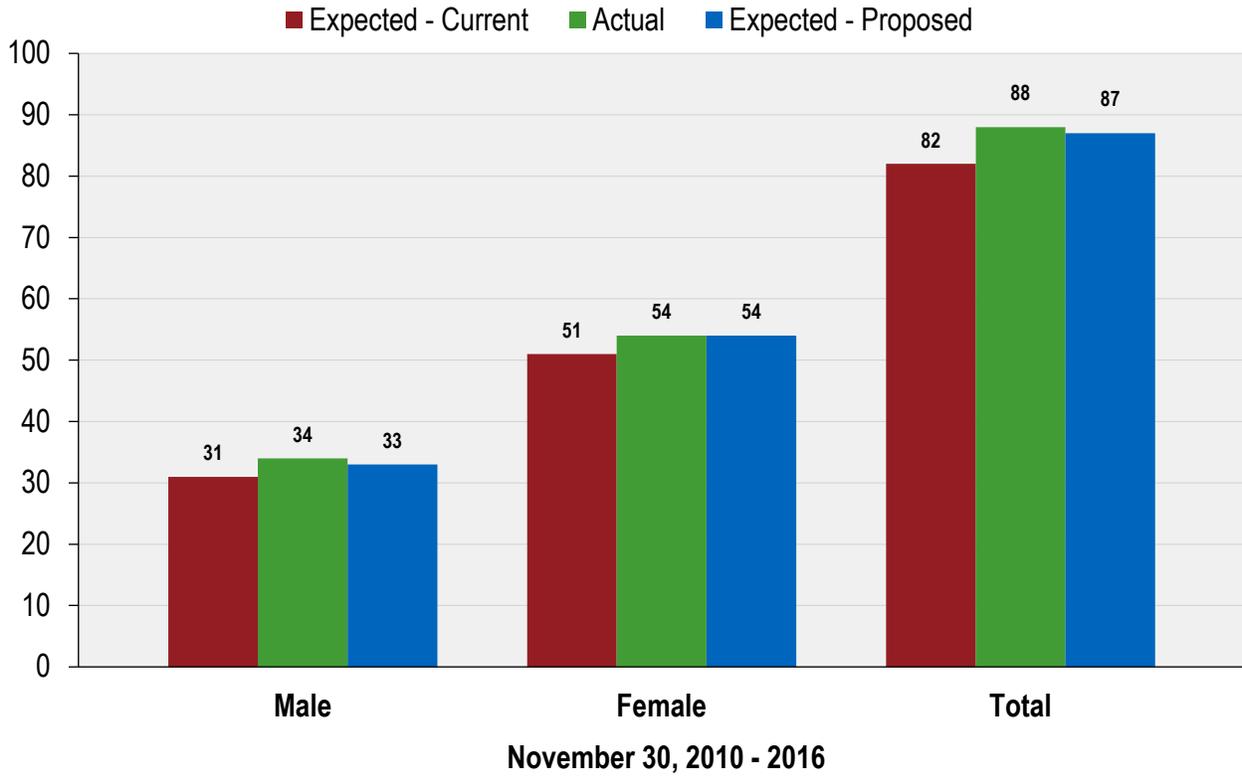
CHART 13: POST-RETIREMENT DEATHS
SAFETY - DISABLED MEMBERS

November 30, 2010 - 2016
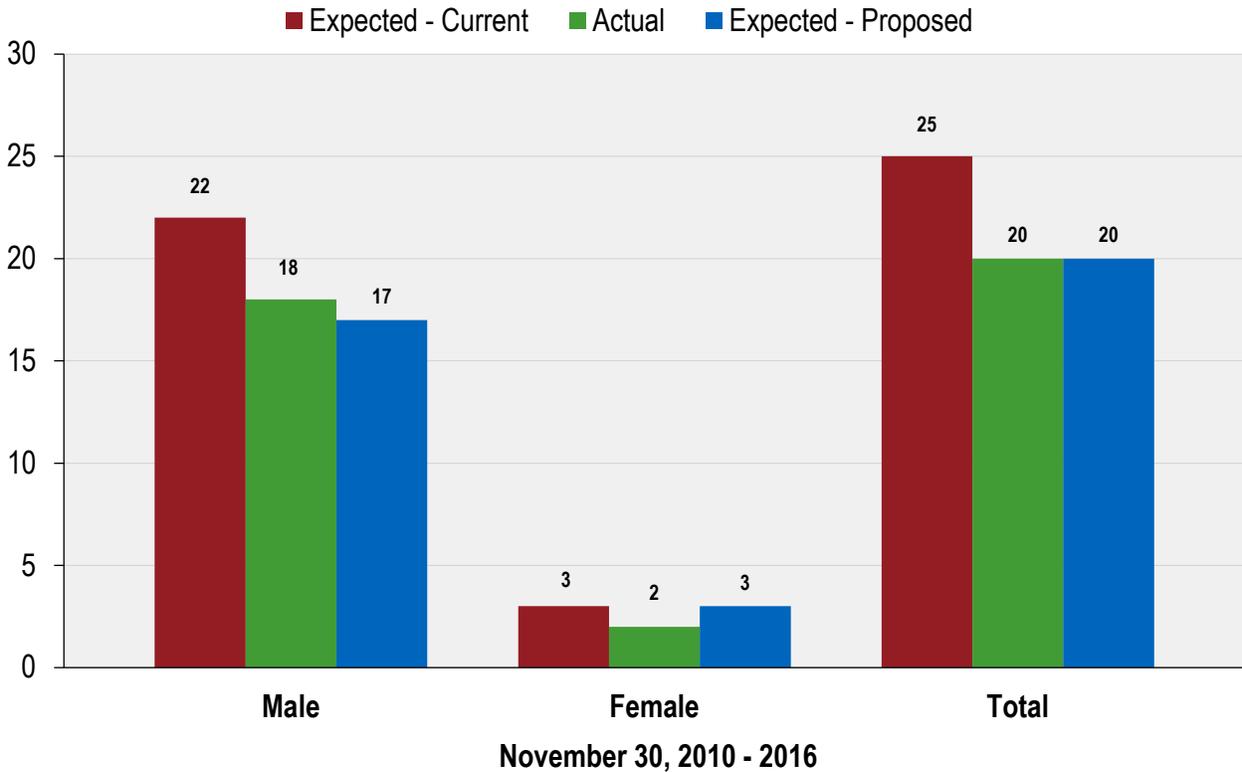
CHART 14: LIFE EXPECTANCIES
GENERAL - DISABLED MEMBERS
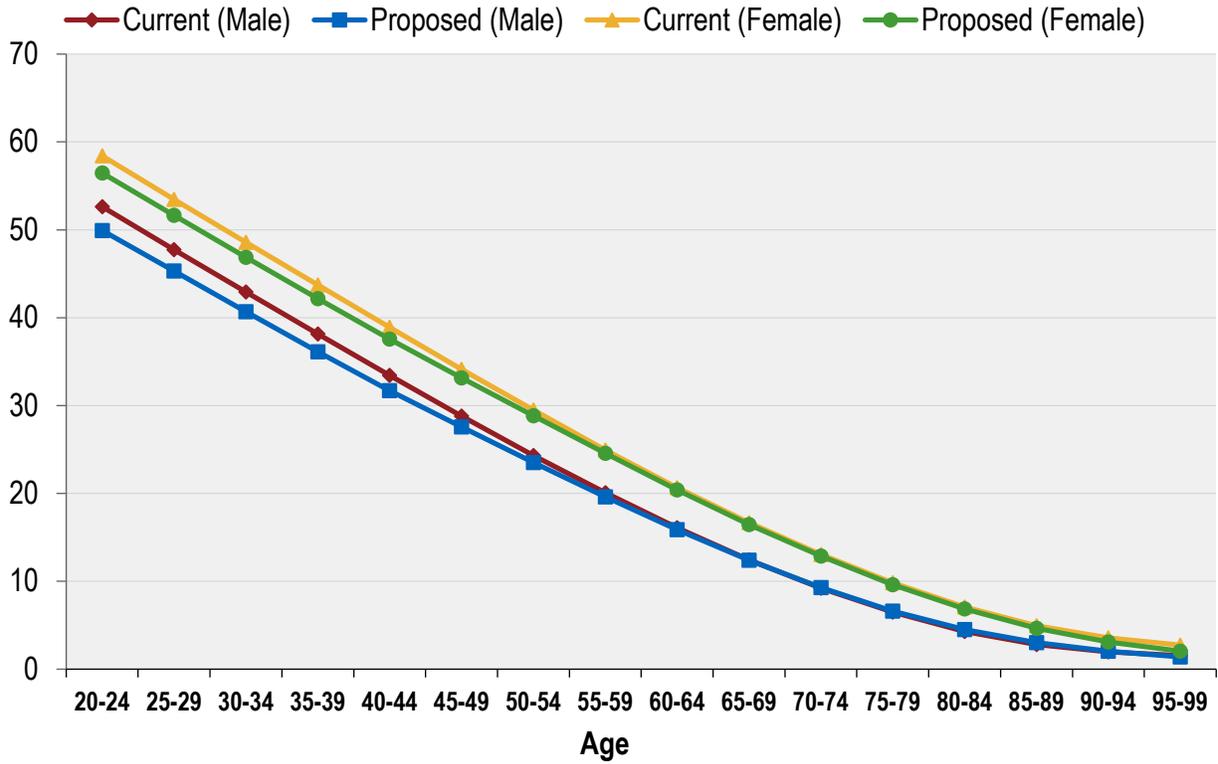
CHART 15: LIFE EXPECTANCIES
SAFETY - DISABLED MEMBERS
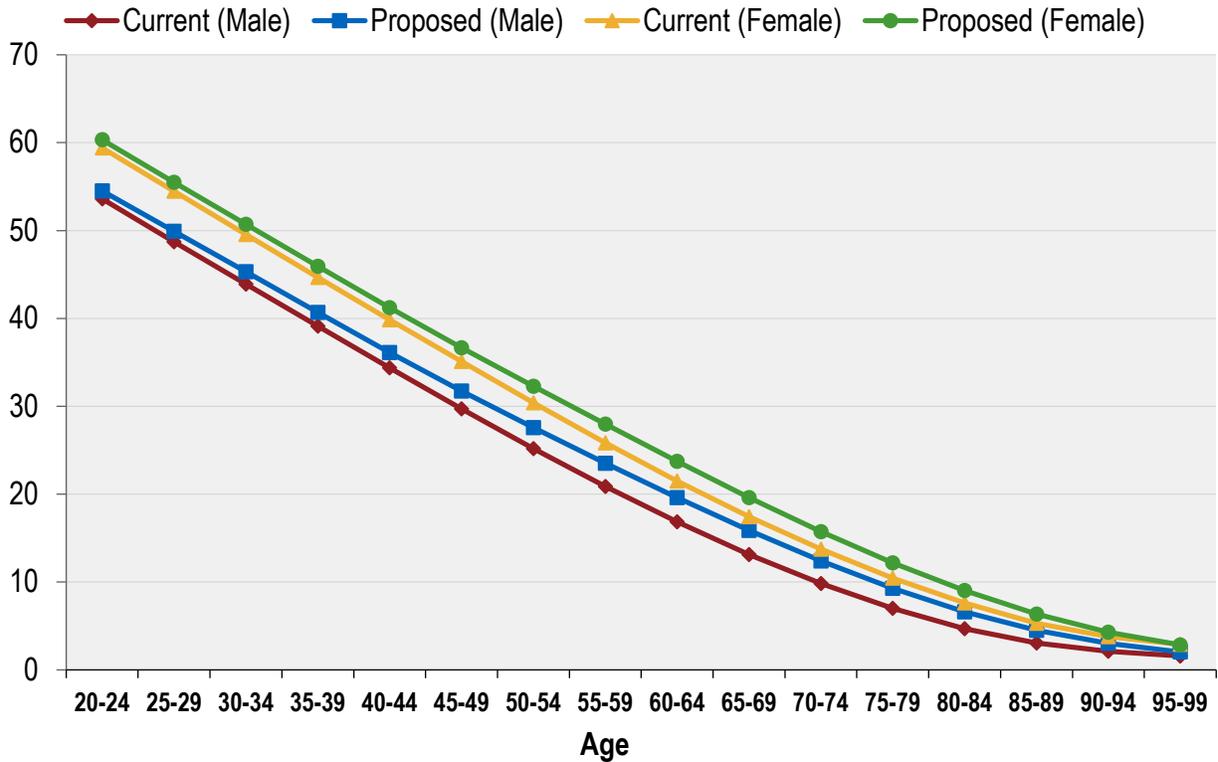
D. Termination Rates

Termination rates include all terminations for reasons other than death, disability, or retirement. Under the current assumption structure there is a separate set of assumptions for members with less than five years of service and members with five or more years of service. There is also another set of assumptions to anticipate the percentage of members who will withdraw their contributions and members who will leave their contributions on deposit and receive a deferred vested benefit.

The termination experience over the last three years for General and Safety members separated between those members with under five years of service and those with five or more years of service is as follows:

Rates of Termination – Fewer than Five Years of Service

	Termination Rate (%)					
	General			Safety		
Years of Service	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
0 – 1	10.00	11.55	11.00	5.00	3.01	4.00
1 – 2	9.00	9.12	9.00	4.00	3.38	3.50
2 – 3	7.00	9.40	8.00	3.00	4.35	3.50
3 – 4	6.00	6.65	6.00	2.00	2.73	2.50
4 – 5	5.00	6.59	6.00	1.00	2.30	2.00

Rates of Termination – Five or More Years of Service

	Termination Rate (%)					
	General			Safety		
Age	Current Rate*	Actual Rate	Proposed Rate*	Current Rate*	Actual Rate	Proposed Rate*
20 – 24	5.00	0.00	6.00	2.00	0.00	2.00
25 – 29	5.00	9.00	6.00	2.00	0.00	2.00
30 – 34	5.00	5.23	5.00	1.50	2.78	2.00
35 – 39	4.00	5.33	4.00	1.00	1.64	1.50
40 – 44	3.00	3.18	3.00	1.00	1.03	1.00
45 – 49	2.50	2.51	3.00	1.00	0.68	1.00
50 – 54	2.50	7.17	3.00	1.00	4.23	1.00
55 – 59	2.50	6.50	3.00	1.00	6.35	1.00
60 – 64	2.50	6.00	3.00	0.00	3.45	0.00
65 – 69	2.50	8.82	3.00	0.00	0.00	0.00

* *At central age in the age range shown.*

It is important to note that, in the table above, not every age category has enough exposures and/or decrements such that the results in that category are statistically credible. This is mainly the case at the highest age categories since most members in those categories are eligible to retire and, therefore, they have been excluded from our review of this experience.

Chart 16 compares actual to expected terminations of the past three years for both the current and proposed assumptions for General members and Safety members.

Chart 17 shows the current, along with the proposed termination rates for General members with less than five years of service. Chart 18 shows the same information as Chart 17, but for Safety members.

Chart 19 shows the current, along with the proposed termination rates for General members with five or more years of service. Chart 20 shows the same information as Chart 19, but for Safety members.

Based upon the recent experience, we recommend increases to the termination rates for General members with less than five years of service. For Safety members with less than five years of service, the termination rates have been adjusted down very slightly overall. For General members with five or more years of service, we have increased the termination rates at most ages. For Safety members with five or more years of service, we have increased the termination rates at the younger ages. We also continue to assume that all termination rates are zero for all members eligible to retire; that is, it is assumed that members eligible to retire at termination will retire rather than defer their benefit.

The following table shows the currently assumed, actual and recommended assumed percentages for members who will elect a refund of contributions upon termination and members who will elect to leave their contributions on deposit and receive a deferred vested benefit. The current assumption is that 60% of all members who terminate with less than five years of service will withdraw their contributions and 40% will choose a deferred vested benefit. For members with five or more years of service, the current assumption is that 40% of all members will withdraw their contributions and 60% will receive a deferred vested benefit.

	Election for Refund of Contributions					
	Members with Fewer than Five Years of Service			Members with Five or More Years of Service		
	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
General	60%	46%	60%	40%	27%	35%
Safety	60%	48%	60%	40%	26%	35%
	Election for Deferred Vested Benefit					
	Members with Fewer than Five Years of Service			Members with Five or More Years of Service		
	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
General	40%	54%	40%	60%	73%	65%
Safety	40%	52%	40%	60%	74%	65%

As shown above, we have recommended a reduction in the assumption for the percentage of members electing a refund of contributions for members with five or more years of service (i.e., from 40% to 35%) for both General and Safety members. However, we have recommended no change in the refund assumption for members with less than five years of service (i.e., it remains at 60%) even though observed experience differs from the current assumption. This is because there often appears to be a lag between a member terminating employment and ultimately electing a refund of contributions. Accordingly, we have also looked at the experience over the three-year study period of members who have been initially classified as inactive vested members and then ultimately elected a refund of contributions. Based on this experience, we observed that for members with less than five years of service, the actual rate of refund election increased from 46% for General members terminating only from active service (as shown in the table above) to about 66% when inactive vested members are included. Similarly, the actual rate of refund election increased from 48% for Safety members terminating only from active service (also shown above) to about 57% when inactive vested members are included, for members with less than five years of service. Based on these observations, we have recommended no change in the refund assumption for members with less than five years of service.

CHART 16: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED

November 30, 2013 - 2016
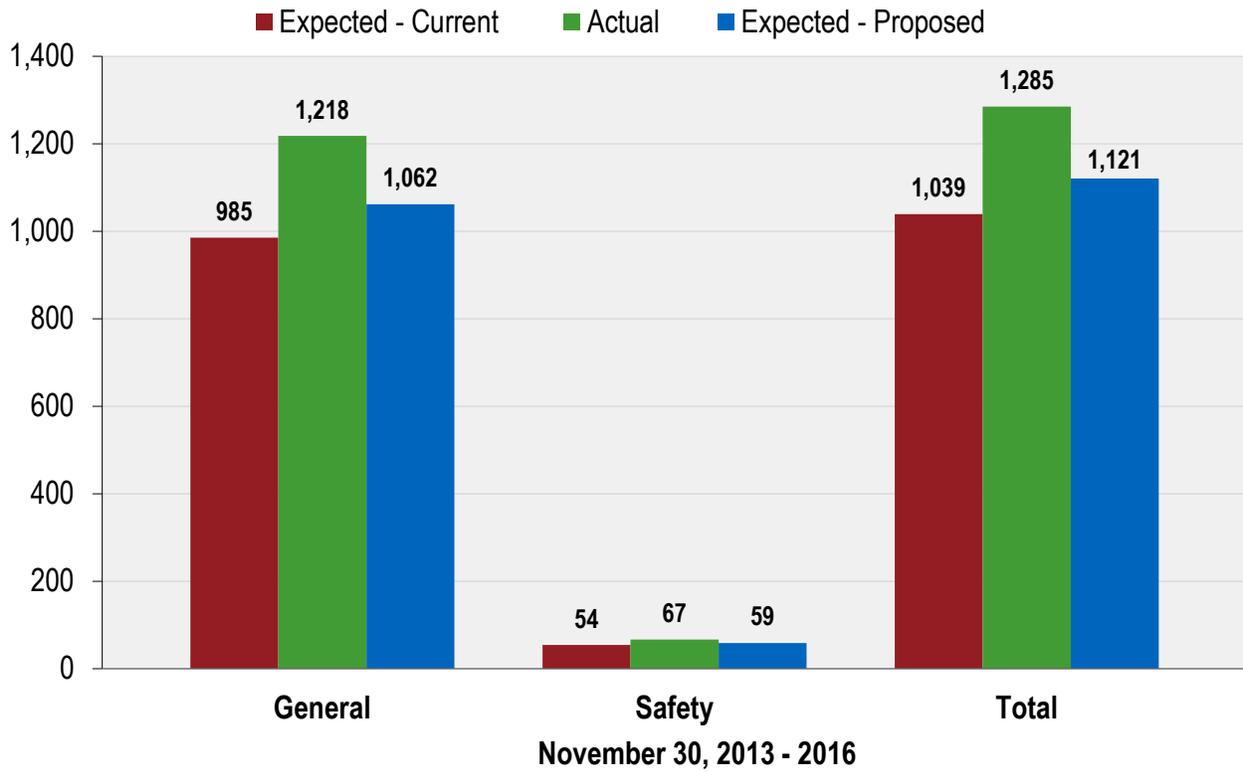
CHART 17: TERMINATION RATES – GENERAL LESS THAN FIVE YEARS OF SERVICE
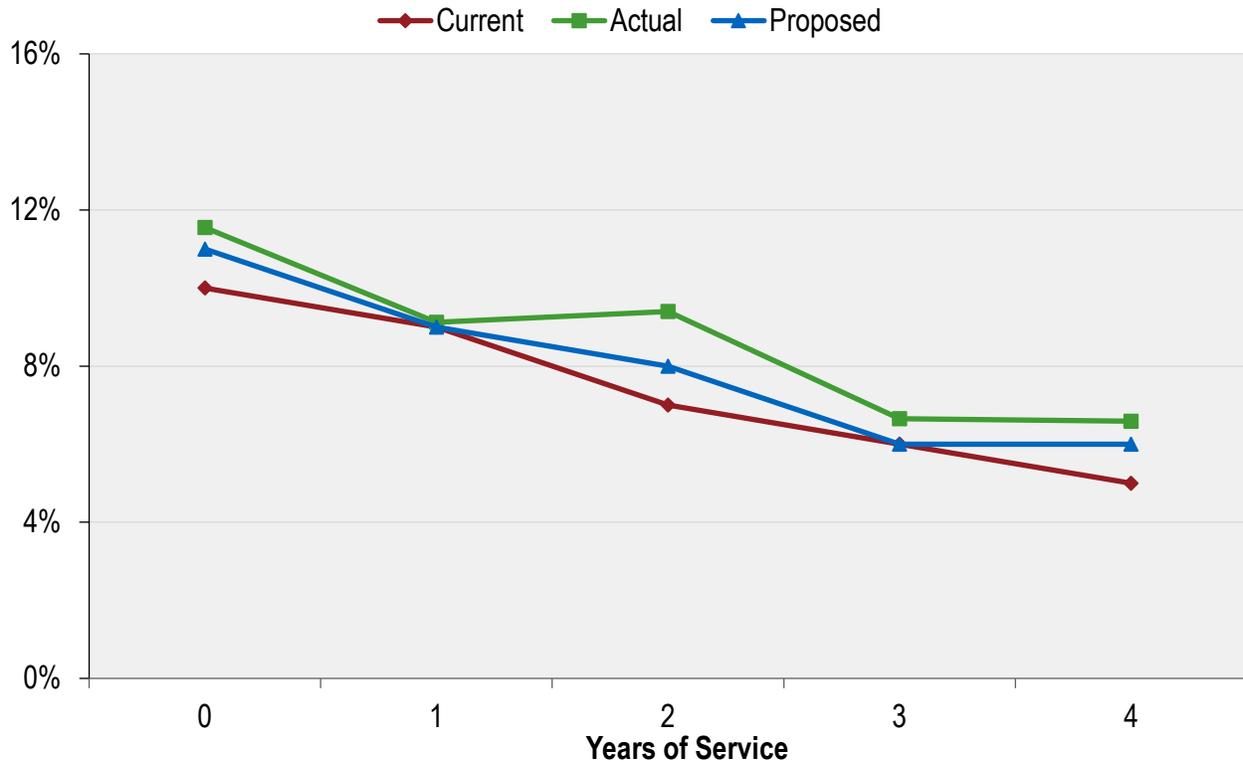
Years of Service

CHART 18: TERMINATION RATES – SAFETY
LESS THAN FIVE YEARS OF SERVICE

Legend: Current, Actual, Proposed
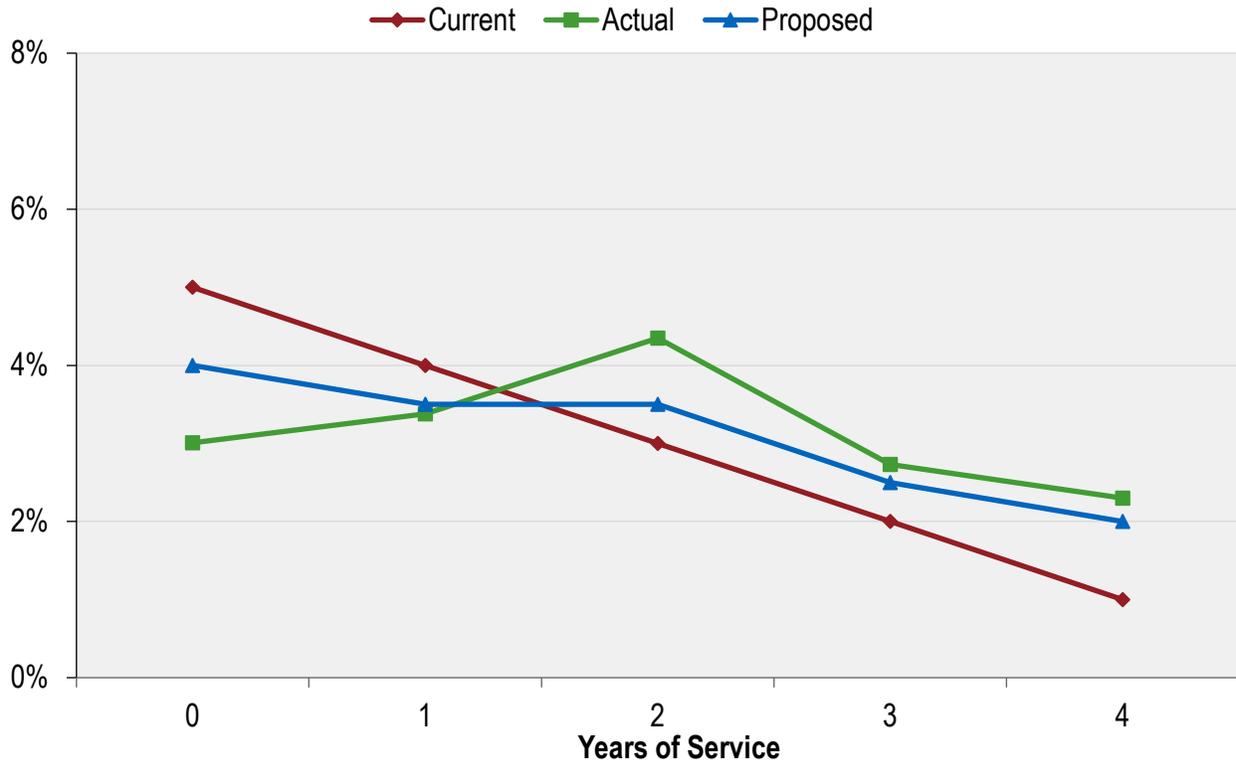
Years of Service

CHART 19: TERMINATION RATES – GENERAL
FIVE OR MORE YEARS OF SERVICE

Legend: Current, Actual, Proposed

Age
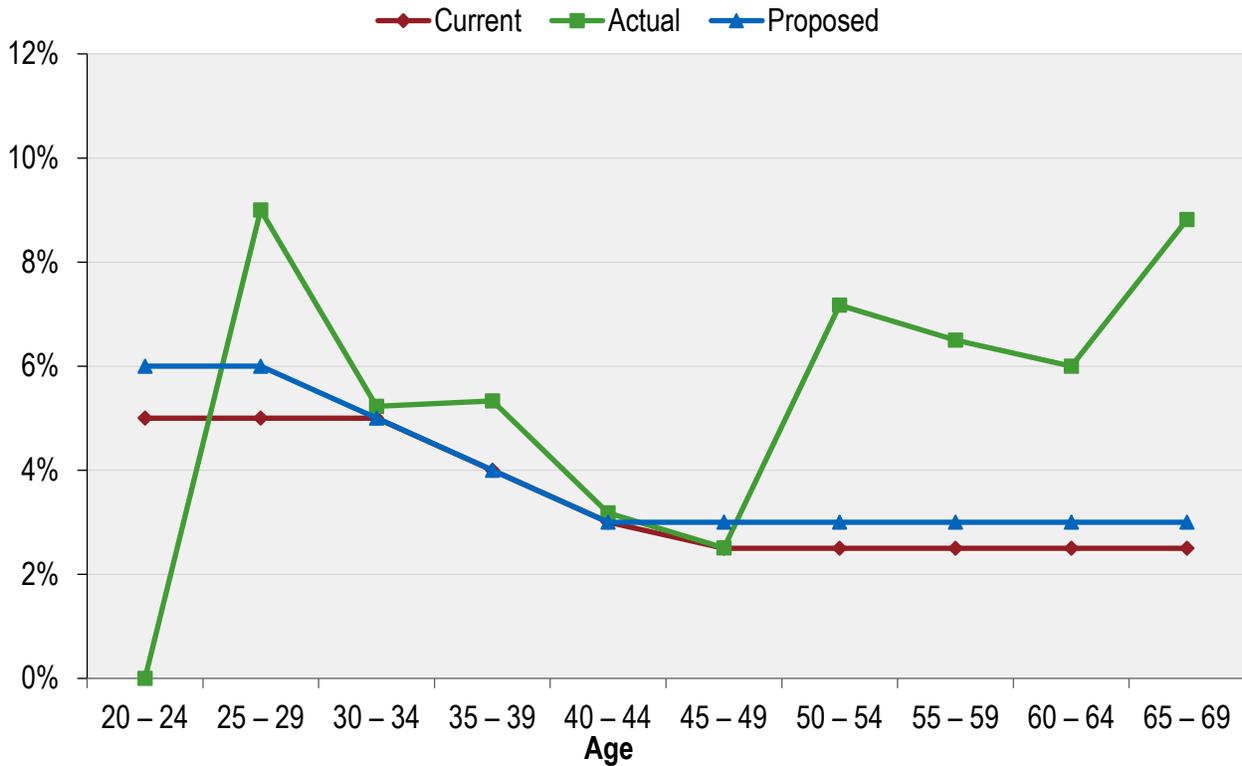
**CHART 20: TERMINATION RATES – SAFETY
FIVE OR MORE YEARS OF SERVICE**
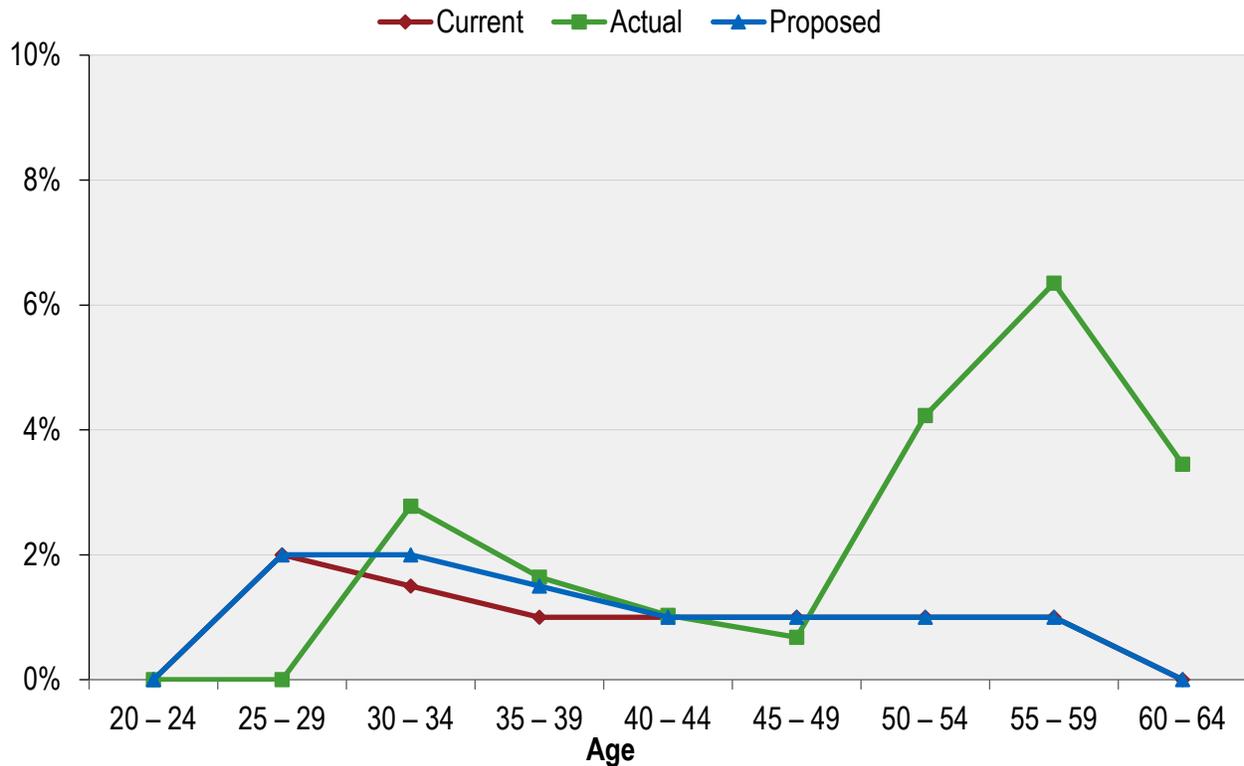
E. Disability Incidence Rates

When a member becomes disabled, he or she may be entitled to either a 50% of pay pension (service connected disability), or a pension that depends upon the member's years of service (non-service connected disability). The following summarizes the actual incidence of combined service and non-service connected disabilities over the past three years compared to the current and proposed assumptions for combined service-connected and non-service connected disability incidence:

Rates of Disability Incidence

Age	Disability Incidence Rate (%)					
	General			Safety		
	Current Rate*	Observed Rate	Proposed Rate*	Current Rate*	Observed Rate	Proposed Rate*
20 – 24	0.00	0.00	0.00	0.00	0.00	0.00
25 – 29	0.01	0.00	0.01	0.05	0.00	0.05
30 – 34	0.05	0.00	0.05	0.35	0.50	0.40
35 – 39	0.10	0.03	0.05	0.45	1.12	0.70
40 – 44	0.15	0.06	0.10	0.50	1.29	0.75
45 – 49	0.25	0.23	0.25	0.75	0.89	0.80
50 – 54	0.35	0.35	0.35	1.75	3.15	2.00
55 – 59	0.40	0.43	0.40	2.00	1.50	2.00
60 – 64	0.45	0.39	0.45	2.25	5.38	3.00
65 – 69	0.50	0.42	0.45	0.00	2.08	0.00

* At central age in the age range shown.

Chart 21 compares the actual number of non-service connected and service connected disabilities over the past three years to that expected under both the current and proposed assumptions. The proposed disability rates were adjusted to reflect the past three years' experience. Note that we have reflected in the observed disability incidences those members whose applications for a disability retirement are pending as of the end date of the experience study. Consistent with the last experience study, we have applied a 75% probability to anticipate the number that will be granted a disability benefit.

Chart 22 shows actual disablement rates, compared to the assumed and proposed rates for General members.

Since 57% of all new disabled General members received a service connected disability, we are recommending that 60% of the proposed disability rates continue to be used to anticipate service connected disability retirement (i.e., this 60% assumption remains unchanged). The remaining 40% of the proposed disability rates will be used to anticipate non-service connected disability.

Chart 23 graphs the same information as Chart 22, but for Safety members.

Since 93% of all new disabled Safety members received a service connected disability, we are recommending that 100% of the proposed disability rates continue to be used to anticipate service connected disability retirement (i.e., this 100% assumption remains unchanged).

CHART 21: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED

November 30, 2013 - 2016
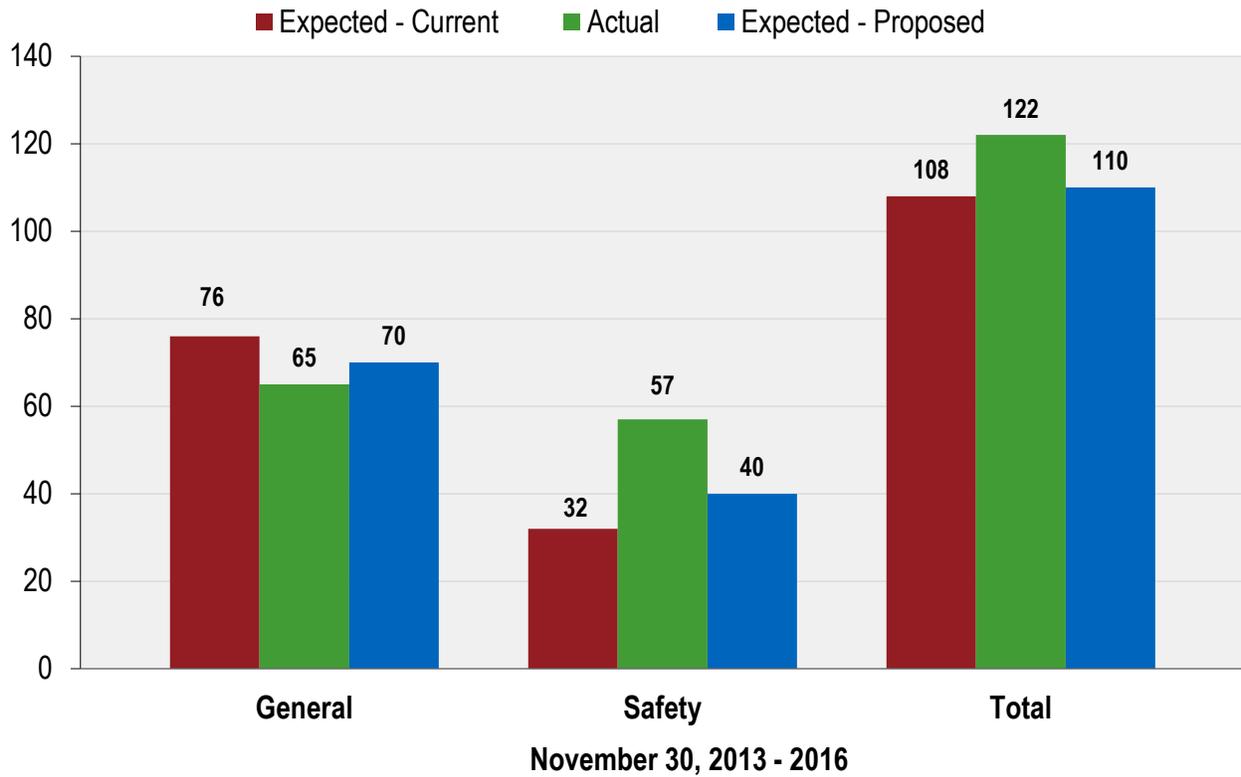
CHART 22: DISABILITY INCIDENCE RATES GENERAL MEMBERS
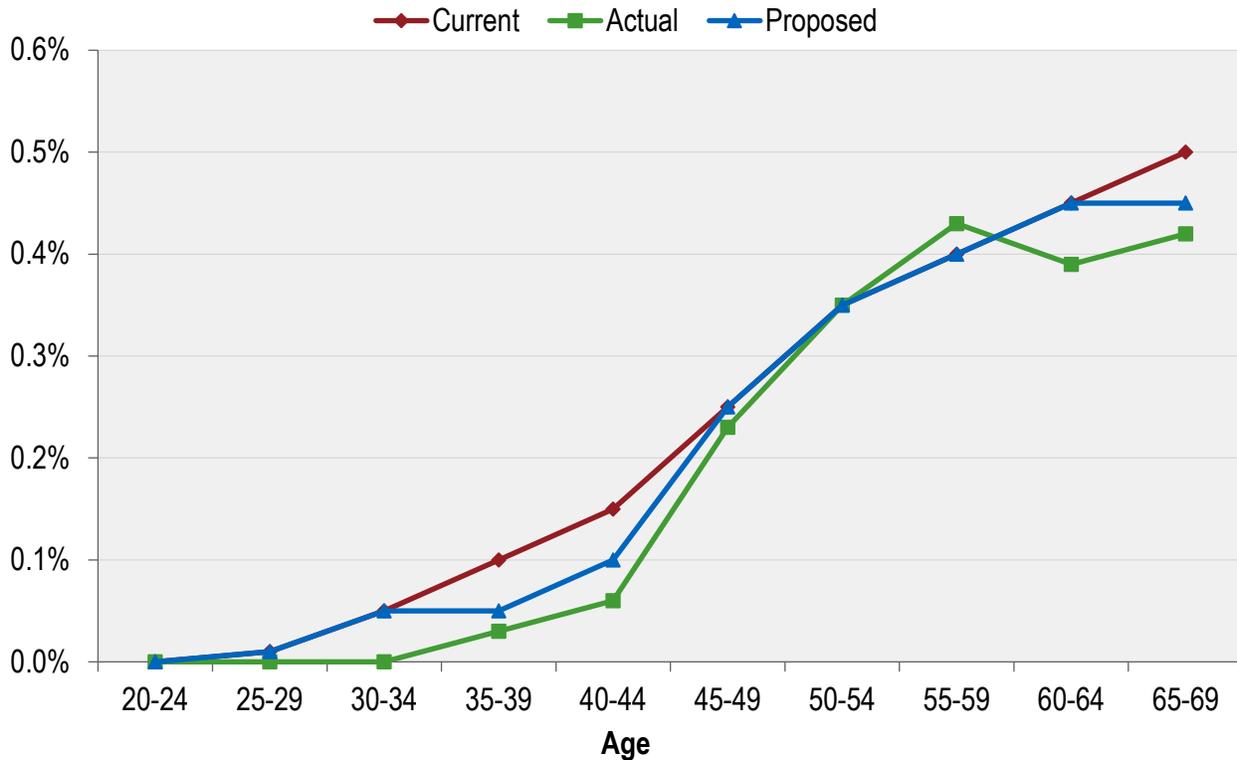
**CHART 23: DISABILITY INCIDENCE RATES
SAFETY MEMBERS**
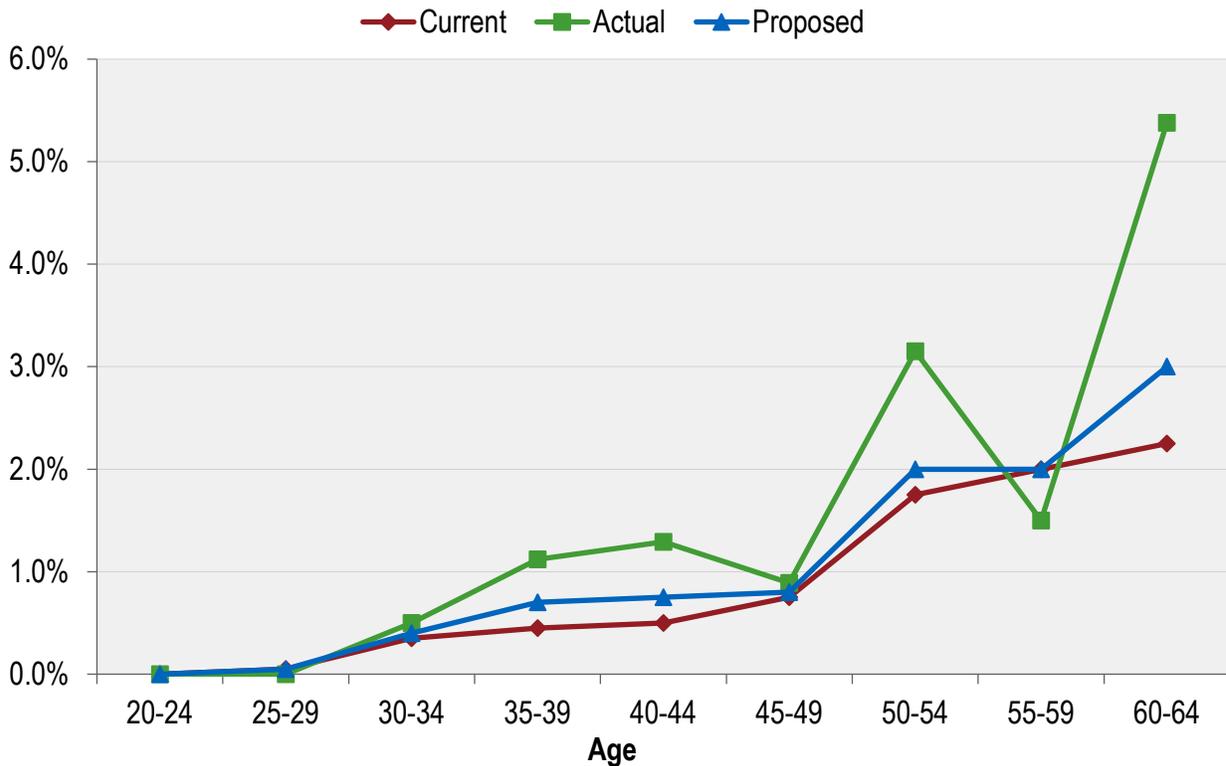
F. Other Assumptions

Survivor Continuance

In prior valuations, it was assumed that 70% of all active male members and 50% of all active female members would have an eligible survivor when they retired. According to the experience of members who retired recently, about 73% of all male members and 48% of all female members were married at retirement. We recommend maintaining this assumption at 70% for male members and 50% for female members.

For members who retired during the last three years, we observed that male retired members were about 3 years older than their female spouses, and female retired members were about 2 years younger than their male spouses. Accordingly, we recommend that we continue to apply an assumption that when active male members retire, female spouses will be 3 years younger than their male member spouses (i.e., no change to the current assumption). However, we recommend that we apply an assumption that when active female members retire, male spouses will be 2 years younger than their female member spouses (i.e., a decrease in the current assumption). Spouses will still be assumed to be of the opposite sex to the member until we have more actual experience concerning domestic partners.

Reciprocity

In prior valuations, it was assumed that 30% of future inactive General and 60% of future inactive Safety deferred vested participants would become members of a reciprocal system and receive 4.15% and 4.45% salary increases, respectively, from termination until their expected date of retirement. Based on the experience reported by the Association during the last three years, on average 28% of General and 60% of Safety members went on to be covered by a reciprocal retirement system. For this experience study, we recommend maintaining the current 30% reciprocity assumption for deferred vested General members and the current 60% reciprocity assumption for deferred vested Safety members.

Based on our recommended merit and longevity salary increase assumptions after 11 years of service of 0.40% and 0.80% for General and Safety, respectively, on the recommended inflation assumption of 3.00%, and on the across-the-board salary increase assumption of 0.50%, we propose that a 3.90% and 4.30% salary increase assumption be used to anticipate salary increases from termination to the expected date of retirement for General and Safety reciprocities, respectively.

Conversion of Unused Sick Leave

The current assumption for converting sick leave into additional service credit at retirement is that for each year of employment, an employee will convert approximately 0.005 years of sick leave into additional service credit at retirement for both General and Safety members. We have observed that the conversion of sick leave for new retirees over each of the last three years has averaged about 0.003 years for each year of employment for General members and about 0.007 years for Safety members. Based on this observed experience, we recommend that the sick leave conversion assumption be decreased from 0.005 to 0.003 years of additional service credit at retirement for each year of employment for General members, and that the assumption be increased from 0.005 to 0.006 years for Safety members.

V. Cost Impact

The table on the following page shows the changes in key valuation results due to the recommended assumption changes, as if they were applied in the December 31, 2016 actuarial valuation. If all of the proposed assumption changes were implemented, the Plan's average employer rate would have increased by 3.46% of compensation, and the average member rate would have increased by 0.64% of compensation, for a total contribution rate increase of 4.10% of payroll. The Plan's Unfunded Actuarial Accrued Liability would have increased by $363.8 million, causing the funded ratio to decrease from 78.1% to 74.8% on a valuation value of assets basis.

Of the various assumption changes, the most significant cost impacts are from the reduction in the investment return assumption from 7.60% to 7.25% per year, and the change in the post-retirement mortality assumptions to reflect longer life expectancies for future retirees. Both of these changes increase costs and liabilities. Of the 4.10% of payroll rate impact, about 3.75% of payroll is due to the recommended investment return assumption, 1.08% of payroll is due to the recommended mortality assumption, and the rest (i.e., a decrease of 0.73% of payroll) is due to the other recommended economic and non-economic assumptions.

Charts 24 through 31 show the member contribution rates from the December 31, 2016 actuarial valuation along with the member rates based on the proposed assumptions.

	Summary of Key Valuation Results as of December 31, 2016 (Dollar amounts in thousands)			
	Current Assumptions		**Proposed Assumptions**	
Employer Contribution Rates:	**Total Rate (%)**	**Estimated Annual Amount[1]**	**Total Rate (%)**	**Estimated Annual Amount[1]**
County Only				
General Tier 1	20.10	$2,663	22.56	$2,981
General Tier 2	19.37	80,221	22.03	91,073
General Tier 4	18.63	20,936	21.37	24,129
Safety Tier 1	68.31	792	76.44	885
Safety Tier 2	53.25	66,320	60.78	75,594
Safety Tier 2C	54.64	1,654	62.36	1,885
Safety Tier 2D	51.11	6,470	58.59	7,415
Safety Tier 4	50.90	11,762	57.74	13,422
County Combined	27.09	190,818	30.88	217,384
AHS, Court & First 5 Only				
General Tier 1	20.81	901	23.27	1,004
General Tier 2	20.08	43,356	22.74	49,020
General Tier 4	19.34	13,514	22.08	15,473
Other Districts				
General Tier 1	26.21	1,203	28.63	1,311
General Tier 2	25.48	86	28.10	94
General Tier 3	26.39	777	29.68	873
General Tier 4 (Housing Authority, Office of Education)	24.74	97	27.44	108
General Tier 4 (LARPD Only)	19.76	199	22.80	231
All Categories Combined	**25.00**	**250,951**	**28.46**	**285,498**

	Total Rate (%)	Estimated Annual Amount[1]	Total Rate (%)	Estimated Annual Amount[1]
Average Member Contribution Rates:	**Total Rate (%)**	**Estimated Annual Amount[1]**	**Total Rate (%)**	**Estimated Annual Amount[1]**
General Tier 1	9.19	$2,036	9.86	$2,180
General Tier 2	7.36	46,398	7.86	49,464
General Tier 3	13.15	387	13.99	412
General Tier 4	8.10	14,876	8.87	16,356
Safety Tier 1	12.22	142	12.88	149
Safety Tier 2	15.04	18,731	15.98	19,875
Safety Tier 2C	12.53	379	13.52	409
Safety Tier 2D	16.32	2,066	17.29	2,188
Safety Tier 4	14.20	3,281	15.96	3,710
All Categories Combined	**8.80**	**88,296**	**9.44**	**94,743**

Funded Status:				
Actuarial Accrued Liability [2]	$8,237,715		$8,601,541	
Valuation Value of Assets (VVA) [3]	$6,436,138		$6,436,138	
Funded Percentage	78.1%		74.8%	
Unfunded Actuarial Accrued Liability (UAAL) based on VVA	$1,801,577		$2,165,403	

[1] Based on projected payroll of $1,003,651,000 under the current assumptions and $1,003,208,000 under the proposed assumptions.

[2] Excludes liabilities held for SRBR and other non-valuation reserves.

[3] Excludes Reserve for Interest Fluctuations (Contingency Reserve) if positive, SRBR, and 401 (h) Reserve.

Chart 24: General Tier 1 Member Contribution Rates

Chart 25: General Tier 2 Member Contribution Rates

Chart 26: General Tier 3 Member Contribution Rates

Chart 27: Safety Tier 1 Member Contribution Rates

Chart 28: Safety Tier 2 Member Contribution Rates

Chart 29: Safety Tier 2C Member Contribution Rates

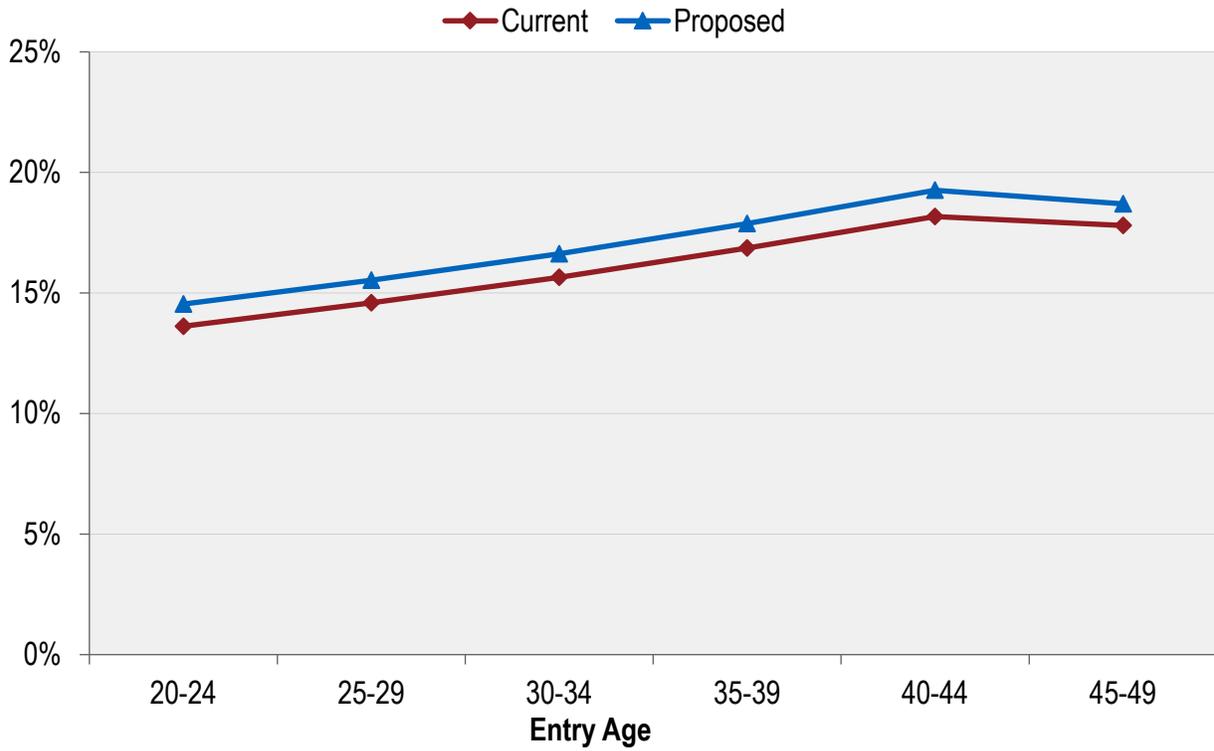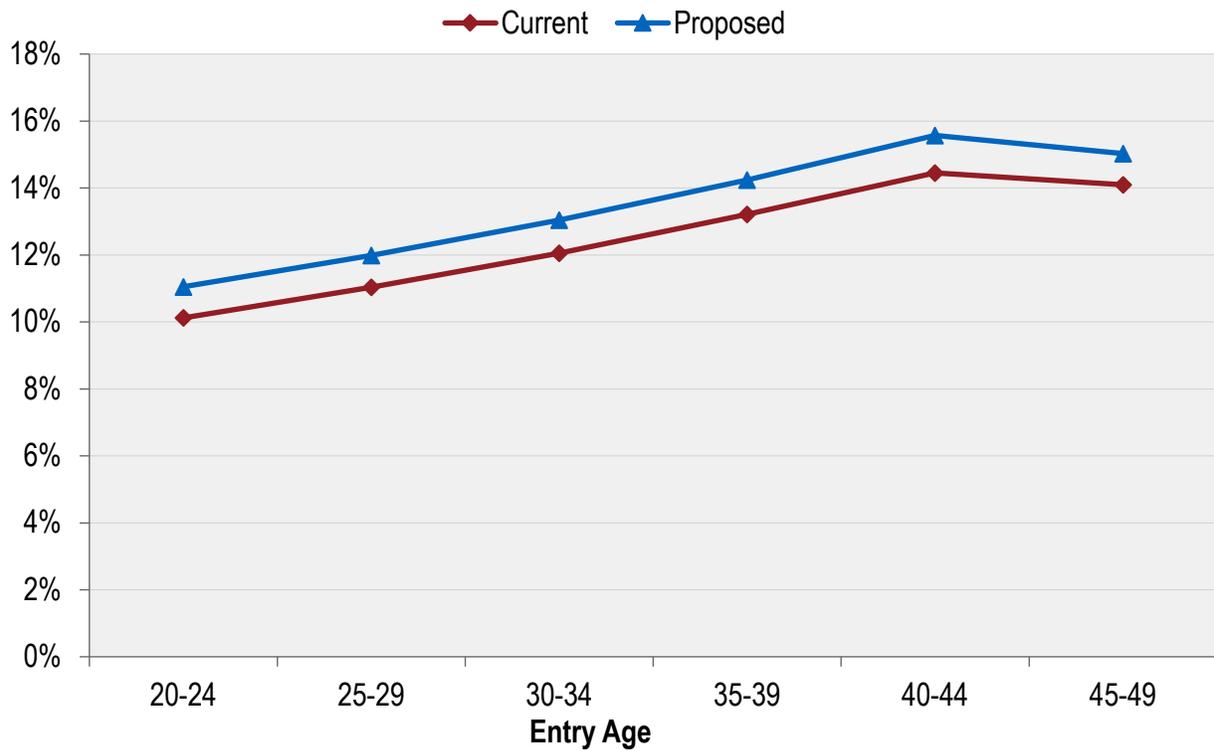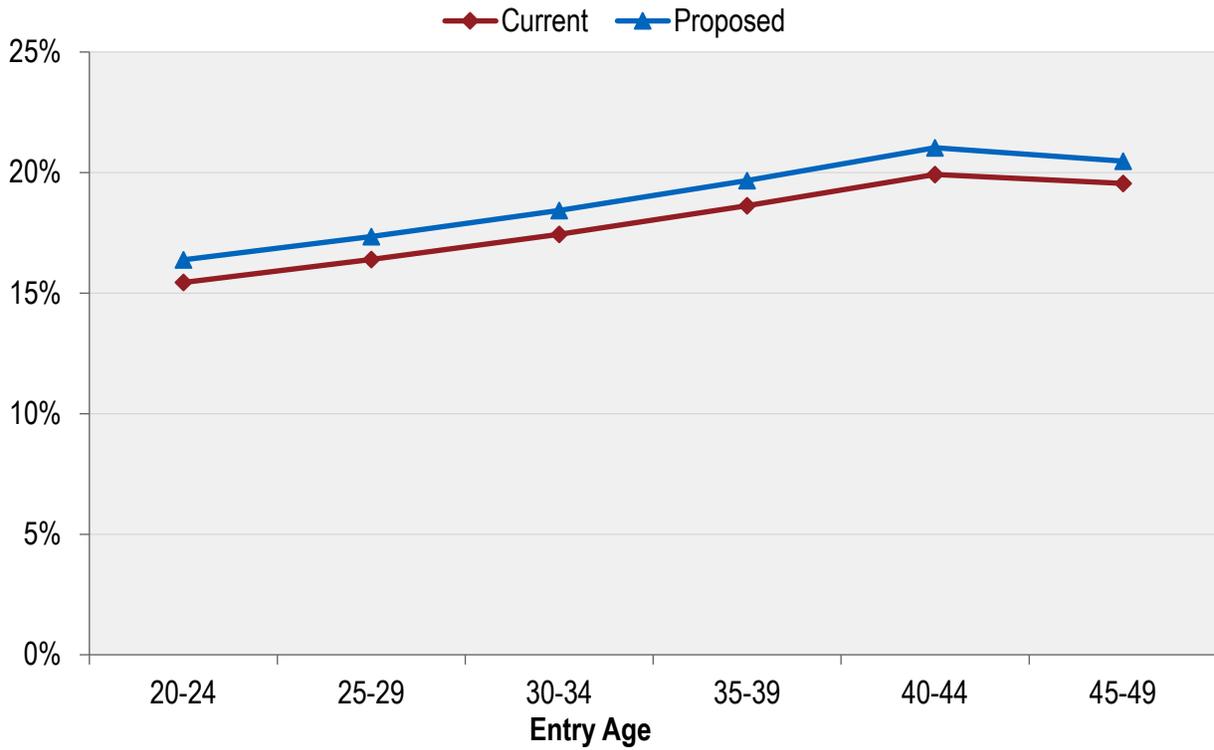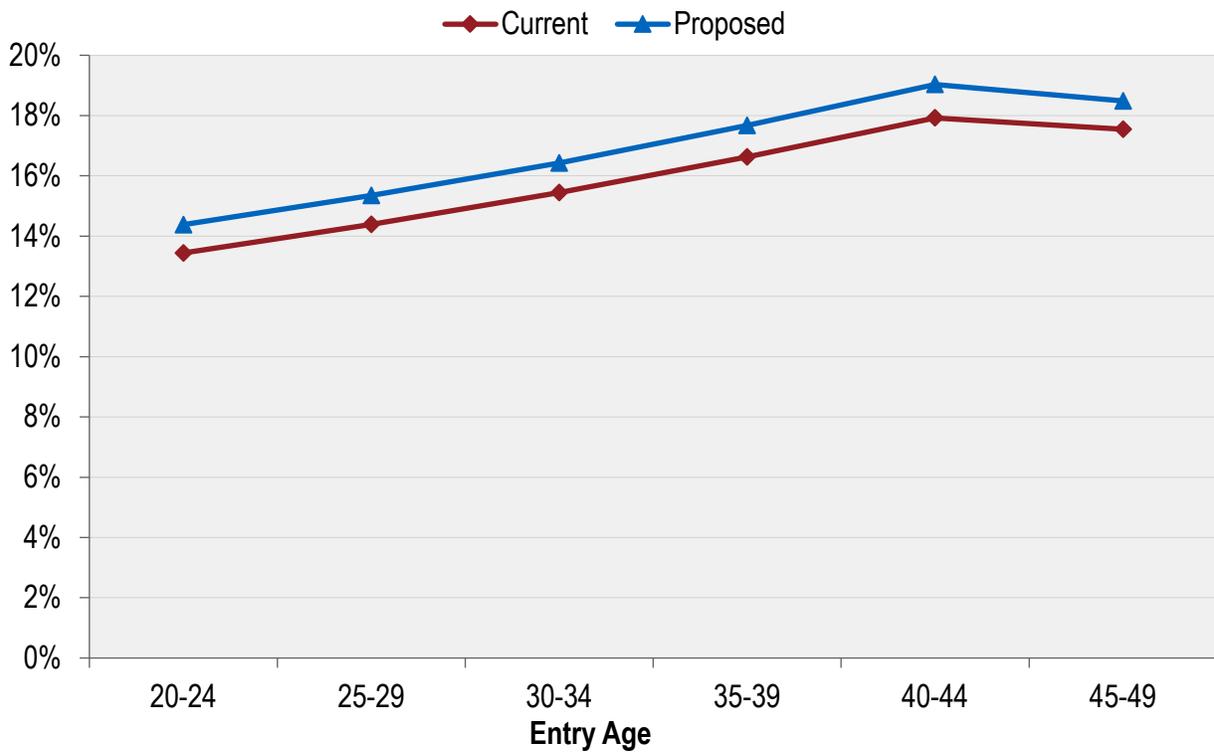## Chart 30: Safety Tier 2D Member Contribution Rates for Members with Less than 5 Years of Vesting Service

Chart 31: Safety Tier 2D Member Contribution Rates for Members 5 or More Years of Vesting Service

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.60%, net of investment and administration expenses.
Employee Contribution Crediting Rate:	7.60%, compounded semi-annually.
Consumer Price Index (CPI):	Increases of 3.25% per year. Retiree COLA increases due to CPI subject to a 3% maximum change per year for General Tier 1, General Tier 3, and Safety Tier 1, and 2% maximum change per year for General Tier 2, General Tier 4, Safety Tier 2, Safety Tier 2C, Safety Tier 2D, and Safety Tier 4.
Payroll Growth:	Inflation of 3.25% per year plus real "across the board" salary increases of 0.50% per year.
Increase in Section 7522.10 Compensation Limit:	Increase of 3.25% per year from valuation date.

Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 3.25%; plus an additional 0.50% for real "across the board" salary increases (other than inflation); plus the following merit and promotional increases:		
Years of Service	**General**	**Safety**
0 – 1	3.70%	6.70%
1 – 2	3.70	6.70
2 – 3	3.20	5.90
3 – 4	2.10	3.80
4 – 5	1.70	3.30
5 – 6	1.40	2.50
6 – 7	1.30	1.40
7 – 8	1.10	0.90
8 – 9	0.70	0.80
9 – 10	0.60	0.80
10 – 11	0.50	0.70
11 or More	0.40	0.70

Terminal Pay Assumptions

	Additional pay elements are expected to be received during a member's final average earnings period. The percentages, added to the final year salary, used in this valuation are:	
	Service Retirement	**Disability Retirement**
General Tier 1	8.0%	6.5%
General Tier 2	3.0%	1.4%
General Tier 3	8.0%	6.5%
General Tier 4	N/A	N/A
Safety Tier 1	8.5%	6.4%
Safety Tier 2	4.0%	2.1%
Safety Tier 2C	4.0%	2.1%
Safety Tier 2D	4.0%	2.1%
Safety Tier 4	N/A	N/A

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

➤ **General Members and All Beneficiaries:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set back one year for males and females.

➤ **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, with no setback for males and set back two years for females.

Post-Retirement Mortality Rates – Disabled

➤ **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward seven years for males and set forward four years for females.

➤ **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward six years for males and set forward three years for females.

The above mortality tables contain a margin of about 10% for General and Safety members and beneficiaries combined, based on actual to expected deaths, as a provision to reflect future mortality improvement, based on a review of mortality experience as of the measurement date.

Employee Contribution Rates

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set back one year for males and females, weighted 30% male and 70% female.

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, with no setback for males and set back two years for females, weighted 75% male and 25% female.

Optional Forms of Benefit

Service Retirement and All Beneficiaries

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set back one year for males and females, weighted 30% male and 70% female.

> **General Beneficiaries:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set back one year for males and females, weighted 70% male and 30% female.

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, with no setback for males and set back two years for females, weighted 75% male and 25% female.

> **Safety Beneficiaries:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set back one year for males and females, weighted 25% male and 75% female.

Disability Retirement

> **General Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward seven years for males and set forward four years for females, weighted 30% male and 70% female.

> **Safety Members:** RP-2000 Combined Healthy Mortality Table projected with Scale BB to 2020, set forward six years for males and set forward three years for females, weighted 75% male and 25% female.

Mortality Rates before Retirement

Age	Rate (%)			
	General		Safety	
	Male	Female	Male	Female
25	0.04	0.02	0.04	0.02
30	0.04	0.02	0.04	0.02
35	0.07	0.04	0.07	0.04
40	0.10	0.06	0.10	0.06
45	0.13	0.10	0.14	0.09
50	0.19	0.15	0.20	0.14
55	0.30	0.22	0.34	0.21
60	0.53	0.37	0.59	0.33
65	0.90	0.68	1.00	0.60

All pre-retirement deaths are assumed to be non-service connected.

Disability Incidence Rates

Age	Rate (%)	
	General[1]	Safety[2]
20	0.00	0.00
25	0.01	0.03
30	0.03	0.23
35	0.08	0.41
40	0.13	0.48
45	0.21	0.65
50	0.31	1.35
55	0.38	1.90
60	0.43	2.15

[1]   *60% of General disabilities are assumed to be service connected disabilities. The other 40% are assumed to be non-service connected disabilities.*

[2]   *100% of Safety disabilities are assumed to be service connected disabilities.*

Termination Rates – Less than Five Years of Service[1]

Years of Service	Rate (%)	
	General	Safety
0	10.00	5.00
1	9.00	4.00
2	7.00	3.00
3	6.00	2.00
4	5.00	1.00

Termination Rates – Five or More Years of Service[2]

Age	Rate (%)	
	General	Safety
20	5.00	2.00
25	5.00	2.00
30	5.00	1.70
35	4.40	1.20
40	3.40	1.00
45	2.70	1.00
50	2.50	1.00
55	2.50	1.00
60	2.50	0.40

[1] *60% of all terminated members will choose a refund of contributions and 40% will choose a deferred vested benefit.*

[2] *40% of all terminated members will choose a refund of contributions and 60% will choose a deferred vested benefit. No termination is assumed after a member is eligible for retirement.*

Retirement Rates

	Rate (%)			
	General			
Age	Tier 1	Tier 2	Tier 3	Tier 4
50	4.00	2.00	6.00	0.00
51	4.00	2.00	3.00	0.00
52	4.00	2.00	5.00	4.00
53	4.00	2.00	6.00	1.50
54	4.00	2.00	6.00	1.50
55	7.00	2.00	12.00	2.50
56	9.00	3.00	13.00	2.50
57	12.00	4.00	13.00	3.50
58	12.00	4.00	14.00	4.50
59	16.00	5.00	16.00	4.50
60	24.00	6.00	21.00	4.50
61	24.00	9.00	20.00	7.50
62	40.00	18.00	30.00	19.00
63	35.00	18.00	25.00	15.00
64	35.00	20.00	25.00	17.00
65	35.00	25.00	30.00	21.00
66	35.00	25.00	25.00	20.00
67	30.00	25.00	25.00	20.00
68	25.00	30.00	25.00	30.00
69	35.00	35.00	50.00	35.00
70	100.00	100.00	100.00	100.00

Retirement Rates (continued)

	Rate (%)			
	Safety			
Age	**Tier 1[1]**	**Tier 2, 2D[1]**	**Tier 2C[1]**	**Tier 4**
50	35.00	15.00	4.00	4.00
51	30.00	15.00	2.00	2.00
52	25.00	15.00	2.00	2.00
53	35.00	15.00	3.00	3.00
54	45.00	15.00	6.00	6.00
55	45.00	15.00	10.00	10.00
56	45.00	20.00	12.00	12.00
57	45.00	25.00	20.00	20.00
58	45.00	25.00	10.00	10.00
59	45.00	25.00	15.00	15.00
60	100.00	30.00	60.00	60.00
61	100.00	30.00	60.00	60.00
62	100.00	30.00	60.00	60.00
63	100.00	30.00	60.00	60.00
64	100.00	100.00	100.00	100.00

[1] *Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.*

Retirement Age and Benefit for Deferred Vested Members:	For deferred vested members, retirement age assumptions are as follows: General Age: 60 Safety Age: 56 For future deferred vested members who terminate with less than five years of service and are not vested, we assume that they will retire at age 70 for both General and Safety if they decide to leave their contributions on deposit. We assume that 30% of future General and 60% of future Safety deferred vested members will continue to work for a reciprocal employer. For reciprocals, we assume 4.15% and 4.45% compensation increases per annum for General and Safety, respectively.
Future Benefit Accruals:	1.0 year of service per year of employment plus 0.005 years of additional service to anticipate conversion of unused sick leave for each year of employment.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Inclusion of Deferred Vested Members:	All deferred vested members are included in the valuation.
Percent Married:	70% of male members; 50% of female members.
Age of Spouse:	Female (or male) spouses are 3 years younger (or older) than their spouses.

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.25%, net of investment and administration expenses.
Employee Contribution Crediting Rate:	7.25%, compounded semi-annually.
Consumer Price Index (CPI):	Increases of 3.00% per year. Retiree COLA increases due to CPI subject to a 3% maximum change per year for General Tier 1, General Tier 3, and Safety Tier 1, and 2% maximum change per year for General Tier 2, General Tier 4, Safety Tier 2, Safety Tier 2C, Safety Tier 2D, and Safety Tier 4.
Payroll Growth:	Inflation of 3.00% per year plus real "across the board" salary increases of 0.50% per year.
Increase in Section 7522.10 Compensation Limit:	Increase of 3.00% per year from valuation date.

Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 3.00%; plus an additional 0.50% for real "across the board" salary increases (other than inflation); plus the following merit and promotional increases:		
Years of Service	**General**	**Safety**
0 – 1	4.80%	7.80%
1 – 2	4.80	7.80
2 – 3	3.90	7.00
3 – 4	2.40	4.40
4 – 5	1.90	3.50
5 – 6	1.60	2.30
6 – 7	1.50	1.60
7 – 8	1.10	1.00
8 – 9	0.80	1.00
9 – 10	0.80	0.90
10 – 11	0.50	0.80
11 or More	0.40	0.80

Terminal Pay Assumptions

Additional pay elements are expected to be received during a member's final average earnings period. The percentages, added to the final year salary, used in this valuation are:		
	Service Retirement	**Disability Retirement**
General Tier 1	8.0%	6.5%
General Tier 2	3.0%	1.4%
General Tier 3	8.0%	6.5%
General Tier 4	N/A	N/A
Safety Tier 1	8.5%	6.4%
Safety Tier 2	3.5%	2.1%
Safety Tier 2C	3.5%	2.1%
Safety Tier 2D	3.5%	2.1%
Safety Tier 4	N/A	N/A

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

➤ **General Members and All Beneficiaries:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Table, with no setback for males and females, projected generationally with the two-dimensional MP-2016 projection scale.

➤ **Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Table, with no setback for males and females, projected generationally with the two-dimensional MP-2016 projection scale.

Post-Retirement Mortality Rates – Disabled

➤ **General Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Table, set forward seven years for males and set forward four years for females, projected generationally with the two-dimensional MP-2016 projection scale,.

➤ **Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Table, set forward two years for males and with no set forward for females, projected generationally with the two-dimensional MP-2016 projection scale.

Pre-Retirement Mortality Rates

➤ **General and Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Employee Mortality Table times 80%, projected generationally with the two-dimensional MP-2016 projection scale.

Employee Contribution Rates

> **General Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 30% male and 70% female.

> **Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 75% male and 25% female.

Optional Forms of Benefit

Service Retirement and All Beneficiaries

> **General Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 30% male and 70% female.

> **General Beneficiaries:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 70% male and 30% female.

> **Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 75% male and 25% female.

> **Safety Beneficiaries:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, with no setback for males and females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 25% male and 75% female.

Disability Retirement

> **General Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, set forward seven years for males and set forward four years for females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 30% male and 70% female.

> **Safety Members:** Headcount-Weighted RP-2014 (RPH-2014) Healthy Annuitant Mortality Tables, set forward two years for males and with no set forward for females, projected 20 years with the two-dimensional mortality improvement Scale MP-2016, weighted 75% male and 25% female.

The RPH-2014 mortality tables and adjustments as shown above reflect the mortality experience as of the measurement date. The generational projection is a provision for future mortality improvement.

Mortality Rates before Retirement[1]

Age	Rate (%)			
	General[2]		Safety[2]	
	Male	Female	Male	Female
25	0.05	0.02	0.05	0.02
30	0.05	0.02	0.05	0.02
35	0.05	0.03	0.05	0.03
40	0.06	0.04	0.06	0.04
45	0.10	0.07	0.10	0.07
50	0.17	0.11	0.17	0.11
55	0.27	0.17	0.27	0.17
60	0.45	0.24	0.45	0.24
65	0.78	0.36	0.78	0.36

[1] *Note that generational projections beyond the base year (2014) are not reflected in the above mortality rates. All pre-retirement deaths are assumed to be non-service connected.*

[2] *Based on the Headcount-Weighted RP-2014 (RPH-2014) Employee Mortality Tables times 80%, projected generationally with the two-dimensional MP-2016 projection scale.*

Disability Incidence Rates

Age	Rate (%)	
	General[1]	Safety[2]
20	0.00	0.00
25	0.01	0.03
30	0.03	0.26
35	0.05	0.58
40	0.08	0.73
45	0.19	0.78
50	0.31	1.52
55	0.38	2.00
60	0.43	2.60

[1] *60% of General disabilities are assumed to be service connected disabilities. The other 40% are assumed to be non-service connected disabilities.*

[2] *100% of Safety disabilities are assumed to be service connected disabilities.*

Termination Rates – Less than Five Years of Service[1]

Years of Service	Rate (%)	
	General	Safety
0	11.00	4.00
1	9.00	3.50
2	8.00	3.50
3	6.00	2.50
4	6.00	2.00

Termination Rates – Five or More Years of Service[2]

Age	Rate (%)	
	General	Safety
20	6.00	2.00
25	6.00	2.00
30	5.40	2.00
35	4.40	1.70
40	3.40	1.20
45	3.00	1.00
50	3.00	1.00
55	3.00	1.00
60	3.00	0.40

[1] *60% of all terminated members will choose a refund of contributions and 40% will choose a deferred vested benefit.*

[2] *35% of all terminated members will choose a refund of contributions and 65% will choose a deferred vested benefit. No termination is assumed after a member is eligible for retirement.*

Retirement Rates

Age	Rate (%) General			
	Tier 1	Tier 2	Tier 3	Tier 4
50	4.00	2.00	6.00	0.00
51	4.00	2.00	3.00	0.00
52	4.00	2.00	5.00	4.00
53	4.00	2.00	6.00	1.50
54	4.00	2.00	6.00	1.50
55	6.00	2.00	12.00	2.00
56	8.00	3.00	13.00	2.50
57	10.00	4.00	13.00	3.50
58	12.00	4.00	14.00	3.50
59	14.00	5.00	16.00	4.50
60	20.00	7.00	21.00	6.00
61	20.00	9.00	20.00	8.00
62	35.00	15.00	30.00	18.00
63	30.00	16.00	25.00	15.00
64	30.00	18.00	25.00	17.00
65	35.00	25.00	30.00	22.00
66	35.00	25.00	25.00	25.00
67	30.00	25.00	25.00	25.00
68	30.00	30.00	25.00	30.00
69	35.00	35.00	50.00	35.00
70	65.00	50.00	65.00	50.00
71	65.00	50.00	65.00	50.00
72	65.00	50.00	65.00	50.00
73	65.00	50.00	65.00	50.00
74	65.00	50.00	65.00	50.00
75	100.00	100.00	100.00	100.00

Retirement Rates (continued)

Age	Rate (%) Safety			
	Tier 1[1]	Tier 2, 2D[1]	Tier 2C[1]	Tier 4
49	0.00	10.00	0.00	0.00
50	35.00	15.00	4.00	4.00
51	30.00	15.00	2.00	2.00
52	25.00	15.00	2.00	2.00
53	35.00	15.00	3.00	3.00
54	45.00	15.00	6.00	6.00
55	45.00	15.00	10.00	10.00
56	45.00	15.00	12.00	12.00
57	45.00	15.00	20.00	20.00
58	45.00	20.00	10.00	10.00
59	45.00	20.00	15.00	15.00
60	45.00	30.00	60.00	60.00
61	45.00	30.00	60.00	60.00
62	45.00	30.00	60.00	60.00
63	45.00	30.00	60.00	60.00
64	45.00	50.00	60.00	60.00
65	100.00	100.00	100.00	100.00

[1] Retirement rate is 100% after a member accrues a benefit of 100% of final average earnings.

Retirement Age and Benefit for Deferred Vested Members:	For deferred vested members, retirement age assumptions are as follows:
	General Age: 61 Safety Age: 56
	For future deferred vested members who terminate with less than five years of service and are not vested, we assume that they will retire at age 70 for both General and Safety if they decide to leave their contributions on deposit.
	We assume that 30% of future General and 60% of future Safety deferred vested members will continue to work for a reciprocal employer. For reciprocals, we assume 3.90% and 4.30% compensation increases per annum for General and Safety, respectively.
Future Benefit Accruals:	1.0 year of service per year of employment, plus 0.003 years of additional service for General members and 0.006 years of additional service for Safety members, to anticipate conversion of unused sick leave for each year of employment.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Inclusion of Deferred Vested Members:	All deferred vested members are included in the valuation.
Percent Married:	70% of male members; 50% of female members.
Age of Spouse:	Female spouses are 3 years younger than their male member spouses. Male spouses are 2 years older than their female member spouses.