Segal Consulting

Contra Costa County Employees' Retirement Association

ACTUARIAL EXPERIENCE STUDY

Analysis of Actuarial Experience
During the Period
January 1, 2015 through December 31, 2017

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April 23, 2019

Board of Retirement
Contra Costa County Employees' Retirement Association
1355 Willow Way, Suite 221
Concord, CA 94520

Re: Review of Actuarial Assumptions for the December 31, 2018 Actuarial Valuation

Dear Members of the Board:

We are pleased to submit this report of our review of the actuarial experience for the Contra Costa County Employees' Retirement Association (CCCERA). This study utilizes the census data for the period January 1, 2015 to December 31, 2017 and provides the proposed actuarial assumptions, both economic and demographic, to be used in the December 31, 2018 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,

Paul Angelo, FSA, MAAA, FCA, EA
Senior Vice President and Actuary

John Monroe, ASA, MAAA, EA
Vice President and 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 plan, 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 modified, 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 means that year's experience is treated as 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 in maintaining adequate funding, while paying the 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 review the economic and demographic actuarial assumptions and to compare the actual experience with that expected under the current assumptions during the three-year experience period from January 1, 2015 through December 31, 2017. 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 merit and promotion salary increases, retirement from active employment, retirement age for deferred vested members, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases, percentage of members with an eligible spouse or domestic partner, pre-retirement mortality, healthy life post-retirement mortality, disabled life post-retirement mortality, beneficiary mortality, termination, disability incidence (service and non-service connected), leave cashouts, and sick leave conversions.

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 COLA increases to retired members.	Maintain the inflation assumption at 2.75% per annum as discussed in Section (III)(A).
9	Investment Return: The estimated average net rate of return on current and future assets of the Association as of the valuation date. This rate is used to discount liabilities.	Maintain the investment return assumption at 7.00% 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 promotion increases	Maintain the current inflationary salary increase assumption at 2.75% 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 remain at 3.25%. Change the merit and promotion increases to those developed in Section (III)(C). Future merit and promotion salary increases are lower for General members with 15 or more years of service and higher for Safety members at most years of service categories under the proposed assumptions.
22	Administrative Expenses: Expenses incurred in connection with the plan's operation.	Maintain the administrative expense load assumption to be equal to the actual administrative expenses for the prior year as a percent of actual payroll for the prior year. Based on the December 31, 2017 valuation, the administrative expense load was 1.13% of payroll.
23	Retirement Rates: The probability of retirement at each age at which participants are eligible to retire. Other Retirement Related Assumptions including: • Retirement age for deferred vested members • Future reciprocal members and reciprocal salary increases • Percent married and spousal age differences for members not yet retired	For active members, adjust the current retirement rates to those developed in Section (IV)(A). For General Tier 1 and 3 Enhanced and Safety Tier A Enhanced we are proposing different sets of age based retirement assumptions for those with less than 30 years of service and for those with 30 or more years of service. The retirement rate assumptions anticipate later retirements overall for both General and Safety members. For deferred vested members, maintain the assumed retirement age at 59 for General members for both with and without reciprocity and reduce the assumed retirement age from 54 to 53 for Safety members with reciprocity and from 54 to 50 for Safety members without reciprocity. Maintain the current proportion of future deferred vested members expected to be covered by a reciprocal system at 40% for General members and increase the assumption from 65% to 70% for Safety members. In addition, reduce the reciprocal salary increase assumption from 4.75% to 3.75% for General members and from 4.75% to 4.25% for Safety members. For active and deferred vested members, reduce the percent married at retirement assumption from 75% to 65% for males and maintain the percent married at retirement assumption at 50% for females. Maintain the spouse age difference assumption that male retirees are three years older than their spouses and female retirees are two years younger than their spouses.

Pg #	Actuarial Assumption Categories	Recommendation
39 48	Mortality Rates: The probability of dying at each age. Mortality rates are used to project life expectancies.	For pre-retirement mortality: Current base table: Headcount-Weighted RP-2014 Employee Mortality Table, multiplied by 75%. Recommended base table for General Members: Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table. Recommended base table for Safety Members: Pub-2010 Safety Employee Amount-Weighted Above-Median Mortality Table. For healthy General retirees: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table. Recommended base table: Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table. For healthy Safety retirees: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table, set back three years. Recommended base table: Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table, multiplied by 105% for males and 100% for females. For all beneficiaries: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table. Recommended base table: Pub-2010 Contingent Survivor Amount-Weighted Above-Median Mortality Table, multiplied by 105%. For disabled General retirees: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table, set forward eight years. Recommended base table: Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table, multiplied by 105% for males and 100% for females. For disabled Safety retirees: Current base table: Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table, set forward three years. Recommended base table: Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table, multiplied by 105% for males and 100% for females. All current tables are projected generationally with the two-dimensional mortality improvement scale MP-2015. All recommended tables are projected generationally with the two-dimensional mortality improvement scale MP-2018. For member contribution rates, optional forms and reserves, change the mortality rates to those developed in Section (IV)(B).
53	Termination Rates: The probability of leaving employment at each age and receiving either a refund of contributions or a deferred vested retirement benefit.	Adjust the current termination rates to those developed in Section (IV)(D). The recommended assumptions will anticipate more terminations for General and Safety members.

Pg #	Actuarial Assumption Categories	Recommendation
57	Disability Incidence Rates: The probability of becoming disabled at each age.	Adjust the current disability rates to those developed in Section (IV)(E). The recommended assumptions will anticipate less disability retirements for General Tiers 3 and 5 and Safety members.
63	Leave Cashouts: Additional pay elements that are expected to be received during the member's final average earnings period.	Adjust the current leave cashout assumptions to those developed in Section (IV)(F). The recommended assumptions will anticipate slightly lower leave cashouts overall.
67	Service from Unused Sick Leave Conversions: Additional service that is expected to be received when the member retires due to conversion of unused sick leave.	Adjust the current service from unused sick leave conversion assumptions to those developed in Section (IV)(G) The recommended assumptions will anticipate less sick leave conversions.

We have estimated the impact of all the recommended demographic and economic assumptions as if they were applied to the December 31, 2017 actuarial valuation. The table below shows the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section IV of this report) and the recommended economic assumption changes (as recommended in Section III of this report).

Cost Impact of the Recommended Assumptions	
Impact on Employer	
Change due to demographic assumptions	-1.14%
Change due to economic assumptions	-0.08%
Total change in average employer rate	-1.22%
Total estimated change in annual dollar amount ($000s)	$(10,187)
Impact on Member	
Change due to demographic assumptions	0.00%
Change due to economic assumptions	0.00%
Total change in average member rate	0.00%
Total estimated change in annual dollar amount ($000s)	$146[1]
Impact on UAAL and Funded Percentage	
Change in UAAL	Decrease of $83 million
Change in funded percentage	From 88.5% to 89.3%

Of the various demographic assumption changes, the most significant cost impact is from the mortality assumption change followed by the retirement assumption change. The only economic assumption change is in the merit and promotion component of the salary increase assumption.

Section II provides some background on the basic principles and methodology used for the experience study and for the review of the economic and demographic actuarial assumptions. A detailed discussion of each assumption 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.

[1] Even though there is no change in the average member rate as a percent of pay, there is an increase in estimated total member contributions in dollars. The increase in estimated contribution dollars is due to larger projected payroll under the recommended assumptions.

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, percent of members assumed to go on to work for a reciprocal system, reciprocal salary increases, leave cashouts and conversion of service from unused sick leave.

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 members and drives increases in the allowances of retired members.

- **Investment Return:** Expected long-term rate of return on the Association's investments after investment 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 "across the board" real pay increases in excess of price inflation. It is also assumed that members will receive raises above these average increases as they advance in their careers. These are commonly referred to as merit and promotion increases. Payments to amortize any Unfunded Actuarial Accrued Liability (UAAL) are assumed to increase each year by the price inflation rate plus any "across the board" real 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 of death 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 it is set using both historical information and long-term forecasts. Following is an analysis of 15 and 30 year moving averages of historical inflation rates:

HISTORICAL CONSUMER PRICE INDEX – 1930 TO 2018[2]
(U.S. City Average - All Urban Consumers)

	25th Percentile	Median	75th Percentile
15-year moving averages	2.4%	3.3%	4.5%
30-year moving averages	2.9%	3.8%	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 178 large public retirement funds[3] in their 2017 fiscal year valuations was 2.75%. In California, CalSTRS and ten 1937 Act CERL systems (including CCCERA) use an inflation assumption of 2.75%, one 1937 Act CERL system uses an inflation assumption of 2.90% and two 1937 Act CERL systems use an inflation assumption of 2.50%. CalPERS recently lowered their inflation assumption from 2.75% to 2.50% over a 3-year period. Seven other 1937 Act CERL systems use an inflation assumption of 3.00%.

CCCERA's investment consultant, Verus, anticipates an annual inflation rate of 1.80% over a 30-year horizon, while the average inflation assumption provided by Verus and six other investment advisory firms retained by Segal's California public sector clients was 2.35%. Note that, in general, investment consultants use a time horizon[4] for this assumption that is shorter than the time horizon of the actuarial valuation.

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2 Source: Bureau of Labor Statistics – Based on CPI for All items in U.S. city average, all urban consumers, not seasonally adjusted (Series Id: CUUR0000SA0)

3 Among 178 large public retirement funds, the inflation assumption was not available for 32 of the public retirement funds in the survey data.

4 The time horizon used by the seven investment consultants included in our review generally ranges from 10 years to 30 years and Verus uses both 10-year or 30-year horizons.

To find a forecast of inflation based on a longer time horizon, we referred to the 2018 report on the financial status of the Social Security program.[5] 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 using an inflation assumption 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.[6] As of March 2019, the difference in yields is about 1.96%, which provides a measure of market expectations of inflation.

Based on all of the above information, we recommend maintaining the current 2.75% annual inflation assumption for the December 31, 2018 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, since 2018 we have been recommending the same 2.75% inflation assumption in our experience studies for our California based public retirement system clients.

Retiree Cost of Living Increases

Consistent with our recommended inflation assumption, we recommend maintaining the current assumptions to value the post-retirement COLA benefit. The current and proposed COLA assumptions are shown below:

Maximum COLA	Current Assumption	Proposed Assumption
2.00%	2.00%	2.00%
3.00%	2.75%	2.75%
4.00%	2.75%	2.75%

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 assumptions.

[5] Source: Social Security Administration – The 2018 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds

[6] Source: Board of Governors of the Federal Reserve System

- Using lower long-term COLA assumptions based on a stochastic analysis would mean that an actuarial loss would occur even when the inflation assumption of 2.75% 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 assumptions. Therefore, we continue to recommend setting the COLA assumptions based on the long-term annual inflation assumption, as we have in prior years.

B. Investment Return

The investment return assumption is comprised of two primary components, inflation and real rate of investment return, with adjustments for 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 association's portfolio will vary with the Board's asset allocation among asset classes.

The following is CCCERA's current target asset allocation along with two sets of 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" 2019 January return assumptions over a 30-year horizon by their assumed 1.80% inflation rate. The second column of returns (except for Global Infrastructure, Private Credit, REIT, Value Add Real Estate, Opportunistic Real Estate, and Risk Parity) represents the average of a sample of real rate of return assumptions. The sample includes the expected annual real rate of return provided to us by Verus and six other investment advisory firms retained by Segal's public sector clients. We believe these averages are a reasonable consensus forecast of long-term future market returns in excess of inflation.

CCCERA'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[7]	Average Assumed Real Rate of Return from a Sample of Consultants to Segal's California Public Sector Clients[8]
Large Cap US Equity	5.00%	5.00%	5.44%
Developed International Equity	13.00%	6.90%	6.54%
Emerging Market Equity	11.00%	8.60%	8.73%
Short-Term Gov't/Credit	23.00%	1.40%	0.84%
US Treasury	3.00%	1.40%	1.05%
Private Equity	8.00%	9.90%	9.27%
Risk Diversifying	7.00%	3.20%	3.53%
Global Infrastructure	3.00%	7.90%	7.90%[9]
Private Credit	12.00%	5.80%	5.80%[9]
REIT	1.00%	6.80%	6.80%[9]
Value Add Real Estate	5.00%	8.80%	8.80%[9]
Opportunistic Real Estate	4.00%	12.00%	12.00%[9]
Risk Parity	5.00%	5.80%	5.80%[9]
Total	**100.00%**	**5.68%**	**5.51%**

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 No. 27, Section 3.6.3.d, which states:

> "Investment Manager Performance - Anticipating superior (or inferior) investment manager performance may be unduly optimistic (or 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 management strategy unless the actuary has reason to believe, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the long term."

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.

[7] Derived by reducing Verus' nominal return assumptions by their 1.80% inflation assumption over a 30-year horizon.

[8] These are based on the projected arithmetic returns provided by Verus and six other investment advisory firms serving the county retirement association of Contra Costa and 16 other city and county retirement systems in California. These return assumptions are gross of any applicable investment expenses.

[9] For these asset classes, Verus' assumptions are 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' assumptions should more closely reflect the underlying investments made specifically for CCCERA.

2. Using a sample average of expected real rate of returns allows the CCCERA's investment return assumption to reflect a broader range of capital market information and should help reduce year to year volatility in the investment return assumption.

3. Therefore, we recommend that the 5.51% portfolio real rate of return be used to determine CCCERA's investment return assumption. This is 0.32% higher than the return that was used three years ago in the review of the recommended investment return assumption for the December 31, 2015 valuation. The difference is due to changes in CCCERA's target asset allocation (0.27%), changes in the real rate of return assumptions provided to us by the investment advisory firms (0.19%) and the interaction effect between these two changes (-0.14%).

Investment Expenses

For funding purposes, the real rate of return assumption for the portfolio needs to be adjusted for investment expenses expected to be paid from investment income. The following table provides the investment expenses in relation to the Actuarial Value of Assets as of the beginning of the year, for the five-year period ending December 31, 2017.

INVESTMENT EXPENSES AS A PERCENTAGE OF ACTUARIAL VALUE OF ASSETS ($ in '000s)

Year Ending December 31	Actuarial Value of Assets[10]	Investment Expenses	Investment %
2013	$5,497,194	$38,158	0.69%
2014	5,922,449	41,600	0.70%
2015	6,572,560	43,059	0.66%
2016	7,151,936	46,328	0.65%
2017	7,622,351	42,865	0.56%
Five-Year Average			**0.65%**
Current Assumption			**0.64%**
Proposed Assumption			**0.65%**

As shown above, we have increased the future expense assumption from 0.64% to 0.65%. This assumption will be re-examined in subsequent assumption reviews as new data becomes available.

Note related to investment expenses paid to active managers – As cited above, under Section 3.6.3.d of ASOP No. 27, the effect of an active investment management strategy can be considered "net of investment expenses" when determining whether "the actuary has reason to believe, based on relevant supporting data, that such superior or inferior returns represent a reasonable expectation over the long term."

It is our understanding that a summary is not available of the investment expenses broken down by active and passive portfolio management expenses. Therefore, we are unable to perform a

[10] As of beginning of plan year.

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.

For this study, we have continued 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 is adjusted to reflect the potential risk of shortfalls in the return assumptions. CCCERA'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] This is consistent with our experience that retirement plan fiduciaries would generally prefer that returns exceed the assumed rate more often than not.

The 5.51% expected real rate of return developed earlier in this report was based on expected mean or average arithmetic returns. In our model, the confidence level associated with a particular risk adjustment represents the relative likelihood that future investment earnings would equal or exceed the assumed earnings over a 15-year period on an expected value basis.[12] 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. 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 55%.

Three years ago, the Board adopted an investment return assumption of 7.00%. That return implied a risk adjustment of 0.30%, reflecting a confidence level of 54% that the actual average return over 15 years would not fall below the assumed return, assuming that the distribution of returns over that period follows the normal statistical distribution.[13]

If we use the same 54% confidence level from our last study to set this year's risk adjustment, based on the current long-term portfolio standard deviation of 10.30% provided by Verus, the corresponding risk adjustment would be 0.28%. Together with the other investment return components, this would result in an investment return assumption of 7.33%, which is 0.33% higher than the current assumption of 7.00%.

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

[12] If a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

[13] Based on an annual portfolio return standard deviation of 10.80% provided by Verus. 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.

Based on the general practice of using one-quarter percentage point increments for economic assumptions, we evaluated the effect on the confidence level of other alternative investment return assumptions. In particular, maintaining the current net investment return assumption of 7.00% would have a risk adjustment of 0.61% which corresponds to a confidence level of 59%.

The table below shows CCCERA's recommended investment return assumption, the risk adjustment and confidence level compared to the historical values for prior studies.

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

Years Ending December 31	Investment Return	Risk Adjustment	Corresponding Confidence Level
2006 – 2008	7.80%	0.86%	60%
2009 – 2011	7.75%	0.41%	55%
2012 – 2014	7.25%	0.25%	53%
2015 – 2017	7.00%[14]	0.30%	54%
2018 (Recommended)	**7.00%[14]**	**0.61%**	**59%**

As we have discussed in prior experience studies, the risk adjustment model and associated confidence level is most useful as a means for comparing how CCCERA has positioned itself relative to risk over periods of time.[15] The use of an expected return with a 59% confidence level under Segal's model 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 59% is above the range of about 50% to 55% confidence levels that correspond to the risk adjustments currently used by most of Segal's other California public retirement system clients. However, it is similar to the confidence levels associated with the assumptions adopted by the Board over 10 years ago in the table above.
- We have not taken into account any additional returns ("alpha") that might be earned on active management. This means that if active management generates enough alpha to cover its related expenses, this would increase returns. This aspect of Segal's model is further evaluated in the next section.

[14] These investment return assumptions are gross of administrative expenses.

[15] 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."

- As with any model, the results of the risk adjustment model should be evaluated for reasonableness and consistency. This is discussed in the later section on "Comparisons with Other Public Retirement Systems".

Taking into account the factors above, we recommend the Board maintain the 7.00% assumption that implies a 0.61% risk adjustment and reflecting a confidence level of 59%.

Recommended Investment Return Assumption

The following table summarizes the components of the investment return assumption developed in the previous discussion. For comparison purposes, we have also included similar values from the last study.

	December 31, 2018	December 31, 2015
Assumption Component	**Recommended**	**Adopted**
Inflation	2.75%	2.75%
Plus Average Real Rate of Return	5.51%	5.19%
Minus Expense Adjustment	(0.65%)	(0.64%)
Minus Risk Adjustment	(0.61%)	(0.30%)
Total	**7.00%**	**7.00%**
Confidence Level	**59%**	**54%**

Based on this analysis, we recommend that the investment return assumption be maintained at 7.00% per annum.

Comparison with Alternative Model used to Review Investment Return Assumption

Since our appointment as actuary for CCCERA in 2003, we have consistently reviewed investment return assumptions based on our model that incorporates expected arithmetic real returns for the different asset classes and for the entire portfolio as one component of that model.[16] The use of "forward looking expected arithmetic returns" is one of the approaches discussed for use in the Selection of Economic Assumptions for Measuring Pension Obligations under Actuarial Standards of Practice (ASOP) No. 27.

Besides using forward looking expected arithmetic returns, ASOP No. 27 also discussed setting investment return assumptions using an alternative "forward looking expected geometric returns" approach.[17] Even though expected geometric returns are lower than expected arithmetic returns, those California public retirement systems that have set investment return assumptions using this alternative approach have in practice adopted investment return assumptions that are comparable to those adopted by the Board for CCCERA. This is because under the model used by those

[16] Again, as discussed in footnote 12, if a retirement system uses the expected arithmetic average return as the discount rate in the funding valuation, that retirement system is expected to have no surplus or asset shortfall relative to its expected obligations assuming all actuarial assumptions are met in the future.

[17] If a retirement system uses the expected geometric average return as the discount rate in the funding valuation, that retirement system is expected to have asset value that generally converges to the median accumulated value as the time horizon lengthens assuming all actuarial assumptions are met in the future.

retirement systems, their investment return assumptions are not reduced to anticipate future investment expenses.[18]

For comparison, we evaluated the 7.00% recommended assumptions based on the expected geometric return for the entire portfolio, gross of the investment expenses. Under that model, over a 20-year period, there is a 61% likelihood that future average geometric returns will meet or exceed 7.00%.[19]

Comparisons with Other Public Retirement Systems

One final test of 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 an investment return assumption of 7.00% or lower is becoming more common among California public sector retirement systems. In particular, ten of the 1937 Act CERL systems (including CCCERA) use a 7.00% investment return assumption with one 1937 Act CERL system at 6.75%. The San Jose and San Diego City retirement systems use investment return assumptions of 6.75% and 6.50%, respectively. Furthermore, the CalPERS Board approved a reduction in the earnings assumption to 7.00% and CalSTRS adopted a 7.00% earnings assumption for the 2017 valuation. Most other public sector retirement systems in California are currently using a 7.25% earnings assumption.

The following table compares CCCERA's recommended net investment return assumption against those of the 178 large public retirement funds[20] in their 2017 fiscal year valuations based on information found in the Public Plans Data website, which is produced in partnership with the NASRA:

		Public Plans Data[21]		
Assumption	**CCCERA**	**Low**	**Median**	**High**
Net Investment Return	7.00%	5.75%	7.50%	8.50%

The detailed data shows that more than two-thirds of the systems have an investment return assumption in the range of 6.75% to 7.50%, and a little less than one-half of those systems (or about one-third overall) have used an assumption of 7.50%. Also, about one-third of the systems 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.

[18] This means that if that model were to be applied to CCCERA, the expected geometric return would not be adjusted for the approximately 0.65% investment expenses paid by CCCERA.

[19] We performed this stochastic simulation using the capital market assumptions included in the 2018 survey prepared by Horizon Actuarial Services. That simulation was performed using 10,000 trial outcomes of future market returns, using assumptions from 20-year arithmetic returns, standard deviations and correlation matrix that were found in the 2018 survey that included responses from 34 investment advisors. In addition, we adjusted the arithmetic returns from this survey for real estate to be more consistent with the real estate classes that are part of CCCERA's target asset allocation.

[20] Among 178 large public retirement funds, the investment return assumption was not available for 25 of the public retirement funds in the survey data.

[21] Public Plans Data website – Produced in partnership with the National Association of State Retirement Administrators (NASRA)

In summary, we believe that the recommended assumption of 7.00% provides for a risk margin within the risk adjustment model that is consistent with CCCERA'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. These two impacts are discussed separately below.

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

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 maintained at 2.75% 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 have averaged about 0.3% - 0.7% 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 June 2018. 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, which is not necessarily based on individual plan experience. However, recent salary experience with public systems in California as well as anecdotal discussions with plans and plan sponsors indicate lower future real wage growth expectations for public sector employees. We also note that for CCCERA's active members, the actual average inflation plus "across the board" increase (i.e., wage inflation) over the three-year period ending December 31, 2017 was 4.41% for General and Safety members combined, which is higher than the change in CPI of 3.66% during that same period:

Valuation Date	Actual Average Increase[22]	Actual Change in CPI[23]
December 31, 2015	1.89%	3.53%
December 31, 2016	3.14%	2.94%
December 31, 2017	8.19%	4.50%
Three-Year Average	**4.41%**	**3.66%**

Considering these factors, we recommend maintaining the real "across the board" salary increase assumption at 0.50%. This means that the combined inflation and "across the board" salary increase assumption will remain at 3.25%.

3. **Merit and Promotion 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 CCCERA, there are service-specific merit and promotion increases.

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

   a. Measuring each continuing member's actual salary increase over each year of the experience period on a salary-weighted basis, with higher weights assigned to experience from members with larger salaries;

   b. Excluding any members with increases of more than 50% or decrease of more than 25% during any particular year;

   c. Categorizing these increases according to member demographics;

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

   e. Averaging these annual increases over the experience period; and

   f. 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 promotion assumptions should be used in combination with the recommended 3.25% assumed inflation and real "across the board" increases.

   Due to the high variability of the actual salary increases, we have analyzed this assumption using the data for the past six years. We believe that when the experience from the current and prior studies is combined into an average result, it provides a more reasonable representation of potential future merit and promotion salary increases over the long-term.

[22] 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.

[23] Based on the change in December CPI for the San Francisco-Oakland-Hayward Area.

The following table shows the General members' actual average merit and promotion increases by years of service over the three-year period from January 1, 2015 through December 31, 2017 along with the actual average increases based on combining the current three-year period with the three-year period from the prior experience study (recalculated on a salary-weighted basis). The current and proposed assumptions are also shown. The actual increases for the most recent three-year period were reduced by the actual average inflation plus "across the board" increase (i.e., wage inflation, estimated as the increase in average salaries) for each year during the current three-year experience period (4.57% on average).

Merit and Promotion Increases – General

	Rate (%)			
Years of Service	Current Assumptions	Actual Average Increase (Last 3 Years)	Actual Average Increases from Current and Prior Study	Proposed Assumption
Less than 1	10.00	18.22	20.18	12.00
1 – 2	7.25	5.84	6.36	7.00
2 – 3	5.25	4.44	4.97	5.25
3 – 4	3.75	3.12	3.60	3.75
4 – 5	2.75	1.09	2.26	2.75
5 – 6	2.25	1.25	2.44	2.25
6 – 7	1.75	1.05	2.12	1.75
7 – 8	1.50	1.62	1.95	1.50
8 – 9	1.25	0.48	1.17	1.40
9 – 10	1.20	0.71	1.46	1.30
10 – 11	1.15	0.42	1.69	1.20
11 – 12	1.10	-0.12	0.89	1.10
12 – 13	1.00	0.40	1.21	1.00
13 – 14	0.90	-0.13	0.70	0.90
14 – 15	0.80	-0.10	0.65	0.80
15 – 16	0.75	-0.31	0.62	0.75
16 – 17	0.75	-0.77	-0.02	0.70
17 – 18	0.75	-0.24	0.30	0.65
18 – 19	0.75	-0.38	0.22	0.60
19 – 20	0.75	-0.64	0.26	0.55
20 & Over	0.75	-0.57	0.21	0.50

The following table provides the same information for Safety members. The actual average merit and promotion increases were determined by reducing the actual average total salary increases by the actual average inflation plus real "across the board" increase (i.e., wage inflation, estimated as the increase in average salaries) for each year during the current three-year experience period (4.00% on average).

Merit and Promotion Increases – Safety

	Rate (%)			
Years of Service	Current Assumptions	Actual Average Increase (Last 3 Years)	Actual Average Increases from Current and Prior Study	Proposed Assumption
Less than 1	10.50	23.86	24.14	13.00
1 – 2	7.25	9.12	8.48	8.00
2 – 3	5.75	5.26	5.76	5.75
3 – 4	4.50	5.12	5.10	4.75
4 – 5	3.00	2.76	2.57	2.75
5 – 6	1.75	1.22	2.11	2.00
6 – 7	1.25	1.72	1.99	1.75
7 – 8	1.20	1.07	1.37	1.50
8 – 9	1.15	1.17	1.44	1.40
9 – 10	1.10	1.17	1.55	1.30
10 – 11	1.05	0.85	1.27	1.25
11 – 12	1.00	0.73	1.67	1.20
12 – 13	0.95	0.93	1.48	1.15
13 – 14	0.85	0.90	1.50	1.10
14 – 15	0.80	2.02	2.43	1.05
15 – 16	0.75	1.73	2.24	1.00
16 – 17	0.75	0.75	1.17	1.00
17 – 18	0.75	0.58	1.01	1.00
18 – 19	0.75	1.83	1.82	1.00
19 – 20	0.75	1.50	1.96	1.00
20 & Over	0.75	1.47	2.04	1.00

Chart 1 compares actual experience with the current and proposed rates of actual merit and promotion increases for General members. Also shown is the actual merit and promotion increases based on an average of both the current and previous three-year experience periods.

Chart 2 compares actual experience with the current and proposed rates of actual merit and promotion increases for Safety members. Also shown is the actual merit and promotion increases based on an average of both the current and previous three-year experience periods.

Based on this experience, we are recommending increases in the merit and promotion salary increase assumption for a few of the years of service categories for General members with less than 11 years of service. Decreases are being recommended for General members with 15 or more years of service. For Safety members, increases are being recommended for most years of service categories.

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 promotion increases are not an influence, because this average pay is not specific to an individual.

Under the Board's current practice, the UAAL contribution rate is developed by assuming that the total payroll for all active members will increase annually over the amortization periods at the same assumed rates of inflation plus real "across the board" salary increase assumptions as are used to project the member's future benefits.

We recommend that the active member payroll increase assumption be maintained at 3.25% annually, consistent with the combined inflation plus real "across the board" salary increase assumptions.

CHART 1: MERIT AND PROMOTION SALARY INCREASE RATES
GENERAL MEMBERS

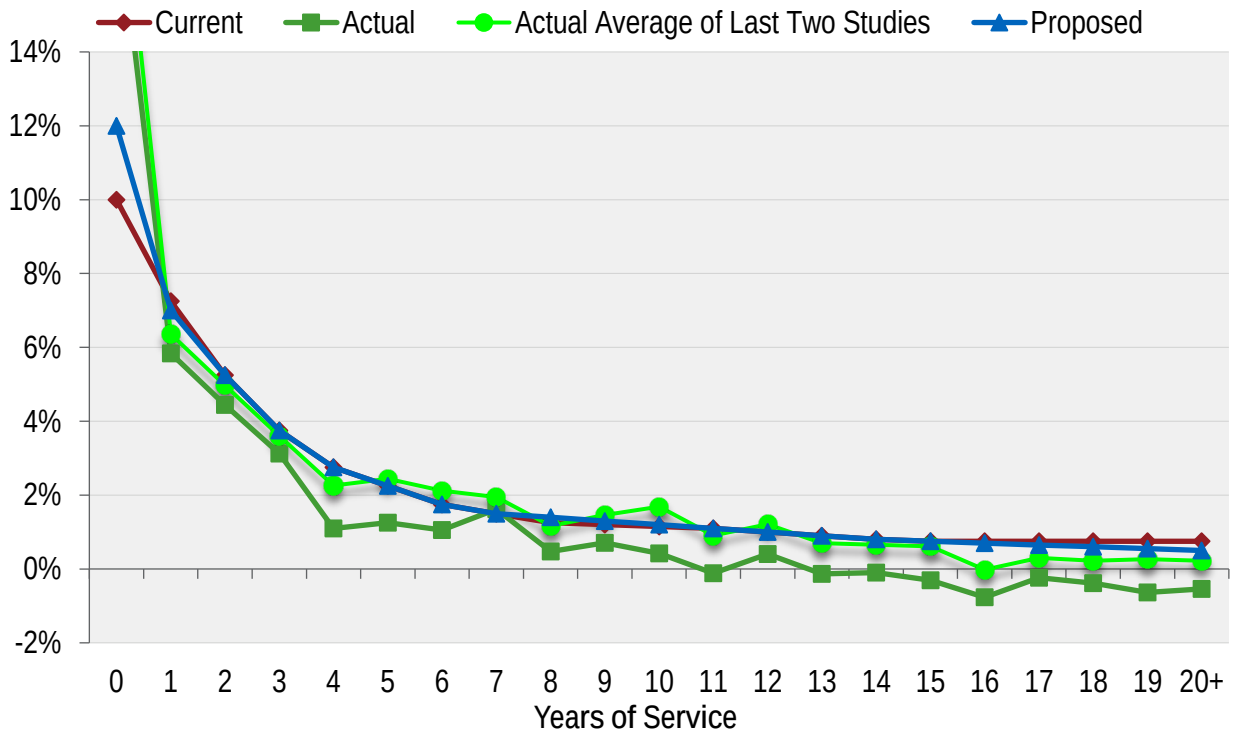
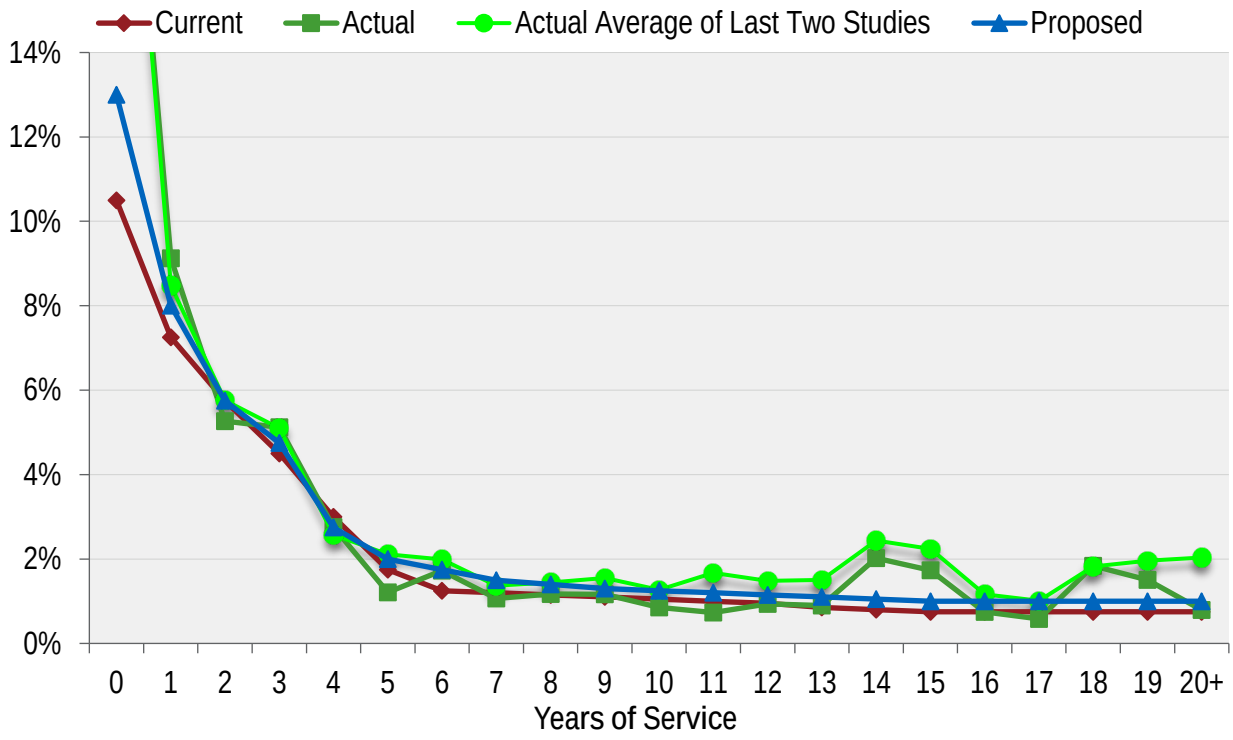


CHART 2: MERIT AND PROMOTION SALARY INCREASE RATES
SAFETY MEMBERS



D. Administrative Expenses

Like benefit payments made to members, expenses incurred in connection with the plan's operation are paid from CCCERA's assets. These expenses include fees for administrative, legal, accounting, and actuarial services, as well as routine costs for printing, mailings, computer-related activities, and other functions carried out by the plan. They do not include investment-related expenses.

In order to reflect future administrative expenses in the contribution rates, a load is calculated based on actual administrative expenses as a percentage of payroll. It is allocated to both the employer and the member based on normal cost (before expenses) for the employer and the member. This assumption changes each year based on actual administrative expenses and payroll.

The following table shows actual administrative expenses as a percent of payroll:

Administrative Expenses as a Percentage of Payroll			
Year Ending December 31,	**Actual Payroll for Year**	**Actual Administrative Expenses**	**Total %**
2015	$709,818,858	$8,115,359	1.14%
2016	755,138,882	8,486,463	1.12%
2017	809,960,088	9,146,115	1.13%
Average	**$758,305,943**	**$8,582,646**	**1.13%**

The experience shows that actual administrative expenses when expressed as a percent of payroll have been stable during the three-year period shown above.

We recommend maintaining the practice of setting the administrative expense assumption to be equal to the actual administrative expenses for the prior year as a percent of payroll for the prior year (i.e., 1.13% based on the December 31, 2017 valuation).

There will still be actuarial gains and losses associated with this assumption, however, it will adjust to the most recent experience in each valuation.

IV. Demographic Assumptions

A. Retirement Rates

The age at which a member retires from service (i.e., does not retire 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.

Currently, the assumed retirement rates are a function of only member's age. Our experience review analyzed recent years' retirement experience both as a function of age and years of service in relation to the probability of retirement. Our review concludes that the retirement rates correlate both with age and with years of service for General Tier 1 Enhanced, General Tier 3 Enhanced and Safety Tier A Enhanced.

As a result of this observation, we recommend that retirement rates be structured as a function of both age and years of service for General Tier 1 Enhanced, General Tier 3 Enhanced and Safety Tier A Enhanced. The new structure of retirement assumptions will apply different sets of age based retirement assumptions for those with less than 30 years of service and to those with more than 30 years of service. Due to the limited experience for General Tier 1 Non-Enhanced, Safety Tier C Enhanced, Safety Tier A Non-Enhanced, as well as the General PEPRA Tiers 4 and 5 and Safety PEPRA Tiers D and E, we continue to recommend retirement rates as a function of age only for those tiers.

The tables on the following pages show the observed service retirement rates for members of General Tier 1 Enhanced, General Tier 3 Enhanced, General Tier 1 Non-Enhanced and Safety Tier A Enhanced based on the actual experience over the past three years. As noted in the tables below, for some tiers we have used a six-year period to capture more experience. 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.

Even though there were no actual retirements from General PEPRA Tiers 4 and 5, Safety Tier C Enhanced, Safety Tier A Non-Enhanced, and Safety PEPRA Tiers D and E, we are nonetheless recommending changes at some ages to commensurate with the changes we are recommending for the other Tiers.

General Tier 1 Enhanced

Age	Rate of Retirement (%)					
	Less than 30 Years of Service			30 or More Years of Service		
	Current Rate	Actual Rate*	Proposed Rate	Current Rate	Actual Rate*	Proposed Rate
50	5.00	4.17	5.00	5.00	0.00	9.00
51	4.00	0.90	4.00	4.00	11.11	7.20
52	5.00	3.64	4.00	5.00	10.00	7.20
53	5.00	1.92	4.00	5.00	8.33	7.20
54	14.00	10.00	12.00	14.00	23.81	21.60
55	20.00	13.89	15.00	20.00	34.62	27.00
56	20.00	16.67	17.00	20.00	16.67	30.60
57	20.00	16.30	17.00	20.00	34.78	30.60
58	20.00	10.13	17.00	20.00	0.00	30.60
59	25.00	20.00	22.00	25.00	32.00	26.40
60	28.00	7.94	25.00	28.00	33.33	30.00
61	35.00	25.86	30.00	35.00	50.00	36.00
62	35.00	26.19	30.00	35.00	33.33	36.00
63	30.00	20.59	25.00	30.00	10.00	30.00
64	30.00	15.15	25.00	30.00	0.00	30.00
65	35.00	33.33	35.00	35.00	0.00	35.00
66	40.00	38.89	40.00	40.00	0.00	40.00
67	40.00	36.36	40.00	40.00	N/A	40.00
68	40.00	57.14	40.00	40.00	N/A	40.00
69	40.00	20.00	40.00	40.00	N/A	40.00
70	50.00	25.00	35.00	50.00	100.00	35.00
71	50.00	0.00	35.00	50.00	N/A	35.00
72	50.00	0.00	35.00	50.00	N/A	35.00
73	50.00	50.00	35.00	50.00	N/A	35.00
74	50.00	0.00	35.00	50.00	N/A	35.00
75 & Over	100.00	12.50	100.00	100.00	N/A	100.00

**Actual rates shown are based on six years of data.*

Note that we first developed a base set of proposed retirement rates for General Tier 1 Enhanced members with less than 30 years of service. Then, the proposed retirement rates for General Tier 1 Enhanced members with 30 or more years of service are set to a percentage of the base rates as follows: 180% for ages less than 59; 120% for ages 59 to 64 and 100% for ages 65 and over.

As shown above, we are recommending overall decreases in the retirement rates for General Tier 1 Enhanced members with less than 30 years of service and recommending overall increases in the retirement rates at most of the early ages for General Tier 1 Enhanced members with 30 or more years of service. The net result of these recommendations is for later retirements.

Chart 3 that follows later in this section compares actual experience with the current and proposed rates of retirement for General Tier 1 Enhanced members with less than 30 years of service.

Chart 4 compares actual experience with the current and proposed rates of retirement for General Tier 1 Enhanced members with 30 or more years of service.

General Tier 3 Enhanced

	Rate of Retirement (%)					
	Less than 30 Years of Service			30 or More Years of Service		
Age	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
50	4.00	3.79	4.00	4.00	15.79	7.20
51	3.00	2.54	3.00	3.00	9.09	5.40
52	3.00	2.90	3.00	3.00	3.13	5.40
53	5.00	3.57	4.00	5.00	8.16	7.20
54	6.00	6.31	6.00	6.00	7.84	10.80
55	10.00	8.68	8.00	10.00	17.54	14.40
56	10.00	6.90	8.00	10.00	10.87	9.60
57	10.00	7.75	9.00	10.00	7.84	10.80
58	12.00	8.14	10.00	12.00	17.02	12.00
59	13.00	11.62	12.00	13.00	14.00	14.40
60	15.00	9.83	13.00	15.00	10.64	15.60
61	20.00	15.28	18.00	20.00	25.00	21.60
62	25.00	21.59	22.00	25.00	28.00	26.40
63	25.00	20.56	22.00	25.00	42.11	26.40
64	30.00	23.10	25.00	30.00	16.67	30.00
65	35.00	31.94	32.00	35.00	40.00	32.00
66	35.00	32.45	32.00	35.00	22.22	32.00
67	35.00	29.46	30.00	35.00	0.00	30.00
68	35.00	25.93	30.00	35.00	0.00	30.00
69	35.00	22.86	30.00	35.00	33.33	30.00
70	40.00	35.71	35.00	40.00	0.00	35.00
71	40.00	26.09	35.00	40.00	0.00	35.00
72	40.00	16.13	35.00	40.00	0.00	35.00
73	40.00	15.38	35.00	40.00	0.00	35.00
74	40.00	15.79	35.00	40.00	N/A	35.00
75 & Over	100.00	19.44	100.00	100.00	N/A	100.00

**Actual rates shown are based on six years of data.*

Note that we first developed a base set of proposed retirement rates for General Tier 3 Enhanced members with less than 30 years of service. Then, the proposed retirement rates for General Tier 3 Enhanced members with 30 or more years of service are set to a percentage of the base

rates as follows: 180% for ages less than 56; 120% for ages 56 to 64 and 100% for ages 65 and over.

As shown above, we are recommending overall decreases in the retirement rates for General Tier 3 Enhanced members with less than 30 years of service and recommending overall increases in the retirement rates at most of the early ages for General Tier 3 Enhanced members with 30 or more years of service. The net result of these recommendations is for later retirements.

Chart 5 compares actual experience with the current and proposed rates of retirement for General Tier 3 Enhanced members with less than 30 years of service.

Chart 6 compares actual experience with the current and proposed rates of retirement for General Tier 3 Enhanced members with 30 or more years of service.

Safety Tier A Enhanced

	Rate of Retirement (%)					
	Less than 30 Years of Service			30 or More Years of Service		
Age	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
45	4.00	8.75	7.00	4.00	N/A	8.75
46	3.00	2.68	3.00	3.00	N/A	3.75
47	10.00	9.49	10.00	10.00	0.00	12.50
48	10.00	8.11	10.00	10.00	0.00	12.50
49	25.00	25.00	25.00	25.00	66.67	31.25
50	30.00	22.47	25.00	30.00	100.00	31.25
51	30.00	22.29	25.00	30.00	0.00	31.25
52	25.00	13.33	18.00	25.00	11.11	22.50
53	25.00	16.85	18.00	25.00	16.67	22.50
54	25.00	13.24	18.00	25.00	25.00	22.50
55	28.00	14.00	20.00	28.00	50.00	30.00
56	25.00	2.44	20.00	25.00	25.00	30.00
57	25.00	16.13	22.00	25.00	25.00	33.00
58	35.00	16.67	22.00	35.00	66.67	33.00
59	35.00	9.52	22.00	35.00	N/A	33.00
60	35.00	21.74	25.00	35.00	33.33	37.50
61	35.00	12.50	25.00	35.00	33.33	37.50
62	35.00	23.53	25.00	35.00	0.00	37.50
63	35.00	8.33	30.00	35.00	50.00	45.00
64	50.00	37.50	40.00	50.00	50.00	60.00
65 & Over	100.00	53.33	100.00	100.00	100.00	100.00

**Actual rates shown are based on six years of data.*

Note that we first developed a base set of proposed retirement rates for Safety Tier A Enhanced members with less than 30 years of service. Then, the proposed retirement rates for Safety Tier A

Enhanced members with 30 or more years of service are set to a percentage of the base rates as follows: 125% for ages less than 55; and 100% for ages 55 and over.

As shown above, we are recommending overall decreases in the retirement rates for Safety Tier A Enhanced members with less than 30 years of service and recommending overall increases in the retirement rates for Safety Tier A Enhanced members with 30 or more years of service. The net result of these recommendations is for later retirements.

Chart 7 compares actual experience with the current and proposed rates of retirement for Safety Tier A Enhanced members with less than 30 years of service.

Chart 8 compares actual experience with the current and proposed rates of retirement for Safety Tier A Enhanced members with 30 or more years of service.

Safety Tier C Enhanced

	Rate of Retirement (%)	
Age	Current Rate	Proposed Rate
45	2.00	2.00
46	1.00	1.00
47	4.00	4.00
48	4.00	4.00
49	12.00	12.00
50	18.00	18.00
51	18.00	18.00
52	15.00	15.00
53	15.00	15.00
54	15.00	15.00
55	18.00	18.00
56	15.00	15.00
57	15.00	15.00
58	25.00	25.00
59	25.00	25.00
60	30.00	25.00
61	30.00	25.00
62	30.00	25.00
63	30.00	30.00
64	40.00	35.00
65 & Over	100.00	100.00

Only a relatively small closed group of members is covered by the Safety Tier C Enhanced formula. There were no actual retirements during this period for members in this tier. We have based our recommended rates on a combination of the current assumption used for Safety Tier C Enhanced and some of the proposed changes in rates for Safety Tier A Enhanced members.

As shown above, we are recommending decreases in some of the retirement rates for Safety Tier C Enhanced members.

Chart 9 compares the current and proposed rates of retirement for Safety Tier C Enhanced members.

General Tier 1 Non-Enhanced

	Rate of Retirement (%)		
Age	Current Rate	Actual Rate	Proposed Rate
50	3.00	N/A	3.00
51	3.00	N/A	3.00
52	3.00	N/A	3.00
53	3.00	N/A	3.00
54	3.00	N/A	3.00
55	10.00	N/A	10.00
56	10.00	N/A	10.00
57	10.00	N/A	10.00
58	10.00	N/A	10.00
59	10.00	N/A	10.00
60	25.00	N/A	25.00
61	15.00	N/A	15.00
62	40.00	N/A	40.00
63	35.00	N/A	35.00
64	30.00	N/A	30.00
65	40.00	100.00	40.00
66	35.00	N/A	35.00
67	35.00	N/A	35.00
68	35.00	N/A	35.00
69	35.00	N/A	35.00
70	50.00	N/A	40.00
71	50.00	N/A	40.00
72	50.00	N/A	40.00
73	50.00	N/A	50.00
74	50.00	N/A	50.00
75 & Over	100.00	N/A	100.00

Only a very small group of members is covered by the General Tier 1 Non-Enhanced formula.

As shown above, we are recommending decreases in some of the retirement rates for General Tier 1 Non-Enhanced members.

Chart 10 compares actual experience with the current and proposed rates of retirement for General Tier 1 Non-Enhanced members.

Safety Tier A Non-Enhanced

	Rate of Retirement (%)	
Age	Current Rate	Proposed Rate
45	0.00	0.00
46	0.00	0.00
47	0.00	0.00
48	0.00	0.00
49	0.00	0.00
50	5.00	5.00
51	4.00	4.00
52	4.00	4.00
53	5.00	5.00
54	8.00	6.00
55	10.00	10.00
56	10.00	10.00
57	12.00	18.00
58	18.00	18.00
59	20.00	18.00
60	20.00	18.00
61	20.00	20.00
62	20.00	20.00
63	20.00	20.00
64	100.00	25.00
65	100.00	100.00
66 & Over	100.00	100.00

Only a very small group of members is covered by the Safety Tier A Non-Enhanced formula. There were no actual retirements during this period for members in this tier. We have set our recommended rates equal to the proposed rates for Safety PEPRA members since these two tiers have very similar benefit formulas.

As shown above, we are recommending changes in the retirement rates for Safety Tier A Non-Enhanced members.

Chart 11 compares the current and proposed rates of retirement for Safety Tier A Non-Enhanced members.

General PEPRA Tiers 4 and 5 and Safety PEPRA Tiers D and E

	Rate of Retirement (%)			
	General PEPRA Tiers 4 and 5		Safety PEPRA Tiers D and E	
Age	Current Rate	Proposed Rate	Current Rate	Proposed Rate
50	0.00	0.00	5.00	5.00
51	0.00	0.00	4.00	4.00
52	2.00	2.00	4.00	4.00
53	3.00	3.00	5.00	5.00
54	3.00	3.00	6.00	6.00
55	5.00	5.00	10.00	10.00
56	5.00	5.00	10.00	10.00
57	6.00	6.00	18.00	18.00
58	8.00	6.00	18.00	18.00
59	9.00	8.00	18.00	18.00
60	10.00	8.00	18.00	18.00
61	14.00	12.00	20.00	20.00
62	20.00	18.00	20.00	20.00
63	20.00	18.00	20.00	20.00
64	20.00	20.00	30.00	25.00
65	25.00	25.00	30.00	100.00
66	30.00	25.00	100.00	100.00
67	30.00	25.00	100.00	100.00
68	30.00	25.00	100.00	100.00
69	30.00	25.00	100.00	100.00
70	50.00	40.00	100.00	100.00
71	50.00	40.00	100.00	100.00
72	50.00	40.00	100.00	100.00
73	50.00	40.00	100.00	100.00
74	50.00	40.00	100.00	100.00
75 & Over	100.00	100.00	100.00	100.00

There were no actual retirements during this period for members in these tiers. We have based our recommended rates on a combination of the current assumptions used for these tiers and some of the proposed changes in rates for the legacy (non-PEPRA) tiers.

As shown above, we are recommending overall decreases in retirement rates for General PEPRA Tiers 4 and 5 and Safety PEPRA Tiers D and E members.

Chart 12 compares the current and proposed rates of retirement for General PEPRA Tier 4 and 5 members.

Chart 13 compares with the current and proposed rates of retirement for Safety PEPRA Tier D and E members.

Deferred Vested Members

In prior valuations, deferred vested General and Safety members were assumed to retire at ages 59 and 54, respectively. The average age at retirement over the prior three years is shown in the table below. Also shown are the current ages assumed and the ages we propose. This table includes experience broken out by those deferred vested members both with and without reciprocity.

Retirement Age for Deferred Vested Members				
	General With Reciprocity	General Without Reciprocity	Safety With Reciprocity	Safety Without Reciprocity
Average Age	60.4	59.7	51.9	49.8
Current Assumption	59.0	59.0	54.0	54.0
Proposed Assumption	**59.0**	**59.0**	**53.0**	**50.0**

As shown above, we recommend maintaining the deferred vested retirement assumption of age 59 for General members both with and without reciprocity. We also recommend decreasing the deferred vested retirement assumption for Safety members with reciprocity from age 54 to age 53 and from age 54 to age 50 for Safety members without reciprocity.

Reciprocity

Under the current assumptions, it was assumed that 40% of future General deferred vested members and 65% of future Safety deferred vested members would be covered under a reciprocal retirement system and receive 4.75% annual salary increases from termination until their date of retirement.

As of December 31, 2017, about 43% of the General deferred vested members went on to be covered by a reciprocal retirement system. Additionally, about 71% of the Safety deferred vested members went on to be covered by a reciprocal retirement system. We also examined data on new retirements from deferred vested status. That data showed a lower percentage of members that had reciprocity. Therefore, we continued to rely upon the data for all deferred vested members in each valuation when setting this assumption.

We recommend maintaining the reciprocity assumption of 40% for future General deferred vested members and increasing the reciprocity assumption from 65% to 70% for future Safety deferred vested members.

The annual reciprocal salary increase assumption is based on the ultimate merit and promotion salary increase assumptions (for members with 20 or more years of service) for General and Safety members together with the 2.75% inflation and 0.50% real "across the board" salary increase assumptions that are recommended earlier in Section III of this report. This assumption is utilized to anticipate salary increases (under the reciprocal system) from termination from CCCERA to the expected date of retirement.

We recommend decreasing the annual reciprocal salary increase assumption from 4.75% to 3.75% (i.e., 2.75% inflation plus 0.50% "across the board" plus 0.50% merit and

promotion) for General deferred vested members and from 4.75% to 4.25% (i.e., 2.75% inflation plus 0.50% "across the board" plus 1.00% merit and promotion) for Safety deferred vested members.

Survivor Continuance under Unmodified Option

In prior valuations, it was assumed that 75% of all active and inactive male members and 50% of all active and inactive female members would be married or have an eligible domestic partner and select the unmodified option when they retire.

The following table shows the observed percentage of new retirees with an eligible spouse or domestic partner at the time of retirement based on the actual experience over the past three years. Also shown are the current rates assumed and the rates we propose:

	New Retirees – Actual Percent with Eligible Spouse or Domestic Partner and Selected Unmodified Option	
Year	**Male**	**Female**
2015	53%	47%
2016	64%	52%
2017	61%	49%
Total	**60%**	**49%**
Current Assumption	**75%**	**50%**
Proposed Assumption	**65%**	**50%**

As shown above, we recommend decreasing the percent married assumption for male members from 75% to 65% and maintaining the percent married assumption for female members at 50%.

Since the value of the survivor's benefit is dependent on the survivor's age and sex, we must also have assumptions for the age and sex of the survivor. Based on the experience for members who retired during the current three-year period and studies done for other retirement systems, we recommend the following:

1. Since the majority of survivors are of the opposite sex, even with the inclusion of domestic partners, we will continue to assume that for all active and inactive members, the survivor's sex is the opposite of the member.

2. The current and proposed assumption for the age of the survivor for all active and inactive members are shown below. These assumptions will continue to be monitored in future experience studies.

	Survivor's Age as Compared to Member's Age		
Beneficiary Sex	**Current Assumption**	**Actual CCCERA Experience**	**Proposed Assumption**
Male	2 years older	1.9 years older	2 years older
Female	3 years younger	2.8 years younger	3 years younger

CHART 3: RETIREMENT RATES – GENERAL TIER 1 ENHANCED MEMBERS LESS THAN 30 YEARS OF SERVICE

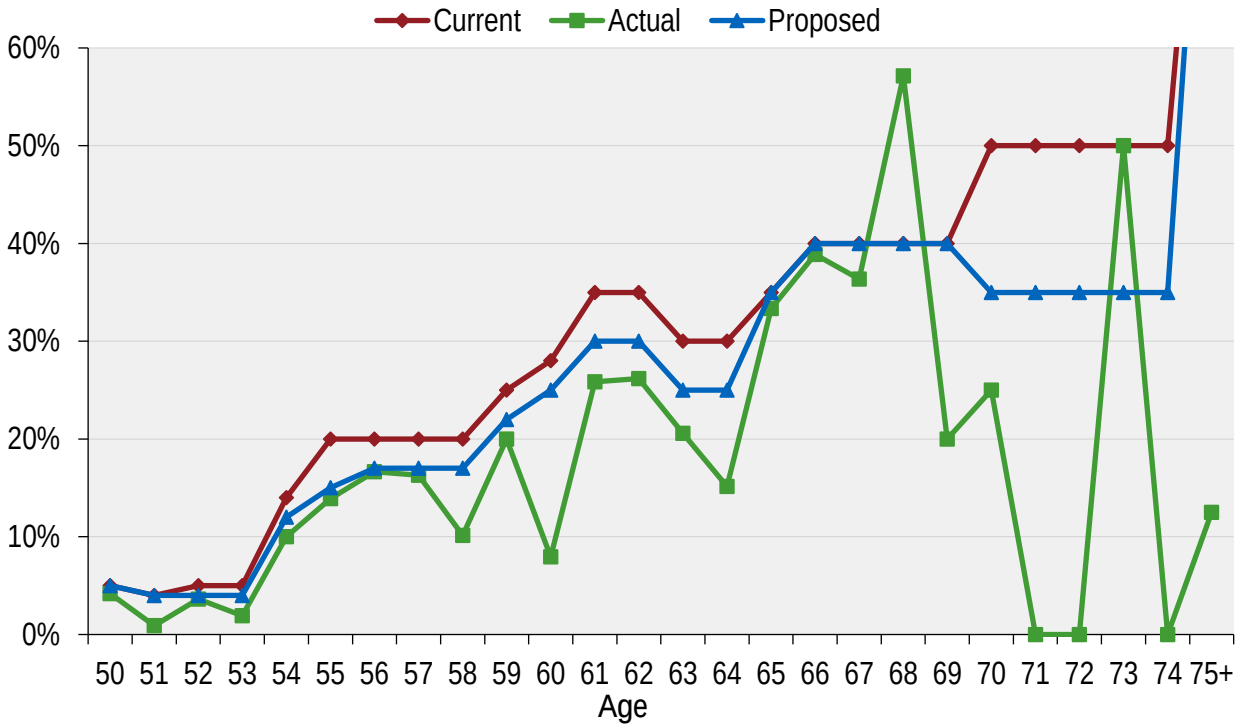


CHART 4: RETIREMENT RATES – GENERAL TIER 1 ENHANCED MEMBERS 30 OR MORE YEARS OF SERVICE

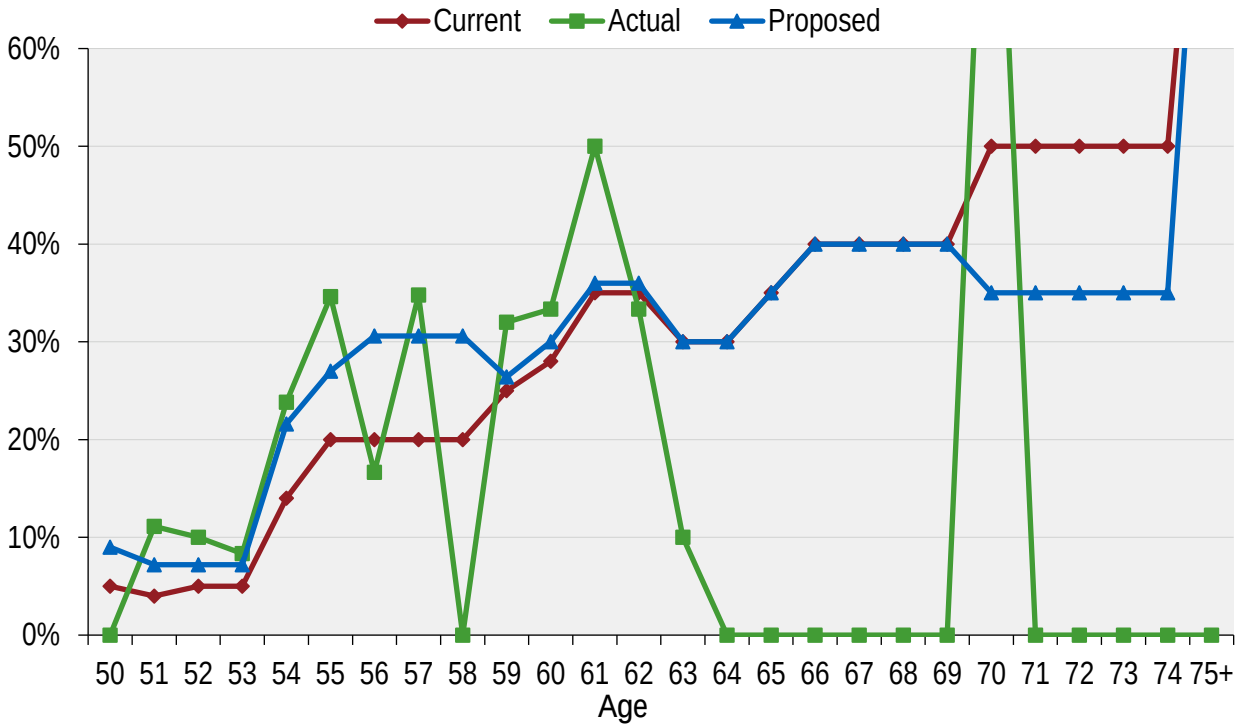


CHART 5: RETIREMENT RATES – GENERAL TIER 3 ENHANCED MEMBERS LESS THAN 30 YEARS OF SERVICE

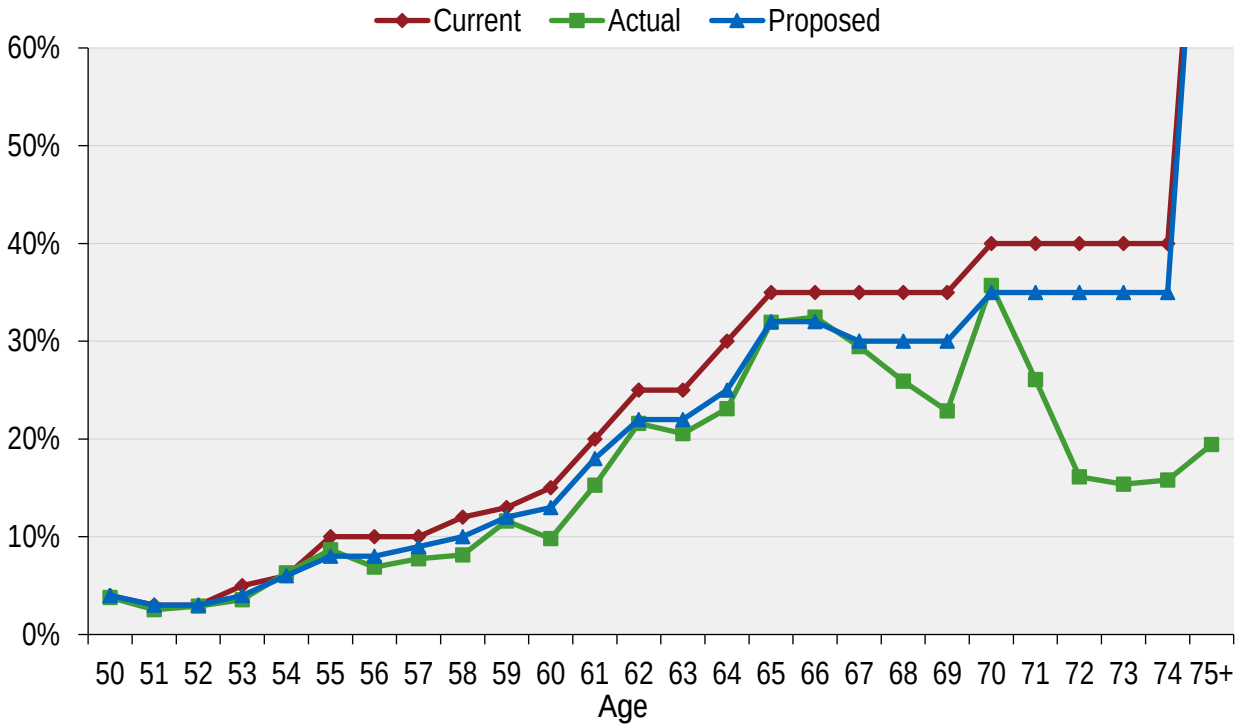


CHART 6: RETIREMENT RATES – GENERAL TIER 3 ENHANCED MEMBERS 30 OR MORE YEARS OF SERVICE

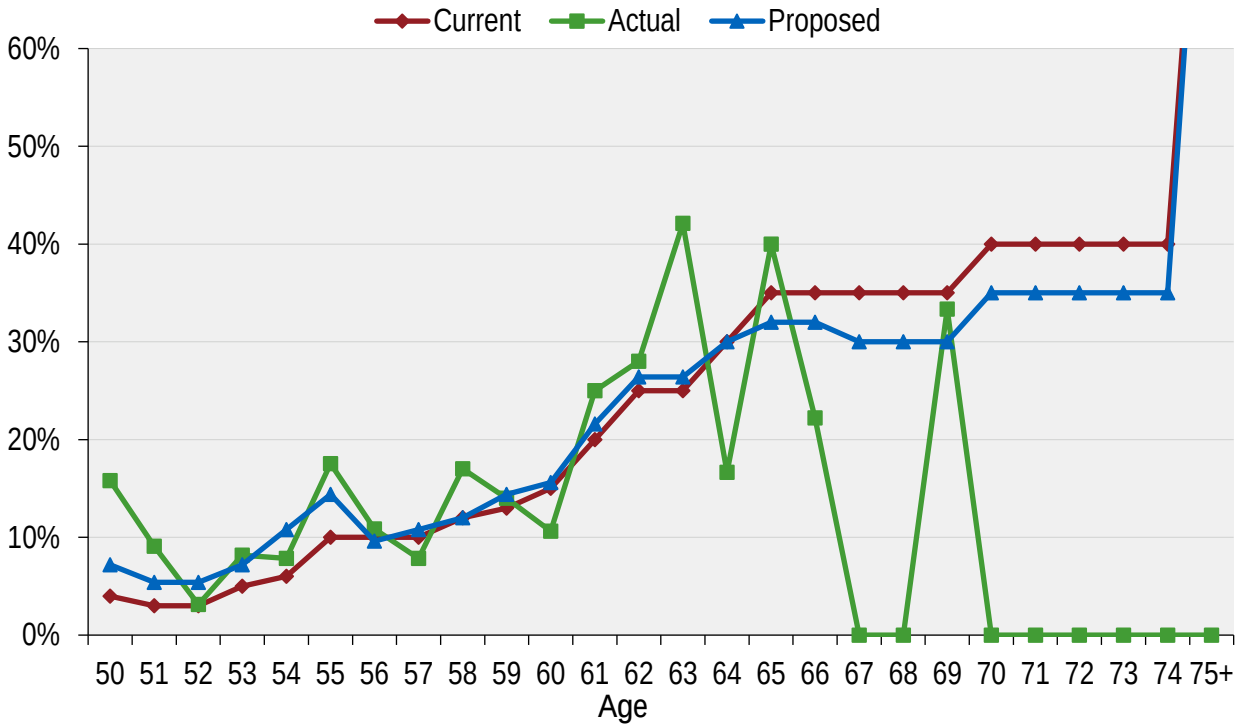


CHART 7: RETIREMENT RATES – SAFETY TIER A ENHANCED MEMBERS LESS THAN 30 YEARS OF SERVICE

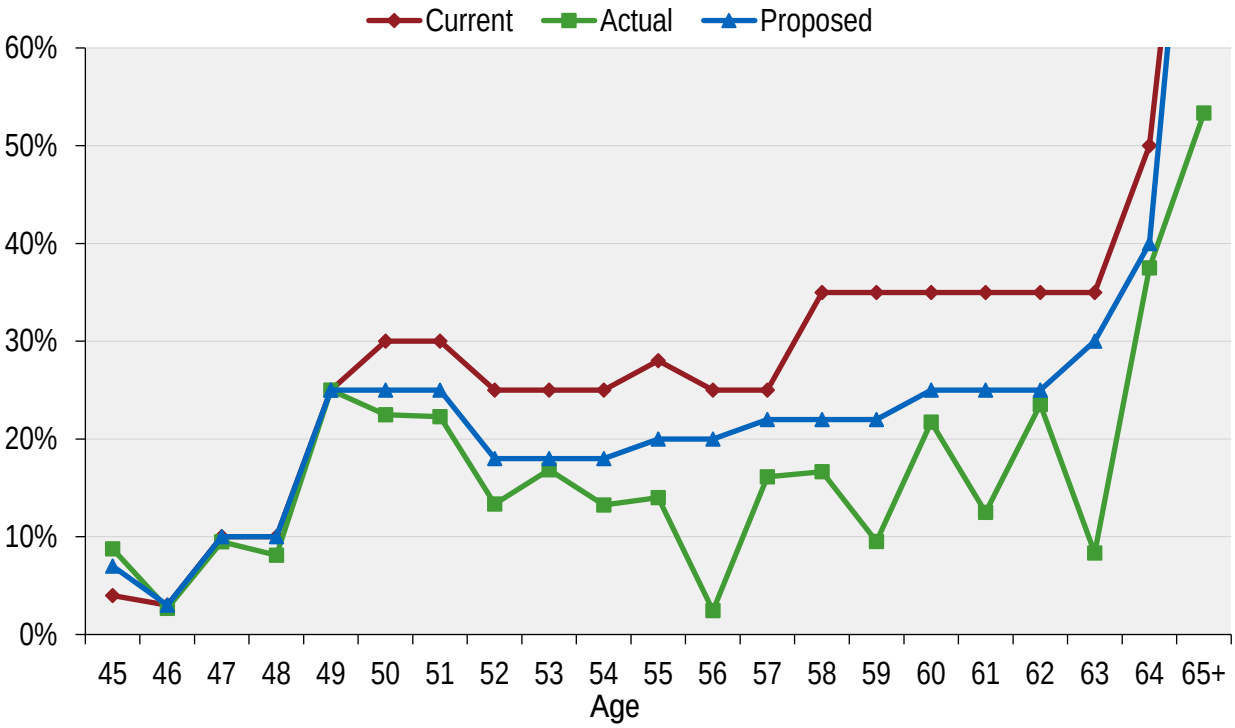


CHART 8: RETIREMENT RATES – SAFETY TIER A ENHANCED MEMBERS 30 OR MORE YEARS OF SERVICE

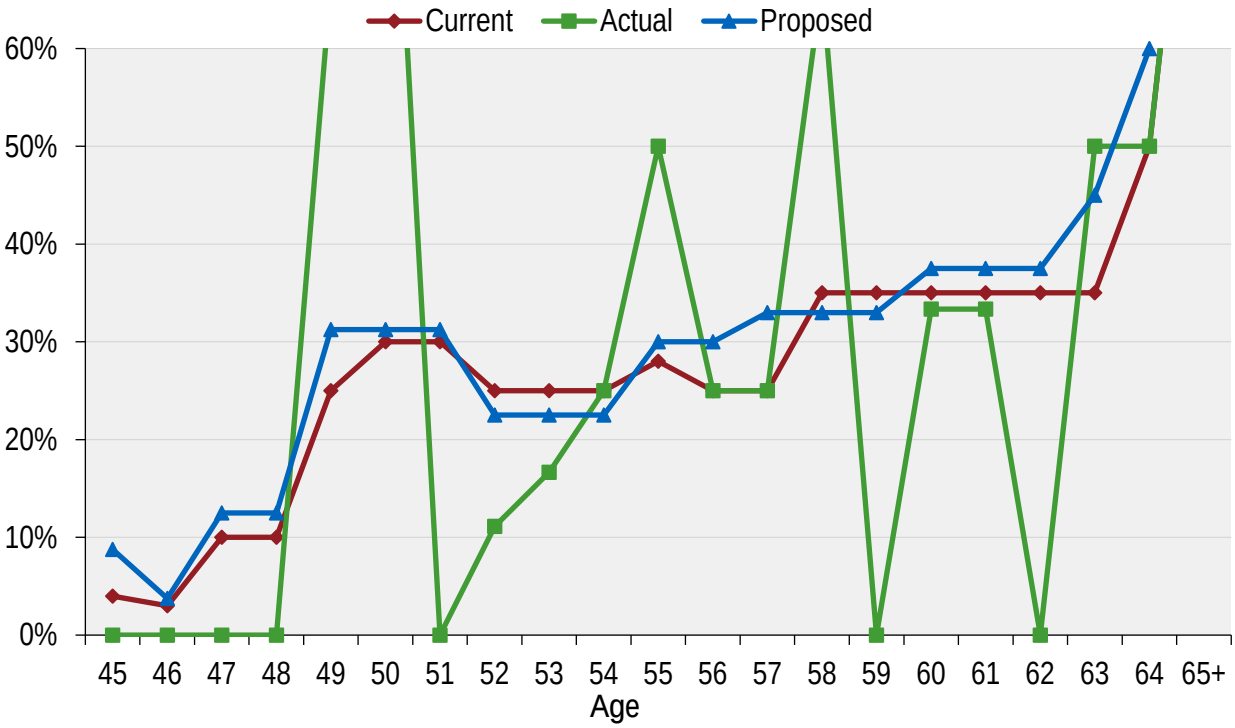


CHART 9: RETIREMENT RATES – SAFETY TIER C ENHANCED MEMBERS

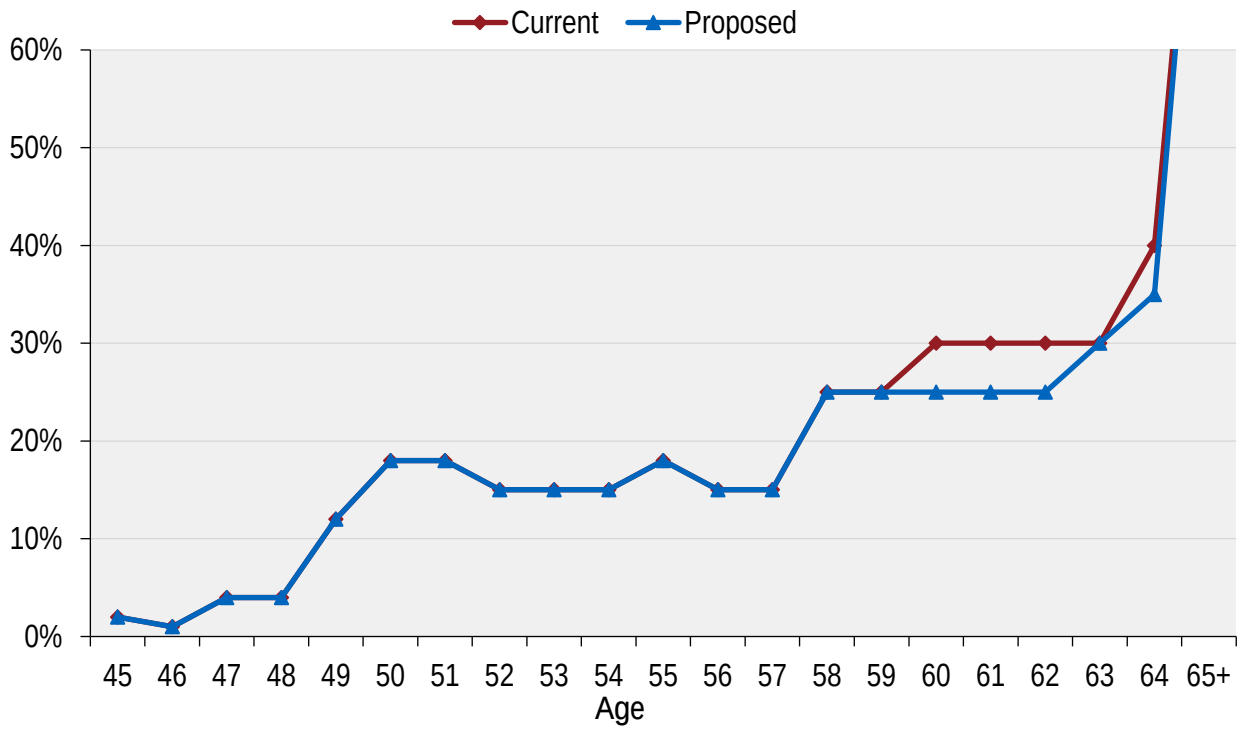


CHART 10: RETIREMENT RATES – GENERAL TIER 1 NON-ENHANCED MEMBERS

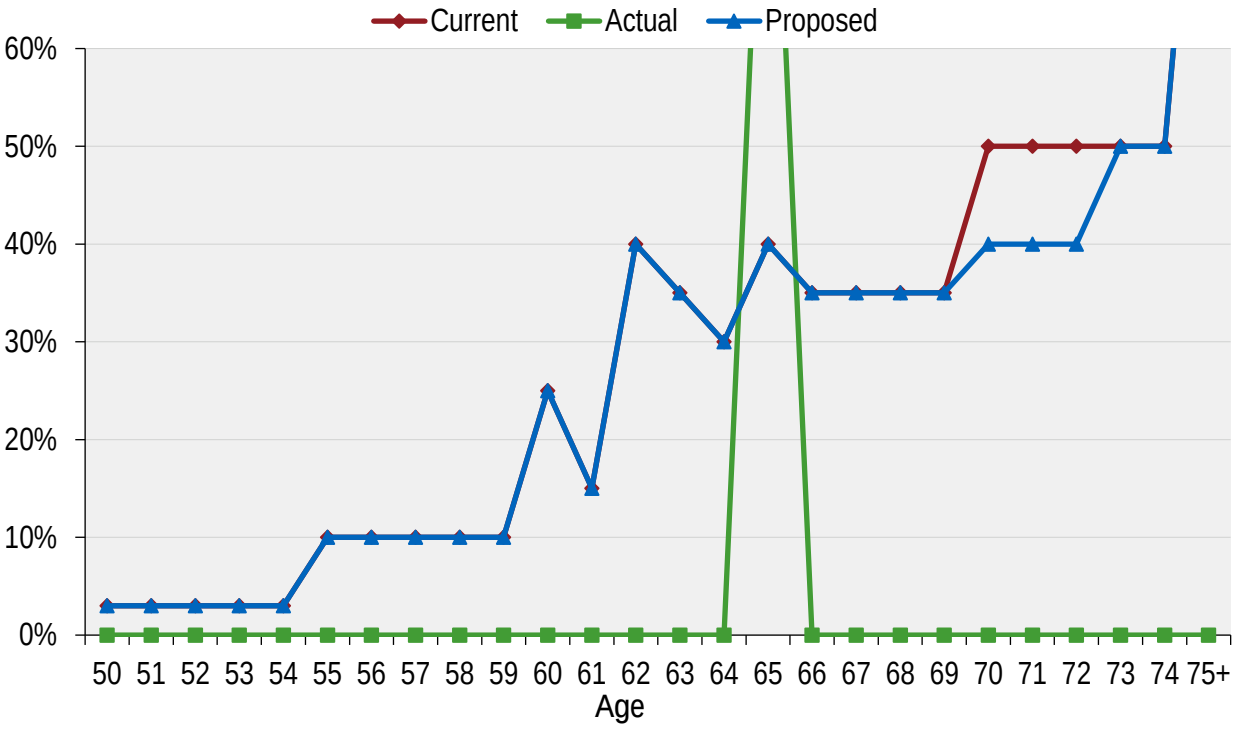


CHART 11: RETIREMENT RATES – SAFETY TIER A NON-ENHANCED MEMBERS

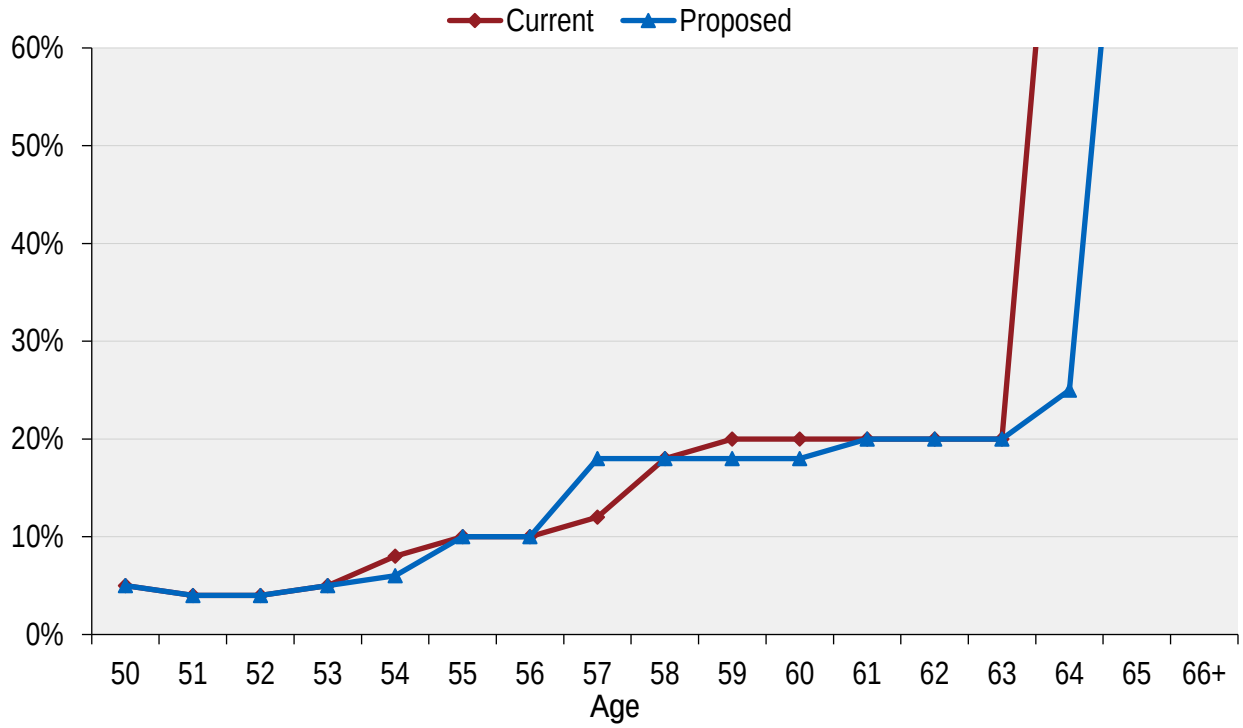


CHART 12: RETIREMENT RATES – GENERAL PEPRA TIERS 4 AND 5 MEMBERS

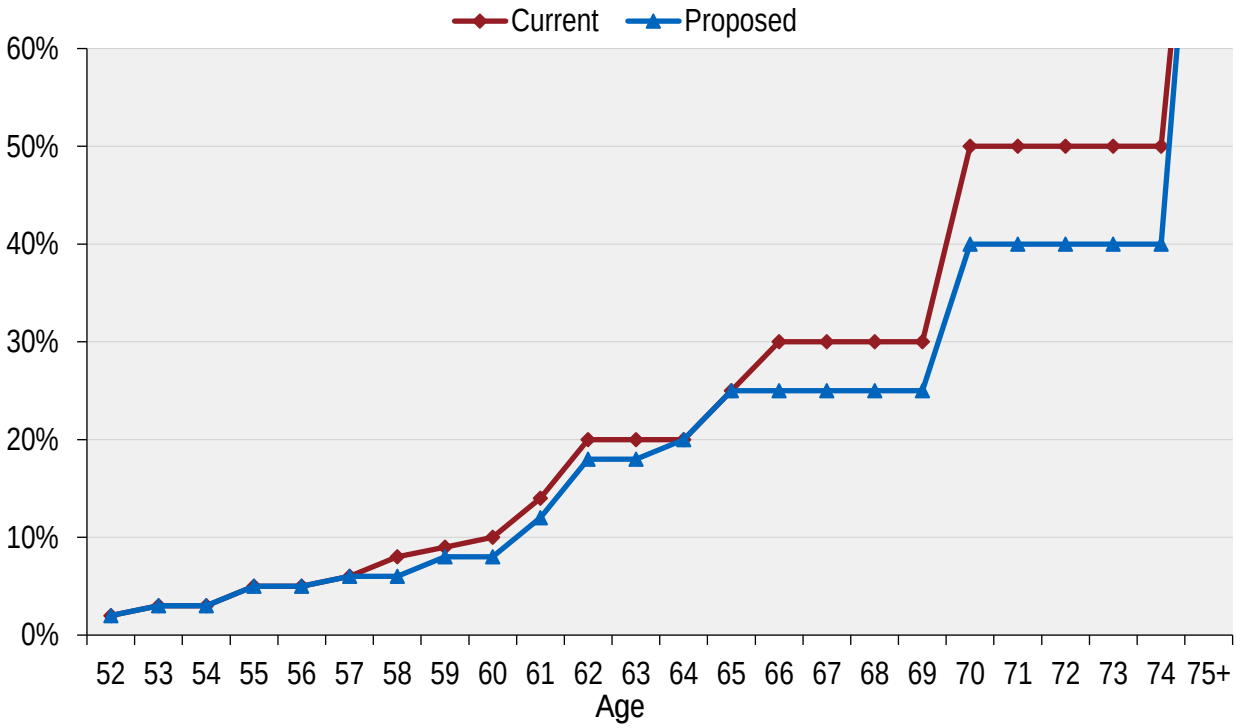
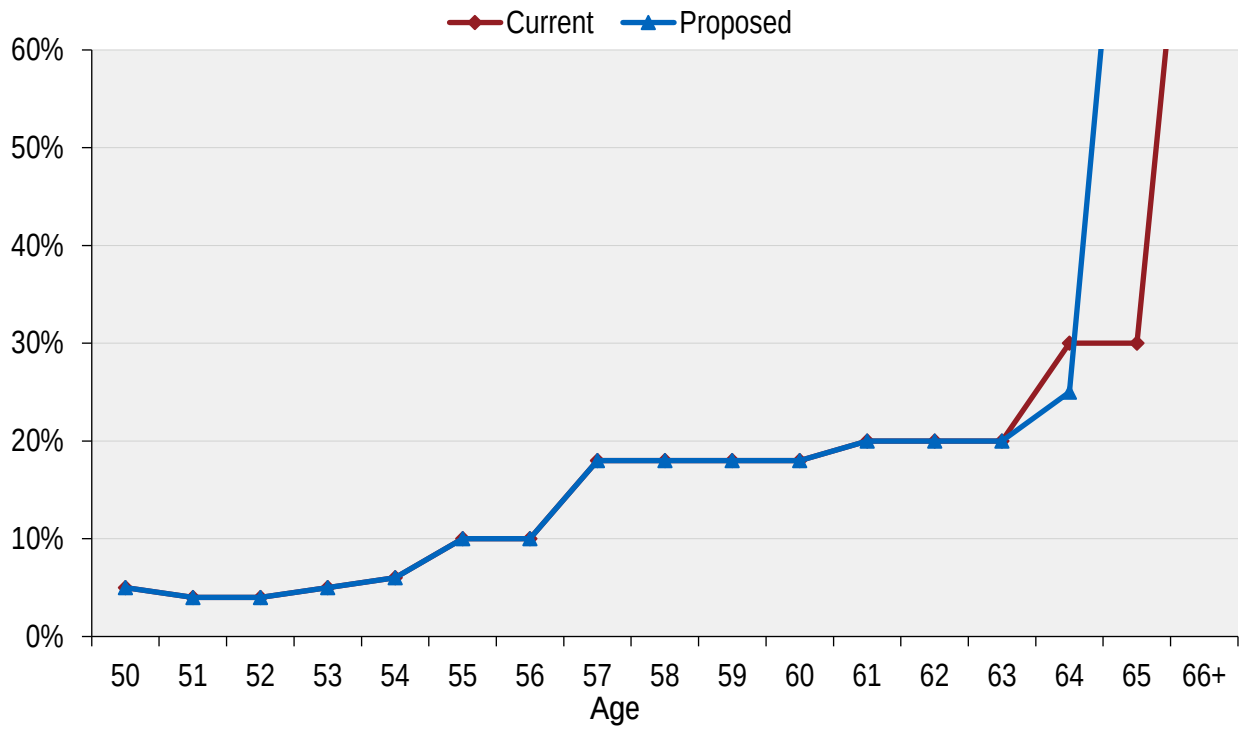


CHART 13: RETIREMENT RATES – SAFETY PEPRA TIERS D AND E MEMBERS



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 Headcount-Weighted RP-2014 Healthy Annuitant Table, projected generationally with the two-dimensional scale MP-2015. For Safety members, the table currently being used for post-service retirement mortality rates is the Headcount-Weighted RP-2014 Healthy Annuitant Table set back three years, projected generationally with the two-dimensional scale MP-2015. Beneficiaries are assumed to have the same mortality as General members who have taken a service (non-disability) retirement.

When we conducted the last experience study, we discussed with the Board that we would recommend a switch from a Headcount-Weighted to a Benefit-Weighted table, but only after the Society of Actuaries (SOA) provides mortality tables based on public sector experience comparable to the RP-2014 mortality tables developed using data collected from private and multi-employer pension plans.

The Retirement Plans Experience Committee (RPEC) of the SOA has recently published the Pub-2010 Public Retirement Plans Mortality tables (Pub-2010). For the first time, the Pub-2010 mortality tables are based exclusively on public sector pension plan experience in the United States. Within the Pub-2010 family of mortality tables, there are separate tables by job categories of General, Safety and Teachers. Included with the mortality tables is the analysis prepared by RPEC that continues to observe that benefit amount for healthy retirees and salary for employees are the most significant predictors of mortality differences within the job categories. Therefore, Pub-2010 includes mortality rates developed for annuitants on a "benefit" weighted basis, with higher credibility assigned to experience from annuitants receiving larger benefits.

As the Pub-2010 study shows that benefit (or salary for employees) is a significant predictor of mortality difference, the Pub-2010 family of mortality tables also include mortality rates based on population with above-median benefit amount (or salary for employees), below-median benefit amount (or salary for employees) and total population within each job category. The median benefit amounts used to determine the above-median and below-median mortality rates as shown in the Pub-2010 report for General and Safety are as follows:

	Median Amounts ($) by Gender, Job Category, and Status			
	Males		Females	
Job Category	Employees	Retirees	Employees	Retirees
General	45,800	21,200	34,700	11,900
Safety	72,200	36,900	61,800	29,200

Note: Values shown as of 2010.

Even after we adjust the above amounts by a reasonable measure of U.S. price inflation from 2010 to 2018 for a total increase of less than 20%, the benefit amounts (or salaries) paid to CCCERA's members were generally greater than the adjusted median amounts shown above.

Therefore, we recommend that the above-median version of the mortality tables for each job category be used.

We continue to recommend that the mortality improvement scale be projected generationally where each future year has its own mortality table that reflects the forecasted improvements, using the published improvement scales. 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.

We understand that RPEC intends to publish annual updates to their mortality improvement scales. Improvement scale MP-2018 is the latest improvement scale available. We recommend that the Board adopt the Benefit-Weighted Above-Median Pub-2010 mortality table (adjusted for CCCERA experience), and project the mortality improvement generationally using the MP-2018 mortality improvement scale. The MP-2018 scale projects lower future mortality improvement as compared to the currently used MP-2015 scale.

In order to use more actual CCCERA experience in our analysis, we have used experience for a nine-year period by using data from the current (from January 1, 2015 to December 31, 2017) and the last two (from January 1, 2012 to December 31, 2014 and from January 1, 2009 to December 31, 2011) experience study periods to analyze this assumption.

Even with the use of nine years of experience, based on standard statistical theory the data is only partially credible especially under the recommended benefit-weighted basis when dispersion of retirees' benefit amounts is taken into account. In 2008 the SOA published an article recommending that mortality assumptions include an adjustment for credibility. Under this approach, the number of deaths needed for full credibility for a headcount-weighted mortality table is just over 1,000, where full credibility means a 90% confidence that the actual experience will be within 5% of the expected value. Therefore, in our recommended assumptions, we have only partially adjusted the Pub-2010 mortality tables to fit CCCERA's experience. In future experience studies, more data will be available which may further increase the credibility of the CCCERA experience.

Pre-Retirement Mortality

For General and Safety members, the table currently being used for pre-retirement mortality rates is the Headcount-Weighted RP-2014 Employee Mortality Table (separate tables for males and females) multiplied by 75%, projected generationally with the two-dimensional scale MP-2015.

For General members, we recommend changing the pre-retirement mortality to follow the Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

For Safety members, we recommend changing the pre-retirement mortality to follow the Pub-2010 Safety Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

We also recommend maintaining the current assumption that all pre-retirement deaths are assumed to be non-service connected for both General and Safety members.

Post-Retirement Mortality (Service Retirements)

Among all retired members, the actual deaths compared to the expected deaths weighted by benefit amounts under the current assumptions for the last nine years are shown in the table below. We also show the deaths weighted by benefit amount under the proposed assumptions. As noted above, we are recommending the continued use of a generational mortality table. A generational mortality table incorporates an 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.

Also, the proposed mortality table reflects current experience to the extent that the experience is credible based on standard statistical theory. For CCCERA, the volume of General member data makes it relatively credible. In contrast, there is much less Safety data, so it is given substantially less credibility. That is why the proposed tables (as shown in the table below) after adjustments for partial credibility have actual to expected ratios of 101% and 109% for General and Safety, respectively. In future years the ratio should remain around 101% and 109% for General and Safety, respectively, as long as actual mortality improves at the same rates as anticipated by the generational mortality tables. The number of actual deaths compared to the number expected under the current and proposed assumptions weighted by benefit amounts for the last nine years are as follows:

	General Members – Healthy ($ in millions)			Safety Members – Healthy ($ in millions)		
Gender	**Current Expected Weighted Deaths**	**Actual Weighted Deaths**	**Proposed Expected Weighted Deaths**	**Current Expected Weighted Deaths**	**Actual Weighted Deaths**	**Proposed Expected Weighted Deaths**
Male	$21.0	$17.2	$17.4	$11.1	$12.2	$10.8
Female	$20.1	$18.0	$17.3	$0.8	$0.5	$0.9
Total	**$41.1**	**$35.2**	**$34.7**	**$11.9**	**$12.7**	**$11.7**
Actual / Expected	86%		101%	107%		109%*

Notes: (1) Experience shown above is weighted by annual benefit amounts for deceased members instead of by headcounts.

(2) Expected amounts under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

** If we use the benchmark Pub-2010 Safety table without any adjustments, the proposed actual to expected ratio would be 114%.*

We recommend changing the General post-retirement table to the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 101%.

We recommend changing the Safety post-retirement table to the Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 109%.

For this transitional year for informational purposes only, we have also provided in the table below the actual and expected deaths computed without weighting these by benefit amounts. This is similar to how actual and expected deaths ratios were developed based on the prior headcount approach.

	General Members – Healthy			Safety Members – Healthy		
Gender	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	473	439	395	139	161	140
Female	770	767	678	15	13	17
Total	**1,243**	**1,206**	**1,073**	**154**	**174**	**157**
Actual / Expected	97%		112%	113%		111%

Notes: (1) Experience shown above is weighted by headcounts for deceased members instead of by annual benefit amounts.

(2) The proposed expected deaths are based on the recommended Pub-2010 Amount-Weighted Above-Median Mortality Tables.

Chart 14 compares the actual to expected deaths on a benefit-weighted basis for General members under the current and proposed assumptions over the past nine years.

Chart 15 compares the actual to expected deaths on a benefit-weighted basis for Safety members under the current and proposed assumptions over the past nine years.

Chart 16 compares the actual to expected number of deaths on a headcount-weighted basis for General members under the current and proposed assumptions over the past nine years, provided for informational purposes only.

Chart 17 compares the actual to expected number of deaths on a headcount-weighted basis for Safety members under the current and proposed assumptions over the past nine years, provided for informational purposes only.

Chart 18 shows the life expectancies (i.e., expected future lifetime) under the current and proposed tables for General members on a benefit-weighted basis. Life expectancies under the current and proposed generational mortality rates are based on age as of 2019. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

Chart 19 shows the life expectancies under the current and proposed tables for Safety members on a benefit-weighted basis. Life expectancies under the current and proposed generational mortality rates are based on age as of 2019. This graph shows that the life expectancies actually decrease under the proposed assumptions.

Beneficiaries Mortality

In studying the mortality for all General and Safety beneficiaries in our prior experience study, we reviewed the actual deaths compared to the expected deaths and recommended the same mortality tables for healthy General retirees and all beneficiaries. However, Pub-2010 has separate mortality tables for healthy retirees and contingent annuitants.

The Pub-2010 Contingent Survivors Table is developed only based on contingent survivor data after the death of the retirees. This is consistent with the mortality experience that we have available for beneficiaries. The Pub-2010 contingent survivor mortality rates are comparable to CCCERA's actual mortality experience for beneficiaries.

For all beneficiaries, we recommend changing the mortality assumption to follow the Pub-2010 Contingent Survivor Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

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

There are administrative reasons why a generational mortality table is more difficult to implement for determining member contributions for legacy tiers (i.e., non-CalPEPRA), 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 from the measurement year over a period that is close to the duration of the benefit payments for active members. We would recommend the use of this approximation for determining member contributions for employees in the legacy tiers.

For determining contributions for General and Safety legacy members, we recommend the following mortality tables, based on the proposed valuation mortality for each group along with the actual gender distributions:

For General members, we recommend the Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 30% male and 70% female.

For Safety members, we recommend the Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected 30 years (from 2010) with the two-dimensional mortality improvement scale MP-2018, weighted 85% male and 15% female.

For optional forms of payment and reserves, we would apply a similar methodology. However, the projection of the mortality improvement would be from the measurement year over a period that is close to the duration of the benefit payments for active members retiring in the next three years. The recommended tables along with the mortality rates will be provided in a separate letter at a later date, similar to prior years.

For General and Safety service retirements, we recommend using the corresponding base tables and adjustments described within this section, projected 20 years with the two-dimensional mortality improvement scale MP-2018 along with weighting based on actual gender distributions for each group.

For all beneficiaries, we recommend using the corresponding base tables and adjustments described within this section, projected 20 years with the two-dimensional mortality improvement scale MP-2018 along with weighting based on the inverse of the actual gender distributions for each group.

For General and Safety disability retirements, we recommend using the corresponding base tables and adjustments described within the following section, projected 20 years with the two-dimensional mortality improvement scale MP-2018 along with weighting based on actual gender distributions for each group.

CHART 14: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS NON-DISABLED GENERAL MEMBERS (IN MILLIONS) (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

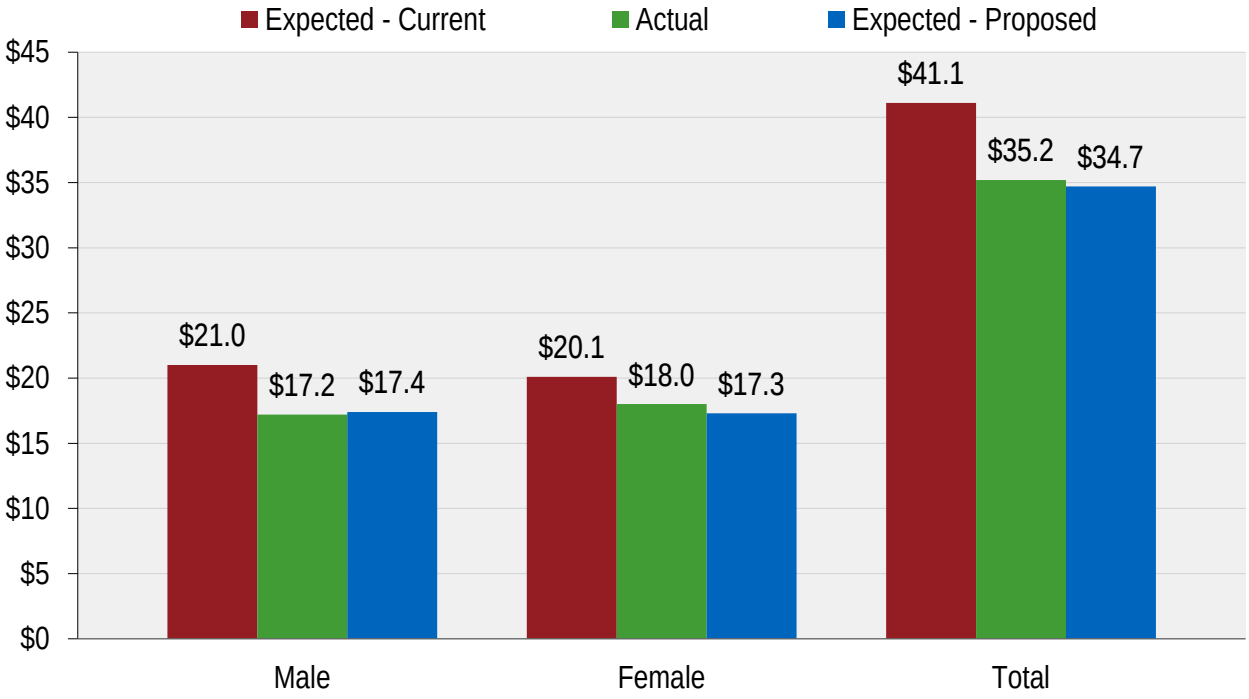


CHART 15: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS NON-DISABLED SAFETY MEMBERS (IN MILLIONS) (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

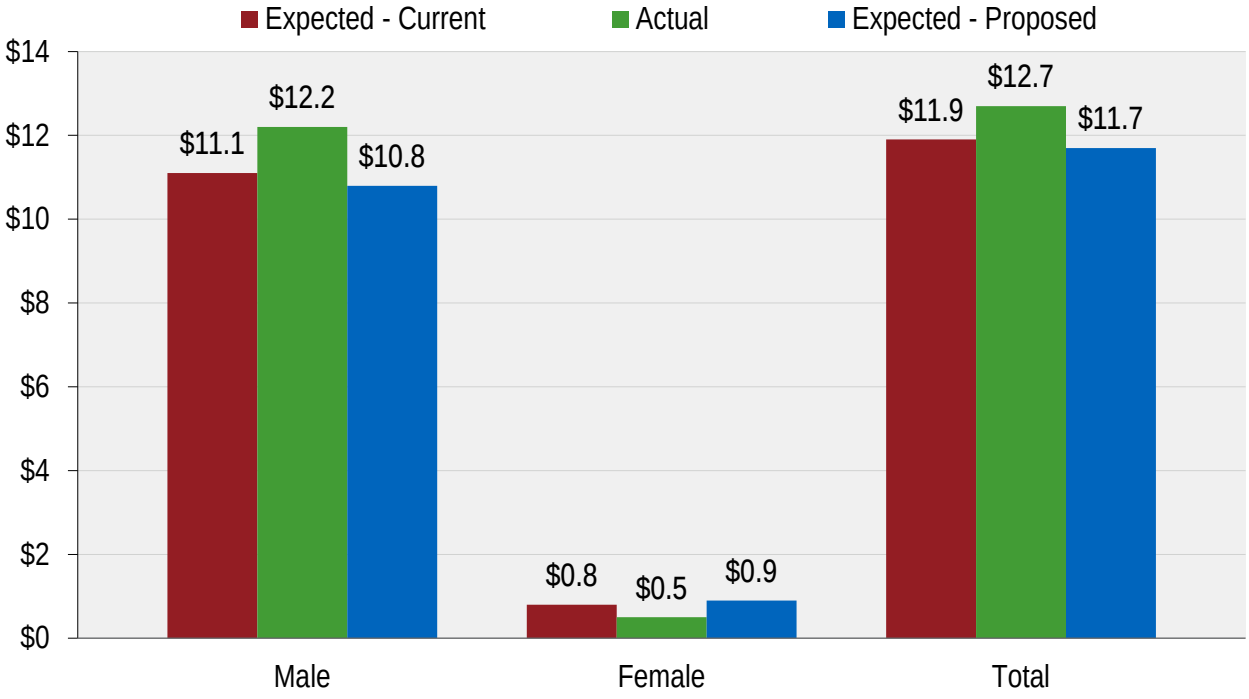


CHART 16: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS NON-DISABLED GENERAL MEMBERS (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

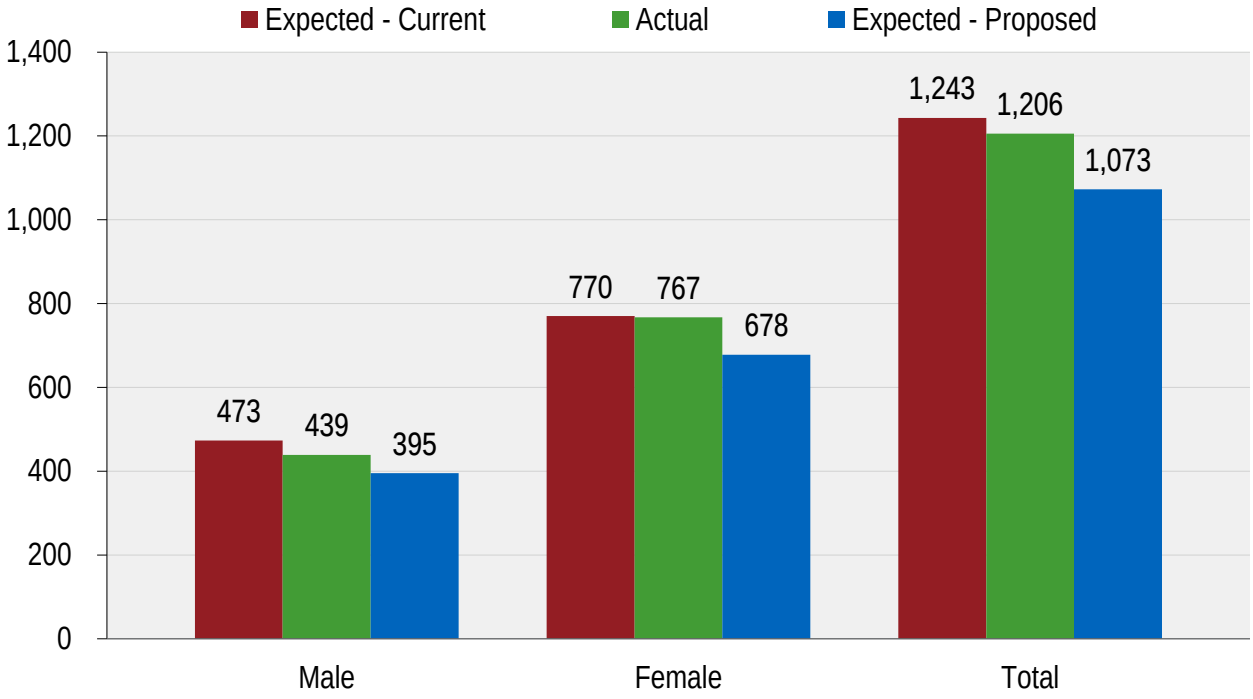


CHART 17: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS NON-DISABLED SAFETY MEMBERS (IN MILLIONS) (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

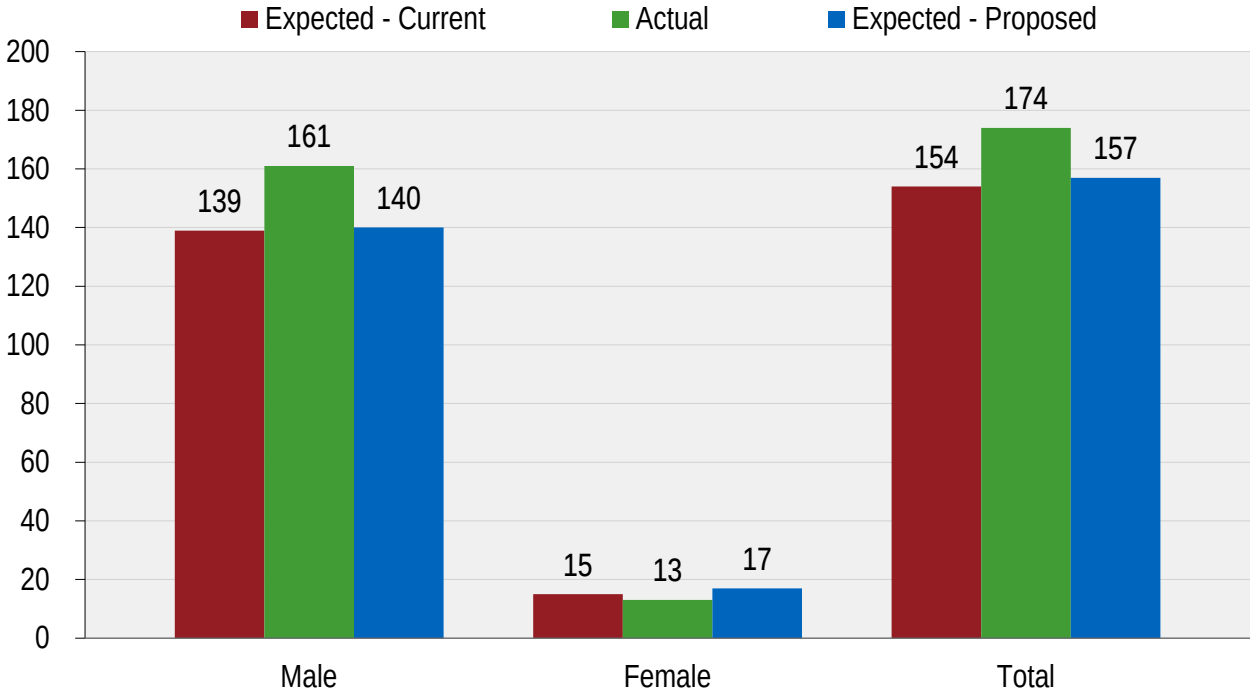


CHART 18: BENEFIT-WEIGHTED LIFE EXPECTANCIES
NON-DISABLED GENERAL MEMBERS

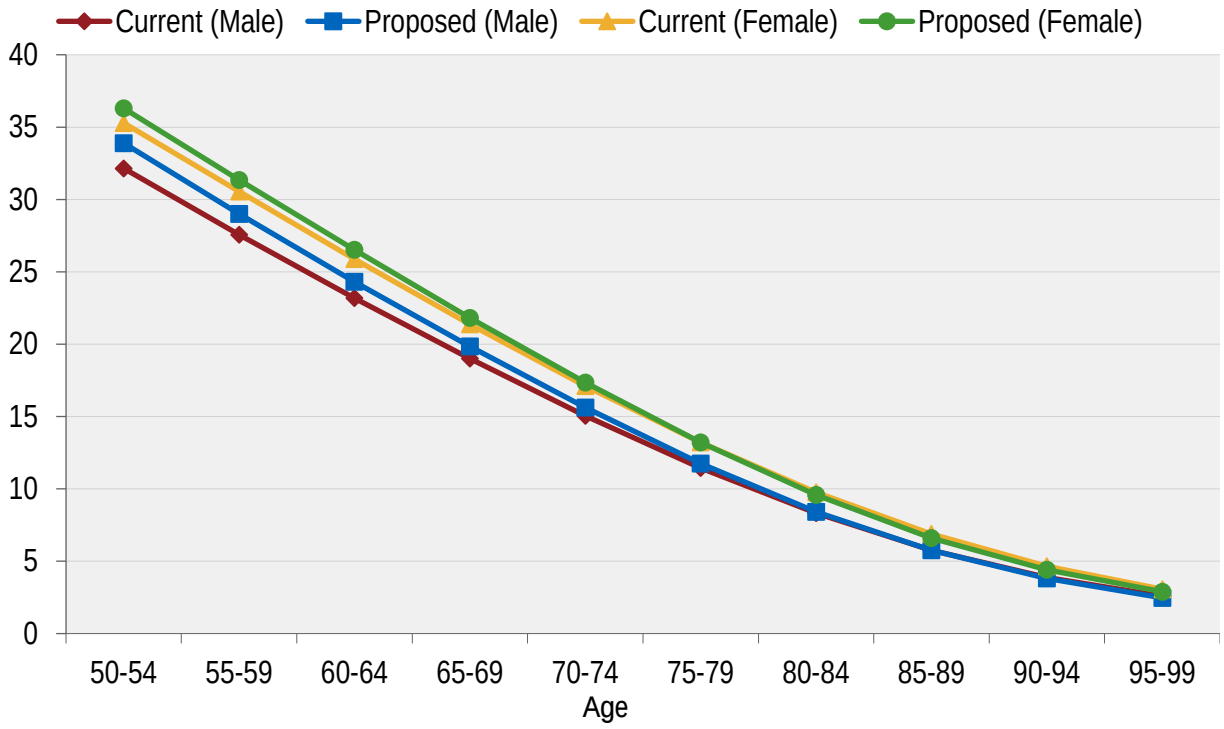
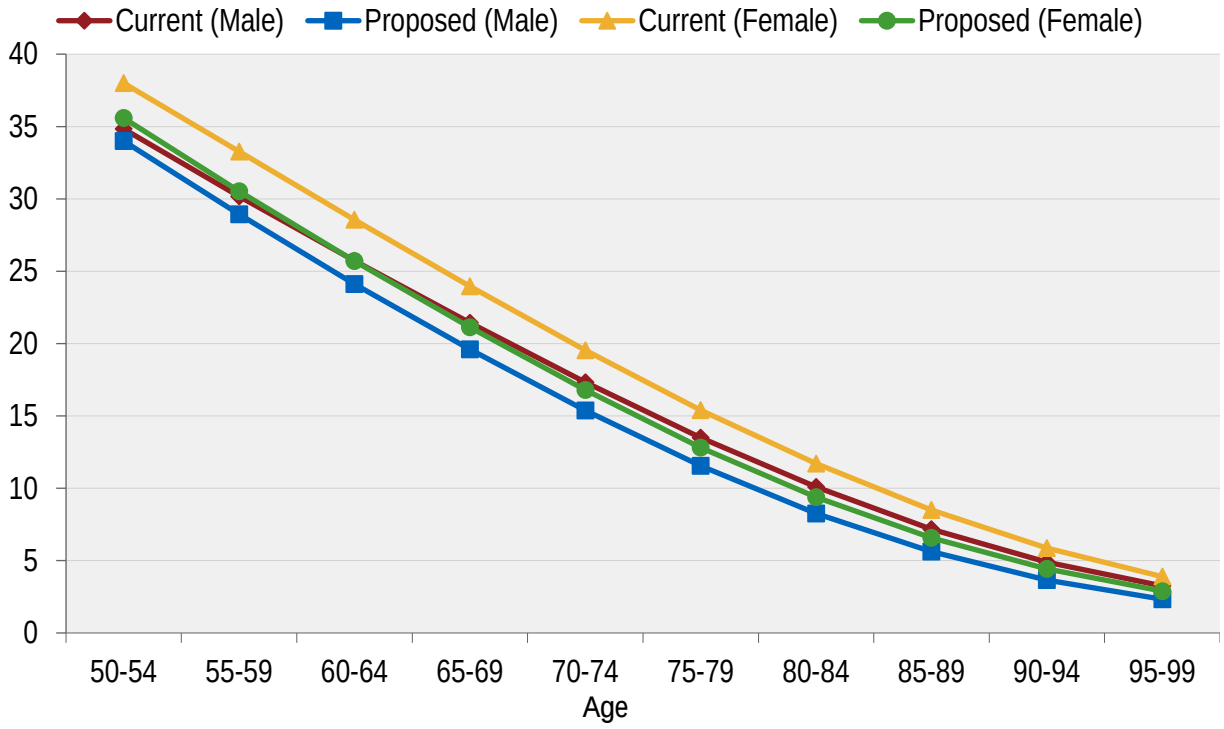


CHART 19: BENEFIT-WEIGHTED LIFE EXPECTANCIES
NON-DISABLED SAFETY MEMBERS



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 Headcount-Weighted RP-2014 Healthy Annuitant Table set forward eight years, projected generationally with the two-dimensional scale MP-2015. For Safety members, the table currently being used is the Headcount-Weighted RP-2014 Healthy Annuitant Table set forward three years, projected generationally with the two-dimensional scale MP-2015.

Post-Retirement Mortality (Disability Retirements)

The number of actual deaths compared to the number expected under the current and proposed assumptions weighted by benefit amounts for the last nine years are as follows:

	General Members- Disabled ($ in millions)			Safety Members- Disabled ($ in millions)		
Gender	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths	Current Expected Weighted Deaths	Actual Weighted Deaths	Proposed Expected Weighted Deaths
Male	$2.07	$2.01	$1.70	$5.35	$4.63	$4.14
Female	$2.89	$2.50	$2.45	$0.23	$0.08	$0.19
Total	**$4.96**	**$4.51**	**$4.15**	**$5.58**	**$4.71**	**$4.33**
Actual / Expected	91%		109%	84%		109%

Notes: (1) Experience shown above is weighted by annual benefit amounts for deceased members instead of by headcounts.

(2) Expected amounts under the proposed generational mortality table are based on mortality rates from the base year projected with mortality improvements to the experience study period.

The Pub-2010 family of mortality tables provide separate disabled retiree mortality tables for Non-Safety disabled retirees and Safety disabled retirees.

Based on the actual experience, we recommend updating the current table for General disabled members to the Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 109%.

Furthermore, based on the actual experience, we recommend updating the current table for Safety disabled members to the Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018. The recommended mortality tables will have an actual to expected ratio of 109%.

For this transitional year for informational purposes only, we have also provided in the table below the actual and expected deaths computed without weighting these by benefit amounts.

This is similar to how actual and expected deaths ratios were developed based on the prior headcount approach.

	General Members – Disabled			Safety Members – Disabled		
Gender	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths	Current Expected Deaths	Actual Deaths	Proposed Expected Deaths
Male	65	63	53	84	78	65
Female	108	102	91	5	2	4
Total	**173**	**165**	**144**	**89**	**80**	**69**
Actual / Expected	95%		115%	90%		116%

Notes: (1) Experience shown above is weighted by headcounts for deceased members instead of by annual benefit amounts.

(2) The proposed expected deaths are based on the recommended Pub-2010 Amount-Weighted Mortality Tables.

Chart 20 compares the actual to expected deaths on a benefit-weighted basis for disabled General members under the current and proposed assumptions over the past nine years.

Chart 21 compares the actual to expected deaths on a benefit-weighted basis for disabled Safety members under the current and proposed assumptions over the past nine years.

Chart 22 compares the actual to expected number of deaths on a headcount-weighted basis for disabled General members under the current and proposed assumptions over the past nine years, provided for informational purposes only.

Chart 23 compares the actual to expected number of deaths on a headcount-weighted basis for disabled Safety members under the current and proposed assumptions over the past nine years, provided for informational purposes only.

Chart 24 shows the life expectancies (i.e., expected future lifetime) under the current and proposed tables for disabled General members on a benefit-weighted basis. Life expectancies under the current and proposed generational mortality rates are based on age as of 2019. In practice, life expectancies will be assumed to increase based on applying the mortality improvement scale.

Chart 25 shows the life expectancies under the current and proposed tables for disabled Safety members on a benefit-weighted basis. Life expectancies under the current and proposed generational mortality rates are based on age as of 2019.

CHART 20: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS DISABLED GENERAL MEMBERS (IN MILLIONS) (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

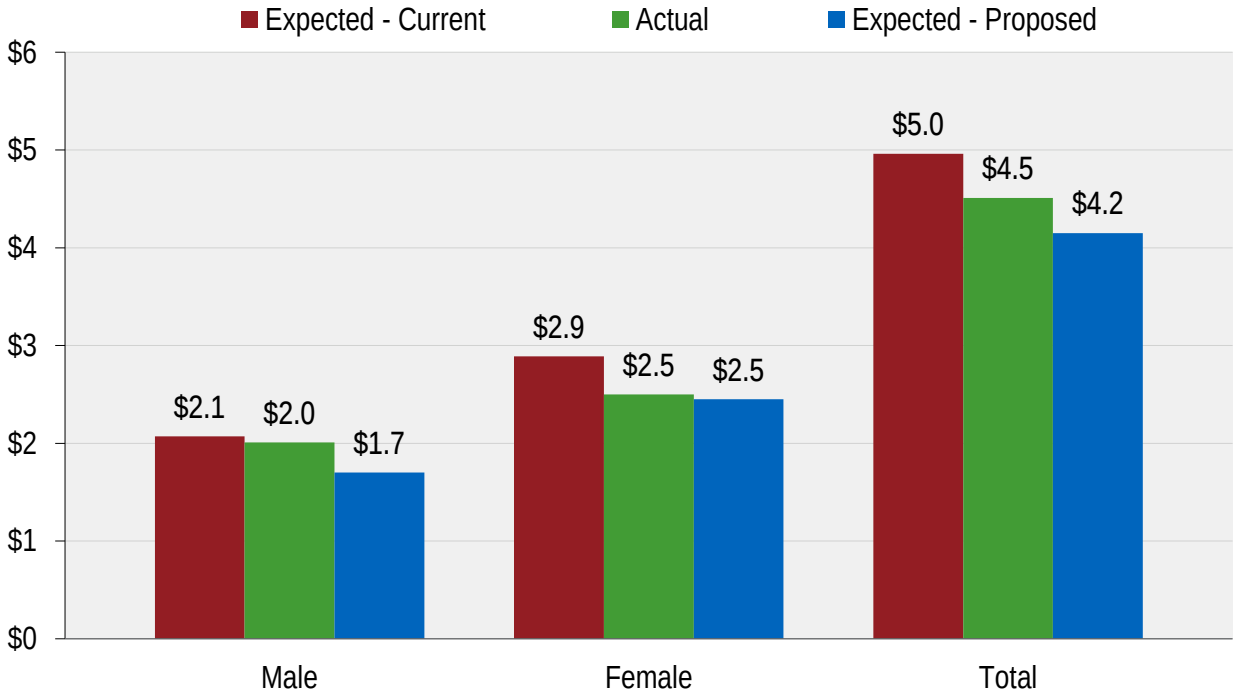


CHART 21: POST-RETIREMENT BENEFIT-WEIGHTED DEATHS DISABLED SAFETY MEMBERS (IN MILLIONS) (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

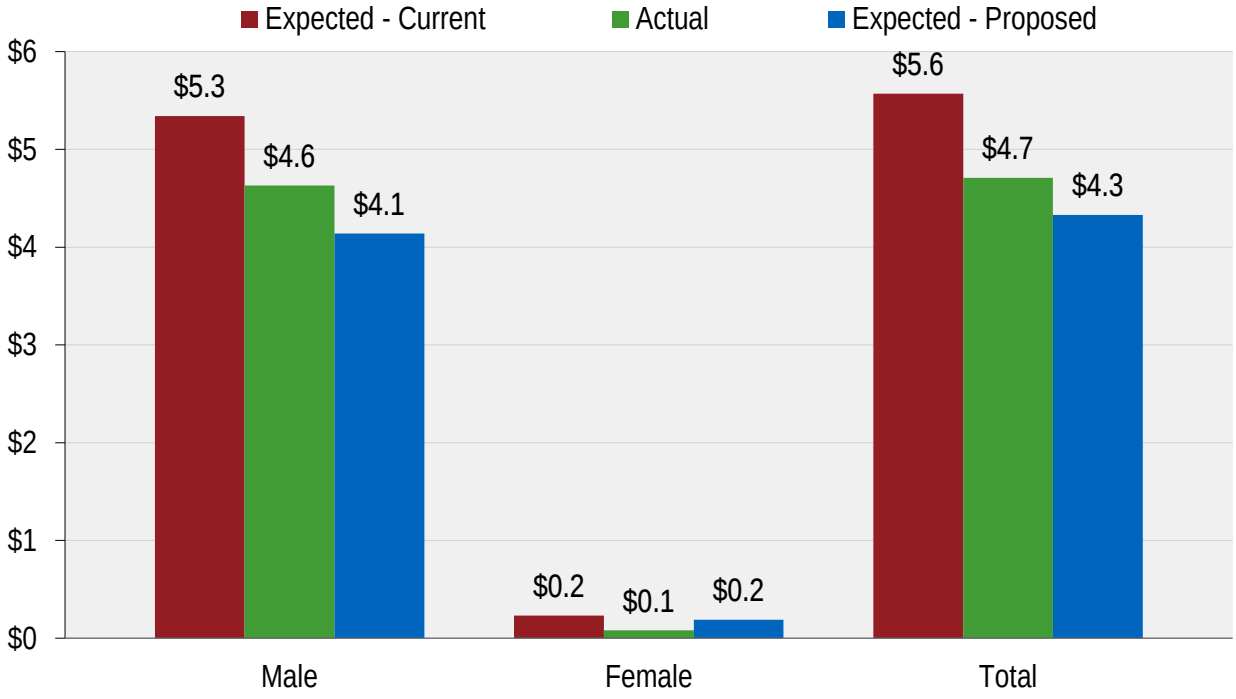


CHART 22: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS DISABLED GENERAL MEMBERS (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

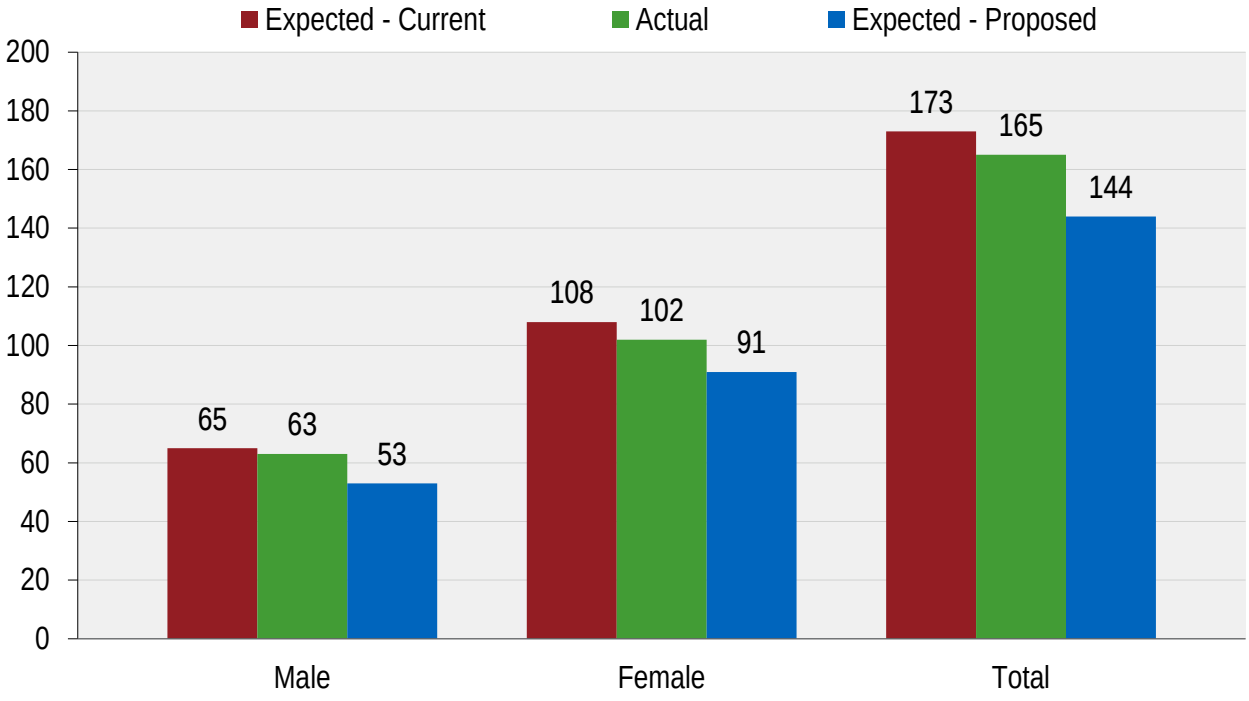


CHART 23: POST-RETIREMENT HEADCOUNT-WEIGHTED DEATHS DISABLED SAFETY MEMBERS (JANUARY 1, 2009 THROUGH DECEMBER 31, 2017)

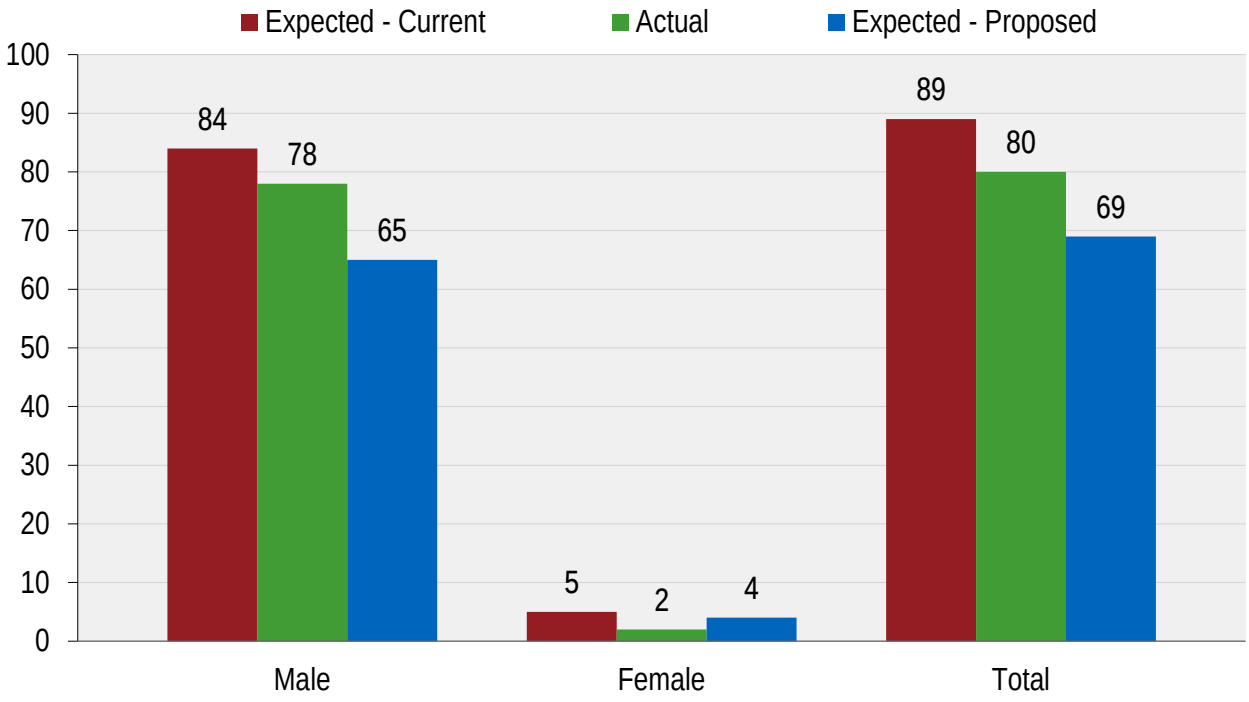


CHART 24: BENEFIT-WEIGHTED LIFE EXPECTANCIES
DISABLED GENERAL MEMBERS

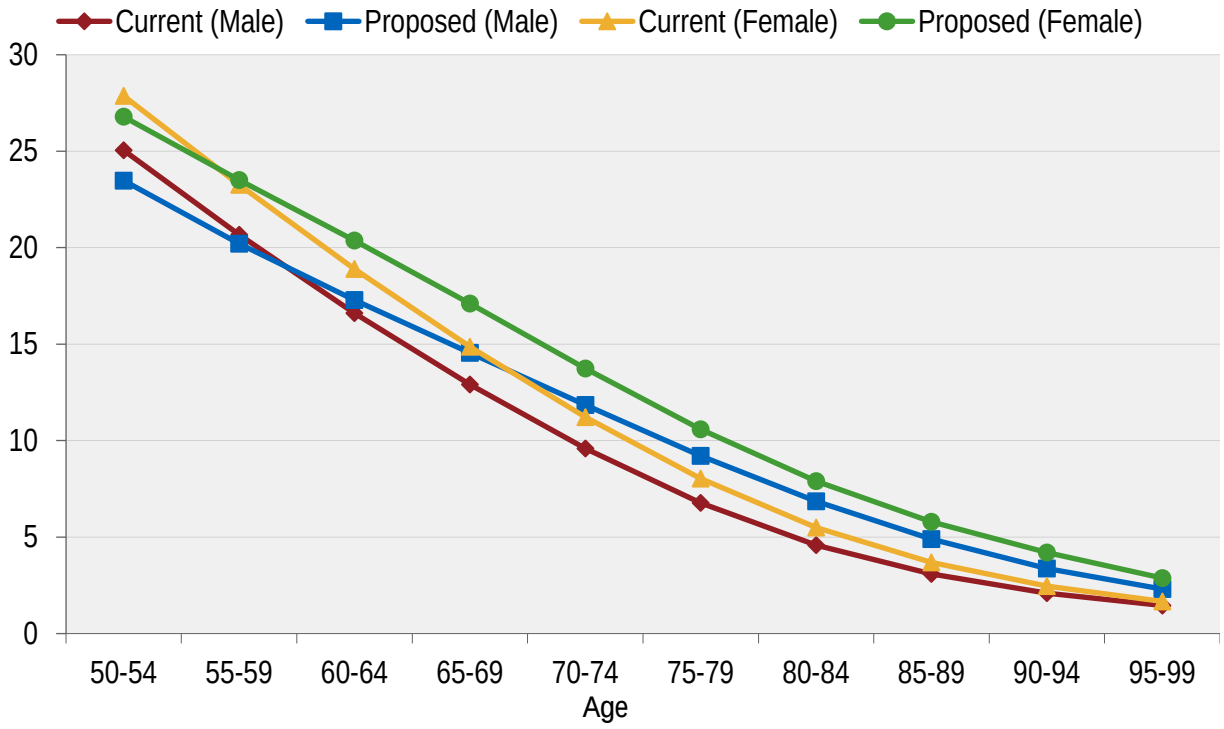
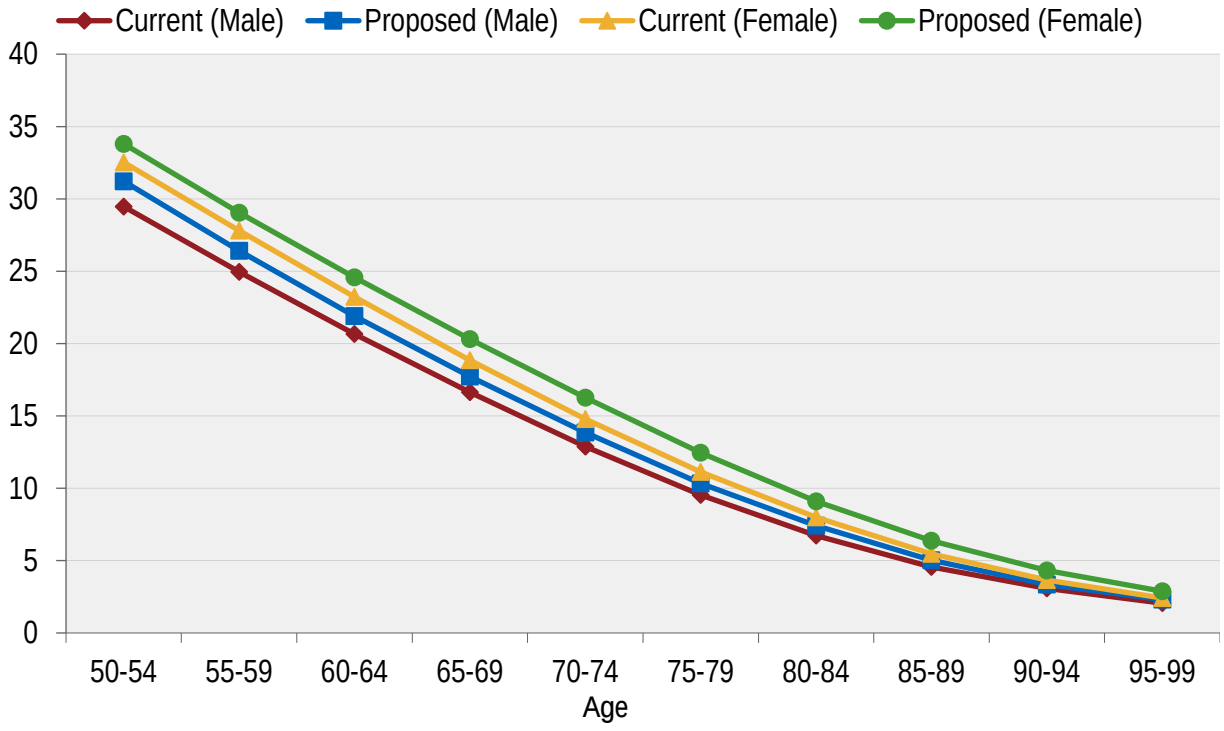


CHART 25: BENEFIT-WEIGHTED LIFE EXPECTANCIES
DISABLED SAFETY MEMBERS



D. Termination Rates

Termination rates include all terminations for reasons other than death, disability, or retirement. Under the current assumptions there is an overall incidence of termination assumed, combined with an assumption that a member will choose between a refund of member contributions and a deferred vested benefit based on which option is more valuable, as measured by its present value at the date of the member's termination.

We recommend maintaining the assumption that a terminating member will elect whichever option has the greater value: a refund of member contributions or a deferred vested benefit.

Currently, there are separate termination assumptions for General and Safety members and they are a function of years of service. We recommend maintaining this assumption structure. The following table shows the observed termination rates for General and Safety members based on the actual experience over the past three years. We have excluded any members that were eligible for retirement. Also shown are the current rates assumed and the rates we propose:

Rates of Termination

	Rates of Termination (%)					
	General			Safety		
Years of Service	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
Less than 1	13.50	16.15	14.00	13.00	7.90	12.50
1 – 2	9.25	9.52	9.50	8.00	13.82	10.00
2 – 3	9.00	9.89	9.25	7.00	8.77	8.25
3 – 4	6.00	7.43	6.50	5.50	5.65	5.75
4 – 5	4.50	7.31	5.25	3.75	7.19	5.00
5 – 6	4.25	6.27	5.00	3.25	6.54	4.25
6 – 7	3.75	6.08	4.50	3.00	3.10	3.50
7 – 8	3.50	5.22	4.25	2.75	5.61	3.25
8 – 9	3.25	4.30	3.75	2.50	4.33	3.00
9 – 10	3.00	4.42	3.50	2.25	1.06	2.50
10 – 11	2.75	3.47	3.25	2.00	2.76	2.25
11 – 12	2.50	6.00	3.00	1.90	3.33	2.10
12 – 13	2.40	3.90	2.75	1.80	2.52	2.00
13 – 14	2.30	2.54	2.50	1.70	4.30	1.90
14 – 15	2.20	4.30	2.50	1.60	1.53	1.80
15 – 16	2.10	2.57	2.25	1.50	1.14	1.70
16 – 17	2.00	3.81	2.25	1.40	2.67	1.60
17 – 18	2.00	2.58	2.00	1.30	1.65	1.50
18 – 19	2.00	3.85	2.00	1.20	0.00	1.25
19 – 20	1.75	3.23	1.75	1.10	1.49	1.00
20 & Over	1.50	1.07	1.25	1.00	0.00	0.75

It is important to note that not every service category has enough exposures and/or decrements such that the results in that category are statistically credible. This is mainly the case for those members with twenty or more years of service since most members with that much service are eligible to retire and were excluded from the experience as mentioned above.

As shown above, we are recommending overall increases in the termination rates for both General and Safety members.

The actual number of terminations over the three-year period was higher than what was assumed. We also examined the prior three-year experience period and we believe that the combined average result of the two three-year experience periods provides a reasonable representation of expected future terminations over the long-term.

Chart 26 compares the actual to expected number of terminations over the past three years for the current and proposed assumptions for General members.

Chart 27 compares the actual experience over the past three years with the current and proposed rates of termination for General members. The chart also shows the actual experience based on an average of both the current and previous three-year experience periods.

Chart 28 compares the actual to expected number of terminations over the past three years for the current and proposed assumptions for Safety members.

Chart 29 compares the actual experience over the past three years with the current and proposed rates of termination for Safety members. The chart also shows the actual experience based on an average of both the current and previous three-year experience periods.

Currently, termination rates are not applied for members assumed to retire, that is, we assume that members eligible to retire at termination will retire in accordance with the retirement rate assumptions rather than terminate and defer their benefit. The actual termination experience over the three-year period shows that there are some terminations occurring for members eligible to retire.

We recommend maintaining the assumption that members who are assumed to retire will elect to receive their retirement benefit in lieu of a deferred vested benefit.

CHART 26: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – GENERAL MEMBERS

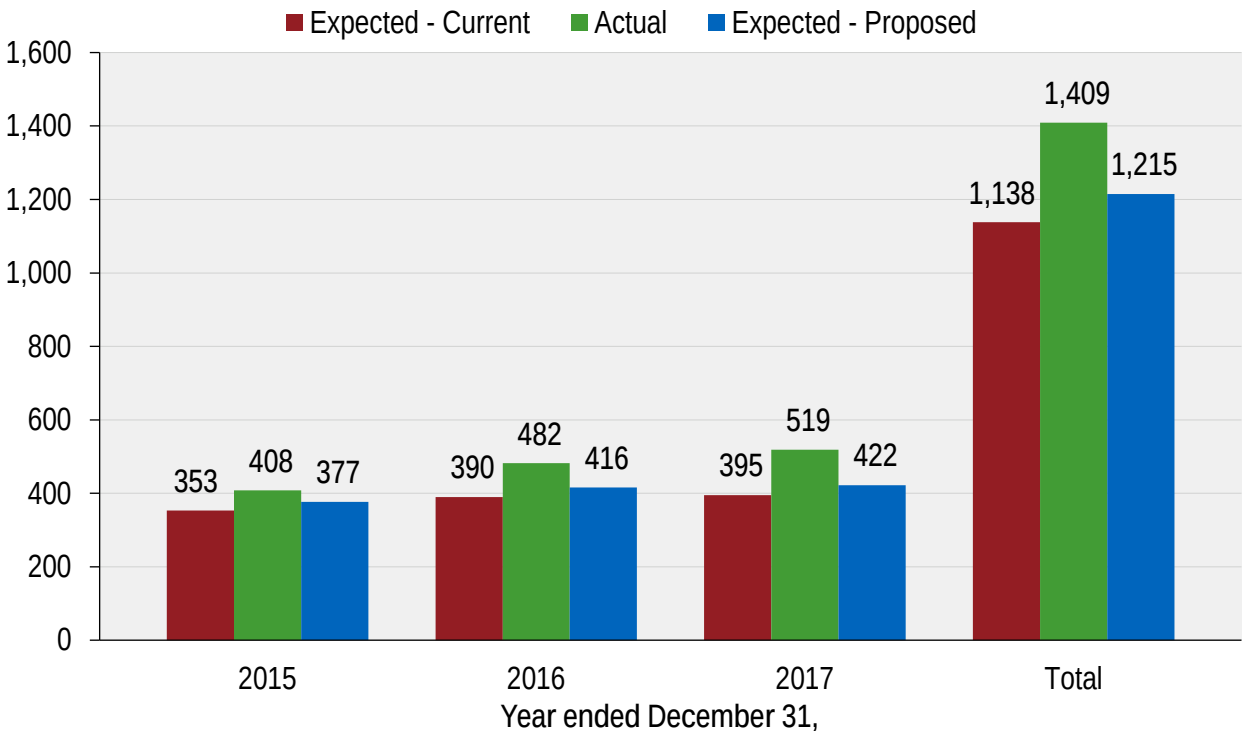


CHART 27: TERMINATION RATES – GENERAL MEMBERS

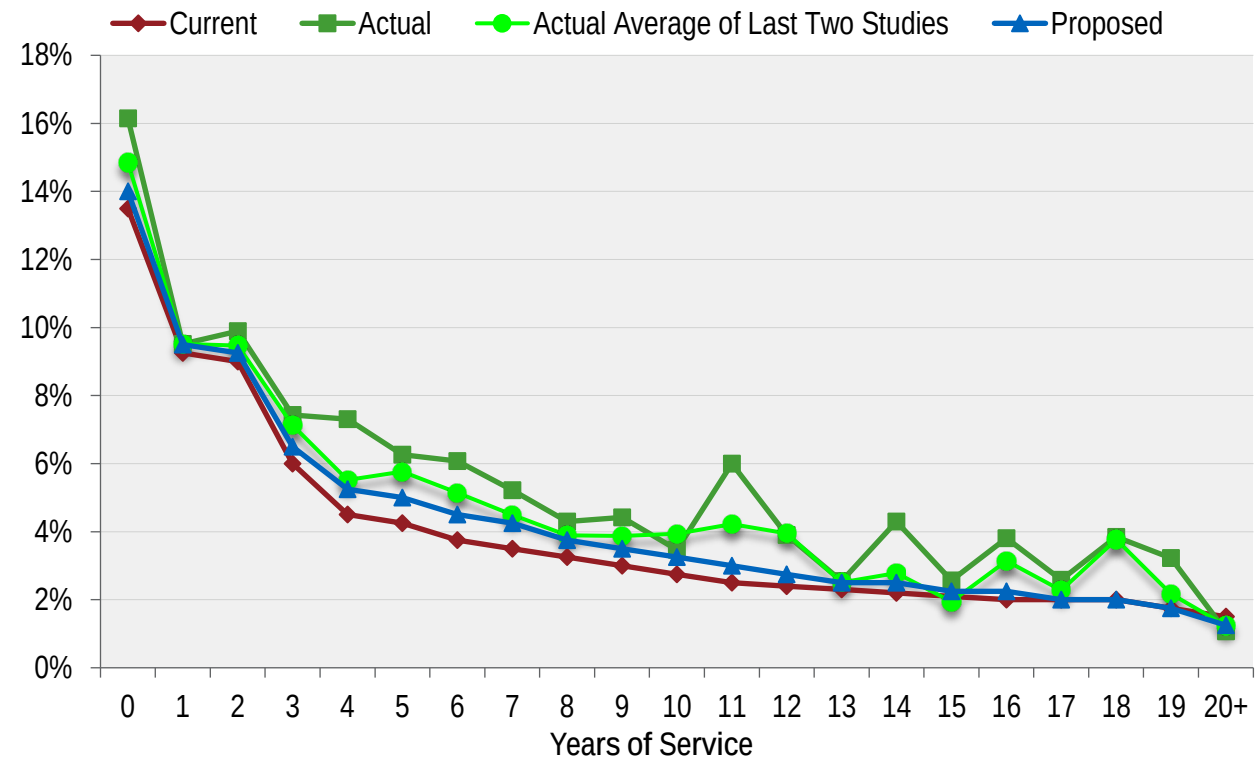


CHART 28: ACTUAL NUMBER OF TERMINATIONS COMPARED TO EXPECTED – SAFETY MEMBERS

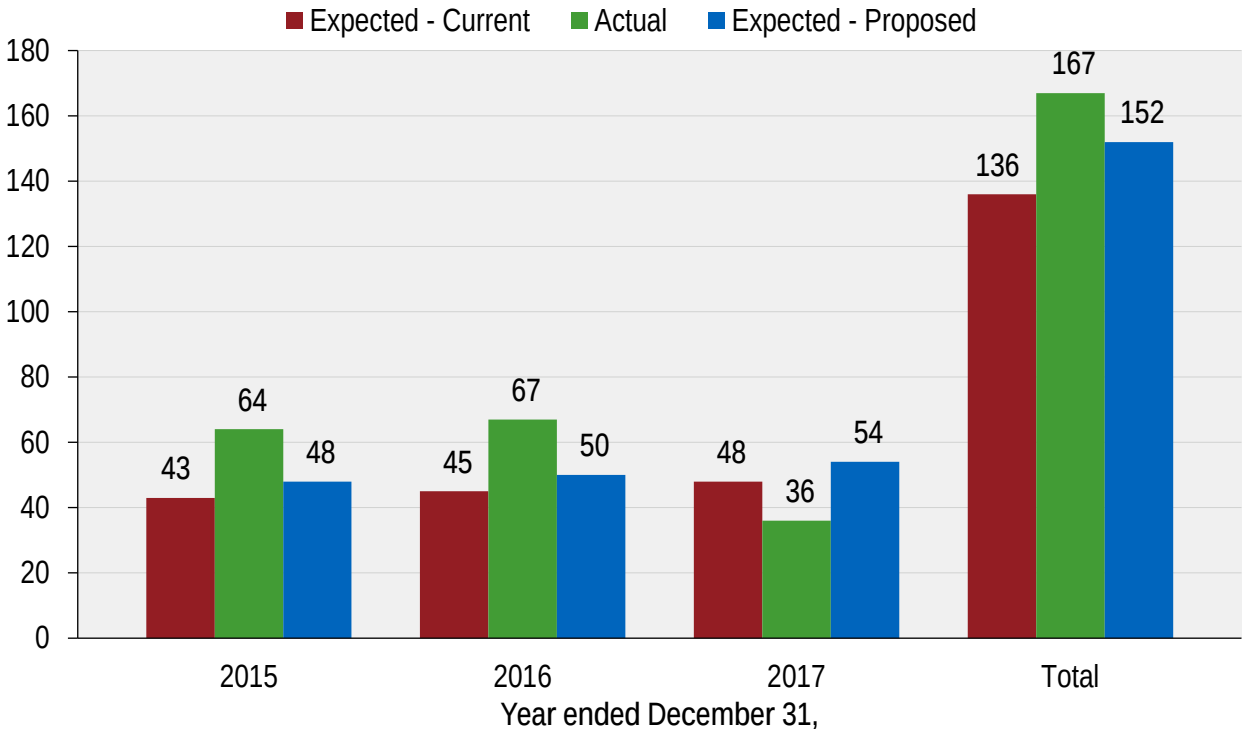
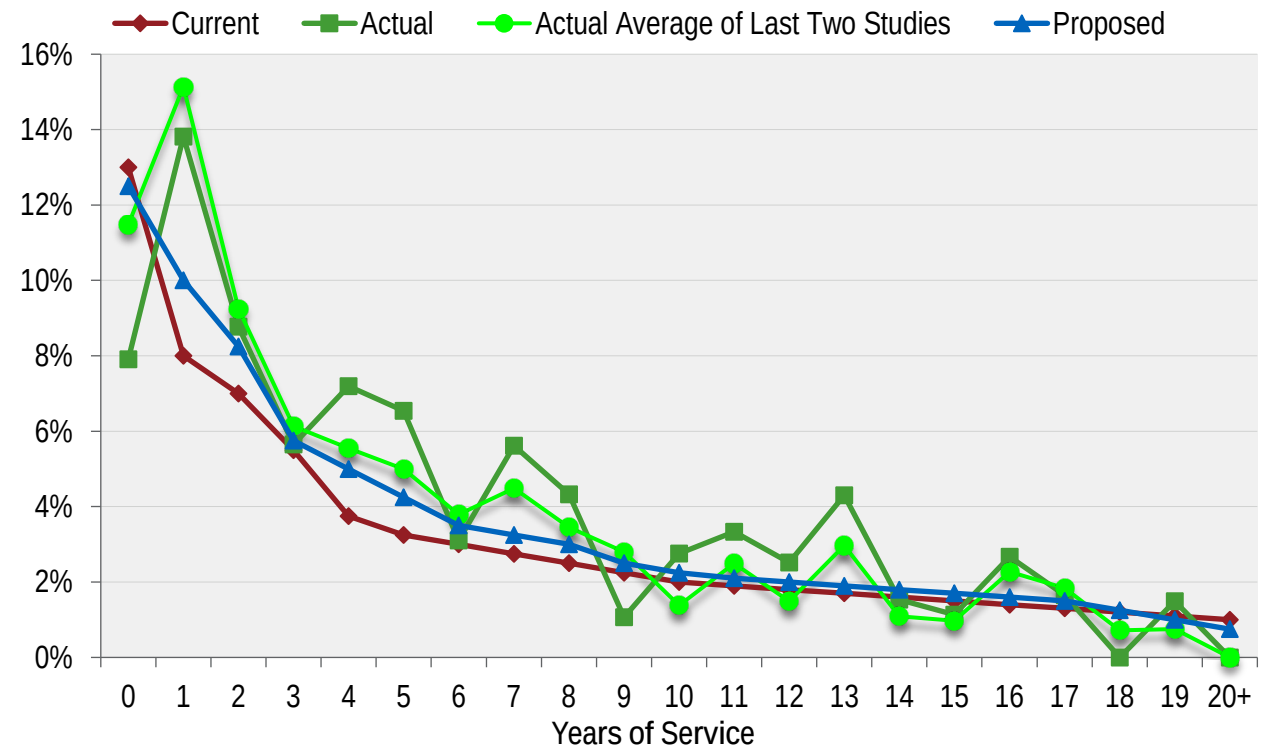


CHART 29: TERMINATION RATES – SAFETY MEMBERS



E. Disability Incidence Rates

When a member becomes disabled, he or she may be entitled to at least 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 table shows the observed combined service and non-service disability incidence rates based on the actual experience over the past three years. Also shown are the current rates assumed and the rates we propose:

Disability Incidence – General

	Disability Incidence Rate (%)*					
	General Tier 1 and Tier 4			General Tier 3 and Tier 5		
Age	Current Rate	Actual Rate	Proposed Rate	Current Rate	Actual Rate	Proposed Rate
20 – 24	0.01	0.00	0.01	0.01	0.00	0.01
25 – 29	0.02	0.00	0.02	0.02	0.00	0.02
30 – 34	0.05	0.00	0.05	0.04	0.00	0.04
35 – 39	0.10	0.00	0.10	0.06	0.04	0.06
40 – 44	0.30	0.00	0.30	0.10	0.11	0.10
45 – 49	0.40	1.34	0.40	0.15	0.09	0.12
50 – 54	0.60	0.00	0.60	0.16	0.03	0.14
55 – 59	0.60	0.00	0.60	0.22	0.17	0.18
60 – 64	0.60	0.51	0.60	0.32	0.14	0.25
65 – 69	0.60	1.67	0.60	0.32	0.00	0.25
70 – 74	0.60	8.33	0.60	0.32	0.00	0.25

* Total rates for service and non-service connected disabilities

As shown above, we are recommending maintaining the disability incidence rates for General Tier 1 and Tier 4 members. We are also recommending overall decreases in the disability incidence rates for General Tier 3 and 5 members.

Disability Incidence – Safety

Age	Disability Incidence Rate (%)*		
	Safety		
	Current Rate	Actual Rate	Proposed Rate
20 – 24	0.10	0.00	0.10
25 – 29	0.30	0.00	0.20
30 – 34	0.50	0.15	0.40
35 – 39	0.60	0.29	0.50
40 – 44	0.70	0.63	0.60
45 – 49	1.20	0.55	1.10
50 – 54	4.00	3.18	3.50
55 – 59	5.00	1.76	4.00
60 – 64	5.00	1.35	4.50
65 – 69	5.00	0.00	4.50

* Total rates for service and non-service connected disabilities

As shown above, we are recommending overall decreases in the disability incidence rates for Safety members.

The actual disability incidence experience during the current three-year period was lower than expected. The recommended disability incidence rates were reduced to reflect some of that experience. We will continue to monitor this experience in future experience studies and make further reductions as necessary.

The observed percentage of members over the past three-year period that received a service connected disability is shown in the table below. Also shown are the current percentage assumed and the percentage we propose.

Percentage of Members Receiving a Service Connected Disability			
	General Tier 1 and Tier 4	General Tier 3 and Tier 5	Safety
Percent Receiving Service Connect Disabilities	57%	31%	94%
Current Assumption	65%	30%	100%
Proposed Assumption	**60%**	**30%**	**100%**

As shown above, we recommend decreasing the assumption from 65% to 60% of General Tier 1 and Tier 4 disabled members will receive a service connected disability. The remaining 40% of General disabled members will be assumed to receive a non-service connected disability.

We also recommend maintaining the assumption that 30% of General Tier 3 and Tier 5 members and 100% of Safety members will receive a service connected disability. The

remaining 70% of General Tier 3 and Tier 5 members will be assumed to receive a non-service connected disability.

Chart 30 compares the actual to expected number of disabilities over the past three years for the current and proposed assumptions for General Tier 1 and Tier 4 members.

Chart 31 compares the actual experience over the past three years with the current and proposed rates of disability incidence for General Tier 1 and Tier 4 members.

Chart 32 compares the actual to expected number of disabilities over the past three years for the current and proposed assumptions for General Tier 3 and Tier 5 members.

Chart 33 compares the actual experience over the past three years with the current and proposed rates of disability incidence for General Tier 3 and Tier 5 members.

Chart 34 compares the actual to expected number of disabilities over the past three years for the current and proposed assumptions for Safety members.

Chart 35 compares the actual experience over the past three years with the current and proposed rates of disability incidence for Safety members.

CHART 30: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED – GENERAL TIER 1 AND TIER 4 MEMBERS

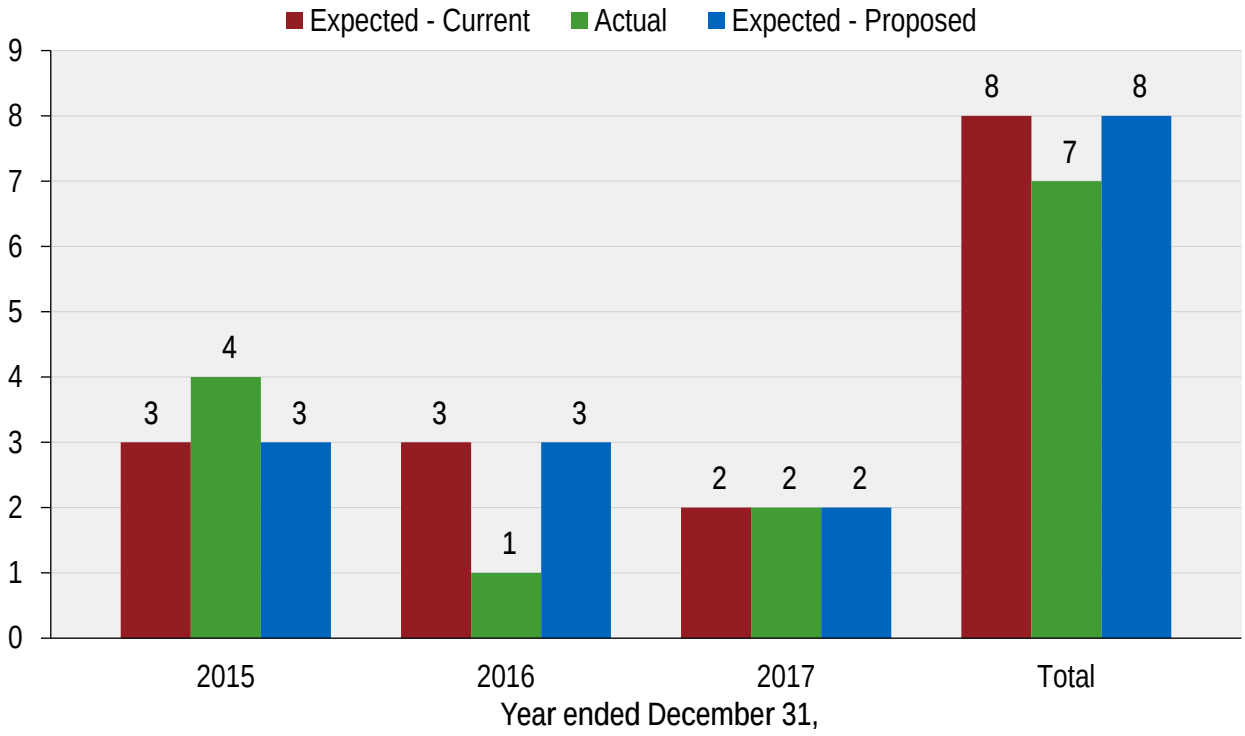


CHART 31: DISABILITY INCIDENCE RATES – GENERAL TIER 1 AND TIER 4 MEMBERS

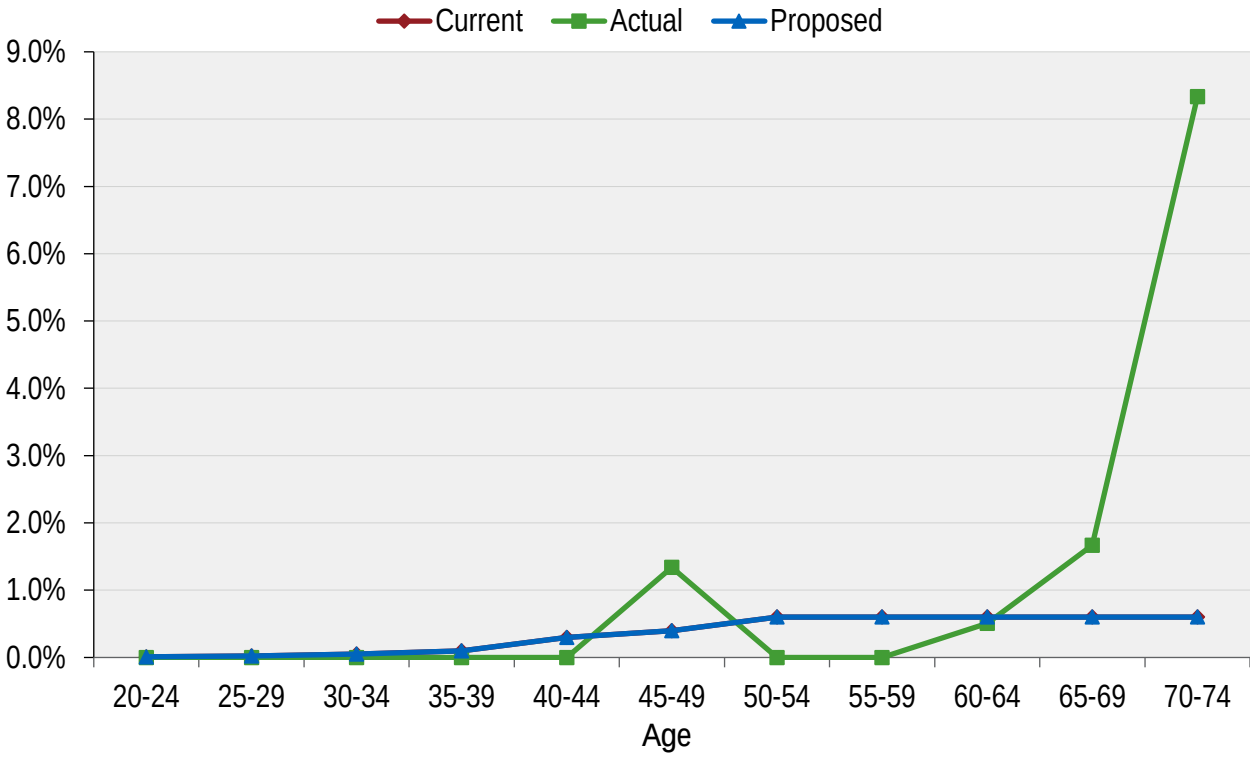


CHART 32: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED – GENERAL TIER 3 AND TIER 5 MEMBERS

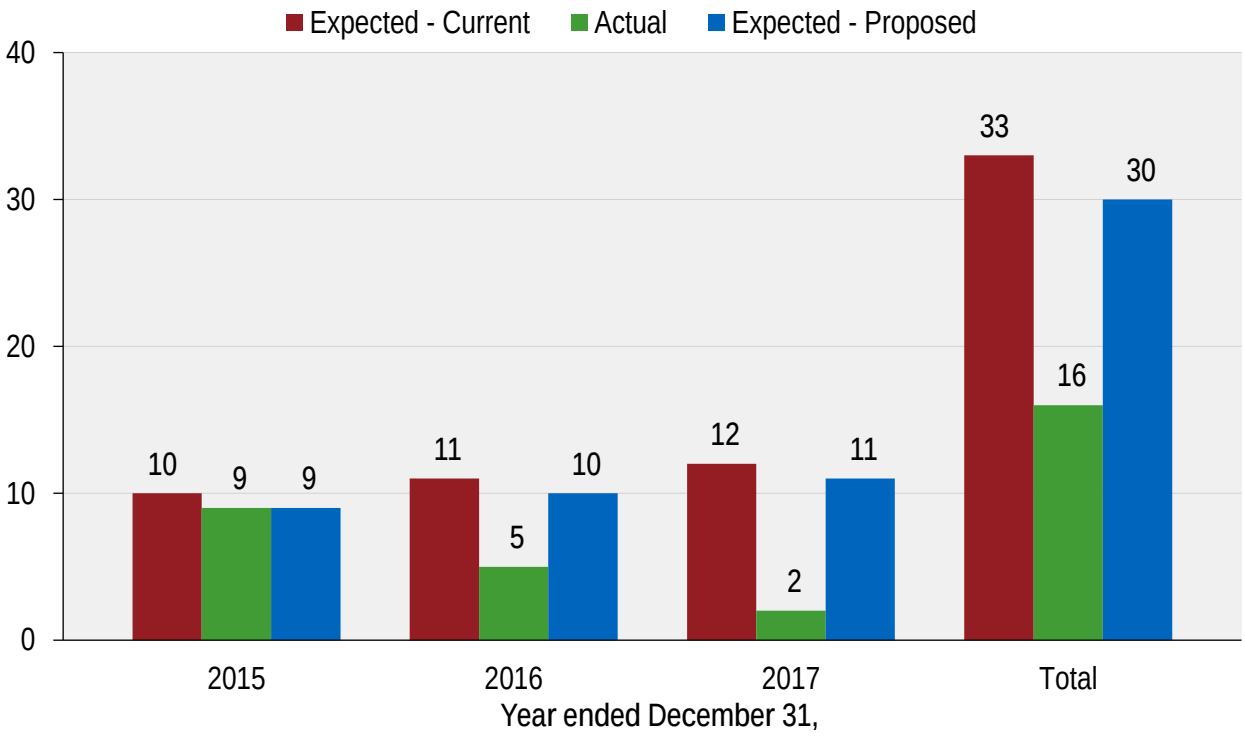


CHART 33: DISABILITY INCIDENCE RATES – GENERAL TIER 3 AND TIER 5 MEMBERS

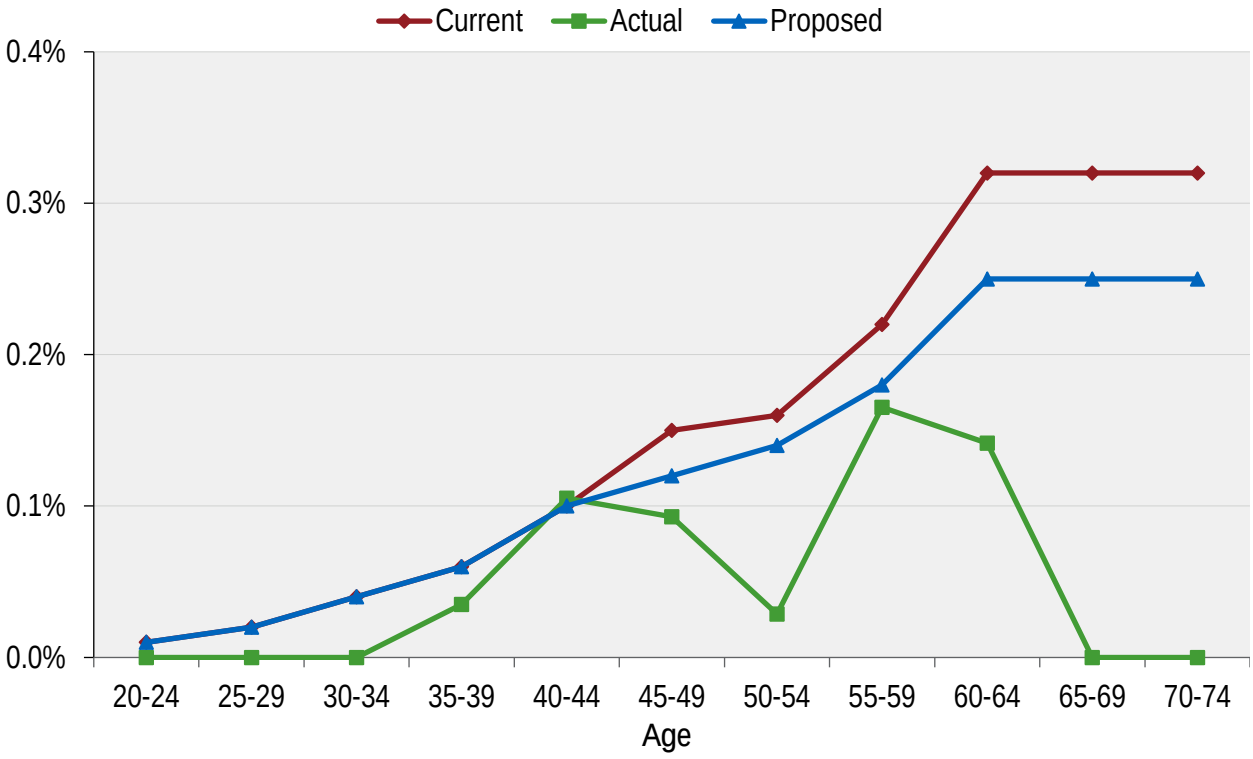


CHART 34: ACTUAL NUMBER OF DISABILITIES COMPARED TO EXPECTED –SAFETY MEMBERS

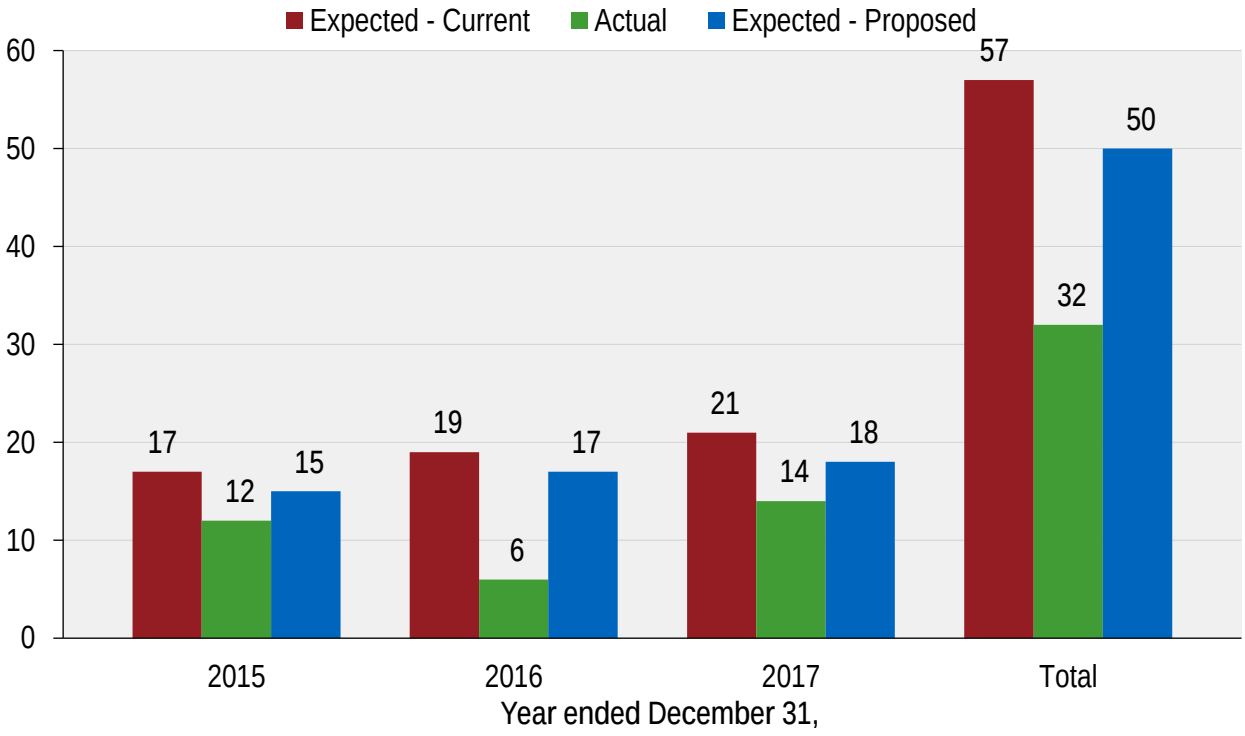
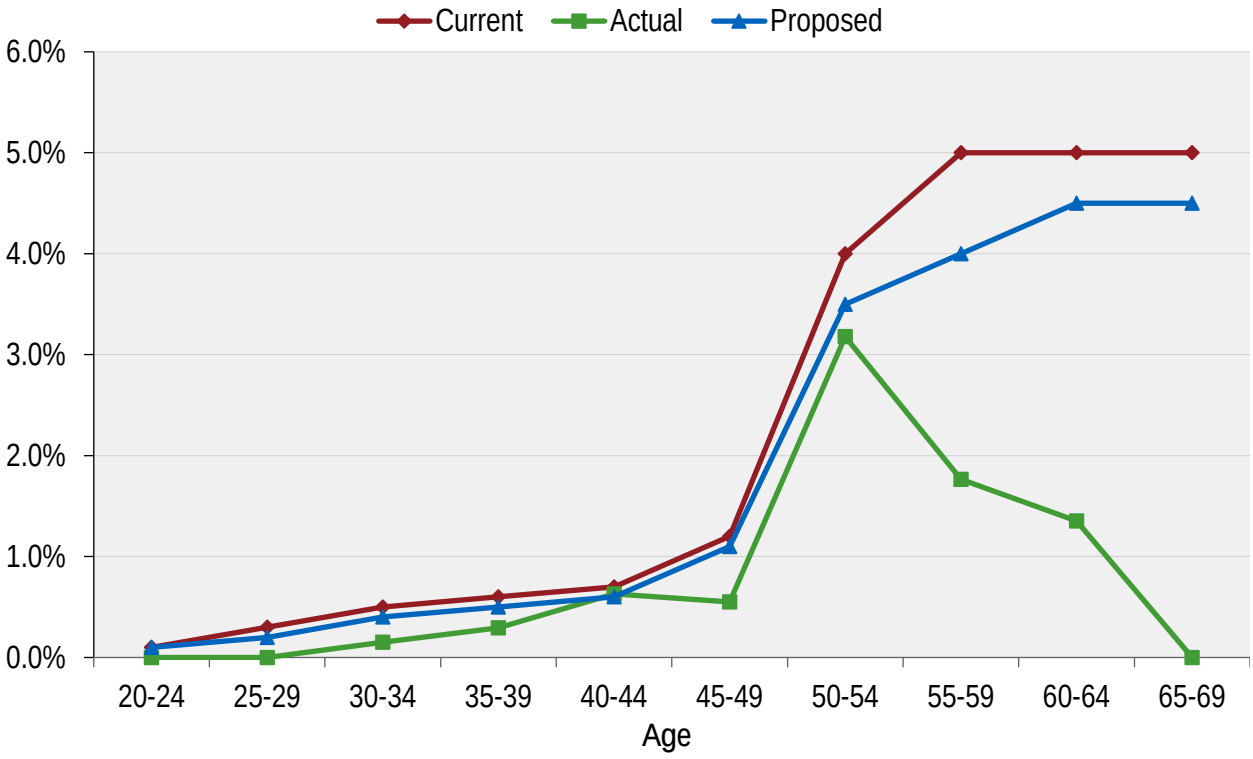


CHART 35: DISABILITY INCIDENCE RATES – SAFETY MEMBERS



F. Leave Cashouts

In 1998, the Board of Retirement, in the course of actions related to the Paulson Settlement, determined that several additional pay elements should be included as Earnable Compensation. These additional pay elements fall into two categories:

- Ongoing Pay Elements – Those that are expected to be received relatively uniformly over a member's employment years; and
- Leave Cashout Elements – Those that are expected to be received mostly 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 a separate actuarial assumption to anticipate its impact on a member's retirement benefit. Note that members in the PEPRA tiers do not have a leave cashout assumption, because leave cashout elements are not included in pensionable compensation under the PEPRA formulas.

AB 197 required CCCERA to implement a policy where certain terminal pay elements are no longer included in the determination of compensation for retirement purposes. This applies to all legacy tiers. In addition, the Board decided to discontinue "straddling" where employees could time their leave cashouts so that two leave cashouts would occur during their 12-month final average earnings period. The Board decided that only one such payment should be included on a prospective basis.

The cost of this pay element is recognized in the valuation as an employer and member cost in both the basic and COLA components.

The following tables show the estimated leave cashouts for non-PEPRA members as a percentage of current pay based on actual experience over the past three years. The leave cashouts shown are only those that occur during the member's final average earnings period.

The results are summarized by cost group followed by a key showing the employers in each cost group. Also shown are the current rate assumed and the rates we propose.

It is not always clear from the member data how much additional leave is cashed out in the years right before retirement as compared to what is cashed out in earlier years of service. Our recommended leave cashout assumptions are set based on what is reported during the final average earnings period, which implicitly assumes no leave cashouts prior to that period. However, in some cases we have reduced the assumptions to account for some possibility of leave cashouts occurring in earlier years.

	Average Leave Cashout as a % of Final Average Pay (Excluding such Leave Cashout) by Cost Group						
Year	Cost Group #1	Cost Group #2 (Tier 2)	Cost Group #2 (Tier 3)	Cost Group #3	Cost Group #4	Cost Group #5	Cost Group #6
2015	0.95%	0.33%	0.55%	1.56%	0.86%	0.00%	0.00%
2016	0.87%	0.36%	0.43%	3.59%	0.72%	5.74%	N/A
2017	1.01%	0.39%	0.49%	5.41%	0.00%	0.00%	0.00%
Average	**0.93%**	**0.36%**	**0.49%**	**4.18%**	**0.64%**	**1.91%**	**0.00%**
Retiring Member Count							
2015	15	118	186	5	7	2	2
2016	28	124	187	13	4	2	0
2017	18	146	249	17	3	2	1
Average	61	388	622	35	14	6	3
Current Assumption	**1.25%**	**0.50%**	**1.00%**	**5.50%**	**0.50%**	**1.00%**	**0.75%**
Proposed Assumption	**1.00%**	**0.50%**	**0.75%**	**4.75%**	**0.50%**	**1.25%**	**0.25%**

	Average Leave Cashout as a % of Final Average Pay (Excluding such Leave Cashout) by Cost Group						
Year	Cost Group #7	Cost Group #8	Cost Group #9	Cost Group #10	Cost Group #11	Cost Group #12	Terminated Employers
2015	0.66%	0.00%	0.00%	0.00%	2.36%	N/A	0.00%
2016	0.49%	1.55%	0.00%	0.00%	3.63%	N/A	N/A
2017	0.40%	0.27%	0.00%	0.00%	3.18%	N/A	0.00%
Average	**0.49%**	**0.51%**	**0.00%**	**0.00%**	**3.00%**	**N/A**	**0.00%**
Retiring Member Count							
2015	19	2	3	1	3	0	1
2016	30	4	1	3	1	0	0
2017	35	13	2	2	7	0	2
Average	84	19	6	6	11	0	3
Current Assumption	**1.00%**	**0.75%**	**0.00%**	**1.00%**	**2.50%**	**2.50%**	**0.00%**
Proposed Assumption	**0.75%**	**0.50%**	**0.00%**	**0.50%**	**2.50%**	**2.00%**	**0.00%**

As shown above, we are recommending adjustments in the leave cashout assumptions for most cost groups. The recommended assumptions will anticipate slightly lower leave cashouts overall.

General

Summary of Cost Groups and Employers		
Cost Group	**Employer Name**	**Benefit Structure**
(1)	County General	Tier 1 Enhanced/PEPRA Tier 4
	Local Agency Formation Commission	Tier 1 Enhanced/PEPRA Tier 4
	Contra Costa Mosquito and Vector Control District	Tier 1 Enhanced/PEPRA Tier 4
	Bethel Island Municipal District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
	First 5-Children & Families Commission	Tier 1 Enhanced/PEPRA Tier 4
	Contra Costa County Employees' Retirement Association	Tier 1 Enhanced/PEPRA Tier 4
	Superior Court	Tier 1 Enhanced/PEPRA Tier 4
	East Contra Costa Fire Protection District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
	Moraga-Orinda Fire District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
	Rodeo-Hercules Fire Protection District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
	San Ramon Valley Fire District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
(2)	County General	Tier 3 Enhanced/PEPRA Tier 5
	In-Home Supportive Services Authority	Tier 3 Enhanced/PEPRA Tier 5
	Contra Costa Mosquito and Vector Control District	Tier 3 Enhanced/PEPRA Tier 5
	Superior Court	Tier 3 Enhanced/PEPRA Tier 5
(3)	Central Contra Costa Sanitary District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
(4)	Contra Costa Housing Authority	Tier 1 Enhanced/PEPRA Tier 4
(5)	Contra Costa County Fire Protection District (Non-Integrated)	Tier 1 Enhanced/PEPRA Tier 4
(6)	Rodeo Sanitary District	Tier 1 Non-Enhanced/PEPRA Tier 4
	Byron Brentwood Cemetery	Tier 1 Non-Enhanced/PEPRA Tier 4

Safety

Summary of Cost Groups and Employers		
Cost Group	**Employer Name**	**Benefit Structure**
(7)	County Safety	Tier A Enhanced/PEPRA Tier D
(8)	Contra Costa County Fire Protection District	Tier A Enhanced/PEPRA Tier D/E
	East Contra Costa Fire Protection District	Tier A Enhanced/PEPRA Tier D
(9)	County Safety	Tier C Enhanced/PEPRA Tier E
		(Members hired on or after January 1, 2007)
(10)	Moraga-Orinda Fire District	Tier A Enhanced/PEPRA Tier D
(11)	San Ramon Valley Fire District	Tier A Enhanced/PEPRA Tier D
(12)	Rodeo-Hercules Fire Protection District	Tier A Non-Enhanced/PEPRA Tier D

G. Service from Unused Sick Leave

At retirement, members can convert their unused sick leave to increase the service credit used in the calculation of their retirement benefit. The actuarial valuation anticipates this additional benefit using an assumption to estimate the proportional increase in service that will occur due to unused sick leave conversions.

Pursuant to Section 31641.01, the cost of this benefit for the non-PEPRA tiers will be charged only to employers and will not affect member contribution rates.

The following table shows the estimated sick leave converted to service credit as a percentage of total service credit (before including the sick leave converted to service credit) at retirement separately for General and Safety members as well as non-disabled and disabled members, based on the actual experience over the past three years. Also shown are the current rates assumed and the rates we propose:

	Sick Leave Converted to Service Credit as Percentage of Total Service (Before Including the Sick Leave to be Converted)			
	Non-Disabled Retirees		Disabled Retirees	
Year	General	Safety	General	Safety
2015	0.75%	1.45%	0.03%	0.60%
2016	0.64%	1.18%	0.00%	0.83%
2017	0.77%	1.33%	0.00%	0.09%
Weighted Average	**0.72%**	**1.31%**	**0.02%**	**0.42%**
Weighted Average From Prior Study	**0.95%**	**1.81%**	**0.06%**	**1.37%**
Current Assumption	**1.20%**	**1.90%**	**0.08%**	**1.30%**
Proposed Assumption	**1.10%**	**1.80%**	**0.06%**	**1.20%**

As shown above, we recommend decreasing the current sick leave conversion assumption for all non-disabled and disabled members.

V. Cost Impact

We have estimated the impact of all the recommended demographic and economic assumptions as if they were applied to the December 31, 2017 actuarial valuation. The table below shows the changes in the employer and member contribution rates due to the proposed assumption changes separately for the recommended demographic assumption changes (as recommended in Section IV of this report) and the recommended economic assumption changes (as recommended in Section III of this report).

Cost Impact of the Recommended Assumptions Based on December 31, 2017 Actuarial Valuation	
Impact on Employer	
Change due to demographic assumptions	-1.14%
Change due to economic assumptions	-0.08%
Total change in average employer rate	-1.22%
Total estimated change in annual dollar amount ($000s)	$(10,187)
Impact on Member	
Change due to demographic assumptions	0.00%
Change due to economic assumptions	0.00%
Total change in average member rate	0.00%
Total estimated change in annual dollar amount ($000s)	$146[24]
Impact on UAAL and Funded Percentage	
Change in UAAL	Decrease of $83 million
Change in funded percentage	From 88.5% to 89.3%

Of the various demographic assumption changes, the most significant cost impact is from the mortality assumption change followed by the retirement assumption change. The mortality assumption change results in an increase in the employer contribution rate for General and a decrease for Safety. The only economic assumption change is in the merit and promotion component of the salary increase assumption.

We have also analyzed in the tables below the average employer and member contribution rate impacts by each Cost Group due to the recommended assumption changes as if they were applied to the December 31, 2017 actuarial valuation.

While the information in this table is combined for legacy (non-PEPRA) tiers and PEPRA tiers, there are generally small increases in member rates for legacy (non-PEPRA) tiers and slightly larger decreases for PEPRA tiers.

[24] Even though there is no change in the average member rate as a percent of pay, there is an increase in estimated total member contributions in dollars. The increase in estimated contribution dollars is due to larger projected payroll under the recommended assumptions.

Employer Contribution Rate Impact (% of Payroll)				
Cost Group	Normal Cost	UAAL	Total	Estimated Dollar Amounts ($ in '000s)[25]
General				
Cost Group #1 – County and Small Districts (Tier 1 and 4)	-0.52%	-0.10%	-0.62%	$(154)
Cost Group #2 – County and Small Districts (Tier 3 and 5)	-0.36%	-0.06%	-0.42%	(2,547)
Cost Group #3 – Central Contra Costa Sanitary District	-0.66%	0.22%	-0.44%	(147)
Cost Group #4 – Contra Costa Housing Authority	-0.42%	0.00%	-0.42%	(24)
Cost Group #5 – Contra Costa County Fire Protection District	-0.42%	0.75%	0.33%	17
Cost Group #6 – Small Districts (Non-Enhanced Tier 1 and 4)	-0.55%	-0.02%	-0.57%	(5)
Safety				
Cost Group #7 – County (Tier A and D)	-0.94%	-3.78%	-4.72%	$(2,790)
Cost Group #8 – Contra Costa and East Fire Protection Districts	-0.79%	-4.85%	-5.64%	(1,941)
Cost Group #9 – County (Tier C and E)	-0.48%	-3.78%	-4.26%	(1,378)
Cost Group #10 – Moraga-Orinda Fire District	-0.72%	-4.30%	-5.02%	(356)
Cost Group #11 – San Ramon Valley Fire District	-0.50%	-3.35%	-3.85%	(780)
Cost Group #12 – Rodeo-Hercules Fire Protection District	-0.75%	-3.20%	-3.95%	(81)
All Cost Groups Combined	**-0.44%**	**-0.78%**	**-1.22%**	**$(10,187)**

Member Contribution Rate Impact (% of Payroll)		
Cost Group	Total	Estimated Dollar Amounts ($ in '000s)[25]
General		
Cost Group #1 – County and Small Districts (Tier 1 and 4)	-0.03%	$(8)
Cost Group #2 – County and Small Districts (Tier 3 and 5)	0.00%	56
Cost Group #3 – Central Contra Costa Sanitary District	-0.09%	(30)
Cost Group #4 – Contra Costa Housing Authority	-0.02%	(1)
Cost Group #5 – Contra Costa County Fire Protection District	-0.01%	(0)
Cost Group #6 – Small Districts (Non-Enhanced Tier 1 and 4)	0.06%	0
Safety		
Cost Group #7 – County (Tier A and D)	0.06%	$62
Cost Group #8 – Contra Costa and East Fire Protection Districts	0.05%	36
Cost Group #9 – County (Tier C and E)	-0.17%	(25)
Cost Group #10 – Moraga-Orinda Fire District	0.08%	9
Cost Group #11 – San Ramon Valley Fire District	0.15%	44
Cost Group #12 – Rodeo-Hercules Fire Protection District	0.10%	3
All Cost Groups Combined	**0.00%**	**$146**

[25] Based on December 31, 2017 projected annual payroll as determined using all of the proposed assumptions.

Appendix A: Current Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.00%, net of investment expenses.
Administrative Expenses:	Actual administrative expenses as a percentage of payroll allocated to both the employer and the member based on normal cost (before expenses) for the employer and member. This assumption changes each year based on the actual administrative expenses and actual payroll. The administrative expense load was 1.13% of payroll based on the December 31, 2017 actuarial valuation.
Employee Contribution Crediting Rate:	7.00%, compounded semi-annually
Consumer Price Index:	Increase of 2.75% per year; retiree COLA increases due to CPI subject to a 3.00% maximum change per year (valued as a 2.75% increase) except for Tier 3 and PEPRA Tier 5 disability benefits and Tier 2 benefits which are subject to a 4.00% maximum change per year (valued as a 2.75% increase). Safety Tier C benefits, Safety PEPRA Tier E benefits and benefits for PEPRA Tier 4 and Tier 5 members covered under certain memoranda of understanding are subject to a 2.00% maximum change per year. For members that have COLA banks, they are reflected in projected future COLAs. The actual COLA granted by CCCERA on April 1, 2018 has been reflected for nonactive members in the December 31, 2017 valuation.
Payroll Growth:	Inflation of 2.75% per year plus “across the board” real salary increases of 0.50% per year.
Increase in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 2.75% per year from the valuation date.
Increase in Section 7522.10 Compensation Limit:	Increase of 2.75% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 2.75% per year; plus "across the board" real salary increases of 0.50% per year; plus the following merit and promotion increases:		
Years of Service	**General**	**Safety**
Less than 1	10.00	10.50
1 – 2	7.25	7.25
2 – 3	5.25	5.75
3 – 4	3.75	4.50
4 – 5	2.75	3.00
5 – 6	2.25	1.75
6 – 7	1.75	1.25
7 – 8	1.50	1.20
8 – 9	1.25	1.15
9 – 10	1.20	1.10
10 – 11	1.15	1.05
11 – 12	1.10	1.00
12 – 13	1.00	0.95
13 – 14	0.90	0.85
14 – 15	0.80	0.80
15 – 16	0.75	0.75
16 – 17	0.75	0.75
17 – 18	0.75	0.75
18 – 19	0.75	0.75
19 – 20	0.75	0.75
20 & Over	0.75	0.75

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

- **General Members and all Beneficiaries:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table, projected generationally with the two-dimensional scale MP-2015.
- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table set back three years, projected generationally with the two-dimensional scale MP-2015.

Post-Retirement Mortality Rates – Disabled

- **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table set forward eight years, projected generationally with the two-dimensional scale MP-2015.
- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table set forward three years, projected generationally with the two-dimensional scale MP-2015.

Member Contribution Rates

- **General Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table, projected to 2034 with the two-dimensional scale MP-2015, weighted 30% male and 70% female.

- **Safety Members:** Headcount-Weighted RP-2014 Healthy Annuitant Mortality Table set back three years, projected to 2034 with the two-dimensional scale MP-2015, weighted 85% male and 15% female.

Pre-Retirement Mortality Rates

- **General and Safety Members:** Headcount-Weighted RP-2014 Employee Mortality Table multiplied by 75%, projected generationally with the two-dimensional scale MP-2015.

	Rate (%)*			
	General		Safety	
Age	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	0.09	0.06	0.09	0.06
50	0.16	0.10	0.16	0.10
55	0.26	0.16	0.26	0.16
60	0.42	0.23	0.42	0.23
65	0.73	0.33	0.73	0.33

* *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.

Disability Incidence Rates

	Rate (%)		
Age	General Tier 1 and Tier 4	General Tier 3 and Tier 5	Safety
20	0.01	0.01	0.02
25	0.02	0.02	0.22
30	0.04	0.03	0.42
35	0.08	0.05	0.56
40	0.22	0.08	0.66
45	0.36	0.13	1.00
50	0.52	0.16	2.88
55	0.60	0.20	4.60
60	0.60	0.28	5.00
65	0.60	0.32	5.00
70	0.60	0.32	5.00

65% of General Tier 1 and Tier 4 disabilities are assumed to be duty disabilities. The other 35% are assumed to be ordinary disabilities.

30% of General Tier 3 and Tier 5 disabilities are assumed to be duty disabilities. The other 70% are assumed to be ordinary disabilities.

100% of Safety disabilities are assumed to be duty disabilities.

Termination Rates

	Rate (%)	
Years of Service	**General**	**Safety**
Less than 1	13.50	13.00
1 – 2	9.25	8.00
2 – 3	9.00	7.00
3 – 4	6.00	5.50
4 – 5	4.50	3.75
5 – 6	4.25	3.25
6 – 7	3.75	3.00
7 – 8	3.50	2.75
8 – 9	3.25	2.50
9 – 10	3.00	2.25
10 – 11	2.75	2.00
11 – 12	2.50	1.90
12 – 13	2.40	1.80
13 – 14	2.30	1.70
14 – 15	2.20	1.60
15 – 16	2.10	1.50
16 – 17	2.00	1.40
17 – 18	2.00	1.30
18 – 19	2.00	1.20
19 – 20	1.75	1.10
20 & Over	1.50	1.00

The member is assumed to receive the greater of the member's contribution balance or a deferred retirement benefit.

No withdrawal is assumed after a member is first assumed to retire.

Retirement Rates

Age	Rate (%)			
	General			
	Tier 1 Enhanced	Tier 3 Enhanced	Tier 1 Non-Enhanced	PEPRA Tier 4 and Tier 5
50	5.00	4.00	3.00	0.00
51	4.00	3.00	3.00	0.00
52	5.00	3.00	3.00	2.00
53	5.00	5.00	3.00	3.00
54	14.00	6.00	3.00	3.00
55	20.00	10.00	10.00	5.00
56	20.00	10.00	10.00	5.00
57	20.00	10.00	10.00	6.00
58	20.00	12.00	10.00	8.00
59	25.00	13.00	10.00	9.00
60	28.00	15.00	25.00	10.00
61	35.00	20.00	15.00	14.00
62	35.00	25.00	40.00	20.00
63	30.00	25.00	35.00	20.00
64	30.00	30.00	30.00	20.00
65	35.00	35.00	40.00	25.00
66	40.00	35.00	35.00	30.00
67	40.00	35.00	35.00	30.00
68	40.00	35.00	35.00	30.00
69	40.00	35.00	35.00	30.00
70	50.00	40.00	50.00	50.00
71	50.00	40.00	50.00	50.00
72	50.00	40.00	50.00	50.00
73	50.00	40.00	50.00	50.00
74	50.00	40.00	50.00	50.00
75 & Over	100.00	100.00	100.00	100.00

Retirement Rates

Age	Rate (%)			
	Safety			
	Tier A Enhanced	Tier C Enhanced	Tier A Non-Enhanced	PEPRA Tier D and Tier E
45	4.00	2.00	0.00	0.00
46	3.00	1.00	0.00	0.00
47	10.00	4.00	0.00	0.00
48	10.00	4.00	0.00	0.00
49	25.00	12.00	0.00	0.00
50	30.00	18.00	5.00	5.00
51	30.00	18.00	4.00	4.00
52	25.00	15.00	4.00	4.00
53	25.00	15.00	5.00	5.00
54	25.00	15.00	8.00	6.00
55	28.00	18.00	10.00	10.00
56	25.00	15.00	10.00	10.00
57	25.00	15.00	12.00	18.00
58	35.00	25.00	18.00	18.00
59	35.00	25.00	20.00	18.00
60	35.00	30.00	20.00	18.00
61	35.00	30.00	20.00	20.00
62	35.00	30.00	20.00	20.00
63	35.00	30.00	20.00	20.00
64	50.00	40.00	100.00	30.00
65	100.00	100.00	100.00	30.00
66 & Over	100.00	100.00	100.00	100.00

Retirement Age and Benefit for Deferred Vested Members:	For current and future deferred vested members, retirement assumptions are as follows: General Age: 59 Safety Age: 54 We assume that 40% and 65% of future General and Safety deferred vested members, respectively, will continue to work for a reciprocal employer. For reciprocals, we assume 4.75% compensation increases per annum.
Future Benefit Accruals:	1.0 year of service per year for full-time employees. Continuation of current partial service accrual for part-time employees.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Percent Married:	75% of male members and 50% of female members are assumed to be married at retirement or pre-retirement death and to select Unmodified option. There is no explicit assumption for children's benefits.
Age of Spouse:	Male retirees are 3 years older than their spouses, and Female retirees are 2 years younger than their spouses.

Offsets by Other Plans of the Employer for Disability Benefits:	The Plan requires members who retire because of disability from General Tier 3 and PEPRA General Tier 5 to offset the Plan's disability benefits with other Plans of the employer. We have not assumed any offsets in this valuation.
Leave Cashout Assumptions:	The following assumptions for leave cashouts as a percentage of final average pay are used: *General Tiers 1, 2 and 3 Safety Tiers A and C* Cost Group 1 1.25% Cost Group 2 0.50% for Tier 2 1.00% for Tier 3 Cost Group 3 5.50% Cost Group 4 0.50% Cost Group 5 1.00% Cost Group 6 0.75% Cost Group 7 1.00% Cost Group 8 0.75% Cost Group 9 0.00% Cost Group 10 1.00% Cost Group 11 2.50% Cost Group 12 2.50% *PEPRA General Tiers 4 and 5 PEPRA Safety Tiers D and E* None
Service From Accumulated Sick Leave Conversion:	The following assumptions for additional service converted from accumulated sick leave as a percentage of service at retirement are used: *Service Retirements:* General: 1.20% Safety: 1.90% *Disability Retirements:* General: 0.08% Safety: 1.30% Pursuant to Section 31641.01, the cost of this benefit for the non-PEPRA tiers will be charged only to employers and will not affect member contribution rates.

Appendix B: Proposed Actuarial Assumptions

Economic Assumptions

Net Investment Return:	7.00%, net of investment expenses.
Administrative Expenses:	Actual administrative expenses as a percentage of payroll allocated to both the employer and the member based on normal cost (before expenses) for the employer and member. based on normal cost (before expenses) for the employer and member. This assumption changes each year based on the actual administrative expenses and actual payroll. The administrative expense load was 1.13% of payroll based on the December 31, 2017 actuarial valuation.
Employee Contribution Crediting Rate:	7.00%, compounded semi-annually
Consumer Price Index:	Increase of 2.75% per year; retiree COLA increases due to CPI subject to a 3.00% maximum change per year (valued as a 2.75% increase) except for Tier 3 and PEPRA Tier 5 disability benefits and Tier 2 benefits which are subject to a 4.00% maximum change per year (valued as a 2.75% increase). Safety Tier C benefits, Safety PEPRA Tier E benefits and benefits for PEPRA Tier 4 and Tier 5 members covered under certain memoranda of understanding are subject to a 2.00% maximum change per year. For members that have COLA banks, they are reflected in projected future COLAs. The actual COLA granted by CCCERA on April 1, 2018 has been reflected for nonactive members in the December 31, 2017 valuation.
Payroll Growth:	Inflation of 2.75% per year plus “across the board” real salary increases of 0.50% per year.
Increase in Internal Revenue Code Section 401(a)(17) Compensation Limit:	Increase of 2.75% per year from the valuation date.
Increase in Section 7522.10 Compensation Limit:	Increase of 2.75% per year from the valuation date.

Individual Salary Increases

Annual Rate of Compensation Increase (%)		
Inflation: 2.75% per year; plus "across the board" real salary increases of 0.50% per year; plus the following merit and promotion increases:		
Years of Service	**General**	**Safety**
Less than 1	12.00	13.00
1 – 2	7.00	8.00
2 – 3	5.25	5.75
3 – 4	3.75	4.75
4 – 5	2.75	2.75
5 – 6	2.25	2.00
6 – 7	1.75	1.75
7 – 8	1.50	1.50
8 – 9	1.40	1.40
9 – 10	1.30	1.30
10 – 11	1.20	1.25
11 – 12	1.10	1.20
12 – 13	1.00	1.15
13 – 14	0.90	1.10
14 – 15	0.80	1.05
15 – 16	0.75	1.00
16 – 17	0.70	1.00
17 – 18	0.65	1.00
18 – 19	0.60	1.00
19 – 20	0.55	1.00
20 & Over	0.50	1.00

Demographic Assumptions

Post-Retirement Mortality Rates – Healthy

- **General Members:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

- **Safety Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

Post-Retirement Mortality Rates – Disabled

- **General Members:** Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for

females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

- **Safety Members:** Pub-2010 Safety Disabled Retiree Amount-Weighted Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

Mortality Rates – Beneficiaries

- Pub-2010 Contingent Survivor Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and females, projected generationally with the two-dimensional mortality improvement scale MP-2018.

Member Contribution Rates

- **General Members:** Pub-2010 General Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 30% male and 70% female.

- **Safety Members:** Pub-2010 Safety Healthy Retiree Amount-Weighted Above-Median Mortality Table (separate tables for males and females) multiplied by 105% for males and 100% for females, projected 30 years with the two-dimensional mortality improvement scale MP-2018, weighted 85% male and 15% female.

Pre-Retirement Mortality Rates

- **General Members:** Pub-2010 General Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

- **Safety Members:** Pub-2010 Safety Employee Amount-Weighted Above-Median Mortality Table (separate tables for males and females), projected generationally with the two-dimensional mortality improvement scale MP-2018.

Pre-Retirement Mortality Rates (continued)

Age	Rate (%)*			
	General		Safety	
	Male	Female	Male	Female
25	0.02	0.01	0.03	0.02
30	0.03	0.01	0.04	0.02
35	0.04	0.02	0.04	0.03
40	0.06	0.03	0.05	0.04
45	0.09	0.05	0.07	0.06
50	0.13	0.08	0.10	0.08
55	0.19	0.11	0.15	0.11
60	0.28	0.17	0.23	0.14
65	0.41	0.27	0.35	0.20
70	0.61	0.44	0.66	0.39

* *Generational projections beyond the base year (2010) are not reflected in the above mortality rates.*

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

Disability Incidence Rates

Age	Rate (%)		
	General Tier 1 and Tier 4	General Tier 3 and Tier 5	Safety
20	0.01	0.01	0.02
25	0.02	0.02	0.16
30	0.04	0.03	0.32
35	0.08	0.05	0.46
40	0.22	0.08	0.56
45	0.36	0.11	0.90
50	0.52	0.13	2.54
55	0.60	0.16	3.80
60	0.60	0.22	4.30
65	0.60	0.25	4.50
70	0.60	0.25	4.50

60% of General Tier 1 and Tier 4 disabilities are assumed to be service connected disabilities. The other 40% are assumed to be non-service connected disabilities.

30% of General Tier 3 and Tier 5 disabilities are assumed to be service connected disabilities. The other 70% are assumed to be non-service connected disabilities.

100% of Safety disabilities are assumed to be service connected disabilities.

Termination Rates

	Rate (%)	
Years of Service	**General**	**Safety**
Less than 1	14.00	12.50
1 – 2	9.50	10.00
2 – 3	9.25	8.25
3 – 4	6.50	5.75
4 – 5	5.25	5.00
5 – 6	5.00	4.25
6 – 7	4.50	3.50
7 – 8	4.25	3.25
8 – 9	3.75	3.00
9 – 10	3.50	2.50
10 – 11	3.25	2.25
11 – 12	3.00	2.10
12 – 13	2.75	2.00
13 – 14	2.50	1.90
14 – 15	2.50	1.80
15 – 16	2.25	1.70
16 – 17	2.25	1.60
17 – 18	2.00	1.50
18 – 19	2.00	1.25
19 – 20	1.75	1.00
20 & Over	1.25	0.75

The member is assumed to receive the greater of the member's contribution balance or a deferred retirement benefit.

No withdrawal is assumed after a member is first assumed to retire.

Retirement Rates

Age	Rate (%)					
	General					
	Tier 1 Enhanced		Tier 3 Enhanced			
	Less than 30 Years of Service	Over 30 Years of Service	Less than 30 Years of Service	Over 30 Years of Service	Tier 1 Non-Enhanced	PEPRA Tier 4 and Tier 5
50	5.00	9.00	4.00	7.20	3.00	0.00
51	4.00	7.20	3.00	5.40	3.00	0.00
52	4.00	7.20	3.00	5.40	3.00	2.00
53	4.00	7.20	4.00	7.20	3.00	3.00
54	12.00	21.60	6.00	10.80	3.00	3.00
55	15.00	27.00	8.00	14.40	10.00	5.00
56	17.00	30.60	8.00	9.60	10.00	5.00
57	17.00	30.60	9.00	10.80	10.00	6.00
58	17.00	30.60	10.00	12.00	10.00	6.00
59	22.00	26.40	12.00	14.40	10.00	8.00
60	25.00	30.00	13.00	15.60	25.00	8.00
61	30.00	36.00	18.00	21.60	15.00	12.00
62	30.00	36.00	22.00	26.40	40.00	18.00
63	25.00	30.00	22.00	26.40	35.00	18.00
64	25.00	30.00	25.00	30.00	30.00	20.00
65	35.00	35.00	32.00	32.00	40.00	25.00
66	40.00	40.00	32.00	32.00	35.00	25.00
67	40.00	40.00	30.00	30.00	35.00	25.00
68	40.00	40.00	30.00	30.00	35.00	25.00
69	40.00	40.00	30.00	30.00	35.00	25.00
70	35.00	35.00	35.00	35.00	40.00	40.00
71	35.00	35.00	35.00	35.00	40.00	40.00
72	35.00	35.00	35.00	35.00	40.00	40.00
73	35.00	35.00	35.00	35.00	50.00	40.00
74	35.00	35.00	35.00	35.00	50.00	40.00
75 & Over	100.00	100.00	100.00	100.00	100.00	100.00

Retirement Rates

Age	Rate (%)			
	Safety			
	Tier A Enhanced		Tier C Enhanced	Tier A Non-Enhanced and PEPRA Tier D and Tier E
	Less than 30 Years of Service	Over 30 Years of Service		
45	7.00	8.75	2.00	0.00
46	3.00	3.75	1.00	0.00
47	10.00	12.50	4.00	0.00
48	10.00	12.50	4.00	0.00
49	25.00	31.25	12.00	0.00
50	25.00	31.25	18.00	5.00
51	25.00	31.25	18.00	4.00
52	18.00	22.50	15.00	4.00
53	18.00	22.50	15.00	5.00
54	18.00	22.50	15.00	6.00
55	20.00	30.00	18.00	10.00
56	20.00	30.00	15.00	10.00
57	22.00	33.00	15.00	18.00
58	22.00	33.00	25.00	18.00
59	22.00	33.00	25.00	18.00
60	25.00	37.50	25.00	18.00
61	25.00	37.50	25.00	20.00
62	25.00	37.50	25.00	20.00
63	30.00	45.00	30.00	20.00
64	40.00	60.00	35.00	25.00
65 & Over	100.00	100.00	100.00	100.00

Retirement Age and Benefit for Deferred Vested Members:	General: 59 Safety With Reciprocity: 53 Safety Without Reciprocity: 50 40% and 70% of future General and Safety deferred vested members, respectively, are assumed to continue to work for a reciprocal employer. For reciprocals, we assume 3.75% and 4.25% compensation increases per annum for General and Safety, respectively.
Future Benefit Accruals:	1.0 year of service per year for full-time employees. Continuation of current partial service accrual for part-time employees.
Unknown Data for Members:	Same as those exhibited by members with similar known characteristics. If not specified, members are assumed to be male.
Percent Married:	65% of male members and 50% of female members are assumed to be married at retirement or pre-retirement death and to select Unmodified option. There is no explicit assumption for children's benefits.
Age of Spouse:	Male retirees are 3 years older than their spouses, and Female retirees are 2 years younger than their spouses.

Offsets by Other Plans of the Employer for Disability Benefits:	The Plan requires members who retire because of disability from General Tier 3 and PEPRA General Tier 5 to offset the Plan's disability benefits with other Plans of the employer. We have not assumed any offsets in this valuation.
Leave Cashout Assumptions:	The following assumptions for leave cashouts as a percentage of final average pay are used: *General Tiers 1, 2 and 3 Safety Tiers A and C* Cost Group 1 1.00% Cost Group 2 0.50% for Tier 2 0.75% for Tier 3 Cost Group 3 4.75% Cost Group 4 0.50% Cost Group 5 1.25% Cost Group 6 0.25% Cost Group 7 0.75% Cost Group 8 0.50% Cost Group 9 0.00% Cost Group 10 0.50% Cost Group 11 2.50% Cost Group 12 2.00% Terminated Employers 0.00% *PEPRA General Tiers 4 and 5 PEPRA Safety Tiers D and E* None
Service From Accumulated Sick Leave Conversion:	The following assumptions for additional service converted from accumulated sick leave as a percentage of service at retirement are used: *Service Retirements:* General: 1.10% Safety: 1.80% *Disability Retirements:* General: 0.06% Safety: 1.20% Pursuant to Section 31641.01, the cost of this benefit for the non-PEPRA tiers will be charged only to employers and will not affect member contribution rates.