California State Teachers' Retirement System

Replication and Review of 2020 Experience Analysis

Produced by Cheiron

April 2020

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SECTION I – EXECUTIVE SUMMARY

Summary of Findings

Overall, we found the recommendations made by Milliman in the 2020 Experience Analysis covering the period from July 1, 2015 to June 30, 2018 to be reasonable, and we agree with the rationales and processes that led to their recommendations. As part of our replication and review, we examined the raw demographic data provided by CalSTRS, and found that our independent analysis of the System's experience matched Milliman's within a reasonable range, and generally supported their proposed assumptions. The following summarizes our key observations and recommendations (described in detail in this report), which we offer for Milliman and CalSTRS to consider in performing the next experience analysis:

- Consider using a benefit-weighted analysis to develop future base mortality tables instead of applying a margin to a headcount-weighted analysis. These approaches might produce similar results, but the adjustments Milliman used prior to and after age 70 may be different if developed on a benefit-weighted basis, changing the pattern of assumed mortality rates.
- Consider using the benefit-weighted PubT-2010 tables (instead of RP-2014) as the basis for mortality rates before adjusting for CalSTRS specific experience.
- Consider reducing the select period for disabled mortality rates from three years to two years.
- Provide additional explanation and rationale for using a 1.1% ultimate mortality improvement assumption instead of other reasonable assumptions, including the more common 1.0%.
- Consider whether or not separate retirement assumptions are needed for 25 and 30 years of service or if those assumptions could be combined with the assumptions for 26 to 29 years of service and 31 or more years of service respectively. (We commend Milliman for adding the additional service groups for retirement rates.)
- Consider using the same retirement rates for the 1990 benefit structure as for the post 1990 benefit structure.
- Consider reducing refund rates, particularly for members with more years of service, so that the actual-to-expected ratio is 100% or greater.
- Review the methodology for actuarially equivalent optional factors to account for anti-selection and generational mortality.
- Provide additional explanation and rationale for using Medicare premium trend rates exceeding those used in the Medicare Trustees Report.

We appreciate the time spent by Milliman to explain details of their methods and reconcile any discrepancies between our analyses. The details in the following sections are intended to support the findings described above as well as the verification of the reasonability of the assumptions proposed by Milliman.

SECTION II – CERTIFICATION

The purpose of this report is to present the results of our independent replication and review of the 2020 Experience Analysis performed by Milliman for the California State Teachers' Retirement System (CalSTRS). The experience analysis covers experience from July 1, 2015 through June 30, 2018. This report is for the use of CalSTRS in selecting methods and assumptions for the funding valuations of the Defined Benefit Program, the Cash Balance Benefit Program, the Defined Benefit Supplement Program, and the Medicare Premium Payment Program.

In preparing our report, we relied on information (some oral and some written) supplied by CalSTRS. This information includes, but is not limited to, the plan provisions and membership data. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standard of Practice No. 23.

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

This report was prepared for CalSTRS for the purposes described herein. Other users of this report are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to any other user.

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SECTION III – ECONOMIC ASSUMPTIONS

Price Inflation

Milliman recommended no change to the 2.75% assumed rate of price inflation in the 2020 Experience Analysis. We find their recommendation as well as the supporting rationale and process that led to the recommendation to be reasonable. We also concur with the information they presented that supports an alternative recommendation (2.50%) and would recommend that if current market conditions and expectations continue the Board should consider reducing the price inflation assumption.

In their report, Milliman indicated that current market prices (as of December 2019) show a break-even inflation rate of approximately 1.8% over the next 30 years. We concur with their calculation of the break-even inflation rate – the difference between the yield of inflation-indexed versus non-inflation indexed 30-year Treasury securities – and note that it is significantly lower than the recommended assumption of 2.75%. The spread between the securities described above has not exceeded 2.15% in the period since July 1, 2015.

Survey of CPI Assumptions

	Economic Forecasters	Horizon Survey	Public Plan Database	California Survey
Minimum	1.90%	1.80%	2.25%	2.50%
25th Percentile	2.07%	2.10%	2.50%	2.75%
50th Percentile	2.20%	2.30%	2.75%	3.00%
75th Percentile	2.30%	2.50%	3.00%	3.00%
Maximum	3.20%	2.70%	4.00%	3.25%

Legend: Min to 25th, 25th to 50th, 50th to 75th, 75th to Max
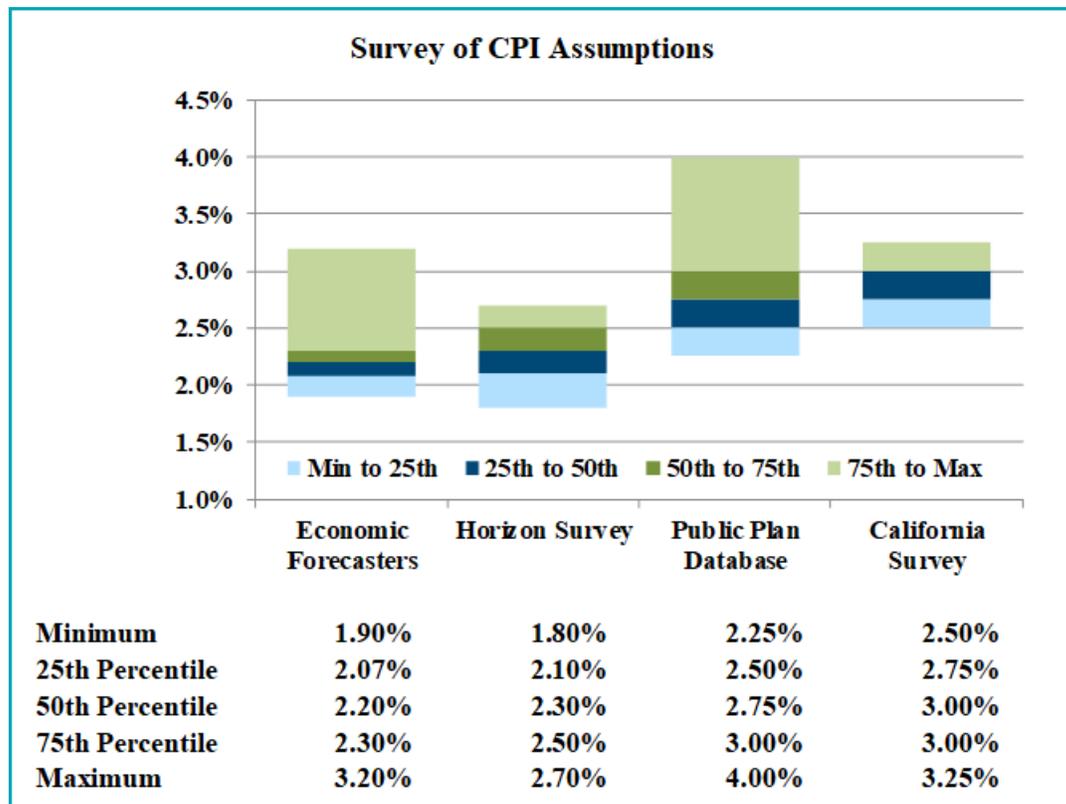
We also note that the latest survey of 10-year inflation forecasts published by the Federal Reserve Bank of Philadelphia shows 28 professional forecasts ranging from 1.90% to 3.20% with a median forecast of 2.20%. The latest survey of 20-year inflation forecasts by investment consultants published by Horizon Actuarial Services shows forecasts ranging from 1.80% to 2.70% with a median forecast of 2.30%. The Public Plans Database maintained by the Center for Retirement Research at Boston College shows inflation assumptions ranging from 2.25% to

SECTION III – ECONOMIC ASSUMPTIONS

4.00% with a median forecast of 2.75%. Finally, Cheiron's survey of California public pension systems shows inflation assumptions ranging from 2.50% to 3.25% with a median forecast of 3.00% for 2019. Milliman's proposed assumption falls within these ranges for all but the Horizon survey, where the highest assumption (2.70%) is within five basis points of Milliman's recommended rate.

Wage Growth

Milliman recommended maintaining an assumption that wages will grow at a rate of 0.75% above price inflation over the long term. This assumption is used to project across-the-board wage growth for individuals. In addition, individual wages are projected to increase for merit. Milliman stated that a lower assumption of 0.50% above price inflation would also be reasonable. Overall, we concur with the recommended assumption as well as the rationale and process that led to the recommendation, including the alternative presented.

In particular, we agree that wages are likely to be correlated with overall U.S. price inflation, as wages for CalSTRS members can be expected to grow at a level above that of California price inflation, and it is reasonable to expect that U.S. and California price inflation will be highly correlated over the long term.

Milliman cites one projection – from the Office of the Chief Actuary of the Social Security Administration – that indicates a significantly higher estimate (1.2% per year) of long-term wage growth above price inflation than reflected in the current 0.75% assumption. However, we note that the Social Security Administration (SSA) assumption – as well as the data sources cited by Milliman on historical wage growth – are based on increases in mean wages, which have consistently exceeded increases in median wages, due to the excess wage gains experienced by individuals at the highest levels of the U.S. wage scale, which is not likely to include CalSTRS members. Based on Social Security data from 1990 to 2018, mean wages grew by an average of 0.5% per year more than median wages.

We do have one recommendation related to the growth in wages for some members, which was included in our prior replication and review. Milliman noted 2% at 62 members (i.e., those members hired in 2013 or later subject to the provisions of the Public Employee Pension Reform Act) are subject to a more restrictive definition of creditable compensation, which includes an indexed dollar cap on compensation. Milliman notes that this cap is required by law to increase based only on price inflation; we believe they should explicitly state the rate of increase used to project growth in the cap in future years in their valuation and experience study reports.

Payroll Growth

For the most recent experience study, Milliman included a recommendation that aggregate pensionable payroll will grow at the same rate as wages, or 0.75% above inflation over the long term. They also included a discussion of factors that may cause the level of overall payroll to lag behind the level of wage growth, and suggested that the Board could consider a lower payroll increase assumption than that used for projecting the growth in individual wages. These factors

include expected declines in the student population, growth in charter schools, and more restrictive definitions of pensionable compensation for the 2% at 62 membership. We recommended that Milliman consider this last factor as part of our prior replication and review, and appreciate their discussion of this and the other issues raised. Overall, we concur with the proposed assumption as well as the rationale and process that led to the recommendation and the alternative to assume a payroll growth rate that is 0.25% less than the wage growth assumption.

Investment Return

Milliman recommended no change to the investment return assumptions used by CalSTRS: 7.00% for the DB and DBS programs, and 6.50% for the CBB program, net of administrative and investment-related expenses. Milliman also stated that alternative assumptions – either 0.25% or 0.50% lower than the recommended assumptions – would also be reasonable. We concur with the recommended rates and the reasonability of the alternative assumptions, as well as the rationale and process that led to the recommendation.

We reviewed the documentation referred to by Milliman in their study from Item 7 of the May 2019 Investment Committee meeting, and concluded that the mappings and application of the capital market assumptions onto the asset classes reflected in the target asset allocation (as adopted at the November 2019 Investment Committee meeting) appear reasonable[1].

We verified the adjustments made for administrative expenses, and agreed with Milliman's conclusion that any adjustments for additional investment expenses should be expected to be minimal. We also agree that a reduction in the price inflation component of the capital market expectations would generally result in a similar (though not necessarily identical) reduction in the overall nominal investment return expectation.

We independently calculated the expected return based on the target asset allocation and the 2019 average capital market assumption survey published by Horizon Actuarial Services, as done by Milliman, and generated similar expected returns to those reported by Milliman. As Milliman noted in their review, there is not always a perfect one-to-one mapping of the asset classes described in the CalSTRS target allocation with those included in the capital market assumptions by each investment consultant. We believe the impact of any differences in the expectations for these classes should not significantly affect the overall portfolio expectations.

We agree that the CalSTRS capital market expectations (as specified in the May 2019 Investment Committee meeting) generate an average real return expectation (4.30%, after deducting 10 basis points for administrative expenses) very close to the current and

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1 We note one minor issue with respect to the allocation reported by Milliman in their draft experience study report, which included a 10% allocation to fixed income and 12% to risk mitigation strategies. Information provided on the CalSTRS website from the November 2019 meeting indicated the actual policy included a 12% allocation to fixed income and 10% to risk mitigation strategies (Investment Policy and Management Plan Revision – 2019 ALM Study Implementation Plan). However, we also note that the reversal of these amounts would only affect the expected return in the portfolio by 0.02% (two basis points), so we believe the results presented by Milliman are still reasonable even if there was a minor misapplication of the asset class mapping.

recommended real expected return for the CalSTRS DB and DBS portfolios (4.25%). We also note that the range of expectations lends support to Milliman's conclusion that alternative investment return assumptions are reasonable. We concur that the significant decline in yields on fixed income that have occurred since most 2019 capital market assumptions were developed would help support the lower investment return alternatives.

We also modeled the impact on the expected returns based on the capital market assumptions from the Horizon survey, assuming the private equity and real estate classes were excluded from the asset allocation (with the allocations to the other classes increased proportionately to make up the difference). The impact was to reduce the average expected real return by about 0.60% for the portfolio, close to the 0.50% adjustment reported by Milliman based on CalSTRS' capital market assumptions. Based on this information, we believe Milliman's recommendation to use an expected return for the CBB Program 50 basis points lower than the return for the entire CalSTRS investment portfolio to be reasonable.

Typically, we recommend that the discussion of the investment return assumption in an experience study contain some discussion of the likelihood of different investment returns for the target portfolio, not just the average expected return. Generally, this will take the form of a probability distribution of the expected returns. We would encourage Milliman to include more information on the distribution and likelihood of potential returns in future experience studies.

Interest on Member Accounts

Milliman recommended retaining a small margin (0.25%) in the assumed rate above inflation used to credit future member account balances for the DB program. They also recommended retaining the investment return assumption – 7.00% and 6.50% for the DBS and CBB Programs, respectively – as the assumed long-term crediting rate for the member accounts for these programs. We concur with the recommended rates as well as the rationale and process that led to the recommendations.

For the DB Program, the Board's policy is to credit interest to the member contribution accounts based on a two-year Treasury rate. We agree with Milliman's observation that the return on two-year Treasuries has been less than inflation over most of the past 10 years. We also agree with their recommendation to adopt a long-term assumption which includes a low, but still slightly positive, real expected return on two-year Treasuries of 0.25% above the long-term inflation assumption. However, as we suggested in the last experience study replication and review, we recommend that in the next experience study, Milliman could include additional data to support their recommendation, in particular by showing the expected (real) return on a short-term Treasury asset class, as provided by the CalSTRS Investment Office and/or their external investment consultants.

For the CBB and DBS Programs, the Board's policy is currently to credit interest to member accounts based on a statutory minimum (tied to the 30-year Treasury note), plus an additional earnings credit. The additional earnings credit is set by Board policy, and is currently based on a

procedure that compares the funded ratio of the Plan to certain thresholds, based on the assumed standard deviation of the investment portfolio.

Milliman states that the "long-term intention is to allocate all of the investment earnings to the member accounts. Therefore, the assumed long-term credit to member accounts should be the same as the recommended investment return assumption…" We believe this approach to be reasonable, as the Board's crediting policy could be adjusted by future Board action if the current policy were not meeting the long-term intention of crediting the investment returns to the member accounts.

CBB and DBS Program Standard Deviation

Milliman recommended assumed standard deviation rates for the assets of the CBB and DBS Programs (to be used in the additional earning crediting policies as described above) of 11.0% and 13.1%, respectively, representing reductions from the current assumptions of 13.00% and 15.00%. We find the recommended assumptions, as well as the process that led to the recommendations, to be reasonable.

As part of our analysis of the investment return, we independently calculated the expected portfolio standard deviation using the CalSTRS capital market assumptions as well as the average expectations from the Horizon survey, for both the overall CalSTRS portfolio and the CalSTRS portfolio excluding the private equity and real estate asset classes. For the CBB portfolio – i.e., the portfolio excluding private equity and real estate – we computed a standard deviation of 10.6% using the CalSTRS expectations and 11.3% using the Horizon expectations. Therefore, we conclude Milliman's 11.0% recommendation for the standard deviation for the CBB portfolio to be reasonable.

In order to determine the final recommended standard deviation for the DBS portfolio, Milliman included an adjustment to account for the fact that a portion of the overall return on CalSTRS assets will be used to cover the guaranteed return on the SBMA assets (stated by Milliman to be equal to the valuation assumption, under state law). We performed a similar analysis to that described by Milliman: computing the expected impact on the volatility of the non-SBMA assets and holding the return on the SBMA portion of the portfolio constant. Based on the CalSTRS capital market expectations, we developed a range on the portfolio standard deviation between 12.4% and 13.5%, based on the percentage of SBMA assets ranging from 7% (the current level) up to 14% (the ultimate projected level provided by Milliman). Based on this analysis, we believe Milliman's recommended assumption of 13.1% to be reasonable.

SECTION IV – SALARY INCREASES DUE TO PROMOTION AND LONGEVITY

Based on our independent analysis of salary increases due to promotion and longevity (merit increases) as summarized below, we believe Milliman's proposed assumptions are reasonable.

Milliman used the 16-year period from July 1, 2002 to June 30, 2018 for their analysis of salary increases due to promotion and longevity (merit salary increases). We do not have data for the entire 16-year period, but we reviewed data from the eight-year period from July 1, 2010 to June 30, 2018.

Estimated Actual Wage Inflation

The table below shows the average earnable salary in each year of our analysis and the rate of increase between years. Over the period, the average annual increase was 2.1 percent.

Development of Actual Wage Inflation				
Valuation Year	Count	Earnable Salaries	Average Salary	Actual Increase
2010	441,484	$ 28,326,003,570	$ 64,161	
2011	429,531	$ 27,522,112,217	$ 64,075	-0.13%
2012	421,434	$ 27,287,056,211	$ 64,748	1.05%
2013	416,572	$ 27,317,536,911	$ 65,577	1.28%
2014	420,786	$ 28,313,396,978	$ 67,287	2.61%
2015	429,460	$ 29,889,018,352	$ 69,597	3.43%
2016	438,531	$ 31,815,483,706	$ 72,550	4.24%
2017	445,933	$ 33,153,340,871	$ 74,346	2.48%
2018	449,595	$ 33,991,176,134	$ 75,604	1.69%

## Salary Increases Due to Promotion and Longevity

For our independent analysis of merit salary increases, we first determined the average merit increase for each year of service for each fiscal year by subtracting the actual wage inflation shown in the table above from the average nominal increase for members who were active at both the beginning and end of the fiscal year. We computed a weighted average for the eight-year period by adjusting salaries for each fiscal year to the last fiscal year.

The charts on the following two pages show our independently calculated average observed rates compared to the current assumptions.

SECTION IV – SALARY INCREASES DUE TO PROMOTION AND LONGEVITY

Merit Salary Increases - Entry Ages < 25
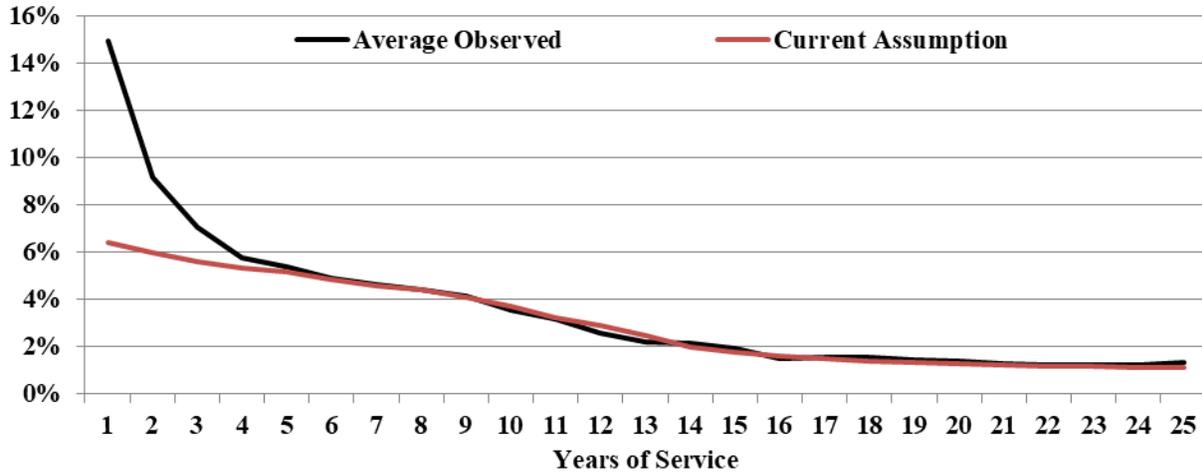

Merit Salary Increases - Entry Ages 25 - 29
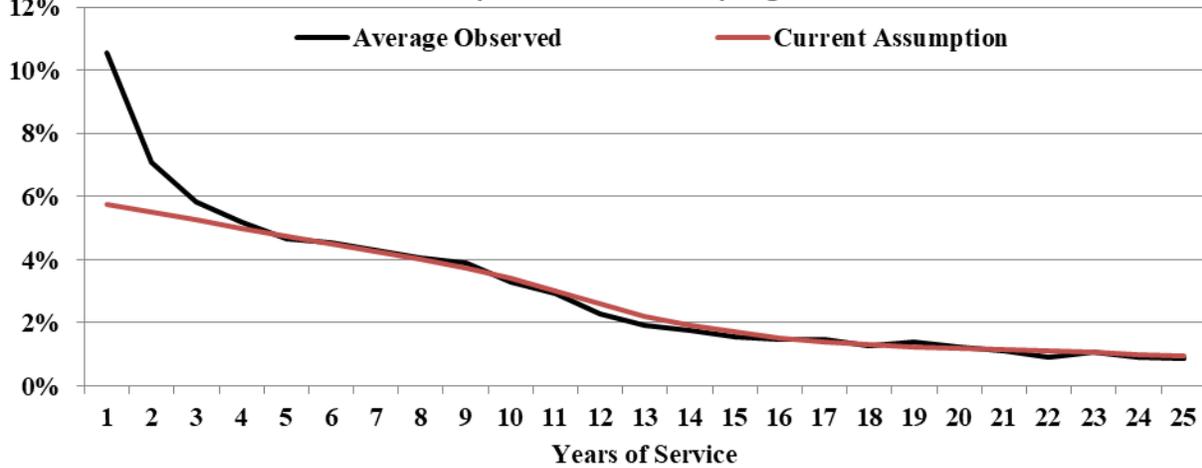
Merit Salary Increases - Entry Ages 30 - 34
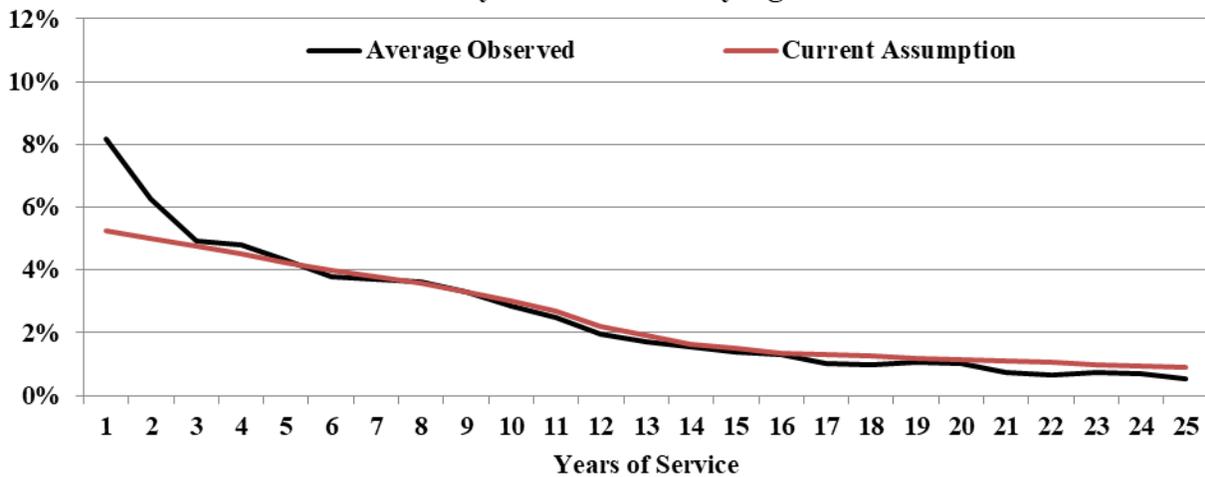
## SECTION IV – SALARY INCREASES DUE TO PROMOTION AND LONGEVITY

Merit Salary Increases - Entry Ages 35 - 39
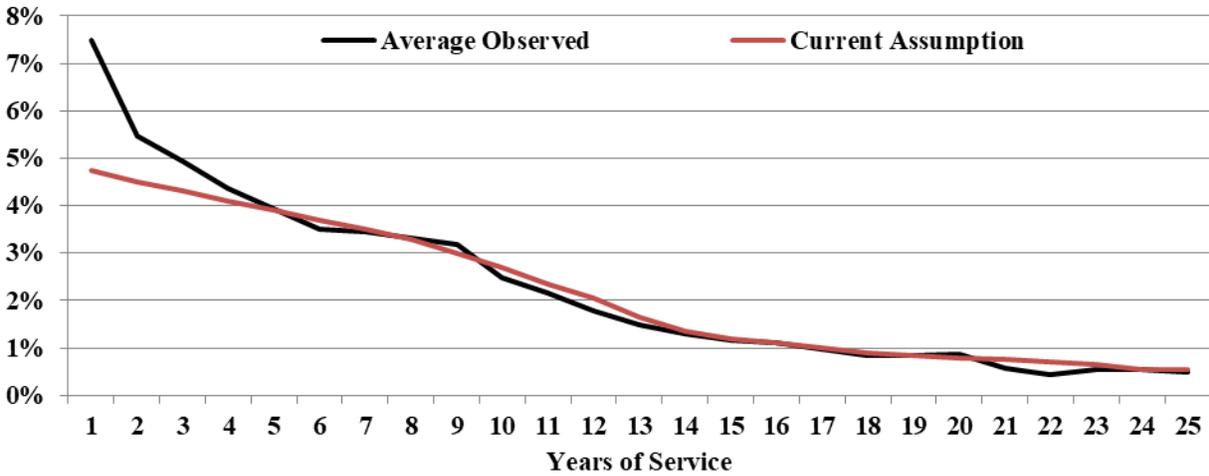
Merit Salary Increases - Entry Ages 40 - 44
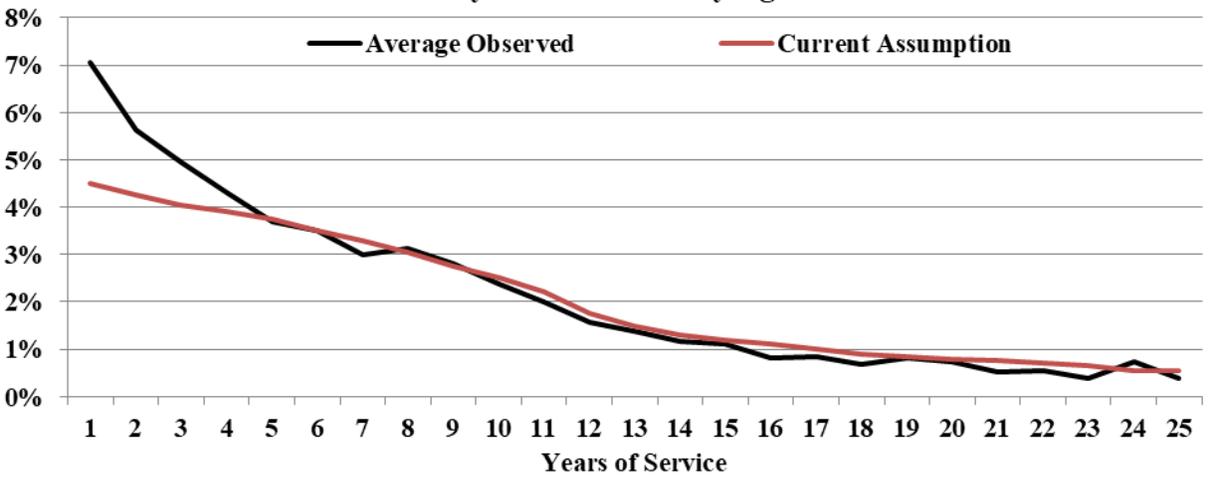
Merit Salary Increases - Entry Ages 45 +
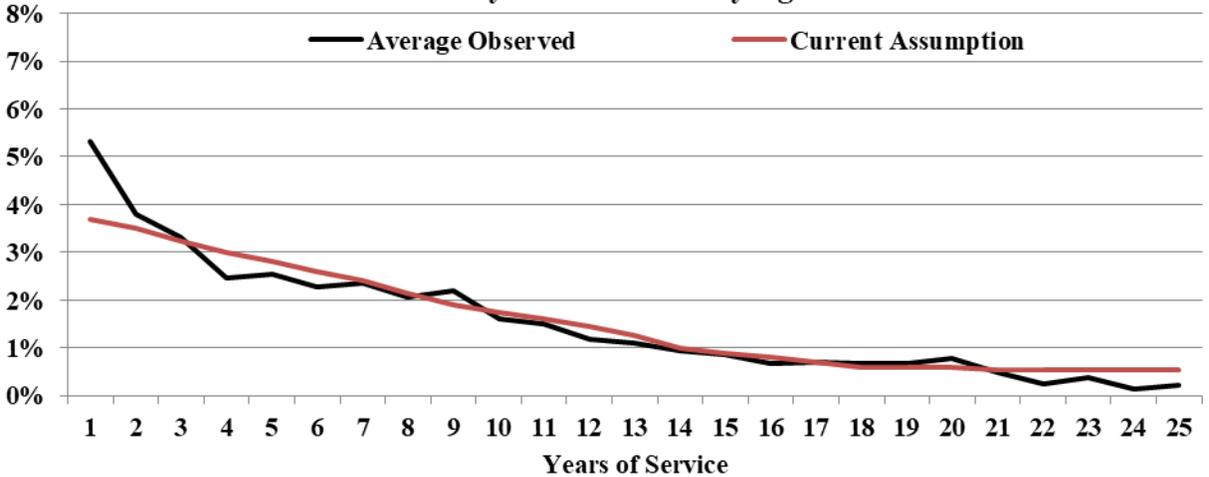
SECTION IV – SALARY INCREASES DUE TO PROMOTION AND LONGEVITY

Based on our independent analysis, we believe the current merit salary increase assumptions remain reasonable. We note that the average actual rates of merit salary increases we observed in the first year or two of service are generally higher than those observed or proposed by Milliman. However, the merit salary assumptions in these years are not expected to have a material impact on the Plan's overall projected benefits, and we know from experience that there can be difficulties and inconsistencies in computing the actual rates of salary increase for members at the very beginning of their careers.

SECTION V – DEMOGRAPHIC METHODOLOGY

Demographic Assumption Analysis Methodology

For the demographic assumptions in the experience analysis, we collected the same data used by Milliman in their analysis. We analyzed the data independently to determine the number of actual decrements by type and the number of exposures to those decrements. Cheiron uses a different methodology than Milliman to determine the exposures and observed probability of a given decrement when multiple decrements compete with each other. The different methodologies should produce similar, though not identical, numbers of expected decrements and similar assumptions.

The first part of our analysis is simply to compare the number of actual decrements and exposures for each type of decrement as well as the average rate of decrement. If our independent analysis matches Milliman's analysis within a reasonable range, CalSTRS can be confident that the basis on which assumptions are proposed is valid.

There will inevitably be differences between our calculations and those produced by Milliman. For actual decrements, some are clear-cut, but there are always data issues where, for example, an active member one year is reported as inactive the next year and the type of decrement is not clear. There are also members who are eligible for retirement, but decrement as a termination instead of a service retirement. The treatment of these different situations in the data can vary, resulting in differences in the determination of the actual decrements used in the experience analysis. Similar differences in the number of members exposed to each decrement can lead to differences in the number of expected decrements.

In the second part of our analysis, we use the observed rates from our independent analysis to develop a 90 percent confidence interval around the observed rate. The true rate during the experience study period falls within this range with 90 percent confidence. In general, we believe the assumption should fall within the 90 percent confidence interval unless there is reason to believe that the future experience will vary from the experience during the study period. Consequently, we compare the current and proposed assumptions to the confidence intervals to assess whether or not they are reasonable.

Finally, for some of the assumptions, we explore whether a different or more refined structure to the assumption may be appropriate.

SECTION VI – MORTALITY

Based on our independent analysis of the experience data, we believe the mortality assumptions proposed by Milliman (primarily updating the current base tables for mortality improvement) are reasonable. As discussed below, we have a few recommendations to be considered for the next experience analysis.

Data Comparison

The base mortality rates were analyzed separately by gender for healthy retirees (and beneficiaries), disabled retirees, and active employees. The table below shows the comparison of actual deaths, exposures, and the average mortality rate determined by Milliman to the same statistics determined in our independent analysis. There are some minor variations, but all of the average rates are reasonably close. As a result, the data on which Milliman based its recommended assumptions appears to be reasonable.

Comparison of Decrements and Exposures									
	Milliman Data			Cheiron Data			Difference		
Assumption	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**
Retiree Mortality									
Males	8,168	243,802	3.35%	8,380	242,994	3.45%	212	-808	0.10%
Females	11,366	515,816	2.20%	11,844	511,545	2.32%	478	-4,271	0.11%
Disabled Mortality									
Males 1-3	39	1,254	3.11%	47	1,320	3.56%	8	66	0.45%
Males 4+	264	5,851	4.51%	268	5,905	4.54%	4	54	0.03%
Females 1-3	114	4,129	2.76%	116	4,072	2.85%	2	-57	0.09%
Females 4+	536	18,330	2.92%	570	18,549	3.07%	34	219	0.15%
Beneficiary Mortality									
Males	878	17,056	5.15%	1,099	21,078	5.21%	221	4,022	0.07%
Females	2,480	48,961	5.07%	2,866	55,260	5.19%	386	6,299	0.12%
Active Mortality									
Males	474	388,877	0.12%	478	370,105	0.13%	4	-18,772	0.01%
Females	648	993,533	0.07%	653	943,807	0.07%	5	-49,726	0.00%

Retiree Mortality

As a rule of thumb, in order to have credible data to develop mortality rates, there should be 1,000 deaths. If there are 1,000 deaths in aggregate, the data is only sufficiently credible to fully adjust the curve of a published mortality table such that the A/E ratio is 100%. With over 8,000 male deaths and over 11,000 female deaths, CalSTRS has sufficient data to develop relatively refined tables based solely on its own data or to fully adjust another published table.

Milliman has chosen to adjust the curves of the RP 2014 white collar mortality table with a different adjustment after age 70 than before age 70. We believe that the published table and the specific adjustments should be disclosed in the experience study report.

In the future, consideration should be given to developing rates based on the recently published Pub-2010 tables for teachers (PubT-2010). The published table that is selected determines the pattern of mortality rates, which is then adjusted up or down to match CalSTRS experience in

aggregate. The table below shows the difference between the patterns of mortality rates for the RP-2014 table adjusted for CalSTRS and the PubT-2010 table.

Retiree Mortality Rates
Ratio of CalSTRS to PubT-2010 Rates
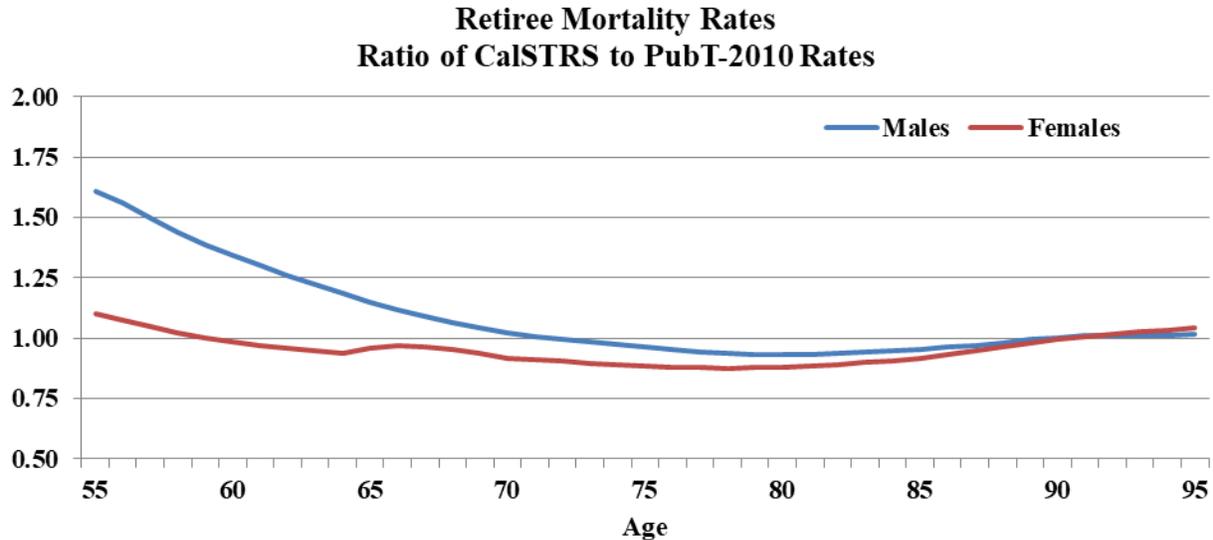
An alternative that would fully reflect the pattern of CalSTRS experience would be to develop mortality rates for retirees based on the experience for grouped ages solely from the CalSTRS data and graduating the rates for individual ages based on the grouped rates.

Mortality rates should be studied on a benefits-weighted basis instead of just on counts. Higher income members tend to live longer than lower income members, and higher income members have larger benefits. The liability for a pension plan depends on how long the benefits are paid so if larger benefits are paid longer, that fact needs to be incorporated into the valuation. Milliman's analysis, however, is based on counts.

As a teacher retirement system, CalSTRS is relatively homogenous, making a benefits-weighted analysis somewhat less important. Milliman notes that the grand total A/E ratio drops from about 106% to 102% when switching to a benefits-weighted analysis.

However, we recommend CalSTRS consider using a benefit-weighted analysis to develop future base mortality tables instead of applying a margin to a headcount-weighted analysis. These approaches might produce similar results, but the adjustments Milliman used prior to and after age 70 may be different if developed on a benefit-weighted basis, changing the pattern of assumed mortality rates.

The charts on the next two pages show the current assumptions compared to benefits-weighted observed rates and their associated confidence intervals.

SECTION VI – MORTALITY

Male Retired Mortality

Male Retired Mortality

Female Retired Mortality
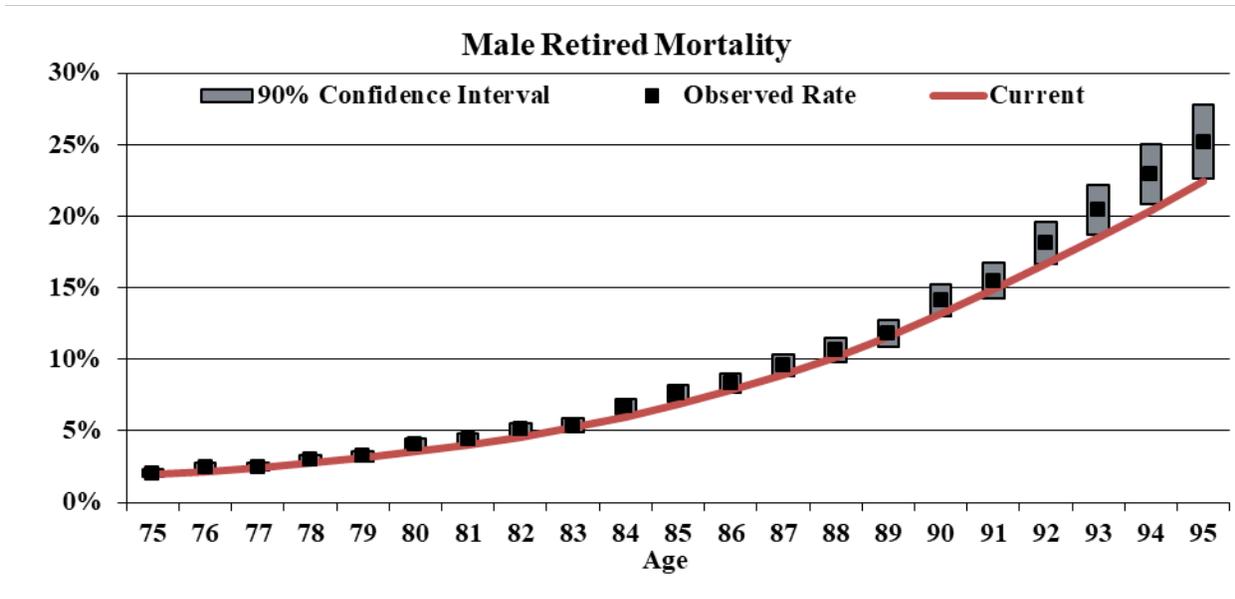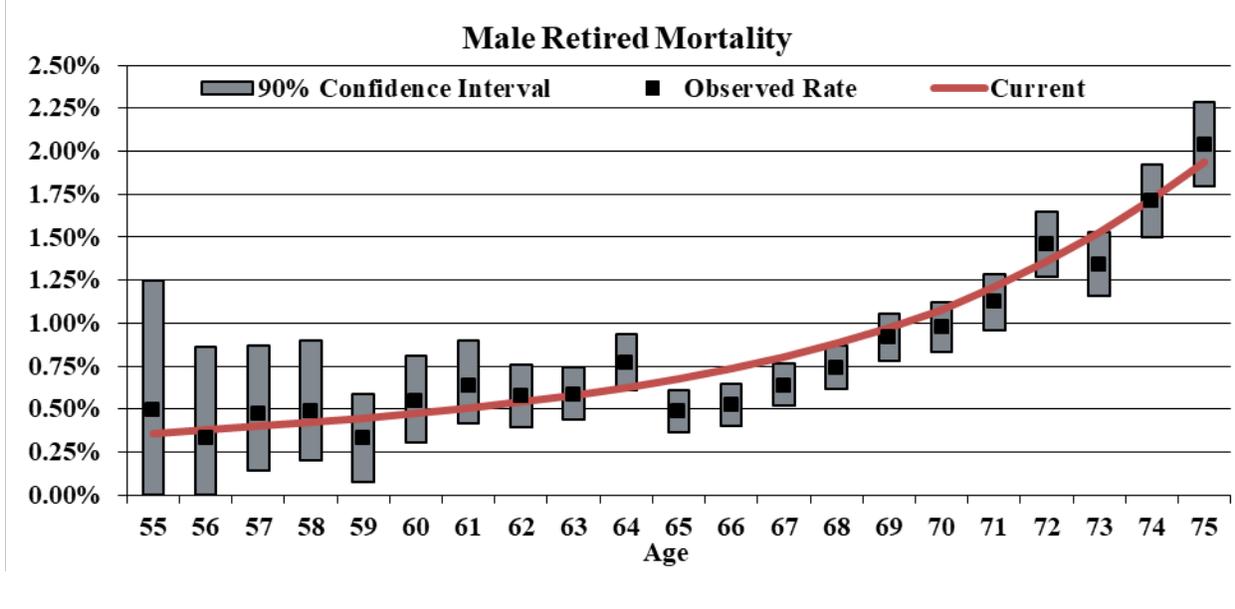

Female Retired Mortality
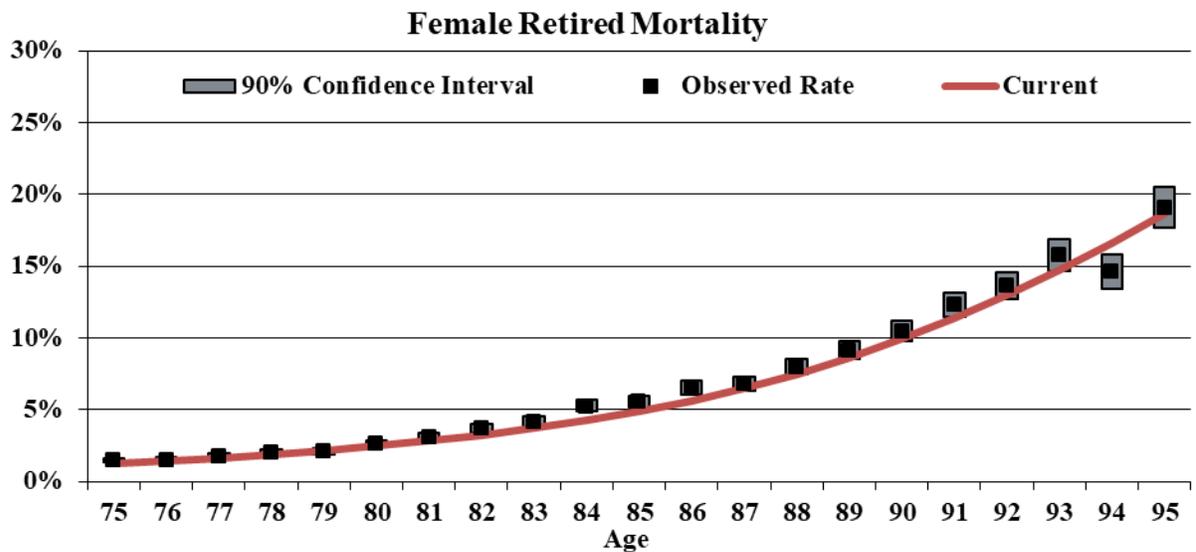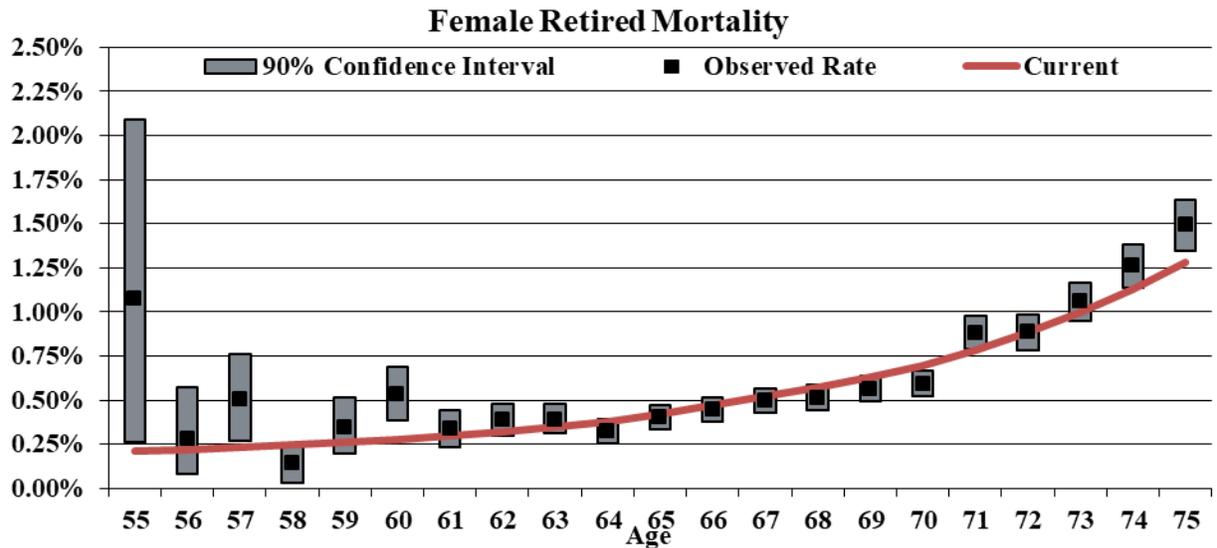
The current mortality rates appear to be reasonable, but in the future CalSTRS should consider a benefits-weighted analysis based on the PubT-2010 tables.

Disabled Annuitants

Milliman recommends no change to the current select and ultimate mortality rates for disabled retirees. The current select period includes flat mortality rates regardless of age for the first three years following disablement. For the ultimate tables, Milliman uses the RP-2014 Disabled mortality tables set back two years for males and females. The charts on the following page show the observed rates and 90 percent confidence intervals for groups of ages compared to the current assumptions for the ultimate mortality rates. The current rates appear reasonable.

SECTION VI – MORTALITY

Male Disabled Annuitant Mortality

Female Disabled Annuitant Mortality
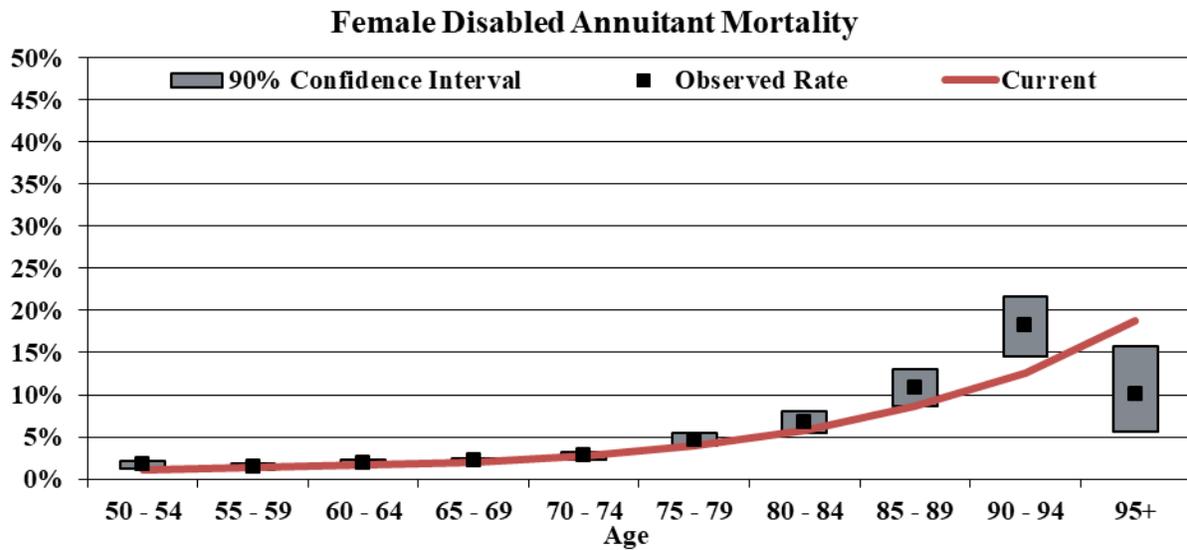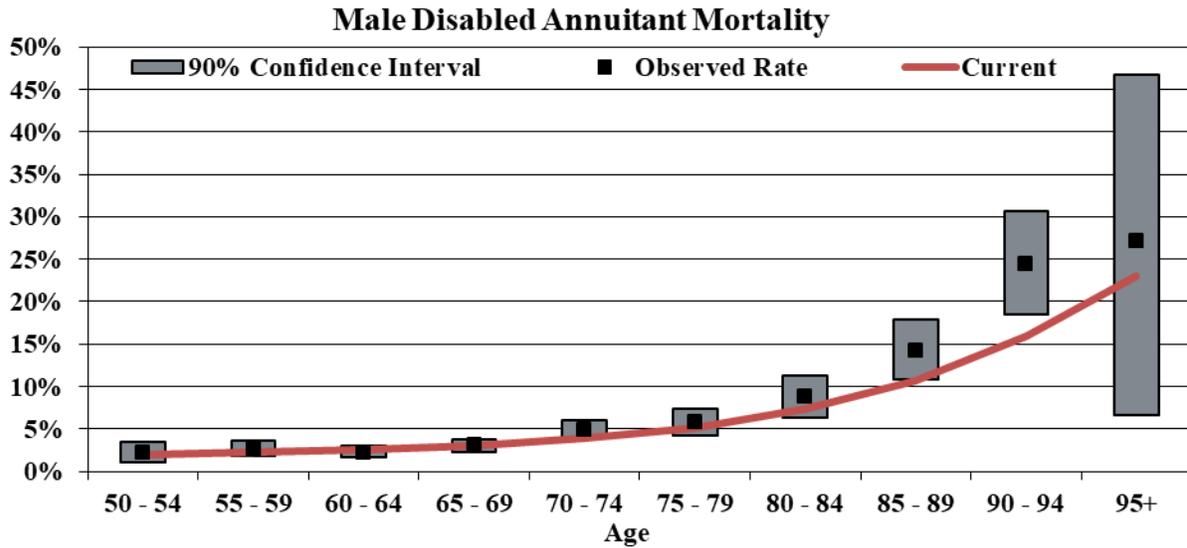
With far less than 1,000 deaths in each of the first three years following disablement, there is a question about the credibility of the data for a select assumption. In the chart on the next page, the observed weighted average rates and 90 percent confidence intervals for males and females are compared to the current assumptions for the select year as well as the weighted average ultimate assumptions. To the extent the ultimate assumption falls within the confidence interval of the observed select rates, there may not be justification for a select assumption.

Select Disability Mortality
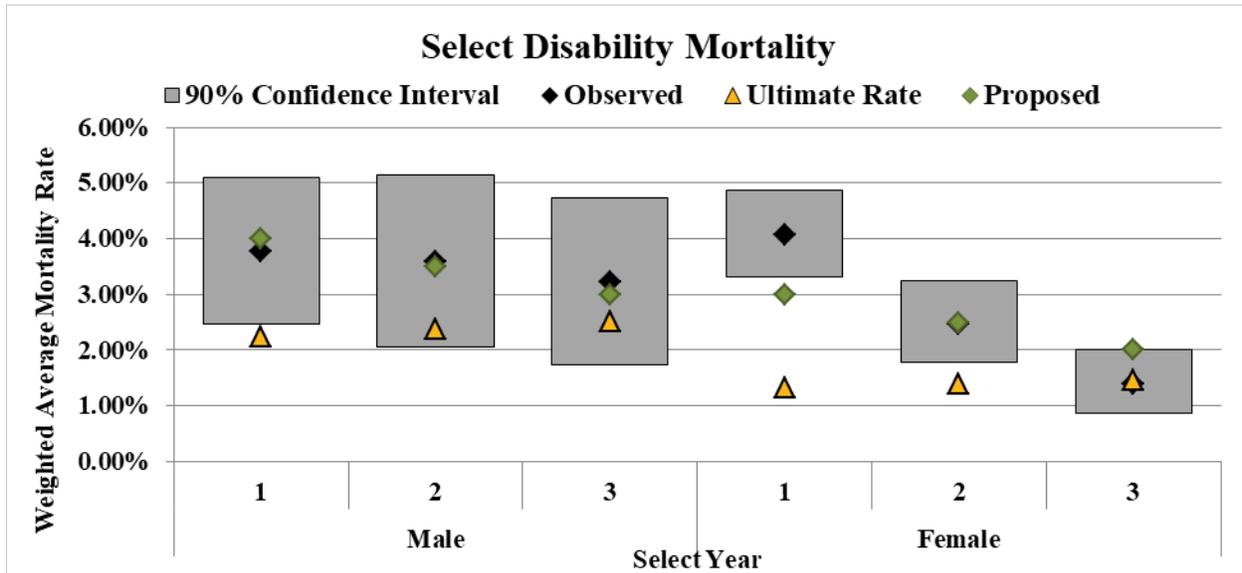
There is evidence that the mortality rates are higher in the first year after disablement, but the evidence weakens somewhat in the second year and is much weaker by the third year. In the first select year, the ultimate assumption is clearly below the confidence interval for the observed rates. In the second select year, the ultimate rate is below the confidence interval for females, but is within the confidence interval for males. In the third select year, the ultimate rate is within the confidence intervals for both males and females. For females in the third select year, the ultimate assumption is virtually identical to the experience.

In future studies, we suggest that Milliman consider reducing the select period to two years. In addition, we recommend that the credibility for a select assumption be explicitly considered and to the extent the data is partially credible, that it be blended with the ultimate rates.

Beneficiaries

It is common practice to use the same healthy mortality table for retirees and beneficiaries as Milliman has done and proposes to continue doing. Milliman notes "…observed experience continues to show a significant amount of consistency between retirees and beneficiaries." While we believe this approach is reasonable, we note that the Pub-2010 mortality study found significant differences between teacher mortality rates and general member retirement rates. Some beneficiaries may also be teachers, but we would expect beneficiary mortality to more closely track the general member mortality from the Pub-2010 study. Consequently, we suggest that Milliman consider such a change in the next experience study.

Active Employees

The current mortality rates for active employees are based on the RP-2014 white-collar mortality tables set back two years. Milliman proposes to change these mortality rates to 85% of the

SECTION VI – MORTALITY

PubT-2010 Employee tables. We believe the proposed assumptions are reasonable. However, Milliman should specifically disclose the published table being used and the adjustment to it.

The charts below show the observed rates and 90 percent confidence intervals compared to the current and proposed assumptions.
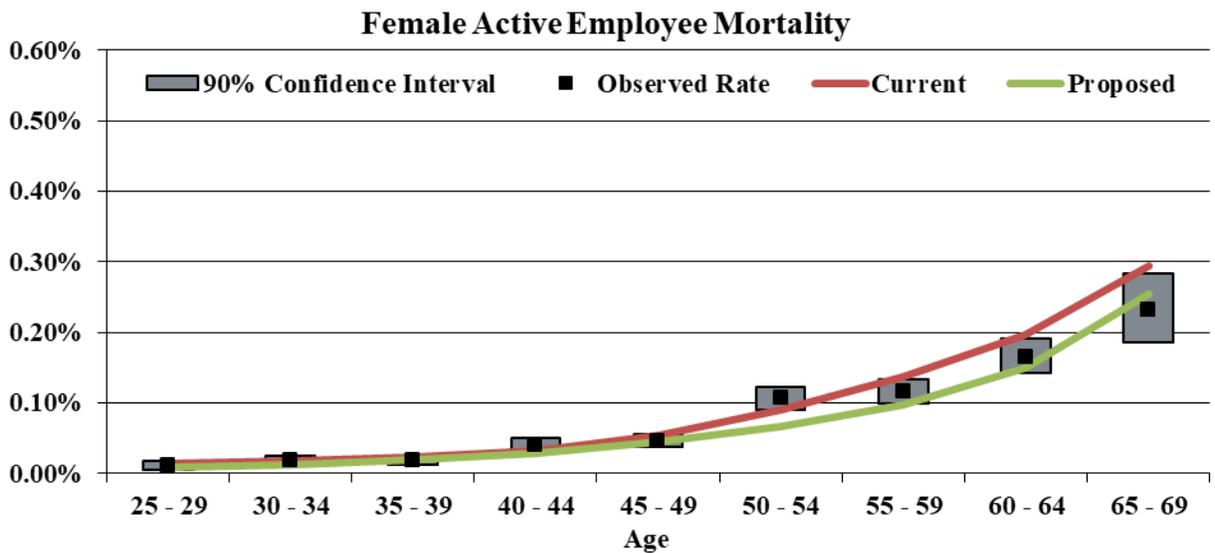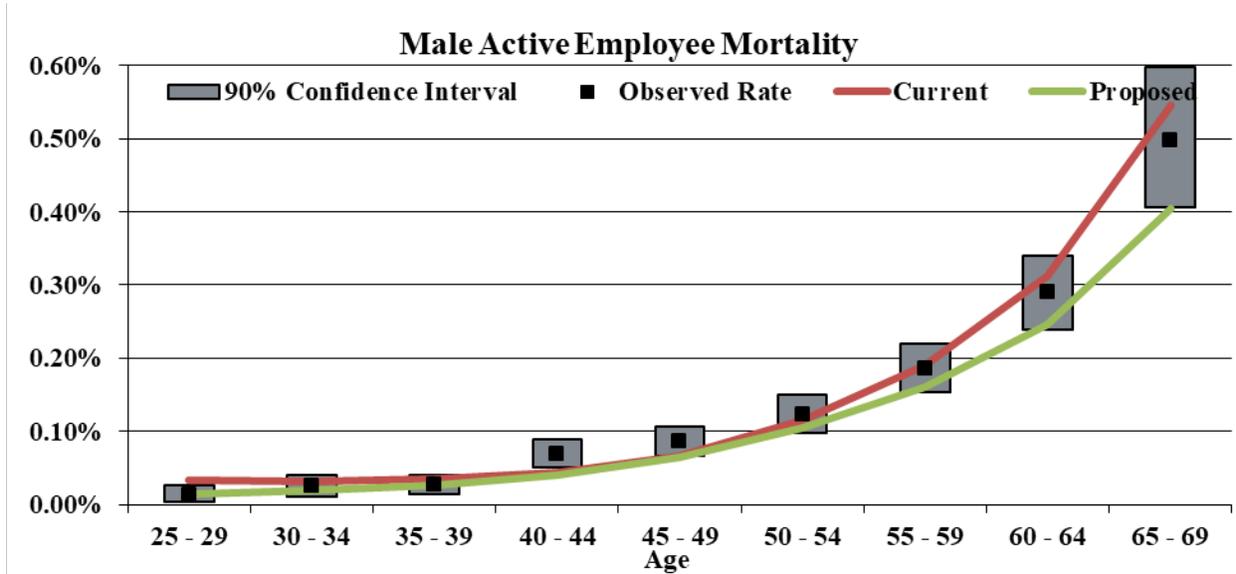
Improvement Projection Scale

The tables developed above serve as base tables, and the mortality rates in those tables are projected to improve according to a separately adopted projection scale. The current projection scale from the Society of Actuaries is named MP-2019 and has different projection rates by age

SECTION VI – MORTALITY

and year until it converges to a flat rate of 1.0% for ages under 85 for years 2035 and later. This method is intended to take the latest historical rates of improvement as a starting point and gradually converge to the ultimate rate over 20 years.

There are a number of assumptions in this model that have a subjective component. Milliman recommends simplifying the model and using a flat annual rate of improvement of 1.1%. Based on our experience, we believe this assumption is reasonable, but is more conservative than most other mortality improvement assumptions. For example, the intermediate assumption for Social Security is a long-term mortality improvement of 1.06% for ages 50 to 64 and 0.76% for ages 65 to 84. We would like to see more explanation and rationale as to why Milliman selected this assumption as opposed to other reasonable assumptions.

Milliman recommends updating the projection scale from 110% of MP-2016 Ultimate to 110% of MP-2019 Ultimate. Other than the year referenced in the name, this change makes no difference in the projection rate because the two scales are equivalent – both MP tables reflect the same ultimate rate of 1.0% for ages under 85.

Typically, base tables are developed as of and projected from the midpoint of the experience study. Milliman's experience study report states in a footnote that the base tables have been projected forward to a new base year of 2019. We agree that this approach is reasonable.

SECTION VII – SERVICE RETIREMENT

Our independent analysis of the service retirement rates proposed by Milliman indicates that in aggregate the assumptions are reasonable.

Data Comparison

Milliman reported their determination of exposures to service retirement and the actual number of retirements by age for three different service groupings:

- Less than 25 years of service,
- 25 through 29 years of service, and
- 30 or more years of service.

The table below shows the comparison of actual retirements, exposures, and the average retirement rate determined by Milliman to the same statistics determined in our independent analysis. There are some variations, but all of the average rates for members under 30 years of service are reasonably close. As shown on the following pages, the proposed assumptions for members with 30 or more years of service are still reasonable based on our analysis of the data. As a result, the data on which Milliman based its recommended assumption appears to be reasonable.

Comparison of Decrements and Exposures									
	Milliman Data			Cheiron Data			Difference		
Assumption	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**
Service Retirement									
Less than 25 Years									
Males	4,107	50,901	8.07%	4,208	52,503	8.01%	101	1,602	-0.05%
Females	11,255	127,204	8.85%	11,646	131,438	8.86%	391	4,234	0.01%
25 - 29 Years									
Males	1,845	14,774	12.49%	1,888	15,378	12.28%	43	604	-0.21%
Females	5,075	31,317	16.21%	5,070	32,871	15.42%	-5	1,554	-0.78%
30 or More Years									
Males	3,595	14,054	25.58%	3,474	15,393	22.57%	-121	1,339	-3.01%
Females	7,415	30,777	24.09%	7,122	33,366	21.35%	-293	2,589	-2.75%

For 2% at 60 members, Milliman proposes moving from three to eight separate tables based on the following service categories:

- 5 to 9 years of service,
- 10 to 14 years of service,
- 15 to 19 years of service,
- 20 to 24 years of service,
- 25 years of service,
- 26 to 29 years of service,
- 30 years of service, and
- 31 or more years of service.

We had recommended some of these additional groups in our replication and review of the prior experience study, so we appreciate the additional groups Milliman has added.

SECTION VII – SERVICE RETIREMENT

Less Than 25 Years of Service

The charts below and on the following pages show the observed rates of service retirement and the 90 percent confidence intervals around those rates based on our analysis of the data compared to the current and proposed assumptions for members with less than 25 years of service. Milliman proposed separate service retirement rates for male and female members in five year service groupings.

2% at 60 - Female Retirement Rates For 5 to 9 Years of Service
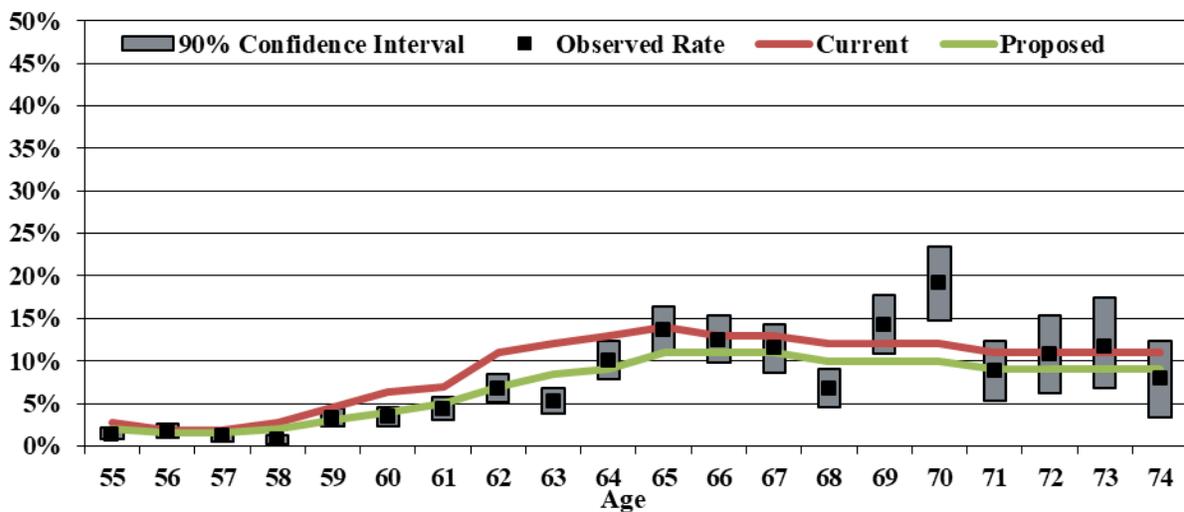
2% at 60 - Male Retirement Rates For 5 to 9 Years of Service

SECTION VII – SERVICE RETIREMENT

2% at 60 - Female Retirement Rates For 10 to 14 Years of Service
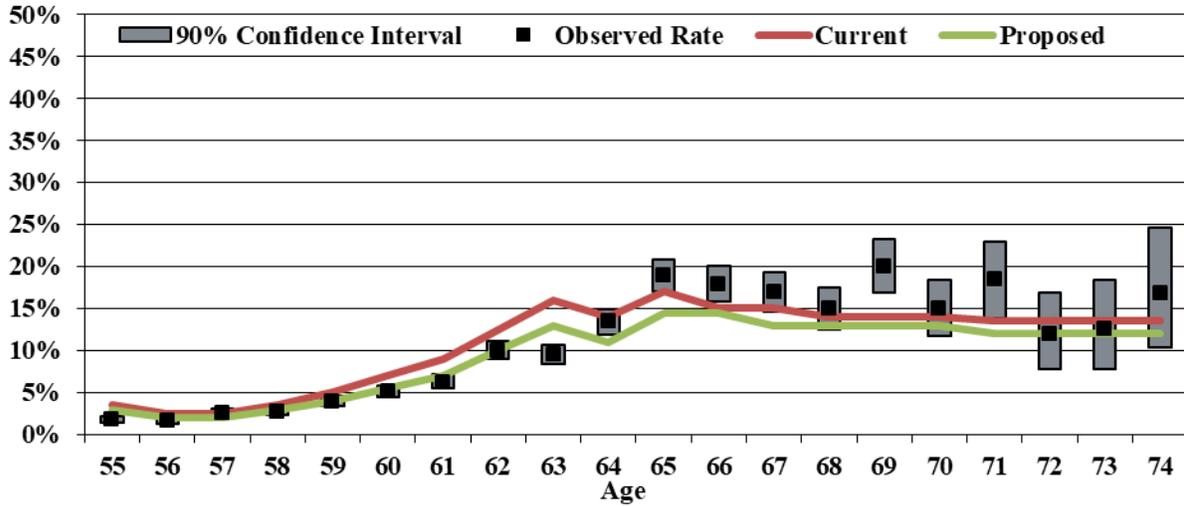
2% at 60 - Male Retirement Rates For 10 to 14 Years of Service

2% at 60 - Female Retirement Rates For 15 to 19 Years of Service

2% at 60 - Male Retirement Rates For 15 to 19 Years of Service

2% at 60 - Female Retirement Rates For 20 to 24 Years of Service

2% at 60 - Male Retirement Rates For 20 to 24 Years of Service
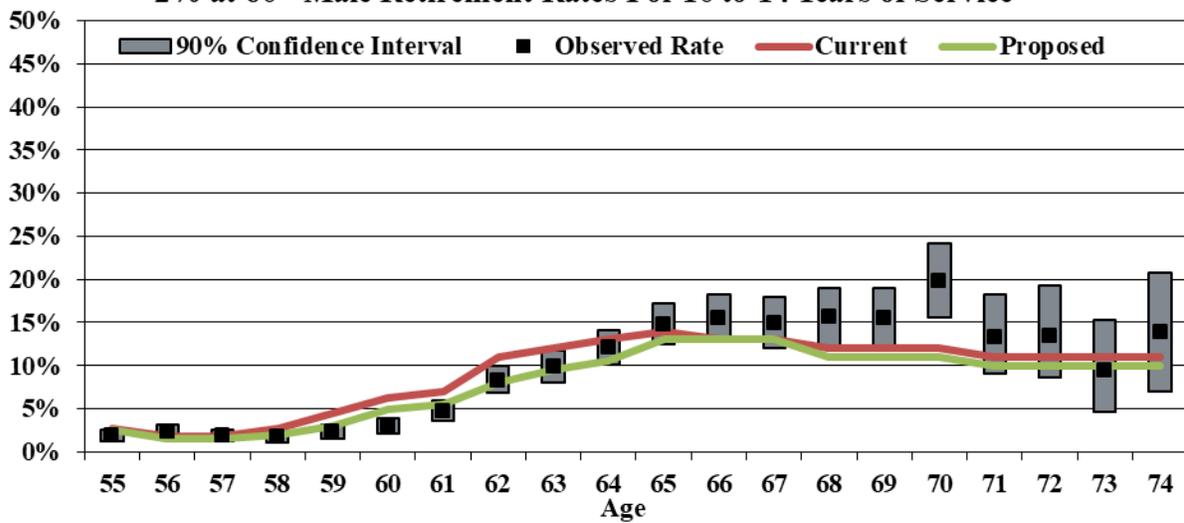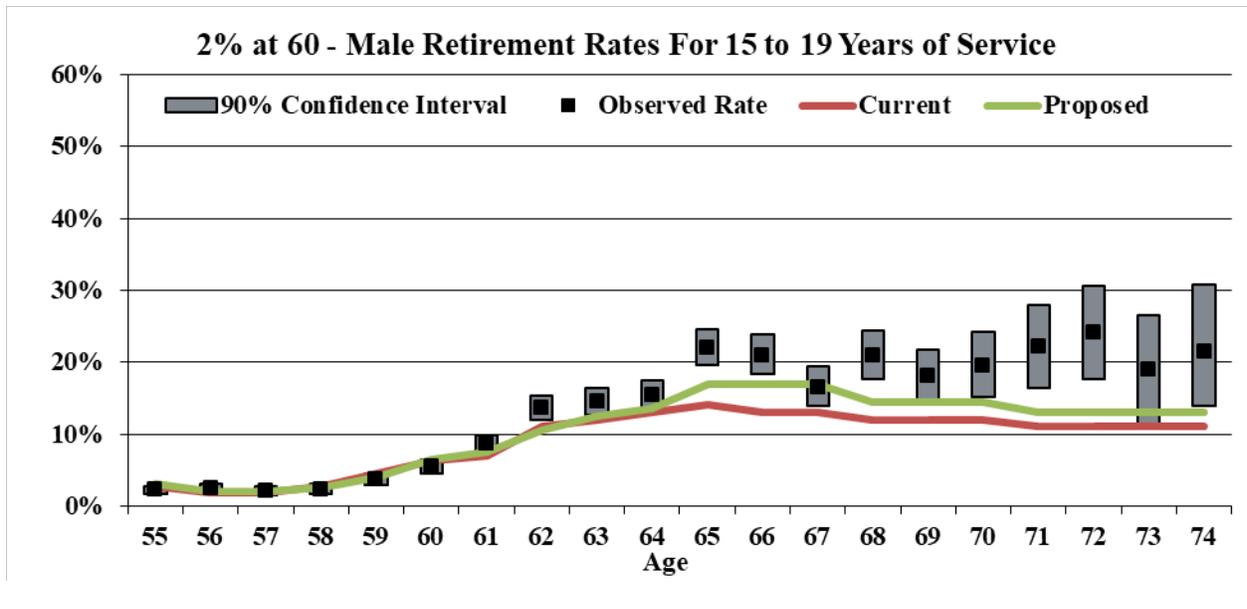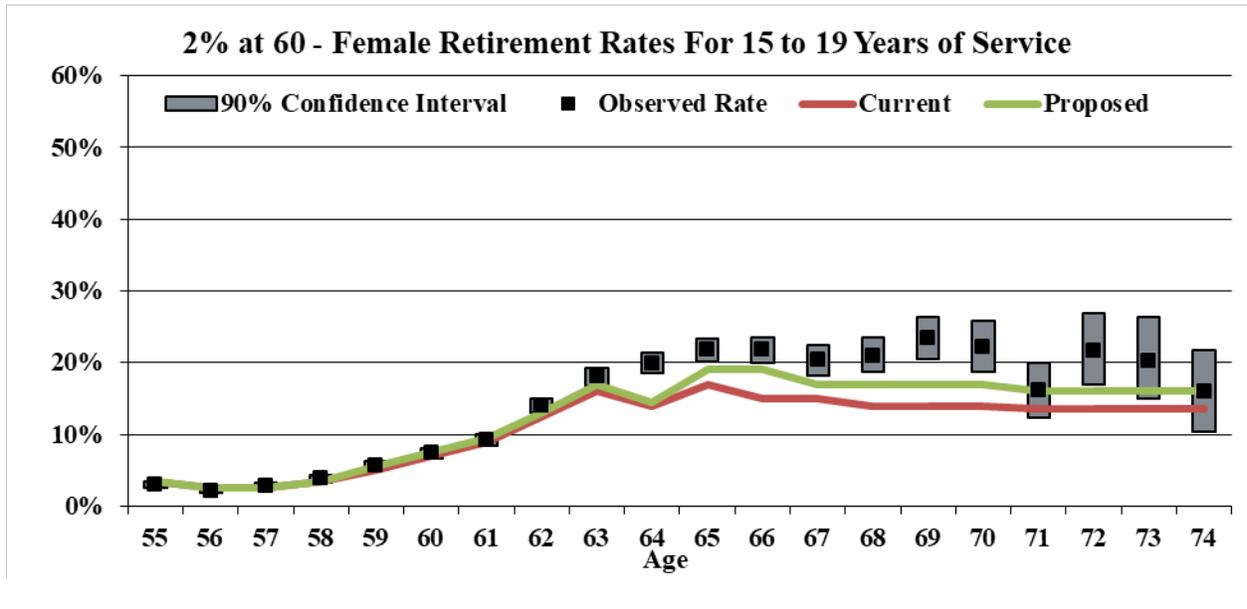
In aggregate, we believe the proposed assumptions for these service groups are reasonable, and the addition of the different service groupings appears to have been warranted. If this retirement experience persists, Milliman may want to consider further increasing the retirement rates at the older ages for some of the service groups.

## 25 through 29 Years of Service

For members with 25 or more years of service, final compensation is based on the highest 12 consecutive months instead of the highest three consecutive years. Consequently, Milliman proposes separate retirement rates for members with 25 years of service when this added benefit first becomes available.

SECTION VII – SERVICE RETIREMENT

The charts below and on the following page show the observed rates of service retirement and the 90 percent confidence intervals around those rates based on our analysis of the data compared to the current and proposed assumptions for members with 25 to 29 years of service. Separate charts are shown for males and females and for members with 25 years of service and 26 through 29 years of service.


2% at 60 - Female Retirement Rates For 25 Years of Service

2% at 60 - Male Retirement Rates For 25 Years of Service

2% at 60 - Female Retirement Rates For 26 to 29 Years of Service

2% at 60 - Male Retirement Rates For 26 to 29 Years of Service

We believe the proposed assumptions for these service groups are reasonable. However, it isn't clear that a separate assumption set is needed for members with 25 years of service.

30 or More Years of Service

Members with 30 or more years of service can retire as early as age 50 and receive an increase of 0.2% in the age factor with a maximum age factor of 2.4% (achieved at about age 61.5 with 30 or more years of service). Consequently, Milliman proposes separate retirement rates for members with 30 years of service when this added benefit first becomes available.

SECTION VII – SERVICE RETIREMENT

The charts below and on the following page show the observed rates of service retirement and the 90 percent confidence intervals around those rates based on our analysis of the data compared to the current and proposed assumptions for members with 30 or more years of service. Separate charts are shown for males and females and for members with 30 years of service and 31 or more years of service.

2% at 60 - Female Retirement Rates For 30 Years of Service


2% at 60 - Male Retirement Rates For 30 Years of Service

2% at 60 - Female Retirement Rates For 31 or More Years of Service

2% at 60 - Male Retirement Rates For 31 or More Years of Service

Based on this analysis, we believe the assumptions proposed by Milliman are reasonable. However, it isn't clear that a separate assumption set is needed for members with 30 years of service.

2% at 62 Members

For the 2% at 62 members, Milliman correctly points out that there is insufficient data on which to base a retirement assumption and the retirement patterns are likely to be different than for the 2% at 60 members. As a result, the proposed rates are based primarily on professional judgment. We agree with Milliman's recommended move to six service-based retirement rate tables for 2% at 62 members without additional tables specific to 25 and 30 years of service.

SECTION VII – SERVICE RETIREMENT

Benefits are generally lower (particularly prior to age 62) for the 2% at 62 members, and the 2% at 60 members receive a career factor adjustment and a longevity bonus after 30 years of service neither of which apply to 2% at 62 members. As a result, we would expect the 2% at 62 members to retire later and the impact of reaching 30 years of service to be less, but we would still expect the retirement rates to be higher for members with more service. We believe the proposed service-based retirement rates capture this expected pattern in a reasonable manner.

1990 Benefit Structure

The current retirement rates for the 1990 Benefit Structure are based on experience from the time the 1990 benefit structure applied and are based solely on age. Recognizing that retirement rates depend on service as well as age, Milliman is recommending an update to these rates to reflect the likely pattern for five-year service groups. We commend Milliman for proposing this change to more accurately reflect likely retirement patterns if the 1990 Benefit Structure were still in effect, but we question the efficacy of continuing to set separate retirement rates for the 1990 Benefit Structure at all.

These retirement rates are used to determine the normal cost and actuarial obligation under the 1990 Benefit Structure that is paid for by the State of California as opposed to the School Districts. While the change from the 1990 Benefit Structure likely changed retirement rates, other factors in the decades since that structure was last in place have also likely changed retirement rates. Relying on decades old experience for this assumption is questionnable. Furthermore, the members being valued only retire once, and when they retire, the actuarial obligation under the 1990 Benefit Structure is valued based on their actual retirement date – not a hypothetical date they would have retired if the 1990 Benefit Structure were still in effect.

If the regular retirement assumptions are exactly met, there will be ongoing gains or losses on the 1990 Benefit Structure due to members actual retirement dates. In addition, because the normal cost for the 1990 Benefit Structure doesn't accumulate to the value of the 1990 benefits upon expected retirement, the allocation of the 1990 assets for pre-2014 service is also distorted and doesn't get corrected with the gain or loss at retirement. Consequently, we believe Milliman and CalSTRS should consider using the same retirement rates for the 1990 Benefit Structure as for the post-1990 benefit structure. There would still be different normal cost rates and actuarial obligations for the 1990 Benefit Structure, but the normal cost rate would not reflect the hypothetical changes in retirement behavior. It would, however, reflect the obligation expected upon retirement for the 1990 Benefit Structure.

SECTION VIII – DISABILITY RETIREMENT

Based on our independent analysis of disability retirement rates as summarized below, we believe Milliman's proposed assumptions are reasonable.

Data Comparison

Milliman provided us their determination of exposures to disability retirement and the actual number of disability retirements by age for Coverage A and Coverage B. The table below compares the actual disability retirements, exposures, and the average disability retirement rate determined by Milliman to the same statistics determined in our independent analysis. There are some minor variations, but all of the average rates are very close. As a result, the data on which Milliman based its recommended assumption appears to be reasonable.

Comparison of Decrements and Exposures									
	Milliman Data			Cheiron Data			Difference		
Assumption	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**
Disability Retirement									
Males - Cov A	29	41,445	0.07%	29	42,415	0.07%	0	970	0.00%
Males - Cov B	259	258,771	0.10%	242	231,414	0.10%	-17	-27,357	0.00%
Females - Cov A	107	102,268	0.10%	100	103,992	0.10%	-7	1,724	-0.01%
Females - Cov B	844	668,443	0.13%	805	595,177	0.14%	-39	-73,266	0.01%

Our understanding is that Milliman includes a 10% load to account for a lag in disability determinations. Our approach looked at actual future valuation status to determine disabilities that occurred after a lag and would presumably show slightly lower counts in the final study year.

Coverage A

The charts on the following page show the observed rates of disability and 90 percent confidence intervals for members from age 40 through 59 in five-year age groups based on our analysis of the data compared to the current and proposed assumptions for Coverage A members. Milliman proposed slightly lower rates of disability at all ages. The proposed assumptions remain within or close to the confidence intervals at all ages, indicating that the assumptions are reasonable. In the future, CalSTRS may want to consider further reductions in the disability rates if observed experience remains below expectations.

SECTION VIII – DISABILITY RETIREMENT

Coverage A - Female Disability Incidence Rates

Coverage A - Male Disability Incidence Rates
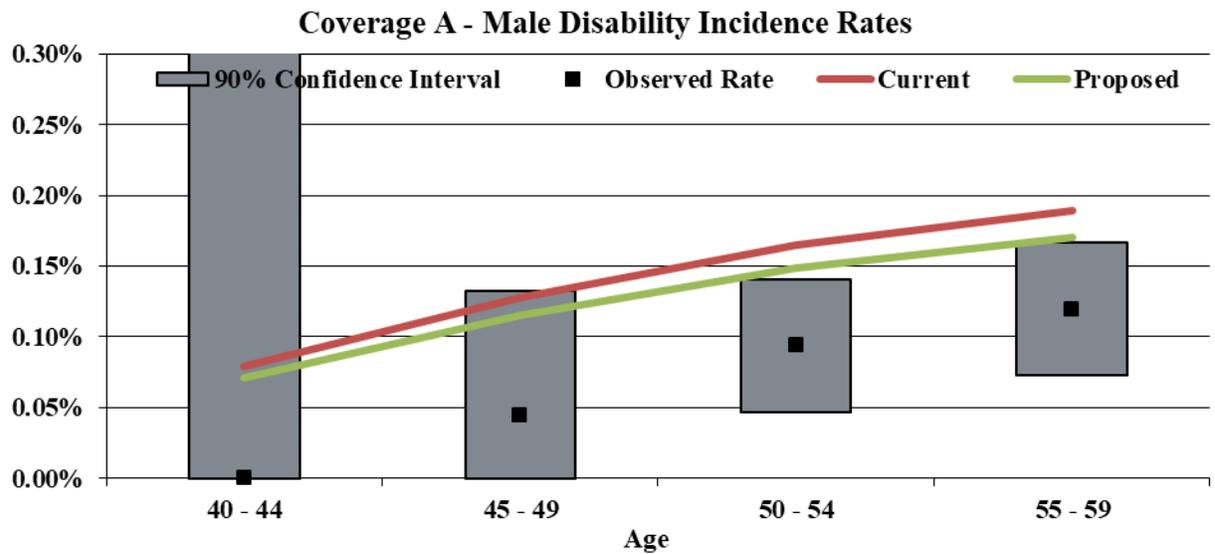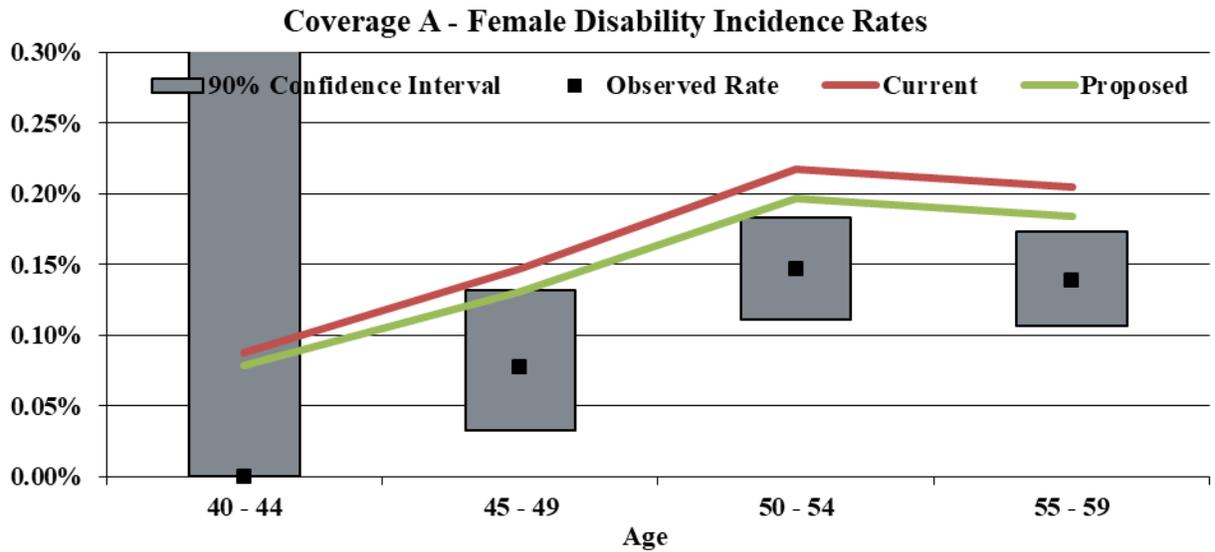
SECTION VIII – DISABILITY RETIREMENT

Coverage B

The charts below show the observed rates of disability and 90 percent confidence intervals for members from age 30 through 69 in five-year age groups based on our analysis of the data compared to the current and proposed assumptions for Coverage B members. Milliman proposed the same or slightly lower rates of disability at all ages. The proposed assumptions track the pattern of observed experience closely and remain within or close to the confidence intervals, indicating that the assumptions are reasonable. In the future, CalSTRS may want to consider further reductions in the disability rates if observed experience remains below expectations.

Coverage B - Female Disability Incidence Rates
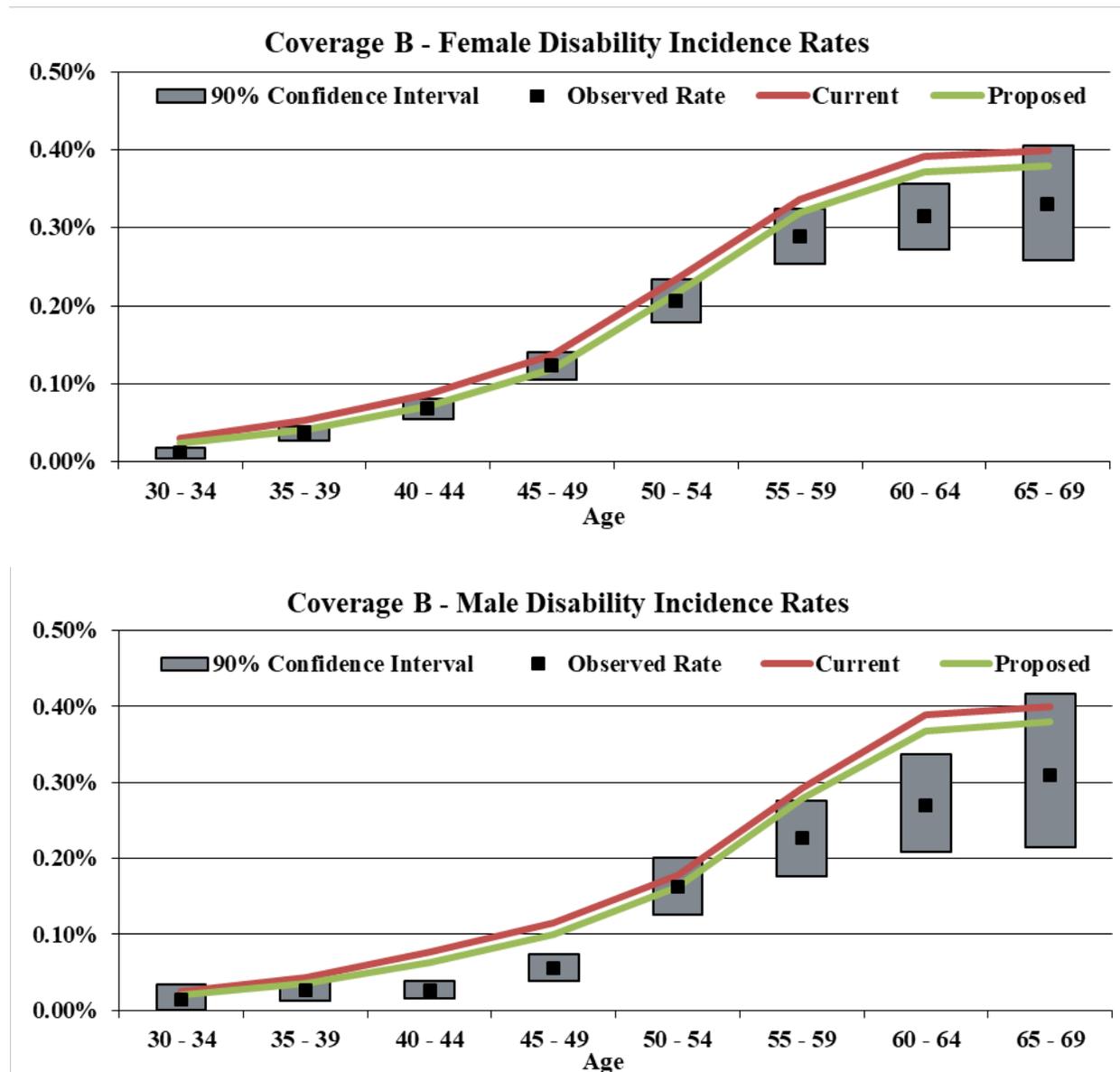
Coverage B - Male Disability Incidence Rates

SECTION IX – OTHER TERMINATIONS OF EMPLOYMENT

Data Comparison

Milliman provided us their determination of gross terminations, rehires, and net terminations by attained age for various service groups. The table below compares the actual terminations net of rehires, exposures, and the average net termination rate determined by Milliman to the same statistics determined in our independent analysis. There are some minor variations, but all of the average rates are very close. As a result, the data on which Milliman based its recommended assumption appears to be reasonable.

	Comparison of Decrements and Exposures								
	Milliman Data			Cheiron Data			Difference		
Assumption	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**	**Actual**	**Exposures**	**Rate**
Net Termination									
Males	7,602	277,600	2.74%	8,208	278,354	2.95%	606	754	0.21%
Females	15,567	736,039	2.11%	16,749	729,037	2.30%	1,182	-7,002	0.18%

Service-Based Net Termination Rates

Our analysis of the service-based net termination rates indicates that they are reasonable assumptions. The rates for active members terminating employment are offset by rehires of members with the same total service as those terminating. Given the number of rehires in CalSTRS experience, we believe this to be a reasonable approach. It results in a higher liability for active members, but lower actuarial losses for rehires.

The charts on the following page show the observed rates of termination net of rehires and 90 percent confidence intervals for members from one to 29 years of service based on our analysis of the data compared to the current and proposed assumptions. Milliman proposed slightly lower rates of termination at all ages, with a further downward adjustment to reflect greater weight for members working full-time. Our independent analysis shows the proposed assumptions track the pattern of observed experience closely and remain within or close to the confidence intervals, indicating that the assumptions are reasonable.

SECTION IX – OTHER TERMINATIONS OF EMPLOYMENT

Female Termination Rates
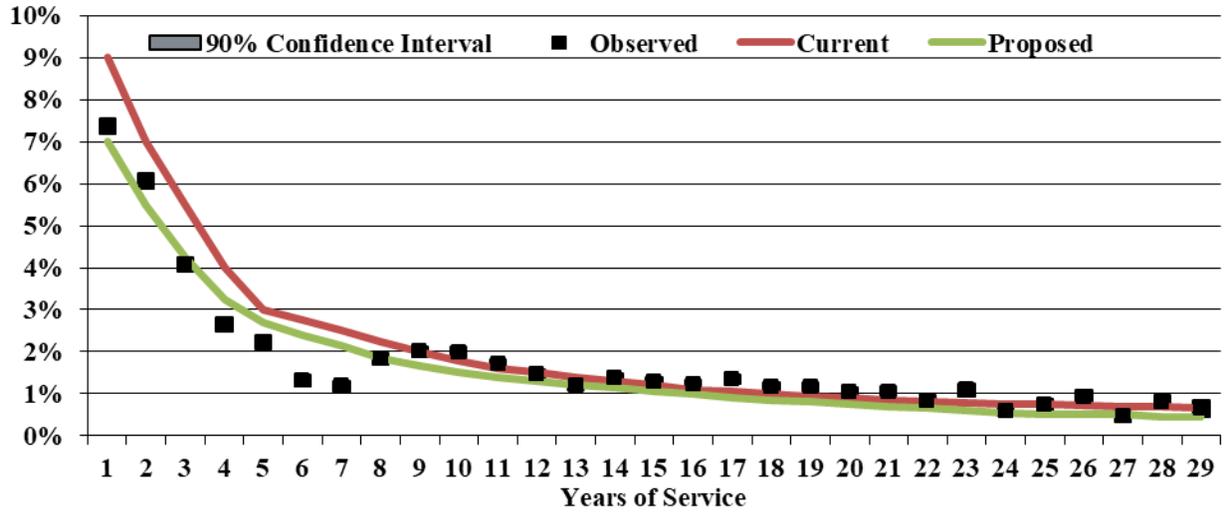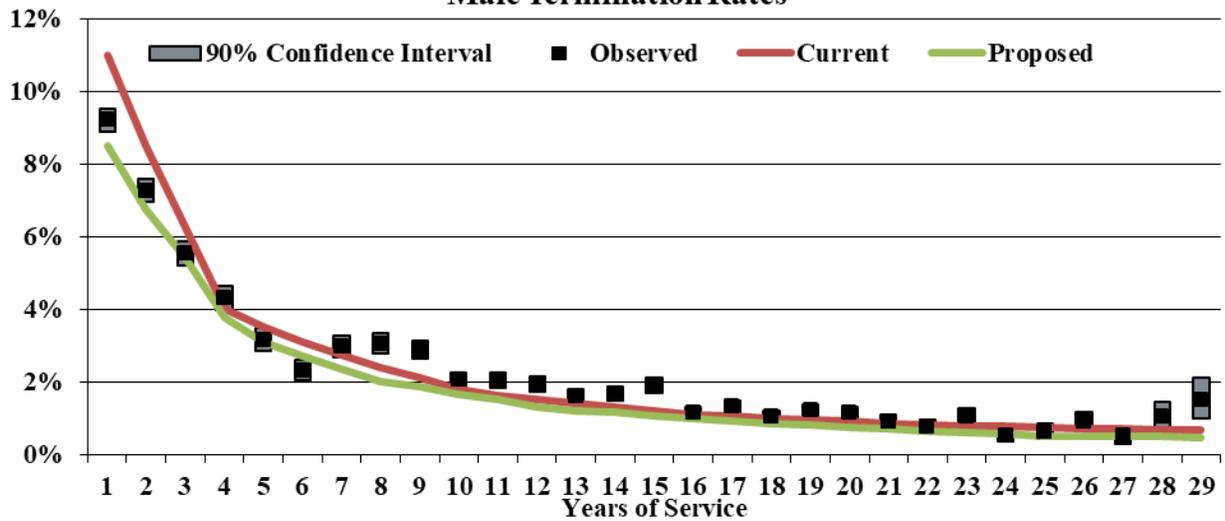
Male Termination Rates

## SECTION X – PROBABILITY OF REFUND UPON VESTED TERMINATION

Based on our independent analysis of net refund rates as summarized below, we believe Milliman's proposed assumptions are reasonable.

Data Comparison

Milliman provided us their determination of net refunds by entry age for various service groups. The table below compares the actual refunds, exposures, and the average refund rate determined by Milliman to the same statistics determined in our independent analysis. The average rates are close for all service groups except 5 to 9 years. We believe this discrepancy is due to a difference in when a member is determined to be fully vested and note that about 80% of the exposures we excluded elected a refund. As a result, the data on which Milliman based its recommended assumption appears to be reasonable.

Comparison of Decrements and Exposures									
	Milliman Data			Cheiron Data			Difference		
Assumption	Actual	Exposures	Rate	Actual	Exposures	Rate	Actual	Exposures	Rate
Refund									
5-9 Years Service	2,022	4,149	48.73%	1,490	3,486	42.74%	-532	-663	-5.99%
10-14 Years Service	614	2,591	23.70%	530	2,355	22.51%	-84	-236	-1.19%
15-19 Years Service	199	1,358	14.65%	171	1,219	14.03%	-28	-139	-0.63%
20-24 Years Service	33	429	7.69%	33	352	9.38%	0	-77	1.68%
25-29 Years Service	5	162	3.09%	4	111	3.60%	-1	-51	0.52%
Total	2,873	8,689	33.06%	2,228	7,523	29.62%	-645	-1,166	-3.45%

Review of Proposed Assumptions

The current assumptions are different for males and females, but the proposed assumptions are the same. We support this consolidation.

The charts on the following pages show the observed rates of refund and 90 percent confidence intervals for members with five or more years of service based on our analysis of the data compared to the current and proposed assumptions. The proposed assumptions generally track the pattern of observed experience, but do not always fall within the confidence intervals. In the future, CalSTRS may want to consider reductions in the refund rates, particularly at greater years of service if the observed experience continues to remain below the assumption. We note that Milliman reports an overall actual-to-expected ratio of 94% for the proposed refund assumptions, and we would prefer it to be closer to or in excess of 100%, especially for members with more years of service. Increases in refund rates may also be appropriate for some groups with less years of service.

SECTION X – PROBABILITY OF REFUND UPON VESTED TERMINATION

Unisex Net Refund Rates for Entry Ages Under 25

Unisex Net Refund Rates for Entry Ages 25 to 29

SECTION X – PROBABILITY OF REFUND UPON VESTED TERMINATION

Unisex Net Refund Rates for Entry Ages 30 to 34

Unisex Net Refund Rates for Entry Ages 35 to 39

SECTION X – PROBABILITY OF REFUND UPON VESTED TERMINATION

Unisex Net Refund Rates for Entry Ages 40 to 44

Unisex Net Refund Rates for Entry Ages 45 and Older
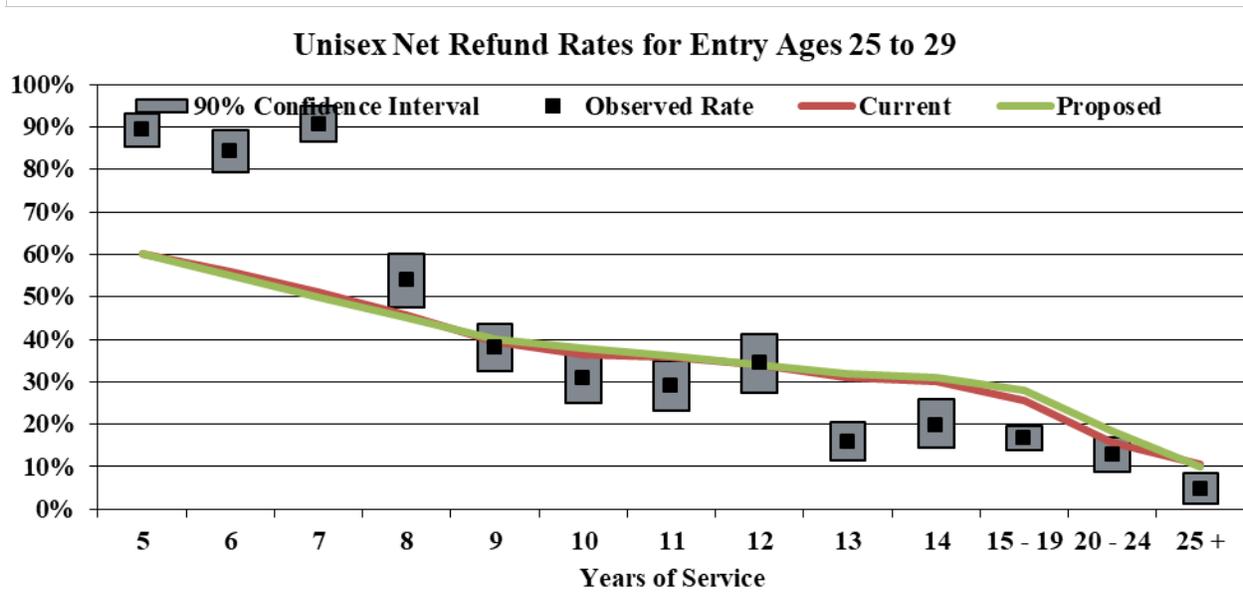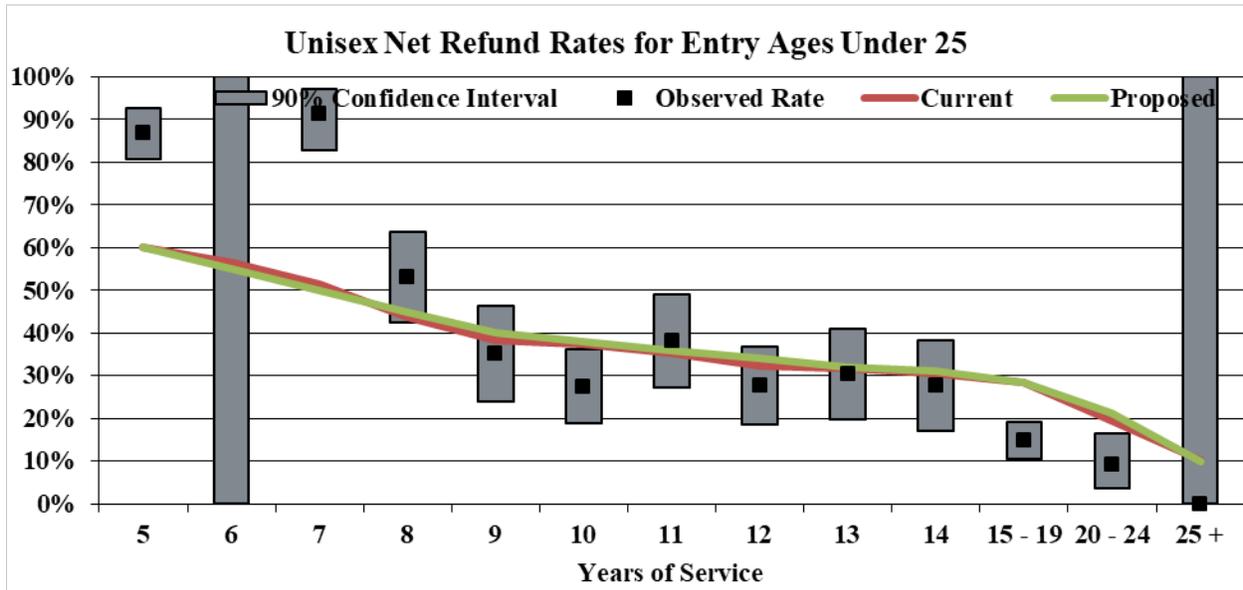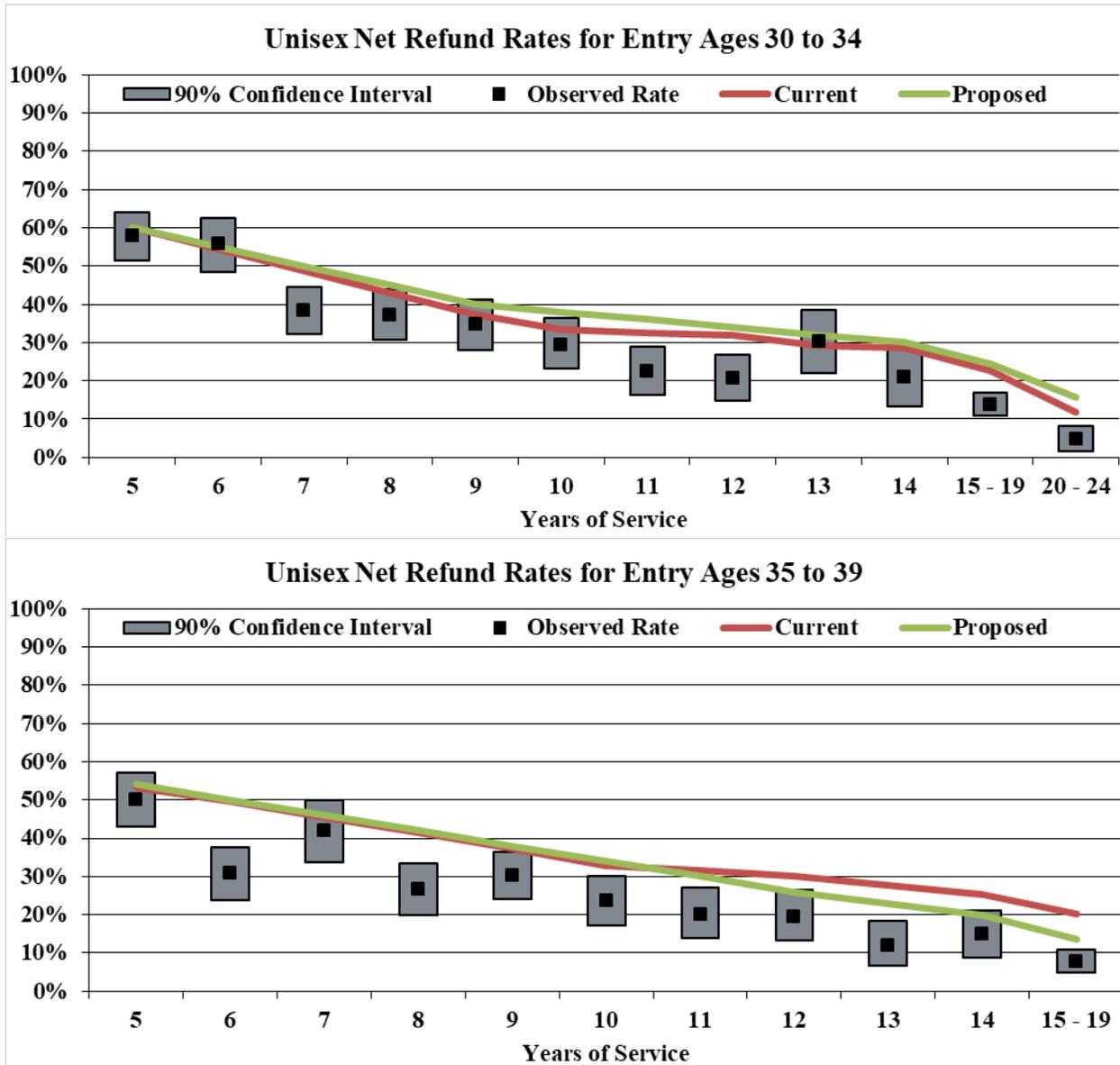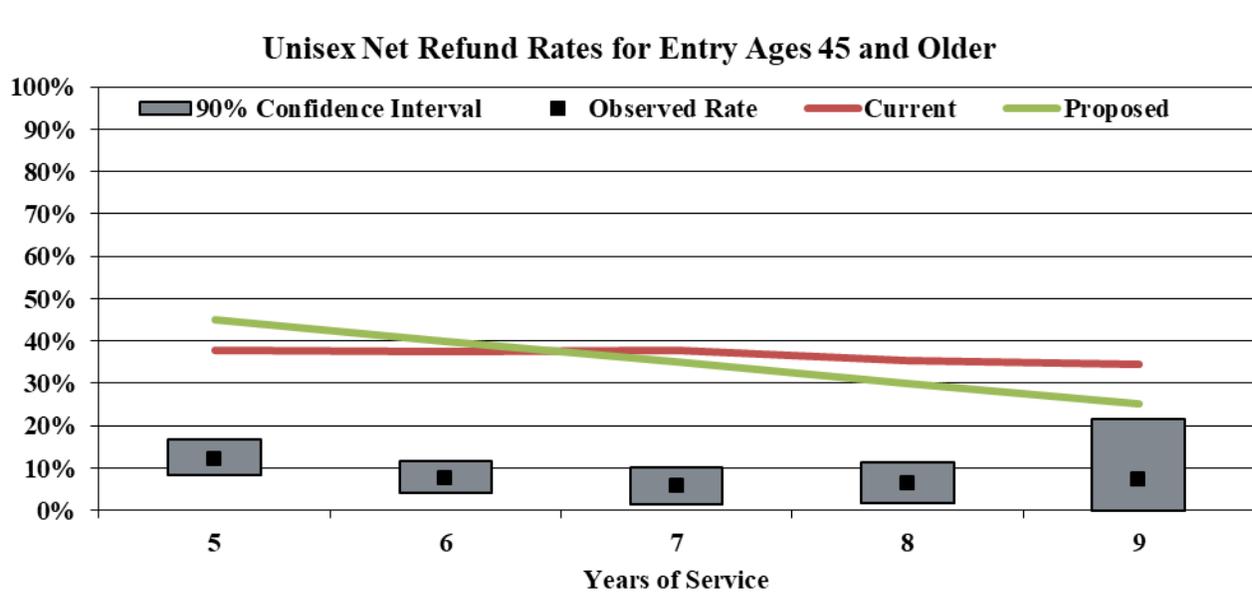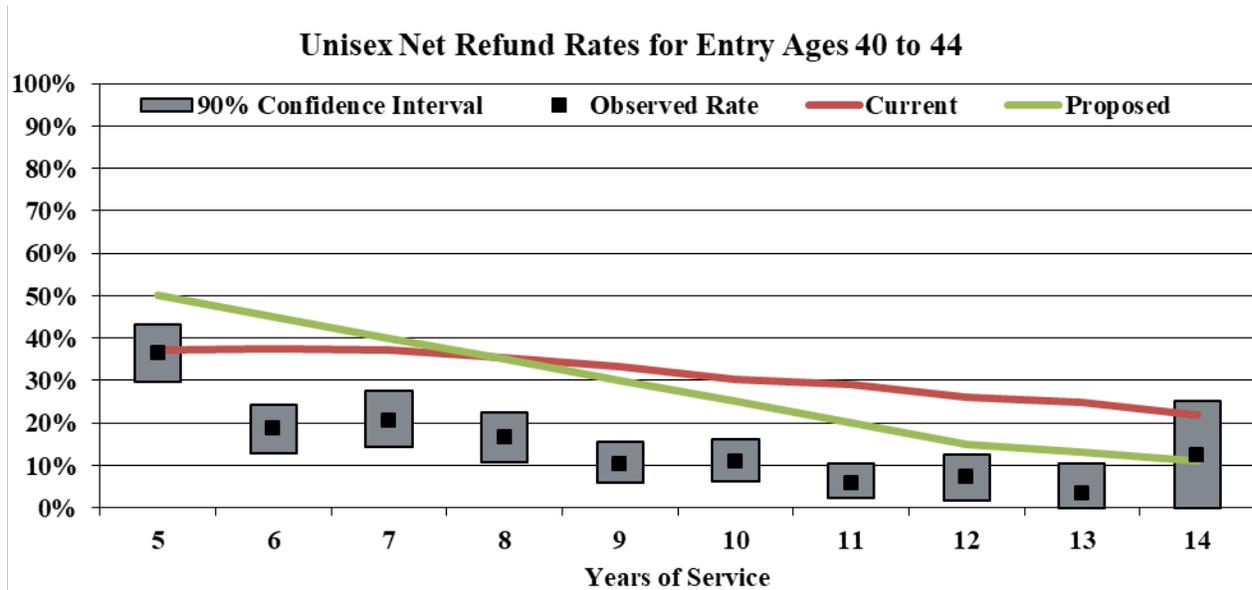
SECTION XI – ACTUARIAL METHODS AND MISCELLANEOUS ASSUMPTIONS

Actuarial Cost Method

For the DB program, CalSTRS uses the Entry Age Normal (EAN) Actuarial Cost Method, which allocates the present value of future benefits over the expected years of service of active participants. This method is the most widely used cost method among public sector pension plans and this is the method required under GASB 67 and 68. Milliman has proposed a technical change to members who selected Coverage A death benefits to calculate the normal cost based on the Coverage A benefit provisions. We find the EAN Cost Method reasonable and appropriate and concur with the technical change proposed.

For determining the actuarial obligation attributed to service earned prior to July 1, 2014, Milliman uses the Projected Unit Credit (PUC) Actuarial Cost Method. Under the PUC method, the actuarial obligation for service prior to July 1, 2014 is based on the projected benefits using credited service as of July 1, 2014 and projected salaries. We concur that the PUC Actuarial Cost Method is reasonable and appropriate for this purpose.

For the CBB and DBS programs, CalSTRS uses the Traditional Unit Credit (TUC or UC) Cost Method. This method is consistent with the funding objectives and long-term goals of these programs, where the benefits are expected to be derived from the member's accumulated account balances. The use of an alternative method – such as the EAN method – could result in a funded ratio for the program different than 100%, even though ultimately the benefits will be based on the assets available (since there is currently no funding mechanism to make up for any shortfall if the assets of the program consistently decline below the account balances, based on the minimum interest crediting rate.) If there are any significant developments in the funding status of the program or governing legislation that would result in an expectation that the benefits payable were likely to exceed the assets based on the current contribution rates, then a reconsideration of the funding method would be appropriate. We agree that GASB 67/68 requires the use of the EAN method for financial reporting purposes.

Actuarial Value of Assets

The Actuarial Value of Assets for the DB program is determined using a method that smooths investment gains or losses over approximately a three-year period, with no corridor around the Market Value of Assets.

The primary purpose for smoothing out gains and losses over multiple years is to reduce contribution volatility. Smoothing the market gains and losses over a reasonable period of time to determine the Actuarial Value of Assets is a generally accepted approach. We believe this method, which conforms to generally accepted practice, is reasonable. There are some systems that include a corridor around how far the Actuarial Value of Assets could diverge from market value; at the same time, it is generally accepted that smoothing over three years is sufficiently short to not need a corridor.

SECTION XI – ACTUARIAL METHODS AND MISCELLANEOUS ASSUMPTIONS

Previously, CalSTRS did not fund on an actuarially determined, variable contribution rate basis. If that were still the case, we would not see the need to use a smoothed Actuarial Value of Assets, in particular because GASB 67 now requires that the funding progress be disclosed using the Market Value of Assets. However, now that CalSTRS is moving toward an actuarially-determined contribution policy, there is some justification to use a smoothed asset value for managing contribution rate volatility. We caution, however, that there are significant controls in statute on how much contributions can vary from year to year, and we encourage Milliman and CalSTRS to analyze the implications of combining an asset smoothing method with the statutory restrictions on contribution volatility.

We agree with the use of the Market Value of Assets to determine the asset value for the CBB, DBS and MPP programs, since the use of a smoothed value is not needed to manage the contribution rate volatility as described for the DB program above.

Valuation of Current Inactive Members

Milliman recommended no change to the methodology used to estimate and value the benefits payable to currently inactive members. Milliman's method for valuing these deferred benefits is to estimate a benefit using the service information contained in the actual data, in addition to the most recently available pay information for each individual (or an average pay amount, if no pay information for the individual can be found). We find this methodology to be reasonable.

Inactive Member Retirement Age

Milliman recommended the continued use of an assumed commencement age of 60 for inactive 2% at 60 members. We support this assumption, based on our own independent review of the data, which indicated an average attained age at commencement of 60.8, matching Milliman. Milliman notes that this average is closer to 61; however, we agree that commencements after age 65 inflate the average. We calculate the average attained age at commencement as 59.6 for inactive members commencing at age 65 or earlier.

We also concur with Milliman's recommendation to use an assumed commencement age of 62 for inactive 2% at 62 members, based on the differences in the benefit formula, and reflecting the fact that there is currently not enough information available to independently set an assumption for this group based on actual data.

Number of Children

We did not collect the information necessary to confirm Milliman's recommendation to continue the current assumptions regarding the number of children assumed for active members. However, we note that this assumption – used for determining the number assumed eligible for minors' survival and disability benefits – is not expected to have a significant impact on the overall valuation results.

SECTION XI – ACTUARIAL METHODS AND MISCELLANEOUS ASSUMPTIONS

Assumed Offsets

Similarly, we did not collect the information necessary to confirm Milliman's recommendation to assume no offsets for future death and disability benefits, but to value the offsets as they occur (producing small actuarial gains). We believe this approach to be reasonable – especially given Milliman's observation that fewer than 10 members are currently receiving such offsets – and consistent with the approach used in many other public retirement systems.

Probability of Eligible Survivor for Active Death Benefit

For active death benefits, the current probability of eligible survivor assumption is 85% for males and 65% for females. Milliman recommends no change to this assumption.

Milliman stated in their experience analysis that they were unable to perform a statistically valid study of this assumption, based on the inability to identify deaths where the benefit is a refund of contributions. We do not find these proposed rates to be unreasonable, as they are reasonably close to the marital assumptions used by several of our clients.

However, we still recommend that Milliman attempt to come up with an approach to review the assumption using the CalSTRS experience at the time of the next experience study – perhaps by reviewing a sample of individual records for those that include an active member death during a specified timeframe.

Sick Leave Load

Milliman recommended a reduction in the load to account for future accumulation of unused sick leave, from 1.8% to 1.7% of current credited service. This recommendation is based on an observation that sick leave service for new retirees during the study period was approximately 1.49% of non-sick leave credited service. Milliman recommended not fully reflecting the 1.49% observed rate because the prior study showed a higher percentage over five years. We agree that both their approach and recommended assumption are reasonable based on our own independent review of the data, which indicated an average ratio of sick leave service to non-sick leave service of approximately 1.52% for the current study period.

However, we note that the lower average for this study period is largely driven by the data for 2018 retirees where sick leave service only accounted for 0.9% of total service. The 2018 percentage is by far the lowest out of the nine years of data available to us. The significant drop in 2018 could just be an anomaly, but it could also be either a data issue that implies no assumption change or a policy change that implies that a bigger adjustment may be warranted. We recommend that Milliman consider giving greater weight to recent experience if, going forward, the average sick leave service remains closer to the 2018 level.

SECTION XI – ACTUARIAL METHODS AND MISCELLANEOUS ASSUMPTIONS

Option Factors

We support Milliman's recommendation that the option factors should be updated to reflect any changes to the mortality assumptions or investment return assumptions used in the actuarial valuation. There are no such recommended changes in Milliman's current experience analysis; however, generational mortality assumptions result in changes in mortality rates every year. Milliman recommended that CalSTRS continue with the current simplification of changing the mortality tables used for the option factors following each experience study, rather than every year. We agree that this simplified approach is reasonable.

Milliman recommends a further simplification that the option factors be based on the generational mortality table for a member who attains age 60 at the midpoint of the period the option factors would apply. This simplification is also reasonable, but we recommend that Milliman and CalSTRS consider using factors reflecting the full set of generational mortality tables used in the valuation, but based on ages attained at the midpoint of the period. For a midpoint of 2022, factors for age 60 would be based on mortality rates for a member born in 1962, but factors for age 65 would be based on mortality rates for a member born in 1957. This approach would produce more accurate option factors at all ages.

We also support Milliman's recommendations regarding the proportions of males versus females used to compute the various optional form adjustments; our independent review of the data for retirees electing these options indicated male versus female percentages reasonably close to those proposed.

Milliman recommended adjustments (loads) to the mortality rates used to calculate the optional forms for the first four years after retirement for those members who elect a 100% continuance benefit (Options 2 and 6). Although these adjustments to account for anti-selection make theoretical sense, the actual experience has varied significantly over the past few experience studies. In the current study, Milliman presents actual load experience that differs – substantially for females in the first year – from the current assumptions. While we match Milliman's actual experience calculations reasonably well based on our own independent review of the data, we have some concerns about the credibility of the mortality loads given that our calculations show expected deaths of about 25-30 per year and 15-20 per year for males and females, respectively.

We note that with the new proposed rates, the loads are smaller and the select period has been reduced to two years for males and three years for females. We suggest that the credibility for a select assumption be explicitly considered, and to the extent the data is only partially credible, that any adjustments should be closer to 100% than the observed rates suggested by the data.

Estimated Impact of One-Year Final Compensation

Milliman recommends no change to the approach used to isolate the value of the 1990 benefits for current retirees. In particular, the approach is to use a table that varies by year of retirement to estimate the increase in the benefit from the use of one-year versus three-year final average pay.

SECTION XI – ACTUARIAL METHODS AND MISCELLANEOUS ASSUMPTIONS

We found this methodology to be reasonable. We appreciate that Milliman considered whether the average increase be computed on a headcount, or service-weighted basis as we had suggested in our prior replication and review. Milliman concluded that the two approaches produced consistent results. We concur with continued use of the method with adjustments to produce the assumption used for years after 2018 (i.e., adjusting by the wage growth plus ultimate merit salary assumption).

SECTION XII – ASSUMPTIONS SPECIFIC TO THE MPP PROGRAM

We reviewed the assumptions specific to the MPP Program as described in Milliman's 2020 Experience Analysis and found them to be reasonable.

Investment Return Assumption and Discount Rate

We agree with the recommendation to continue to use the same investment return assumption as for the DB Program to estimate the present value of the MPP Program liabilities. The most recent GASB 74/75 valuation for CalSTRS states that the MPP Program benefits are effectively funded on a pay-as-you-go basis through the THBF. Therefore, we concur with Milliman's recommendation to use the Bond Buyer 20-year Bond GO index to determine the municipal bond rate used to discount the projected benefits for GASB 74/75 reporting.

MPP Program Participation Rates

We reviewed the analysis of the MPP Program participation rates and the associated recommendations and found them to be reasonable. We independently analyzed and calculated the actual participation rates shown in Exhibit 11-1 based on data provided by CalSTRS. Our analysis showed an identical actual enrollment rate (of 0.06%) when calculated across all ages.

However, our analysis showed slightly higher actual enrollment rates among the pre-65 retirees than those shown by Milliman (2.48% for those retired in 2001 or later and 1.41% for those who retired prior to 2001, versus rates of 1.88% and 0.98%, respectively, as shown by Milliman in Exhibit 11-1). Milliman notified us that they included all retirees between the ages of 63 and 65.49 at the beginning of the study period in the pre-65 group, because there is often a lag between when the member turns 65 and when they appear in the Part A data. We find this explanation to be reasonable, and believe that the rates we computed without this adjustment would still support the proposed participation assumption of 2.00% for all pre-65 retirees. The rates we computed for those enrolling after age 65 also support Milliman's proposed assumptions.

Medicare Premium Trend Rates

We reviewed the medical trend assumptions and found them to be reasonable. However, we note that the per capita trend Medicare Part A and Part B assumptions proposed by Milliman for years 2029 and beyond (ranging from 4.3% – 5.1%) are higher than those shown in the most recent Medicare Trustees report, which range from 3.7% – 4.9% as shown in Table II.D1. Milliman references this report as one of the sources for their development of the projected trends. We recommend that in future studies, if Milliman continues to rely on information from the Medicare Trustees report in developing their assumption, they provide a discussion of why their recommendations would differ from those contained in that report, if applicable. For example, we note that the underlying general inflation assumption recommended in their experience study report is 2.75%, compared to the long-term intermediate inflation assumption of 2.60% reported in the Trustee's report, which may account for some, though likely not all, of the difference between Milliman's proposed trend rates and those in the Trustee's report.

APPENDIX A – GLOSSARY OF TERMS

1. **90 Percent Confidence Interval**

   The 90 Percent Confidence Interval is the range around the observed rate in which the true rate during the experience study period is expected to fall 90 percent of the time. For example, if you flip a coin 10 times, you will not always observe five heads and five tails even though there is a 50 percent chance of heads and a 50 percent chance of tails. If you were to observe six heads, the 90 percent confidence interval would still encompass the true underlying probability of 50 percent and provides support to retain an assumption of 50 percent.

2. **Actual**

   The actual number of decrements of a specified type observed during the experience study period.

3. **Actual-to-Expected Ratio (A/E Ratio)**

   The ratio of the actual number of decrements observed during the experience study period to the expected number of decrements under either the current or the proposed set of assumptions. Ideally, this ratio would be 100%, unless there is reason to assume that future experience will differ from the experience during the study period.

4. **Actuarial Cost Method**

   A procedure for allocating the actuarial present value of projected benefits to time periods, usually in the form of a normal cost that is the amount allocated to a particular year and an actuarial liability that is the amount allocated to prior years.

5. **Actuarial Gain or Loss**

   The difference in Actuarial Liability from what was expected that is attributable to differences between actual experience and assumed experience.

6. **Decrement**

   In the experience study, a decrement refers to a change in an individual member's status of a specified type. For example, there are a number of ways an active employee may change status including: service retirement, disability retirement, termination of employment, or death. Each of these is a type of decrement that is tabulated as part of the experience study.

7. **Expected**

   The expected number of decrements of a specified type during the experience study period based on either the current or proposed set of assumptions.

APPENDIX A – GLOSSARY OF TERMS

8. Exposures

The number of members exposed to a specified type of decrement during the period from one valuation date to the next.

9. Merit Salary Increases

Salary increases above those provided across the board to all employees. These increases may be attributed to promotion, longevity, or merit.

10. Observed Rate

The actual number of decrements of a specified type divided by the number of exposures to the same decrement.

11. Price Inflation

The average change over time in the prices paid for a market basket of consumer goods and services. For purposes of the experience study, we use the measure, CPI-U, as published by the Bureau of Labor Statistics.

12. Wage Growth

The average change over time in overall wages (also wage inflation).