Vermont State Teachers' Retirement System

Experience Review

July 1, 2014 through June 30, 2019

October 2020 / Matt Strom / Kathy Riley

Segal

Actuarial Certification

This experience study of the Vermont State Teachers' Retirement System for the five year period ending June 30, 2019 was prepared in accordance with generally accepted actuarial principles and practices. This study was completed at the request of the Board to review and update, as necessary, the assumptions used in the actuarial valuation. This document should not be shared, copied or quoted, in whole or in part, without the consent of Segal, except to the extent otherwise required by law.

The census information on which this experience study was based was prepared by the Office of the State Treasurer for use in the annual valuations.

The actuarial calculations were directed under the supervision of Kathleen Riley, FSA, MAAA, EA, and Matthew Strom, FSA, MAAA, EA. 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. To the best of our knowledge, the information supplied in this experience study is complete and accurate. Further, in our opinion, the recommended assumptions are reasonably related to the experience of and the expectations for the System.

Agenda

Overview

Summary of Recommended Assumptions

Cost Impact

Analysis:

- Economic Assumptions
- Demographic Assumptions

Overview: Purpose of an Experience Study

An experience study provides the basis for developing recommended assumptions to be used in the annual actuarial valuation

- Performed on a periodic basis, typically every five years
- Last full VSTRS experience study was prepared in 2016 for the 4-year period ending June 30, 2014
  - Subsequently, a review of certain economic assumptions (investment return, inflation, and COLA) and a review of the mortality assumption were prepared in 2017
- Current full study is based on the 5-year period July 1, 2014 through June 30, 2019

Actuarial Standards of Practice No. 27 and 35 provide guidance on best practices for performing assumption-setting analysis

- Each assumption should be "reasonable"

Segal's role is to make appropriate recommendations to the Board for each assumption

- The assumptions are the Board's assumptions and the Board can adopt all, none, or some of the recommendations of the actuary

Overview: How Assumptions Are Set

Review past experience ("actual") and compare with assumptions ("expected")

Determine trends – make judgments about the future

Develop component parts of each assumption

- Maintain internal consistency

Keep in mind:

- No "right" answer
- Assumptions are long-term

Overview: Actuarial Assumptions

Economic

- Inflation
- Investment return
- Salary increase
- Payroll growth
- COLA

Demographic

- Death after retirement
- Death in active service
- Retirement
- Termination
- Disability

Actuaries make assumptions as to when and why a member will leave active service and estimate the amount, duration and present value of the pension benefits paid.

Summary of Assumption Impact

Assumption	Description	Impact on Liability/Cost	Impact on Gain/Loss
Inflation	The rate at which price levels are rising and purchasing power is falling	The impact that inflation has on liability and cost varies by each economic assumption	The impact that inflation has on gain/loss varies by each economic assumption
Investment Return	Based on invested plan asset categories and assumed rates of return for each asset class	Higher assumption causes lower liability and cost	Higher than anticipated actuarial return will create actuarial gains
Salary Increases	The expected rate of future salary increases for employees at various ages or years from hire	Higher assumption causes higher liability and cost	Higher than anticipated salary increases to actives will create actuarial losses
Payroll Growth	Used to project covered payroll to estimate the employer normal cost for budgeting purposes	Higher assumption causes higher cost, but has no impact on liability	Payroll growth has no impact on gain/loss
COLA	An annual increase in benefits to counteract inflation	Higher assumption causes higher liability and cost	Higher than anticipated COLAs will create actuarial losses
Mortality	The probability of dying within one year at each age	Lower mortality increases liability and cost	Higher than anticipated mortality will create actuarial gains
Retirement	The age (or ages) when employees are expected to retire	Earlier assumed retirement usually increases liability and cost	If more members retired later in their careers, this could result in gains. Generally, losses result when a member retires earlier without a full actuarial reduction. Other scenarios may result in gains/losses.
Termination	The expected rate of termination for employees at various ages or years from hire	Greater assumed termination decreases liability and cost	Higher than anticipated terminations will likely result in actuarial gains
Disability	The age (or ages) when employees are expected to become disabled	Greater incidence of disability usually slightly increases liability and cost	Greater incidence of disability than anticipated will likely result in slight actuarial losses

Summary of Economic Assumptions

Assumption	Current	Proposed	Impact on Actuarially Determined Contribution
Inflation	2.50%	2.30%	N/A
Investment Return	7.50%	7.15%[1]	Increase
Salary Scale	Merit/seniority rates (including productivity) based on years since date of hire plus inflation	Minor increases to the merit and seniority (and productivity) portion of individual salary increases for members between age 20-59 and minor decreases for members age 60 and older plus the revised inflation assumption	Slight Increase
Payroll growth	3.00%	No change	N/A
COLA	2.55% for Group A and 1.40% for Group C	2.40% for Group A and 1.35% for Group C	Slight Decrease

[1] A range of reasonable investment return assumptions was first identified (7.00% to 7.25%). Within the reasonable range, 7.15% was proposed because it results in a similar confidence level as the current assumption when last studied. However, we believe that choosing the lowest end of the reasonable range, and, therefore, increasing the associated confidence level, is preferable. During the discussions regarding this and related presentations, it was also noted that the target asset allocation on which our analysis was based had not yet been reached and would not be reached for several years. As a result, all Boards, including VPIC, approved an investment return assumption of 7.00%.

Summary of Demographic Assumptions

Assumption	Current	Proposed	Impact on Actuarially Determined Contribution
Healthy Post-Retirement Mortality - Retirees	98% of RP-2006 White Collar Annuitant with generational projection using Scale SSA-2017	PubT-2010 Teacher Healthy Retiree Amount-Weighted Table with generational projection using scale MP-2019	Increase
Healthy Post-Retirement Mortality - Beneficiaries	Same as Retirees mortality above	109% of the Pub-2010 Contingent Survivor Amount-Weighted Table with generational projection using scale MP-2019	Slight Decrease
Disabled Post-Retirement Mortality	RP-2006 Disabled Mortality Table with generational projection using Scale SSA-2017	PubNS-2010 Non-Safety Disabled Retiree Amount-Weighted Mortality Table with generational projection using scale MP-2019	Slight Increase
Active Mortality	98% of RP-2006 White Collar Employee with generational projection using Scale SSA-2017	PubT-2010 Teacher Employee Amount-Weighted Table with generational projection using scale MP-2019	Slight Increase

Summary of Demographic Assumptions

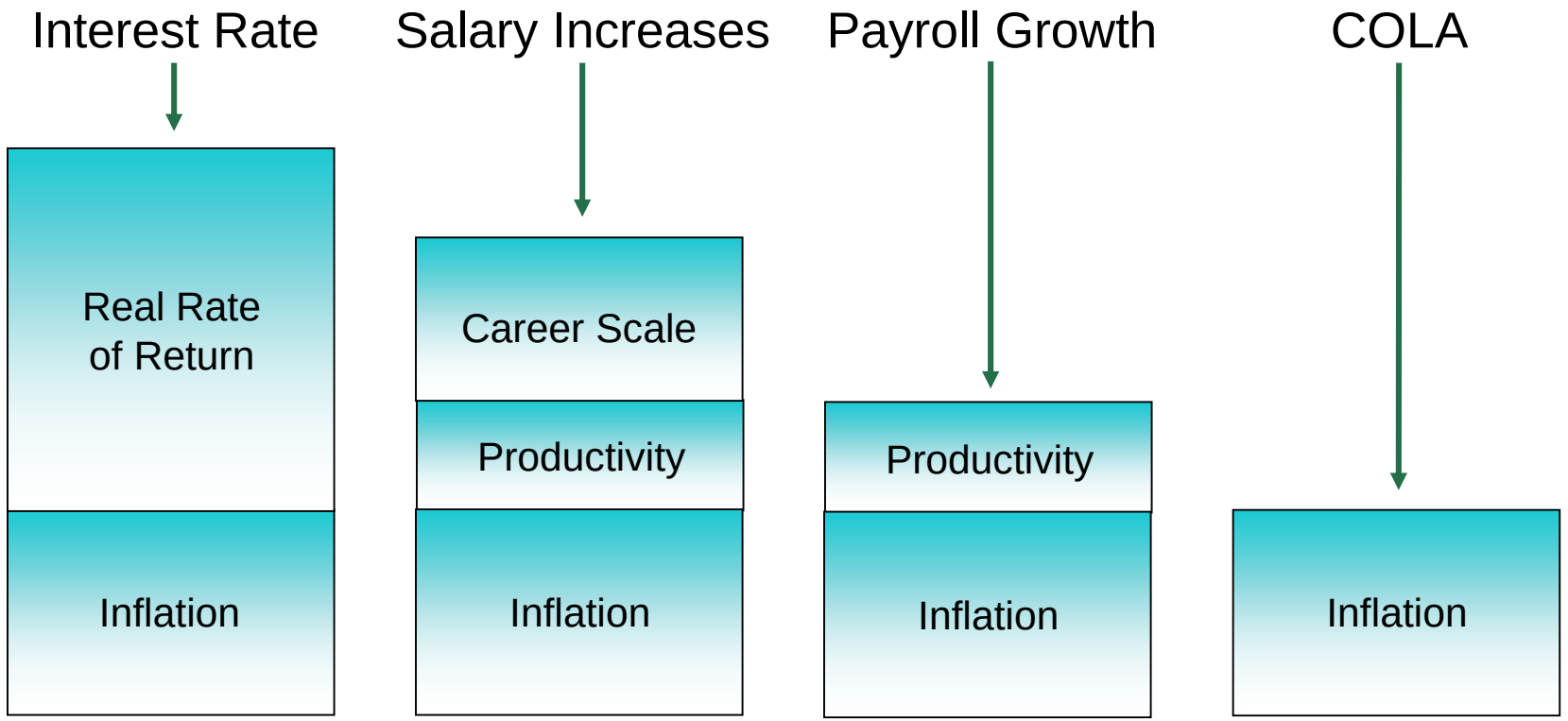
Assumption	Current	Proposed	Impact on Actuarially Determined Contribution
Active Retirement	Complex series of age-based rates applicable to various groups (Group A, Group C grandfathered, Group C non-grandfathered) that vary depending on whether the member is eligible for a reduced or unreduced benefit	For Group A and Group C-GF: One set of age-based rates for members eligible for unreduced benefits and one set of age-based rates for all other members	Slight Increase
		For Group C-NGF: A rate of 30% for members during the first year of unreduced eligibility, one set of age-based rates for members after the first year of unreduced eligibility, and one set of age-based rates for all other members	Slight Decrease
Inactive Retirement	All deferred members assumed to retire at Normal Retirement Age with a deferred vested benefit	Group A and Group C-GF: Add a rate of 10% from ERA for each year until NRA, then 100% at NRA	Slight Increase
		Group C-NGF: A rate of 50% from age 62-69, then 100% at age 70	Slight Decrease
Termination	Gender distinct age-based rates	Major reductions to all rates of termination and elimination of liability load	Increase
Disability Retirement	Gender distinct age-based rates	Increase current female rates by 5% and decrease current male rates by 10%	Slight Increase
Spouse Information	85% male members and 35% female members are married, male spouses are three years older than female spouses, and 100% of spouses are opposite gender	No changes	N/A

Cost Impact (Based on the June 30, 2019 Actuarial Valuation)

Description	Current Assumptions	All Proposed Demographic Assumptions	All Proposed Demographic and Economic Assumptions Including 7.00%
Actuarial Accrued Liability *Change from prior column* *Cumulative change*	$3,505.3M	$3,641.6M *+136.3M* *+136.3M*	$3,831.5M *+189.9M* *+326.2M*
Actuarial Value of Assets	$1,950.9M	$1,950.9M	$1,950.9M
Unfunded Actuarial Accrued Liability	$1,554.5M	$1,690.7M	$1,880.6M
Funded Percentage *Change from prior column* *Cumulative change*	55.7%	53.6% *-2.1%* *-2.1%*	50.9% *-2.7%* *-4.8%*
Normal Cost *Change from prior column* *Cumulative change*	$40.8M	$60.9M *+20.1M* *+20.1M*	$69.2M *+8.3M* *+28.4M*
Actuarially Determined Contribution for FY 2021 *Change from prior column* *Cumulative change*	$135.6M	$168.1M *+32.5M* *+32.5M*	$186.4M *+18.3M* *+50.8M*

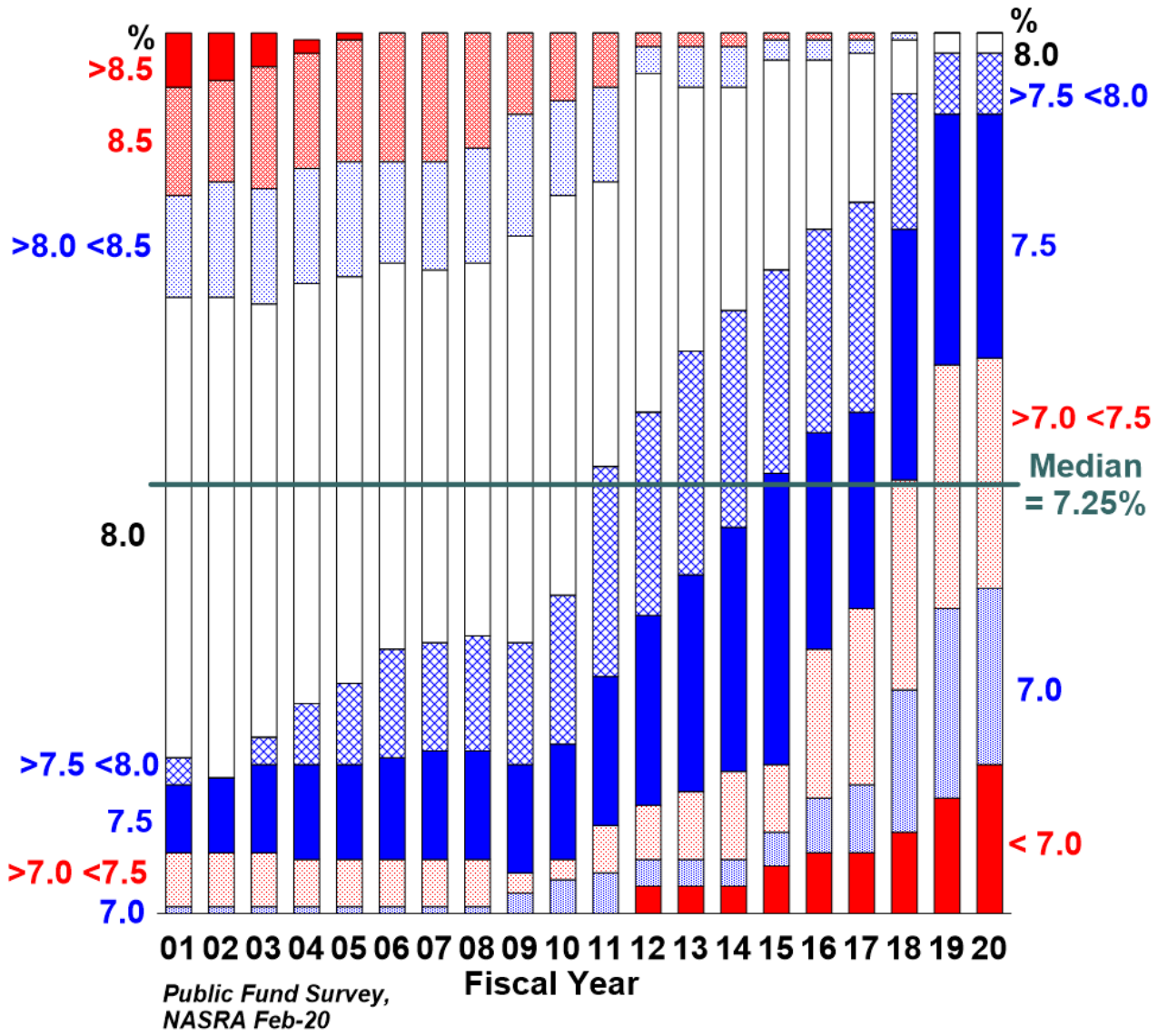
Basis for Setting Economic Assumptions

Each economic assumption has 2 or 3 components



Each component should be consistent across all economic assumptions, but may include a provision for adverse deviation.

Distribution of Historical Return Assumptions



Since 2001, the median investment return assumption has been moving downward and this trend is expected to continue as more systems complete experience review cycles.

Assumed Rate of Inflation

Inflation represents the annual increase in the cost of living

The current inflation assumption is 2.50%

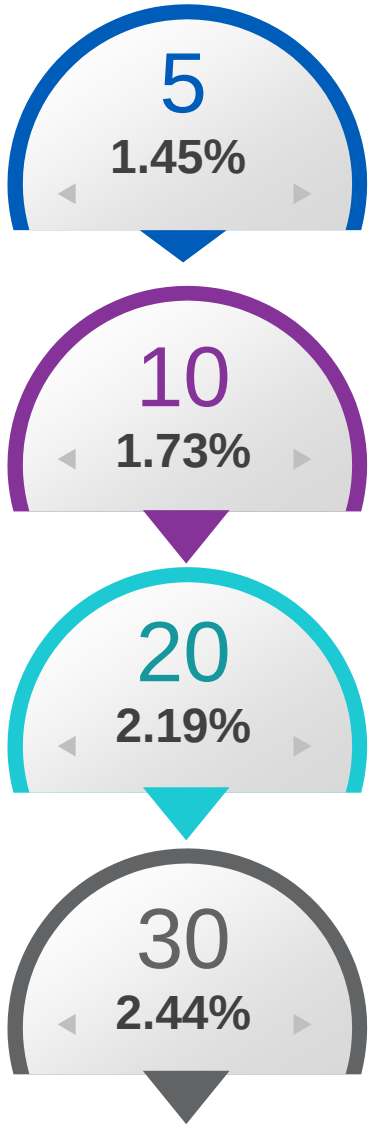
- Inflation is a component of the following economic assumptions:
  - Investment return
  - Individual salary increases and payroll growth
  - Cost-of-living-adjustments

Segal's recommendation is to lower the assumption from 2.50% to 2.30%, based on:

- The average 20-year inflation assumption from the 2019 Horizon Survey of Capital Market Expectations is 2.29%;
- The market's expectation of inflation is similar over 20-year and 30-year time horizons; and
- The Philadelphia Federal Reserve Bank Survey of Professional Forecasters 10-year outlook (2.20%) is consistent with the 10-year average from the Horizon Survey (2.21%).

Assumed Rate of Inflation *(continued)*

As of June 30, 2019, the historical national inflation (CPI-U) averages are:



5-year Average

The most recent 5-year average increase in CPI-U is 1.45%

10-year Average

The most recent 10-year average increase in CPI-U is 1.73%

20-year Average

The most recent 20-year average increase in CPI-U is 2.19%

30-year Average

The most recent 30-year average increase in CPI-U is 2.44%

Assumed Rate of Inflation *(continued)*

In addition to historical inflation, other metrics to consider are current market expectations and estimates from professional forecasters and economists

By observing the difference between the yields on US Treasury bonds with and without inflation indexing, we can calculate the rate of inflation that investors expect. As of June 2019, the yields on 10-year, 20-year, and 30-year Treasury bonds were as follows:

	10-Year	20-Year	30-Year
Non-inflation indexed:	2.07%	2.36%	2.57%
Inflation indexed:	0.37%	0.59%	0.79%
Delta:	1.70%	1.77%	1.78%

- The differences ranging between 1.70% to 1.78% represent the financial market's current expectations of inflation over the next 10 to 30 years

Assumed Rate of Inflation *(continued)*

Source	10-Year	20-Year
Federal Reserve Bank of Philadelphia Fourth Quarter 2019 Survey of Professional Forecasters	2.20%	
2019 Horizon Survey of Capital Market Expectations	2.21%	2.29%
NEPC	2.25%*	
Segal Marco Advisors	2.00%	2.00%

*2.25% is the 2019 NEPC 5-7 year inflation assumption

We recommend that the Board lower the inflation assumption from 2.50% to 2.30%

Assumed Rate of Investment Return

The investment return is a principal assumption used in any actuarial valuation and is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plan

The current investment return assumption of 7.50% consists of three components:

- Inflation*: 2.50%
- Real rate of return: 5.05%
- Adjustment for conservatism: (0.05%)

Our approach is to analyze inflation and real return separately

*The proposed inflation assumption is 2.30%

Basis for Expected Real Rate of Return

We have based our analysis of the expected real rate of return on the Horizon Survey of Capital Market Assumptions (2019 Edition)

- This survey compiles and averages the capital market assumptions of 34 investment consultants (including NEPC and Segal Marco Advisors)
  - 16 respondents provided assumptions for "long term", or 20 years
- Expected arithmetic returns are used to determine the expected returns by asset class
- The 20-year expected geometric portfolio real rate of return was generated from the 50th percentile of 5,000 simulated portfolio return trials

Geometric Real Rate of Return

	Asset Class	20-Year Horizon Annual Arithmetic Real Return	Target Allocation[1]	Weighted Real Return
Equity	US Large Cap	6.05%	11.63%	0.70%
	US Small Cap	7.23%	10.63%	0.77%
	International Developed	7.01%	14.59%	1.02%
	Emerging Markets	9.38%	6.15%	0.58%
	Private Equity	10.53%	10.00%	1.05%
Fixed/Alternative	US Core	2.17%	20.00%	0.43%
	International Debt Emerging	4.47%	4.00%	0.18%
	TIPS	1.40%	3.00%	0.04%
	Real Estate	5.65%	8.00%	0.45%
	Hedge Funds	4.32%	10.00%	0.43%
	Infrastructure	6.17%	2.00%	0.12%
	Total		**100%**	**5.79%**
	Adjustment to Geometric			(0.54%)
	Geometric Real Rate of Return[2]			**5.25%**

[1] Several equity classes include a portion of the target allocation to Global Equity.

[2] Geometric Real Rate of Return is the compounded 50th percentile return over 20 years. Arithmetic returns represent the expected return for a single year. Geometric returns take into account year-over-year compounding over the 20 year period.

Adjustment for Current Market Outlook

From 2019 to 2020, the investment market outlook changed and many investment consultants lowered their expectations

- Capital market assumptions from the Horizon Survey are aggregated based on investment consultant expectations from Q1 2019
- As an example, using VPIC's target allocation, the change in 50th percentile return based on Segal Marco Advisors capital market assumptions between January 2019 and January 2020 is a decrease of 0.32%
- We recommend an additional downward adjustment to the expected real rate of return to reflect the change in market outlook since early 2019

Geometric real rate of return	5.25%
Less adjustment for update in market outlook from January 2019 to January 2020	(0.30%)
Modified real rate of return	4.95%

Assumed Rate of Return Alternatives

Over a 20-year period, the Fund is expected to earn an annual real rate of return of at least 4.95% half of the time

- Lowering the expected real rate of return to 4.85% will increase the likelihood of meeting the expectation over a 20-year period to 51.3%

Component	Current	50/50: 7.25%	7.15%	7.00%
Inflation	2.50%	2.30%	2.30%	2.30%
Real Rate of Return	5.05%	4.95%	4.95%	4.95%
Adjustment for Adverse Deviation	(0.05%)	(0.00%)	(0.10%)	(0.25%)
Total	7.50%	7.25%	7.15%	7.00%
Confidence Level*	51%	50.0%	51.3%	53.1%

* The Confidence Level indicates the likelihood that expectations will be met over a 20-year period. An increase in the confidence level indicates that the plan is more likely to meet the expected rate of return.

We recommend that the Board lower the return assumption from 7.50% to 7.15%[1] to maintain a confidence level consistent with how the current assumption was set. A lower assumption such as 7.00% would increase that confidence level to 53.1%.

[1] A range of reasonable investment return assumptions was first identified (7.00% to 7.25%). Within the reasonable range, 7.15% was proposed because it results in a similar confidence level as the current assumption when last studied. However, we believe that choosing the lowest end of the reasonable range, and, therefore, increasing the associated confidence level, is preferable. During the discussions regarding this and related presentations, it was also noted that the target asset allocation on which our analysis was based had not yet been reached and would not be reached for several years. As a result, all Boards, including VPIC, approved an investment return assumption of 7.00%.

Assumed Rates of Individual Salary Increase

In order to project future benefits, salaries are projected forward over the expected lifetime for each active member

Individual member salary increase components:

- Inflation
- Productivity
- Merit and seniority increases

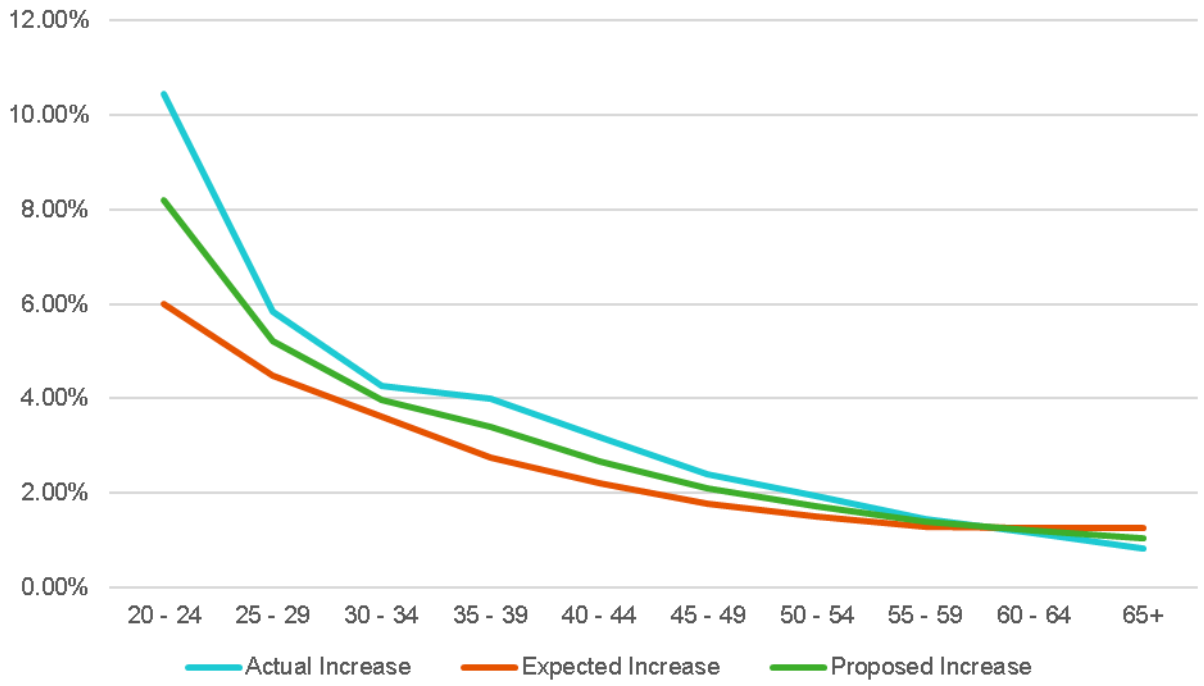
Since merit and seniority increases are unique to each retirement system, it is appropriate to base this assumption on recent experience

- We study the merit and seniority increases (plus productivity) separately from inflation
- Between 2014 and 2019, inflation averaged 1.5%

Assumed Rates of Salary Increase *(continued)*

The following table compares the actual and expected individual salary increases over the past 5 years, adjusted to remove actual annual inflation of about 1.5% over the experience period:

Age	Actual Increase	Expected Increase	Proposed Increase
20 - 24	10.45%	6.01%	8.20%
25 - 29	5.83%	4.50%	5.23%
30 - 34	4.27%	3.62%	3.98%
35 - 39	4.00%	2.75%	3.40%
40 - 44	3.19%	2.21%	2.67%
45 - 49	2.39%	1.77%	2.10%
50 - 54	1.93%	1.49%	1.71%
55 - 59	1.46%	1.28%	1.40%
60 - 64	1.16%	1.25%	1.21%
65+	0.82%	1.25%	1.05%
Total	2.84%	2.17%	2.52%



Based on this experience, we recommend minor increases to the merit and seniority (and productivity) portion of individual salary increases for members between ages 20-59 and minor decreases for members age 60 and older.

Assumed Rate of Payroll Growth

The payroll growth assumption is used to project covered payroll to estimate the employer normal cost for the two fiscal years following the valuation year for budgeting purposes

A higher payroll growth assumption is more conservative

- A higher assumption relative to actual experience results in an otherwise larger employer normal cost

The current payroll growth assumption of 3.00% consists of the following components:

Inflation	2.50%
Productivity	0.50%
Total payroll growth	3.00%

Assumed Rate of Payroll Growth *(continued)*

As the recommended inflation component is 2.30%, we need to examine the productivity component

Productivity can be measured as the excess of the increase in the National Average Wage over inflation. As of June 2019:

- The 20-year average of the National Average Wage is 3.0%
- The 20-year average inflation is 2.2%
- Therefore, productivity has averaged about 0.8% over the last 20 years

We recommend a slight increase of 0.2% to the productivity component (from 0.5% to 0.7%), to bring this assumption more in line with national average wage growth over the last 20 years

Assumed Rate of Payroll Growth *(continued)*

The following table summarizes the System's historical payroll and active population growth:

Year Ended June 30	Annualized Payroll ($ in Millions)	Active Members
2019	$624.9	9,862
2014	567.1	9,952
2009	561.6	10,799
2004	453.5	10,315
2000	388.0	10,234

- 5-year average: 2.0% -0.2%
- 10-year average: 1.1% -0.9%
- 15-year average: 2.2% -0.3%
- 19-year average: 2.6% -0.2%

Payroll increases have averaged nearly 2.8%/year since 2000, adjusting for headcount

Assumed Rate of Payroll Growth *(continued)*

The following table summarizes the components of the current and recommended payroll growth assumption:

Component	Current	Recommended
Inflation	2.50%	2.30%
Productivity	0.50%	0.70%
Total payroll growth	3.00%	3.00%

We recommend no change to the 3.00% payroll growth assumption

Assumed COLA Increases

Cost of Living Adjustments (COLAs) are generally linked to inflation

VSTRS contains the following COLA provisions:

- Equal to **CPI**, but not less than **1%**[1] or more than **5%** (Group A)
- Equal to **one-half of CPI**, but not less than **1%**[1] or more than **5%** (Group C)

We studied expected future COLAs based on stochastic projections of the recommended 2.30% inflation assumption, subject to the above parameters

As a result, we recommend the following COLA assumptions:

- Group A: 2.40% (currently 2.55%)
- Group C: 1.35% (currently 1.40%)

[1] Per statute, the COLA will be 0% in years that follow a year with negative CPI, subject to applicable offset of future increases.

Overview: How Mortality Assumption Is Set

Review past experience

Compare past experience ("actual") with assumptions ("expected")

- Examine both headcounts and benefit-weighted experience

Determine appropriate standardized table as basis for new assumption

Assess credibility of data set and calculate weighting factor

- Actual experience can be the assumption basis for fully-credible data
- Partially-credible data is blended with standardized table
- Typically, we assume 1,082 deaths needed in a subgroup to be considered fully-credible
  - 90% confident that results are within a range of 5% around the mean

Death After Retirement

The current post-retirement mortality assumption is 98% of the RP-2006 White Collar Annuitant with generational projection using Scale SSA-2017

Our analysis uses a benefit-weighted approach, which weights the probability of death with each annuitant's pension benefit

- This methodology takes into consideration any correlation between the health of the annuitant and the size of the benefit

In 2019, the Society of Actuaries published a series of Pub-2010 mortality tables derived from public plan experience

- Three broad classifications based on teachers, public safety, and general employees
- Contingent annuitant mortality studied separately from retiree mortality
  - Contingent annuitant mortality is generally worse than retiree mortality
- Separate mortality tables for "healthy" annuitants and those members retiring with a disability pension

For purposes of comparing actual experience to expected, Pub-2010 mortality rates have been projected to 2016, the mid-point of the experience period, with scale MP-2019

Death After Retirement (*continued*)

Over the experience period, there were fewer actual retiree deaths than expected for both males and females and there were more actual beneficiary deaths than expected for both males and females

Recommend updating base tables to appropriate Pub-2010 mortality tables, with adjustments for VSTRS-specific experience where "credible" data exists

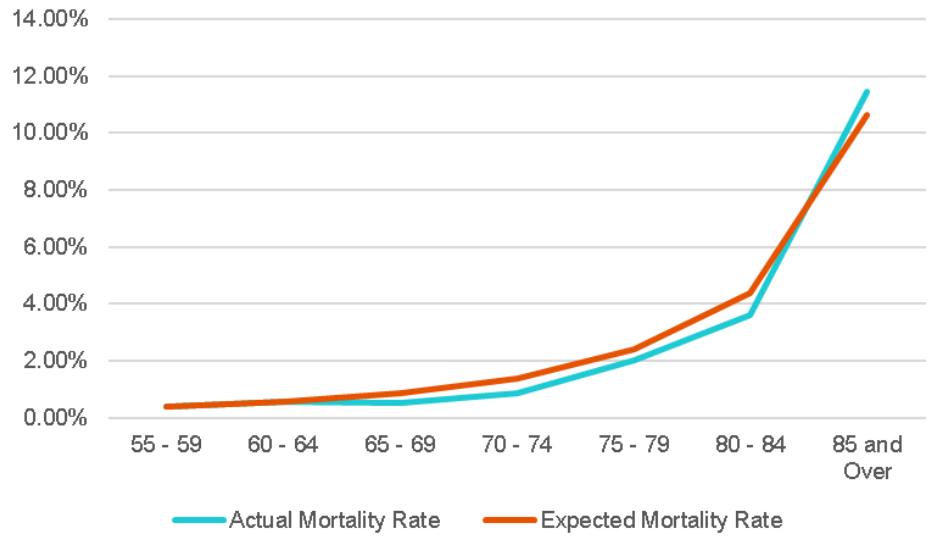
- PubT-2010 Retiree Table based on teacher dataset ages 55 through 120
- PubT-2010 Employee Table based on teacher dataset ages 18 through 80
- PubNS-2010 Non-Safety Disabled Retiree Table based on teacher and general employee dataset
- Pub-2010 Contingent Survivor Table based on entire dataset of contingent annuitants

Recommend reflecting future mortality improvement by applying Projection Scale MP-2019 on a generational basis

- The Social Security Administration Office of the Chief Actuary has recently released its report on long-range demographic assumptions used in the 2020 Trustees report. The report includes a projection of mortality improvement, which is used to generate projection scale SSA-2020. This scale reflects historical U.S. population mortality data, while MP-2019 reflects historical pensioner mortality data.

Analysis – Healthy Retiree Mortality (Unisex)

Actual Versus Expected Experience, Benefit-Weighted Basis

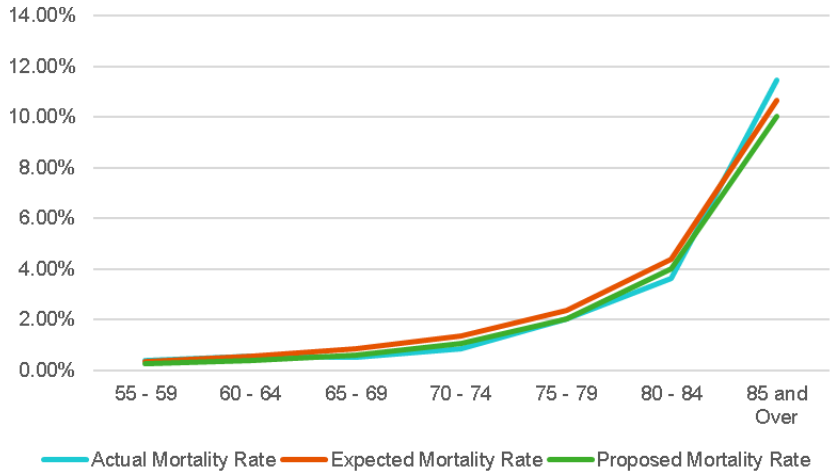


Basis	Exposures	Actual Deaths/Benefits for Participants who Died	Expected	Actual to Expected***
Counts	40,534	754*	821	92%
Benefits**	$803,387	$11,168	$13,368	84%

* 754 actual deaths in the observation period yields partial credibility of 84%
** Based on annual benefits in thousands of dollars
***Actual to Expected ratios indicate how well the actual experience aligns with the current assumptions. The closer the ratio is to 100%, the closer the current assumptions align with the actual experience.

Analysis – Healthy Retiree Mortality (Unisex)

Actual Versus Proposed Experience, Benefit-Weighted Basis



On a benefit-weighted basis, unadjusted PubT-2010 Retiree Table results in a reduction of $11,161,000 in benefits due to the proposed assumption

- As this is sufficiently close to the $11,168,000 actual value, a credibility-weighted adjustment is unnecessary

Recommend unadjusted PubT-2010 Retiree Table

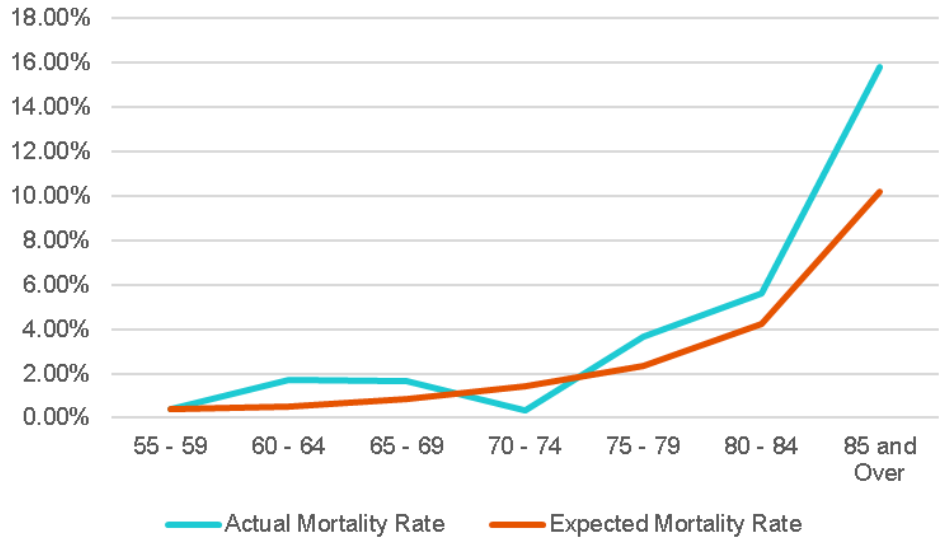
Basis	Exposures	Actual Benefits for Participants who Died	Proposed	Actual to Proposed**
Benefits*	$803,387	$11,168	$11,161	100%

* Based on annual benefits in thousands of dollars

**Actual to Proposed ratios indicate how well the actual experience aligns with the proposed assumptions. The closer the ratio is to 100%, the closer the proposed assumptions align with the actual experience.

Analysis – Beneficiary Mortality (Unisex)

Actual Versus Expected Experience, Benefit-Weighted Basis

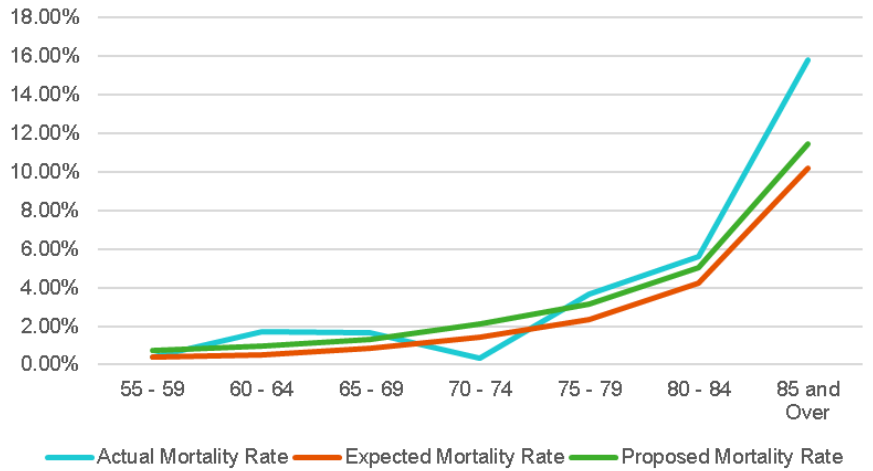


Basis	Exposures	Actual Deaths/Benefits for Participants who Died	Expected	Actual to Expected***
Counts	2,131	120*	79	152%
Benefits**	$27,462	$1,212	$841	144%

* 120 actual deaths in the observation period yields partial credibility of 33%
** Based on annual benefits in thousands of dollars
***Actual to Expected ratios indicate how well the actual experience aligns with the current assumptions. The closer the ratio is to 100%, the closer the current assumptions align with the actual experience.

Analysis – Beneficiary Mortality (Unisex)

Actual Versus Proposed Experience, Benefit-Weighted Basis



On a benefit weighted basis, unadjusted Pub-2010 Contingent Survivor Table results in a reduction of $951,000 in benefits due to the proposed assumption

- Credibility-weighted adjustment (33%) results in a reduction of $1,038,000 in benefits due to the proposed assumption

Recommend 109% of Pub-2010 Contingent Survivor Table

Basis	Exposures	Actual Benefits for Participants who Died	Proposed	Actual to Proposed**
Benefits*	$27,462	$1,212	$1,039	117%

* Based on annual benefits in thousands of dollars

**Actual to Proposed ratios indicate how well the actual experience aligns with the proposed assumptions. The closer the ratio is to 100%, the closer the proposed assumptions align with the actual experience.

Analysis – Healthy Retiree & Beneficiary Mortality

- The Appendix includes information on actual and expected experience separately for males and females
- Because each group individually yields less credibility, the experience has been combined to determine the credibility weighting factor that was used

Death After Retirement (Disabled)

Mortality experience for disabled annuitants has been less than the current assumption

- The ratio of actual to expected deaths on a benefit-weighted basis is 55%

We recommend updating to the unadjusted "non-safety" version of the Pub-2010 mortality table for disabled retirees

- The limited actual experience is insufficient to warrant making an adjustment to the published table

Recommend accounting for future mortality improvement by applying Projection Scale MP-2019 on a generational basis

Actual Versus Proposed Experience, Benefits-Weighted Basis, Unisex

Basis	Exposures	Actual Deaths/ Benefits for Participants who Died	Expected	Actual to Expected**	Proposed	Actual to Proposed**
Counts	787	22	32	69%		
Benefits*	$37,627	$750	$1,364	55%	$1,280	59%

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Death While In Active Service

Mortality rates applied to active members

- Very few members die in active service
  - Liability associated with active death is a small percentage of the total liability
  - Plan experience is insufficient to set assumption

The current assumptions include separate mortality tables for active and retired members

- Since we are using the new PubT-2010 Retiree Table for retired lives, we recommend using the PubT-2010 Employee Table for active members
  - No adjustment to the published table, given the limited credibility of the group

Retirement Eligibilities

Eligibility criteria for retirement differs by group:

- Group A
- Group C
  - Grandfathered (GF): Members who were hired within five years of normal retirement eligibility as defined prior to July 1, 2010
  - Non-Grandfathered (NGF): Members who do not meet the criteria to be grandfathered

	Unreduced Benefits	Reduced Benefits
Group A	Age 60 or 30 years of creditable service	Age 55 and 5 years of creditable service
Group C-GF	Age 62 or 30 years of creditable service	Age 55 and 5 years of creditable service
Group C-NGF	Age 65 or age plus creditable service equal to 90	Age 55 and 5 years of creditable service

Active Member Retirements

Current rates:

- Separate, complex series of rates applicable to each group (Group A, Group C grandfathered, Group C non-grandfathered)
- Unisex rates that vary depending on whether the member is eligible for a reduced or unreduced benefit
- Vary based on member's age

We have analyzed retirement experience by group on a benefit-weighted basis for the following eligibilities:

- Eligible for an unreduced benefit
- Eligible for an unreduced benefit in the first year only
- Eligible for an unreduced benefit in all other years
- All other members

The retirement rates take into account each individual's eligibility requirements

Active Retirements – Group A

Unreduced benefits (30+ years of service, less than age 60):

- There was limited experience

Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$243	$29	$24	119%	$24	119%

Recommend leaving these rates unchanged

* Based on annual benefits in thousands of dollars
**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group A

All other members:

- There was still somewhat limited experience, but there were many more retirements than expected

Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$928	$389	$222	175%	$283	137%

We recommend increasing the rates throughout all ages

* Based on annual benefits in thousands of dollars
**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group C Grandfathered

Unreduced (30+ Years of Service, < Age 62):

- There were more retirements than expected

Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$52,817	$9,141	$7,232	126%	$8,110	113%

Recommend increasing some rates at various ages

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group C Grandfathered

All Other Members:

- The experience was very consistent with the current assumptions

Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$73,544	$21,916	$18,659	117%	$18,659	117%

Recommend leaving these rates unchanged

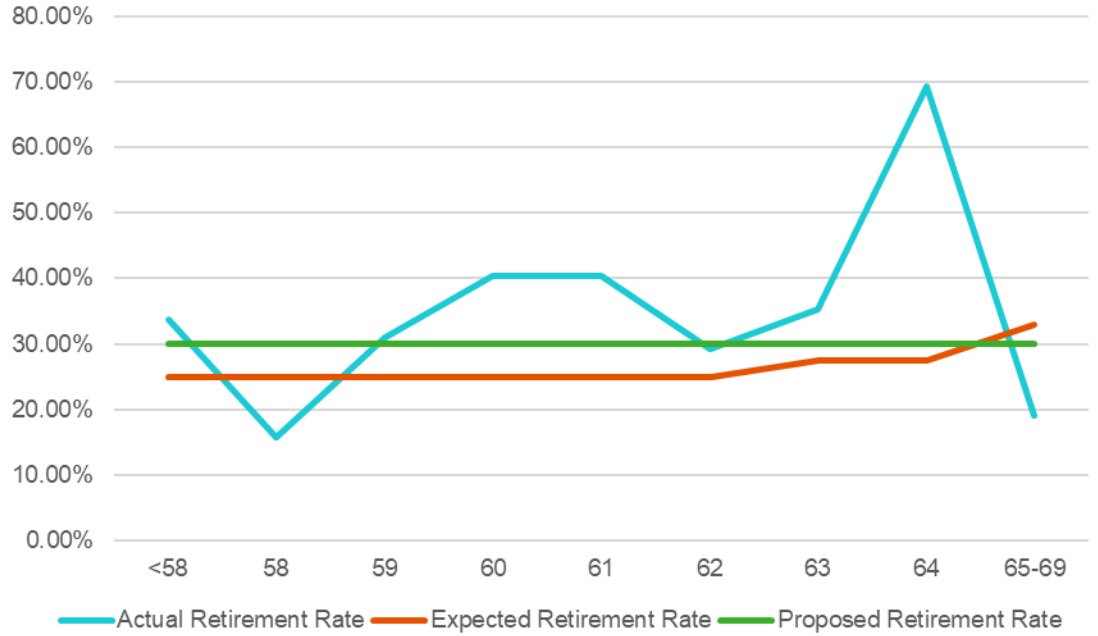
* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group C Non-Grandfathered

First Year After Rule of 90:

- The prior rates were unnecessarily complex and the experience was greater than expected



Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$9,106	$3,138	$2,312	136%	$2,732	115%

Recommend simplifying the assumption to a single rate that produces more retirements in total

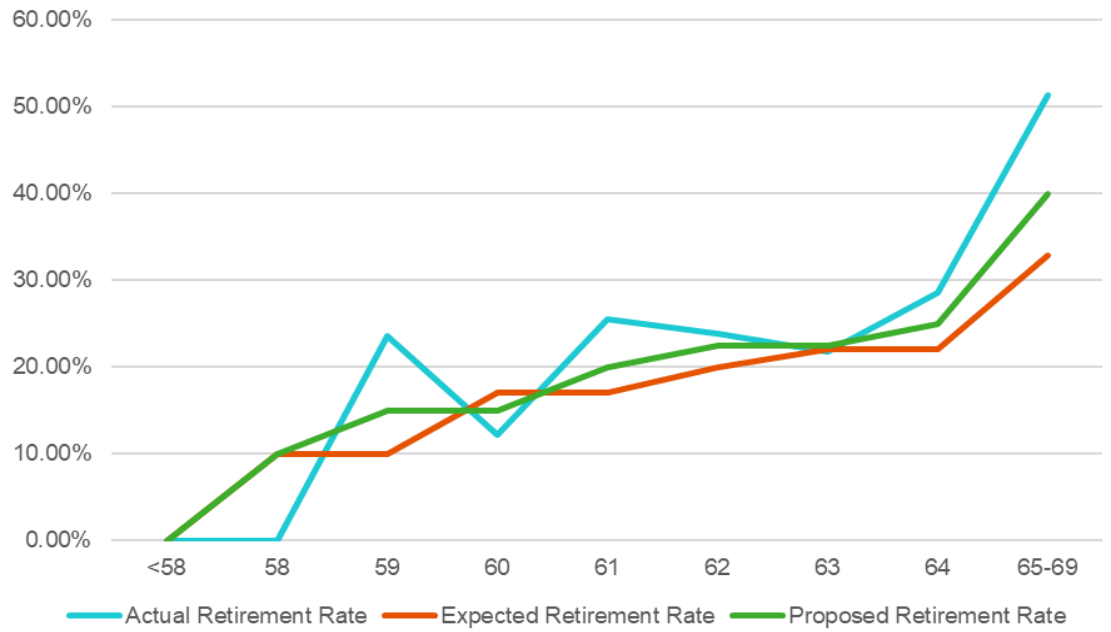
* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group C Non-Grandfathered

More than 1 Year After Rule of 90:

- The experience was greater than expected



Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$7,311	$1,755	$1,424	123%	$1,579	111%

Recommend increasing the current rates at various ages

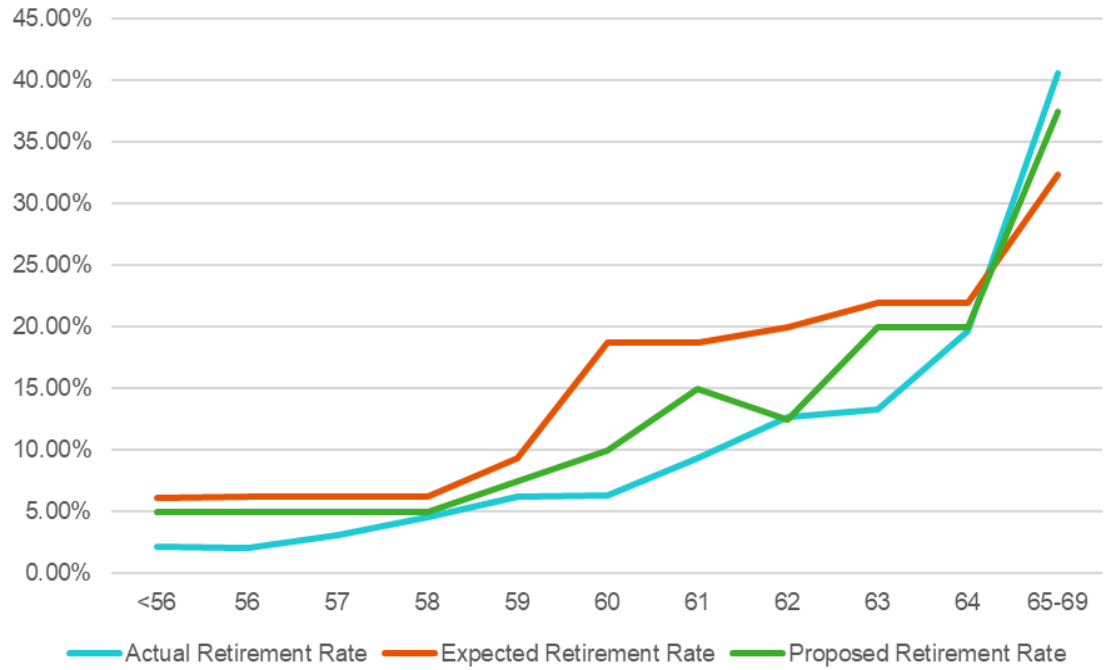
* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Active Retirements – Group C Non-Grandfathered

Before Rule of 90 (all other members):

- The experience was much less than expected



Exposures*	Actual Benefits for Participants who Retired*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$158,832	$9,127	$17,282	53%	$12,967	70%

Recommend adding retirement rates from age 50-55 and reducing the current rates

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Inactive Vested Retirements

The current assumption is that 100% of inactive vested members will retire at normal retirement age (NRA)

We have analyzed inactive vested (IV) retirement experience on a benefit-weighted basis for Group A, Group C Non-Grandfathered, and Group C Grandfathered

- Actual experience has shown that a material number of people have retired from inactive status earlier than their NRA, so we recommend implementing IV retirement rates that better match the actual experience

Group A:

- Limited IV retirement experience available
- Of $62k in benefits from IV members eligible to commence early with reduced benefits, $43k actually retired
- Of $91k in benefits from IV members eligible to commence normal retirement benefits, $91k actually retired
- We recommend adjusting the current IV retirement rates to 10% for each early retirement age (ERA) until NRA, then 100% of the remaining inactive vested members retire at NRA

Inactive Vested Retirements (*continued*)

Group C Non-Grandfathered:

- Of $5,472k in benefits from IV members eligible to commence early with reduced benefits, $403k actually retired
- Of $152k in benefits from IV members eligible to commence normal retirement benefits, $142k actually retired
- We recommend adjusting the current IV retirement rates to 10% for each early retirement age (ERA) until NRA, then 100% of the remaining inactive vested members retire at NRA

Group C Grandfathered:

- Of $279k in benefits from IV members eligible to commence early with reduced benefits, $261k actually retired
- Of $1,430k in benefits from IV members eligible to commence normal retirement benefits, $575k actually retired
- We recommend adjusting the current IV retirement rates to 50% for each age from age 62 through age 69, then 100% of the remaining inactive vested members retire at age 70

Termination

Experience shows that substantially fewer active members are terminating prior to retirement than expected

The experience is similar for both males and females

Current rates are age-based and sex-distinct

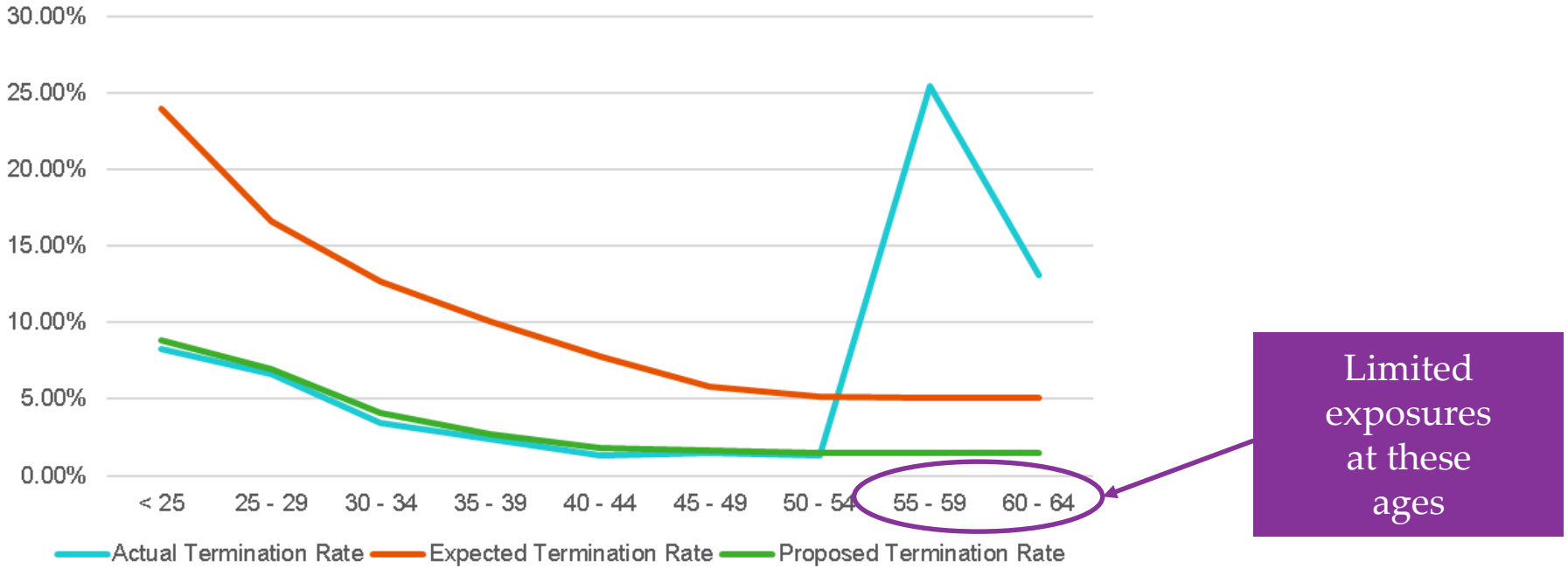
- Current rates represent "total" turnover and a liability "load" is used to hold additional liability for terminating members to offset potential losses due to rehires
- The current combination of high turnover rates and liability loads has been generating net experience losses for many years

We recommend a change in methodology that should reduce experience losses from turnover in the future

- Recommended rates are determined net of rehires and no liability loads are applied

The graphs that follow show the actual, expected, and proposed termination rates based on age

Termination – Females



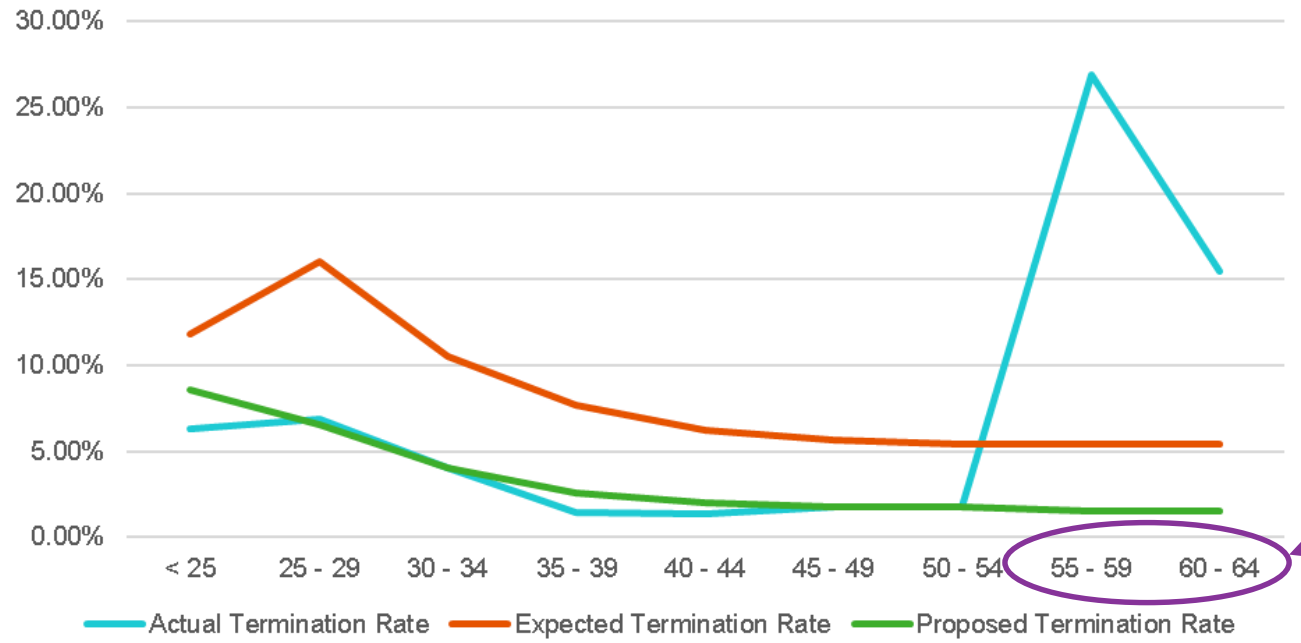
Exposures*	Actual Benefits for Participants who Terminated*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$269,773	$6,279	$19,438	32%	$5,500	114%

Recommend substantially reducing the female termination rates to reflect net turnover experience

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Termination – Males



Limited exposures at these ages

Exposures*	Actual Benefits for Participants who Terminated*	Expected*	Actual to Expected**	Proposed*	Actual to Proposed**
$106,305	$2,385	$6,637	36%	$2,184	109%

Recommend substantially reducing the male termination rates to reflect net turnover experience

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Disability Retirement

Experience over the prior five years shows that more female active members and fewer male active members retired under a disability pension than expected

From 2014 to 2019:

- $321k in benefits from active female members were expected to start receiving a disability pension; and
- $371k in benefits from active female members actually started receiving a disability pension

We recommend a 5% increase to current female rates related to disability retirement

- $144k in benefits from active male members were expected to start receiving a disability pension; and
- $112k in benefits from active male members actually started receiving a disability pension

We recommend a 10% decrease to current male rates related to disability retirement

Spouse Information

Current assumptions:

- 85% of male members and 35% of female members are married
- Male spouses are three years older than female spouses
- 100% of spouses are opposite gender

We have limited information on marital status

We reviewed actual election information from the data and the percentages are slightly lower than the current assumption of 85%/35%. However, the same assumption is used to value pre-retirement death benefits, which is based on actual marital status at the time of death.

Therefore, we recommend no change to these assumptions

Appendix

Assumed Rates of Salary Increase

The following tables show the total current and proposed individual salary increase assumption by age, including the current inflation assumption of 2.50% and proposed inflation assumption of 2.30%:

Age	Current Total Salary Increase Rate	Proposed Total Salary Increase Rate
20-24	8.51%	10.50%
25	7.78%	9.50%
26	7.34%	8.30%
27	6.91%	7.50%
28	6.76%	6.80%
29	6.61%	6.60%
30	6.47%	6.50%
31	6.32%	6.40%
32	6.18%	6.30%
33	5.98%	6.20%
34	5.79%	6.10%
35	5.60%	5.95%
36	5.40%	5.80%
37	5.21%	5.70%
38	5.11%	5.60%

Age	Current Total Salary Increase Rate	Proposed Total Salary Increase Rate
39	5.01%	5.50%
40	4.92%	5.30%
41	4.82%	5.15%
42	4.72%	5.00%
43	4.63%	4.85%
44	4.53%	4.60%
45	4.43%	4.50%
46	4.33%	4.45%
47	4.24%	4.40%
48	4.19%	4.35%
49	4.14%	4.30%
50	4.09%	4.20%
51	4.04%	4.10%
52	4.00%	4.00%
53	3.95%	3.90%

Age	Current Total Salary Increase Rate	Proposed Total Salary Increase Rate
54	3.90%	3.85%
55	3.85%	3.80%
56	3.80%	3.75%
57	3.75%	3.70%
58	3.75%	3.65%
59	3.75%	3.60%
60	3.75%	3.55%
61	3.75%	3.50%
62	3.75%	3.50%
63	3.75%	3.50%
64	3.75%	3.45%
65	3.75%	3.40%
66	3.75%	3.35%
67+	3.75%	3.30%

Active Retirement

The following tables show the proposed active retirement rates for members in Group C-NGF:

Group C-NGF – More than 1 Year after Rule of 90

Age	Proposed Active Retirement Rate
<56	20.00%
56	10.00%
57	10.00%
58	10.00%
59	15.00%
60	15.00%
61	20.00%
62	22.50%
63	22.50%
64	25.00%
65	40.00%
66	30.00%
67	30.00%
68	30.00%
69	30.00%
70+	100.00%

Group C-NGF – First Year after Rule of 90

Age	Proposed Active Retirement Rate
<70	30.00%
70+	100.00%

Group C-NGF – Before Rule of 90

Age	Proposed Active Retirement Rate
<59	5.00%
59	7.50%
60	10.00%
61	15.00%
62	12.50%
63	20.00%
64	20.00%
65	40.00%
66	30.00%
67	30.00%
68	30.00%
69	30.00%
70+	100.00%

Active Retirement

The following tables show the proposed active retirement rates for members in Group C-GF and Group A:

Group C-GF – 30+ Years of Service, Less Than Age 62

Age	Proposed Active Retirement Rate
50	40.00%
51	20.00%
52	20.00%
53	20.00%
54	20.00%
55	10.00%
56	10.00%
57	10.00%
58	10.00%
59	15.00%
60	25.00%
61	17.00%

Group C-GF – All Other Members

Age	Proposed Active Retirement Rate
55	6.125%
56	6.250%
57	6.250%
58	6.250%
59	9.375%
60	18.750%
61	18.750%
62	20.000%
63	22.000%
64	22.000%
65	33.000%
66	33.000%
67	33.000%
68	22.000%
69	33.000%
70+	100.000%

Group A – 30+ Years of Service, Less Than Age 60

Age	Proposed Active Retirement Rate
50	40.00%
51	20.00%
52	20.00%
53	20.00%
54	20.00%
55	20.00%
56	10.00%
57	10.00%
58	10.00%
59	10.00%

Group A – All Other Members

Age	Proposed Active Retirement Rate
55	7.50%
56	7.50%
57	7.50%
58	7.50%
59	12.50%
60	30.00%
61	25.00%
62	30.00%
63	30.00%
64	30.00%
65	40.00%
66	40.00%
67	40.00%
68	50.00%
69	50.00%
70+	100.000%

Inactive Retirement

The following tables show the proposed inactive retirement rates for members in all groups:

Group A

Age	Proposed Inactive Retirement Rate
55	10.00%
56	10.00%
57	10.00%
58	10.00%
59	10.00%
60+	100.00%

Group C-GF

Age	Proposed Inactive Retirement Rate
62	50.00%
63	50.00%
64	50.00%
65	50.00%
66	50.00%
67	50.00%
68	50.00%
69	50.00%
70+	100.00%

Group C-NGF

Age	Proposed Inactive Retirement Rate
55	10.00%
56	10.00%
57	10.00%
58	10.00%
59	10.00%
60	10.00%
61	10.00%
62	10.00%
63	10.00%
64	10.00%
65+	100.00%

Disability Retirement – Females

The following tables show the proposed disability retirement rates for female members in all groups:

Age	Proposed Disability Retirement Rate
20-38	0.008%
39	0.011%
40	0.011%
41	0.011%
42	0.013%
43	0.016%
44	0.021%
45	0.024%
46	0.026%
47	0.029%
48	0.032%
49	0.034%
50	0.074%
51	0.079%
52	0.084%

Age	Proposed Disability Retirement Rate
53	0.089%
54	0.095%
55	0.050%
56	0.053%
57	0.055%
58	0.064%
59	0.075%
60	0.088%
61	0.106%
62	0.127%
63	0.151%
64	0.179%
65	0.209%
66	0.243%
67	0.279%

Age	Proposed Disability Retirement Rate
68	0.319%
69	0.362%

Disability Retirement – Males

The following tables show the proposed disability retirement rates for male members in all groups:

Age	Proposed Disability Retirement Rate
20-25	0.005%
26	0.007%
27	0.007%
28	0.007%
29	0.007%
30	0.007%
31	0.007%
32	0.007%
33	0.007%
34	0.009%
35	0.009%
36	0.011%
37	0.011%
38	0.014%
39	0.016%

Age	Proposed Disability Retirement Rate
40	0.014%
41	0.015%
42	0.017%
43	0.018%
44	0.022%
45	0.023%
46	0.025%
47	0.026%
48	0.027%
49	0.029%
50	0.060%
51	0.063%
52	0.066%
53	0.068%
54	0.071%

Age	Proposed Disability Retirement Rate
55	0.040%
56	0.048%
57	0.064%
58	0.085%
59	0.105%
60	0.132%
61	0.165%
62	0.207%
63	0.259%
64	0.324%

Termination – Females

The following tables show the proposed termination rates for female members in all groups:

Age	Proposed Termination Rate
15-22	9.50%
23	9.10%
24	8.70%
25	8.30%
26	7.90%
27	7.50%
28	6.80%
29	6.10%
30	5.40%
31	4.70%
32	4.00%
33	3.75%
34	3.50%
35	3.25%
36	3.00%

Age	Proposed Termination Rate
37	2.75%
38	2.55%
39	2.35%
40	2.15%
41	1.95%
42	1.75%
43	1.72%
44	1.69%
45	1.66%
46	1.63%
47	1.60%
48	1.58%
49	1.56%
50	1.54%
51	1.52%

Age	Proposed Termination Rate
52+	1.50%

Termination – Males

The following tables show the proposed termination rates for male members in all groups:

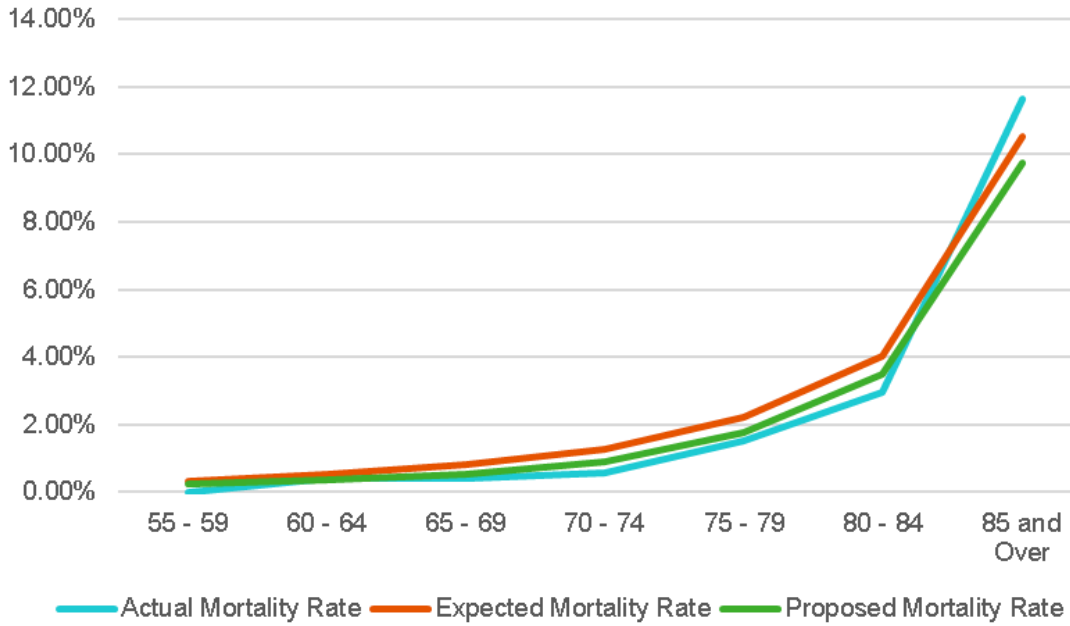
Age	Proposed Termination Rate
15-22	9.00%
23	8.60%
24	8.20%
25	7.80%
26	7.40%
27	7.00%
28	6.40%
29	5.80%
30	5.20%
31	4.60%
32	4.00%
33	3.70%
34	3.40%
35	3.10%
36	2.80%

Age	Proposed Termination Rate
37	2.50%
38	2.40%
39	2.30%
40	2.20%
41	2.10%
42	2.00%
43	1.95%
44	1.90%
45	1.85%
46	1.80%
47	1.75%
48	1.75%
49	1.75%
50	1.75%
51	1.75%

Age	Proposed Termination Rate
52	1.75%
53	1.70%
54	1.65%
55	1.60%
56	1.55%
57+	1.50%

Analysis – Healthy Retiree Mortality (Female)

Actual Versus Proposed Experience, Benefit-Weighted Basis



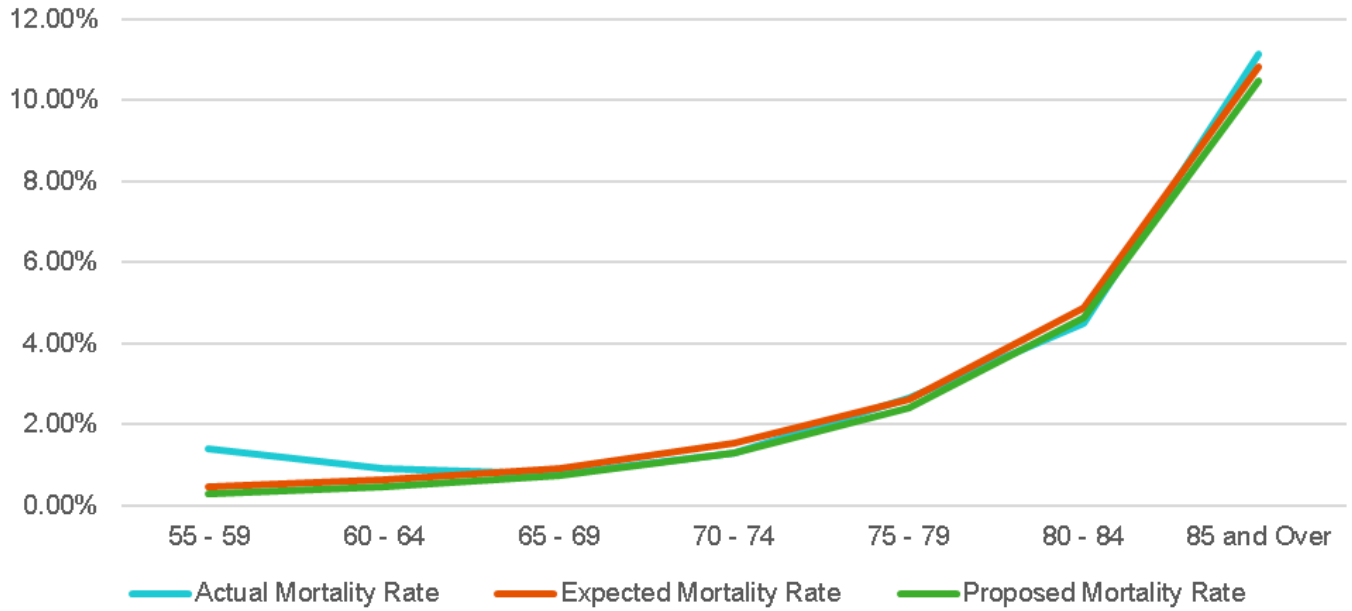
Basis	Exposures	Actual Benefits for Participants who Died	Expected	Actual to Expected**	Proposed	Actual to Proposed**
Counts	26,751	417	510	82%		
Benefits*	$509,440	$5,634	$7,690	73%	$6,086	93%

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Analysis – Healthy Retiree Mortality (Male)

Actual Versus Proposed Experience, Benefit-Weighted Basis



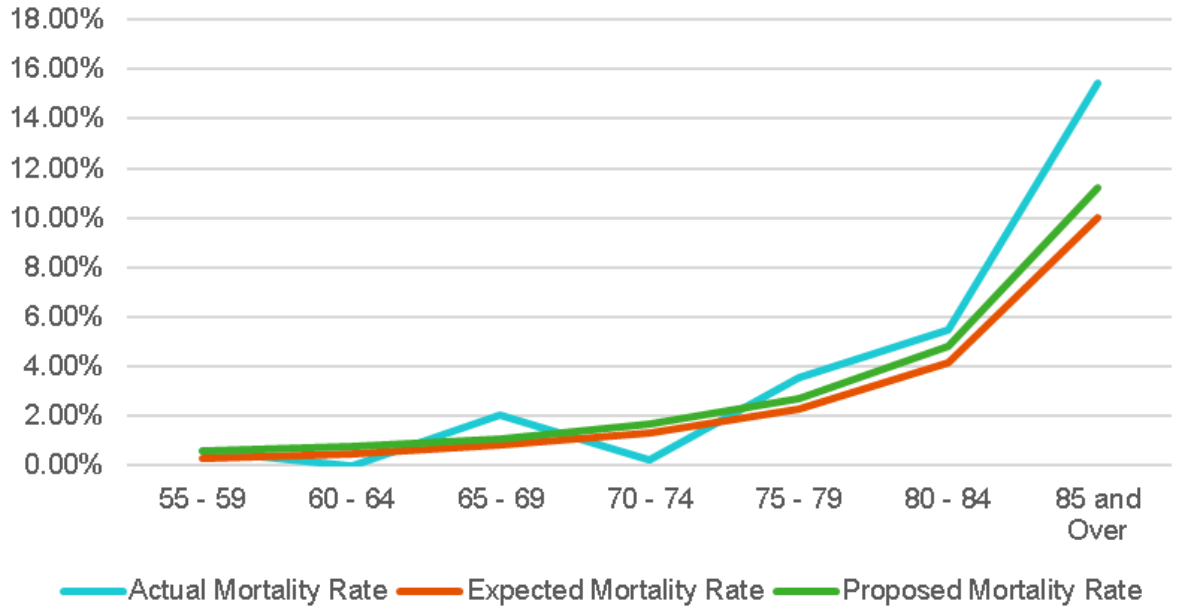
Basis	Exposures	Actual Benefits for Participants who Died	Expected	Actual to Expected**	Proposed	Actual to Proposed**
Counts	13,783	337	311	108%		
Benefits*	$293,946	$5,534	$5,678	97%	$5,075	109%

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Analysis – Beneficiary Mortality (Female)

Actual Versus Proposed Experience, Benefit-Weighted Basis



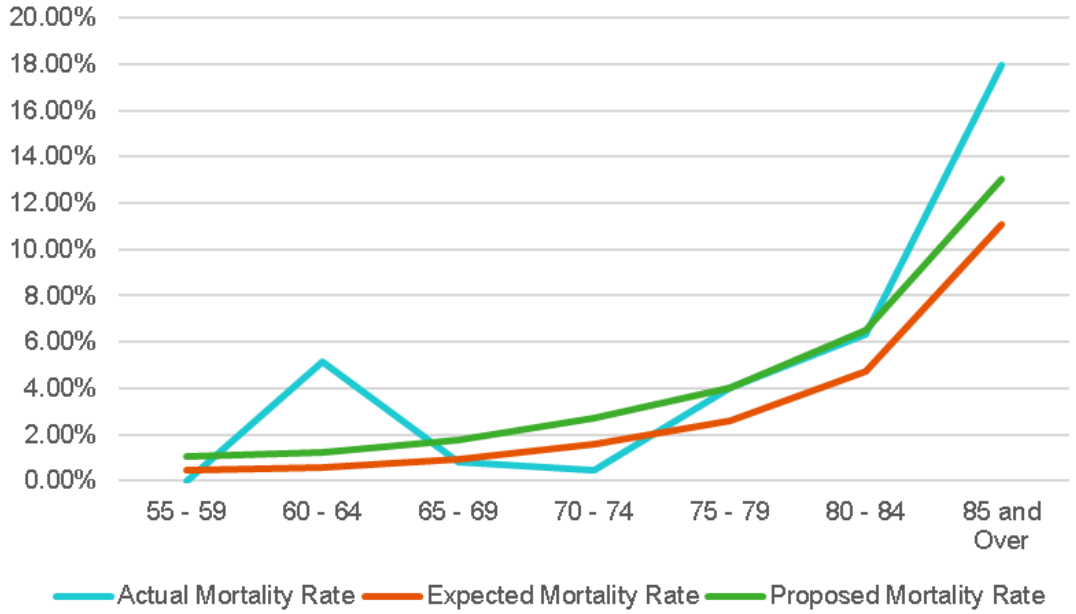
Basis	Exposures	Actual Benefits for Participants who Died	Expected	Actual to Expected**	Proposed	Actual to Proposed**
Counts	1,523	90	58	154%		
Benefits*	$19,555	$927	$646	144%	$753	123%

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Analysis – Beneficiary Mortality (Male)

Actual Versus Proposed Experience, Benefit-Weighted Basis



Basis	Exposures	Actual Benefits for Participants who Died	Expected	Actual to Expected**	Proposed	Actual to Proposed**
Counts	608	30	20	147%		
Benefits*	$7,907	$284	$194	146%	$286	100%

* Based on annual benefits in thousands of dollars

**Actual to Expected/Proposed ratios indicate how well the actual experience aligns with the current/proposed assumptions. The closer the ratio is to 100%, the closer the current/proposed assumptions align with the actual experience.

Inactive/Deferred Methodology Change

Current Methodology:

All Active members who terminate become Inactive, then Inactive members become Deferred after remaining Inactive for at least 5 years

- *Active Members*: Liability based on accrued benefit
- *Inactive Members*: Liability based on 250% of the accumulated contributions
- *Deferred Members*: Liability based on accrued benefit

Consistently experiencing large turnover losses for prior actives and unexpected gains for prior Inactives who return-to-work (due to the 250% load), resulting in net experience losses

Proposed Methodology:

All Active members or Inactive members who terminate/are terminated with at least 5 years of service become immediately Deferred

- *Active Members*: Liability based on accrued benefit
- *Inactive Members*: Liability based on 100% of the accumulated contributions (remove the additional load)
- *Deferred Members*: Liability based on accrued benefit

Produces small turnover gains for prior actives and losses for prior Inactives who return-to-work (due to removing 250% load)