New Hampshire Retirement System

4-Year Experience Study
July 1, 2019 Through June 30, 2023

GRS

April 5, 2024

Board of Trustees
New Hampshire Retirement System
54 Regional Drive
Concord, New Hampshire 03301

Re: New Hampshire Retirement System Experience Study

Dear Board Members:

Presented in this report are the results of a 4-year actuarial experience study of the New Hampshire Retirement System (NHRS). The Study was conducted for the purpose of reviewing and, where necessary, updating the assumptions used in the actuarial valuation model. This report provides the rationale for the economic and demographic assumptions used in the valuation.

This report should not be relied on for any purpose other than that described above. It was prepared at the request of the Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board. GRS is not responsible for unauthorized use of this report.

The report was based upon information furnished by New Hampshire Retirement System (NHRS) staff, concerning active members, terminated members, retirees and beneficiaries for the valuations as of June 30, 2019, 2020, 2021, 2022 and 2023. We checked for internal and year-to-year consistency, but did not otherwise audit the data. We are not responsible for the accuracy or completeness of the data provided by NHRS.

New Hampshire law stipulates that the Board shall have the actuary make an actuarial investigation into the experience of the System at least every five years (RSA 100-A:14, IX) and shall adopt actuarial assumptions as necessary. The Board's Funding Policy states that the Board shall have the actuary make an actuarial investigation into the experience of the System every four years and shall adopt actuarial assumptions as necessary. If circumstances warrant, the Board may undertake an experience study or change assumptions more frequently based on the recommendation of the actuary. This investigation (experience study) covered the four-year period from July 1, 2019 to June 30, 2023, and was carried out using generally accepted actuarial principles and techniques.

This report reflects actuarial experience observed during, and subsequent to, the COVID-19 pandemic. It is reasonable to assume that this actuarial experience was influenced by the pandemic both directly and indirectly. The extent to which long-term demographic trends and member behavior were affected by the circumstances of this time period cannot be explicitly defined. In some circumstances it may be necessary to assign less credibility to experience observed during the pandemic if it is reasonable to believe that it will not persist. Where necessary, experience from the prior experience study covering the period from July 1, 1016 through June 30, 2019 was incorporated to improve credibility.

This report was prepared using our proprietary valuation model and related software which, in our professional judgment, has the capability to provide results that are consistent with the purposes of the valuation, and has no material limitations or known weaknesses. We performed tests to ensure that the model reasonably represents that which is intended to be modeled.
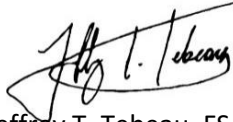
To the best of our knowledge, the report is complete and accurate and was conducted in accordance with the standards of practice promulgated by the Actuarial Standards Board. We believe that the recommended actuarial assumptions contained in this report are reasonable under the Actuarial Standards of Practice and in compliance with the NHRS Statutes. The combined effect of the assumptions, excluding prescribed assumptions or methods set by law, is expected to have no significant bias (i.e., not significantly optimistic or pessimistic).

Heidi G. Barry, Jeffrey T. Tebeau, and Casey T. Ahlbrandt-Rains are independent of the plan sponsor, are Members of the American Academy of Actuaries (MAAA), and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

Respectfully submitted,
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SECTION A

OVERVIEW AND SUMMARY OF RESULTS

Introduction

The statutory funding requirements for the New Hampshire Retirement System (NHRS) can be found in RSA 100-A:16 for Pension and RSA 100-A:53, 100-A:53-b, 100-A:53-c, and 100-A:53-d for medical subsidy benefits. The Actuarial Funding Policy adopted by the NHRS states the following Funding Objectives:

> "The main financial objective of the New Hampshire Retirement System is to receive employer and member contributions to fund the long-term costs of benefits provided by statute to plan members and beneficiaries. From the perspective of the members and beneficiaries, a funding policy based on actuarially determined contributions is one which will pay all benefits provided by statute when due. From the perspective of the contributing plan sponsors and taxpayers, the actuarially determined contributions have the additional objectives of keeping contribution rates relatively stable as a percentage of active member payroll and equitably allocating the costs over the active members' period of active service. The Statute goes on to say that this shall be achieved by use of the entry age normal actuarial cost method and amortizing the unfunded actuarial accrued liability as a level percent of payroll. For pension funding, the payment of benefits is supported in part by income earned on investment assets. This funding policy meets those criteria. It is stipulated by state law and implemented through the application of Board adopted governance policies."

Under RSA 100-A:14 IX of the NHRS statute, the actuarial assumptions are adopted by the Retirement Board after consultation with the actuary. The Board adopts actuarial assumptions and an actuarial cost method to best attempt to meet the funding objective. The entry age normal actuarial cost method is designed to determine contributions which are expected to remain level as a percent of payroll. The economic assumptions used for budgeting contributions under this method are based on reasonable estimates of future experience.

The actuarial principle in force is that over time contributions and investment income must be sufficient to pay benefits throughout retirement. Actuarial valuations make a number of assumptions to estimate investment accumulation and benefit payouts in order to determine the required level percent of payroll objective. From year to year, actual experience on any assumption will not coincide exactly with assumed experience. NHRS copes with these continually changing differences by having biennial rate-setting valuations and annual valuations for the ACFR and GASB accounting purposes, with experience studies at least every five years. Under RSA 100-A:14, IX, since 1970 the System has undergone an experience study at least every five years. The Board recently amended its Funding Policy to perform an experience study every four years. The four-year period will enable updating assumptions with every other biennial rate setting valuation. The Funding Policy allows the Board to undertake an experience study or change assumptions more frequently based on the recommendation of the actuary, if circumstances warrant.

Introduction

The purpose of the experience study is to systematically review the actuarial assumptions used in the annual valuation. The actuarial valuation is a mathematical model designed to meet the funding objectives.

The mathematical model is necessary in a defined benefit plan because there are "knowns" and "unknowns" which must be evaluated before the level contribution rate can be determined. The knowns are:

- Who participates in the plan

- The demographic characteristics of each active and inactive member (i.e., age, sex, salary, service, etc.)

- The demographic characteristics of each retired member and beneficiary (i.e., age, sex, benefit, form of payment, etc.)

- The conditions and characteristics of the plan (i.e., type and amount of benefits payable, eligibility for benefits, length of time benefit is payable, etc.)

- The current purchasing power of a dollar

- The value of the pool of assets

- How the pool of assets is invested

The unknowns are:

- Who will retire and at what age, service and final average salary

- Who will quit before becoming vested for a benefit

- Who will quit and be entitled to a future vested benefit

- Who will become disabled

- How long will members and their beneficiaries live (before and after retirement)

- What is the future purchasing power of a dollar (future inflation)

- How much income the pool of assets will generate

Introduction

The valuation model takes the "knowns," incorporates assumptions about the "unknowns" and develops the estimated cost of the plan for the current members. This cost is then financed using an actuarial cost method to determine the level contribution requirement.

Because future experience cannot be predicted with certainty, the costs can only be estimated. The valuation model is revisited at least biennially to re-determine the employer contribution rates based upon experience which has already occurred and assumptions about future experience.

When Fund experience deviates from expected experience, a gain or loss is generated. This gain or loss is then amortized over a period of future years and applied as an offset or addition to the normal cost contribution. Over time it is expected that the gains and losses will offset each other. If they do not, then one or more of the actuarial assumptions should be modified to reflect actual emerging experience.

Each year, as of June 30, the liabilities of the New Hampshire Retirement System are valued. In order to perform the valuation, assumptions must be made regarding the future experience of the System with regard to the following risk areas:

- Rates of withdrawal of active participants
- Rates of disability among active participants
- Patterns of salary increases to active participants
- Rates of retirement among active participants
- Rates of mortality among active participants, retirees, and beneficiaries
- Long-term rates of investment return to be generated by the assets of the System
- Other actuarial assumptions as necessary

Introduction

Assumptions should be carefully chosen and continually monitored. A poor initial choice of assumptions or continued use of outdated assumptions can lead to:

- Understated costs resulting in either an inability to pay benefits when due, or sharp increases in required contributions at some point in the future; or

- Overstated costs resulting in an unnecessarily large burden on the current generation of participants, employers and taxpayers.

A single set of assumptions will not be suitable indefinitely. Conditions change, and our understanding of conditions (whether or not they are changing) also changes.

No single study experience period should be given full credibility in the setting of actuarial valuation assumptions. When we see significant differences between what is expected from our assumptions and actual experience, our strategy in recommending a change in assumptions is usually to select rates that would produce results somewhere between the actual and expected experience. In this way, with each experience study the actuarial assumptions become better and better representations of actual experience. Consequently, temporary conditions that might influence a particular experience study period will not unduly influence the choice of long-term assumptions.

We are recommending certain changes in assumptions. The various assumption changes and their impact on the required contributions are described on the following pages. Actuarial assumptions were last revised with the June 30, 2019 regular actuarial valuation.

Actuarial Standards of Practice ("ASOPs")

The Actuarial Standards Board ("ASB") provides guidance on measuring the costs of financing post-retirement benefits, as well as setting assumptions to develop these measurements, through the following Actuarial Standards of Practices ("ASOPs"):

(1) ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*;
(2) ASOP No. 23, *Data Quality*;
(3) ASOP No. 25, *Credibility Procedures*;
(4) ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*;
(5) ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*;
(6) ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*; *and*
(7) ASOP No. 56, *Modeling.*

In particular, Actuarial Standards of Practice Nos. 23 and 25 provide guidance to assist actuaries in assessing the appropriateness and statistical credibility of data when performing experience studies.

The recommended assumptions provided in this report are consistent with the preceding actuarial standards of practice.

Observations

The actuarial valuation funding method is the entry age normal cost actuarial funding method. Each year, actuarial gains and losses are measured in the aggregate. The assumptions were last updated effective July 1, 2019, so the first relevant gain/(loss) measurement is as of June 30, 2020. The table below shows the estimated gains and losses for the trust (pension and medical subsidy) during the period of the study:

Estimate of Gain/(Loss) on Fund ($Millions)*

June 30	Total		Investment		Liability		Total Gain/(Loss) as a % of Beginning of Year Accrued Liability
2020	$	(102.8)	$	(109.3)	$	6.5	(0.7)%
2021		364.9		382.1		(17.2)	2.3 %
2022		(69.3)		18.8		(88.1)	(0.4)%
2023		(22.0)		17.1		(39.1)	(0.1)%
Total	$	170.8	$	308.7	$	(137.9)	

Totals may not add due to rounding

This aggregate analysis sets the starting point for the experience study. Note that gain and loss analysis can be further broken down by member classification and by major assumption. A more detailed gain and loss analysis was not in the scope of this study.

The System has experienced cumulative gains during the experience period. The cumulative investment gains are certainly good news, but by themselves they are insufficient for assessing the reasonableness of the assumed rate of return. The liability losses have offset some of the investment gains for the System. Changes in assumptions driven by those specific observations that contributed to these liability losses (primarily salary increases) served to increase actuarial liabilities, but were offset by the collective changes in other assumptions. In total, the assumption changes we are recommending will decrease the liability realized between the June 30, 2021 and June 30, 2023 rate setting valuations, relative to the baseline results using current assumptions and before reflecting changes in economic assumptions.

Note: In the aggregate, the proposed demographic assumption changes decrease the actuarial accrued liability and employer contribution rates. This report contains additional information assessing the impact of various assumption change scenarios on the funded status as of June 30, 2023 and employer contribution rates for the 2026-27 biennium.

This report reflects actuarial experience observed during, and subsequent to, the COVID-19 pandemic. It is reasonable to assume that this actuarial experience was influenced by the pandemic both directly and indirectly. The extent to which long-term demographic trends and member behavior were affected by the circumstances of this time period cannot be explicitly defined. In some circumstances we assigned less credibility to experience observed during the pandemic as it is reasonable to believe that it will not persist.

Summary of Economic Assumptions

Background: The selection of economic assumptions for pension valuations is governed by Actuarial Standard of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations. Economic assumptions may be based on estimates of future experience or observations of estimates inherent in market data. Appropriate recent and long-term historical economic data may also be useful, but without giving undue weight to recent experience. For purposes of the valuation assumptions, our recommendations are based on estimates of future experience.

Rate of Investment Return, net of investment expenses, on System assets was studied based on the current investment policy and future capital market expectations from twelve nationally recognized investment firms. Investment return expectations were analyzed for the System as a whole. Based on this analysis, we recommend no changes to the assumed rate of investment return of 6.75%.

Rate of Price Inflation on a basket of goods purchased was studied in the aggregate. While not directly used in the calculation of plan liabilities, the rate of price inflation is the first building block for evaluating the rate of investment return. Based on this analysis, we recommend increasing the assumed rate of price inflation from 2.00% to 2.25%.

Rate of Wage Inflation on member pay in general corresponds to increases in average member pay driven by aggregate market forces. For a stable workforce with a constant active membership headcount, the rate of wage inflation is a reasonable estimate of total payroll growth. Generally, the rate of wage inflation is a long-term assumption. Short-term expectations, if justifiably different from long-term expectations, may be reflected in a select and ultimate wage inflation assumption. Based on this analysis, we recommend increasing the assumed rate of wage inflation from 2.75% to 3.0%.

Rates of Merit and Longevity Salary Increases on member pay in general correspond to increases experienced by members as they progress through their careers. As with the prior experience study, we studied rates of merit and longevity pay increases separately by member classification. We recommend changes in rates of merit and longevity pay increases for all member classifications.

Summary of Economic Assumptions

End of Career Pay Increases may occur for those members with a definition of compensation which includes information generally unreported during regular annual valuations such as severance pay, end-of-career longevity payments, and pay for unused sick or vacation time. The definition of compensation changed for members who had not attained vested status prior to January 1, 2012 during the experience study period. A load assumption is applied to each member classification in the valuation model to account for end of career pay increases. We studied the impact of end of career pay increases for recent retirees in vested status prior to January 1, 2012. We recommend minor adjustments to decrease the load assumptions for all four member classifications. We recommend applying half of the load assumptions to the members who had not attained vested status prior to January 1, 2012 until enough experience is available to analyze this group.

Assumed Population Size for active headcount by membership classification is generally assumed to be level for future years provided that the plan remains open to new hires and the State and Political Subdivisions provide the same level of services to future constituencies. For purposes of this study, we consider this with the economic assumptions because of its relationship to the total payroll growth assumption which is a critical component of the level percent of payroll amortization of the unfunded actuarial accrued pension liability and the solvency medical subsidy contributions. Based on additional census data provided by System staff, we studied active member population expectations by membership classification. For all membership classifications except Teachers, we recommend maintaining the current assumption of a level active headcount based on the expected growth of the general population in the State of New Hampshire. For Teachers, we recommend maintaining the assumption of a decline of 0.50% per year, based on the expected decrease of the school-age population in the State of New Hampshire.

Administrative Expenses paid from plan expenses other than for investment purposes are funded through employer contributions in the normal cost. We analyzed administrative expenses for the System as a whole during the experience study period as a percentage of member payroll. We recommend maintaining the 0.35% administrative expense assumption as a percent of payroll.

Additional analysis supporting the recommended changes to the economic assumptions may be found in Sections B and J of this report.

Summary of Demographic Assumptions

Background

The selection of demographic assumptions for pension valuations is governed by ASOP No. 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations. In general, recent patterns of non-economic activity (rates of withdrawal, disability, death, retirement, and mortality) tend to be reliable predictors of future experience. However, past activity will also contain anomalies (or special circumstances) that cannot be assumed to replicate in the future. The actuary attempts to identify and remove these anomalies before creating recommended rates. The goal is to identify long-term trends in activity and move the rates toward those trends as a result of the periodic investigations. In establishing our recommendations, we have considered the results of the prior study, as well as the observed trends from this study.

Analysis of actuarial experience can be found in Sections C through G. The proposed rates and detail on the development can be found in their entirety in the Appendix.

For mortality, we apply a more formal credibility procedure in accordance with ASOP No. 25, Credibility Procedures. NHRS has a large enough aggregate population to be considered credible for determining an appropriate set of base tables, however the separate member classifications are not large enough for full credibility.

The Society of Actuaries' (SOA) most recently published tables for U.S. public pension plans are the Pub-2010 tables published in February 2019. The SOA also published the MP-2021 projection scales to reflect mortality improvements after 2021. We recommend using these tables with an adjustment based on our partial credibility analysis discussed above and in more detail in Section C of this report. The magnitude of the impact varied by member classification, but generally decreased cost estimates for all four member classifications.

Rates of Withdrawal from service without entitlement to an immediate benefit (other than a separation benefit) are segregated into two categories:

- Service based (select), covering an initial employment period
- Age based (ultimate), beginning after the initial employment period

Members who leave active employment, for reasons other than retirement or death, may be eligible for the following payments from the pension trust:

- A refund of employee contributions, or
- A deferred retirement benefit, if they are vested

Deferred retirement benefits are based on the pay and service credit at the time of withdrawal. The benefit is frozen, and not payable until sometime in the future. Consequently, members who withdraw receive much less from the plan then members who stay in employment until retirement. Higher rates of withdrawal result in lower computed contributions, and vice versa. Due to the small group size, males and females were studied together.

We separated the members into two groups for the analysis: 1) members with fewer than 5 years of credited service, and 2) those members with 5 or more years of credited service.

Although male and female rates were examined independently for all groups, male and female experience was ultimately combined for all four groups to improve credibility. In addition, the length of the service-based period was reviewed. Currently the service-based period is 5 years for Groups I and II. We do not recommend changing the service-based period. We recommend increases in the overall rates of termination.

Rates of Disability from active service with entitlement to a disability benefit were studied by member classification. The assumed rates of disability (leaving active service due to injury or illness while not entitled to age and service retirement benefits) are a minor ingredient in cost calculations, since the incidence of disability is low. While higher rates of disability generally would result in somewhat higher computed contributions for NHRS, and vice versa, the assumed probabilities for this decrement also have a secondary effect on the calculated liability for other assumptions because of their impact on the expected career length of an active member.

Disability rates were studied for accidental and ordinary combined. The incidence of disability is too low to establish a meaningful level of credibility; therefore, we have scaled the prior assumptions for this decrement to experience over the study period.   We recommend a slight decrease in the overall rates of disability for the Employee group, increases in the assumed rates for Group II members, while maintaining current rates for the Teachers group.

Rates of Retirement from service with entitlement to an immediate benefit are segregated into two categories of eligibility requirements:

- ▪ Age Based
- ▪ Age and Service Based

Age-based retirement rates are assumed to apply specifically to members attaining service retirement eligibility at age 60 or 65. Members who attain eligibility by meeting a combined age and service requirement generally retire at younger ages.

The benefit provisions of the Retirement System establish the minimum age and service requirements for unreduced or normal retirement. However, the actual cost of retirement is determined by when members actually retire. The assumption about timing of retirements is a major ingredient in cost calculations. Note that higher rates of retirement with full benefits generally results in higher computed contributions, and vice versa.

NHRS Group I members hired before July 1, 2011 may retire with a reduced benefit at age 50 with 10 years of service or under the rule of 70 with 20 years of service. We refer to these cases as early reduced retirements, since the retiring members receive smaller benefits than if they had waited until normal retirement to retire. Early retirement eligibility conditions for those hired on or after July 1, 2011 are at age 60 with 30 years of service.

Summary of Demographic Assumptions

Generally, because of the subsidized early retirement reduction, these members' immediate reduced benefits generally have a slightly greater value than the deferred benefit to which they would be eligible if they did not request early commencement of the benefit. Higher rates of early retirement generally result in moderately higher computed contributions, and vice versa. To allow for a higher degree of credibility, male and female rates were observed together and the proposed rates are for the combined population.

GRS proposes to lower assumed rates of normal retirement of Group I after age 70 to account for individuals working to later ages. The proposed rates of normal retirement for Group I were generally lowered overall from current assumptions.

Normal retirement rates for Group II members are currently applied based on the member's age. GRS proposes adjusting this assumption to take these members' service into account. The proposed rates of normal retirement were increased for Police and decreased for Fire from current assumptions.

End-of-Career Payments: Some members have a definition of compensation which includes amounts for severance pay, end-of-career longevity payments, and pay for unused sick or vacation time. We have reviewed the liability and normal cost loads for members who have attained vested status prior to January 1, 2012 and suggest that adjustments be made accordingly. The definition of Average Final Compensation (AFC) was modified effective August 14, 2022 for Group II members who have not attained vested status prior to January 1, 2012 but who were hired prior to July 1, 2011. Since there is no experience for these members, we have assumed a load of half that used for members who were who attained vested status prior to January 1, 2012. We will study this assumption in more detail as experience emerges.

Forfeitures: Experience continues to indicate that some vested members are refunding and forfeiting their pensions. Under the current assumption, the present value of future benefits will not be less than the accumulated contributions at the time of decrement. We recommend no change in this assumption.

Marriage Assumption: Based on the members who retired during the study period, we recommend lowering the marriage assumption to 50% for Group I members (from 55%) and maintaining the marriage assumption at 65% for Group II members. This assumption relates to the benefits payable resulting from death-in-service for Group I and Group II and the automatic death after retirement spousal benefit for Group II.

Data: We continue to work with System Staff to identify data needs and refine data quality.

Expected Impact of Proposed Demographic Changes
on Employer Contribution Rate

Group I

Employees				Teachers		
	Likely Direction of Change on Employer Rate Due to Proposed				**Likely Direction of Change on Employer Rate Due to Proposed**	
Assumption	**NC**	**UAAL**	**Assumption**	**NC**	**UAAL**
Baseline (FY 2026-2027)	2.51%	10.69%	Baseline (FY 2026-2027)	2.73%	15.76%
Rates of Age-Based Withdrawal	Marginal Decr.	Marginal Decr.	Rates of Age-Based Withdrawal	Moderate Decr.	Moderate Decr.
Rates of Service-Based Withdrawal	Marginal Decr.	Marginal Decr.	Rates of Service-Based Withdrawal	Marginal Decr.	Marginal Decr.
Rates of Disability	Marginal Decr.	Marginal Decr.	Rates of Disability	No Change	No Change
Rates of Age-Based Retirement	Marginal Decr.	Marginal Decr.	Rates of Age-Based Retirement	Marginal Decr.	Marginal Decr.
Rates of Age-Based Early Retirement	Marginal Decr.	Marginal Decr.	Rates of Age-Based Early Retirement	Marginal Decr.	Marginal Decr.
Rates of Rule-Based Early Retirement	Marginal Decr.	Marginal Decr.	Rates of Rule-Based Early Retirement	Marginal Decr.	Marginal Decr.
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.	Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Healthy Mortality	Marginal Decr.	Marginal Decr.	Post-Retirement Healthy Mortality	Marginal Incr.	Marginal Incr.
Post-Retirement Disabled Mortality	Marginal Decr.	Marginal Decr.	Post-Retirement Disabled Mortality	Marginal Decr.	Marginal Decr.
Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.	Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.
Forfeitures	No Change	No Change	Forfeitures	No Change	No Change
End of Career Payments	Marginal Decr.	Marginal Decr.	End of Career Payments	Marginal Decr.	Marginal Decr.
Marriage Assumption	Marginal Decr.	Marginal Decr.	Marriage Assumption	Marginal Decr.	Marginal Decr.
Administrative Expenses	No Change	No Change	Administrative Expenses	No Change	No Change
Aggregate (at 6.75% / 2.75%)	Marginal Decr.	Moderate Decr.	Aggregate (at 6.75% / 2.75%)	Moderate Decr.	Moderate Decr.
Proposed Demographic (FY 2026-2027)	2.28%	10.19%	Proposed Demographic (FY 2026-2027)	2.68%	15.51%

Order of Magnitude
Marginal < Moderate < Material*

*Impact by source was not explicitly assessed. Roughly speaking, marginal means below 0.25% of payroll and material means 1.00% of payroll or more.

Changes described are relative to what the 2026-2027 employer rates would have been without any assumption changes.

Expected Impact of Proposed Demographic Changes on Employer Contribution Rate

Group II

Police				Fire			
		Likely Direction of Change on Employer Rate Due to Proposed				**Likely Direction of Change on Employer Rate Due to Proposed**	
Assumption	**NC**	**UAAL**		**Assumption**	**NC**	**UAAL**	
Baseline (FY 2026-2027)	5.57%	23.29%		Baseline (FY 2026-2027)	5.83%	21.34%	
Rates of Age-Based Withdrawal	Marginal Decr.	Marginal Decr.		Rates of Age-Based Withdrawal	Marginal Decr.	Marginal Decr.	
Rates of Service-Based Withdrawal	Marginal Decr.	Marginal Decr.		Rates of Service-Based Withdrawal	Marginal Decr.	Marginal Decr.	
Rates of Disability	Marginal Incr.	Marginal Incr.		Rates of Disability	Marginal Incr.	Marginal Incr.	
Rates of Age-Based Retirement	Marginal Incr.	Marginal Incr.		Rates of Age-Based Retirement	Marginal Decr.	Marginal Decr.	
Rates of Service-Based Retirement	Marginal Incr.	Marginal Incr.		Rates of Service-Based Retirement	Marginal Decr.	Marginal Decr.	
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.		Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.	
Post-Retirement Healthy Mortality	Marginal Decr.	Marginal Decr.		Post-Retirement Healthy Mortality	Marginal Decr.	Marginal Decr.	
Post-Retirement Disabled Mortality	Marginal Decr.	Marginal Decr.		Post-Retirement Disabled Mortality	Marginal Decr.	Marginal Decr.	
Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.		Merit and Longevity Salary Increases	Marginal Incr.	Marginal Incr.	
Forfeitures	No Change	No Change		Forfeitures	No Change	No Change	
End of Career Payments	Moderate Decr.	Moderate Decr.		End of Career Payments	Moderate Decr.	Moderate Decr.	
Marriage Assumption	No Change	No Change		Marriage Assumption	No Change	No Change	
Administrative Expenses	No Change	No Change		Administrative Expenses	No Change	No Change	
Aggregate (at 6.75% / 2.75%)	Marginal Incr.	Marginal Decr.		Aggregate (at 6.75% / 2.75%)	Marginal Incr.	Marginal Decr.	
Proposed Demographic (FY 2026-2027)	5.65%	23.27%		Proposed Demographic (FY 2026-2027)	5.86%	21.11%	

Order of Magnitude
Marginal < Moderate < Material*

*Impact by source was not explicitly assessed. Roughly speaking, marginal means below 0.25% of payroll and material means 1.00% of payroll or more.

Changes described are relative to what the 2026-2027 employer rates would have been without any assumption changes.

2019-2023 Experience Study
The Effect of Alternate Assumptions on the June 30, 2023 Actuarial Valuation
NHRS in Total@
($ in Millions)

	June 30, 2021 Valuation Results (2024-2025 Rates)	June 30, 2023 Valuation Results (2026-2027 Rates)			
Demographic Assumptions	Prior	Prior	Proposed		
Economic Assumptions	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Alt 1 (6.75%/3.00%/2.25%)	Alt 2 (6.50%/3.00%/2.25%)
Employer Pension Normal Cost	3.16%	3.09%	2.98%	3.15%	3.66%
Pension UAAL Payment*	14.63%	14.60%	14.27%	14.12%	15.09%
Total Pension Contribution	17.79%	17.69%	17.25%	17.27%	18.75%
Employer Medical Subsidy Contribution	1.05%	0.87%	0.87%	0.85%	0.85%
Total Employer Contribution	**18.84%**	**18.56%**	**18.12%**	**18.12%**	**19.60%**
Total Estimated Employer $ Contribution&	$ 619.2	$ 613.7	$ 621.0	$ 626.4	$ 676.8
Pension					
Actuarial Accrued Liability (AAL)	$ 15,991.2	$ 17,105.0	$ 16,969.7	$ 17,030.4	$ 17,533.6
Actuarial Value of Assets (AVA)	$ 10,268.3	$ 11,495.6	$ 11,495.6	$ 11,495.6	$ 11,495.6
UAAL	$ 5,722.9	$ 5,609.4	$ 5,474.1	$ 5,534.8	$ 6,038.0
Funded Percent (AVA/AAL)	64.2%	67.2%	67.7%	67.5%	65.6%
Medical Subsidy					
AAL	$ 614.2	$ 524.8	$ 519.0	$ 507.3	$ 507.3
AVA	$ 44.4	$ 50.3	$ 50.3	$ 50.3	$ 50.3
UAAL	$ 569.8	$ 474.5	$ 468.7	$ 457.0	$ 457.0
Funded Percent (AVA/AAL)	7.2%	9.6%	9.7%	9.9%	9.9%

@   Totals may not add due to rounding.

*   The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2023.

&   Total estimated employer dollar contribution for FY 2025 for rates adopted from June 30, 2021 valuation and for FY 2026 for rates based on the June 30, 2023 valuation.

2019-2023 Experience Study
The Effect of Alternate Assumptions on the June 30, 2023 Actuarial Valuation
Employees
($ in Millions)

	June 30, 2021 Valuation Results (2024-2025 Rates)			June 30, 2023 Valuation Results (2026-2027 Rates)											
Demographic Assumptions	Prior			Prior			Proposed									
Economic Assumptions	Prior (6.75%/2.75%/2.00%)			Prior (6.75%/2.75%/2.00%)			Prior (6.75%/2.75%/2.00%)			Alt 1 (6.75%/3.00%/2.25%)			Alt 2 (6.50%/3.00%/2.25%)		
	State	Pol. Sub.	Total	State	Pol. Sub.	Total	State	Pol. Sub.	Total	State	Pol. Sub.	Total	State	Pol. Sub.	Total
Employer Pension Normal Cost	2.48%	2.48%	2.48%	2.51%	2.51%	2.51%	2.28%	2.28%	2.28%	2.42%	2.42%	2.42%	2.79%	2.79%	2.79%
Pension UAAL Payment*	10.79%	10.79%	10.79%	10.69%	10.69%	10.69%	10.19%	10.19%	10.19%	10.11%	10.11%	10.11%	10.71%	10.71%	10.71%
Total Pension Contribution	13.27%	13.27%	13.27%	13.20%	13.20%	13.20%	12.47%	12.47%	12.47%	12.53%	12.53%	12.53%	13.50%	13.50%	13.50%
Employer Medical Subsidy Contribution	0.58%	0.26%		0.35%	0.23%		0.35%	0.23%		0.34%	0.22%		0.34%	0.22%	
Total Employer Contribution	13.85%	13.53%		13.55%	13.43%		12.82%	12.70%		12.87%	12.75%		13.84%	13.72%	
Total Estimated Employer $ Contribution&			$ 198.3			$ 183.9			$ 195.4			$ 197.6			$ 212.6
Pension															
Actuarial Accrued Liability (AAL)			$ 5,326.7			$ 5,711.3			$ 5,623.4			$ 5,645.1			$ 5,793.4
Actuarial Value of Assets (AVA)			$ 3,449.6			$ 3,850.7			$ 3,850.7			$ 3,850.7			$ 3,850.7
UAAL			$ 1,877.1			$ 1,860.6			$ 1,772.7			$ 1,794.4			$ 1,942.7
Funded Percent (AVA/AAL)			64.8%			67.4%			68.5%			68.2%			66.5%
Medical Subsidy															
Accrued Liability	$ 50.7	$ 46.8	$ 97.5	$ 37.6	$ 38.2	$ 75.8	$ 36.9	$ 37.4	$ 74.3	$ 36.2	$ 36.8	$ 73.0	$ 36.2	$ 36.8	$ 73.0
Valuation Assets	$ 2.9	$ 11.3	$ 14.2	$ 3.8	$ 9.1	$ 12.9	$ 3.8	$ 9.1	$ 12.9	$ 3.8	$ 9.1	$ 12.9	$ 3.8	$ 9.1	$ 12.9
UAAL	$ 47.8	$ 35.5	$ 83.3	$ 33.8	$ 29.2	$ 63.0	$ 33.1	$ 28.4	$ 61.4	$ 32.4	$ 27.7	$ 60.2	$ 32.4	$ 27.7	$ 60.2
Funded Percent (AVA/AAL)	5.7%	24.1%	14.6%	10.1%	23.7%	17.0%	10.3%	24.2%	17.3%	10.5%	24.7%	17.6%	10.5%	24.7%	17.6%

* *The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2023.*

& *Total estimated employer dollar contribution for FY 2025 for rates adopted from June 30, 2021 valuation and for FY 2026 for rates based on the June 30, 2023 valuation.*

2019-2023 Experience Study
The Effect of Alternate Assumptions on the June 30, 2023 Actuarial Valuation
Teachers
($ in Millions)

	June 30, 2021 Valuation Results (2024-2025 Rates)	June 30, 2023 Valuation Results (2026-2027 Rates)			
Demographic Assumptions	Prior	Prior	Proposed		
Economic Assumptions	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Alt 1 (6.75%/3.00%/2.25%)	Alt 2 (6.50%/3.00%/2.25%)
Employer Pension Normal Cost	2.71%	2.73%	2.68%	2.89%	3.39%
Pension UAAL Payment*	15.80%	15.76%	15.51%	15.39%	16.27%
Total Pension Contribution	18.51%	18.49%	18.19%	18.28%	19.66%
Employer Medical Subsidy Contribution	1.13%	0.97%	0.96%	0.95%	0.95%
Total Employer Contribution	**19.64%**	**19.46%**	**19.15%**	**19.23%**	**20.61%**
Total Estimated Employer $ Contribution&	$ 257.2	$ 262.2	$ 258.0	$ 261.0	$ 279.7
Pension					
Actuarial Accrued Liability (AAL)	$ 6,182.9	$ 6,549.0	$ 6,509.8	$ 6,538.0	$ 6,723.3
Actuarial Value of Assets (AVA)	$ 3,752.1	$ 4,211.0	$ 4,211.0	$ 4,211.0	$ 4,211.0
UAAL	$ 2,430.8	$ 2,338.0	$ 2,298.8	$ 2,327.0	$ 2,512.3
Funded Percent (AVA/AAL)	60.7%	64.3%	64.7%	64.4%	62.6%
Medical Subsidy					
AAL	$ 213.8	$ 181.4	$ 179.1	$ 175.8	$ 175.8
AVA	$ 10.0	$ 14.7	$ 14.7	$ 14.7	$ 14.7
UAAL	$ 203.8	$ 166.7	$ 164.4	$ 161.1	$ 161.1
Funded Percent (AVA/AAL)	4.7%	8.1%	8.2%	8.4%	8.4%

* The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2023. The headcount growth assumption for Teachers is (0.50)% per year. This assumption is reflected in the level percent of payroll amortization of the UAAL, therefore, the UAAL is amortized using an assumption of 2.25%.

& Total estimated employer dollar contribution for FY 2025 for rates adopted from June 30, 2021 valuation and for FY 2026 for rates based on the June 30, 2023 valuation.

2019-2023 Experience Study
The Effect of Alternate Assumptions on the June 30, 2023 Actuarial Valuation
Police
($ in Millions)

	June 30, 2021 Valuation Results (2024-2025 Rates)	June 30, 2023 Valuation Results (2026-2027 Rates)			
Demographic Assumptions	Prior	Prior	Proposed		
Economic Assumptions	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Alt 1 (6.75%/3.00%/2.25%)	Alt 2 (6.50%/3.00%/2.25%)
Employer Pension Normal Cost	6.10%	5.57%	5.65%	5.80%	6.68%
Pension UAAL Payment*	22.58%	23.29%	23.27%	22.92%	25.00%
Total Pension Contribution	28.68%	28.86%	28.92%	28.72%	31.68%
Employer Medical Subsidy Contribution	2.60%	2.24%	2.26%	2.23%	2.23%
Total Employer Contribution	**31.28%**	**31.10%**	**31.18%**	**30.95%**	**33.91%**
Total Estimated Employer $ Contribution&	$ 114.1	$ 117.9	$ 118.2	$ 118.2	$ 129.5
Pension					
Actuarial Accrued Liability (AAL)	$ 3,053.4	$ 3,311.5	$ 3,308.7	$ 3,316.6	$ 3,433.3
Actuarial Value of Assets (AVA)	$ 2,062.2	$ 2,310.6	$ 2,310.6	$ 2,310.6	$ 2,310.6
UAAL	$ 991.2	$ 1,000.9	$ 998.2	$ 1,006.0	$ 1,122.8
Funded Percent (AVA/AAL)	67.5%	69.8%	69.8%	69.7%	67.3%
Medical Subsidy (Police and Fire Combined)					
AAL	$ 302.9	$ 267.7	$ 265.7	$ 258.5	$ 258.5
AVA	$ 20.1	$ 22.7	$ 22.7	$ 22.7	$ 22.7
UAAL	$ 282.7	$ 244.9	$ 242.9	$ 235.8	$ 235.8
Funded Percent (AVA/AAL)	6.6%	8.5%	8.6%	8.8%	8.8%

* The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2023.

& Total estimated employer dollar contribution for FY 2025 for rates adopted from June 30, 2021 valuation and for FY 2026 for rates based on the June 30, 2023 valuation.

2019-2023 Experience Study
The Effect of Alternate Assumptions on the June 30, 2023 Actuarial Valuation
Fire
($ in Millions)

	June 30, 2021 Valuation Results (2024-2025 Rates)	June 30, 2023 Valuation Results (2026-2027 Rates)			
Demographic Assumptions	Prior	Prior	Proposed		
Economic Assumptions	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Prior (6.75%/2.75%/2.00%)	Alt 1 (6.75%/3.00%/2.25%)	Alt 2 (6.50%/3.00%/2.25%)
Employer Pension Normal Cost	6.28%	5.83%	5.86%	6.10%	7.10%
Pension UAAL Payment*	21.47%	21.34%	21.11%	20.82%	22.99%
Total Pension Contribution	27.75%	27.17%	26.97%	26.92%	30.09%
Employer Medical Subsidy Contribution	2.60%	2.24%	2.26%	2.23%	2.23%
Total Employer Contribution	**30.35%**	**29.41%**	**29.23%**	**29.15%**	**32.32%**
Total Estimated Employer $ Contribution&	$ 49.5	$ 49.7	$ 49.4	$ 49.7	$ 55.1
Pension					
Actuarial Accrued Liability (AAL)	$ 1,428.2	$ 1,533.2	$ 1,527.8	$ 1,530.8	$ 1,583.5
Actuarial Value of Assets (AVA)	$ 1,004.4	$ 1,123.3	$ 1,123.3	$ 1,123.3	$ 1,123.3
UAAL	$ 423.8	$ 409.9	$ 404.4	$ 407.5	$ 460.2
Funded Percent (AVA/AAL)	70.3%	73.3%	73.5%	73.4%	70.9%
Medical Subsidy (Police and Fire Combined)					
AAL	$ 302.9	$ 267.7	$ 265.7	$ 258.5	$ 258.5
AVA	$ 20.1	$ 22.7	$ 22.7	$ 22.7	$ 22.7
UAAL	$ 282.7	$ 244.9	$ 242.9	$ 235.8	$ 235.8
Funded Percent (AVA/AAL)	6.6%	8.5%	8.6%	8.8%	8.8%

* The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2023.

& Total estimated employer dollar contribution for FY 2025 for rates adopted from June 30, 2021 valuation and for FY 2026 for rates based on the June 30, 2023 valuation.

SECTION B

ECONOMIC ASSUMPTIONS

Economic Assumptions

The relevant Actuarial Standard of Practice (ASOP) for economic assumptions is ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations. Under ASOP No. 27, Section 3.6, an economic assumption is reasonable if it has the following characteristics:

- It is appropriate for the purpose of the measurement,
- It reflects the actuary's professional judgment,
- It takes into account current and historical data that is relevant to selecting the assumption for the measurement date, to the extent such relevant data is reasonably available,
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data (if any), or a combination thereof, and
- It is expected to have no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included (as discussed in Section 3.5.1) or when alternative assumptions are used for the assessment of risk, in accordance with ASOP No. 51, Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions.

All economic assumptions in this report are considered expectations of future experience as opposed to market-measures. For each assumption, we include our analysis and rationale for the selection and our recommendations in this report.

This experience study reviews the following economic assumptions used in the valuations:

- Price Inflation
- Rate of Investment Return
- Wage Inflation and Payroll Growth
- Merit and Seniority Pay Increases
- End-of-Career Pay Increases
- Size of the active population, (economic because of its relationship to total payroll growth)
- Administrative Expenses

Price Inflation Assumption

Price Inflation is the first building block for other economic assumptions. The assumed rate of inflation, as other economic assumptions, must be a forward-looking expectation of future experience. We survey multiple sources for future price inflation expectations over the next 30 years. A summary of this information is shown in the following table.

Forward-Looking Price Inflation Forecasts[a]	
Congressional Budget Office[b]	
5-Year Annual Average	2.83%
10-Year Annual Average	2.57%
Federal Reserve Bank of Philadelphia[c]	
5-Year Annual Average	2.60%
10-Year Annual Average	2.40%
Federal Reserve Bank of Cleveland[d]	
10-Year Expectation	2.28%
20-Year Expectation	2.33%
30-Year Expectation	2.39%
Federal Reserve Bank of St. Louis[e]	
10-Year Breakeven Inflation	2.18%
20-Year Breakeven Inflation	2.42%
30-Year Breakeven Inflation	2.19%
U.S. Department of the Treasury[f]	
10-Year Breakeven Inflation	2.09%
20-Year Breakeven Inflation	2.37%
30-Year Breakeven Inflation	2.19%
50-Year Breakeven Inflation	2.29%
100-Year Breakeven Inflation	2.36%
Social Security Trustees[g]	
Ultimate Intermediate Assumption	2.40%

[a] End of the Fourth Quarter, 2023. Version 2024-01-25 by Gabriel, Roeder, Smith & Company.

[b] *The Budget and Economic Outlook: 2023 to 2033,* Release Date: February 2023, Consumer Price Index (CPI-U), Percentage Change from Year to Year, 5-Year Annual Average (2023 - 2027), 10-Year Annual Average (2023 - 2032).

[c] *Fourth Quarter 2023 Survey of Professional Forecasters,* Release Date: November 13, 2023, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2023 - 2027), 10-Year Annual Average (2023 - 2032).

[d] Inflation Expectations, Model output date: December 1, 2023.

[e] The breakeven inflation rate represents a measure of expected inflation derived from X-Year Treasury Constant Maturity Securities and X-Year Treasury Inflation-Indexed Constant Maturity Securities. Observation date: December, 2023.

[f] *The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, December, 2023.

[g] *The 2023 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds,* March 31, 2023, p. 10, Key Assumptions and Summary Measures for the Last 65 Years of the Long-Range (75-year) Projection Period, Intermediate, Consumer Price Index (CPI-W).

Recommendation

While there has been a trend of lowering price inflation expectations over the previous decade, the current price inflation assumption is 2.00% which is below all of the forecasts above. We recommend increasing the price inflation assumption to 2.25%. For purposes of the analysis for other economic assumptions in this report, we have used a price inflation assumption of 2.25% per year.

Assumed Investment Return

For purposes of budgeting contributions as a level percentage of payroll for public employee retirement systems, the assumed rate of investment return is used as the discount rate to determine the present value of a system's pension obligations. For most valuations, an actuarial investment return assumption based on expected future experience is a single estimate for all years and therefore implicitly assumes that returns above and below expectations will "average out" over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned, while the investment risk is not reflected until actual experience emerges with each valuation.

The analysis of the investment return assumption in this report is based on forward-looking measures of expected investment return outcomes for the asset classes in the System's current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from twelve nationally recognized investment firms. We have compared this analysis with that of the System's Investment Staff and Investment Advisor, Callan. We thank the System's Staff and Callan for their cooperation. We have attempted to make our analysis as independent as possible and used our discussions with System Staff as confirmation of our understanding of the Board's investment objectives.

Our analysis is based on the GRS 2023 Capital Market Assumption Modeler (CMAM). The purpose of the CMAM is to assess the reasonability of the assumed rate of return for use in the actuarial valuations for the plan. In our professional judgment the CMAM has the capability to provide results that are consistent with this purpose. A description of the strengths, limitations and weaknesses of the model are incorporated in this report. In our opinion, the limitations and weaknesses are not material. We performed tests to ensure that the model reasonably represents that which is intended to be modeled. We are relying on the GRS actuaries and Internal Software, Training, and Processes Team who developed and maintain the model.

Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking expectations developed by several major investment firms. We update our CMAM on an annual basis, most recently in 2023. The capital market assumptions in the 2023 CMAM are from the following investment advisors (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Meketa, Mercer, NEPC, RVK, Verus, and Wilshire. We believe that the benefit of performing this analysis using multiple investment firms is to recognize the uncertain nature of the items affecting the selection of the investment return assumption. While there may be differences in asset classes, investment horizons, inflation assumptions, treatment of investment expenses, excess manager performance (i.e., alpha), etc., we have attempted to align the various assumption sets from the different investment firms to be as consistent as possible. In some cases, we have made minor adjustments or assumptions to align the various assumptions sets with our model.

For purposes of this analysis, we requested and received updated capital market expectations from Callan for 2024. We have updated the CMAM to include Callan's 2024 capital market assumptions but have not adjusted the other eleven investment firms' assumptions. We have reasonably matched Callan's total portfolio return expectations for both the 10-year and 30-year horizons.

Assumed Investment Return

To the best of our ability, we have adapted the System's investment policy to fit with the investment advisors' assumptions adjusting for these known differences in assumptions and methodology. In the following charts, to the extent possible, all returns are net of passive investment expenses and have no assumption for excess manager performance (alpha) in excess of active management fees. Plan administrative expenses, other than custodial and professional fees, are incorporated in the employer contributions and are therefore excluded from this analysis.

For purposes of this analysis, we have reviewed the following investment allocation based on the Board's Investment Policy which will become effective July 1, 2024:

Asset Class	Target Allocation
Large Cap Equities	15.0%
Small/Mid Cap Equities	15.0%
Int'l Equities (Unhedged)	5.0%
Emerging Int'l Equities	5.0%
Private Equity	10.0%
Core Bonds	9.0%
Absolute Return Fixed Income	6.0%
Global Multi-Sector Fixed Income	10.0%
Private Debt	10.0%
Core Real Estate	10.0%
Infrastructure	5.0%
Total	100.0%

The arithmetic expected return developed from this asset allocation is shown in Table 1 on the following page. The CMAM begins with the nominal expected return from each advisor (column 2), takes out each advisor's price inflation assumption (column 3) to arrive at the real return (column 4). We then incorporate the proposed price inflation assumption of 2.25% (column 5) to get the adjusted nominal return (column 6). Investment expenses not already netted out of the return and/or administrative expenses paid out of trust assets which are not reflected in the employer contributions (column 7) are netted out of the return. The final arithmetic expected return is shown in column 8. Note that the arithmetic return is in general higher than the median return due to the compounding effect of random returns. In general, the difference between the arithmetic and median return will be larger for larger standard deviation of returns. We have shown the standard deviation of returns as the investment risk in column 9.

Assumed Investment Return

ASOP No. 27, Section 3.6.2, states that the actuary "should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement." This range of reasonable assumptions is evident from the wide range of results from the 11 investment advisors show in our CMAM.

Table 1

Capital Market Assumption Set (CMA)	CMA Expected Nominal Return	CMA Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	7.11%	2.90%	4.21%	2.25%	6.46%	0.00%	6.46%	11.95%
2	6.77%	2.50%	4.27%	2.25%	6.52%	0.00%	6.52%	11.54%
3	7.50%	2.50%	5.00%	2.25%	7.25%	0.00%	7.25%	11.94%
4	7.40%	2.31%	5.09%	2.25%	7.34%	0.00%	7.34%	12.02%
5	7.70%	2.51%	5.19%	2.25%	7.44%	0.00%	7.44%	12.76%
6	8.23%	2.90%	5.33%	2.25%	7.58%	0.00%	7.58%	13.06%
7	7.63%	2.26%	5.37%	2.25%	7.62%	0.00%	7.62%	11.81%
8	7.91%	2.62%	5.29%	2.25%	7.54%	0.00%	7.54%	10.84%
9	7.80%	2.41%	5.39%	2.25%	7.64%	0.00%	7.64%	11.29%
10	8.28%	2.54%	5.74%	2.25%	7.99%	0.00%	7.99%	12.02%
11	8.34%	2.28%	6.06%	2.25%	8.31%	0.00%	8.31%	11.70%
Average	**7.70%**	**2.52%**	**5.18%**	**2.25%**	**7.43%**	**0.00%**	**7.43%**	**11.90%**

GRS 2023 CMAM

The average expected nominal return from column 8 is 7.43% based on a price inflation of 2.25%. This is the average arithmetic rate of return. The arithmetic rate of return represents the average future expected return which is higher than the median future expected. Accumulating assets and cash flows at the average arithmetic rate of return is expected to produce the average asset amount over time. However, in any given year it is less than 50% likely that the arithmetic average rate of return will be achieved. Moreover, over a period of longer than one year, the realized rate of return is generally computed as a geometric average. Additional analysis is required to adjust to the median (or geometric average) return.

Next, we compare the probabilities of achieving returns over a 10-year horizon in Table 2 on the following page. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 6.75% as well as 6.50%. These estimates are based on the assumption that the distribution of returns for the next 10 years is the same each year.

Assumed Investment Return

Table 2

GRS 2023 CMAM					
Capital Market Assumption Set (CMA)	Distribution of 10-Year Average Geometric Net Nominal Return 40th	50th	60th	Probability of exceeding 6.75%	Probability of exceeding 6.50%
(1)	(2)	(3)	(4)	(5)	(6)
1	4.85%	5.80%	6.75%	39.99%	25.36%
2	4.99%	5.90%	6.82%	40.75%	40.56%
3	5.65%	6.59%	7.54%	48.29%	41.41%
4	5.72%	6.67%	7.63%	49.16%	41.61%
5	5.69%	6.69%	7.71%	49.42%	42.81%
6	5.76%	6.79%	7.83%	50.41%	47.24%
7	6.04%	6.98%	7.92%	52.45%	51.34%
8	6.14%	6.99%	7.86%	52.86%	51.65%
9	6.16%	7.06%	7.96%	53.45%	54.74%
10	6.38%	7.33%	8.29%	56.12%	55.33%
11	6.76%	7.69%	8.62%	60.11%	61.36%
Average*	5.75%	6.75%	7.75%	50%	64%

Averages in this table are rounded to the nearest 0.25%.

The 50th percentile return is also related to the geometric average return. The geometric average of a sequence of returns over a number of years is the compound average of those returns over the number of years compounded. As the number of years in the geometric average increase and if the distributions of returns each year are independent and identically distributed, then the geometric average will converge to the median return. The median return may be considered a reasonable rate of return for purposes of the valuation. The average of 50th percentile returns among the 11 assumption sets is 6.75% per year. (Note that the 6.75% median shown is based on the 2.25% price inflation assumption. This analysis would result in a median return of 7.00% using a price inflation assumption of 2.50%.)

Column 5 of the table above shows the estimated probability of achieving the current 6.75% assumed rate of return over a 10-year period. The average probability of achieving 6.75% among the 11 assumption sets over 20 years is also 50%. (All probabilities shown are based on the 2.25% price inflation assumption. Probabilities may increase roughly 3-4% using a 2.50% price inflation assumption.)

Assumed Investment Return

Recommendation

In summary, a reasonable range for the assumed rate of return based on the current CMAM's 10-year investment horizon is between the median of 6.75% and the (arithmetic) nominal expected return of 7.43%. Returns outside that range are not necessarily unreasonable, but a separate justification may be needed. Based upon the results of our analysis, we believe that the current investment return assumption of 6.75% remains reasonable. After persisting declines in capital market expectations over the previous two decades, the most recent year's set of assumptions gathered by GRS are the first notable increase that has been observed. We will continue monitoring developments in these expectations and evaluate whether or not there is a consistent trend with the next experience study. Given that capital market expectations in the next 5 years may revert back to expectation levels seen in calendar years 2019 through 2022, we believe that it is also reasonable for the Board to consider lowering the investment return assumption. We have presented 6.50% as an additional investment return assumption for the Board's consideration.

Nothing in this report should be construed as GRS giving investment advice.

Wage Inflation and Payroll Growth

The wage inflation assumption represents the real wage growth over time in the general economy. It is the assumption on how much the pay scales themselves will change year to year, not necessarily how much the pay increases received by individuals are, or even necessarily how the payroll in total may change, which can be affected by population changes, etc. Wage inflation consists of two components, (1) a portion due to pure price inflation (i.e., increases due to changes in the CPI), and (2) increases in average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

In more recent periods, such as the 10-year period from 2012 through 2022, average compensation outpaced inflation by 90 basis points (based on the Social Security National Average Earnings Index and CPI-U which had 10-year averages of 3.5% and 2.6% respectively). The current assumed spread of wage over price inflation is 0.75% (2.75% wage inflation less 2.00% price inflation).

One measure of short-term wage inflation is the increase in average pay. The following table shows the increase in the average member pay for each of the four member classifications and in total over the experience study period.

		Increase in Average Pay				
		Employees	Teachers	Police	Fire	Total
	2019 - 2020	2.6%	1.2%	2.2%	2.7%	2.1%
	2020 - 2021	2.3%	2.0%	3.1%	7.2%	2.5%
	2021 - 2022	4.8%	1.9%	4.8%	(0.4)%	3.3%
	2022 - 2023	3.3%	3.2%	5.4%	3.5%	3.5%
Wage Inflation	2019 - 2023	**3.2%**	**2.1%**	**3.9%**	**3.2%**	**2.8%**
Price Inflation		**4.5%**	**4.5%**	**4.5%**	**4.5%**	**4.5%**
Spread of Wages Over Prices		**(1.3)%**	**(2.4)%**	**(0.6)%**	**(1.3)%**	**(1.6)%**

Historically high inflation in recent years has been observed subsequent to the COVID-19 pandemic, which is likely a combination of price inflation witnessed during this period as well as employer efforts to retain employees by paying higher salaries in a period of increased turnover among employees. It is unclear if circumstances that have driven these increases will persist. Our analysis accounts for persisting long-term trends by making incremental adjustments to assumptions where necessary, while attempting to be mindful of the risks of overcorrecting, which results in changes in assumptions of opposing directions at each subsequent experience study. Trends in wage inflation will continue to be monitored for persisting long-term trends, and adjustments to assumptions will be made where it is deemed reasonable and appropriate.

These NHRS-based measures may not be perfect since the demographics within each member classification shift over time, but they give an indication that, in general, recent experienced wage inflation has not exceeded price inflation as much as historical norms.

Based on this information, our opinion is that it would be reasonable to increase the 2.75% wage inflation assumption. The selection of wage inflation is linked to the selection of price inflation. On a forward-looking basis, we believe that the current spread of wages over prices of 0.75% is reasonable. A lower spread between wages and prices would also be reasonable.

Recommendation

We recommend increasing the assumed rate of wage inflation (and total payroll growth) from the current 2.75% to 3.00% and maintaining the assumption that assumed payroll growth for the Teachers group will be 50 percentage points lower than that of the other groups.

Merit and Longevity Assumptions

Reviewing the Merit and Longevity Assumptions

Pay increases granted to active members typically consist of two pieces:

- An across-the-board, economic type of increase granted to most or all members of the group. This increase is typically tied to wage inflation or cost of living changes, and

- An increase as a result of merit and seniority. This increase is typically related to the performance of an individual and includes promotions and increased years of experience.

The assumption for across-the-board increases is the pay inflation assumption discussed in the wage inflation section. The merit and seniority portion of pay increases are discussed in this section.

We reviewed the merit and seniority pay increases experienced by member classification during the 4-year period. The 4-year increase in total pay was subtracted from the actual pay increases to obtain the merit/seniority portion of the pay increases. It should be noted that the results of the analysis are sensitive to the estimated wage inflation component.

Valuation Date June 30,	Actives	Total NHRS Populaton Payroll	Annual Payroll Increase	4-year Average Increase
2019	48,288	$ 2,825,006,022		
2020	48,479	2,894,708,279	2.5%	
2021	48,582	2,972,968,504	2.7%	
2022	48,687	3,077,583,995	3.5%	
2023	48,589	3,178,096,144	3.3%	**3.0%**

The results of the analysis are shown on the following pages. Using the technique described above, observed pay increases were generally higher for all four member classifications.

Recommendation

We recommend changing the assumed rates of merit and longevity pay increases for all member classifications as indicated on the following pages.

Merit and Longevity Pay Increases – Group I

Service Based Merit & Seniority Pay Increase Experience - Employees
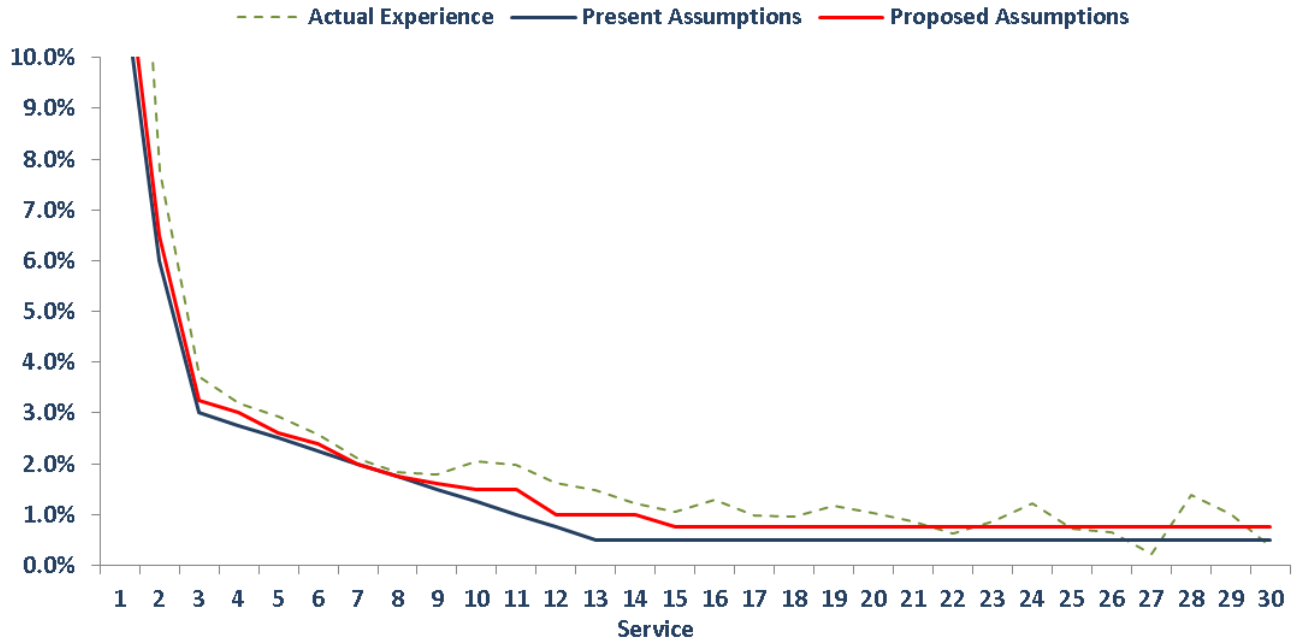
Service Based Merit & Seniority Pay Increase Experience - Teachers
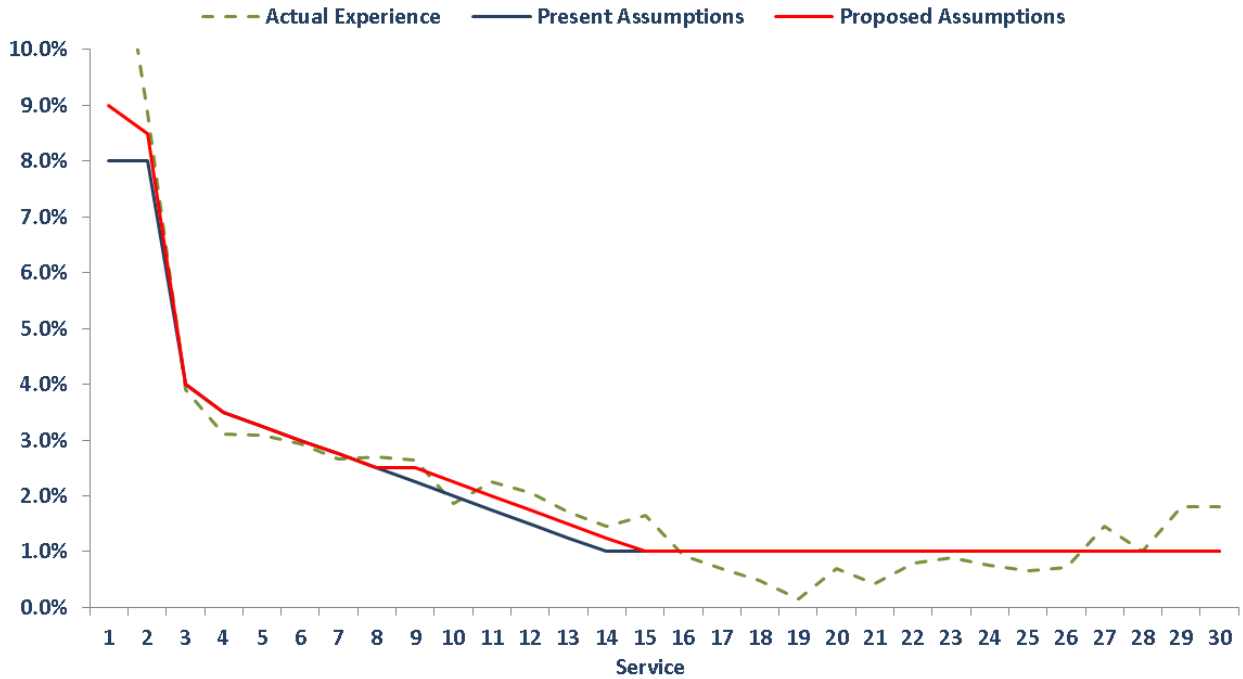
Actual merit is actual total reduced by average annual wage increases of the total population during the period of 3.0%.

Merit and Longevity Pay Increases – Group II

Service Based Merit & Seniority Pay Increase Experience - Police
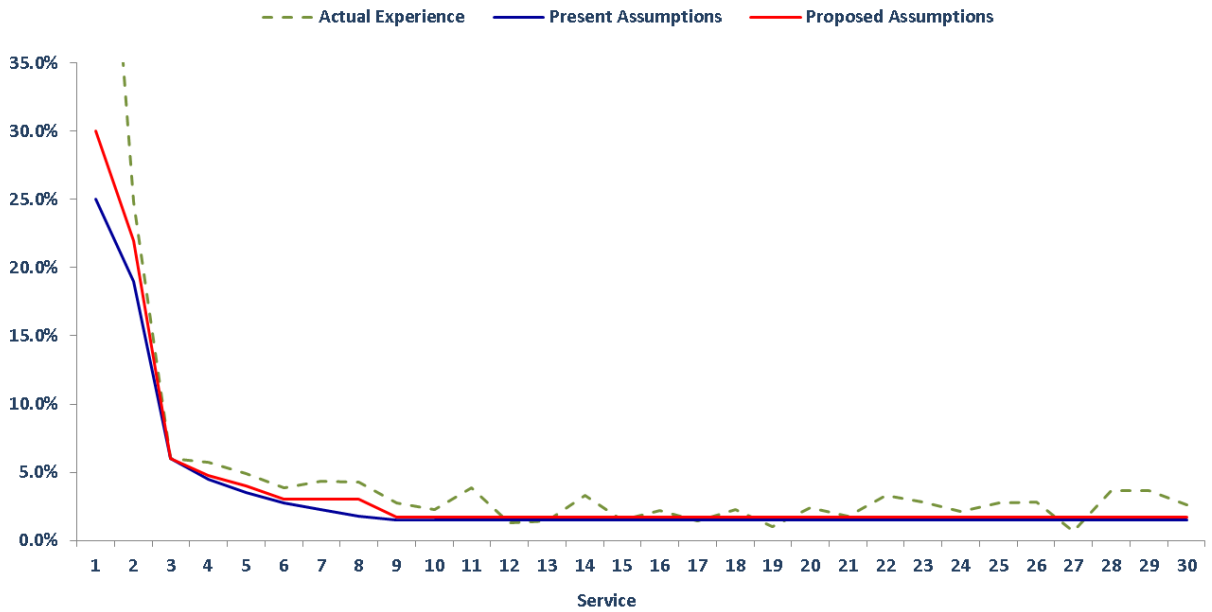
Service Based Merit & Seniority Pay Increase Experience - Fire
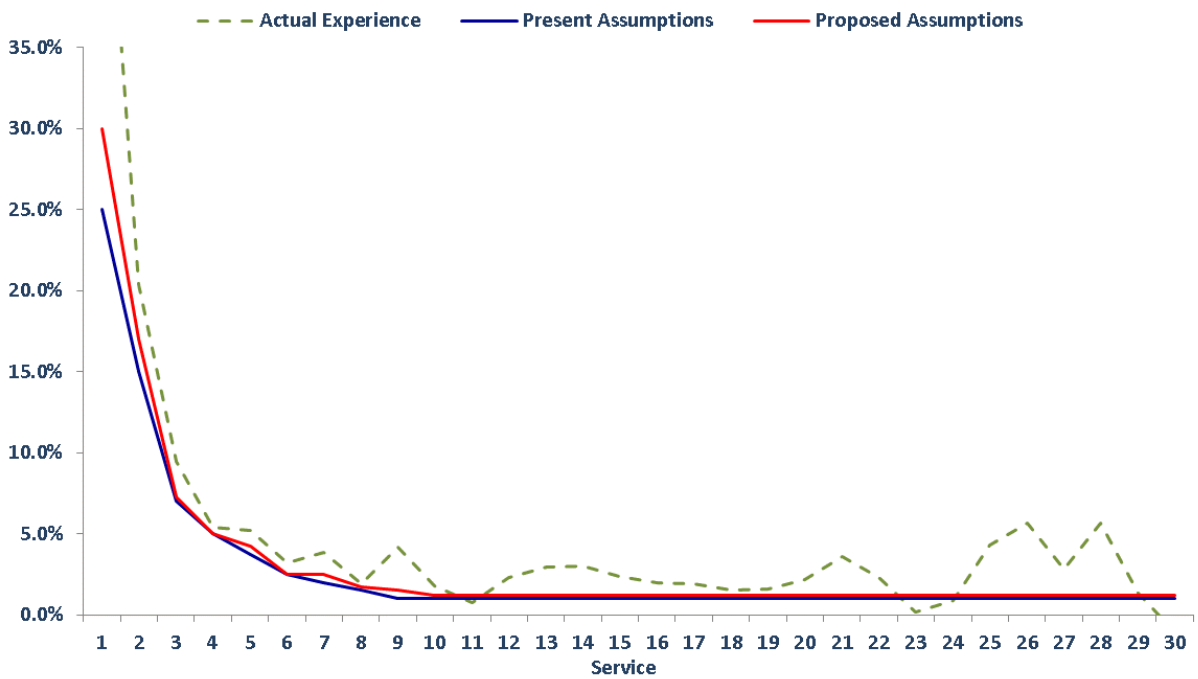
Actual merit is actual total reduced by average annual wage increases of the total population during the period of 3.0%.

Population Size

Reviewing the Population Size Assumption

The active member population is currently assumed to remain constant for Employees, Police and Fire. The Teachers' active member population is assumed to decrease 0.5% per year. This affects the projection of the payroll for the amortization of the unfunded actuarial accrued pension liability and the solvency medical subsidy contributions. If payroll growth is less than assumed, this affects both the payment received from the Employers during a particular year and the rate calculated in the following actuarial valuation.

Looking at two historical sources, the number of full-time state and local employees reported by the U.S. Census Bureau and the NHRS active member headcount both reached their peak in 2009 right before the Great Recession. The definitions of part-time for purposes of the U.S. Census Bureau and NHRS participation may not be identical, but the relationship between all full-time state and local employees and NHRS active members appears generally consistent over time. In the last experience study, we observed that the active member count for NHRS had remained relatively stable whereas the number of part-time state and local employees had declined. In this study period, the active member count for NHRS continued to remain stable. The counts for full-time state and local employees based on census data has also remained stable while the number of part-time employees has declined.

State and Local Employees - All Job Classifications

Year	U.S. Census Annual Survey[1]		NHRS[2]
	Full Time	**Part Time**	
2012	59,892	30,448	48,625
2013	57,227	29,974	48,688
2014	58,293	31,776	48,307
2015	58,334	32,359	47,812
2016	58,135	30,306	48,069
2017	58,106	30,489	47,886
2018	57,188	28,646	48,121
2019	58,017	29,474	48,288
2020	58,912	27,675	48,479
2021	57,445	24,724	48,582
2022	58,170	25,670	48,687

Annual Rate of Change

All Years	-0.29%	-1.69%	0.01%
Last 5 years	0.02%	-3.38%	0.33%
Last 4 years	0.43%	-2.71%	0.29%
Last 3 years	0.09%	-4.50%	0.27%

[1]   *Historical information for the State of New Hampshire based on U.S. Census Annual Surveys of Public Employment & Payroll, March 2023.*

[2]   *Historical information based on data submitted for the annual valuations.*

Population Size

We explore future active member population expectations separately by member classification. For purposes of these analyses, we rely on the New Hampshire population projections through 2045 produced by the New Hampshire Office of Planning and Development at the New Hampshire Department of Business and Economic Affairs and the State's Regional Planning Commissions State, County, and Municipal Population Projections report from September 2022. In addition, we rely on additional data from the New Hampshire Department of Education for analysis of the Teachers.

Independent review and audit of these reports is outside the scope of this project.

Population Size

Employees

We compare the historical and projected ratios of the New Hampshire general population to the number of active Employee members.

June 30	Employees Headcount[1]	Annual Rate of Change	New Hampshire Population[2]	Annual Rate of Change	Population/ Employee Ratio	Annual Rate of Change
			Historical Information			
2012	24,747	-3.10%	1,321,000	0.23%	53.38	3.44%
2013	24,809	0.25%	1,323,459	0.19%	53.35	-0.06%
2014	24,545	-1.06%	1,326,813	0.25%	54.06	1.33%
2015	24,298	-1.01%	1,330,834	0.30%	54.77	1.32%
2016	24,520	0.91%	1,334,591	0.28%	54.43	-0.63%
2017	24,478	-0.17%	1,342,612	0.60%	54.85	0.77%
2018	24,511	0.13%	1,356,265	1.02%	55.33	0.88%
2019	24,654	0.58%	1,359,711	0.25%	55.15	-0.33%
2020	24,602	-0.21%	1,377,529	1.31%	55.99	1.52%
2021	24,558	-0.18%	1,388,992	0.83%	56.56	1.01%
2022	24,644	0.35%	1,395,231	0.45%	56.62	0.10%
2023	24,640	-0.02%	1,402,054	0.49%	56.90	0.51%
			Projections			
2024	24,640	0.00%	1,410,683	0.62%	57.25	0.62%
2025	24,640	0.00%	1,430,601	1.41%	58.06	1.41%
2030	24,640	0.00%	1,473,286	0.59%	59.79	0.59%
2035	24,640	0.00%	1,501,045	0.37%	60.92	0.37%
2040	24,640	0.00%	1,511,770	0.14%	61.35	0.14%
2045	24,640	0.00%	1,509,955	-0.02%	61.28	-0.02%

[1]Historical information based on data submitted for the annual valuations. Projections are based on the prospective Employees Headcount assumption.

[2]Historical information is based on the New Hampshire Office of Planning and Development historical reports. Projections are based on the State of New Hampshire, Office of Planning and Development and the State's Regional Planning Commissions County Population Projections.

The ratio of the general population to active Employees for 2023 is 56.90, roughly a 7% increase since 2012 when the ratio was 53.38. A projection of 0% growth in the active member headcount through 2045 results in a ratio of 61.28, roughly an increase of 8% from 2023. While there is no hard and fast rule that says active Employee headcounts will grow in sync with the general population, it is reasonable to assume that this population will remain stable.

Population Size

Teachers

We compare the historical and projected ratios of the New Hampshire school-age population to the number of active Teacher members.

Historical Information

June 30	Teachers Headcount[1]	Annual Rate of Change	General Population Age 5-19[2]	Public District School Students[3]	Students/ Population	Annual Rate of Change	Student/ Teacher Ratio	Annual Rate of Change
2012	18,161	-1.65%		185,278		-1.76%	10.20	-0.11%
2013	18,084	-0.42%		181,900		-1.82%	10.06	-1.41%
2014	17,986	-0.54%		178,947		-1.62%	9.95	-1.09%
2015	17,732	-1.41%	239,585	176,685	74%	-1.26%	9.96	0.15%
2016	17,784	0.29%		174,015		-1.51%	9.78	-1.80%
2017	17,617	-0.94%		171,942		-1.19%	9.76	-0.25%
2018	17,752	0.77%		170,410		-0.89%	9.60	-1.64%
2019	17,730	-0.12%		169,050		-0.80%	9.53	-0.67%
2020	17,917	1.05%	227,133	167,584	74%	-0.87%	9.35	-1.90%
2021	18,131	1.19%		159,012		-5.12%	8.77	-6.23%
2022	18,217	0.47%		159,460		0.28%	8.75	-0.19%
2023	18,141	-0.42%		157,721		-1.09%	8.69	-0.68%

Projections

June 30	Teachers Headcount[1]	Annual Rate of Change	General Population Age 5-19[2]	Public District School Students[3]	Students/ Population	Annual Rate of Change	Student/ Teacher Ratio	Annual Rate of Change
2024	18,050	-0.50%		155,253	74%	-1.56%	8.60	-1.07%
2025	17,960	-0.50%	215,103	158,708	74%	2.23%	8.84	2.74%
2030	17,516	-0.50%	219,212	161,740	74%	0.38%	9.23	0.88%
2035	17,082	-0.50%	228,480	168,578	74%	0.83%	9.87	1.34%
2040	16,659	-0.50%	237,942	175,559	74%	0.81%	10.54	1.32%
2045	16,247	-0.50%	235,182	173,523	74%	-0.23%	10.68	0.27%

[1]Historical information based on data submitted for the annual valuations. Projections are based on the prospective Teachers Headcount assumption.

[2]Historical and projected general population counts are based on State of New Hampshire Office of Planning and Development and the State's Regional Planning Commissions County Population Projections, 2020-2050, prepared by RLS Demographics.

[3]Historical information based on New Hampshire Department of Education data as of January 16, 2024. Projections based on State of New Hampshire, Office of Planning and Development and the State's Regional Planning Commissions County Population Projections, 2020-2050, 74% of ages 5-19.

The ratio of public-school students relative to the age 5-19 general population has remained fairly level (based on a very small set of historical data points) at 74%. We apply the current 74% to the projected general population to estimate the number of public-school students. The ratio of the school-age population to active Teachers for 2023 is 8.69, roughly a 15% decrease since 2012 when the ratio was 10.20. This suggests that the active Teacher workforce has not declined as rapidly as the school-age population from 2012 to 2023. With the current 0.5% decrease assumption, the student/teacher ratio gradually increases through 2045. We consider a levelling or modestly increasing ratio of students to Teachers as a reasonable assumption. Therefore, we recommend no change to the annual decrease in the active Teacher population of 0.50% per year.

Population Size

Police

We compare the historical and projected ratios of the New Hampshire general population to the number of active Police members.

		Historical Information				
June 30	Police Headcount[1]	Annual Rate of Change	New Hampshire Population[2]	Annual Rate of Change	Population/ Police Ratio	Annual Rate of Change
2012	4,118	-0.29%	1,321,000	0.23%	320.79	0.52%
2013	4,187	1.68%	1,323,459	0.19%	316.09	-1.46%
2014	4,166	-0.50%	1,326,813	0.25%	318.49	0.76%
2015	4,174	0.19%	1,330,834	0.30%	318.84	0.11%
2016	4,139	-0.84%	1,334,591	0.28%	322.44	1.13%
2017	4,151	0.29%	1,342,612	0.60%	323.44	0.31%
2018	4,197	1.11%	1,356,265	1.02%	323.15	-0.09%
2019	4,216	0.45%	1,359,711	0.25%	322.51	-0.20%
2020	4,256	0.95%	1,377,529	1.31%	323.67	0.36%
2021	4,184	-1.69%	1,388,992	0.83%	331.98	2.57%
2022	4,103	-1.94%	1,395,231	0.45%	340.05	2.43%
2023	4,042	-1.49%	1,402,054	0.49%	346.87	2.01%
		Projections				
June 30	Police Headcount[1]	Annual Rate of Change	New Hampshire Population[2]	Annual Rate of Change	Population/ Police Ratio	Annual Rate of Change
2024	4,042	0.00%	1,410,683	0.62%	349.01	0.62%
2025	4,042	0.00%	1,430,601	1.41%	353.93	1.41%
2030	4,042	0.00%	1,473,286	0.59%	364.49	0.59%
2035	4,042	0.00%	1,501,045	0.37%	371.36	0.37%
2040	4,042	0.00%	1,511,770	0.14%	374.02	0.14%
2045	4,042	0.00%	1,509,955	-0.02%	373.57	-0.02%

[1]Historical information based on data submitted for the annual valuations. Projections are based on the prospective Police Headcount assumption.

[2]Historical information is based on the New Hampshire Office of Planning and Development historical reports. Projections are based on the State of New Hampshire, Office of Planning and Development and the State's Regional Planning Commissions County Population Projections.

The ratio of the general population to active Police members for 2023 is 346.87, roughly an 8% increase since 2012 when the ratio was 320.79. A projection of 0% growth in the active member headcount through 2045 results in a ratio of 373.57, roughly an increase of 8% from 2023. While there is no hard and fast rule that says active Police headcounts will grow in sync with the general population, it is reasonable to assume that recent declines in active police members will not continue indefinitely given the projected population increase. We recommend no change to the assumption that the Police active member population will remain stable.

Population Size

Fire

We compare the historical and projected ratios of the New Hampshire general population to the number of active Fire members.

		Historical Information				
June 30	Fire Headcount[1]	Annual Rate of Change	New Hampshire Population[2]	Annual Rate of Change	Population/ Fire Ratio	Annual Rate of Change
2012	1,599	-0.25%	1,321,000	0.23%	826.14	0.48%
2013	1,608	0.56%	1,323,459	0.19%	823.05	-0.37%
2014	1,610	0.12%	1,326,813	0.25%	824.11	0.13%
2015	1,608	-0.12%	1,330,834	0.30%	827.63	0.43%
2016	1,626	1.12%	1,334,591	0.28%	820.78	-0.83%
2017	1,640	0.86%	1,342,612	0.60%	818.67	-0.26%
2018	1,661	1.28%	1,356,265	1.02%	816.54	-0.26%
2019	1,688	1.63%	1,359,711	0.25%	805.52	-1.35%
2020	1,704	0.95%	1,377,529	1.31%	808.41	0.36%
2021	1,709	0.29%	1,388,992	0.83%	812.75	0.54%
2022	1,723	0.82%	1,395,231	0.45%	809.77	-0.37%
2023	1,766	2.50%	1,402,054	0.49%	793.92	-1.96%
		Projections				
June 30	Fire Headcount[1]	Annual Rate of Change	New Hampshire Population[2]	Annual Rate of Change	Population/ Fire Ratio	Annual Rate of Change
2024	1,766	0.00%	1,410,683	0.62%	798.80	0.62%
2025	1,766	0.00%	1,430,601	1.41%	810.08	1.41%
2030	1,766	0.00%	1,473,286	0.59%	834.25	0.59%
2035	1,766	0.00%	1,501,045	0.37%	849.97	0.37%
2040	1,766	0.00%	1,511,770	0.14%	856.04	0.14%
2045	1,766	0.00%	1,509,955	-0.02%	855.01	-0.02%

[1]Historical information based on data submitted for the annual valuations. Projections are based on the prospective Fire Headcount assumption.

[2]Historical information is based on the New Hampshire Office of Planning and Development historical reports. Projections are based on the State of New Hampshire, Office of Planning and Development and the State's Regional Planning Commissions County Population Projections.

The ratio of the general population to active Fire members for 2023 is 793.92, about a 4% decrease since 2012 when the ratio was 826.14. A projection of 0% growth in the active member headcount through 2045 results in a ratio of 855.01, roughly an increase of 8% from 2023. While there is no hard and fast rule that says active Fire headcounts will grow in sync with the general population, it is reasonable to assume that the active headcount will remain constant. We recommend no change to the assumption that the Fire active member population will remain stable.

Population Size

Recommendation

We recommend maintaining the assumption of a constant active member population for Employees, Police, and Fire and maintaining the active member population decline assumption of 0.50% per year for Teachers.

Medical Subsidy

The investment return rate assumed in the medical subsidy valuations is 6.75% per year, compounded annually (net after investment expenses) for purposes of computing Total OPEB liabilities and other disclosures required by GASB (where applicable). However, for determining the solvency contribution rate for the medical subsidy account, the investment return rate assumption is 2.75%, where applicable.

Under New Hampshire law, the medical subsidy is not pre-funded. For funding purposes, our rationale for selecting the discount rate for the medical subsidy is to consider the long-term expectation of short-term investments. Low-risk asset classes, such as those used for short-term investments where liquidity is a priority, may generally be expected to earn yields of price inflation plus a margin. Therefore, we recommend no changes to the assumed rate of return on short-term assets used of 2.75%.

Note that for GASB accounting purposes, the current accounting standard requires the use of the long-term expected rate of return on assets as long as assets are projected to fund the benefits, followed by a municipal bond yield thereafter. The GASB discount rate will be determined each year based on the accounting standards.

Recommendation

We recommend no changes to the short-term investment return assumption of 2.75% for the purposes of the medical subsidy funding and accounting, respectively.

End of Career Payments

End of Career Payments may occur for those members with a definition of compensation which includes information generally unreported during regular annual valuations such as severance pay, end-of-career longevity payments, and pay for unused sick or vacation time. The definition of compensation changed for members who had not attained vested status prior to January 1, 2012 and for those hired on and after July 1, 2011. There was insufficient data from that population to assess end of career payments.

Summary of Data

	Retiree Data Available For Load Analysis as of June 30, 2023				
	Employees	**Teachers**	**Police**	**Fire**	**Total**
(a) Members retiring in 4 yr. period ending 6/30/23	2,909	1,877	618	233	5,637
(d) Members in (a) that had 6 complete years of active pay history	2,224	1,739	570	224	4,757

Summary of Results

Group	(A) Liability/Normal Cost Load	(B) Raw Load Results Using Final 3 Years Prior to Retirement	(C) Recommended Liability/Normal Cost Load	(D) Change from Current (A) to Recommended (D)
Employees	8.5%	8.0%	**8.0%**	-0.5%
Teachers	5.5%	4.6%	**5.0%**	-0.5%
Police	11.0%	8.8%	**9.5%**	-1.5%
Fire	12.0%	9.9%	**10.5%**	-1.5%

(A)   The current assumptions used to model severance pay.
(B)   Average ratio (payroll-weighted) of actual AFC at retirement to the 3-year average compensation based on earnable compensation reported for annual valuations in the 3 years immediately preceding retirement.
(C)   Recommended assumption based on 1/2 weighting of (B) and 1/2 of (A) rounded down to nearest 0.50%.
(D)   The change from current (A) to recommended (C).

Increases in actual versus expected AFC observed in vested terminations were significantly less than those among members who decremented under service retirement (above).

Recommendation

We recommend decreasing the assumed liability/normal costs loads for end of career payments for all groups as shown above, and only applying 25% of the respective loads to vested terminations.

Administrative Expense Assumption

EXPENSE LOAD ANALYSIS

Fiscal Year Ending	Admin. & Misc. Expenses *	Total Payroll	As a % of Payroll
6/30/2020	$ 9,934,283	$ 2,894,708,279	0.34%
6/30/2021	9,952,213	2,972,968,504	0.33%
6/30/2022	11,528,274	3,077,583,995	0.37%
6/30/2023	11,632,501	3,178,096,144	0.37%
4-year average			**0.35%**

* As defined by GASB Statement No. 68. Includes administrative, custodial and professional fees and other non-investment expenses.

The assumption for the administrative expenses is included in the normal cost. Administrative expenses are determined by the Board through its budgeting process. The cost estimates contained in this report include the current assumption of 0.35% of payroll in the normal cost.

Recommendation

We recommend maintaining a 0.35% administrative expense assumption as a percent of payroll.

SECTION C

DEMOGRAPHIC ASSUMPTIONS – MORTALITY

Demographic Assumptions

Background

Actuarial Standard of Practice No. 35 – Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations

ASOP No. 35 applies to actuaries when they are selecting demographic and all other assumptions not covered by ASOP No. 27, Selection of Economic Assumptions for Measuring Pension Obligations.

The actuary should identify the types of demographic assumptions to use for a specific measurement. In doing so, the actuary should determine the following:

   (a)   The purpose and nature of the measurement;
   (b)   The plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
   (c)   The characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, and volatility);
   (d)   The contingencies that give rise to benefits or result in loss of benefits;
   (e)   The significance of each assumption; and
   (f)   The characteristics of the covered group.

Throughout the 4-year experience study period, a participant may decrement (i.e., change status) either by retiring, terminating, becoming disabled, or dying.   In general, our analysis of the NHRS decrement experience is based on both headcount-weighted experience with the exception of mortality where we use liability-weighted experience. For each decrement, the exposure is the number (or liability) of those who were subject to the specific decrement, the expected is the number (or liability) of those exposed who were assumed to decrement and the actual is the number (or liability) of those exposed who actually did decrement. The ratio of actual to expected decrements (the A/E ratio) provides a quick summary of experience for a particular decrement in total.

While the A/E ratio gives a rough indication of the actual vs. expected experience, it does not necessarily dictate what changes, if any, we may suggest. An A/E ratio of 100% does not preclude a suggested change in the assumption. The following are a few reasons we may suggest a new assumption across various A/E ratios:

   (1) Experience for an assumption – or a subgroup affected by an assumption – may be too small to assign full credibility,
   (2) The direction of the change in this study may be the opposite of the change made in the last study which runs the risk of flip-flopping assumptions,
   (3) We may intentionally wish to maintain a ratio other than 100%, such as leaving a margin for static mortality improvement,
   (4) It may not be possible to have the A/E ratio on a headcount-weighted and liability-weighted basis both equal 100%, or
   (5) There may be other facts and circumstances about the underlying data, the specific experience period, or the interaction with plan provisions or other changes. In addition, even if the A/E ratio is 100% in the aggregate, we may make changes to individual rates within the full assumption set.

Demographic Assumptions

A headcount-weighted decrement is designed to mimic the event of a person decrementing. A liability-weighted decrement is designed to mimic the associated liability of a person decrementing, which in turn should reduce the likelihood of a gain or a loss. Actuarial practice on using headcount-weighted vs. liability-weighted is evolving. In general, from the perspective of mitigating gains and losses, we prefer to consider liability-weighted analysis whenever appropriate. In our experience, liability-weighted analysis is most appropriate for mortality. Other decrement assumptions tend to be similar on a headcount-weighted and liability-weighted basis.

The statistical analysis required for studying actuarial assumptions depends on the quantity and quality of the underlying data. The more reliable – or statistically "credible" – data that we have, the more refined we can make our analysis.

The pertinent ASOPs for these purposes are:

- ASOP No. 23, Data Quality; and
- ASOP No. 25, Credibility Procedures.

The demographic analysis in this report is organized as follows: mortality experience is reviewed in Section C. Each other major demographic assumption is reviewed in detail in Sections D through G, including rates of retirement, termination and disability, for the separate member classifications.

This analysis is based on the actuarial valuation data for the four-year period from July 1, 2019, to June 30, 2023. To account for excess mortality attributable to the COVID pandemic, the analysis in this section was then extended to cover the period of 2016 through 2023.

Mortality Experience

Perhaps the most critical demographic assumption used in pension valuations is mortality. Rates of mortality affect our estimate of how long each individual is expected to live and consequently how long each individual is expected to receive a pension. Life expectancy in turn has a direct impact on pension plan liabilities. To account for excess mortality attributable to the COVID pandemic, the analysis in this section covers the period of 2016 through 2023. Excess mortality for males in the Employee group was significant during the latter part of the period resulting in the exclusion of 2022 and 2023 experience from the analysis for this group.

The mortality experience was reviewed on a benefit-weighted basis for healthy retired members. The observed experience was compared to the current mortality tables.

Proposed mortality assumption: Continued use of group-specific Pub-2010 Mortality Tables respectively for healthy annuitants, disabled annuitants, and active employees, projected with fully generational mortality improvement using MP-2021, and partial credibility adjustment are shown below (for healthy annuitants). Credibility adjustments for Police and Fire are combined.

	Employees	Teachers	Police/Fire
Male	102%	106%	101%
Female*	107%	104%	101%

*Proposed mortality table for Females in the Employee group is the below-median income table.

Scaling factors applied to the mortality table probabilities were developed in a manner consistent with guidance in the 2017 Society of Actuaries publication titled *Credibility Educational Resource for Pension Actuaries: Application of Credibility Theory to Mortality Assumption.*

Disabled Retirees
Disabled mortality experience during the study period was not sufficient to be fully credible. We recommend continued use of the group-specific Pub-2010 Disabled Retiree mortality tables with no scaling factor.

Active Members
Active mortality experience during the study period was not sufficient to be fully credible. We recommend continued use of the respective group-specific Pub-2010 Employee mortality tables with no scaling factor. There was insufficient experience to warrant a change in the ordinary/accidental death weighting assumption.

	Employees	Teachers	Police/Fire
Ordinary	98%	98%	50%
Accidental	2%	2%	50%

The proposed mortality assumption updates resulted in a slight reduction in actuarial accrued liabilities.

Healthy Retiree Mortality Experience – Employees

Males
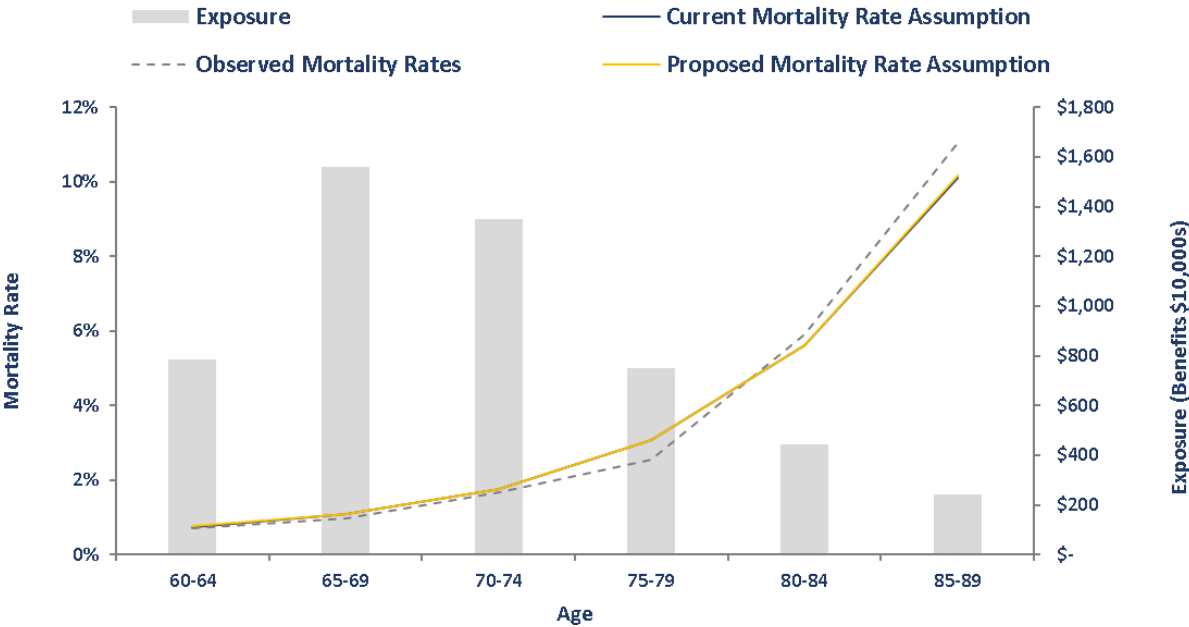
Females
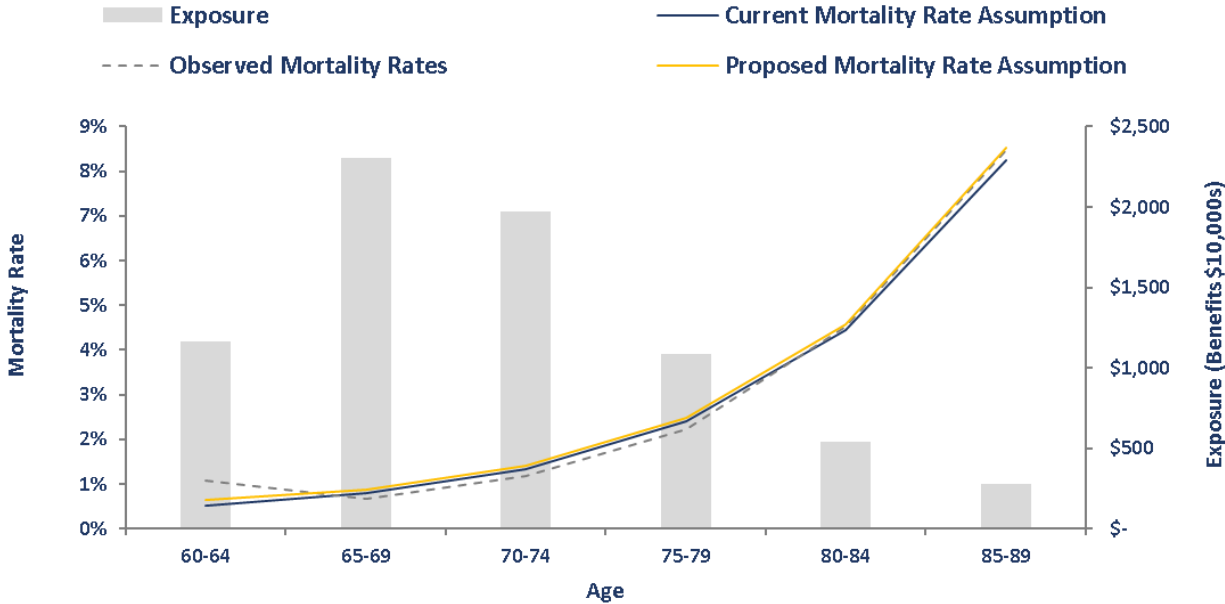
Healthy Male Retiree Mortality Experience – Teachers

Males
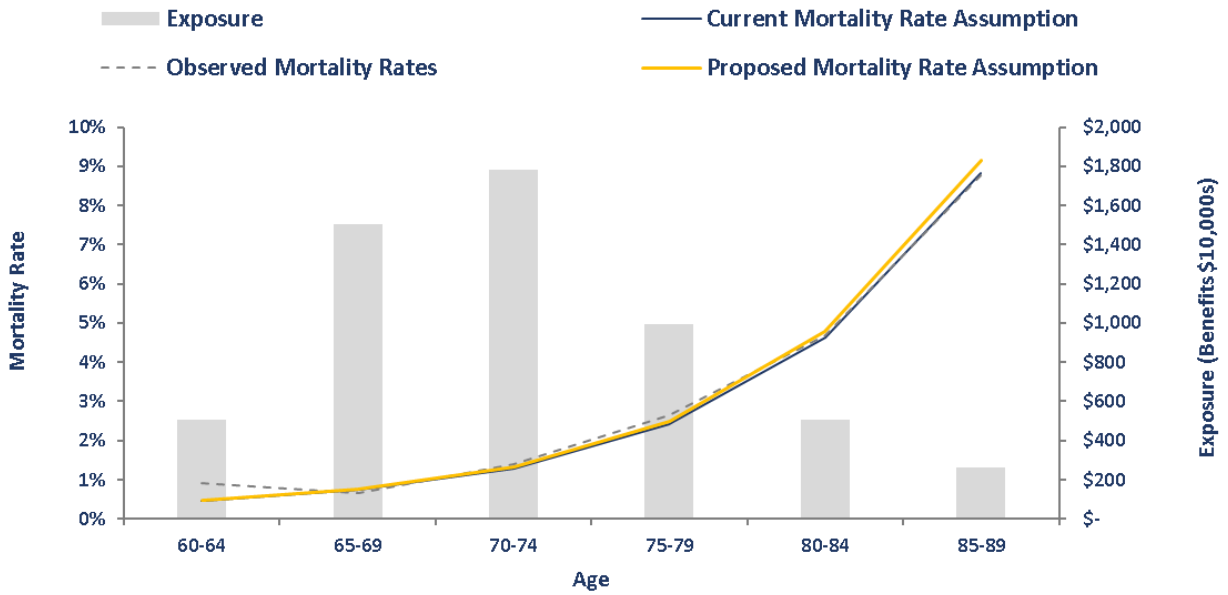
Females
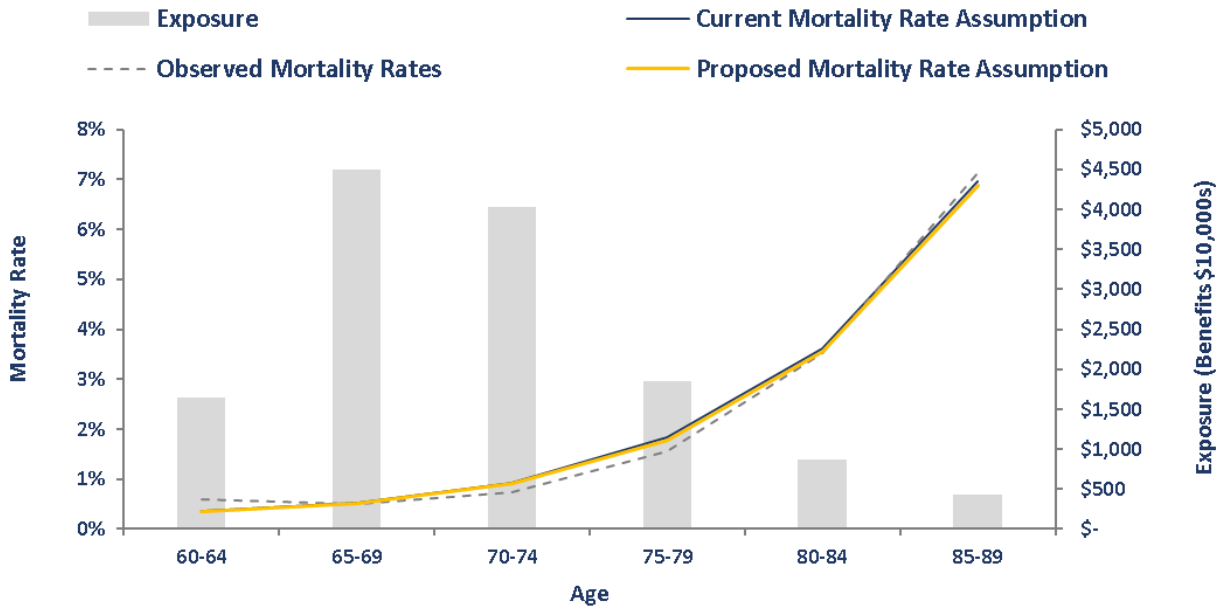
Healthy Male Retiree Mortality Experience – Police and Fire

Males
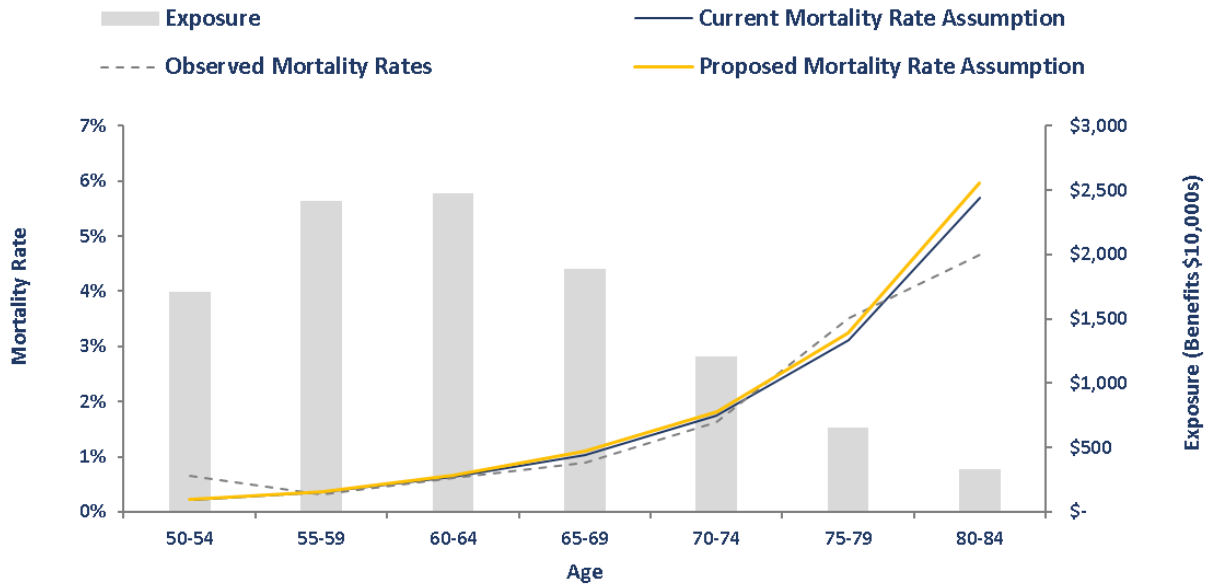
Females
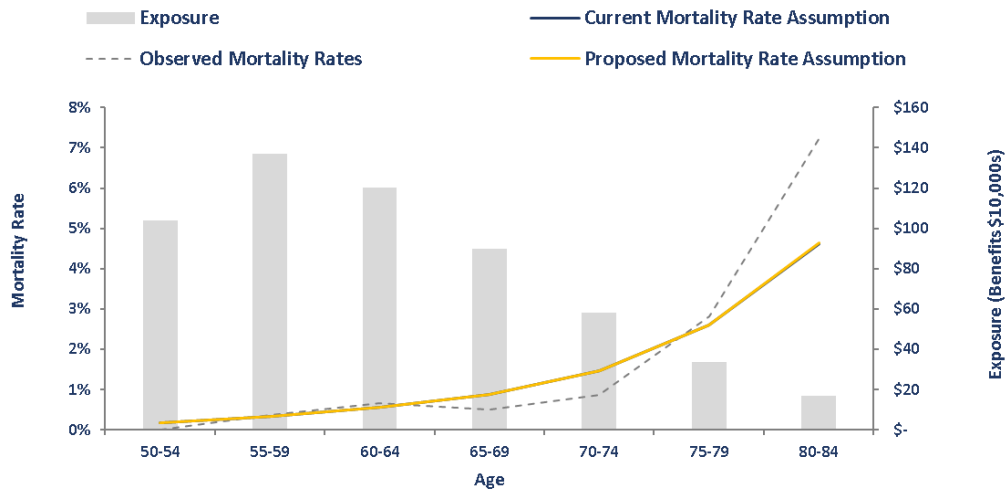
SECTION D

DEMOGRAPHIC ASSUMPTIONS – EMPLOYEES

Demographic Assumptions - Employees

Withdrawal Experience

We separated the members into two groups for the analysis: 1) members with 5 or fewer years of credited service, and 2) members with 5 or more years of credited service. To allow for a higher degree of credibility, male and female rates were observed together and the proposed rates are for the combined population.

Service Based Withdrawal

Overall, the plan experienced more withdrawals for members with fewer than 5 years of credited service (6,139) than projected by the present assumptions (5,659). This experience suggests a need to increase the assumed rates of withdrawal among individuals with fewer than 5 years of service. This assumption was lowered in the last experience study; therefore, we suggest only a slight increase in rates to adjust this assumption.

Demographic Assumptions - Employees

Age Based Withdrawal

Overall, the plan experienced greater withdrawals (2,107) among members more than projected by the present assumptions (1,842). This experience suggests a need to increase the assumed rates of withdrawal among these individuals with 5 or more years of service.
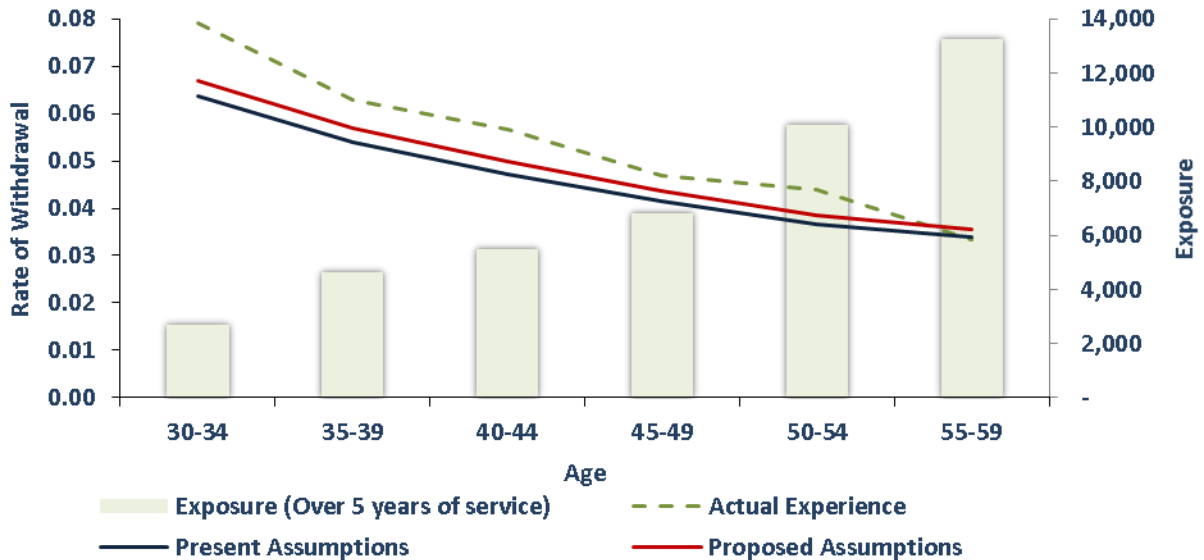
Terminations (both with and without deferred benefits) for members with early retirement eligibility continue to be observed. The current assumptions include rates of termination for members during early retirement eligibility. We suggest that rates of withdrawal continue to be included for members eligible for early retirement.

Recommendation

We recommend adoption of the proposed withdrawal assumptions combined for males and females. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Employees

Disability Experience

We reviewed the disability experience during the 4-year period. Overall, the plan experienced fewer disability retirements (46) than projected by the present assumptions (79). This experience suggests a need to decrease the assumed rates of disability. Under credibility theory, if the data for observing a decrement is too small to be credible, a rational approach is to scale changes from the prior assumptions in the direction of observed experience.

Other

Approximately 26% of disabilities during the period were considered accidental disabilities, and 38% in the previous experience study period, versus the current assumption of 40%. We will continue to monitor this assumption and make updates if needed for the next experience study.

Recommendation

We recommend lowering disability retirement rates and continuing to keep these rates combined for male and female individuals. In addition, we recommend continuing to assume that 40% of disabilities are accidental. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Employees

Retirement Experience

Recent decades have seen a trend towards individuals having longer healthier lives, and the lower level of income in this group also creates an economic incentive to work longer, thereby leading to longer careers and members retiring at later ages. Current assumed rates of retirement for the Employee group assign 100% probability of retiring at age 70. This assumption was set at this level as a margin for adverse experience. Consequently, actual retirements for this group have consistently been lower than assumed.

Actuarial Experience by Year - Employees
Retirements
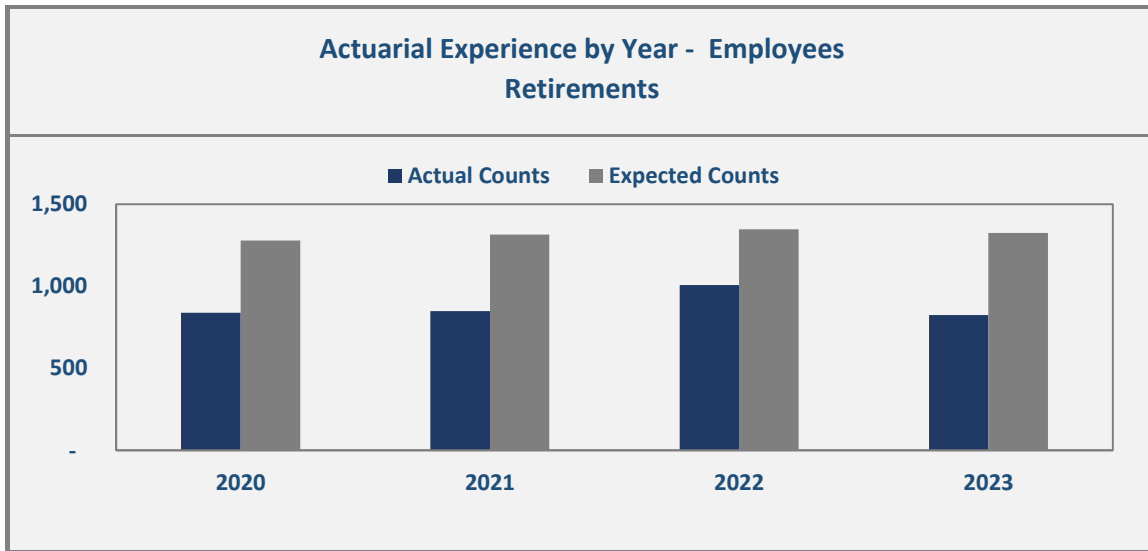
The persisting trend of later retirement ages among these members suggests a need to consider revising this assumption to set rates of retirement at age 70 and above based on actual experience.

Demographic Assumptions - Employees

Overall male Employee retirements (1,091) were less than projected by the present assumptions (1,531). Likewise, for female members actual retirements (1,818) were less than expected (2,408). Observed rates of retirement were slightly higher than assumed between ages 65 and 70 in both cases. Similar rates of retirement were observed to persist after age 70.

Male Employees

Exposure (Tiers A and B Male Employees) — — Actual Experience
Present Assumptions ——— Proposed Assumptions

Female Employees

Exposure (Tiers A and B Female Employees) — — Actual Experience
Present Assumptions ——— Proposed Assumptions
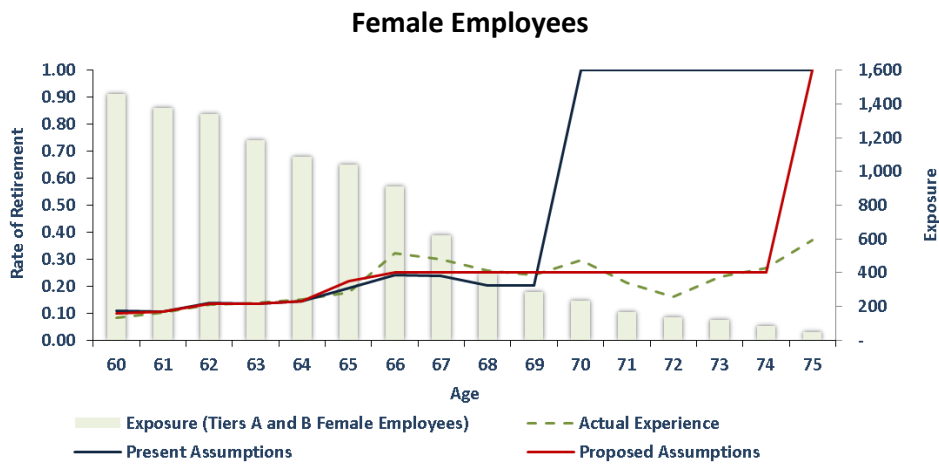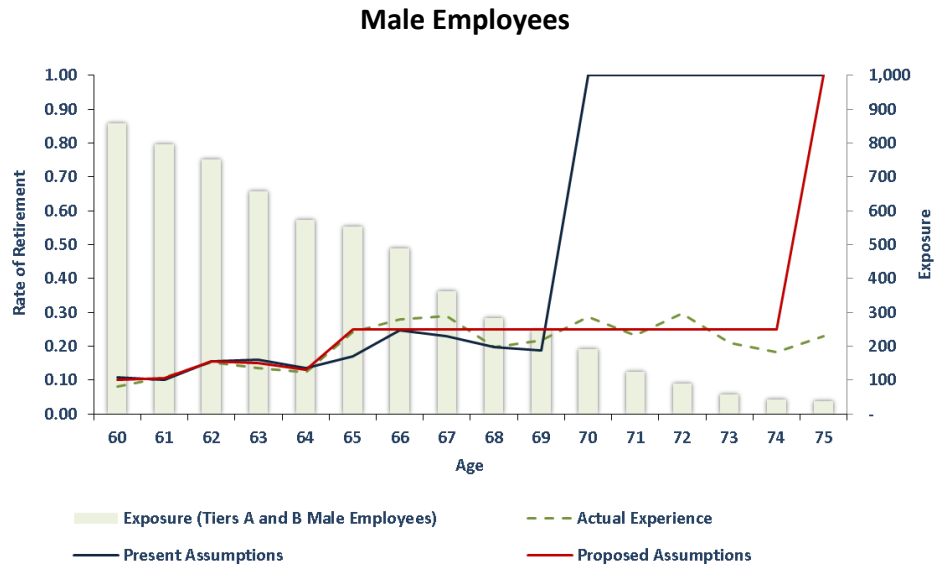
We propose slight adjustments to increase rates of retirement prior to age 70 and extending experience-based rates to age 74, after which 100% retirement will be assumed at age 75. Although there was limited data, retirement rates for those hired on or after July 1, 2011 (Tier C) were also examined and rates or retirement for that tier of members were lowered. These rates will be further adjusted in the future as experience emerges to lend greater credibility.

Recommendation

We recommend adoption of the proposed normal retirement rates for male and female individuals. See Appendix for disclosure of assumed rates.

Demographic Assumptions - Employees

Early Retirement Experience

Among active members during the study period that meet early retirement eligibility at age 50 with 10 years of service, the plan experienced fewer early retirements (166) than projected by the present assumptions (248). Male and female experience was combined to provide more credibility.
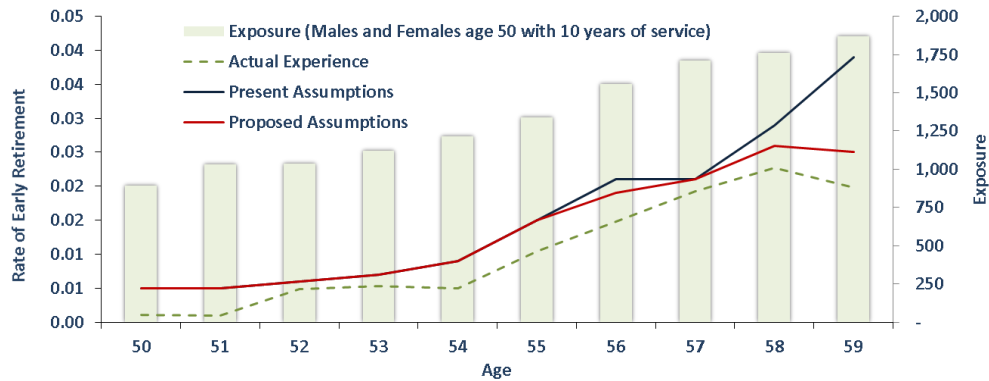
This experience suggests a need to lower the assumed rates of early retirement among eligible individuals. Proposed rates include adjustments at later ages to reduce the probability of early reduced retirement.

The plan also experienced fewer early retirements (193) than projected by the present assumptions (250) among active members during the 4-year period that meet early retirement eligibility under the rule of 70. This experience suggests a need to lower the assumed rates of early retirement among eligible individuals. Male and female experience was combined to provide more credibility.
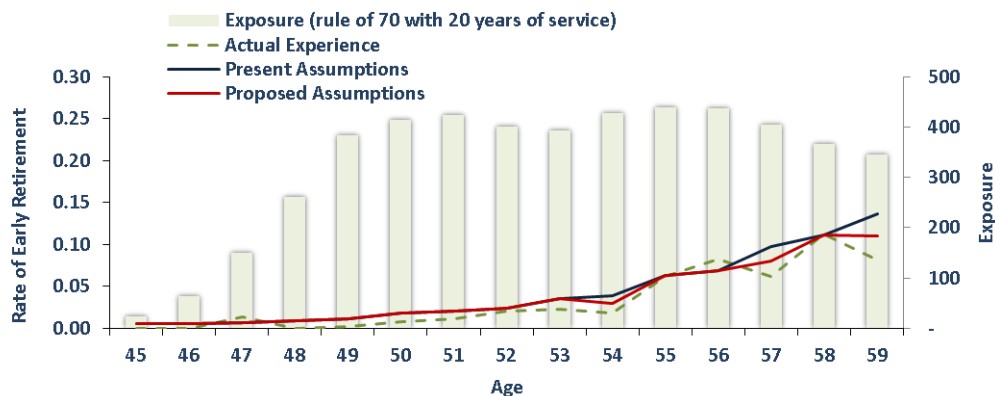
Early retirement eligibility conditions for those hired on or after July 1, 2011 are at age 60 with 30 years of service. Retirement rates for those members will be studied in the future as experience emerges. For purposes of this study, early retirement rates for those hired on or after July 1, 2011 are set to match the normal retirement rates of those hired before July 1, 2011 to model pent-up demand for retirement.

Recommendation

We recommend adoption of the proposed early retirement rates combined for male and female individuals. See Appendix for disclosure of proposed rates.

SECTION E

DEMOGRAPHIC ASSUMPTIONS – TEACHERS

Demographic Assumptions - Teachers

Withdrawal Experience

The observed number of withdrawals (1,546) was lower than the number projected by the present assumptions (1,791) among members with fewer than 5 years of credited service. This suggests that the current rates of withdrawal among individuals with fewer than 5 years of service can be slightly lowered.

The analysis for members with 5 or more years of credited service yields more withdrawals (1,524) than expected under current assumptions (1,481). Based on this analysis, we have proposed to increase assumed age-based withdrawal rates for most ages.
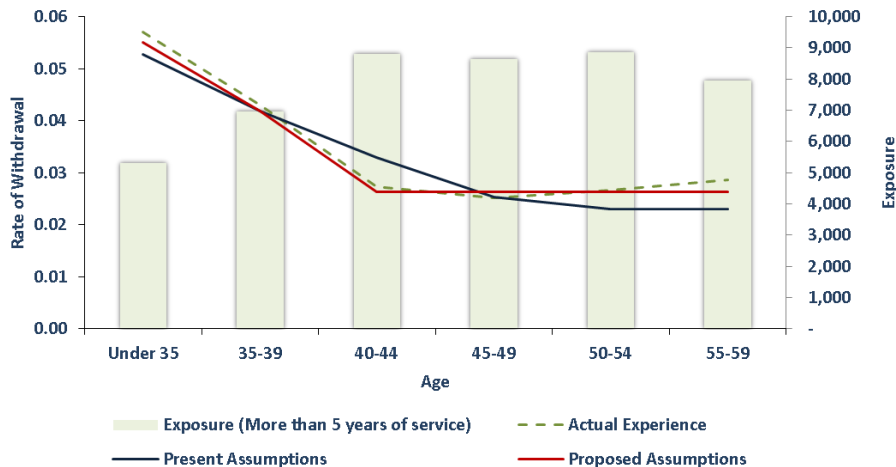
Terminations (both with and without deferred benefits) for members with early retirement eligibility continue to be observed. The current assumptions include rates of termination for members during early retirement eligibility. We suggest that rates of withdrawal continue to be included for members eligible for early retirement.
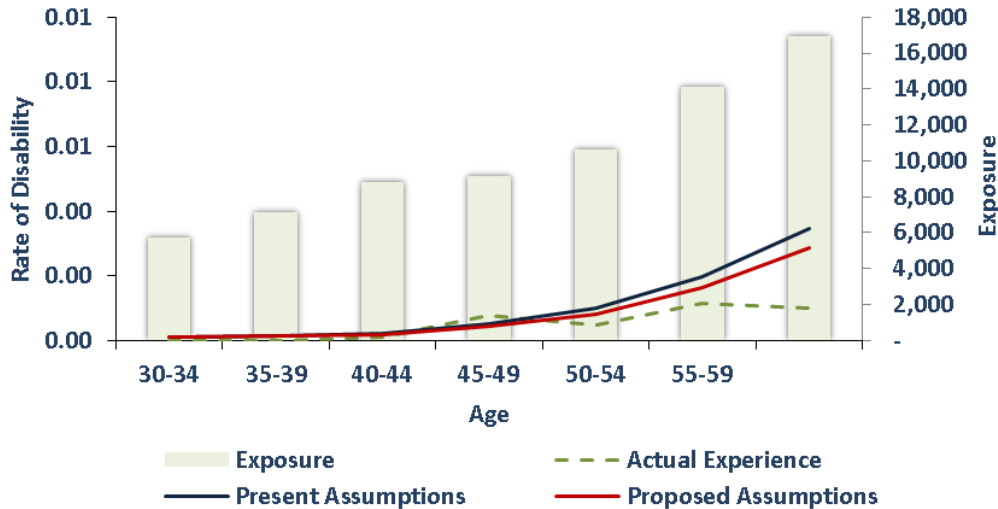
Recommendation

We recommend adoption of the proposed withdrawal assumptions combined for males and females. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Teachers

Disability Experience

Disability experience during the 4-year period was roughly in line with expectations. Overall, the plan experienced more disability retirements (24) than projected by the present assumptions (18), however there were fewer disabilities in the prior 4-year period. This experience suggests that the current assumption is reasonable for estimating the frequency of disabilities.
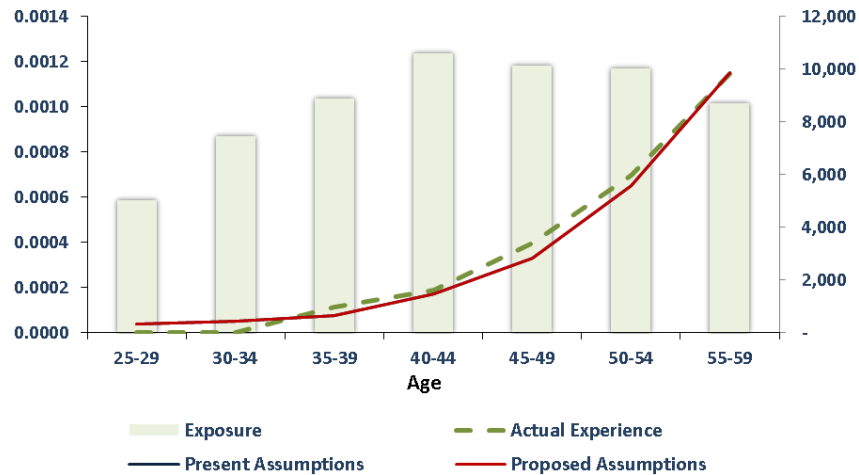
Two accidental disability retirements were observed during the 4-year period, constituting roughly 7% of total disabilities versus the current assumption of 20%. We will continue to monitor this assumption, and if so few accidental disability retirements continue to be observed, suggest it be lowered in the future.

Recommendation

We recommend no changes to disability retirement rates combined for male and female individuals. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Teachers

Age and Service (Normal) Retirement Experience

As with the Employee group, Group I members hired on or after July 1, 2011 may retire at age 65 with unreduced benefits. Male and female rates were looked at separately. Overall, Teacher retirements during the 4-year period (334 males, 1,543 females) were less than projected by the present assumptions (447 males, 1,608 females) for members hired prior to July 1, 2011. Observed rates of retirement were slightly higher than assumed between ages 65 and 70 for females. In both cases similar rates of retirement were observed to persist after age 70.
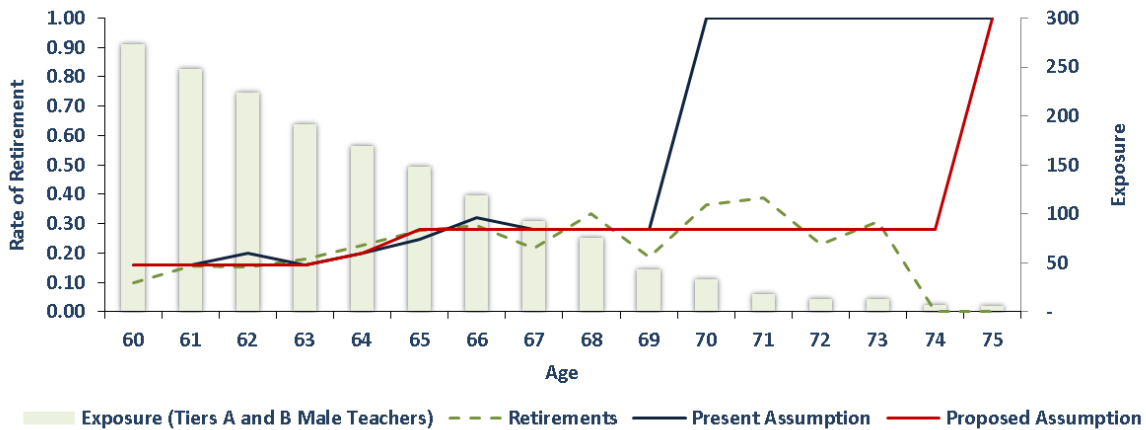
Male Employees

Female Employees
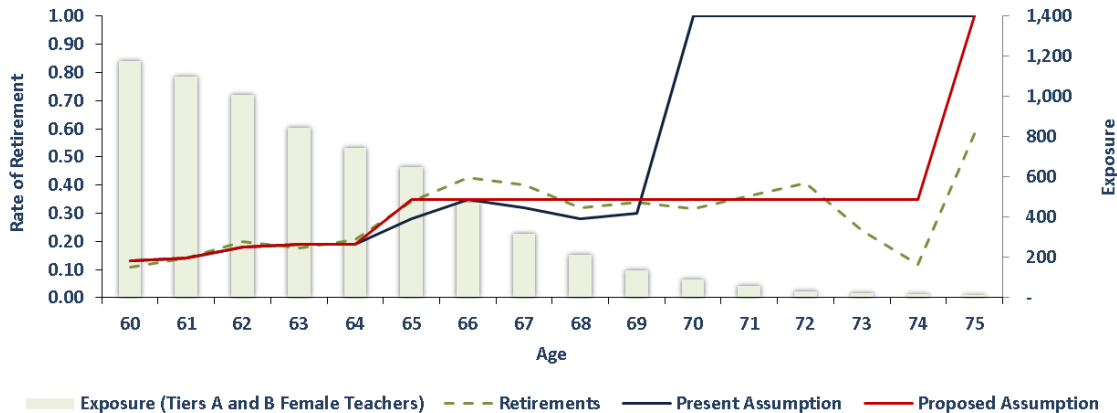
Retirement rates for those hired on or after July 1, 2011 (Tier C) was also examined, but exposures at eligible ages were very low for the Teacher group. Rates of retirement for that tier of members were lowered slightly. These rates will be further adjusted in the future as experience emerges to lend greater credibility.

Recommendation

We recommend adoption of the proposed normal retirement rates for male and female individuals. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Teachers

Early Retirement Experience

We reviewed the early retirement experience among active members during the study period that meet early retirement eligibility at age 50 with 10 years of service. The actual number of early retirements (168) is less than the number projected by the present assumptions (212). This suggests that the current rates of early retirement among eligible individuals can be decreased. Male and female experience was combined to provide more credibility.
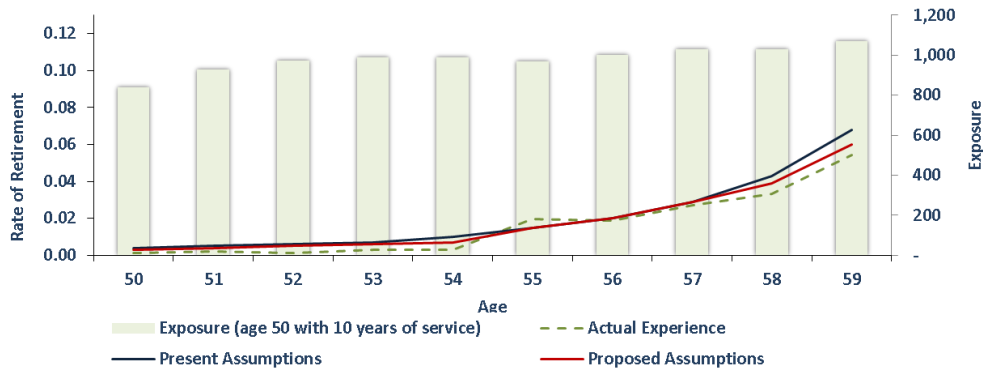
We also reviewed the early retirement experience among active members during the study period that meet early retirement eligibility under the rule of 70. Overall, the plan experienced fewer early retirements under this condition (152) than projected by the present assumptions (212). This experience suggests a need to lower these assumed rates of early retirement. Male and female experience was combined to provide more credibility.
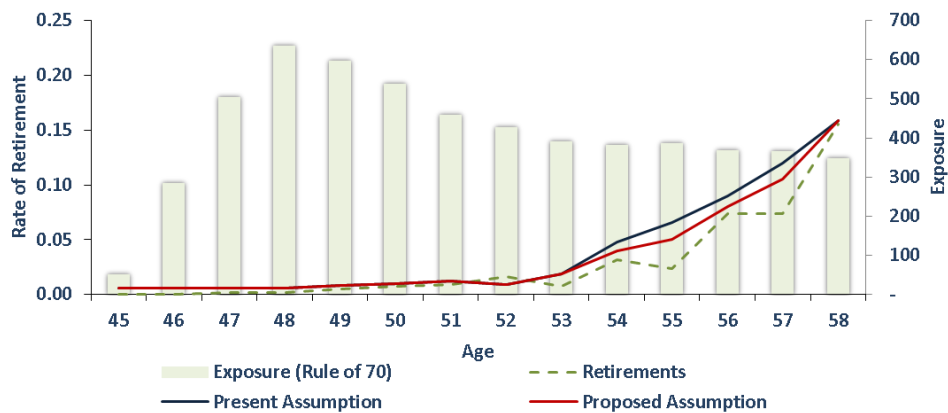
Retirement rates for those hired on or after July 1, 2011 will be studied in the future as experience emerges. For purposes of this study, early retirement rates for those hired on or after July 1, 2011 are set to match the normal retirement rates of those hired before July 1, 2011 to model pent-up demand for retirement.

Recommendation

We recommend adoption of the proposed early retirement rates combined for male and female individuals. See Appendix for disclosure of proposed rates.

SECTION F

DEMOGRAPHIC ASSUMPTIONS – POLICE

Demographic Assumptions - Police

Withdrawal Experience

We separated the members into two groups for the analysis: 1) members with fewer than 5 years of credited service, and 2) members with 5 or more years of credited service. To allow for a higher degree of credibility, male and female rates were observed together and the proposed rates are for the combined population.

The analysis for members with fewer than 5 years of credited service shows that the plan experienced more withdrawals (712) than projected by the present assumptions (613).   This experience suggests a need to increase the assumed rates of withdrawal among members with fewer than 5 years of service.
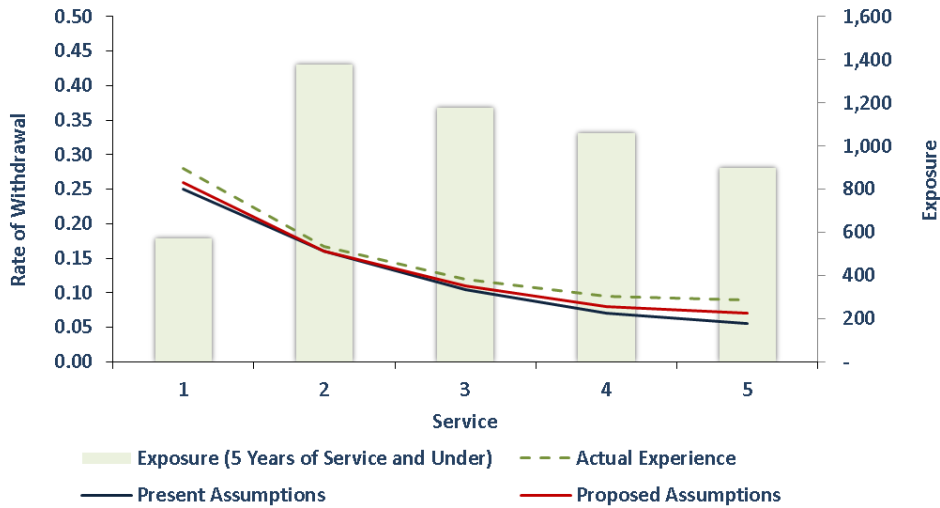
For members with 5 or more years of credited service, the plan experienced more withdrawals (355) than projected by the present assumptions (270).   This experience suggests a need to increase the assumed rates of withdrawal among individuals with 5 or more years of service.
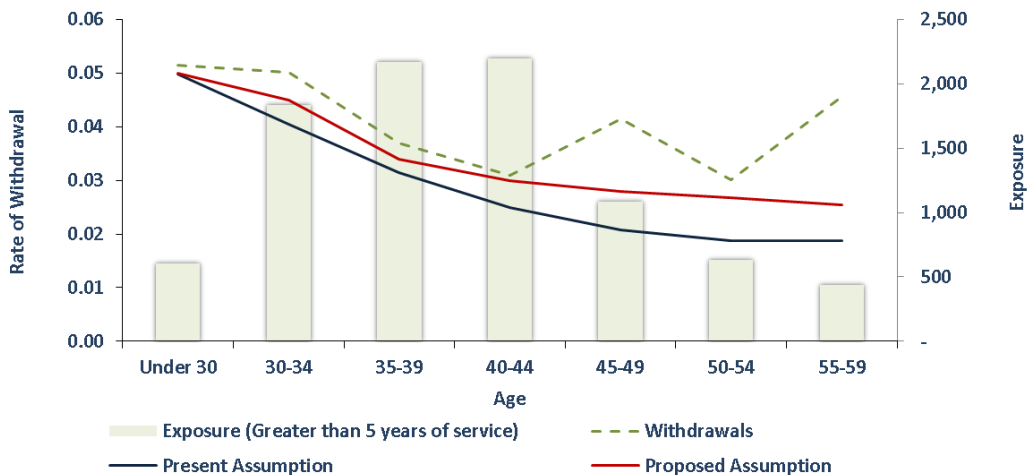
Recommendation

We recommend adoption of the proposed withdrawal assumptions. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Police

Disability Experience

The assumed rates of disability (leaving active service due to injury or illness while not entitled to age and service retirement benefits) are a minor ingredient in cost calculations, since the incidence of disability is low. Higher rates of disability generally would result in somewhat higher computed contributions for NHRS, and vice versa.

We reviewed the disability experience during the 4-year period. Overall, the plan experienced more disability retirements (44) than projected by the present assumptions (33). This experience suggests a need to increase the assumed rates of disability. Under credibility theory, if the data is too small to be credible, a rational approach is to scale changes from the prior assumptions in the direction of observed experience.
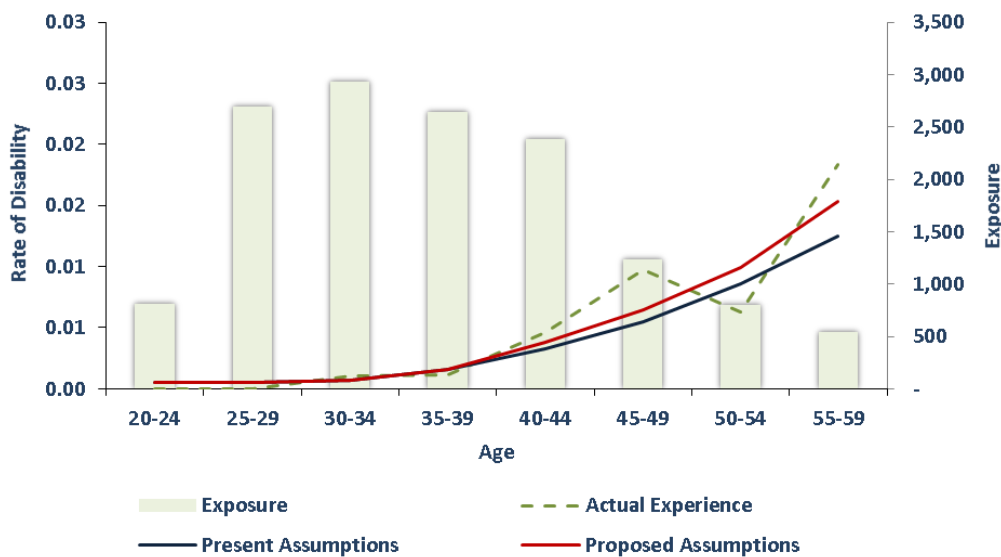
The actual incidence of accidental vs. ordinary disability was 73% accidental and 27% ordinary vs. the assumption of 75%/25%. This experience suggests that this assumption remains reasonable.

Recommendation

We recommend adoption of the proposed rates of disability retirement rates. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Police

Age and Service (Normal) Retirement Experience

Overall, retirements observed for the Police group (620) during the 4-year period were greater than expectations based on current assumptions (600). In particular, retirement rates were higher than expected for eligible members in their mid-50s.
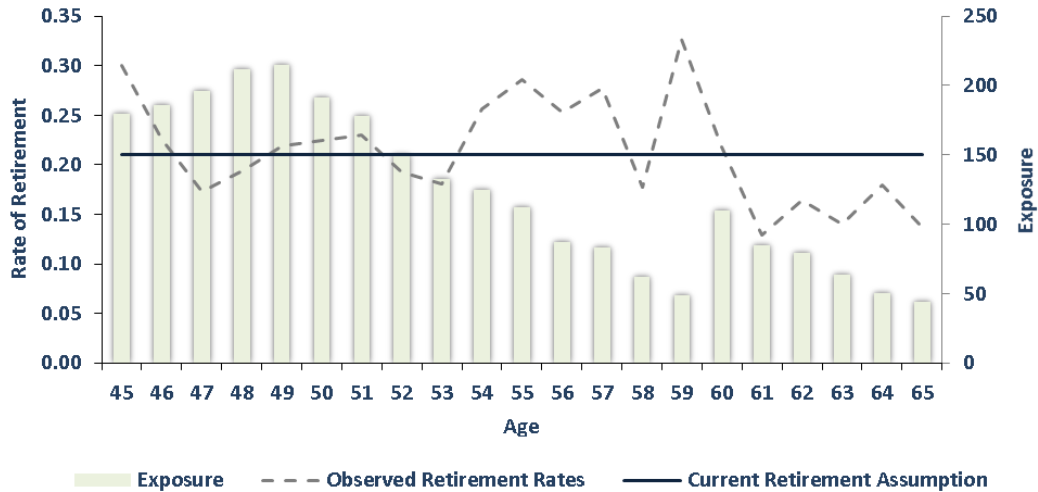
Current rates of retirement for the Police group are set based solely on the member's age when eligible. Retirements experience thus far has been among members who had attained vested status by January 1, 2011. Most of these retirements were members "waiting" to attain the service requirement necessary to become eligible under the combined age and service condition of age 45 with 20 years of service. The current assumption has functioned reasonably well to predict the retirement age of this cohort, however as this subset of the active population diminishes, the impact of the appropriateness in the assumed retirement pattern for members in the newer tiers will emerge. Therefore, we believe it is meaningful to establish a pattern of retirement among this group that is more likely to be consistent with actual behavior.

Rates for these newer tiers have historically been based on the underlying rates developed based on observed retirement experience of the old tier, with a margin at earlier ages to capture pent up demand for those members that had to "wait" longer to reach eligibility. Based on our analysis, development of a retirement assumption that accounts for a member's service, rather than simply their age, would result in a more effective means of modeling this pent-up demand. As such, it is our recommendation that a service-based element be incorporated into this assumption, as most active police members would likely retire under the applicable combination of age and service required for service retirement (as opposed to just the age-based requirement).

Demographic Assumptions - Police

To develop proposed rates for this assumption, experience data for eligible active members was partitioned into those who met the combined age and service retirement eligibility condition (with 20 or more years of service), and those who would likely retire under the age-only condition (age 60 with any amount of service). As we can see, the proportion of members affected by age-based eligibility is quite low relative to that of members for whom both age and service requirements would apply.
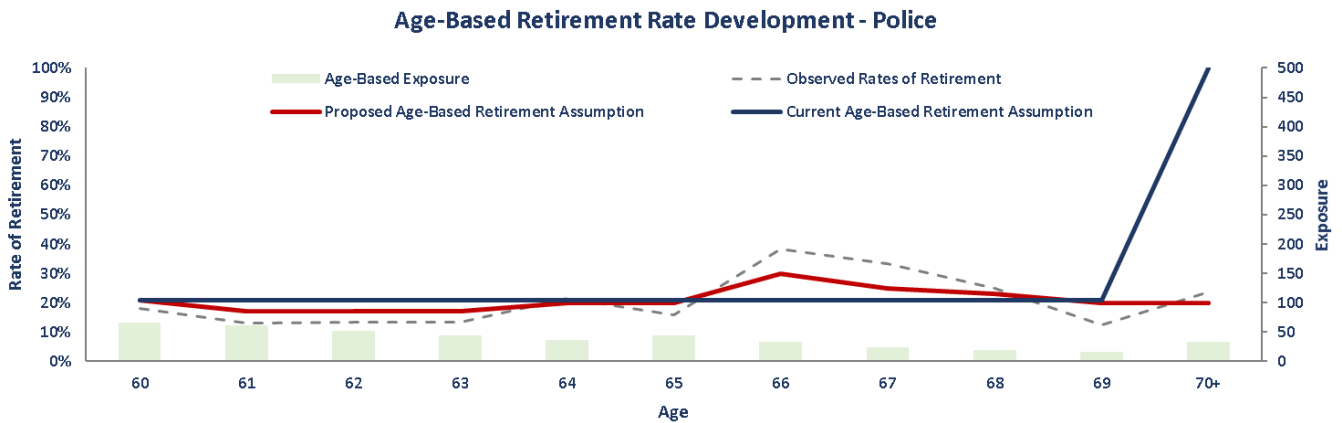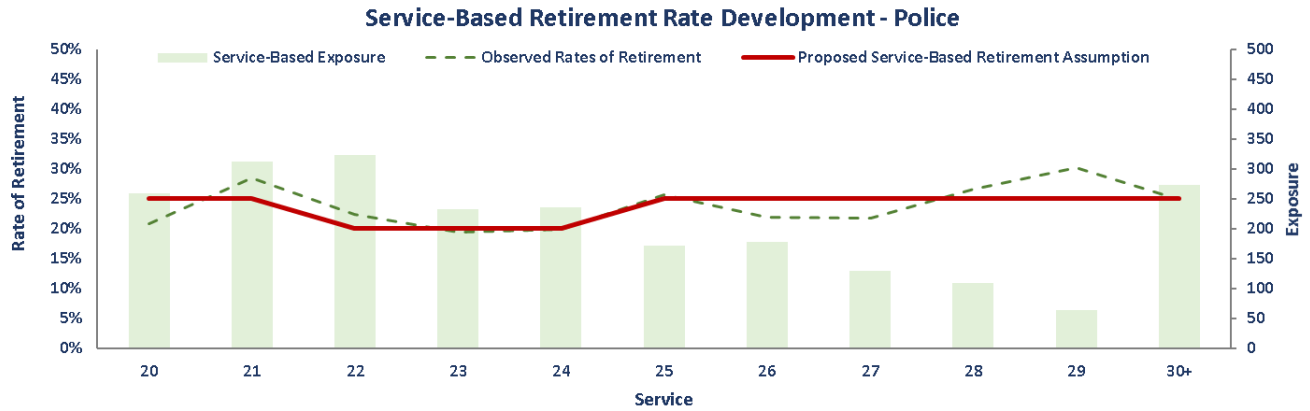
Service-Based Retirement Rate Development - Police

Age-Based Retirement Rate Development - Police

Proposed rates of retirement are set to 100% at service of 40 years for service-based rates, and age 75 for age-based rates.

Proposed service-based rates are set such that the probability of retiring in the first two years after attaining eligibility is higher than the subsequent three. We propose that this same service-based pattern be applied to new tiers of Police members, with the modification that the pattern begin at first attainment of the applicable eligibility, and that the first two years have an increase of one percentage point per additional year of service credit required to be retirement eligible. Retirement rates for newer tiers will be studied in the future as experience emerges.

Recommendations

We recommend adoption of the proposed normal retirement rates, in particular the transition to the use of service-based retirement rates, where applicable. See Appendix for disclosure of proposed rates.

SECTION G

DEMOGRAPHIC ASSUMPTIONS – FIRE

Demographic Assumptions - Fire

Withdrawal Experience

Withdrawals from active service among Fire members appear to have accelerated following the COVID-19 pandemic. There were nearly as many vested and non-vested withdrawals in 2022-2023 as there were in in the 6 years prior (2016-2021). It is unknown whether this trend in member behavior will persist. To achieve a higher degree of credibility in assessing and developing a withdrawal assumption, experience for years 2016-2023 was included in the analysis.

Counts of Total Fire Withdrawals 2016-2023
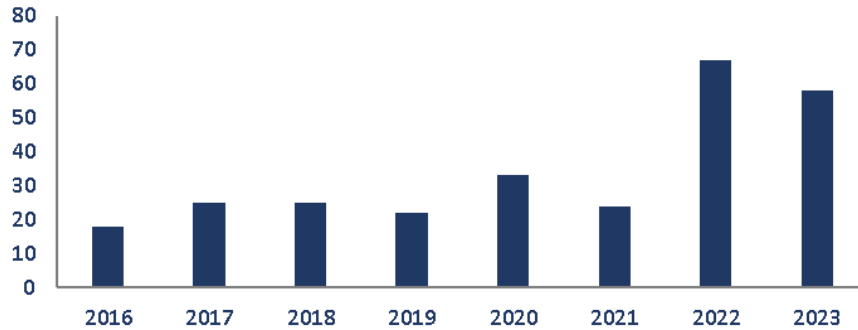
Previously assumed rates of withdrawal were reduced as part of the last experience study. In an effort to avoid overcorrection, proposed rates were developed to be a closer fit with experience observed over the 8-year period.

Among Fire members with fewer than 5 years of credited service, there were significantly higher levels of withdrawal (97) in the 4-year period than projected by the present assumptions (53). Observed rates of withdrawal for these members were not quite as high over the 8-year period but still warranted an increase in assumed probabilities.
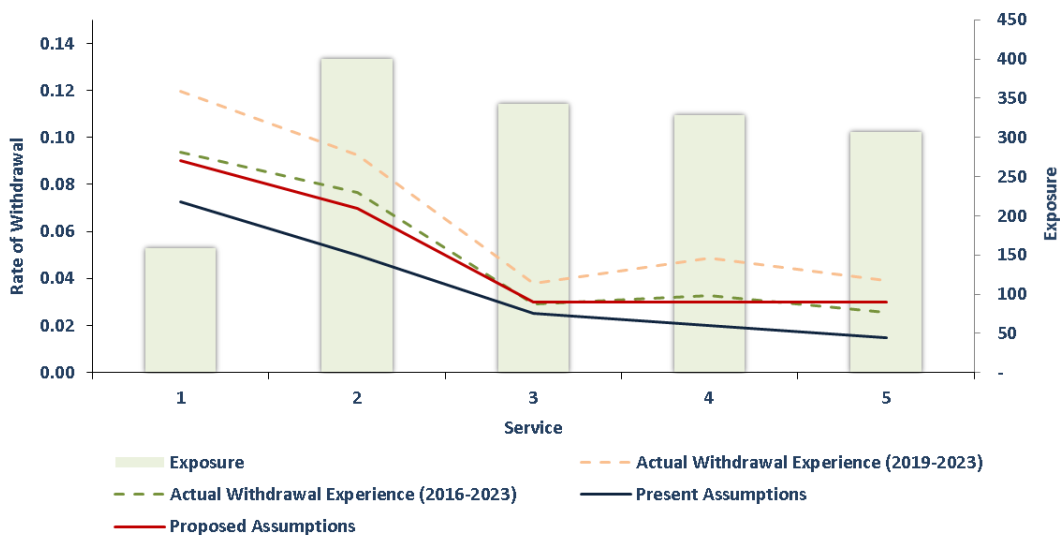
Demographic Assumptions - Fire

There were more withdrawals of members with greater than 5 years of service (78) during the 4-year period than expected (41), while experience over the 8-year period was more in line with current assumptions. Proposed assumptions would adjust current rates to be slightly higher at younger ages while leaving the rates at older ages unchanged.
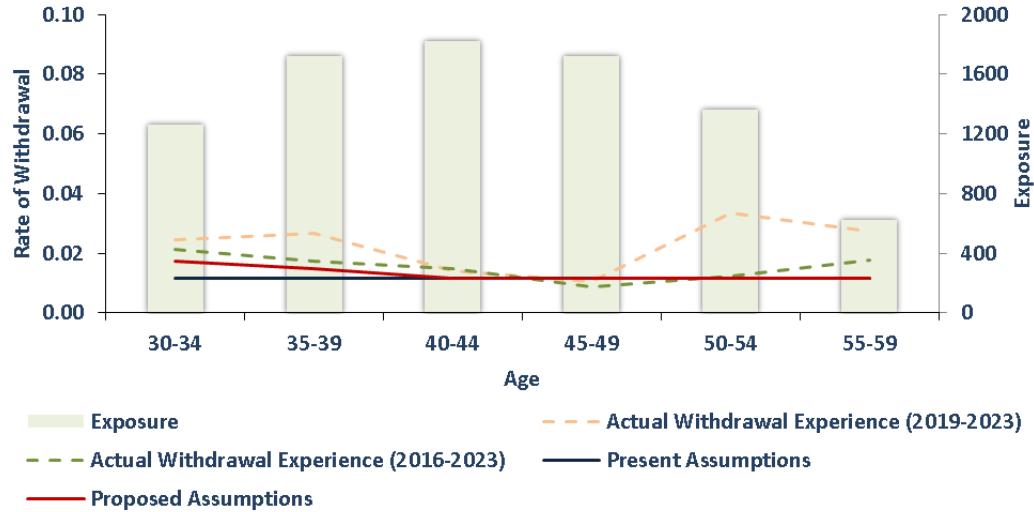
Rates of withdrawal at older ages appear to have been a potential consequence of circumstances surrounding the COVID-19 pandemic. We will monitor future experience driven by trends in these rates and adjust in the next experience study, if necessary.

Recommendation

We recommend adoption of the proposed withdrawal assumptions. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Fire

Disability Experience

Observed disability retirements consistently exceeded expectations over the 4-year period. There were 30 instances observed versus 11 expected, however in 2023 alone there were nearly six times as many as projected based on the current assumption.

Actuarial Experience by Year - Fire Disability
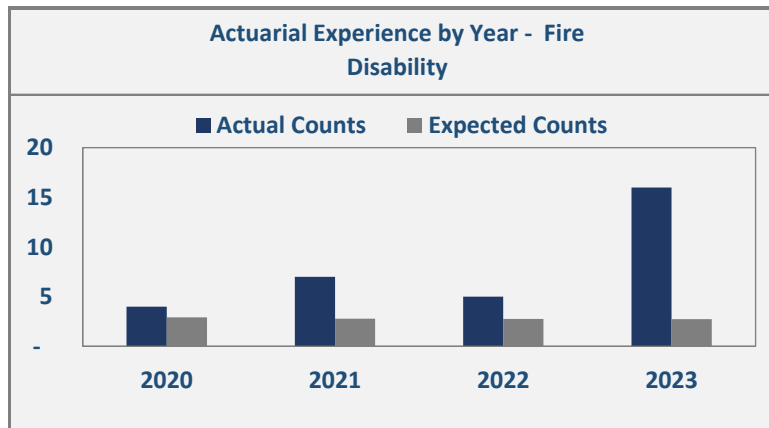
Assumed rates were adjusted downward in conjunction with the previous study, therefore data for the 8-year period from 2016 onward was included in our analysis. Although rates of disability over the 8-year period were slightly lower than assumed probabilities, there was a persisting trend of higher than expected disabilities over the most recent 4-year period. Consequently, our proposed rates would adjust the current rates to be marginally higher at older ages.
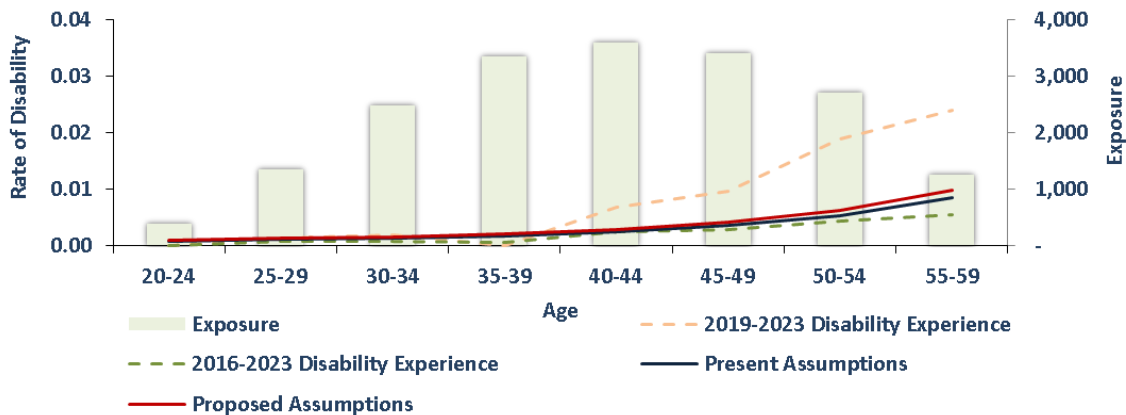
The incidence of accidental vs. ordinary disability over the 8-year period was about 76% accidental and 24% ordinary vs. the assumption of 60%/40%. This experience suggests that a change in the assumption is warranted.

Recommendation

We recommend adoption of the proposed rates of disability retirement rates. In addition, we recommend assuming that approximately 80% of disabilities are accidental. See Appendix for disclosure of proposed rates.

Demographic Assumptions - Fire

Age and Service (Normal) Retirement Experience

Although a member's service is a necessary component in determining retirement eligibility, the current retirement assumption for the Fire group, as with Police, is based solely on the member's age. Similar to the Police group, retirement experience is only available for Tier A. Unlike the experience observed among Police members, rates of retirement among the Fire group have consistently been lower than expectations.

Overall retirements observed for the Fire group (233) during the 4-year period were less than expectations based on current assumptions (260).
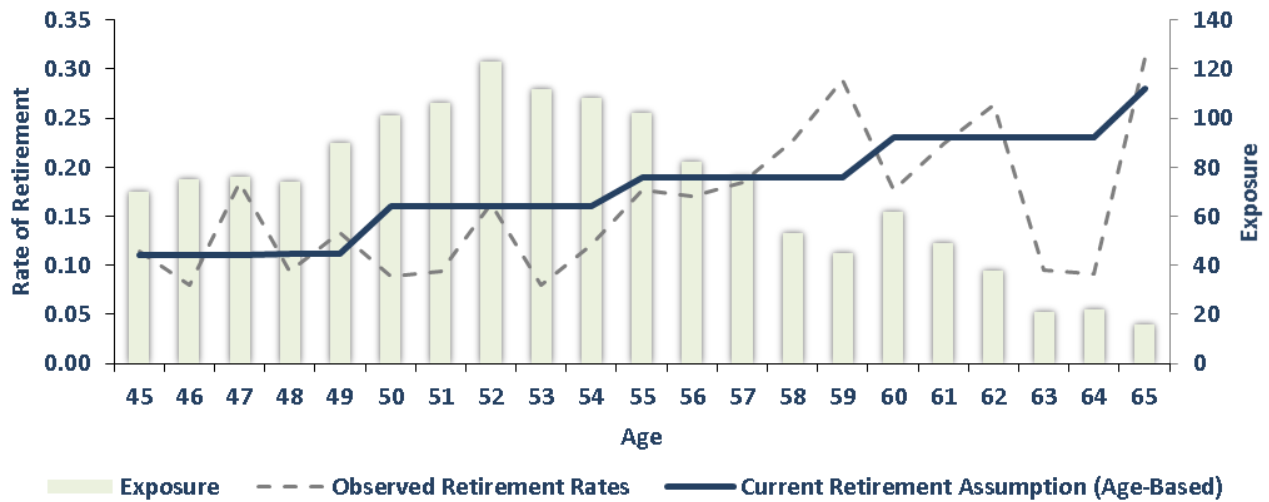
In our opinion the pattern of retirement among eligible active Fire members would be better modeled by incorporating a member's service.

The method for developing our proposed retirement assumptions involved isolating the age-based subset of experience data from the subset with eligibility based on both age and service.

Demographic Assumptions - Fire

Unlike the behavior observed in Police, retirement rates among Tier A Fire members are significantly lower and appear to exhibit little evidence of pent up demand for retirement at first eligibility. The rates of retirement also appear to increase rather reliably with each additional year of service.
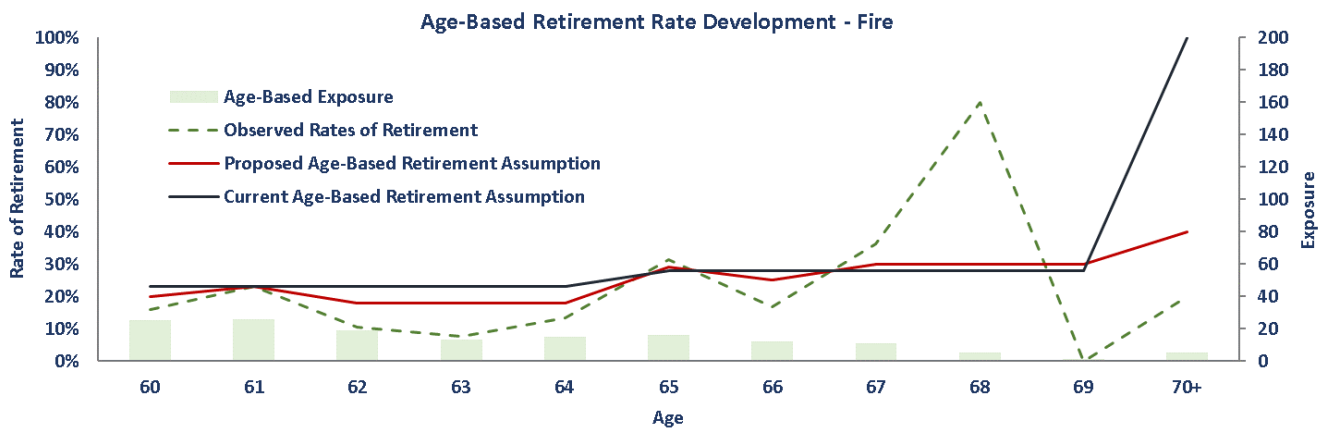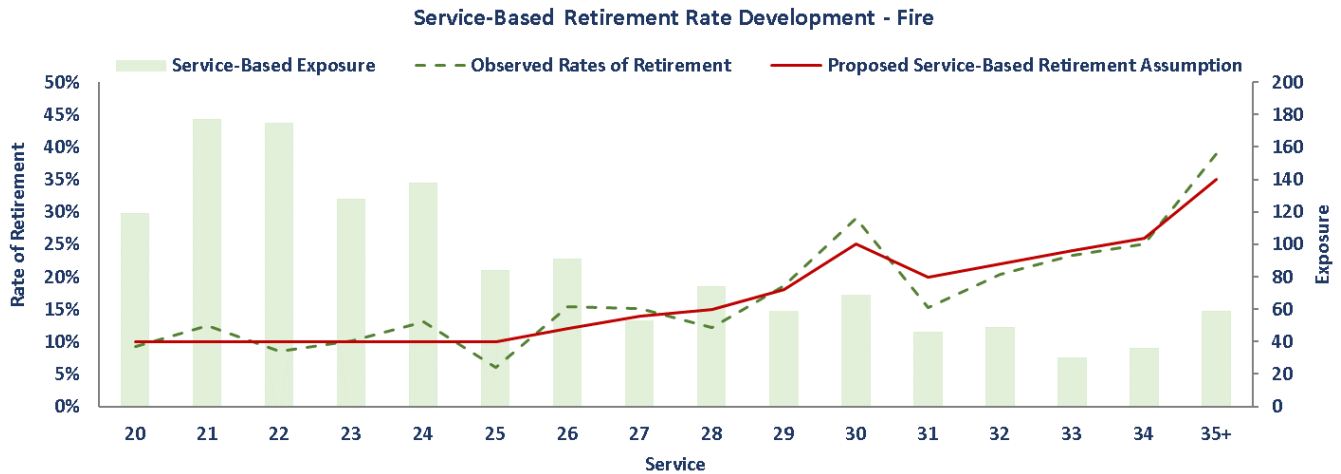
Service-Based Retirement Rate Development - Fire

Age-Based Retirement Rate Development - Fire

Proposed rates of retirement are set to 100% at service of 40 years for service-based rates, and age 75 for age-based rates.

Proposed service-based rates to Fire members in Tier A do not account for increases in probability at first attainment of retirement eligibility, as this was not observed. However, we do feel it would be appropriate to model pent-up demand in retirement patterns for newer tiers with higher eligibility requirements than that of the tier upon which development of assumed rates is based. Therefore, we propose that this same service-based pattern be applied to new tiers of Fire members, with the modification that the first two years have an increase of one percentage point per additional year of service credit required to be retirement eligible. Retirement rates for newer tiers will be studied in the future as experience emerges.

Recommendations

We recommend adoption of the proposed normal retirement rates, in particular the transition to the use of service-based retirement rates, where applicable. See Appendix for disclosure of proposed rates.

SECTION H

ACTUARIAL METHODS

Actuarial Methods

Excerpts from the Board Funding Policy adopted March 11, 2014 and revised March 10, 2020:

Actuarial Cost Method

The law stipulates under RSA 100-A:16 the use of the entry age normal actuarial cost method for each of the four member classifications. The purpose of this method is to determine the annual Normal Cost for each individual active member, payable from the date of employment to the date of retirement, that is:

    (i)   Sufficient to accumulate to the value of the member's benefit at the time of retirement, and

    (ii)   A constant percentage of the member's year by year projected covered pay.

The Actuarial Accrued Liability under this cost method is the accumulation of normal costs accrued prior to the actuarial valuation date.   The Actuarial Accrued Liability represents the theoretical amount of assets required to fund benefits earned on members' past service. The Normal Cost represents the cost required to fund benefits accruing during the current year.

Under RSA 100-A:16, II (i), if the actuarially determined normal contribution rate as set forth in subparagraphs (b) and (c) on account of any of the various member classifications shall be negative in any fiscal year, then the excess amount resulting from the difference between zero and the negative actuarially determined normal contribution rate shall be used to reduce the member contribution rate for that member classification in that fiscal year.

Under RSA 100-A:16, II-a. (a) if within a member classification the employer rates have lowered to require them to be equal to the member rates, then for all subsequent years the employer rates and the members rates for such member classification shall continue to be equal whether the system liabilities increase or decrease.

Medical Subsidy

Liabilities are determined under the entry-age actuarial cost method. Under New Hampshire Statute, contribution rates to the 401(h) sub-trust are determined as the lesser of 25% of the employers' total contributions or the actuarial required contribution rate that keeps the medical subsidy sub-trust solvent (the "solvency rate"). Under IRS Regulations, 401(h) sub-trust contributions are limited by 25% of the total contributions to the plan (other than contributions to fund past service credits). NHRS maintains the historical information for determining compliance with IRC Section 401(h). A test for compliance with IRC Section 401(h) was outside the scope of this valuation.

Actuarial Methods

Asset Valuation Method

The Actuarial Value of Assets is based on the market value with investment gains and losses smoothed over 5 years. The Actuarial Value of Assets will not consistently be above or below the Market Value and is expected to converge to the Market Value in a relatively short period of time. At any time, it may be either greater or less than Market Value. During periods when investment performance exceeds the assumed rate, Actuarial Value of Assets will tend to be less than Market Value. During periods when investment performance is less than the assumed rate, Actuarial Value of Assets will tend to be greater than Market Value. If assumed rates are exactly realized for 4 consecutive years, the Actuarial Value will become equal to Market Value.

Actuarial Value is limited to a 20% corridor around the Market Value. This means that if the preliminary development of the Actuarial Value results in an amount that is greater than 120% of the Market Value (or less than 80% of the Market Value), the final Actuarial Value is limited to 120% (or 80%) of the Market Value. Any gains or losses on the Market Value outside of the 20% corridor are therefore recognized immediately.

Pension Amortization Method

The law stipulates under RSA 100-A:16 II(e) that actuarial accrued liabilities are amortized by level (principal & interest combined) percent-of-payroll contributions from the contribution effective date. The unfunded liability as of June 30, 2017 shall be amortized through 2039. Each subsequent change in liability as calculated in odd-numbered years shall be separately amortized over a fixed period of no longer than 20 years.

The amortization method is a level percentage of payroll, consistent with RSA 100-A:16 II (b) and (c).

Pension Funding Target

The funding objective is to achieve 100% funding. For this purpose, 100% funding means that the Actuarial Value of Assets equals the Actuarial Accrued Liability. The amortization objective is to reach 100% funding over remaining layers of amortization periods.

Medical Subsidy Funding Policy

Medical Subsidy benefits provided through NHRS are funded on a pay-as-you-go basis. The medical subsidy benefits provided by statute are fixed rates for a declining population.

The actuarial cost method does not anticipate accumulating assets for medical subsidy benefits. The data reported for the medical subsidy benefits has undergone significant clean-up efforts during the prior experience study period. The data reports all those currently receiving a subsidy as well as those who could opt-in at any point in the future.

Actuarial Methods

The Board's Actuarial Policy provides for a 20% margin (50% for Teachers) in the medical subsidy contribution rates. This means that the projected contribution for each medical subsidy plan is expected to maintain assets of at least 20% (50% for Teachers) of annual benefit payments at the end of each year in the projection. Prior to any assumption changes, the projected assets at the end of the June 30, 2024 fiscal year for each medical subsidy plan is as follows:

State Employees:	87%
Political Subdivision Employees:	191%
Teachers:	75%
Police and Fire:	123%
Grand Total:	107%

These projected 2024 margins are contingent upon the market value of assets earning 6.75% and payroll growing at 2.75% (2.25% for Teachers) in the year ending June 30, 2024.

One purpose of maintaining a margin is that the contribution rate setting process significantly limits the Board's flexibility in averting a cash shortfall in the medical subsidy plans. For example, the contribution rates established based on the June 30, 2023 actuarial valuation will take effect beginning in fiscal year 2026, in other words beginning July 1, 2025. A lot may happen to the assets and the payroll on which the contributions depend between now and July 1, 2025. Moreover, after the 2026-2027 biennial rates are set, the next regular opportunity for the Board to set rates will be approximately two years from now and will not affect incoming contributions until July 1, 2027. This delay illustrates the necessity of the margin.

We note that the U.S. Social Security System is required to maintain a margin of 100% of expected annual benefit payments. In a sense, both the NHRS medical subsidy and Social Security are funded on a solvency basis. A significant difference for NHRS is that the expected medical subsidy benefits are fixed amounts for a declining population. For NHRS, a margin that is set too high could theoretically lead to over-contributing in the early years and a build-up of assets over time, contrary to the statutory solvency funding objective. For example, based on the projected margins shown above, increasing the margin requirement to 100% would require immediate contribution increases for two of the four medical subsidy plans and even all four plans in order to maintain a 100% margin in all future years. Under current actuarial assumptions, the assets would be expected to increase indefinitely with this margin if all assumptions are met.

Considerations for Actuarial Methods

We recommend continued use of the current actuarial cost method, asset valuation method and amortization method for pension and medical subsidy benefits. We recommend that the Board maintain the medical subsidy margin at 20% (50% for Teachers).

SECTION I

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Proposed Miscellaneous and Technical Assumptions

Optional Factors

Option factors for administration of benefits are adopted by the Board. Factors will be reviewed after the Board has adopted mortality and interest rate assumptions.

Marriage Assumption

The current marriage assumption for Group I members is that 55% of males and 55% of females are assumed to be married for purposes of death-in-service benefits. For Group II, the current assumption is that 65% of males and 65% of females are assumed to be married for purposes of death-in-service and death after retirement benefits. Male spouses are assumed to be three years older than female spouses for active member valuation purposes. Experience, as shown in the table below, indicates that the Group I assumption may be decreased and the Group II assumption may be maintained. We propose the assumption that 50% of males and females are married for Group I, and 65% for Group II.

	Group I		Group II	
	Employees	**Teachers**	**Police**	**Fire**
# Retirees (Excluding Survivors) =	18,352	13,612	3,849	1,481
# Retirees (Excluding Survivors) with J & S Benefit =	8,096	6,845	2,388	972
% Retirees (Excluding Survivors) with J & S Benefit =	44%	50%	62%	66%
Current Marriage Assumption =	55%	55%	65%	65%
Proposed Marriage Assumption =	**50%**	**50%**	**65%**	**65%**

Service Purchases

Currently 1 month of service was added to the reported service for all active participants in consideration of potential subsidized service purchases in the future. Service purchase calculations are based on actuarial equivalent factors without adjustment for anti-selection. We studied the active member data for service purchases to model the potential cost of anti-selection.

	Group I		Group II	
	Employees	**Teachers**	**Police**	**Fire**
Total Active Members as of June 30, 2023 =	24,765	18,162	4,049	1,775
Active Members Who Have Purchased Service =	340	176	63	18
Average Service Purchase Years =	3.05	3.08	2.37	2.37
Average Service Purchase (in years) Over Total Active Member Group =	0.04	0.03	0.04	0.02
# Months to Add to Active Member Service =	**1**	**1**	**1**	**1**

As a result of our analysis, we recommend continuing to add 1 month of additional service to the reported service for all active participants in consideration of potential subsidized service purchases in the future.

Proposed Miscellaneous and Technical Assumptions

Medical Subsidy

Opt-out assumption: Currently, actual medical subsidy recipients are included in the valuation plus 25% of those who opted-out. For those members reported as eligible in the future but not currently receiving, we assumed that members would commence benefits at age eligibility. Below is the analysis on this assumption.

	2021	2022	2023	Total
Opt-In	62	55	60	177
Opt-Out (Total per year)	2,975	2,944	2,952	8,871
% Opting In	2.1%	1.9%	2.0%	2.0%
Total records reported	12,366	12,104	11,862	36,332
Average # year benefits will be paid out				10.97
% of Members ultimately expected to opt into benefits*				24.2%

*Total percentage opting in (2.0%) compounded over expected years benefits will be paid out (10.97 years).

Beginning with the June 30, 2020 actuarial valuation, NHRS Staff provided additional data to the actuary to more easily determine if a new Opt-In record belongs to a survivor of a member or a member who previously Opted-Out of the benefit. For this reason, we have excluded a comparison of the 2019-2020 data in our analysis.

As a result of our analysis, we recommend continuing the 25% assumption of those who opted out of medical benefits but may opt back in.

Discount rate assumption: Under New Hampshire law, the medical subsidy is not pre-funded. For funding purposes, our rationale for selecting the discount rate for the medical subsidy is to consider the long-term expectation of short-term investments. From a macroeconomic perspective, in the long run low-risk investments may generally be expected to earn yields of price inflation plus a margin for productivity. The economic rationale is the same as the rationale for the wage inflation assumption. Therefore, we recommend continuing the current practice of setting the funding discount rate for the medical subsidy equal to the wage inflation assumption.

Note that for GASB accounting purposes, the current accounting standard requires the use of the long-term expected rate of return on assets as long as assets are projected to fund the benefits, followed by a municipal bond yield thereafter. The GASB discount rate will be determined each year based on the accounting standards.

Forfeitures

There is no forfeiture assumption in the valuation. Instead, the present value of future benefits cannot be less than the accumulated member contributions at the time of decrement. We briefly reviewed the 2023 actuarial data for the incidence of forfeitures. About 5% of active members appear to forfeit their retirement benefit in lieu of a refund of actuarial accrued contributions. We therefore recommend maintaining the current assumption.

Miscellaneous and Technical Assumptions

Administrative & Investment Expenses

The investment return assumption is intended to be the return net of investment expenses. Assumed administrative expenses are added to the Normal Cost, and were 0.35% of payroll.

Benefit Service

Exact Fractional service is used to determine the amount of benefit payable.

COLA

None assumed.

Decrement Operation (Proposed)

Disability and turnover decrements do not operate during normal retirement eligibility for Group I and Group II members. They do operate for early retirement for Group I members.

Decrement Timing

Normal and early retirement decrements for the Teachers group are assumed to occur at the beginning of the year. All other decrements for all groups were assumed to occur mid-year.

Eligibility Testing

Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

Incidence of Contributions

Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in this report, and the actual payroll payable at the time contributions are made.

Normal Form of Benefit

This valuation assumes that members will elect the normal form of payment. Alternate forms of payment are available and are actuarially adjusted based on the valuation interest and mortality.

Group I: The assumed normal form of benefit is a straight life benefit.

Group II: The assumed normal form of benefit is straight life for single members and joint and 50% survivor for married members.

Miscellaneous and Technical Assumptions

Pay Increase Timing

Beginning of (Fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.

New Entrant Profile

For purposes of projecting the normal cost to the beginning of the rate setting biennium, the new entrant profile is based on actual members with 3-8 years of service on the valuation date.

Service Credit Accruals

It is assumed that members accrue one year of service credit per year.

Split Benefits

Active members with service in more than one plan are valued as if all service accrued is in their current plan. Split benefits are valued upon retirement, as reported in the data.

Medical Subsidy

Actual medical subsidy recipients are included in the valuation plus 25% of those who opted-out. For those members reported as eligible in the future but not currently receiving, we assumed that members would commence benefits at age eligibility.

The solvency rates for the medical subsidy benefits were determined to provide an estimated margin of 20% of the benefits (50% for Teachers) by the end of the first year of the biennium and thereafter. The margin is intended to mitigate the risk of insolvency due to adverse experience.

A retired member's medical subsidy amount is provided by System staff. If the member is under the age of 65, the pre-65 subsidy amount used is the amount reported by System staff, and the post-65 subsidy amount is assumed to be at the post-65 rates.

It is assumed that 80% of active married members will have their spouses continue to receive a medical subsidy under the plan.

IRC Section 415(b) and 401(a)(17)

For purposes of the valuation, the limitations under IRC Section 401(a)(17) and 415(b) were not reflected due to immateriality. Our analysis indicates that there are no participants that are impacted by the IRC limitations.

Recommendation

We recommend continued use of the Miscellaneous and Technical Assumptions with the exceptions discussed earlier in this section, in particular, the marriage assumption, service purchase assumption and forfeiture assumption.

SECTION J

APPENDIX – PROPOSED ASSUMPTION DEVELOPMENT DETAILS

EMPLOYEES
Summary of Proposed Active Decrement Rates

Service Based Salary Scale

% Merit Increases in Salaries Next Year	
Service Index	Rate
1	13.00%
2	6.50%
3	3.25%
4	3.00%
5	2.60%
6	2.40%
7	2.00%
8	1.75%
9	1.60%
10	1.50%
11	1.50%
12	1.00%
13	1.00%
14	1.00%
15	0.75%
16	0.75%
17	0.75%
18	0.75%
19	0.75%
20	0.75%
21	0.75%
22	0.75%
23	0.75%
24	0.75%
25	0.75%
26	0.75%
27	0.75%
28	0.75%
29	0.75%
30	0.75%
31	0.75%
32	0.75%
33	0.75%
34	0.75%
35	0.75%
36	0.75%
37	0.75%
38	0.75%
39	0.75%
40	0.75%

Select Withdrawal

Less than 5 Years of Service		
Service Index	Male	Female
1	27.50%	27.50%
2	21.50%	21.50%
3	15.30%	15.30%
4	12.50%	12.50%
5	10.00%	10.00%

Ultimate Withdrawal

5 or more Years of Service		
Age	Male	Female
25	8.70%	8.70%
26	8.38%	8.38%
27	8.06%	8.06%
28	7.77%	7.77%
29	7.48%	7.48%
30	7.21%	7.21%
31	6.95%	6.95%
32	6.70%	6.70%
33	6.47%	6.47%
34	6.26%	6.26%
35	6.05%	6.05%
36	5.88%	5.88%
37	5.70%	5.70%
38	5.54%	5.54%
39	5.39%	5.39%
40	5.24%	5.24%
41	5.10%	5.10%
42	4.98%	4.98%
43	4.86%	4.86%
44	4.73%	4.73%
45	4.62%	4.62%
46	4.49%	4.49%
47	4.37%	4.37%
48	4.24%	4.24%
49	4.12%	4.12%
50	4.01%	4.01%
51	3.93%	3.93%
52	3.86%	3.86%
53	3.79%	3.79%
54	3.73%	3.73%

Disability Rates

% Becoming Disabled		
Age	Male	Female
20	0.00%	0.00%
21	0.00%	0.00%
22	0.00%	0.00%
23	0.00%	0.00%
24	0.00%	0.00%
25	0.01%	0.01%
26	0.01%	0.01%
27	0.01%	0.01%
28	0.01%	0.01%
29	0.01%	0.01%
30	0.01%	0.01%
31	0.01%	0.01%
32	0.01%	0.01%
33	0.01%	0.01%
34	0.01%	0.01%
35	0.02%	0.02%
36	0.02%	0.02%
37	0.02%	0.02%
38	0.02%	0.02%
39	0.03%	0.03%
40	0.03%	0.03%
41	0.04%	0.04%
42	0.04%	0.04%
43	0.05%	0.05%
44	0.06%	0.06%
45	0.06%	0.06%
46	0.07%	0.07%
47	0.08%	0.08%
48	0.09%	0.09%
49	0.11%	0.11%
50	0.13%	0.13%
51	0.14%	0.14%
52	0.16%	0.16%
53	0.18%	0.18%
54	0.21%	0.21%
55	0.23%	0.23%
56	0.26%	0.26%
57	0.29%	0.29%
58	0.32%	0.32%
59	0.35%	0.35%
60	0.38%	0.38%

Ordinary	60%
Accidental	40%

Early Retirement Pattern

Age and Service Pre 7/1/11		
	% Retiring	
Age	Male	Female
50	0.50%	0.50%
51	0.50%	0.50%
52	0.60%	0.60%
53	0.70%	0.70%
54	0.90%	0.90%
55	1.50%	1.50%
56	1.90%	1.90%
57	2.10%	2.10%
58	2.60%	2.60%
59	2.50%	2.50%

Rule 70 Pre 7/1/11

	% Retiring	
Age	Male	Female
45	0.60%	0.60%
46	0.60%	0.60%
47	0.60%	0.60%
48	0.60%	0.60%
49	0.60%	0.60%
50	0.80%	0.80%
51	1.00%	1.00%
52	1.20%	1.20%
53	0.90%	0.90%
54	1.90%	1.90%
55	4.00%	4.00%
56	5.00%	5.00%
57	8.00%	8.00%
58	10.50%	10.50%
59	15.90%	15.90%

Age and Service Post 7/1/11

	% Retiring	
Age	Male	Female
60	10.0%	10.0%
61	10.5%	10.5%
62	15.5%	13.5%
63	15.0%	13.6%
64	13.0%	14.5%

Normal Retirement Pattern

Age and Service Pre 7/1/11		
	% Retiring	
Age	Male	Female
60	10.0%	10.0%
61	10.5%	10.5%
62	15.5%	13.5%
63	15.0%	13.6%
64	13.0%	14.5%
65	25.0%	22.0%
66	25.0%	25.0%
67	25.0%	25.0%
68	25.0%	25.0%
69	25.0%	25.0%
70	25.0%	25.0%
71	25.0%	25.0%
72	25.0%	25.0%
73	25.0%	25.0%
74	25.0%	25.0%
75	100.0%	100.0%

Age and Service Post 7/1/11

	% Retiring	
Age	Male	Female
65	30.0%	30.0%
66	25.0%	25.0%
67	20.0%	15.0%
68	15.0%	15.0%
69	15.0%	15.0%
70	15.0%	15.0%
71	15.0%	15.0%
72	15.0%	15.0%
73	15.0%	15.0%
74	15.0%	15.0%
75	100.0%	100.0%

EMPLOYEES
Development of Proposed Withdrawal Rates

Ultimate Withdrawal

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	87	821	0.1060	0.0903	0.0952	62	65
30-34	213	2,697	0.0790	0.0636	0.0670	171	180
35-39	291	4,621	0.0630	0.0541	0.0570	249	263
40-44	312	5,501	0.0567	0.0472	0.0498	260	274
45-49	321	6,835	0.0470	0.0414	0.0437	282	297
50-54	443	10,084	0.0439	0.0366	0.0386	370	389
55-59	440	13,230	0.0333	0.0338	0.0356	448	471
Totals	**2,107**	**43,789**	**0.0481**	**0.0421**	**0.0443**	**1,842**	**1,939**

*   Sample rates are taken from midpoint of age group.

** "Expected withdrawals - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
"Expected withdrawals - Present" is the sum of actual probabilities applied in the valuation.
Exposures for those with more than 5 years of experience have been adjusted to reflect the change in
assumption to consider withdrawals separately during early retirement eligibility.

Select Withdrawal

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	1,202	3,913	0.3072	0.2700	0.2750	1,057	1,076
2	2,302	10,115	0.2276	0.2100	0.2150	2,125	2,175
3	1,207	7,598	0.1589	0.1500	0.1530	1,140	1,162
4	865	6,597	0.1311	0.1200	0.1250	791	825
5	563	5,456	0.1032	0.1000	0.1000	546	546
Totals	**6,139**	**33,679**	**0.1823**	**0.1680**	**0.1717**	**5,659**	**5,784**

Development of Proposed Disability Rates

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	**46**	**72,505**	**0.0008**	**0.00108**	**0.00090**	**78.5**	**65.5**

EMPLOYEES
Development of Proposed Male Normal Retirement Rates

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	69	859	0.0803	0.1080	0.1000	93	86
61	86	797	0.1079	0.1010	0.1050	80	84
62	115	752	0.1529	0.1550	0.1550	117	117
63	89	657	0.1355	0.1610	0.1500	106	99
64	71	574	0.1237	0.1350	0.1300	77	75
65	134	553	0.2425	0.1710	0.2500	94	138
66	137	488	0.2807	0.2480	0.2500	121	122
67	105	363	0.2893	0.2310	0.2500	84	91
68	56	284	0.1972	0.1980	0.2500	56	71
69	54	247	0.2186	0.1880	0.2500	46	62
70	55	191	0.2880	1.0000	0.2500	191	48
71	29	125	0.2320	1.0000	0.2500	125	31
72	27	91	0.2967	1.0000	0.2500	91	23
73	12	57	0.2105	1.0000	0.2500	57	14
74	8	44	0.1818	1.0000	0.2500	44	11
75	9	39	0.2308	1.0000	1.0000	39	39
Totals	**1,058**	**6,121**	**0.1729**	**0.0000**	**0.0000**	**1,421**	**1,111**

Development of Proposed Female Normal Retirement Rates

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	119	1,459	0.0816	0.1080	0.1000	158	146
61	143	1,378	0.1038	0.1050	0.1050	145	145
62	176	1,341	0.1312	0.1390	0.1350	186	181
63	165	1,184	0.1394	0.1360	0.1360	161	161
64	164	1,085	0.1512	0.1430	0.1450	155	157
65	183	1,041	0.1758	0.1920	0.2200	200	229
66	294	909	0.3234	0.2400	0.2500	218	227
67	185	619	0.2989	0.2370	0.2500	147	155
68	101	393	0.2570	0.2020	0.2500	79	98
69	69	287	0.2404	0.2010	0.2500	58	72
71	35	166	0.2108	1.0000	0.2500	166	42
72	22	136	0.1618	1.0000	0.2500	136	34
73	28	119	0.2353	1.0000	0.2500	119	30
74	22	82	0.2683	1.0000	0.2500	82	21
75	17	46	0.3696	1.0000	1.0000	46	46
Totals	1,792	10,479	0.1710	0.0000	0.0000	2,290	1,803

* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages. "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.

EMPLOYEES
Development of Proposed Combined Early Retirement Rates
(Age-Based)

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
51	1	1,031	0.0010	0.0050	0.0050	5	5
52	5	1,038	0.0048	0.0060	0.0060	6	6
53	6	1,123	0.0053	0.0070	0.0070	8	8
54	6	1,214	0.0049	0.0090	0.0090	11	11
55	14	1,340	0.0104	0.0150	0.0150	20	20
56	23	1,558	0.0148	0.0210	0.0190	33	30
57	33	1,710	0.0193	0.0210	0.0210	36	36
58	40	1,760	0.0227	0.0290	0.0260	51	46
59	37	1,871	0.0198	0.0390	0.0250	73	47
Total	**166**	**13,538**	**0.0123**	**0.0183**	**0.0157**	**248**	**213**

Development of Proposed Combined Early Retirement Rates
(Rule of 70)

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45	-	24	0.0000	0.0060	0.0060	-	-
46	-	64	0.0000	0.0060	0.0060	0	-
47	2	151	0.0132	0.0070	0.0070	1	1
48	-	262	0.0000	0.0090	0.0090	2	2
49	1	383	0.0026	0.0110	0.0110	4	4
50	3	414	0.0072	0.0180	0.0180	7	7
51	5	424	0.0118	0.0210	0.0210	9	9
52	8	402	0.0199	0.0240	0.0240	10	10
53	9	394	0.0228	0.0350	0.0350	14	14
54	8	428	0.0187	0.0390	0.0300	17	13
55	27	440	0.0614	0.0630	0.0630	28	28
56	36	437	0.0824	0.0690	0.0690	30	30
57	25	405	0.0617	0.0980	0.0800	40	32
58	41	366	0.1120	0.1110	0.1110	41	41
59	28	346	0.0809	0.1370	0.1100	47	38
Total	**193**	**4,940**	**12.8400**	**0.0000**	**0.0187**	**250**	**229**

* *"Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages.*
  "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.

Teachers
Summary of Proposed Active Decrement Rates

Service Based Salary Scale

% Merit Increases in Salaries Next Year

Service Index	Rate
1	9.00%
2	8.50%
3	4.00%
4	3.50%
5	3.25%
6	3.00%
7	2.75%
8	2.50%
9	2.50%
10	2.25%
11	2.00%
12	1.75%
13	1.50%
14	1.25%
15	1.00%
16	1.00%
17	1.00%
18	1.00%
19	1.00%
20	1.00%
21	1.00%
22	1.00%
23	1.00%
24	1.00%
25	1.00%
26	1.00%
27	1.00%
28	1.00%
29	1.00%
30	1.00%
31	1.00%
32	1.00%
33	1.00%
34	1.00%
35	1.00%
36	1.00%
37	1.00%
38	1.00%
39	1.00%
40	1.00%

Select Withdrawal

Less than 5 Years of Service

Service Index	Male	Female
1	25.00%	25.00%
2	13.00%	13.00%
3	11.00%	11.00%
4	10.00%	10.00%
5	8.00%	8.00%

Ultimate Withdrawal

5 or more Years of Service

Age	Male	Female
25	7.79%	7.79%
26	7.08%	7.08%
27	6.38%	6.38%
28	6.20%	6.20%
29	6.03%	6.03%
30	5.85%	5.85%
31	5.68%	5.68%
32	5.50%	5.50%
33	5.24%	5.24%
34	4.97%	4.97%
35	4.71%	4.71%
36	4.44%	4.44%
37	4.18%	4.18%
38	3.87%	3.87%
39	3.56%	3.56%
40	3.26%	3.26%
41	2.95%	2.95%
42	2.64%	2.64%
43	2.64%	2.64%
44	2.64%	2.64%
45	2.64%	2.64%
46	2.64%	2.64%
47	2.64%	2.64%
48	2.64%	2.64%
49	2.64%	2.64%
50	2.64%	2.64%
51	2.64%	2.64%
52	2.64%	2.64%
53	2.64%	2.64%
54	2.64%	2.64%

Disability Rates

% Becoming Disabled

Age	Male	Female
20	0.00%	0.00%
21	0.00%	0.00%
22	0.00%	0.00%
23	0.00%	0.00%
24	0.00%	0.00%
25	0.00%	0.00%
26	0.00%	0.00%
27	0.00%	0.00%
28	0.00%	0.00%
29	0.00%	0.00%
30	0.00%	0.00%
31	0.00%	0.00%
32	0.01%	0.01%
33	0.01%	0.01%
34	0.01%	0.01%
35	0.01%	0.01%
36	0.01%	0.01%
37	0.01%	0.01%
38	0.01%	0.01%
39	0.01%	0.01%
40	0.01%	0.01%
41	0.01%	0.01%
42	0.02%	0.02%
43	0.02%	0.02%
44	0.02%	0.02%
45	0.02%	0.02%
46	0.03%	0.03%
47	0.03%	0.03%
48	0.04%	0.04%
49	0.04%	0.04%
50	0.05%	0.05%
51	0.06%	0.06%
52	0.07%	0.07%
53	0.07%	0.07%
54	0.08%	0.08%
55	0.09%	0.09%
56	0.10%	0.10%
57	0.12%	0.12%
58	0.13%	0.13%
59	0.14%	0.14%
60	0.15%	0.15%

Ordinary	80%
Accidental	20%

Early Retirement Pattern

Age and Service Pre 7/1/11

Age	Male % Retiring	Female % Retiring
50	0.30%	0.30%
51	0.40%	0.40%
52	0.50%	0.50%
53	0.60%	0.60%
54	0.70%	0.70%
55	1.50%	1.50%
56	2.00%	2.00%
57	2.90%	2.90%
58	3.90%	3.90%
59	6.00%	6.00%

Rule 70 Pre 7/1/11

Age	Male % Retiring	Female % Retiring
45	0.6%	0.6%
46	0.6%	0.6%
47	0.6%	0.6%
48	0.6%	0.6%
49	0.6%	0.6%
50	0.8%	0.8%
51	1.0%	1.0%
52	1.2%	1.2%
53	0.9%	0.9%
54	1.9%	1.9%
55	4.0%	4.0%
56	5.0%	5.0%
57	8.0%	8.0%
58	10.5%	10.5%
59	15.9%	15.9%

Age and Service Post 7/1/11

Age	Male % Retiring	Female % Retiring
60	16.0%	13.0%
61	16.0%	14.0%
62	16.0%	18.0%
63	16.0%	19.0%
64	20.0%	19.0%

Normal Retirement Pattern

Age and Service Pre 7/1/11

Age	Male % Retiring	Female % Retiring
60	16.0%	13.0%
61	16.0%	14.0%
62	16.0%	18.0%
63	16.0%	19.0%
64	20.0%	19.0%
65	28.0%	35.0%
66	28.0%	35.0%
67	28.0%	35.0%
68	28.0%	35.0%
69	28.0%	35.0%
70	28.0%	35.0%
71	28.0%	35.0%
72	28.0%	35.0%
73	28.0%	35.0%
74	28.0%	35.0%
75	100.0%	100.0%

Age and Service Post 7/1/11

Age	Male % Retiring	Female % Retiring
65	50.0%	50.0%
66	50.0%	50.0%
67	25.0%	25.0%
68	25.0%	25.0%
69	25.0%	25.0%
70	25.0%	25.0%
71	25.0%	25.0%
72	25.0%	25.0%
73	25.0%	25.0%
74	25.0%	25.0%
75	100.0%	100.0%

TEACHERS
Development of Proposed Withdrawal Rates

Ultimate Withdrawal

Age	Withdrawals	Exposure	Crude Rates	Sample Rates* Present	Sample Rates* Proposed	Expected Withdrawals** Present	Expected Withdrawals** Proposed
Under 30	57	817	0.0698	0.0880	0.0990	53	50
30-34	246	4,493	0.0548	0.0528	0.0550	238	242
35-39	299	6,961	0.0430	0.0418	0.0418	291	287
40-44	241	8,799	0.0274	0.0330	0.0264	291	248
45-49	218	8,653	0.0252	0.0253	0.0264	224	228
50-54	236	8,852	0.0267	0.0231	0.0264	207	234
55-59	227	7,946	0.0286	0.0231	0.0264	177	210
Totals	**1,524**	**46,521**	**0.0328**	**0.0318**	**0.0322**	**1,481**	**1,499**

* Sample rates are taken from midpoint of age group.

** "Expected withdrawals - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
"Expected withdrawals - Present" is the sum of actual probabilities applied in the valuation.
Exposures for those with more than 5 years of experience have been adjusted to reflect the change in
assumption to consider withdrawals separately during early retirement eligibility.

Select Withdrawal

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates Present	Sample Rates Proposed	Expected Withdrawals Present	Expected Withdrawals Proposed
1	59	232	0.2543	0.2500	0.2500	58	58
2	482	4,133	0.1166	0.1500	0.1300	620	537
3	410	3,929	0.1044	0.1200	0.1100	473	432
4	345	3,649	0.0945	0.1000	0.1000	366	365
5	250	3,420	0.0731	0.0800	0.0800	274	274
Totals	**1,546**	**15,363**	**0.1006**	**0.1166**	**0.1084**	**1,791**	**1,666**

Development of Proposed Disability Rates

Age	Disabilities	Exposure	Crude Rates	Sample Rates Present	Sample Rates Proposed	Expected Disabilities Present	Expected Disabilities Proposed
Totals	**24**	**60,842**	**0.0004**	**0.00030**	**0.00030**	**18.1**	**18.4**

TEACHERS
Development of Proposed Normal Retirement Rates

Males

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	27	273	0.0989	0.1600	0.1600	44	44
61	39	248	0.1573	0.1600	0.1600	40	40
62	34	224	0.1518	0.2000	0.1600	45	36
63	34	191	0.1780	0.1600	0.1600	31	31
64	38	169	0.2249	0.2000	0.2000	34	34
65	41	148	0.2770	0.2450	0.2800	36	41
66	35	119	0.2941	0.3200	0.2800	38	33
67	20	93	0.2151	0.2800	0.2800	26	26
68	25	75	0.3333	0.2800	0.2800	21	21
69	8	43	0.1860	0.2800	0.2800	12	12
70	12	33	0.3636	1.0000	0.2800	33	9
71	7	18	0.3889	1.0000	0.2800	18	5
72	3	13	0.2308	1.0000	0.2800	13	4
73	4	13	0.3077	1.0000	0.2800	13	4
74	-	7	0.0000	1.0000	0.2800	7	2
75	-	6	0.0000	1.0000	1.0000	-	-
Totals	327	1,673	0.1955	0.0000	0.0000	411	342
75 & Over	7	36	0.1944	1.0000	1.0000	36	36
Total	**334**	**1,709**				**447**	**378**

Females

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	127	1,177	0.1079	0.1300	0.1300	153	153
61	155	1,100	0.1409	0.1400	0.1400	154	154
62	201	1,009	0.1992	0.1800	0.1800	182	182
63	149	847	0.1759	0.1900	0.1900	161	161
64	154	746	0.2064	0.1900	0.1900	142	142
65	222	649	0.3421	0.2800	0.3500	182	227
66	201	471	0.4268	0.3500	0.3500	165	165
67	127	316	0.4019	0.3200	0.3500	101	111
68	69	215	0.3209	0.2800	0.3500	60	75
69	47	138	0.3406	0.3000	0.3500	41	48
70	29	92	0.3152	1.0000	0.3500	92	32
71	22	61	0.3607	1.0000	0.3500	61	21
72	13	32	0.4063	1.0000	0.3500	32	11
73	5	21	0.2381	1.0000	0.3500	21	7
74	2	17	0.1176	1.0000	0.3500	17	6
Totals	1,530	6,903	0.2216	0.0000	0.0000	1,576	1,507
75 & Over	13	32	0.4063	1.0000	1.0000	32	32
Total	**1,543**	**6,935**				**1,608**	**1,539**

* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
  "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.

TEACHERS
Development of Proposed Early Retirement Rates

Age-Based Early Retirement

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
50	1	840	0.0012	0.0040	0.0030	4	3
51	2	929	0.0022	0.0050	0.0040	5	4
52	1	974	0.0010	0.0060	0.0050	6	5
53	3	988	0.0030	0.0070	0.0060	7	6
54	3	988	0.0030	0.0100	0.0070	10	7
55	19	970	0.0196	0.0150	0.0150	14	15
56	19	1,002	0.0190	0.0200	0.0200	20	20
57	28	1,028	0.0272	0.0290	0.0290	30	30
58	34	1,029	0.0330	0.0430	0.0390	44	40
59	58	1,072	0.0541	0.0680	0.0600	73	64
Total	**168**	**9,820**	**0.0171**	**0.0216**	**0.0198**	**212**	**194**

Rule of 70 Early Retirement

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45	-	3	0.0000	0.0060	0.0060	-	-
46	-	52	0.0000	0.0060	0.0060	-	-
47	-	284	0.0000	0.0060	0.0060	1	2
48	1	505	0.0020	0.0060	0.0060	3	3
49	1	636	0.0016	0.0060	0.0060	4	4
50	3	598	0.0050	0.0080	0.0080	4	5
51	4	539	0.0074	0.0100	0.0100	6	5
52	4	459	0.0087	0.0120	0.0120	6	6
53	7	428	0.0164	0.0090	0.0090	4	4
54	3	392	0.0077	0.0190	0.0190	7	7
55	12	381	0.0315	0.0480	0.0400	19	15
56	9	387	0.0233	0.0660	0.0500	26	19
57	27	368	0.0734	0.0900	0.0800	33	29
58	27	366	0.0738	0.1200	0.1050	44	38
59	54	347	0.1556	0.1590	0.1590	55	55
Total	**152**	**5,745**	**0.0265**	**0.0369**	**0.0334**	**212**	**192**

*   *"Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages. "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.*

Police
Summary of Proposed Active Decrement Rates

Service Based Salary Scale			Select Withdrawal				Disability Rates		

Service Based Salary Scale

% Merit Increases in Salaries Next Year	
Service Index	**Rate**
1	30.00%
2	22.00%
3	6.00%
4	4.75%
5	4.00%
6	3.00%
7	3.00%
8	3.00%
9	1.75%
10	1.75%
11	1.75%
12	1.75%
13	1.75%
14	1.75%
15	1.75%
16	1.75%
17	1.75%
18	1.75%
19	1.75%
20	1.75%
21	1.75%
22	1.75%
23	1.75%
24	1.75%
25	1.75%
26	1.75%
27	1.75%
28	1.75%
29	1.75%
30	1.75%
31	1.75%
32	1.75%
33	1.75%
34	1.75%
35	1.75%
36	1.75%
37	1.75%
38	1.75%
39	1.75%
40	1.75%

Select Withdrawal

Less than 5 Years of Service		
Service Index	**Male**	**Female**
1	26.00%	26.00%
2	16.00%	16.00%
3	11.00%	11.00%
4	8.00%	8.00%
5	7.00%	7.00%

Ultimate Withdrawal

5 or more Years of Service		
Age	**Male**	**Female**
25	7.00%	7.00%
26	6.00%	6.00%
27	6.00%	6.00%
28	5.00%	5.00%
29	5.00%	5.00%
30	5.00%	5.00%
31	5.00%	5.00%
32	5.00%	5.00%
33	5.00%	5.00%
34	4.50%	4.50%
35	4.20%	4.20%
36	4.00%	4.00%
37	3.80%	3.80%
38	3.60%	3.60%
39	3.40%	3.40%
40	3.30%	3.30%
41	3.20%	3.20%
42	3.10%	3.10%
43	3.05%	3.05%
44	3.00%	3.00%
45	2.95%	2.95%
46	2.88%	2.88%
47	2.85%	2.85%
48	2.83%	2.83%
49	2.80%	2.80%
50	2.78%	2.78%
51	2.75%	2.75%
52	2.73%	2.73%
53	2.70%	2.70%
54	2.68%	2.68%

Disability Rates

	% Becoming Disabled	
Age	**Male**	**Female**
20	0.05%	0.05%
21	0.05%	0.05%
22	0.05%	0.05%
23	0.05%	0.05%
24	0.05%	0.05%
25	0.05%	0.05%
26	0.05%	0.05%
27	0.05%	0.05%
28	0.05%	0.05%
29	0.05%	0.05%
30	0.05%	0.05%
31	0.06%	0.06%
32	0.07%	0.07%
33	0.08%	0.08%
34	0.10%	0.10%
35	0.12%	0.12%
36	0.14%	0.14%
37	0.16%	0.16%
38	0.19%	0.19%
39	0.22%	0.22%
40	0.27%	0.27%
41	0.32%	0.32%
42	0.38%	0.38%
43	0.46%	0.46%
44	0.50%	0.50%
45	0.54%	0.54%
46	0.59%	0.59%
47	0.65%	0.65%
48	0.71%	0.71%
49	0.77%	0.77%
50	0.84%	0.84%
51	0.91%	0.91%
52	1.00%	1.00%
53	1.08%	1.08%
54	1.18%	1.18%
55	1.29%	1.29%
56	1.41%	1.41%
57	1.53%	1.53%
58	1.67%	1.67%
59	1.82%	1.82%
60	0.00%	0.00%

Ordinary	25%
Accidental	75%

POLICE
Summary of Proposed Active Decrement Rates (Concluded)
RATES OF RETIREMENT

For Members Hired Prior to July 1, 2011
Who Attained Vested Status as of January 1, 2012

Service-Based Rates		Age-Based Rates	
	% of Active Members		% of Active Members
Service	Retiring Within Next Year	Age	Retiring Within Next Year
20	25%	60	21%
21	25%	61	17%
22	20%	62	17%
23	20%	63	17%
24	20%	64	20%
25	25%	65	20%
26	25%	66	30%
27	25%	67	25%
28	25%	68	23%
29	25%	69	20%
30	25%	70	20%
31	25%	71	20%
32	25%	72	20%
33	25%	73	20%
34	25%	74	20%
35	25%	75	100%
36	25%		
37	25%		
38	25%		
39	25%		
40	100%		

Year of Retirement Eligibility	For Members Hired on or After July 1, 2011 and for Members Hired Prior to July 1, 2011 Who Have Non-Vested Status as of January 1, 2012				
	Age 46 with 21 years	Age 47 with 22 years	Age 48 with 23 years	Age 49 with 24 years	Age 52.5* with 25 years
1	26%	27%	28%	29%	30%
2	26%	27%	28%	29%	30%
3	20%	20%	20%	20%	20%
4	20%	20%	20%	20%	20%
5	20%	20%	20%	20%	20%
6 & Over	25%	25%	25%	25%	25%

Members Hired on or After July 1, 2011 are eligible for a reduced early retirement benefit at age 50 with 25 years of service. Rates applied to retirement under these conditions are set equal to the applicable Service-Based rates minus 10 percentage points.

Age-based retirement assumption for these members is equal to that applied to members hired prior to July 1, 2022.

Police
Development of Proposed Withdrawal Rates

Age-Based Withdrawal

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	31	603	0.0514	0.0497	0.0500	30	30
30-34	92	1833	0.0502	0.0405	0.0450	74	82
35-39	80	2169	0.0369	0.0314	0.0340	68	74
40-44	68	2197	0.0310	0.0250	0.0300	55	66
45-49	45	1084	0.0415	0.0208	0.0280	23	30
50-54	19	630	0.0302	0.0188	0.0268	12	17
55-59	**20**	**438**	**0.0457**	**0.0188**	**0.0255**	**8**	**11**
Total	**355**	**8954**				**270**	**311**

* Sample rates are taken from midpoint of age group.
** "Expected withdrawals - New" is calculated as the sum of rates applied to exposure at individual ages.
  "Expected withdrawals - Old" is the sum of actual probabilities applied in the valuation.

Service-Based Withdrawal

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	160	570	0.2807	0.2500	0.2600	143	148
2	230	1,378	0.1669	0.1600	0.1600	221	220
3	140	1,177	0.1189	0.1050	0.1100	124	129
4	101	1,059	0.0954	0.0700	0.0800	75	85
5	81	898	0.0902	0.0550	0.0700	50	63
Totals	**712**	**5,082**	**0.1401**	**0.1206**	**0.1269**	**613**	**645**

Development of Proposed Disability Rates

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	**44**	**14,039**	**0.0031**	**0.00237**	**0.00270**	**33.3**	**37.9**

Police
Development of Proposed Retirement Rates

Age-Based Retirement

Age	Retirements	Exposure	Crude Rates	Sample Rates Present	Sample Rates Proposed	Expected Retirements Present	Expected Retirements Proposed
60	12	66	0.1818	0.2100	0.2100	14	14
61	8	61	0.1311	0.2100	0.1700	13	10
62	7	52	0.1346	0.2100	0.1700	11	9
63	6	45	0.1333	0.2100	0.1700	9	8
64	8	37	0.2162	0.2100	0.2000	8	7
65	7	44	0.1591	0.2100	0.2000	9	9
66	13	34	0.3824	0.2100	0.3000	7	10
67	8	24	0.3333	0.2100	0.2500	5	6
68	5	20	0.2500	0.2100	0.2300	4	5
69	2	16	0.1250	0.2100	0.2000	3	3
70 & Over	8	34	0.2353	1.0000	0.2000	34	7
Total	**84**	**433**				**118**	**88**

Service-Based Retirement

Service	Retirements	Exposure	Crude Rates	Proposed Rates	Expected Retirements
20	54	259	0.1818	0.2500	65
21	89	312	0.1311	0.2500	78
22	72	322	0.1346	0.2000	64
23	45	232	0.1333	0.2000	46
24	47	236	0.2162	0.2000	47
25	44	172	0.1591	0.2500	43
26	39	178	0.3824	0.2500	45
27	28	129	0.3333	0.2500	32
28	29	109	0.2500	0.2500	27
29	19	63	0.1250	0.2500	16
30 & Over	18	68	0.2353	0.2500	17
Total	**484**	**2,080**			**481**

Fire
Summary of Proposed Active Decrement Rates

Service Based

Salary Scale		Select Withdrawal			Disability Rates		

Salary Scale — % Merit Increases in Salaries Next Year

Service Index	Rate
1	30.00%
2	17.00%
3	7.25%
4	5.00%
5	4.25%
6	2.50%
7	2.50%
8	1.75%
9	1.50%
10	1.20%
11	1.20%
12	1.20%
13	1.20%
14	1.20%
15	1.20%
16	1.20%
17	1.20%
18	1.20%
19	1.20%
20	1.20%
21	1.20%
22	1.20%
23	1.20%
24	1.20%
25	1.20%
26	1.20%
27	1.20%
28	1.20%
29	1.20%
30	1.20%
31	1.20%
32	1.20%
33	1.20%
34	1.20%
35	1.20%
36	1.20%
37	1.20%
38	1.20%
39	1.20%
40	1.20%

Select Withdrawal — Less than 5 Years of Service

Service Index	Male	Female
1	9.00%	9.00%
2	7.00%	7.00%
3	3.00%	3.00%
4	3.00%	3.00%
5	3.00%	3.00%

Ultimate Withdrawal — 5 or more Years of Service

Age	Male	Female
25	1.15%	1.15%
26	1.15%	1.15%
27	1.15%	1.15%
28	1.15%	1.15%
29	1.15%	1.15%
30	1.75%	1.75%
31	1.75%	1.75%
32	1.75%	1.75%
33	1.75%	1.75%
34	1.75%	1.75%
35	1.50%	1.50%
36	1.50%	1.50%
37	1.50%	1.50%
38	1.50%	1.50%
39	1.50%	1.50%
40	1.15%	1.15%
41	1.15%	1.15%
42	1.15%	1.15%
43	1.15%	1.15%
44	1.15%	1.15%
45	1.15%	1.15%
46	1.15%	1.15%
47	1.15%	1.15%
48	1.15%	1.15%
49	1.15%	1.15%
50	1.15%	1.15%
51	1.15%	1.15%
52	1.15%	1.15%
53	1.15%	1.15%
54	1.15%	1.15%

Disability Rates — % Becoming Disabled

Age	Male	Female
20	0.08%	0.08%
21	0.09%	0.09%
22	0.10%	0.10%
23	0.11%	0.11%
24	0.11%	0.11%
25	0.12%	0.12%
26	0.13%	0.13%
27	0.13%	0.13%
28	0.14%	0.14%
29	0.14%	0.14%
30	0.15%	0.15%
31	0.15%	0.15%
32	0.16%	0.16%
33	0.16%	0.16%
34	0.17%	0.17%
35	0.18%	0.18%
36	0.19%	0.19%
37	0.20%	0.20%
38	0.21%	0.21%
39	0.23%	0.23%
40	0.25%	0.25%
41	0.27%	0.27%
42	0.29%	0.29%
43	0.31%	0.31%
44	0.34%	0.34%
45	0.36%	0.36%
46	0.39%	0.39%
47	0.42%	0.42%
48	0.46%	0.46%
49	0.49%	0.49%
50	0.53%	0.53%
51	0.57%	0.57%
52	0.62%	0.62%
53	0.67%	0.67%
54	0.73%	0.73%
55	0.80%	0.80%
56	0.89%	0.89%
57	0.98%	0.98%
58	1.09%	1.09%
59	1.21%	1.21%
60	1.35%	1.35%

Ordinary	30%
Accidental	70%

Fire
Summary of Proposed Active Decrement Rates (Concluded)

RATES OF RETIREMENT

For Members Hired Prior to July 1, 2011
Who Attained Vested Status as of January 1, 2012

	Service-Based Rates		Age-Based Rates
Service	**% of Active Members Retiring Within Next Year**	**Age**	**% of Active Members Retiring Within Next Year**
20	10%	60	20%
21	10%	61	23%
22	10%	62	18%
23	10%	63	18%
24	10%	64	18%
25	10%	65	29%
26	12%	66	25%
27	14%	67	30%
28	15%	68	30%
29	18%	69	30%
30	25%	70	40%
31	20%	71	40%
32	22%	72	40%
33	24%	73	40%
34	26%	74	40%
35	35%	75	100%
36	35%		
37	35%		
38	35%		
39	35%		
40	100%		

For Members Hired on or After July 1, 2011 and for Members Hired Prior to July 1, 2011 Who Have Non-Vested Status as of January 1, 2012

Service	Age 46 with 21 years	Age 47 with 22 years	Age 48 with 23 years	Age 49 with 24 years	Age 52.5* with 25 years
20	11%	12%	13%	14%	15%
21	11%	12%	13%	14%	15%

Members Hired on or After July 1, 2011 are eligible for a reduced early retirement benefit at age 50 with 25 years of service. Rates applied to retirement under these conditions are set equal to the applicable Service-Based rates minus 10 percentage points.

Retirement rates for eligible member with 22 years of service or more, as well as age-based retirement rates for these members are equal to those applied to members hired prior to July 1, 2022.

Fire
Development of Proposed Withdrawal Rates

Ultimate Withdrawal

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	1	214	0.0047	0.0115	0.0115	2	2
30-34	15	615	0.0244	0.0115	0.0175	7	11
35-39	24	898	0.0267	0.0115	0.0150	10	13
40-44	13	921	0.0141	0.0115	0.0115	10	10
45-49	5	473	0.0106	0.0115	0.0115	5	5
50-54	15	448	0.0335	0.0115	0.0115	5	5
55-59	5	183	0.0273	0.0115	0.0115	2	2
Totals	**78**	**3,752**	**0.0208**	**0.0109**	**0.0128**	**41**	**48**

*   Sample rates are taken from midpoint of age group.

** "Expected withdrawals - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
"Expected withdrawals - Present" is the sum of actual probabilities applied in the valuation.
Exposures for those with more than 5 years of experience have been adjusted to reflect the change in
assumption to consider withdrawals separately during early retirement eligibility.

Select Withdrawal

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	19	159	0.1195	0.0725	0.0900	12	14
2	37	400	0.0925	0.0500	0.0700	21	28
3	13	343	0.0379	0.0250	0.0300	9	10
4	16	328	0.0488	0.0200	0.0300	6	10
5	12	307	0.0391	0.0150	0.0300	5	9
Totals	**97**	**1,537**	**0.0631**	**0.0345**	**0.0462**	**53**	**71**

Development of Proposed Disability Rates

Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	**29**	**5,289**	**0.0055**	**0.0021**	**0.0026**	**11.0**	**13.7**

Healthy Retiree Mortality
Proposed Rates* - Employees

Age	% Dying Next Year Male	Female	Age	% Dying Next Year Male	Female
50	0.2864%	0.4087%	81	4.9016%	4.0272%
51	0.3057%	0.4217%	82	5.5485%	4.5660%
52	0.3284%	0.4372%	83	6.2752%	5.1817%
53	0.3540%	0.4551%	84	7.0916%	5.8844%
54	0.3847%	0.4744%	85	8.0019%	6.6856%
55	0.4184%	0.4948%	86	9.0026%	7.5968%
56	0.4561%	0.5139%	87	10.0961%	8.6252%
57	0.4977%	0.5330%	88	11.2879%	9.7740%
58	0.5424%	0.5511%	89	12.5803%	11.0344%
59	0.5914%	0.5705%	90	13.9647%	12.3904%
60	0.6419%	0.5899%	91	15.4309%	13.7954%
61	0.6944%	0.6106%	92	16.9612%	15.2125%
62	0.7500%	0.6327%	93	18.5467%	16.6395%
63	0.8069%	0.6566%	94	20.1809%	18.0708%
64	0.8683%	0.6809%	95	21.8442%	19.5398%
65	0.9363%	0.7075%	96	23.6602%	21.1595%
66	1.0121%	0.7670%	97	25.5398%	22.8897%
67	1.0987%	0.8347%	98	27.4780%	24.7518%
68	1.1966%	0.9136%	99	29.4831%	26.7532%
69	1.3088%	1.0041%	100	31.5249%	28.8927%
70	1.4365%	1.1098%	101	33.5889%	31.1274%
71	1.5810%	1.2326%	102	35.6502%	33.3950%
72	1.7473%	1.3740%	103	37.6972%	35.6695%
73	1.9368%	1.5380%	104	39.6995%	37.9302%
74	2.1557%	1.7260%	105	41.6402%	40.1662%
75	2.4067%	1.9415%	106	43.5241%	42.3395%
76	2.6947%	2.1861%	107	45.3472%	44.4555%
77	3.0253%	2.4638%	108	47.0655%	46.4954%
78	3.4045%	2.7819%	109	48.7105%	48.4360%
79	3.8378%	3.1423%	110	100.0000%	100.0000%
80	4.3338%	3.5544%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Disabled Retiree Mortality
Proposed Rates* - Employees

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	1.5124%	1.3489%	81	7.0903%	5.9952%
51	1.5982%	1.4069%	82	7.6985%	6.5913%
52	1.6917%	1.4736%	83	8.3635%	7.2464%
53	1.7926%	1.5499%	84	9.0902%	7.9645%
54	1.9000%	1.6310%	85	9.8758%	8.7501%
55	2.0118%	1.7139%	86	10.7199%	9.5697%
56	2.1259%	1.7937%	87	11.6245%	10.4096%
57	2.2382%	1.8670%	88	12.6005%	11.2634%
58	2.3498%	1.9301%	89	13.8227%	12.1273%
59	2.4570%	1.9817%	90	15.1662%	13.0087%
60	2.5611%	2.0230%	91	16.5419%	13.9318%
61	2.6612%	2.0528%	92	17.9227%	14.9066%
62	2.7606%	2.0767%	93	19.3044%	15.9569%
63	2.8612%	2.0984%	94	20.6953%	17.0894%
64	2.9611%	2.1195%	95	22.0980%	18.3309%
65	3.0602%	2.1462%	96	23.6606%	19.7762%
66	3.1590%	2.1810%	97	25.3117%	21.3922%
67	3.2597%	2.2301%	98	27.0654%	23.1325%
68	3.3636%	2.2967%	99	28.9410%	25.0030%
69	3.4761%	2.3843%	100	30.9068%	27.0025%
70	3.6002%	2.4967%	101	32.9303%	29.0910%
71	3.7436%	2.6343%	102	34.9512%	31.2103%
72	3.9083%	2.8009%	103	36.9580%	33.3360%
73	4.1016%	2.9976%	104	38.9211%	35.4488%
74	4.3260%	3.2278%	105	40.8237%	37.5385%
75	4.5864%	3.4953%	106	42.6707%	39.5696%
76	4.8843%	3.7995%	107	44.4580%	41.5472%
77	5.2251%	4.1446%	108	46.1426%	43.4536%
78	5.6118%	4.5341%	109	47.7554%	45.2673%
79	6.0495%	4.9699%	110	100.0000%	100.0000%
80	6.5396%	5.4551%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Pre-Retirement Mortality
Proposed Rates* - Employees

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	0.1404%	0.0755%	81	2.0585%	1.6073%
51	0.1512%	0.0825%	82	2.7540%	2.1369%
52	0.1628%	0.0901%	83	3.6836%	2.8388%
53	0.1764%	0.0992%	84	4.9283%	3.7695%
54	0.1909%	0.1089%	85	6.5958%	5.0010%
55	0.2084%	0.1210%	86	8.8261%	6.6299%
56	0.2279%	0.1334%	87	9.8981%	7.5487%
57	0.2503%	0.1467%	88	11.0666%	8.5779%
58	0.2744%	0.1607%	89	12.3336%	9.7117%
59	0.2995%	0.1760%	90	13.6909%	10.9353%
60	0.3264%	0.1924%	91	15.1283%	12.2314%
61	0.3543%	0.2084%	92	16.6286%	13.5756%
62	0.3826%	0.2248%	93	18.1830%	14.9675%
63	0.4120%	0.2427%	94	19.7852%	16.3974%
64	0.4409%	0.2618%	95	21.4159%	17.8816%
65	0.4705%	0.2816%	96	23.1963%	19.5107%
66	0.5006%	0.3040%	97	25.0390%	21.2340%
67	0.5327%	0.3295%	98	26.9392%	23.0570%
68	0.5670%	0.3576%	99	28.9050%	24.9819%
69	0.6059%	0.3895%	100	30.9068%	27.0025%
70	0.6488%	0.4266%	101	32.9303%	29.0910%
71	0.6981%	0.4690%	102	34.9512%	31.2103%
72	0.7531%	0.5171%	103	36.9580%	33.3360%
73	0.8160%	0.5720%	104	38.9211%	35.4488%
74	0.8874%	0.6346%	105	40.8237%	37.5385%
75	0.9682%	0.7055%	106	42.6707%	39.5696%
76	1.0585%	0.7850%	107	44.4580%	41.5472%
77	1.1605%	0.8736%	108	46.1426%	43.4536%
78	1.2732%	0.9738%	109	47.7554%	45.2673%
79	1.3993%	1.0846%	110	100.0000%	100.0000%
80	1.5397%	1.2078%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Healthy Retiree Mortality
Proposed Rates* - Teachers

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	0.1138%	0.0766%	81	4.1356%	3.0556%
51	0.1287%	0.0915%	82	4.7171%	3.5042%
52	0.1469%	0.1101%	83	5.3810%	4.0146%
53	0.1681%	0.1336%	84	6.1405%	4.5957%
54	0.1934%	0.1624%	85	7.0041%	5.2527%
55	0.2249%	0.1975%	86	7.9769%	5.9932%
56	0.2508%	0.2180%	87	9.0648%	6.8274%
57	0.2799%	0.2394%	88	10.2794%	7.7653%
58	0.3130%	0.2624%	89	11.6292%	8.8159%
59	0.3486%	0.2854%	90	13.1157%	9.9887%
60	0.3872%	0.3087%	91	14.7358%	11.3052%
61	0.4290%	0.3330%	92	16.4691%	12.7562%
62	0.4745%	0.3570%	93	18.2970%	14.3398%
63	0.5216%	0.3827%	94	20.1972%	16.0279%
64	0.5742%	0.4099%	95	22.1315%	17.8095%
65	0.6309%	0.4413%	96	24.2092%	19.7469%
66	0.6943%	0.4757%	97	26.3221%	21.7582%
67	0.7656%	0.5169%	98	28.4546%	23.8264%
68	0.8468%	0.5662%	99	30.6103%	25.9365%
69	0.9396%	0.6259%	100	32.7612%	28.0826%
70	1.0468%	0.6986%	101	34.9061%	30.2546%
71	1.1713%	0.7852%	102	37.0483%	32.4587%
72	1.3151%	0.8886%	103	39.1755%	34.6694%
73	1.4833%	1.0116%	104	41.2564%	36.8668%
74	1.6773%	1.1566%	105	43.2731%	39.0400%
75	1.9017%	1.3267%	106	45.2309%	41.1524%
76	2.1619%	1.5251%	107	47.1255%	43.2091%
77	2.4592%	1.7534%	108	48.9112%	45.1917%
78	2.7985%	2.0162%	109	50.6207%	47.0780%
79	3.1865%	2.3178%	110	100.0000%	100.0000%
80	3.6283%	2.6615%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Disabled Retiree Mortality
Proposed Rates* - Teachers

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	1.5124%	1.3489%	81	7.0903%	5.9952%
51	1.5982%	1.4069%	82	7.6985%	6.5913%
52	1.6917%	1.4736%	83	8.3635%	7.2464%
53	1.7926%	1.5499%	84	9.0902%	7.9645%
54	1.9000%	1.6310%	85	9.8758%	8.7501%
55	2.0118%	1.7139%	86	10.7199%	9.5697%
56	2.1259%	1.7937%	87	11.6245%	10.4096%
57	2.2382%	1.8670%	88	12.6005%	11.2634%
58	2.3498%	1.9301%	89	13.8227%	12.1273%
59	2.4570%	1.9817%	90	15.1662%	13.0087%
60	2.5611%	2.0230%	91	16.5419%	13.9318%
61	2.6612%	2.0528%	92	17.9227%	14.9066%
62	2.7606%	2.0767%	93	19.3044%	15.9569%
63	2.8612%	2.0984%	94	20.6953%	17.0894%
64	2.9611%	2.1195%	95	22.0980%	18.3309%
65	3.0602%	2.1462%	96	23.6606%	19.7762%
66	3.1590%	2.1810%	97	25.3117%	21.3922%
67	3.2597%	2.2301%	98	27.0654%	23.1325%
68	3.3636%	2.2967%	99	28.9410%	25.0030%
69	3.4761%	2.3843%	100	30.9068%	27.0025%
70	3.6002%	2.4967%	101	32.9303%	29.0910%
71	3.7436%	2.6343%	102	34.9512%	31.2103%
72	3.9083%	2.8009%	103	36.9580%	33.3360%
73	4.1016%	2.9976%	104	38.9211%	35.4488%
74	4.3260%	3.2278%	105	40.8237%	37.5385%
75	4.5864%	3.4953%	106	42.6707%	39.5696%
76	4.8843%	3.7995%	107	44.4580%	41.5472%
77	5.2251%	4.1446%	108	46.1426%	43.4536%
78	5.6118%	4.5341%	109	47.7554%	45.2673%
79	6.0495%	4.9699%	110	100.0000%	100.0000%
80	6.5396%	5.4551%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Pre-Retirement Mortality
Proposed Rates* - Teachers

	% Dying Next Year				% Dying Next Year	
Age	**Male**	**Female**	**Age**	**Male**	**Female**	
50	0.1046%	0.0664%	81	2.3840%	2.0448%	
51	0.1139%	0.0724%	82	2.9994%	2.5194%	
52	0.1238%	0.0799%	83	3.7730%	3.1014%	
53	0.1362%	0.0869%	84	4.7485%	3.8162%	
54	0.1496%	0.0954%	85	5.9775%	4.6916%	
55	0.1637%	0.1053%	86	7.5254%	5.7627%	
56	0.1806%	0.1153%	87	8.5517%	6.5648%	
57	0.1993%	0.1263%	88	9.6975%	7.4666%	
58	0.2205%	0.1390%	89	10.9709%	8.4768%	
59	0.2439%	0.1522%	90	12.3733%	9.6045%	
60	0.2701%	0.1665%	91	13.9017%	10.8704%	
61	0.2997%	0.1817%	92	15.5369%	12.2656%	
62	0.3310%	0.1985%	93	17.2613%	13.7883%	
63	0.3637%	0.2158%	94	19.0540%	15.4114%	
64	0.3992%	0.2355%	95	20.8788%	17.1245%	
65	0.4373%	0.2569%	96	22.8389%	18.9874%	
66	0.4759%	0.2808%	97	24.8322%	20.9213%	
67	0.5172%	0.3077%	98	26.8440%	22.9100%	
68	0.5603%	0.3397%	99	28.8776%	24.9389%	
69	0.6069%	0.3780%	100	30.9068%	27.0025%	
70	0.6543%	0.4231%	101	32.9303%	29.0910%	
71	0.7045%	0.4768%	102	34.9512%	31.2103%	
72	0.7584%	0.5405%	103	36.9580%	33.3360%	
73	0.8169%	0.6144%	104	38.9211%	35.4488%	
74	0.8803%	0.7023%	105	40.8237%	37.5385%	
75	0.9514%	0.8042%	106	42.6707%	39.5696%	
76	1.0885%	0.9283%	107	44.4580%	41.5472%	
77	1.2478%	1.0729%	108	46.1426%	43.4536%	
78	1.4332%	1.2410%	109	47.7554%	45.2673%	
79	1.6476%	1.4341%	110	100.0000%	100.0000%	
80	1.8957%	1.6582%				

Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.

Healthy Retiree Mortality
Proposed Rates* - Police and Fire

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	0.1827%	0.1369%	81	5.1869%	4.0861%
51	0.1990%	0.1546%	82	5.8645%	4.5901%
52	0.2170%	0.1744%	83	6.6225%	5.1525%
53	0.2385%	0.1976%	84	7.4742%	5.7805%
54	0.2641%	0.2249%	85	8.4251%	6.4803%
55	0.2941%	0.2563%	86	9.4818%	7.2583%
56	0.3288%	0.2917%	87	10.6500%	8.1263%
57	0.3689%	0.3303%	88	11.9444%	9.0946%
58	0.4152%	0.3724%	89	13.3757%	10.1699%
59	0.4671%	0.4172%	90	14.9475%	11.3601%
60	0.5250%	0.4659%	91	16.5561%	12.6329%
61	0.5887%	0.5152%	92	18.1331%	13.9569%
62	0.6572%	0.5666%	93	19.6528%	15.3260%
63	0.7305%	0.6207%	94	21.1182%	16.7296%
64	0.8094%	0.6782%	95	22.5372%	18.1871%
65	0.8946%	0.7398%	96	24.0781%	19.7923%
66	0.9863%	0.8057%	97	25.6872%	21.4973%
67	1.0870%	0.8798%	98	27.4008%	23.3117%
68	1.1974%	0.9643%	99	29.2504%	25.2385%
69	1.3215%	1.0599%	100	31.2159%	27.2725%
70	1.4616%	1.1710%	101	33.2596%	29.3819%
71	1.6217%	1.2975%	102	35.3007%	31.5224%
72	1.8029%	1.4437%	103	37.3276%	33.6694%
73	2.0105%	1.6117%	104	39.3103%	35.8033%
74	2.2491%	1.8037%	105	41.2319%	37.9139%
75	2.5214%	2.0240%	106	43.0974%	39.9653%
76	2.8332%	2.2730%	107	44.9026%	41.9627%
77	3.1891%	2.5547%	108	46.6040%	43.8881%
78	3.5962%	2.8740%	109	48.2330%	45.7200%
79	4.0599%	3.2318%	110	100.0000%	100.0000%
80	4.5870%	3.6340%			

* Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.

Disabled Retiree Mortality
Proposed Rates* - Police and Fire

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
50	0.3326%	0.2765%	81	5.5254%	4.0456%
51	0.3482%	0.3025%	82	6.1237%	4.5447%
52	0.3676%	0.3334%	83	6.7890%	5.1015%
53	0.3919%	0.3686%	84	7.5446%	5.7233%
54	0.4214%	0.4087%	85	8.4129%	6.4161%
55	0.4568%	0.4536%	86	9.3879%	7.1864%
56	0.4994%	0.5023%	87	10.5446%	8.0458%
57	0.5507%	0.5541%	88	11.8261%	9.0046%
58	0.6106%	0.6097%	89	13.2433%	10.0692%
59	0.6780%	0.6657%	90	14.7995%	11.2476%
60	0.7521%	0.7230%	91	16.3922%	12.5078%
61	0.8332%	0.7800%	92	17.9536%	13.8187%
62	0.9178%	0.8364%	93	19.4582%	15.1743%
63	1.0068%	0.8931%	94	20.9091%	16.5640%
64	1.0977%	0.9498%	95	22.3141%	18.0070%
65	1.1923%	1.0093%	96	23.8397%	19.5963%
66	1.2901%	1.0719%	97	25.4329%	21.2845%
67	1.3941%	1.1415%	98	27.1295%	23.0809%
68	1.5043%	1.2185%	99	28.9608%	24.9886%
69	1.6245%	1.3049%	100	30.9068%	27.0025%
70	1.7600%	1.4045%	101	32.9303%	29.0910%
71	1.9141%	1.5170%	102	34.9512%	31.2103%
72	2.0954%	1.6447%	103	36.9580%	33.3360%
73	2.3099%	1.7896%	104	38.9211%	35.4488%
74	2.5646%	1.9516%	105	40.8237%	37.5385%
75	2.8630%	2.1332%	106	42.6707%	39.5696%
76	3.2056%	2.3367%	107	44.4580%	41.5472%
77	3.5934%	2.5658%	108	46.1426%	43.4536%
78	4.0212%	2.8455%	109	47.7554%	45.2673%
79	4.4844%	3.1998%	110	100.0000%	100.0000%
80	4.9822%	3.5980%			

* *Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.*

Pre-Retirement Mortality
Proposed Rates* - Police and Fire

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1131%	0.0828%	81	2.9912%	2.0933%
51	0.1204%	0.0889%	82	3.7598%	2.6826%
52	0.1303%	0.0956%	83	4.7251%	3.4353%
53	0.1409%	0.1030%	84	5.9400%	4.3965%
54	0.1524%	0.1118%	85	7.4687%	5.6227%
55	0.1665%	0.1210%	86	9.3879%	7.1864%
56	0.1835%	0.1313%	87	10.5446%	8.0458%
57	0.2012%	0.1426%	88	11.8261%	9.0046%
58	0.2225%	0.1524%	89	13.2433%	10.0692%
59	0.2459%	0.1636%	90	14.7995%	11.2476%
60	0.2701%	0.1738%	91	16.3922%	12.5078%
61	0.2966%	0.1827%	92	17.9536%	13.8187%
62	0.3248%	0.1924%	93	19.4582%	15.1743%
63	0.3534%	0.2009%	94	20.9091%	16.5640%
64	0.3818%	0.2092%	95	22.3141%	18.0070%
65	0.4122%	0.2169%	96	23.8397%	19.5963%
66	0.4601%	0.2436%	97	25.4329%	21.2845%
67	0.5114%	0.2731%	98	27.1295%	23.0809%
68	0.5698%	0.3084%	99	28.9608%	24.9886%
69	0.6341%	0.3489%	100	30.9068%	27.0025%
70	0.7069%	0.3961%	101	32.9303%	29.0910%
71	0.7900%	0.4516%	102	34.9512%	31.2103%
72	0.8853%	0.5171%	103	36.9580%	33.3360%
73	0.9944%	0.5936%	104	38.9211%	35.4488%
74	1.1196%	0.6832%	105	40.8237%	37.5385%
75	1.2650%	0.7885%	106	42.6707%	39.5696%
76	1.4308%	0.9108%	107	44.4580%	41.5472%
77	1.6220%	1.0534%	108	46.1426%	43.4536%
78	1.8417%	1.2195%	109	47.7554%	45.2673%
79	2.0936%	1.4107%	110	100.0000%	100.0000%
80	2.3807%	1.6319%			

* Applicable to calendar year 2023. Rates in future years are determined by the above rates and the MP-2021 projection scale.

SECTION K

GLOSSARY

Glossary

The following glossary is intended to provide definitions of a number of terms which are used throughout this report and which are somewhat unique to the discussion of an Experience Study.

Actuarial Decrement. The actual number of decrements which occurred during the study. This number is a straight tabulation of the actual number of occurrences of the particular decrement in question. Normally, the actual number of decrements will be subdivided by age and possibly sex.

Aggregate Assumptions. Assumptions which vary only by sex and/or age. The impact of year of service on the decrement is ignored. All experience is combined by age and/or sex without regard to service. Rates of death and disablement are more appropriate to aggregate measurement in a retirement system.

Crude Rate of Decrement. The rate of decrement determined by dividing the actual number of the respective decrement for that age and sex by the corresponding exposure for that age and sex. The rate is described as a crude rate because no smoothing or elimination of statistical fluctuations has been made. It is indicative of the underlying true rate of the decrement and is the basis used in graduation to obtain the graduated or tabular rate.

Decrements. The decrements are the means by which a member ceases to be a member. For active members, the decrements are death, withdrawal, service retirement, and disability retirement. For retired members, the only decrement is death. The purpose of the Experience Study is to determine the underlying rates of each decrement.

Expected Decrement. This is the number of occurrences of a given decrement expected to occur for a given age and sex based on the number of lives exposed to the risk of the particular decrement and the current assumed rate for that decrement. It may also be referred to as the tabular number of decrements. It is the number of deaths, withdrawals, retirements, or disabilities (whichever is applicable) that would have actually occurred had the actuarial assumptions been exactly realized.

Exposure. The number of lives exposed to a given risk of decrement for a particular age and sex. It represents the number of members who could have potentially died, retired, become disabled, or withdrawn at that particular age and for that particular sex. This term will also be described as "the number exposed to a given risk."

Graduated Rates. Graduation is the mathematical process by which a set of crude rates of a particular type is translated into graduated or tabular rates. The graduation process attempts to smooth out statistical fluctuations and to arrive at a set of rates that adequately fit the underlying actual experience of the crude rates that are being graduated. The graduation process involves smoothing the results, but at the same time trying to fit the results to be consistent with the original data. It requires that the actuary exercise his or her judgment in what the underlying shape of the risk curve should look like.

Glossary

Interpolated Rates. For the active rates of decrement (death, disability, retirement, and withdrawal), the actuary will develop graduated rates based on quinquennial age groupings (see definition). To arrive at the rates of decrement for ages between two quinquennial ages, the graduated quinquennial rates must be interpolated for these intermediate ages. The interpolated results are arrived at by applying a mathematical interpolation formula to the quinquennial graduated rates.

Merit and Seniority Pay Increase Rate. The portion of the total salary scale which varies by service. It reflects the impact of moving up the salary grid in a given year, rather than the increase in the overall grid. It includes the salary increase associated with promotions during the year.

Quinquennial Age Groupings. For the active decrements, it is preferable to group the experience in five-year age groups for graduation and analysis purposes so as to minimize statistical fluctuations resulting from a lack of exposure which may occur for individual ages. Quinquennial age grouping is the five-year age grouping which is used to develop the graduated rates of decrement for active membership. The quinquennial age is the central age of the five-year grouping.

Tabular Rates. The tabular rate of decrement or salary increase is the rate determined by the graduation and interpolation process. It is the expected rate of change as opposed to the crude rate of change. It is deemed to be the underlying rate applicable to the decrement or to the rate of salary increase. In the first phase of the study, the actual results are compared to the expected results based on the tabular rates developed by the previous study. The second phase of the study determines the new tabular rates based on the crude rates. The final phase of the study compares the actual decrement to the expected decrement based on the new tabular rates.

Wage Inflation. The general rate of increase in salaries during a year. It is the component of the total salary scale which is independent of age or service. It consists of two components: inflation and productivity increases. It may be viewed as the ultimate rate of increase if there are no more step-rate/promotional increases applicable.