

New Hampshire Retirement System

4-Year Experience Study

July 1, 2015 Through June 30, 2019





April 20, 2020

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, 2015, 2016, 2017, 2018 and 2019. 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 5 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 4 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 4-year period from July 1, 2015 to June 30, 2019, and was carried out using generally accepted actuarial principles and techniques.

This report does not reflect the recent and still developing impact of COVID-19, which is likely to influence demographic experience and economic expectations, at least in the short-term. We will continue to monitor these developments and their impact on the system.

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.

David T. Kausch, Heidi G. Barry, 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 CAFR 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 will the pool of assets 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 model is revisited at least biennially to re-determine the cost estimates 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;
- 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, 2015 regular actuarial valuation.

Actuarial Standards of Practice (“ASOPs”)

The Actuarial Standards Board (“ASB”) provides guidance on measuring the costs of financing a retirement program 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. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*;
- (3) ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*; and
- (4) ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*.

In addition, Actuarial Standards of Practice Nos. 23 and 56, *Data Quality and Credibility Procedures*, provide guidance to actuaries on, among other things, when the actuary represents the data being used as statistically or mathematically credible such as in an experience study.

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, 2015 so the first relevant gain/(loss) measurement is as of June 30, 2016. 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
2016	\$ 5.7	\$ (30.1)	\$ 35.8	0.0 %
2017	115.2	141.4	(26.2)	0.8 %
2018	25.9	93.3	(67.4)	0.2 %
2019	(78.4)	(60.3)	(18.1)	(0.5)%
Total	\$ 68.5	\$ 144.3	\$ (75.9)	

** 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. In total, the assumption changes we are recommending will increase the liability realized between the June 30, 2017 and June 30, 2019 rate setting valuations.

Note: In the aggregate, the proposed demographic assumption changes increase 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, 2019 and employer contribution rates for the 2022-23 biennium.

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 fourteen nationally recognized investment consultants. Investment return expectations were analyzed for the System as a whole. Based on this analysis, we recommend lowering the assumed rate of investment return.

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 lowering the assumed rate of wage inflation.

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 lowering the assumed rate of price inflation.

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 and for those hired on and after July 1, 2011. We studied the impact of end of career pay increases for recent retirees subject to the prior definition of compensation. We recommend minor adjustments to increase the assumptions for Employees, Teachers and Fire and decrease the assumption for Police.

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 considering assuming a decrease in active member population size 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.

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 magnitude of the impact varied by member classification, but generally increased cost estimates. We use a partial credibility procedure based on the limited fluctuation method to determine appropriate adjustments to the base table to be applied to each gender within each member classification.

The Society of Actuaries (SOA) published new tables for U.S. public pension plans called the Pub-2010 tables in February 2019. The SOA also published the MP-2019 projection scales to reflect mortality improvements after 2019. 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. Please see Section C for more information.

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

Male and female rates were looked at independently for all groups. Male and female experience was ultimately combined for all four groups. 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 decreases in the overall rates of termination.

Development of the rates is shown in Sections D through G. The proposed rates are detailed in their entirety in Section J.

Rates of Disability from active service with entitlement to a disability benefit were studied by member classification. 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 decrease in the overall rates of disability for all four member classifications.

Development of the rates is shown in Sections D through G. The proposed rates are detailed in their entirety in Section J.



Summary of Demographic Assumptions

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

- Rule-based for those Group I members retiring under the rule of 70 with 20 years of service condition for early retirement
- Age-based for those Group I members retiring based on the age 50 with 10 years of service condition for early retirement
- Age-based for those members retiring under normal retirement

Male and female experience was studied separately for Group I and jointly for Group II. In general, proposed rates of retirement were lowered from current assumptions.

Development of the rates is shown in Sections D through G. The proposed rates are detailed in their entirety in Section J.

Miscellaneous Observations: Data suggests that terminations and disabilities are occurring for Group I members eligible for early retirement. The current assumption is to assume that Group I members may terminate or become disabled during early retirement and Group II members may terminate or become disabled during service retirement. This experience is consistent with the prior experience study and we therefore recommend no change for Group I members. We recommend Group II members only be assumed to retire during retirement eligibility.

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.

Forfeitures: Experience continues to indicate that some vested members are refunding and forfeiting their pensions. Under the current assumption it is assumed that 25% of members who quit before retirement with 10-15 years of service will elect to refund and forfeit their pension. We recommend removing this assumption and replacing it with the assumption that the present value of future benefits will not be less than the accumulated contributions at the time of decrement.

Marriage Assumption: Based on the members who retired during the study period, we recommend lowering the marriage assumption to 55% for Group I members (from 60%) and increasing the marriage assumption to 65% for Group II members (from 60%). This assumption relates to the benefits payable resulting from death-in-service for Groups I and Group II and the automatic death after retirement spousal benefit for Group II.

Data: The data submitted by NHRS Staff has undergone changes during the experience study period. In particular, remaining contribution balances of retirees as of the valuation date are provided with the data in addition to the original balance amount at retirement. Deferred accrued benefit amounts have also been modified to reflect the expected Normal Retirement benefit amount. This data was first submitted for the June 30, 2019 actuarial valuation. The analysis in this report for years prior to 2019 was adjusted appropriately.

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		
Assumption	Likely Direction of Change on Employer Rate Due to Proposed	
	NC	UAAL
Prior (FY 2022-2023)	1.81%	8.71%
Rates of Age-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Service-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Disability	Marginal Decr.	Marginal Decr.
Rates of Age-Based Retirement	Marginal Decr.	Marginal Decr.
Rates of Age-Based Early Retirement	Moderate Decr.	Moderate Decr.
Rates of Rule-Based Early Retirement	Marginal Decr.	Marginal Decr.
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Healthy Mortality	Moderate Incr.	Material Incr.
Post-Retirement Disabled Mortality	Marginal Incr.	Marginal Incr.
Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.
Forfeitures	Marginal Incr.	Marginal Incr.
End of Career Payments	Moderate Incr.	Moderate Incr.
Marriage Assumption	Marginal Decr.	Marginal Decr.
Administrative Expenses	No Change	No Change
Aggregate (at 7.25% / 3.25%)	Moderate Incr.	Material Incr.
Proposed	2.19%	9.77%

Teachers		
Assumption	Likely Direction of Change on Employer Rate Due to Proposed	
	NC	UAAL
Prior (FY 2022-2023)	1.74%	14.07%
Rates of Age-Based Withdrawal	Moderate Incr.	Moderate Incr.
Rates of Service-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Disability	Marginal Decr.	Marginal Decr.
Rates of Age-Based Retirement	Moderate Decr.	Moderate Decr.
Rates of Age-Based Early Retirement	Marginal Decr.	Marginal Decr.
Rates of Rule-Based Early Retirement	Marginal Decr.	Marginal Decr.
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Healthy Mortality	Moderate Incr.	Moderate Incr.
Post-Retirement Disabled Mortality	Marginal Incr.	Marginal Incr.
Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.
Forfeitures	Marginal Incr.	Marginal Incr.
End of Career Payments	Moderate Incr.	Moderate Incr.
Marriage Assumption	Marginal Decr.	Marginal Decr.
Administrative Expenses	No Change	No Change
Aggregate (at 7.25% / 3.25%)	Moderate Incr.	Moderate Incr.
Proposed	2.31%	14.68%

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 2022-2023 employer rates would have been without any assumption changes. Rate comparisons shown on pages A-12 through A-16 are made between the previously certified rates from the 2020-2021 biennium which were set based on the June 30, 2017 actuarial valuation. The system recognized asset gains in both 2018 and 2019 which would have reduced contribution rates prior to the proposed assumption changes.



Expected Impact of Proposed Demographic Changes on Employer Contribution Rate

Group II

Police		
Assumption	Likely Direction of Change on Employer Rate Due to Proposed	
	NC	UAAL
Prior (FY 2022-2023)	4.43%	19.38%
Rates of Age-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Service-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Disability	Moderate Decr.	Moderate Decr.
Rates of Age-Based Retirement	Moderate Decr.	Moderate Decr.
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Healthy Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Disabled Mortality	Moderate Incr.	Moderate Incr.
Merit and Longevity Salary Increases	Moderate Incr.	Moderate Incr.
Forfeitures	Marginal Incr.	Marginal Incr.
End of Career Payments	Marginal Decr.	Marginal Decr.
Marriage Assumption	Marginal Incr.	Marginal Incr.
Administrative Expenses	No Change	No Change
Aggregate (at 7.25% / 3.25%)	Moderate Incr.	Moderate Incr.
Proposed	5.58%	20.13%

Fire		
Assumption	Likely Direction of Change on Employer Rate Due to Proposed	
	NC	UAAL
Prior (FY 2022-2023)	5.67%	18.96%
Rates of Age-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Service-Based Withdrawal	Marginal Incr.	Marginal Incr.
Rates of Disability	Marginal Decr.	Marginal Decr.
Rates of Age-Based Retirement	Moderate Decr.	Moderate Decr.
Pre-Retirement Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Healthy Mortality	Marginal Decr.	Marginal Decr.
Post-Retirement Disabled Mortality	Moderate Incr.	Moderate Incr.
Merit and Longevity Salary Increases	Marginal Incr.	Marginal Incr.
Forfeitures	Marginal Incr.	Marginal Incr.
End of Career Payments	Moderate Incr.	Moderate Incr.
Marriage Assumption	Marginal Incr.	Marginal Incr.
Administrative Expenses	No Change	No Change
Aggregate (at 7.25% / 3.25%)	Moderate Incr.	Marginal Decr.
Proposed	5.86%	18.75%

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 2022-2023 employer rates would have been without any assumption changes. Rate comparisons shown on pages A-12 through A-16 are made between the previously certified rates from the 2020-2021 biennium which were set based on the June 30, 2017 actuarial valuation. The system recognized asset gains in both 2018 and 2019 which would have reduced contribution rates prior to the proposed assumption changes.

2015-2019 Experience Study

The Effect of Alternate Assumptions on the June 30, 2019 Actuarial Valuation

NHRS in Total@ (\$ in Millions)

	<i>June 30, 2017 Valuation Results (2020-2021 Rates)</i>		June 30, 2019 Valuation Results (2022-2023 Rates)			
	Prior	Prior	Proposed			
Demographic Assumptions	Prior	Prior	Prior	Alt 1	Alt 2	Alt 3
Economic Assumptions	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Alt 1 (7.00%/2.75%/2.00%)	Alt 2 (6.75%/2.75%/2.00%)	Alt 3 (6.50%/2.75%/2.00%)
Employer Pension Normal Cost	2.44%	2.34%	2.78%	2.85%	3.34%	3.88%
Pension UAAL Payment*	<u>12.73%</u>	<u>12.51%</u>	<u>13.31%</u>	<u>14.47%</u>	<u>15.33%</u>	<u>16.20%</u>
Total Pension Contribution	15.17%	14.85%	16.09%	17.32%	18.67%	20.08%
Employer Medical Subsidy Contribution	<u>1.58%</u>	<u>1.28%</u>	<u>1.24%</u>	<u>1.28%</u>	<u>1.28%</u>	<u>1.28%</u>
Total Employer Contribution	16.75%	16.13%	17.33%	18.60%	19.95%	21.36%
Total Estimated Employer \$ Contribution^{&}	\$ 503.7	\$ 494.7	\$ 535.7	\$ 566.6	\$ 607.7	\$ 650.9
<u>Pension</u>						
Actuarial Accrued Liability (AAL)	\$ 13,208.4	\$ 14,075.3	\$ 14,333.8	\$ 14,607.2	\$ 15,014.2	\$ 15,440.6
Actuarial Value of Assets (AVA)	<u>\$ 8,165.7</u>	<u>\$ 9,121.9</u>	<u>\$ 9,121.9</u>	<u>\$ 9,121.9</u>	<u>\$ 9,121.9</u>	<u>\$ 9,121.9</u>
UAAL	\$ 5,042.7	\$ 4,953.4	\$ 5,211.9	\$ 5,485.3	\$ 5,892.3	\$ 6,318.7
Funded Percent (AVA/AAL)	61.8%	64.8%	63.6%	62.4%	60.8%	59.1%
<u>Medical Subsidy</u>						
AAL	\$ 696.5	\$ 657.6	\$ 661.8	\$ 695.4	\$ 695.4	\$ 695.4
AVA	<u>\$ 38.9</u>	<u>\$ 36.6</u>	<u>\$ 36.6</u>	<u>\$ 36.6</u>	<u>\$ 36.6</u>	<u>\$ 36.6</u>
UAAL	\$ 657.6	\$ 621.0	\$ 625.2	\$ 658.8	\$ 658.8	\$ 658.8
Funded Percent (AVA/AAL)	5.6%	5.6%	5.5%	5.3%	5.3%	5.3%

@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, 2019.

&Total estimated employer dollar contribution for FY 2021 for rates adopted from June 30, 2017 valuation and for FY 2022 for rates based on the June 30, 2019 valuation.



2015-2019 Experience Study

The Effect of Alternate Assumptions on the June 30, 2019 Actuarial Valuation

Employees (\$ in Millions)

	June 30, 2017 Valuation Results (2020-2021 Rates)						June 30, 2019 Valuation Results (2022-2023 Rates)											
	Prior			Prior			Proposed											
	Prior (7.25%/3.25%/2.50%)			Prior (7.25%/3.25%/2.50%)			Prior (7.25%/3.25%/2.50%)			Alt 1 (7.00%/2.75%/2.00%)			Alt 2 (6.75%/2.75%/2.00%)			Alt 3 (6.50%/2.75%/2.00%)		
	State	Pol. Sub.	Total	State	Sub.	Total	State	Sub.	Total	State	Sub.	Total	State	Sub.	Total	State	Pol. Sub.	Total
Demographic Assumptions																		
Economic Assumptions																		
Employer Pension Normal Cost	1.92%	1.92%	1.92%	1.81%	1.81%	1.81%	2.19%	2.19%	2.19%	2.23%	2.23%	2.23%	2.58%	2.58%	2.58%	2.98%	2.98%	2.98%
Pension UAAL Payment*	8.96%	8.96%	8.96%	8.71%	8.71%	8.71%	9.77%	9.77%	9.77%	10.57%	10.57%	10.57%	11.17%	11.17%	11.17%	11.77%	11.77%	11.77%
Total Pension Contribution	10.88%	10.88%	10.88%	10.52%	10.52%	10.52%	11.96%	11.96%	11.96%	12.80%	12.80%	12.80%	13.75%	13.75%	13.75%	14.75%	14.75%	14.75%
Employer Medical Subsidy Contribution	1.05%	0.29%		0.73%	0.28%		0.76%	0.30%		0.78%	0.31%		0.78%	0.31%		0.79%	0.32%	
Total Employer Contribution	11.93%	11.17%		11.25%	10.80%		12.72%	12.26%		13.58%	13.11%		14.53%	14.06%		15.54%	15.07%	
Total Estimated Employer \$ Contribution^{&}			\$ 154.4			\$ 150.8			\$ 170.9			\$ 179.9			\$ 192.8			\$ 206.4
Pension																		
Actuarial Accrued Liability (AAL)			\$ 4,340.1			\$ 4,612.3			\$ 4,777.6			\$ 4,859.6			\$ 4,989.0			\$ 5,124.4
Actuarial Value of Assets (AVA)			\$ 2,734.6			\$ 3,064.0			\$ 3,064.0			\$ 3,064.0			\$ 3,064.0			\$ 3,064.0
UAAL			\$ 1,605.5			\$ 1,548.3			\$ 1,713.6			\$ 1,795.6			\$ 1,925.0			\$ 2,060.4
Funded Percent (AVA/AAL)			63.0%			66.4%			64.1%			63.1%			61.4%			59.8%
Medical Subsidy																		
Accrued Liability	\$ 67.7	\$ 53.7	\$ 121.4	\$ 57.8	\$ 49.6	\$ 107.4	\$ 61.0	\$ 52.3	\$ 113.3	\$ 63.4	\$ 54.3	\$ 117.7	\$ 63.4	\$ 54.3	\$ 117.7	\$ 63.4	\$ 54.3	\$ 117.7
Valuation Assets	\$ 3.2	\$ 18.3	\$ 21.5	\$ 2.1	\$ 14.6	\$ 16.7	\$ 2.1	\$ 14.6	\$ 16.7	\$ 2.1	\$ 14.6	\$ 16.7	\$ 2.1	\$ 14.6	\$ 16.7	\$ 2.1	\$ 14.6	\$ 16.7
UAAL	\$ 64.5	\$ 35.4	\$ 99.9	\$ 55.7	\$ 35.0	\$ 90.7	\$ 58.9	\$ 37.7	\$ 96.6	\$ 61.3	\$ 39.7	\$ 101.0	\$ 61.3	\$ 39.7	\$ 101.0	\$ 61.3	\$ 39.7	\$ 101.0
Funded Percent (AVA/AAL)	4.7%	34.1%	17.7%	3.6%	29.4%	15.5%	3.4%	27.9%	14.7%	3.3%	26.9%	14.2%	3.3%	26.9%	14.2%	3.3%	26.9%	14.2%

*The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2019.

[&]Total estimated employer dollar contribution for FY 2021 for rates adopted from June 30, 2017 valuation and for FY 2022 for rates based on the June 30, 2019 valuation.



2015-2019 Experience Study

The Effect of Alternate Assumptions on the June 30, 2019 Actuarial Valuation

Teachers

(\$ in Millions)

	<i>June 30, 2017 Valuation Results (2020-2021 Rates)</i>		June 30, 2019 Valuation Results (2022-2023 Rates)			
	Prior	Prior	Proposed			
	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Alt 1 (7.00%/2.75%/2.00%)	Alt 2 (6.75%/2.75%/2.00%)	Alt 3 (6.50%/2.75%/2.00%)
Demographic Assumptions						
Economic Assumptions						
Employer Pension Normal Cost	1.86%	1.74%	2.31%	2.33%	2.82%	3.32%
Pension UAAL Payment*	<u>14.13%</u>	<u>14.07%</u>	<u>14.68%</u>	<u>15.83%</u>	<u>16.66%</u>	<u>17.52%</u>
Total Pension Contribution	15.99%	15.81%	16.99%	18.16%	19.48%	20.84%
Employer Medical Subsidy Contribution	<u>1.81%</u>	<u>1.29%</u>	<u>1.31%</u>	<u>1.35%</u>	<u>1.35%</u>	<u>1.35%</u>
Total Employer Contribution	17.80%	17.10%	18.30%	19.51%	20.83%	22.19%
Total Estimated Employer \$ Contribution^{&}	\$ 213.0	\$ 210.7	\$ 225.4	\$ 236.9	\$ 252.9	\$ 269.4
<u>Pension</u>						
Actuarial Accrued Liability (AAL)	\$ 5,163.7	\$ 5,504.5	\$ 5,577.9	\$ 5,677.4	\$ 5,837.5	\$ 6,005.3
Actuarial Value of Assets (AVA)	<u>\$ 2,979.0</u>	<u>\$ 3,326.1</u>	<u>\$ 3,326.1</u>	<u>\$ 3,326.1</u>	<u>\$ 3,326.1</u>	<u>\$ 3,326.1</u>
UAAL	\$ 2,184.7	\$ 2,178.4	\$ 2,251.8	\$ 2,351.3	\$ 2,511.4	\$ 2,679.2
Funded Percent (AVA/AAL)	57.7%	60.4%	59.6%	58.6%	57.0%	55.4%
<u>Medical Subsidy</u>						
AAL	\$ 241.5	\$ 229.9	\$ 231.8	\$ 241.7	\$ 241.7	\$ 241.7
AVA	<u>\$ 6.5</u>	<u>\$ 4.2</u>	<u>\$ 4.2</u>	<u>\$ 4.2</u>	<u>\$ 4.2</u>	<u>\$ 4.2</u>
UAAL	\$ 235.0	\$ 225.7	\$ 227.6	\$ 237.5	\$ 237.5	\$ 237.5
Funded Percent (AVA/AAL)	2.7%	1.8%	1.8%	1.7%	1.7%	1.7%

*The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2019.

&Total estimated employer dollar contribution for FY 2021 for rates adopted from June 30, 2017 valuation and for FY 2022 for rates based on the June 30, 2019 valuation.



2015-2019 Experience Study

The Effect of Alternate Assumptions on the June 30, 2019 Actuarial Valuation

Police

(\$ in Millions)

	<i>June 30, 2017 Valuation Results (2020-2021 Rates)</i>		June 30, 2019 Valuation Results (2022-2023 Rates)			
	Prior	Prior	Proposed			Prior
Economic Assumptions	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Alt 1 (7.00%/2.75%/2.00%)	Alt 2 (6.75%/2.75%/2.00%)	Alt 3 (6.50%/2.75%/2.00%)
Demographic Assumptions						
Employer Pension Normal Cost	5.04%	4.43%	5.58%	5.85%	6.72%	7.72%
Pension UAAL Payment*	<u>19.73%</u>	<u>19.38%</u>	<u>20.13%</u>	<u>22.36%</u>	<u>23.95%</u>	<u>25.57%</u>
Total Pension Contribution	24.77%	23.81%	25.71%	28.21%	30.67%	33.29%
Employer Medical Subsidy Contribution	<u>3.66%</u>	<u>3.19%</u>	<u>3.10%</u>	<u>3.21%</u>	<u>3.21%</u>	<u>3.22%</u>
Total Employer Contribution	28.43%	27.00%	28.81%	31.42%	33.88%	36.51%
Total Estimated Employer \$ Contribution^{&}	\$ 94.0	\$ 93.0	\$ 99.3	\$ 106.7	\$ 115.0	\$ 124.0
<u>Pension</u>						
Actuarial Accrued Liability (AAL)	\$ 2,524.1	\$ 2,707.4	\$ 2,731.3	\$ 2,795.6	\$ 2,877.2	\$ 2,962.9
Actuarial Value of Assets (AVA)	<u>\$ 1,650.9</u>	<u>\$ 1,838.9</u>	<u>\$ 1,838.9</u>	<u>\$ 1,838.9</u>	<u>\$ 1,838.9</u>	<u>\$ 1,838.9</u>
UAAL	\$ 873.2	\$ 868.5	\$ 892.4	\$ 956.7	\$ 1,038.3	\$ 1,124.0
Funded Percent (AVA/AAL)	65.4%	67.9%	67.3%	65.8%	63.9%	62.1%
<u>Medical Subsidy (Police and Fire Combined)</u>						
AAL	\$ 333.7	\$ 320.3	\$ 316.7	\$ 336.0	\$ 336.0	\$ 336.0
AVA	<u>\$ 10.9</u>	<u>\$ 15.8</u>	<u>\$ 15.8</u>	<u>\$ 15.8</u>	<u>\$ 15.8</u>	<u>\$ 15.8</u>
UAAL	\$ 322.8	\$ 304.5	\$ 300.9	\$ 320.2	\$ 320.2	\$ 320.2
Funded Percent (AVA/AAL)	3.3%	4.9%	5.0%	4.7%	4.7%	4.7%

*The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2019.

&Total estimated employer dollar contribution for FY 2021 for rates adopted from June 30, 2017 valuation and for FY 2022 for rates based on the June 30, 2019 valuation.



2015-2019 Experience Study

The Effect of Alternate Assumptions on the June 30, 2019 Actuarial Valuation

Fire

(\$ in Millions)

	<i>June 30, 2017 Valuation Results (2020-2021 Rates)</i>		June 30, 2019 Valuation Results (2022-2023 Rates)			
	Prior	Prior	Proposed			Prior
Demographic Assumptions	Prior	Prior	Prior	Alt 1	Alt 2	Alt 3
Economic Assumptions	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	Prior (7.25%/3.25%/2.50%)	(7.00%/2.75%/2.00%)	(6.75%/2.75%/2.00%)	(6.50%/2.75%/2.00%)
Employer Pension Normal Cost	6.35%	5.67%	5.86%	6.06%	7.07%	8.16%
Pension UAAL Payment*	<u>20.08%</u>	<u>18.96%</u>	<u>18.75%</u>	<u>20.97%</u>	<u>22.71%</u>	<u>24.46%</u>
Total Pension Contribution	26.43%	24.63%	24.61%	27.03%	29.78%	32.62%
Employer Medical Subsidy Contribution	<u>3.66%</u>	<u>3.19%</u>	<u>3.10%</u>	<u>3.21%</u>	<u>3.21%</u>	<u>3.22%</u>
Total Employer Contribution	30.09%	27.82%	27.71%	30.24%	32.99%	35.84%
Total Estimated Employer \$ Contribution^{&}	\$ 42.3	\$ 40.3	\$ 40.1	\$ 43.1	\$ 47.0	\$ 51.1
<u>Pension</u>						
Actuarial Accrued Liability (AAL)	\$ 1,180.6	\$ 1,251.1	\$ 1,246.9	\$ 1,274.6	\$ 1,310.4	\$ 1,348.0
Actuarial Value of Assets (AVA)	\$ 801.2	\$ 893.0	\$ 893.0	\$ 893.0	\$ 893.0	\$ 893.0
UAAL	\$ 379.4	\$ 358.1	\$ 353.9	\$ 381.6	\$ 417.4	\$ 455.0
Funded Percent (AVA/AAL)	67.9%	71.4%	71.6%	70.1%	68.1%	66.2%
<u>Medical Subsidy (Police and Fire Combined)</u>						
AAL	\$ 333.7	\$ 320.3	\$ 316.7	\$ 336.0	\$ 336.0	\$ 336.0
AVA	\$ 10.9	\$ 15.8	\$ 15.8	\$ 15.8	\$ 15.8	\$ 15.8
UAAL	\$ 322.8	\$ 304.5	\$ 300.9	\$ 320.2	\$ 320.2	\$ 320.2
Funded Percent (AVA/AAL)	3.3%	4.9%	5.0%	4.7%	4.7%	4.7%

*The UAAL amortization payment as a level percent of pay required to fully amortize the UAAL over multiple periods beginning July 1, 2019.

&Total estimated employer dollar contribution for FY 2021 for rates adopted from June 30, 2017 valuation and for FY 2022 for rates based on the June 30, 2019 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 historical and current economic data that is relevant as of the measurement date,
- It reflects the actuary's estimate of future experiences, observations of estimates inherent in market data, or a combination thereof, and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or other factors are included and disclosed under section 3.5.1, or when alternative assumptions are used for the assessment of risk.

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

This report does not reflect the recent and still developing impact of COVID-19, which is likely to influence demographic experience and economic expectations, at least in the short-term. We will continue to monitor these developments and their impact on retirement plans.

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	2.46%
10-Year Annual Average	2.38%
Federal Reserve Bank of Philadelphia^c	
5-Year Annual Average	2.20%
10-Year Annual Average	2.20%
Federal Reserve Bank of Cleveland^d	
10-Year Expectation	1.71%
20-Year Expectation	1.93%
30-Year Expectation	2.09%
Federal Reserve Bank of St. Louis^e	
10-Year Breakeven Inflation	1.61%
20-Year Breakeven Inflation	1.81%
30-Year Breakeven Inflation	1.78%
U.S. Department of the Treasury^f	
10-Year Breakeven Inflation	1.65%
20-Year Breakeven Inflation	1.78%
30-Year Breakeven Inflation	1.87%
50-Year Breakeven Inflation	1.95%
100-Year Breakeven Inflation	2.00%
Social Security Trustees^g	
Ultimate Intermediate Assumption	2.60%

^a Version 2019-12-31 by Gabriel, Roeder, Smith & Company. Revised 2020-02-26.

^b *The Budget and Economic Outlook: 2020 to 2030*, Consumer Price Index (CPI-U), Percentage Change from Fourth Quarter to Fourth Quarter, 5-Year Annual Average (2020 - 2024), 10-Year Annual Average (2020 - 2029).

^c *Survey of Professional Forecasters, Fourth Quarter 2019*, Release Date: November 15, 2019, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2019 - 2023), 10-Year Annual Average (2019 - 2028).

^d Inflation Expectations, Model output date: December 1, 2019.

^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 1, 2020.

^f *The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, December, 2019.

^g *The 2019 Annual Reports of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, April 25, 2019, Long-range (75-year) assumptions, Intermediate, Consumer Price Index (CPI-W), for 2021 and later.

Based on this information, there is a continuing trend of lowering price inflation expectations. The current price inflation assumption is 2.50% which exceeds all of the forecasts above except the Social Security Trustees assumption. We recommend lowering the price inflation assumption to 2.00%. For purposes of the analysis for other economic assumptions in this report, we have used a price inflation assumption of 2.00% 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 likely 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 fourteen nationally recognized investment advisors. We have compared this analysis with that of the System's Investment Staff and Investment Advisor, NEPC. We thank the System's Staff and NEPC 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 Capital Market Assumption Modeler (CMAM). 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 consulting firms. We update our CMAM on an annual basis, most recently in 2019. The capital market assumptions in the 2019 CMAM are from the following investment advisors (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Marquette Associates, Meketa, Mercer, NEPC, RVK, Verus, Voya and Wilshire. We believe the benefit of performing this analysis using multiple investment advising 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 advisors to be as consistent as possible.

For purposes of this analysis, we requested and received updated capital market expectations from NEPC for 2020. We have updated the CMAM to include NEPC's 2020 capital market assumptions but have not adjusted the other 13 investment advisors' assumptions. We have reasonably matched NEPC's total portfolio return expectations for both the 10-year and 30-year horizons.

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.

Assumed Investment Return

It is important to note that certain alternative asset classes such as hedge funds and private equity may have implicit or explicit expectations of higher returns. In February 2019, the American Academy of Actuaries issued a public policy practice note: Forecasting Investment Returns and Expected Return Assumptions for Pension Actuaries. This Practice Note suggests that for alternative asset classes such as private equity, forecasting returns is challenging due to lack of data. In particular,

Private equity return expectations may be estimated by adding an illiquidity premium to the expected return for public equities. Some research papers identify this illiquidity premium at 2.5% to 3.0% based on historical analysis of available data. However, many practitioners opt for a more modest 1.0% to 2.5% illiquidity premium, as can be seen in their published capital market assumptions reports.

One approach is to analyze the implied capital market line of the average expectations of the various asset classes of all the investment advisors. A regression analysis of these average expectations suggests that the return expectations for private equity in the CMAM may be 1.0% to 1.5% higher than implied by the level of risk. A similar analysis for hedge funds in the CMAM indicates they may be 0.5% to 1.0% higher than implied by the level of risk. For purposes of this analysis, no adjustment has been made.

For purposes of this analysis, we have reviewed the following investment allocation based on the Board’s Investment Policy:

Asset Class	Target Allocation
Large Cap Equities	22.5%
Small/Mid Cap Equities	7.5%
Int’l Equities (Unhedged)	13.0%
Emerging Int’l Equities	7.0%
Private Equity	10.0%
Core Bonds	9.0%
Absolute Return Fixed Income	6.0%
Global Multi-Sector Fixed Income	10.0%
Private Debt	5.0%
Core Real Estate	10.0%
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 2.00% (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 fourteen investment advisors show in our CMAM.

Table 1

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant 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	5.36%	2.20%	3.16%	2.00%	5.16%	0.00%	5.16%	11.84%
2	6.84%	2.50%	4.34%	2.00%	6.34%	0.00%	6.34%	12.95%
3	6.71%	2.30%	4.41%	2.00%	6.41%	0.00%	6.41%	12.95%
4	6.89%	2.50%	4.39%	2.00%	6.39%	0.00%	6.39%	12.46%
5	6.53%	2.20%	4.33%	2.00%	6.33%	0.00%	6.33%	10.26%
6	6.64%	2.00%	4.64%	2.00%	6.64%	0.00%	6.64%	10.91%
7	7.37%	2.21%	5.16%	2.00%	7.16%	0.00%	7.16%	13.26%
8	7.54%	2.26%	5.28%	2.00%	7.28%	0.00%	7.28%	13.98%
9	7.29%	2.00%	5.29%	2.00%	7.29%	0.00%	7.29%	12.40%
10	7.60%	2.31%	5.29%	2.00%	7.29%	0.00%	7.29%	12.15%
11	7.95%	2.30%	5.65%	2.00%	7.65%	0.00%	7.65%	11.82%
12	8.14%	2.15%	5.99%	2.00%	7.99%	0.00%	7.99%	12.86%
13	7.78%	1.70%	6.08%	2.00%	8.08%	0.00%	8.08%	12.90%
14	8.05%	2.00%	6.05%	2.00%	8.05%	0.00%	8.05%	11.07%
Average	7.19%	2.19%	5.00%	2.00%	7.00%	0.00%	7.00%	12.27%

The average expected nominal return from column 8 is 7.00% based on a price inflation of 2.00%. This is the average arithmetic rate of return. (Note that this analysis would result in an average expected nominal return of 7.25% using a price inflation assumption of 2.25%). The arithmetic rate of return represents the average future expected return which is higher than the median future expected. Setting the valuation assumption at the arithmetic expected return means that over time the average accumulated assets are expected to grow at this rate. However, in any given year it is less than 50% likely that this return will be achieved. Additional analysis is required to adjust to the median (or geometric average) return.

Next, we compare the probabilities of achieving returns over a 20-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 7.25% as well as 7.00%, 6.75%, 6.50%, and 6.25% over a 20-year horizon. Note that the investment horizon for most of the capital market assumption sets is between 5 and 10 years (the average is 9.7 or roughly 10 years). For purposes of this analysis, no adjustment has been made to return expectations for 20 years. In other words, the second 10 years are expected to have the same distribution of returns as the first 10 years. A different assumption would result in a different distribution of returns.

Assumed Investment Return

Table 2

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of exceeding 7.25%	Probability of exceeding 7.00%	Probability of exceeding 6.75%	Probability of exceeding 6.50%	Probability of exceeding 6.25%
	40th	50th	60th					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	3.83%	4.50%	5.16%	15.00%	17.27%	19.76%	22.46%	25.36%
2	4.84%	5.56%	6.29%	27.96%	30.92%	34.02%	37.24%	40.56%
3	4.90%	5.63%	6.35%	28.69%	31.69%	34.82%	38.07%	41.41%
4	4.97%	5.66%	6.37%	28.41%	31.51%	34.76%	38.14%	41.61%
5	5.26%	5.84%	6.41%	26.88%	30.57%	34.48%	38.57%	42.81%
6	5.47%	6.08%	6.70%	31.57%	35.29%	39.17%	43.17%	47.24%
7	5.61%	6.35%	7.09%	37.97%	41.23%	44.57%	47.94%	51.34%
8	5.60%	6.38%	7.16%	38.92%	42.03%	45.20%	48.42%	51.65%
9	5.88%	6.58%	7.27%	40.34%	43.88%	47.49%	51.12%	54.74%
10	5.93%	6.61%	7.29%	40.63%	44.25%	47.93%	51.63%	55.33%
11	6.34%	7.00%	7.67%	46.26%	50.06%	53.86%	57.64%	61.36%
12	6.52%	7.24%	7.96%	49.80%	53.31%	56.79%	60.24%	63.61%
13	6.60%	7.32%	8.05%	51.00%	54.49%	57.96%	61.37%	64.70%
14	6.86%	7.48%	8.11%	53.78%	57.81%	61.77%	65.62%	69.32%
Average*	5.50%	6.25%	7.00%	37%	40%	44%	47%	51%

*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 is 6.25% per year. (Note that the 6.25% median shown is based on the 2.00% price inflation assumption. This analysis would result in a median return of 6.50% using a price inflation assumption of 2.25%.)


Column 5 of the table above shows the estimated probability of achieving the current 7.25% assumed rate of return over a 20-year period. The average probability of achieving 7.25% over 20 years is 37%. (All probabilities shown are based on the 2.00% price inflation assumption. Probabilities may increase roughly 3-4% using a 2.25% price inflation assumption.)

Another approach to extending beyond the 10-year investment horizon is to review capital market expectations over longer periods. We requested capital market assumptions over a longer horizon from each of the fourteen investment advisors. Six of the investment advisors provided capital market assumptions over a period of 20, 25, or 30 years, the other eight did not provide assumptions over a period longer than 10 years. Each of the six that provided assumptions over a longer horizon had

Assumed Investment Return

different expectations after the first 10 years. However, two of those six indicated that return expectations after the 10th year were set based on historical return experience, as opposed to a market-based or forward-looking methodology that is predominately used in the development of the 10-year expectations. The other investment advisors did not provide a description of methodology for the longer horizon. The average geometric return over a 20-30-year horizon from the six investment advisors is 7.00%.

We understand that NEPC shared their own analysis as well as that of Alliance Bernstein, J.P. Morgan, and Neuberger Berman. The summary of that analysis as communicated by NEPC is as follows:



Forecasted Returns Based on the NHRS Portfolio

	10 Years	20 Years	30 Years
NEPC	6.0%	N/A	7.2%
Alliance Bernstein	5.9%	6.3%	6.6%
J.P. Morgan	6.3%*	6.8%	N/A
Neuberger Berman	4.8%**	5.9%	N/A
*10-15 year assumption			
**5-7 year assumption			

Geometric return assumptions shown

The consensus averages from our analysis of the geometric return assumption are:

	10 Years	30 Years
GRS	6.25%	7.00%

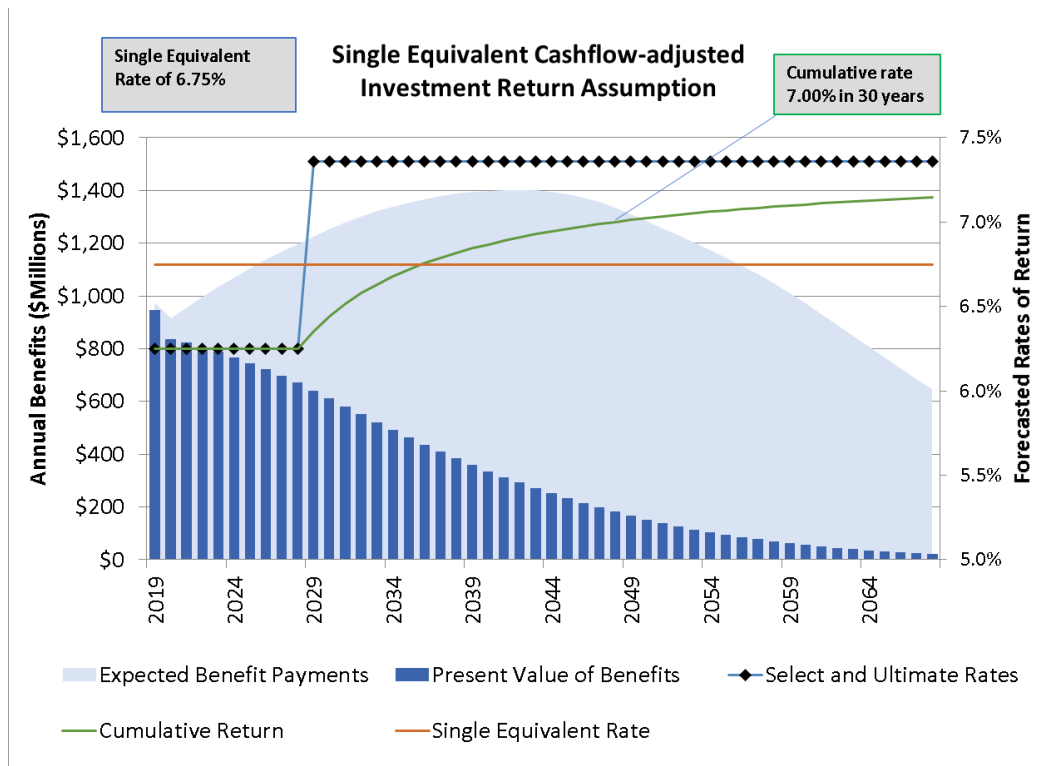
Our results are within the range of the analysis from the various investment advisors as communicated by NEPC. For the rest of our analysis, we will use our 6.25%/7.00% 10-year/30-year average expectations.

In order to get to 7.00% over 30 years after achieving 6.25% for the first 10 years (referred to as the select rate), returns for years 11 to 30 would have to be 7.36% per year (referred to as the ultimate rate). A key question is how much weight to give to the 10-year expectation and the 30-year expectation. For purposes of the valuation, we generally select one assumption for all years. In our view, it is important to give the 10-year expectations a fair amount of weight. We provide two examples as to why we think this is an appropriate approach. In each of these examples, we assume that the select and ultimate rates are met exactly in each year.

Assumed Investment Return

First, we could compute the duration of the present value of future benefits for all NHRS members. This duration is essentially a weighted-average of the expected years of benefit payments where the weighting is on the basis of the present value of those future payments. The duration for NHRS in total as of June 30, 2019 is about 13 years. This suggests that the investment experience over the next 13 years will be a key driver for the benefit security of the current membership. If we take a straight weighted-average of the select and ultimate rates in effect over the 13-year duration, we arrive at an expected return of approximately 6.50%.

Second, we could compute the single equivalent rate of investment return based on the present value of future benefits for all NHRS members. For this we first compute the present value of future benefits using the select and ultimate investment return rates then solve for the single equivalent discount rate that results in the same present value. Essentially, this results in a weighted-average of the select and ultimate rates where the weighting is based on expected benefit payments. The resulting single equivalent rate, based on the June 30, 2019 valuation, is 6.75% per year. This process is illustrated by the following chart.



This second approach yields a higher assumption than the first in this case (approximately 6.75% vs. 6.50%).

Our recommendation is that the Board lower the assumed rate of return from 7.25% to an assumption in the range of 6.25% to 7.00%. Given the discussion on the investment horizon, we suggest that the Board give consideration to an assumption of 6.75% or lower.

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

Wage Inflation and Payroll Growth

In more recent periods, such as the 10-year period from 2008 through 2018, average compensation outpaced inflation by 50 basis points (based on the Social Security National Average Earnings Index and CPI-U which had 10-year averages of 2.3% and 1.8% respectively). The current assumed spread of wage over price inflation is 0.75% (3.25% wage inflation less 2.50% 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
	2015 - 2016	(0.1)%	1.2%	1.2%	0.2%	0.5%
	2016 - 2017	4.0%	1.7%	3.4%	3.2%	2.9%
	2017 - 2018	2.0%	3.2%	2.7%	2.8%	2.7%
	2018 - 2019	2.7%	1.9%	3.1%	0.5%	2.3%
Wage Inflation	2015-2019	2.1%	2.0%	2.6%	1.7%	2.1%
Price Inflation		1.6%	1.6%	1.6%	1.6%	1.6%
Spread of Wages Over Prices		0.5%	0.4%	1.0%	0.1%	0.5%

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 lower the 3.25% 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 lowering the assumed rate of wage inflation below the current 3.25%. For purposes of the analysis for other economic assumptions in this report, we have used a wage inflation assumption of 2.75% per year. For groups with a constant assumed active workforce, we assume that payroll growth will be at the wage inflation assumption. A reduction for Teachers' headcount and payroll growth assumption is discussed on page B-22.

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		Total NHRS	Annual Payroll	4-year Average
June 30,	Actives	Populaton Payroll	Increase	Increase
2015	47,812	\$ 2,575,031,210		
2016	48,069	2,601,403,606	1.0%	
2017	47,886	2,667,611,532	2.5%	
2018	48,121	2,752,235,069	3.2%	
2019	48,288	2,825,006,022	2.6%	2.3%

The results of the analysis are shown on pages B-11 through B-18. 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 page B-11 through B-18.

Merit and Longevity Pay Increases

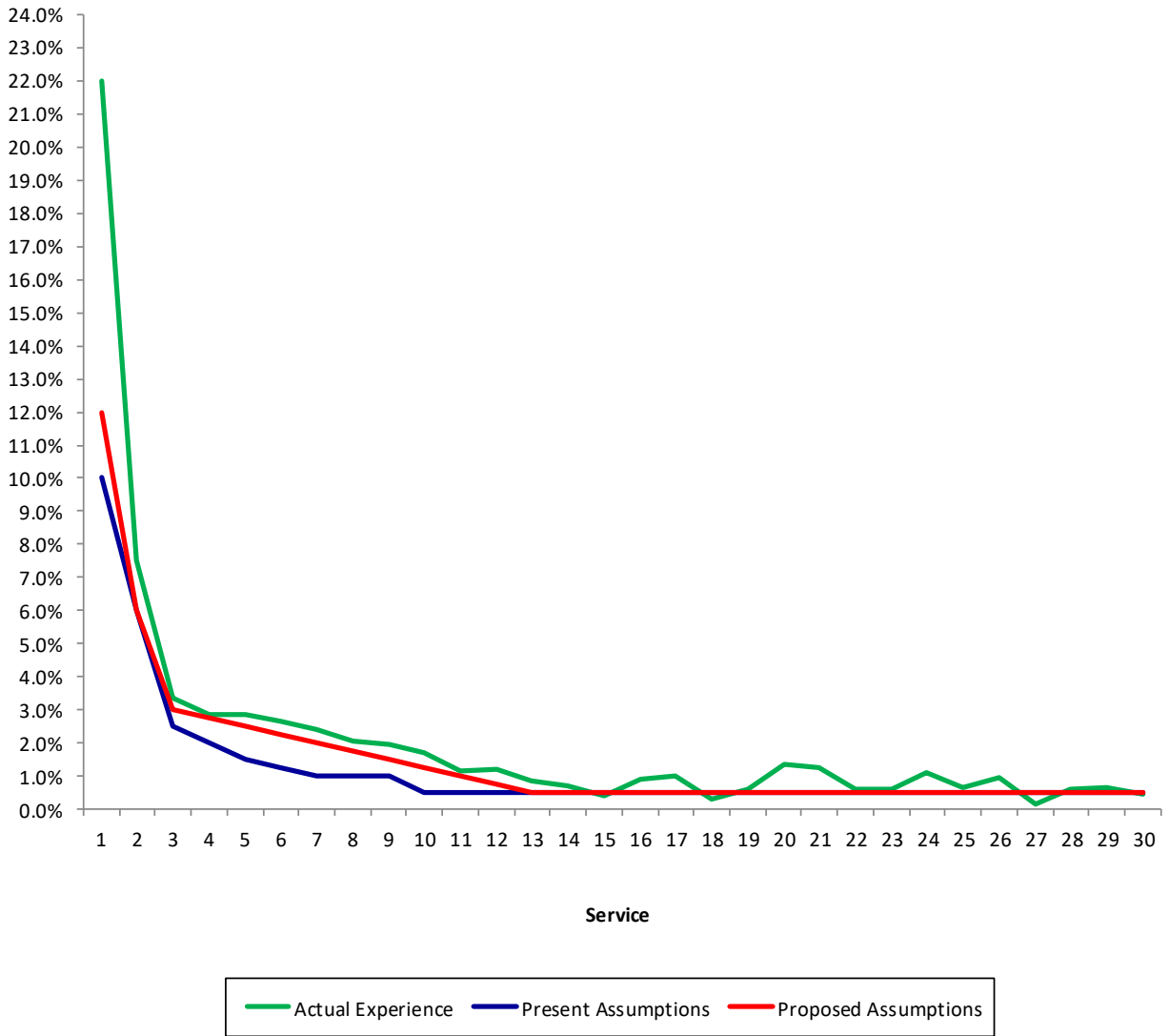
Employees

Service Index	Number	Merit/Seniority % Increase		
		Actual*	Expected	
			Present	Proposed
1	2,582	22.01 %	10.00 %	12.00 %
2	7,479	7.53 %	6.00 %	6.00 %
3	6,095	3.37 %	2.50 %	3.00 %
4	4,893	2.86 %	2.00 %	2.75 %
5	4,042	2.87 %	1.50 %	2.50 %
6	3,472	2.65 %	1.25 %	2.25 %
7	3,063	2.43 %	1.00 %	2.00 %
8	3,179	2.07 %	1.00 %	1.75 %
9	3,504	1.97 %	1.00 %	1.50 %
10	3,730	1.68 %	0.50 %	1.25 %
11	3,882	1.14 %	0.50 %	1.00 %
12	3,705	1.19 %	0.50 %	0.75 %
13	3,378	0.86 %	0.50 %	0.50 %
14	3,192	0.70 %	0.50 %	0.50 %
15	3,057	0.43 %	0.50 %	0.50 %
16	2,946	0.93 %	0.50 %	0.50 %
17	2,813	1.02 %	0.50 %	0.50 %
18	2,591	0.33 %	0.50 %	0.50 %
19	2,229	0.59 %	0.50 %	0.50 %
20	1,929	1.35 %	0.50 %	0.50 %
21	1,611	1.23 %	0.50 %	0.50 %
22	1,422	0.62 %	0.50 %	0.50 %
23	1,251	0.62 %	0.50 %	0.50 %
24	1,150	1.11 %	0.50 %	0.50 %
25	1,054	0.67 %	0.50 %	0.50 %
26	965	0.96 %	0.50 %	0.50 %
27	992	0.16 %	0.50 %	0.50 %
28	996	0.60 %	0.50 %	0.50 %
29	975	0.68 %	0.50 %	0.50 %
30	906	0.45 %	0.50 %	0.50 %
Total	83,083			

* Actual merit is actual total reduced by average annual wage increases of the total population during the period of 2.3%.

Merit and Longevity Pay Increases

Employees



Merit and Longevity Pay Increases

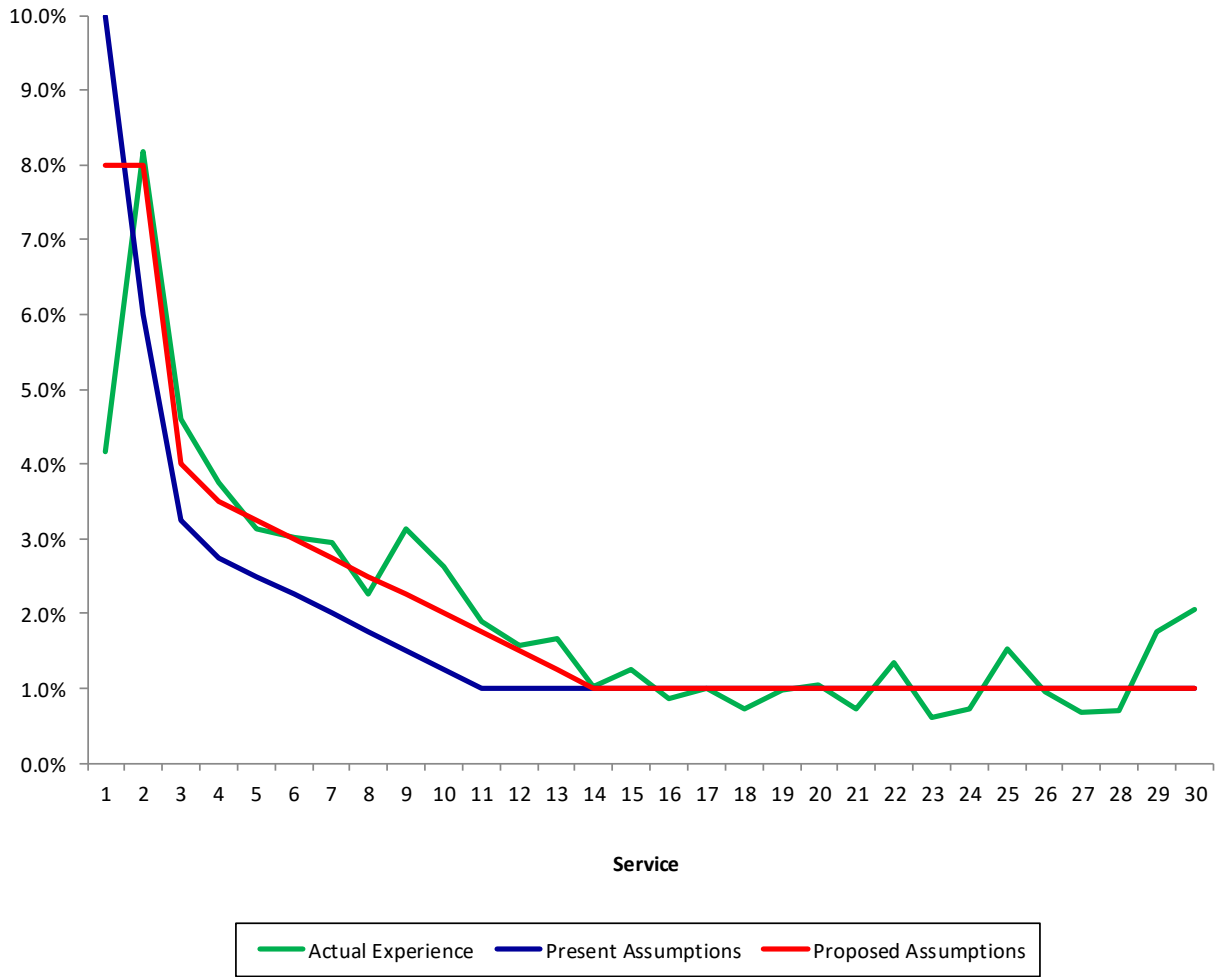
Teachers

Service Index	Number	Merit/Seniority % Increase		
		Actual*	Expected	
			Present	Proposed
1	156	4.16 %	10.00 %	8.00 %
2	3,311	8.17 %	6.00 %	8.00 %
3	3,290	4.59 %	3.25 %	4.00 %
4	2,993	3.74 %	2.75 %	3.50 %
5	2,685	3.14 %	2.50 %	3.25 %
6	2,401	3.01 %	2.25 %	3.00 %
7	2,351	2.94 %	2.00 %	2.75 %
8	2,476	2.25 %	1.75 %	2.50 %
9	2,741	3.13 %	1.50 %	2.25 %
10	2,885	2.62 %	1.25 %	2.00 %
11	3,003	1.91 %	1.00 %	1.75 %
12	2,994	1.58 %	1.00 %	1.50 %
13	2,816	1.67 %	1.00 %	1.25 %
14	2,743	1.03 %	1.00 %	1.00 %
15	2,675	1.26 %	1.00 %	1.00 %
16	2,629	0.86 %	1.00 %	1.00 %
17	2,623	1.00 %	1.00 %	1.00 %
18	2,438	0.72 %	1.00 %	1.00 %
19	2,253	0.97 %	1.00 %	1.00 %
20	1,961	1.04 %	1.00 %	1.00 %
21	1,643	0.72 %	1.00 %	1.00 %
22	1,465	1.35 %	1.00 %	1.00 %
23	1,241	0.61 %	1.00 %	1.00 %
24	1,056	0.72 %	1.00 %	1.00 %
25	875	1.54 %	1.00 %	1.00 %
26	752	0.94 %	1.00 %	1.00 %
27	700	0.68 %	1.00 %	1.00 %
28	741	0.71 %	1.00 %	1.00 %
29	771	1.75 %	1.00 %	1.00 %
30	769	2.06 %	1.00 %	1.00 %
Total	61,437			

* Actual merit is actual total reduced by average annual wage increases of the total population during the period of 2.3%.

Merit and Longevity Pay Increases

Teachers



Merit and Longevity Pay Increases

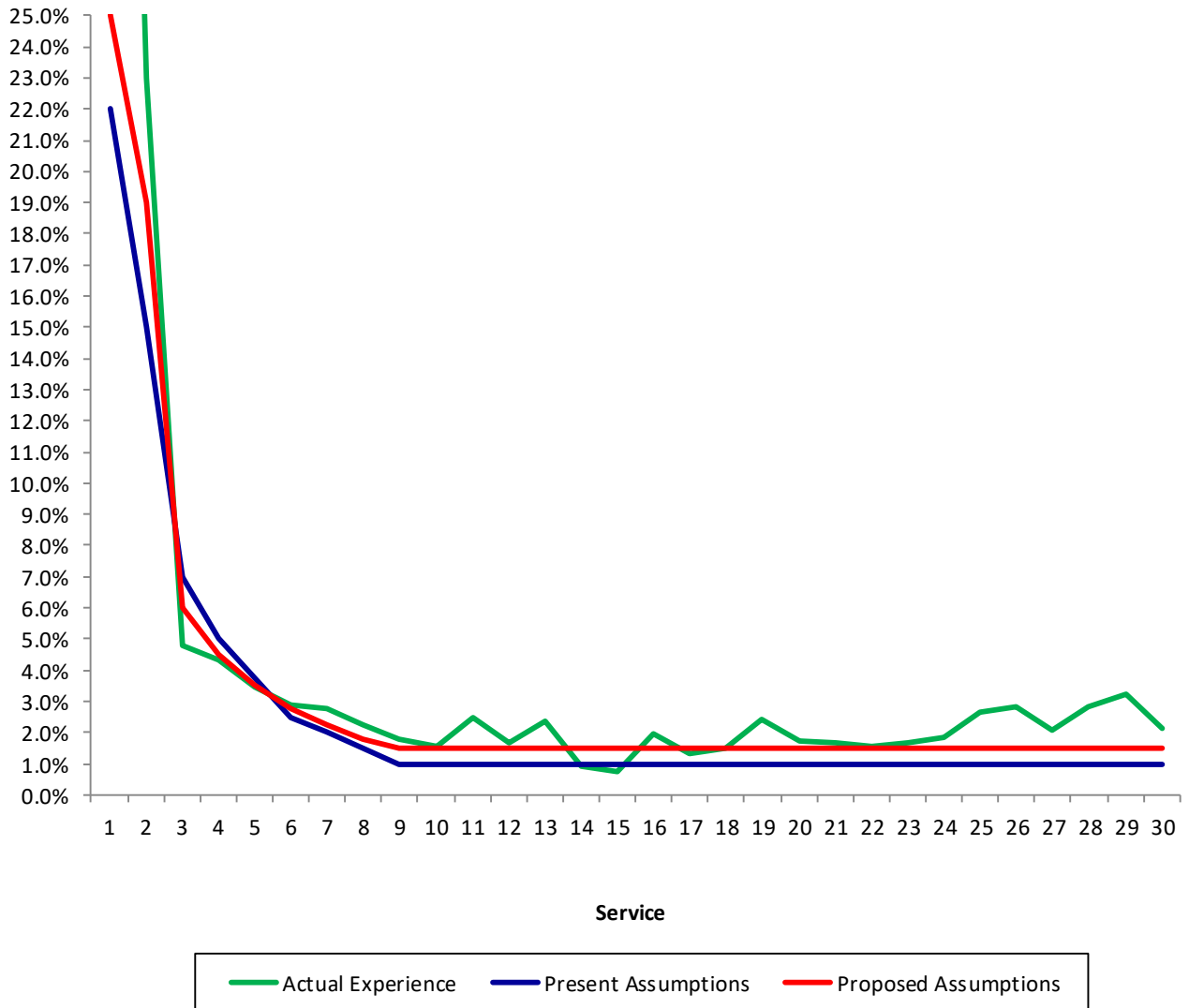
Police

Service		Merit/Seniority % Increase		
		Actual*	Expected	
			Present	Proposed
Index	Number			
1	422	61.88 %	22.00 %	25.00 %
2	1,135	23.01 %	15.00 %	19.00 %
3	960	4.81 %	7.00 %	6.00 %
4	844	4.33 %	5.00 %	4.50 %
5	763	3.46 %	3.75 %	3.50 %
6	632	2.87 %	2.50 %	2.75 %
7	546	2.75 %	2.00 %	2.25 %
8	547	2.24 %	1.50 %	1.80 %
9	586	1.77 %	1.00 %	1.50 %
10	623	1.53 %	1.00 %	1.50 %
11	689	2.45 %	1.00 %	1.50 %
12	683	1.67 %	1.00 %	1.50 %
13	623	2.36 %	1.00 %	1.50 %
14	588	0.93 %	1.00 %	1.50 %
15	592	0.76 %	1.00 %	1.50 %
16	612	1.95 %	1.00 %	1.50 %
17	661	1.32 %	1.00 %	1.50 %
18	628	1.53 %	1.00 %	1.50 %
19	557	2.45 %	1.00 %	1.50 %
20	453	1.71 %	1.00 %	1.50 %
21	352	1.69 %	1.00 %	1.50 %
22	315	1.56 %	1.00 %	1.50 %
23	275	1.67 %	1.00 %	1.50 %
24	218	1.83 %	1.00 %	1.50 %
25	166	2.65 %	1.00 %	1.50 %
26	139	2.84 %	1.00 %	1.50 %
27	127	2.10 %	1.00 %	1.50 %
28	102	2.85 %	1.00 %	1.50 %
29	93	3.24 %	1.00 %	1.50 %
30	79	2.15 %	1.00 %	1.50 %
Total	15,010			

* Actual merit is actual total reduced by average annual wage increases of the total population during the period of 2.3%.

Merit and Longevity Pay Increases

Police



Merit and Longevity Pay Increases

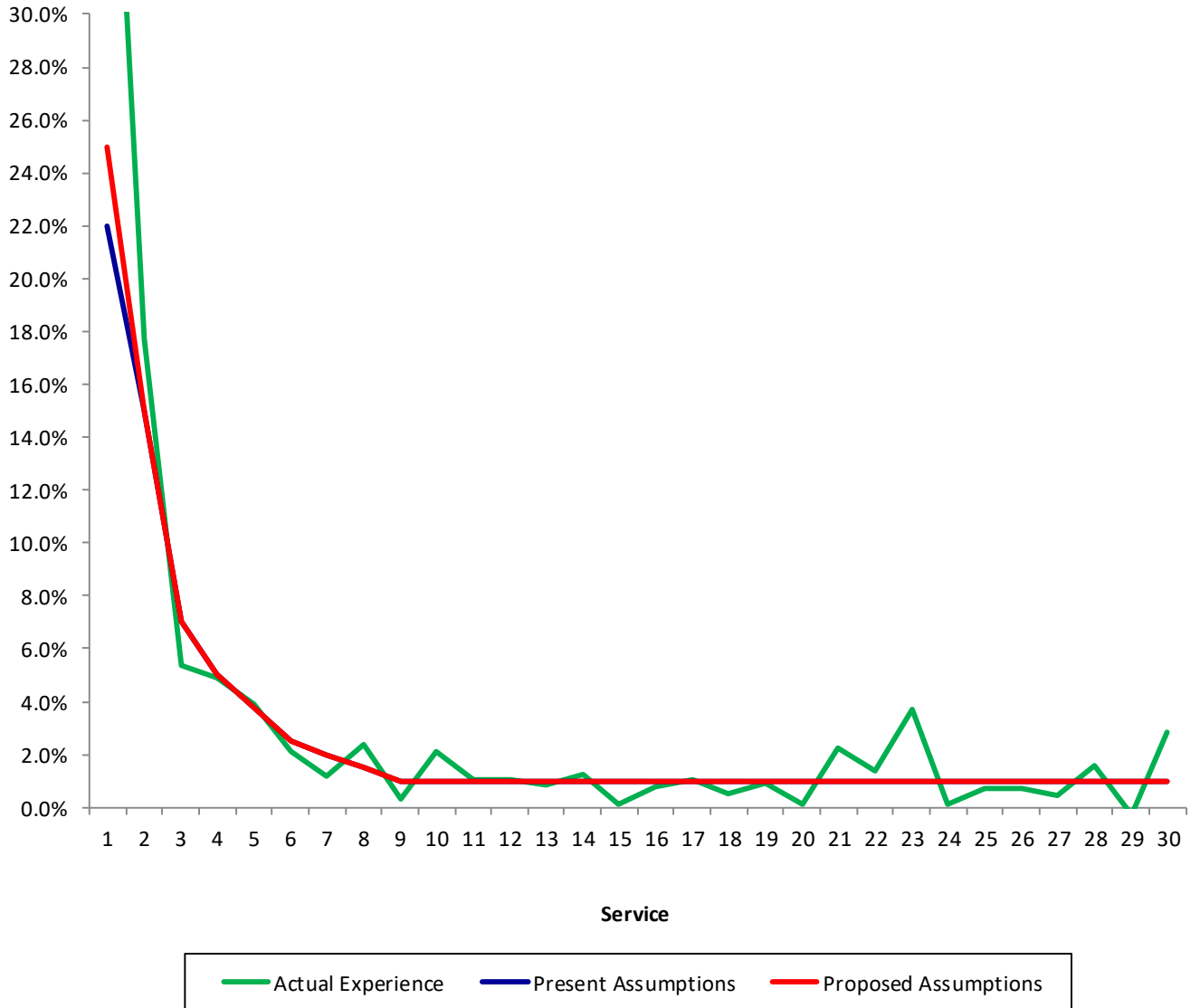
Fire

Service		Merit/Seniority % Increase		
		Actual*	Expected	
			Present	Proposed
Index	Number			
1	121	43.92 %	22.00 %	25.00 %
2	302	17.75 %	15.00 %	15.00 %
3	270	5.39 %	7.00 %	7.00 %
4	247	4.91 %	5.00 %	5.00 %
5	236	3.91 %	3.75 %	3.75 %
6	204	2.11 %	2.50 %	2.50 %
7	185	1.17 %	2.00 %	2.00 %
8	204	2.39 %	1.50 %	1.50 %
9	226	0.31 %	1.00 %	1.00 %
10	253	2.13 %	1.00 %	1.00 %
11	281	1.03 %	1.00 %	1.00 %
12	269	1.04 %	1.00 %	1.00 %
13	272	0.83 %	1.00 %	1.00 %
14	286	1.22 %	1.00 %	1.00 %
15	327	0.13 %	1.00 %	1.00 %
16	335	0.81 %	1.00 %	1.00 %
17	307	1.07 %	1.00 %	1.00 %
18	285	0.50 %	1.00 %	1.00 %
19	226	0.88 %	1.00 %	1.00 %
20	197	0.13 %	1.00 %	1.00 %
21	151	2.25 %	1.00 %	1.00 %
22	126	1.37 %	1.00 %	1.00 %
23	113	3.70 %	1.00 %	1.00 %
24	97	0.11 %	1.00 %	1.00 %
25	85	0.74 %	1.00 %	1.00 %
26	85	0.73 %	1.00 %	1.00 %
27	87	0.44 %	1.00 %	1.00 %
28	81	1.55 %	1.00 %	1.00 %
29	86	(0.26)%	1.00 %	1.00 %
30	74	2.83 %	1.00 %	1.00 %
Total	6,018			

* Actual merit is actual total reduced by average annual wage increases of the total population during the period of 2.3%.

Merit and Longevity Pay Increases

Fire



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 a gradual shift in employment from full time to part time resulting in declining NHRS active membership, but it was not clear whether the trend would persist or level out. In this study period the active member count for NHRS has remained relatively stable whereas the number of part time state and local employees has declined.

State and Local Employees - All Job Classifications

Year	U.S. Census Annual Survey ¹		NHRS ²
	Full Time	Part Time	
2007	61,801	26,304	50,802
2008	61,395	25,611	50,988
2009	63,213	26,599	51,032
2010	61,639	29,477	50,467
2011	60,630	29,292	49,738
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

Annual Rate of Change

All Years	-0.70%	0.78%	-0.49%
Last 5 years	-0.01%	-0.90%	-0.23%
Last 4 years	-0.48%	-2.56%	-0.10%
Last 3 years	-0.66%	-3.98%	0.21%

¹ Historical information based on data submitted for the annual valuations.

² Historical information for the State of New Hampshire based on U.S. Census Annual Surveys of Public Employment & Payroll, March 2018.

Population Size

It is not clear whether the shift to part time employees will return, especially in light of the recent economic shock concurrent with the COVID-19 outbreak. No adjustment has been made to this analysis in conjunction with COVID-19.

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 2040 produced by the State of New Hampshire, Office of Energy and Planning Regional Planning Commission's County Population Projections report from 2016. 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.

Historical Information						
June 30	Employees' Headcount ¹	Annual Rate of Change	New Hampshire Population ²	Annual Rate of Change	Population/ Employee Ratio	Annual Rate of Change
2007	26,474	0.00%	1,315,000	0.00%	49.67	0.00%
2008	26,507	0.12%	1,315,000	0.00%	49.61	-0.12%
2009	26,352	-0.58%	1,324,575	0.73%	50.26	1.32%
2010	25,987	-1.39%	1,316,470	-0.61%	50.66	0.78%
2011	25,539	-1.72%	1,318,000	0.12%	51.61	1.87%
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%
Projections						
June 30	Employees' Headcount ¹	Annual Rate of Change	New Hampshire Population ²	Annual Rate of Change	Population/ Employee Ratio	Annual Rate of Change
2020	24,511	0.00%	1,349,908	0.00%	55.07	0.00%
2025	24,511	0.00%	1,374,702	0.36%	56.09	0.36%
2030	24,511	0.00%	1,402,878	0.41%	57.23	0.41%
2035	24,511	0.00%	1,422,530	0.28%	58.04	0.28%
2040	24,511	0.00%	1,432,730	0.14%	58.45	0.14%

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

²Historical information based on New Hampshire Office of Energy and Planning historical reports. Projections based on State of New Hampshire, Office of Energy and Planning Regional Planning Commissions County Population Projections.

The ratio of the general population to active Employees for 2018 is 55.33, roughly a 11% increase since 2007 when the ratio was 49.67. A projection of 0% growth in the active member headcount through 2040 results in a ratio of 58.45, roughly an increase of 6% from 2018. 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 the recent decline in active members will not continue indefinitely given the projected population increase.

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
2007	18,477			200,975			10.88	
2008	18,509	0.17%		195,668		-2.64%	10.57	-2.81%
2009	18,709	1.08%		192,811		-1.46%	10.31	-2.51%
2010	18,603	-0.57%	255,996	191,802	75%	-0.52%	10.31	0.04%
2011	18,466	-0.74%		188,595		-1.67%	10.21	-0.94%
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%

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
2020	17,291	-0.50%	230,191	169,757	74%	0.08%	9.82	0.59%
2025	16,863	-0.50%	225,576	166,354	74%	-0.40%	9.86	0.10%
2030	16,446	-0.50%	228,127	168,235	74%	0.23%	10.23	0.73%
2035	16,039	-0.50%	231,533	170,747	74%	0.30%	10.65	0.80%
2040	15,642	-0.50%	231,669	170,847	74%	0.01%	10.92	0.51%

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

²Historical and projected general population counts are based on State of New Hampshire, Office of Energy and Planning Regional Planning Commissions County Population Projections, 2016, prepared by RLS Demographics.

³Historical information based on New Hampshire Department of Education data as of December 23, 2019. Projections based on State of New Hampshire, Office of Energy and Planning Regional Planning Commissions County Population Projections, 2016, 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 74-75%. 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 2019 is 9.53, roughly a 12% decrease since 2007 when the ratio was 10.88. This suggests that the active Teacher workforce has not declined as rapidly as the school-age population from 2007 to 2019. With the current 0.5% decrease assumption, the student/teacher ratio stabilizes then gradually increases through 2040. 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
2007	4,263	0.00%	1,315,000	0.00%	308.47	0.00%
2008	4,332	1.62%	1,315,000	0.00%	303.55	-1.59%
2009	4,318	-0.32%	1,324,575	0.73%	306.76	1.05%
2010	4,231	-2.01%	1,316,470	-0.61%	311.15	1.43%
2011	4,130	-2.39%	1,318,000	0.12%	319.13	2.56%
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%

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
2020	4,197	0.00%	1,349,908	0.00%	321.64	0.00%
2025	4,197	0.00%	1,374,702	0.36%	327.54	0.36%
2030	4,197	0.00%	1,402,878	0.41%	334.26	0.41%
2035	4,197	0.00%	1,422,530	0.28%	338.94	0.28%
2040	4,197	0.00%	1,432,730	0.14%	341.37	0.14%

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

²Historical information based on New Hampshire Office of Energy and Planning historical reports. Projections based on State of New Hampshire, Office of Energy and Planning Regional Planning Commissions County Population Projections.

The ratio of the general population to active Police members for 2018 is 323.15, roughly a 5% increase since 2007 when the ratio was 308.47. A projection of 0% growth in the active member headcount through 2040 results in a ratio of 341.37, roughly an increase of 6% from 2018. 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 previous declines in active members will not continue indefinitely given the projected population increase.

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
2007	1,588	0.00%	1,315,000	0.00%	828.09	0.00%
2008	1,640	3.27%	1,315,000	0.00%	801.83	-3.17%
2009	1,653	0.79%	1,324,575	0.73%	801.32	-0.06%
2010	1,646	-0.42%	1,316,470	-0.61%	799.80	-0.19%
2011	1,603	-2.61%	1,318,000	0.12%	822.21	2.80%
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%

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
2020	1,661	0.00%	1,349,908	0.00%	812.71	0.00%
2025	1,661	0.00%	1,374,702	0.36%	827.64	0.36%
2030	1,661	0.00%	1,402,878	0.41%	844.60	0.41%
2035	1,661	0.00%	1,422,530	0.28%	856.43	0.28%
2040	1,661	0.00%	1,432,730	0.14%	862.57	0.14%

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

²Historical information based on New Hampshire Office of Energy and Planning historical reports. Projections based on State of New Hampshire, Office of Energy and Planning Regional Planning Commissions County Population Projections.

The ratio of the general population to active Fire members for 2018 is 816.54, about a 1% decrease since 2007 when the ratio was 828.09. A projection of 0% growth in the active member headcount through 2040 results in a ratio of 862.57, roughly an increase of 6% from 2018. 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 despite recent marginal declines.

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 3.25% per year, compounded annually (net after investment expenses) for purposes of computing accrued 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 was 7.25%, 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. Currently, short-term, low-risk investments are experiencing very low yields. 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. Therefore, we recommend setting the funding discount rate for the medical subsidy equal to the wage inflation.

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 using the wage inflation assumption and investment return assumption adopted by the Board for 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 insufficient data from that population to assess end of career payments.

Summary of Data

	Retiree Data as of June 30, 2019				
	Employees	Teachers	Police	Fire	Total
Number of Retirees	18,824	13,740	4,082	1,706	38,352
Pension Payroll	\$263,176,582	\$305,526,678	\$150,659,988	\$69,273,048	\$788,636,296
Average Age	71.9	71.7	64.4	66.6	70.8
Average Pay	\$13,981	\$22,236	\$36,908	\$40,606	\$20,563

	Retiree Data Available For Load Analysis as of June 30, 2019*				
	Employees	Teachers	Police	Fire	Total
(a) Members retiring in 4 yr. period ending 6/30/19	4,387	2,834	689	267	8,177
(b) Members in (a) for which final AFC was available	3,925	2,572	534	198	7,229
(c) Members in (b) that had 3 complete years of active pay history	3,898	2,564	531	197	7,190
(d) Members in (b) that had 6 complete years of active pay history	3,816	1,867	380	145	6,208

* Includes members who have retired from deferred status.

Summary of Results

Group	(A)	(B)	(C)	(D)	(E)
	Liability/Normal Cost Load	Raw Load Results Using Final 3 Years Prior to Retirement	Raw Load Results Using Reported Pays 4-6 Years Prior to Retirement	Recommended Liability/Normal Cost Load	Change from Current (A) to Recommended (D)
Employees	7.5%	10.7%	17.8%	8.5%	1.0%
Teachers	5.0%	6.9%	17.1%	5.5%	0.5%
Police	11.5%	10.7%	21.8%	11.0%	(0.5)%
Fire	11.5%	13.2%	22.1%	12.0%	0.5%

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

Recommendation

We recommend increasing the assumed liability/normal costs loads for end of career payments for Employees, Teacher and Fire. We recommend decreasing the assumed liability/normal costs loads for end of career payments for Police.

Administrative Expense Assumption

EXPENSE LOAD ANALYSIS

<u>Fiscal Year Ending</u>	<u>Admin. & Misc. Expenses *</u>	<u>Total Payroll</u>	<u>As a % of Payroll</u>
6/30/2016	\$ 8,474,130	\$ 2,601,403,606	0.33%
6/30/2017	9,065,216	2,667,611,532	0.34%
6/30/2018	9,287,693	2,752,235,069	0.34%
6/30/2019	9,112,537	2,825,006,022	0.32%
4-year average			0.33%

* 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, 2015, to June 30, 2019.

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.

Mortality rates have generally decreased over time in the U.S., meaning that life expectancies have generally increased over time. The assumption for future decreases in mortality is referred to as the mortality improvement assumption. In general, the mortality and mortality improvement assumptions are treated separately. The analysis in this section covers the period of 2015 through 2019. During this time, mortality improvement may have occurred. A general procedure is to adjust the actual experience for mortality improvements during the study period to the central year, in this case 2017. For purposes of this study, proposed mortality rates shown in the tables have been adjusted to the central year 2017 using the MP-2019 projection scales.

In January 2019, the Society of Actuaries (SOA) issued the final version of Pub-2010 Public Retirement Plans Mortality Tables. This is the first set of mortality rates published based on U.S. public sector experience. In this study, the SOA examined mortality for Teachers, Public Safety, and General employment categories. The SOA also studied mortality rates by gender, income (in total and separated into above and below median), and status (active employees, retirees, disabled retirees, and contingent survivors). As a consequence, there are over 90 Pub-2010 tables to select from.

In August 2018, the Society of Actuaries (SOA) reviewed the comprehensive annual financial reports of the majority of large public sector employees' retirement systems for a review of their mortality assumptions. The SOA report included analysis of certain annuity values under current assumptions and the new Pub-2010 tables.

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

- **Current mortality assumption:** RP-2014 Healthy Annuitant Mortality Tables, with fully generational mortality improvement using MP-2015 and the following partial credibility adjustments.

	<u>Employees</u>	<u>Teachers</u>	<u>Police</u>	<u>Fire</u>
Male	116%	100%	99%	100%
Female	124%	87%	106%	101%

- **Proposed mortality assumption:** Group-specific Pub-2010 Mortality Tables respectively for healthy annuitants, disabled annuitants, and active employees, projected with fully generational mortality improvement using MP-2019, and partial credibility adjustment shown on page C-5 (for healthy annuitants). Credibility adjustments for Police and Fire are combined.

Mortality Experience

The impact of the proposed mortality and mortality improvement assumptions was different for each member classification. Employees had the largest relative increase of approximately 3% of actuarial accrued liability due to their experience and gender mix. The other member classifications had a relative increase of approximately 1% of actuarial accrued liability. A portion of the increase for Police and Fire was as a result of applying a separate post-disabled mortality assumption from Employees and Teachers from the Pub-2010 tables.

The expected new liability-weighted deaths for each gender are based on the Pub-2010 Healthy Retiree tables. Based on the good fit of the liability-weighted deaths, these tables are an appropriate selection for the System as a whole. Tables have been extended to younger ages as needed using a cubic spline method with the published Juvenile rates. Additional adjustments by member classification are described below.

Disabled Retirees

Disabled mortality experience during the study period was not sufficient to be fully credible. We recommend adopting the respective group-specific Pub-2010 Disabled Retiree mortality tables.

Active Members

Active mortality experience during the study period was not sufficient to be fully credible. We recommend adopting the respective group-specific Pub-2010 Employee mortality tables. There was insufficient experience to warrant a change in the ordinary/accidental death weighting assumption.

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

Mortality Improvement

We recommend projecting fully generational mortality improvement with Scale MP-2019 to the selected Pub-2010 tables with a base year of 2010.

Partial Credibility

We use the limited fluctuation credibility procedure to determine the appropriate scaling factor of the base mortality tables for each gender and each member classification on a liability-weighted basis. In each case, the Z-factor is computed based on the experience of the group being studied. This Z-factor is a measure of the credibility of the pertinent group.

The Best Fit is the ratio of actual to expected deaths using the base table. The final scale is then determined as the weighted average of the Best Fit and 100% based on the Z-factor. For example, for male Employees, the Z-factor of 47% suggests the data for that group is 47% credible. The Best Fit for that group would be to scale the base tables by 103%. The final scale of 101% is the credibility-weighted average ($101\% = 47\% \times 103\% + 53\% \times 100\%$). Factors for other groups are determined similarly.

Retiree Mortality Experience

	Deaths Needed For Full Credibility	Observed NHRS Healthy Retiree Deaths		
		Employees	Teachers	Police/Fire
Male	3,701	812	522	556
Female	2,389	568	782	24
		Employees Teachers Police/Fire		
Z-Male		47%	38%	39%
Z-Female		49%	57%	10%
Scale-Male		101%	102%	96%
Scale-Female		109%	105%	99%
Best Fit Male		103%	106%	90%
Best Fit Female		118%	108%	92%

The specifics of the recommended mortality tables follow:

Employees:

Healthy Annuitant: *PubG-2010* amount-weighted Healthy Retiree General Mortality Tables
 Disabled Annuitant: *PubG-2010* amount-weighted Disabled Retiree General Mortality Tables
 Active Member: *PubG-2010* amount-weighted Employee General Mortality Tables

Teachers:

Healthy Annuitant: *PubT-2010* amount-weighted Healthy Retiree Teachers Mortality Tables
 Disabled Annuitant: *PubT-2010* amount-weighted Disabled Retiree Teachers Mortality Tables
 Active Member: *PubT-2010* amount-weighted Employee Teachers Mortality Tables

Police and Fire:

Healthy Annuitant: *PubS-2010* amount-weighted Healthy Retiree Safety Mortality Tables
 Disabled Annuitant: *PubS-2010* amount-weighted Disabled Retiree Safety Mortality Tables
 Active Member: *PubS-2010* amount-weighted Employee Safety Mortality Tables

Note: Mortality rates for disabled retirees under *PubG-2010* and *PubT-2010* are equal.

Recommendation

We recommend adoption of the proposed mortality rates, partial credibility adjustments, and improvement scales.



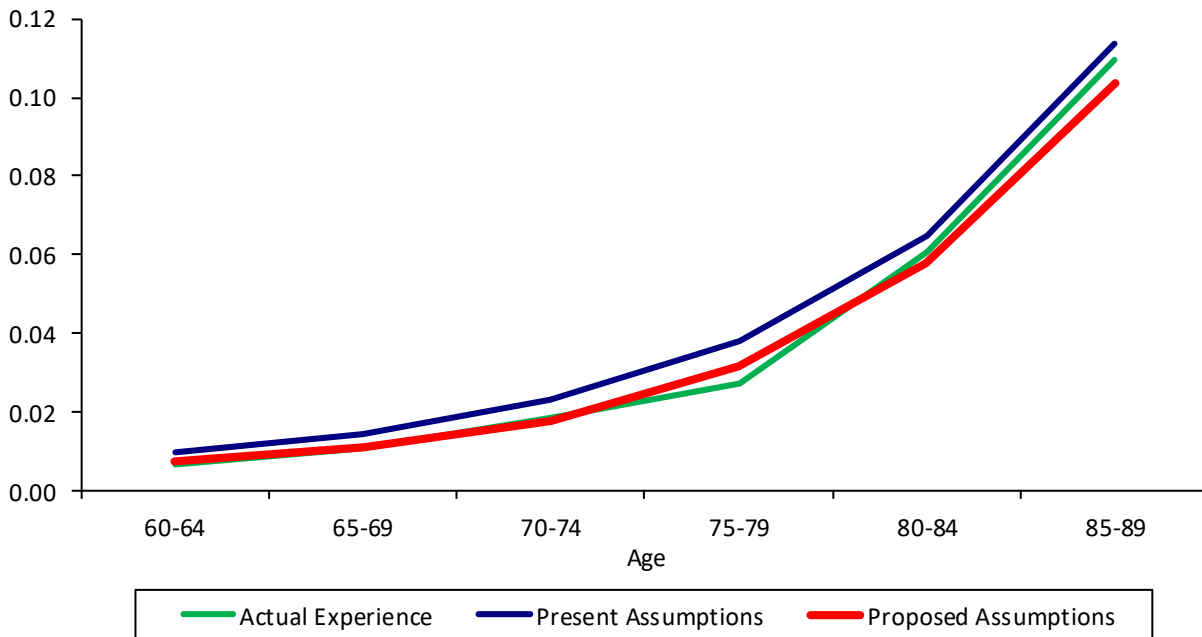
Healthy Male Retiree Mortality Experience – Employees

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	12.3	370.4	0.033213	0.005146	0.003339	2.0	1.3
55-59	11.9	1,572.1	0.007565	0.007301	0.005099	12.0	8.5
60-64	49.6	7,550.0	0.006572	0.010060	0.007454	79.1	58.5
65-69	129.7	12,098.6	0.010718	0.014574	0.010898	179.8	134.9
70-74	173.4	9,309.1	0.018629	0.023000	0.017963	210.9	164.7
75-79	121.3	4,450.4	0.027248	0.038000	0.031687	165.2	137.5
80-84	144.8	2,390.4	0.060591	0.064940	0.057682	152.5	135.1
85-89	110.9	1,014.3	0.109359	0.113513	0.103449	110.6	100.6
90-94	49.2	256.5	0.191945	0.193012	0.171795	47.6	42.5
95-99	8.0	36.4	0.218643	0.288893	0.258011	9.6	8.6
100-104	0.6	1.3	0.441388	0.404267	0.359140	0.5	0.4
105-109	-	-	N/A			-	-
Other	-	-	N/A			-	-
Totals	811.7	39,049.5	0.020786	0.024836	0.020301	969.8	792.7

* Sample rates are taken from midpoint of age group.

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



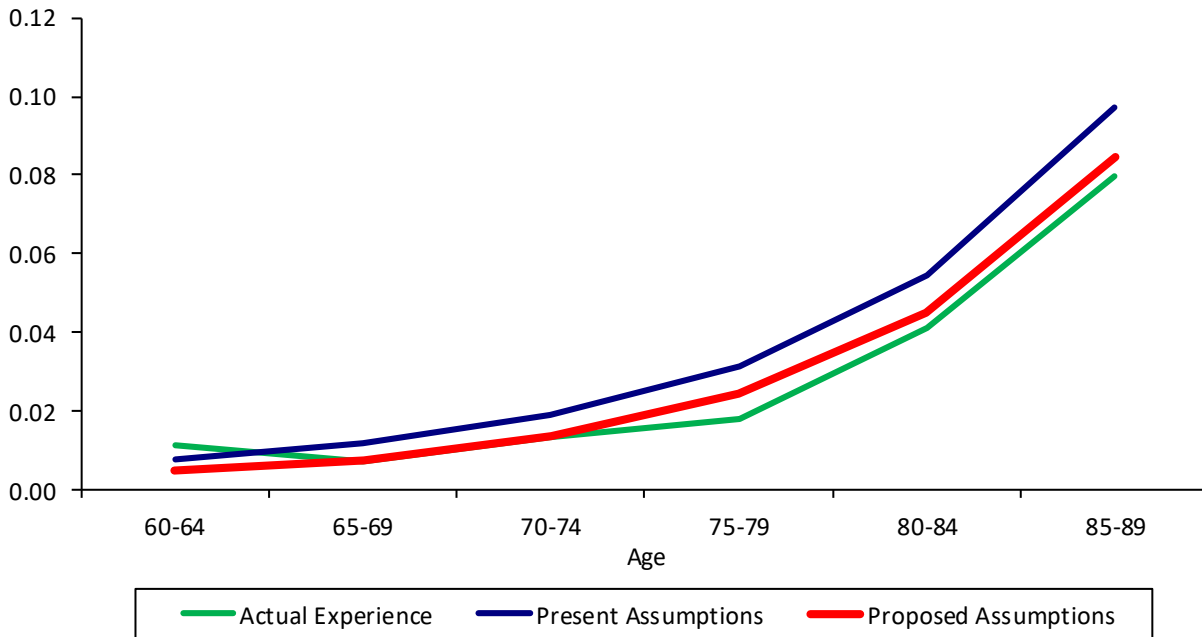
Healthy Female Retiree Mortality Experience – Employees

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	3.3	272.4	0.011977	0.003665	0.002690	1.1	0.8
55-59	43.6	1,899.3	0.022972	0.005230	0.003687	10.4	7.3
60-64	84.2	7,521.4	0.011199	0.007604	0.005019	59.6	39.4
65-69	86.8	12,248.2	0.007087	0.011689	0.007768	145.7	97.3
70-74	113.0	8,452.0	0.013375	0.019019	0.013479	157.7	111.8
75-79	69.4	3,869.0	0.017944	0.031652	0.024429	119.0	91.5
80-84	70.3	1,696.8	0.041412	0.054765	0.044996	91.8	75.4
85-89	56.7	712.1	0.079611	0.097406	0.084470	67.3	58.2
90-94	31.9	249.1	0.127978	0.168117	0.150409	40.3	36.0
95-99	7.9	32.7	0.240665	0.264527	0.235708	8.0	7.1
100-104	1.0	3.4	0.289157	0.385902	0.345444	1.3	1.1
105-109	0.1	0.2	0.487712	0.509125	0.457374	0.1	0.1
Other	-	-	N/A			-	-
Totals	568.2	36,956.7	0.015375	0.018999	0.014228	702.1	525.8

* Sample rates are taken from midpoint of age group.

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



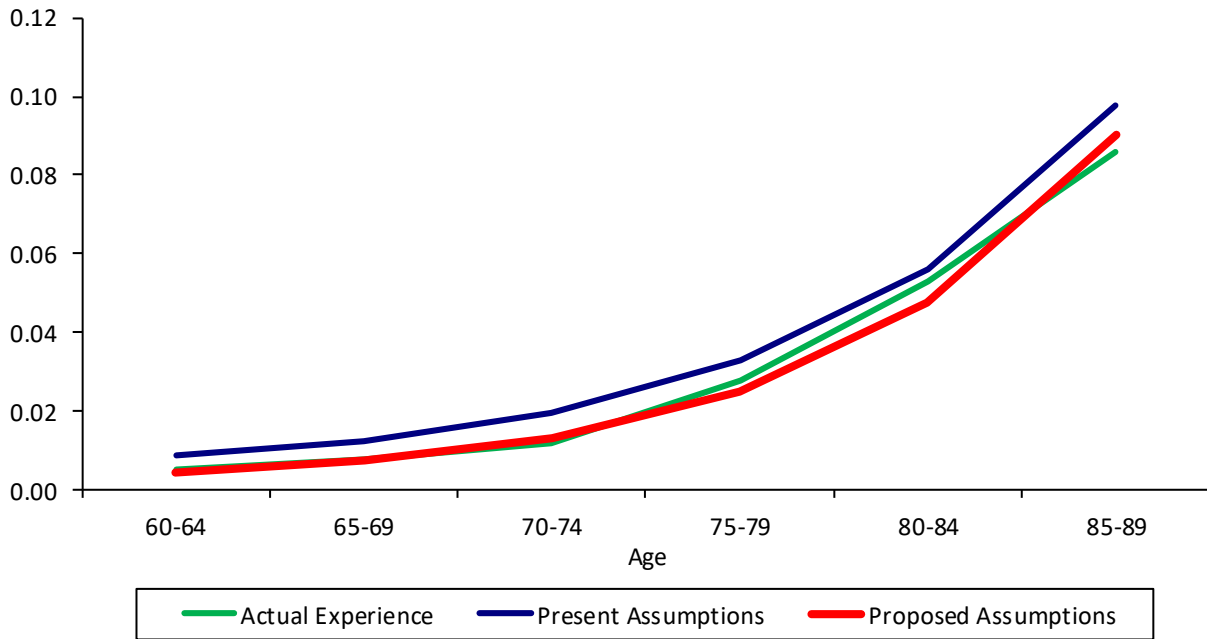
Healthy Male Retiree Mortality Experience – Teachers

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	0.7	35.7	0.018832	0.004436	0.001452	0.2	0.1
55-59	2.5	514.1	0.004833	0.006294	0.002788	3.4	1.5
60-64	20.7	4,079.1	0.005065	0.008672	0.004582	37.2	20.0
65-69	85.0	10,714.4	0.007930	0.012564	0.007380	138.5	82.1
70-74	113.1	9,374.7	0.012059	0.019828	0.013139	181.7	120.1
75-79	105.1	3,761.6	0.027943	0.032759	0.025031	120.6	91.7
80-84	110.4	2,090.7	0.052790	0.055983	0.047655	115.9	98.6
85-89	66.7	778.1	0.085704	0.097856	0.090262	72.2	66.2
90-94	14.3	117.4	0.121956	0.166390	0.162106	17.7	17.0
95-99	3.7	9.8	0.372412	0.249046	0.258413	2.2	2.3
100-104	-	2.9	0.000000	0.348506	0.362696	0.9	1.0
105-109	-	-	N/A			-	-
Other	-	-	N/A			-	-
Totals	522.0	31,478.6	0.016582	0.021934	0.015905	690.4	500.7

* Sample rates are taken from midpoint of age group.

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



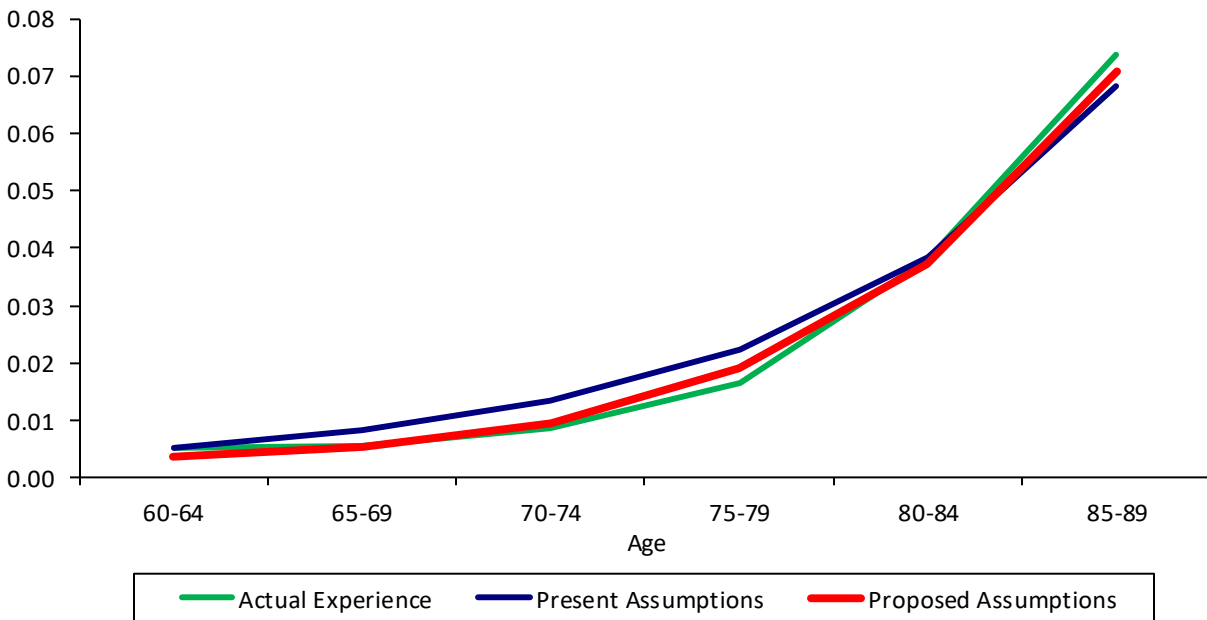
Healthy Female Retiree Mortality Experience – Teachers

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	6.4	143.2	0.044697	0.002572	0.001201	0.4	0.2
55-59	9.8	1,531.0	0.006434	0.003670	0.002525	6.0	4.1
60-64	65.7	12,548.6	0.005235	0.005335	0.003611	70.9	47.6
65-69	155.1	28,175.4	0.005506	0.008201	0.005376	235.4	155.4
70-74	155.0	17,991.4	0.008616	0.013344	0.009610	231.9	166.4
75-79	105.0	6,375.9	0.016468	0.022208	0.018912	138.4	117.2
80-84	119.5	3,141.5	0.038055	0.038424	0.037049	118.1	113.4
85-89	84.9	1,151.4	0.073755	0.068341	0.070764	75.8	78.3
90-94	48.7	405.5	0.120079	0.117953	0.130909	46.1	51.0
95-99	25.9	98.8	0.262321	0.185595	0.223715	17.8	21.3
100-104	5.4	15.1	0.355109	0.270754	0.332767	3.9	4.8
105-109	0.1	0.4	0.322130	0.357209	0.440589	0.1	0.2
Other	-	-	N/A			-	-
Totals	781.6	71,578.1	0.010920	0.013198	0.010617	944.7	760.0

* Sample rates are taken from midpoint of age group.

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



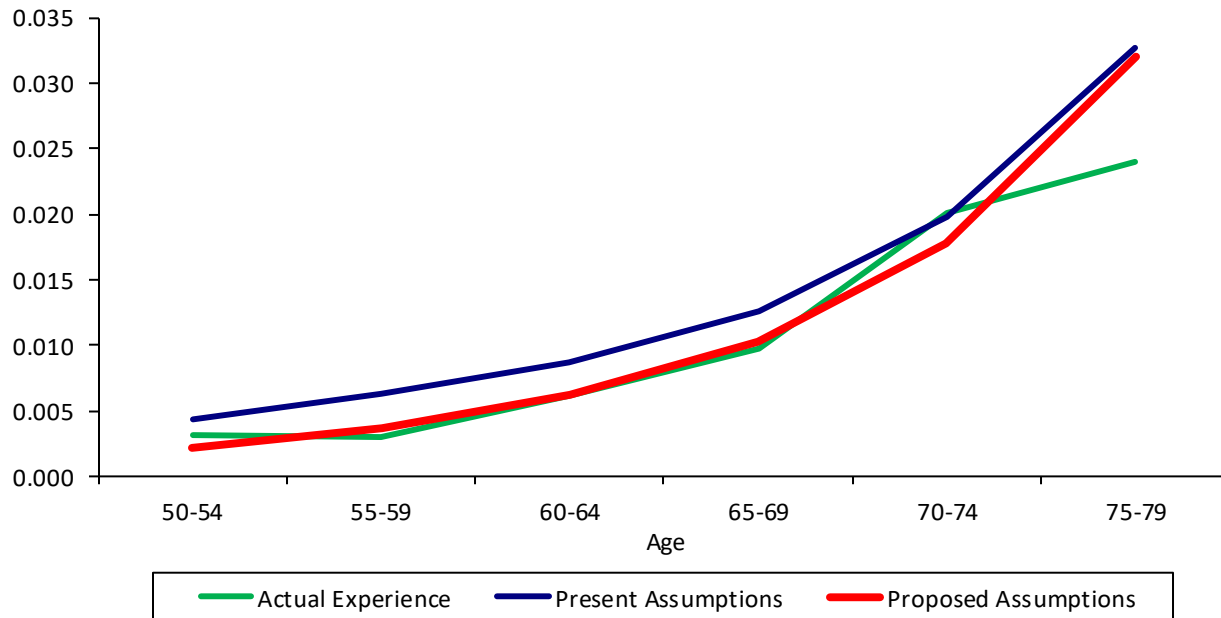
Healthy Male Retiree Mortality Experience – Police and Fire

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	40.3	12,709.2	0.003168	0.004436	0.002119	57.0	27.6
55-59	49.5	16,620.1	0.002981	0.006294	0.003628	105.4	61.6
60-64	91.7	14,968.3	0.006125	0.008672	0.006270	130.0	93.8
65-69	102.2	10,476.8	0.009754	0.012564	0.010349	130.8	107.5
70-74	116.3	5,801.7	0.020041	0.019828	0.017791	112.9	101.2
75-79	65.5	2,734.3	0.023936	0.032759	0.032063	87.9	85.9
80-84	42.8	1,054.7	0.040561	0.055983	0.058523	57.4	59.8
85-89	34.1	384.9	0.088559	0.097856	0.104749	36.3	38.8
90-94	13.4	103.1	0.129902	0.166390	0.176302	15.8	16.8
95-99	0.7	8.2	0.087260	0.249046	0.249095	2.2	2.2
100-104	-	1.4	0.000000	0.348506	0.341361	0.4	0.4
105-109	-	-	N/A			-	-
Other	-	-	N/A			-	-
Totals	556.4	64,862.8	0.008578	0.011351	0.009184	736.3	595.7

* Sample rates are taken from midpoint of age group.

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



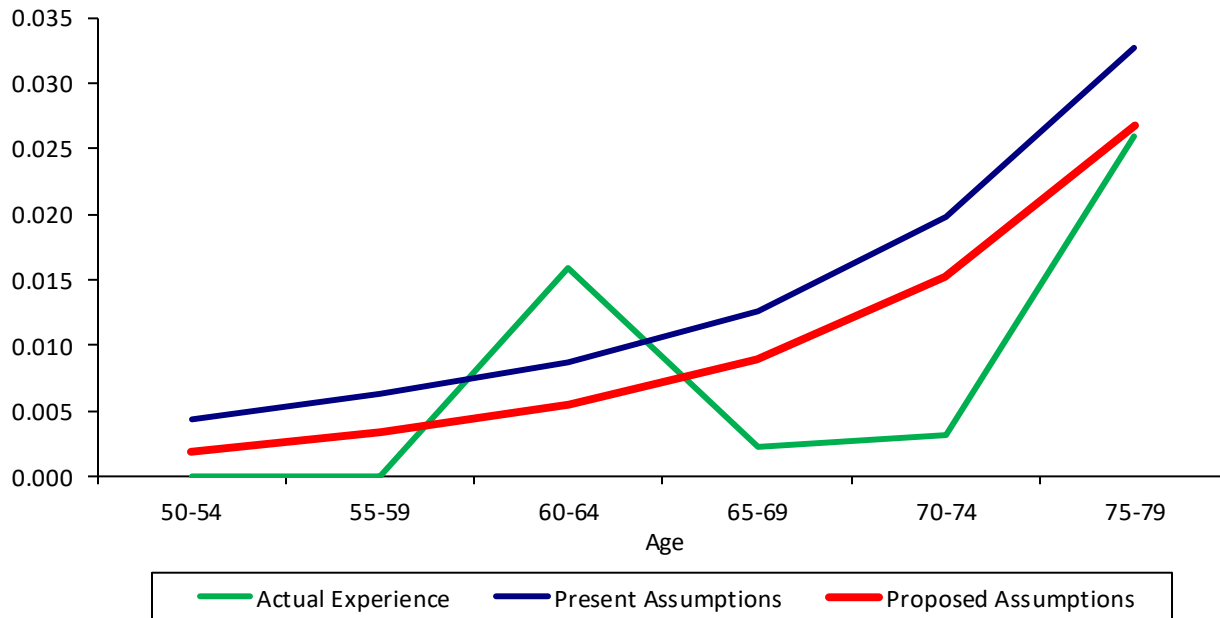
Healthy Female Retiree Mortality Experience – Police and Fire

Actual and expected deaths and exposures are **liability weighted** with a scaling factor of \$100,000.

Age	Deaths	Exposure	Crude Rates	Sample Rates*		Expected Deaths**	
				Present	Proposed	Present	Proposed
50-54	-	673.6	0.000000	0.004436	0.001847	3.0	1.2
55-59	-	886.1	0.000000	0.006294	0.003381	5.5	2.9
60-64	11.2	703.7	0.015922	0.008672	0.005563	6.1	3.9
65-69	1.1	460.2	0.002341	0.012564	0.008884	5.8	4.1
70-74	0.9	274.8	0.003217	0.019828	0.015159	5.4	4.1
75-79	3.6	138.5	0.025966	0.032759	0.026751	4.3	3.5
80-84	3.8	63.1	0.059856	0.055983	0.047118	3.5	3.0
85-89	1.3	18.1	0.070292	0.097856	0.081772	1.7	1.4
90-94	1.7	9.2	0.185194	0.166390	0.139057	1.4	1.1
95-99	0.2	0.3	0.489339	0.249046	0.214593	0.1	0.1
100-104	-	-	N/A			-	-
105-109	-	-	N/A			-	-
Other	-	-	N/A			-	-
Totals	23.7	3,227.8	0.007341	0.011377	0.007869	36.7	25.4

* Sample rates are taken from midpoint of age group.

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



SECTION D

DEMOGRAPHIC ASSUMPTIONS – EMPLOYEES

Demographic Assumptions - Employees

Withdrawal Experience

Findings

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 than members who stay in employment until retirement. Higher rates of withdrawal result in lower computed contributions, and vice-versa.

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.

The analysis for members with fewer than 5 years of credited service is shown on pages D-6. Overall, the plan experienced fewer withdrawals (4,988) than projected by the present assumptions (5,043 – see totals on page D-6). This experience suggests a need to lower the assumed rates of withdrawal among individuals with fewer than 5 years of service.

The analysis for members with 5 or more years of credited service is shown on pages D-5. Overall, the plan experienced fewer withdrawals (1,935) than projected by the present assumptions (2,096 – see totals on page D-5). This experience suggests a need to lower the assumed rates of withdrawal among individuals with 5 or more years of service.

Other

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.

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

We recommend adoption of the proposed withdrawal assumptions combined for males and females.

Demographic Assumptions - Employees

Disability Experience

Findings

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. To allow for a higher degree of credibility, male and female rates were observed together and the proposed rates are for the combined population.

We reviewed the disability experience during the 4-year period. The results are shown on page D-8. Overall, the plan experienced fewer disability retirements (62) than projected by the present assumptions (150.1 – see totals on page D-7). This experience suggests a need to decrease 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.

Other

Approximately 38% of disabilities during the period were considered accidental disabilities, versus the current assumption of 40%. This experience suggests that the current assumption concerning the frequency of accidental and ordinary disabilities continues to be appropriate.

Recommendation

We recommend adoption of the proposed disability retirement rates combined for male and female individuals. In addition, we recommend continuing to assume that 40% of disabilities are accidental.

Demographic Assumptions - Employees

Age and Service (Normal) Retirement Experience

Findings

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. Group I members hired before July 1, 2011 may retire at age 60 with unreduced benefits. 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 for members hired prior to July 1, 2011. 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, retirement rates for those hired on or after July 1, 2011 are adjusted in the first two years of unreduced retirement eligibility to model pent-up demand for retirement.

Males

We reviewed the retirement experience among active male members during the study period. The results are shown on page D-8. For active male members under the age of 70, the plan experienced fewer retirements (1,048) than projected by the present assumptions (1,090 – see totals on page D-8). This experience suggests a need to lower the assumed rates of retirement among eligible male individuals. Retirement rates for ages 70 and above are set to 100% as a margin for adverse experience. 143 retirements of male actives age 70 and older were observed versus 623 expected.

Females

We reviewed the retirement experience among active female members during the study period. The results are shown on page D-9. Current assumptions for female members eligible for normal retirement during the study period overestimated retirements in earlier ages while the assumed retirements over age 65 (and below 70) were underestimated. For female members under age 70, the plan experienced slightly more retirements (1,663) than projected by the present assumptions (1,658 – see totals on page D-9). This experience suggests a need to lower the assumed rates of retirement in earlier ages and increase those in later years for eligible female individuals. Retirement rates for ages 70 and above are set to 100% as a margin for adverse experience. 170 retirements of female actives age 70 and older were observed versus 757 expected.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendations

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



Demographic Assumptions - Employees

Early Retirement Experience

Findings

NHRS Employees 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 they were eligible for normal retirement. Early retirement eligibility conditions for those hired on or after July 1, 2011 are at age 60 with 30 years of service.

Generally, because of the subsidized early retirement reduction, these members' immediate reduced benefits have a slightly greater value than the deferred benefit for 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. 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.

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 results are shown on page D-10. Overall, the plan experienced fewer early retirements (217) than projected by the present assumptions (355 – see totals on page D-10). This experience suggests a need to lower the assumed rates of early retirement among eligible individuals.

We also reviewed the early retirement experience among active members during the study period that meet early retirement eligibility under the rule of 70. The results are shown on page D-11. Overall, the plan experienced fewer early retirements (222) than projected by the present assumptions (289 – see totals on page D-11). This experience suggests a need to lower the assumed rates of early retirement among eligible individuals.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

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

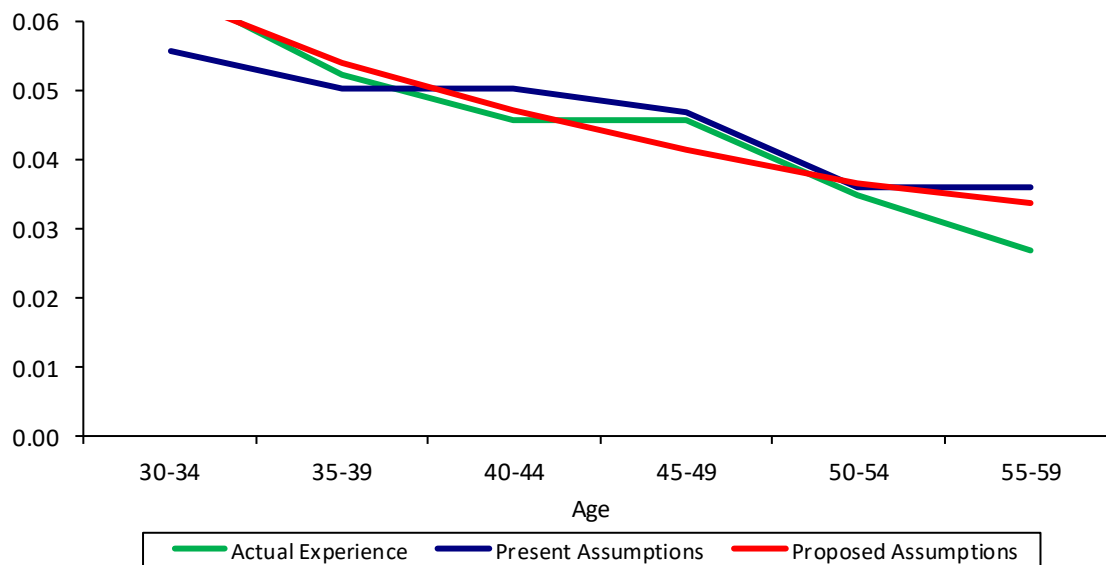
Demographic Assumptions - Employees

Male & Female Age-Based Withdrawal Experience

A withdrawal is a separation from active member status for a reason other than disability, death or retirement and may be either vested or non-vested.

Summary of Age-Based Withdrawal Experience With 5 or More Years of Service

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	72	725	0.0993	0.0720	0.0903	51	54
30-34	180	2,780	0.0647	0.0558	0.0636	159	175
35-39	223	4,268	0.0522	0.0504	0.0541	216	231
40-44	242	5,304	0.0456	0.0504	0.0472	269	250
45-49	395	8,661	0.0456	0.0468	0.0414	402	357
50-54	424	12,121	0.0350	0.0360	0.0366	453	443
55-59	399	14,911	0.0268	0.0360	0.0338	546	504
Totals	1,935	48,770	0.0397	0.0430	0.0413	2,096	2,014



Demographic Assumptions - Employees

Male & Female Service-Based Withdrawal Experience

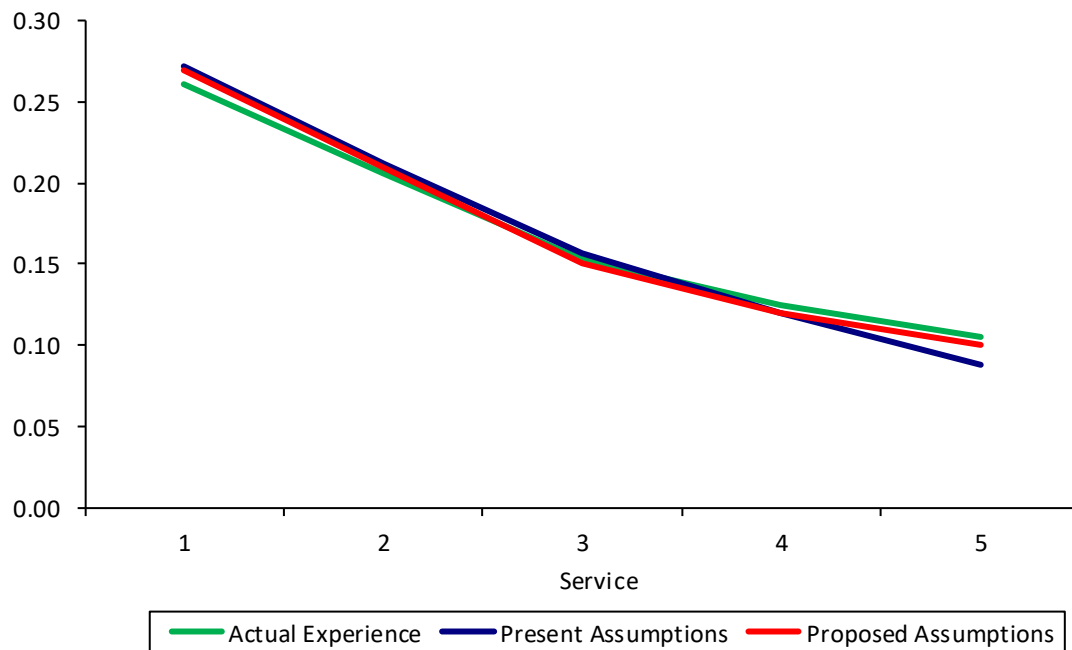
Summary of Service-Based Withdrawal Experience With Less Than 5 Years of Service

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	893	3,417	0.2613	0.2725	0.2700	935	923
2	1,900	9,210	0.2063	0.2125	0.2100	1,967	1,934
3	1,072	6,989	0.1534	0.1562	0.1500	1,101	1,048
4	670	5,394	0.1242	0.1200	0.1200	656	647
5	453	4,294	0.1055	0.0878	0.1000	384	429
Totals	4,988	29,304	0.1702	0.1721	0.1700	5,043	4,981

* 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.



Demographic Assumptions - Employees Male & Female Disability Experience

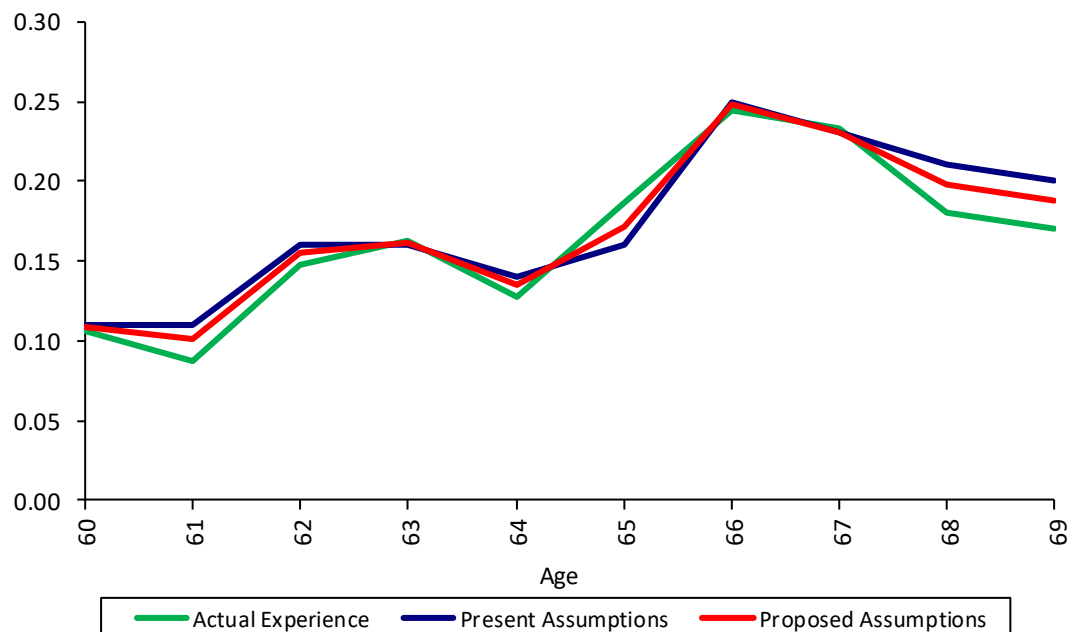
Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	62	74,916	0.00083	0.00200	0.00152	150.1	113.7

Rates in the tables are aggregated due to the small number of actual disabilities.

Demographic Assumptions – Employees Male Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	112	1,058	0.1059	0.1100	0.1080	116	114
61	85	978	0.0869	0.1100	0.1010	108	99
62	138	937	0.1473	0.1600	0.1550	150	145
63	138	845	0.1633	0.1600	0.1610	135	136
64	94	738	0.1274	0.1400	0.1350	103	100
65	142	760	0.1868	0.1600	0.1710	122	130
66	147	601	0.2446	0.2500	0.2480	150	149
67	102	437	0.2334	0.2300	0.2310	101	101
68	54	299	0.1806	0.2100	0.1980	63	59
69	36	211	0.1706	0.2000	0.1880	42	40
Totals	1,048	6,864	0.1527	0.1588	0.1563	1,090	1,073
70 & Over	143	623	0.2295	1.0000	1.0000	623	623
Total	1,191	7,487	0.1591	0.2288	0.2265	1,713	1,696

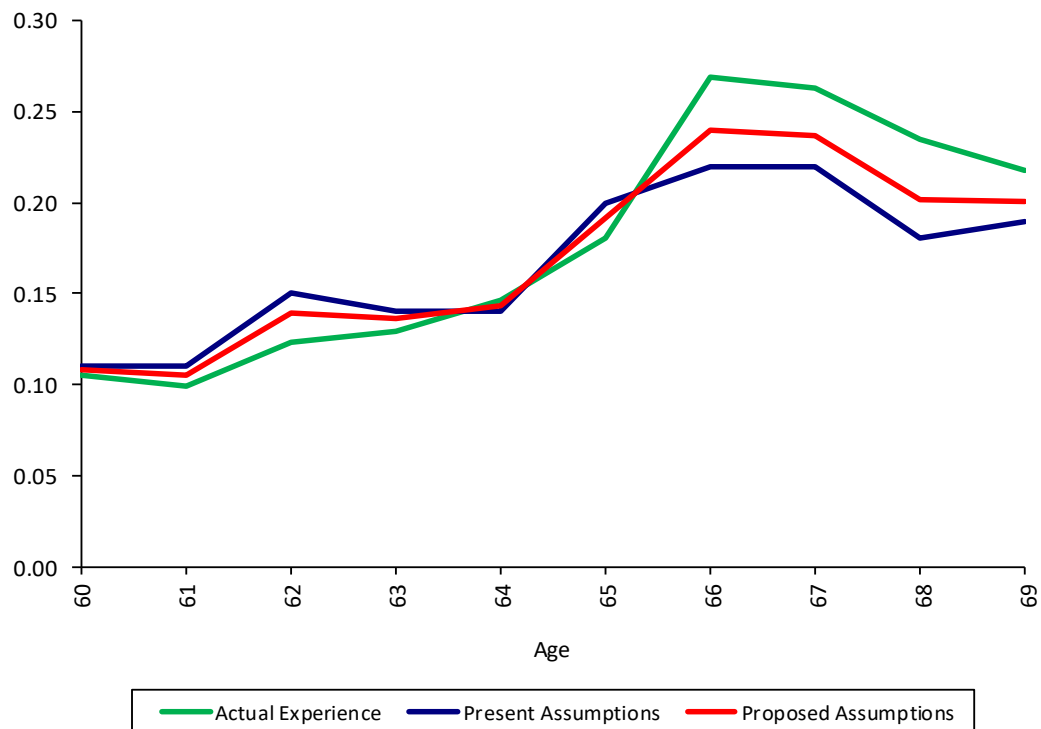
* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages. "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.



Demographic Assumptions - Employees Female Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	197	1,868	0.1055	0.1100	0.1080	205	202
61	170	1,723	0.0987	0.1100	0.1050	190	181
62	195	1,576	0.1237	0.1500	0.1390	236	219
63	177	1,367	0.1295	0.1400	0.1360	191	186
64	170	1,160	0.1466	0.1400	0.1430	162	166
65	194	1,073	0.1808	0.2000	0.1920	215	206
66	229	851	0.2691	0.2200	0.2400	187	204
67	158	601	0.2629	0.2200	0.2370	132	142
68	101	430	0.2349	0.1800	0.2020	77	87
69	72	331	0.2175	0.1900	0.2010	63	67
Totals	1,663	10,980	0.1515	0.1510	0.1512	1,658	1,660
70 & Over	170	757	0.2246	1.0000	1.0000	757	757
Total	1,833	11,737	0.1562	0.2057	0.2059	2,415	2,417

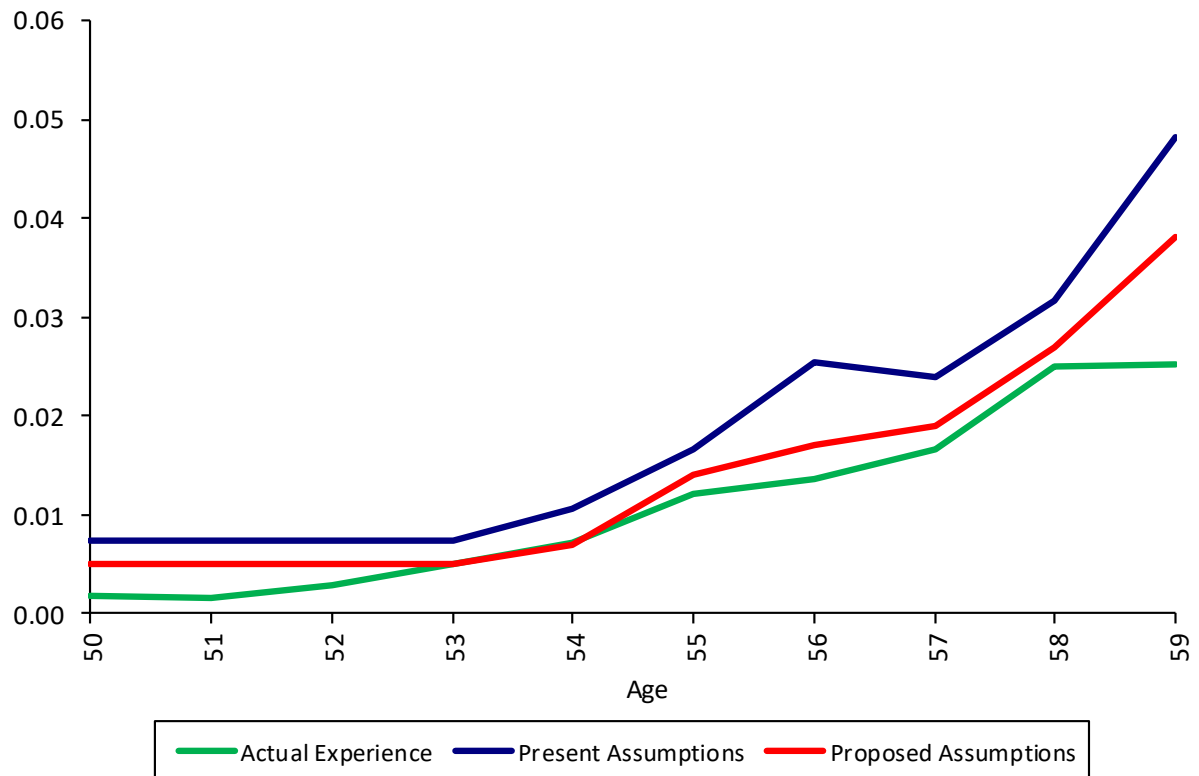
* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages. "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.



Demographic Assumptions – Employees Male & Female Age-Based Early Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
50	2	1,082	0.0018	0.0075	0.0050	8	5
51	2	1,205	0.0017	0.0075	0.0050	9	6
52	4	1,394	0.0029	0.0075	0.0060	11	8
53	8	1,556	0.0051	0.0075	0.0070	12	11
54	12	1,670	0.0072	0.0107	0.0090	17	15
55	22	1,819	0.0121	0.0166	0.0150	30	27
56	26	1,907	0.0136	0.0255	0.0210	48	40
57	33	1,996	0.0165	0.0239	0.0210	48	42
58	53	2,118	0.0250	0.0316	0.0290	67	61
59	55	2,174	0.0253	0.0483	0.0390	105	85
Total	217	16,921	0.0128	0.0210	0.0177	355	300

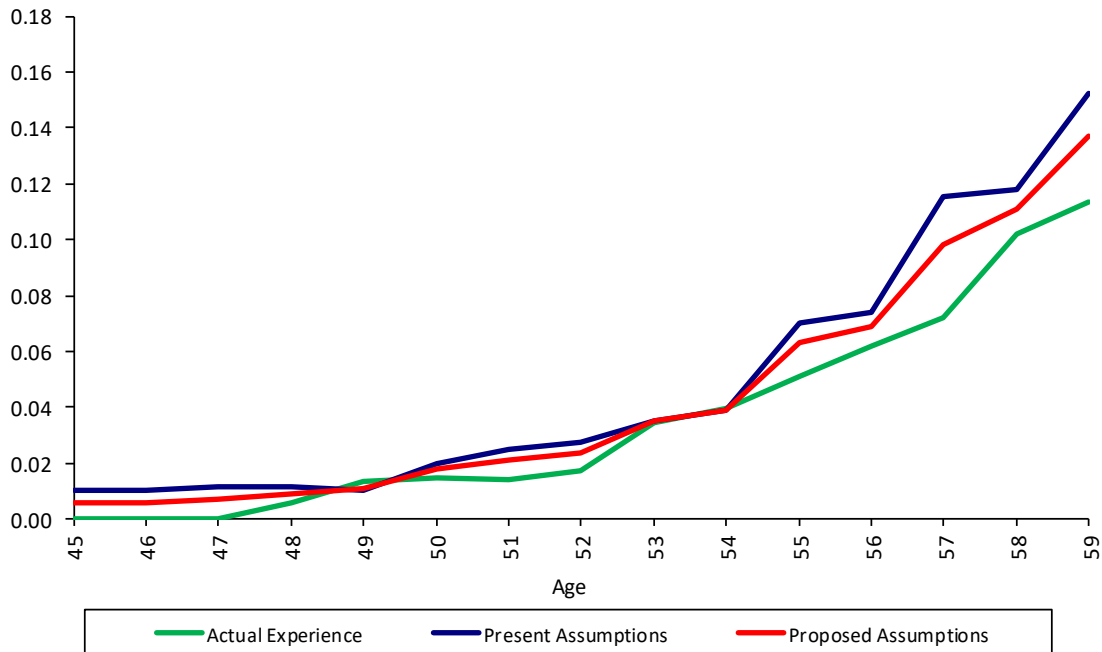
* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages. "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.



Demographic Assumptions - Employees Male & Female Rule-70 Early Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45	-	34	0.0000	0.0100	0.0060	-	-
46	-	114	0.0000	0.0100	0.0060	1	1
47	-	232	0.0000	0.0114	0.0070	3	2
48	2	336	0.0060	0.0113	0.0090	4	3
49	6	451	0.0133	0.0100	0.0110	5	5
50	7	474	0.0148	0.0198	0.0180	9	9
51	7	497	0.0141	0.0250	0.0210	12	10
52	9	514	0.0175	0.0278	0.0240	14	12
53	18	521	0.0345	0.0350	0.0350	18	18
54	19	479	0.0397	0.0388	0.0390	19	19
55	24	467	0.0514	0.0704	0.0630	33	29
56	27	434	0.0622	0.0738	0.0690	32	30
57	29	404	0.0718	0.1153	0.0980	47	40
58	38	372	0.1022	0.1176	0.1110	44	41
59	36	318	0.1132	0.1526	0.1370	49	44
Total	222	5,647	0.0393	0.0512	0.0466	289	263

"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.



SECTION E

DEMOGRAPHIC ASSUMPTIONS – TEACHERS

Demographic Assumptions - Teachers

Withdrawal Experience

Findings

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 than members who stay in employment until retirement. Higher rates of withdrawal result in lower computed contributions, and vice-versa.

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 is shown on page E-6. Overall, the actual number of withdrawals (1,307) is lower than the number projected by the present assumptions (1,731 – see totals on page E-6). This suggests that the current rates of withdrawal among individuals with fewer than 5 years of service can be lowered.

The analysis for members with 5 or more years of credited service is shown on page E-5. Overall, the plan experienced fewer withdrawals (1,316) than projected by the present assumptions (1,607 – see totals on page E-5). This experience suggests a need to lower the assumed rates of withdrawal among individuals with 5 or more years of service.

Other

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.

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

We recommend adoption of the proposed withdrawal assumptions combined for males and females.

Demographic Assumptions - Teachers

Disability Experience

Findings

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. To allow for a higher degree of credibility, male and female rates were observed together and the proposed rates are for the combined population.

We reviewed the disability experience during the 4-year period. The results are shown on page E-7. Overall, the plan experienced fewer disability retirements (18) than projected by the present assumptions (61.8 – see totals on page E-7). This experience suggests a need to decrease 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.

Other

The only incidences of disability during the study period were ordinary. The current assumption is that 67% of disabilities are ordinary while 33% are accidental. This experience suggests that a change in the assumption is warranted.

Recommendation

We recommend adoption of the proposed disability retirement rates combined for male and female individuals. In addition, we recommend assuming that 80% of disabilities are ordinary.

Demographic Assumptions - Teachers

Age and Service (Normal) Retirement Experience

Findings

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. Group I members hired before July 1, 2011 may retire at age 60 with unreduced benefits. 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 for members hired prior to July 1, 2011. 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, retirement rates for those hired on or after July 1, 2011 are adjusted in the first two years of unreduced retirement eligibility to model pent-up demand for retirement.

Males

We reviewed the retirement experience among active male members during the study period. The results are shown on page E-8. Current assumptions for male members eligible for normal retirement during the study period overestimated retirements in earlier ages while the assumed retirements over age 65 (and below 70) were underestimated. For male members under age 70, the plan experienced less retirements (361) than projected by the present assumptions (415 – see totals on page E-8). This experience suggests a need to decrease the assumed rates of retirement in earlier ages and increase those in later years for eligible male individuals. Retirement rates for ages 70 and above are set to 100% as a margin for adverse experience. 27 retirements of male actives age 70 and older were observed versus 108 expected.

Females

We reviewed the retirement experience among active female members during the study period. The results are shown on page E-9. Current assumptions for female members eligible for normal retirement during the study period overestimated retirements in earlier ages while the assumed retirements over age 65 (and below 70) were underestimated. For female members under age 70, the plan experienced slightly less retirements (1,546) than projected by the present assumptions (1,547 – see totals on page E-9). This experience suggests a need to decrease the assumed rates of retirement in earlier ages and increase those in later years for eligible female individuals. Retirement rates for ages 70 and above are set to 100% as a margin for adverse experience. 76 retirements of female actives age 70 and older were observed versus 219 expected.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

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

Demographic Assumptions - Teachers

Early Retirement Experience

Findings

NHRS Teachers 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.

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. 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.

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 results are shown on page E-10. The actual number of early retirements (172) is less than the number projected by the present assumptions (288 – see totals on page E-10). This suggests that the current rates of early retirement among eligible individuals can be decreased.

We also reviewed the early retirement experience among active members during the study period that meet early retirement eligibility under the rule of 70. The results are shown on page E-11. Overall, the plan experienced fewer early retirements (192) than projected by the present assumptions (283 – see totals on page E-11). This experience suggests a need to lower the assumed rates of early retirement among eligible individuals.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

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

Demographic Assumptions - Teachers

Male & Female Age-Based Withdrawal Experience

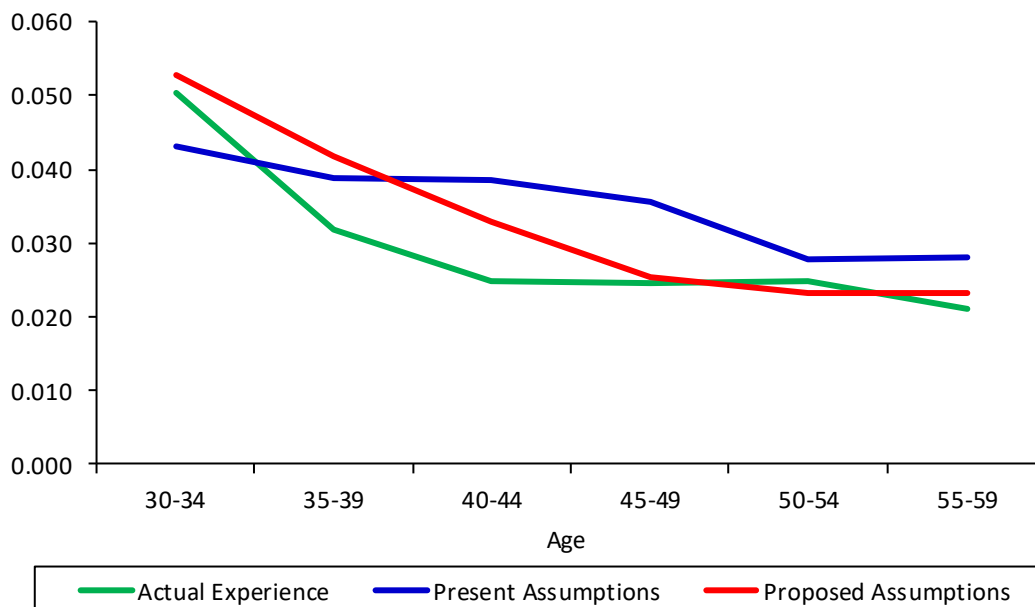
Summary of Age-Based Withdrawal Experience With 5 or More Years of Service

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	47	663	0.0709	0.0567	0.0880	37	43
30-34	244	4,854	0.0503	0.0432	0.0528	214	255
35-39	239	7,503	0.0319	0.0388	0.0418	291	314
40-44	190	7,683	0.0247	0.0385	0.0330	296	255
45-49	203	8,242	0.0246	0.0357	0.0253	293	214
50-54	201	8,094	0.0248	0.0277	0.0231	231	189
55-59	192	9,077	0.0212	0.0281	0.0231	245	210
Totals	1,316	46,116	0.0285	0.0348	0.0321	1,607	1,480

* 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.

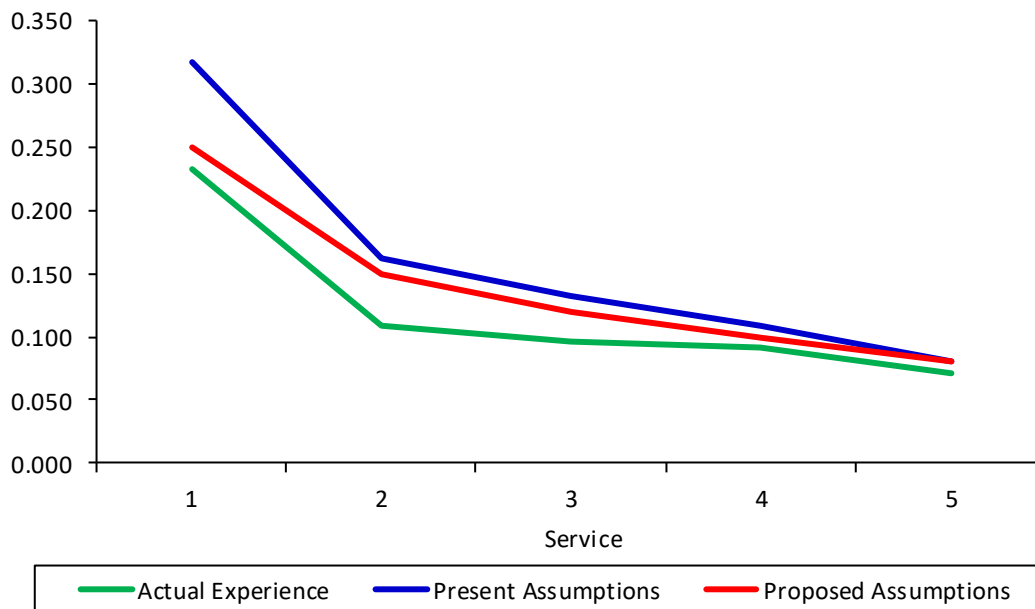


Demographic Assumptions - Teachers

Male & Female Service-Based Withdrawal Experience

Summary of Service-Based Withdrawal Experience With Less Than 5 Years of Service

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	46	198	0.2323	0.3177	0.2500	63	50
2	405	3,698	0.1095	0.1621	0.1500	601	555
3	349	3,627	0.0962	0.1319	0.1200	480	435
4	301	3,282	0.0917	0.1081	0.1000	356	328
5	206	2,874	0.0717	0.0800	0.0800	231	230
Totals	1,307	13,679	0.0955	0.1265	0.1168	1,731	1,598



Demographic Assumptions - Teachers Male & Female Disability Experience

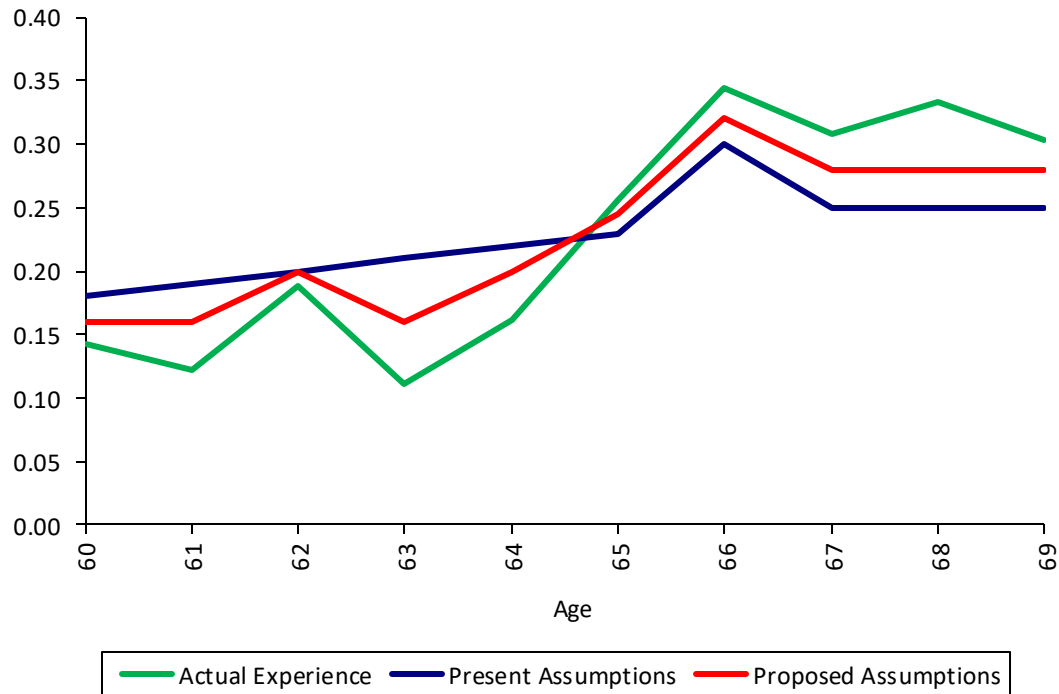
Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	18	53,002	0.0003	0.00117	0.00043	61.8	22.8

Rates in the tables are aggregated due to the small number of actual disabilities.

Demographic Assumptions - Teachers Male Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	46	322	0.1429	0.1800	0.1600	58	52
61	34	279	0.1219	0.1900	0.1600	53	45
62	50	265	0.1887	0.2000	0.2000	53	53
63	28	252	0.1111	0.2100	0.1600	53	40
64	35	216	0.1620	0.2200	0.2000	48	43
65	52	203	0.2562	0.2300	0.2450	51	50
66	49	142	0.3451	0.3000	0.3200	45	45
67	28	91	0.3077	0.2500	0.2800	23	25
68	22	66	0.3333	0.2500	0.2800	17	18
69	17	56	0.3036	0.2500	0.2800	14	16
Totals	361	1,892	0.1908	0.2193	0.2045	415	387
70 & Over	27	108	0.2500	1.0000	1.0000	108	108
Total	388	2,000	0.1940	0.2615	0.2475	523	495

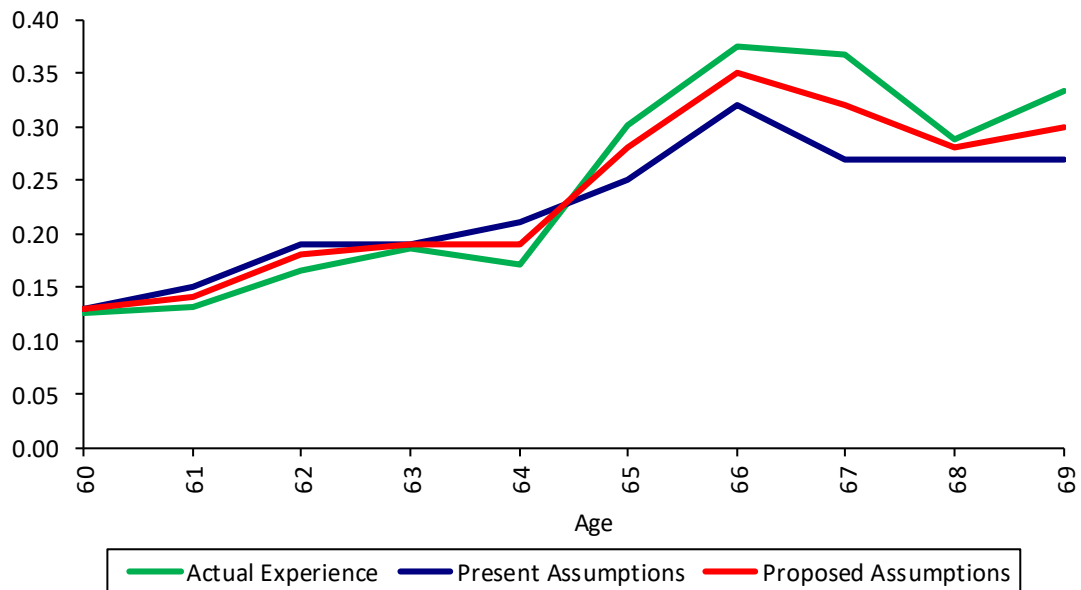
* "Expected retirements - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
 "Expected retirements - Present" is the sum of actual probabilities applied in the valuation.



Demographic Assumptions - Teachers Female Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
60	182	1,441	0.1263	0.1300	0.1300	187	187
61	173	1,307	0.1324	0.1500	0.1400	196	183
62	200	1,203	0.1663	0.1900	0.1800	229	217
63	203	1,088	0.1866	0.1900	0.1900	207	207
64	159	931	0.1708	0.2100	0.1900	196	177
65	241	797	0.3024	0.2500	0.2800	208	223
66	194	516	0.3760	0.3200	0.3500	169	181
67	106	288	0.3681	0.2700	0.3200	78	92
68	48	166	0.2892	0.2700	0.2800	45	46
69	40	120	0.3333	0.2700	0.3000	32	36
Totals	1,546	7,857	0.1968	0.1969	0.1971	1,547	1,549
70 & Over	76	219	0.3470	1.0000	1.0000	219	219
Total	1,622	8,076	0.2008	0.2187	0.2189	1,766	1,768

* "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.

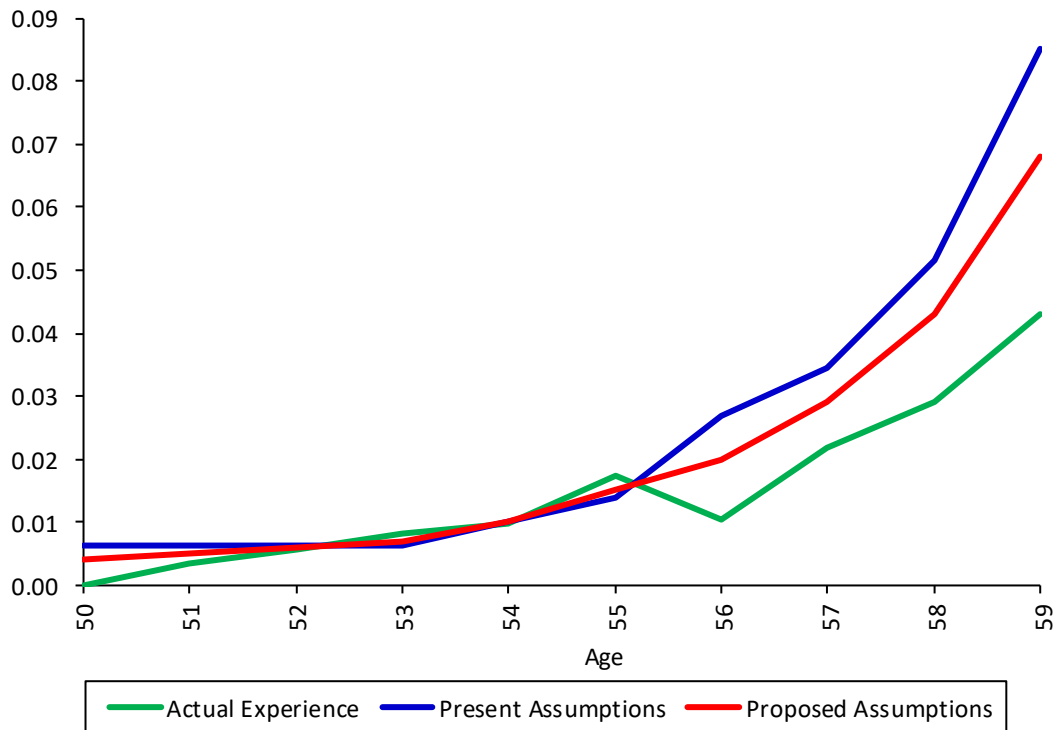


Demographic Assumptions - Teachers

Male & Female Age-Based Early Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
50	-	865	0.0000	0.0063	0.0040	5	3
51	3	887	0.0034	0.0063	0.0050	5	4
52	5	912	0.0055	0.0063	0.0060	5	5
53	8	979	0.0082	0.0062	0.0070	6	7
54	10	1,039	0.0096	0.0100	0.0100	10	10
55	19	1,103	0.0172	0.0140	0.0150	15	17
56	12	1,154	0.0104	0.0269	0.0200	31	23
57	26	1,201	0.0216	0.0344	0.0290	41	35
58	36	1,238	0.0291	0.0517	0.0430	64	53
59	53	1,230	0.0431	0.0852	0.0680	105	84
Total	172	10,608	0.0162	0.0271	0.0227	288	241

*"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.

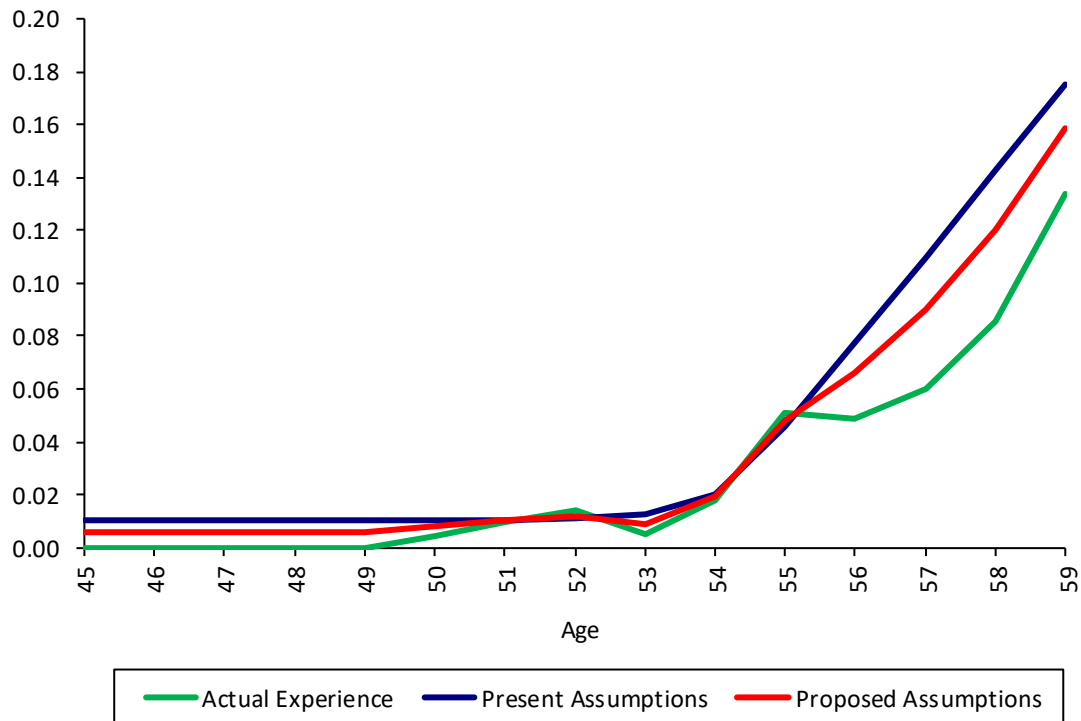


Demographic Assumptions - Teachers

Male & Female Rule of 70 Early Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45	-	7	0.0000	0.0100	0.0060	-	-
46	-	42	0.0000	0.0100	0.0060	-	-
47	-	189	0.0000	0.0100	0.0060	1	1
48	-	329	0.0000	0.0100	0.0060	3	2
49	-	460	0.0000	0.0100	0.0060	4	3
50	2	435	0.0046	0.0100	0.0080	4	3
51	4	409	0.0098	0.0100	0.0100	4	4
52	6	438	0.0137	0.0112	0.0120	5	5
53	2	421	0.0048	0.0124	0.0090	5	4
54	8	442	0.0181	0.0200	0.0190	9	8
55	23	454	0.0507	0.0455	0.0480	21	22
56	22	452	0.0487	0.0775	0.0660	35	30
57	28	468	0.0598	0.1100	0.0900	52	42
58	39	456	0.0855	0.1426	0.1200	65	55
59	58	433	0.1339	0.1752	0.1590	75	69
Total	192	5,435	0.0353	0.0521	0.0456	283	248

* "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.



SECTION F

DEMOGRAPHIC ASSUMPTIONS – POLICE

Demographic Assumptions - Police

Withdrawal Experience

Findings

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 than members who stay in employment until retirement. Higher rates of withdrawal result in lower computed contributions, and vice-versa.

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 is shown on page F-5. Overall, the plan experienced fewer withdrawals (565) than projected by the present assumptions (594 – see totals on page F-5). This experience suggests a need to lower the assumed rates of withdrawal among members with fewer than 5 years of service.

For members with more than 5 or more years of credited service, the plan experienced fewer withdrawals (314) than projected by the present assumptions (381 – see totals on page F-4). This experience suggests a need to lower the assumed rates of withdrawal among individuals with 5 or more years of service.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

We recommend adoption of the proposed withdrawal assumptions.

Demographic Assumptions - Police

Disability Experience

Findings

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. The results are shown on page F-6. Overall, the plan experienced less disability retirements (41) than projected by the present assumptions (58.8 – see totals on page F-6). This experience suggests a need to decrease 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 76% accidental and 24% ordinary vs. the assumption of 50%/50%. 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 75% of disabilities are accidental.

Demographic Assumptions - Police

Age and Service (Normal) Retirement Experience

Findings

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.

We reviewed the retirement experience among active members during the study period. The results are shown on page F-7. The plan experienced fewer retirements (518) than projected by the present assumptions (618 – see totals on page F-7). This experience suggests a need to lower the assumed rates of retirement.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

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, retirement rates for those hired on or after July 1, 2011 are adjusted in the first five years of retirement eligibility to model pent-up demand for retirement.

Recommendations

We recommend adoption of the proposed normal retirement rates.

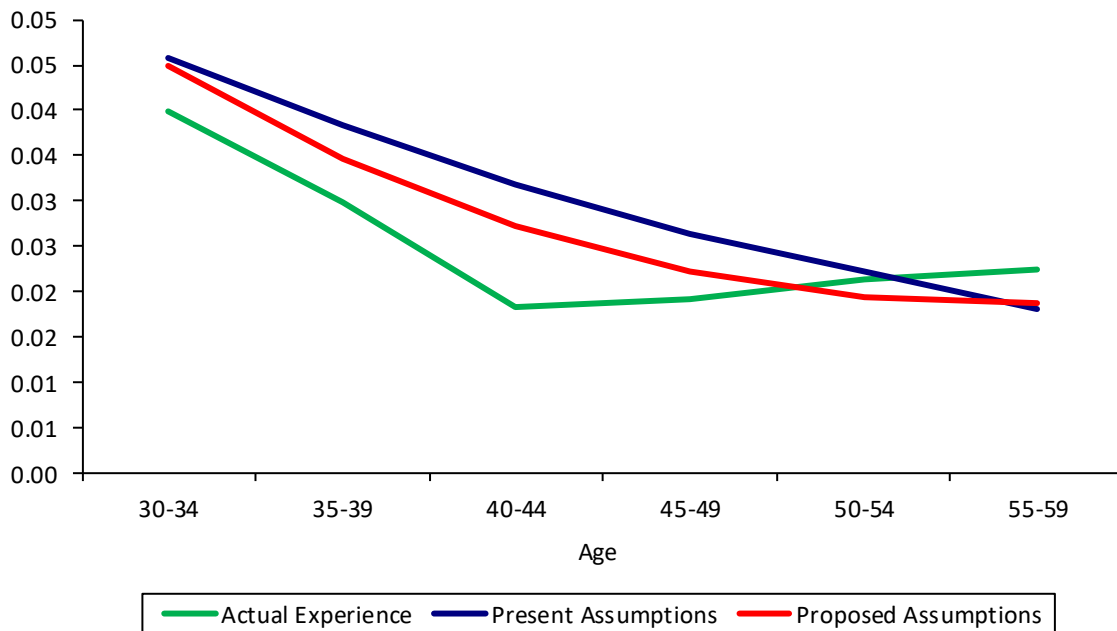
Demographic Assumptions - Police Age-Based Withdrawal Experience

Summary of Male & Female Age-Based Withdrawal Experience With 5 or More Years of Service

Age	Withdrawal	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	39	486	0.0802	0.0547	0.0579	26	27
30-34	72	1,806	0.0399	0.0458	0.0448	83	80
35-39	66	2,210	0.0299	0.0384	0.0347	85	76
40-44	45	2,448	0.0184	0.0318	0.0273	78	67
45-49	45	2,360	0.0191	0.0264	0.0222	63	53
50-54	30	1,402	0.0214	0.0222	0.0194	32	28
55-59	17	756	0.0225	0.0181	0.0188	14	14
Totals	314	11,468	0.0274	0.0332	0.0301	381	345

* Sample rates are taken from midpoint of age group.

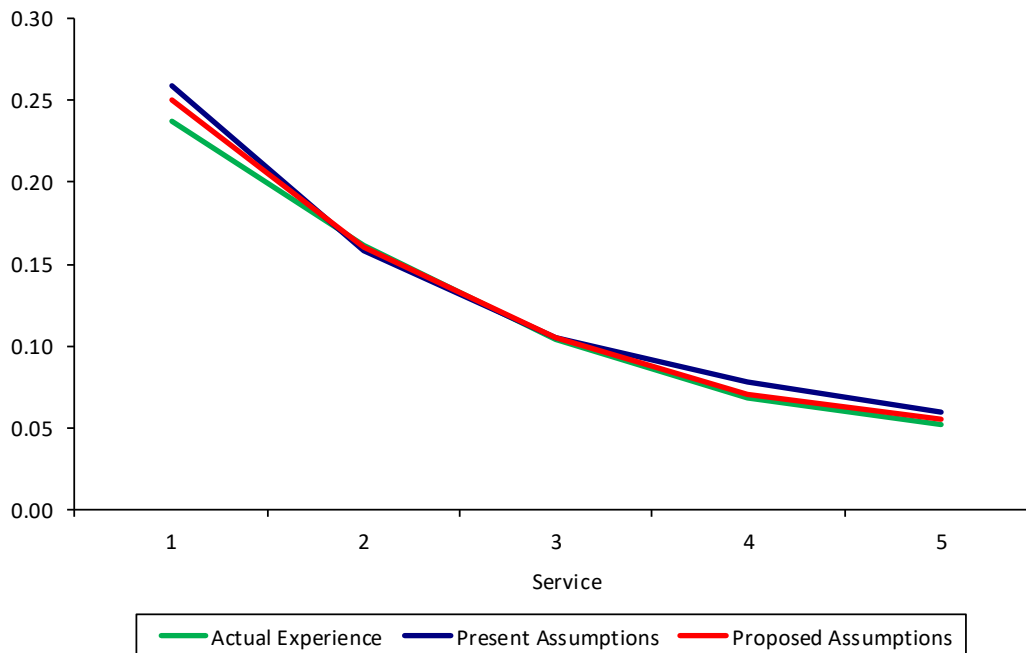
** "Expected withdrawals - Proposed" is calculated as the sum of rates applied to exposure at individual ages.
"Expected withdrawals - Present" is the sum of actual probabilities applied in the valuation.



Demographic Assumptions - Police Service-Based Withdrawal Experience

Summary of Male & Female Service-Based Withdrawal Experience With Less Than 5 Years of Service

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	131	553	0.2369	0.2584	0.2500	143	138
2	218	1,354	0.1610	0.1586	0.1600	216	217
3	112	1,073	0.1044	0.1049	0.1050	114	113
4	62	907	0.0684	0.0775	0.0700	72	63
5	42	807	0.0520	0.0590	0.0550	49	44
Totals	565	4,694	0.1204	0.1265	0.1225	594	575



Demographic Assumptions - Police Male & Female Disability Experience

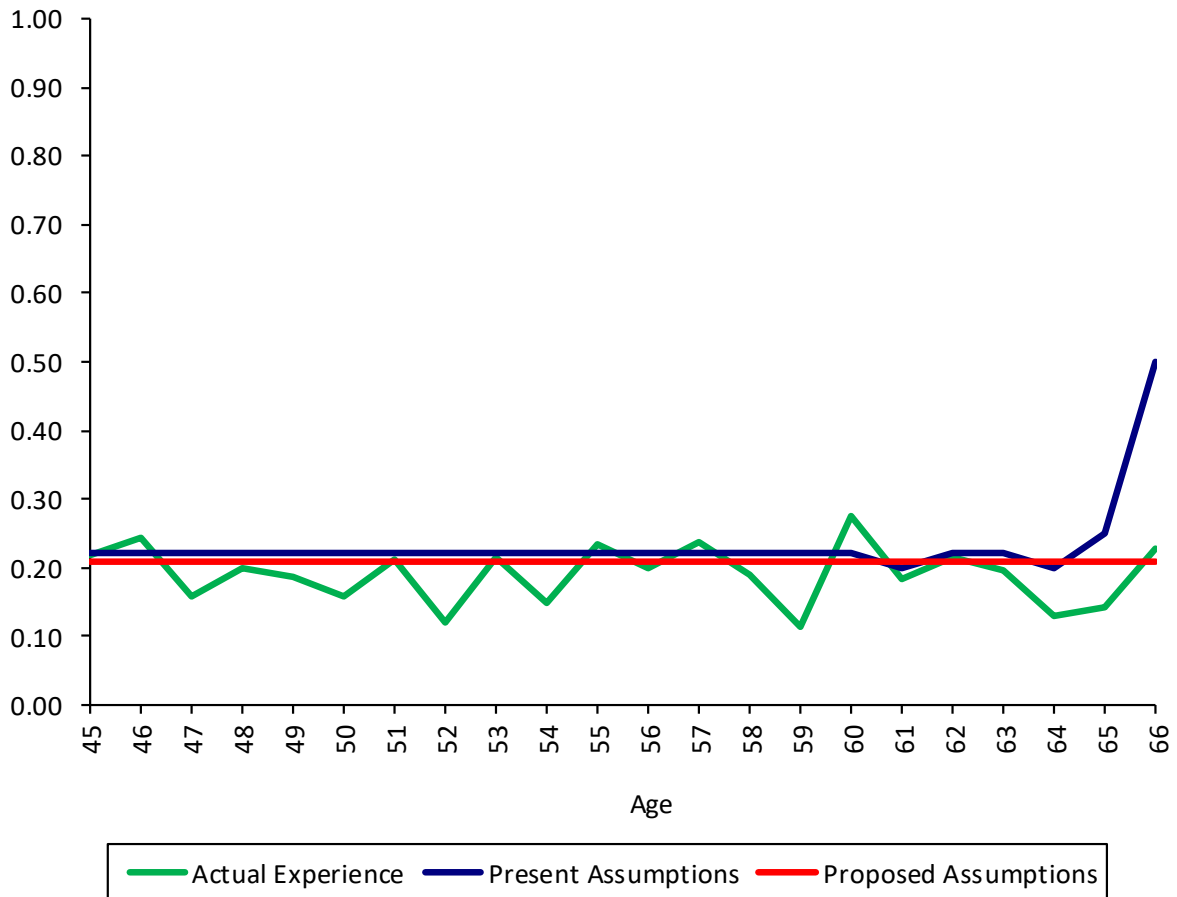
Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	41	16,121	0.0025	0.00365	0.00270	58.8	43.5

Rates in the table are aggregated due to the small number of actual disabilities.

Demographic Assumptions – Police Male & Female Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45-49	216	1,061	0.2036	0.2200	0.2100	234	223
50-54	118	683	0.1728	0.2200	0.2100	150	143
55-59	71	357	0.1989	0.2200	0.2100	79	75
60-64	85	398	0.2136	0.2200	0.2100	85	85
65-69	24	124	0.1935	0.5000	0.2100	55	25
70 & Over	4	15	0.2667	1.0000	1.0000	15	15
Total	518	2,638	0.1964	0.2343	0.2146	618	566

* "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.



SECTION G

DEMOGRAPHIC ASSUMPTIONS – FIRE

Demographic Assumptions - Fire

Withdrawal Experience

Findings

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 than 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.

The analysis for members with fewer than 5 years of credited service is shown on page G-5. Overall, the plan experienced fewer withdrawals (36) than projected by the present assumptions (44 – see totals on page G-5). This experience suggests a need to lower the assumed rates of withdrawal among individuals with fewer than 5 years of service.

The analysis for members with 5 or more years of credited service is shown on page G-4. Overall, the plan experienced fewer withdrawals (54) than projected by the present assumptions (62 – see totals on page G-4). This experience suggests a need to lower the assumed rates of withdrawal among individuals with 5 or more years of service.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

Recommendation

We recommend adoption of the proposed withdrawal assumptions.

Demographic Assumptions - Fire

Disability Experience

Findings

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. The results are shown on page G-6. Overall, the plan experienced less disability retirements (14) than projected by the present assumptions (20.6 – see totals on page G-6). This experience suggests a need to lower 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 57% accidental and 43% ordinary vs. the assumption of 50%/50%. 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 60% of disabilities are accidental.

Demographic Assumptions - Fire

Age and Service (Normal) Retirement Experience

Findings

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.

We reviewed the retirement experience among active members during the study period. The results are shown on pages G-7. The plan experienced fewer retirements (191) than projected by the present assumptions (252 – see totals on page G-7). This experience suggests a need to lower the assumed rates of retirement.

Other

The economic conditions during the experience study period were more stable than the prior experience study. Therefore, we made no special adjustments to account for unusual economic events. The COVID-19 outbreak and the concurrent economic disruption may alter member behavior, but any adjustments to this decrement assumption would be purely speculative at this point so none were made.

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, retirement rates for those hired on or after July 1, 2011 are adjusted in the first five years of retirement eligibility to model pent-up demand for retirement.

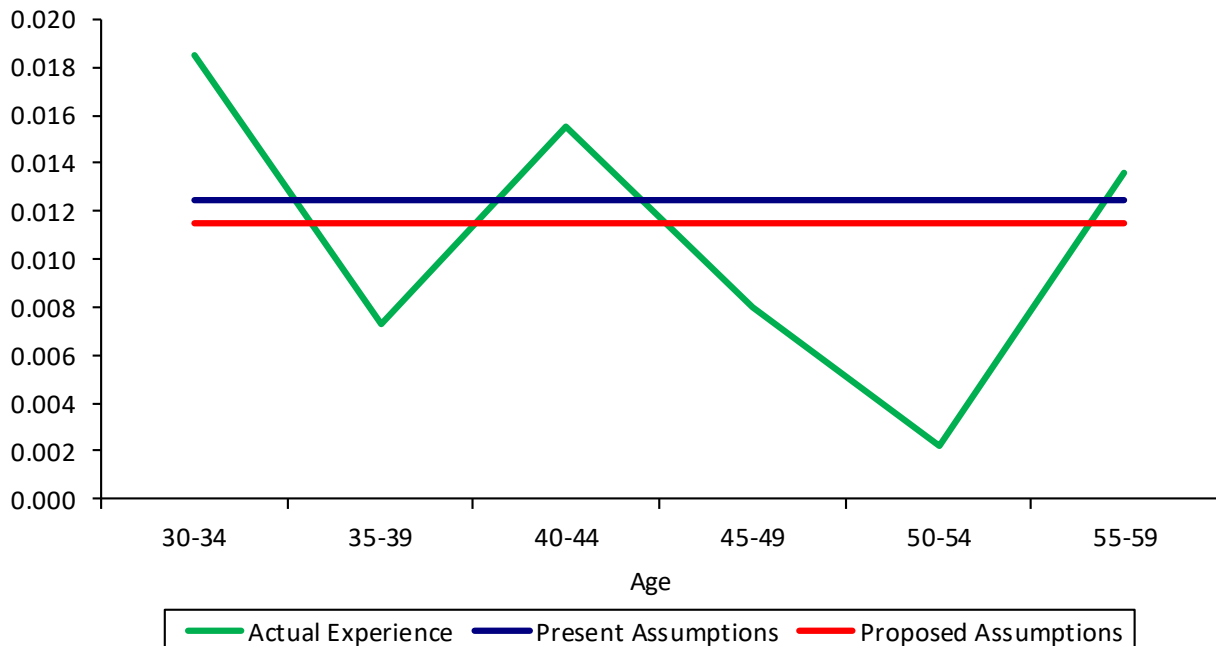
Recommendations

We recommend adoption of the proposed normal retirement rates.

Demographic Assumptions – Fire Age Based Withdrawal Experience

Summary of Male & Female Age-Based Withdrawal Experience With 5 or More Years of Service

Age	Withdrawals	Exposure	Crude Rates	Sample Rates*		Expected Withdrawals**	
				Present	Proposed	Present	Proposed
Under 30	4	175	0.0229	0.0125	0.0115	2	2
30-34	12	649	0.0185	0.0125	0.0115	8	7
35-39	6	826	0.0073	0.0125	0.0115	10	9
40-44	14	900	0.0156	0.0125	0.0115	11	10
45-49	10	1,249	0.0080	0.0125	0.0115	15	14
50-54	2	917	0.0022	0.0125	0.0115	11	10
55-59	6	440	0.0136	0.0125	0.0115	5	5
Totals	54	5,156	0.0105	0.0120	0.0111	62	57



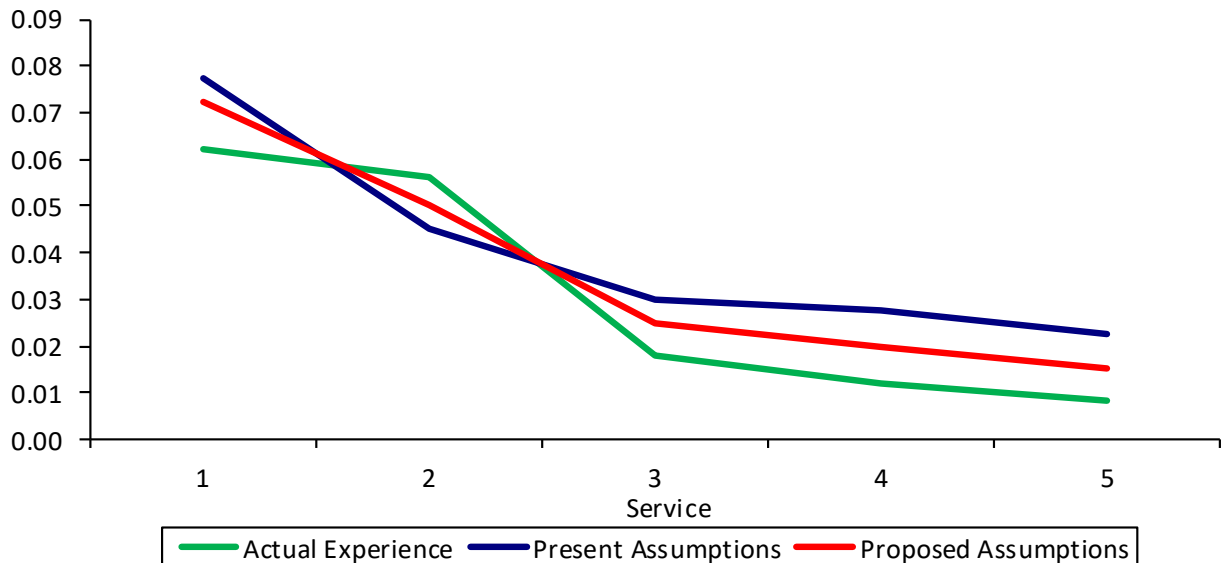
Demographic Assumptions – Fire Service Based Withdrawal Experience

Summary of Male & Female Service-Based Withdrawal Experience With Less Than 5 Years of Service

Service Index	Withdrawals	Exposure	Crude Rates	Sample Rates		Expected Withdrawals	
				Present	Proposed	Present	Proposed
1	8	129	0.0620	0.0775	0.0725	10	9
2	18	320	0.0563	0.0450	0.0500	14	16
3	5	275	0.0182	0.0300	0.0250	8	7
4	3	250	0.0120	0.0275	0.0200	7	5
5	2	238	0.0084	0.0225	0.0150	5	4
Totals	36	1,212	0.0297	0.0363	0.0338	44	41

* 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.



Demographic Assumptions – Fire Male & Female Disability Experience

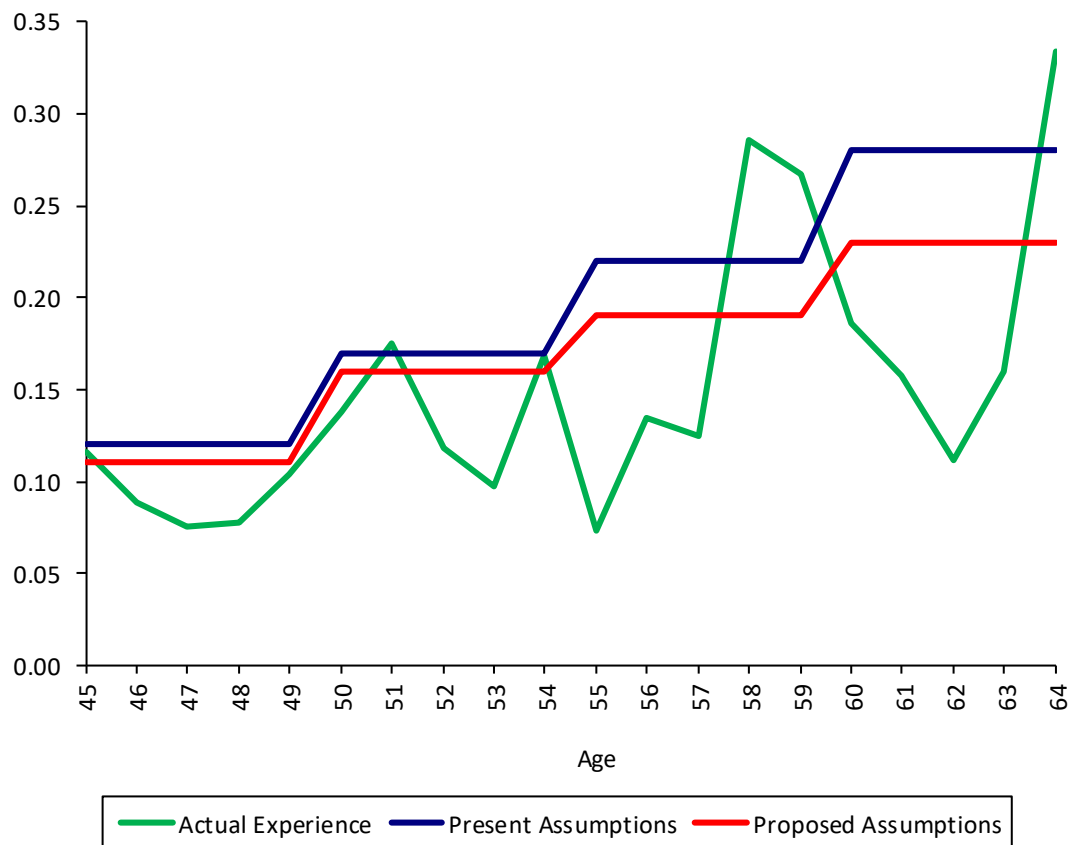
Age	Disabilities	Exposure	Crude Rates	Sample Rates		Expected Disabilities	
				Present	Proposed	Present	Proposed
Totals	14	6,355	0.0022	0.0032	0.0028	20.6	18.1

Rates in the table are aggregated due to the small number of actual disabilities.

Demographic Assumptions - Fire Male & Female Age-Based Retirement Experience

Age	Retirements	Exposure	Crude Rates	Sample Rates		Expected Retirements*	
				Present	Proposed	Present	Proposed
45-49	43	472	0.0911	0.1200	0.1100	55	53
50-54	71	505	0.1406	0.1700	0.1600	84	81
55-59	45	277	0.1625	0.2200	0.1900	60	54
60-64	27	151	0.1788	0.2800	0.2300	41	35
65-69	5	25	0.2000	0.2800	0.2800	8	8
70 & Over	-	4	0.0000	1.0000	1.0000	4	4
Total	191	1,434	0.1332	0.1757	0.1611	252	231

* "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.



SECTION H

ACTUARIAL METHODS

Actuarial Methods

Excerpts from the Board Funding Policy adopted March 11, 2014 and revised October 8, 2019:

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 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.

The Board's Actuarial Policy provides for a 20% margin 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% of annual benefit payments at the end of each year in the projection. Prior to any assumption

Actuarial Methods

changes, the projected assets at the end of the June 30, 2020 fiscal year for each medical subsidy plan is as follows:

State Employees:	33%
Political Subdivision Employees:	249%
Teachers:	28%
Police and Fire:	91%
Grand Total:	74%

These projected 2020 margins are contingent upon the market value of assets earning 7.25% and payroll growing at 3.25% (2.75% for Teachers) in the year ending June 30, 2020.

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, 2019 actuarial valuation will take effect beginning in fiscal year 2022, in other words beginning July 1, 2021. A lot may happen to the assets and the payroll on which the contributions depend between now and July 1, 2021. Moreover, after the 2022-2023 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, 2023. This delay illustrates the necessity of the 20% 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 three 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.

We suggest that the Board consider an increase in the margin from 20% to 50%. We have not performed an analysis of this scenario and the results will depend on the final assumptions as adopted by the Board. However, the projected 2020 margins shown above indicate that State Employees and Teachers would both require contribution rate increases. If the Board wishes to explore alternatives, we would be happy to prepare additional analysis. It may be beneficial to include additional quantitative risk analysis such as stress testing through the next biennium.

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 consider increasing the medical subsidy margin from 20% to 50%.

SECTION I

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Proposed Miscellaneous and Technical Assumptions

Optional 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 60% of males and 60% of females are assumed to be married for purposes of death-in-service benefits. For Group II, the current assumption is that 60% of males and 60% 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 increased. We propose the assumption that 55% 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) =	16,151	12,007	3,330	1,295
# Retirees (Excluding Survivors) with J & S Benefit =	7,715	6,396	2,188	903
% Retirees (Excluding Survivors) with J & S Benefit =	48%	53%	66%	70%
Current Marriage Assumption =	60%	60%	60%	60%
Proposed Marriage Assumption =	55%	55%	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, 2019 =	24,654	17,730	4,216	1,688
Active Members Who Have Purchased Service =	533	261	51	13
Average Service Purchase Years =	3.13	3.44	2.19	1.87
Average Service Purchase (in years) Over Total Active Member Group =	0.07	0.05	0.03	0.01
# 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.

	2016	2017	2018	2019	Total
Opt-In	88	63	62	59	272
Opt-Out (Total per year)	2,871	2,875	2,876	2,931	11,553
% Opting In	3.1%	2.2%	2.2%	2.0%	2.4%
Total records reported	13,017	12,901	12,769	12,639	51,326
Average # year benefits will be paid out					10.98
% of Members ultimately expected to opt into benefits*					29.1%

**Total percentage opting in (2.4%) compounded over expected years benefits will be paid out (10.98 years).*

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. Currently, short-term, low-risk investments are experiencing very low yields. 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

Currently, it is assumed that 25% of members who quit before retirement with 10-15 years of service will elect to refund and forfeit their pension. We briefly reviewed the 2019 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 removing the current forfeiture assumption. Alternatively, the present value of future benefits will not be less than the accumulated member contributions at the time of decrement.

Other Miscellaneous and Technical Assumptions

A number of additional miscellaneous and technical assumptions are used in the actuarial valuation. The present assumptions are listed on the following pages.

Miscellaneous and Technical Assumptions

<i>Administrative & Investment Expenses</i>	The investment return assumption is intended to be the return net of investment expenses. Annual administrative expenses are assumed to be 0.35% of payroll.
<i>Benefit Service</i>	Exact Fractional service is used to determine the amount of benefit payable.
<i>COLA</i>	None assumed.
<i>Decrement Operation (Proposed)</i>	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.
<i>Decrement Timing</i>	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.
<i>Eligibility Testing</i>	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.
<i>Incidence of Contributions</i>	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.
<i>Normal Form of Benefit</i>	<p>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.</p> <p>Group I: The assumed normal form of benefit is a straight life benefit.</p> <p>Group II: The assumed normal form of benefit is straight life for single members and joint and 50% survivor for married members.</p>

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.

Medical Subsidy Actual medical subsidy recipients are included in the valuation plus 25% of those who opted-out.

The solvency rates for the medical subsidy benefits are determined to provide an estimated margin of 20% of the benefits by the end of the first year of the biennium and thereafter.

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.

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 on pages I-1 and I-2, in particular, the marriage assumption, service purchase assumption and forfeiture assumption.

We have incorporated suggestions from the independent actuarial auditor where appropriate.

SECTION J

COMPREHENSIVE LISTING OF RECOMMENDED ASSUMPTIONS

EMPLOYEES

Proposed Rates

Service Based Salary Scale		Select Withdrawal			Disability Rates			Early Retirement Pattern			Normal Retirement Pattern				
% Merit Increases in Salaries Next Year		Less than 5 Years of Service			Age	% Becoming Disabled		Age and Service Pre 7/1/11			Age and Service Pre 7/1/11				
		Service Index	Male	Female		Male	Female	Age	% Retiring		Age	% Retiring			
Service Index	Rate														
1	12.00%	1	27.00%	27.00%	20	0.00%	0.00%	50	0.50%	0.50%	60	10.8%	10.8%		
2	6.00%	2	21.00%	21.00%	21	0.00%	0.00%	51	0.50%	0.50%	61	10.1%	10.5%		
3	3.00%	3	15.00%	15.00%	22	0.00%	0.00%	52	0.60%	0.60%	62	15.5%	13.9%		
4	2.75%	4	12.00%	12.00%	23	0.00%	0.00%	53	0.70%	0.70%	63	16.1%	13.6%		
5	2.50%	5	10.00%	10.00%	24	0.00%	0.00%	54	0.90%	0.90%	64	13.5%	14.3%		
6	2.25%	Sw	1269	1269	25	0.01%	0.01%	55	1.50%	1.50%	65	17.1%	19.2%		
7	2.00%	Ultimate Withdrawal			26	0.01%	0.01%	56	2.10%	2.10%	66	24.8%	24.0%		
8	1.75%	5 or more Years of Service			27	0.01%	0.01%	57	2.10%	2.10%	67	23.1%	23.7%		
9	1.50%	Age	Male	Female	28	0.01%	0.01%	58	2.90%	2.90%	68	19.8%	20.2%		
10	1.25%	25	8.26%	8.26%	29	0.01%	0.01%	59	3.90%	3.90%	69	18.8%	20.1%		
11	1.00%	26	7.95%	7.95%	30	0.01%	0.01%	Rx	3084	3084	70	100.0%	100.0%		
12	0.75%	27	7.65%	7.65%	31	0.01%	0.01%	anchor	50	50	Rx	3082	3083		
13	0.50%	28	7.37%	7.37%	32	0.02%	0.02%				anchor	60	60		
14	0.50%	29	7.10%	7.10%	33	0.02%	0.02%	Rule 70			Age and Service				
15	0.50%	30	6.84%	6.84%	34	0.02%	0.02%	Pre 7/1/11			Post 7/1/11				
16	0.50%	31	6.59%	6.59%	35	0.02%	0.02%	Age	% Retiring		Age	% Retiring			
17	0.50%	32	6.36%	6.36%	36	0.02%	0.02%								
18	0.50%	33	6.14%	6.14%	37	0.02%	0.02%	45	0.60%	0.60%	65	45.0%	44.0%		
19	0.50%	34	5.93%	5.93%	38	0.03%	0.03%	46	0.60%	0.60%	66	45.0%	44.0%		
20	0.50%	35	5.74%	5.74%	39	0.03%	0.03%	47	0.70%	0.70%	67	23.0%	22.0%		
21	0.50%	36	5.57%	5.57%	40	0.04%	0.04%	48	0.90%	0.90%	68	21.0%	18.0%		
22	0.50%	37	5.41%	5.41%	41	0.04%	0.04%	49	1.10%	1.10%	69	20.0%	19.0%		
23	0.50%	38	5.25%	5.25%	42	0.05%	0.05%	50	1.80%	1.80%	70	100.0%	100.0%		
24	0.50%	39	5.11%	5.11%	43	0.06%	0.06%	51	2.10%	2.10%	Rx	999	999		
25	0.50%	40	4.97%	4.97%	44	0.07%	0.07%	52	2.40%	2.40%	anchor	65	65		
26	0.50%	41	4.84%	4.84%	45	0.07%	0.07%	53	3.50%	3.50%					
27	0.50%	42	4.72%	4.72%	46	0.09%	0.09%	54	3.90%	3.90%					
28	0.50%	43	4.61%	4.61%	47	0.10%	0.10%	55	6.30%	6.30%					
29	0.50%	44	4.49%	4.49%	48	0.11%	0.11%	56	6.90%	6.90%					
30	0.50%	45	4.39%	4.39%	49	0.13%	0.13%	57	9.80%	9.80%					
31	0.50%	46	4.26%	4.26%	50	0.15%	0.15%	58	11.10%	11.10%					
32	0.50%	47	4.14%	4.14%	51	0.17%	0.17%	59	13.70%	13.70%					
33	0.50%	48	4.02%	4.02%	52	0.20%	0.20%	Rx	3085	3085					
34	0.50%	49	3.91%	3.91%	53	0.22%	0.22%	anchor	45	45					
35	0.50%	50	3.81%	3.81%	54	0.25%	0.25%	Age and Service							
36	0.50%	51	3.73%	3.73%	55	0.28%	0.28%	Post 7/1/11							
37	0.50%	52	3.66%	3.66%	56	0.31%	0.31%	Age	% Retiring						
38	0.50%	53	3.60%	3.60%	57	0.35%	0.35%								
39	0.50%	54	3.53%	3.53%	58	0.38%	0.38%	60	10.8%	10.8%					
40	0.50%	Wx	37	37	59	0.42%	0.42%	61	10.1%	10.5%					
Ref	853	Wx Mult	129.0%	129.0%	60	0.46%	0.46%	62	15.5%	13.9%					
					Hx	19	19	63	16.1%	13.6%					
					Mult	60%	60%	64	13.5%	14.3%					
					Ordinary	60%		Rx	3082	3083					
					Accidental	40%		anchor	60	60					



TEACHERS

Proposed Rates

Service Based Salary Scale		Select Withdrawal			Disability Rates			Early Retirement Pattern			Normal Retirement Pattern		
% Merit Increases in Salaries Next Year		Less than 5 Years of Service			Age	% Becoming Disabled		Age and Service Pre 7/1/11			Age and Service Pre 7/1/11		
Service Index	Rate	Service Index	Male	Female		Male	Female	Age	% Retiring		Age	% Retiring	
1	8.00%	1	25.00%	25.00%	20	0.00%	0.00%	50	0.40%	0.40%	60	16.0%	13.0%
2	8.00%	2	15.00%	15.00%	21	0.00%	0.00%	51	0.50%	0.50%	61	16.0%	14.0%
3	4.00%	3	12.00%	12.00%	22	0.00%	0.00%	52	0.60%	0.60%	62	20.0%	18.0%
4	3.50%	4	10.00%	10.00%	23	0.00%	0.00%	53	0.70%	0.70%	63	16.0%	19.0%
5	3.25%	5	8.00%	8.00%	24	0.00%	0.00%	54	1.00%	1.00%	64	20.0%	19.0%
6	3.00%	Sw	81	81	25	0.00%	0.00%	55	1.50%	1.50%	65	24.5%	28.0%
7	2.75%	Ultimate Withdrawal			26	0.00%	0.00%	56	2.00%	2.00%	66	32.0%	35.0%
8	2.50%	5 or more Years of Service			27	0.00%	0.00%	57	2.90%	2.90%	67	28.0%	32.0%
9	2.25%	Age	Male	Female	28	0.00%	0.00%	58	4.30%	4.30%	68	28.0%	28.0%
10	2.00%	25	7.74%	7.74%	29	0.00%	0.00%	59	6.80%	6.80%	69	28.0%	30.0%
11	1.75%	26	7.39%	7.39%	30	0.00%	0.00%	Rx	3088	3088	70	100.0%	100.0%
12	1.50%	27	7.04%	7.04%	31	0.00%	0.00%	anchor	50	50	Rx	3086	3087
13	1.25%	28	6.69%	6.69%	32	0.01%	0.01%				anchor	60	60
14	1.00%	29	6.34%	6.34%	33	0.01%	0.01%	Rule 70			Age and Service Post 7/1/11		
15	1.00%	30	5.98%	5.98%	34	0.01%	0.01%	Pre 7/1/11			Post 7/1/11		
16	1.00%	31	5.63%	5.63%	35	0.01%	0.01%	Age	% Retiring		Age	% Retiring	
17	1.00%	32	5.28%	5.28%	36	0.01%	0.01%						
18	1.00%	33	5.06%	5.06%	37	0.01%	0.01%	45	0.6%	0.6%	65	58.0%	56.0%
19	1.00%	34	4.84%	4.84%	38	0.01%	0.01%	46	0.6%	0.6%	66	58.0%	56.0%
20	1.00%	35	4.62%	4.62%	39	0.01%	0.01%	47	0.6%	0.6%	67	25.0%	27.0%
21	1.00%	36	4.40%	4.40%	40	0.01%	0.01%	48	0.6%	0.6%	68	25.0%	27.0%
22	1.00%	37	4.18%	4.18%	41	0.01%	0.01%	49	0.6%	0.6%	69	25.0%	27.0%
23	1.00%	38	4.00%	4.00%	42	0.02%	0.02%	50	0.8%	0.8%	70	100.0%	100.0%
24	1.00%	39	3.83%	3.83%	43	0.02%	0.02%	51	1.0%	1.0%	Rx	999	999
25	1.00%	40	3.65%	3.65%	44	0.02%	0.02%	52	1.2%	1.2%	anchor	65	65
26	1.00%	41	3.48%	3.48%	45	0.02%	0.02%	53	0.9%	0.9%			
27	1.00%	42	3.30%	3.30%	46	0.03%	0.03%	54	1.9%	1.9%			
28	1.00%	43	3.15%	3.15%	47	0.03%	0.03%	55	4.8%	4.8%			
29	1.00%	44	2.99%	2.99%	48	0.04%	0.04%	56	6.6%	6.6%			
30	1.00%	45	2.84%	2.84%	49	0.04%	0.04%	57	6.6%	6.6%			
31	1.00%	46	2.68%	2.68%	50	0.05%	0.05%	58	9.0%	9.0%			
32	1.00%	47	2.53%	2.53%	51	0.06%	0.06%	59	12.0%	12.0%			
33	1.00%	48	2.49%	2.49%	52	0.07%	0.07%	Rx	3089	3089			
34	1.00%	49	2.44%	2.44%	53	0.07%	0.07%	anchor	45	45			
35	1.00%	50	2.40%	2.40%	54	0.08%	0.08%	Age and Service Post 7/1/11					
36	1.00%	51	2.35%	2.35%	55	0.09%	0.09%	Age	% Retiring				
37	1.00%	52	2.31%	2.31%	56	0.10%	0.10%						
38	1.00%	53	2.31%	2.31%	57	0.12%	0.12%	60	16.0%	13.0%			
39	1.00%	54	2.31%	2.31%	58	0.13%	0.13%	61	16.0%	14.0%			
40	1.00%	Wx	870	870	59	0.14%	0.14%	62	20.0%	18.0%			
Ref	854	Wx Mult	110.0%	110.0%	60	0.15%	0.15%	63	16.0%	19.0%			
					Hx	19	19	64	20.0%	19.0%			
					Mult	20%	20%	Rx	3086	3087			
					Ordinary		80%	anchor	60	60			
					Accidental		20%						

POLICE

Proposed Rates

Service Based Salary Scale

% Merit Increases in Salaries Next Year	
Service Index	Rate
1	25.00%
2	19.00%
3	6.00%
4	4.50%
5	3.50%
6	2.75%
7	2.25%
8	1.80%
9	1.50%
10	1.50%
11	1.50%
12	1.50%
13	1.50%
14	1.50%
15	1.50%
16	1.50%
17	1.50%
18	1.50%
19	1.50%
20	1.50%
21	1.50%
22	1.50%
23	1.50%
24	1.50%
25	1.50%
26	1.50%
27	1.50%
28	1.50%
29	1.50%
30	1.50%
31	1.50%
32	1.50%
33	1.50%
34	1.50%
35	1.50%
36	1.50%
37	1.50%
38	1.50%
39	1.50%
40	1.50%

Ref 855

Select Withdrawal

Less than 5 Years of Service		
Service Index	Male	Female
1	25.00%	25.00%
2	16.00%	16.00%
3	10.50%	10.50%
4	7.00%	7.00%
5	5.50%	5.50%
Sw	1270	1270

Ultimate Withdrawal

5 or more Years of Service		
Age	Male	Female
25	6.58%	6.58%
26	6.11%	6.11%
27	5.79%	5.79%
28	5.50%	5.50%
29	5.23%	5.23%
30	4.97%	4.97%
31	4.72%	4.72%
32	4.48%	4.48%
33	4.26%	4.26%
34	4.05%	4.05%
35	3.84%	3.84%
36	3.65%	3.65%
37	3.47%	3.47%
38	3.30%	3.30%
39	3.14%	3.14%
40	2.99%	2.99%
41	2.85%	2.85%
42	2.73%	2.73%
43	2.60%	2.60%
44	2.50%	2.50%
45	2.39%	2.39%
46	2.30%	2.30%
47	2.22%	2.22%
48	2.15%	2.15%
49	2.08%	2.08%
50	2.03%	2.03%
51	1.98%	1.98%
52	1.94%	1.94%
53	1.88%	1.88%
54	1.88%	1.88%

Wx 80 80
Wx Mult 47.0% 47.0%

Disability Rates

Age	% Becoming Disabled	
	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	0.25%	0.25%
41	0.29%	0.29%
42	0.33%	0.33%
43	0.36%	0.36%
44	0.41%	0.41%
45	0.46%	0.46%
46	0.50%	0.50%
47	0.55%	0.55%
48	0.61%	0.61%
49	0.67%	0.67%
50	0.73%	0.73%
51	0.79%	0.79%
52	0.86%	0.86%
53	0.93%	0.93%
54	1.01%	1.01%
55	1.09%	1.09%
56	1.16%	1.16%
57	1.25%	1.25%
58	1.34%	1.34%
59	1.43%	1.43%
60	0.00%	0.00%

Hx 35 35
Mult 65% 65%

Ordinary	25%
Accidental	75%

FIRE

Proposed Rates

Service Based

Salary Scale

% Merit Increases in Salaries Next Year	
Service Index	Rate
1	0.00%
2	0.00%
3	0.00%
4	0.00%
5	0.00%
6	0.00%
7	0.00%
8	0.00%
9	0.00%
10	0.00%
11	0.00%
12	0.00%
13	0.00%
14	0.00%
15	0.00%
16	0.00%
17	0.00%
18	0.00%
19	0.00%
20	0.00%
21	0.00%
22	0.00%
23	0.00%
24	0.00%
25	0.00%
26	0.00%
27	0.00%
28	0.00%
29	0.00%
30	0.00%
31	0.00%
32	0.00%
33	0.00%
34	0.00%
35	0.00%
36	0.00%
37	0.00%
38	0.00%
39	0.00%
40	0.00%

Ref 861

Select Withdrawal

Less than 5 Years of Service		
Service Index	Male	Female
1	7.25%	7.25%
2	5.00%	5.00%
3	2.50%	2.50%
4	2.00%	2.00%
5	1.50%	1.50%
Sw	1271	1271

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	1.15%	1.15%
31	1.15%	1.15%
32	1.15%	1.15%
33	1.15%	1.15%
34	1.15%	1.15%
35	1.15%	1.15%
36	1.15%	1.15%
37	1.15%	1.15%
38	1.15%	1.15%
39	1.15%	1.15%
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%

Wx 151 151
Wx Mult 115% 115%

Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.07%	0.07%
21	0.08%	0.08%
22	0.08%	0.08%
23	0.09%	0.09%
24	0.10%	0.10%
25	0.10%	0.10%
26	0.11%	0.11%
27	0.11%	0.11%
28	0.12%	0.12%
29	0.12%	0.12%
30	0.13%	0.13%
31	0.13%	0.13%
32	0.14%	0.14%
33	0.14%	0.14%
34	0.15%	0.15%
35	0.15%	0.15%
36	0.16%	0.16%
37	0.17%	0.17%
38	0.18%	0.18%
39	0.20%	0.20%
40	0.21%	0.21%
41	0.23%	0.23%
42	0.25%	0.25%
43	0.27%	0.27%
44	0.29%	0.29%
45	0.31%	0.31%
46	0.34%	0.34%
47	0.36%	0.36%
48	0.39%	0.39%
49	0.42%	0.42%
50	0.46%	0.46%
51	0.49%	0.49%
52	0.53%	0.53%
53	0.57%	0.57%
54	0.63%	0.63%
55	0.69%	0.69%
56	0.76%	0.76%
57	0.84%	0.84%
58	0.94%	0.94%
59	1.04%	1.04%
60	1.16%	1.16%

Hx 3 3
Mult 60% 60%

Ordinary	40%
Accidental	60%

FIRE

Proposed Rates (Concluded)

RATES OF RETIREMENT

(Applying to Eligible Members)

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

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

Retirement Ages	% of Active Members Retiring Within Next Year	Age 46 with 21 years	Age 47 with 22 years	Age 48 with 23 years	Age 49 with 24 years	Age 50 with 25 years
45	11%					
46	11%	15%				
47	11%	15%	18%			
48	11%	15%	18%	22%		
49	11%	15%	18%	22%	26%	
50	16%	15%	18%	21%	26%	30%
51	16%	16%	18%	21%	26%	30%
52	16%	16%	16%	21%	21%	30%
53	16%	16%	16%	16%	21%	22%
54	16%	16%	16%	16%	16%	22%
55	19%	19%	19%	19%	19%	19%
56	19%	19%	19%	19%	19%	19%
57	22%	22%	22%	22%	22%	22%
58	19%	19%	19%	19%	19%	19%
59	19%	19%	19%	19%	19%	19%
60	23%	23%	23%	23%	23%	23%
61	23%	23%	23%	23%	23%	23%
62	23%	23%	23%	23%	23%	23%
63	23%	23%	23%	23%	23%	23%
64	23%	23%	23%	23%	23%	23%
65	28%	28%	28%	28%	28%	28%
66	28%	28%	28%	28%	28%	28%
67	28%	28%	28%	28%	28%	28%
68	28%	28%	28%	28%	28%	28%
69	28%	28%	28%	28%	28%	28%
70	100%	100%	100%	100%	100%	100%

Healthy Retiree Mortality Proposed Rates* - Employees

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.2817%	0.2335%	81	5.0434%	3.9346%
51	0.3045%	0.2486%	82	5.6958%	4.4588%
52	0.3308%	0.2670%	83	6.4289%	5.0563%
53	0.3595%	0.2867%	84	7.2461%	5.7379%
54	0.3925%	0.3067%	85	8.1541%	6.5132%
55	0.4280%	0.3279%	86	9.1518%	7.3966%
56	0.4667%	0.3496%	87	10.2386%	8.3938%
57	0.5083%	0.3722%	88	11.4220%	9.5086%
58	0.5523%	0.3941%	89	12.6952%	10.7364%
59	0.6000%	0.4185%	90	14.0640%	12.0685%
60	0.6483%	0.4446%	91	15.5063%	13.4799%
61	0.6986%	0.4748%	92	17.0167%	14.9478%
62	0.7515%	0.5089%	93	18.5756%	16.4722%
63	0.8058%	0.5491%	94	20.1818%	18.0550%
64	0.8649%	0.5934%	95	21.8298%	19.7088%
65	0.9306%	0.6453%	96	23.6589%	21.5044%
66	1.0059%	0.7048%	97	25.5436%	23.4155%
67	1.0930%	0.7731%	98	27.5015%	25.4335%
68	1.1937%	0.8536%	99	29.5084%	27.5567%
69	1.3111%	0.9471%	100	31.5488%	29.7767%
70	1.4458%	1.0552%	101	33.6043%	32.0701%
71	1.5994%	1.1806%	102	35.6558%	34.3822%
72	1.7773%	1.3250%	103	37.6729%	36.7019%
73	1.9792%	1.4901%	104	39.6461%	38.9928%
74	2.2111%	1.6784%	105	41.5634%	41.2542%
75	2.4760%	1.8922%	106	43.4220%	43.4733%
76	2.7780%	2.1336%	107	45.1956%	45.6048%
77	3.1222%	2.4076%	108	46.8940%	47.6545%
78	3.5147%	2.7186%	109	48.4845%	49.6136%
79	3.9600%	3.0716%	110	100.0000%	100.0000%
80	4.4672%	3.4748%			

Ref #2705sb0x1.01 #2706sb0x1.09

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Disabled Retiree Mortality Proposed Rates* - Employees

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	1.5020%	1.4307%	81	7.3676%	6.2433%
51	1.6078%	1.5025%	82	7.9811%	6.8400%
52	1.7207%	1.5808%	83	8.6530%	7.4956%
53	1.8381%	1.6650%	84	9.3804%	8.2086%
54	1.9576%	1.7502%	85	10.1634%	8.9857%
55	2.0785%	1.8323%	86	11.0054%	9.7948%
56	2.1966%	1.9060%	87	11.9053%	10.6193%
57	2.3089%	1.9684%	88	12.8764%	11.4546%
58	2.4159%	2.0170%	89	14.0871%	12.2998%
59	2.5173%	2.0522%	90	15.4253%	13.1713%
60	2.6126%	2.0777%	91	16.7874%	14.0861%
61	2.7041%	2.0944%	92	18.1594%	15.0581%
62	2.7936%	2.1094%	93	19.5260%	16.1111%
63	2.8855%	2.1259%	94	20.9013%	17.2631%
64	2.9786%	2.1482%	95	22.3021%	18.5358%
65	3.0721%	2.1788%	96	23.8936%	19.9973%
66	3.1704%	2.2243%	97	25.5661%	21.6422%
67	3.2750%	2.2865%	98	27.3568%	23.4098%
68	3.3889%	2.3695%	99	29.2525%	25.3027%
69	3.5166%	2.4751%	100	31.2364%	27.3181%
70	3.6595%	2.6065%	101	33.2716%	29.4221%
71	3.8247%	2.7638%	102	35.3028%	31.5433%
72	4.0148%	2.9493%	103	37.2999%	33.6715%
73	4.2330%	3.1634%	104	39.2536%	35.7732%
74	4.4812%	3.4098%	105	41.1519%	37.8479%
75	4.7653%	3.6905%	106	42.9921%	39.8838%
76	5.0851%	4.0076%	107	44.7481%	41.8393%
77	5.4460%	4.3635%	108	46.4297%	43.7197%
78	5.8508%	4.7621%	109	48.0045%	45.5171%
79	6.3039%	5.2066%	110	100.0000%	100.0000%
80	6.8078%	5.6993%	Ref	#2711sb0x1	#2712sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Pre-Retirement Mortality Proposed Rates* - Employees

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1394%	0.0801%	81	2.1390%	1.6738%
51	0.1521%	0.0881%	82	2.8551%	2.2175%
52	0.1656%	0.0966%	83	3.8111%	2.9364%
53	0.1808%	0.1066%	84	5.0856%	3.8851%
54	0.1967%	0.1169%	85	6.7878%	5.1357%
55	0.2153%	0.1294%	86	9.0612%	6.7859%
56	0.2355%	0.1417%	87	10.1372%	7.7007%
57	0.2582%	0.1546%	88	11.3089%	8.7235%
58	0.2821%	0.1679%	89	12.5695%	9.8499%
59	0.3069%	0.1823%	90	13.9248%	11.0720%
60	0.3330%	0.1976%	91	15.3528%	12.3669%
61	0.3600%	0.2126%	92	16.8482%	13.7136%
62	0.3872%	0.2283%	93	18.3917%	15.1121%
63	0.4155%	0.2458%	94	19.9820%	16.5642%
64	0.4435%	0.2653%	95	21.6137%	18.0815%
65	0.4723%	0.2859%	96	23.4247%	19.7288%
66	0.5024%	0.3100%	97	25.2907%	21.4821%
67	0.5352%	0.3378%	98	27.2292%	23.3335%
68	0.5712%	0.3689%	99	29.2162%	25.2814%
69	0.6130%	0.4043%	100	31.2364%	27.3181%
70	0.6595%	0.4453%	101	33.2716%	29.4221%
71	0.7132%	0.4920%	102	35.3028%	31.5433%
72	0.7736%	0.5445%	103	37.2999%	33.6715%
73	0.8422%	0.6036%	104	39.2536%	35.7732%
74	0.9192%	0.6704%	105	41.1519%	37.8479%
75	1.0059%	0.7449%	106	42.9921%	39.8838%
76	1.1021%	0.8280%	107	44.7481%	41.8393%
77	1.2095%	0.9197%	108	46.4297%	43.7197%
78	1.3274%	1.0228%	109	48.0045%	45.5171%
79	1.4582%	1.1363%	110	100.0000%	100.0000%
80	1.6028%	1.2619%	Ref	#2723sb0x1	#2724sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Healthy Retiree Mortality Proposed Rates* - Teachers

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1088%	0.0820%	81	4.1352%	3.2127%
51	0.1245%	0.0987%	82	4.7057%	3.6713%
52	0.1438%	0.1193%	83	5.3572%	4.1927%
53	0.1660%	0.1450%	84	6.0973%	4.7821%
54	0.1918%	0.1760%	85	6.9360%	5.4460%
55	0.2237%	0.2132%	86	7.8803%	6.1932%
56	0.2494%	0.2338%	87	8.9335%	7.0320%
57	0.2778%	0.2548%	88	10.1080%	7.9730%
58	0.3098%	0.2769%	89	11.4044%	9.0273%
59	0.3436%	0.2983%	90	12.8364%	10.2107%
60	0.3801%	0.3201%	91	14.3902%	11.5403%
61	0.4195%	0.3430%	92	16.0569%	13.0098%
62	0.4620%	0.3661%	93	17.8086%	14.6176%
63	0.5062%	0.3914%	94	19.6285%	16.3465%
64	0.5558%	0.4195%	95	21.4931%	18.1818%
65	0.6094%	0.4522%	96	23.5252%	20.1596%
66	0.6704%	0.4898%	97	25.5834%	22.2241%
67	0.7402%	0.5351%	98	27.6757%	24.3439%
68	0.8210%	0.5898%	99	29.7723%	26.4998%
69	0.9146%	0.6559%	100	31.8611%	28.6840%
70	1.0239%	0.7364%	101	33.9370%	30.8932%
71	1.1515%	0.8317%	102	36.0089%	33.1205%
72	1.3000%	0.9446%	103	38.0459%	35.3551%
73	1.4730%	1.0778%	104	40.0387%	37.5619%
74	1.6719%	1.2335%	105	41.9749%	39.7403%
75	1.9014%	1.4142%	106	43.8519%	41.8780%
76	2.1658%	1.6239%	107	45.6431%	43.9313%
77	2.4665%	1.8639%	108	47.3583%	45.9057%
78	2.8076%	2.1380%	109	48.9646%	47.7930%
79	3.1952%	2.4515%	110	100.0000%	100.0000%
80	3.6345%	2.8074%	Ref	#2701sb0x1.02	#2702sb0x1.05

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Disabled Retiree Mortality Proposed Rates* - Teachers

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	1.5020%	1.4307%	81	7.3676%	6.2433%
51	1.6078%	1.5025%	82	7.9811%	6.8400%
52	1.7207%	1.5808%	83	8.6530%	7.4956%
53	1.8381%	1.6650%	84	9.3804%	8.2086%
54	1.9576%	1.7502%	85	10.1634%	8.9857%
55	2.0785%	1.8323%	86	11.0054%	9.7948%
56	2.1966%	1.9060%	87	11.9053%	10.6193%
57	2.3089%	1.9684%	88	12.8764%	11.4546%
58	2.4159%	2.0170%	89	14.0871%	12.2998%
59	2.5173%	2.0522%	90	15.4253%	13.1713%
60	2.6126%	2.0777%	91	16.7874%	14.0861%
61	2.7041%	2.0944%	92	18.1594%	15.0581%
62	2.7936%	2.1094%	93	19.5260%	16.1111%
63	2.8855%	2.1259%	94	20.9013%	17.2631%
64	2.9786%	2.1482%	95	22.3021%	18.5358%
65	3.0721%	2.1788%	96	23.8936%	19.9973%
66	3.1704%	2.2243%	97	25.5661%	21.6422%
67	3.2750%	2.2865%	98	27.3568%	23.4098%
68	3.3889%	2.3695%	99	29.2525%	25.3027%
69	3.5166%	2.4751%	100	31.2364%	27.3181%
70	3.6595%	2.6065%	101	33.2716%	29.4221%
71	3.8247%	2.7638%	102	35.3028%	31.5433%
72	4.0148%	2.9493%	103	37.2999%	33.6715%
73	4.2330%	3.1634%	104	39.2536%	35.7732%
74	4.4812%	3.4098%	105	41.1519%	37.8479%
75	4.7653%	3.6905%	106	42.9921%	39.8838%
76	5.0851%	4.0076%	107	44.7481%	41.8393%
77	5.4460%	4.3635%	108	46.4297%	43.7197%
78	5.8508%	4.7621%	109	48.0045%	45.5171%
79	6.3039%	5.2066%	110	100.0000%	100.0000%
80	6.8078%	5.6993%	Ref	#2707sb0x1	#2708sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Pre-Retirement Mortality Proposed Rates* - Teachers

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1039%	0.0704%	81	2.4772%	2.1294%
51	0.1146%	0.0773%	82	3.1095%	2.6145%
52	0.1259%	0.0857%	83	3.9036%	3.2080%
53	0.1397%	0.0934%	84	4.9001%	3.9331%
54	0.1541%	0.1024%	85	6.1516%	4.8179%
55	0.1691%	0.1125%	86	7.7258%	5.8983%
56	0.1866%	0.1225%	87	8.7583%	6.6971%
57	0.2056%	0.1332%	88	9.9098%	7.5933%
58	0.2267%	0.1453%	89	11.1808%	8.5974%
59	0.2499%	0.1576%	90	12.5847%	9.7245%
60	0.2756%	0.1710%	91	14.1080%	10.9908%
61	0.3045%	0.1854%	92	15.7421%	12.3903%
62	0.3350%	0.2016%	93	17.4594%	13.9215%
63	0.3668%	0.2186%	94	19.2436%	15.5681%
64	0.4015%	0.2387%	95	21.0717%	17.3160%
65	0.4390%	0.2608%	96	23.0639%	19.1996%
66	0.4776%	0.2863%	97	25.0818%	21.1658%
67	0.5196%	0.3154%	98	27.1330%	23.1847%
68	0.5645%	0.3505%	99	29.1885%	25.2379%
69	0.6139%	0.3924%	100	31.2364%	27.3181%
70	0.6651%	0.4417%	101	33.2716%	29.4221%
71	0.7198%	0.5002%	102	35.3028%	31.5433%
72	0.7791%	0.5691%	103	37.2999%	33.6715%
73	0.8431%	0.6484%	104	39.2536%	35.7732%
74	0.9119%	0.7419%	105	41.1519%	37.8479%
75	0.9885%	0.8491%	106	42.9921%	39.8838%
76	1.1333%	0.9792%	107	44.7481%	41.8393%
77	1.3006%	1.1296%	108	46.4297%	43.7197%
78	1.4943%	1.3034%	109	48.0045%	45.5171%
79	1.7169%	1.5024%	110	100.0000%	100.0000%
80	1.9734%	1.7325%	Ref	#2719sb0x1	#2720sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Healthy Retiree Mortality Proposed Rates* - Police and Fire

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1725%	0.1423%	81	5.1229%	4.1710%
51	0.1903%	0.1619%	82	5.7788%	4.6690%
52	0.2099%	0.1834%	83	6.5125%	5.2242%
53	0.2324%	0.2081%	84	7.3309%	5.8397%
54	0.2586%	0.2365%	85	8.2412%	6.5229%
55	0.2889%	0.2687%	86	9.2524%	7.2819%
56	0.3228%	0.3037%	87	10.3673%	8.1258%
57	0.3616%	0.3413%	88	11.6017%	9.0659%
58	0.4058%	0.3814%	89	12.9567%	10.1103%
59	0.4548%	0.4235%	90	14.4502%	11.2743%
60	0.5091%	0.4691%	91	15.9701%	12.5199%
61	0.5686%	0.5153%	92	17.4631%	13.8196%
62	0.6322%	0.5641%	93	18.8942%	15.1677%
63	0.7002%	0.6165%	94	20.2724%	16.5651%
64	0.7739%	0.6738%	95	21.6195%	18.0262%
65	0.8535%	0.7362%	96	23.1115%	19.6172%
66	0.9408%	0.8054%	97	24.6611%	21.3179%
67	1.0380%	0.8842%	98	26.3247%	23.1241%
68	1.1466%	0.9752%	99	28.1017%	25.0353%
69	1.2708%	1.0785%	100	29.9869%	27.0449%
70	1.4121%	1.1982%	101	31.9407%	29.1279%
71	1.5748%	1.3343%	102	33.8907%	31.2279%
72	1.7604%	1.4900%	103	35.8079%	33.3348%
73	1.9722%	1.6672%	104	37.6835%	35.4155%
74	2.2144%	1.8676%	105	39.5058%	37.4694%
75	2.4900%	2.0946%	106	41.2724%	39.4850%
76	2.8036%	2.3501%	107	42.9582%	41.4209%
77	3.1593%	2.6365%	108	44.5725%	43.2825%
78	3.5637%	2.9587%	109	46.0843%	45.0619%
79	4.0212%	3.3187%	110	100.0000%	100.0000%
80	4.5387%	3.7215%			

Ref #2703sb0x0.96 #2704sb0x0.99

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Disabled Retiree Mortality Proposed Rates* - Police and Fire

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.3303%	0.2933%	81	5.7415%	4.2131%
51	0.3503%	0.3230%	82	6.3485%	4.7162%
52	0.3739%	0.3576%	83	7.0241%	5.2770%
53	0.4019%	0.3960%	84	7.7854%	5.8987%
54	0.4342%	0.4386%	85	8.6579%	6.5888%
55	0.4719%	0.4849%	86	9.6379%	7.3555%
56	0.5160%	0.5338%	87	10.7993%	8.2079%
57	0.5681%	0.5842%	88	12.0851%	9.1575%
58	0.6278%	0.6372%	89	13.4966%	10.2124%
59	0.6946%	0.6894%	90	15.0523%	11.3882%
60	0.7672%	0.7425%	91	16.6355%	12.6464%
61	0.8466%	0.7959%	92	18.1907%	13.9592%
62	0.9288%	0.8495%	93	19.6815%	15.3209%
63	1.0154%	0.9048%	94	21.1171%	16.7324%
64	1.1042%	0.9626%	95	22.5203%	18.2083%
65	1.1970%	1.0247%	96	24.0745%	19.8154%
66	1.2948%	1.0932%	97	25.6886%	21.5332%
67	1.4006%	1.1703%	98	27.4216%	23.3577%
68	1.5156%	1.2572%	99	29.2726%	25.2882%
69	1.6435%	1.3546%	100	31.2364%	27.3181%
70	1.7889%	1.4663%	101	33.2716%	29.4221%
71	1.9556%	1.5915%	102	35.3028%	31.5433%
72	2.1525%	1.7319%	103	37.2999%	33.6715%
73	2.3839%	1.8885%	104	39.2536%	35.7732%
74	2.6566%	2.0616%	105	41.1519%	37.8479%
75	2.9747%	2.2523%	106	42.9921%	39.8838%
76	3.3374%	2.4646%	107	44.7481%	41.8393%
77	3.7453%	2.7013%	108	46.4297%	43.7197%
78	4.1924%	2.9886%	109	48.0045%	45.5171%
79	4.6729%	3.3522%	110	100.0000%	100.0000%
80	5.1864%	3.7591%			

Ref #2709sb0x1 #2710sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 projection scale.

Pre-Retirement Mortality Proposed Rates* - Police and Fire

Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female
50	0.1123%	0.0878%	81	3.1082%	2.1799%
51	0.1212%	0.0949%	82	3.8978%	2.7838%
52	0.1325%	0.1026%	83	4.8886%	3.5535%
53	0.1445%	0.1107%	84	6.1296%	4.5313%
54	0.1570%	0.1200%	85	7.6862%	5.7741%
55	0.1721%	0.1294%	86	9.6379%	7.3555%
56	0.1896%	0.1396%	87	10.7993%	8.2079%
57	0.2076%	0.1503%	88	12.0851%	9.1575%
58	0.2288%	0.1593%	89	13.4966%	10.2124%
59	0.2519%	0.1694%	90	15.0523%	11.3882%
60	0.2756%	0.1785%	91	16.6355%	12.6464%
61	0.3014%	0.1864%	92	18.1907%	13.9592%
62	0.3287%	0.1954%	93	19.6815%	15.3209%
63	0.3564%	0.2035%	94	21.1171%	16.7324%
64	0.3841%	0.2121%	95	22.5203%	18.2083%
65	0.4138%	0.2202%	96	24.0745%	19.8154%
66	0.4617%	0.2484%	97	25.6886%	21.5332%
67	0.5138%	0.2800%	98	27.4216%	23.3577%
68	0.5741%	0.3182%	99	29.2726%	25.2882%
69	0.6415%	0.3622%	100	31.2364%	27.3181%
70	0.7186%	0.4135%	101	33.2716%	29.4221%
71	0.8072%	0.4738%	102	35.3028%	31.5433%
72	0.9094%	0.5445%	103	37.2999%	33.6715%
73	1.0263%	0.6265%	104	39.2536%	35.7732%
74	1.1598%	0.7218%	105	41.1519%	37.8479%
75	1.3143%	0.8325%	106	42.9921%	39.8838%
76	1.4896%	0.9606%	107	44.7481%	41.8393%
77	1.6905%	1.1091%	108	46.4297%	43.7197%
78	1.9201%	1.2808%	109	48.0045%	45.5171%
79	2.1817%	1.4779%	110	100.0000%	100.0000%
80	2.4783%	1.7050%			

Ref #2721sb0x1 #2722sb0x1

* Applicable to calendar year 2019. Rates in future years are determined by the above rates and the MP-2019 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.