

Minnesota State Employees Retirement Fund

4-Year Experience Study

July 1, 2018 Through June 30, 2022





June 29, 2023

Minnesota State Retirement System
State Employees Retirement Fund
St. Paul, Minnesota

Dear Board of Directors of the State Employees Retirement Fund:

The results of the four-year **actuarial experience study** of the State Employees Retirement Fund (SERF) are presented in this report. The investigation was conducted for the purpose of updating the actuarial assumptions used in valuing the actuarial liabilities of the State Employees Retirement Fund.

The investigation was based upon the statistical data furnished for annual active member and retired life actuarial valuations concerning members who died, withdrew, became disabled or retired during the four-year period of the study by the Minnesota State Retirement System (MSRS). We checked for internal and year-to-year consistency, but did not audit the data. We are not responsible for the accuracy or completeness of the information provided by MSRS.

The investigation covered the four-year period from **July 1, 2018 to June 30, 2022**, and was carried out using generally accepted actuarial principles and techniques.

We believe that the actuarial assumptions recommended in this experience study report represent individually and in the aggregate reasonable estimates of future experience of the State Employees Retirement Fund.

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

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report was performed in accordance with Minnesota Statutes Section 356.215 and the requirements of the Standards for Actuarial Work established by the Legislative Commission on Pensions and Retirement. We certify that, to the best of our knowledge, this report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board.

Board of Directors
Minnesota State Retirement System
State Employees Retirement Fund
June 29, 2023

Brian B. Murphy, Bonita J. Wurst and Sheryl L. Christensen are independent of the plan sponsor and 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. In addition, GRS meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

Respectfully submitted,
Gabriel, Roeder, Smith & Company



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Actuarial Experience Study 2018-2022

TABLE OF CONTENTS

| Item | Section |
|---|----------------|
| Overview and Summary of Results | A |
| Economic Assumptions | B |
| Pay Increases | C |
| Retirement Experience | D |
| Withdrawal Experience | E |
| Disability Experience | F |
| Mortality Experience | G |
| Actuarial Methods | H |
| Miscellaneous and Technical Assumptions | I |
| Proposed Assumption Listing | J |
| Glossary | K |
| Appendix | L |

SECTION A

OVERVIEW AND SUMMARY OF RESULTS

Summary of Findings

The four-year period (July 1, 2018 to June 30, 2022) covered by this experience study provided sufficient data to form a basis for recommending changes in some of the assumptions and/or methods used in actuarial valuations of the State Employees Retirement Fund. The recommended changes in actuarial assumptions and methods resulting from this experience study are summarized below:

Recommendations

- Adjust rates of merit and seniority, resulting in slightly lower proposed merit and seniority overall.
- Adjust assumed retirement rates:
 - Minor increase in the rate of assumed unreduced retirements (i.e., Normal Retirement).
 - Minor changes to the assumed Rule of 90 retirement rates, resulting in a slight decrease in assumed Rule of 90 retirements.
 - Minor changes to the assumed Tier 1 early retirement rates, resulting in slightly more assumed Tier 1 early retirements.
 - Adjustments to early retirement rates for Tier 2 members, generally resulting in fewer assumed early retirements
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
 - The overall impact is a minor increase in assumed terminations for males and a decrease in assumed terminations for females.
- Lower rates of disability.
- Continued use of the Pub-2010 General mortality table, with rates adjusted to better fit observed plan experience and with future improvement projected using scale MP-2021.
- No change in the actuarial funding method.
- Consider alternatives to the current closed period amortization policy.
- Change Minnesota Standards for Actuarial Work requirements related to projected payroll.
- Minor changes to the percent married and form of payment assumptions.
- Minor changes to the assumptions made with respect to missing participant data.

The recommendations are summarized on the following pages.

Introduction

Each year as of June 30, the actuarial liabilities of the 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 members (leaving before eligible to retire).
- Rates of **disability** among active members.
- Patterns of **pay increases** to active members.
- Rates of **retirement** among active members.
- Rates of **mortality** among active members, retirees, and beneficiaries.
- Long-term rates of **investment return** to be generated by the assets of the System.

Assumptions should be carefully chosen and continually monitored. An unrealistic set of assumptions can lead to:

- Understated costs resulting in either an inability to pay benefits when due, or gradual increases in required contributions as time progresses;
- Overstated costs resulting in an unnecessarily large burden on the current generation of employers and taxpayers.

All actuarial assumptions are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement or the MSRS Board of Directors.

A single set of assumptions will not be suitable indefinitely. Things change, and our understanding of things (whether or not they are changing) also changes. The package of assumptions is then adjusted to reflect basic experience trends -- but not random year to year fluctuations. Actuarial assumptions were last revised for the June 30, 2020 actuarial valuations based on the results of the most recent experience study. Assumptions in effect prior to June 30, 2022 are ignored for purposes of this report.

No single 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 the actual experience, we generally recommend a change in assumptions that produces 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 and methods. The various assumption changes are described on the following pages.

Summary of Decrement Experience 2018 - 2022

Results presented in this exhibit and in the body of the report are liability weighted for retirement, withdrawal and active mortality and benefit weighted for healthy and disabled retiree mortality.

| Decrement Risk Area | Actual Number | Expected | | |
|--------------------------------------|---------------|---------------------|----------------------|----------|
| | | Present Assumptions | Proposed Assumptions | Change |
| <i>Unreduced Retirement (\$000s)</i> | | | | |
| Normal Retirement* | 794,907 | 732,976 | 770,934 | 37,958 |
| Rule of 90 | 679,476 | 705,911 | 687,896 | (18,015) |
| <i>Reduced Retirement (\$000s)</i> | | | | |
| Tier 1 Early Retirement | 65,210 | 60,349 | 62,805 | 2,456 |
| Tier 2 Early Retirement | 571,562 | 578,076 | 567,368 | (10,708) |
| <i>Withdrawal (\$000s)</i> | | | | |
| Males | 309,221 | 308,324 | 309,614 | 1,290 |
| Females | 394,565 | 425,409 | 407,503 | (17,906) |
| <i>Disability</i> | | | | |
| Males | 59 | 124 | 87 | (37) |
| Females | 74 | 146 | 105 | (41) |
| <i>Mortality (\$000s)</i> | | | | |
| Healthy Retired Lives - Male | 54,352 | 52,952 | 53,284 | 332 |
| - Female | 31,931 | 31,391 | 31,563 | 172 |
| Disabled Retired Lives** - Male | 2,669 | 2,394 | 2,341 | (53) |
| - Female | 2,120 | 2,163 | 1,848 | (315) |
| Active Lives** - Male | 27,307 | 25,856 | 27,055 | 1,199 |
| - Female | 16,220 | 17,387 | 16,237 | (1,150) |

* Normal Retirements less than age 71. See Section D for full detail.

** Adjustments to fit plan experience are limited due to a lack of credible data (deaths).

SECTION B

ECONOMIC ASSUMPTIONS

Economic Assumptions – Introduction

Economic assumptions include **long-term rates of investment return** (net of administrative and investment expenses), **inflation** (the across-the-board portion of salary increases), **payroll growth**, and pay increases due to **merit and seniority**. Unlike demographic activities, economic activities do not lend themselves to analysis solely on the basis of internal historical patterns because both salary increases and investment return are affected more by external forces; namely inflation (both wage and price), general productivity changes and the local economic environment which defy accurate long-term prediction. Estimates of economic activities are generally selected on the basis of the expectations in an inflation-free environment and then both long-term rates of investment return and wage inflation are increased by some provision for long-term inflation.

Current economic assumptions for MSRS are as follows:

| | |
|--------------------------|--------|
| Investment Return | 7.00%* |
| Inflation | 2.25% |
| Payroll Growth | 3.00% |

** Recent legislation changed the investment return assumption from 7.5% to 7.0% effective July 1, 2023.*

The remainder of this section addresses the economic assumptions other than pay increases due to merit and seniority. Pay increases due to merit and seniority are addressed in Section C.

Sources considered in the analysis of the economic assumptions included:

- Asset allocation information provided on May 31, 2023 by the State Board of Investment (SBI) for the State of Minnesota
- Future expectations of other investment consultants
- 2023 Social Security Trustees Report
- Historical observations of inflation statistics and investment returns
- U.S. Department of the Treasury yield curve rates (www.treasury.gov)
- National Average Wage Index

Economic Assumptions – ASOP No. 27

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standards of Practice (ASOP) No. 27. The standard requires that the selected economic assumptions be consistent with each other. That is, the selection of the investment return assumption should be consistent with the selection of the payroll growth and inflation assumptions.

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

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

Economic Assumptions – Inflation

Inflation. Over the past 70 years, price inflation has averaged 3.5%. This result is heavily affected by the high inflationary period of the 1970s and early 1980s. During the past decade, price inflation averaged 2.6%.

| Calendar Year Period | Inflation (CPI) |
|---------------------------------|----------------------------|
| 1950-1959 | 2.2% |
| 1960-1969 | 2.5% |
| 1970-1979 | 7.4% |
| 1980-1989 | 5.1% |
| 1990-1999 | 2.9% |
| 2000-2009 | 2.5% |
| 2010-2019 | 1.8% |
| 2010 | 1.5% |
| 2011 | 3.0% |
| 2012 | 1.7% |
| 2013 | 1.5% |
| 2014 | 0.8% |
| 2015 | 0.7% |
| 2016 | 2.1% |
| 2017 | 2.1% |
| 2018 | 1.9% |
| 2019 | 2.3% |
| 2020 | 1.4% |
| 2021 | 7.0% |
| 2022 | 6.4% |
| Last 5 Years | 3.8% |
| Last 10 Years | 2.6% |
| Last 20 Years | 2.5% |
| Last 30 Years | 2.5% |
| Last 40 Years | 2.8% |
| Last 50 Years | 4.0% |
| Last 60 Years | 3.9% |
| Last 70 Years | 3.5% |

The 2016 Asset Liability Study done by Callan for the SBI used a 2.25% price inflation assumption. The Federal Reserve System has a target inflation rate of 2.0%.

Economic Assumptions – Inflation

Future Expectations

The table below shows forward looking price inflation forecasts:

| Forward-Looking Price Inflation Forecasts^a | |
|--|-------|
| Congressional Budget Office^b | |
| 5-Year Annual Average | 2.83% |
| 10-Year Annual Average | 2.57% |
| Federal Reserve Bank of Philadelphia^c | |
| 5-Year Annual Average | 2.50% |
| 10-Year Annual Average | 2.37% |
| Federal Reserve Bank of Cleveland^d | |
| 10-Year Expectation | 2.26% |
| 20-Year Expectation | 2.35% |
| 30-Year Expectation | 2.42% |
| Federal Reserve Bank of St. Louis^e | |
| 10-Year Breakeven Inflation | 2.30% |
| 20-Year Breakeven Inflation | 2.51% |
| 30-Year Breakeven Inflation | 2.26% |
| U.S. Department of the Treasury^f | |
| 10-Year Breakeven Inflation | 2.16% |
| 20-Year Breakeven Inflation | 2.40% |
| 30-Year Breakeven Inflation | 2.21% |
| 50-Year Breakeven Inflation | 2.33% |
| 100-Year Breakeven Inflation | 2.41% |
| Social Security Trustees^g | |
| Ultimate Intermediate Assumption | 2.40% |

^aEnd of the First Quarter, 2023. Version 2023-05-03 by Gabriel, Roeder, Smith & Company

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

^cFirst Quarter 2023 Survey of Professional Forecasters, Release Date: February 10, 2023, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2023 - 2027), 10-Year Annual Average (2023 - 2032).

^dInflation Expectations, Model output date: March 1, 2023.

^eThe 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: March, 2023.

^fThe Treasury Breakeven Inflation (TBI) Curve, Monthly Average Rates, March, 2023.

^gThe 2023 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds, March 31, 2023, Long-range (75-year) assumptions, Intermediate, Consumer Price Index (CPI-W).

Economic Assumptions – Inflation

Other Considerations

We examined the capital market assumption sets for eleven investment consulting firms, as shown in the investment return analysis in this section. The average assumption for inflation was 2.52%, with a range of 2.26% to 2.90%. However, the investment consulting firms typically set their assumptions based on a shorter time horizon, while actuaries must make much longer projections.

Recommendation

Although current inflation rates are higher than they have been in previous decades, the future outlook from the sources in the table on the prior page suggest 2.25% continues to be reasonable. We recommend maintaining a price inflation assumption of 2.25%.

Economic Assumptions – Payroll Growth

Payroll growth (wage inflation) represents the expected growth in total payroll for a stable population. Increases or decreases in covered population that lead to a change in total payroll are not reflected in this assumption. Wage inflation consists of two components, 1) a portion due to pure price inflation (i.e., increases due to changes in the CPI), and 2) increases on average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

The current payroll growth assumption is 3.00%, which is comprised of a 2.25% price inflation assumption plus a real wage growth assumption of 0.75%. The payroll growth assumption is used to develop the amount necessary to amortize the unfunded actuarial accrued liability using the level percent of pay methodology.

Salary increases for longer-service employees are almost entirely driven by wage inflation. Many of the factors that result in pay increases are largely inapplicable or have diminished importance for longer-service employees. Step or service-related increases have ceased or are minimal. Promotions occur with less frequency. Additional training or acquisition of advanced degrees usually occurs early in the career. Thus, longer service employees' wages are assumed to grow at the overall rate of wage inflation.

SERF salary increases observed in the study level off after about twenty-five years of service. For members with 25 or more years of service, the observed average salary increase during the four-year period was 2.65%. Inflation was volatile during this four-year period, averaging 1.1% for the first two fiscal years and 7.2% for the last two fiscal years, with the 4-year average equal to 4.1%. Therefore, long-service employees received an average salary increase of 1.45% below inflation primarily due to the high inflation in the most recent years.

Based upon the data reviewed, we recommend keeping the current real wage growth assumption at 0.75%. When combined with the 2.25% price inflation assumption, the recommended payroll growth assumption remains at 3.00%. As noted above, the recommended payroll growth assumption is appropriate for a stable population.

Economic Assumptions – Investment Return

Investment Return. The investment return assumption is the actuarial assumption that has the largest impact on actuarial valuation results.

It is our understanding that the SBI's most recent asset liability study resulted in an expected net rate of return of 7.3%, comprised of an inflation assumption of 2.25%, and a real rate of return assumption of 5.05%. The asset liability study was completed by Callan in 2016.

MSRS' Annual Comprehensive Financial Report for the fiscal year ending June 30, 2022 includes the following investment return statistics:

- SBI retirement funds returned 5.7 percentage points above the CPI over the last 20 years.
- The average return over the ten-year period ending June 30, 2022 was 9.4%.

The following chart shows the estimated annual investment return on an actuarial and market value basis for each year in the four-year period under consideration:

| Fiscal Year Ending | Actuarial Value of Assets | Market Value of Assets |
|---|--------------------------------------|-----------------------------------|
| June 30, 2019 | 7.4% | 7.3% |
| June 30, 2020 | 7.3% | 4.2% |
| June 30, 2021 | 13.0% | 30.3% |
| June 30, 2022 | 9.5% | -6.4% |
| Average annual investment return July 1, 2018 to June 30, 2022 | 9.3% | 8.1% |

Historical results provide some useful and interesting information but are not the sole basis for forward-looking assumptions.

Economic Assumptions – 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 current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from eleven nationally recognized investment consultants.

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

We are relying on the GRS actuaries and Internal Software, Training, and Processes Team who developed and maintain the model.

Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis. The capital market assumptions in the 2023 CMAM are from the following investment consultants (in alphabetical order): Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Meketa, Mercer, NEPC, Verus, and Wilshire. We believe the benefit of performing this analysis using multiple investment consulting 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 consultants to be as consistent as possible. In some cases, we have made minor adjustments or assumptions to align the various assumptions sets with our model.

Each investment firm provided capital market assumptions over an investment horizon of approximately 10 years. Although investment firms often refer to this period as "short-term" it is important to remember that 10 years is actually a very long time. In fact, the duration of the liabilities of the General Employees Retirement Plan is 11 years. Therefore, returns during the next ten years will affect the plan's funding materially. A subset of six investment firms provided capital market expectations over a longer horizon, varying between 20 and 30 years. For purposes of this report, the analysis is generally based on the 10-year expectations provided by the investment firms.

Economic Assumptions – Investment Return

In general, our understanding is that the methodology for developing these capital market expectations is forward-looking, not purely backward-looking. Over the years prior to 2022, we have observed a general decreasing trend in capital market expectations. However, we have also observed that some of the investment firms' assumption sets are dependent on the market conditions at the time they are developed and consequently may be sensitive to short-term market fluctuations. Some expectations are contrarian – meaning that when the market is high, future expectations are lowered and when the market is low, future expectations are raised. The amount of these fluctuations as they appear in the year-to-year capital market assumptions varies between the various investment firms.

Each year, the GRS CMAM reflects the most up-to-date information at the time the data was collected (typically reflecting the firms' expectations at the beginning of the calendar year). Compared to the 2022 survey, the 2023 survey generally shows higher return expectations for most asset classes. If we consider the three-year average of return expectations, the general decreasing trend has reversed and the short-term fluctuations are diminished.

To the best of our ability, we have adapted the System's investment policy to fit with the consultants' assumptions adjusting for these known differences in assumptions and methodology. The asset classes in the system's investment allocation often do not exactly align with the asset classes of all investment firms in the survey. This may require us to make approximations which can introduce some subjectivity into the process. In the following charts, to the extent possible, all returns are net of passive investment expenses and administrative expenses and have no assumption for excess manager performance (alpha) in excess of active management fees.

Presented below is the current target asset allocation, provided to GRS by the SBI for use in this study:

| Asset Class | Asset Allocation |
|-----------------|------------------|
| Public Equity | 50% |
| Fixed income | 25 |
| Private Markets | 25 |

We note that any uninvested portion of the Private Markets allocation is held in cash.

Economic Assumptions – Investment Return

Additionally, the following background information was provided by the SBI regarding the actual asset allocation as of December 31, 2022. SBI staff provided assurances that no significant changes in asset allocation are expected and that these are appropriate to use going forward.

| Asset Class | Total Fund Allocation |
|---|-----------------------|
| Domestic Equity | 33.5% |
| International Equity | 15.5% |
| Global Equity | 1.0% |
| Core/Core Plus | 5.4% |
| Return Seeking | 5.0% |
| Treasury Protection | 9.2% |
| Short Duration Ladder + Cash | 4.7% |
| Private Equity | 18.1% |
| Private Credit | 2.1% |
| Real Assets | 2.8% |
| Real Estate | 2.4% |
| Cash (uninvested private market allocation) | 0.3% |

The CMAM begins with the nominal expected return from each Capital Market Assumption (CMA) set, takes out each CMA's price inflation assumption to arrive at the real return. We then incorporate the current price inflation assumption of 2.25% to get the adjusted nominal return. 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 are netted out of the return. 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 compare the probabilities of achieving returns over a 10-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the assumption of 7.0% (effective July 1, 2023) over a 10-year horizon. These estimates are based on the assumption that the distribution of returns for the next 10 years is the same each year. The average median return from the last three years of CMAMs is shown at the bottom of the table on the next page for reference.

Economic Assumptions – Investment Return

| GRS 2023 CMAM | | | | |
|---|--|--------------|--------------|--------------------------------|
| Capital Market Assumption Set (CMA) | Distribution of 10-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.00% |
| | 40th | 50th | 60th | |
| (1) | (2) | (3) | (4) | (5) |
| 1 | 5.09% | 6.18% | 7.28% | 42.50% |
| 2 | 5.38% | 6.50% | 7.63% | 45.50% |
| 3 | 5.77% | 6.94% | 8.12% | 49.46% |
| 4 | 6.02% | 7.13% | 8.24% | 51.14% |
| 5 | 6.06% | 7.18% | 8.32% | 51.65% |
| 6 | 6.26% | 7.38% | 8.50% | 53.41% |
| 7 | 6.35% | 7.44% | 8.54% | 54.07% |
| 8 | 6.33% | 7.55% | 8.78% | 54.51% |
| 9 | 6.76% | 7.79% | 8.83% | 57.74% |
| 10 | 6.79% | 7.84% | 8.90% | 58.05% |
| 11 | 6.75% | 7.91% | 9.08% | 57.84% |
| Average | 6.14% | 7.26% | 8.38% | 52.35% |
| Average from last 3 CMAMs over 10-year horizon | | 6.32% | | |

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 increases 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 7.26% per year.

Column 5 shows the estimated probability of achieving a 7.00% assumed rate of return over a 10-year period. The average probability of achieving 7.00% over 10 years is 52%.

As discussed, the 2023 CMAM generally results in higher expectations than previous years on the 10-year horizon. For reference, the 3-year average CMAM median return is 6.32%.

ASOP No. 27, Section 3.6.2, states that “[d]ue to the uncertain nature of the items for which assumptions are selected, the actuary may consider several different assumptions reasonable for a given measurement. Different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop, both for an individual actuary, and across actuarial practice.” This range of reasonable assumptions is evident from the summaries we show from our CMAM.

In our opinion, the assumed rate of return effective July 1, 2023 of 7.00% is a reasonable assumption based on this analysis.

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



SECTION C

PAY INCREASES

Pay Increases Due to Merit and Seniority

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 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 Section B. The merit and seniority portion of pay increases is discussed on this page.

We reviewed the merit and seniority pay increases during the four-year period. For each year, we excluded individual pay increases that were more than 30% and also excluded individual pay increases that were less than -30%. Some occurrences of a negative salary increase are reasonable and expected in a plan that covers part-time employees. While this was a relatively small number of records, the experience distorted the experience of the overall group.

In order to study the merit and seniority portion of the salary increase assumption, it is necessary to separate out the portion attributable to wage inflation. Based on our review of salary experience for SERF members for the period July 1, 2018 through June 30, 2022, we observed that members with longer service averaged about a 2.65% annual increase for this period. For our analysis of the merit and seniority portion of total salary increase, we assumed that the salary increase amount in excess of the total salary increase for the longer-service members (i.e., those with 25 or more years of service) was attributable to wage inflation only. This assumes that once members reach a certain length of service, merit and seniority increases are much less common.

Pay Increases Due to Merit and Seniority

Findings

The assumed wage inflation was 3.00% during the study period. During the four years of the study, we estimated that the average actual wage inflation component of pay increases was around 2.65% for members of the State Employees Retirement Fund. This estimated actual increase was subtracted from the actual pay increases to obtain the estimated merit/seniority portion of the pay increases. It should be noted that the results of the analysis are very sensitive to the estimated wage inflation component.

Gross actual salary increases averaged 4.34% over the four-year period, ranging from 3.97% in 2022 to 4.53% in 2021. After adjusting for the 2.65% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 1.69%, ranging from 1.32% to 1.88%.

| Fiscal Year Ending | Exposures | Gross | | Net* | |
|-----------------------|----------------|--------------|--------------|--------------|--------------|
| | | Actual | Expected | Actual | Expected |
| 2019 | 41,854 | 4.42% | 5.04% | 1.77% | 2.04% |
| 2020 | 42,358 | 4.46% | 5.10% | 1.81% | 2.10% |
| 2021 | 43,239 | 4.53% | 5.17% | 1.88% | 2.17% |
| 2022 | 41,122 | 3.97% | 4.91% | 1.32% | 1.91% |
| Total | 168,573 | 4.34% | 5.05% | 1.69% | 2.05% |

* Net Expected increases are equal to Gross Expected increases minus the current assumed wage inflation assumption of 3.00%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 2.65%.

The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were lower than the presently assumed increases during the first few years.

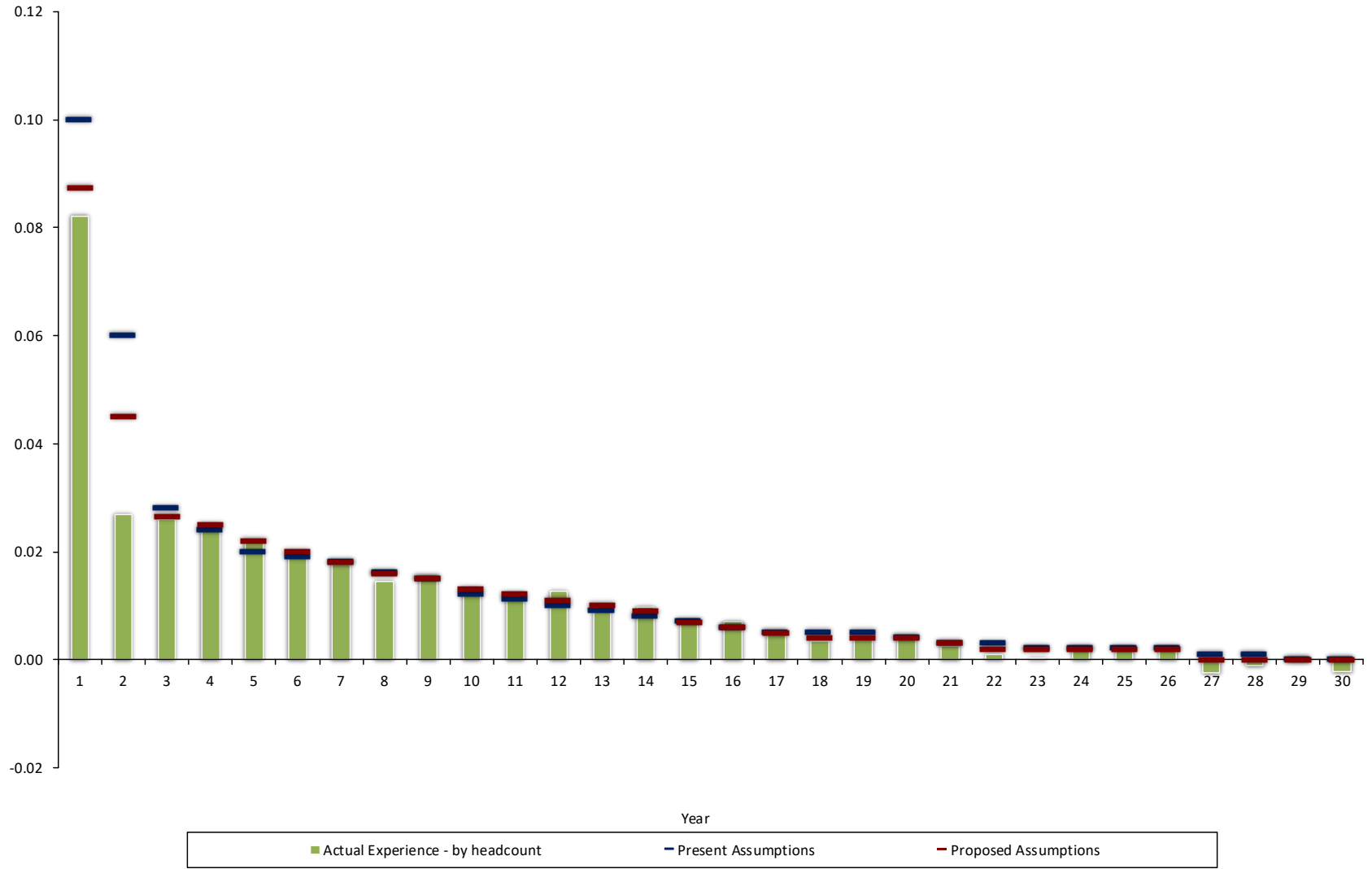
Recommendation

We recommend adjustments to the current merit/seniority pay increase assumption as shown on the following page.

Pay Increases Due to Merit and Seniority

| Year | Exposures | Total % Increase | | | Merit/Seniority % Increase | | |
|--------------|----------------|---------------------|---------------|---------------|----------------------------|---------------|---------------|
| | | Actual | Rates | | Actual | Rates | |
| | | Population Weighted | Current | Proposed | Population Weighted | Current | Proposed |
| 1 | 15,114 | 10.87 % | 13.00 % | 11.75 % | 8.22 % | 10.00 % | 8.75 % |
| 2 | 13,955 | 5.34 % | 9.00 % | 7.50 % | 2.69 % | 6.00 % | 4.50 % |
| 3 | 12,192 | 5.24 % | 5.80 % | 5.65 % | 2.59 % | 2.80 % | 2.65 % |
| 4 | 10,628 | 5.13 % | 5.40 % | 5.50 % | 2.48 % | 2.40 % | 2.50 % |
| 5 | 9,725 | 4.85 % | 5.00 % | 5.20 % | 2.20 % | 2.00 % | 2.20 % |
| 6 | 8,698 | 4.62 % | 4.90 % | 5.00 % | 1.97 % | 1.90 % | 2.00 % |
| 7 | 7,608 | 4.42 % | 4.80 % | 4.80 % | 1.77 % | 1.80 % | 1.80 % |
| 8 | 6,607 | 4.09 % | 4.60 % | 4.60 % | 1.44 % | 1.60 % | 1.60 % |
| 9 | 5,599 | 4.17 % | 4.50 % | 4.50 % | 1.52 % | 1.50 % | 1.50 % |
| 10 | 5,146 | 3.97 % | 4.20 % | 4.30 % | 1.32 % | 1.20 % | 1.30 % |
| 11 | 5,369 | 3.87 % | 4.10 % | 4.20 % | 1.22 % | 1.10 % | 1.20 % |
| 12 | 5,443 | 3.92 % | 4.00 % | 4.10 % | 1.27 % | 1.00 % | 1.10 % |
| 13 | 5,319 | 3.60 % | 3.90 % | 4.00 % | 0.95 % | 0.90 % | 1.00 % |
| 14 | 4,786 | 3.62 % | 3.80 % | 3.90 % | 0.97 % | 0.80 % | 0.90 % |
| 15 | 3,920 | 3.37 % | 3.70 % | 3.70 % | 0.72 % | 0.70 % | 0.70 % |
| 16 | 3,396 | 3.34 % | 3.60 % | 3.60 % | 0.69 % | 0.60 % | 0.60 % |
| 17 | 3,255 | 3.11 % | 3.50 % | 3.50 % | 0.46 % | 0.50 % | 0.50 % |
| 18 | 3,388 | 2.99 % | 3.50 % | 3.40 % | 0.34 % | 0.50 % | 0.40 % |
| 19 | 3,544 | 3.02 % | 3.50 % | 3.40 % | 0.37 % | 0.50 % | 0.40 % |
| 20 | 3,592 | 3.02 % | 3.40 % | 3.40 % | 0.37 % | 0.40 % | 0.40 % |
| 21 | 3,278 | 2.90 % | 3.30 % | 3.30 % | 0.25 % | 0.30 % | 0.30 % |
| 22 | 2,831 | 2.74 % | 3.30 % | 3.20 % | 0.09 % | 0.30 % | 0.20 % |
| 23 | 2,430 | 2.69 % | 3.20 % | 3.20 % | 0.04 % | 0.20 % | 0.20 % |
| 24 | 2,075 | 2.88 % | 3.20 % | 3.20 % | 0.23 % | 0.20 % | 0.20 % |
| 25 | 1,812 | 2.87 % | 3.20 % | 3.20 % | 0.22 % | 0.20 % | 0.20 % |
| 26 | 1,683 | 2.85 % | 3.20 % | 3.20 % | 0.20 % | 0.20 % | 0.20 % |
| 27 | 1,571 | 2.40 % | 3.10 % | 3.00 % | (0.25)% | 0.10 % | 0.00 % |
| 28 | 1,661 | 2.54 % | 3.10 % | 3.00 % | (0.11)% | 0.10 % | 0.00 % |
| 29 | 1,700 | 2.66 % | 3.00 % | 3.00 % | 0.01 % | 0.00 % | 0.00 % |
| 30+ | 12,248 | 2.43 % | 3.00 % | 3.00 % | (0.22)% | 0.00 % | 0.00 % |
| Total | 168,573 | 4.34 % | 5.05 % | 4.89 % | 1.69 % | 2.05 % | 1.89 % |

Pay Increases Due to Merit and Seniority



SECTION D

RETIREMENT EXPERIENCE

Liability Weighted Analysis

In most recent experience studies, we have noticed that in order to develop assumptions that reduce the size of the gain or loss in a particular decrement it is necessary to consider the relative magnitude of the liability of the members that decrement, rather than number counts alone. For example, consider a plan with only two members who are both the same age and assume member one has a liability of \$10,000 and member two has a liability of \$90,000. If one of the members leaves and forfeits all of his or her liability, the net rate of decrement is one out of two for a rate of 50%. However, the net gain or loss to the system will be 10% if member one leaves versus 90% if member two leaves.

As a result, some of our tables include a column entitled 'liability weighted rate' or 'benefit weighted'. This represents the crude rate of decrement on a liability or benefit weighted basis as opposed to strictly a number count basis. The liability weighted rates were found to be most highly correlated with withdrawal and retirement decrements. This makes some intuitive sense, since retirement and termination decisions are often made based on how much the members have to gain or lose if they retire or change jobs, whereas death and disability is typically not a decision at all, rather an event that happens to someone. Comments on specific assumptions are provided on the following pages.

While mortality is not a voluntary human behavior, a recent study by the Society of Actuaries found that mortality experience was highly correlated with education and income. That is, people with higher incomes and higher levels of education tended to live longer than others. As such, we also studied mortality rates on a "benefit weighted" basis. This is discussed in more detail on page G-1.

Age and Service Unreduced (Normal) Retirement

Findings

The benefit provisions of the State Employees Retirement Fund (SERF) establish the minimum age and service requirements for unreduced or normal retirement. However, the actual cost of retirement is determined 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.

Some members terminate employment with eligibility for retirement but elect to defer the benefit. We included these terminations as retirements for the purposes of this study.

The current assumption ends at age 71; in other words, we assume all members currently under the age of 71 will retire by the age of 71. However, for members currently age 71 or older, we assume retirement one year after the valuation date (effectively 18 months due to mid-year decrementing), as required by the Minnesota Standards for Actuarial Work. As such, members over age 70 are not included in our analysis since these members are assumed to work an additional year and then retire. During the four-year period, there were 368 actual retirements at ages 71 and older including 110 actual retirements at age 71. We believe assuming 100% retirement at age 71 is an appropriately conservative approach.

Overall, on both a population-weighted and liability-weighted basis, the plan experienced more unreduced retirements than projected by the present assumptions. We recommend modifying the assumed unreduced retirement rates, as shown on the next page.

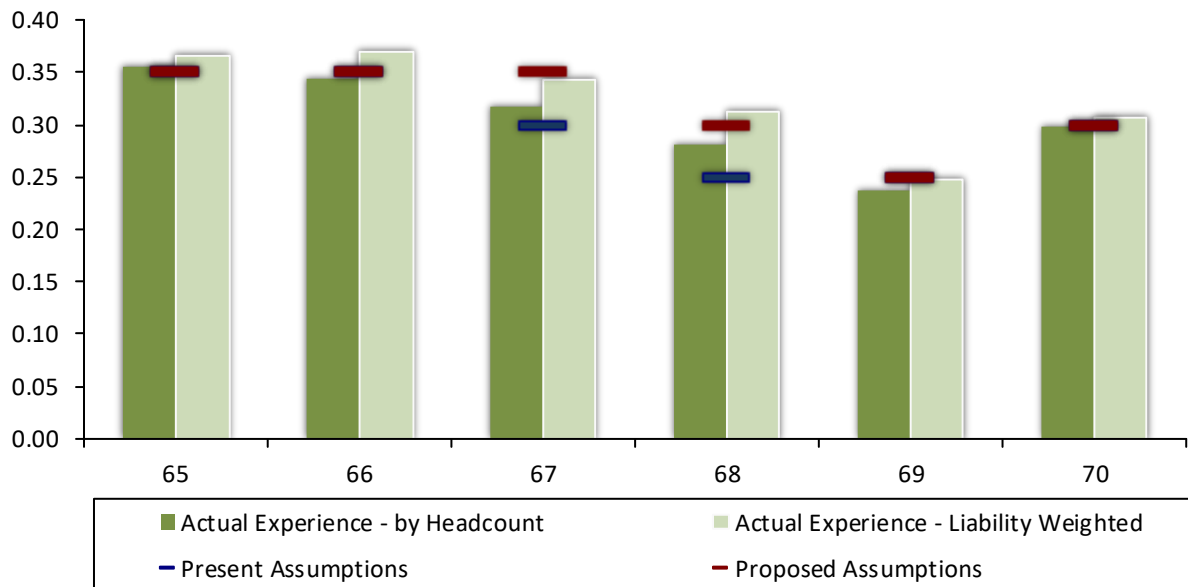
Age and Service Unreduced (Normal) Retirement

Recommendations

We recommend changes to the retirement rates as indicated below, which increase rates at all ages but not as much as the liability weighted actual experience suggests. In addition, we recommend the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year, the same as members younger than age 71.

| Age | Actual Retirements (\$000s) | Exposure (\$000s) | Crude Rates | | Rates | | Expected Retirements (\$000s) | | Actuals/Expecteds | |
|--------|-----------------------------|-------------------|-------------|-----------|---------|----------|-------------------------------|----------|-------------------|----------|
| | | | Population | Liability | Present | Proposed | Present | Proposed | Present | Proposed |
| 65 | 180,182 | 492,572 | 35.6% | 36.6% | 35.0% | 35.0% | 172,400 | 172,400 | 104.5% | 104.5% |
| 66 | 261,851 | 706,766 | 34.4% | 37.0% | 35.0% | 35.0% | 247,368 | 247,368 | 105.9% | 105.9% |
| 67 | 154,549 | 449,388 | 31.8% | 34.4% | 30.0% | 35.0% | 134,816 | 157,286 | 114.6% | 98.3% |
| 68 | 96,697 | 309,749 | 28.1% | 31.2% | 25.0% | 30.0% | 77,437 | 92,925 | 124.9% | 104.1% |
| 69 | 53,131 | 213,935 | 23.7% | 24.8% | 25.0% | 25.0% | 53,484 | 53,484 | 99.3% | 99.3% |
| 70 | 48,496 | 158,236 | 29.8% | 30.6% | 30.0% | 30.0% | 47,471 | 47,471 | 102.2% | 102.2% |
| 71+ | * | * | N/A | N/A | * | * | - | - | N/A | N/A |
| Totals | 794,907 | 2,330,646 | 31.6% | 34.1% | 31.4% | 33.1% | 732,976 | 770,934 | 108.4% | 103.1% |

* The current assumption prescribed by the Minnesota Standards for Actuarial Work is that members who have reached 100% retirement eligibility will delay retirement for one year. Therefore, even though there are members that are over age 70, these members are not included in the analysis above since retirement is assumed to be delayed one year. There were 368 actual retirements over age 70.



Rule of 90 (Unreduced) Early Retirement

Findings

SERF members who were hired prior to July 1, 1989 may retire with an unreduced benefit when age plus service is at least 90 years. We refer to these cases as Rule of 90 early retirements.

Generally, because of the subsidized early retirement benefit, these members are expected to retire at a higher rate than those members that do not qualify for Rule of 90. Higher rates of Rule of 90 retirement generally result in higher computed contributions due to the enhanced benefit, and vice versa.

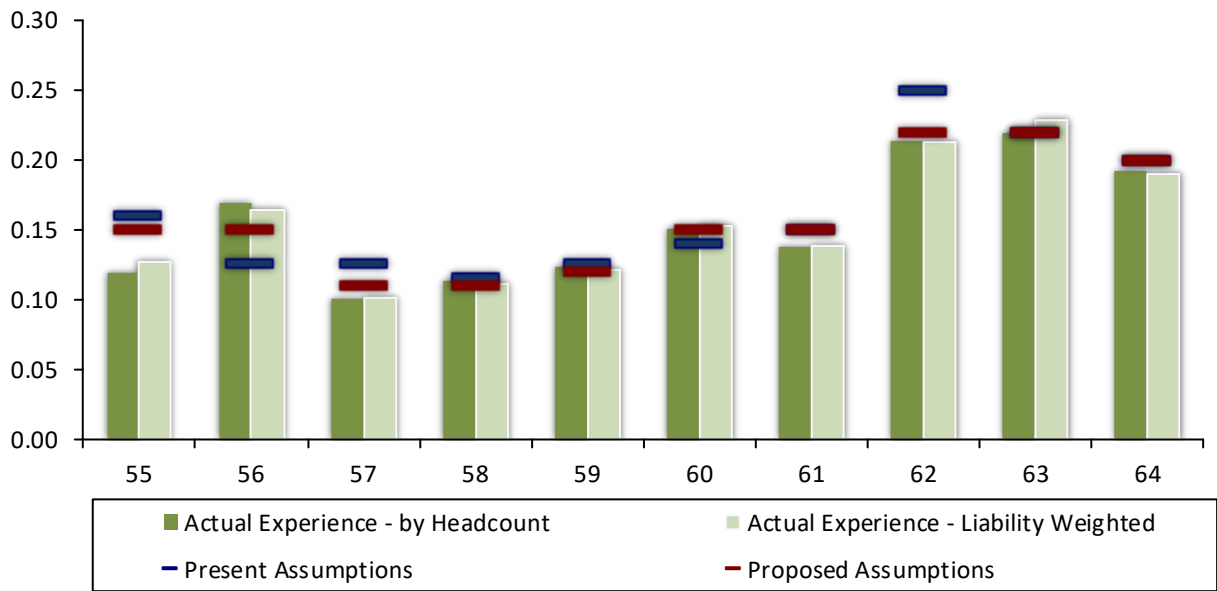
We reviewed the experience during the study period. Overall, on both a population-weighted and liability-weighted basis, the plan experienced fewer Rule of 90 early retirements than projected by the present assumptions.

Recommendation

We recommend minor adjustments to the Rule of 90 retirement rates to reflect the observed experience.

Rule of 90 (Unreduced) Early Retirement

| Age | Actual Retirements (\$000s) | Exposure (\$000s) | Crude Rates | | Rates | | Expected Retirements (\$000s) | | Actuals/Expecteds | |
|--------|-----------------------------|-------------------|-------------|-----------|---------|----------|-------------------------------|----------|-------------------|----------|
| | | | Population | Liability | Present | Proposed | Present | Proposed | Present | Proposed |
| 55 | 6,697 | 52,591 | 12.0% | 12.7% | 16.0% | 15.0% | 8,415 | 7,889 | 79.6% | 84.9% |
| 56 | 23,687 | 144,041 | 17.0% | 16.4% | 12.5% | 15.0% | 18,005 | 21,606 | 131.6% | 109.6% |
| 57 | 27,729 | 272,396 | 10.1% | 10.2% | 12.5% | 11.0% | 34,050 | 29,964 | 81.4% | 92.5% |
| 58 | 45,349 | 407,768 | 11.4% | 11.1% | 11.5% | 11.0% | 46,893 | 44,854 | 96.7% | 101.1% |
| 59 | 61,691 | 507,284 | 12.4% | 12.2% | 12.5% | 12.0% | 63,411 | 60,874 | 97.3% | 101.3% |
| 60 | 87,310 | 568,505 | 15.1% | 15.4% | 14.0% | 15.0% | 79,591 | 85,276 | 109.7% | 102.4% |
| 61 | 78,979 | 568,860 | 13.8% | 13.9% | 15.0% | 15.0% | 85,329 | 85,329 | 92.6% | 92.6% |
| 62 | 128,506 | 603,789 | 21.4% | 21.3% | 25.0% | 22.0% | 150,947 | 132,834 | 85.1% | 96.7% |
| 63 | 126,376 | 552,454 | 21.9% | 22.9% | 22.0% | 22.0% | 121,540 | 121,540 | 104.0% | 104.0% |
| 64 | 93,151 | 488,651 | 19.2% | 19.1% | 20.0% | 20.0% | 97,730 | 97,730 | 95.3% | 95.3% |
| Totals | 679,476 | 4,166,339 | 16.2% | 16.3% | 16.9% | 16.5% | 705,911 | 687,896 | 96.3% | 98.8% |



Tier 1 Reduced Early Retirement

Findings

SERF members who were hired prior to July 1, 1989 (Tier 1 members) may also retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as Tier 1 early retirements.

The early retirement benefit payable to Tier 1 members is the greater of (a) or (b):

- (a) 1.2% of average salary for each of the first ten years of service and 1.7% for each subsequent year with a reduction equal to 0.25% for each month the member is under age 65 (or age 62 if 30 or more years of service).
- (b) 1.7% of average salary for each year of service with actuarial reduction for each month the member is under age 65.

Early retirement benefits were changed as follows effective June 30, 2018:

- The augmentation adjustment in actuarial early retirement factors is eliminated over a five-year period starting July 1, 2019, resulting in actuarial equivalence after June 30, 2024;
- Post-retirement benefit increases changed to 1.0% for five years beginning January 1, 2019 and 1.5% thereafter; and
- The first benefit increase is delayed until Normal Retirement Age for retirements on or after January 1, 2024 (2023 legislation reversed this benefit change and will therefore never be implemented).

Because these benefits are reduced, these members are expected to retire at a lower rate than Tier 1 members who have attained Rule of 90. Higher rates of early retirement generally result in higher computed contributions, and vice versa.

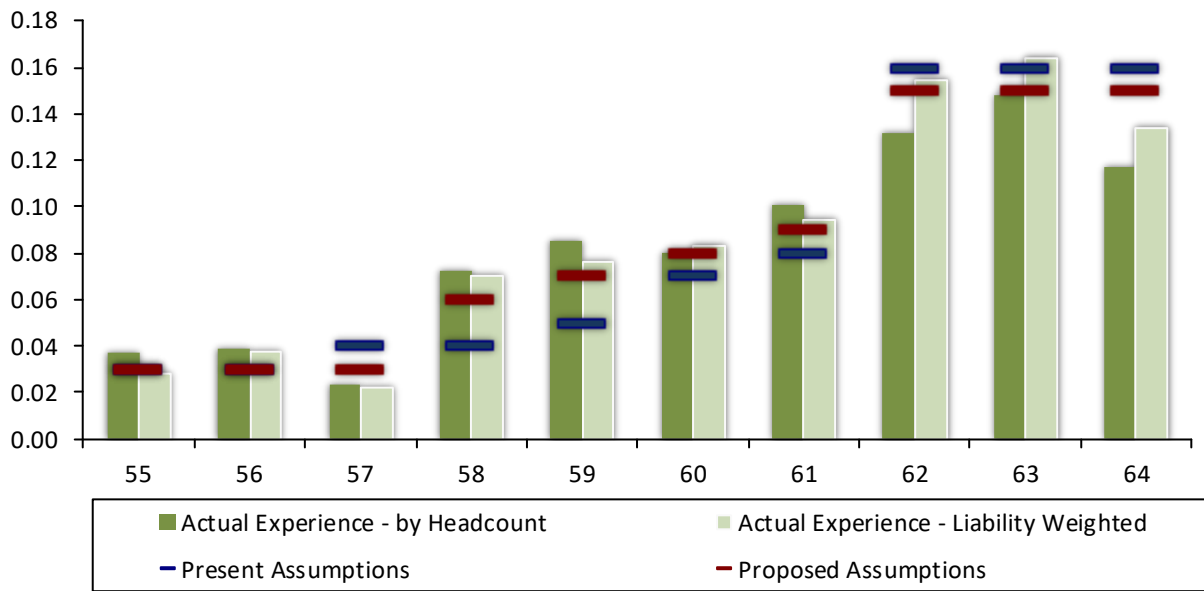
We reviewed the experience during the study period. Overall, on both a population-weighted and liability-weighted basis, the plan experienced more Tier 1 reduced early retirements than projected by the present assumptions.

Recommendation

We recommend adjustments to the Tier 1 early retirement rates to reflect the observed experience.

Tier 1 Reduced Early Retirement

| Age | Actual Retirements (\$000s) | Exposure (\$000s) | Crude Rates | | Rates | | Expected (\$000s) | | Actuals/Expecteds | |
|--------|-----------------------------|-------------------|-------------|-----------|---------|----------|-------------------|----------|-------------------|----------|
| | | | Population | Liability | Present | Proposed | Present | Proposed | Present | Proposed |
| 55 | 5,438 | 192,148 | 3.7% | 2.8% | 3.0% | 3.0% | 5,764 | 5,764 | 94.3% | 94.3% |
| 56 | 7,713 | 204,348 | 3.9% | 3.8% | 3.0% | 3.0% | 6,130 | 6,130 | 125.8% | 125.8% |
| 57 | 3,767 | 173,808 | 2.4% | 2.2% | 4.0% | 3.0% | 6,952 | 5,214 | 54.2% | 72.2% |
| 58 | 8,448 | 120,008 | 7.3% | 7.0% | 4.0% | 6.0% | 4,800 | 7,200 | 176.0% | 117.3% |
| 59 | 7,243 | 94,902 | 8.5% | 7.6% | 5.0% | 7.0% | 4,745 | 6,643 | 152.7% | 109.0% |
| 60 | 5,758 | 69,324 | 8.0% | 8.3% | 7.0% | 8.0% | 4,853 | 5,546 | 118.6% | 103.8% |
| 61 | 5,635 | 59,894 | 10.1% | 9.4% | 8.0% | 9.0% | 4,792 | 5,390 | 117.6% | 104.5% |
| 62 | 8,252 | 53,291 | 13.1% | 15.5% | 16.0% | 15.0% | 8,527 | 7,994 | 96.8% | 103.2% |
| 63 | 7,720 | 47,155 | 14.8% | 16.4% | 16.0% | 15.0% | 7,545 | 7,073 | 102.3% | 109.1% |
| 64 | 5,236 | 39,004 | 11.7% | 13.4% | 16.0% | 15.0% | 6,241 | 5,851 | 83.9% | 89.5% |
| Totals | 65,210 | 1,053,881 | 7.0% | 6.2% | 5.7% | 6.0% | 60,349 | 62,805 | 108.1% | 103.8% |



Tier 2 Reduced Early Retirement

Findings

SERF members who were hired after June 30, 1989 (Tier 2 members) may retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as Tier 2 early retirements.

Early retirement benefits were changed as follows effective June 30, 2018:

- the augmentation adjustment in actuarial early retirement factors is eliminated over a five-year period starting July 1, 2019, resulting in actuarial equivalence after June 30, 2024;
- post-retirement benefit increases changed to 1.0% for five years beginning January 1, 2019 and 1.5% thereafter; and
- the first benefit increase is delayed until Normal Retirement Age for retirements on or after January 1, 2024 (2023 legislation reversed this benefit change and will therefore never be implemented).

The Tier 2 early retirement benefit is the actuarial equivalent of the member's Normal Retirement benefit. In other words, there is no subsidy for early retirement. Because of the actuarially equivalent early retirement reduction, these members' benefits have about the same value as 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 slightly lower computed contributions, and vice versa.

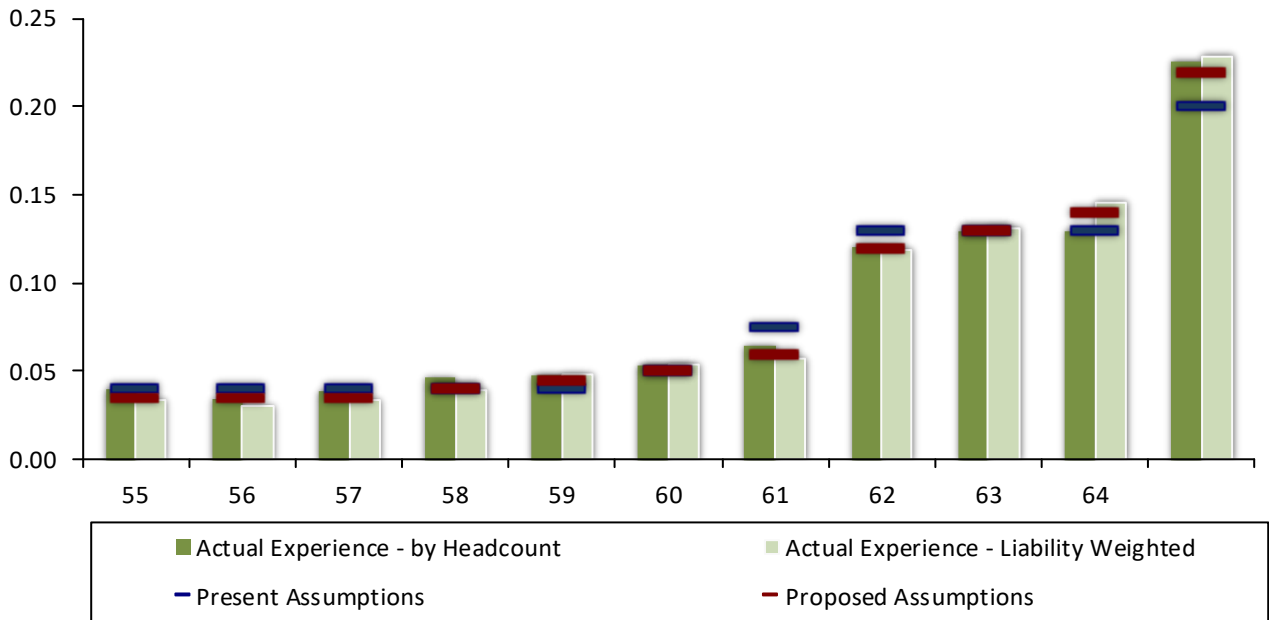
We reviewed the experience during the study period. On both a population-weighted and liability-weighted basis, there were approximately the same amount of Tier 2 reduced early retirements as projected by the present assumptions.

Recommendation

We recommend adjustments to the Tier 2 early retirement rates to reflect the observed experience.

Tier 2 Reduced Early Retirement

| Age | Actual Retirements (\$000s) | Exposure (\$000s) | Crude Rates | | Rates | | Expected Retirements (\$000s) | | Actuals/Expecteds | |
|--------|-----------------------------|-------------------|-------------|-----------|---------|----------|-------------------------------|----------|-------------------|----------|
| | | | Population | Liability | Present | Proposed | Present | Proposed | Present | Proposed |
| 55 | 25,477 | 756,076 | 4.0% | 3.4% | 4.0% | 3.5% | 30,243 | 26,463 | 84.2% | 96.3% |
| 56 | 23,699 | 782,810 | 3.5% | 3.0% | 4.0% | 3.5% | 31,312 | 27,398 | 75.7% | 86.5% |
| 57 | 26,889 | 796,961 | 3.9% | 3.4% | 4.0% | 3.5% | 31,878 | 27,894 | 84.3% | 96.4% |
| 58 | 30,673 | 781,923 | 4.6% | 3.9% | 4.0% | 4.0% | 31,277 | 31,277 | 98.1% | 98.1% |
| 59 | 37,149 | 772,045 | 4.8% | 4.8% | 4.0% | 4.5% | 30,882 | 34,742 | 120.3% | 106.9% |
| 60 | 39,332 | 734,117 | 5.3% | 5.4% | 5.0% | 5.0% | 36,706 | 36,706 | 107.2% | 107.2% |
| 61 | 41,176 | 715,091 | 6.4% | 5.8% | 7.5% | 6.0% | 53,632 | 42,905 | 76.8% | 96.0% |
| 62 | 81,502 | 683,340 | 12.0% | 11.9% | 13.0% | 12.0% | 88,834 | 82,001 | 91.7% | 99.4% |
| 63 | 81,311 | 619,258 | 12.9% | 13.1% | 13.0% | 13.0% | 80,504 | 80,504 | 101.0% | 101.0% |
| 64 | 78,109 | 536,809 | 13.0% | 14.6% | 13.0% | 14.0% | 69,785 | 75,153 | 111.9% | 103.9% |
| 65 | 106,245 | 465,114 | 22.6% | 22.8% | 20.0% | 22.0% | 93,023 | 102,325 | 114.2% | 103.8% |
| Totals | 571,562 | 7,643,544 | 7.5% | 7.5% | 7.6% | 7.4% | 578,076 | 567,368 | 98.9% | 100.7% |



Retirement from Deferred Status

Members who terminate after completing three years of service (five if hired after June 30, 2010) are vested and entitled to either a refund of employee contributions, with interest, or a deferred retirement benefit.

While some members actually elect a refund even if it is less valuable than the deferred annuity, the current valuation assumption is that members will elect a refund only if it is more valuable than the deferred annuity. When a member elects a refund that is less valuable than his or her deferred annuity (or when a member elects the deferred annuity even if the refund is more valuable), the plan experiences a small liability gain. Since the current assumption results in very small gains to the plan, we recommend no change to this assumption.

For those deferred vested members for whom the deferred benefit is more valuable than a refund, the current valuation assumption is that the member will commence benefits at Normal Retirement Age. Except for long-service members hired prior to July 1, 1989 that may qualify for a subsidized reduction, when a member elects to commence benefits prior to Normal Retirement Age, the benefit is reduced on an actuarially equivalent basis, meaning there is no liability gain or loss to the plan. We recommend no change to this set of assumptions.

SECTION E

WITHDRAWAL EXPERIENCE

Withdrawal Experience

Members who leave active employment, for reasons other than retirement, disability 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 increased with augmentation (if applicable) from termination until January 1, 2019 and is payable at Normal Retirement (or at Early Retirement with a reduction). 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.

Some members are eligible for retirement when they terminate employment but elect to defer the benefit and are consequently reported for the valuation as a termination with a deferred benefit. We included these terminations as retirements for the purposes of this study.

Current valuation termination rates for members are gender-specific and service-based. The withdrawal assumption review was done on a liability-weighted basis, as described earlier in the report.

Withdrawal Experience

Findings

When we reviewed the liability that decremented out of the plan during the prior four-year period, we observed that the plan experienced slightly more liability than expected decrementing from the plan due to terminations in total. However, the experience for the fiscal year ending June 30, 2021 had much lower rates of actual withdrawals and the experience for the fiscal year ending June 30, 2022 had much higher rates of actual withdrawals, which may have been related to the COVID-19 pandemic. Due to this volatility, we did not adjust the withdrawal tables as much as we would have otherwise for females.

Recommendation

We recommend slight adjustments to the current rates for males and lower rates for years 2 to 10 for females.

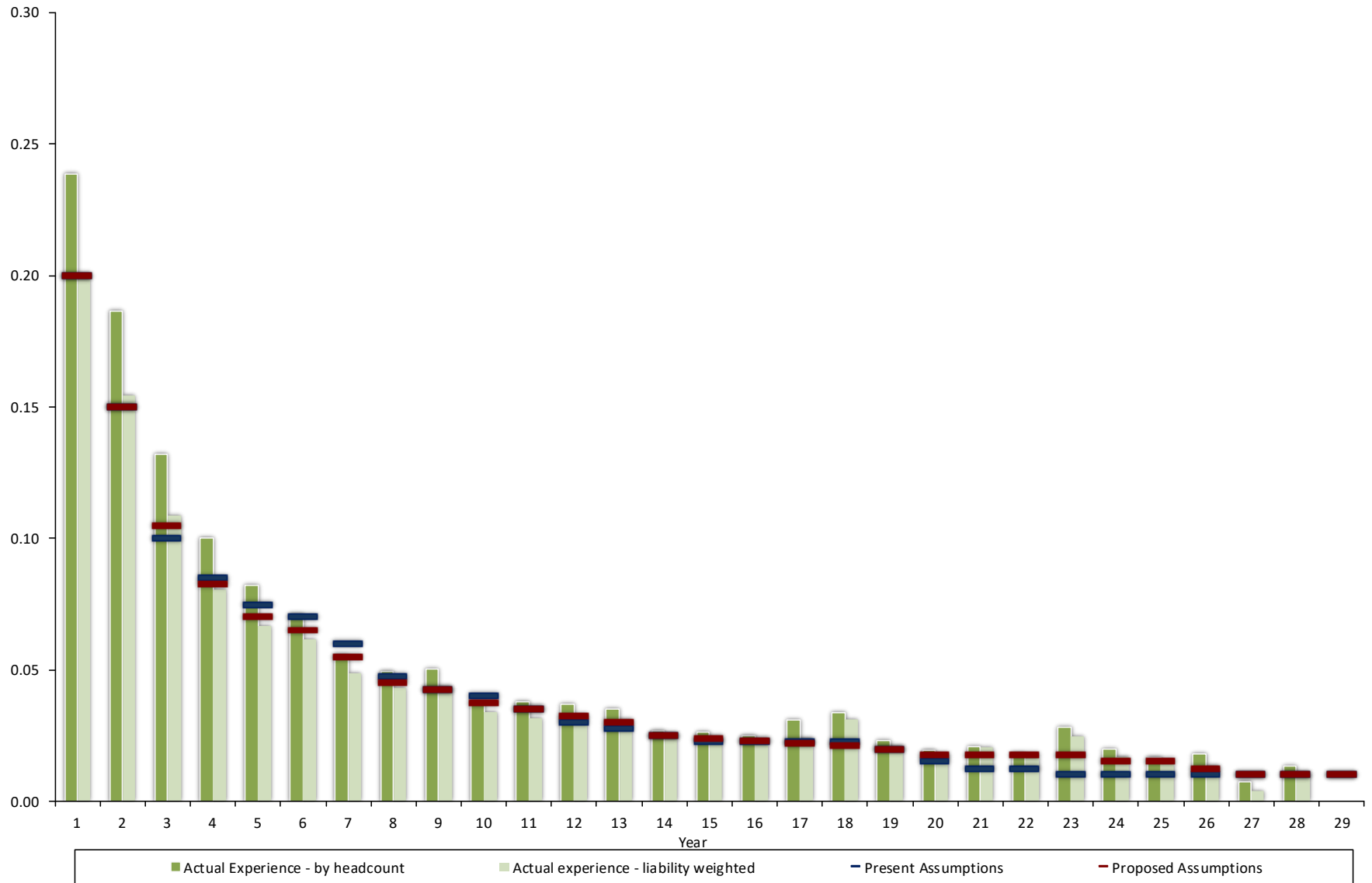
Withdrawal Experience

Males

| Year | Liability Weighted (\$000s) | | Crude Rates | | Sample Rates | | Liability Weighted (\$000s) | | Ratio of | |
|---------------|-----------------------------|------------------|---------------------|--------------------|--------------|--------------|-----------------------------|----------------|-------------------|--------------|
| | Withdrawal | Exposure | Population Weighted | Liability Weighted | | | Expected Withdrawals | | Actuals/Expecteds | |
| | | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| 1 | 18,459 | 92,957 | 23.85% | 19.86% | 20.00% | 20.00% | 18,591 | 18,591 | 99.3% | 99.3% |
| 2 | 53,629 | 347,747 | 18.63% | 15.42% | 15.00% | 15.00% | 52,162 | 52,162 | 102.8% | 102.8% |
| 3 | 43,927 | 404,841 | 13.22% | 10.85% | 10.00% | 10.50% | 40,484 | 42,508 | 108.5% | 103.3% |
| 4 | 31,419 | 389,224 | 10.02% | 8.07% | 8.50% | 8.25% | 33,084 | 32,111 | 95.0% | 97.8% |
| 5 | 23,155 | 347,439 | 8.21% | 6.66% | 7.50% | 7.00% | 26,058 | 24,321 | 88.9% | 95.2% |
| 6 | 19,435 | 315,078 | 7.10% | 6.17% | 7.00% | 6.50% | 22,055 | 20,480 | 88.1% | 94.9% |
| 7 | 14,892 | 305,679 | 5.56% | 4.87% | 6.00% | 5.50% | 18,341 | 16,812 | 81.2% | 88.6% |
| 8 | 12,430 | 286,700 | 4.94% | 4.34% | 4.75% | 4.50% | 13,618 | 12,901 | 91.3% | 96.3% |
| 9 | 11,349 | 262,029 | 5.02% | 4.33% | 4.25% | 4.25% | 11,136 | 11,136 | 101.9% | 101.9% |
| 10 | 7,860 | 231,761 | 3.74% | 3.39% | 4.00% | 3.75% | 9,270 | 8,691 | 84.8% | 90.4% |
| 11 | 6,929 | 219,508 | 3.78% | 3.16% | 3.50% | 3.50% | 7,683 | 7,683 | 90.2% | 90.2% |
| 12 | 7,701 | 237,813 | 3.71% | 3.24% | 3.00% | 3.25% | 7,134 | 7,729 | 107.9% | 99.6% |
| 13 | 7,443 | 241,826 | 3.51% | 3.08% | 2.75% | 3.00% | 6,650 | 7,255 | 111.9% | 102.6% |
| 14 | 5,706 | 234,503 | 2.65% | 2.43% | 2.50% | 2.50% | 5,863 | 5,863 | 97.3% | 97.3% |
| 15 | 5,090 | 215,513 | 2.62% | 2.36% | 2.25% | 2.40% | 4,849 | 5,172 | 105.0% | 98.4% |
| 16 | 3,916 | 184,048 | 2.47% | 2.13% | 2.25% | 2.30% | 4,141 | 4,233 | 94.6% | 92.5% |
| 17 | 3,921 | 163,963 | 3.11% | 2.39% | 2.25% | 2.20% | 3,689 | 3,607 | 106.3% | 108.7% |
| 18 | 5,176 | 167,444 | 3.35% | 3.09% | 2.25% | 2.10% | 3,768 | 3,516 | 137.4% | 147.2% |
| 19 | 3,279 | 167,568 | 2.33% | 1.96% | 2.00% | 2.00% | 3,351 | 3,351 | 97.8% | 97.8% |
| 20 | 3,296 | 185,826 | 1.92% | 1.77% | 1.50% | 1.75% | 2,787 | 3,252 | 118.3% | 101.4% |
| 21 | 4,094 | 198,992 | 2.09% | 2.06% | 1.25% | 1.75% | 2,487 | 3,482 | 164.6% | 117.6% |
| 22 | 3,059 | 185,804 | 1.78% | 1.65% | 1.25% | 1.75% | 2,323 | 3,252 | 131.7% | 94.1% |
| 23 | 4,138 | 168,096 | 2.81% | 2.46% | 1.00% | 1.75% | 1,681 | 2,942 | 246.2% | 140.7% |
| 24 | 2,288 | 137,165 | 1.98% | 1.67% | 1.00% | 1.50% | 1,372 | 2,057 | 166.8% | 111.2% |
| 25 | 1,528 | 108,268 | 1.66% | 1.41% | 1.00% | 1.50% | 1,083 | 1,624 | 141.2% | 94.1% |
| 26 | 1,165 | 87,455 | 1.82% | 1.33% | 1.00% | 1.25% | 875 | 1,093 | 133.3% | 106.6% |
| 27 | 292 | 74,471 | 0.75% | 0.39% | 1.00% | 1.00% | 745 | 745 | 39.2% | 39.2% |
| 28 | 655 | 65,229 | 1.35% | 1.00% | 1.00% | 1.00% | 652 | 652 | 100.4% | 100.4% |
| 29 | - | 63,950 | 0.00% | 0.00% | 1.00% | 1.00% | 640 | 640 | 0.0% | 0.0% |
| 30+ | 2,987 | 175,141 | 1.71% | 1.71% | 1.00% | 1.00% | 1,751 | 1,751 | 170.6% | 170.6% |
| Totals | 309,221 | 6,266,041 | 9.06% | 4.93% | 4.92% | 4.94% | 308,324 | 309,614 | 100.3% | 99.9% |



Withdrawal Experience Males



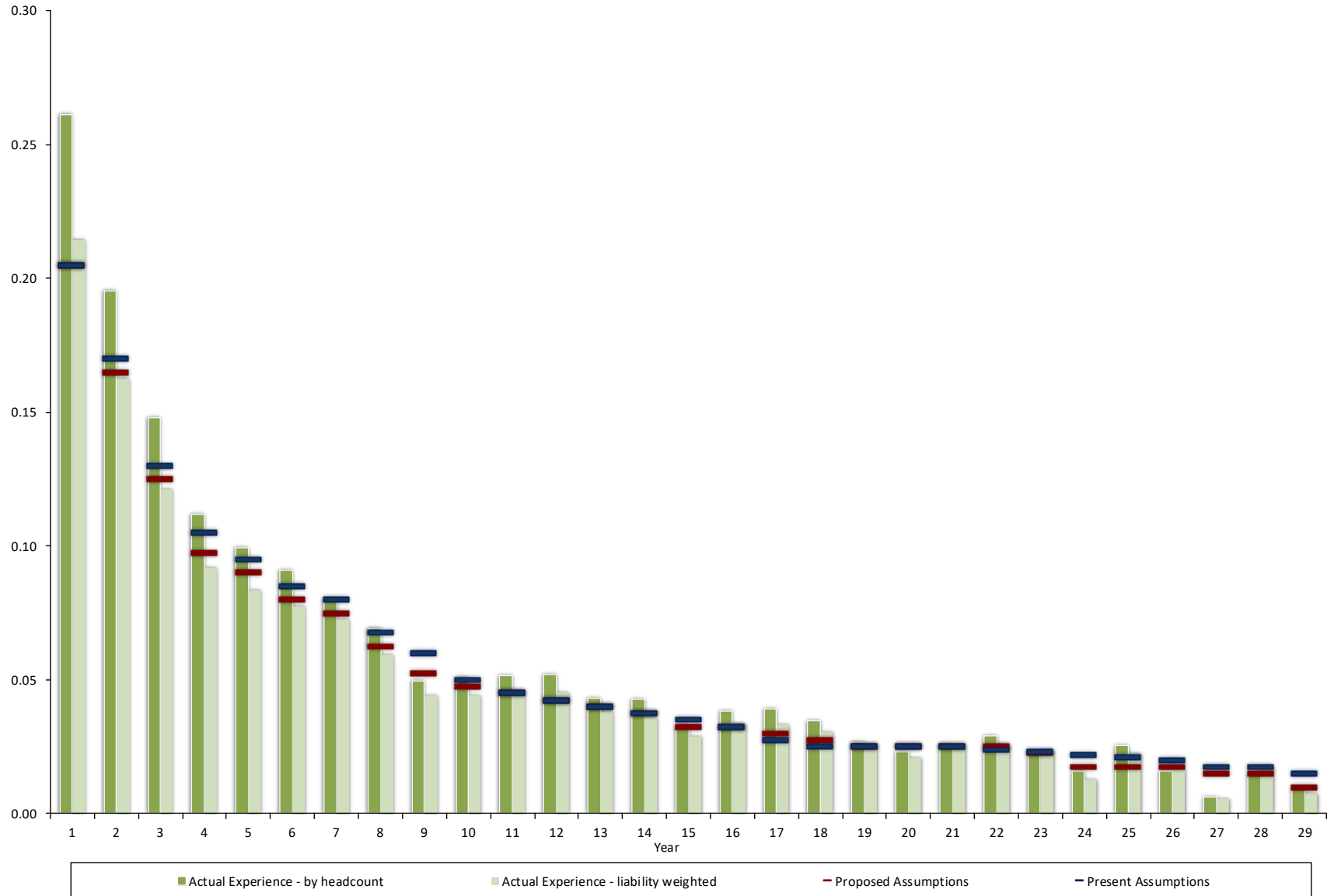
Withdrawal Experience

Females

| Year | Liability Weighted (\$ 000s) | | Crude Rates | | Sample Rates | | Liability Weighted (\$ 000s) | | | |
|---------------|------------------------------|------------------|---------------------|--------------------|--------------|--------------|------------------------------|----------------|----------------------------|--------------|
| | Withdrawals | Exposure | Population Weighted | Liability Weighted | | | Expected Withdrawals | | Ratio of Actuals/Expecteds | |
| | | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | | |
| 1 | 23,400 | 109,178 | 26.14% | 21.43% | 20.50% | 20.50% | 22,381 | 22,381 | 104.5% | 104.5% |
| 2 | 63,768 | 392,470 | 19.52% | 16.25% | 17.00% | 16.50% | 66,720 | 64,758 | 95.6% | 98.5% |
| 3 | 53,986 | 445,371 | 14.81% | 12.12% | 13.00% | 12.50% | 57,898 | 55,671 | 93.2% | 97.0% |
| 4 | 38,720 | 421,613 | 11.19% | 9.18% | 10.50% | 9.75% | 44,269 | 41,107 | 87.5% | 94.2% |
| 5 | 31,027 | 372,384 | 9.95% | 8.33% | 9.50% | 9.00% | 35,377 | 33,515 | 87.7% | 92.6% |
| 6 | 26,001 | 336,055 | 9.10% | 7.74% | 8.50% | 8.00% | 28,565 | 26,884 | 91.0% | 96.7% |
| 7 | 22,910 | 316,106 | 8.01% | 7.25% | 8.00% | 7.50% | 25,288 | 23,708 | 90.6% | 96.6% |
| 8 | 16,990 | 286,475 | 6.94% | 5.93% | 6.75% | 6.25% | 19,337 | 17,905 | 87.9% | 94.9% |
| 9 | 11,377 | 257,376 | 4.94% | 4.42% | 6.00% | 5.25% | 15,443 | 13,512 | 73.7% | 84.2% |
| 10 | 9,867 | 223,219 | 5.07% | 4.42% | 5.00% | 4.75% | 11,161 | 10,603 | 88.4% | 93.1% |
| 11 | 9,693 | 215,844 | 5.16% | 4.49% | 4.50% | 4.50% | 9,713 | 9,713 | 99.8% | 99.8% |
| 12 | 10,753 | 236,814 | 5.21% | 4.54% | 4.25% | 4.25% | 10,065 | 10,065 | 106.8% | 106.8% |
| 13 | 9,876 | 258,962 | 4.31% | 3.81% | 4.00% | 4.00% | 10,358 | 10,358 | 95.3% | 95.3% |
| 14 | 9,438 | 265,165 | 4.26% | 3.56% | 3.75% | 3.75% | 9,944 | 9,944 | 94.9% | 94.9% |
| 15 | 7,168 | 248,845 | 3.30% | 2.88% | 3.50% | 3.25% | 8,710 | 8,087 | 82.3% | 88.6% |
| 16 | 6,984 | 205,930 | 3.83% | 3.39% | 3.25% | 3.25% | 6,693 | 6,693 | 104.4% | 104.4% |
| 17 | 5,975 | 180,270 | 3.91% | 3.31% | 2.75% | 3.00% | 4,957 | 5,408 | 120.5% | 110.5% |
| 18 | 5,106 | 168,316 | 3.47% | 3.03% | 2.50% | 2.75% | 4,208 | 4,629 | 121.4% | 110.3% |
| 19 | 4,509 | 175,374 | 2.66% | 2.57% | 2.50% | 2.50% | 4,384 | 4,384 | 102.8% | 102.8% |
| 20 | 3,813 | 183,351 | 2.30% | 2.08% | 2.50% | 2.50% | 4,584 | 4,584 | 83.2% | 83.2% |
| 21 | 4,723 | 189,184 | 2.55% | 2.50% | 2.50% | 2.50% | 4,730 | 4,730 | 99.9% | 99.9% |
| 22 | 4,550 | 175,105 | 2.89% | 2.60% | 2.40% | 2.50% | 4,203 | 4,378 | 108.3% | 103.9% |
| 23 | 3,597 | 152,747 | 2.22% | 2.36% | 2.30% | 2.25% | 3,513 | 3,437 | 102.4% | 104.7% |
| 24 | 1,672 | 129,152 | 1.58% | 1.29% | 2.20% | 1.75% | 2,841 | 2,260 | 58.8% | 74.0% |
| 25 | 2,438 | 109,132 | 2.56% | 2.23% | 2.10% | 1.75% | 2,292 | 1,910 | 106.4% | 127.7% |
| 26 | 1,516 | 91,055 | 1.59% | 1.67% | 2.00% | 1.75% | 1,821 | 1,593 | 83.3% | 95.2% |
| 27 | 436 | 79,991 | 0.62% | 0.54% | 1.75% | 1.50% | 1,400 | 1,200 | 31.1% | 36.3% |
| 28 | 1,223 | 69,823 | 1.47% | 1.75% | 1.75% | 1.50% | 1,222 | 1,047 | 100.1% | 116.8% |
| 29 | 453 | 58,676 | 0.90% | 0.77% | 1.50% | 1.00% | 880 | 587 | 51.5% | 77.3% |
| 30+ | 2,594 | 245,283 | 1.09% | 1.06% | 1.00% | 1.00% | 2,453 | 2,453 | 105.8% | 105.8% |
| Totals | 394,565 | 6,599,266 | 10.83% | 5.98% | 6.45% | 6.17% | 425,409 | 407,503 | 92.7% | 96.8% |



Withdrawal Experience Females



SECTION F

DISABILITY EXPERIENCE

Disability Experience

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

Findings

We reviewed the disability experience during the four-year period. The results are shown on the following pages. Overall, the actual number of disability retirements (133) is about 49 percent of the number projected by the present assumption (270 – see charts on the following pages).

The process of qualifying for a disability benefit requires some burden of proof. This process may result in a member being reported as a termination or withdrawal while the disability application is being reviewed. In fact, over the course of the four-year period, there were approximately 55 members who were reclassified as a disability retirement after first being reported as a termination. In recognition of this process, we recommend lowering the assumed rates of disability, but not as low as reported by the actual experience.

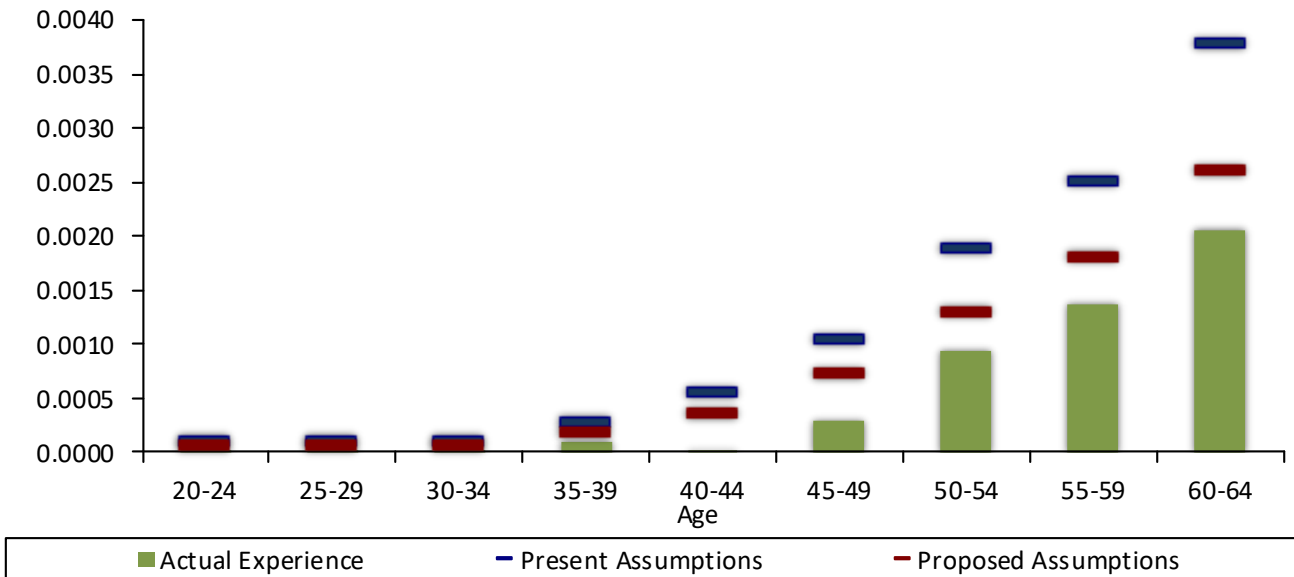
Recommendation

We recommend adopting lower rates of disability.

Disability Experience Males

Male Disability Table

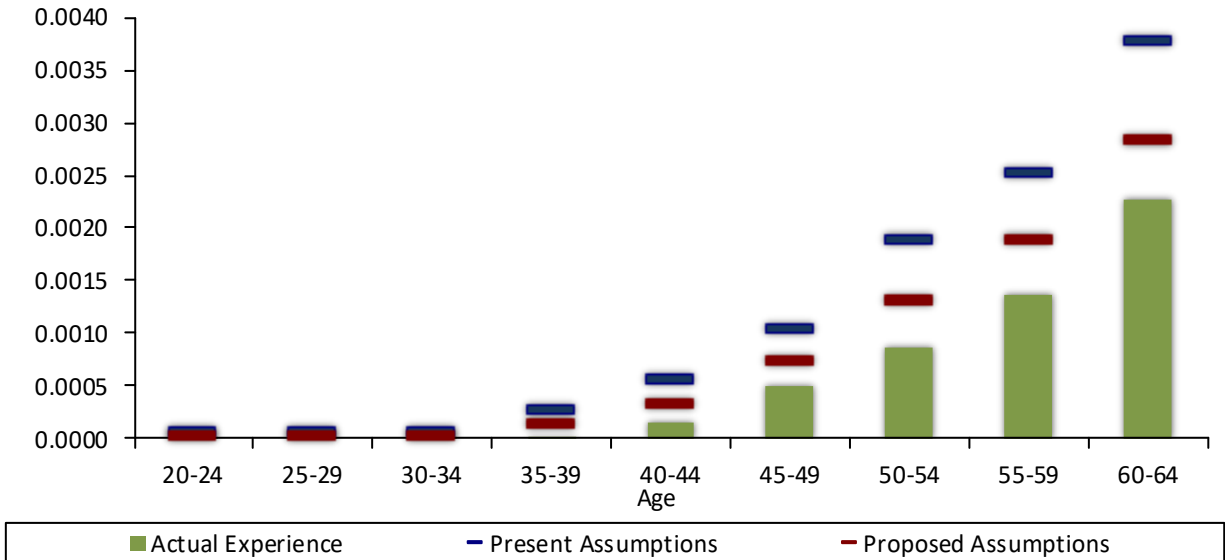
| Age | Population Weighted | | Crude Rates | Sample Rates | | Population Weighted Expected Disabilities | | Ratio of Actuals/Expecteds | |
|---------------|---------------------|---------------|----------------|----------------|----------------|---|-------------|----------------------------|--------------|
| | Disabilities | Exposure | | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | |
| Under 20 | 0 | - | N/A | 0.0100% | 0.0070% | - | - | N/A | N/A |
| 20-24 | 0 | 1,397 | 0.0000% | 0.0100% | 0.0070% | 0.1 | 0.1 | 0.1% | 0.1% |
| 25-29 | 0 | 5,967 | 0.0000% | 0.0100% | 0.0070% | 0.6 | 0.4 | 0.0% | 0.0% |
| 30-34 | 0 | 9,188 | 0.0000% | 0.0100% | 0.0076% | 1.0 | 0.7 | 0.0% | 0.0% |
| 35-39 | 1 | 11,187 | 0.0089% | 0.0280% | 0.0187% | 3.0 | 2.1 | 33.4% | 47.9% |
| 40-44 | 0 | 10,616 | 0.0000% | 0.0560% | 0.0370% | 5.6 | 3.9 | 0.0% | 0.0% |
| 45-49 | 3 | 9,905 | 0.0303% | 0.1050% | 0.0739% | 10.5 | 7.3 | 28.7% | 41.0% |
| 50-54 | 11 | 11,594 | 0.0949% | 0.1890% | 0.1308% | 21.7 | 15.2 | 50.8% | 72.6% |
| 55-59 | 19 | 13,845 | 0.1372% | 0.2520% | 0.1819% | 36.0 | 25.2 | 52.8% | 75.5% |
| 60-64 | 25 | 12,141 | 0.2059% | 0.3780% | 0.2620% | 45.5 | 31.8 | 55.0% | 78.6% |
| Totals | 59 | 85,840 | 0.0687% | 0.1443% | 0.1010% | 123.9 | 86.7 | 47.6% | 68.0% |



Disability Experience Females

Female Disability Table

| Age | Population Weighted | | Crude Rates | Sample Rates | | Population Weighted Expected Disabilities | | Ratio of Actuals/Expecteds | |
|---------------|---------------------|----------------|----------------|----------------|----------------|---|--------------|----------------------------|--------------|
| | Disabilities | Exposure | | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | |
| Under 20 | 0 | - | N/A | 0.0000% | 0.0000% | - | - | N/A | N/A |
| 20-24 | 0 | 2,342 | 0.0000% | 0.0070% | 0.0035% | 0.2 | 0.1 | 0.1% | 0.1% |
| 25-29 | 0 | 8,875 | 0.0000% | 0.0070% | 0.0035% | 0.6 | 0.3 | 0.0% | 0.0% |
| 30-34 | 0 | 12,248 | 0.0000% | 0.0070% | 0.0035% | 1.0 | 0.5 | 0.0% | 0.0% |
| 35-39 | 0 | 14,117 | 0.0000% | 0.0280% | 0.0140% | 3.8 | 1.9 | 0.0% | 0.0% |
| 40-44 | 2 | 12,995 | 0.0154% | 0.0560% | 0.0336% | 6.9 | 4.0 | 29.1% | 49.5% |
| 45-49 | 6 | 11,980 | 0.0501% | 0.1050% | 0.0735% | 12.7 | 8.9 | 47.4% | 67.8% |
| 50-54 | 12 | 13,902 | 0.0863% | 0.1890% | 0.1323% | 26.0 | 18.2 | 46.2% | 66.1% |
| 55-59 | 22 | 16,222 | 0.1356% | 0.2520% | 0.1890% | 42.1 | 31.6 | 52.2% | 69.6% |
| 60-64 | 32 | 14,131 | 0.2265% | 0.3780% | 0.2835% | 52.8 | 39.6 | 60.7% | 80.9% |
| Totals | 74 | 106,812 | 0.0693% | 0.1367% | 0.0983% | 146.0 | 105.0 | 50.7% | 70.5% |



SECTION G

MORTALITY EXPERIENCE

Mortality Experience

Post-retirement mortality is an important component in cost calculations and should be updated from time to time to reflect current and expected future longevity improvements. Pre-retirement mortality is a relatively minor component in cost calculations. The frequency of pre-retirement deaths is so low that mortality assumptions based on actual experience can only be produced for very large retirement systems, if at all.

Actuarial Standards of Practice

Actuarial Standards of Practice (ASOP) No. 35 Disclosure Section 4.1.1 states, “The disclosure of the mortality assumption should contain sufficient detail to permit another qualified actuary to understand the provision made for future mortality improvement. If the actuary assumes zero mortality improvement after the measurement date, the actuary should state that no provision was made for future mortality improvement.” The current mortality rates used in the valuation include a provision for future mortality improvement.

Mortality Tables and Projection Scales

Prior to the last experience study, the Society of Actuaries published a mortality study that was specific to public sector retirement systems. This is a very comprehensive study and there are numerous mortality tables created for each classification of employee (General members, Public Safety, Teachers, Survivors, Juvenile, headcount-weighted, benefit-weighted, above median, below median).

One of the key findings of the study is that there is a high correlation between longevity and income and education. As such, the SOA highly recommended the use of ‘benefit weighted’ rates when developing mortality tables. We were able to review SERF retiree and disability mortality on a ‘benefit weighted’ basis and have shown the results on page G-4 through G-7 of this report. Consistent with the SOA study, SERF members with higher benefits generally appear to experience longer lifespans, resulting in lower mortality rates.

Fully generational tables, which are utilized for the MSRS valuations, help take into account future improvements in mortality that are expected to occur. Typically, the Society of Actuaries updates the projection scale annually; however, no Scale MP-2022 was issued due to skewed mortality experience during the COVID-19 pandemic. The latest published table is called the MP-2021 Projection Scale.

Credibility

During the four-year period, there were 2,214 male retiree deaths and 1,920 female retiree deaths. Therefore, the experience is considered fully credible and there is no credibility constraint when fitting the standard healthy retiree mortality tables to the plan’s experience.

The number of observed deaths for active members was low and applying partial credibility would not change the recommended table materially; therefore, we are recommending no adjustments to the standard pre-retirement mortality tables.

Mortality Experience

For the disabled retiree mortality analysis, we use what is termed “the limited fluctuation credibility procedure” to determine the appropriate scaling factor of the base mortality tables for each gender. In each case, the Credibility Factor is computed based on the experience over the last eight years of the specific group being studied. This Credibility Factor is a measure of the credibility of the pertinent group with a 90% confidence interval.

The Best Fit is the ratio of actual to expected deaths using the base table. The Final Scale Factor is then determined as the weighted average of the Best Fit and 100% based on the Credibility Factor. For example, the Credibility Factor for Disabled Male Retirees is 47%, suggesting that the data for this group is 47% credible (there were not enough deaths among disabled retirees to be completely credible). The Best Fit for this group would be to scale the base tables by 122%. The Final Scale Factor of 110% is the credibility-weighted average ($110\% = 47\% \times 122\% + 53\% \times 100\%$). The Final Scale Factor for disabled female retiree mortality is determined similarly.

| | Deaths Needed for Full Credibility | Observed Deaths | Credibility Factor | Best Fit | Final Scale Factor |
|--------------------------|------------------------------------|-----------------|--------------------|----------|--------------------|
| Disabled male retirees | 1,430 | 315* | .4693 | 1.22 | 1.10 |
| Disabled female retirees | 1,574 | 299* | .4357 | 1.39 | 1.17 |

* Observed deaths over the past eight years

Findings

We reviewed the mortality experience during the four-year period. The results are shown on the following pages.

Healthy Retirees

Due to potential anti-selection bias, as well as data needs which are outside the scope of the annual valuation process, we did not include beneficiary and survivor mortality experience in our study.

In total, on a benefit weighted basis, the plan experienced more male liabilities removed due to deaths than expected (\$54,352,000 actual versus \$52,952,000 expected). The actual number of deaths on a benefit-weighted basis among retired females (\$31,931,000) was slightly more than the number projected by the present assumptions (\$31,391,000). While this seems like a good fit, the fit varies by age groups.

Disabled Retirees

On a benefit-weighted basis, the plan experienced more liabilities removed due to deaths among disabled males (\$2,669,000) than projected by the present assumptions (\$2,394,000). The actual number of deaths on a benefit-weighted basis among disabled females (\$2,120,000) was approximately the same as the number projected by the present assumptions (\$2,163,000).

Active Members

On a liability-weighted basis, the plan experienced more liabilities removed due to deaths among active males (\$27,307,000) than projected by the present assumptions (\$25,856,000). The actual number of deaths among active female members (\$16,220,000) was less than the number projected by the present assumption (\$17,387,000).



Mortality Experience

Recommendations

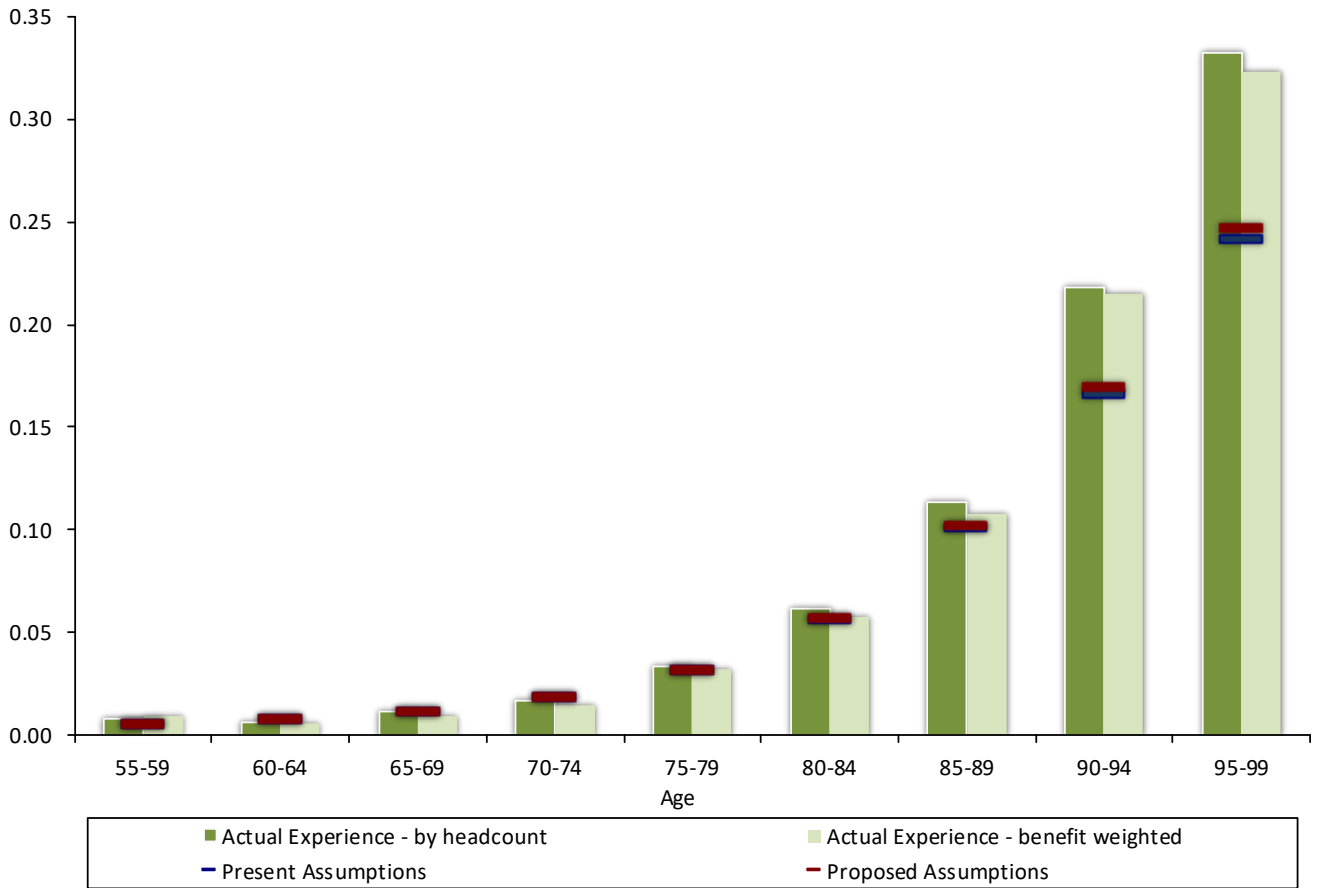
We did not find a published standard table that fit the observed experience at all ages. We recommend continued use of the Pub-2010 mortality tables, with adjustments, in order to produce a better fit to observed experience when possible. In some cases, even after adjustments, the fit was not uniform and we put more credibility on the rates in the published table than the plan's experience over the past four years.

Our recommended mortality tables are listed below (all recommended tables are Benefit Weighted):

| | |
|---------------------------|---|
| Healthy Male Retirees: | Pub-2010 Male Healthy Retired General Mortality Table, adjusted for mortality improvements using projection scale MP-2021. Rates are multiplied by a factor of 1.04. |
| Healthy Female Retirees: | Pub-2010 Female Healthy Retired General Mortality Table, adjusted for mortality improvements using projection scale MP-2021. Rates are multiplied by a factor of 1.10. |
| Disabled Male Retirees: | Pub-2010 Male General/Teacher Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021. Rates are multiplied by a factor of 1.10. |
| Disabled Female Retirees: | Pub-2010 Female General/Teacher Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021. Rates are multiplied by a factor of 1.17. |
| Male Active Members: | Pub-2010 Male General Employee Mortality Table adjusted for mortality improvements using projection scale MP-2021. |
| Female Active Members: | Pub-2010 Female General Employee Mortality Table adjusted for mortality improvements using projection scale MP-2021. |

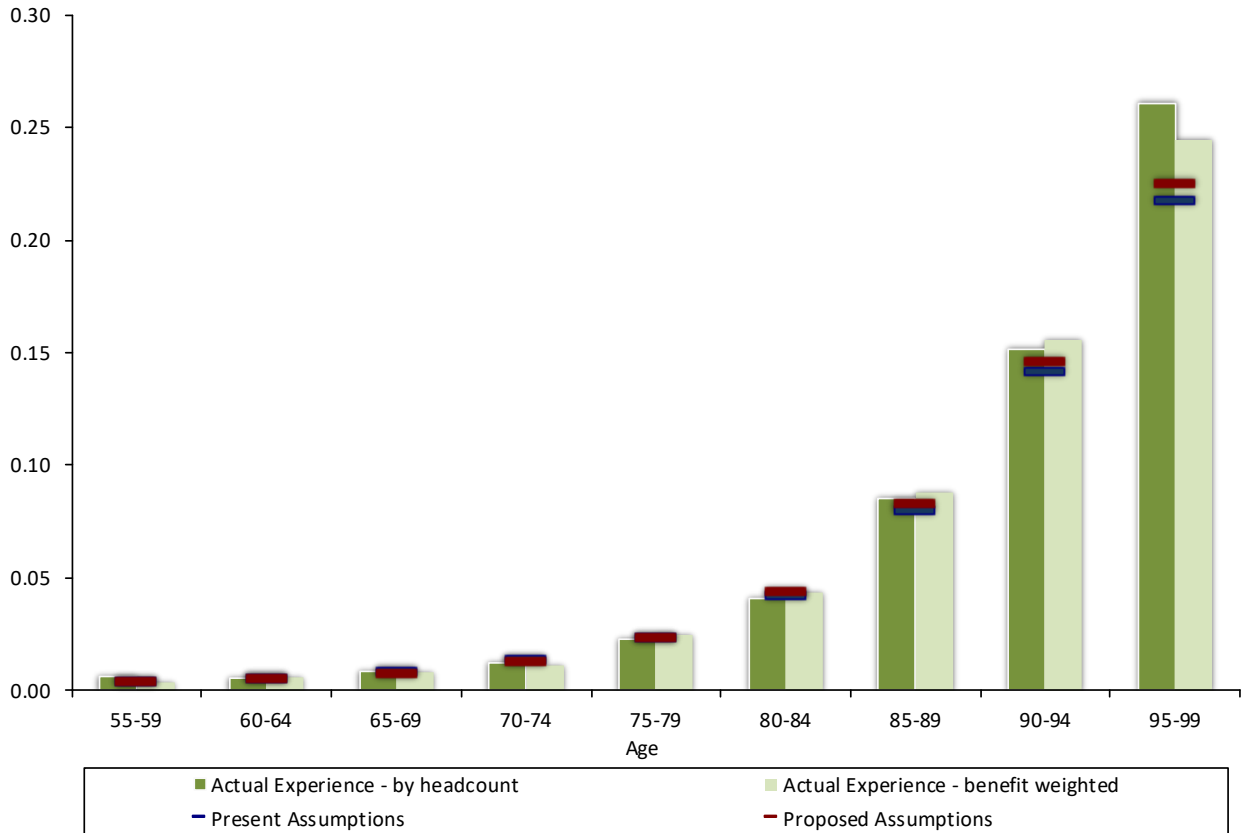
Post-Retirement Mortality Experience Healthy Males

| Age | Benefit Weighted (\$000s) | | Crude Rates | | Sample Rates | | Benefit Weighted (\$000s) | | Ratio of | |
|---------------|---------------------------|------------------|------------------|--------------------|--------------|--------------|---------------------------|---------------|-------------------|---------------|
| | Deaths | Exposure | Benefit Weighted | Headcount Weighted | Sample Rates | | Expected Deaths | | Actuals/Expecteds | |
| | | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| 55-59 | 161 | 17,163 | 0.94% | 0.82% | 0.57% | 0.57% | 97 | 98 | 165.6% | 164.8% |
| 60-64 | 841 | 137,753 | 0.61% | 0.64% | 0.80% | 0.81% | 1,107 | 1,111 | 76.0% | 75.7% |
| 65-69 | 3,865 | 403,615 | 0.96% | 1.13% | 1.17% | 1.16% | 4,715 | 4,693 | 82.0% | 82.4% |
| 70-74 | 6,842 | 463,925 | 1.47% | 1.67% | 1.82% | 1.81% | 8,461 | 8,381 | 80.9% | 81.6% |
| 75-79 | 9,031 | 284,958 | 3.17% | 3.32% | 3.13% | 3.13% | 8,930 | 8,912 | 101.1% | 101.3% |
| 80-84 | 9,449 | 165,053 | 5.73% | 6.13% | 5.67% | 5.72% | 9,356 | 9,436 | 101.0% | 100.1% |
| 85-89 | 11,189 | 103,472 | 10.81% | 11.38% | 10.07% | 10.24% | 10,424 | 10,591 | 107.3% | 105.6% |
| 90-94 | 9,073 | 42,135 | 21.53% | 21.80% | 16.61% | 16.95% | 6,999 | 7,140 | 129.6% | 127.1% |
| 95-99 | 3,690 | 11,430 | 32.28% | 33.24% | 24.23% | 24.72% | 2,769 | 2,826 | 133.2% | 130.6% |
| 100+ | 210 | 283 | 74.23% | 62.50% | 33.13% | 33.60% | 94 | 95 | 224.1% | 220.9% |
| Totals | 54,352 | 1,629,787 | 3.33% | 3.30% | 3.25% | 3.27% | 52,952 | 53,284 | 102.6% | 102.0% |



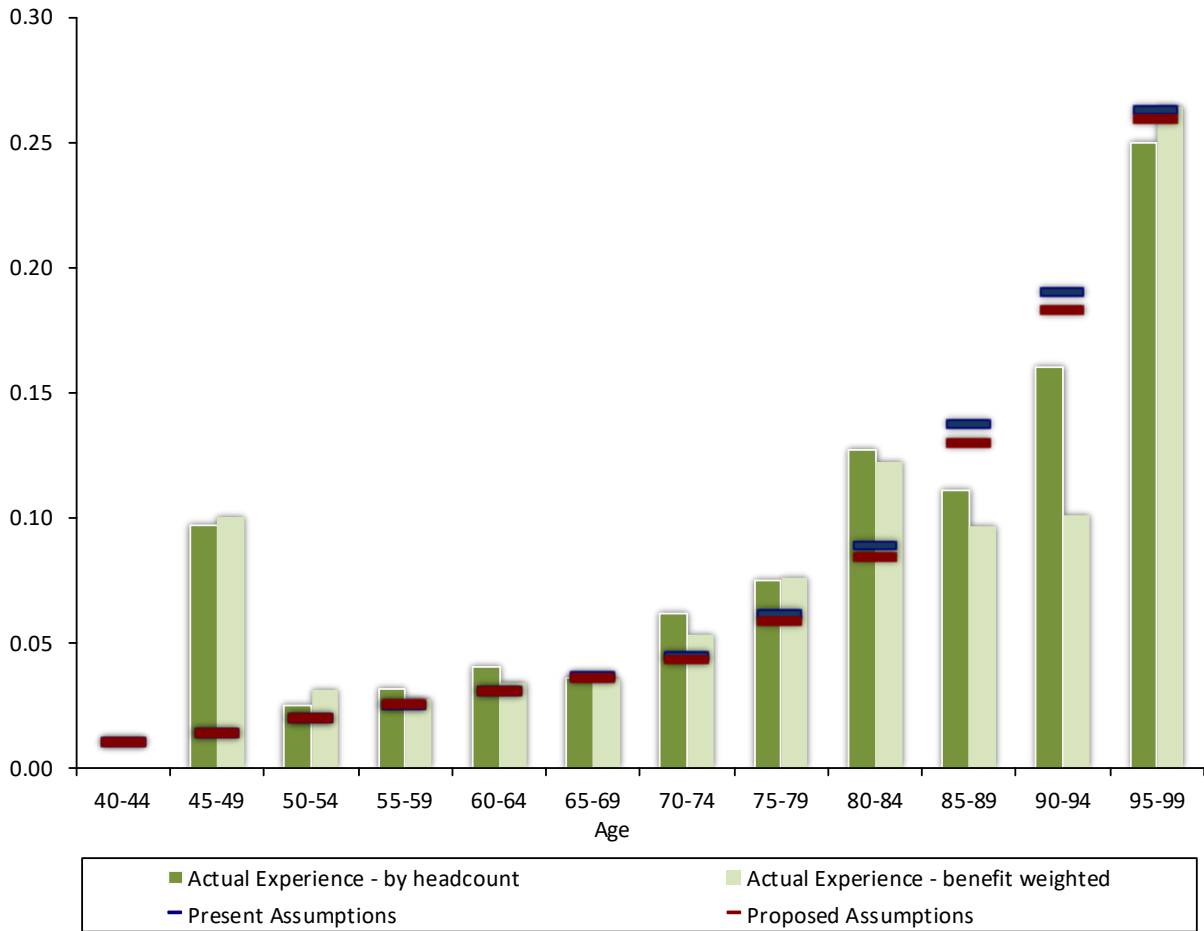
Post-Retirement Mortality Experience Healthy Females

| Age | Benefit Weighted (\$000s) | | Crude Rates | | Sample Rates | | Benefit Weighted (\$000s) | | Ratio of Actuals/Expecteds | |
|---------------|---------------------------|------------------|------------------|--------------------|--------------|--------------|---------------------------|---------------|----------------------------|---------------|
| | Deaths | Exposure | Benefit Weighted | Headcount Weighted | Present | Proposed* | Present | Proposed* | Present | Proposed* |
| | | | | | | | | | | |
| 55-59 | 112 | 33,306 | 0.34% | 0.61% | 0.37% | 0.39% | 124 | 129 | 89.9% | 86.7% |
| 60-64 | 1,030 | 178,094 | 0.58% | 0.56% | 0.55% | 0.53% | 972 | 949 | 105.9% | 108.5% |
| 65-69 | 3,523 | 442,359 | 0.80% | 0.82% | 0.84% | 0.79% | 3,713 | 3,490 | 94.9% | 100.9% |
| 70-74 | 4,343 | 387,229 | 1.12% | 1.21% | 1.34% | 1.29% | 5,198 | 5,000 | 83.6% | 86.9% |
| 75-79 | 4,730 | 194,900 | 2.43% | 2.25% | 2.32% | 2.33% | 4,518 | 4,543 | 104.7% | 104.1% |
| 80-84 | 4,409 | 102,447 | 4.30% | 4.09% | 4.22% | 4.36% | 4,327 | 4,471 | 101.9% | 98.6% |
| 85-89 | 5,237 | 59,419 | 8.81% | 8.49% | 8.01% | 8.31% | 4,757 | 4,940 | 110.1% | 106.0% |
| 90-94 | 5,358 | 34,421 | 15.56% | 15.18% | 14.15% | 14.65% | 4,869 | 5,042 | 110.0% | 106.3% |
| 95-99 | 2,659 | 10,876 | 24.45% | 26.11% | 21.82% | 22.51% | 2,374 | 2,448 | 112.0% | 108.6% |
| 100+ | 530 | 1,655 | 32.04% | 37.50% | 32.62% | 33.33% | 540 | 552 | 98.2% | 96.1% |
| Totals | 31,931 | 1,444,706 | 2.21% | 2.36% | 2.17% | 2.18% | 31,391 | 31,563 | 101.7% | 101.2% |



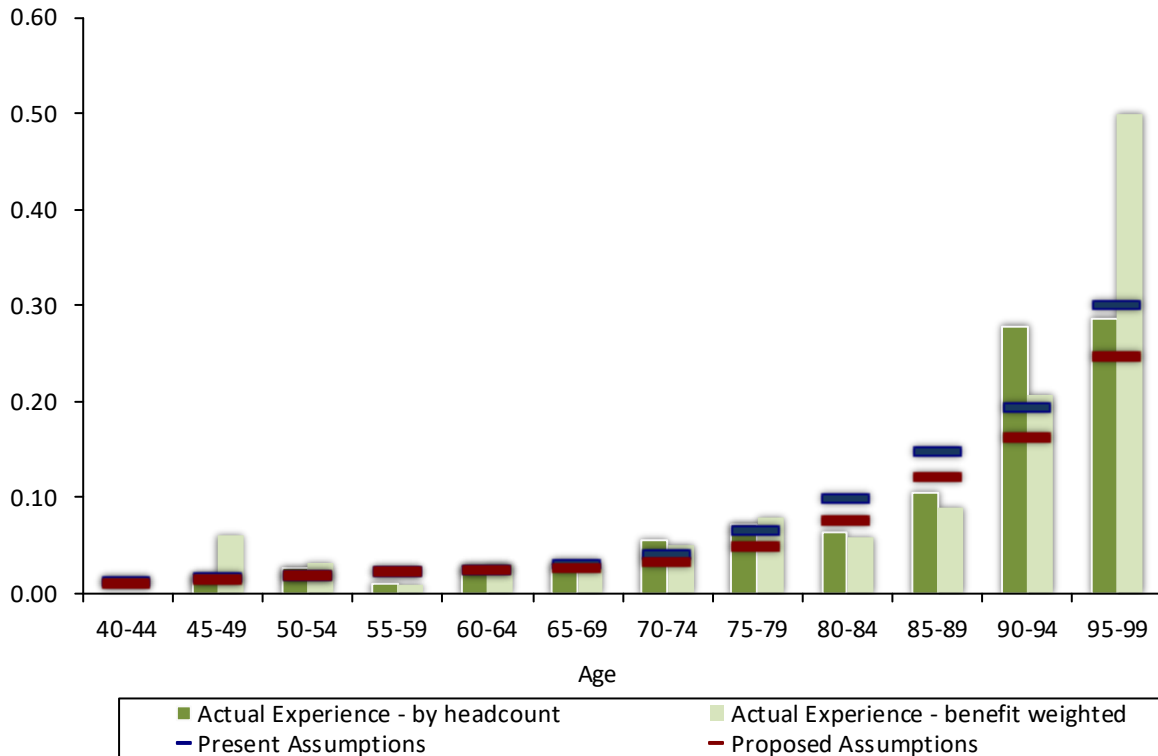
Post-Retirement Mortality Experience Disabled Males

| Age | Benefit Weighted (\$000s) | | Crude Rates | | Sample Rates | | Benefit Weighted (\$000s) | | Ratio of Actuals/Expecteds | |
|---------------|---------------------------|---------------|------------------|--------------------|--------------|--------------|---------------------------|--------------|----------------------------|---------------|
| | Deaths | Exposure | Benefit Weighted | Headcount Weighted | Sample Rates | | Expected Deaths | | Present | Proposed |
| | | | | | Present | Proposed | Present | Proposed | | |
| 40-44 | - | 115 | 0.00% | 0.00% | 1.01% | 1.01% | 1 | 1 | 0.0% | 0.0% |
| 45-49 | 24 | 239 | 10.04% | 9.68% | 1.40% | 1.36% | 3 | 3 | 715.8% | 736.6% |
| 50-54 | 26 | 828 | 3.14% | 2.50% | 1.95% | 1.96% | 16 | 16 | 161.3% | 159.8% |
| 55-59 | 106 | 3,885 | 2.73% | 3.17% | 2.48% | 2.56% | 96 | 100 | 110.2% | 106.4% |
| 60-64 | 373 | 10,874 | 3.43% | 4.01% | 3.04% | 3.09% | 330 | 336 | 113.0% | 111.2% |
| 65-69 | 489 | 13,779 | 3.55% | 3.58% | 3.65% | 3.62% | 503 | 498 | 97.2% | 98.1% |
| 70-74 | 692 | 13,108 | 5.28% | 6.18% | 4.47% | 4.33% | 585 | 568 | 118.2% | 121.8% |
| 75-79 | 420 | 5,543 | 7.58% | 7.52% | 6.14% | 5.85% | 340 | 324 | 123.5% | 129.5% |
| 80-84 | 374 | 3,051 | 12.26% | 12.72% | 8.87% | 8.42% | 271 | 257 | 138.2% | 145.5% |
| 85-89 | 91 | 940 | 9.68% | 11.11% | 13.77% | 13.04% | 129 | 123 | 70.3% | 74.3% |
| 90-94 | 51 | 505 | 10.10% | 16.00% | 18.99% | 18.31% | 96 | 92 | 53.2% | 55.1% |
| 95-99 | 23 | 87 | 26.44% | 25.00% | 26.29% | 25.91% | 23 | 23 | 100.6% | 102.0% |
| 100+ | - | - | N/A | N/A | N/A | N/A | - | - | N/A | N/A |
| Totals | 2,669 | 52,954 | 5.04% | 5.37% | 4.52% | 4.42% | 2,394 | 2,341 | 111.5% | 114.0% |



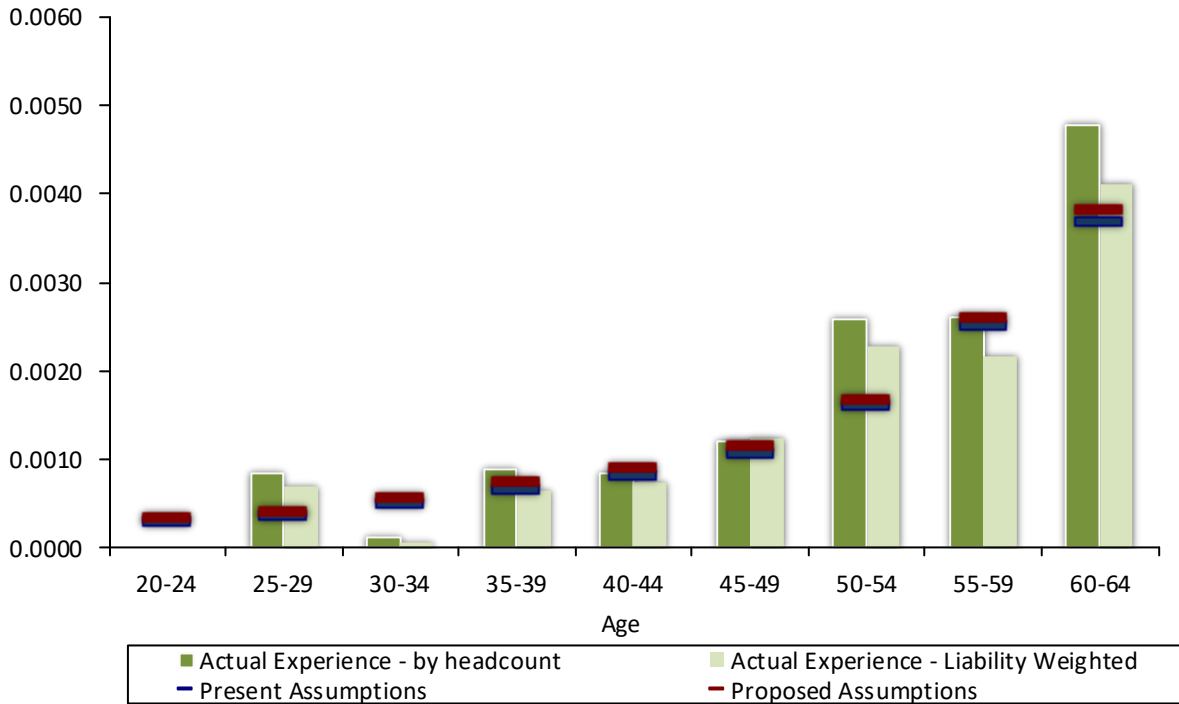
Post-Retirement Mortality Experience Disabled Females

| Age | Benefit Weighted (\$000s) | | Crude Rates | | Sample Rates | | Benefit Weighted (\$000s) | | Ratio of Actuals/Expecteds | |
|---------------|---------------------------|---------------|------------------|--------------------|--------------|--------------|---------------------------|--------------|----------------------------|---------------|
| | Deaths | Exposure | Benefit Weighted | Headcount Weighted | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | | |
| 40-44 | - | 141 | 0.00% | 0.00% | 1.25% | 0.96% | 2 | 1 | 0.0% | 0.0% |
| 45-49 | 26 | 426 | 6.10% | 1.89% | 1.52% | 1.31% | 6 | 6 | 400.2% | 465.7% |
| 50-54 | 50 | 1,561 | 3.20% | 2.58% | 1.87% | 1.84% | 29 | 29 | 171.7% | 174.2% |
| 55-59 | 61 | 6,404 | 0.95% | 1.00% | 2.21% | 2.25% | 141 | 144 | 43.2% | 42.4% |
| 60-64 | 392 | 13,667 | 2.87% | 2.56% | 2.51% | 2.45% | 344 | 335 | 114.1% | 117.2% |
| 65-69 | 396 | 15,114 | 2.62% | 2.89% | 3.03% | 2.66% | 458 | 401 | 86.4% | 98.6% |
| 70-74 | 531 | 10,550 | 5.03% | 5.59% | 4.10% | 3.29% | 432 | 347 | 122.8% | 153.0% |
| 75-79 | 362 | 4,635 | 7.81% | 7.23% | 6.54% | 4.99% | 303 | 231 | 119.4% | 156.7% |
| 80-84 | 149 | 2,538 | 5.87% | 6.40% | 9.94% | 7.59% | 252 | 193 | 59.0% | 77.4% |
| 85-89 | 77 | 869 | 8.86% | 10.53% | 14.75% | 12.21% | 128 | 106 | 60.1% | 72.6% |
| 90-94 | 53 | 255 | 20.78% | 27.78% | 19.37% | 16.21% | 49 | 41 | 107.3% | 128.2% |
| 95-99 | 23 | 46 | 50.00% | 28.57% | 30.01% | 24.66% | 14 | 11 | 166.6% | 202.7% |
| Totals | 2,120 | 56,214 | 3.77% | 3.79% | 3.85% | 3.29% | 2,163 | 1,848 | 98.0% | 114.7% |



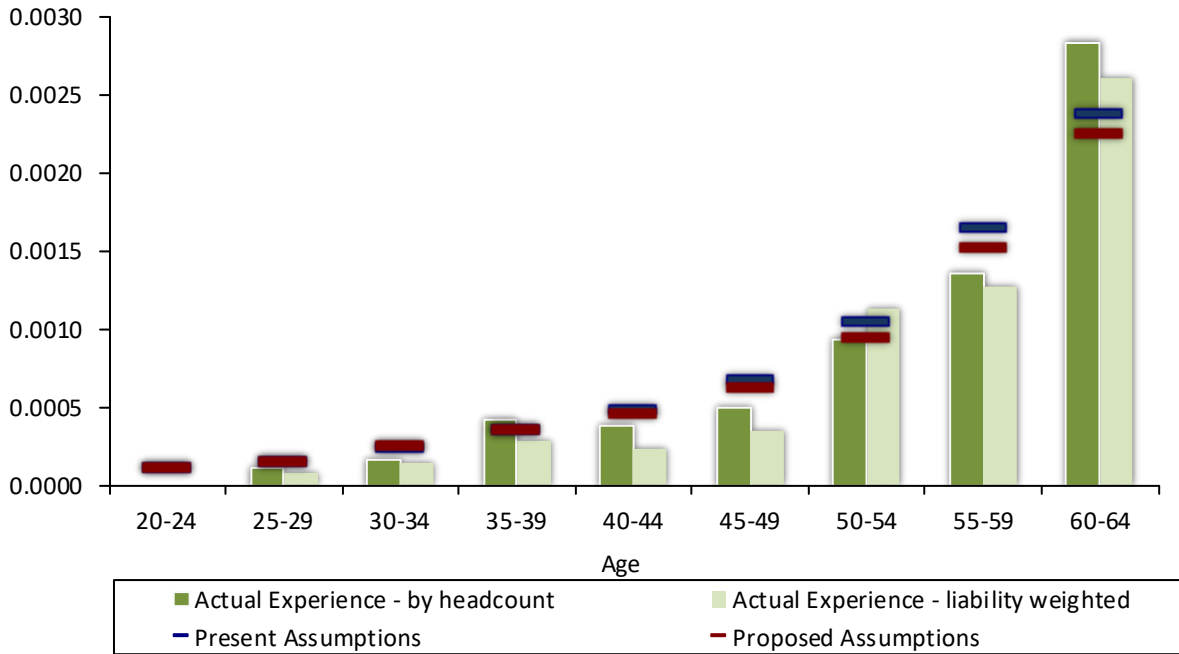
Pre-Retirement Mortality Experience Healthy Males

| Age | Liability Weighted (\$000s) | | Crude Rates | | Sample Rates | | Liability Weighted (\$000s) | | Ratio of Actuals/Expecteds | |
|---------------|-----------------------------|-------------------|--------------------|---------------------|--------------|--------------|-----------------------------|---------------|----------------------------|---------------|
| | Deaths | Exposure | Liability Weighted | Population Weighted | Sample Rates | | Expected Deaths | | Ratio of Actuals/Expecteds | |
| | | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| Under 20 | - | 125 | 0.00% | 0.00% | 0.04% | 0.04% | 0 | 0 | 0.0% | 0.0% |
| 20-24 | - | 33,160 | 0.00% | 0.00% | 0.03% | 0.03% | 10 | 11 | 0.0% | 0.0% |
| 25-29 | 162 | 233,488 | 0.07% | 0.08% | 0.04% | 0.04% | 85 | 94 | 190.0% | 172.2% |
| 30-34 | 32 | 525,925 | 0.01% | 0.01% | 0.05% | 0.06% | 268 | 302 | 11.9% | 10.6% |
| 35-39 | 594 | 900,550 | 0.07% | 0.09% | 0.07% | 0.07% | 593 | 675 | 100.2% | 88.0% |
| 40-44 | 837 | 1,127,287 | 0.07% | 0.08% | 0.08% | 0.09% | 913 | 1,028 | 91.7% | 81.4% |
| 45-49 | 1,597 | 1,296,926 | 0.12% | 0.12% | 0.11% | 0.12% | 1,389 | 1,510 | 115.0% | 105.7% |
| 50-54 | 4,420 | 1,939,181 | 0.23% | 0.26% | 0.16% | 0.17% | 3,109 | 3,252 | 142.2% | 135.9% |
| 55-59 | 6,674 | 3,096,260 | 0.22% | 0.26% | 0.25% | 0.26% | 7,763 | 8,041 | 86.0% | 83.0% |
| 60-64 | 12,991 | 3,165,928 | 0.41% | 0.48% | 0.37% | 0.38% | 11,727 | 12,142 | 110.8% | 107.0% |
| Totals | 27,307 | 12,318,830 | 0.22% | 0.19% | 0.21% | 0.22% | 25,856 | 27,055 | 105.6% | 100.9% |



Pre-Retirement Mortality Experience Healthy Females

| Age | Liability Weighted (\$000s) | | Crude Rates | | Sample Rates | | Liability Weighted (\$000s) | | Ratio of Actuals/Expecteds | |
|---------------|-----------------------------|-------------------|--------------------|---------------------|-----------------|--------------|-----------------------------|---------------|----------------------------|--------------|
| | Deaths | Exposure | Liability Weighted | Population Weighted | Expected Deaths | | Ratio of Actuals/Expecteds | | | |
| | | | | | Present | Proposed | Present | Proposed | | |
| Under 20 | - | 412 | 0.00% | 0.00% | 0.01% | 0.01% | 0 | 0 | 0.0% | 0.0% |
| 20-24 | - | 40,783 | 0.00% | 0.00% | 0.01% | 0.01% | 5 | 5 | 0.0% | 0.0% |
| 25-29 | 22 | 269,471 | 0.01% | 0.01% | 0.01% | 0.01% | 39 | 39 | 56.7% | 56.1% |
| 30-34 | 80 | 572,947 | 0.01% | 0.02% | 0.02% | 0.02% | 139 | 142 | 57.4% | 56.4% |
| 35-39 | 271 | 943,886 | 0.03% | 0.04% | 0.04% | 0.04% | 339 | 336 | 79.9% | 80.7% |
| 40-44 | 266 | 1,165,400 | 0.02% | 0.04% | 0.05% | 0.05% | 564 | 538 | 47.1% | 49.4% |
| 45-49 | 479 | 1,355,036 | 0.04% | 0.05% | 0.07% | 0.06% | 915 | 847 | 52.4% | 56.5% |
| 50-54 | 2,300 | 2,030,978 | 0.11% | 0.09% | 0.10% | 0.09% | 2,119 | 1,928 | 108.5% | 119.3% |
| 55-59 | 4,119 | 3,230,478 | 0.13% | 0.14% | 0.16% | 0.15% | 5,326 | 4,922 | 77.3% | 83.7% |
| 60-64 | 8,683 | 3,322,926 | 0.26% | 0.28% | 0.24% | 0.23% | 7,940 | 7,480 | 109.4% | 116.1% |
| Totals | 16,220 | 12,932,317 | 0.13% | 0.09% | 0.13% | 0.13% | 17,387 | 16,237 | 93.3% | 99.9% |



SECTION H

ACTUARIAL METHODS

Asset Valuation Method

Background

Employer contribution calculations are based on a smoothed asset valuation method (the actuarial value of assets). Such smoothed valuation methods aid in developing a contribution amount calculated to remain approximately level from year to year.

Per Minnesota Statute 356.215(f), the actuarial value of assets is based on a five-year moving average of expected and market values determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year, net of investment income for the fiscal year;
- The investment gain or (loss) is equal to the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year; and
- The asset value is the sum of the expected asset value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four plan years.

During periods when investment performance exceeds the assumed rate, the actuarial value of assets will tend to be less than the market value of assets. During periods when investment performance is less than the assumed rate, the actuarial value of assets will tend to be greater than the market value of assets. If assumed rates are exactly realized for four consecutive years, the actuarial value of assets will become equal to market value of assets.

This asset valuation method satisfies current standards of practice, which require that the asset valuation method reflect some function of market value, be unbiased in relation to market value, and recognize gains and losses consistently and over a reasonable period.

In 2007, the Actuarial Standards Board issued a standard on asset valuation methods which requires that the asset valuation method bear a reasonable relationship to current market value. There may be some concern that if the deviation between the funding value of assets and the market value of assets becomes too large, it could be considered unreasonable. The alternative to allowing large deviations usually involves setting upper and lower bounds (corridors) for the relationship between funding value and market value. Once a corridor limit is reached, any further market experience in the same direction is recognized immediately, which can introduce substantial fluctuations in the results of the actuarial valuation. If a 20% corridor were applied to the June 30, 2018 actuarial value of assets, it would not change the numerical result (the asset value would be unchanged).

Recommendation

We recommend continued use of the current asset valuation method. MSRS should continue to consider results based on the market value of assets as well as the actuarial value of assets, especially when the two values are significantly different.

Funding Policy – Actuarial Funding Method

An actuarial funding method is a set of techniques for conversion of the actuarial present values of benefits into contribution information. Minnesota Statute requires the actuary to use the entry age actuarial cost method, characterized by:

1. Normal Cost – the level percent of payroll contribution, paid from each member’s date of plan entry to date of retirement, which will accumulate enough assets at retirement to fund the member’s projected benefits from retirement to death.
2. Actuarial Accrued Liability – the assets which would have accumulated to date had contributions been made at the level of the normal cost since the date of the first benefit accrual, all actuarial assumptions had been exactly realized, and there had been no benefit changes. It is the amount sufficient, when combined with the accumulation of future normal cost amounts, to theoretically fund all benefits at retirement for a member.

The total contribution produced by an actuarial method is the total of the normal cost and an amount to amortize any unfunded actuarial accrued liability.

The entry age actuarial method is the most prevalent funding method in the public sector. It is appropriate for the public sector because it produces costs that remain stable as a percentage of payroll over time, resulting in normal cost contributions that are theoretically level as a percentage of payroll.

Recommendations

We recommend continued use of the entry age actuarial cost method.

Funding Policy – Amortization

Amortization Period

Minnesota Statute 356.215, Subdivision 11 specifies June 30, 2048 as the established date for full funding of the State Employees Retirement Fund (SERF). If the unfunded liability increases due to changes in benefits, assumptions, or methods, the statutory amortization date may be extended (limited to 30 years). The June 30, 2022 actuarial valuation amortizes the UAAL over a 26-year period. The amortization period decreases each year by one year (like a typical mortgage).

Past practice has typically been to re-establish a new 30-year statutory amortization period occasionally in order to minimize volatility and manage cost requirements. This practice shifts costs to the future. In lieu of this, MSRS could consider using a shorter maximum period, such as 15, 20 or 25 years. Actuarial practice, including Actuarial Standards of Practice, is moving toward shorter amortization periods than in the past.

Another option to consider is the use of “layered” amortization – which continues to amortize the initial unfunded liability over the closed amortization period, but spreads out gains/losses and other liability changes as they occur over separate closed periods. This methodology maintains steady progress toward eliminating the unfunded liability.

Amortization Method

Because SERF is an open retirement plan (new employees enter the plan) and contributions are intended to remain approximately level as a percent of payroll, level percent of payroll amortization payments are used.

Longer amortization periods combined with the level percent of pay methodology results in initial payments that are less than the “interest only” payment on the unfunded actuarial accrued liability (UAAL), i.e., “negative amortization.” Payments less than the interest only amount will result in the UAAL increasing for an initial period of time. Based on the proposed assumptions of 7.00% interest and 3.00% payroll growth and if contributions to the plan are equal to the required contribution amount, payments will continue to be less than the interest only amount, with amortization payments exceeding the interest only amount once the period declines to 21 years. This means that the UAAL is expected to increase for the next five years under the current funding policy. Negative amortization, once commonly accepted, is increasingly attracting criticism. We greatly prefer combinations of amortization methods and assumptions that result in the UAAL decreasing each year.

We note that the legislature extended the amortization period six years in 2018 (from 2042 to 2048). If the legislature hadn’t taken this action, the amortization for the 2023 fiscal year would be greater than the interest on the UAAL and the plan would not be experiencing negative amortization.

Funding Policy – Amortization

Actual growth in SERF payroll every year in the past ten years has exceeded the expected rate of 3.00% with the exception of the fiscal year ending June 30, 2021, which is likely due to the COVID-19 pandemic. If payroll grows slower than expected, contributions collected will also be less than expected, and insufficient to eliminate the UAAL by the statutory amortization date. Some plans address this issue by not permitting the payroll growth assumption to exceed the actual average growth rate over the past 5 years. We will continue to monitor actual payroll growth; if at some point in the future actual payroll growth falls short of expectations, a method change should be considered.

Recommendation

We recommend MSRS consider an alternative to the current amortization policy, since the current method results in approximately five years of negative amortization and an increasing Unfunded Actuarial Accrued Liability. Alternatives to consider include layered amortization, a shorter closed period, or applying a minimum amortization amount that is equal to interest on the unfunded actuarial accrued liability. We also recommend continued use of the level percent of payroll amortization method. Lastly, we recommend closely monitoring actual payroll growth with implementation of a payroll growth assumption equal to recent experience if payroll growth falls short of the recommended 3.0% growth assumption.

Funding Policy – Projected Payroll

Required contributions are expressed as a percent of payroll. The Minnesota Standards for Actuarial Work state that the projected payroll will be developed from the reported payroll in the base year by increasing each person's pay by one full year's pay increase according to the actuarial salary scale. This appears to make sense on the surface, but in our judgment such a calculation is not fully in compliance with level percent of payroll funding. There are two issues:

1. With respect to the total payroll used for the amortization of the unfunded liability: Total payroll is expected to increase at 3% according to the actuarial assumptions. The total payroll, increased at the assumed payroll growth rate, is the proper series of payroll amounts over which to fund the unfunded liability. The first year payroll stated in the Minnesota Standards is not consistent with this principle. It produces a higher value for the payroll and therefore lowers the contribution rate as a percent of payroll.
2. With respect to the normal cost dollar amount: The normal cost percentage for active members is developed as the ratio of the present value of future benefits at entry age to the present value of future pay at entry age. The present value of future pay must take into account both the timing of pay increases within the year, and the probability that an individual may exit the active member group during the year. The first year payroll stated in the Minnesota Standards is not mathematically consistent with this principle since it assumes the member will earn an entire year of payroll, even though there may be a probability of decrement for the member during the year.

Recommendation

We recommend the Minnesota Standards for Actuarial Practice be amended to be less prescriptive and more principles-based, so that the actuaries for the systems may use their best judgment to calculate contribution rates and liabilities in a mathematically consistent manner and in accordance with actuarial standards of practice.

SECTION I

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Marital Status

Married members will frequently make different annuity selections than non-married members. The current valuation assumption is that 80% of male members and 60% of female members are married. Actual marital status is used for retired members.

Findings

We reviewed the marital status of healthy members retiring from active status during the four-year period. The results are shown below.

| Gender | Married New Retirees | Total New Retirees | Crude Rates | Sample Rates | | Expected Married Retirees | | Ratio of Actual/Expected | |
|--------------|----------------------|--------------------|---------------|--------------|----------|---------------------------|--------------|--------------------------|---------------|
| | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| Males | 2,149 | 2,820 | 76.21% | 80.00% | 75.00% | 2,256 | 2,115 | 95.3% | 101.6% |
| Females | 2,182 | 3,407 | 64.04% | 60.00% | 65.00% | 2,044 | 2,215 | 106.7% | 98.5% |
| Total | 4,331 | 6,227 | 69.55% | | | 4,300 | 4,330 | 100.7% | 100.0% |

The experience shows that there are more married new retirees than expected for females and fewer married new retirees than expected for males.

Recommendation

We recommend decreasing the marital status assumption for males to 75% and increasing the marital status assumption for females to 65%.

Age of Survivor

Joint & Survivor annuity benefit amounts are determined based on the member’s and survivor’s age. Currently, the valuation assumes that male members have a beneficiary two years younger and female members have a beneficiary two years older. This assumption is used to predict the length of expected payments payable to a future survivor.

Findings

We reviewed the ages of married new retirees and their beneficiaries during the four-year period. The results are shown below.

| Gender | Married New Retirees | Average Age Difference | Expected Age Difference | | Ratio of Actual/Expected | |
|--------------|----------------------|------------------------|-------------------------|----------|--------------------------|----------|
| | | | Present | Proposed | Present | Proposed |
| Males | 2,149 | 2.45 | 2.00 | 2.00 | 122.5% | 122.5% |
| Females | 2,182 | -1.71 | -2.00 | -2.00 | 85.5% | 85.5% |
| Total | 4,331 | | | | | |

The experience shows that the age difference for males has remained relatively stable. Actual average age differences for male new retirees were 2.64 years in the 2008-2014 study, 2.40 years in the 2014-2018 study, and 2.45 in this 2018-2022 study. Age differences for females, on the other hand, were trending down but have now rebounded slightly. Actual average age differences for female new retirees were -1.88 years in the 2008-2014 study, -1.55 years in the 2014-2018 study, and -1.71 years in the 2018-2022 study.

Recommendation

We recommend maintaining the current survivor age difference assumption.

Form of Payment

Upon retirement, a member can elect any of the following forms of payment:

- Single-life annuity – the benefit is paid for the lifetime of the member. No benefit is payable to a beneficiary upon the member’s death.
- 15 Year Certain & Life – a reduced benefit is paid for the lifetime of the member. If the member dies before 180 payments have been made, the benefit continues to be paid to a beneficiary or estate until 180 payments have been made.
- 50% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 50% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 75% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 75% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.
- 100% Joint & Survivor – a reduced benefit is paid for the lifetime of the member. Upon death of the member, 100% of the benefit is paid to a beneficiary. If the beneficiary predeceases the member, the benefit reverts back to the single life annuity amount.

If the member elects a joint & survivor form of payment and the beneficiary predeceases the member, the benefit “bounces back” to the single life annuity at the time of the beneficiary’s death. There is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan). In order to capture the cost of this subsidy in the annual valuation, an assumption is made regarding the form of payment elections of future retirees.

Married members retiring from active status are currently assumed to elect annuities as follows:

| | |
|----------|--|
| Males: | 0% elect 15 Year Certain & Life option |
| | 10% elect 50% Joint & Survivor option |
| | 15% elect 75% Joint & Survivor option |
| | 65% elect 100% Joint & Survivor option |
| Females: | 0% elect 15 Year Certain & Life option |
| | 15% elect 50% Joint & Survivor option |
| | 10% elect 75% Joint & Survivor option |
| | 40% elect 100% Joint & Survivor option |

Remaining married and unmarried members are assumed to elect the Single-life option.

Findings

We reviewed the benefit elections of married new retirees during the four-year period. The results are shown on the following pages.

We found that married new retirees elections were approximately as assumed.

Recommendation

We recommend maintaining the current assumed elected form of payment for male retirees and minor changes to the assumed elected form of payment for female retirees.



Form of Payment

Male Experience

| Form of Payment | Actual Electing Annuity | Married New Retirees | Crude Rates | Sample Rates | | Expected Electing Annuity | | Ratio of Actuals/Expected | |
|------------------------|-------------------------------|----------------------------|----------------|----------------|----------------|------------------------------|---------------|------------------------------|----------|
| | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | |
| Single-life annuity | 245 | 2,149 | 11.40% | 10.00% | 10.00% | 214.9 | 214.9 | 114.0% | 114.0% |
| 15 year certain & life | 6 | 2,149 | 0.28% | 0.00% | 0.00% | 0.0 | 0.0 | N/A | N/A |
| 50% joint & Survivor | 228 | 2,149 | 10.61% | 10.00% | 10.00% | 214.9 | 214.9 | 106.1% | 106.1% |
| 75% joint & Survivor | 247 | 2,149 | 11.49% | 15.00% | 15.00% | 322.4 | 322.4 | 76.6% | 76.6% |
| 100% joint & Survivor | 1,423 | 2,149 | 66.22% | 65.00% | 65.00% | 1396.9 | 1396.9 | 101.9% | 101.9% |
| Total | 2,149 | 2,149 | 100.00% | 100.00% | 100.00% | 2149.0 | 2149.0 | | |

Female Experience

| Form of Payment | Actual Electing Annuity | Married New Retirees | Crude Rates | Sample Rates | | Expected Electing Annuity | | Ratio of Actuals/Expected | |
|------------------------|-------------------------------|----------------------------|----------------|----------------|----------------|------------------------------|---------------|------------------------------|----------|
| | | | | Present | Proposed | Present | Proposed | Present | Proposed |
| | | | | | | | | | |
| Single-life annuity | 585 | 2,182 | 26.81% | 35.00% | 25.00% | 763.7 | 545.5 | 76.6% | 107.2% |
| 15 year certain & life | 18 | 2,182 | 0.82% | 0.00% | 0.00% | 0.0 | 0.0 | N/A | N/A |
| 50% joint & Survivor | 383 | 2,182 | 17.55% | 15.00% | 20.00% | 327.3 | 436.4 | 117.0% | 87.8% |
| 75% joint & Survivor | 248 | 2,182 | 11.37% | 10.00% | 10.00% | 218.2 | 218.2 | 113.7% | 113.7% |
| 100% joint & Survivor | 948 | 2,182 | 43.45% | 40.00% | 45.00% | 872.8 | 981.9 | 108.6% | 96.5% |
| Total | 2,182 | 2,182 | 100.00% | 100.00% | 100.00% | 2182.0 | 2182.0 | | |

Actuarial Equivalent Factors

Early retirement and Joint and Survivor benefits are actuarially equivalent to the Single-life annuity. Actuarial equivalent factors are based on the RP-2014 mortality table for healthy annuitants, white collar adjustment, male rates set forward two years, projected to 2019 using Scale MP-2015, blended 50% males, 5.88% post-retirement interest and 7.5% pre-retirement interest. Reflecting statutory requirements, joint and survivor factors are based on an interest assumption of 6.5%.

Recommendation

We recommend updating the actuarial equivalent factors to reflect changes in interest and expected mortality and developing an appropriate implementation schedule.

Assumptions for Missing Participant Data

Background

To prepare the annual valuation report, GRS uses and relies on participant data supplied by MSRS. In cases where submitted data was missing or incomplete, the following assumptions are currently applied:

Data for active members:

- For members reported with zero or invalid salary (<\$100): Salary is set equal to prior year salary, if available, otherwise, high five salary with a 10% load to account for salary increases. If neither pay nor high five salary is available, salary is set to \$45,000.
- For members reported with zero or negative service: Due to the small number of members with zero service, and based on direction from MSRS, no change is made to the reported data.
- For members reported without a gender: assume the member is female.
- For members reported with an invalid date of birth: assume the member was hired at age 37.

Data for terminated members:

- For members reported with a missing or invalid benefit: If available, GRS calculates benefits for these members using the reported Average Salary, Credited Service and Termination Date provided. If Average Salary was not reported or invalid, it is assumed equal to a value of \$40,000. If termination date was not reported, it is assumed the member terminated at age 40 (or current age if younger than 40). If credited service was either not reported or invalid, it is assumed to equal 5.0 years.
- For members reported without a gender: assume the member is female.
- For members reported with an invalid date of birth: assume age 37 at valuation date.

Data for members receiving benefits:

- For members reported without a gender: assume female gender.
- For members reported without a benefit: due to the small number of members with missing benefits, no adjustment is made to the reported data.
- Survivor members reported with a certain and life option but with a certain end date prior to the valuation date are excluded from the valuation.
- For retired members reported with a survivor option and a survivor date of death: assume no benefit was payable to the survivor, and the member benefit already reflected the increase to the life annuity (i.e., "bounce back,") if applicable.
- For retired members reported with a bounceback annuity but not reported with a reasonable reduction factor: assume a factor of 0.80, 0.85 and 0.90 was assumed for the 100%, 75% and 50% joint and survivor annuity, respectively.
- For retired members reported with a survivor option and an invalid or missing survivor gender and/or survivor date of birth: apply the valuation assumptions for the survivor gender and/or date of birth.

Recommendation

We recommend updating the assumptions for missing participant data as follows:

- *For active members reported with zero or invalid salary (<\$100) and prior pay or high five salary is not available, assume salary is equal to the average salary of new members with one to five years of service as of the prior valuation date. This value is \$52,000 as of July 1, 2022.*
- *For terminated members reported with a missing or invalid benefit and Average Salary was not reported or invalid, assume Average Salary equals \$58,000.*

Proposed Miscellaneous and Technical Assumptions

Background

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

The Allowance for Combined Service Annuity assumptions are based on an analysis completed by the LCPR actuary and documented in a report dated October 2016.

Recommendation

Miscellaneous and Technical Assumptions are listed on the next page. We recommend continued use of the other Miscellaneous and Technical Assumptions.

Miscellaneous and Technical Assumptions

| | |
|--|--|
| <i>Benefit Service</i> | Exact fractional service is used to determine the amount of benefit payable. |
| <i>Decrement Operation</i> | Withdrawal decrements do not operate during retirement eligibility. |
| <i>Decrement Timing</i> | Decrements of all types are 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>Forfeitures</i> | For vested separations from service, it is assumed that members separating will withdraw their contributions and forfeit an employer financed benefit when the value of member contributions is greater than the value of the employer financed benefit. |
| <i>Incidence of Contributions</i> | Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work. |
| <i>Liability Adjustments</i> | Liabilities for former members are increased by 15% for vested members and 3% for non-vested members to account for the effect of some participants having eligibility for a Combined Service Annuity. |
| <i>Pay Increase Timing</i> | Pay increases were assumed to be at the beginning of the fiscal year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date. |
| <i>Service Credit Accruals</i> | Members were assumed to accrue one year of service credit per year. |

SECTION J

PROPOSED ASSUMPTION LISTING

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Merit and Seniority Pay Increases

| % Merit & Seniority Increased in Salaries Next Year | |
|---|-------|
| Year | Rate |
| 1 | 8.75% |
| 2 | 4.50% |
| 3 | 2.65% |
| 4 | 2.50% |
| 5 | 2.20% |
| 6 | 2.00% |
| 7 | 1.80% |
| 8 | 1.60% |
| 9 | 1.50% |
| 10 | 1.30% |
| 11 | 1.20% |
| 12 | 1.10% |
| 13 | 1.00% |
| 14 | 0.90% |
| 15 | 0.70% |
| 16 | 0.60% |
| 17 | 0.50% |
| 18 | 0.40% |
| 19 | 0.40% |
| 20 | 0.40% |
| 21 | 0.30% |
| 22 | 0.20% |
| 23 | 0.20% |
| 24 | 0.20% |
| 25 | 0.20% |
| 26 | 0.20% |
| 27 | 0.00% |
| 28 | 0.00% |
| 29 | 0.00% |
| 30+ | 0.00% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Age & Service Retirement Pattern Unreduced (Normal) Retirement

| Age | % Retiring |
|------|------------|
| 65 | 35.0% |
| 66 | 35.0% |
| 67 | 35.0% |
| 68 | 30.0% |
| 69 | 25.0% |
| 70 | 30.0% |
| 71+* | * |

* *The current assumption prescribed by the Minnesota Standards for Actuarial Work is that members who have reached 100% retirement eligibility will delay retirement one year.*

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Rule of 90 Retirement Pattern

| Age | % Retiring |
|-----|------------|
| 55 | 15.0% |
| 56 | 15.0% |
| 57 | 11.0% |
| 58 | 11.0% |
| 59 | 12.0% |
| 60 | 15.0% |
| 61 | 15.0% |
| 62 | 22.0% |
| 63 | 22.0% |
| 64 | 20.0% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Age & Service Retirement Pattern Tier 1 Reduced (Early) Retirement

| Age | % Retiring |
|-----|------------|
| 55 | 3.0% |
| 56 | 3.0% |
| 57 | 3.0% |
| 58 | 6.0% |
| 59 | 7.0% |
| 60 | 8.0% |
| 61 | 9.0% |
| 62 | 15.0% |
| 63 | 15.0% |
| 64 | 15.0% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Age & Service Retirement Pattern Tier 2 Reduced (Early) Retirement

| Age | % Retiring |
|-----|------------|
| 55 | 3.5% |
| 56 | 3.5% |
| 57 | 3.5% |
| 58 | 4.0% |
| 59 | 4.5% |
| 60 | 5.0% |
| 61 | 6.0% |
| 62 | 12.0% |
| 63 | 13.0% |
| 64 | 14.0% |
| 65 | 22.0% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Withdrawal

| Year | % Withdrawals | |
|------|---------------|--------|
| | Male | Female |
| 1 | 20.00% | 20.50% |
| 2 | 15.00% | 16.50% |
| 3 | 10.50% | 12.50% |
| 4 | 8.25% | 9.75% |
| 5 | 7.00% | 9.00% |
| 6 | 6.50% | 8.00% |
| 7 | 5.50% | 7.50% |
| 8 | 4.50% | 6.25% |
| 9 | 4.25% | 5.25% |
| 10 | 3.75% | 4.75% |
| 11 | 3.50% | 4.50% |
| 12 | 3.25% | 4.25% |
| 13 | 3.00% | 4.00% |
| 14 | 2.50% | 3.75% |
| 15 | 2.40% | 3.25% |
| 16 | 2.30% | 3.25% |
| 17 | 2.20% | 3.00% |
| 18 | 2.10% | 2.75% |
| 19 | 2.00% | 2.50% |
| 20 | 1.75% | 2.50% |
| 21 | 1.75% | 2.50% |
| 22 | 1.75% | 2.50% |
| 23 | 1.75% | 2.25% |
| 24 | 1.50% | 1.75% |
| 25 | 1.50% | 1.75% |
| 26 | 1.25% | 1.75% |
| 27 | 1.00% | 1.50% |
| 28 | 1.00% | 1.50% |
| 29 | 1.00% | 1.00% |
| 30+ | 1.00% | 1.00% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Disability Rates

| Year | % Becoming Disabled | |
|------|---------------------|---------|
| | Male | Female |
| 20 | 0.0070% | 0.0035% |
| 21 | 0.0070% | 0.0035% |
| 22 | 0.0070% | 0.0035% |
| 23 | 0.0070% | 0.0035% |
| 24 | 0.0070% | 0.0035% |
| 25 | 0.0070% | 0.0035% |
| 26 | 0.0070% | 0.0035% |
| 27 | 0.0070% | 0.0035% |
| 28 | 0.0070% | 0.0035% |
| 29 | 0.0070% | 0.0035% |
| 30 | 0.0070% | 0.0035% |
| 31 | 0.0070% | 0.0035% |
| 32 | 0.0070% | 0.0035% |
| 33 | 0.0070% | 0.0035% |
| 34 | 0.0098% | 0.0070% |
| 35 | 0.0098% | 0.0070% |
| 36 | 0.0147% | 0.0105% |
| 37 | 0.0196% | 0.0140% |
| 38 | 0.0245% | 0.0175% |
| 39 | 0.0245% | 0.0175% |
| 40 | 0.0294% | 0.0221% |
| 41 | 0.0343% | 0.0294% |
| 42 | 0.0392% | 0.0336% |
| 43 | 0.0392% | 0.0336% |
| 44 | 0.0441% | 0.0378% |
| 45 | 0.0539% | 0.0539% |
| 46 | 0.0637% | 0.0637% |
| 47 | 0.0735% | 0.0735% |
| 48 | 0.0833% | 0.0833% |
| 49 | 0.0931% | 0.0931% |
| 50 | 0.1078% | 0.1078% |
| 51 | 0.1176% | 0.1176% |
| 52 | 0.1323% | 0.1323% |
| 53 | 0.1421% | 0.1421% |
| 54 | 0.1519% | 0.1519% |
| 55 | 0.1568% | 0.1680% |
| 56 | 0.1666% | 0.1785% |
| 57 | 0.1764% | 0.1890% |
| 58 | 0.1960% | 0.2100% |
| 59 | 0.2107% | 0.2258% |
| 60 | 0.2303% | 0.2468% |
| 61 | 0.2450% | 0.2625% |
| 62 | 0.2646% | 0.2835% |
| 63 | 0.2842% | 0.3045% |
| 64 | 0.2989% | 0.3203% |

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Healthy Post-Retirement Mortality Rates

| Age in 2022 | % Dying Next Year* | | Age in 2022 | % Dying Next Year* | |
|----------------|--------------------|--------|----------------|--------------------|--------|
| | Male | Female | | Male | Female |
| 50 | 0.29% | 0.22% | 81 | 5.04% | 3.85% |
| 51 | 0.31% | 0.24% | 82 | 5.70% | 4.37% |
| 52 | 0.34% | 0.25% | 83 | 6.45% | 4.97% |
| 53 | 0.36% | 0.27% | 84 | 7.28% | 5.66% |
| 54 | 0.39% | 0.29% | 85 | 8.22% | 6.44% |
| 55 | 0.43% | 0.31% | 86 | 9.24% | 7.34% |
| 56 | 0.47% | 0.34% | 87 | 10.36% | 8.35% |
| 57 | 0.51% | 0.36% | 88 | 11.58% | 9.48% |
| 58 | 0.56% | 0.38% | 89 | 12.90% | 10.73% |
| 59 | 0.61% | 0.41% | 90 | 14.31% | 12.08% |
| 60 | 0.66% | 0.44% | 91 | 15.81% | 13.50% |
| 61 | 0.71% | 0.47% | 92 | 17.37% | 14.98% |
| 62 | 0.77% | 0.51% | 93 | 18.99% | 16.51% |
| 63 | 0.83% | 0.55% | 94 | 20.66% | 18.09% |
| 64 | 0.89% | 0.59% | 95 | 22.35% | 19.72% |
| 65 | 0.96% | 0.64% | 96 | 24.21% | 21.52% |
| 66 | 1.04% | 0.70% | 97 | 26.13% | 23.41% |
| 67 | 1.12% | 0.76% | 98 | 28.11% | 25.42% |
| 68 | 1.22% | 0.84% | 99 | 30.16% | 27.55% |
| 69 | 1.34% | 0.93% | 100 | 32.25% | 29.78% |
| 70 | 1.47% | 1.03% | 101 | 34.36% | 32.08% |
| 71 | 1.62% | 1.14% | 102 | 36.47% | 34.41% |
| 72 | 1.79% | 1.28% | 103 | 38.55% | 36.75% |
| 73 | 1.99% | 1.44% | 104 | 40.59% | 39.08% |
| 74 | 2.21% | 1.62% | 105 | 42.57% | 41.38% |
| 75 | 2.47% | 1.83% | 106 | 44.48% | 43.61% |
| 76 | 2.77% | 2.06% | 107 | 46.33% | 45.78% |
| 77 | 3.11% | 2.33% | 108 | 48.08% | 47.87% |
| 78 | 3.50% | 2.64% | 109 | 49.75% | 49.86% |
| 79 | 3.95% | 2.99% | 110 | 51.10% | 51.74% |
| 80 | 4.46% | 3.39% | | | |

* The rates shown are Pub-2010 mortality for healthy annuitants, General table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2021.

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Disabled Post-Retirement Mortality Rates

| Age in 2022 | % Dying Next Year* | | Age in 2022 | % Dying Next Year* | |
|----------------|--------------------|--------|----------------|--------------------|--------|
| | Male | Female | | Male | Female |
| 20 | 0.47% | 0.30% | 56 | 2.36% | 2.12% |
| 21 | 0.45% | 0.28% | 57 | 2.48% | 2.21% |
| 22 | 0.42% | 0.26% | 58 | 2.61% | 2.28% |
| 23 | 0.38% | 0.24% | 59 | 2.72% | 2.34% |
| 24 | 0.36% | 0.23% | 60 | 2.84% | 2.38% |
| 25 | 0.36% | 0.23% | 61 | 2.95% | 2.42% |
| 26 | 0.39% | 0.26% | 62 | 3.05% | 2.44% |
| 27 | 0.43% | 0.30% | 63 | 3.16% | 2.47% |
| 28 | 0.46% | 0.33% | 64 | 3.27% | 2.49% |
| 29 | 0.50% | 0.37% | 65 | 3.38% | 2.52% |
| 30 | 0.54% | 0.41% | 66 | 3.49% | 2.56% |
| 31 | 0.59% | 0.46% | 67 | 3.60% | 2.62% |
| 32 | 0.63% | 0.51% | 68 | 3.71% | 2.70% |
| 33 | 0.67% | 0.56% | 69 | 3.84% | 2.81% |
| 34 | 0.71% | 0.60% | 70 | 3.98% | 2.94% |
| 35 | 0.75% | 0.65% | 71 | 4.14% | 3.11% |
| 36 | 0.79% | 0.70% | 72 | 4.32% | 3.31% |
| 37 | 0.83% | 0.74% | 73 | 4.54% | 3.54% |
| 38 | 0.87% | 0.78% | 74 | 4.79% | 3.81% |
| 39 | 0.91% | 0.83% | 75 | 5.08% | 4.13% |
| 40 | 0.95% | 0.87% | 76 | 5.41% | 4.49% |
| 41 | 0.99% | 0.91% | 77 | 5.80% | 4.90% |
| 42 | 1.03% | 0.95% | 78 | 6.23% | 5.36% |
| 43 | 1.07% | 1.00% | 79 | 6.71% | 5.87% |
| 44 | 1.13% | 1.06% | 80 | 7.26% | 6.44% |
| 45 | 1.19% | 1.12% | 81 | 7.87% | 7.08% |
| 46 | 1.26% | 1.19% | 82 | 8.54% | 7.78% |
| 47 | 1.34% | 1.27% | 83 | 9.27% | 8.54% |
| 48 | 1.44% | 1.36% | 84 | 10.07% | 9.38% |
| 49 | 1.54% | 1.47% | 85 | 10.94% | 10.30% |
| 50 | 1.66% | 1.59% | 86 | 11.87% | 11.26% |
| 51 | 1.76% | 1.66% | 87 | 12.87% | 12.25% |
| 52 | 1.87% | 1.74% | 88 | 13.94% | 13.24% |
| 53 | 1.98% | 1.83% | 89 | 15.29% | 14.25% |
| 54 | 2.10% | 1.93% | 90 | 16.77% | 15.28% |
| 55 | 2.23% | 2.03% | | | |

* The rates shown are Pub-2010 mortality for disabled annuitants, General/Teachers table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2021.

Proposed Actuarial Assumptions Based on 2018-2022 Experience Study

Healthy Pre-Retirement Mortality Rates

| Age in 2022 | % Dying Next Year* | | Age in 2022 | % Dying Next Year* | |
|----------------|--------------------|--------|----------------|--------------------|--------|
| | Male | Female | | Male | Female |
| 20 | 0.04% | 0.01% | 46 | 0.11% | 0.06% |
| 21 | 0.04% | 0.01% | 47 | 0.12% | 0.06% |
| 22 | 0.04% | 0.01% | 48 | 0.12% | 0.07% |
| 23 | 0.03% | 0.01% | 49 | 0.13% | 0.07% |
| 24 | 0.03% | 0.01% | 50 | 0.14% | 0.08% |
| 25 | 0.03% | 0.01% | 51 | 0.15% | 0.08% |
| 26 | 0.04% | 0.01% | 52 | 0.16% | 0.09% |
| 27 | 0.04% | 0.01% | 53 | 0.18% | 0.10% |
| 28 | 0.04% | 0.02% | 54 | 0.19% | 0.11% |
| 29 | 0.05% | 0.02% | 55 | 0.21% | 0.12% |
| 30 | 0.05% | 0.02% | 56 | 0.23% | 0.13% |
| 31 | 0.05% | 0.02% | 57 | 0.25% | 0.15% |
| 32 | 0.06% | 0.03% | 58 | 0.28% | 0.16% |
| 33 | 0.06% | 0.03% | 59 | 0.30% | 0.18% |
| 34 | 0.07% | 0.03% | 60 | 0.33% | 0.19% |
| 35 | 0.07% | 0.03% | 61 | 0.36% | 0.21% |
| 36 | 0.07% | 0.03% | 62 | 0.38% | 0.23% |
| 37 | 0.08% | 0.04% | 63 | 0.41% | 0.24% |
| 38 | 0.08% | 0.04% | 64 | 0.44% | 0.26% |
| 39 | 0.08% | 0.04% | 65 | 0.47% | 0.28% |
| 40 | 0.09% | 0.04% | 66 | 0.50% | 0.31% |
| 41 | 0.09% | 0.05% | 67 | 0.53% | 0.33% |
| 42 | 0.09% | 0.05% | 68 | 0.57% | 0.36% |
| 43 | 0.10% | 0.05% | 69 | 0.61% | 0.39% |
| 44 | 0.10% | 0.05% | 70 | 0.65% | 0.43% |
| 45 | 0.11% | 0.05% | | | |

* The rates shown are Pub-2010 mortality for employees, General table, with adjustments, if applicable (see Section G). Recommended rates include mortality improvements using projection scale MP-2021.

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.

SECTION L

APPENDIX

Appendix – Detailed Experience Analysis

In this section, we present the annual experience for each major assumption that was analyzed for the study. Please note that totals may not sum correctly due to rounding of intermediate results.

Appendix – Detailed Experience Analysis Salary Increases

| 2018-2022 Experience | | | |
|----------------------|----------------|------------------------|--------------------------|
| Year | Exposure | Gross Actual Increases | Gross Expected Increases |
| 1 | 15,114 | 10.87% | 13.00% |
| 2 | 13,955 | 5.34% | 9.00% |
| 3 | 12,192 | 5.24% | 5.80% |
| 4 | 10,628 | 5.13% | 5.40% |
| 5 | 9,725 | 4.85% | 5.00% |
| 6 | 8,698 | 4.62% | 4.90% |
| 7 | 7,608 | 4.42% | 4.80% |
| 8 | 6,607 | 4.09% | 4.60% |
| 9 | 5,599 | 4.17% | 4.50% |
| 10 | 5,146 | 3.97% | 4.20% |
| 11 | 5,369 | 3.87% | 4.10% |
| 12 | 5,443 | 3.92% | 4.00% |
| 13 | 5,319 | 3.60% | 3.90% |
| 14 | 4,786 | 3.62% | 3.80% |
| 15 | 3,920 | 3.37% | 3.70% |
| 16 | 3,396 | 3.34% | 3.60% |
| 17 | 3,255 | 3.11% | 3.50% |
| 18 | 3,388 | 2.99% | 3.50% |
| 19 | 3,544 | 3.02% | 3.50% |
| 20 | 3,592 | 3.02% | 3.40% |
| 21 | 3,278 | 2.90% | 3.30% |
| 22 | 2,831 | 2.74% | 3.30% |
| 23 | 2,430 | 2.69% | 3.20% |
| 24 | 2,075 | 2.88% | 3.20% |
| 25 | 1,812 | 2.87% | 3.20% |
| 26 | 1,683 | 2.85% | 3.20% |
| 27 | 1,571 | 2.40% | 3.10% |
| 28 | 1,661 | 2.54% | 3.10% |
| 29 | 1,700 | 2.66% | 3.00% |
| 30+ | 12,248 | 2.43% | 3.00% |
| Totals | 168,573 | 4.34% | 5.05% |

Appendix – Detailed Experience Analysis Salary Increases

| 2018-2019 Experience | | | | 2019-2020 Experience | | | |
|----------------------|---------------|------------------------|--------------------------|----------------------|---------------|------------------------|--------------------------|
| Year | Exposure | Gross Actual Increases | Gross Expected Increases | Year | Exposure | Gross Actual Increases | Gross Expected Increases |
| 1 | 4,005 | 11.25% | 13.00% | 1 | 4,191 | 11.09% | 13.00% |
| 2 | 3,449 | 5.32% | 9.00% | 2 | 3,341 | 5.53% | 9.00% |
| 3 | 2,759 | 5.27% | 5.80% | 3 | 3,119 | 5.49% | 5.80% |
| 4 | 2,413 | 4.98% | 5.40% | 4 | 2,537 | 5.36% | 5.40% |
| 5 | 2,468 | 4.92% | 5.00% | 5 | 2,242 | 4.51% | 5.00% |
| 6 | 2,120 | 4.86% | 4.90% | 6 | 2,302 | 4.96% | 4.90% |
| 7 | 1,501 | 4.68% | 4.80% | 7 | 1,987 | 4.47% | 4.80% |
| 8 | 1,253 | 3.99% | 4.60% | 8 | 1,428 | 4.38% | 4.60% |
| 9 | 1,284 | 4.53% | 4.50% | 9 | 1,178 | 4.09% | 4.50% |
| 10 | 1,570 | 3.99% | 4.20% | 10 | 1,220 | 4.33% | 4.20% |
| 11 | 1,694 | 3.99% | 4.10% | 11 | 1,484 | 3.83% | 4.10% |
| 12 | 1,387 | 4.34% | 4.00% | 12 | 1,587 | 3.91% | 4.00% |
| 13 | 1,211 | 3.77% | 3.90% | 13 | 1,295 | 3.65% | 3.90% |
| 14 | 1,022 | 3.76% | 3.80% | 14 | 1,136 | 3.56% | 3.80% |
| 15 | 756 | 3.45% | 3.70% | 15 | 961 | 3.23% | 3.70% |
| 16 | 826 | 3.10% | 3.60% | 16 | 696 | 3.54% | 3.60% |
| 17 | 1,010 | 3.36% | 3.50% | 17 | 767 | 2.86% | 3.50% |
| 18 | 1,110 | 3.09% | 3.50% | 18 | 963 | 3.11% | 3.50% |
| 19 | 972 | 3.07% | 3.50% | 19 | 1,025 | 2.86% | 3.50% |
| 20 | 923 | 2.86% | 3.40% | 20 | 907 | 3.51% | 3.40% |
| 21 | 719 | 3.09% | 3.30% | 21 | 866 | 2.76% | 3.30% |
| 22 | 574 | 2.84% | 3.30% | 22 | 666 | 2.91% | 3.30% |
| 23 | 537 | 2.51% | 3.20% | 23 | 545 | 2.55% | 3.20% |
| 24 | 531 | 3.10% | 3.20% | 24 | 487 | 3.00% | 3.20% |
| 25 | 437 | 2.80% | 3.20% | 25 | 485 | 2.95% | 3.20% |
| 26 | 454 | 2.87% | 3.20% | 26 | 401 | 3.03% | 3.20% |
| 27 | 413 | 2.33% | 3.10% | 27 | 410 | 2.70% | 3.10% |
| 28 | 597 | 2.32% | 3.10% | 28 | 370 | 2.61% | 3.10% |
| 29 | 520 | 2.88% | 3.00% | 29 | 535 | 2.64% | 3.00% |
| 30+ | 3,339 | 2.49% | 3.00% | 30+ | 3,227 | 2.38% | 3.00% |
| Totals | 41,854 | 4.42% | 5.04% | Totals | 42,358 | 4.46% | 5.10% |

Appendix – Detailed Experience Analysis Salary Increases

| 2020-2021 Experience | | | | 2021-2022 Experience | | | |
|----------------------|---------------|------------------------|--------------------------|----------------------|---------------|------------------------|--------------------------|
| Year | Exposure | Gross Actual Increases | Gross Expected Increases | Year | Exposure | Gross Actual Increases | Gross Expected Increases |
| 1 | 4,377 | 11.39% | 13.00% | 1 | 2,541 | 9.12% | 13.00% |
| 2 | 3,715 | 5.59% | 9.00% | 2 | 3,450 | 4.93% | 9.00% |
| 3 | 3,075 | 5.07% | 5.80% | 3 | 3,239 | 5.14% | 5.80% |
| 4 | 2,971 | 5.28% | 5.40% | 4 | 2,707 | 4.89% | 5.40% |
| 5 | 2,386 | 5.00% | 5.00% | 5 | 2,629 | 4.94% | 5.00% |
| 6 | 2,098 | 4.74% | 4.90% | 6 | 2,178 | 3.96% | 4.90% |
| 7 | 2,198 | 4.42% | 4.80% | 7 | 1,922 | 4.19% | 4.80% |
| 8 | 1,886 | 4.16% | 4.60% | 8 | 2,040 | 3.90% | 4.60% |
| 9 | 1,365 | 4.19% | 4.50% | 9 | 1,772 | 3.98% | 4.50% |
| 10 | 1,109 | 3.61% | 4.20% | 10 | 1,247 | 3.91% | 4.20% |
| 11 | 1,144 | 3.56% | 4.10% | 11 | 1,047 | 4.09% | 4.10% |
| 12 | 1,397 | 3.86% | 4.00% | 12 | 1,072 | 3.54% | 4.00% |
| 13 | 1,519 | 3.51% | 3.90% | 13 | 1,294 | 3.50% | 3.90% |
| 14 | 1,214 | 3.68% | 3.80% | 14 | 1,414 | 3.53% | 3.80% |
| 15 | 1,069 | 3.22% | 3.70% | 15 | 1,134 | 3.55% | 3.70% |
| 16 | 887 | 3.29% | 3.60% | 16 | 987 | 3.45% | 3.60% |
| 17 | 649 | 3.40% | 3.50% | 17 | 829 | 2.86% | 3.50% |
| 18 | 702 | 3.08% | 3.50% | 18 | 613 | 2.56% | 3.50% |
| 19 | 899 | 3.27% | 3.50% | 19 | 648 | 2.85% | 3.50% |
| 20 | 929 | 2.98% | 3.40% | 20 | 833 | 2.73% | 3.40% |
| 21 | 837 | 2.88% | 3.30% | 21 | 856 | 2.90% | 3.30% |
| 22 | 807 | 2.94% | 3.30% | 22 | 784 | 2.34% | 3.30% |
| 23 | 613 | 2.76% | 3.20% | 23 | 735 | 2.84% | 3.20% |
| 24 | 493 | 2.77% | 3.20% | 24 | 564 | 2.68% | 3.20% |
| 25 | 440 | 2.98% | 3.20% | 25 | 450 | 2.73% | 3.20% |
| 26 | 443 | 3.26% | 3.20% | 26 | 385 | 2.18% | 3.20% |
| 27 | 360 | 2.84% | 3.10% | 27 | 388 | 1.77% | 3.10% |
| 28 | 359 | 2.84% | 3.10% | 28 | 335 | 2.51% | 3.10% |
| 29 | 329 | 2.96% | 3.00% | 29 | 316 | 2.14% | 3.00% |
| 30+ | 2,969 | 2.73% | 3.00% | 30+ | 2,713 | 2.12% | 3.00% |
| Totals | 43,239 | 4.53% | 5.17% | Totals | 41,122 | 3.97% | 4.91% |

Appendix – Detailed Experience Analysis Rule of 90 Retirement*

2018-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 6,697 | 52,591 | 8,415 | 79.6% |
| 56 | 23,687 | 144,041 | 18,005 | 131.6% |
| 57 | 27,729 | 272,396 | 34,050 | 81.4% |
| 58 | 45,349 | 407,768 | 46,893 | 96.7% |
| 59 | 61,691 | 507,284 | 63,411 | 97.3% |
| 60 | 87,310 | 568,505 | 79,591 | 109.7% |
| 61 | 78,979 | 568,860 | 85,329 | 92.6% |
| 62 | 128,506 | 603,789 | 150,947 | 85.1% |
| 63 | 126,376 | 552,454 | 121,540 | 104.0% |
| 64 | 93,151 | 488,651 | 97,730 | 95.3% |
| Totals | 679,476 | 4,166,339 | 705,910 | 96.3% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Rule of 90 Retirement*

2018-2019 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 1,664 | 18,299 | 2,928 | 56.8% |
| 56 | 7,550 | 42,062 | 5,258 | 143.6% |
| 57 | 7,164 | 77,650 | 9,706 | 73.8% |
| 58 | 10,950 | 103,675 | 11,923 | 91.8% |
| 59 | 14,563 | 143,384 | 17,923 | 81.3% |
| 60 | 22,316 | 153,301 | 21,462 | 104.0% |
| 61 | 22,726 | 156,995 | 23,549 | 96.5% |
| 62 | 38,004 | 176,260 | 44,065 | 86.2% |
| 63 | 30,905 | 157,347 | 34,616 | 89.3% |
| 64 | 24,718 | 121,784 | 24,357 | 101.5% |
| Totals | 180,561 | 1,150,757 | 195,787 | 92.2% |

2019-2020 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 2,598 | 16,946 | 2,711 | 95.8% |
| 56 | 8,297 | 38,559 | 4,820 | 172.1% |
| 57 | 5,923 | 69,439 | 8,680 | 68.2% |
| 58 | 14,775 | 117,183 | 13,476 | 109.6% |
| 59 | 17,243 | 127,166 | 15,896 | 108.5% |
| 60 | 26,024 | 160,930 | 22,530 | 115.5% |
| 61 | 14,481 | 147,655 | 22,148 | 65.4% |
| 62 | 28,762 | 147,473 | 36,868 | 78.0% |
| 63 | 34,016 | 149,286 | 32,843 | 103.6% |
| 64 | 21,988 | 135,793 | 27,159 | 81.0% |
| Totals | 174,106 | 1,110,431 | 187,131 | 93.0% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Rule of 90 Retirement*

2020-2021 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 627 | 11,225 | 1,796 | 34.9% |
| 56 | 4,888 | 34,383 | 4,298 | 113.7% |
| 57 | 7,078 | 64,146 | 8,018 | 88.3% |
| 58 | 13,368 | 105,951 | 12,184 | 109.7% |
| 59 | 13,566 | 130,951 | 16,369 | 82.9% |
| 60 | 20,678 | 123,798 | 17,332 | 119.3% |
| 61 | 24,870 | 149,209 | 22,381 | 111.1% |
| 62 | 30,848 | 143,496 | 35,874 | 86.0% |
| 63 | 31,655 | 128,803 | 28,337 | 111.7% |
| 64 | 26,074 | 124,183 | 24,837 | 105.0% |
| Totals | 173,652 | 1,016,146 | 171,426 | 101.3% |

2021-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|----------------|-------------------------|---------------------|
| 55 | 1,808 | 6,120 | 979 | 184.6% |
| 56 | 2,951 | 29,037 | 3,630 | 81.3% |
| 57 | 7,564 | 61,161 | 7,645 | 98.9% |
| 58 | 6,256 | 80,959 | 9,310 | 67.2% |
| 59 | 16,319 | 105,783 | 13,223 | 123.4% |
| 60 | 18,293 | 130,475 | 18,267 | 100.1% |
| 61 | 16,902 | 115,001 | 17,250 | 98.0% |
| 62 | 30,893 | 136,559 | 34,140 | 90.5% |
| 63 | 29,800 | 117,018 | 25,744 | 115.8% |
| 64 | 20,371 | 106,891 | 21,378 | 95.3% |
| Totals | 151,156 | 889,004 | 151,566 | 99.7% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 1 Members

2018-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 5,438 | 192,148 | 5,764 | 94.3% |
| 56 | 7,713 | 204,348 | 6,130 | 125.8% |
| 57 | 3,767 | 173,808 | 6,952 | 54.2% |
| 58 | 8,448 | 120,008 | 4,800 | 176.0% |
| 59 | 7,243 | 94,902 | 4,745 | 152.6% |
| 60 | 5,758 | 69,324 | 4,853 | 118.7% |
| 61 | 5,635 | 59,894 | 4,792 | 117.6% |
| 62 | 8,252 | 53,291 | 8,527 | 96.8% |
| 63 | 7,720 | 47,155 | 7,545 | 102.3% |
| 64 | 5,236 | 39,004 | 6,241 | 83.9% |
| 65 | 180,182 | 492,572 | 172,400 | 104.5% |
| 66 | 127,106 | 327,077 | 114,477 | 111.0% |
| 67 | 74,938 | 218,328 | 65,498 | 114.4% |
| 68 | 57,715 | 157,510 | 39,378 | 146.6% |
| 69 | 31,963 | 108,131 | 27,033 | 118.2% |
| 70 | 27,412 | 84,777 | 25,433 | 107.8% |
| Totals | 564,527 | 2,442,275 | 504,568 | 111.9% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 1 Members

2018-2019 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|----------------|-------------------------|---------------------|
| 55 | 2,614 | 77,475 | 2,324 | 112.5% |
| 56 | 1,443 | 80,551 | 2,417 | 59.7% |
| 57 | 1,282 | 77,109 | 3,084 | 41.6% |
| 58 | 2,431 | 50,272 | 2,011 | 120.9% |
| 59 | 3,419 | 42,939 | 2,147 | 159.3% |
| 60 | 620 | 18,487 | 1,294 | 47.9% |
| 61 | 2,657 | 17,957 | 1,437 | 184.9% |
| 62 | 3,207 | 17,449 | 2,792 | 114.9% |
| 63 | 3,371 | 13,911 | 2,226 | 151.5% |
| 64 | 1,520 | 11,524 | 1,844 | 82.4% |
| 65 | 44,719 | 133,854 | 46,849 | 95.5% |
| 66 | 32,222 | 78,927 | 27,624 | 116.6% |
| 67 | 18,754 | 57,048 | 17,114 | 109.6% |
| 68 | 13,508 | 40,571 | 10,143 | 133.2% |
| 69 | 5,973 | 29,014 | 7,253 | 82.3% |
| 70 | 5,188 | 22,902 | 6,871 | 75.5% |
| Totals | 142,929 | 769,988 | 137,429 | 104.0% |

2019-2020 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|----------------|-------------------------|---------------------|
| 55 | 1,754 | 57,935 | 1,738 | 100.9% |
| 56 | 3,195 | 60,556 | 1,817 | 175.9% |
| 57 | 605 | 52,983 | 2,119 | 28.6% |
| 58 | 3,293 | 39,178 | 1,567 | 210.1% |
| 59 | 639 | 24,247 | 1,212 | 52.7% |
| 60 | 2,745 | 20,688 | 1,448 | 189.5% |
| 61 | 846 | 14,139 | 1,131 | 74.8% |
| 62 | 1,734 | 13,873 | 2,220 | 78.1% |
| 63 | 1,639 | 12,462 | 1,994 | 82.2% |
| 64 | 1,021 | 9,512 | 1,522 | 67.1% |
| 65 | 37,897 | 114,023 | 39,908 | 95.0% |
| 66 | 34,960 | 92,625 | 32,419 | 107.8% |
| 67 | 11,644 | 49,904 | 14,971 | 77.8% |
| 68 | 14,070 | 39,913 | 9,978 | 141.0% |
| 69 | 8,379 | 28,448 | 7,112 | 117.8% |
| 70 | 10,486 | 24,648 | 7,394 | 141.8% |
| Totals | 134,909 | 655,135 | 128,551 | 104.9% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 1 Members

2020-2021 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|----------------|-------------------------|---------------------|
| 55 | 778 | 37,662 | 1,130 | 68.9% |
| 56 | 1,351 | 40,839 | 1,225 | 110.3% |
| 57 | 1,767 | 30,989 | 1,240 | 142.6% |
| 58 | 1,567 | 18,212 | 728 | 215.1% |
| 59 | 1,879 | 16,796 | 840 | 223.8% |
| 60 | 935 | 18,637 | 1,305 | 71.6% |
| 61 | 967 | 14,064 | 1,125 | 85.9% |
| 62 | 1,907 | 11,807 | 1,889 | 100.9% |
| 63 | 1,412 | 10,267 | 1,643 | 86.0% |
| 64 | 1,730 | 9,368 | 1,499 | 115.4% |
| 65 | 55,555 | 130,352 | 45,623 | 121.8% |
| 66 | 28,977 | 79,210 | 27,723 | 104.5% |
| 67 | 22,634 | 59,378 | 17,813 | 127.1% |
| 68 | 15,715 | 38,682 | 9,670 | 162.5% |
| 69 | 11,710 | 26,490 | 6,622 | 176.8% |
| 70 | 8,519 | 21,253 | 6,376 | 133.6% |
| Totals | 157,402 | 564,005 | 126,452 | 124.5% |

2021-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|----------------|-------------------------|---------------------|
| 55 | 291 | 19,076 | 572 | 50.8% |
| 56 | 1,724 | 22,402 | 672 | 256.5% |
| 57 | 113 | 12,726 | 509 | 22.1% |
| 58 | 1,157 | 12,346 | 494 | 234.2% |
| 59 | 1,305 | 10,920 | 546 | 239.0% |
| 60 | 1,458 | 11,513 | 806 | 181.0% |
| 61 | 1,166 | 13,734 | 1,099 | 106.1% |
| 62 | 1,405 | 10,162 | 1,626 | 86.4% |
| 63 | 1,298 | 10,515 | 1,682 | 77.1% |
| 64 | 965 | 8,600 | 1,376 | 70.1% |
| 65 | 42,011 | 114,343 | 40,020 | 105.0% |
| 66 | 30,947 | 76,316 | 26,710 | 115.9% |
| 67 | 21,906 | 51,998 | 15,599 | 140.4% |
| 68 | 14,421 | 38,345 | 9,586 | 150.4% |
| 69 | 5,901 | 24,179 | 6,045 | 97.6% |
| 70 | 3,220 | 15,973 | 4,792 | 67.2% |
| Totals | 129,287 | 453,148 | 112,135 | 115.3% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 2 Members

2018-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 25,477 | 756,076 | 30,243 | 84.2% |
| 56 | 23,699 | 782,810 | 31,312 | 75.7% |
| 57 | 26,889 | 796,961 | 31,878 | 84.3% |
| 58 | 30,673 | 781,923 | 31,277 | 98.1% |
| 59 | 37,149 | 772,045 | 30,882 | 120.3% |
| 60 | 39,332 | 734,117 | 36,706 | 107.2% |
| 61 | 41,176 | 715,091 | 53,632 | 76.8% |
| 62 | 81,502 | 683,340 | 88,834 | 91.7% |
| 63 | 81,311 | 619,258 | 80,504 | 101.0% |
| 64 | 78,109 | 536,809 | 69,785 | 111.9% |
| 65 | 106,245 | 465,114 | 93,023 | 114.2% |
| 66 | 134,745 | 379,688 | 132,891 | 101.4% |
| 67 | 79,611 | 231,061 | 69,318 | 114.8% |
| 68 | 38,982 | 152,239 | 38,060 | 102.4% |
| 69 | 21,168 | 105,804 | 26,451 | 80.0% |
| 70 | 21,084 | 73,460 | 22,038 | 95.7% |
| Totals | 867,152 | 8,585,795 | 866,834 | 100.0% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 2 Members

2018-2019 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 5,454 | 170,601 | 6,824 | 79.9% |
| 56 | 4,431 | 182,368 | 7,295 | 60.7% |
| 57 | 5,464 | 166,963 | 6,679 | 81.8% |
| 58 | 7,353 | 172,882 | 6,915 | 106.3% |
| 59 | 7,282 | 165,666 | 6,627 | 109.9% |
| 60 | 8,386 | 168,052 | 8,403 | 99.8% |
| 61 | 8,229 | 156,180 | 11,713 | 70.3% |
| 62 | 18,894 | 143,389 | 18,641 | 101.4% |
| 63 | 15,884 | 135,911 | 17,668 | 89.9% |
| 64 | 16,726 | 120,575 | 15,675 | 106.7% |
| 65 | 20,063 | 101,113 | 20,223 | 99.2% |
| 66 | 28,776 | 79,091 | 27,682 | 104.0% |
| 67 | 12,318 | 44,498 | 13,349 | 92.3% |
| 68 | 7,961 | 35,000 | 8,750 | 91.0% |
| 69 | 4,894 | 19,601 | 4,900 | 99.9% |
| 70 | 2,817 | 12,563 | 3,769 | 74.7% |
| Totals | 174,932 | 1,874,455 | 185,112 | 94.5% |

2019-2020 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/ Expected |
|---------------|-----------------------|------------------|-------------------------|---------------------|
| 55 | 5,041 | 196,353 | 7,854 | 64.2% |
| 56 | 6,442 | 186,511 | 7,460 | 86.4% |
| 57 | 6,924 | 198,916 | 7,957 | 87.0% |
| 58 | 7,318 | 179,902 | 7,196 | 101.7% |
| 59 | 11,303 | 182,549 | 7,302 | 154.8% |
| 60 | 8,723 | 173,070 | 8,654 | 100.8% |
| 61 | 7,970 | 175,988 | 13,199 | 60.4% |
| 62 | 17,958 | 163,557 | 21,262 | 84.5% |
| 63 | 19,006 | 138,311 | 17,980 | 105.7% |
| 64 | 16,174 | 133,519 | 17,357 | 93.2% |
| 65 | 25,734 | 114,675 | 22,935 | 112.2% |
| 66 | 29,255 | 90,218 | 31,576 | 92.6% |
| 67 | 17,732 | 53,754 | 16,126 | 110.0% |
| 68 | 9,872 | 33,904 | 8,476 | 116.5% |
| 69 | 5,386 | 28,906 | 7,227 | 74.5% |
| 70 | 5,452 | 15,905 | 4,772 | 114.3% |
| Totals | 200,290 | 2,066,039 | 207,334 | 96.6% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Non-Rule of 90 Retirement* – Tier 2 Members

2020-2021 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/Expected |
|---------------|--------------------|------------------|----------------------|-----------------|
| 55 | 6,597 | 185,595 | 7,424 | 88.9% |
| 56 | 6,046 | 213,137 | 8,525 | 70.9% |
| 57 | 5,758 | 200,985 | 8,039 | 71.6% |
| 58 | 5,770 | 213,098 | 8,524 | 67.7% |
| 59 | 9,252 | 193,780 | 7,751 | 119.4% |
| 60 | 8,184 | 189,876 | 9,494 | 86.2% |
| 61 | 10,967 | 183,297 | 13,747 | 79.8% |
| 62 | 21,303 | 187,046 | 24,316 | 87.6% |
| 63 | 23,869 | 162,108 | 21,074 | 113.3% |
| 64 | 21,367 | 130,966 | 17,026 | 125.5% |
| 65 | 28,725 | 128,756 | 25,751 | 111.5% |
| 66 | 36,123 | 98,874 | 34,606 | 104.4% |
| 67 | 23,212 | 65,377 | 19,613 | 118.4% |
| 68 | 9,208 | 38,653 | 9,663 | 95.3% |
| 69 | 6,233 | 25,597 | 6,399 | 97.4% |
| 70 | 6,257 | 24,212 | 7,264 | 86.1% |
| Totals | 228,870 | 2,241,355 | 229,216 | 99.8% |

2021-2022 Experience (\$000s)

| Age | Actual Retirements | Exposure | Expected Retirements | Actual/Expected |
|---------------|--------------------|------------------|----------------------|-----------------|
| 55 | 8,386 | 203,528 | 8,141 | 103.0% |
| 56 | 6,779 | 200,794 | 8,032 | 84.4% |
| 57 | 8,743 | 230,097 | 9,204 | 95.0% |
| 58 | 10,232 | 216,042 | 8,642 | 118.4% |
| 59 | 9,313 | 230,050 | 9,202 | 101.2% |
| 60 | 14,039 | 203,118 | 10,156 | 138.2% |
| 61 | 14,010 | 199,626 | 14,972 | 93.6% |
| 62 | 23,346 | 189,347 | 24,615 | 94.8% |
| 63 | 22,553 | 182,928 | 23,781 | 94.8% |
| 64 | 23,843 | 151,748 | 19,727 | 120.9% |
| 65 | 31,722 | 120,570 | 24,114 | 131.6% |
| 66 | 40,591 | 111,505 | 39,027 | 104.0% |
| 67 | 26,349 | 67,432 | 20,230 | 130.3% |
| 68 | 11,941 | 44,681 | 11,170 | 106.9% |
| 69 | 4,654 | 31,700 | 7,925 | 58.7% |
| 70 | 6,557 | 20,779 | 6,234 | 105.2% |
| Totals | 263,060 | 2,403,946 | 245,171 | 107.3% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Withdrawals*

2018-2022 Experience (\$000s)

| Year | Males | | | | Year | Females | | | |
|---------------|---------------------|------------------|-----------------------|-----------------|---------------|---------------------|------------------|-----------------------|-----------------|
| | Actual Terminations | Exposure | Expected Terminations | Actual/Expected | | Actual Terminations | Exposure | Expected Terminations | Actual/Expected |
| 1 | 18,459 | 92,957 | 18,591 | 99.3% | 1 | 23,400 | 109,178 | 22,381 | 104.5% |
| 2 | 53,629 | 347,747 | 52,162 | 102.8% | 2 | 63,768 | 392,470 | 66,720 | 95.6% |
| 3 | 43,927 | 404,841 | 40,484 | 108.5% | 3 | 53,986 | 445,371 | 57,898 | 93.2% |
| 4 | 31,419 | 389,224 | 33,084 | 95.0% | 4 | 38,720 | 421,613 | 44,269 | 87.5% |
| 5 | 23,155 | 347,439 | 26,058 | 88.9% | 5 | 31,027 | 372,384 | 35,377 | 87.7% |
| 6 | 19,435 | 315,078 | 22,055 | 88.1% | 6 | 26,001 | 336,055 | 28,565 | 91.0% |
| 7 | 14,892 | 305,679 | 18,341 | 81.2% | 7 | 22,910 | 316,106 | 25,288 | 90.6% |
| 8 | 12,430 | 286,700 | 13,618 | 91.3% | 8 | 16,990 | 286,475 | 19,337 | 87.9% |
| 9 | 11,349 | 262,029 | 11,136 | 101.9% | 9 | 11,377 | 257,376 | 15,443 | 73.7% |
| 10 | 7,860 | 231,761 | 9,270 | 84.8% | 10 | 9,867 | 223,219 | 11,161 | 88.4% |
| 11 | 6,929 | 219,508 | 7,683 | 90.2% | 11 | 9,693 | 215,844 | 9,713 | 99.8% |
| 12 | 7,701 | 237,813 | 7,134 | 107.9% | 12 | 10,753 | 236,814 | 10,065 | 106.8% |
| 13 | 7,443 | 241,826 | 6,650 | 111.9% | 13 | 9,876 | 258,962 | 10,358 | 95.3% |
| 14 | 5,706 | 234,503 | 5,863 | 97.3% | 14 | 9,438 | 265,165 | 9,944 | 94.9% |
| 15 | 5,090 | 215,513 | 4,849 | 105.0% | 15 | 7,168 | 248,845 | 8,710 | 82.3% |
| 16 | 3,916 | 184,048 | 4,141 | 94.6% | 16 | 6,984 | 205,930 | 6,693 | 104.4% |
| 17 | 3,921 | 163,963 | 3,689 | 106.3% | 17 | 5,975 | 180,270 | 4,957 | 120.5% |
| 18 | 5,176 | 167,444 | 3,767 | 137.4% | 18 | 5,106 | 168,316 | 4,208 | 121.4% |
| 19 | 3,279 | 167,568 | 3,351 | 97.8% | 19 | 4,509 | 175,374 | 4,384 | 102.8% |
| 20 | 3,296 | 185,826 | 2,787 | 118.3% | 20 | 3,813 | 183,351 | 4,584 | 83.2% |
| 21 | 4,094 | 198,992 | 2,487 | 164.6% | 21 | 4,723 | 189,184 | 4,730 | 99.9% |
| 22 | 3,059 | 185,804 | 2,323 | 131.7% | 22 | 4,550 | 175,105 | 4,203 | 108.3% |
| 23 | 4,138 | 168,096 | 1,681 | 246.2% | 23 | 3,597 | 152,747 | 3,513 | 102.4% |
| 24 | 2,288 | 137,165 | 1,372 | 166.8% | 24 | 1,672 | 129,152 | 2,841 | 58.8% |
| 25 | 1,528 | 108,268 | 1,083 | 141.2% | 25 | 2,438 | 109,132 | 2,292 | 106.4% |
| 26 | 1,165 | 87,455 | 875 | 133.3% | 26 | 1,516 | 91,055 | 1,821 | 83.3% |
| 27 | 292 | 74,471 | 745 | 39.2% | 27 | 436 | 79,991 | 1,400 | 31.1% |
| 28 | 655 | 65,229 | 652 | 100.4% | 28 | 1,223 | 69,823 | 1,222 | 100.1% |
| 29 | - | 63,950 | 640 | 0.0% | 29 | 453 | 58,676 | 880 | 51.5% |
| 30+ | 2,987 | 175,141 | 1,751 | 170.6% | 30 | 2,594 | 245,283 | 2,453 | 105.8% |
| Totals | 309,221 | 6,266,041 | 308,324 | 100.3% | Totals | 394,565 | 6,599,266 | 425,409 | 92.7% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Withdrawals*

2018-2019 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|---------------------|------------------|-----------------------|-----------------|---------------|---------------------|------------------|-----------------------|-----------------|
| Year | Actual Terminations | Exposure | Expected Terminations | Actual/Expected | Year | Actual Terminations | Exposure | Expected Terminations | Actual/Expected |
| 1 | 5,219 | 25,609 | 5,122 | 101.9% | 1 | 5,323 | 28,171 | 5,775 | 92.2% |
| 2 | 13,308 | 85,794 | 12,869 | 103.4% | 2 | 17,557 | 99,667 | 16,943 | 103.6% |
| 3 | 10,342 | 96,848 | 9,685 | 106.8% | 3 | 12,576 | 101,597 | 13,208 | 95.2% |
| 4 | 6,883 | 82,684 | 7,028 | 97.9% | 4 | 7,095 | 87,210 | 9,157 | 77.5% |
| 5 | 5,472 | 76,322 | 5,724 | 95.6% | 5 | 7,093 | 80,502 | 7,648 | 92.7% |
| 6 | 4,436 | 76,202 | 5,334 | 83.2% | 6 | 6,011 | 79,335 | 6,744 | 89.1% |
| 7 | 3,572 | 72,741 | 4,364 | 81.8% | 7 | 5,190 | 71,224 | 5,698 | 91.1% |
| 8 | 1,866 | 52,661 | 2,501 | 74.6% | 8 | 2,823 | 48,651 | 3,284 | 86.0% |
| 9 | 2,000 | 46,779 | 1,988 | 100.6% | 9 | 2,442 | 44,230 | 2,654 | 92.0% |
| 10 | 1,810 | 51,203 | 2,048 | 88.4% | 10 | 1,709 | 47,002 | 2,350 | 72.7% |
| 11 | 2,724 | 62,770 | 2,197 | 124.0% | 11 | 2,909 | 63,713 | 2,867 | 101.4% |
| 12 | 2,646 | 68,465 | 2,054 | 128.8% | 12 | 3,825 | 73,468 | 3,122 | 122.5% |
| 13 | 1,881 | 54,157 | 1,489 | 126.3% | 13 | 2,508 | 66,073 | 2,643 | 94.9% |
| 14 | 1,115 | 46,900 | 1,173 | 95.1% | 14 | 1,694 | 56,025 | 2,101 | 80.6% |
| 15 | 1,256 | 45,849 | 1,032 | 121.8% | 15 | 1,297 | 49,984 | 1,749 | 74.2% |
| 16 | 810 | 33,134 | 746 | 108.7% | 16 | 1,205 | 35,432 | 1,152 | 104.7% |
| 17 | 1,188 | 36,097 | 812 | 146.2% | 17 | 1,501 | 41,205 | 1,133 | 132.5% |
| 18 | 1,675 | 52,231 | 1,175 | 142.5% | 18 | 1,360 | 47,126 | 1,178 | 115.4% |
| 19 | 1,122 | 48,509 | 970 | 115.6% | 19 | 1,307 | 54,328 | 1,358 | 96.2% |
| 20 | 1,391 | 54,863 | 823 | 169.1% | 20 | 889 | 49,324 | 1,233 | 72.1% |
| 21 | 810 | 51,450 | 643 | 125.9% | 21 | 740 | 45,665 | 1,142 | 64.8% |
| 22 | 483 | 43,868 | 548 | 88.1% | 22 | 584 | 39,864 | 957 | 61.0% |
| 23 | 1,436 | 32,380 | 324 | 443.5% | 23 | 805 | 26,826 | 617 | 130.5% |
| 24 | - | 25,457 | 255 | 0.0% | 24 | 846 | 29,572 | 651 | 130.1% |
| 25 | 164 | 23,808 | 238 | 68.7% | 25 | 850 | 29,188 | 613 | 138.6% |
| 26 | 191 | 18,294 | 183 | 104.5% | 26 | - | 19,358 | 387 | 0.0% |
| 27 | - | 21,820 | 218 | 0.0% | 27 | - | 17,121 | 300 | 0.0% |
| 28 | 230 | 15,463 | 155 | 148.7% | 28 | - | 14,508 | 254 | 0.0% |
| 29 | - | 24,260 | 243 | 0.0% | 29 | - | 21,319 | 320 | 0.0% |
| 30+ | 1,017 | 55,671 | 557 | 182.7% | 30+ | 1,144 | 85,749 | 857 | 133.4% |
| Totals | 75,047 | 1,482,290 | 72,498 | 103.5% | Totals | 91,284 | 1,553,438 | 98,094 | 93.1% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Withdrawals*

2019-2020 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|------------------------|------------------|--------------------------|---------------------|---------------|------------------------|------------------|--------------------------|---------------------|
| Year | Actual Terminations | Exposure | Expected Terminations | Actual/ Expected | Year | Actual Terminations | Exposure | Expected Terminations | Actual/ Expected |
| 1 | 5,112 | 26,038 | 5,208 | 98.2% | 1 | 7,220 | 31,559 | 6,470 | 111.6% |
| 2 | 15,158 | 96,217 | 14,433 | 105.0% | 2 | 18,153 | 107,888 | 18,341 | 99.0% |
| 3 | 11,463 | 94,272 | 9,427 | 121.6% | 3 | 12,758 | 105,639 | 13,733 | 92.9% |
| 4 | 7,272 | 99,255 | 8,437 | 86.2% | 4 | 10,341 | 104,144 | 10,935 | 94.6% |
| 5 | 4,597 | 78,856 | 5,914 | 77.7% | 5 | 6,981 | 85,404 | 8,113 | 86.0% |
| 6 | 4,409 | 72,597 | 5,082 | 86.8% | 6 | 5,845 | 74,073 | 6,296 | 92.8% |
| 7 | 3,784 | 78,948 | 4,737 | 79.9% | 7 | 6,238 | 81,830 | 6,546 | 95.3% |
| 8 | 3,010 | 73,835 | 3,507 | 85.8% | 8 | 5,230 | 73,970 | 4,993 | 104.7% |
| 9 | 2,220 | 54,197 | 2,303 | 96.4% | 9 | 2,083 | 48,702 | 2,922 | 71.3% |
| 10 | 1,393 | 46,904 | 1,876 | 74.2% | 10 | 2,418 | 45,056 | 2,253 | 107.3% |
| 11 | 1,227 | 51,601 | 1,806 | 67.9% | 11 | 1,624 | 49,567 | 2,231 | 72.8% |
| 12 | 2,194 | 64,025 | 1,921 | 114.2% | 12 | 3,098 | 64,553 | 2,743 | 112.9% |
| 13 | 1,930 | 68,015 | 1,870 | 103.2% | 13 | 3,848 | 74,766 | 2,991 | 128.7% |
| 14 | 2,009 | 54,140 | 1,353 | 148.4% | 14 | 2,539 | 66,053 | 2,477 | 102.5% |
| 15 | 2,085 | 47,540 | 1,070 | 194.9% | 15 | 1,822 | 55,171 | 1,931 | 94.3% |
| 16 | 624 | 46,518 | 1,047 | 59.6% | 16 | 1,821 | 49,304 | 1,602 | 113.7% |
| 17 | 796 | 32,432 | 730 | 109.1% | 17 | 1,174 | 35,290 | 970 | 121.0% |
| 18 | 1,332 | 35,853 | 807 | 165.1% | 18 | 1,497 | 39,268 | 982 | 152.5% |
| 19 | 1,049 | 50,994 | 1,020 | 102.9% | 19 | 1,423 | 47,139 | 1,178 | 120.8% |
| 20 | 818 | 46,550 | 698 | 117.2% | 20 | 1,601 | 51,194 | 1,280 | 125.1% |
| 21 | 1,174 | 50,030 | 625 | 187.6% | 21 | 1,583 | 47,026 | 1,176 | 134.7% |
| 22 | 774 | 49,474 | 618 | 125.2% | 22 | 1,293 | 43,708 | 1,049 | 123.3% |
| 23 | 949 | 41,721 | 417 | 227.5% | 23 | 764 | 37,900 | 872 | 87.7% |
| 24 | 527 | 30,011 | 300 | 175.7% | 24 | 209 | 24,881 | 547 | 38.2% |
| 25 | 451 | 23,708 | 237 | 190.4% | 25 | 222 | 23,771 | 499 | 44.6% |
| 26 | 150 | 21,906 | 219 | 68.5% | 26 | 586 | 27,691 | 554 | 105.8% |
| 27 | 141 | 15,375 | 154 | 91.7% | 27 | - | 17,635 | 309 | 0.0% |
| 28 | - | 19,173 | 192 | 0.0% | 28 | 662 | 15,818 | 277 | 239.0% |
| 29 | - | 13,032 | 130 | 0.0% | 29 | 330 | 11,932 | 179 | 184.2% |
| 30+ | - | 48,278 | 483 | 0.0% | 30+ | 720 | 68,364 | 684 | 105.3% |
| Totals | 76,646 | 1,531,498 | 76,621 | 100.0% | Totals | 104,083 | 1,609,298 | 105,133 | 99.0% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Withdrawals*

2020-2021 Experience (\$000s)

| Year | Males | | | | Year | Females | | | |
|---------------|---------------------|------------------|-----------------------|-----------------|---------------|---------------------|------------------|-----------------------|-----------------|
| | Actual Terminations | Exposure | Expected Terminations | Actual/Expected | | Actual Terminations | Exposure | Expected Terminations | Actual/Expected |
| 1 | 4,101 | 25,225 | 5,045 | 81.3% | 1 | 4,939 | 26,477 | 5,428 | 91.0% |
| 2 | 12,125 | 96,992 | 14,549 | 83.3% | 2 | 13,333 | 110,288 | 18,749 | 71.1% |
| 3 | 8,159 | 104,993 | 10,499 | 77.7% | 3 | 11,072 | 115,790 | 15,053 | 73.6% |
| 4 | 5,904 | 95,907 | 8,152 | 72.4% | 4 | 8,658 | 108,564 | 11,399 | 76.0% |
| 5 | 5,027 | 97,181 | 7,289 | 69.0% | 5 | 5,566 | 100,972 | 9,592 | 58.0% |
| 6 | 2,369 | 72,025 | 5,042 | 47.0% | 6 | 4,051 | 81,756 | 6,949 | 58.3% |
| 7 | 2,810 | 76,206 | 4,572 | 61.5% | 7 | 4,229 | 75,711 | 6,057 | 69.8% |
| 8 | 2,361 | 82,181 | 3,904 | 60.5% | 8 | 3,357 | 83,446 | 5,633 | 59.6% |
| 9 | 2,701 | 75,420 | 3,205 | 84.3% | 9 | 2,004 | 75,686 | 4,541 | 44.1% |
| 10 | 691 | 55,825 | 2,233 | 30.9% | 10 | 1,630 | 50,745 | 2,537 | 64.3% |
| 11 | 1,134 | 48,883 | 1,711 | 66.3% | 11 | 1,775 | 47,146 | 2,122 | 83.7% |
| 12 | 1,296 | 53,084 | 1,593 | 81.4% | 12 | 1,722 | 52,031 | 2,211 | 77.9% |
| 13 | 1,956 | 65,878 | 1,812 | 108.0% | 13 | 877 | 64,061 | 2,562 | 34.2% |
| 14 | 683 | 67,485 | 1,687 | 40.5% | 14 | 1,948 | 75,203 | 2,820 | 69.1% |
| 15 | 785 | 54,044 | 1,216 | 64.5% | 15 | 1,953 | 66,444 | 2,326 | 84.0% |
| 16 | 704 | 47,660 | 1,072 | 65.6% | 16 | 1,134 | 55,168 | 1,793 | 63.2% |
| 17 | 619 | 47,499 | 1,069 | 57.9% | 17 | 1,105 | 47,605 | 1,309 | 84.4% |
| 18 | 389 | 31,733 | 714 | 54.4% | 18 | 308 | 34,788 | 870 | 35.4% |
| 19 | 172 | 35,658 | 713 | 24.1% | 19 | 1,011 | 38,388 | 960 | 105.4% |
| 20 | 417 | 49,348 | 740 | 56.3% | 20 | 607 | 45,963 | 1,149 | 52.8% |
| 21 | 1,683 | 46,108 | 576 | 292.0% | 21 | 1,184 | 48,831 | 1,221 | 97.0% |
| 22 | 743 | 48,480 | 606 | 122.7% | 22 | 1,013 | 44,438 | 1,067 | 94.9% |
| 23 | 347 | 47,163 | 472 | 73.7% | 23 | 419 | 43,298 | 996 | 42.1% |
| 24 | 447 | 38,966 | 390 | 114.7% | 24 | 195 | 35,730 | 786 | 24.9% |
| 25 | - | 26,300 | 263 | 0.0% | 25 | 885 | 23,615 | 496 | 178.4% |
| 26 | - | 21,405 | 214 | 0.0% | 26 | 666 | 21,492 | 430 | 154.9% |
| 27 | - | 19,541 | 195 | 0.0% | 27 | 199 | 25,816 | 452 | 44.0% |
| 28 | 167 | 13,991 | 140 | 119.7% | 28 | - | 16,232 | 284 | 0.0% |
| 29 | - | 15,653 | 157 | 0.0% | 29 | - | 11,707 | 176 | 0.0% |
| 30+ | 502 | 40,021 | 400 | 125.4% | 30+ | 596 | 50,582 | 506 | 117.8% |
| Totals | 58,290 | 1,600,854 | 80,229 | 72.7% | Totals | 76,435 | 1,677,973 | 110,472 | 69.2% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Withdrawals*

2021-2022 Experience (\$000s)

| Year | Males | | | | Year | Females | | | |
|---------------|---------------------|------------------|-----------------------|-----------------|---------------|---------------------|------------------|-----------------------|-----------------|
| | Actual Terminations | Exposure | Expected Terminations | Actual/Expected | | Actual Terminations | Exposure | Expected Terminations | Actual/Expected |
| 1 | 4,027 | 16,085 | 3,217 | 125.2% | 1 | 5,917 | 22,970 | 4,709 | 125.7% |
| 2 | 13,038 | 68,744 | 10,312 | 126.4% | 2 | 14,726 | 74,627 | 12,687 | 116.1% |
| 3 | 13,963 | 108,727 | 10,873 | 128.4% | 3 | 17,580 | 122,345 | 15,905 | 110.5% |
| 4 | 11,361 | 111,378 | 9,467 | 120.0% | 4 | 12,627 | 121,694 | 12,778 | 98.8% |
| 5 | 8,060 | 95,080 | 7,131 | 113.0% | 5 | 11,386 | 105,506 | 10,023 | 113.6% |
| 6 | 8,221 | 94,253 | 6,598 | 124.6% | 6 | 10,094 | 100,890 | 8,576 | 117.7% |
| 7 | 4,726 | 77,784 | 4,667 | 101.3% | 7 | 7,253 | 87,340 | 6,987 | 103.8% |
| 8 | 5,194 | 78,023 | 3,706 | 140.1% | 8 | 5,580 | 80,408 | 5,428 | 102.8% |
| 9 | 4,429 | 85,633 | 3,639 | 121.7% | 9 | 4,847 | 88,758 | 5,325 | 91.0% |
| 10 | 3,966 | 77,829 | 3,113 | 127.4% | 10 | 4,109 | 80,416 | 4,021 | 102.2% |
| 11 | 1,844 | 56,254 | 1,969 | 93.7% | 11 | 3,386 | 55,418 | 2,494 | 135.8% |
| 12 | 1,565 | 52,239 | 1,567 | 99.9% | 12 | 2,108 | 46,763 | 1,987 | 106.1% |
| 13 | 1,676 | 53,777 | 1,479 | 113.4% | 13 | 2,644 | 54,062 | 2,162 | 122.3% |
| 14 | 1,900 | 65,978 | 1,649 | 115.2% | 14 | 3,257 | 67,883 | 2,546 | 127.9% |
| 15 | 964 | 68,080 | 1,532 | 62.9% | 15 | 2,096 | 77,246 | 2,704 | 77.5% |
| 16 | 1,779 | 56,737 | 1,277 | 139.3% | 16 | 2,824 | 66,026 | 2,146 | 131.6% |
| 17 | 1,318 | 47,935 | 1,079 | 122.2% | 17 | 2,195 | 56,170 | 1,545 | 142.1% |
| 18 | 1,780 | 47,627 | 1,072 | 166.1% | 18 | 1,942 | 47,134 | 1,178 | 164.8% |
| 19 | 936 | 32,407 | 648 | 144.5% | 19 | 768 | 35,518 | 888 | 86.5% |
| 20 | 670 | 35,066 | 526 | 127.3% | 20 | 717 | 36,870 | 922 | 77.7% |
| 21 | 428 | 51,404 | 643 | 66.6% | 21 | 1,216 | 47,662 | 1,192 | 102.1% |
| 22 | 1,058 | 43,981 | 550 | 192.5% | 22 | 1,660 | 47,095 | 1,130 | 146.9% |
| 23 | 1,405 | 46,832 | 468 | 300.1% | 23 | 1,609 | 44,723 | 1,029 | 156.5% |
| 24 | 1,314 | 42,730 | 427 | 307.6% | 24 | 421 | 38,969 | 857 | 49.1% |
| 25 | 913 | 34,453 | 345 | 265.1% | 25 | 481 | 32,557 | 684 | 70.4% |
| 26 | 824 | 25,850 | 259 | 318.8% | 26 | 264 | 22,514 | 450 | 58.7% |
| 27 | 151 | 17,736 | 177 | 85.2% | 27 | 237 | 19,419 | 340 | 69.8% |
| 28 | 257 | 16,602 | 166 | 155.0% | 28 | 561 | 23,264 | 407 | 137.9% |
| 29 | - | 11,005 | 110 | 0.0% | 29 | 124 | 13,719 | 206 | 60.1% |
| 30+ | 1,468 | 31,171 | 312 | 471.1% | 30+ | 134 | 40,588 | 406 | 33.1% |
| Totals | 99,238 | 1,651,400 | 78,976 | 125.7% | Totals | 122,763 | 1,758,557 | 111,710 | 109.9% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Disability Retirements

2018-2022 Experience

| Males | | | | | Females | | | | |
|---------------|---------------------|---------------|-----------------------|-----------------|---------------|---------------------|----------------|-----------------------|-----------------|
| Age Group | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected | Age Group | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected |
| Under 20 | - | - | - | N/A | Under 20 | - | - | - | N/A |
| 20-24 | - | 1,397 | 0.1 | 0.0% | 20-24 | - | 2,342 | 0.2 | 0.0% |
| 25-29 | - | 5,967 | 0.6 | 0.0% | 25-29 | - | 8,875 | 0.6 | 0.0% |
| 30-34 | - | 9,188 | 1.0 | 0.0% | 30-34 | - | 12,248 | 1.0 | 0.0% |
| 35-39 | 1 | 11,187 | 3.0 | 33.4% | 35-39 | - | 14,117 | 3.8 | 0.0% |
| 40-44 | - | 10,616 | 5.6 | 0.0% | 40-44 | 2 | 12,995 | 6.9 | 29.1% |
| 45-49 | 3 | 9,905 | 10.5 | 28.7% | 45-49 | 6 | 11,980 | 12.6 | 47.4% |
| 50-54 | 11 | 11,594 | 21.7 | 50.8% | 50-54 | 12 | 13,902 | 25.9 | 46.2% |
| 55-59 | 19 | 13,845 | 36.0 | 52.8% | 55-59 | 22 | 16,222 | 42.1 | 52.2% |
| 60-64 | 25 | 12,141 | 45.4 | 55.0% | 60-64 | 32 | 14,131 | 52.8 | 60.7% |
| Totals | 59 | 85,840 | 123.9 | 47.6% | Totals | 74 | 106,812 | 146.0 | 50.7% |

Appendix – Detailed Experience Analysis Disability Retirements

2018-2019 Experience

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------------|---------------|-----------------------|-----------------|---------------|---------------------|---------------|-----------------------|-----------------|
| | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected | | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected |
| Under 20 | - | - | - | N/A | Under 20 | - | - | - | N/A |
| 20-24 | - | 372 | 0.0 | 0.0% | 20-24 | - | 587 | 0.0 | 0.0% |
| 25-29 | - | 1,564 | 0.2 | 0.0% | 25-29 | - | 2,281 | 0.2 | 0.0% |
| 30-34 | - | 2,323 | 0.3 | 0.0% | 30-34 | - | 3,078 | 0.3 | 0.0% |
| 35-39 | - | 2,710 | 0.7 | 0.0% | 35-39 | - | 3,371 | 0.9 | 0.0% |
| 40-44 | - | 2,434 | 1.3 | 0.0% | 40-44 | - | 2,981 | 1.6 | 0.0% |
| 45-49 | - | 2,482 | 2.7 | 0.0% | 45-49 | 3 | 3,009 | 3.2 | 92.9% |
| 50-54 | 4 | 2,928 | 5.5 | 73.0% | 50-54 | 3 | 3,479 | 6.5 | 45.9% |
| 55-59 | 3 | 3,570 | 9.2 | 32.5% | 55-59 | 3 | 4,276 | 11.1 | 27.0% |
| 60-64 | 9 | 3,100 | 11.6 | 77.7% | 60-64 | 11 | 3,535 | 13.2 | 83.3% |
| Totals | 16 | 21,483 | 31.4 | 50.9% | Totals | 20 | 26,597 | 37.0 | 54.0% |

2019-2020 Experience

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------------|---------------|-----------------------|--------------|---------------|---------------------|---------------|-----------------------|-----------------|
| | Actual Disabilities | Exposure | Expected Disabilities | 0 Expected | | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected |
| Under 20 | - | - | - | N/A | Under 20 | - | - | - | N/A |
| 20-24 | - | 372 | 0.0 | 0.0% | 20-24 | - | 600 | 0.0 | 0.0% |
| 25-29 | - | 1,508 | 0.2 | 0.0% | 25-29 | - | 2,281 | 0.2 | 0.0% |
| 30-34 | - | 2,362 | 0.3 | 0.0% | 30-34 | - | 3,156 | 0.3 | 0.0% |
| 35-39 | 1 | 2,830 | 0.8 | 133.1% | 35-39 | - | 3,551 | 0.9 | 0.0% |
| 40-44 | - | 2,602 | 1.4 | 0.0% | 40-44 | - | 3,207 | 1.7 | 0.0% |
| 45-49 | 2 | 2,455 | 2.6 | 77.2% | 45-49 | 2 | 2,980 | 3.2 | 63.2% |
| 50-54 | 1 | 2,909 | 5.4 | 18.5% | 50-54 | 4 | 3,473 | 6.5 | 61.8% |
| 55-59 | 5 | 3,559 | 9.2 | 54.2% | 55-59 | 7 | 4,153 | 10.8 | 65.1% |
| 60-64 | 8 | 3,078 | 11.5 | 69.4% | 60-64 | 5 | 3,606 | 13.4 | 37.2% |
| Totals | 17 | 21,675 | 31.3 | 54.3% | Totals | 18 | 27,007 | 36.9 | 48.7% |



Appendix – Detailed Experience Analysis Disability Retirements

2020-2021 Experience

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------------|---------------|-----------------------|-----------------|---------------|---------------------|---------------|-----------------------|-----------------|
| | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected | | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected |
| Under 20 | - | - | - | N/A | Under 20 | - | - | - | N/A |
| 20-24 | - | 345 | 0.0 | 0.0% | 20-24 | - | 561 | 0.0 | 0.0% |
| 25-29 | - | 1,479 | 0.1 | 0.0% | 25-29 | - | 2,178 | 0.2 | 0.0% |
| 30-34 | - | 2,334 | 0.3 | 0.0% | 30-34 | - | 3,069 | 0.3 | 0.0% |
| 35-39 | - | 2,846 | 0.8 | 0.0% | 35-39 | - | 3,609 | 1.0 | 0.0% |
| 40-44 | - | 2,743 | 1.4 | 0.0% | 40-44 | 1 | 3,328 | 1.8 | 56.8% |
| 45-49 | 1 | 2,475 | 2.6 | 38.6% | 45-49 | - | 2,983 | 3.1 | 0.0% |
| 50-54 | 2 | 2,912 | 5.4 | 36.8% | 50-54 | 2 | 3,494 | 6.5 | 30.8% |
| 55-59 | 4 | 3,443 | 9.0 | 44.6% | 55-59 | 6 | 3,986 | 10.4 | 57.9% |
| 60-64 | 4 | 2,997 | 11.2 | 35.6% | 60-64 | 5 | 3,552 | 13.2 | 37.8% |
| Totals | 11 | 21,574 | 30.9 | 35.6% | Totals | 14 | 26,760 | 36.4 | 38.5% |

2021-2022 Experience

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------------|---------------|-----------------------|-----------------|---------------|---------------------|---------------|-----------------------|-----------------|
| | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected | | Actual Disabilities | Exposure | Expected Disabilities | Actual/Expected |
| Under 20 | - | - | - | N/A | Under 20 | - | - | - | N/A |
| 20-24 | - | 308 | 0.0 | 0.0% | 20-24 | - | 594 | 0.0 | 0.0% |
| 25-29 | - | 1,416 | 0.1 | 0.0% | 25-29 | - | 2,135 | 0.1 | 0.0% |
| 30-34 | - | 2,169 | 0.2 | 0.0% | 30-34 | - | 2,945 | 0.3 | 0.0% |
| 35-39 | - | 2,801 | 0.8 | 0.0% | 35-39 | - | 3,586 | 1.0 | 0.0% |
| 40-44 | - | 2,837 | 1.5 | 0.0% | 40-44 | 1 | 3,479 | 1.8 | 54.2% |
| 45-49 | - | 2,493 | 2.6 | 0.0% | 45-49 | 1 | 3,008 | 3.1 | 31.9% |
| 50-54 | 4 | 2,845 | 5.3 | 75.0% | 50-54 | 3 | 3,456 | 6.5 | 46.5% |
| 55-59 | 7 | 3,273 | 8.5 | 81.9% | 55-59 | 6 | 3,807 | 9.9 | 60.5% |
| 60-64 | 4 | 2,966 | 11.1 | 36.1% | 60-64 | 11 | 3,438 | 12.9 | 85.5% |
| Totals | 15 | 21,108 | 30.2 | 49.6% | Totals | 22 | 26,448 | 35.6 | 61.8% |

Appendix – Detailed Experience Analysis Post-Retirement Mortality*

2018-2022 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|------------------|-----------------|-----------------|---------------|---------------|------------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 55-59 | 161 | 17,163 | 97 | 165.6% | 55-59 | 112 | 33,306 | 124 | 89.9% |
| 60-64 | 841 | 137,753 | 1,107 | 76.0% | 60-64 | 1,030 | 178,094 | 972 | 105.9% |
| 65-69 | 3,865 | 403,615 | 4,715 | 82.0% | 65-69 | 3,523 | 442,359 | 3,713 | 94.9% |
| 70-74 | 6,842 | 463,925 | 8,461 | 80.9% | 70-74 | 4,343 | 387,229 | 5,198 | 83.6% |
| 75-79 | 9,031 | 284,958 | 8,930 | 101.1% | 75-79 | 4,730 | 194,900 | 4,518 | 104.7% |
| 80-84 | 9,449 | 165,053 | 9,355 | 101.0% | 80-84 | 4,409 | 102,447 | 4,327 | 101.9% |
| 85-89 | 11,189 | 103,472 | 10,424 | 107.3% | 85-89 | 5,237 | 59,419 | 4,757 | 110.1% |
| 90-94 | 9,073 | 42,135 | 6,999 | 129.6% | 90-94 | 5,358 | 34,421 | 4,869 | 110.0% |
| 95-99 | 3,690 | 11,430 | 2,769 | 133.2% | 95-99 | 2,659 | 10,876 | 2,374 | 112.0% |
| 100+ | 210 | 283 | 94 | 224.1% | 100+ | 530 | 1,655 | 540 | 98.2% |
| Totals | 54,352 | 1,629,787 | 52,952 | 102.6% | Totals | 31,931 | 1,444,706 | 31,391 | 101.7% |

* Results are benefits weighted

Appendix – Detailed Experience Analysis Post-Retirement Mortality*

2018-2019 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|----------------|-----------------|-----------------|---------------|---------------|----------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 55-59 | 63 | 4,878 | 28 | 223.4% | 55-59 | 34 | 8,351 | 31 | 108.4% |
| 60-64 | 116 | 36,809 | 297 | 39.2% | 60-64 | 257 | 45,081 | 246 | 104.4% |
| 65-69 | 1,023 | 102,545 | 1,198 | 85.4% | 65-69 | 916 | 102,147 | 855 | 107.1% |
| 70-74 | 1,453 | 101,415 | 1,832 | 79.3% | 70-74 | 802 | 79,500 | 1,059 | 75.8% |
| 75-79 | 1,700 | 63,833 | 2,012 | 84.5% | 75-79 | 1,001 | 40,723 | 953 | 105.0% |
| 80-84 | 1,724 | 38,149 | 2,208 | 78.1% | 80-84 | 1,007 | 22,672 | 973 | 103.5% |
| 85-89 | 2,951 | 24,415 | 2,471 | 119.4% | 85-89 | 1,147 | 14,152 | 1,146 | 100.1% |
| 90-94 | 1,778 | 10,770 | 1,814 | 98.0% | 90-94 | 1,213 | 8,542 | 1,210 | 100.2% |
| 95-99 | 545 | 2,215 | 545 | 100.1% | 95-99 | 561 | 2,540 | 560 | 100.2% |
| 100+ | 22 | 41 | 14 | 158.9% | 100+ | 124 | 357 | 120 | 103.4% |
| Totals | 11,377 | 385,071 | 12,421 | 91.6% | Totals | 7,062 | 324,065 | 7,153 | 98.7% |

2019-2020 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|----------------|-----------------|-----------------|---------------|---------------|----------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 55-59 | 12 | 4,470 | 26 | 48.3% | 55-59 | 6 | 8,216 | 31 | 19.6% |
| 60-64 | 241 | 35,519 | 286 | 84.1% | 60-64 | 256 | 45,623 | 251 | 101.8% |
| 65-69 | 1,174 | 101,274 | 1,183 | 99.3% | 65-69 | 783 | 107,529 | 903 | 86.7% |
| 70-74 | 1,310 | 113,168 | 2,053 | 63.8% | 70-74 | 752 | 90,475 | 1,209 | 62.2% |
| 75-79 | 2,434 | 67,101 | 2,108 | 115.4% | 75-79 | 1,129 | 45,307 | 1,054 | 107.1% |
| 80-84 | 2,392 | 40,506 | 2,298 | 104.1% | 80-84 | 1,077 | 24,320 | 1,034 | 104.2% |
| 85-89 | 2,917 | 25,613 | 2,579 | 113.1% | 85-89 | 1,099 | 14,721 | 1,188 | 92.5% |
| 90-94 | 2,529 | 10,682 | 1,792 | 141.1% | 90-94 | 1,205 | 8,577 | 1,226 | 98.3% |
| 95-99 | 830 | 2,840 | 684 | 121.2% | 95-99 | 742 | 2,671 | 592 | 125.4% |
| 100+ | 97 | 111 | 36 | 266.9% | 100+ | 91 | 337 | 113 | 80.1% |
| Totals | 13,936 | 401,285 | 13,047 | 106.8% | Totals | 7,140 | 347,776 | 7,601 | 93.9% |

* Results are benefits weighted



Appendix – Detailed Experience Analysis Post-Retirement Mortality*

2020-2021 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|----------------|-----------------|-----------------|---------------|---------------|----------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 55-59 | 78 | 4,057 | 23 | 343.4% | 55-59 | 46 | 9,114 | 34 | 134.1% |
| 60-64 | 167 | 33,944 | 272 | 61.3% | 60-64 | 268 | 43,189 | 236 | 113.2% |
| 65-69 | 725 | 100,862 | 1,180 | 61.5% | 65-69 | 973 | 114,720 | 965 | 100.8% |
| 70-74 | 1,912 | 122,284 | 2,245 | 85.2% | 70-74 | 1,162 | 102,411 | 1,383 | 84.1% |
| 75-79 | 2,505 | 72,224 | 2,274 | 110.2% | 75-79 | 1,473 | 50,256 | 1,170 | 125.9% |
| 80-84 | 2,470 | 41,364 | 2,329 | 106.1% | 80-84 | 1,440 | 26,334 | 1,111 | 129.5% |
| 85-89 | 2,298 | 26,518 | 2,658 | 86.5% | 85-89 | 1,561 | 15,127 | 1,208 | 129.3% |
| 90-94 | 2,051 | 10,390 | 1,730 | 118.6% | 90-94 | 1,341 | 8,632 | 1,219 | 110.0% |
| 95-99 | 910 | 2,961 | 720 | 126.4% | 95-99 | 769 | 2,879 | 624 | 123.2% |
| 100+ | 14 | 36 | 12 | 110.2% | 100+ | 96 | 398 | 129 | 74.9% |
| Totals | 13,129 | 414,641 | 13,442 | 97.7% | Totals | 9,129 | 373,060 | 8,079 | 113.0% |

2021-2022 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|----------------|-----------------|-----------------|---------------|---------------|----------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 55-59 | 8 | 3,757 | 21 | 38.6% | 55-59 | 26 | 7,625 | 28 | 92.2% |
| 60-64 | 317 | 31,480 | 252 | 126.0% | 60-64 | 249 | 44,201 | 239 | 104.4% |
| 65-69 | 942 | 98,933 | 1,154 | 81.7% | 65-69 | 851 | 117,963 | 990 | 86.0% |
| 70-74 | 2,167 | 127,057 | 2,330 | 93.0% | 70-74 | 1,626 | 114,843 | 1,547 | 105.1% |
| 75-79 | 2,392 | 81,800 | 2,536 | 94.3% | 75-79 | 1,127 | 58,615 | 1,340 | 84.1% |
| 80-84 | 2,862 | 45,034 | 2,520 | 113.6% | 80-84 | 886 | 29,122 | 1,209 | 73.3% |
| 85-89 | 3,023 | 26,926 | 2,717 | 111.3% | 85-89 | 1,430 | 15,419 | 1,215 | 117.7% |
| 90-94 | 2,716 | 10,293 | 1,663 | 163.3% | 90-94 | 1,598 | 8,669 | 1,214 | 131.7% |
| 95-99 | 1,405 | 3,413 | 820 | 171.4% | 95-99 | 587 | 2,787 | 598 | 98.1% |
| 100+ | 77 | 96 | 31 | 248.8% | 100+ | 219 | 562 | 178 | 123.1% |
| Totals | 15,910 | 428,789 | 14,042 | 113.3% | Totals | 8,600 | 399,805 | 8,558 | 100.5% |

* Results are benefits weighted



Appendix – Detailed Experience Analysis Disabled Mortality*

2018-2022 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|---------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 40-44 | - | 115 | 1 | 0.0% | 41-44 | - | 141 | 2 | 0.0% |
| 45-49 | 24 | 239 | 3 | 715.8% | 45-49 | 26 | 426 | 6 | 400.2% |
| 50-54 | 26 | 828 | 16 | 161.3% | 50-54 | 50 | 1,561 | 29 | 171.7% |
| 55-59 | 106 | 3,885 | 96 | 110.2% | 55-59 | 61 | 6,404 | 141 | 43.2% |
| 60-64 | 373 | 10,874 | 330 | 113.0% | 60-64 | 392 | 13,667 | 344 | 114.1% |
| 65-69 | 489 | 13,779 | 503 | 97.2% | 65-69 | 396 | 15,114 | 458 | 86.4% |
| 70-74 | 692 | 13,108 | 585 | 118.2% | 70-74 | 531 | 10,550 | 432 | 122.8% |
| 75-79 | 420 | 5,543 | 340 | 123.5% | 75-79 | 362 | 4,635 | 303 | 119.4% |
| 80-84 | 374 | 3,051 | 271 | 138.2% | 80-84 | 149 | 2,538 | 252 | 59.0% |
| 85-89 | 91 | 940 | 129 | 70.3% | 85-89 | 77 | 869 | 128 | 60.1% |
| 90-94 | 51 | 505 | 96 | 53.2% | 90-94 | 53 | 255 | 49 | 107.3% |
| 95-99 | 23 | 87 | 23 | 100.6% | 95-99 | 23 | 46 | 14 | 166.6% |
| 100+ | - | - | - | N/A | 100+ | - | 8 | 3 | 0.0% |
| Totals | 2,669 | 52,954 | 2,394 | 111.5% | Totals | 2,120 | 56,214 | 2,163 | 98.0% |

* Results are benefits weighted

Appendix – Detailed Experience Analysis Disabled Mortality*

2018-2019 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|---------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 40-44 | - | 29 | 0 | - | 41-44 | - | 41 | 1 | - |
| 45-49 | - | 50 | 1 | - | 45-49 | - | 88 | 1 | - |
| 50-54 | - | 287 | 6 | - | 50-54 | 23 | 500 | 9 | 2 |
| 55-59 | 2 | 1,300 | 33 | 0 | 55-59 | - | 1,922 | 43 | - |
| 60-64 | 88 | 2,747 | 83 | 1 | 60-64 | 117 | 3,615 | 91 | 1 |
| 65-69 | 104 | 3,869 | 141 | 1 | 65-69 | 73 | 3,727 | 114 | 1 |
| 70-74 | 148 | 2,867 | 128 | 1 | 70-74 | 194 | 1,894 | 78 | 2 |
| 75-79 | 60 | 1,216 | 75 | 1 | 75-79 | 94 | 1,217 | 78 | 1 |
| 80-84 | 101 | 745 | 65 | 2 | 80-84 | - | 512 | 50 | - |
| 85-89 | - | 257 | 37 | - | 85-89 | 23 | 242 | 37 | 1 |
| 90-94 | 9 | 50 | 10 | 1 | 90-94 | 14 | 14 | 3 | 5 |
| 95-99 | - | 22 | 6 | - | 95-99 | 18 | 27 | 8 | 2 |
| 100+ | - | - | - | N/A | 100+ | - | - | - | N/A |
| Totals | 512 | 13,439 | 583 | 87.8% | Totals | 556 | 13,799 | 513 | 108.4% |

2019-2020 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|---------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 40-44 | - | 31 | 0 | - | 41-44 | - | 39 | 0 | - |
| 45-49 | 13 | 59 | 1 | 16 | 45-49 | - | 102 | 2 | - |
| 50-54 | 19 | 217 | 4 | 4 | 50-54 | 27 | 452 | 8 | 3 |
| 55-59 | 52 | 1,035 | 26 | 2 | 55-59 | 38 | 1,594 | 35 | 1 |
| 60-64 | 64 | 2,882 | 88 | 1 | 60-64 | 100 | 3,555 | 89 | 1 |
| 65-69 | 108 | 3,467 | 127 | 1 | 65-69 | 91 | 3,897 | 118 | 1 |
| 70-74 | 121 | 3,183 | 141 | 1 | 70-74 | 76 | 2,396 | 98 | 1 |
| 75-79 | 191 | 1,469 | 91 | 2 | 75-79 | 22 | 1,128 | 74 | 0 |
| 80-84 | 62 | 714 | 65 | 1 | 80-84 | 78 | 610 | 61 | 1 |
| 85-89 | 29 | 248 | 36 | 1 | 85-89 | 43 | 180 | 27 | 2 |
| 90-94 | 5 | 90 | 17 | 0 | 90-94 | - | 74 | 14 | - |
| 95-99 | - | 22 | 6 | - | 95-99 | - | 9 | 3 | - |
| 100+ | - | - | - | N/A | 100+ | - | - | - | N/A |
| Totals | 664 | 13,417 | 601 | 110.4% | Totals | 475 | 14,036 | 530 | 89.7% |

* Results are benefits weighted



Appendix – Detailed Experience Analysis Disabled Mortality*

2020-2021 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|---------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 40-44 | - | 29 | 0 | - | 41-44 | - | 32 | 0 | - |
| 45-49 | 4 | 62 | 1 | 5 | 45-49 | 26 | 119 | 2 | 14 |
| 50-54 | - | 167 | 3 | - | 50-54 | - | 316 | 6 | - |
| 55-59 | 39 | 794 | 19 | 2 | 55-59 | 11 | 1,545 | 34 | 0 |
| 60-64 | 122 | 2,805 | 85 | 1 | 60-64 | 96 | 3,382 | 85 | 1 |
| 65-69 | 230 | 3,379 | 123 | 2 | 65-69 | 141 | 3,819 | 116 | 1 |
| 70-74 | 242 | 3,544 | 159 | 2 | 70-74 | 120 | 2,882 | 118 | 1 |
| 75-79 | 102 | 1,296 | 79 | 1 | 75-79 | 78 | 1,154 | 76 | 1 |
| 80-84 | 109 | 811 | 72 | 2 | 80-84 | 14 | 653 | 65 | 0 |
| 85-89 | 47 | 225 | 30 | 2 | 85-89 | 11 | 198 | 29 | 0 |
| 90-94 | 17 | 177 | 33 | 1 | 90-94 | 32 | 88 | 17 | 2 |
| 95-99 | 23 | 23 | 7 | 4 | 95-99 | - | 5 | 2 | - |
| 100+ | - | - | - | N/A | 100+ | - | 4 | 1 | - |
| Totals | 935 | 13,312 | 612 | 152.9% | Totals | 529 | 14,197 | 551 | 96.0% |

2021-2022 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|---------------|-----------------|-----------------|---------------|---------------|---------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| 40-44 | - | 26 | 0 | - | 41-44 | - | 29 | 0 | - |
| 45-49 | 7 | 68 | 1 | 7 | 45-49 | - | 117 | 2 | - |
| 50-54 | 7 | 157 | 3 | 2 | 50-54 | - | 293 | 5 | - |
| 55-59 | 13 | 756 | 19 | 1 | 55-59 | 12 | 1,343 | 29 | 0 |
| 60-64 | 99 | 2,440 | 74 | 1 | 60-64 | 79 | 3,115 | 78 | 1 |
| 65-69 | 47 | 3,064 | 112 | 0 | 65-69 | 91 | 3,671 | 110 | 1 |
| 70-74 | 181 | 3,514 | 158 | 1 | 70-74 | 141 | 3,378 | 139 | 1 |
| 75-79 | 67 | 1,562 | 95 | 1 | 75-79 | 168 | 1,136 | 74 | 2 |
| 80-84 | 102 | 781 | 70 | 1 | 80-84 | 57 | 763 | 76 | 1 |
| 85-89 | 15 | 210 | 27 | 1 | 85-89 | - | 249 | 35 | - |
| 90-94 | 20 | 188 | 36 | 1 | 90-94 | 7 | 79 | 16 | 0 |
| 95-99 | - | 20 | 5 | - | 95-99 | 5 | 5 | 2 | 3 |
| 100+ | - | - | - | N/A | 100+ | - | 4 | 2 | - |
| Totals | 558 | 12,786 | 598 | 93.3% | Totals | 560 | 14,182 | 569 | 98.4% |

* Results are benefits weighted



Appendix – Detailed Experience Analysis Pre-Retirement Mortality*

2018-2022 Experience (\$000s)

| Age Group | Males | | | | Age Group | Females | | | |
|---------------|---------------|-------------------|-----------------|-----------------|---------------|---------------|-------------------|-----------------|-----------------|
| | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| Under 20 | - | 125 | 0 | 0.0% | Under 20 | - | 412 | 0 | 0.0% |
| 20-24 | - | 33,160 | 10 | 0.0% | 20-24 | - | 40,783 | 5 | 0.0% |
| 25-29 | 162 | 233,488 | 85 | 190.0% | 25-29 | 22 | 269,471 | 39 | 56.7% |
| 30-34 | 32 | 525,925 | 268 | 11.9% | 30-34 | 80 | 572,947 | 139 | 57.4% |
| 35-39 | 594 | 900,550 | 593 | 100.2% | 35-39 | 271 | 943,886 | 339 | 79.9% |
| 40-44 | 837 | 1,127,287 | 913 | 91.7% | 40-44 | 266 | 1,165,400 | 564 | 47.1% |
| 45-49 | 1,597 | 1,296,926 | 1,389 | 115.0% | 45-49 | 479 | 1,355,036 | 915 | 52.4% |
| 50-54 | 4,420 | 1,939,181 | 3,109 | 142.2% | 50-54 | 2,300 | 2,030,978 | 2,119 | 108.5% |
| 55-59 | 6,674 | 3,096,260 | 7,763 | 86.0% | 55-59 | 4,119 | 3,230,478 | 5,326 | 77.3% |
| 60-64 | 12,991 | 3,165,928 | 11,727 | 110.8% | 60-64 | 8,683 | 3,322,926 | 7,940 | 109.4% |
| Totals | 27,307 | 12,318,830 | 25,856 | 105.6% | Totals | 16,220 | 12,932,317 | 17,387 | 93.3% |

* Results are liability weighted

Appendix – Detailed Experience Analysis Pre-Retirement Mortality*

2018-2019 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|---------------|------------------|-----------------|-----------------|---------------|---------------|------------------|-----------------|-----------------|
| Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| Under 20 | - | 23 | 0 | 0.0% | Under 20 | - | 104 | 0 | 0.0% |
| 20-24 | - | 8,257 | 3 | 0.0% | 20-24 | - | 9,204 | 1 | 0.0% |
| 25-29 | 60 | 56,493 | 21 | 292.2% | 25-29 | - | 64,760 | 9 | 0.0% |
| 30-34 | - | 125,314 | 63 | 0.0% | 30-34 | 44 | 135,089 | 32 | 136.1% |
| 35-39 | 31 | 205,265 | 132 | 23.5% | 35-39 | - | 212,200 | 75 | 0.0% |
| 40-44 | 225 | 245,294 | 195 | 115.2% | 40-44 | 97 | 250,336 | 120 | 80.9% |
| 45-49 | 390 | 309,316 | 334 | 116.9% | 45-49 | 194 | 321,257 | 219 | 88.5% |
| 50-54 | 986 | 484,058 | 788 | 125.2% | 50-54 | 798 | 508,960 | 541 | 147.4% |
| 55-59 | 1,485 | 786,488 | 1,977 | 75.1% | 55-59 | 1,539 | 849,462 | 1,410 | 109.2% |
| 60-64 | 2,492 | 795,549 | 2,958 | 84.3% | 60-64 | 1,613 | 806,869 | 1,930 | 83.6% |
| Totals | 5,669 | 3,016,057 | 6,469 | 87.6% | Totals | 4,285 | 3,158,241 | 4,338 | 98.8% |

2019-2020 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|---------------|------------------|-----------------|-----------------|---------------|---------------|------------------|-----------------|-----------------|
| Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| Under 20 | - | 41 | 0 | 0.0% | Under 20 | - | 110 | 0 | 0.0% |
| 20-24 | - | 8,206 | 3 | 0.0% | 20-24 | - | 10,130 | 1 | 0.0% |
| 25-29 | 79 | 56,370 | 21 | 385.1% | 25-29 | - | 66,924 | 10 | 0.0% |
| 30-34 | - | 131,023 | 66 | 0.0% | 30-34 | - | 143,768 | 35 | 0.0% |
| 35-39 | 101 | 220,302 | 144 | 70.1% | 35-39 | 48 | 227,959 | 82 | 58.8% |
| 40-44 | 127 | 267,365 | 215 | 59.1% | 40-44 | 99 | 276,898 | 133 | 74.2% |
| 45-49 | 25 | 314,154 | 336 | 7.4% | 45-49 | - | 328,585 | 223 | 0.0% |
| 50-54 | 210 | 480,263 | 769 | 27.3% | 50-54 | 790 | 499,694 | 523 | 151.0% |
| 55-59 | 1,309 | 792,095 | 1,988 | 65.9% | 55-59 | 151 | 824,719 | 1,360 | 11.1% |
| 60-64 | 2,443 | 792,868 | 2,952 | 82.8% | 60-64 | 1,079 | 841,072 | 2,009 | 53.7% |
| Totals | 4,294 | 3,062,687 | 6,493 | 66.1% | Totals | 2,167 | 3,219,859 | 4,376 | 49.5% |

* Results are liability weighted



Appendix – Detailed Experience Analysis Pre-Retirement Mortality*

2020-2021 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|---------------|------------------|-----------------|-----------------|---------------|---------------|------------------|-----------------|-----------------|
| Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| Under 20 | - | 6 | 0 | 0.0% | Under 20 | - | 77 | 0 | 0.0% |
| 20-24 | - | 9,063 | 3 | 0.0% | 20-24 | - | 10,903 | 1 | 0.0% |
| 25-29 | 23 | 59,549 | 22 | 105.7% | 25-29 | - | 68,155 | 10 | 0.0% |
| 30-34 | 32 | 136,153 | 70 | 45.8% | 30-34 | 36 | 146,093 | 36 | 100.8% |
| 35-39 | 203 | 233,547 | 155 | 130.8% | 35-39 | 78 | 245,319 | 89 | 88.0% |
| 40-44 | 278 | 293,796 | 239 | 116.3% | 40-44 | 57 | 302,299 | 147 | 38.9% |
| 45-49 | 50 | 325,781 | 347 | 14.4% | 45-49 | 156 | 341,226 | 229 | 68.1% |
| 50-54 | 745 | 489,347 | 780 | 95.5% | 50-54 | 224 | 505,573 | 522 | 42.9% |
| 55-59 | 591 | 775,009 | 1,947 | 30.4% | 55-59 | 1,364 | 792,146 | 1,303 | 104.7% |
| 60-64 | 3,335 | 779,807 | 2,889 | 115.4% | 60-64 | 2,806 | 846,571 | 2,022 | 138.8% |
| Totals | 5,257 | 3,102,058 | 6,452 | 81.5% | Totals | 4,721 | 3,258,362 | 4,358 | 108.3% |

2021-2022 Experience (\$000s)

| Males | | | | | Females | | | | |
|---------------|---------------|------------------|-----------------|-----------------|---------------|---------------|------------------|-----------------|-----------------|
| Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected | Age Group | Actual Deaths | Exposure | Expected Deaths | Actual/Expected |
| Under 20 | - | 55 | 0 | 0.0% | Under 20 | - | 121 | 0 | 0.0% |
| 20-24 | - | 7,634 | 2 | 0.0% | 20-24 | - | 10,546 | 1 | 0.0% |
| 25-29 | - | 61,076 | 22 | 0.0% | 25-29 | 22 | 69,632 | 10 | 218.6% |
| 30-34 | - | 133,435 | 69 | 0.0% | 30-34 | - | 147,997 | 36 | 0.0% |
| 35-39 | 259 | 241,436 | 162 | 160.3% | 35-39 | 145 | 258,408 | 94 | 154.0% |
| 40-44 | 207 | 320,832 | 263 | 78.6% | 40-44 | 13 | 335,867 | 164 | 7.9% |
| 45-49 | 1,132 | 347,675 | 372 | 304.5% | 45-49 | 129 | 363,968 | 244 | 52.8% |
| 50-54 | 2,479 | 485,513 | 772 | 321.2% | 50-54 | 488 | 516,751 | 532 | 91.7% |
| 55-59 | 3,289 | 742,668 | 1,852 | 177.6% | 55-59 | 1,065 | 764,151 | 1,253 | 85.0% |
| 60-64 | 4,721 | 797,704 | 2,928 | 161.2% | 60-64 | 3,185 | 828,414 | 1,979 | 161.0% |
| Totals | 12,087 | 3,138,028 | 6,442 | 187.6% | Totals | 5,047 | 3,295,855 | 4,315 | 117.0% |

* Results are liability weighted

