Minnesota Correctional Employees Retirement Fund

Four-Year Experience Study

July 1, 2019 through June 30, 2023

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July 16, 2024

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

Dear Board of Directors:

The results of the four-year ***actuarial experience study*** of the Correctional Employees Retirement Fund (CERF) 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 Correctional 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, 2019 to June 30, 2023***, 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 Correctional 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. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board.

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.

277 Coon Rapids Boulevard | Suite 212 | Coon Rapids, Minnesota 55433-2629

Board of Directors
Minnesota State Retirement System
Correctional Employees Retirement Fund
July 16, 2024

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,

Bonita J. Wurst, ASA, EA, FCA, MAAA

Sheryl L. Christensen, FSA, EA, FCA, MAAA

BJW/SLC:sc

Actuarial Experience Study
2019-2023

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SECTION A

OVERVIEW AND SUMMARY OF RESULTS

Summary of Findings

The four-year period (July 1, 2019 to June 30, 2023) 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 Correctional 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 proposed merit and seniority increases that are, in total, approximately 21 basis points lower on average than the current rates.
- Adjust assumed retirement rates:
  - Increase the rate of assumed unreduced retirements (i.e., Normal Retirement) prior to age 58, and ages 61, 64, 67 and 68. Decrease the rate of assumed unreduced retirements at ages 62 and 63. Overall, proposed rates produce more unreduced retirements than the current rates.
  - Decrease rates of assumed early retirement rates prior to age 53 and increase rates at ages 53 and 54. Overall, proposed rates produce slightly fewer reduced retirements than the current rates.
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
  - In general, proposed rates are higher than present assumptions for males with less than 15 years of service.
  - Proposed rates for females are higher in the first two years and year five and are lower than the present assumptions otherwise. Overall, the new rates predict fewer female withdrawals.
- Minor changes to current rates of disability below age 50 and lower rates of disability at ages 50 and older.
- Change the base mortality table from PUB-2010 General to PUB-2010 Public Safety. Update mortality projection scale to MP-2021.
- Minor changes to the form of payment assumptions and miscellaneous data assumptions.

The recommendations are summarized on the following pages.

Review of the investment return assumption and actuarial methods is outside the scope of this experience study. Please refer to GRS' State Employees Retirement Fund experience study dated June 29, 2023. This report concluded that the current investment return assumption of 7.0% was within a reasonable range as of the date of the report.

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; and
- 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 revised for the June 30, 2021 actuarial valuation based on the results of the most recent experience study. Economic assumptions were last revised for the June 30, 2023 actuarial valuation. All experience was compared to assumptions in effect as of the June 30, 2023 actuarial valuation.

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
2019-2023

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
Unreduced Retirement ($000s)	183,095	154,528	171,669	17,141
Reduced Retirement ($000s)	25,779	27,537	27,011	(526)
Withdrawal ($000s)				
Males	81,406	69,648	76,250	6,602
Females	67,339	70,783	68,684	(2,099)
Disability				
Males	30	33	31	(2)
Females	10	19	13	(6)
Mortality ($000s)				
Healthy Retired Lives** - Male	3,732	3,327	3,356	29
- Female	1,039	816	939	123
Disabled Retired Lives** - Male	328	466	178	(288)
- Female	270	191	80	(111)
Active Lives** - Male	3,932	3,626	3,059	(567)
- Female	1,482	979	1,050	71

* *Normal retirements less than age 70. See Section C for full detail.*

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

In general, increased incidence of withdrawals and lower future salaries result in lower liability and contribution requirements while increased incidence of unreduced retirements result in higher liabilities and contribution requirements. We will follow up with the impact of the proposed changes.

SECTION B

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.

For the Correctional fund, the general inflation assumption is currently 2.25% and the payroll growth assumption is currently 3.00%.

General inflation, as measured by the change in Consumer Price Index, has averaged about 4.5% over the four-year period ending June 30, 2023. During the 2020 to 2022 calendar year period, the increase in the national average earnings have been about 5.7% (the 2023 national average earnings amount was not available at the time this report was published).

Active membership decreased consistently for three years from 4,582 as of July 1, 2019 to a low of 4,420 as of July 1, 2022. Active membership as of July 1, 2023 was 4,426, a slight increase from July 1, 2022. Overall, active membership decreased 3.4%, from 4,582 as of July 1, 2019 to 4,426 as of July 1, 2023. We note that, although active membership decreased, payroll continued to increase during this period at approximately the assumed annual rate of 3.00%, on average.

A thorough review of general inflation and payroll growth is presented in Section B of the MSRS State Employees Retirement Fund experience study report dated June 29, 2023. In that report, we concluded:

> "although current inflation rates are higher than they have been in previous decades, the future outlook … suggest 2.25% continues to be reasonable."
>
> and
>
> "When combined with the 2.25% price inflation assumption, the recommended payroll growth assumption remains at 3.00% ... The recommended payroll growth assumption is appropriate for a stable population."

We recommend maintaining the price inflation assumption of 2.25% and a payroll growth assumption of 3.00% for the Correctional Fund. These assumptions are supported by experience and are consistent with the assumption used for MSRS' State Employees Retirement Fund.

Pay Increases Due to Merit and Seniority

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 CERF members for the period July 1, 2019 through June 30, 2023, we observed that members with longer service averaged approximately a 4.6% 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 20 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.

Findings

The assumed wage inflation was 3.00% during the study period. During the four years of the study, we estimate the average actual wage inflation component of pay increases was around 4.6% for members of the Correctional Employee Retirement Fund (based on the average increase for members with 20 or more years of service). However, we note average salary for this group of members varied and increased each year in the study period, from 3.5% in 2020 to 6.4% in 2023. This estimated actual wage inflation of 4.6% 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 5.69% over the four-year period, ranging from 4.03% in 2021 to 6.83% in 2022. After adjusting for the 4.60% average wage inflation for this period, the average net salary increases (i.e., merit and seniority) averaged 1.09%, ranging from -0.57% to 2.23%. Note, this does not mean that members on average received negative merit and seniority increases in 2021.

Fiscal Year Ending	Exposures	Gross		Net*	
		Actual	Expected	Actual	Expected
2020	3,665	5.32%	4.93%	0.72%	1.93%
2021	3,739	4.03%	4.90%	-0.57%	1.90%
2022	3,433	6.83%	4.69%	2.23%	1.69%
2023	3,147	6.67%	4.64%	2.07%	1.64%
Total	**13,984**	**5.69%**	**4.79%**	**1.09%**	**1.79%**

* *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 4.60%.*

Pay Increases Due to Merit and Seniority

The results of our analysis are shown below. Using the techniques described above, observed merit and seniority pay increases were higher than the presently assumed increase during the last two years and lower than the current assumption in the first two years. However, we note the experience was volatile and did not follow an expected pattern. The four-year period was very unique, with a pandemic and civil unrest. We also note there were more terminations than expected and the number of active members decreased during the period. For these reasons, we partially recognized the actual experience and made minor changes.

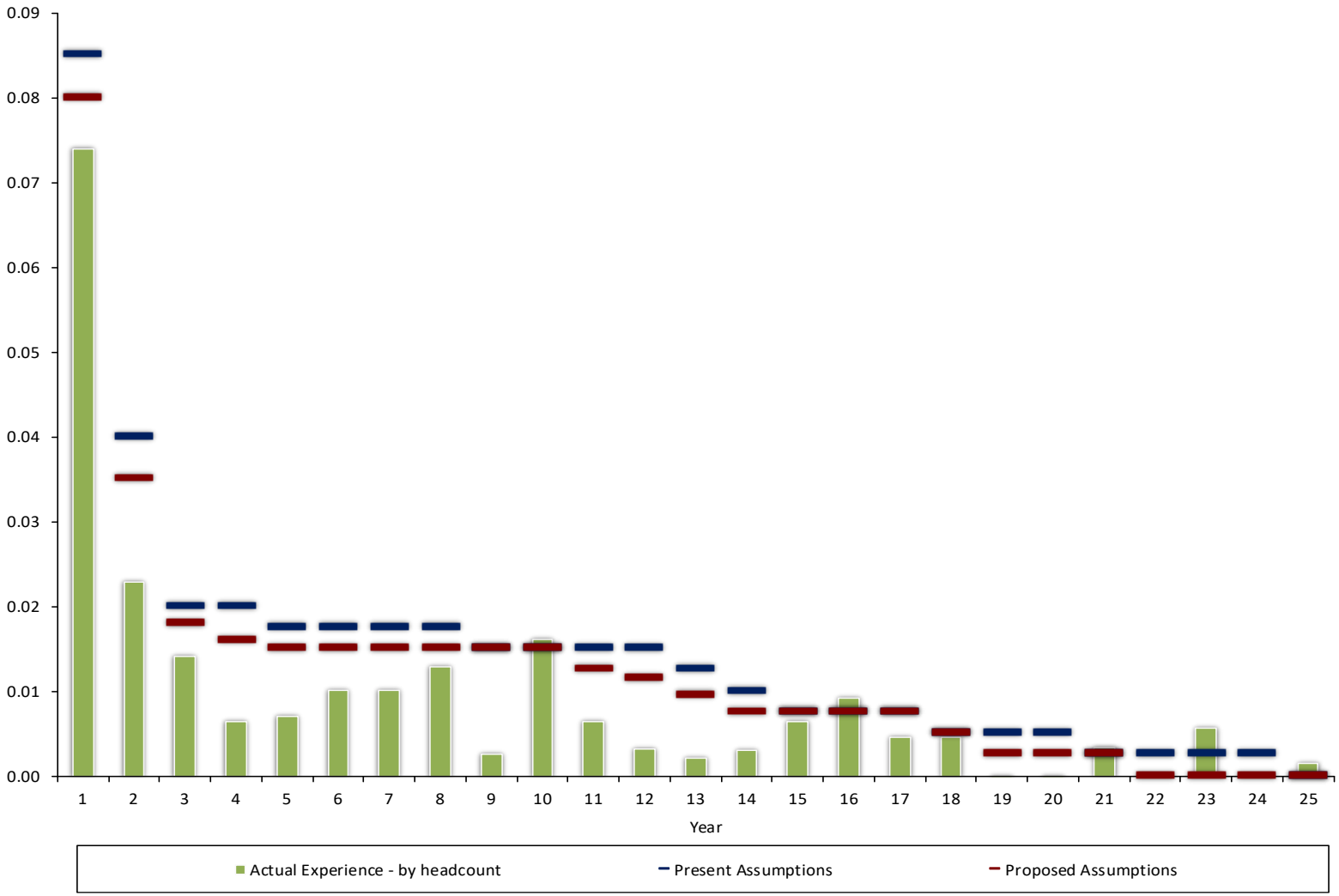
Recommendation

We recommend adjustments to the current merit/seniority pay increase assumption as shown below. Overall, the proposed merit/seniority rates are 21 basis points lower than the current assumption.

Year	Exposures	Total % Increase			Merit/Seniority % Increase		
		Rates			Rates		
		Actual	Current	Proposed	Actual	Current	Proposed
1	982	11.99 %	11.50 %	11.00 %	7.39 %	8.50 %	8.00 %
2	1,026	6.89 %	7.00 %	6.50 %	2.29 %	4.00 %	3.50 %
3	1,016	6.02 %	5.00 %	4.80 %	1.42 %	2.00 %	1.80 %
4	962	5.24 %	5.00 %	4.60 %	0.64 %	2.00 %	1.60 %
5	888	5.30 %	4.75 %	4.50 %	0.70 %	1.75 %	1.50 %
6	821	5.61 %	4.75 %	4.50 %	1.01 %	1.75 %	1.50 %
7	718	5.61 %	4.75 %	4.50 %	1.01 %	1.75 %	1.50 %
8	654	5.89 %	4.75 %	4.50 %	1.29 %	1.75 %	1.50 %
9	543	4.85 %	4.50 %	4.50 %	0.25 %	1.50 %	1.50 %
10	469	6.21 %	4.50 %	4.50 %	1.61 %	1.50 %	1.50 %
11	425	5.24 %	4.50 %	4.25 %	0.64 %	1.50 %	1.25 %
12	497	4.92 %	4.50 %	4.15 %	0.32 %	1.50 %	1.15 %
13	603	4.81 %	4.25 %	3.95 %	0.21 %	1.25 %	0.95 %
14	679	4.90 %	4.00 %	3.75 %	0.30 %	1.00 %	0.75 %
15	644	5.24 %	3.75 %	3.75 %	0.64 %	0.75 %	0.75 %
16	520	5.52 %	3.75 %	3.75 %	0.92 %	0.75 %	0.75 %
17	400	5.06 %	3.75 %	3.75 %	0.46 %	0.75 %	0.75 %
18	313	5.06 %	3.50 %	3.50 %	0.46 %	0.50 %	0.50 %
19	273	4.18 %	3.50 %	3.25 %	(0.42)%	0.50 %	0.25 %
20	253	4.43 %	3.50 %	3.25 %	(0.17)%	0.50 %	0.25 %
21	223	4.93 %	3.25 %	3.25 %	0.33 %	0.25 %	0.25 %
22	197	3.85 %	3.25 %	3.00 %	(0.75)%	0.25 %	0.00 %
23	157	5.16 %	3.25 %	3.00 %	0.56 %	0.25 %	0.00 %
24	147	4.11 %	3.25 %	3.00 %	(0.49)%	0.25 %	0.00 %
25+	574	4.74 %	3.00 %	3.00 %	0.14 %	0.00 %	0.00 %
Total	**13,984**	**5.69 %**	**4.79 %**	**4.58 %**	**1.09 %**	**1.79 %**	**1.58 %**

Totals equal weighted average of results for each service year in the table.

Pay Increases Due to Merit and Seniority



SECTION C

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 in the mortality section of this report.

Age and Service Unreduced (Normal) Retirement

Findings

The benefit provisions of the Correctional Employees Retirement Fund (CERF) 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 70; in other words, we assume all members currently under the age of 70 will retire by the age of 70. However, for members currently age 70 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, there are no Exposures for ages over 70 since the valuation assumption is all of these members work an additional year and then retire. During the four-year period, there were ten actual retirements at ages 70 and older.

Overall, on a liability-weighted basis, the plan experienced more unreduced retirements than projected by the present assumptions, and on a population-weighted basis the plan experiences less population weighted retirements than expected.

Recommendations

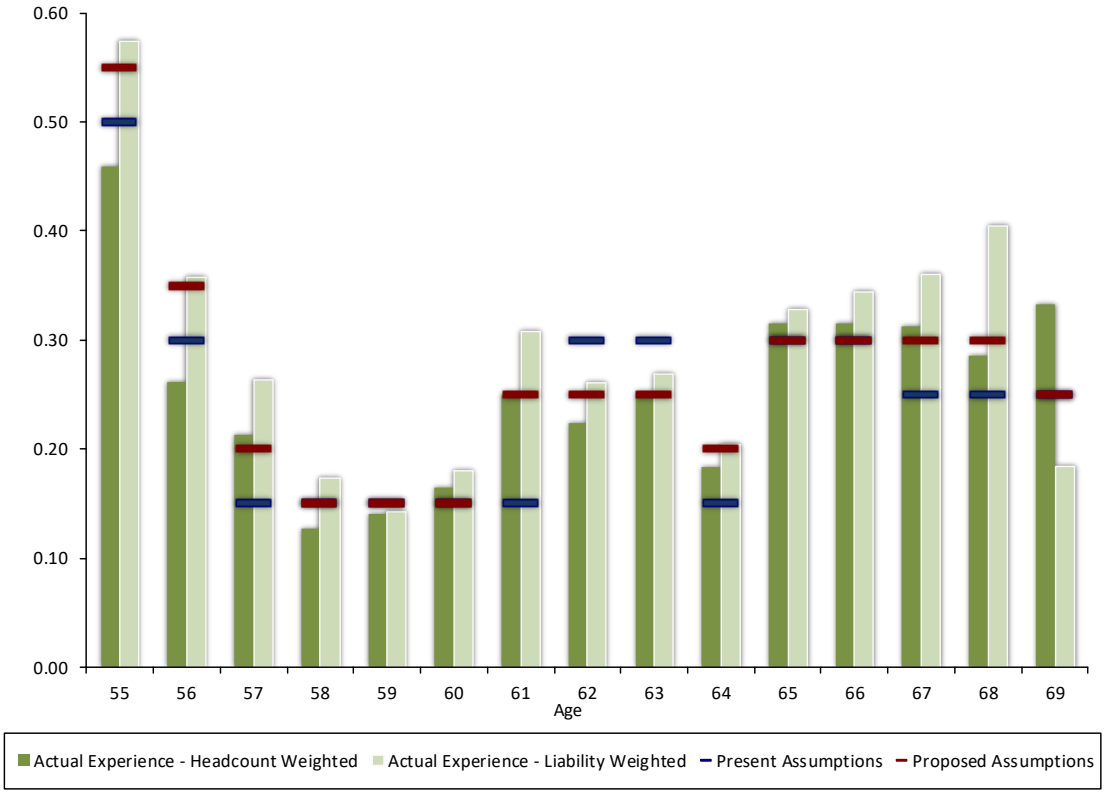
We recommend adjusting the assumed unreduced retirement rates to reflect observed liability weighted experience, as shown on the next page. In addition, we recommend the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year after the valuation date, the same as members younger than age 70.

Age and Service Unreduced (Normal) Retirement

Age	Actual Retirements ($000s)	Exposure ($000s)	Crude Rates		Rates		Expected Retirements ($000s)		Actuals/Expecteds	
			Population	Liability	Present	Proposed	Present	Proposed	Present	Proposed
55	110,358	192,349	45.88%	57.37%	50.00%	55.00%	96,174	105,792	114.7%	104.3%
56	31,197	87,383	26.19%	35.70%	30.00%	35.00%	26,215	30,584	119.0%	102.0%
57	16,597	63,088	21.26%	26.31%	15.00%	20.00%	9,463	12,618	175.4%	131.5%
58	8,804	50,794	12.71%	17.33%	15.00%	15.00%	7,619	7,619	115.6%	115.6%
59	7,271	50,947	13.98%	14.27%	15.00%	15.00%	7,642	7,642	95.1%	95.1%
60	8,868	49,425	16.48%	17.94%	15.00%	15.00%	7,414	7,414	119.6%	119.6%
61	13,120	42,696	25.00%	30.73%	15.00%	25.00%	6,404	10,674	204.9%	122.9%
62	8,817	33,727	22.40%	26.14%	30.00%	25.00%	10,118	8,432	87.1%	104.6%
63	7,116	26,444	24.77%	26.91%	30.00%	25.00%	7,933	6,611	89.7%	107.6%
64	3,515	17,249	18.31%	20.38%	15.00%	20.00%	2,587	3,450	135.8%	101.9%
65	5,171	15,794	31.58%	32.74%	30.00%	30.00%	4,738	4,738	109.1%	109.1%
66	3,786	11,006	31.48%	34.40%	30.00%	30.00%	3,302	3,302	114.7%	114.7%
67	2,641	7,316	31.25%	36.09%	25.00%	30.00%	1,829	2,195	144.4%	120.3%
68	1,996	4,939	28.57%	40.41%	25.00%	30.00%	1,235	1,482	161.6%	134.7%
69	689	3,741	33.33%	18.42%	25.00%	25.00%	935	935	73.7%	73.7%
70	*	*	N/A	N/A	*	*	N/A	N/A	N/A	N/A
Totals	183,095	493,986	26.69%	37.06%	31.28%	34.75%	154,528	171,669	118.5%	106.7%

*

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 69, these members are not included in the Exposures since retirement is assumed to be delayed one year. There were 10 actual retirements over age 69.



Reduced Early Retirement

Findings

CERF members may retire with a reduced benefit prior to the attainment of Normal Retirement. We refer to these cases as early retirements.

Early retirement benefits are equal to the normal retirement benefit with a reduction for early retirement as follows:

> Normal Retirement Benefit based on Allowable Service and Average Salary at retirement date reduced by 5/12% (2/10% if hired before July 1, 2010 and retired before July 1, 2019) per month for each month that the member is under age 55.

Generally, higher rates of early retirement generally result in slightly lower computed contributions, and vice versa.

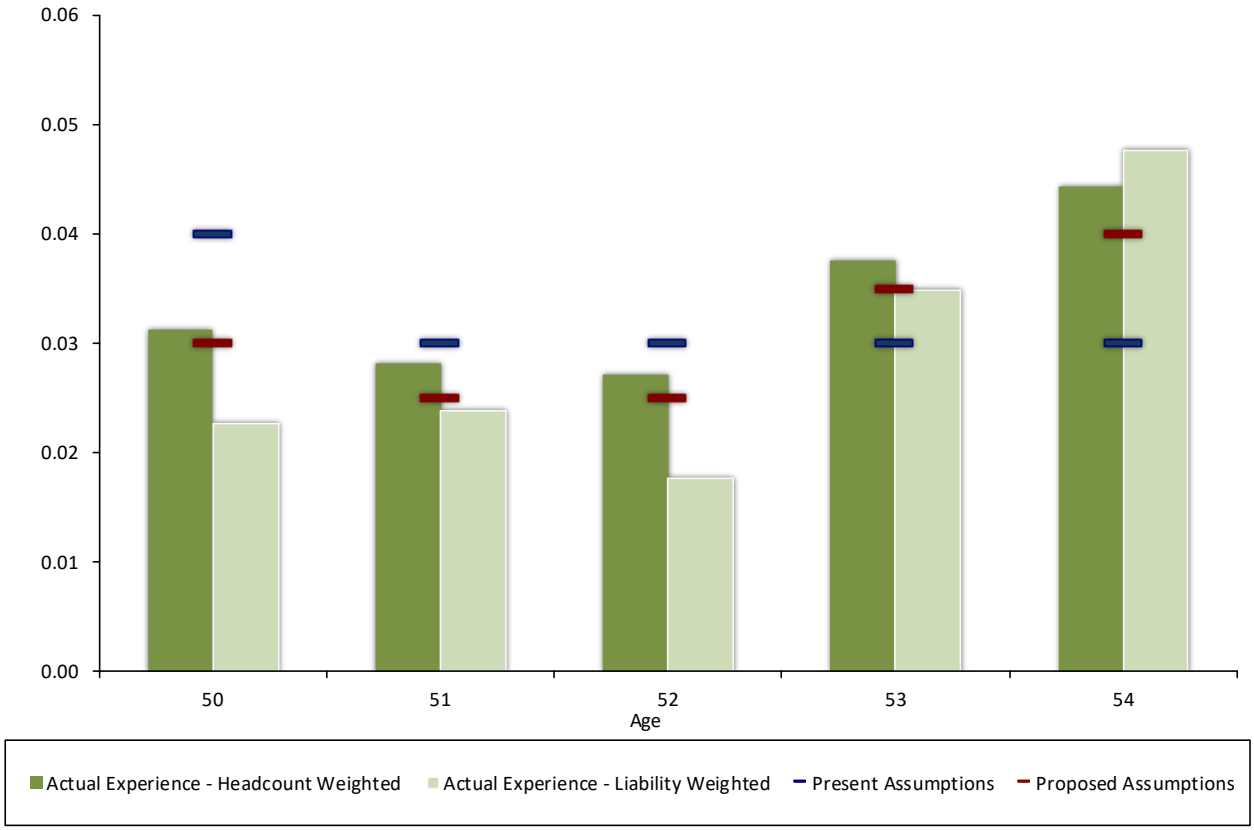
On both a population and liability weighted basis, retirement rates were lower than expected prior to age 53 and higher than expected for ages 53 and 54.

Recommendation

We recommend slight adjustments to early retirement rates as shown on the next page.

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
50	3,552	157,086	3.13%	2.26%	4.00%	3.00%	6,283	4,713	56.5%	75.4%
51	4,019	168,810	2.82%	2.38%	3.00%	2.50%	5,064	4,220	79.4%	95.2%
52	3,113	176,058	2.71%	1.77%	3.00%	2.50%	5,282	4,401	58.9%	70.7%
53	6,033	173,342	3.76%	3.48%	3.00%	3.50%	5,200	6,067	116.0%	99.4%
54	9,062	190,245	4.42%	4.76%	3.00%	4.00%	5,707	7,610	158.8%	119.1%
Totals	25,779	865,540	3.38%	2.98%	3.18%	3.12%	27,537	27,011	93.6%	95.4%



Retirement from Deferred Status

Members who terminate and meet the following vesting requirements are entitled to either a refund of employee contributions, with interest, or a deferred retirement benefit:

	Vesting Percent if First Hired	
Years of Service	Before July 1, 2010	After June 30, 2010
<3	0	0
3 – 4	100	0
5	100	50
6	100	60
7	100	70
8	100	80
9	100	90
10+	100	100

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 the member's 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. The benefit is reduced on approximately an actuarially equivalent basis, meaning this assumption results in no significant liability gain or loss to the plan if retirement occurs prior to Normal Retirement Age. We recommend no change to this set of assumptions.

SECTION D

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, with higher terminations assumed early in the member's career. The withdrawal assumption review was done on a liability-weighted basis, as described earlier in the report.

Note, that if a member who terminated during the experience period were later reclassified as a disability that they were not including as a termination for this study.

Findings

When we reviewed the liability that decremented out of the plan during the prior four-year period, we observed that the plan experienced more liability decrementing from the plan due to male terminations than expected and less decrementing from the plan due to female terminations than expected. We also note that terminations for members during the 2020-2021 fiscal year were lower and during the 2022-2023 fiscal year were higher than the other years in this study. Due to this volatility, we did not adjust the withdrawal rates as much as we would have otherwise.

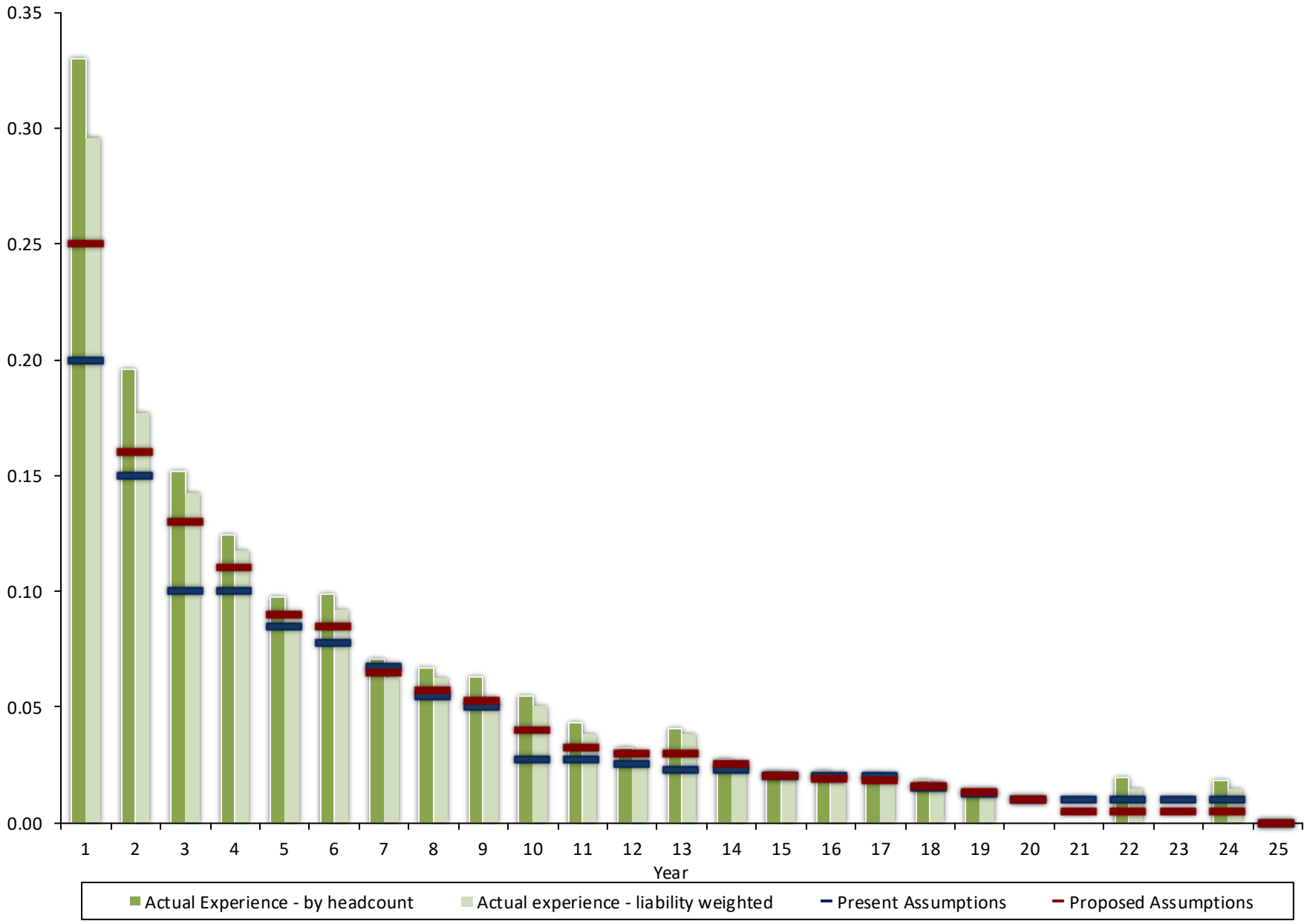
Recommendation

For male rates, we recommend an overall increase in assumed rates of withdrawal, especially early in the member's career. For female rates, we recommend an overall decrease in rates of withdrawal, with an increase in the first two years of service and lower rates of withdrawal mid-career. Our recommended rates of withdrawal are detailed on the next pages.

Withdrawal Experience* – Males

Year	Liability Weighted ($000s)		Crude Rates		Sample Rates		Liability Weighted ($000s)			
							Expected Withdrawals		Ratio of Actuals/Expecteds	
	Actual	Exposure	Population Weighted	Liability Weighted	Present	Proposed	Present	Proposed	Present	Proposed
1	6,100	20,591	33.01%	29.63%	20.00%	25.00%	4,119	5,148	148.1%	118.5%
2	11,392	64,323	19.61%	17.71%	15.00%	16.00%	9,648	10,292	118.1%	110.7%
3	10,360	72,639	15.19%	14.26%	10.00%	13.00%	7,264	9,443	142.6%	109.7%
4	8,353	71,044	12.46%	11.76%	10.00%	11.00%	7,104	7,815	117.6%	106.9%
5	6,283	70,744	9.77%	8.88%	8.50%	9.00%	6,013	6,367	104.5%	98.7%
6	6,531	70,841	9.88%	9.22%	7.75%	8.50%	5,490	6,021	119.0%	108.5%
7	4,364	69,365	7.05%	6.29%	6.75%	6.50%	4,682	4,509	93.2%	96.8%
8	3,980	63,706	6.70%	6.25%	5.50%	5.75%	3,504	3,663	113.6%	108.6%
9	3,352	62,128	6.30%	5.40%	5.00%	5.25%	3,106	3,262	107.9%	102.8%
10	2,885	57,406	5.50%	5.03%	2.75%	4.00%	1,579	2,296	182.8%	125.7%
11	2,101	55,049	4.30%	3.82%	2.75%	3.25%	1,514	1,789	138.8%	117.5%
12	1,740	59,089	3.21%	2.95%	2.50%	3.00%	1,477	1,773	117.8%	98.2%
13	2,629	68,934	4.04%	3.81%	2.25%	3.00%	1,551	2,068	169.5%	127.1%
14	2,236	91,244	2.69%	2.45%	2.25%	2.50%	2,053	2,281	108.9%	98.0%
15	2,220	109,520	2.14%	2.03%	2.00%	2.00%	2,190	2,190	101.3%	101.4%
16	1,834	111,939	2.23%	1.64%	2.00%	1.90%	2,239	2,127	81.9%	86.2%
17	1,777	99,108	2.05%	1.79%	2.00%	1.80%	1,982	1,784	89.7%	99.6%
18	1,379	80,192	1.82%	1.72%	1.50%	1.60%	1,203	1,283	114.6%	107.5%
19	813	60,518	1.27%	1.34%	1.25%	1.30%	756	787	107.4%	103.2%
20	-	53,103	0.00%	0.00%	1.00%	1.00%	531	531	0.0%	0.0%
21	-	47,753	0.00%	0.00%	1.00%	0.50%	478	239	0.0%	0.0%
22	679	47,110	1.96%	1.44%	1.00%	0.50%	471	236	144.2%	287.9%
23	-	42,087	0.00%	0.00%	1.00%	0.50%	421	210	0.0%	0.0%
24	398	27,168	1.85%	1.47%	1.00%	0.50%	272	136	146.6%	292.8%
25+	-	21,783	0.00%	0.00%	0.00%	0.00%	-	-	N/A	N/A
Totals	**81,406**	**1,597,380**	**9.28%**	**5.10%**	**4.36%**	**4.77%**	**69,648**	**76,250**	**116.9%**	**106.8%**

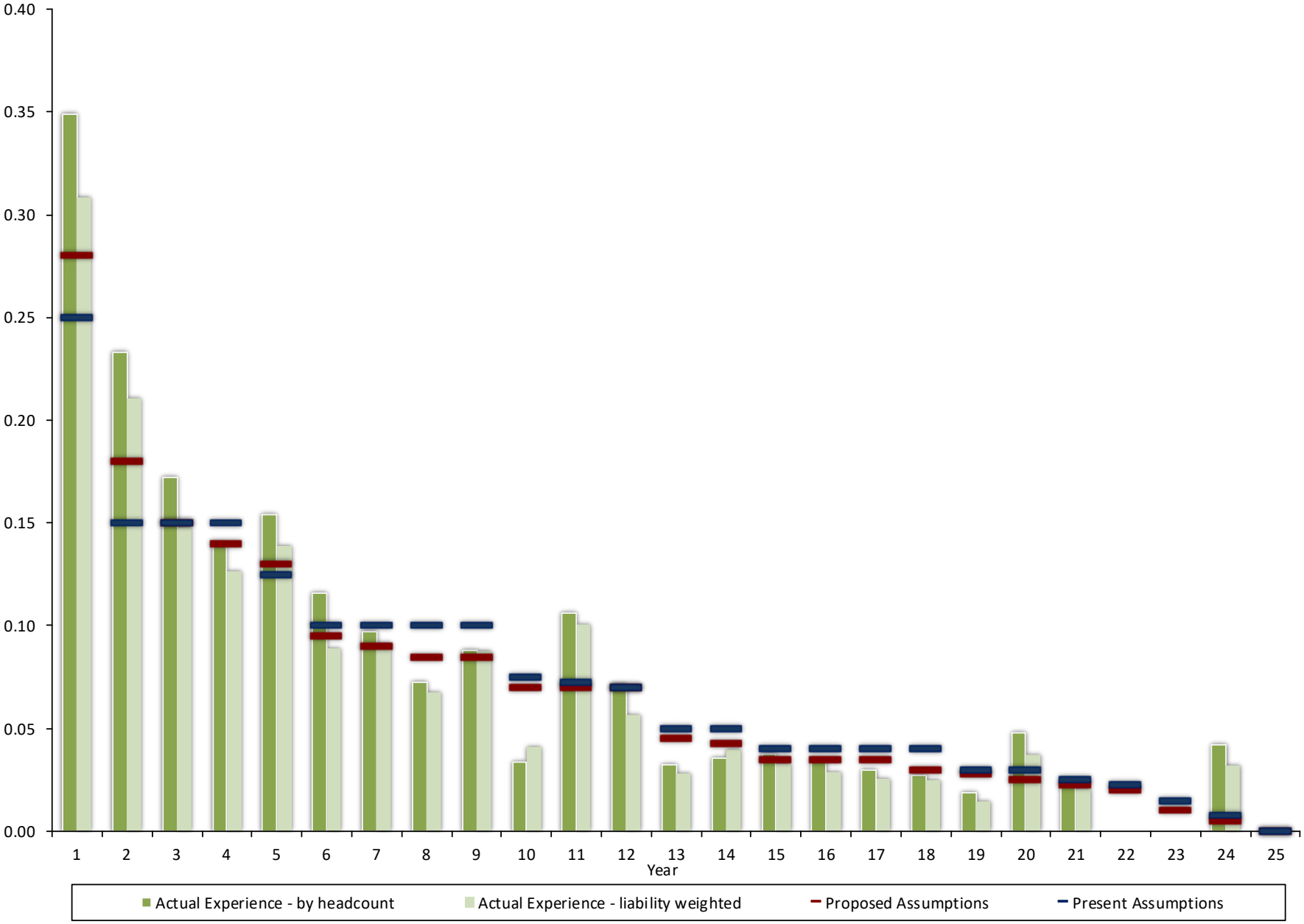
Withdrawal Experience – Males



Withdrawal Experience – Females

Year	Liability Weighted ($ 000s)		Crude Rates		Sample Rates		Liability Weighted ($ 000s)			
							Expected Withdrawals		Ratio of Actuals/Expecteds	
	Actual	Exposure	Population Weighted	Liability Weighted	Present	Proposed	Present	Proposed	Present	Proposed
1	4,940	16,029	34.91%	30.82%	25.00%	28.00%	4,007	4,488	123.3%	110.1%
2	11,006	52,173	23.32%	21.10%	15.00%	18.00%	7,826	9,391	140.6%	117.2%
3	7,619	51,520	17.25%	14.79%	15.00%	15.00%	7,728	7,728	98.6%	98.6%
4	6,808	53,784	13.97%	12.66%	15.00%	14.00%	8,068	7,530	84.4%	90.4%
5	7,450	53,590	15.40%	13.90%	12.50%	13.00%	6,699	6,967	111.2%	106.9%
6	4,264	47,782	11.57%	8.92%	10.00%	9.50%	4,778	4,539	89.2%	93.9%
7	4,242	46,684	9.68%	9.09%	10.00%	9.00%	4,668	4,202	90.9%	101.0%
8	2,891	42,934	7.22%	6.73%	10.00%	8.50%	4,293	3,649	67.3%	79.2%
9	3,496	40,025	8.77%	8.74%	10.00%	8.50%	4,002	3,402	87.4%	102.8%
10	1,470	36,092	3.37%	4.07%	7.50%	7.00%	2,707	2,526	54.3%	58.2%
11	3,142	31,201	10.64%	10.07%	7.25%	7.00%	2,262	2,184	138.9%	143.9%
12	1,503	26,684	7.14%	5.63%	7.00%	7.00%	1,868	1,868	80.5%	80.5%
13	945	33,339	3.23%	2.84%	5.00%	4.50%	1,667	1,500	56.7%	63.0%
14	1,553	38,950	3.55%	3.99%	5.00%	4.25%	1,947	1,655	79.8%	93.8%
15	1,517	46,586	3.75%	3.26%	4.00%	3.50%	1,863	1,631	81.4%	93.0%
16	1,289	44,786	3.42%	2.88%	4.00%	3.50%	1,791	1,567	71.9%	82.2%
17	865	33,655	3.00%	2.57%	4.00%	3.50%	1,346	1,178	64.3%	73.4%
18	672	27,129	2.70%	2.48%	4.00%	3.00%	1,085	814	62.0%	82.6%
19	281	19,894	1.85%	1.41%	3.00%	2.75%	597	547	47.1%	51.5%
20	613	16,526	4.76%	3.71%	3.00%	2.50%	496	413	123.5%	148.3%
21	369	18,110	2.38%	2.04%	2.50%	2.25%	453	407	81.5%	90.7%
22	-	15,369	0.00%	0.00%	2.25%	2.00%	346	307	0.0%	0.0%
23	-	12,811	0.00%	0.00%	1.50%	1.00%	192	128	0.0%	0.0%
24	402	12,504	4.17%	3.21%	0.75%	0.50%	94	63	427.6%	638.1%
25+	-	8,668	0.00%	0.00%	0.00%	0.00%	-	-	N/A	N/A
Totals	**67,339**	**826,823**	**13.70%**	**8.14%**	**8.56%**	**8.31%**	**70,783**	**68,684**	**95.1%**	**98.0%**

Withdrawal Experience – Females



SECTION E

DISABILITY EXPERIENCE

Disability Experience

Correctional members who are unable to perform normal duties are eligible to receive a disability benefit. Members must have at least one year of service if hired before July 1, 2009 or be vested if hired after June 30, 2009, unless disability is duty-related.

The current disability benefit is equal to 2.4% of average salary (2.2% if first hired after June 30, 2010) for each year of service, with a minimum benefit equal to 36% of average salary if hired prior to July 1, 2009 (50% of average salary if disability is duty-related, regardless of hire date).

Payments begin at disability and end at age 55 (age 65 if hired prior to July 1, 2009) or the five-year anniversary of the effective date of the disability benefit, whichever is later. At that time, the member may elect an actuarially equivalent option (unless an optional form of payment was elected at the time of disability).

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.

All disabilities are assumed to be duty-related since actual disability status (duty or non-duty related) is not reported in the valuation data.

Findings

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. Over the course of the four-year period, there were 3 members who were reclassified as a disability retirement after first being reported as a termination. In recognition of this process, we included these members in our analysis and recommend rates including these incidences.

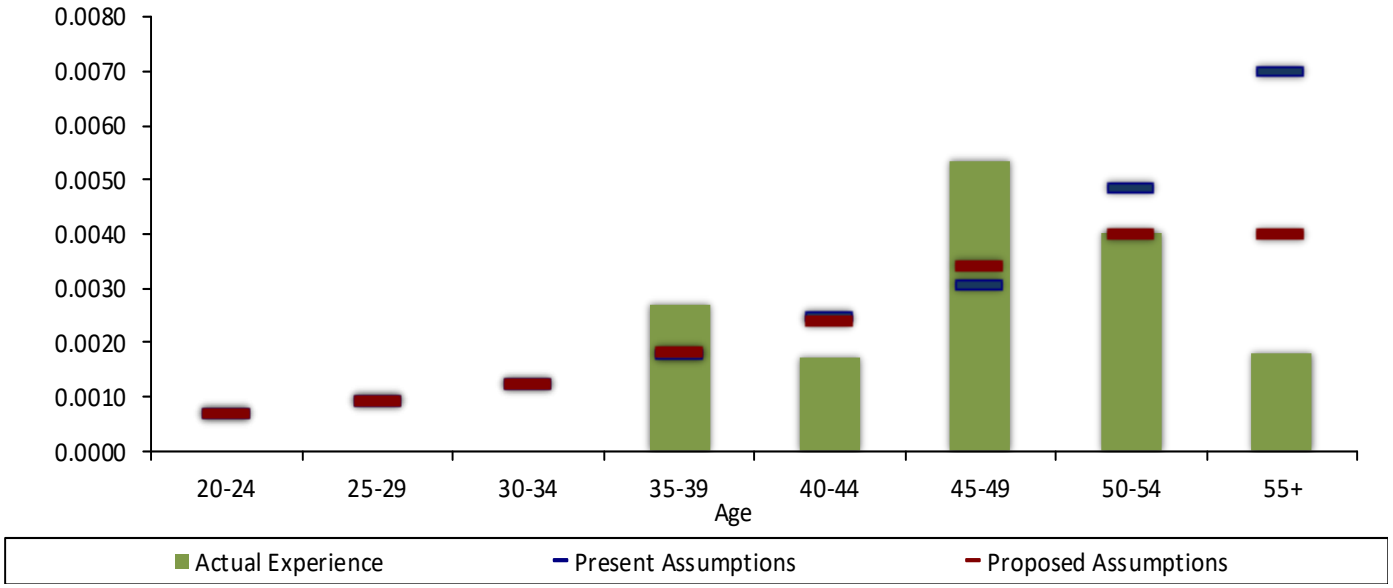
We reviewed the disability experience during the four-year period. The results are shown on the following pages. Overall, the actual number of disability retirements (40) is about 76% of the number projected by the present assumption (52 – see charts on the following pages).

Recommendation

We recommend minor adjustments to the rates prior to age 50 and lower rates of disability for members age 50 and older.

Disability Experience
Males and Females

Age	Population Weighted Disabilities	Population Weighted Exposure	Crude Rates	Sample Rates Present	Sample Rates Proposed	Population Weighted Expected Disabilities Present	Population Weighted Expected Disabilities Proposed	Population Weighted Ratio of Actuals/Expecteds Present	Population Weighted Ratio of Actuals/Expecteds Proposed
Under 20	-	-	N/A	0.0100%	0.0100%	-	-	N/A	N/A
20-24	-	604	0.0000%	0.0713%	0.0713%	0.4	0.4	0.0%	0.0%
25-29	-	1,763	0.0000%	0.0912%	0.0912%	1.6	1.6	0.0%	0.0%
30-34	-	2,423	0.0000%	0.1223%	0.1223%	3.0	3.0	0.0%	0.0%
35-39	8	2,962	0.2701%	0.1786%	0.1844%	5.3	5.5	151.3%	146.5%
40-44	5	2,863	0.1746%	0.2469%	0.2408%	7.1	6.9	70.7%	72.5%
45-49	13	2,425	0.5361%	0.3053%	0.3402%	7.4	8.3	175.6%	157.6%
50-54	10	2,477	0.4037%	0.4847%	0.4000%	12.0	9.9	83.3%	100.9%
55+	4	2,238	0.1787%	0.7000%	0.4000%	15.7	9.0	25.5%	44.7%
Totals	**40**	**17,755**	**0.2253%**	**0.2953%**	**0.2504%**	**52.4**	**44.5**	**76.3%**	**90.0%**



SECTION F

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 the CERF retiree and disability mortality on a 'benefit weighted' basis and have shown the results in this section. Consistent with the SOA study, CERF 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

Most pension systems will have insufficient data for full credibility in setting a mortality assumption. The general rule of thumb is that approximately 1,000 deaths are required of each gender in the experience period for full credibility with a 90% confidence level. When less than 1,000 deaths occur during the experience study period, partial credibility can be given to the plan's experience based on the actual number of deaths that occurred.

During the four-year period, there were 161 male retiree deaths and 62 female retiree deaths. The healthy retiree mortality experience is not considered to be credible since there are so few deaths. Pre-retirement mortality and disabled retiree mortality experience is also not considered to be credible.

Mortality Experience

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 deaths than expected ($3,732,000 actual versus $3,327,000 expected). The actual number of deaths on a benefit weighted basis among retired females ($1,039,000) was also more than the number projected by the present assumptions ($816,000).

Disabled Retirees

On a benefit weighted basis, the plan experienced fewer deaths among disabled males ($328,000) than projected by the present assumptions ($465,000). The actual number of deaths on a benefit weighted basis among disabled females ($270,000) was more than the number projected by the present assumptions ($190,000).

Active Members

On a liability weighted basis, the actual amount of deaths among active male members ($3,932,000) was higher than the number projected by the present assumption ($3,626,000). The plan also experienced more deaths on a liability weighted basis among females ($1,482,000) than projected by the present assumptions ($979,000).

Mortality Experience

Recommendations

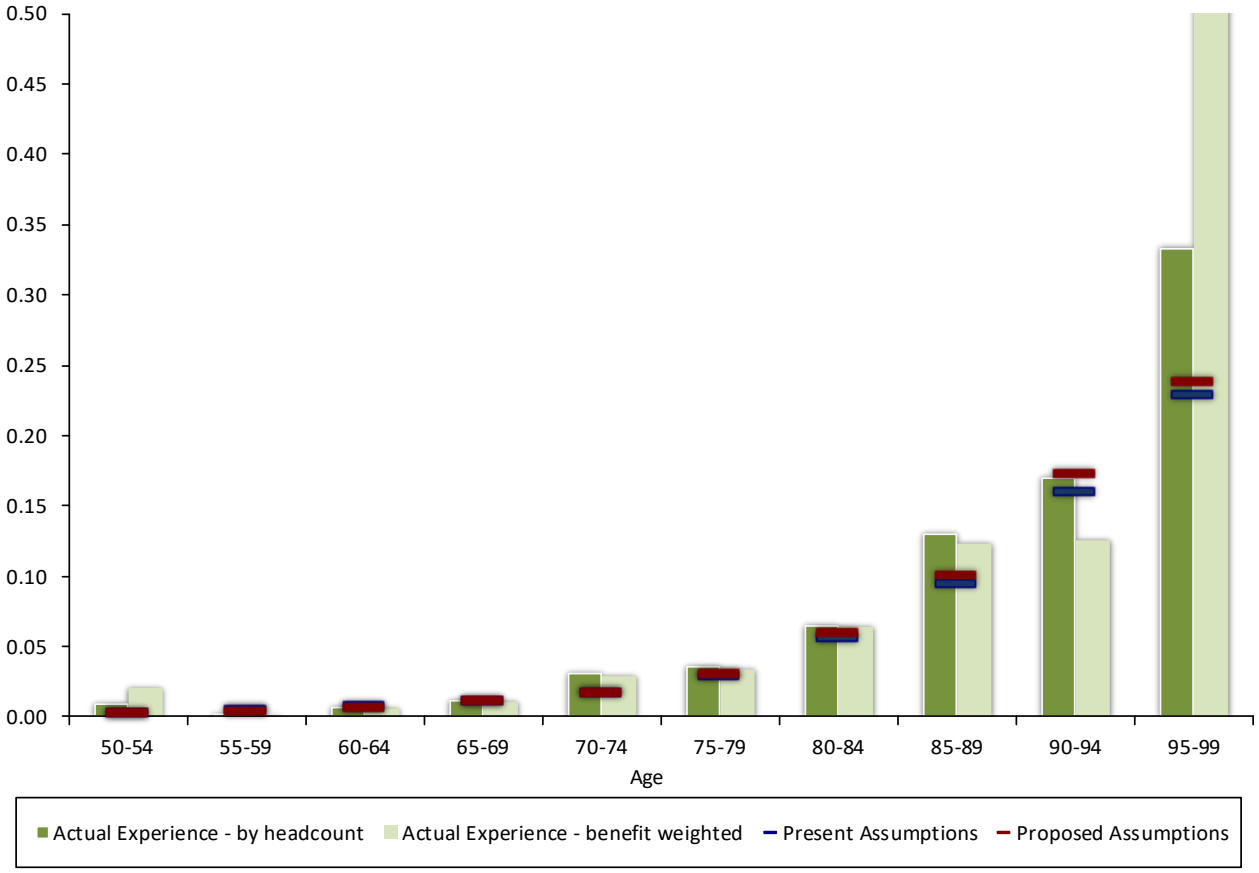
Due to the size of this plan, the experience is not considered credible. We recommend adoption of the following mortality tables (all recommended tables are Benefit Weighted):

Healthy Male Retirees:	Pub-2010 Male Healthy Retired Public Safety Mortality Table, adjusted for mortality improvements using projection scale MP-2021.
Healthy Female Retirees:	Pub-2010 Female Healthy Retired Public Safety Mortality Table, adjusted for mortality improvements using projection scale MP-2021.
Disabled Male Retirees:	Pub-2010 Male Public Safety Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021.
Disabled Female Retirees:	Pub-2010 Female Public Safety Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2021.
Male Active Members:	Pub-2010 Male Public Safety Employee Mortality Table adjusted for mortality improvements using projection scale MP-2021.
Female Active Members:	Pub-2010 Female Public Safety Employee Mortality Table adjusted for mortality improvements using projection scale MP-2021.

We reviewed both the public safety and general plan Pub-2010 mortality tables and found the safety plan mortality rates to be a better fit in most cases. Although the recommended pre-retirement and disability mortality tables appear to not be a good fit based on the plan's actual experience, the plan's experience is not considered to be credible, as noted earlier in this report. The number of active member and disabled retiree deaths during the four-year period was very low (16 male deaths and 4 female deaths among active members; 17 male deaths and 12 female deaths among disabled retirees).

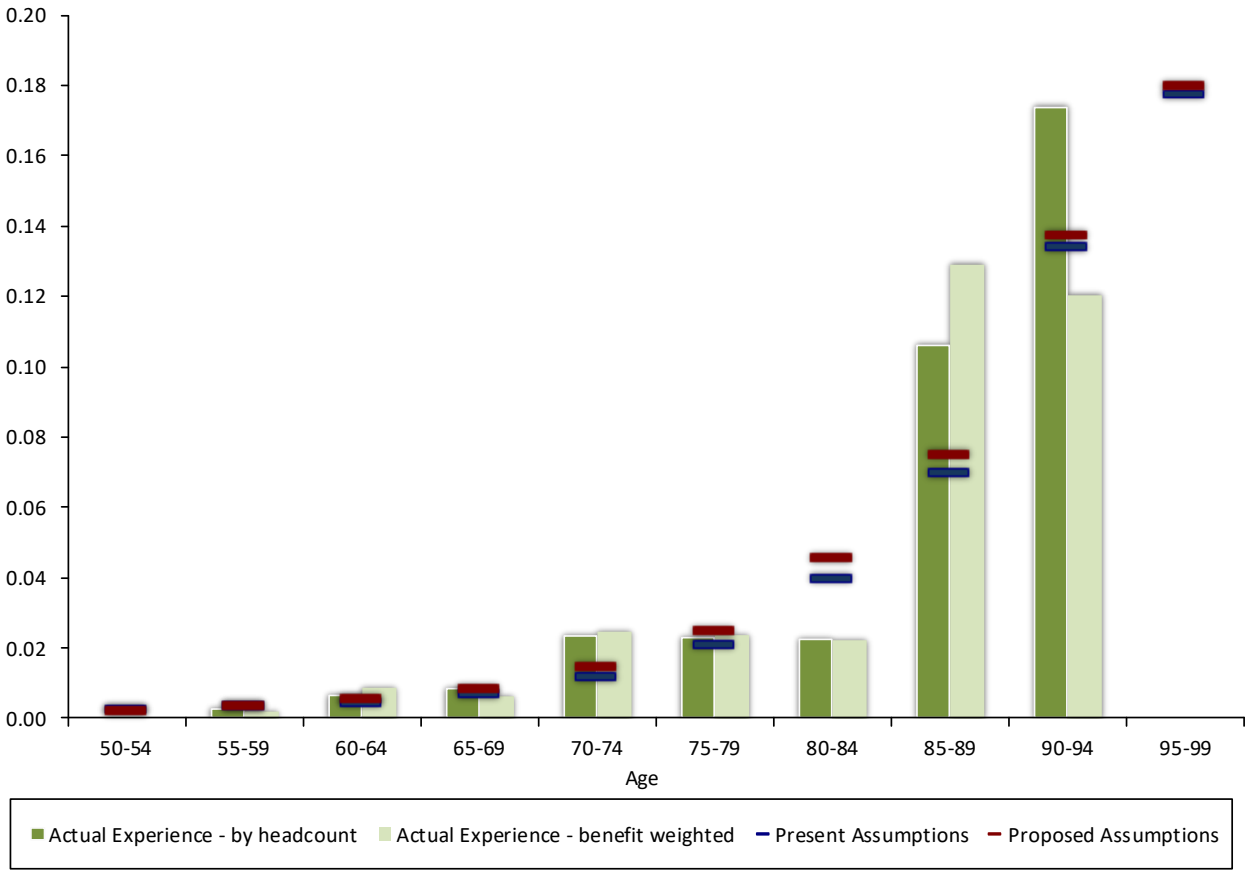
Post-Retirement Mortality Experience
Healthy Males

	Benefit Weighted ($000s)		Crude Rates				Benefit Weighted ($000s)		Ratio of	
			Benefit	Headcount	Sample Rates		Expected Deaths		Actuals/Expecteds	
Age	Deaths	Exposure	Weighted	Weighted	Present	Proposed	Present	Proposed	Present	Proposed
50-54	38	1,810	0.0210	0.0095	0.0035	0.0024	6.4	4.4	592.1%	873.1%
55-59	52	41,486	0.0013	0.0016	0.0052	0.0039	214.4	162.7	24.3%	32.0%
60-64	292	52,281	0.0056	0.0071	0.0074	0.0065	385.0	340.7	75.8%	85.7%
65-69	462	41,084	0.0112	0.0114	0.0109	0.0109	447.3	446.2	103.3%	103.5%
70-74	847	29,449	0.0288	0.0310	0.0173	0.0178	508.3	525.6	166.6%	161.2%
75-79	523	15,490	0.0338	0.0353	0.0296	0.0312	459.2	483.8	113.9%	108.1%
80-84	568	8,822	0.0644	0.0640	0.0563	0.0598	497.1	527.7	114.3%	107.6%
85-89	608	4,937	0.1232	0.1304	0.0949	0.1014	468.8	500.5	129.7%	121.5%
90-94	206	1,637	0.1258	0.1702	0.1603	0.1738	262.3	284.5	78.5%	72.4%
95-99	136	259	0.5251	0.3333	0.2291	0.2382	59.3	61.7	229.2%	220.4%
100+	-	56	0.0000	0.0000	0.3291	0.3307	18.4	18.5	0.0%	0.0%
Totals	**3,732**	**197,311**	**0.0189**	**0.0209**	**0.0169**	**0.0170**	**3,326.6**	**3,356.3**	**112.2%**	**111.2%**



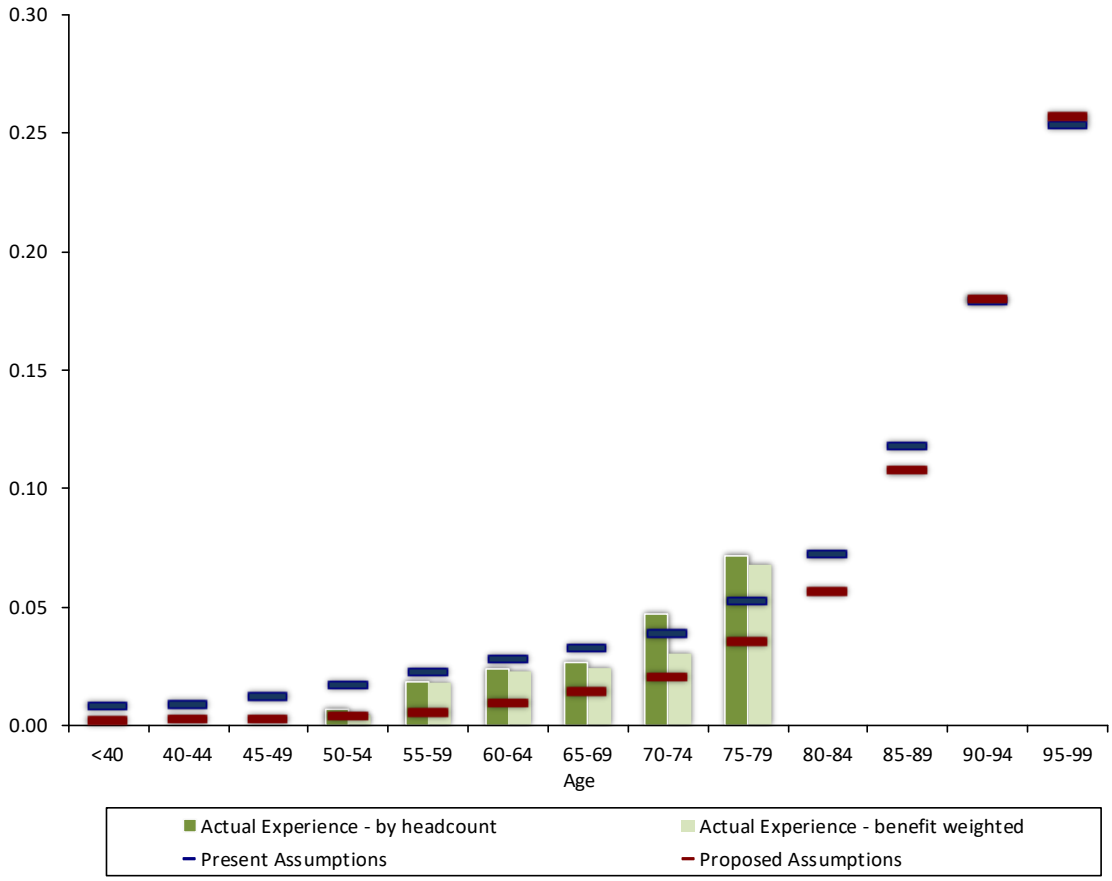
Post-Retirement Mortality Experience
Healthy Females

	Benefit Weighted ($000s)		Crude Rates				Benefit Weighted ($000s)		Ratio of	
			Benefit	Headcount	Sample Rates		Expected Deaths		Actuals/Expecteds	
Age	Deaths	Exposure	Weighted	Weighted	Present	Proposed	Present	Proposed	Present	Proposed
50-54	-	1,205	0.0000	0.0000	0.0026	0.0020	3.1	2.4	0.0%	0.0%
55-59	37	17,920	0.0021	0.0027	0.0035	0.0035	62.5	63.0	59.2%	58.8%
60-64	209	24,768	0.0084	0.0067	0.0047	0.0056	116.3	139.1	179.8%	150.3%
65-69	107	17,599	0.0061	0.0084	0.0070	0.0087	123.4	152.7	86.7%	70.1%
70-74	266	10,863	0.0245	0.0237	0.0119	0.0145	129.7	157.4	205.0%	169.0%
75-79	136	5,784	0.0235	0.0230	0.0211	0.0250	121.9	144.8	111.6%	93.9%
80-84	52	2,350	0.0221	0.0224	0.0399	0.0456	93.8	107.1	55.4%	48.6%
85-89	147	1,140	0.1289	0.1061	0.0697	0.0750	79.4	85.5	185.1%	171.9%
90-94	60	499	0.1202	0.1739	0.1342	0.1373	66.9	68.5	89.6%	87.6%
95-99	-	22	0.0000	0.0000	0.1775	0.1801	3.9	4.0	0.0%	0.0%
100+	25	49	0.5102	0.5000	0.3038	0.3036	14.9	14.9	168.0%	168.1%
Totals	**1,039**	**82,199**	**0.0126**	**0.0135**	**0.0099**	**0.0114**	**815.9**	**939.3**	**127.3%**	**110.6%**



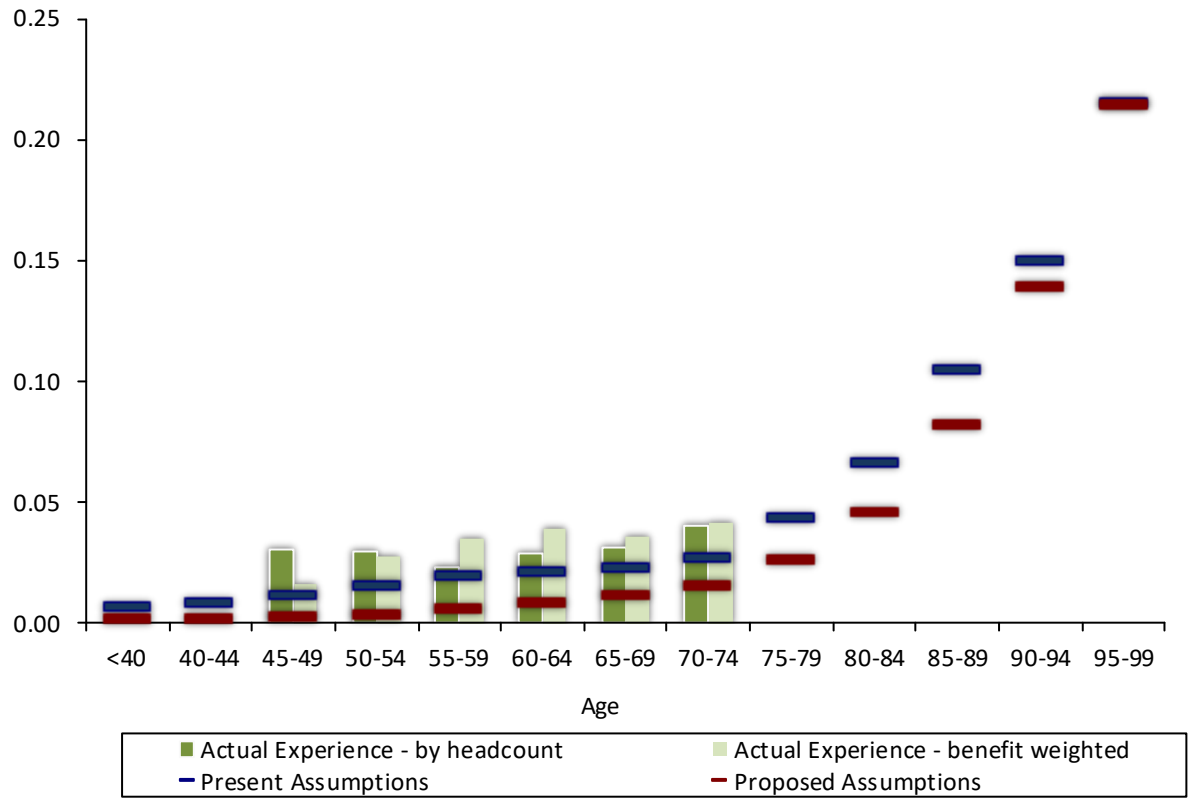
Post-Retirement Mortality Experience
Disabled Males

Age	Benefit Weighted ($000s)		Crude Rates		Sample Rates		Benefit Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Benefit Weighted	Headcount Weighted	Present	Proposed	Present	Proposed	Present	Proposed
<40	-	90	0.00%	0.00%	0.78%	0.22%	0.7	0.2	0.0%	0.0%
40-44	-	631	0.00%	0.00%	0.91%	0.24%	5.7	1.5	0.0%	0.0%
45-49	-	1,611	0.00%	0.00%	1.23%	0.29%	19.9	4.6	0.0%	0.0%
50-54	13	3,141	0.41%	0.69%	1.71%	0.37%	53.6	11.7	24.3%	111.0%
55-59	67	3,685	1.82%	1.82%	2.26%	0.56%	83.1	20.5	80.6%	327.3%
60-64	84	3,725	2.26%	2.41%	2.79%	0.93%	103.9	34.8	80.9%	241.6%
65-69	60	2,461	2.44%	2.63%	3.28%	1.41%	80.7	34.7	74.4%	172.9%
70-74	53	1,769	3.00%	4.71%	3.90%	2.05%	69.0	36.2	76.8%	146.3%
75-79	51	755	6.76%	7.14%	5.26%	3.55%	39.7	26.8	128.4%	190.5%
80-84	-	134	0.00%	0.00%	7.24%	5.62%	9.7	7.5	0.0%	0.0%
85-89	-	-	N/A	N/A	11.81%	10.78%	-	-	N/A	N/A
90-94	-	-	N/A	N/A	17.90%	18.01%	-	-	N/A	N/A
95-99	-	-	N/A	N/A	25.35%	25.67%	-	-	N/A	N/A
100+	-	-	N/A	N/A	42.94%	43.03%	-	-	N/A	N/A
Totals	**328**	**18,002**	**1.82%**	**2.08%**	**2.59%**	**0.99%**	**466.0**	**178.5**	**70.4%**	**183.8%**



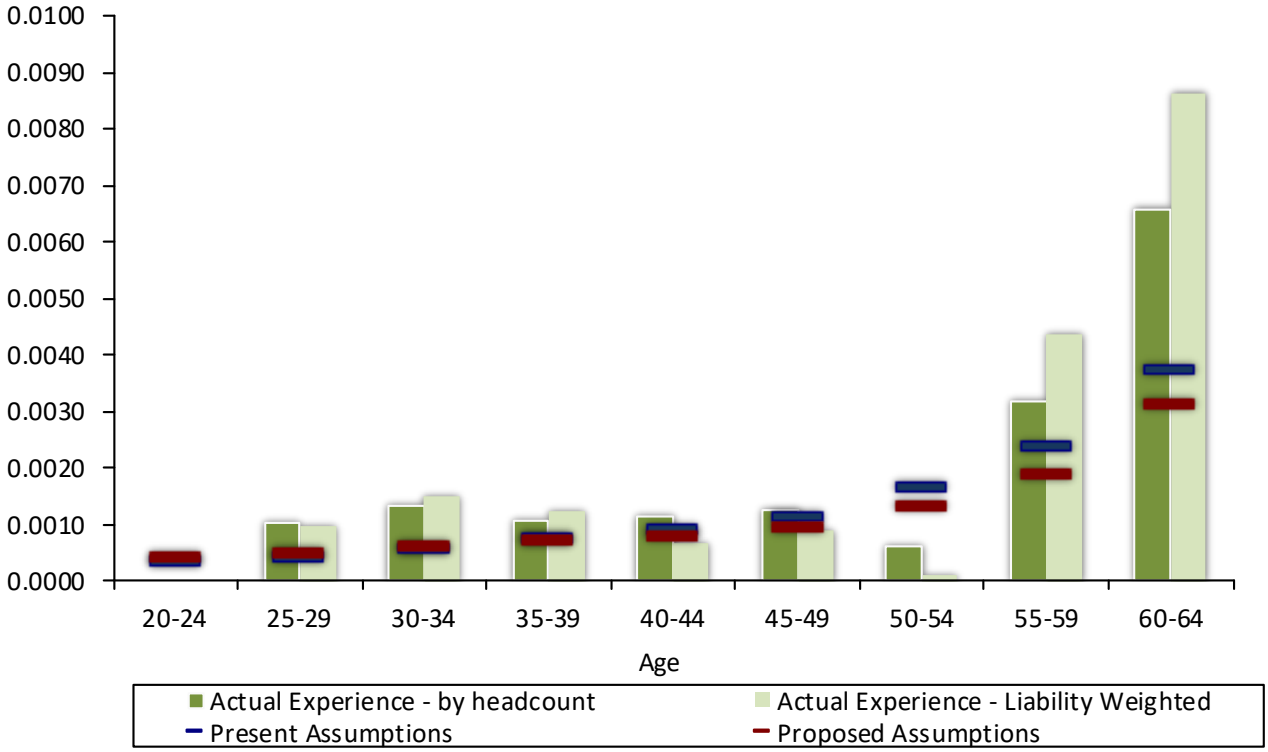
Post-Retirement Mortality Experience
Disabled Females

Age	Benefit Weighted ($000s) Deaths	Exposure	Crude Rates Benefit Weighted	Headcount Weighted	Sample Rates Present	Proposed	Benefit Weighted ($000s) Expected Deaths Present	Proposed	Ratio of Actuals/Expecteds Present	Proposed
<40	-	134	0.00%	0.00%	0.66%	0.18%	0.9	0.2	0.0%	0.0%
40-44	-	405	0.00%	0.00%	0.83%	0.20%	3.4	0.8	0.0%	0.0%
45-49	10	607	1.65%	3.03%	1.18%	0.24%	7.2	1.5	139.4%	673.3%
50-54	37	1,338	2.77%	2.99%	1.56%	0.34%	20.8	4.5	177.7%	819.2%
55-59	61	1,756	3.47%	2.27%	1.96%	0.58%	34.4	10.1	177.5%	603.4%
60-64	69	1,771	3.90%	2.88%	2.11%	0.84%	37.5	14.8	184.2%	465.6%
65-69	71	1,966	3.61%	3.13%	2.30%	1.16%	45.2	22.8	157.2%	311.5%
70-74	22	536	4.10%	4.00%	2.73%	1.54%	14.6	8.2	150.4%	267.0%
75-79	-	444	0.00%	0.00%	4.33%	2.67%	19.2	11.8	0.0%	0.0%
80-84	-	122	0.00%	0.00%	6.68%	4.57%	8.1	5.6	0.0%	0.0%
85-89	-	-	N/A	N/A	10.49%	8.20%	-	-	N/A	N/A
90-94	-	-	N/A	N/A	14.97%	13.93%	-	-	N/A	N/A
95-99	-	-	N/A	N/A	21.57%	21.47%	-	-	N/A	N/A
100+	-	-	N/A	N/A	40.64%	40.63%	-	-	N/A	N/A
Totals	**270**	**9,079**	**2.97%**	**2.57%**	**2.11%**	**0.89%**	**191.2**	**80.4**	**141.2%**	**335.7%**



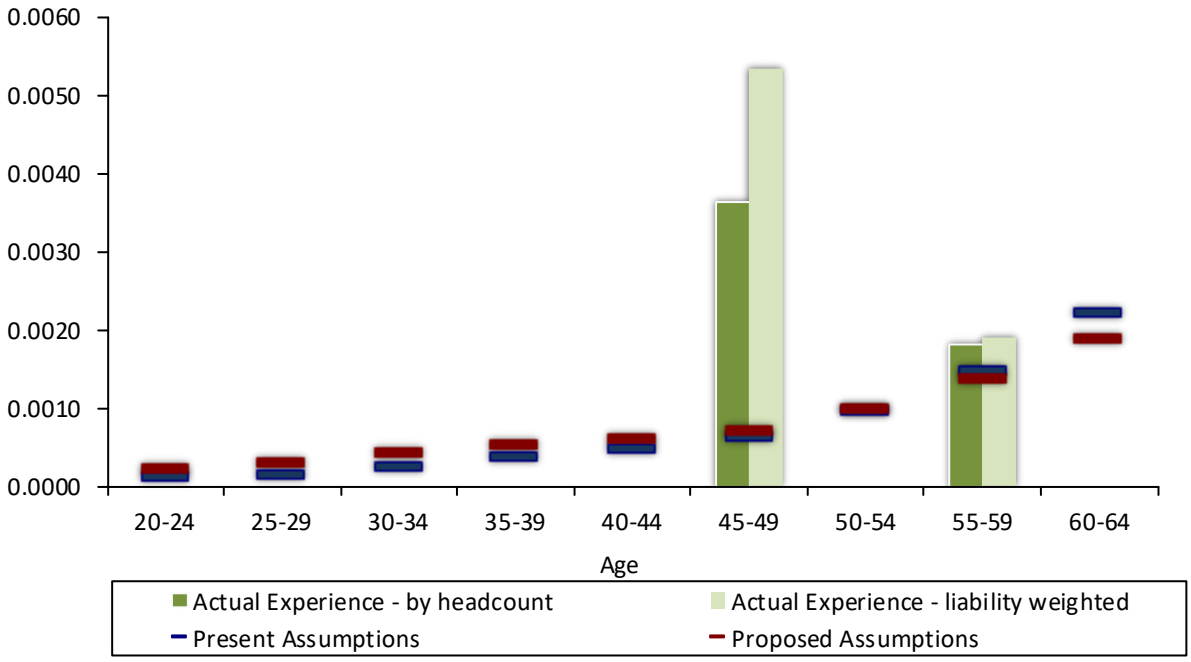
Pre-Retirement Mortality Experience
Healthy Males

Age	Liability Weighted ($000s)		Crude Rates		Sample Rates		Liability Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted	Present	Proposed	Present	Proposed	Present	Proposed
Under 20	-	56	0.00%	0.00%	0.04%	0.04%	0.0	0.0	0.0%	0.0%
20-24	-	16,698	0.00%	0.00%	0.04%	0.04%	5.9	7.1	0.0%	0.0%
25-29	83	84,964	0.10%	0.10%	0.04%	0.05%	35.4	42.6	234.7%	194.7%
30-34	284	187,969	0.15%	0.13%	0.06%	0.06%	111.1	117.3	255.7%	242.1%
35-39	442	361,031	0.12%	0.11%	0.08%	0.07%	274.4	263.8	161.1%	167.5%
40-44	298	438,989	0.07%	0.11%	0.09%	0.08%	398.0	354.5	74.9%	84.1%
45-49	450	508,668	0.09%	0.13%	0.12%	0.10%	586.3	487.2	76.7%	92.4%
50-54	68	636,790	0.01%	0.06%	0.17%	0.13%	1,061.7	846.3	6.4%	8.0%
55-59	1,356	311,667	0.44%	0.32%	0.24%	0.19%	742.8	594.0	182.6%	228.3%
60-64	951	110,223	0.86%	0.66%	0.37%	0.31%	410.8	346.5	231.5%	274.5%
Totals	**3,932**	**2,657,055**	**0.15%**	**0.15%**	**0.14%**	**0.12%**	**3,626.3**	**3,059.4**	**108.4%**	**128.5%**



Pre-Retirement Mortality Experience
Healthy Females

Age	Liability Weighted ($000s)		Crude Rates		Sample Rates		Liability Weighted ($000s) Expected Deaths		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted	Present	Proposed	Present	Proposed	Present	Proposed
Under 20	-	20	0.00%	0.00%	0.01%	0.02%	0.0	0.0	0.0%	0.0%
20-24	-	13,698	0.00%	0.00%	0.01%	0.02%	1.6	2.9	0.0%	0.0%
25-29	-	52,768	0.00%	0.00%	0.01%	0.03%	7.8	15.5	0.0%	0.0%
30-34	-	99,446	0.00%	0.00%	0.03%	0.04%	24.9	42.1	0.0%	0.0%
35-39	-	182,370	0.00%	0.00%	0.04%	0.05%	66.8	97.1	0.0%	0.0%
40-44	-	247,851	0.00%	0.00%	0.05%	0.06%	117.5	148.6	0.0%	0.0%
45-49	1,200	223,953	0.54%	0.36%	0.06%	0.07%	143.6	159.2	835.5%	753.8%
50-54	-	254,841	0.00%	0.00%	0.10%	0.10%	246.7	249.8	0.0%	0.0%
55-59	282	148,619	0.19%	0.18%	0.15%	0.14%	219.8	206.5	128.3%	136.6%
60-64	-	67,803	0.00%	0.00%	0.22%	0.19%	150.5	127.8	0.0%	0.0%
Totals	**1,482**	**1,291,369**	**0.11%**	**0.06%**	**0.08%**	**0.08%**	**979.4**	**1,049.5**	**151.3%**	**141.2%**



SECTION G

MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Marital Status

Married members will frequently make different annuity selections than non-married members. The current valuation assumption is 75% of male members are married 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	291	383	75.98%	75.00%	75.00%	287	287	101.3%	101.3%
Females	100	182	54.95%	60.00%	60.00%	109	109	91.6%	91.6%
Total	**391**	**565**	**69.20%**			**396**	**396**	**98.6%**	**98.6%**

In the analysis of retirements during the four-year period presented in Section C of this report, we included members who terminated employment after retirement eligibility but did not begin receiving payments. The analysis above includes only those members that terminated employment and began receiving payments.

The experience shows that the number of married new retirees is lower than expected for females. However, we do not recommend a change at this time since this assumption was lowered in the last experience study.

Recommendation

We recommend maintaining the current assumption of 75% married for males and 60% married for females.

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.

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	291	2.29	2.00	2.00	114.5%	114.5%
Females	100	-1.74	-2.00	-2.00	87.0%	87.0%
Total	**391**					

The experience shows that the average age difference for males is 2.29 years. However, the year-by-year experience ranges from 1.51 years (2020-2021 experience of 70 retirees) to 2.71 years (2022-2023 experience of 85 retirees). Similarly, the average age difference for females is -1.74 with year-by-year experience ranging from -3.48 (2019-2020 experience of 23 retirees) to -0.89 years (2021-2022 experience of 31 retirees).

Recommendation

We recommend continuing the present 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 (other than a refund of remaining employee contributions, if applicable) 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 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.

There is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan). Married members retiring from active status are currently assumed to elect annuities as follows:

Males:	12.5% elect 50% Joint & Survivor option
	12.5% elect 75% Joint & Survivor option
	65.0% elect 100% Joint & Survivor option
Females:	15.0% elect 50% Joint & Survivor option
	10.0% elect 75% Joint & Survivor option
	50.0% 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.

For new male retirees, experience was approximately as expected. For new female retirees, we found more married new retirees are electing the joint & survivor options.

Recommendation

We recommend increasing the assumed percentage electing the joint and survivor annuities as shown on the next page and reducing the assumed percentage electing the single life annuity accordingly for new married female retirees. We recommend minor adjustments to the assumed percentage electing the joint and survivor annuities for new male retirees.

Form of Payment

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	27	291	9.28%	10.00%	10.00%	29.10	29.10	92.8%	92.8%
50% joint & Survivor	43	291	14.78%	12.50%	15.00%	36.38	43.65	118.2%	98.5%
75% joint & Survivor	28	291	9.62%	12.50%	10.00%	36.38	29.10	77.0%	96.2%
100% joint & Survivor	193	291	66.32%	65.00%	65.00%	189.15	189.15	102.0%	102.0%
Total	**291**	**291**	**100.00%**	**100.00%**	**100.00%**	**291.00**	**291.00**		

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	17	100	17.00%	25.00%	15.00%	25.00	15.00	68.0%	113.3%
50% joint & Survivor	19	100	19.00%	15.00%	20.00%	15.00	20.00	126.7%	95.0%
75% joint & Survivor	5	100	5.00%	10.00%	5.00%	10.00	5.00	50.0%	100.0%
100% joint & Survivor	59	100	59.00%	50.00%	60.00%	50.00	60.00	118.0%	98.3%
Total	**100**	**100**	**100.00%**	**100.00%**	**100.00%**	**100.00**	**100.00**		

Actuarial Equivalent Factors

Joint and Survivor benefits are actuarially equivalent to the Single-life annuity, except there is no actuarial reduction for the bounce-back feature (i.e., this is subsidized by the plan). Current actuarial equivalent factors are based on the RP-2014 mortality table for healthy annuitants, reflecting projected mortality improvements for a member turning age 56 in 2021 using Scale MP-2017, white collar adjustment, male rates set forward two years, female rates set forward one year, blended 70% males, 5.91% 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.

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 invalid service (<0): service is set to 0 years.
- For members reported without a gender: assume the member is male.

Data for terminated members:

- For members reported without a benefit, we calculate benefits using the reported Average Salary, Credited Service, and Termination Date provided.
    - If Average Salary was not reported: Assume a value of $45,000.
    - If Credited Service was not reported: Assume a value of 5.0 years.
- For members reported without a gender: assume the member is male.

Data for retired members:

- For members reported without a gender: assume retirees are male and beneficiaries are female.
- For members reported without a benefit: no adjustment is made.
- For members reported with a bounceback annuity and an unreasonable reduction factor (<.5 or >1), a factor of 0.80, 0.85, and 0.90 is assumed for the 100%, 75% and 50% joint and survivor annuity, respectively.

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 at hire of new members with one to five years of service as of the last projection required by the Legislative Commission on Pensions and Retirement. This value is $53,000 as of July 1, 2022.*
- *For active members reported with an invalid date of birth: assume member was hired at the same age as new members with one to five years of service as of the last projection required by the Legislative Commission on Pensions and Retirement. This value is 34 years as of July 1, 2022.*
- *For terminated members if Average Salary was not reported or invalid: assume Average Salary equals $62,000.*
- *For terminated members reported without Credited Service: assume a value equal to elapsed time from hire to termination date; if elapsed time is not available, assume six years.*
- *For terminated members reported without a date of birth: assume age 42 at valuation date.*

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. Updating the analysis of these assumptions is outside the scope of this assignment due to significant data requirements.

Recommendation

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

Miscellaneous and Technical Assumptions

Benefit Service	Exact fractional service is used to determine the amount of benefit payable.
Decrement Operation	Withdrawal decrements do not operate during retirement eligibility.
Decrement Timing	Decrements of all types are assumed to occur mid-year.
Eligibility Testing	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.
Forfeitures	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.
Incidence of Contributions	Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.
Liability Adjustments	Liabilities for former members are increased by 17% for vested members and 6% for non-vested members to account for the effect of some participants having eligibility for a Combined Service Annuity.
Pay Increase Timing	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.
Service Credit Accruals	Members were assumed to accrue one year of service credit per year.

SECTION H

PROPOSED ASSUMPTION LISTING

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Merit and Seniority Pay Increases

% Merit Increases in Salaries Next Year	
Service Index	Rate
1	8.00%
2	3.50%
3	1.80%
4	1.60%
5	1.50%
6	1.50%
7	1.50%
8	1.50%
9	1.50%
10	1.50%
11	1.25%
12	1.15%
13	0.95%
14	0.75%
15	0.75%
16	0.75%
17	0.75%
18	0.50%
19	0.25%
20	0.25%
21	0.25%
22	0.00%
23	0.00%
24	0.00%
25+	0.00%

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Age and Service Retirement Pattern
Unreduced (Normal) Retirement

Age	% Retiring
55	55.0%
56	35.0%
57	20.0%
58	15.0%
59	15.0%
60	15.0%
61	25.0%
62	25.0%
63	25.0%
64	20.0%
65	30.0%
66	30.0%
67	30.0%
68	30.0%
69	25.0%
70+*	100.0%

** 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 the 2019-2023 Experience Study

Age and Service Retirement Pattern
Reduced (Early) Retirement

Age	% Retiring
50	3.0%
51	2.5%
52	2.5%
53	3.5%
54	4.0%

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Withdrawal

Year	% Withdrawals	
	Male	Female
1	25.00%	28.00%
2	16.00%	18.00%
3	13.00%	15.00%
4	11.00%	14.00%
5	9.00%	13.00%
6	8.50%	9.50%
7	6.50%	9.00%
8	5.75%	8.50%
9	5.25%	8.50%
10	4.00%	7.00%
11	3.25%	7.00%
12	3.00%	7.00%
13	3.00%	4.50%
14	2.50%	4.25%
15	2.00%	3.50%
16	1.90%	3.50%
17	1.80%	3.50%
18	1.60%	3.00%
19	1.30%	2.75%
20	1.00%	2.50%
21	0.50%	2.25%
22	0.50%	2.00%
23	0.50%	1.00%
24	0.50%	0.50%
25+	0.00%	0.00%

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.0500%	0.0500%
21	0.0500%	0.0500%
22	0.0700%	0.0700%
23	0.0700%	0.0700%
24	0.0800%	0.0800%
25	0.0800%	0.0800%
26	0.0800%	0.0800%
27	0.0900%	0.0900%
28	0.0900%	0.0900%
29	0.1100%	0.1100%
30	0.1100%	0.1100%
31	0.1200%	0.1200%
32	0.1200%	0.1200%
33	0.1300%	0.1300%
34	0.1300%	0.1300%
35	0.1700%	0.1700%
36	0.1700%	0.1700%
37	0.1700%	0.1700%
38	0.2000%	0.2000%
39	0.2100%	0.2100%
40	0.2200%	0.2200%
41	0.2400%	0.2400%
42	0.2470%	0.2470%
43	0.2500%	0.2500%
44	0.2500%	0.2500%
45	0.2500%	0.2500%
46	0.2500%	0.2500%
47	0.4000%	0.4000%
48	0.4000%	0.4000%
49	0.4000%	0.4000%
50	0.4000%	0.4000%
51	0.4000%	0.4000%
52	0.4000%	0.4000%
53	0.4000%	0.4000%
54	0.4000%	0.4000%
55+	0.4000%	0.4000%

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Healthy Post-Retirement Mortality Rates

Age in 2023	% Dying Next Year*	
	Male	Female
50	0.18%	0.14%
51	0.20%	0.15%
52	0.21%	0.17%
53	0.24%	0.20%
54	0.26%	0.22%
55	0.29%	0.25%
56	0.33%	0.29%
57	0.37%	0.33%
58	0.41%	0.37%
59	0.46%	0.41%
60	0.52%	0.46%
61	0.58%	0.51%
62	0.65%	0.56%
63	0.72%	0.61%
64	0.80%	0.67%
65	0.89%	0.73%
66	0.98%	0.80%
67	1.08%	0.87%
68	1.19%	0.95%
69	1.31%	1.05%
70	1.45%	1.16%
71	1.61%	1.28%
72	1.79%	1.43%
73	1.99%	1.60%
74	2.23%	1.79%
75	2.50%	2.00%
76	2.81%	2.25%
77	3.16%	2.53%
78	3.56%	2.85%
79	4.02%	3.20%
80	4.54%	3.60%

Age in 2023	% Dying Next Year*	
	Male	Female
81	5.14%	4.05%
82	5.81%	4.54%
83	6.56%	5.10%
84	7.40%	5.72%
85	8.34%	6.42%
86	9.39%	7.19%
87	10.54%	8.05%
88	11.83%	9.00%
89	13.24%	10.07%
90	14.80%	11.25%
91	16.39%	12.51%
92	17.95%	13.82%
93	19.46%	15.17%
94	20.91%	16.56%
95	22.31%	18.01%
96	23.84%	19.60%
97	25.43%	21.28%
98	27.13%	23.08%
99	28.96%	24.99%
100	30.91%	27.00%
101	32.93%	29.09%
102	34.95%	31.21%
103	36.96%	33.34%
104	38.92%	35.45%
105	40.82%	37.54%
106	42.67%	39.57%
107	44.46%	41.55%
108	46.14%	43.45%
109	47.76%	45.27%
110	49.07%	46.99%

** The rates shown are Pub-2010 mortality for healthy annuitants, Public Safety table. Recommended rates include mortality improvements using projection scale MP-2021 from a base year of 2010.*

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Disabled Post-Retirement Mortality Rates

Age in 2023	% Dying Next Year*	
	Male	Female
20	0.13%	0.06%
21	0.13%	0.06%
22	0.13%	0.07%
23	0.13%	0.07%
24	0.13%	0.07%
25	0.13%	0.08%
26	0.14%	0.09%
27	0.15%	0.10%
28	0.15%	0.11%
29	0.16%	0.11%
30	0.17%	0.12%
31	0.18%	0.13%
32	0.19%	0.14%
33	0.20%	0.15%
34	0.20%	0.16%
35	0.21%	0.17%
36	0.22%	0.18%
37	0.22%	0.18%
38	0.23%	0.19%
39	0.23%	0.19%
40	0.24%	0.20%
41	0.24%	0.20%
42	0.25%	0.20%
43	0.25%	0.21%
44	0.26%	0.21%
45	0.26%	0.22%
46	0.27%	0.23%
47	0.28%	0.23%
48	0.30%	0.25%
49	0.31%	0.26%
50	0.33%	0.28%
51	0.35%	0.30%
52	0.37%	0.33%
53	0.39%	0.37%
54	0.42%	0.41%
55	0.46%	0.45%

Age in 2023	% Dying Next Year*	
	Male	Female
56	0.50%	0.50%
57	0.55%	0.55%
58	0.61%	0.61%
59	0.68%	0.67%
60	0.75%	0.72%
61	0.83%	0.78%
62	0.92%	0.84%
63	1.01%	0.89%
64	1.10%	0.95%
65	1.19%	1.01%
66	1.29%	1.07%
67	1.39%	1.14%
68	1.50%	1.22%
69	1.62%	1.30%
70	1.76%	1.40%
71	1.91%	1.52%
72	2.10%	1.64%
73	2.31%	1.79%
74	2.56%	1.95%
75	2.86%	2.13%
76	3.21%	2.34%
77	3.59%	2.57%
78	4.02%	2.85%
79	4.48%	3.20%
80	4.98%	3.60%
81	5.53%	4.05%
82	6.12%	4.54%
83	6.79%	5.10%
84	7.54%	5.72%
85	8.41%	6.42%
86	9.39%	7.19%
87	10.54%	8.05%
88	11.83%	9.00%
89	13.24%	10.07%
90	14.80%	11.25%

** The rates shown are Pub-2010 mortality for disabled annuitants, Public Safety table. Recommended rates include mortality improvements using projection scale MP-2021 from a base year of 2010.*

Proposed Actuarial Assumptions
Based on the 2019-2023 Experience Study

Healthy Pre-Retirement Mortality Rates

Age in 2023	% Dying Next Year*	
	Male	Female
20	0.04%	0.02%
21	0.04%	0.02%
22	0.04%	0.02%
23	0.04%	0.02%
24	0.04%	0.02%
25	0.04%	0.02%
26	0.05%	0.03%
27	0.05%	0.03%
28	0.05%	0.03%
29	0.06%	0.03%
30	0.06%	0.04%
31	0.06%	0.04%
32	0.06%	0.04%
33	0.07%	0.05%
34	0.07%	0.05%
35	0.07%	0.05%
36	0.07%	0.05%
37	0.07%	0.06%
38	0.08%	0.06%
39	0.08%	0.06%
40	0.08%	0.06%
41	0.08%	0.06%
42	0.08%	0.06%
43	0.08%	0.06%
44	0.09%	0.06%
45	0.09%	0.07%

Age in B6	% Dying Next Year*	
	Male	Female
46	0.09%	0.07%
47	0.10%	0.07%
48	0.10%	0.07%
49	0.11%	0.08%
50	0.11%	0.08%
51	0.12%	0.09%
52	0.13%	0.10%
53	0.14%	0.10%
54	0.15%	0.11%
55	0.17%	0.12%
56	0.18%	0.13%
57	0.20%	0.14%
58	0.22%	0.15%
59	0.25%	0.16%
60	0.27%	0.17%
61	0.30%	0.18%
62	0.32%	0.19%
63	0.35%	0.20%
64	0.38%	0.21%
65	0.41%	0.22%
66	0.46%	0.24%
67	0.51%	0.27%
68	0.57%	0.31%
69	0.63%	0.35%
70	0.71%	0.40%

* *The rates shown are Pub-2010 mortality for employees, Public Safety. Recommended rates include mortality improvements using projection scale MP-2021 from a base year of 2010.*

SECTION I

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.

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.

Glossary

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 J

APPENDIX

Appendix – Detailed Experience Analysis

In this section, we present the annual experience for each major assumption that was analyzed for the study. Results are based on liability-weighted experience for withdrawal, retirement and pre-retirement mortality, benefit-weighted for post-retirement and disabled mortality, and population-weighted for all other analysis. Please note that totals may not sum correctly due to rounding of intermediate results.

Appendix – Detailed Experience Analysis
Salary Increases

2019-2023 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	982	11.99%	11.50%
2	1,026	6.89%	7.00%
3	1,016	6.02%	5.00%
4	962	5.24%	5.00%
5	888	5.30%	4.75%
6	821	5.61%	4.75%
7	718	5.61%	4.75%
8	654	5.89%	4.75%
9	543	4.85%	4.50%
10	469	6.21%	4.50%
11	425	5.24%	4.50%
12	497	4.92%	4.50%
13	603	4.81%	4.25%
14	679	4.90%	4.00%
15	644	5.24%	3.75%
16	520	5.52%	3.75%
17	400	5.06%	3.75%
18	313	5.06%	3.50%
19	273	4.18%	3.50%
20	253	4.43%	3.50%
21	223	4.93%	3.25%
22	197	3.85%	3.25%
23	157	5.16%	3.25%
24	147	4.11%	3.25%
25+	574	4.74%	3.00%
Totals	**13,984**	**5.69%**	**4.79%**

Appendix – Detailed Experience Analysis
Salary Increases

2019-2020 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	307	12.57%	11.50%
2	308	7.16%	7.00%
3	294	6.47%	5.00%
4	264	5.03%	5.00%
5	219	4.78%	4.75%
6	191	5.35%	4.75%
7	174	4.74%	4.75%
8	164	6.10%	4.75%
9	93	4.73%	4.50%
10	106	5.07%	4.50%
11	127	3.66%	4.50%
12	211	4.82%	4.50%
13	208	4.52%	4.25%
14	186	4.18%	4.00%
15	118	3.54%	3.75%
16	78	4.22%	3.75%
17	83	3.54%	3.75%
18	81	4.73%	3.50%
19	71	3.39%	3.50%
20	59	2.91%	3.50%
21	53	4.57%	3.25%
22	44	2.57%	3.25%
23	33	3.09%	3.25%
24	44	3.68%	3.25%
25+	149	3.72%	3.00%
Totals	**3,665**	**5.32%**	**4.93%**

Appendix – Detailed Experience Analysis
Salary Increases

2020-2021 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	314	11.85%	11.50%
2	295	6.70%	7.00%
3	275	4.34%	5.00%
4	269	3.59%	5.00%
5	251	2.82%	4.75%
6	202	2.86%	4.75%
7	180	3.59%	4.75%
8	158	2.89%	4.75%
9	160	2.11%	4.50%
10	87	3.63%	4.50%
11	102	2.67%	4.50%
12	123	2.64%	4.50%
13	200	2.68%	4.25%
14	203	3.14%	4.00%
15	183	3.75%	3.75%
16	116	3.20%	3.75%
17	73	2.44%	3.75%
18	79	4.23%	3.50%
19	76	3.27%	3.50%
20	71	3.48%	3.50%
21	52	3.42%	3.25%
22	49	1.91%	3.25%
23	37	4.25%	3.25%
24	32	3.06%	3.25%
25+	152	3.69%	3.00%
Totals	**3,739**	**4.03%**	**4.90%**

Appendix – Detailed Experience Analysis
Salary Increases

2021-2022 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	188	9.99%	11.50%
2	242	7.40%	7.00%
3	254	7.29%	5.00%
4	219	7.78%	5.00%
5	234	6.53%	4.75%
6	225	6.60%	4.75%
7	180	7.53%	4.75%
8	167	6.94%	4.75%
9	145	7.04%	4.50%
10	138	7.72%	4.50%
11	80	7.95%	4.50%
12	93	7.02%	4.50%
13	116	7.78%	4.25%
14	182	6.64%	4.00%
15	180	6.53%	3.75%
16	168	7.07%	3.75%
17	96	6.72%	3.75%
18	62	5.12%	3.50%
19	67	5.34%	3.50%
20	65	4.50%	3.50%
21	64	5.87%	3.25%
22	48	4.86%	3.25%
23	45	3.86%	3.25%
24	35	3.83%	3.25%
25+	140	5.10%	3.00%
Totals	**3,433**	**6.83%**	**4.69%**

Appendix – Detailed Experience Analysis
Salary Increases

2022-2023 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	173	13.35%	11.50%
2	181	6.13%	7.00%
3	193	6.01%	5.00%
4	210	4.94%	5.00%
5	184	7.43%	4.75%
6	203	7.32%	4.75%
7	184	6.38%	4.75%
8	165	7.24%	4.75%
9	145	5.69%	4.50%
10	138	7.11%	4.50%
11	116	7.10%	4.50%
12	70	6.15%	4.50%
13	79	6.45%	4.25%
14	108	6.30%	4.00%
15	163	6.52%	3.75%
16	158	6.10%	3.75%
17	148	5.99%	3.75%
18	91	5.98%	3.50%
19	59	4.88%	3.50%
20	58	6.78%	3.50%
21	54	5.52%	3.25%
22	56	5.62%	3.25%
23	42	8.80%	3.25%
24	36	5.64%	3.25%
25+	133	6.47%	3.00%
Totals	**3,147**	**6.67%**	**4.64%**

Appendix – Detailed Experience Analysis
Retirements

2019-2023 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	3,552	157,086	6,283	56.5%
51	4,019	168,810	5,064	79.4%
52	3,113	176,058	5,282	58.9%
53	6,033	173,342	5,200	116.0%
54	9,062	190,245	5,707	158.8%
55	110,358	192,349	96,174	114.7%
56	31,197	87,383	26,215	119.0%
57	16,597	63,088	9,463	175.4%
58	8,804	50,794	7,619	115.6%
59	7,271	50,947	7,642	95.1%
60	8,868	49,425	7,414	119.6%
61	13,120	42,696	6,404	204.9%
62	8,817	33,727	10,118	87.1%
63	7,116	26,444	7,933	89.7%
64	3,515	17,249	2,587	135.8%
65	5,171	15,794	4,738	109.1%
66	3,786	11,006	3,302	114.7%
67	2,641	7,316	1,829	144.4%
68	1,996	4,939	1,235	161.6%
69	689	3,741	935	73.7%
Totals	**255,725**	**1,522,439**	**221,147**	**115.6%**

Appendix – Detailed Experience Analysis
Retirements

2019-2020 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	1,799	32,022	1,281	140.4%
51	1,277	34,890	1,047	122.0%
52	895	47,451	1,424	62.9%
53	1,845	42,208	1,266	145.7%
54	1,902	48,337	1,450	131.2%
55	20,571	39,173	19,587	105.0%
56	5,844	20,071	6,021	97.1%
57	2,690	15,533	2,330	115.5%
58	2,041	10,964	1,645	124.1%
59	1,520	13,543	2,031	74.8%
60	2,333	14,140	2,121	110.0%
61	3,374	8,653	1,298	260.0%
62	2,664	8,062	2,419	110.1%
63	2,778	6,282	1,885	147.4%
64	752	2,662	399	188.3%
65	975	3,933	1,180	82.6%
66	1,051	2,787	836	125.7%
67	738	910	228	324.2%
68	354	1,179	295	120.0%
69	271	1,587	397	68.4%
Totals	**55,674**	**354,388**	**49,138**	**113.3%**

2020-2021 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	944	45,442	1,818	51.9%
51	918	35,282	1,058	86.7%
52	277	36,750	1,103	25.1%
53	631	50,937	1,528	41.3%
54	2,570	44,399	1,332	193.0%
55	25,658	49,741	24,871	103.2%
56	6,099	20,449	6,135	99.4%
57	2,624	15,819	2,373	110.6%
58	2,124	14,356	2,153	98.6%
59	1,017	10,228	1,534	66.3%
60	2,748	13,474	2,021	136.0%
61	3,566	13,019	1,953	182.6%
62	1,946	5,780	1,734	112.3%
63	540	6,111	1,833	29.5%
64	451	4,195	629	71.6%
65	286	2,155	646	44.3%
66	336	3,268	980	34.3%
67	248	1,889	472	52.6%
68	0	204	51	0.0%
69	56	885	221	25.3%
Totals	**53,039**	**374,384**	**54,446**	**97.4%**

Appendix – Detailed Experience Analysis
Retirements

2021-2022 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	144	43,577	1,743	8.3%
51	1,825	50,091	1,503	121.4%
52	1,183	37,478	1,124	105.2%
53	1,382	39,854	1,196	115.6%
54	2,839	55,080	1,652	171.8%
55	26,557	45,807	22,904	115.9%
56	10,657	25,546	7,664	139.0%
57	5,919	15,416	2,312	256.0%
58	2,765	14,281	2,142	129.1%
59	3,220	13,908	2,086	154.3%
60	1,367	10,395	1,559	87.6%
61	2,706	10,889	1,633	165.7%
62	2,541	10,507	3,152	80.6%
63	1,566	4,791	1,437	108.9%
64	1,717	6,505	976	175.9%
65	1,792	4,312	1,294	138.6%
66	939	2,078	623	150.6%
67	1,591	3,263	816	195.0%
68	731	1,709	427	171.0%
69	179	244	61	292.1%
Totals	**71,617**	**395,734**	**56,306**	**127.2%**

2022-2023 Experience ($000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	665	36,044	1,442	46.1%
51	0	48,546	1,456	0.0%
52	759	54,379	1,631	46.5%
53	2,175	40,343	1,210	179.7%
54	1,750	42,429	1,273	137.5%
55	37,572	57,627	28,814	130.4%
56	8,598	21,316	6,395	134.5%
57	5,364	16,320	2,448	219.1%
58	1,874	11,193	1,679	111.6%
59	1,515	13,268	1,990	76.1%
60	2,420	11,416	1,712	141.3%
61	3,474	10,135	1,520	228.5%
62	1,667	9,377	2,813	59.2%
63	2,231	9,260	2,778	80.3%
64	595	3,886	583	102.1%
65	2,117	5,393	1,618	130.9%
66	1,460	2,874	862	169.4%
67	64	1,253	313	20.3%
68	911	1,846	462	197.4%
69	183	1,024	256	71.6%
Totals	**75,396**	**397,932**	**61,256**	**123.1%**

Appendix – Detailed Experience Analysis
Terminations

2019-2023 Experience ($000s)

	Males				Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	6,100	20,591	4,119	148.1%	1	4,940	16,029	4,007	123.3%
2	11,392	64,323	9,648	118.1%	2	11,006	52,173	7,826	140.6%
3	10,360	72,639	7,264	142.6%	3	7,619	51,520	7,728	98.6%
4	8,353	71,044	7,104	117.6%	4	6,808	53,784	8,068	84.4%
5	6,283	70,744	6,013	104.5%	5	7,450	53,590	6,699	111.2%
6	6,531	70,841	5,490	119.0%	6	4,264	47,782	4,778	89.2%
7	4,364	69,365	4,682	93.2%	7	4,242	46,684	4,668	90.9%
8	3,980	63,706	3,504	113.6%	8	2,891	42,934	4,293	67.3%
9	3,352	62,128	3,106	107.9%	9	3,496	40,025	4,002	87.4%
10	2,885	57,406	1,579	182.8%	10	1,470	36,092	2,707	54.3%
11	2,101	55,049	1,514	138.8%	11	3,142	31,201	2,262	138.9%
12	1,740	59,089	1,477	117.8%	12	1,503	26,684	1,868	80.5%
13	2,629	68,934	1,551	169.5%	13	945	33,339	1,667	56.7%
14	2,236	91,244	2,053	108.9%	14	1,553	38,950	1,947	79.7%
15	2,220	109,520	2,190	101.3%	15	1,517	46,586	1,863	81.4%
16	1,834	111,939	2,239	81.9%	16	1,289	44,786	1,791	71.9%
17	1,777	99,108	1,982	89.7%	17	865	33,655	1,346	64.3%
18	1,379	80,192	1,203	114.6%	18	672	27,129	1,085	61.9%
19	813	60,518	756	107.4%	19	281	19,894	597	47.2%
20	-	53,103	531	0.0%	20	613	16,526	496	123.6%
21	-	47,753	478	0.0%	21	369	18,110	453	81.5%
22	679	47,110	471	144.2%	22	-	15,369	346	0.0%
23	-	42,087	421	0.0%	23	-	12,811	192	0.0%
24	398	27,168	272	146.6%	24	402	12,504	94	428.6%
25+	-	21,783	-	N/A	25+	-	8,668	-	N/A
Totals	**81,406**	**1,597,380**	**69,648**	**116.9%**	**Totals**	**67,339**	**826,823**	**70,785**	**95.1%**

Appendix – Detailed Experience Analysis
Terminations

2019-2020 Experience ($000s)

	Males				Females			
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	1,520	5,074	1,015	149.7%	1	1,795	5,640	1,410	127.3%
2	2,653	17,445	2,617	101.4%	2	3,729	16,906	2,536	147.1%
3	2,836	20,745	2,074	136.7%	3	2,053	15,329	2,299	89.3%
4	2,203	18,667	1,867	118.0%	4	2,212	14,355	2,153	102.7%
5	1,357	17,880	1,520	89.3%	5	1,826	14,064	1,758	103.9%
6	2,020	17,602	1,364	148.0%	6	1,120	11,787	1,179	95.0%
7	1,400	14,814	1,000	140.1%	7	289	10,825	1,083	26.7%
8	658	15,137	833	79.0%	8	116	8,151	815	14.2%
9	1,133	14,555	728	155.6%	9	983	8,633	863	113.9%
10	551	9,858	271	203.1%	10	474	5,083	381	124.3%
11	811	11,051	304	266.7%	11	957	6,497	471	203.1%
12	388	17,438	436	89.0%	12	382	7,098	497	77.0%
13	100	26,550	597	16.8%	13	411	13,751	688	59.8%
14	898	33,803	761	118.1%	14	-	10,229	511	0.0%
15	556	27,895	558	99.7%	15	324	11,944	478	67.8%
16	598	18,981	380	157.6%	16	-	6,678	267	0.0%
17	272	13,917	278	97.8%	17	269	3,971	159	169.1%
18	275	13,634	205	134.6%	18	-	4,224	169	0.0%
19	366	12,706	159	230.5%	19	-	5,168	155	0.0%
20	-	15,056	151	0.0%	20	245	4,637	139	176.2%
21	-	12,506	125	0.0%	21	-	4,923	123	0.0%
22	-	9,993	100	0.0%	22	-	2,668	60	0.0%
23	-	6,516	65	0.0%	23	-	2,716	41	0.0%
24	-	4,417	44	0.0%	24	-	4,233	32	0.0%
25+	-	12,486	-	N/A	25+	-	3,423	-	N/A
Totals	**20,594**	**388,727**	**17,450**	**118.0%**	**Totals**	**17,185**	**202,932**	**18,266**	**94.1%**

Appendix – Detailed Experience Analysis
Terminations

2020-2021 Experience ($000s)

	Males				Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	1,421	6,264	1,253	113.4%	1	1,009	4,389	1,097	92.0%
2	1,702	17,448	2,617	65.1%	2	2,865	15,232	2,285	125.4%
3	1,768	19,010	1,901	93.0%	3	1,730	16,205	2,431	71.2%
4	1,876	19,084	1,908	98.3%	4	1,456	13,737	2,061	70.7%
5	1,463	17,904	1,522	96.2%	5	1,565	14,107	1,763	88.7%
6	762	18,662	1,446	52.7%	6	602	12,857	1,286	46.8%
7	937	16,883	1,140	82.2%	7	775	12,320	1,232	62.9%
8	811	14,080	774	104.8%	8	208	11,443	1,144	18.2%
9	720	15,536	777	92.7%	9	101	8,905	891	11.3%
10	-	15,254	419	0.0%	10	323	8,671	650	49.6%
11	76	10,245	282	27.0%	11	317	4,377	317	100.0%
12	201	10,775	269	74.5%	12	175	6,482	454	38.7%
13	622	18,490	416	149.4%	13	297	7,436	372	80.0%
14	1,005	26,645	600	167.6%	14	390	14,006	700	55.7%
15	273	33,928	679	40.3%	15	-	10,158	406	0.0%
16	248	28,853	577	43.0%	16	-	11,661	466	0.0%
17	295	18,739	375	78.6%	17	-	7,456	298	0.0%
18	-	14,115	212	0.0%	18	-	2,695	108	0.0%
19	-	13,856	173	0.0%	19	281	2,902	87	323.4%
20	-	12,351	124	0.0%	20	-	5,410	162	0.0%
21	-	14,662	147	0.0%	21	-	5,019	125	0.0%
22	328	12,054	121	272.3%	22	-	4,169	94	0.0%
23	-	8,677	87	0.0%	23	-	1,358	20	0.0%
24	-	6,022	60	0.0%	24	-	2,925	22	0.0%
25+	-	9,297	-	N/A	25+	-	5,245	-	N/A
Totals	**14,509**	**398,833**	**17,878**	**81.2%**	**Totals**	**12,096**	**209,166**	**18,473**	**65.5%**

Appendix – Detailed Experience Analysis
Terminations

2021-2022 Experience ($000s)

	Males				Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	1,205	3,284	657	183.5%	1	798	2,058	515	155.1%
2	3,688	15,409	2,311	159.6%	2	1,989	8,956	1,343	148.1%
3	2,758	16,709	1,671	165.0%	3	1,732	11,335	1,700	101.8%
4	1,717	17,560	1,756	97.8%	4	1,554	13,643	2,047	75.9%
5	2,254	17,618	1,497	150.5%	5	2,368	12,605	1,576	150.3%
6	1,147	17,501	1,356	84.6%	6	1,778	11,847	1,185	150.1%
7	951	18,346	1,238	76.8%	7	1,353	11,936	1,194	113.4%
8	936	15,453	850	110.1%	8	1,289	10,959	1,096	117.7%
9	1,064	14,979	749	142.0%	9	472	11,924	1,192	39.6%
10	1,186	16,439	452	262.3%	10	-	10,138	760	0.0%
11	206	16,753	461	44.7%	11	986	8,711	632	156.2%
12	444	11,354	284	156.5%	12	-	4,293	300	0.0%
13	423	11,361	256	165.6%	13	-	6,848	342	0.0%
14	-	17,786	400	0.0%	14	636	7,223	361	176.2%
15	790	28,075	562	140.6%	15	707	16,214	649	109.0%
16	719	34,144	683	105.3%	16	546	9,869	395	138.3%
17	-	30,674	613	0.0%	17	212	12,265	491	43.2%
18	866	18,749	281	307.8%	18	-	7,257	290	0.0%
19	-	14,361	180	0.0%	19	-	3,352	101	0.0%
20	-	11,916	119	0.0%	20	367	2,862	86	428.0%
21	-	9,599	96	0.0%	21	-	4,809	120	0.0%
22	351	15,193	152	231.2%	22	-	4,439	100	0.0%
23	-	10,214	102	0.0%	23	-	4,106	62	0.0%
24	-	7,293	73	0.0%	24	402	1,567	12	3421.3%
25+	-	-	-	N/A	25+	-	-	-	N/A
Totals	**20,705**	**390,770**	**16,799**	**123.2%**	**Totals**	**17,190**	**199,217**	**16,547**	**103.9%**

Appendix – Detailed Experience Analysis
Terminations

2022-2023 Experience ($000s)

	Males				Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	1,954	5,968	1,194	163.7%	1	1,337	3,942	986	135.6%
2	3,349	14,021	2,103	159.2%	2	2,423	11,079	1,662	145.8%
3	2,998	16,175	1,617	185.4%	3	2,105	8,650	1,298	162.2%
4	2,557	15,733	1,573	162.5%	4	1,586	12,049	1,807	87.8%
5	1,208	17,342	1,474	81.9%	5	1,691	12,814	1,602	105.6%
6	2,602	17,075	1,323	196.6%	6	764	11,291	1,129	67.6%
7	1,076	19,323	1,304	82.5%	7	1,825	11,603	1,160	157.3%
8	1,575	19,036	1,047	150.4%	8	1,278	12,381	1,238	103.2%
9	436	17,057	853	51.1%	9	1,941	10,562	1,056	183.7%
10	1,149	15,855	436	263.4%	10	674	12,200	915	73.6%
11	1,009	16,999	467	215.8%	11	881	11,616	842	104.7%
12	708	19,522	488	145.0%	12	945	8,811	617	153.2%
13	1,484	12,533	282	526.2%	13	237	5,304	265	89.4%
14	332	13,009	293	113.6%	14	527	7,492	375	140.6%
15	601	19,621	392	153.1%	15	486	8,270	331	146.9%
16	268	29,962	599	44.8%	16	743	16,578	663	112.0%
17	1,210	35,778	716	169.1%	17	384	9,962	398	96.5%
18	238	33,694	505	47.1%	18	672	12,954	518	129.7%
19	446	19,596	245	182.3%	19	-	8,472	254	0.0%
20	-	13,779	138	0.0%	20	-	3,617	109	0.0%
21	-	10,986	110	0.0%	21	369	3,359	84	439.6%
22	-	9,871	99	0.0%	22	-	4,093	92	0.0%
23	-	16,680	167	0.0%	23	-	4,631	69	0.0%
24	398	9,436	94	422.0%	24	-	3,780	28	0.0%
25+	-	-	-	N/A	25+	-	-	-	N/A
Totals	**25,599**	**419,051**	**17,521**	**146.1%**	**Totals**	**20,867**	**215,509**	**17,499**	**119.3%**

Appendix – Detailed Experience Analysis
Disability Retirements

2019-2023 Experience

Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	604	0.4	0.0%
25-29	-	1,763	1.6	0.0%
30-34	-	2,423	3.0	0.0%
35-39	8	2,962	5.3	151.4%
40-44	5	2,863	7.1	70.6%
45-49	13	2,425	7.4	175.4%
50-54	10	2,477	12.0	83.4%
55+	4	2,238	15.7	25.5%
Totals	**40**	**17,755**	**52.5**	**76.2%**

Appendix – Detailed Experience Analysis
Disability Retirements

Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	141	0.1	0.0%
25-29	-	476	0.4	0.0%
30-34	-	652	0.8	0.0%
35-39	-	775	1.4	0.0%
40-44	-	661	1.6	0.0%
45-49	8	624	1.9	416.7%
50-54	3	628	3.1	97.7%
55+	1	500	3.5	28.6%
Totals	**12**	**4,457**	**12.9**	**93.3%**

2020-2021 Experience

Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	141	0.1	0.0%
25-29	-	460	0.4	0.0%
30-34	-	610	0.7	0.0%
35-39	2	754	1.3	149.3%
40-44	2	692	1.7	117.0%
45-49	2	591	1.8	111.1%
50-54	1	635	3.1	32.7%
55+	1	507	3.6	28.2%
Totals	**8**	**4,390**	**12.7**	**62.9%**

Appendix – Detailed Experience Analysis
Disability Retirements

2021-2022 Experience

Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	158	0.1	0.0%
25-29	-	423	0.4	0.0%
30-34	-	603	0.7	0.0%
35-39	2	734	1.3	153.3%
40-44	1	739	1.8	54.9%
45-49	1	586	1.8	56.1%
50-54	5	626	3.0	165.2%
55+	1	627	4.4	22.8%
Totals	**10**	**4,496**	**13.6**	**73.7%**

2022-2023 Experience

Age Group	Actual Disabilities	Exposure	Expected Disabilities	Actual/ Expected
Under 20	-	-	-	N/A
20-24	-	164	0.1	0.0%
25-29	-	404	0.4	0.0%
30-34	-	558	0.7	0.0%
35-39	4	699	1.3	320.0%
40-44	2	771	1.9	104.7%
45-49	2	624	1.9	104.7%
50-54	1	588	2.8	35.2%
55+	1	604	4.2	23.6%
Totals	**10**	**4,412**	**13.3**	**75.1%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2019-2023 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	38	1,810	6.4	592.1%	50-54	-	1,205	3.1	0.0%
55-59	52	41,486	214.4	24.3%	55-59	37	17,920	62.5	59.2%
60-64	292	52,281	385.0	75.8%	60-64	209	24,768	116.3	179.8%
65-69	462	41,084	447.3	103.3%	65-69	107	17,599	123.4	86.7%
70-74	847	29,449	508.3	166.6%	70-74	266	10,863	129.7	205.0%
75-79	523	15,490	459.2	113.9%	75-79	136	5,784	121.9	111.6%
80-84	568	8,822	497.1	114.3%	80-84	52	2,350	93.8	55.4%
85-89	608	4,937	468.8	129.7%	85-89	147	1,140	79.4	185.1%
90-94	206	1,637	262.3	78.5%	90-94	60	499	66.9	89.6%
95-99	136	259	59.3	229.2%	95-99	-	22	3.9	0.0%
100+	-	56	18.4	0.0%	100+	25	49	14.9	168.0%
Totals	**3,732**	**197,311**	**3,326.6**	**112.2%**	**Totals**	**1,039**	**82,199**	**815.9**	**127.3%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2019-2020 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	476	1.7	0.0%	50-54	-	300	0.8	0.0%
55-59	-	10,481	54.7	0.0%	55-59	-	4,431	15.6	0.0%
60-64	72	11,452	84.3	85.4%	60-64	43	5,498	25.8	166.4%
65-69	125	9,780	105.6	118.4%	65-69	34	3,656	25.7	132.1%
70-74	100	6,325	109.1	91.7%	70-74	85	2,326	28.2	301.3%
75-79	110	3,048	89.4	123.1%	75-79	-	1,097	23.5	0.0%
80-84	74	2,395	132.8	55.7%	80-84	21	495	20.2	103.9%
85-89	186	1,026	101.6	183.1%	85-89	-	190	13.3	0.0%
90-94	10	307	50.1	20.0%	90-94	-	133	16.7	0.0%
95-99	-	57	13.6	0.0%	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	24	7.0	0.0%
Totals	**677**	**45,347**	**742.7**	**91.2%**	**Totals**	**183**	**18,150**	**176.8**	**103.5%**

2020-2021 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	38	444	1.6	2437.4%	50-54	-	347	0.9	0.0%
55-59	28	10,208	53.4	52.5%	55-59	14	4,440	15.7	89.4%
60-64	88	12,810	94.7	92.9%	60-64	114	6,081	28.7	396.6%
65-69	154	10,101	110.9	138.8%	65-69	9	4,024	28.3	31.8%
70-74	299	7,008	122.4	244.3%	70-74	71	2,541	30.5	232.8%
75-79	170	3,516	105.1	161.7%	75-79	38	1,278	26.8	141.6%
80-84	223	2,234	126.6	176.2%	80-84	-	621	25.2	0.0%
85-89	88	1,051	95.4	92.2%	85-89	36	215	15.3	235.1%
90-94	56	473	73.5	76.2%	90-94	54	158	21.2	254.8%
95-99	45	84	18.7	241.2%	95-99	-	-	-	N/A
100+	-	18	5.6	0.0%	100+	25	25	7.8	318.8%
Totals	**1,189**	**47,947**	**807.7**	**147.2%**	**Totals**	**361**	**19,730**	**200.4**	**180.1%**

Appendix – Detailed Experience Analysis
Post-Retirement Mortality

2021-2022 Experience ($000s)

Age Group	Males Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Females Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	481	1.7	0.0%	50-54	-	268	0.7	0.0%
55-59	24	10,221	52.9	45.4%	55-59	23	4,342	15.1	152.0%
60-64	32	13,700	101.2	31.6%	60-64	28	6,474	30.3	92.3%
65-69	108	10,264	112.5	96.0%	65-69	11	4,567	32.0	34.4%
70-74	355	7,799	135.5	262.0%	70-74	24	2,915	34.9	68.8%
75-79	121	3,982	118.5	102.1%	75-79	54	1,470	30.9	175.0%
80-84	121	2,152	122.4	98.8%	80-84	31	682	27.5	112.8%
85-89	106	1,317	125.6	84.4%	85-89	23	286	20.4	112.8%
90-94	111	437	72.1	154.0%	90-94	6	105	14.7	40.8%
95-99	33	53	12.7	259.4%	95-99	-	-	-	N/A
100+	-	19	6.2	0.0%	100+	-	-	-	N/A
Totals	**1,011**	**50,425**	**861.4**	**117.4%**	**Totals**	**200**	**21,109**	**206.5**	**96.9%**

2022-2023 Experience ($000s)

Age Group	Males Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Females Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
50-54	-	409	1.5	0.0%	50-54	-	290	0.7	0.0%
55-59	-	10,576	53.5	0.0%	55-59	-	4,707	16.1	0.0%
60-64	100	14,319	104.8	95.4%	60-64	24	6,715	31.3	76.6%
65-69	75	10,939	118.3	63.4%	65-69	53	5,352	37.4	141.8%
70-74	93	8,317	141.4	65.8%	70-74	86	3,081	36.2	237.8%
75-79	122	4,944	146.2	83.4%	75-79	44	1,939	40.7	108.0%
80-84	150	2,041	115.3	130.1%	80-84	-	552	20.9	0.0%
85-89	228	1,543	146.1	156.0%	85-89	88	449	30.5	288.9%
90-94	29	420	66.7	43.5%	90-94	-	103	14.3	0.0%
95-99	58	65	14.4	404.1%	95-99	-	22	3.9	0.0%
100+	-	19	6.6	0.0%	100+	-	-	-	N/A
Totals	**855**	**53,592**	**914.7**	**93.5%**	**Totals**	**295**	**23,210**	**232.1**	**127.1%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

2019-2023 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	56	0.0	0.0%	Under 20	-	20	0.0	0.0%
20-24	-	16,698	5.9	0.0%	20-24	-	13,698	1.6	0.0%
25-29	83	84,964	35.4	234.7%	25-29	-	52,768	7.8	0.0%
30-34	284	187,969	111.1	255.7%	30-34	-	99,446	24.9	0.0%
35-39	442	361,031	274.4	161.1%	35-39	-	182,370	66.8	0.0%
40-44	298	438,989	398.0	74.9%	40-44	-	247,851	117.5	0.0%
45-49	450	508,668	586.3	76.7%	45-49	1,200	223,953	143.6	835.5%
50-54	68	636,790	1,061.7	6.4%	50-54	-	254,841	246.7	0.0%
55-59	1,356	311,667	742.8	182.6%	55-59	282	148,619	219.8	128.3%
60-64	951	110,223	410.8	231.5%	60-64	-	67,803	150.5	0.0%
Totals	**3,932**	**2,657,055**	**3,626.3**	**108.4%**	**Totals**	**1,482**	**1,291,369**	**979.4**	**151.3%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

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	-	-	-	N/A	Under 20	-	20	0.0	0.0%
20-24	-	3,511	1.2	0.0%	20-24	-	2,759	0.3	0.0%
25-29	83	21,003	8.7	957.2%	25-29	-	14,137	2.1	0.0%
30-34	-	49,879	28.8	0.0%	30-34	-	25,248	6.3	0.0%
35-39	-	87,303	64.1	0.0%	35-39	-	50,989	18.3	0.0%
40-44	-	100,182	88.5	0.0%	40-44	-	51,158	23.9	0.0%
45-49	202	123,144	141.2	143.0%	45-49	255	54,664	35.5	717.3%
50-54	-	153,704	259.6	0.0%	50-54	-	58,749	57.9	0.0%
55-59	-	66,133	160.5	0.0%	55-59	-	38,065	57.2	0.0%
60-64	-	27,606	102.2	0.0%	60-64	-	14,872	32.7	0.0%
Totals	**285**	**632,465**	**854.7**	**33.3%**	**Totals**	**255**	**310,661**	**234.3**	**108.8%**

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	-	19	0.0	0.0%	Under 20	-	-	-	N/A
20-24	-	3,379	1.2	0.0%	20-24	-	3,537	0.4	0.0%
25-29	-	21,304	8.8	0.0%	25-29	-	14,088	2.1	0.0%
30-34	-	48,782	28.7	0.0%	30-34	-	24,545	6.1	0.0%
35-39	-	89,638	67.5	0.0%	35-39	-	49,343	17.9	0.0%
40-44	261	105,753	94.9	274.9%	40-44	-	62,657	29.5	0.0%
45-49	248	125,716	144.3	171.9%	45-49	475	51,862	33.2	1432.3%
50-54	-	156,876	261.9	0.0%	50-54	-	63,969	61.7	0.0%
55-59	602	77,698	185.1	325.3%	55-59	-	37,336	55.3	0.0%
60-64	591	28,663	106.9	552.9%	60-64	-	16,188	35.4	0.0%
Totals	**1,702**	**657,828**	**899.3**	**189.2%**	**Totals**	**475**	**323,525**	**241.7**	**196.5%**

Appendix – Detailed Experience Analysis
Pre-Retirement Mortality

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	-	-	-	N/A	Under 20	-	-	-	N/A
20-24	-	4,242	1.5	0.0%	20-24	-	3,655	0.4	0.0%
25-29	-	20,567	8.6	0.0%	25-29	-	12,237	1.8	0.0%
30-34	158	45,652	27.2	581.1%	30-34	-	24,682	6.2	0.0%
35-39	-	92,408	71.1	0.0%	35-39	-	41,012	15.2	0.0%
40-44	-	108,117	98.8	0.0%	40-44	-	64,428	30.6	0.0%
45-49	-	123,157	141.5	0.0%	45-49	-	53,949	34.4	0.0%
50-54	-	166,971	277.6	0.0%	50-54	-	64,517	62.2	0.0%
55-59	754	79,992	191.8	393.1%	55-59	-	38,224	56.4	0.0%
60-64	360	27,166	102.2	352.2%	60-64	-	18,110	40.6	0.0%
Totals	**1,272**	**668,272**	**920.3**	**138.2%**	**Totals**	**-**	**320,814**	**247.9**	**0.0%**

2022-2023 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
Under 20	-	37	0.0	0.0%	Under 20	-	-	-	N/A
20-24	-	5,566	2.0	0.0%	20-24	-	3,747	0.4	0.0%
25-29	-	22,090	9.3	0.0%	25-29	-	12,306	1.8	0.0%
30-34	126	43,656	26.4	477.7%	30-34	-	24,971	6.4	0.0%
35-39	442	91,682	71.6	617.1%	35-39	-	41,026	15.4	0.0%
40-44	37	124,937	115.8	32.0%	40-44	-	69,608	33.5	0.0%
45-49	-	136,651	159.3	0.0%	45-49	470	63,478	40.5	1160.0%
50-54	68	159,239	262.6	25.9%	50-54	-	67,606	64.9	0.0%
55-59	-	87,844	205.5	0.0%	55-59	282	34,994	50.9	554.3%
60-64	-	26,788	99.5	0.0%	60-64	-	18,633	41.7	0.0%
Totals	**673**	**698,490**	**952.0**	**70.7%**	**Totals**	**752**	**336,369**	**255.6**	**294.2%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2019-2023 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
<40	-	90	0.7	0.0%	40-44	-	134	0.9	0.0%
40-44	-	631	5.7	0.0%	40-44	-	405	3.4	0.0%
45-49	-	631	5.7	0.0%	45-49	-	405	3.4	0.0%
50-54	-	1,611	19.9	0.0%	50-54	10	607	7.2	139.4%
55-59	13	3,141	53.6	24.3%	55-59	37	1,338	20.8	177.7%
60-64	67	3,685	83.1	80.6%	60-64	61	1,756	34.4	177.5%
65-69	84	3,725	103.9	80.9%	65-69	69	1,771	37.5	184.2%
70-74	60	2,461	80.7	74.4%	70-74	71	1,966	45.2	157.2%
75-79	53	1,769	69.0	76.8%	75-79	22	536	14.6	150.4%
80-84	51	755	39.7	128.4%	80-84	-	444	19.2	0.0%
85-89	-	134	9.7	0.0%	85-89	-	122	8.1	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	-	-	N/A
Totals	**328**	**18,633**	**471.7**	**69.5%**	**Totals**	**270**	**9,484**	**194.6**	**138.7%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2019-2020 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
<40	-	19	0.1	0.0%	40-44	-	50	0.3	0.0%
40-44	-	160	1.4	0.0%	40-44	-	87	0.7	0.0%
45-49	-	160	1.4	0.0%	45-49	-	87	0.7	0.0%
50-54	-	423	5.1	0.0%	50-54	-	196	2.4	0.0%
55-59	13	716	12.3	105.6%	55-59	-	258	4.0	0.0%
60-64	29	796	18.2	159.4%	60-64	30	489	9.5	315.6%
65-69	26	976	27.1	96.1%	65-69	-	435	9.2	0.0%
70-74	-	636	21.1	0.0%	70-74	-	489	11.1	0.0%
75-79	-	273	10.9	0.0%	75-79	22	44	1.3	1700.4%
80-84	-	133	6.7	0.0%	80-84	-	117	4.6	0.0%
85-89	-	22	1.5	0.0%	85-89	-	22	1.4	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	-	-	N/A
Totals	**68**	**4,314**	**105.8**	**64.3%**	**Totals**	**52**	**2,274**	**45.2**	**115.0%**

2020-2021 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
<40	-	-	-	N/A	40-44	-	34	0.2	0.0%
40-44	-	153	1.4	0.0%	40-44	-	64	0.5	0.0%
45-49	-	153	1.4	0.0%	45-49	-	64	0.5	0.0%
50-54	-	499	6.1	0.0%	50-54	10	181	2.1	482.5%
55-59	-	768	13.2	0.0%	55-59	14	341	5.3	263.8%
60-64	22	874	19.6	112.2%	60-64	-	442	8.7	0.0%
65-69	44	1,030	28.8	152.6%	65-69	16	432	9.1	175.0%
70-74	15	555	18.5	80.9%	70-74	17	538	12.3	138.0%
75-79	-	378	14.8	0.0%	75-79	-	79	2.1	0.0%
80-84	-	179	9.3	0.0%	80-84	-	118	5.0	0.0%
85-89	-	22	1.6	0.0%	85-89	-	22	1.5	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	-	-	N/A
Totals	**81**	**4,611**	**114.6**	**70.7%**	**Totals**	**57**	**2,315**	**47.3**	**120.5%**

Appendix – Detailed Experience Analysis
Disabled Mortality

2021-2022 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
<40	-	45	0.3	0.0%	40-44	-	28	0.2	0.0%
40-44	-	159	1.5	0.0%	40-44	-	100	0.8	0.0%
45-49	-	159	1.5	0.0%	45-49	-	100	0.8	0.0%
50-54	-	368	4.6	0.0%	50-54	-	159	1.9	0.0%
55-59	-	783	13.2	0.0%	55-59	-	328	5.1	0.0%
60-64	-	969	21.7	0.0%	60-64	-	417	8.2	0.0%
65-69	-	891	24.8	0.0%	65-69	23	451	9.5	241.4%
70-74	28	654	21.3	131.7%	70-74	54	531	12.3	439.4%
75-79	15	494	19.1	78.4%	75-79	-	146	3.9	0.0%
80-84	17	233	12.4	136.8%	80-84	-	120	5.5	0.0%
85-89	-	23	1.8	0.0%	85-89	-	23	1.7	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	-	-	N/A
Totals	**60**	**4,778**	**122.2**	**49.1%**	**Totals**	**77**	**2,403**	**50.0**	**154.0%**

2022-2023 Experience ($000s)

	Males					Females			
Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected	Age Group	Actual Deaths	Exposure	Expected Deaths	Actual/ Expected
<40	-	26	0.2	0.0%	40-44	-	22	0.1	0.0%
40-44	-	159	1.5	0.0%	40-44	-	154	1.3	0.0%
45-49	-	159	1.5	0.0%	45-49	-	154	1.3	0.0%
50-54	-	321	4.0	0.0%	50-54	-	71	0.8	0.0%
55-59	-	874	14.9	0.0%	55-59	23	411	6.4	361.4%
60-64	16	1,046	23.6	67.8%	60-64	31	408	8.0	386.9%
65-69	14	828	23.1	60.5%	65-69	30	453	9.6	313.3%
70-74	17	616	19.8	86.0%	70-74	-	408	9.4	0.0%
75-79	38	624	24.2	156.7%	75-79	-	267	7.3	0.0%
80-84	34	210	11.3	300.7%	80-84	-	89	4.2	0.0%
85-89	-	67	4.8	0.0%	85-89	-	55	3.6	0.0%
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
100+	-	-	-	N/A	100+	-	-	-	N/A
Totals	**119**	**4,930**	**129.0**	**92.2%**	**Totals**	**84**	**2,492**	**52.1**	**161.2%**