

# Minnesota Correctional Employees Retirement Fund

Four-Year Experience Study

July 1, 2015 through June 30, 2019





June 30, 2020

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, 2015 to June 30, 2019**, 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.

Board of Directors  
Minnesota State Retirement System  
Correctional Employees Retirement Fund  
June 30, 2020

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

Brian B. Murphy and Bonita J. Wurst 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, Mr. Murphy 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



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BJW/BBM:bd



# Actuarial Experience Study 2015-2019

## Table of Contents

<b>Item</b>	<b>Section</b>
Overview and Summary of Results	A
Pay Increases	B
Retirement Experience	C
Withdrawal Experience	D
Disability Experience	E
Mortality Experience	F
Miscellaneous and Technical Assumptions	G
Proposed Assumption Listing	H
Glossary	I
Appendix	J

## **SECTION A**

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### **OVERVIEW AND SUMMARY OF RESULTS**

## Summary of Findings

The four-year period (July 1, 2015 to June 30, 2019) 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

- Decrease the price inflation assumption from 2.50% to 2.25%.
- Decrease the wage inflation (i.e., payroll growth) assumption from 3.25% to 3.00%.
- Adjust rates of merit and seniority, resulting in proposed merit and seniority increases that are approximately 16 basis points lower on average than the current rates. When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates of approximately 41 basis points.
- Adjust assumed retirement rates:
  - Increase the rate of assumed unreduced retirements (i.e., Normal Retirement) at ages 55, 56, 62 and 63 and decrease the rate of assumed unreduced retirements at ages 64 and 69. Overall, proposed rates produce more unreduced retirements than the current rates.
  - Decrease rates of assumed early retirement rates at ages 50 and 54.
- Change the assumed rates of withdrawal (termination of membership before eligible to retire):
  - Proposed rates are service-based
  - Generally, proposed rates are higher than current rates for males with less than 10 years of service and females with less than 13 years of service.
- Lower rates of disability, especially for those over age 45 and extend the disability incidence assumption to age 70.
- Change the base mortality table to the PUB-2010 General mortality table, with future improvement projected using scale MP-2019.
- Minor changes to the percent married and form of payment 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, 2019. This report concluded that the current investment return assumption was within a reasonable range as of the date of the report, but that a rate near the median, such as 7.0%, would be likely to be sustainable for a longer period.

It is important to note that, by lowering the assumed rate of inflation but not the assumed investment return rate, the assumptions are actually more optimistic than before because the assumed real rate of return is higher than previously assumed. The 7.50% investment return assumption is required per Minnesota Statutes.

## 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, 2017 actuarial valuation based on the results of the most recent experience study. Economic assumptions were last revised for the June 30, 2018 actuarial valuation. All experience was compared to assumptions in effect as of the June 30, 2019 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 2015-2019

Decrement Risk Area	Actual Number	Expected		
		Current Assumptions	Proposed Assumptions	Change
<i>Unreduced Retirement</i>	508	503.2	556.8	53.6
<i>Reduced Retirement</i>	70	83.2	70.2	(13.0)
<i>Withdrawal, &lt; 3 years of service</i>				
Males	385	231.4	331.7	100.3
Females	422	251.4	361.7	110.3
<i>Withdrawal, &gt; 3 years of service</i>				
Males	290	220.5	273.4	52.9
Females	305	197.0	282.3	85.3
<i>Disability</i>	41	45.2	36.7	(8.5)
<i>Mortality</i>				
Healthy Retired Lives - Male	100	102.4	99.0	(3.4)
- Female	31	35.9	32.6	(3.3)
Disabled Retired Lives - Male	14	18.3	17.2	(1.1)
- Female	6	6.9	7.9	1.0
Active Lives - Male	16	9.6	12.6	3.0
- Female	1	4.1	3.8	(0.3)

The figures in the exhibit above are actual headcounts of occurrences. Calculations in the body of the report are liability weighted for retirement, withdrawal and active mortality and benefit weighted for healthy and disabled retiree mortality.



## **SECTION B**

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### **PAY INCREASES**

## Pay Increases

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

- Payroll growth is an across-the-board, economic type of increase granted to most or all members of the group and is associated with a stable or level population. 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.

### Inflation and Payroll Growth

For the Correctional Employees plan, the general inflation assumption is currently 2.50% and the payroll growth assumption is currently 3.25%.

General inflation, as measured by the change in the Consumer Price Index, has averaged about 1.8% over the four-year period ending June 30, 2019. During the 2016 to 2018 calendar year period, the increase in the national average earnings has been about 2.7% (the 2019 national average earnings amount was not available at the time this report was published). Actual annual payroll growth for this plan for the four-year period ending June 30, 2019 has averaged approximately 3.7%. Active membership during this time increased 3.0%, from 4,449 as of July 1, 2015 to 4,582 as of July 1, 2019.

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, 2019. In that report, we recommended a general inflation assumption equal to 2.25% and a payroll growth assumption of 3.00%; note that the decrease in payroll growth assumption is due to the change in inflation only (i.e., there was no recommended change to the 0.75% real wage growth assumption).

We recommend reducing the assumed rate to 2.25% for general inflation and 3.00% for payroll growth (i.e., no recommended change to the 0.75% real wage growth assumption). Changing the inflation assumption to 2.25% is supported by experience and is 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 would have 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 for this group. Based on our review of salary experience for CERF members for the period July 1, 2015 through June 30, 2019, we observed members with longer service averaged about a 2.75% annual increase for this period. We assumed the salary increase amount for these members 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.

The assumed wage inflation was 3.50% at the beginning of the study period and 3.25% as of June 30, 2019. However, as described above, we estimated the average actual wage inflation component of pay increases was around 2.75% for members of the Correctional Employees Retirement Fund. This estimated 2.75% wage inflation increase was subtracted from the actual pay increases to obtain the estimated merit/seniority portion of the pay increases. It should be noted the results of the analysis are very sensitive to the estimated wage inflation component.

# Pay Increases Due to Merit and Seniority

## Findings

Gross actual salary increases averaged 5.00% over the four-year period, ranging from 4.76% in 2018 to 5.28% in 2019. After adjusting for the 2.75% average wage inflation for this period, the average net salary increase (i.e., merit and seniority) averaged 2.25%, ranging from 2.01% to 2.53%.

Fiscal Year Ending	Count	Gross		Net*	
		Expected	Actual	Expected	Actual
2016	3,623	5.63%	5.02%	2.38%	2.27%
2017	3,787	5.88%	4.93%	2.63%	2.18%
2018	3,714	5.67%	4.76%	2.42%	2.01%
2019	3,716	5.64%	5.28%	2.39%	2.53%
<b>Total</b>	<b>14,840</b>	<b>5.71%</b>	<b>5.00%</b>	<b>2.46%</b>	<b>2.25%</b>

\* Net Expected increases are equal to Gross Expected increases minus the current assumed wage inflation assumption of 3.25%. Net Actual increases are equal to Gross Actual increases minus the estimated actual wage inflation for the period of 2.75%.

The results of our analysis are shown on the following page. Using the techniques described above, observed merit and seniority pay increases were generally lower than the presently assumed increases, especially early in the member's career. The result is that the proposed merit and seniority increases are 16 basis points lower on average but with a slightly different allocation. When combined with the proposed decrease in payroll growth assumption, the result is an overall decrease in gross salary increase rates of approximately 41 basis points.

## Recommendation

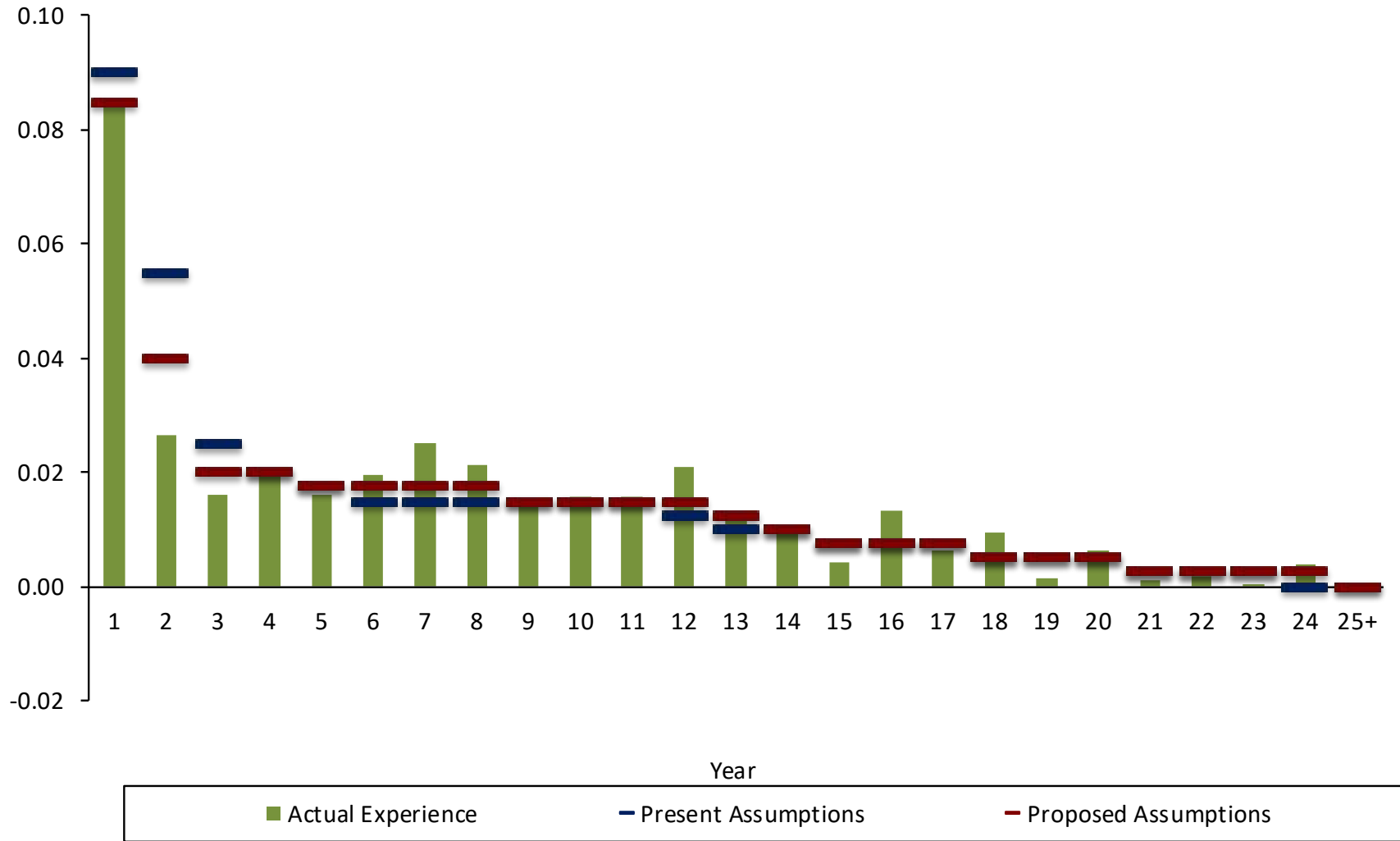
*We recommend adjustments to the current merit/seniority pay increase assumption as shown on the following page.*

## Pay Increases Due to Merit and Seniority

Year	Exposures	Total Salary % Increase			Merit & Seniority % Increase		
		Actual	Current	Proposed	Actual	Current	Proposed
1	1,546	11.28%	12.25%	11.50%	8.53%	9.00%	8.50%
2	1,254	5.39%	8.75%	7.00%	2.64%	5.50%	4.00%
3	1,045	4.36%	5.75%	5.00%	1.61%	2.50%	2.00%
4	906	4.73%	5.25%	5.00%	1.98%	2.00%	2.00%
5	736	4.35%	5.00%	4.75%	1.60%	1.75%	1.75%
6	627	4.72%	4.75%	4.75%	1.97%	1.50%	1.75%
7	584	5.28%	4.75%	4.75%	2.53%	1.50%	1.75%
8	669	4.87%	4.75%	4.75%	2.12%	1.50%	1.75%
9	833	4.28%	4.75%	4.50%	1.53%	1.50%	1.50%
10	898	4.34%	4.75%	4.50%	1.59%	1.50%	1.50%
11	849	4.33%	4.75%	4.50%	1.58%	1.50%	1.50%
12	686	4.84%	4.50%	4.50%	2.09%	1.25%	1.50%
13	561	4.02%	4.25%	4.25%	1.27%	1.00%	1.25%
14	432	3.70%	4.25%	4.00%	0.95%	1.00%	1.00%
15	398	3.18%	4.00%	3.75%	0.43%	0.75%	0.75%
16	380	4.08%	4.00%	3.75%	1.33%	0.75%	0.75%
17	355	3.38%	4.00%	3.75%	0.63%	0.75%	0.75%
18	291	3.68%	3.75%	3.50%	0.93%	0.50%	0.50%
19	245	2.88%	3.75%	3.50%	0.13%	0.50%	0.50%
20	239	3.37%	3.75%	3.50%	0.62%	0.50%	0.50%
21	267	2.86%	3.50%	3.25%	0.11%	0.25%	0.25%
22	232	2.94%	3.50%	3.25%	0.19%	0.25%	0.25%
23	211	2.75%	3.50%	3.25%	0.00%	0.25%	0.25%
24	171	3.15%	3.25%	3.25%	0.40%	0.00%	0.25%
25+	425	2.65%	3.25%	3.00%	-0.10%	0.00%	0.00%
<b>Total*</b>	<b>14,840</b>	<b>5.00%</b>	<b>5.71%</b>	<b>5.30%</b>	<b>2.25%</b>	<b>2.46%</b>	<b>2.30%</b>

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

## Pay Increases Due to Merit and Seniority



## **SECTION C**

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### **RETIREMENT EXPERIENCE**

## Liability-Weighted Analysis

Our experience with similar systems has shown that sometimes the use of assumptions based solely on counts of people retiring or terminating employment does not always reduce the size of the gain or loss in a particular decrement. Sometimes this can be due to the relative magnitude of the actuarial accrued liability of the members that decrement, rather than number counts alone. Consistent with recent experience studies for other MSRS plans, we have used “liability-weighted rate” for certain decrements. This represents the crude rate of decrement on a liability-weighted basis as opposed to strictly a number count basis. The liability-weighted rates were found to be more highly correlated with withdrawal and retirement decrements (particularly with reduced retirement) than with the population related rates. 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 are typically not decisions at all but rather events that happen. Comments on specific assumptions are provided on the following pages.

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



# 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 seven actual retirements at ages 70 and older.

Overall, on a liability-weighted basis, the plan experienced slightly more unreduced retirements than projected by the present assumptions, but the results varied by age.

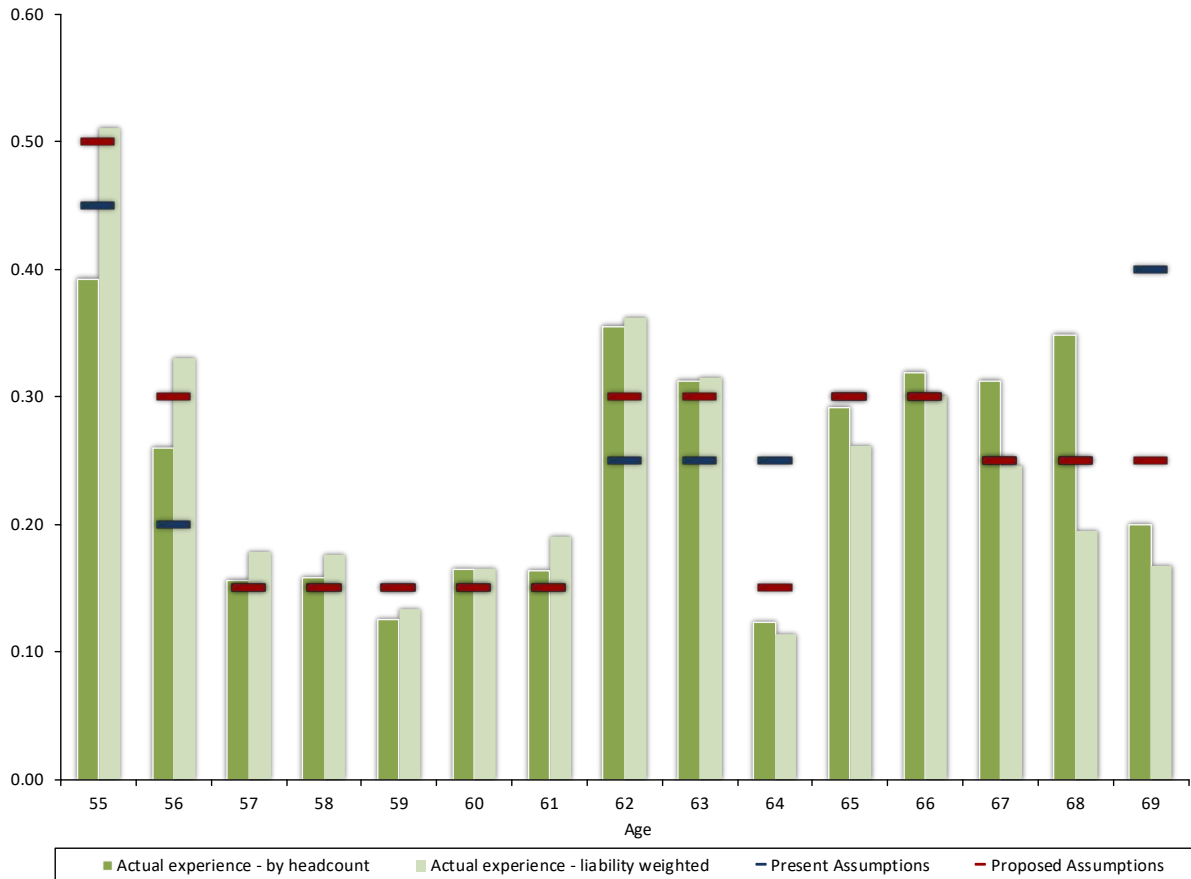
## Recommendations

*We recommend adjusting the assumed unreduced retirement rates to reflect observed 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	Liability Weighted (\$000s)		Crude Rates		Sample Rates		Expected Retirements* (\$000s)		Ratio of Actuals/Expecteds	
	Retirements	Exposure	Liability Weighted	Population Weighted	Current	Proposed	Current	Proposed	Current	Proposed
55	83,149	162,782	0.5108	0.3915	0.4500	0.5000	73,252.04	81,391.00	113.5%	102.2%
56	29,741	89,959	0.3306	0.2593	0.2000	0.3000	17,991.73	26,987.70	165.3%	110.2%
57	11,149	62,698	0.1778	0.1563	0.1500	0.1500	9,404.49	9,404.70	118.5%	118.5%
58	10,187	57,831	0.1762	0.1579	0.1500	0.1500	8,674.76	8,674.65	117.4%	117.4%
59	6,394	47,873	0.1336	0.1250	0.1500	0.1500	7,180.97	7,180.95	89.0%	89.0%
60	6,659	40,329	0.1651	0.1646	0.1500	0.1500	6,049.25	6,049.35	110.1%	110.1%
61	6,725	35,304	0.1905	0.1631	0.1500	0.1500	5,295.66	5,295.60	127.0%	127.0%
62	9,944	27,447	0.3623	0.3545	0.2500	0.3000	6,861.86	8,234.10	144.9%	120.8%
63	5,151	16,381	0.3144	0.3125	0.2500	0.3000	4,095.10	4,914.30	125.8%	104.8%
64	1,334	11,782	0.1132	0.1224	0.2500	0.1500	2,945.85	1,767.30	45.3%	75.5%
65	2,780	10,650	0.2610	0.2909	0.3000	0.3000	3,194.75	3,195.00	87.0%	87.0%
66	2,379	7,915	0.3006	0.3182	0.3000	0.3000	2,374.58	2,374.50	100.2%	100.2%
67	1,638	6,668	0.2457	0.3125	0.2500	0.2500	1,666.89	1,667.00	98.3%	98.3%
68	875	4,494	0.1947	0.3478	0.2500	0.2500	1,123.59	1,123.50	77.9%	77.9%
69	411	2,452	0.1676	0.2000	0.4000	0.2500	980.73	613.00	41.9%	67.0%
70	*	*	N/A	N/A	*	*	N/A	N/A	N/A	N/A
<b>Totals</b>	<b>178,516</b>	<b>584,565</b>					<b>151,092.25</b>	<b>168,872.65</b>	<b>118.2%</b>	<b>105.7%</b>

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



# 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, 2015) 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.

We reviewed the experience during the study period. On a population-weighted basis, there were fewer early retirements than expected. There were similar results on a liability-weighted basis.

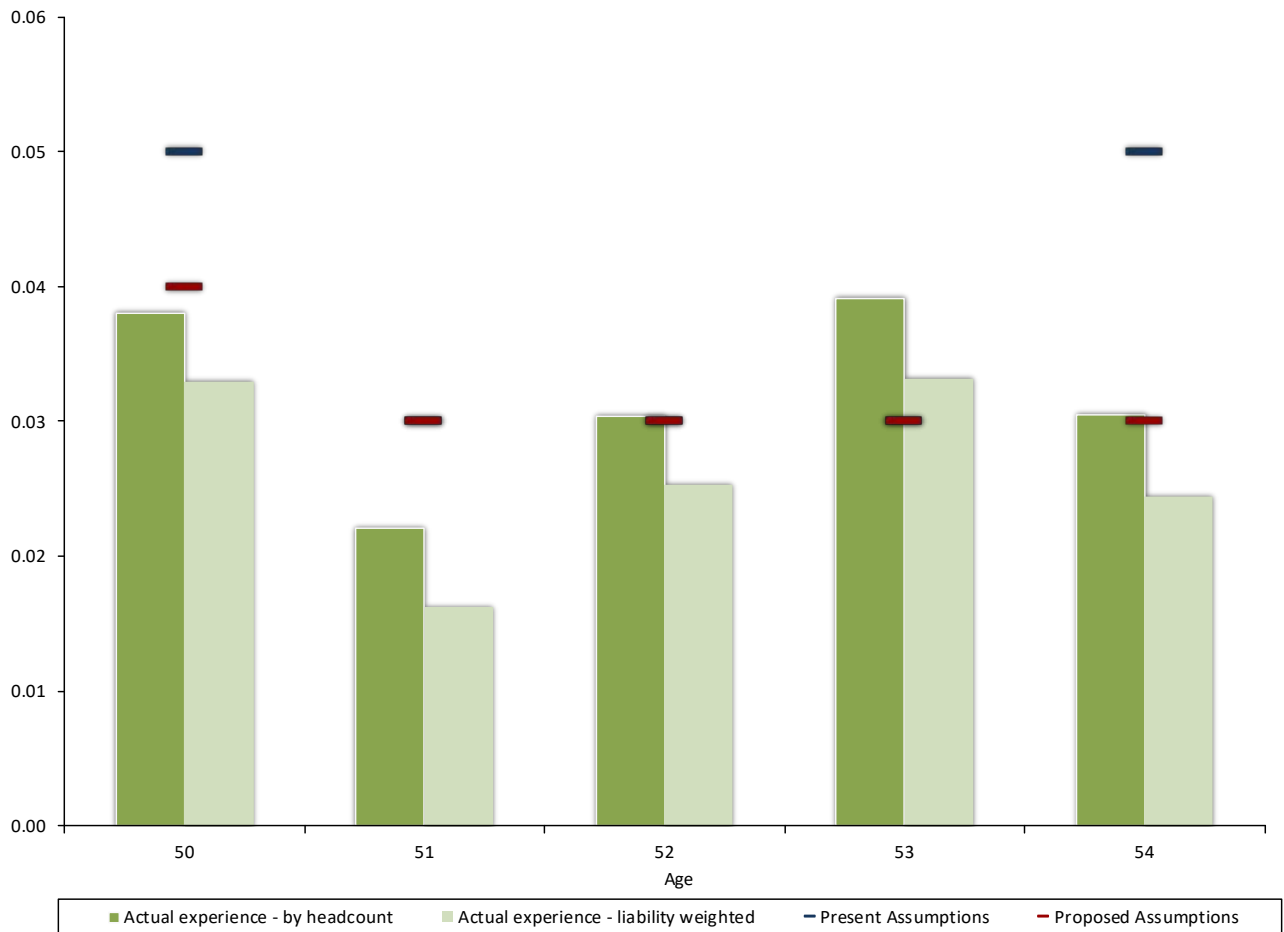
It was noted in the prior experience study that the number of early retirements was greater than expected. The changes to early retirement benefits described above resulted in more early retirements before June 30, 2015 and fewer retirements after June 30, 2015. Our recommendation to decrease early retirement rates is consistent with expected behavior changes as a result of the change in benefit provisions.

## Recommendation

*We recommend a decrease in early retirement rates, as indicated on the next page.*

## Reduced Early Retirement

Age	Liability Weighted (\$000s)		Crude Rates		Sample Rates		Expected Retirements (\$000s)		Ratio of Actuals/Expecteds	
	Retirements	Exposure	Liability Weighted	Population Weighted	Current	Proposed	Current	Proposed	Current	Proposed
50	5,064	153,616	0.0330	0.0380	0.0500	0.0400	7,680.82	6,144.64	65.9%	82.4%
51	2,605	160,128	0.0163	0.0221	0.0300	0.0300	4,803.85	4,803.84	54.2%	54.2%
52	3,918	154,576	0.0253	0.0304	0.0300	0.0300	4,637.26	4,637.28	84.5%	84.5%
53	5,268	159,017	0.0331	0.0391	0.0300	0.0300	4,770.51	4,770.51	110.4%	110.4%
54	3,773	154,414	0.0244	0.0304	0.0500	0.0300	7,720.65	4,632.42	48.9%	81.4%
<b>Total</b>	<b>20,628</b>	<b>781,751</b>	<b>0.0264</b>	<b>0.0320</b>			<b>29,613.09</b>	<b>24,988.69</b>	<b>69.7%</b>	<b>82.5%</b>



## 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:

Years of Service	Vesting Percent if First Hired	
	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**

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### **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 age-based, with higher terminations assumed in the first three years of service. The withdrawal assumption review was done on a liability-weighted basis, as described earlier in the report.

# Withdrawal Experience

## Findings

As we examined patterns of terminations, the experience has a strong relationship to service. As such, our recommended rates are service-based (rather than age-based).

## Recommendation

*We have recommended increased rates of withdrawal as detailed on the next pages.*



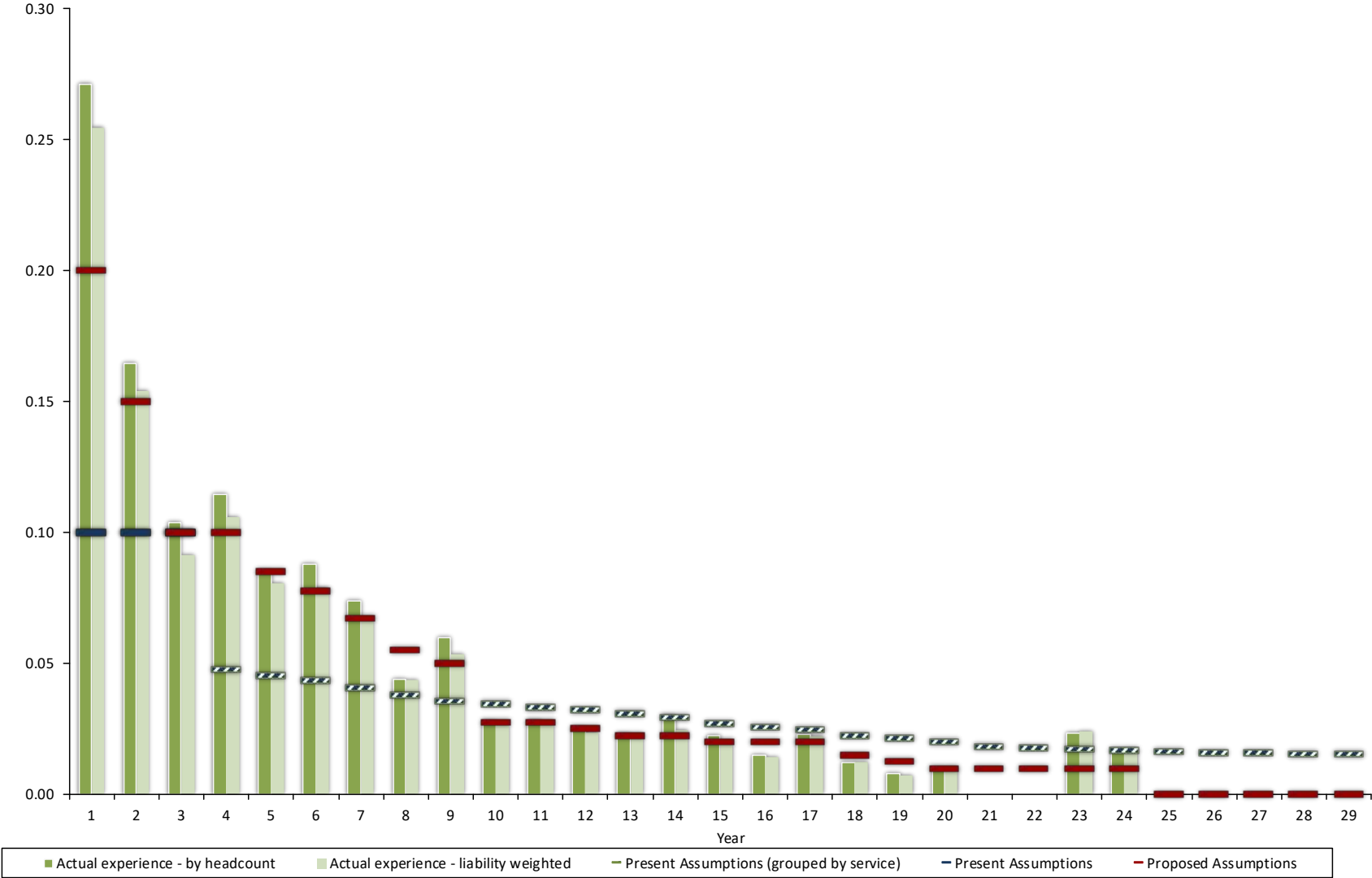
## Withdrawal Experience\* – Males

Year	Liability Weighted (\$ 000s)		Crude Rates		Sample Rates		Liability Weighted (\$ 000s)			
	Withdrawals	Exposure	Population Weighted	Liability Weighted	Expected Withdrawals		Ratio of Actuals/Expecteds			
					Current	Proposed	Current	Proposed		
1	6,622	26,019	0.2709	0.2545	0.1000	0.2000	2,601.92	5,203.85	254.5%	127.3%
2	12,185	79,116	0.1647	0.1540	0.1000	0.1500	7,911.48	11,867.22	154.0%	102.7%
3	7,052	77,195	0.1037	0.0914	0.1000	0.1000	7,719.42	7,719.42	91.4%	91.4%
4	7,217	68,169	0.1147	0.1059	0.0475	0.1000	3,241.35	6,816.93	222.6%	105.9%
5	5,068	62,883	0.0849	0.0806	0.0454	0.0850	2,855.72	5,345.06	177.5%	94.8%
6	4,367	55,488	0.0880	0.0787	0.0434	0.0775	2,407.93	4,300.30	181.3%	101.5%
7	3,317	49,981	0.0737	0.0664	0.0408	0.0675	2,036.89	3,373.69	162.8%	98.3%
8	2,211	50,684	0.0439	0.0436	0.0379	0.0550	1,921.75	2,787.64	115.1%	79.3%
9	3,346	62,503	0.0597	0.0535	0.0353	0.0500	2,207.77	3,125.13	151.5%	107.1%
10	2,213	84,059	0.0276	0.0263	0.0344	0.0275	2,895.46	2,311.62	76.4%	95.7%
11	2,842	103,893	0.0279	0.0274	0.0334	0.0275	3,465.75	2,857.05	82.0%	99.5%
12	2,502	106,836	0.0250	0.0234	0.0322	0.0250	3,436.54	2,670.89	72.8%	93.7%
13	2,119	93,956	0.0228	0.0226	0.0310	0.0225	2,912.13	2,114.00	72.8%	100.2%
14	1,869	76,453	0.0301	0.0245	0.0294	0.0225	2,248.95	1,720.20	83.1%	108.7%
15	1,175	61,062	0.0225	0.0192	0.0270	0.0200	1,651.19	1,221.23	71.2%	96.2%
16	858	59,501	0.0149	0.0144	0.0259	0.0200	1,541.06	1,190.01	55.6%	72.1%
17	1,190	54,177	0.0229	0.0220	0.0246	0.0200	1,335.05	1,083.53	89.1%	109.8%
18	687	56,393	0.0120	0.0122	0.0222	0.0150	1,253.06	845.90	54.8%	81.2%
19	324	45,269	0.0078	0.0072	0.0213	0.0125	962.12	565.86	33.7%	57.3%
20	369	37,453	0.0099	0.0098	0.0199	0.0100	745.45	374.53	49.4%	98.4%
21	-	39,744	0.0000	0.0000	0.0183	0.0100	728.26	397.44	0.0%	0.0%
22	-	45,716	0.0000	0.0000	0.0177	0.0100	809.52	457.16	0.0%	0.0%
23	903	37,426	0.0235	0.0241	0.0172	0.0100	643.79	374.26	140.3%	241.3%
24	485	28,139	0.0161	0.0172	0.0168	0.0100	472.31	281.39	102.6%	172.2%
25	-	20,243	0.0000	0.0000	0.0164	0.0000	331.03	-	0.0%	N/A
26	-	8,701	0.0000	0.0000	0.0159	0.0000	138.70	-	0.0%	N/A
27	-	8,733	0.0000	0.0000	0.0157	0.0000	137.23	-	0.0%	N/A
28	-	4,308	0.0000	0.0000	0.0155	0.0000	66.76	-	0.0%	N/A
29	-	1,269	0.0000	0.0000	0.0155	0.0000	19.68	-	0.0%	N/A
30+	-	649	N/A	0.0000	0.0150	0.0000	9.73	-	0.0%	N/A
<b>Totals</b>	<b>68,920</b>	<b>1,506,016</b>	<b>0.0797</b>	<b>0.0458</b>	<b>0.0390</b>	<b>0.0458</b>	<b>58,708.00</b>	<b>69,004.31</b>	<b>117.4%</b>	<b>99.9%</b>

\* The current withdrawal assumption is based on service for the first three years of employment and based on age after three years of service. Our recommended table is service-based for all years of employment.



# Withdrawal Experience – Males

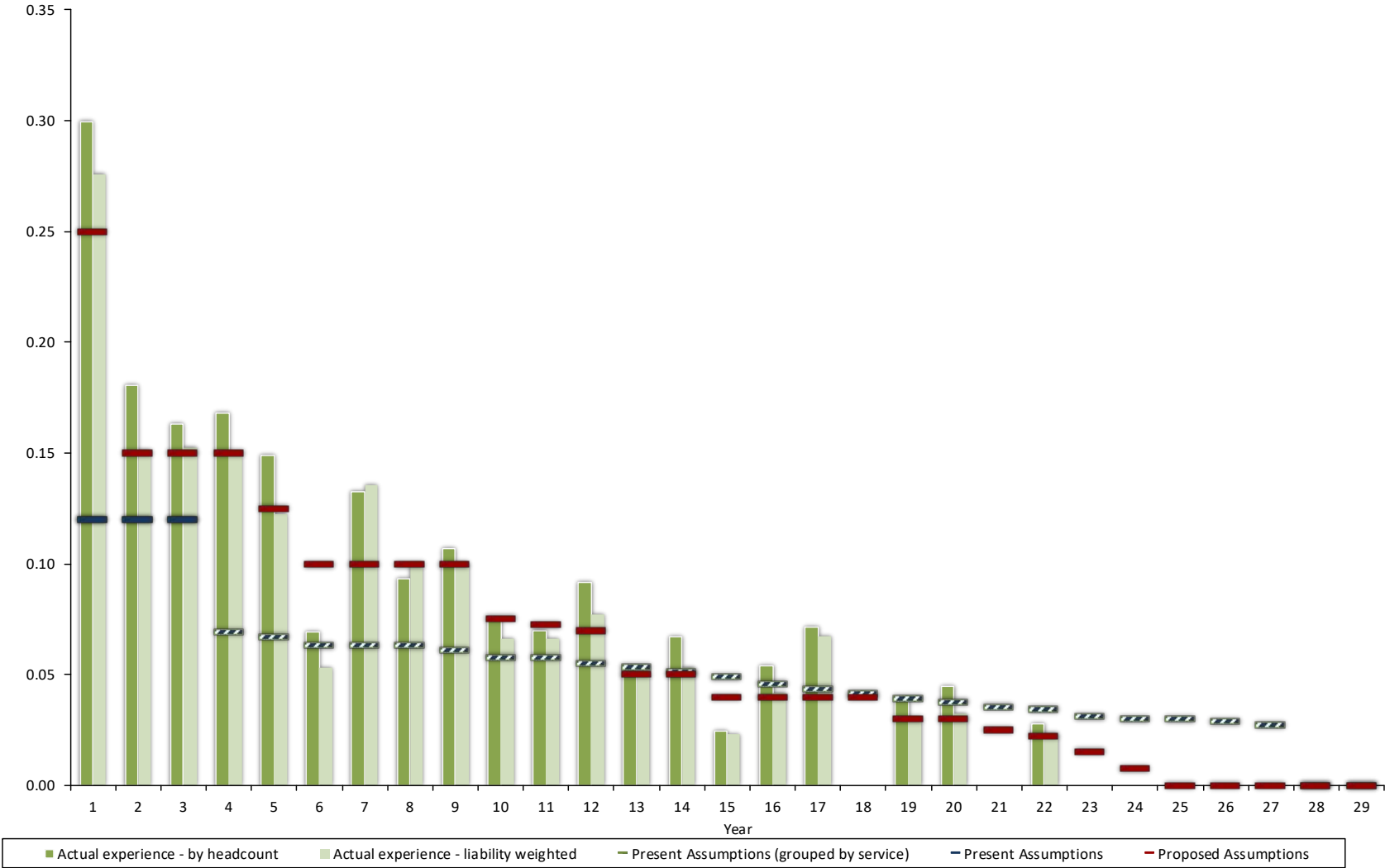


## Withdrawal Experience\* – Females

Year	Liability Weighted (\$000s)		Crude Rates		Sample Rates		Liability Weighted (\$ 000s)		Ratio of	
	Withdrawals	Exposure	Liability Weighted	Population Weighted			Expected Withdrawals		Actuals/Expecteds	
					Current	Proposed	Current	Proposed	Current	Proposed
1	6,670	24,204	0.2756	0.2996	0.1200	0.2500	2,904.41	6,050.86	229.7%	110.2%
2	10,061	66,739	0.1508	0.1806	0.1200	0.1500	8,008.68	10,010.86	125.6%	100.5%
3	9,967	65,431	0.1523	0.1630	0.1200	0.1500	7,857.61	9,822.02	126.8%	101.5%
4	7,536	50,489	0.1493	0.1680	0.0694	0.1500	3,505.30	7,573.32	215.0%	99.5%
5	5,350	43,629	0.1226	0.1488	0.0671	0.1250	2,927.44	5,453.67	182.8%	98.1%
6	1,817	34,268	0.0530	0.0692	0.0632	0.1000	2,165.81	3,426.84	83.9%	53.0%
7	4,169	30,715	0.1357	0.1324	0.0634	0.1000	1,948.18	3,071.48	214.0%	135.7%
8	2,897	29,156	0.0994	0.0930	0.0633	0.1000	1,844.18	2,915.63	157.1%	99.4%
9	3,630	36,330	0.0999	0.1066	0.0612	0.1000	2,224.45	3,633.03	163.2%	99.9%
10	2,985	45,183	0.0661	0.0749	0.0580	0.0750	2,619.19	3,388.73	114.0%	88.1%
11	3,192	48,104	0.0664	0.0696	0.0576	0.0725	2,769.84	3,487.54	115.2%	91.5%
12	3,721	48,109	0.0773	0.0917	0.0549	0.0700	2,638.85	3,367.62	141.0%	110.5%
13	1,760	35,034	0.0502	0.0530	0.0532	0.0500	1,862.39	1,751.71	94.5%	100.5%
14	1,540	28,963	0.0532	0.0672	0.0515	0.0500	1,491.59	1,448.15	103.2%	106.3%
15	506	21,839	0.0232	0.0244	0.0492	0.0400	1,075.21	873.56	47.1%	57.9%
16	887	21,254	0.0417	0.0541	0.0459	0.0400	975.78	850.17	90.9%	104.4%
17	1,495	22,242	0.0672	0.0714	0.0437	0.0400	972.15	889.68	153.8%	168.0%
18	-	19,224	0.0000	0.0000	0.0412	0.0400	792.34	768.97	0.0%	0.0%
19	550	18,421	0.0298	0.0385	0.0391	0.0300	719.85	552.62	76.4%	99.5%
20	561	17,184	0.0327	0.0444	0.0377	0.0300	647.81	515.53	86.6%	108.8%
21	-	13,978	0.0000	0.0000	0.0356	0.0250	497.39	349.45	0.0%	0.0%
22	365	16,029	0.0228	0.0278	0.0341	0.0225	546.72	360.65	66.8%	101.2%
23	-	11,746	0.0000	0.0000	0.0312	0.0150	366.07	176.20	0.0%	0.0%
24	-	6,774	0.0000	0.0000	0.0298	0.0075	201.54	50.80	0.0%	0.0%
25	-	3,571	0.0000	0.0000	0.0302	0.0000	107.91	-	0.0%	N/A
26	-	579	0.0000	0.0000	0.0290	0.0000	16.80	-	0.0%	N/A
27	-	616	0.0000	0.0000	0.0275	0.0000	16.94	-	0.0%	N/A
28	-	-	N/A	N/A	N/A	0.0000	-	-	N/A	N/A
29	-	-	N/A	N/A	N/A	0.0000	-	-	N/A	N/A
30+	-	-	N/A	N/A	N/A	0.0000	-	-	N/A	N/A
<b>Totals</b>	<b>69,660</b>	<b>759,813</b>	<b>0.0917</b>	<b>0.1388</b>	<b>0.0680</b>	<b>0.0932</b>	<b>51,704.43</b>	<b>70,789.09</b>	<b>134.7%</b>	<b>98.4%</b>

\* The current withdrawal assumption is based on service for the first three years of employment and based on age after three years of service.

# Withdrawal Experience – Females



## **SECTION E**

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### **DISABILITY EXPERIENCE**

## Disability Experience

Correctional Employees 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. In fact, over the course of the four-year period, there were approximately 15 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 (41) is about 90 percent of the number projected by the present assumption (45 – see charts on the following pages).

### Recommendation

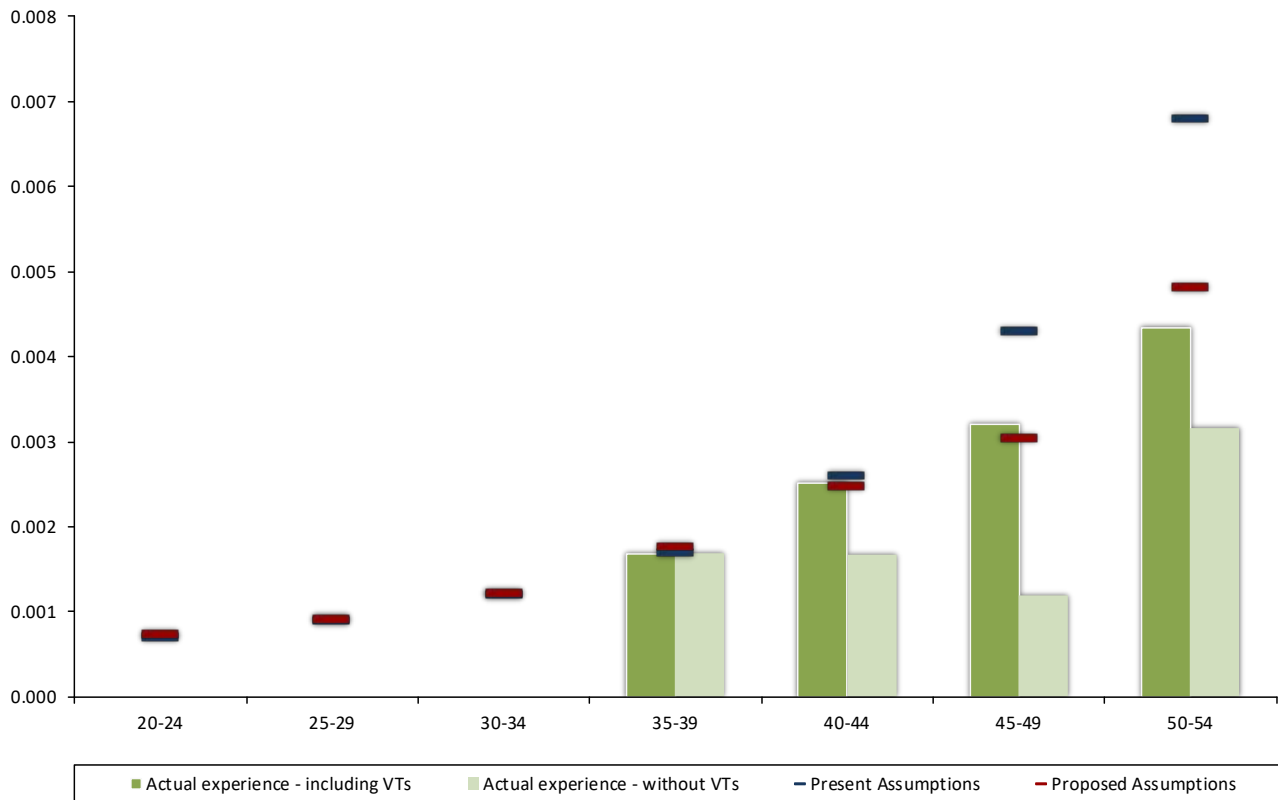
*We recommend adopting lower rates of disability for members age 42 and older. We also recommend continuing the disability incidence assumption to age 70.*

## Disability Experience Males and Females

Age	Disabilities Including Terminations	Exposure**	Crude Rates		Sample Rates*		Expected Disabilities**		Ratio of Actuals/Expecteds	
			With Terminations	Without Terminations	Current	Proposed	Current	Proposed	Current	Proposed
20-24	-	486	0.0000	0.0000	0.0007	0.0007	0.35	0.36	0.0%	0.0%
25-29	-	1,917	0.0000	0.0000	0.0009	0.0009	1.75	1.76	0.0%	0.0%
30-34	-	2,900	0.0000	0.0000	0.0012	0.0012	3.56	3.55	0.0%	0.0%
35-39	5	2,963	0.0017	0.0017	0.0017	0.0018	5.22	5.22	95.7%	95.8%
40-44	6	2,389	0.0025	0.0017	0.0026	0.0025	6.33	5.91	94.7%	101.5%
45-49	8	2,499	0.0032	0.0012	0.0043	0.0030	10.50	7.62	76.2%	105.0%
50-54	11	2,538	0.0043	0.0032	0.0068	0.0048	17.49	12.25	62.9%	89.8%
55-59	7	-	N/A	N/A	0.0000	0.0070	-	-	N/A	N/A
60+	4	-	N/A	N/A	0.0000	0.0070	-	-	N/A	N/A
<b>Totals</b>	<b>41</b>	<b>15,692</b>	<b>0.0026</b>	<b>0.0013</b>	<b>0.0029</b>	<b>0.0023</b>	<b>45.22</b>	<b>36.67</b>	<b>90.7%</b>	<b>111.8%</b>

\* Sample rates taken from the mid-point of the age group.

\*\* Currently, the disability assumption is only applied to members that are not eligible for Normal Retirement (age 55 with three years of service; members hired after June 30, 2010 are eligible after five years of service), which is the reason for no Exposures after age 55.



## **SECTION F**

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### **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.

## The New Mortality Tables and Projection Scale

Recently, 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 income, below median income).

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 CERF retiree and disability mortality on a “benefit-weighted” basis and have shown the results on pages F-4 through F-7 of this report. Consistent with the SOA study, CERF members with higher benefits generally appear to experience longer lifespans, resulting in lower mortality rates.

## Projection Scale

Fully generational tables, which are utilized for the MSRS valuations, help take into account future improvements in mortality that are expected to occur. The Society of Actuaries updates the projection scale annually and the latest published table is called the MP-2019 Projection Scale.

# Mortality Experience

## Findings

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 100 male retiree deaths and 31 female retiree deaths. The healthy retiree mortality experience is not considered to be credible since there were so few deaths. Pre-retirement mortality and disabled retiree experience is also not considered to be credible. Therefore, we are recommending the use of standard mortality tables without adjustment.

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 fewer male deaths than expected (\$2,452,000 actual versus \$2,550,000 expected) and fewer female deaths than expected (\$516,000 actual versus \$595,000 expected).

### **Disabled Retirees**

On a benefit-weighted basis, the plan experienced fewer deaths among disabled males (\$268,000) than projected by the present assumptions (\$382,000). The actual number of deaths on a benefit-weighted basis among disabled females (\$119,000) was also less than the number projected by the present assumptions (\$135,000).

### **Active Members**

On a liability-weighted basis, the actual number of male deaths among active members (\$4,245,000) was greater than the number projected by the present assumption (\$2,475,000). The plan experienced fewer deaths on a liability-weighted basis among females (\$195,000) than projected by the present assumptions (\$911,000).

# Mortality Experience

## Recommendations

*Due to the size of this plan, the experience is not considered credible. As such, we recommend adoption of the Pub-2010 mortality tables. All recommended tables are Benefit-Weighted.*

*We recommend adoption of the following mortality tables:*

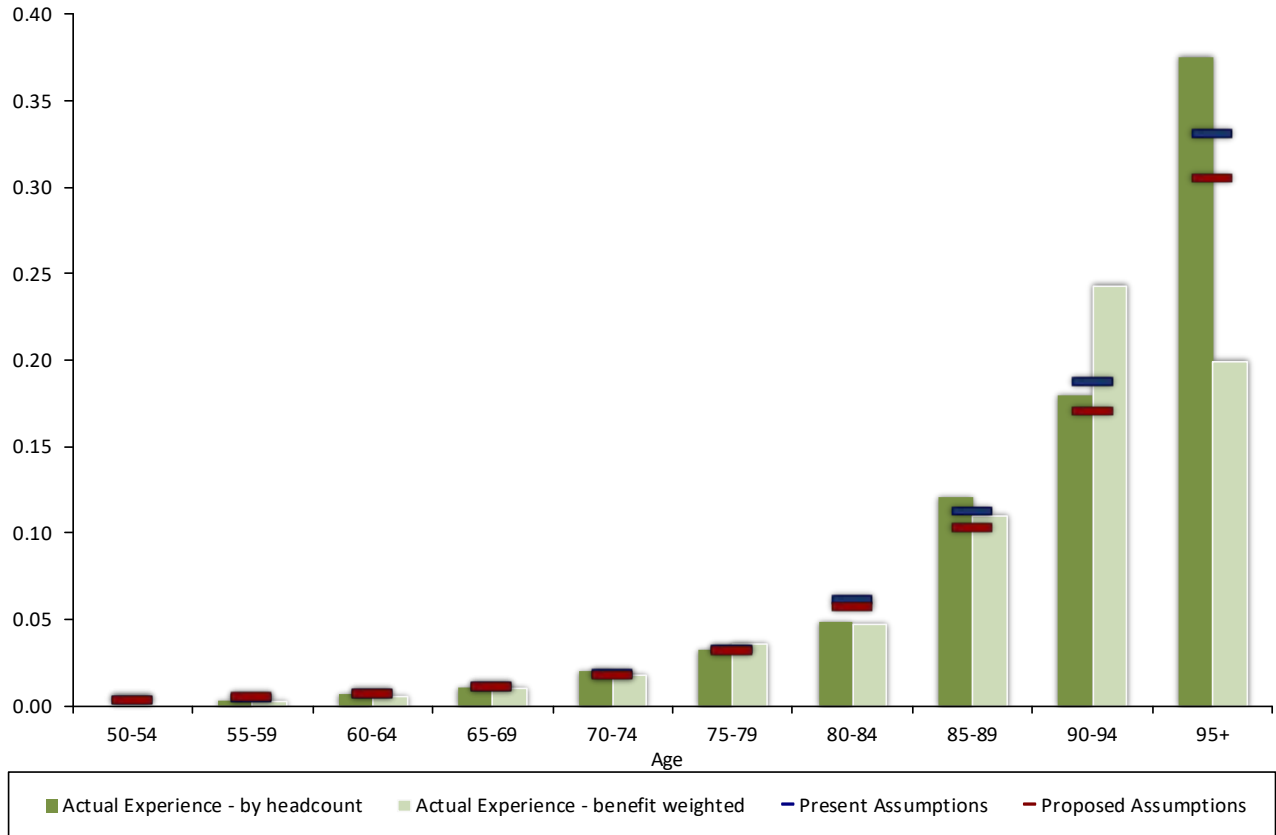
Healthy Male Retirees:	Pub-2010 Male Healthy Retired General Mortality Table adjusted for mortality improvements using projection scale MP-2019.
Healthy Female Retirees:	Pub-2010 Female Healthy Retired General Mortality Table, adjusted for mortality improvements using projection scale MP-2019.
Disabled Male Retirees:	Pub-2010 Male General Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2019.
Disabled Female Retirees:	Pub-2010 Female General Disabled Retiree Mortality Table, adjusted for mortality improvements using projection scale MP-2019.
Male Active Members:	Pub-2010 Male General Mortality Table adjusted for mortality improvements using projection scale MP-2019.
Female Active Members:	Pub-2010 Female General Mortality Table adjusted for mortality improvements using projection scale MP-2019.

We reviewed both the public safety and general plan Pub-2010 mortality tables and found the general 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 and 1 female for active member deaths; 14 male and 6 female for disabled retiree deaths).

## Post-Retirement Mortality Experience Healthy Males

Age	Benefit Weighted (\$000s)		Crude Rates		Sample Rates		Benefit Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Benefit Weighted	Population Weighted	Current	Proposed*	Current	Proposed*	Current	Proposed*
50-54	-	3,844	0.000000	0.000000	0.003279	0.003333	13.57	13.83	0.0%	0.0%
55-59	111	37,988	0.002922	0.003236	0.004786	0.005073	185.97	197.41	59.7%	56.2%
60-64	238	41,352	0.005755	0.006858	0.007100	0.007408	292.15	305.12	81.5%	78.0%
65-69	337	31,570	0.010675	0.010658	0.011164	0.010935	347.20	341.04	97.1%	98.8%
70-74	338	18,555	0.018216	0.020063	0.019046	0.018037	342.65	325.40	98.6%	103.9%
75-79	375	10,457	0.035861	0.032558	0.033459	0.031846	347.33	330.80	108.0%	113.4%
80-84	345	7,311	0.047189	0.049057	0.061104	0.057912	425.79	405.35	81.0%	85.1%
85-89	322	2,926	0.110048	0.121212	0.112286	0.103360	315.72	291.44	102.0%	110.5%
90-94	318	1,309	0.242934	0.179487	0.187768	0.170660	236.89	215.05	134.2%	147.9%
95+	68	342	0.198830	0.375000	0.330893	0.305663	75.86	38.28	89.6%	177.6%
<b>Totals</b>	<b>2,452</b>	<b>155,654</b>	<b>0.015753</b>	<b>0.015625</b>	<b>0.016595</b>	<b>0.015828</b>	<b>2,583.13</b>	<b>2,463.72</b>	<b>94.9%</b>	<b>99.5%</b>

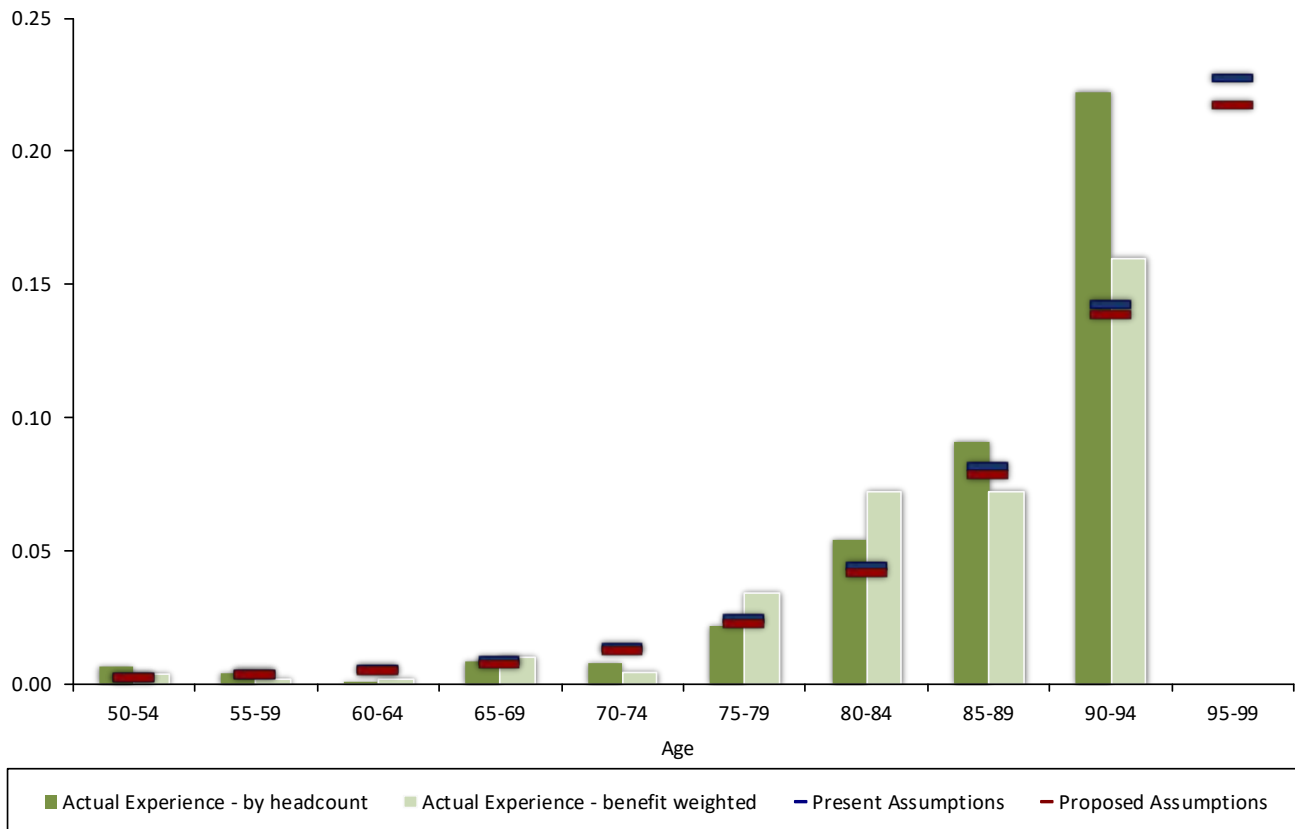
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.



## Post-Retirement Mortality Experience Healthy Females

Age	Benefit Weighted (\$000s)		Crude Rates		Sample Rates		Benefit Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Benefit Weighted	Population Weighted	Present	Proposed	Expected Deaths		Present	Proposed*
					Present	Proposed	Present	Proposed*		
50-54	8	2,142	0.003735	0.006536	0.002342	0.002478	5.43	5.66	147.3%	141.3%
55-59	34	16,704	0.002035	0.003822	0.003477	0.003386	59.30	57.47	57.3%	59.2%
60-64	31	17,521	0.001769	0.000964	0.005437	0.004659	93.65	80.56	33.1%	38.5%
65-69	110	10,734	0.010248	0.008696	0.008518	0.007238	90.34	76.80	121.8%	143.2%
70-74	29	6,707	0.004324	0.008048	0.014053	0.012555	90.57	80.89	32.0%	35.9%
75-79	102	2,991	0.034102	0.021858	0.024468	0.022750	71.22	66.20	143.2%	154.1%
80-84	120	1,659	0.072333	0.053763	0.044481	0.041956	70.07	66.20	171.2%	181.3%
85-89	48	666	0.072072	0.090909	0.081733	0.078565	54.44	52.42	88.2%	91.6%
90-94	34	213	0.159624	0.222222	0.142678	0.138540	27.92	27.17	121.8%	125.1%
95+	-	150	0.000000	0.000000	0.277736	0.267077	31.75	23.07	0.0%	0.0%
<b>Totals</b>	<b>516</b>	<b>59,487</b>	<b>0.008674</b>	<b>0.008590</b>	<b>0.009997</b>	<b>0.009018</b>	<b>594.70</b>	<b>536.44</b>	<b>86.8%</b>	<b>96.2%</b>

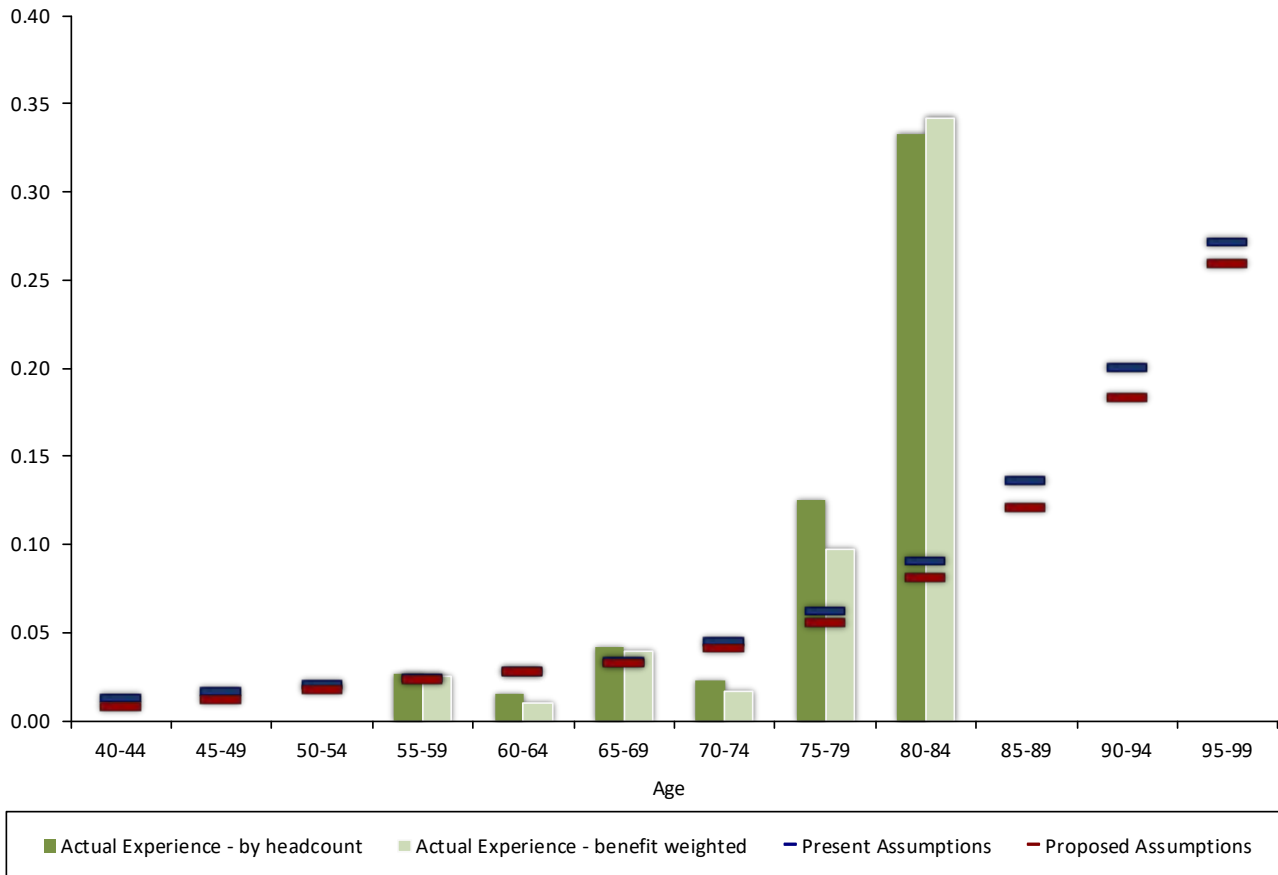
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.



## Post-Retirement Mortality Experience Disabled Males

Age	Benefit Weighted (\$000s)		Crude Rates		Sample Rates		Benefit Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Benefit Weighted	Population Weighted	Current	Proposed*	Expected Deaths		Current	Proposed*
					Current	Proposed*	Current	Proposed*		
40-44	-	763	0.000000	0.000000	0.012840	0.008146	9.96	5.93	0.0%	0.0%
45-49	-	1,777	0.000000	0.000000	0.016459	0.011692	29.04	21.02	0.0%	0.0%
50-54	-	2,545	0.000000	0.000000	0.020297	0.017400	51.63	45.07	0.0%	0.0%
55-59	85	3,376	0.025178	0.026490	0.023873	0.023097	80.52	78.54	105.6%	108.2%
60-64	29	2,838	0.010218	0.015385	0.027814	0.027741	77.97	78.18	37.2%	37.1%
65-69	90	2,279	0.039491	0.042017	0.033855	0.032765	75.34	73.69	119.5%	122.1%
70-74	15	881	0.017026	0.023256	0.044731	0.040848	38.47	35.53	39.0%	42.2%
75-79	22	226	0.097345	0.125000	0.062391	0.055704	13.26	12.00	166.0%	183.3%
80-84	27	79	0.341772	0.333333	0.090566	0.081397	6.59	5.92	409.7%	456.1%
85-89	-	-	N/A	N/A	0.135948	0.121322	-	-	N/A	N/A
90-94	-	-	N/A	N/A	0.200690	0.183382	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.272033	0.259294	-	-	N/A	N/A
<b>Totals</b>	<b>268</b>	<b>14,764</b>	<b>0.018152</b>	<b>0.019635</b>	<b>0.025927</b>	<b>0.024105</b>	<b>382.78</b>	<b>355.88</b>	<b>70.0%</b>	<b>75.3%</b>

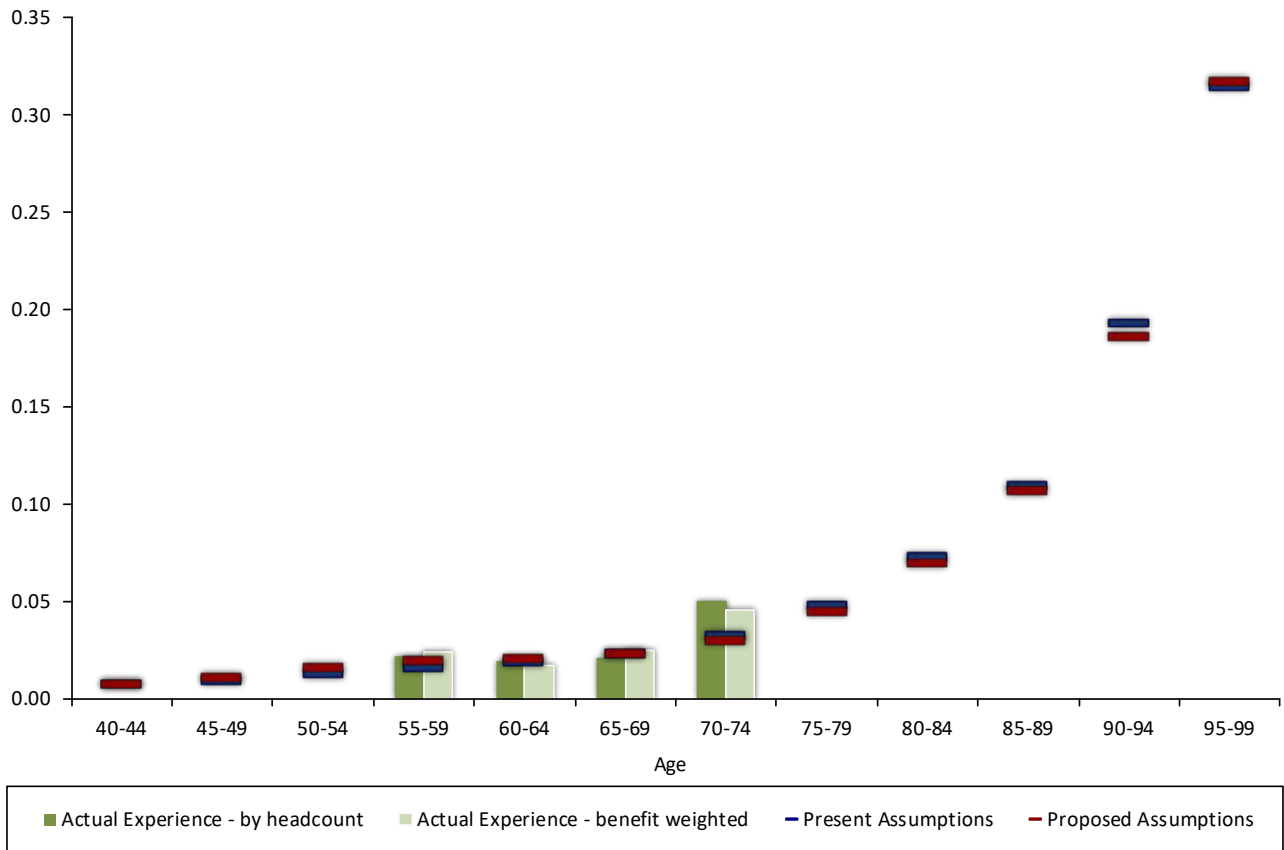
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.



## Post-Retirement Mortality Experience Disabled Females

Age	Benefit Weighted (\$000s)		Crude Rates		Sample Rates		Benefit Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Benefit Weighted	Population Weighted	Current	Proposed	Current	Proposed*	Current	Proposed*
					Expected Deaths	Expected Deaths	Current	Proposed*		
40-44	-	180	0.000000	0.000000	0.007342	0.007796	1.37	1.49	0.0%	0.0%
45-49	-	982	0.000000	0.000000	0.009494	0.011262	9.39	11.27	0.0%	0.0%
50-54	-	1,396	0.000000	0.000000	0.012559	0.015953	17.83	22.69	0.0%	0.0%
55-59	41	1,711	0.023963	0.021505	0.015728	0.019378	26.74	33.10	153.3%	123.9%
60-64	33	1,927	0.017125	0.019417	0.018287	0.020846	35.30	40.23	93.5%	82.0%
65-69	24	973	0.024666	0.020833	0.022850	0.023178	20.97	21.91	114.5%	109.5%
70-74	21	466	0.045064	0.050000	0.032275	0.030284	15.25	14.38	137.7%	146.0%
75-79	-	148	0.000000	0.000000	0.048386	0.044694	6.77	6.33	0.0%	0.0%
80-84	-	22	0.000000	0.000000	0.073475	0.069597	1.33	1.27	0.0%	0.0%
85-89	-	-	N/A	N/A	0.109480	0.106984	-	-	N/A	N/A
90-94	-	-	N/A	N/A	0.192961	0.185774	-	-	N/A	N/A
95-99	-	-	N/A	N/A	0.314945	0.316929	-	-	N/A	N/A
<b>Totals</b>	<b>119</b>	<b>7,805</b>	<b>0.015247</b>	<b>0.014706</b>	<b>0.017288</b>	<b>0.019561</b>	<b>134.94</b>	<b>152.67</b>	<b>88.2%</b>	<b>77.9%</b>

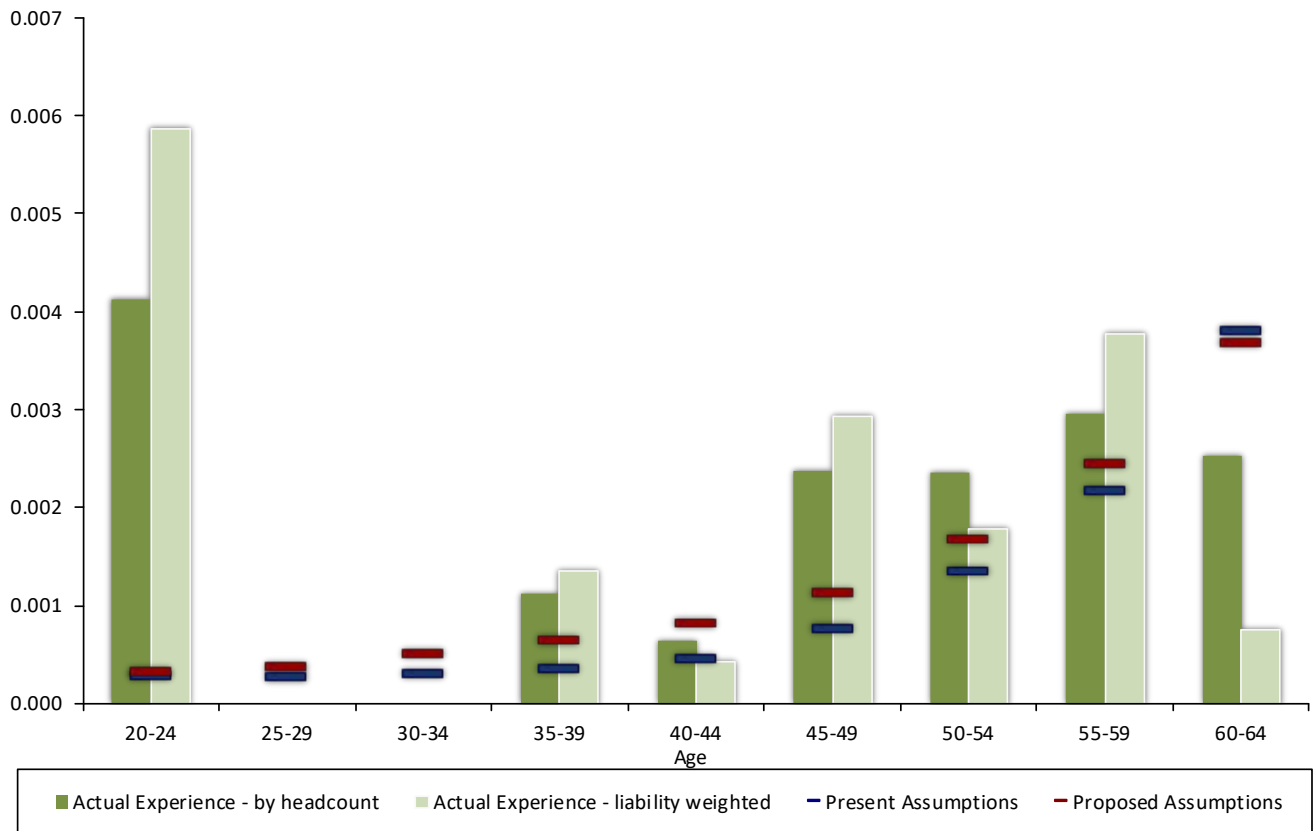
\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.



## Pre-Retirement Mortality Experience Healthy Males

Age	Liability Weighted (\$000s)		Crude Rates		Sample Rates		Liability Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted	Current	Proposed	Expected Deaths		Current	Proposed
					Current	Proposed	Current	Proposed		
20-24	69	11,768	0.0059	0.0041	0.0003	0.0003	3.32	3.87	2081.2%	1782.9%
25-29	-	91,409	0.0000	0.0000	0.0003	0.0004	24.57	34.82	0.0%	0.0%
30-34	-	222,825	0.0000	0.0000	0.0003	0.0005	67.67	114.91	0.0%	0.0%
35-39	427	316,340	0.0013	0.0011	0.0004	0.0007	111.55	206.36	382.8%	206.9%
40-44	157	365,611	0.0004	0.0006	0.0005	0.0008	168.57	300.42	93.1%	52.3%
45-49	1,420	483,504	0.0029	0.0024	0.0008	0.0011	375.79	543.09	377.9%	261.5%
50-54	1,016	571,905	0.0018	0.0024	0.0014	0.0017	777.69	961.71	130.6%	105.6%
55-59	1,094	290,554	0.0038	0.0030	0.0022	0.0025	631.46	713.52	173.2%	153.3%
60-64	62	82,816	0.0007	0.0025	0.0038	0.0037	314.85	305.91	19.7%	20.3%
<b>Totals</b>	<b>4,245</b>	<b>2,436,732</b>	<b>0.0017</b>	<b>0.0014</b>	<b>0.0010</b>	<b>0.0013</b>	<b>2,475.45</b>	<b>3,184.61</b>	<b>171.5%</b>	<b>133.3%</b>

\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.

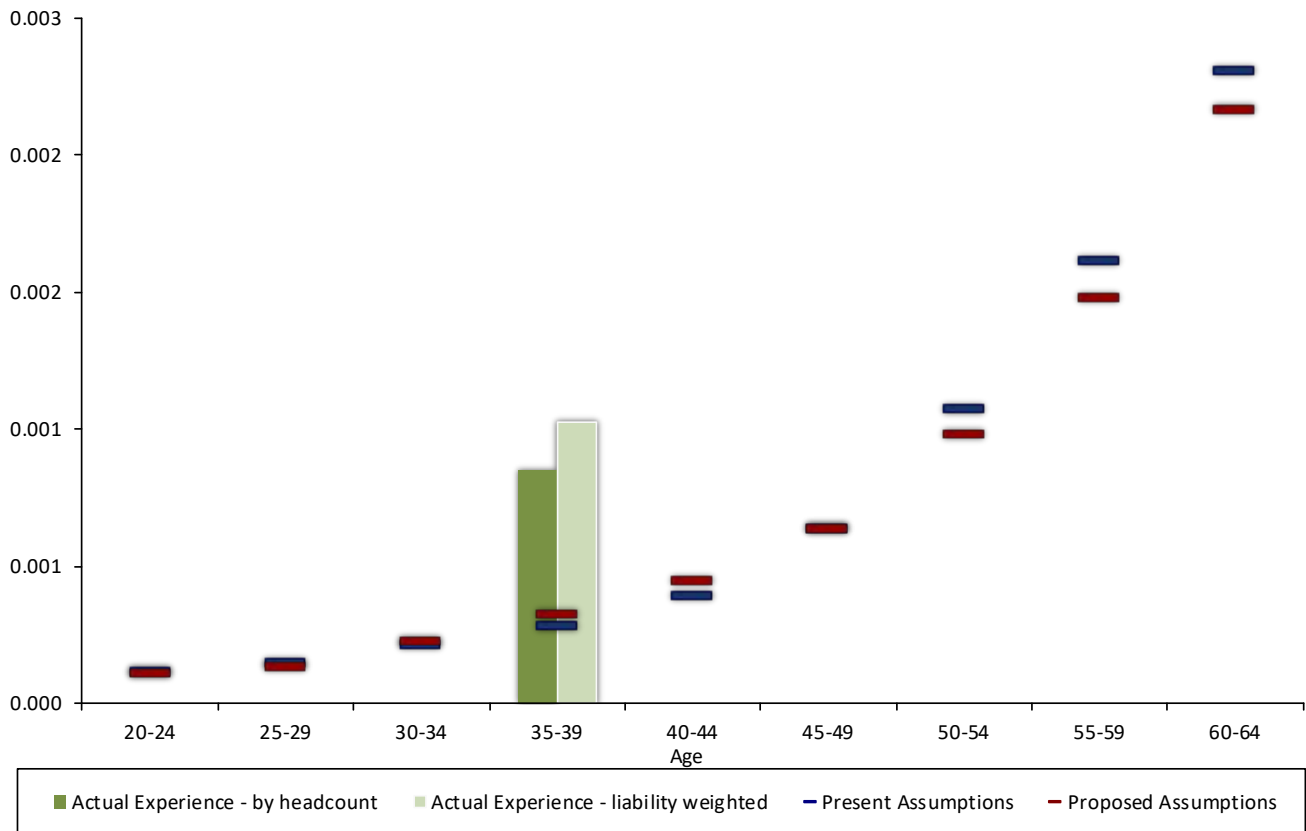




## Pre-Retirement Mortality Experience Healthy Females

Age	Liability Weighted (\$000s)		Crude Rates		Sample Rates		Liability Weighted (\$000s)		Ratio of Actuals/Expecteds	
	Deaths	Exposure	Liability Weighted	Population Weighted	Sample Rates		Expected Deaths		Actuals/Expecteds	
					Current	Proposed	Current	Proposed	Current	Proposed
20-24	-	9,118	0.0000	0.0000	0.0001	0.0001	1.04	0.99	0.0%	0.0%
25-29	-	47,070	0.0000	0.0000	0.0001	0.0001	6.91	6.38	0.0%	0.0%
30-34	-	120,569	0.0000	0.0000	0.0002	0.0002	25.79	27.22	0.0%	0.0%
35-39	195	189,683	0.0010	0.0009	0.0003	0.0003	53.57	61.30	364.0%	318.1%
40-44	-	172,408	0.0000	0.0000	0.0004	0.0004	67.57	76.83	0.0%	0.0%
45-49	-	202,640	0.0000	0.0000	0.0006	0.0006	129.39	129.07	0.0%	0.0%
50-54	-	236,234	0.0000	0.0000	0.0011	0.0010	254.10	232.47	0.0%	0.0%
55-59	-	151,863	0.0000	0.0000	0.0016	0.0015	245.16	224.57	0.0%	0.0%
60-64	-	55,219	0.0000	0.0000	0.0023	0.0022	127.35	119.71	0.0%	0.0%
<b>Totals</b>	<b>195</b>	<b>1,184,804</b>	<b>0.0002</b>	<b>0.0001</b>	<b>0.0008</b>	<b>0.0007</b>	<b>910.88</b>	<b>878.54</b>	<b>21.4%</b>	<b>22.2%</b>

\* In order to show the fit for the four-year period of the study, Proposed Sample Rates and Proposed Expected Deaths were determined using the proposed mortality rates for 2010 projected to the mid-point of the study using projection scale MP-2019.



## **SECTION G**

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### **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 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 Actuals/Expecteds	
				Current	Proposed	Current	Proposed	Current	Proposed
Males	251	337	0.7448	0.7500	0.7500	252.75	252.75	99.3%	99.3%
Females	112	187	0.5989	0.7500	0.6000	140.25	112.20	79.9%	99.8%
<b>Total</b>	<b>363</b>	<b>524</b>	<b>0.6927</b>	<b>0.8500</b>	<b>0.7500</b>	<b>393.00</b>	<b>364.95</b>	<b>92.4%</b>	<b>99.5%</b>

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.

### Recommendation

*We recommend changing the percent married assumption from 75% married for males and 75% married for females to 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 Actuals/Expecteds	
			Current	Proposed	Current	Proposed
Males	251	1.58	2.00	2.00	79.2%	79.2%
Females	112	(2.03)	(2.00)	(2.00)	101.4%	101.4%
<b>Total</b>	<b>363</b>					

The experience shows that the average age difference for males is 1.58 years. However, the year-by-year experience ranges from 1.05 years (2015-2016 experience of 61 retirees) to 1.85 years (2016-2017 experience of 73 retirees).

### Recommendation

*Due to the varied experience and the low number of retirements, 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:	15% elect 50% Joint & Survivor option
	15% elect 75% Joint & Survivor option
	50% elect 100% Joint & Survivor option
Females:	10% elect 50% Joint & Survivor option
	10% elect 75% Joint & Survivor option
	35% elect 100% Joint & Survivor option

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

### Findings

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

We found more married new retirees are electing the joint & survivor options for both males and females.

### 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.*

# Form of Payment

## Male Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Current	Proposed	Current	Proposed	Current	Proposed
Life annuity	24	251	0.0956	0.2000	0.1000	50.20	25.10	47.8%	95.6%
15-year certain & life	4	251	0.0159	0.0000	0.0000	0.00	0.00	N/A	N/A
50% joint & survivor	29	251	0.1155	0.1500	0.1250	37.65	31.38	77.0%	92.4%
75% joint & survivor	30	251	0.1195	0.1500	0.1250	37.65	31.38	79.7%	95.6%
100% joint & survivor	164	251	0.6534	0.5000	0.6500	125.50	163.15	130.7%	100.5%
<b>Total</b>	<b>251</b>	<b>251</b>	<b>1.0000</b>	<b>1.0000</b>	<b>1.0000</b>	<b>251.00</b>	<b>251.01</b>		

## Female Experience

Form of Payment	Actual Electing Annuity	Married New Retirees	Crude Rates	Sample Rates		Expected Electing Annuity		Ratio of Actuals/Expecteds	
				Current	Proposed	Current	Proposed	Current	Proposed
Life annuity	16	112	0.1429	0.4500	0.2500	50.40	28.00	31.7%	57.1%
15-year certain & life	2	112	0.0179	0.0000	0.0000	0.00	0.00	N/A	N/A
50% joint & survivor	21	112	0.1875	0.1000	0.1500	11.20	16.80	187.5%	125.0%
75% joint & survivor	12	112	0.1071	0.1000	0.1000	11.20	11.20	107.1%	107.1%
100% joint & survivor	61	112	0.5446	0.3500	0.5000	39.20	56.00	155.6%	108.9%
<b>Total</b>	<b>112</b>	<b>112</b>	<b>1.0000</b>	<b>1.0000</b>	<b>1.0000</b>	<b>112.00</b>	<b>112.00</b>		

## 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). Effective July 1, 2019 and phased in over a 12 month period, 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 expected mortality and developing an appropriate implementation schedule.*

# 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 page G-7. We recommend continued use of the other Miscellaneous and Technical Assumptions.*



## Miscellaneous and Technical Assumptions

<b><i>Benefit Service</i></b>	Exact fractional service is used to determine the amount of benefit payable.
<b><i>Decrement Operation</i></b>	Withdrawal decrements do not operate during retirement eligibility.
<b><i>Decrement Timing</i></b>	Decrements of all types are assumed to occur mid-year.
<b><i>Eligibility Testing</i></b>	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.
<b><i>Forfeitures</i></b>	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.
<b><i>Incidence of Contributions</i></b>	Contributions are assumed to be received on a monthly basis, per the Standards of Actuarial Work.
<b><i>Liability Adjustments</i></b>	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.
<b><i>Pay Increase Timing</i></b>	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.
<b><i>Service Credit Accruals</i></b>	Members were assumed to accrue one year of service credit per year.

## **SECTION H**

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### **PROPOSED ASSUMPTION LISTING**

# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Merit and Seniority Pay Increases

% Merit & Seniority Increases in Salaries Next Year	
Year	Rate
1	8.50%
2	4.00%
3	2.00%
4	2.00%
5	1.75%
6	1.75%
7	1.75%
8	1.75%
9	1.50%
10	1.50%
11	1.50%
12	1.50%
13	1.25%
14	1.00%
15	0.75%
16	0.75%
17	0.75%
18	0.50%
19	0.50%
20	0.50%
21	0.25%
22	0.25%
23	0.25%
24	0.25%
25+	0.00%

# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Age and Service Retirement Pattern Unreduced (Normal) Retirement

Age	% Retiring
55	50.0%
56	30.0%
57	15.0%
58	15.0%
59	15.0%
60	15.0%
61	15.0%
62	30.0%
63	30.0%
64	15.0%
65	30.0%
66	30.0%
67	25.0%
68	25.0%
69	25.0%
70+*	100%

\* 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 2015-2019 Experience Study

## Age and Service Retirement Pattern Reduced (Early) Retirement

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

# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Withdrawal

Year	% Withdrawing	
	Male	Female
1	20.000%	25.000%
2	15.000%	15.000%
3	10.000%	15.000%
4	10.000%	15.000%
5	8.500%	12.500%
6	7.750%	10.000%
7	6.750%	10.000%
8	5.500%	10.000%
9	5.000%	10.000%
10	2.750%	7.500%
11	2.750%	7.250%
12	2.500%	7.000%
13	2.250%	5.000%
14	2.250%	5.000%
15	2.000%	4.000%
16	2.000%	4.000%
17	2.000%	4.000%
18	1.500%	4.000%
19	1.250%	3.000%
20	1.000%	3.000%
21	1.000%	2.500%
22	1.000%	2.250%
23	1.000%	1.500%
24	1.000%	0.750%
25+	0.000%	0.000%

# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Disability Rates

Age	% Becoming Disabled	
	Male	Female
20	0.050%	0.050%
21	0.050%	0.050%
22	0.070%	0.070%
23	0.070%	0.070%
24	0.080%	0.080%
25	0.080%	0.080%
26	0.080%	0.080%
27	0.090%	0.090%
28	0.090%	0.090%
29	0.110%	0.110%
30	0.110%	0.110%
31	0.120%	0.120%
32	0.120%	0.120%
33	0.130%	0.130%
34	0.130%	0.130%
35	0.150%	0.150%
36	0.160%	0.160%
37	0.170%	0.170%
38	0.200%	0.200%
39	0.210%	0.210%
40	0.220%	0.220%
41	0.240%	0.240%
42	0.247%	0.247%
43	0.261%	0.261%
44	0.272%	0.272%
45	0.280%	0.280%
46	0.293%	0.293%
47	0.301%	0.301%
48	0.308%	0.308%
49	0.343%	0.343%
50	0.378%	0.378%
51	0.427%	0.427%
52	0.476%	0.476%
53	0.539%	0.539%
54	0.602%	0.602%
55+	0.700%	0.700%

# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Healthy Post-Retirement Mortality Rates

Age in 2019	% Dying Next Year*		Age in 2019	% Dying Next Year*	
	Male	Female		Male	Female
50	0.2789%	0.2142%	81	4.9935%	3.6097%
51	0.3015%	0.2281%	82	5.6394%	4.0906%
52	0.3275%	0.2450%	83	6.3652%	4.6388%
53	0.3559%	0.2630%	84	7.1744%	5.2641%
54	0.3886%	0.2814%	85	8.0734%	5.9754%
55	0.4238%	0.3008%	86	9.0612%	6.7859%
56	0.4621%	0.3207%	87	10.1372%	7.7007%
57	0.5033%	0.3415%	88	11.3089%	8.7235%
58	0.5468%	0.3616%	89	12.5695%	9.8499%
59	0.5941%	0.3839%	90	13.9248%	11.0720%
60	0.6419%	0.4079%	91	15.3528%	12.3669%
61	0.6917%	0.4356%	92	16.8482%	13.7136%
62	0.7441%	0.4669%	93	18.3917%	15.1121%
63	0.7978%	0.5038%	94	19.9820%	16.5642%
64	0.8563%	0.5444%	95	21.6137%	18.0815%
65	0.9214%	0.5920%	96	23.4247%	19.7288%
66	0.9959%	0.6466%	97	25.2907%	21.4821%
67	1.0822%	0.7093%	98	27.2292%	23.3335%
68	1.1819%	0.7831%	99	29.2162%	25.2814%
69	1.2981%	0.8689%	100	31.2364%	27.3181%
70	1.4315%	0.9681%	101	33.2716%	29.4221%
71	1.5836%	1.0831%	102	35.3028%	31.5433%
72	1.7597%	1.2156%	103	37.2999%	33.6715%
73	1.9596%	1.3671%	104	39.2536%	35.7732%
74	2.1892%	1.5398%	105	41.1519%	37.8479%
75	2.4515%	1.7360%	106	42.9921%	39.8838%
76	2.7505%	1.9574%	107	44.7481%	41.8393%
77	3.0913%	2.2088%	108	46.4297%	43.7197%
78	3.4799%	2.4941%	109	48.0045%	45.5171%
79	3.9208%	2.8180%	110	49.2895%	47.2105%
80	4.4230%	3.1879%			

\* The rates shown are PUB-2010 mortality for healthy annuitants, General table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.



# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Disabled Post-Retirement Mortality Rates

Age in 2019	% Dying Next Year*		Age in 2019	% Dying Next Year*	
	Male	Female		Male	Female
20	0.4280%	0.2532%	56	2.1966%	1.9060%
21	0.4081%	0.2381%	57	2.3089%	1.9684%
22	0.3803%	0.2192%	58	2.4159%	2.0170%
23	0.3501%	0.2031%	59	2.5173%	2.0522%
24	0.3292%	0.1933%	60	2.6126%	2.0777%
25	0.3264%	0.1976%	61	2.7041%	2.0944%
26	0.3537%	0.2202%	62	2.7936%	2.1094%
27	0.3819%	0.2458%	63	2.8855%	2.1259%
28	0.4122%	0.2745%	64	2.9786%	2.1482%
29	0.4439%	0.3047%	65	3.0721%	2.1788%
30	0.4763%	0.3374%	66	3.1704%	2.2243%
31	0.5091%	0.3720%	67	3.2750%	2.2865%
32	0.5411%	0.4080%	68	3.3889%	2.3695%
33	0.5720%	0.4460%	69	3.5166%	2.4751%
34	0.6034%	0.4837%	70	3.6595%	2.6065%
35	0.6319%	0.5217%	71	3.8247%	2.7638%
36	0.6610%	0.5593%	72	4.0148%	2.9493%
37	0.6898%	0.5972%	73	4.2330%	3.1634%
38	0.7191%	0.6351%	74	4.4812%	3.4098%
39	0.7487%	0.6740%	75	4.7653%	3.6905%
40	0.7798%	0.7140%	76	5.0851%	4.0076%
41	0.8136%	0.7555%	77	5.4460%	4.3635%
42	0.8519%	0.7998%	78	5.8508%	4.7621%
43	0.8955%	0.8482%	79	6.3039%	5.2066%
44	0.9484%	0.9026%	80	6.8078%	5.6993%
45	1.0096%	0.9640%	81	7.3676%	6.2433%
46	1.0828%	1.0335%	82	7.9811%	6.8400%
47	1.1685%	1.1135%	83	8.6530%	7.4956%
48	1.2669%	1.2060%	84	9.3804%	8.2086%
49	1.3775%	1.3119%	85	10.1634%	8.9857%
50	1.5020%	1.4307%	86	11.0054%	9.7948%
51	1.6078%	1.5025%	87	11.9053%	10.6193%
52	1.7207%	1.5808%	88	12.8764%	11.4546%
53	1.8381%	1.6650%	89	14.0871%	12.2998%
54	1.9576%	1.7502%	90	15.4253%	13.1713%
55	2.0785%	1.8323%			

\* The rates shown are PUB-2010 mortality for disabled annuitants, General table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.



# Proposed Actuarial Assumptions Based on 2015-2019 Experience Study

## Healthy Pre-Retirement Mortality Rates

Age in 2019	% Dying Next Year*		Age in 2019	% Dying Next Year*	
	Male	Female		Male	Female
20	0.0384%	0.0141%	46	0.1045%	0.0588%
21	0.0381%	0.0133%	47	0.1110%	0.0630%
22	0.0357%	0.0124%	48	0.1199%	0.0676%
23	0.0343%	0.0115%	49	0.1293%	0.0736%
24	0.0330%	0.0106%	50	0.1394%	0.0801%
25	0.0329%	0.0108%	51	0.1521%	0.0881%
26	0.0363%	0.0123%	52	0.1656%	0.0966%
27	0.0387%	0.0138%	53	0.1808%	0.1066%
28	0.0424%	0.0153%	54	0.1967%	0.1169%
29	0.0448%	0.0169%	55	0.2153%	0.1294%
30	0.0484%	0.0197%	56	0.2355%	0.1417%
31	0.0520%	0.0212%	57	0.2582%	0.1546%
32	0.0554%	0.0239%	58	0.2821%	0.1679%
33	0.0585%	0.0252%	59	0.3069%	0.1823%
34	0.0612%	0.0277%	60	0.3330%	0.1976%
35	0.0648%	0.0299%	61	0.3600%	0.2126%
36	0.0680%	0.0319%	62	0.3872%	0.2283%
37	0.0706%	0.0349%	63	0.4155%	0.2458%
38	0.0739%	0.0364%	64	0.4435%	0.2653%
39	0.0765%	0.0387%	65	0.4723%	0.2859%
40	0.0798%	0.0409%	66	0.5024%	0.3100%
41	0.0825%	0.0439%	67	0.5352%	0.3378%
42	0.0860%	0.0456%	68	0.5712%	0.3689%
43	0.0891%	0.0483%	69	0.6130%	0.4043%
44	0.0932%	0.0510%	70	0.6595%	0.4453%
45	0.0983%	0.0548%			

\* The rates shown are PUB-2010 mortality for employees, General table, with adjustments, if applicable (see Section F). Recommended rates include mortality improvements using projection scale MP-2019.

## **SECTION I**

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### **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**

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### **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

### 2015-2019 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	1,546	11.28%	12.25%
2	1,254	5.39%	8.75%
3	1,045	4.36%	5.75%
4	906	4.73%	5.25%
5	736	4.35%	5.00%
6	627	4.72%	4.75%
7	584	5.28%	4.75%
8	669	4.87%	4.75%
9	833	4.28%	4.75%
10	898	4.34%	4.75%
11	849	4.33%	4.75%
12	686	4.84%	4.50%
13	561	4.02%	4.25%
14	432	3.70%	4.25%
15	398	3.18%	4.00%
16	380	4.08%	4.00%
17	355	3.38%	4.00%
18	291	3.68%	3.75%
19	245	2.88%	3.75%
20	239	3.37%	3.75%
21	267	2.86%	3.50%
22	232	2.94%	3.50%
23	211	2.75%	3.50%
24	171	3.15%	3.25%
25+	425	2.65%	3.25%
<b>Totals</b>	<b>14,840</b>	<b>5.00%</b>	<b>5.71%</b>



## Appendix – Detailed Experience Analysis Salary Increases

### 2015-2016 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	347	12.20%	12.25%
2	292	5.35%	8.75%
3	234	4.14%	5.75%
4	222	4.71%	5.25%
5	125	4.30%	5.00%
6	138	4.05%	4.75%
7	166	5.23%	4.75%
8	292	5.40%	4.75%
9	287	4.86%	4.75%
10	246	3.99%	4.75%
11	159	4.24%	4.75%
12	99	4.01%	4.50%
13	122	4.62%	4.25%
14	99	4.16%	4.25%
15	113	2.80%	4.00%
16	94	2.84%	4.00%
17	86	3.47%	4.00%
18	58	3.37%	3.75%
19	50	3.42%	3.75%
20	80	3.79%	3.75%
21	106	2.67%	3.50%
22	32	3.37%	3.50%
23	35	3.23%	3.50%
24	32	2.63%	3.25%
25+	109	2.58%	3.25%
<b>Totals</b>	<b>3,623</b>	<b>5.02%</b>	<b>5.63%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2016-2017 Experience

Year	Exposure	Gross Actual Increases	Gross Expected Increases
1	490	9.56%	12.25%
2	298	5.40%	8.75%
3	249	3.27%	5.75%
4	217	4.61%	5.25%
5	201	4.64%	5.00%
6	117	4.41%	4.75%
7	131	5.85%	4.75%
8	161	4.49%	4.75%
9	281	3.92%	4.75%
10	260	4.12%	4.75%
11	221	4.59%	4.75%
12	160	4.97%	4.50%
13	92	4.43%	4.25%
14	112	3.49%	4.25%
15	98	3.68%	4.00%
16	101	4.69%	4.00%
17	82	2.93%	4.00%
18	73	3.85%	3.75%
19	57	3.63%	3.75%
20	47	1.79%	3.75%
21	72	3.05%	3.50%
22	98	2.78%	3.50%
23	30	3.91%	3.50%
24	30	3.81%	3.25%
25+	109	4.20%	3.25%
<b>Totals</b>	<b>3,787</b>	<b>4.93%</b>	<b>5.88%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2017-2018 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
1	363	11.67%	12.25%
2	328	5.52%	8.75%
3	268	4.54%	5.75%
4	222	4.47%	5.25%
5	204	4.03%	5.00%
6	190	4.63%	4.75%
7	115	5.33%	4.75%
8	119	4.64%	4.75%
9	147	4.39%	4.75%
10	259	4.19%	4.75%
11	238	3.87%	4.75%
12	205	4.66%	4.50%
13	149	3.51%	4.25%
14	89	3.95%	4.25%
15	101	3.68%	4.00%
16	94	3.70%	4.00%
17	97	3.08%	4.00%
18	73	4.02%	3.75%
19	70	0.49%	3.75%
20	49	2.83%	3.75%
21	44	2.15%	3.50%
22	66	1.58%	3.50%
23	91	2.43%	3.50%
24	28	2.72%	3.25%
25+	105	0.88%	3.25%
<b>Totals</b>	<b>3,714</b>	<b>4.76%</b>	<b>5.67%</b>

## Appendix – Detailed Experience Analysis Salary Increases

### 2018-2019 Experience

Age	Exposure	Gross Actual Increases	Gross Expected Increases
1	346	12.40%	12.25%
2	336	5.30%	8.75%
3	294	5.29%	5.75%
4	245	5.10%	5.25%
5	206	4.40%	5.00%
6	182	5.51%	4.75%
7	172	4.86%	4.75%
8	97	4.16%	4.75%
9	118	3.60%	4.75%
10	133	5.68%	4.75%
11	231	4.62%	4.75%
12	222	5.29%	4.50%
13	198	3.84%	4.25%
14	132	3.34%	4.25%
15	86	2.53%	4.00%
16	91	5.07%	4.00%
17	90	4.02%	4.00%
18	87	3.47%	3.75%
19	68	4.31%	3.75%
20	63	4.44%	3.75%
21	45	3.67%	3.50%
22	36	5.47%	3.50%
23	55	2.35%	3.50%
24	81	3.27%	3.25%
25+	102	2.91%	3.25%
<b>Totals</b>	<b>3,716</b>	<b>5.28%</b>	<b>5.64%</b>

## Appendix – Detailed Experience Analysis Retirements

2015-2019 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	5,064	153,616	7,680.82	65.9%
51	2,605	160,128	4,803.85	54.2%
52	3,918	154,576	4,637.26	84.5%
53	5,268	159,017	4,770.51	110.4%
54	3,773	154,414	7,720.65	48.9%
55	83,149	162,782	73,252.04	113.5%
56	29,741	89,959	17,991.73	165.3%
57	11,149	62,698	9,404.49	118.5%
58	10,187	57,831	8,674.76	117.4%
59	6,394	47,873	7,180.97	89.0%
60	6,659	40,329	6,049.25	110.1%
61	6,725	35,304	5,295.66	127.0%
62	9,944	27,447	6,861.86	144.9%
63	5,151	16,381	4,095.10	125.8%
64	1,334	11,782	2,945.85	45.3%
65	2,780	10,650	3,194.75	87.0%
66	2,379	7,915	2,374.58	100.2%
67	1,638	6,668	1,666.89	98.3%
68	875	4,494	1,123.59	77.9%
69	411	2,452	980.73	41.9%
<b>Totals</b>	<b>199,144</b>	<b>1,366,316</b>	<b>180,705.34</b>	<b>110.2%</b>

## Appendix – Detailed Experience Analysis Retirements

### 2015-2016 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/Expected
50	1,272	38,185	1,909.25	66.6%
51	556	34,240	1,027.20	54.1%
52	321	33,216	996.48	32.2%
53	2,278	40,268	1,208.03	188.6%
54	2,438	36,576	1,828.78	133.3%
55	18,387	42,179	18,980.65	96.9%
56	5,971	24,336	4,867.22	122.7%
57	2,378	12,611	1,891.59	125.7%
58	2,640	13,637	2,045.60	129.1%
59	1,426	9,676	1,451.27	98.3%
60	1,251	9,308	1,396.34	89.6%
61	309	7,336	1,100.42	28.1%
62	1,042	4,694	1,173.55	88.8%
63	1,864	3,817	954.22	195.3%
64	126	2,408	602.04	20.9%
65	568	3,011	903.21	62.9%
66	15	1,973	591.88	2.5%
67	384	1,543	385.75	99.5%
68	395	560	139.94	282.3%
69	135	259	103.57	130.3%
<b>Totals</b>	<b>43,756</b>	<b>319,833</b>	<b>43,556.99</b>	<b>100.5%</b>

### 2016-2017 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/Expected
50	1,245	38,136	1,906.81	65.3%
51	627	40,704	1,221.12	51.3%
52	1,683	36,761	1,102.83	152.6%
53	609	36,043	1,081.30	56.3%
54	478	42,015	2,100.73	22.8%
55	17,611	36,851	16,582.86	106.2%
56	9,722	25,780	5,155.94	188.6%
57	3,734	19,850	2,977.39	125.4%
58	785	11,154	1,673.10	46.9%
59	1,138	12,387	1,858.09	61.2%
60	670	9,178	1,376.63	48.7%
61	2,210	8,936	1,340.37	164.9%
62	3,596	7,703	1,925.83	186.7%
63	884	4,075	1,018.65	86.8%
64	977	2,284	571.10	171.1%
65	611	2,532	759.57	80.4%
66	989	2,621	786.43	125.8%
67	929	2,186	546.39	170.0%
68	-	1,250	312.49	0.0%
69	184	184	73.70	249.7%
<b>Totals</b>	<b>48,682</b>	<b>340,630</b>	<b>44,371.33</b>	<b>109.7%</b>

## Appendix – Detailed Experience Analysis Retirements

### 2017-2018 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	1,202	44,591	2,229.55	53.9%
51	849	40,775	1,223.26	69.4%
52	327	44,495	1,334.84	24.5%
53	1,640	37,595	1,127.84	145.4%
54	358	39,020	1,951.00	18.3%
55	26,380	44,514	20,031.31	131.7%
56	8,268	20,573	4,114.54	200.9%
57	1,891	17,151	2,572.67	73.5%
58	3,267	17,253	2,587.95	126.2%
59	2,091	11,541	1,731.24	120.8%
60	3,028	12,154	1,823.00	166.1%
61	1,909	9,564	1,434.67	133.1%
62	3,210	7,137	1,784.22	179.9%
63	895	4,470	1,117.57	80.1%
64	-	3,350	837.56	0.0%
65	575	1,549	464.57	123.8%
66	983	2,095	628.54	156.4%
67	169	1,790	447.46	37.8%
68	369	1,044	261.08	141.3%
69	-	1,304	521.41	0.0%
<b>Totals</b>	<b>57,411</b>	<b>361,965</b>	<b>48,224.28</b>	<b>119.0%</b>

### 2018-2019 Experience (\$000s)

Age	Actual Retirements	Exposure	Expected Retirements	Actual/ Expected
50	1,345	32,704	1,635.21	82.3%
51	573	44,409	1,332.27	43.0%
52	1,587	40,104	1,203.11	131.9%
53	741	45,111	1,353.34	54.8%
54	499	36,803	1,840.14	27.1%
55	20,771	39,238	17,657.22	117.6%
56	5,780	19,270	3,854.03	150.0%
57	3,146	13,086	1,962.84	160.3%
58	3,495	15,787	2,368.11	147.6%
59	1,739	14,269	2,140.37	81.2%
60	1,710	9,689	1,453.28	117.7%
61	2,297	9,468	1,420.20	161.7%
62	2,096	7,913	1,978.26	106.0%
63	1,508	4,019	1,004.66	150.1%
64	231	3,740	935.15	24.7%
65	1,026	3,558	1,067.40	96.1%
66	392	1,226	367.73	106.6%
67	156	1,149	287.29	54.3%
68	111	1,640	410.08	27.1%
69	92	705	282.05	32.6%
<b>Totals</b>	<b>49,295</b>	<b>343,888</b>	<b>44,552.74</b>	<b>110.6%</b>

## Appendix – Detailed Experience Analysis Terminations – First Three Years

2015-2019 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/ Expected
1	6,622	26,019	2,601.90	254.5%	1	6,670	24,204	2,904.48	229.6%
2	12,185	79,116	7,911.60	154.0%	2	10,061	66,739	8,008.68	125.6%
3	7,052	77,195	7,719.50	91.4%	3	9,967	65,431	7,851.72	126.9%
<b>Totals</b>	<b>25,859</b>	<b>182,330</b>	<b>18,233.00</b>	<b>141.8%</b>	<b>Totals</b>	<b>26,698</b>	<b>156,374</b>	<b>18,764.88</b>	<b>142.3%</b>



## Appendix – Detailed Experience Analysis Terminations – First Three Years

### 2015-2016 Experience (\$000s)

Males					Females				
Year	Actual		Expected Terminations	Actual/Expected	Year	Actual		Expected Terminations	Actual/Expected
	Terminations	Exposure				Terminations	Terminations		
1	1,122	5,289	528.90	212.1%	1	1,503	5,977	717.24	209.6%
2	3,024	17,960	1,796.00	168.4%	2	3,120	16,982	2,037.84	153.1%
3	2,547	18,676	1,867.60	136.4%	3	2,369	14,408	1,728.96	137.0%
<b>Totals</b>	<b>6,693</b>	<b>41,925</b>	<b>4,192.50</b>	<b>159.6%</b>	<b>Totals</b>	<b>6,992</b>	<b>37,367</b>	<b>4,484.04</b>	<b>155.9%</b>

### 2016-2017 Experience (\$000s)

Males					Females				
Year	Actual		Expected Terminations	Actual/Expected	Year	Actual		Expected Terminations	Actual/Expected
	Terminations	Exposure				Terminations	Terminations		
1	1,745	8,014	801.40	217.7%	1	1,873	7,532	903.84	207.2%
2	3,609	21,159	2,115.90	170.6%	2	1,834	17,349	2,081.88	88.1%
3	1,455	18,696	1,869.60	77.8%	3	2,554	16,090	1,930.80	132.3%
<b>Totals</b>	<b>6,809</b>	<b>47,869</b>	<b>4,786.90</b>	<b>142.2%</b>	<b>Totals</b>	<b>6,261</b>	<b>40,971</b>	<b>4,916.52</b>	<b>127.3%</b>

## Appendix – Detailed Experience Analysis Terminations – First Three Years

### 2017-2018 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	1,798	6,214	621.40	289.3%	1	1,431	4,752	570.24	250.9%
2	2,638	20,395	2,039.50	129.3%	2	2,217	17,511	2,101.32	105.5%
3	930	19,641	1,964.10	47.3%	3	2,940	17,611	2,113.32	139.1%
<b>Totals</b>	<b>5,366</b>	<b>46,250</b>	<b>4,625.00</b>	<b>116.0%</b>	<b>Totals</b>	<b>6,588</b>	<b>39,874</b>	<b>4,784.88</b>	<b>137.7%</b>

### 2018-2019 Experience (\$000s)

Males					Females				
Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected	Year	Actual Terminations	Exposure	Expected Terminations	Actual/Expected
1	1,957	6,502	650.20	301.0%	1	1,863	5,943	713.16	261.2%
2	2,914	19,602	1,960.20	148.7%	2	2,890	14,897	1,787.64	161.7%
3	2,120	20,182	2,018.20	105.0%	3	2,104	17,322	2,078.64	101.2%
<b>Totals</b>	<b>6,991</b>	<b>46,286</b>	<b>4,628.60</b>	<b>151.0%</b>	<b>Totals</b>	<b>6,857</b>	<b>38,162</b>	<b>4,579.44</b>	<b>149.7%</b>

## Appendix – Detailed Experience Analysis Terminations – After Third Year

2015-2019 Experience, (\$000s)

Age Group	Males				Age Group	Females			
	Actual Terminations	Exposure	Expected Terminations	Actual/Expected		Actual Terminations	Exposure	Expected Terminations	Actual/Expected
20-24	161	878	87.80	183.4%	20-24	100	812	97.44	102.6%
25-29	3,307	42,970	3,037.40	108.9%	25-29	3,122	20,340	2,065.59	151.1%
30-34	9,613	181,522	8,650.33	111.1%	30-34	9,645	86,510	7,015.53	137.5%
35-39	11,662	285,783	11,700.59	99.7%	35-39	12,819	160,542	10,694.85	119.9%
40-44	8,840	344,082	8,961.54	98.6%	40-44	9,830	148,889	7,296.85	134.7%
45-49	8,692	468,447	8,037.40	108.1%	45-49	6,452	186,348	5,763.63	111.9%
50+	790	-	-	N/A	50+	990	-	-	N/A
<b>Totals</b>	<b>43,065</b>	<b>1,323,682</b>	<b>40,475.07</b>	<b>106.4%</b>	<b>Totals</b>	<b>42,958</b>	<b>603,441</b>	<b>32,933.88</b>	<b>130.4%</b>



## Appendix – Detailed Experience Analysis Terminations – After Third Year

### 2015-2016 Experience, (\$000s)

Age Group	Males				Age Group	Females			
	Actual Terminations	Exposure	Expected Terminations	Actual/Expected		Actual Terminations	Exposure	Expected Terminations	Actual/Expected
20-24	-	132	13.20	0.0%	20-24	-	144	17.28	0.0%
25-29	952	10,598	742.31	128.2%	25-29	756	3,898	394.65	191.6%
30-34	2,382	45,555	2,173.86	109.6%	30-34	2,867	24,995	2,025.32	141.6%
35-39	3,500	64,428	2,643.74	132.4%	35-39	2,476	34,631	2,307.11	107.3%
40-44	1,518	84,642	2,209.98	68.7%	40-44	3,048	34,173	1,653.65	184.3%
45-49	1,496	116,300	1,990.82	75.1%	45-49	894	45,007	1,389.42	64.3%
50+	192	-	-	N/A	50+	119	-	-	N/A
<b>Totals</b>	<b>10,040</b>	<b>321,655</b>	<b>9,773.91</b>	<b>102.7%</b>	<b>Totals</b>	<b>10,160</b>	<b>142,848</b>	<b>7,787.43</b>	<b>130.5%</b>

### 2016-2017 Experience, (\$000s)

Age Group	Males				Age Group	Females			
	Actual Terminations	Exposure	Expected Terminations	Actual/Expected		Actual Terminations	Exposure	Expected Terminations	Actual/Expected
20-24	58	188	18.80	308.5%	20-24	-	114	13.68	0.0%
25-29	750	11,281	791.98	94.7%	25-29	601	4,879	497.93	120.7%
30-34	1,812	46,507	2,216.48	81.8%	30-34	2,043	21,313	1,730.58	118.1%
35-39	2,259	67,731	2,782.39	81.2%	35-39	2,549	39,608	2,647.93	96.3%
40-44	2,656	83,744	2,195.47	121.0%	40-44	2,390	37,105	1,805.74	132.4%
45-49	2,468	122,992	2,111.47	116.9%	45-49	1,449	45,652	1,406.28	103.0%
50+	352	-	-	N/A	50+	468	-	-	N/A
<b>Totals</b>	<b>10,355</b>	<b>332,443</b>	<b>10,116.59</b>	<b>102.4%</b>	<b>Totals</b>	<b>9,500</b>	<b>148,671</b>	<b>8,102.14</b>	<b>117.3%</b>

## Appendix – Detailed Experience Analysis Terminations – After Third Year

### 2017-2018 Experience, (\$000s)

Age Group	Males				Age Group	Females			
	Actual Terminations	Exposure	Expected Terminations	Actual/Expected		Actual Terminations	Exposure	Expected Terminations	Actual/Expected
20-24	-	269	26.90	0.0%	20-24	53	310	37.20	142.5%
25-29	543	10,384	738.85	73.5%	25-29	1,059	6,071	615.16	172.2%
30-34	2,709	46,856	2,233.78	121.3%	30-34	2,324	21,059	1,707.92	136.1%
35-39	2,793	76,782	3,149.18	88.7%	35-39	3,489	44,871	2,990.40	116.7%
40-44	2,499	89,227	2,320.84	107.7%	40-44	2,022	38,157	1,863.45	108.5%
45-49	2,977	115,727	1,996.57	149.1%	45-49	1,796	48,237	1,490.81	120.5%
50+	95	-	-	N/A	50+	196	-	-	N/A
<b>Totals</b>	<b>11,616</b>	<b>339,245</b>	<b>10,466.12</b>	<b>111.0%</b>	<b>Totals</b>	<b>10,939</b>	<b>158,705</b>	<b>8,704.92</b>	<b>125.7%</b>

### 2018-2019 Experience, (\$000s)

Age Group	Males				Age Group	Females			
	Actual Terminations	Exposure	Expected Terminations	Actual/Expected		Actual Terminations	Exposure	Expected Terminations	Actual/Expected
20-24	103	289	28.90	356.4%	20-24	47	244	29.28	160.5%
25-29	1,062	10,707	764.26	139.0%	25-29	706	5,492	557.86	126.6%
30-34	2,710	42,604	2,026.21	133.7%	30-34	2,411	19,143	1,551.71	155.4%
35-39	3,110	76,842	3,125.29	99.5%	35-39	4,305	41,432	2,749.41	156.6%
40-44	2,167	86,469	2,235.25	96.9%	40-44	2,370	39,454	1,974.02	120.1%
45-49	1,751	113,428	1,938.55	90.3%	45-49	2,313	47,452	1,477.11	156.6%
50+	151	-	-	N/A	50+	207	-	-	N/A
<b>Totals</b>	<b>11,054</b>	<b>330,339</b>	<b>10,118.45</b>	<b>109.2%</b>	<b>Totals</b>	<b>12,359</b>	<b>153,217</b>	<b>8,339.39</b>	<b>148.2%</b>



## Appendix – Detailed Experience Analysis Disability Retirements

### 2015-2019 Experience

Age Group	Males and Females			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
20-24	-	486	0.35	0.0%
25-29	-	1,917	1.75	0.0%
30-34	-	2,900	3.56	0.0%
35-39	5	2,963	5.22	95.7%
40-44	6	2,389	6.33	94.7%
45-49	8	2,499	10.50	76.2%
50-54	11	2,538	17.49	62.9%
55-59	7	-	-	N/A
60-64	4	-	-	N/A
<b>Totals</b>	<b>41</b>	<b>15,692</b>	<b>45.22</b>	<b>90.7%</b>

## Appendix – Detailed Experience Analysis Disability Retirements

### 2015-2016 Experience

Age Group	Males and Females			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
20-24	-	89	0.07	0.0%
25-29	-	485	0.44	0.0%
30-34	-	746	0.91	0.0%
35-39	2	682	1.20	167.0%
40-44	-	579	1.54	0.0%
45-49	1	633	2.65	37.7%
50-54	5	631	4.38	114.2%
55-59	3	-	-	N/A
60-64	-	-	-	N/A
<b>Totals</b>	<b>11</b>	<b>3,845</b>	<b>11.19</b>	<b>98.3%</b>

### 2016-2017 Experience

Age Group	Males and Females			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
20-24	-	107	0.08	0.0%
25-29	-	466	0.43	0.0%
30-34	-	738	0.90	0.0%
35-39	1	742	1.30	76.8%
40-44	4	576	1.53	262.1%
45-49	1	637	2.68	37.3%
50-54	2	634	4.37	45.7%
55-59	1	-	-	N/A
60-64	-	-	-	N/A
<b>Totals</b>	<b>9</b>	<b>3,900</b>	<b>11.29</b>	<b>79.7%</b>

## Appendix – Detailed Experience Analysis Disability Retirements

### 2017-2018 Experience

Age Group	Males and Females			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
20-24	-	131	0.10	0.0%
25-29	-	464	0.42	0.0%
30-34	-	717	0.88	0.0%
35-39	-	770	1.36	0.0%
40-44	-	596	1.58	0.0%
45-49	2	615	2.59	77.3%
50-54	2	636	4.34	46.0%
55-59	2	-	-	N/A
60-64	1	-	-	N/A
<b>Totals</b>	<b>7</b>	<b>3,929</b>	<b>11.27</b>	<b>62.1%</b>

### 2018-2019 Experience

Age Group	Males and Females			
	Actual Disabilities	Exposure	Expected Disabilities	Actual/Expected
20-24	-	159	0.11	0.0%
25-29	-	502	0.46	0.0%
30-34	-	699	0.86	0.0%
35-39	2	769	1.37	146.4%
40-44	2	638	1.68	118.7%
45-49	4	614	2.59	154.7%
50-54	2	637	4.40	45.5%
55-59	1	-	-	N/A
60-64	3	-	-	N/A
<b>Totals</b>	<b>14</b>	<b>4,018</b>	<b>11.47</b>	<b>122.0%</b>



## Appendix – Detailed Experience Analysis Post-Retirement Mortality

2015-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
50-54	-	3,844	13.57	0.0%	50-54	8	2,142	5.43	147.3%
55-59	111	37,988	185.97	59.7%	55-59	34	16,704	59.30	57.3%
60-64	238	41,352	292.15	81.5%	60-64	31	17,521	93.65	33.1%
65-69	337	31,570	347.20	97.1%	65-69	110	10,734	90.34	121.8%
70-74	338	18,555	342.65	98.6%	70-74	29	6,707	90.57	32.0%
75-79	375	10,457	347.33	108.0%	75-79	102	2,991	71.22	143.2%
80-84	345	7,311	425.79	81.0%	80-84	120	1,659	70.07	171.2%
85-89	322	2,926	315.72	102.0%	85-89	48	666	54.44	88.2%
90-94	318	1,309	236.89	134.2%	90-94	34	213	27.92	121.8%
95+	68	342	75.86	89.6%	95+	-	150	31.75	0.0%
<b>Totals</b>	<b>2,452</b>	<b>155,654</b>	<b>2,583.13</b>	<b>94.9%</b>	<b>Totals</b>	<b>516</b>	<b>59,487</b>	<b>594.70</b>	<b>86.8%</b>



## Appendix – Detailed Experience Analysis Post-Retirement Mortality

### 2015-2016 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
50-54	-	1,368	4.92	0.0%	50-54	-	829	2.09	0.0%
55-59	2	8,909	44.24	4.5%	55-59	-	3,768	13.52	0.0%
60-64	43	9,642	69.19	62.1%	60-64	-	3,609	19.44	0.0%
65-69	46	6,716	75.40	61.0%	65-69	18	2,344	20.20	89.1%
70-74	90	3,667	69.83	128.9%	70-74	-	1,190	16.32	0.0%
75-79	53	2,389	81.35	65.1%	75-79	55	753	19.01	289.2%
80-84	85	1,388	79.62	106.8%	80-84	32	269	11.96	267.6%
85-89	162	775	81.43	198.9%	85-89	7	167	13.45	52.0%
90-94	100	379	69.34	144.2%	90-94	-	33	4.52	0.0%
95+	-	43	10.53	0.0%	95+	-	23	5.31	0.0%
<b>Totals</b>	<b>581</b>	<b>35,276</b>	<b>585.84</b>	<b>99.2%</b>	<b>Totals</b>	<b>112</b>	<b>12,985</b>	<b>125.82</b>	<b>89.0%</b>

### 2016-2017 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
50-54	-	1,075	3.86	0.0%	50-54	-	610	1.56	0.0%
55-59	-	9,375	46.26	0.0%	55-59	5	4,003	14.24	35.1%
60-64	23	9,813	70.00	32.9%	60-64	-	4,161	22.16	0.0%
65-69	145	7,636	84.88	170.8%	65-69	30	2,618	22.37	134.1%
70-74	77	4,167	77.89	98.9%	70-74	6	1,461	19.94	30.1%
75-79	74	2,609	88.54	83.6%	75-79	47	692	17.02	276.2%
80-84	9	1,577	91.83	9.8%	80-84	34	411	17.40	195.4%
85-89	90	708	76.65	117.4%	85-89	4	130	10.74	37.2%
90-94	28	265	49.00	57.1%	90-94	34	69	9.13	372.2%
95+	68	86	21.68	313.7%	95+	-	23	5.72	0.0%
<b>Totals</b>	<b>514</b>	<b>37,311</b>	<b>610.58</b>	<b>84.2%</b>	<b>Totals</b>	<b>160</b>	<b>14,178</b>	<b>140.29</b>	<b>114.1%</b>



## Appendix – Detailed Experience Analysis Post-Retirement Mortality

### 2017-2018 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
50-54	-	717	2.49	0.0%	50-54	-	454	1.16	0.0%
55-59	73	9,629	46.94	155.5%	55-59	-	4,266	15.03	0.0%
60-64	70	10,552	74.04	94.5%	60-64	-	4,705	24.97	0.0%
65-69	50	8,281	89.86	55.6%	65-69	18	2,778	23.14	77.8%
70-74	67	5,179	95.10	70.5%	70-74	11	1,989	27.10	40.6%
75-79	127	2,619	88.30	143.8%	75-79	-	556	12.98	0.0%
80-84	72	1,946	114.37	63.0%	80-84	40	510	20.54	194.7%
85-89	16	711	79.49	20.1%	85-89	21	172	13.56	154.9%
90-94	139	313	58.49	237.7%	90-94	-	55	6.73	0.0%
95+	-	17	4.76	0.0%	95+	-	24	6.39	0.0%
<b>Totals</b>	<b>614</b>	<b>39,964</b>	<b>653.83</b>	<b>93.9%</b>	<b>Totals</b>	<b>90</b>	<b>15,509</b>	<b>151.60</b>	<b>59.4%</b>

### 2018-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
50-54	-	684	2.31	0.0%	50-54	8	249	0.62	1282.3%
55-59	36	10,075	48.53	74.2%	55-59	29	4,667	16.51	175.6%
60-64	102	11,345	78.92	129.2%	60-64	31	5,046	27.09	114.4%
65-69	96	8,937	97.06	98.9%	65-69	44	2,994	24.62	178.7%
70-74	104	5,542	99.83	104.2%	70-74	12	2,067	27.21	44.1%
75-79	121	2,840	89.15	135.7%	75-79	-	990	22.20	0.0%
80-84	179	2,400	139.97	127.9%	80-84	14	469	20.17	69.4%
85-89	54	732	78.15	69.1%	85-89	16	197	16.69	95.8%
90-94	51	352	60.07	84.9%	90-94	-	56	7.53	0.0%
95+	-	196	38.88	0.0%	95+	-	80	14.34	0.0%
<b>Totals</b>	<b>743</b>	<b>43,103</b>	<b>732.87</b>	<b>101.4%</b>	<b>Totals</b>	<b>154</b>	<b>16,815</b>	<b>177.00</b>	<b>87.0%</b>



## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

2015-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
20-24	69	11,768	3.32	2081.2%	20-24	-	9,118	1.04	0.0%
25-29	-	91,409	24.57	0.0%	25-29	-	47,070	6.91	0.0%
30-34	-	222,825	67.67	0.0%	30-34	-	120,569	25.79	0.0%
35-39	427	316,340	111.55	382.8%	35-39	195	189,683	53.57	364.0%
40-44	157	365,611	168.57	93.1%	40-44	-	172,408	67.57	0.0%
45-49	1,420	483,504	375.79	377.9%	45-49	-	202,640	129.39	0.0%
50-54	1,016	571,905	777.69	130.6%	50-54	-	236,234	254.10	0.0%
55-59	1,094	290,554	631.46	173.2%	55-59	-	151,863	245.16	0.0%
60-64	62	82,816	314.85	19.7%	60-64	-	55,219	127.35	0.0%
<b>Totals</b>	<b>4,245</b>	<b>2,436,732</b>	<b>2,475.45</b>	<b>171.5%</b>	<b>Totals</b>	<b>195</b>	<b>1,184,804</b>	<b>910.88</b>	<b>21.4%</b>

## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

### 2015-2016 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
20-24	-	2,004	0.60	0.0%	20-24	-	1,779	0.22	0.0%
25-29	-	23,095	6.48	0.0%	25-29	-	11,356	1.72	0.0%
30-34	-	55,297	17.29	0.0%	30-34	-	32,779	7.01	0.0%
35-39	-	71,041	25.79	0.0%	35-39	195	41,980	11.91	1637.2%
40-44	-	88,877	42.55	0.0%	40-44	-	39,948	16.12	0.0%
45-49	-	120,231	97.28	0.0%	45-49	-	48,645	32.07	0.0%
50-54	406	133,021	187.05	217.1%	50-54	-	56,342	62.18	0.0%
55-59	-	68,977	150.07	0.0%	55-59	-	38,123	61.85	0.0%
60-64	-	17,198	67.03	0.0%	60-64	-	11,237	25.80	0.0%
<b>Totals</b>	<b>406</b>	<b>579,741</b>	<b>594.15</b>	<b>68.3%</b>	<b>Totals</b>	<b>195</b>	<b>282,189</b>	<b>218.89</b>	<b>89.1%</b>

### 2016-2017 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
20-24	-	2,938	0.84	0.0%	20-24	-	2,038	0.24	0.0%
25-29	-	23,157	6.30	0.0%	25-29	-	11,738	1.74	0.0%
30-34	-	57,464	17.61	0.0%	30-34	-	31,168	6.64	0.0%
35-39	-	76,824	27.33	0.0%	35-39	-	48,304	13.63	0.0%
40-44	-	88,960	41.20	0.0%	40-44	-	41,782	16.58	0.0%
45-49	-	126,965	99.71	0.0%	45-49	-	49,979	32.28	0.0%
50-54	610	141,036	194.62	313.4%	50-54	-	59,248	64.10	0.0%
55-59	324	71,726	157.83	205.3%	55-59	-	39,617	63.84	0.0%
60-64	-	20,409	78.25	0.0%	60-64	-	13,223	30.49	0.0%
<b>Totals</b>	<b>934</b>	<b>609,479</b>	<b>623.69</b>	<b>149.8%</b>	<b>Totals</b>	<b>-</b>	<b>297,097</b>	<b>229.55</b>	<b>0.0%</b>



## Appendix – Detailed Experience Analysis Pre-Retirement Mortality

### 2017-2018 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
20-24	-	3,070	0.85	0.0%	20-24	-	2,522	0.28	0.0%
25-29	-	22,529	5.95	0.0%	25-29	-	11,956	1.73	0.0%
30-34	-	57,675	17.31	0.0%	30-34	-	29,751	6.37	0.0%
35-39	300	84,765	29.60	1013.4%	35-39	-	52,006	14.66	0.0%
40-44	157	94,657	43.07	364.5%	40-44	-	44,859	17.52	0.0%
45-49	-	118,985	90.37	0.0%	45-49	-	52,713	33.47	0.0%
50-54	-	153,270	204.34	0.0%	50-54	-	59,139	63.03	0.0%
55-59	-	77,719	167.79	0.0%	55-59	-	38,831	62.57	0.0%
60-64	-	23,170	86.52	0.0%	60-64	-	15,454	35.80	0.0%
<b>Totals</b>	<b>457</b>	<b>635,840</b>	<b>645.80</b>	<b>70.8%</b>	<b>Totals</b>	-	<b>307,231</b>	<b>235.44</b>	<b>0.0%</b>

### 2018-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
20-24	69	3,756	1.02	6777.5%	20-24	-	2,779	0.31	0.0%
25-29	-	22,628	5.83	0.0%	25-29	-	12,020	1.71	0.0%
30-34	-	52,389	15.46	0.0%	30-34	-	26,871	5.76	0.0%
35-39	127	83,710	28.84	440.4%	35-39	-	47,393	13.36	0.0%
40-44	-	93,117	41.74	0.0%	40-44	-	45,819	17.35	0.0%
45-49	1,420	117,323	88.42	1606.0%	45-49	-	51,303	31.57	0.0%
50-54	-	144,578	191.67	0.0%	50-54	-	61,505	64.79	0.0%
55-59	770	72,132	155.78	494.3%	55-59	-	35,292	56.90	0.0%
60-64	62	22,039	83.06	74.6%	60-64	-	15,305	35.25	0.0%
<b>Totals</b>	<b>2,448</b>	<b>611,672</b>	<b>611.82</b>	<b>400.1%</b>	<b>Totals</b>	-	<b>298,287</b>	<b>227.00</b>	<b>0.0%</b>



## Appendix – Detailed Experience Analysis Disabled Mortality

2015-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	763	9.96	0.0%	40-44	-	180	1.37	0.0%
45-49	-	1,777	29.04	0.0%	45-49	-	982	9.39	0.0%
50-54	-	2,545	51.63	0.0%	50-54	-	1,396	17.83	0.0%
55-59	85	3,376	80.52	105.6%	55-59	41	1,711	26.74	153.3%
60-64	29	2,838	77.97	37.2%	60-64	33	1,927	35.30	93.5%
65-69	90	2,279	75.34	119.5%	65-69	24	973	20.97	114.5%
70-74	15	881	38.47	39.0%	70-74	21	466	15.25	137.7%
75-79	22	226	13.26	166.0%	75-79	-	148	6.77	0.0%
80-84	27	79	6.59	409.7%	80-84	-	22	1.33	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
<b>Totals</b>	<b>268</b>	<b>14,764</b>	<b>382.78</b>	<b>70.0%</b>	<b>Totals</b>	<b>119</b>	<b>7,805</b>	<b>134.94</b>	<b>88.2%</b>



## Appendix – Detailed Experience Analysis Disabled Mortality

### 2015-2016 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	220	2.92	0.0%	40-44	-	69	0.53	0.0%
45-49	-	440	7.37	0.0%	45-49	-	296	2.85	0.0%
50-54	-	572	11.89	0.0%	50-54	-	393	5.06	0.0%
55-59	55	931	22.65	242.8%	55-59	-	386	6.05	0.0%
60-64	11	612	17.31	63.5%	60-64	-	524	9.58	0.0%
65-69	15	428	14.23	105.4%	65-69	-	135	3.02	0.0%
70-74	-	164	7.18	0.0%	70-74	-	109	3.49	0.0%
75-79	22	42	2.56	860.3%	75-79	-	20	0.97	0.0%
80-84	-	26	2.03	0.0%	80-84	-	-	-	N/A
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
<b>Totals</b>	<b>103</b>	<b>3,435</b>	<b>88.15</b>	<b>116.8%</b>	<b>Totals</b>	<b>-</b>	<b>1,932</b>	<b>31.56</b>	<b>0.0%</b>

### 2016-2017 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	162	2.13	0.0%	40-44	-	35	0.27	0.0%
45-49	-	386	6.22	0.0%	45-49	-	239	2.27	0.0%
50-54	-	685	13.88	0.0%	50-54	-	356	4.53	0.0%
55-59	8	814	19.44	41.2%	55-59	-	397	6.20	0.0%
60-64	-	703	19.32	0.0%	60-64	33	571	10.49	314.6%
65-69	16	553	18.23	87.8%	65-69	24	178	3.89	617.0%
70-74	-	215	9.57	0.0%	70-74	-	131	4.32	0.0%
75-79	-	21	1.30	0.0%	75-79	-	21	1.10	0.0%
80-84	-	26	2.16	0.0%	80-84	-	-	-	N/A
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
<b>Totals</b>	<b>24</b>	<b>3,565</b>	<b>92.25</b>	<b>26.0%</b>	<b>Totals</b>	<b>57</b>	<b>1,928</b>	<b>33.05</b>	<b>172.5%</b>





## Appendix – Detailed Experience Analysis Disabled Mortality

### 2017-2018 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	197	2.54	0.0%	40-44	-	38	0.28	0.0%
45-49	-	437	7.11	0.0%	45-49	-	236	2.23	0.0%
50-54	-	700	14.15	0.0%	50-54	-	363	4.67	0.0%
55-59	22	802	19.05	115.5%	55-59	41	442	6.95	589.9%
60-64	-	698	18.96	0.0%	60-64	-	459	8.47	0.0%
65-69	15	678	22.42	66.9%	65-69	-	268	5.80	0.0%
70-74	-	209	9.26	0.0%	70-74	-	104	3.52	0.0%
75-79	-	61	3.51	0.0%	75-79	-	51	2.38	0.0%
80-84	27	27	2.39	1127.4%	80-84	-	-	-	N/A
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
<b>Totals</b>	<b>64</b>	<b>3,809</b>	<b>99.38</b>	<b>64.4%</b>	<b>Totals</b>	<b>41</b>	<b>1,961</b>	<b>34.30</b>	<b>119.5%</b>

### 2018-2019 Experience (\$000s)

Age Group	Males				Age Group	Females			
	Actual Deaths	Exposure	Expected Deaths	Actual/Expected		Actual Deaths	Exposure	Expected Deaths	Actual/Expected
40-44	-	184	2.37	0.0%	40-44	-	38	0.29	0.0%
45-49	-	514	8.34	0.0%	45-49	-	211	2.04	0.0%
50-54	-	588	11.71	0.0%	50-54	-	284	3.58	0.0%
55-59	-	829	19.38	0.0%	55-59	-	486	7.54	0.0%
60-64	18	825	22.39	80.4%	60-64	-	373	6.77	0.0%
65-69	44	620	20.47	214.9%	65-69	-	392	8.26	0.0%
70-74	15	293	12.46	120.4%	70-74	21	122	3.91	536.5%
75-79	-	102	5.89	0.0%	75-79	-	56	2.32	0.0%
80-84	-	-	-	N/A	80-84	-	22	1.33	0.0%
85-89	-	-	-	N/A	85-89	-	-	-	N/A
90-94	-	-	-	N/A	90-94	-	-	-	N/A
95-99	-	-	-	N/A	95-99	-	-	-	N/A
<b>Totals</b>	<b>77</b>	<b>3,955</b>	<b>103.01</b>	<b>74.8%</b>	<b>Totals</b>	<b>21</b>	<b>1,984</b>	<b>36.03</b>	<b>58.3%</b>

