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Teachers' Retirement Board

Connecticut State Teachers' Retirement System
Experience Study for the
Five-Year Period Ending June 30, 2015

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October 29, 2015

Teachers' Retirement Board
State of Connecticut
765 Asylum Avenue
Hartford, CT 06105

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Connecticut Teachers' Retirement System. The purpose of this study is to assess the reasonability of the actuarial assumptions and methods for the System. The actuarial assumptions are used by the actuary to provide a best estimate of the value of all benefits expected to be paid by the System over future years. The valuation uses various methods in determining the required funding necessary to accumulate a sufficient amount of assets to fully fund the expected benefit payments.

This experience study covers the five-year period from July 1, 2010 to June 30, 2015. As a result of the study, it is recommended that revised assumptions be adopted by the Board for future use. Changing assumptions will not change the actual cost of future benefits but will impact the measurement of the expected value of future benefits and the required contributions to maintain actuarial soundness.

The experience study includes all active and inactive members including retired members, disabled members and beneficiaries of deceased members. The demographic experience was studied separately for males and females where gender is a basis for material differences in experience.

This report shows comparisons between the actual and expected cases of separation from active service, actual and expected number of deaths, and actual and expected salary increases. Tables and graphs are used to show the actual rates measured, the rates expected under the current assumptions and, where applicable, the proposed change to rates.

The recommended decrement tables are shown in Appendix A of this report. In the actuary's judgment, the recommended rates are suitable for use until further experience indicates that modifications are needed.

The experience study was performed by, and under the supervision of, independent actuaries who are members of the American Academy of Actuaries with experience in performing valuations for public retirement systems and who meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

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Section I: Introduction

Board Summary

The following table summarizes the findings and recommendations with regard to the actuarial assumptions and methods utilized for actuarial valuations of the Connecticut Teachers' Retirement System. Detailed explanations for the recommendations are found in the sections that follow.

Summary of Recommended Assumptions	
Economic Assumptions	
Rates of Salary Increase	Composed of Inflation component, Real Rate of Wage Increase component and a Service Based Scale.
Inflation	Recommend change from 3.00% to 2.75% rate of inflation.
Real Rate of Wage Increase	Recommend a decrease in the annual rate of real wage increase assumption from 0.75% to 0.50%.
Service Based	Recommend minor changes to the merit portion of the salary scale.
Investment Rate of Return	Composed of Inflation component (3.00% currently) and Real Rate of Return component which is currently 5.50%. We recommend a decrease to the Real Rate of Return to 5.25%. That combined with the recommended 2.75% inflation rate results in an 8.00% recommended Investment Rate of Return. We also provide an alternative assumption of 7.50% which is the midpoint of the reasonable range.
Payroll Growth	Recommend change from 3.75% to 3.25% based upon the sum of the inflation and real rate of wage increase.
Demographic Assumptions	
Withdrawal	Recommend increasing rates.
Retirement	Recommend increasing normal retirement rates for females and, proratable retirement rates for males. Recommend decreasing early retirement rates for both males and females.
Mortality	Recommend updating assumption to a projected white collar version of RPH-2014 Mortality Table.
Disability	Recommend decreasing rates for males.
Marriage Assumption	Recommend no change to the current assumption.
Actuarial Methods	
Actuarial Cost Method	Recommend no change to the current method.
Asset Smoothing	Recommend no change to the current method.
Amortization Method	No recommended changes. Alternatives discussed for consideration.

Section I: Introduction

Impact on Valuation Results

The following table highlights the impact of the recommended changes on the June 30, 2014 actuarial valuation results.

	Impact on Actuarial Valuation Results (Dollar amounts in thousands)		
	2014 Valuation Results	**2014 Valuation Results with Recommended Assumptions and 8.0% assumed investment return**	**2014 Valuation Results with Recommended Assumptions and 7.5% assumed investment return**
Normal Cost Rate	9.73%	10.48%	11.87%
Funded Ratio	59.0%	55.1%	52.3%
Unfunded Actuarial Accrued Liability (UAAL)	$10,802,693	$12,670,013	$14,178,228
Increase in UAAL		$1,867,319	$3,375,534
Employer Contribution Rate	23.65%	28.51%	31.98%
Increase in Employer Rate		4.86%	8.33%
Expected FY 2016 Employer Contribution	$975,578	$1,164,759	$1,306,263
Expected Increase in FY 2016 Employer Contribution		$189,181	$330,685

If the increase in contributions are not incorporated in the FY 2016 contributions, the amounts would be expected to increase with interest at the assumed rate.

Section II: Economic Assumptions

There are three economic assumptions used in the actuarial valuations performed for the System. They are:

- Investment Rate of Return
- Rates of Wage Inflation
- Rate of Payroll Growth

Each of these assumptions is separated into its relevant component parts. The investment rate of return assumption is comprised of an inflation component and a real rate of return component. Similarly the rate of wage inflation assumption is comprised of an inflation component, a real rate of wage increase component (also called the productivity component). Finally, the payroll growth assumption uses the components for inflation and real wage increases in determining a reasonable range for annual growth in total payroll. The actuary is tasked with defining a reasonable range and, where appropriate, recommending a best estimate for each of the economic assumptions.

Actuarial Standard of Practice (ASOP) No. 27, *"Selection of Economic Assumptions for Measuring Pension Obligations"*, provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. Economic assumptions primarily consist of investment return, discount rate, post-retirement benefit increases, inflation, and compensation increases. Measurements of defined benefit obligations include calculations such as funding valuations, liability measurements, and cash flow projections. The actuary should consider the purpose of the measurement, the characteristics of the obligation to be measured, and the materiality of the assumption to the measurement when identifying the types of economic assumptions to use for a specific measurement. For each economic assumption the actuary should:

- Identify components of the assumption (if any)
- Evaluate relevant data
- Consider factors specific to the measurement
- Consider other general factors
- Select a reasonable assumption

Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period.

In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 27.

Inflation

The assumed rate of inflation is the expectation of the long-term annual rate of increase in the Consumer Price Index and is a component of all economic assumptions. This is also called price inflation.

It is important that the inflation assumption be consistently applied throughout the economic assumptions utilized in an actuarial valuation. This is called for in ASOP No. 27 and is also required to meet the parameters for determining pension liabilities and expense under Governmental Accounting Standards Board (GASB) Statements No. 67 and 68.

The current price inflation assumption is an assumed annual rate of 3.0%.

Past Experience: The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The graph below shows the annual increases in the CPI (U) as of December 31st for each of the latest 50 years compared to the current assumed 3.00% rate of inflation.

Annual CPI (U) Increases 1960 - 2015
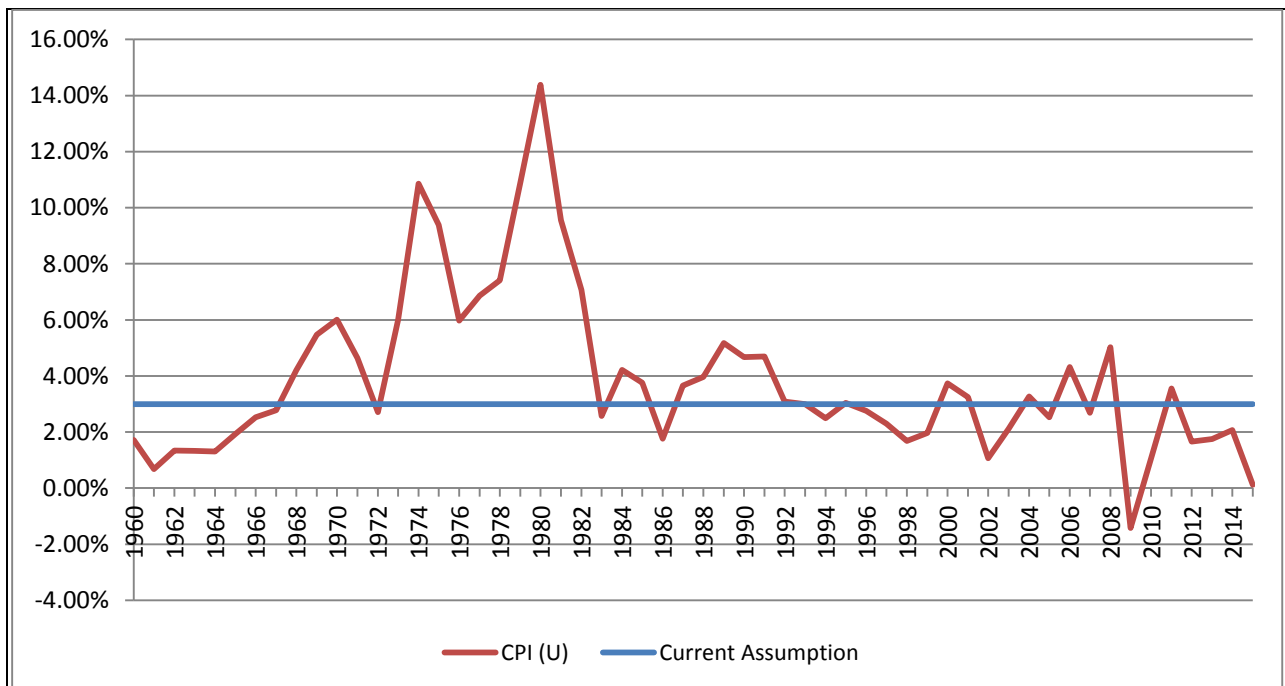
Section II: Economic Assumptions

The table below provides historical annualized rates and annual standard deviation of the CPI-U over periods ending June 30th.

Period	Annualized Rate of Inflation	Annual Standard Deviation
1926 - 2015	2.95%	4.14%
1955 - 2015	3.72%	2.86%
1965- 2015	4.13%	2.94%
1975 - 2015	3.80%	2.92%
1985 - 2015	2.69%	1.46%
1995 - 2015	2.26%	1.46%
2005 - 2015	2.07%	1.93%

Over shorter historical periods, the average annual rate of increase in the CPI-U has been below 3.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. As the rates of inflation decreased after this period so did the volatility of the rates as measured by the annual standard deviation. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Federal Reserve since the early 1980's to stabilize price inflation. The severe recession of 2008-2009 resulted in a short period of deflation followed by lower levels of inflation. The Federal Reserve has combated this weak environment with zero interest rates and quantitative easing. Although the quantitative easing program has ended, the Federal Reserve has disclosed an inflation target of at least 2.0% annually and has stated it will keep interest rates very low until they see progress toward the target.

Additional information to consider is obtained from measuring the spread on treasury inflation protected securities (TIPS) and from the prevailing economic forecasts. The spread between the yield on treasury securities (bonds) and the inflation indexed yield on TIPS of the same maturity is referred to as the "breakeven rate of inflation" and represents the bond market's expectation of inflation over the period to maturity. The table below provides the calculation of the breakeven rate of inflation as of June 30, 2015.

Years to Maturity	Bond Yield	TIPS Yield	Breakeven Rate of Inflation
10	2.35%	0.48%	1.87%
20	2.83%	0.88%	1.95%
30	3.11%	1.11%	2.00%

The bond market's expectation for the rate of inflation over the longer term is approximately 2.00% which is significantly lower than long term historical average annual rates. Additionally, based

upon information contained in the "Survey of Professional Forecasters" for the second quarter of 2015 as published by the Philadelphia Federal Reserve Bank, the median of expected annual rate of inflation for the ten years beginning July 1, 2015 is 2.14%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide additional evidence that the consensus expectations of these experts are for significantly lower rates of inflation than the historical average for the near term future.

Recommendation: It is difficult to accurately predict inflation. Current economic forecasts and the bond market suggest lower inflation over the next ten to thirty years. In the 2014 OASDI Trustees Report, the Chief Actuary for Social Security bases the 75 year cost projections on an intermediate inflation assumption of 2.7% with a range of 1.7% to 3.7%. We concur with a reasonable range of 1.75% - 3.75%, and recommend decreasing the inflation assumption to 2.75%.

Price Inflation Assumption	
Current	3.00%
Reasonable Range	1.75% - 3.75%
Recommended	2.75%

Investment Rate of Return

Background: The assumed investment return is one of the most significant assumptions in the annual actuarial valuation process as it is used to discount the expected future benefit payments for all active, inactive and retired members. Minor changes in this assumption can have a major impact on valuation results. The investment rate of return assumption should reflect the long-term average annual rate of return which can reasonably be expected based on the target asset allocation and capital market assumptions of the investment professionals.

The current assumption is 8.50%, consisting of a price inflation assumption of 3.00% and a real rate of return (return net of inflation) assumption of 5.50%.

Section II: Economic Assumptions

Past Experience: The recent experience over the last 10 years is shown in the table below.

Year Ending 6/30	Market Value Rate of Return
2006	11.08%
2007	17.47%
2008	(4.77%)
2009	(17.84%)
2010	13.45%
2011	21.07%
2012	(1.05%)
2013	12.02%
2014	15.82%
2015	2.84%
Average	6.35%

Historical returns over a short time period are not credible for the purpose of setting the long-term assumed future rate of return.   Particular to this ten year period was the severe decline of 2008-2009 triggered by the collapse in housing prices which resulted in the so called 'Great Recession". In determining the reasonable range for this assumption we first look at long-term historical returns of broad market indices. We focus on the returns of stocks and high-quality bonds because they are the two major components of the portfolio and have significant amounts of performance history.

Analysis: Utilizing the historical real rates of return of the S&P 500 and the Intermediate Government Bond Index for the last 89 years, we determine the historical average annual rate of return of common allocation of large retirement funds (40% stocks/60% bonds to 70% stocks/30% bonds). On this basis the initial reasonable range for expected real rates of return is from 4.7% to 6.0%. The latest information available in the *Public Fund Survey* which shows the most common plan real rate of return assumption of 4.5% with a median equity allocation of 51%.   We then add the recommended inflation assumption of 2.75% to the reasonable range of real returns. This results in reasonable range for the long-term investment rate of return assumption of 7.45% to 8.75% based on historical broad market returns.

In recommending a reasonable range for the investment rate of return assumption, we also consider the capital market assumptions of investment professionals working with the Fund. We were provided the most recent AON Hewitt capital market assumptions and target asset allocation for our analysis by the State Treasurer's Office. We use statistical methods to approximate the longer-term expectation of returns. We consider a reasonable range for this assumption would be between the 25th and 75th percentile of long-term expected returns. Our analysis produces a reasonable

range for the long-term investment return assumption, net of expenses, between 6.3% and 8.7% and the median return (midpoint of the range) is 7.5% as shown in the table below.

Statistical Analysis of Expected Return Distribution							
Time Span In Years	Mean Rates of Return	Standard Deviation	Rates of Return by Percentile				
			5th	25th	50th	75th	95th
1	8.2%	13.1%	-11.7%	-0.8%	7.5%	16.6%	31.0%
5	7.6%	6.3%	-1.6%	3.7%	7.5%	11.5%	17.4%
10	7.5%	4.4%	1.0%	4.8%	7.5%	10.3%	14.4%
20	7.5%	3.1%	2.9%	5.6%	7.5%	9.5%	12.4%
30	7.5%	2.6%	3.7%	5.9%	7.5%	9.1%	11.5%
50	7.5%	2.0%	4.6%	**6.3%**	7.5%	**8.7%**	10.0%

We should note that the capital market assumptions produced by investment consultants vary over time. We recommend that we reassess the reasonable range with each significant future change to the asset allocations.

The most recent survey of large public plans, *Public Fund Survey* reported by the National Association of State Retirement Administrators shows the median investment return assumption of the 126 funds surveyed is 7.9% and the mode of the distribution is 8.0%. There is a clear trend in public plans lowering the investment return assumptions.

Recommendation: Based primarily on analysis of the expected returns of the Fund as currently allocated, we determine a reasonable range to be from 6.3% to 8.7%. Although current 8.50% assumption is within the reasonable range for this assumption, we recommend two alternatives for reducing the investment rate of return assumption. The first alternative for this assumptions would reduce the rate from 8.50% to 8.00% and would result in an assumption which is well within the reasonable range. The second alternative would reduce to the midpoint of the reasonable range of 7.50%. We present the results under both these assumed rates of return.

Investment Return Assumption	
Current	8.5%
Reasonable Range	6.3% - 8.7%
Alternative 1	8.0%
Alternative 2	7.5%

Section II: Economic Assumptions

Wage Inflation

Background: Wage inflation, thought of as the "across the board" rate of salary increases is comprised of the price inflation assumption combined with an assumption for the real rate of wage increases. The real rate of wage increase is the rate of increase in wages above price inflation. In constructing the rates of salary increases assumptions, the rate of wage inflation assumption is further combined with an assumption for service based salary increases. The service based salary increase assumption is provided in the demographic assumption section of the report. The current assumption implies the assumed real rate of wage increase is 0.75%.

Past Experience: The Social Security Administration publishes data on wage growth in the United States. As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Since wage data is only available through 2013 we use that year as the end point.

Period Ending 12/31/2013	Average Annual Rate of Wage Inflation	Average Annual Rate of Price Inflation	Average Annual Rate of Real Wage Increase
5 Years	1.7%	2.1%	(0.4)%
10 Years	2.8%	2.4%	0.4%
20 Years	3.4%	2.4%	1.0%
30 Years	3.7%	2.8%	0.9%
50 Years	4.8%	4.1%	0.7%

As the table above illustrates, real wage increases in the United States have been declining for some time.

Over the past five years of experience data we analyzed, the suggested rate of real wage inflation was 0.37% which is based upon the average rate of salary increases above price inflation for active members with no apparent service based salary increases.

Recommendation: We recommend decreasing the assumption from 0.75% to 0.50% per year real rate of wage increase.

Real Rate of Wage Increase Assumption	
Current	0.75%
Recommended	0.50%

Payroll Growth Assumption

Background: The assumed future increases in the total payroll of active members is an assumption that only affects the amortization of the unfunded accrued liability and therefore the contribution amounts necessary to fully amortize the unfunded actuarial accrued liability over the specified amortization period. The reasonable range for this assumption is typically between the rates of price inflation and the rate of wage inflation.

The current assumption for the payroll growth assumption is 3.75% which is the assumed rate of wage inflation over the period (3.00% price inflation plus 0.75% real rate of wage increases).

Past Experience: Over the past 5 years, the total annual payroll of the System as shown in actuarial valuations has grown at an average annual rate of 0.7%.

Recommendation: We recommend we lower this assumption from 3.75% to 3.25% to reflect the decrease to the assumed annual rate of price inflation as presented above as well as the decrease in the real wage increase assumption.

Real Rate of Wage Increase Assumption	
Current	3.75%
Reasonable Range	2.75% to 3.25%
Recommended	3.25%

Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Connecticut State Teachers' Retirement System. They are:

- Rates of Withdrawal
- Rates of Disability
- Rates of Service Retirement
- Rate of Mortality
- Rates of Service Based Salary Increases

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 35, *"Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations"*, which provides guidance to actuaries in selecting demographic assumptions for measuring obligations under defined benefit plans. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP No. 35.

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2010 through June 30, 2015) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

Detailed tabulations by age, service and/or gender are performed over the entire study period. The analysis of the experience data focuses on the number of members exposed to each decrement (i.e., retirement, withdrawal, mortality, etc.) and those who experience an event. The raw rates are then established based on this analysis. The raw rates are then compared to the assumed rates. If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior. In addition non-recurring events, such as the impact of recent economic events, need to be taken into account in determining the weight to give to recent experience.

The remainder of this section presents the results of the demographic study. We have prepared tables that show a comparison of the actual and expected decrements and the overall ratio of actual to expected results (A/E Ratios) under the current assumptions. If a change is being proposed, the revised A/E Ratios are shown as well. Salary adjustments, other than the economic assumption for wage inflation discussed in the previous section, are treated as demographic assumptions.

Rates of Withdrawal

Background: The rates of withdrawal are used to determine the expected number of separations from active service which will occur prior to eligibility for retirement for reasons other than death and disability (e.g., termination of employment). The assumption does not involve the analysis of the election of separating members to receive a refund of eligible funds. There are two separately developed sets of assumed rates for the withdrawal assumption. The first set of rates is the expected rates of withdrawal from active service for each year of service less than 10 years of service. These separating members are entitled to only a full refund of eligible funds. The second set of rates is the expected age-based rates for active members with 10 or more years of service. These separating members are eligible to elect between a full refund of eligible funds or a deferred annuity based upon benefit accrued to date of separation payable as early as age 60.

Rates of Withdrawal with Less than 10 Years of Service

Past Experience: For the service based rates (less than 10 years of service), the experience indicates that during the period studied, there were many more withdrawals than expected. The following tables provide a comparison of the actual and expected number of withdrawals for members with less than 10 years of service. This table for male withdrawals also includes our expected withdrawals using our recommended rates.

Number of Withdrawals Males with less than 10 years of service			
Service	Actual Withdrawals	Expected Withdrawals under Current Rates	Expected Withdrawals under Proposed Rates
0	117	37.4	37.4
1	308	207.6	268.6
2	225	127.4	185.4
3	186	101.7	146.8
4	134	80.5	109.2
5	127	62.4	87.4
6	110	65.6	82.0
7	93	63.8	76.2
8	101	62.1	70.6
9	73	60.1	71.6
Total	1,474	868.5	1,135.2
Actual to Expected Ratio		1.697	1.298

		Number of Withdrawals	
		Females with less than 10 years of service	
Service	Actual Withdrawals	Expected Withdrawals under Current Rates	Expected Withdrawals under Proposed Rates
0	313	98.8	98.8
1	967	796.7	929.5
2	867	577.4	721.7
3	738	485.7	607.1
4	688	459.0	563.4
5	609	433.6	520.3
6	592	417.1	486.6
7	540	317.5	430.9
8	452	267.8	379.4
9	414	219.1	350.6
Total	6,180	4,072.7	5,088.2
Actual to Expected Ratio		1.517	1.215

An actual to expected ratio of greater than 1.00 results from more actual withdrawals than anticipated and would typically generate actuarial gains to the System. The actual rates of withdrawal over the study period are compared with the rates produced by the current rates and proposed rates in the following graphs.

Withdrawals - Males with < 10 Years of Service

Withdrawals - Females with < 10 Years of Service
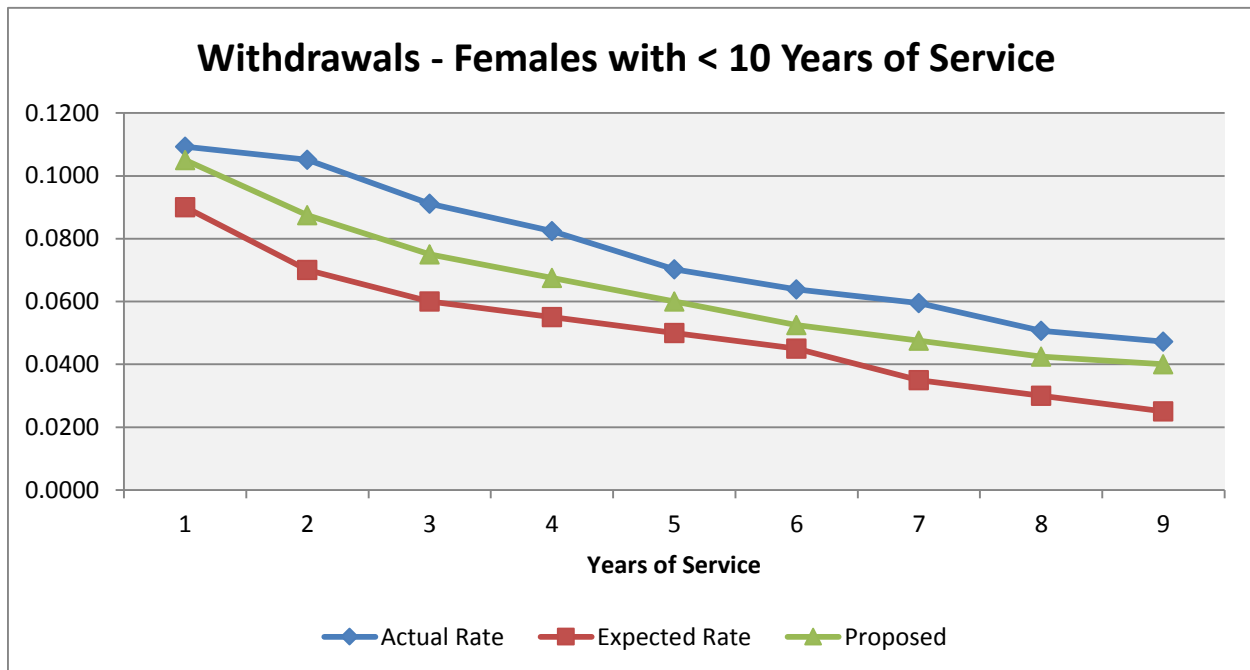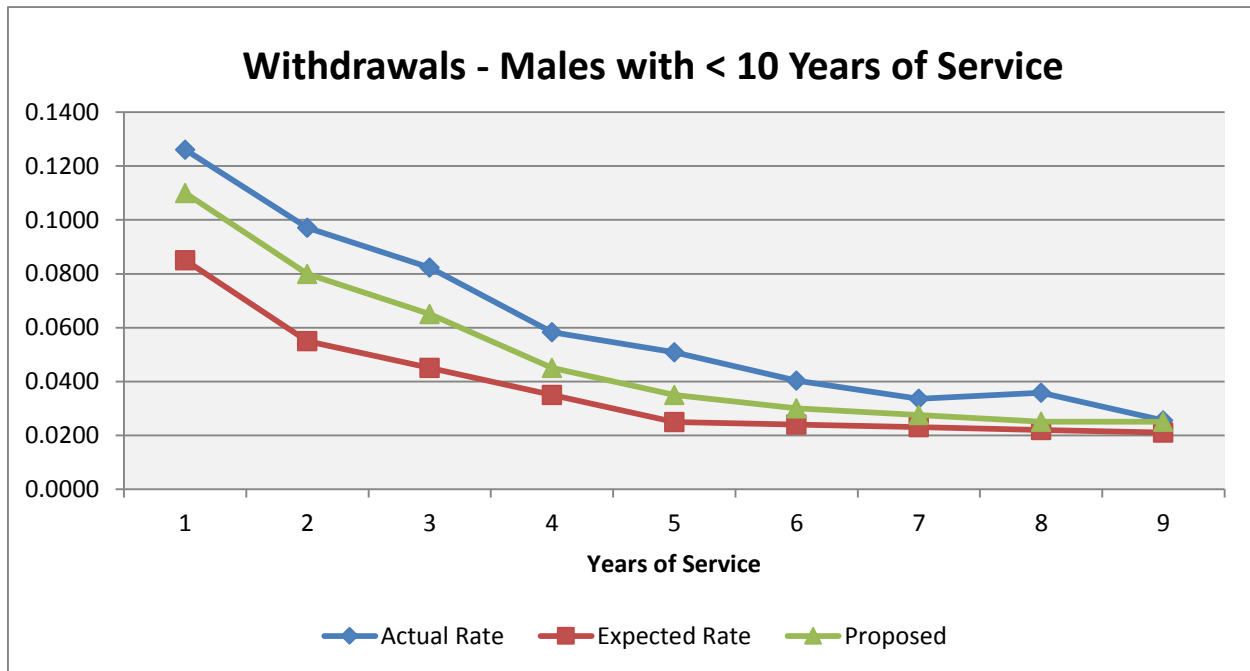
Recommendation: We note that for both males and females, the current rates have predicted many fewer withdrawals than the actual experience for those with less than 10 years of service. These withdrawing members have a relatively small liability which is based upon a distribution of all eligible funds. The actual to expected ratio for males was 1.57 and for females was 1.52. We recommend increasing the withdrawal rates for both males and females.

Rates of Withdrawal with 10 or More Years of Service

Past Experience: For these age based rates for members with at least 10 years of service, the experience indicates that during the period studied there were many more withdrawals than expected for fully vested members. The following tables provide a comparison of the actual and expected number of withdrawals for members with 10 or more years of service as well as the expected number under our recommended rates.

	Number of Withdrawals Males with 10 or more years of service		
Age	Actual Withdrawals	Expected Withdrawals under Current Rates	Expected Withdrawals under Proposed Rates
Under 35	24	12.0	15.0
35-39	106	60.4	75.5
40-44	145	81.6	101.0
45-49	109	70.1	88.7
50-54	105	79.1	88.6
55-59	117	58.1	79.4
Total	606	361.3	448.2
Actual to Expected Ratio		1.677	1.352

		Number of Withdrawals	
		Females with 10 or more years of service	
Age	**Actual Withdrawals**	**Expected Withdrawals under Current Rates**	**Expected Withdrawals under Proposed Rates**
Under 35	176	117.4	134.1
35-39	484	439.3	439.3
40-44	374	290.9	290.9
45-49	293	164.0	233.5
50-54	349	151.8	247.1
55-59	417	158.2	242.9
Total	2,093	1,321.4	1,587.8
Actual to Expected Ratio		1.584	1.318

Since the rates of withdrawal for vested members are much lower than non-vested members, there are not a large number of withdrawals expected or experienced. We recommend increasing rates for both males and females. The actual rates of withdrawal over the study period are compared with the rates produced by our current assumption as well as the rates produced by our recommended assumption.
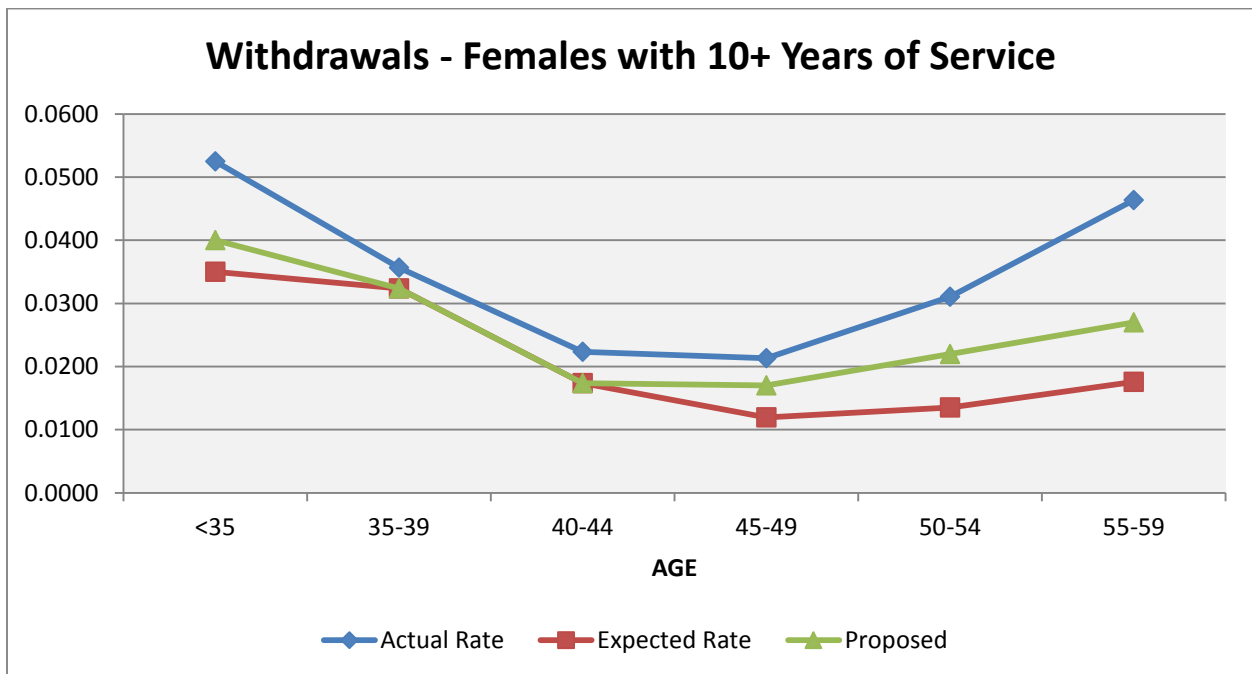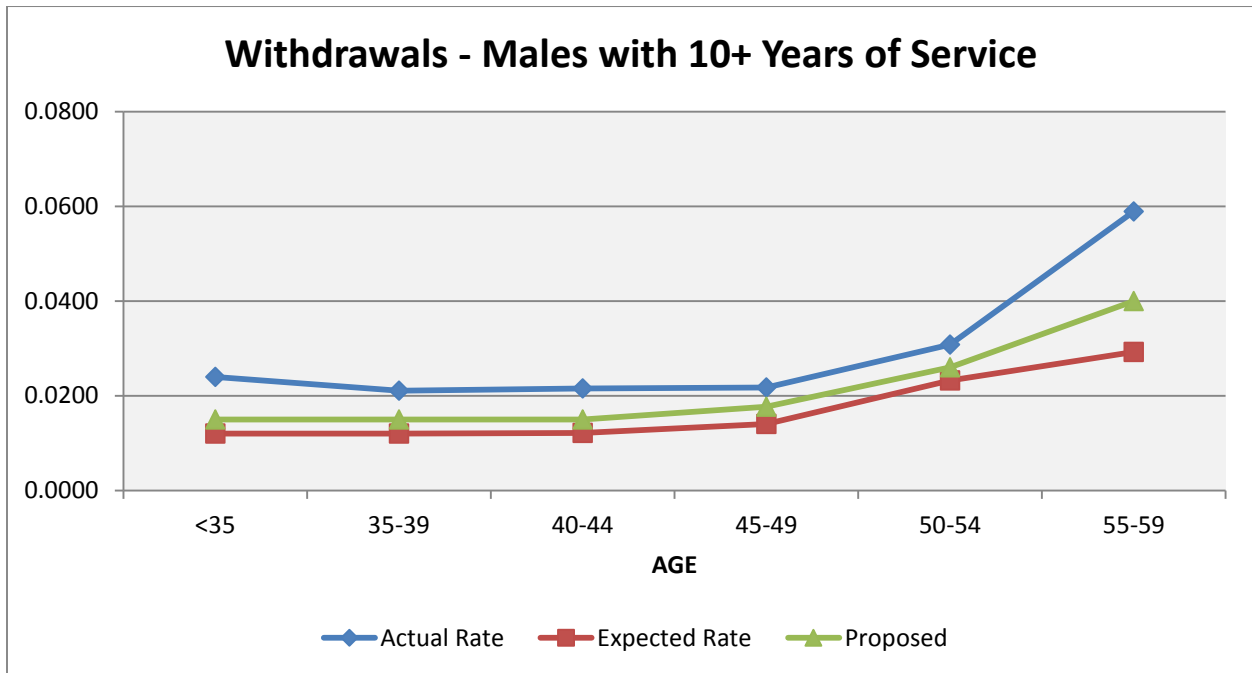
Withdrawals - Males with 10+ Years of Service

Withdrawals - Females with 10+ Years of Service

Recommendation: We recommend increasing rates for both males and females.

Rates of Disability

Background: The rates of disability are used to anticipate the expected number of separations due to disabilities of eligible active members.   As rates of disability are very small, the number of disabilities incurred and expected is small relative to other decrements. When a disability does occur, it will result in an increase in the plan liability to reflect the immediate annuity payable to eligible disabled members at typically earlier ages.

Past Experience: Current experience shows less disabilities than expected, especially for males. Below we provide the charts of the current actual rates observed, the current expected rates and the proposed rates for males.

Active Disability - Females
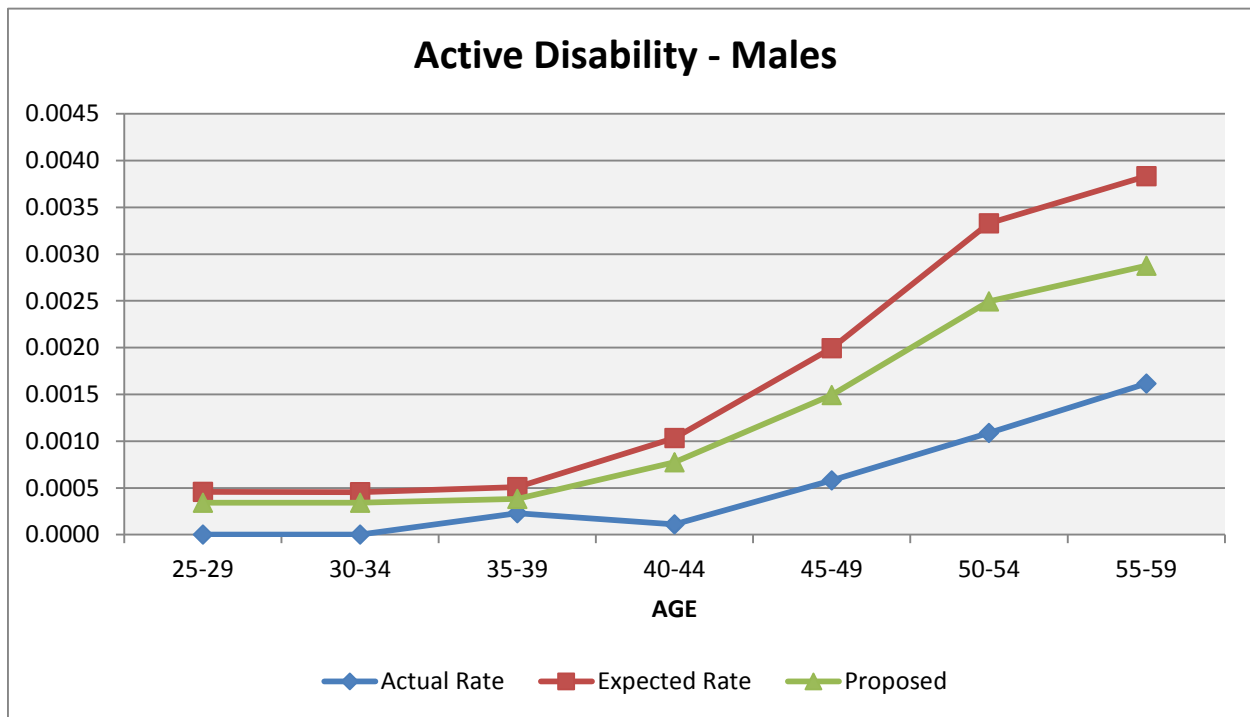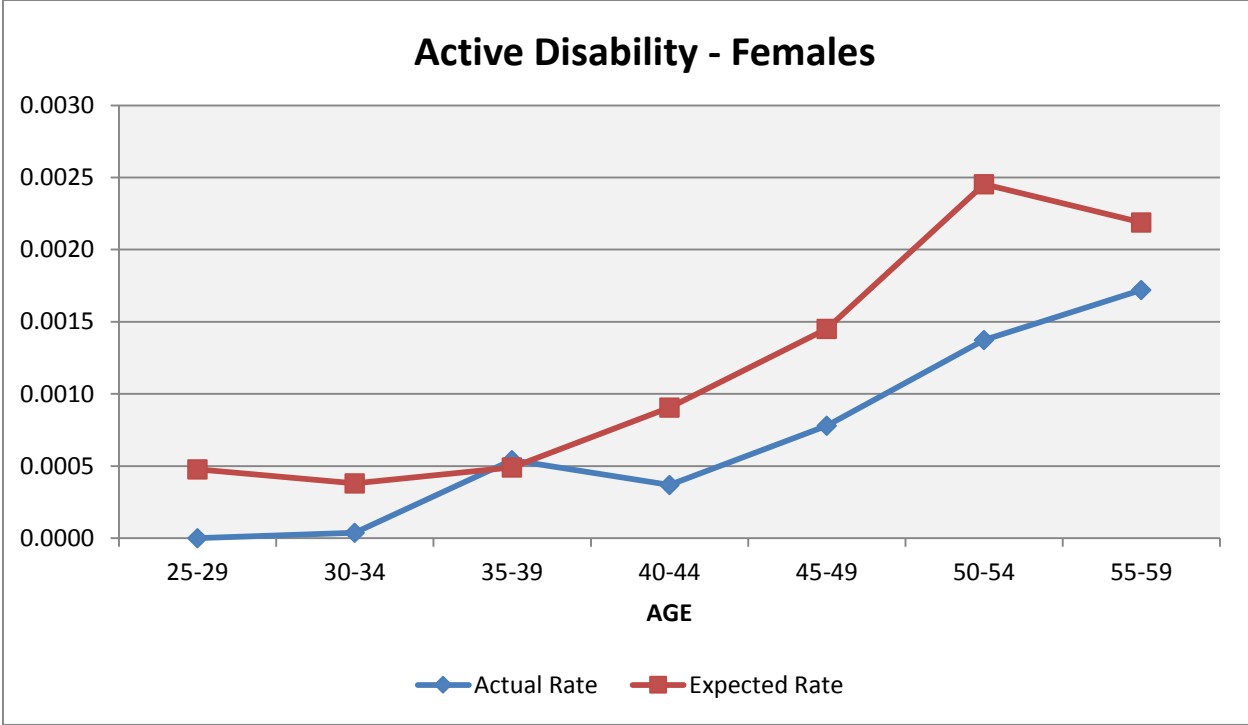
Recommendation: The charts show that the male rates are too high for recent experience. We recommend decreasing the male disability rates by 25%.

Rates of Retirement

Background: The rates of retirement are used to determine the expected number of separations from active service due to retirement. The plan provides for three types of retirement based on different eligibility requirements. There are three sets of retirement decrements to handle the different types of retirement.

Rates of Normal Retirement

Past Experience:

Normal Retirement Experience		
Males eligible for normal retirement		
Age	Actual Retirements	Expected Retirements under Current Rates
Under 55	0	0.0
55	0	0.0
56	0	1.2
57	41	49.3
58	62	93.6
59	107	133.6
60	114	84.3
61	124	91.8
62	112	79.7
63	74	74.0
64	66	66.3
65	55	71.9
66	52	38.2
67	27	28.1
68	17	17.9
69	12	12.9
70 and over	28	85.0
Total	891	927.6
Actual to Expected Ratio		0.961

Over the past five years, there were 891 male actual normal retirements compared to 928 predicted by the normal retirement rates for males.

Normal Retirement Experience			
Females eligible for normal retirement			
Age	Actual Retirements	Expected Retirements under Current Rates	Expected Retirements under Proposed Rates
Under 55	0	0.3	0.6
55	1	0.9	0.8
56	6	6.0	5.5
57	98	108.0	99.0
58	181	214.5	196.6
59	250	276.0	253.0
60	275	184.8	254.1
61	245	188.3	230.2
62	219	159.5	195.0
63	180	130.0	159.0
64	139	98.8	120.7
65	125	99.0	107.3
66	77	68.4	74.1
67	54	47.7	51.7
68	35	33.0	35.8
69	15	22.8	24.7
70 and over	72	124	86.5
Total	1,972	1,761.9	1,894.4
Actual to Expected Ratio		1.119	1.041

Over the past five years, there were 1,972 female actual normal retirements compared with 1,762 predicted by the normal retirement rates for females. As seen in the tables above, the current assumed rates continue to be a good estimate of the expectation of normal retirement rates for males but less so for females. The following graphs show the actual rates of retirement by age compared with the current assumed retirement rates as well as the recommended rates for females. On the following graphs, note the large discrepancies in the rates at the early ages are based on very small amounts of exposure (few members were eligible at these ages). In other words, this small group is very visible on the graphs but has little overall impact.

Normal Retirement - Males

Normal Retirement - Females

Recommendation: We recommend general increases to the female assumed normal retirement rates and no change for male rates.

Section III: Demographic Assumptions

Rates of Proratable Retirement

Past Experience:

Age	Actual Retirements	Expected Retirements under Current Rates	Expected Retirements under Proposed Rates
	Proratable Retirement Experience		
	Males eligible for proratable retirement		
60	15	20.3	20.3
61	14	19.3	19.3
62	10	41.1	24.7
63	20	23.6	26.0
64	14	19.7	19.7
65	22	33.0	21.5
66	27	24.4	24.4
67	17	18.0	18.0
68	11	12.0	12.0
69	11	14.4	12.3
70 and over	9	28.7	28.7
Total	170	254.5	226.8
Actual to Expected Ratio		0.668	0.750

	Proratable Retirement Experience	
	Females eligible for proratable retirement	
Age	**Actual Retirements**	**Expected Retirements under Current Rates**
60	75	83.5
61	85	100.1
62	60	88.9
63	78	57.0
64	59	51.6
65	65	54.2
66	47	34.5
67	27	24.1
68	18	11.3
69	17	12.6
70 and over	32	20.7
Total	563	538.4
Actual to Expected Ratio		1.046

Over the five year period, there were 170 male proratable retirements compared with 255 expected. There were 563 female proratable retirements compared with 538 expected. The following graphs show the actual rates of proratable retirement based on age compared with the current assumed rates of retirement as well as with the recommended rates for males.

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Proratable Retirement - Males

Proratable Retirement - Females

Recommendation: We recommend a general decrease to the proratable retirement assumptions for males.

Rates of Early Retirement

Past Experience: The following tables provide the actual and expected counts of early retirements and include expected counts under the proposed change to the assumption.

Early Retirement Experience Males eligible for early retirement			
Age	Actual Retirements	Expected Retirements under Current Rates	Expected Retirements under Proposed Rates
Under 50	0	4.9	2.4
50	1	3.8	1.9
51	4	5.1	2.6
52	2	8.4	3.4
53	5	13.2	8.8
54	11	20.4	15.3
55	18	26.5	23.5
56	40	40.4	40.4
57	26	56.1	43.6
58	44	54.7	43.8
59	50	51.7	51.7
Total	201	285.2	237.4
Actual to Expected Ratio		0.705	0.847

| | | Early Retirement Experience | |
| | | Females eligible for early retirement | |
Age	Actual Retirements	Expected Retirements under Current Rates	Expected Retirements under Proposed Rates
Under 50	5	28.4	14.2
50	2	18.2	9.1
51	5	21.2	13.3
52	10	36.4	21.2
53	17	47.4	30.5
54	26	61.7	42.4
55	63	105.1	83.2
56	111	136.3	121.7
57	106	136.0	122.4
58	104	135.6	122.9
59	143	128.6	128.6
Total	592	855.0	709.6
Actual to Expected Ratio		0.692	0.834

There were 201 actual male early retirements compared with 285 predicted by the early retirement assumptions. There were 592 female early retirements compared with 855 predicted by the early retirement assumptions. The following graphs show the actual rates of early retirement based on age compared with the current early retirement assumptions as well as with the recommended assumptions.

Early Retirement - Males

Legend: Actual Rate, Expected Rate, Proposed Rate (AGE on x-axis)

Early Retirement - Females

Legend: Actual Rate, Expected Rate, Proposed Rate (AGE on x-axis)
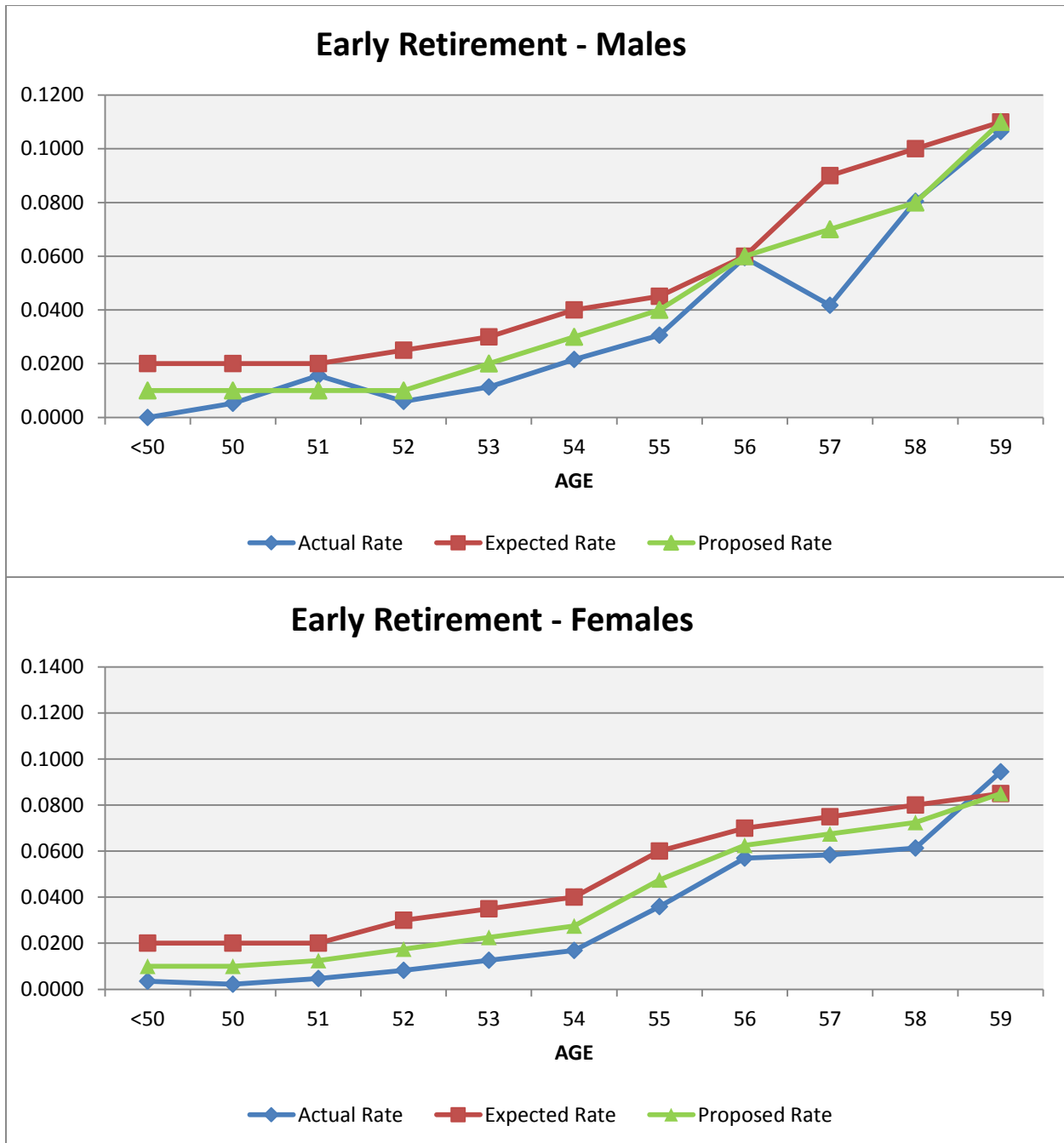
Recommendation: The assumed rates of early retirement were decreased at the time of the last experience study but the actual number of early retirements has decreased substantially from the prior study period. We recommend further decreasing the assumed early retirement rates for both males and females to better recognize the decline in early retirements. As will be noted, our recommended rates only partially reflect the recent experience.

Rates of Mortality

Background: Assumed rates of post-retirement mortality are very important assumptions for the actuarial valuation because they predict life expectancies and therefore, the duration of pension payments. As life expectancies are expected to continue to increase in the future, mortality rates are usually projected by actuaries to anticipate expected mortality improvements. The current mortality rates are projected to 2019.

Rates of Healthy Post-Retirement Mortality

Past Experience:

Post-Retirement Mortality Experience		
Service Retirements and Beneficiaries		
Males		
Age	Actual Deaths	Expected Deaths under Current Assumption
50-54	0	0.1
55-59	6	2.8
60-64	58	47.6
65-69	120	150.6
70-74	154	177.4
75-79	228	225.6
80-84	300	334.6
85-89	345	323.2
90-94	198	182.7
95-99	49	45.7
100 and over	7	10.0
Total	1,465	1,500.3
Actual to Expected Ratio		0.976

Post-Retirement Mortality Experience		
Service Retirements and Beneficiaries		
Females		
Age	Actual Deaths	Expected Deaths under Current Assumption
50-54	6	0.3
55-59	12	8.0
60-64	77	103.7
65-69	167	255.7
70-74	191	278.6
75-79	283	327.6
80-84	459	430.8
85-89	474	450.8
90-94	441	392.6
95-99	235	194.5
100 and over	67	56.2
Total	2,412	2,498.6
Actual to Expected Ratio		0.965

The current assumed rates of mortality for both males and females anticipated more deaths than actually occurred during the five year study period. The male rates predicted 97.6% of actual deaths and the female rates predicted 96.5% of actual deaths. When projecting future mortality improvements, we would expect actual deaths during the study period to be somewhat greater than expected deaths which is not the case. The graphs below show a comparison of the previous, present, and actual rates of post-retirement deaths. We recommend a change to the mortality rates used in the actuarial valuations that is based on updated mortality research and produces rates which anticipates the continuing trend in mortality improvement.

Recommendation: The experience for healthy post-retirement mortality indicates that overall approximately 3% less members have died than expected during the study period which has resulted in minor actuarial losses to the system. The assumption currently in use is the RP-2000 Combined Mortality Table projected 19 years using scale AA, with a two year setback for males and females. We recommend updating the post-retirement mortality assumption to the RPH-2014 White Collar table with employee and annuitant rates blended from ages 50 to 80 projected to the year 2020 using the BB improvement scale and further adjusted to grade in increases (5% for females and 8% for males) to rates over age 80.

Healthy Mortality - Males

Healthy Mortality - Females
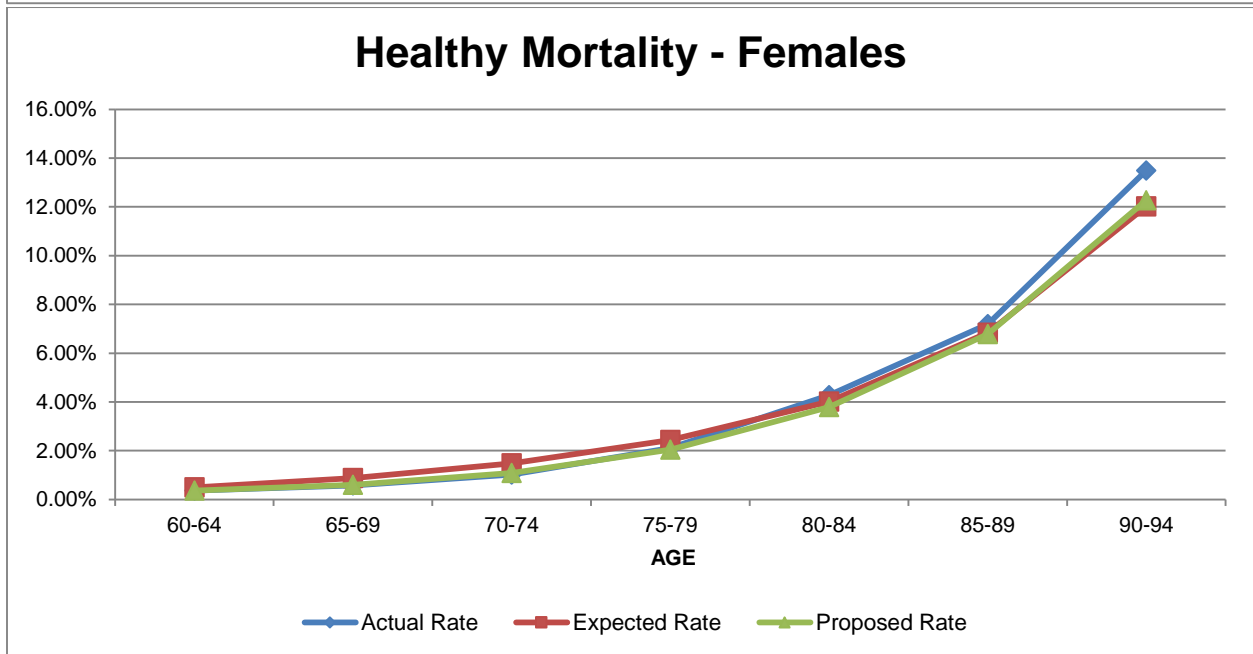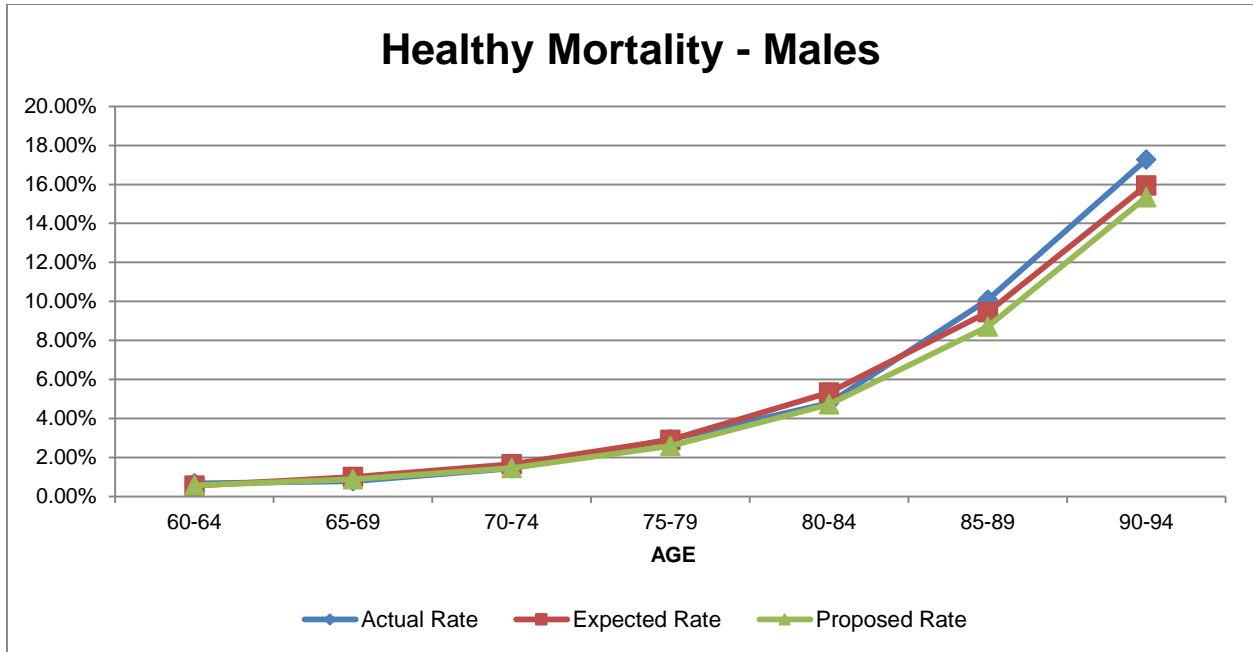
The tables on the following page provide the expected to actual analysis under the recommended mortality assumption.

Post-Retirement Mortality Experience Males Service Retirements and Beneficiaries		
Age	Actual Deaths	Expected Deaths under Proposed Rates
50-54	0	0.2
55-59	6	3.6
60-64	58	50.3
65-69	120	133.7
70-74	154	156.8
75-79	228	201.3
80-84	300	296.5
85-89	345	297.8
90-94	198	175.7
95-99	49	47.1
100 and over	7	11.7
Total	1,465	1,374.6
Actual to Expected Ratio		1.0789

Post-Retirement Mortality Experience Female Service Retirements and Beneficiaries		
Age	Actual Deaths	Expected Deaths under Proposed Rates
50-54	6	0.3
55-59	12	7.2
60-64	77	76.9
65-69	167	174.2
70-74	191	203.4
75-79	283	274.5
80-84	459	407.3
85-89	474	447.3
90-94	441	400.8
95-99	235	222.0
100 and over	67	76.0
Total	2,412	2,289.9
Actual to Expected Ratio		1.0577

Rates of Disability Mortality

Past Experience: There were 11 deaths of male disabled members compared with 4.5 expected over the study period. There were 32 female disabled deaths compare with 9.1 expected over the study period. Since there are not a large number of disabled members in the data, the experience observed is not completely credible when assessing mortality rates.

	Number of Deaths		
	Disability Retirements		
	Males		
Age	**Actual Deaths**	**Expected Deaths under Current Rates**	**Expected Deaths under Proposed Rates**
50-54	2	0.2	0.8
55-59	3	1.3	3.1
60-64	3	0.8	1.4
65-69	0	0.3	0.4
70-74	0	1.0	0.8
75-79	3	0.8	0.5
80-84	0	0.1	0.1
85-89	0	0.0	0.0
90-94	0	0.0	0.0
95-99	0	0.0	0.0
100 and over	0	0.0	0.0
Total	11	4.5	7.0
Actual to Expected Ratio		2.444	1.569

		Number of Deaths Disability Retirements Females	
Age	Actual Deaths	Expected Deaths under Current Rates	Expected Deaths under Proposed Rates
50-54	5	0.8	2.5
55-59	13	3.5	6.5
60-64	10	2.3	3.2
65-69	2	0.9	0.9
70-74	0	0.3	0.1
75-79	2	0.4	0.1
80-84	0	0.0	0.0
85-89	0	0.4	0.3
90-94	0	0.5	0.3
95-99	0	0.0	0.0
100 and over	0	0.0	0.0
Total	32	9.1	13.8
Actual to Expected Ratio		3.536	2.315

Recommendation: The current mortality assumption for disabled members is the mortality assumption for healthy retired members set forward 10 years. We recommend updating this assumption to the RPH-2014 Disabled Mortality Table projected to 2017 with Scale BB.

Rates of Pre-Retirement Mortality

Recommendation: Again, due to the very limited number of active member deaths, we recommend the active mortality assumption be changed to the RPH-2014 White Collar table with employee and annuitant rates blended from ages 50 to 80 projected to the year 2020 using the BB improvement scale and further adjusted to grade in increases (5% for females and 8% for males) to rates over age 80.

Rates of Service Based Salary Increases

Background: The assumed rates of salary increase provide the expected growth in future salaries both for approximating the future benefits to be provided and the future amounts expected to be contributed to the System through normal cost contributions of members and the employer. Therefore, this assumption is very material to valuation results. The actuarial standards of practice recommend a "building block" approach to developing this assumption. Under this approach, the assumption is composed of an assumption for wage inflation (the "across the board" increases of active salaries), and an assumed salary increase scale based on the years of service.

The first step in developing the service based rates of increase is to subtract the apparent wage inflation component from the actual salary rates of increase as measured over the study period. The average annual rate of inflation over the five-year period ending June 30, 2015 was 1.83% and the apparent real rate of wage inflation (wage increases above price inflation or CPI) in the data was 0.37%. The sum of these components equals an apparent annual rate of wage inflation of 2.20% over the five year period. The apparent rate of wage inflation is first removed from the actual rates of salary increase and the remaining rates reflect the apparent service based increases in salaries due to step increases, promotions, and educational increases. Next, we assess the current assumed rates of service based salary increases and recommend adjustments where necessary.

Again, the focus of this assumption is the long-term expectation and should not be significantly affected by short-term fluctuations. The actuary then combines the wage inflation assumption with the assumed rates of service based increases to produce the rates of assumed salary increases based upon years of service.

Past Experience: Total salary increases averaged 3.9% per year compared with 5.1% expected increases in salaries over the five year period. We note that wage inflation or the "across the board" rate of increase has been consistently lower than the 3.75% assumed rate of increase.

Rates of Salary Increases
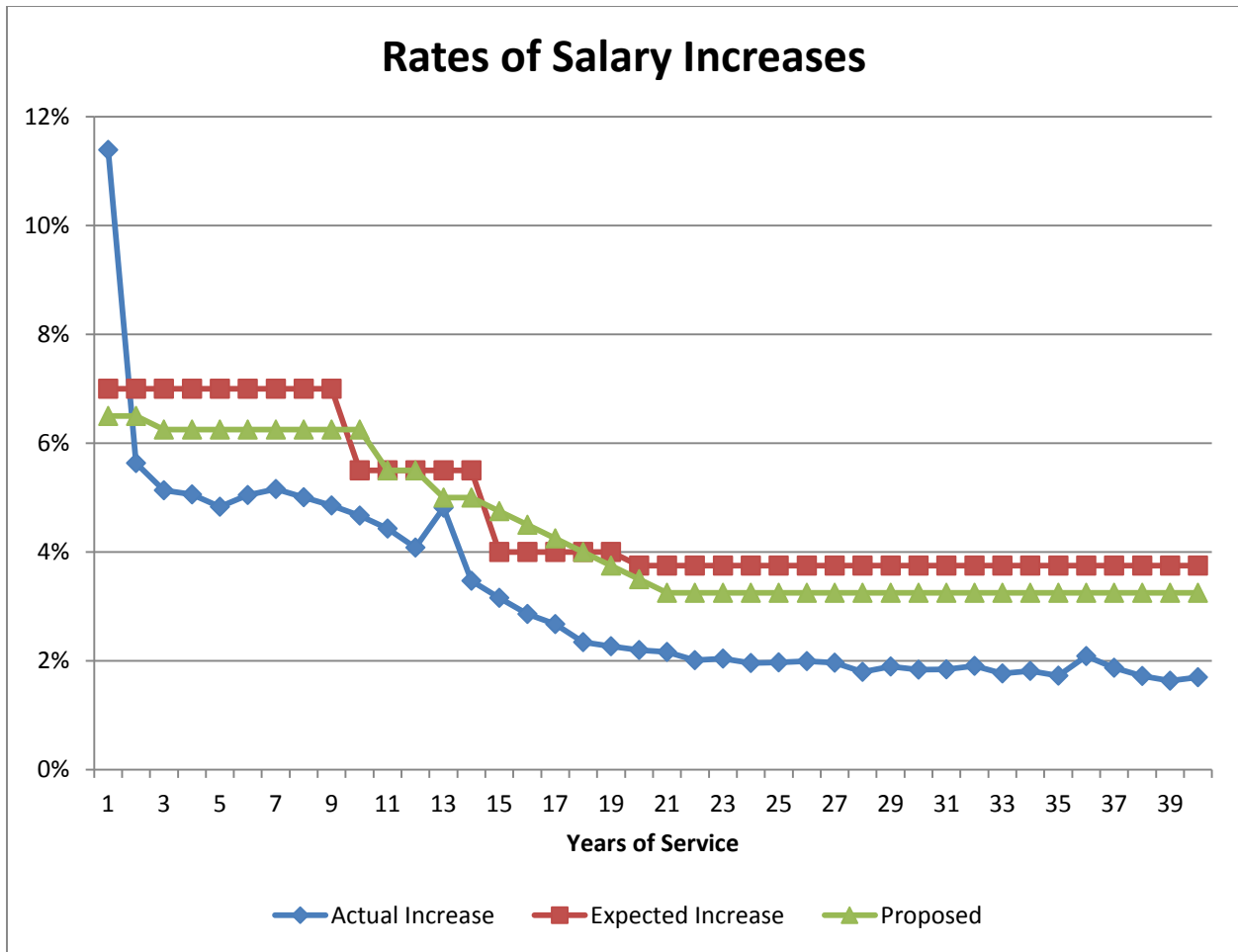
In the graph above, the lower than assumed wage inflation component of the salary increases is shown as the difference between the expected rates (red line) and the actual rates experienced (blue line) beginning around 15 years of service and beyond.

Recommendation: Based upon our analysis, we recommend a 0.50% reduction in the wage inflation assumption from 3.75% to 3.25% as discussed previously in the economic assumptions as well as some decreases in the merit scale.

Other Actuarial Assumptions

Percent Married: Currently 85% of active male members and 75% of active female members are assumed to be married with the male spouse three years older than the female spouse. This is a common and reasonable assumption and we recommend maintaining this assumption.

Cost of Living Increases: For teachers who were members after July 1, 2007, the assumption for cost of living increases was changed from 2.00% annually to 1.75% annually. This is attributable to the decrease in the assumed rates of inflation. We recommend no change to the currently assumed COLA rates of increase for those hired before July 1, 2007.

Section IV: Actuarial Methods

Actuarial Cost Method: The cost method is used to allocate the present value of benefits between past service (actuarial accrued liability) and future service (normal cost). Currently the valuation uses the entry age normal actuarial cost method. This is the most widely used cost method of large public sector plans and has demonstrated the highest degree of stability as compared to alternative methods. We recommend no change to the use of this method.

Actuarial Value of Assets (Smoothing): The purpose of asset smoothing is to dampen the impact that market volatility has on valuation results by spreading the unexpected market gains and losses over several years. Currently, the System uses a four-year actuarial smoothing method. In each valuation, the actuarial value of assets is determined by adjusting the expected actuarial value by 25% of the difference between the actual and expected market value of assets measured in each of the current and three prior years. The current method meets with all applicable actuarial and accounting standards.

Most large retirement systems utilize a smoothing method in determining the value of assets for valuation purposes with a five-year smoothing period being the most common and four-year smoothing being the second most common. In consideration of the recent market performance, a longer smoothing period would reduce the amount of the investment losses recognized in each year but also would be slower to recognize the gains of the markets as they recover. The real impact over time to the funding of the plan will be significantly affected by the long-term investment returns experienced compared to the return assumption and not the length of the asset smoothing period. We do not recommend a change to a longer smoothing period that is applied retroactively. A change to a longer smoothing period applied prospectively would be expected to slow down the recognition of gains experienced as the markets recover and could be expected to increase required funding in future valuations.

Amortization Method: Currently, the unfunded actuarial accrued liability is composed of the original base which is being amortized over a 40 year period beginning July 1, 1991 and several other bases established due to the passage of specific public acts.

Unfunded Actuarial Accrued Liability Bases and Remaining Period as of June 30, 2014	Amount ($000)
Plan in effect 6/30/1991 (17 years)	10,989,122
Public Act 87-381 (3 years)	1,136
Public Act 92-205 (8 years)	(1,317,698)
Public Act 98-251 (13 years)	7,981
Public Act 07-186 (23 years)	1,122,152
Total	10,802,693

Provided all required amortization payments will be deposited in the Fund, all the above bases are expected to be completely amortized. Each base has an amortization payment determined which is expected to remain level as a percentage of payroll. This results in each payment increases in

amount by the expected growth in covered payroll which is currently 3.75% (recommend a decrease to 3.25%).

There are three important attributes of the amortization method. The first is how long the amortization period is in years. The second is how the payments are calculated to be constant in dollar amount or as a percentage of payroll. The last attribute is whether the amortization period remains a constant number of years (open) or if the period decreases one year each year (closed). The current amortization methodology would be called a layered (new bases are established periodically), closed (each period decreases annually), level percentage of payroll (payments are expected to increase each year). The unfunded actuarial accrued liability (liability in excess of assets) is amortized using a level percentage of payroll method over the amortization periods prescribed by statute. The payroll growth assumption is used to determine the percentage of payroll required over the remaining amortization period to fully amortize the unfunded liability. In this study, we recommend a decrease to the annual payroll growth rate from 3.75% to 3.25% which is consistent with our recommendation for the long-term expected rate of wage inflation. In our opinion, the current amortization method meets with all applicable standards as well as the most recent guidance provided to actuaries of public pension plans.

Appendix A: Tables of Recommended Assumptions

TABLE 1 - RATES OF WITHDRAWAL FROM ACTIVE SERVICE

Less than 10 years of service			10 or more years of service		
Years of Service	Male	Female	Age	Male	Female
0	0.1400	0.1200	25	0.0150	0.040
1	0.1100	0.1050	26	0.0150	0.040
2	0.0800	0.0875	27	0.0150	0.040
3	0.0650	0.0750	28	0.0150	0.040
4	0.0450	0.0675	29	0.0150	0.040
5	0.0350	0.0600	30	0.0150	0.040
6	0.0300	0.0525	31	0.0150	0.040
7	0.0275	0.0475	32	0.0150	0.040
8	0.0250	0.0425	33	0.0150	0.040
9	0.0250	0.0400	34	0.0150	0.040
			35	0.0150	0.035
			36	0.0150	0.035
			37	0.0150	0.035
			38	0.0150	0.031
			39	0.0150	0.027
			40	0.0150	0.023
			41	0.0150	0.019
			42	0.0150	0.016
			43	0.0152	0.015
			44	0.0150	0.014
			45	0.0159	0.015
			46	0.0168	0.016
			47	0.0177	0.017
			48	0.0186	0.018
			49	0.0195	0.019
			50	0.0204	0.020
			51	0.0232	0.021
			52	0.0260	0.022
			53	0.0288	0.023
			54	0.0316	0.024
			55	0.0344	0.025
			56	0.0372	0.026
			57	0.0400	0.027
			58	0.0400	0.028
			59	0.0400	0.029

TABLE 2 - RATES OF DISABILITY WHILE IN ACTIVE SERVICE

Age	Male	Female
20	0.000341	0.00050
21	0.000341	0.00050
22	0.000341	0.00050
23	0.000341	0.00050
24	0.000341	0.00050
25	0.000341	0.00050
26	0.000341	0.00050
27	0.000341	0.00050
28	0.000341	0.00047
29	0.000341	0.00044
30	0.000341	0.00041
31	0.000341	0.00038
32	0.000341	0.00035
33	0.000341	0.00037
34	0.000341	0.00039
35	0.000341	0.00041
36	0.000341	0.00043
37	0.000341	0.00045
38	0.000390	0.00054
39	0.000488	0.00063
40	0.000536	0.00072
41	0.000634	0.00081
42	0.000780	0.00090
43	0.000878	0.00100
44	0.001073	0.00110
45	0.001219	0.00120
46	0.001365	0.00130
47	0.001511	0.00140
48	0.001755	0.00181
49	0.002047	0.00222
50	0.002438	0.00263
51	0.002925	0.00304
52	0.003461	0.00345
53	0.003997	0.00376
54	0.004631	0.00407
55	0.005363	0.00438
56	0.006240	0.00469
57	0.007118	0.00500
58	0.008092	0.00500
59	0.009604	0.00500
60	0.009604	0.00500

Appendix A: Tables of Recommended Assumptions

TABLE 3 - RATES OF RETIREMENT FROM ACTIVE SERVICE

Age	Normal		Proratable		Early	
	Male	Female	Male	Female	Male	Female
50	0.275	0.275			0.010	0.0100
51	0.275	0.275			0.010	0.0125
52	0.275	0.275			0.010	0.0175
53	0.275	0.275			0.020	0.0225
54	0.275	0.275			0.030	0.0275
55	0.385	0.275			0.040	0.0475
56	0.385	0.275			0.060	0.0625
57	0.385	0.275			0.070	0.0675
58	0.385	0.275			0.800	0.0725
59	0.385	0.275			0.110	0.0850
60	0.220	0.275	0.060	0.055		
61	0.253	0.275	0.060	0.065		
62	0.253	0.275	0.090	0.075		
63	0.275	0.275	0.110	0.075		
64	0.275	0.275	0.100	0.080		
65	0.363	0.325	0.130	0.125		
66	0.275	0.325	0.200	0.125		
67	0.275	0.325	0.200	0.125		
68	0.275	0.325	0.200	0.120		
69	0.275	0.325	0.300	0.145		
70	1.000	0.325	0.300	0.145		
71	1.000	0.325	0.300	0.145		
72	1.000	0.325	0.300	0.145		
73	1.000	0.325	0.300	0.145		
74	1.000	0.325	0.300	0.180		
75	1.000	0.325	0.300	0.180		
76	1.000	0.325	0.300	0.180		
77	1.000	0.325	0.300	0.180		
78	1.000	0.325	0.300	0.180		
79	1.000	0.325	0.300	0.180		
80	1.000	1.000	1.000	1.000		

TABLE 4 - RATES OF MORTALITY WHILE IN ACTIVE SERVICE

Age	Male	Female
20	0.000377	0.000147
21	0.000411	0.000149
22	0.000427	0.000152
23	0.000433	0.000155
24	0.000423	0.000158
25	0.000412	0.000162
26	0.000406	0.000167
27	0.000401	0.000175
28	0.000399	0.000184
29	0.000400	0.000193
30	0.000404	0.000205
31	0.000409	0.000218
32	0.000416	0.000231
33	0.000425	0.000245
34	0.000436	0.000258
35	0.000448	0.000272
36	0.000462	0.000286
37	0.000476	0.000302
38	0.000492	0.000322
39	0.000513	0.000347
40	0.000539	0.000375
41	0.000574	0.000410
42	0.000617	0.000452
43	0.000672	0.000500
44	0.000739	0.000557
45	0.000818	0.000622
46	0.000911	0.000694
47	0.001017	0.000775
48	0.001133	0.000862
49	0.001262	0.000956
50	0.001476	0.001116
51	0.001707	0.001277
52	0.001952	0.001440
53	0.002215	0.001605
54	0.002497	0.001764
55	0.002800	0.001927
56	0.003115	0.002097
57	0.003435	0.002276
58	0.003780	0.002469
59	0.004153	0.002682
60	0.004557	0.002914
61	0.004994	0.003185
62	0.005471	0.003489
63	0.005994	0.003855
64	0.006572	0.004272
65	0.007214	0.004747
66	0.007930	0.005329
67	0.008733	0.005989
68	0.009632	0.006743
69	0.010703	0.007603
70	0.011906	0.008584

TABLE 5 - RATES OF MORTALITY FOR RETIRED MEMBERS AND BENEFICIARIES

Age	Male	Female	Age	Male	Female
20	0.000377	0.000147	71	0.013254	0.009701
21	0.000411	0.000149	72	0.014764	0.010972
22	0.000427	0.000152	73	0.016456	0.012413
23	0.000433	0.000155	74	0.018358	0.014048
24	0.000423	0.000158	75	0.020499	0.015897
25	0.000412	0.000162	76	0.022920	0.017986
26	0.000406	0.000167	77	0.025665	0.020344
27	0.000401	0.000175	78	0.028785	0.023009
28	0.000399	0.000184	79	0.032341	0.026027
29	0.000400	0.000193	80	0.036764	0.029756
30	0.000404	0.000205	81	0.041663	0.033551
31	0.000409	0.000218	82	0.047268	0.037878
32	0.000416	0.000231	83	0.053671	0.042819
33	0.000425	0.000245	84	0.060966	0.048469
34	0.000436	0.000258	85	0.069254	0.054419
35	0.000448	0.000272	86	0.078639	0.061173
36	0.000462	0.000286	87	0.089777	0.068829
37	0.000476	0.000302	88	0.101456	0.077493
38	0.000492	0.000322	89	0.114547	0.087278
39	0.000513	0.000347	90	0.129207	0.098908
40	0.000539	0.000375	91	0.145349	0.111961
41	0.000574	0.000410	92	0.162866	0.126431
42	0.000617	0.000452	93	0.181644	0.142276
43	0.000672	0.000500	94	0.201553	0.159412
44	0.000739	0.000557	95	0.222458	0.177732
45	0.000818	0.000622	96	0.244220	0.197114
46	0.000911	0.000694	97	0.266698	0.217425
47	0.001017	0.000775	98	0.288014	0.237102
48	0.001133	0.000862	99	0.311375	0.258763
49	0.001262	0.000956	100	0.333049	0.279320
50	0.001476	0.001116	101	0.356802	0.301943
51	0.001707	0.001277	102	0.378394	0.323111
52	0.001952	0.001440	103	0.402065	0.346409
53	0.002215	0.001605	104	0.422954	0.367630
54	0.002497	0.001764	105	0.445857	0.390887
55	0.002800	0.001927	106	0.465422	0.411453
56	0.003115	0.002097	107	0.484085	0.431391
57	0.003435	0.002276	108	0.501759	0.450568
58	0.003780	0.002469	109	0.518386	0.468871
59	0.004153	0.002682	110	0.533926	0.486214
60	0.004557	0.002914	111	0.540000	0.502534
61	0.004994	0.003185	112	0.540000	0.517794
62	0.005471	0.003489	113	0.540000	0.525000
63	0.005994	0.003855	114	0.540000	0.525000
64	0.006572	0.004272	115	0.540000	0.525000
65	0.007214	0.004747	116	0.540000	0.525000
66	0.007930	0.005329	117	0.540000	0.525000
67	0.008733	0.005989	118	0.540000	0.525000
68	0.009632	0.006743	119	0.540000	0.525000
69	0.010703	0.007603	120+	1.000000	1.000000
70	0.011906	0.008584			

Appendix A: Tables of Recommended Assumptions

TABLE 6 - RATES OF MORTALITY FOR DISABILITY MEMBERS

Age	Male	Female	Age	Male	Female
25	0.007249	0.002422	68	0.037134	0.022924
26	0.007137	0.002524	69	0.038934	0.024451
27	0.007072	0.002649	70	0.040909	0.026165
28	0.007053	0.002794	71	0.043079	0.028089
29	0.007086	0.002966	72	0.045476	0.030239
30	0.007166	0.003162	73	0.048120	0.032621
31	0.007288	0.003374	74	0.051026	0.035263
32	0.007436	0.003589	75	0.054230	0.038159
33	0.007614	0.003807	76	0.057754	0.041322
34	0.007834	0.004022	77	0.061631	0.044778
35	0.008064	0.004230	78	0.065896	0.048544
36	0.008301	0.004430	79	0.070589	0.052620
37	0.008538	0.004660	80	0.075768	0.057047
38	0.008804	0.004934	81	0.081486	0.061843
39	0.009126	0.005263	82	0.087797	0.067034
40	0.009549	0.005663	83	0.094777	0.072637
41	0.010123	0.006160	84	0.102511	0.078693
42	0.010864	0.006757	85	0.111066	0.085219
43	0.011797	0.007467	86	0.120533	0.092269
44	0.012942	0.008301	87	0.130990	0.099878
45	0.014310	0.009264	88	0.142542	0.108086
46	0.015138	0.009686	89	0.155261	0.116971
47	0.015960	0.010111	90	0.169267	0.126510
48	0.016777	0.010558	91	0.183305	0.136967
49	0.017593	0.011021	92	0.197381	0.148266
50	0.018406	0.011487	93	0.211601	0.160432
51	0.019213	0.011952	94	0.225967	0.173369
52	0.020015	0.012412	95	0.240524	0.187095
53	0.020884	0.012861	96	0.255318	0.201831
54	0.021771	0.013301	97	0.270335	0.217297
55	0.022661	0.013727	98	0.285585	0.233414
56	0.023553	0.014147	99	0.301190	0.250167
57	0.024437	0.014561	100	0.317099	0.267515
58	0.025309	0.014980	101	0.333346	0.285424
59	0.026182	0.015418	102	0.350068	0.303884
60	0.027070	0.015886	103	0.367166	0.322797
61	0.028007	0.016405	104	0.384820	0.342117
62	0.029010	0.016992	105	0.403002	0.361910
63	0.030098	0.017671	106	0.421662	0.382029
64	0.031283	0.018452	107	0.439676	0.401674
65	0.032573	0.019356	108	0.456830	0.420714
66	0.033969	0.020392	109	0.473108	0.438996
67	0.035485	0.021580	110	0.488467	0.456562

Appendix A: Tables of Recommended Assumptions

TABLE 7 - RATES OF SALARY INCREASES

Years of Service	
0	0.0650
1	0.0650
2	0.0625
3	0.0625
4	0.0625
5	0.0625
6	0.0625
7	0.0625
8	0.0625
9	0.0625
10	0.0550
11	0.0550
12	0.0500
13	0.0500
14	0.0500
15	0.0475
16	0.0450
17	0.0425
18	0.0400
19	0.0375
20	0.0350
21+	0.0325