



Cavanaugh Macdonald
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**CONNECTICUT MUNICIPAL EMPLOYEES'
RETIREMENT SYSTEM**

**EXPERIENCE INVESTIGATION FOR THE
FIVE-YEAR PERIOD ENDING JUNE 30, 2017**



September 11, 2018

State of Connecticut
Municipal Employees' Retirement Commission
55 Elm Street
Hartford, CT 06106

Members of the Commission:

We are pleased to submit the results of an investigation of the economic and demographic experience for the Connecticut Municipal Employees' Retirement System (MERS). The purpose of the investigation was to assess the reasonability of the actuarial assumptions 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, 2012 to June 30, 2017. As a result of the investigation, it is recommended that revised economic assumptions, demographic tables and actuarial methods be adopted by the Actuarial Subcommittee and Commission for future use. Changing the 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 investigation of the experience of members of the System includes all active and retired members as well as beneficiaries of deceased members. In some instances, the experience was investigated separately for males and females since different tables are used for each of these groups.

The results of the investigation indicate that the assumed rates of separation from active service due to withdrawal, disability, retirement and mortality do not accurately reflect the actual and anticipated experience of the Retirement System. As a result of the investigation, new withdrawal, disability, retirement and mortality tables have been developed which reflect more closely the actual experience of the membership.

This report shows a comparison of the actual and expected cases of separation from active service, actual and expected number of deaths, and actual and expected salary increases. These tables are shown based on current assumed expected rates and based on new proposed expected rates. A comparison between the rates of separation and mortality presently in use and the recommended revised rates are also shown in this report.

All rates of separation, mortality and salary increase at each age for each system are shown in the attached tables in Appendix D of this report. In the actuary's judgment, the rates recommended are suitable for use until further experience indicates that modifications are desirable.

The experience investigation 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. The undersigned 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: Executive Summary

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. An actuarial valuation for the Connecticut Municipal Employees' Retirement System (MERS) is prepared annually to determine the actuarial contribution rates required to fund the system on an actuarial reserve basis, (i.e. the current assets plus future contributions, along with investment earnings will be sufficient to provide the benefits promised by the system). The valuation requires the use of certain assumptions with respect to the occurrence of future events, such as rates of death, termination of employment, retirement age, and salary changes to estimate the obligations of the system.

The basic purpose of an experience study is to determine whether the actuarial assumptions currently in use have adequately anticipated the actual emerging experience. This information, along with the professional judgment of Plan personnel and advisors, is used to evaluate the appropriateness of continued use of the current actuarial assumptions. When analyzing experience and assumptions, it is important to recognize that actual experience is reported in the short term while assumptions are intended to be long-term estimates of experience. Therefore, actual experience is expected to vary from study period to study period, without necessarily indicating a change in assumptions is needed.

Cavanaugh Macdonald Consulting, LLC (CMC) has performed a study of the experience of MERS for the five-year period ending June 30, 2017. This report presents the results, analysis, and resulting recommendations of our study. It is anticipated that the changes, if approved, will first be reflected in the June 30, 2018 actuarial valuation.

These assumptions have been developed in accordance with generally recognized and accepted actuarial principles and practices that are consistent with the applicable Actuarial Standards of Practice adopted by the Actuarial Standards Board (ASB). While the recommended assumptions represent our best estimate of future experience, there are other reasonable assumption sets that could be supported by the results of this experience study. Those other sets of reasonable assumptions could produce liabilities and costs that are either higher or lower.

Our Philosophy

Similar to an actuarial valuation, the calculation of actual and expected experience is a fairly mechanical process, and differences between actuaries in this area are generally minor. However, the setting of assumptions differs, as it is more art than science. In this report, we have recommended changes to certain assumptions. To explain our thought process, we offer a brief summary of our philosophy:

- **Do Not Overreact:** When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically recommend rates somewhere between the old rates and the new experience. If the experience during the next study period shows the same result, we will probably recognize the trend at that point in time or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.

Section I: Executive Summary

- **Anticipate Trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.
- **Simplify:** In general, we attempt to identify which factors are significant and eliminate or ignore the ones that do not materially improve the accuracy of the liability projections.

The following summarizes the findings and recommendations with regard to the assumptions utilized for MERS. Detailed explanations for the recommendations are found in the sections that follow.

Recommended Economic Assumption Changes

Economic assumptions are some of the most visible and significant assumptions used in the valuation process. The items in the broad economy modeled by these assumptions can be very volatile over short periods of time, as clearly seen in the economic downturn in 2008 followed by the rebound in many financial markets in the years following. Our goal is to try to find the emerging long-term trends in the midst of this volatility so that we can then apply reasonable assumptions.

Most of the economic assumptions used by actuaries are developed through a building-block approach. For example, the expected return on assets is based on the expectation for inflation plus the expected real return on assets. At the core of the economic assumptions is the inflation assumption. As we discuss later in the report, based on recent trends of inflation, the market pricing of inflation, and the Chief Actuary of the Social Security Administration's view of inflation, **we are recommending a lowering of the price inflation assumption from 3.00% to 2.50%, similar to the Connecticut State Employees Retirement System (SERS)**. While some might argue that inflation may be even lower in the future, we believe these experts are reacting to short-term experience and this lowering of the assumption is consistent with our desire to avoid overreacting.

In addition, we are also recommending that the long-term expected return on assets assumption be lowered from 8.00% to 7.00%, reflecting the 2.50% inflation assumption. This will be discussed in detail later in this report, but the real rate of return of 4.50% (difference between 7.00% and 2.50%) is supported by the analysis of the State Treasurer, the State's investment consultant, Meketa Investment Group and the forecasting models developed in the 2017 Horizon Actuarial Services, LLC. Survey.

We are also recommending that the general wage inflation assumption be decreased from 3.50% to 3.00%, reflecting historical data that shows MERS continues to experience salary gains on the salary assumption and that the real wage growth in the State of Connecticut has not kept up with the current assumption.

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The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	3.00%	2.50%
Investment Return*	8.00%	7.00%
Wage Inflation	3.50%	3.00%

* Net of investment expenses only.

Although we have recommended a change in the set of economic assumptions, we recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding MERS. Actuarial Standards of Practice allow for this difference in approaches and MERS perspective as long as the assumptions are reasonable and consistent.

Section II of this report will provide more detail to these recommended changes.

Actuarial Methods

The basic actuarial methodologies used in the valuation process include the:

- Actuarial Cost Method
- Asset Valuation Method
- Amortization Method

Based on our review, we recommend consideration of an increase in the amortization period of for the payment of the Unfunded Actuarial Accrued Liability (UAAL) to 30 years as of the June 30, 2018 actuarial valuation.

We also recommend the Commission consider a Direct Contribution Rate Smoothing method to phase into the Actuarially Determined Contributions that are calculated with the proposed assumption changes.

Section III of this report will provide more detail to these recommended changes.

Recommended Demographic Assumption Changes

In the experience study, actual demographic experience for the study period is compared to that expected based on the current actuarial assumption. The analysis is most commonly performed based on counts, i.e. each member is one exposure as to the probability of the event occurring and one occurrence if the

Section I: Executive Summary

event actually occurs. Comparing the actual incidence of the event to what was expected (called the Actual-to-Expected ratio, or A/E ratio) then provides the basis for our analysis.

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying in recent years. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date. There have been significant improvements in longevity in the past, although there are different opinions about future expectations. We believe it is prudent to anticipate that the trend will continue to some degree in the future. Therefore, we believe it is appropriate to reflect some future mortality improvement as part of the mortality assumption.

The current post-retirement healthy mortality assumption for MERS is the RP2000 Mortality Table for Annuitants and Non-Annuitants, with a one year age set-forward for males and a one year age set-back for females. This is a static mortality table with a margin for improved mortality. The results of the experience analysis indicate that the mortality data is less than 50% credible for the General Employees and even less for the Police and Fire Employees. We also reviewed the Police and Fire Survivor Benefit Fund mortality data and there was not a significant amount of deaths to consider credible in setting a mortality table. Therefore, we will rely on a widely-used base mortality table with future mortality improvement. **We are recommending that MERS adopt a static mortality approach using the most recent Society of Actuaries base mortality table, the RP2014 Mortality Table.** More information will be discussed later in the report.

The following is a list of other recommended changes to the demographic assumptions for MERS.

- **Retirement:** For General Employees, the number of retirements for the period were very close to expected. Therefore, we recommend small adjustments in the rates of retirement at most ages. For Police and Fire, there were less retirements than expected, so therefore, we recommend small reductions the rates of retirement at most ages.
- **Disability:** We recommend decreasing the rates of disability further as the number of disability retirements experienced in MERS continues to decline.
- **Withdrawal:** We recommend splitting the rates of withdrawal for those with less than five years of service and those with 5 or more years of service. We also recommend changing the rates of withdrawal to better match the experience of MERS.
- **Merit Salary Scale:** The current salary scale is based on the age of the employee. We recommend going to a service-based salary scale where there are higher rates of salary increase at lower levels of service and lower rates of salary increase at higher levels of service.

Section IV of this report will provide more detail to these recommended changes.

Section I: Executive Summary

Financial Impact

The following tables highlight the impact of the recommended changes on the unfunded actuarial accrued liabilities (UAAL), actuarially determined employer contribution (ADEC) rate as a percentage of payroll, and the funding ratio based on actuarial value of assets for the pension valuation as of June 30, 2016.

MERS Results (\$ in Thousands)

	(A)	(B)	(C)
	June 30, 2016 Valuation	With changes to Demographic Assumptions Only	With changes Demographic and Economic Assumptions
Discount Rate	8.00%	8.00%	7.00%
UAAL	\$394,841	\$460,011	\$826,241
Amortization Period	23 years	23 years	23 years
Funding Ratio	86.1%	84.2%	74.7%
ADEC			
General with SS	11.74%	12.22%	18.31%
General without SS	12.15%	12.93%	22.13%
Police and Fire with SS	17.13%	16.09%	24.32%
Police and Fire without SS	16.93%	15.42%	25.44%

SS = Social Security Coverage

A Direct Contribution Rate Smoothing method is recommended for consideration to phase into the Actuarially Determined Employer Contribution rates in column C above that are calculated with all the proposed assumption changes.

Section II: Economic Assumptions

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

- Price Inflation
- Investment Return
- Wage Inflation

Note that future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return and the rates of salary increases. However, it is not directly used in the valuation process.

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. ASOP No. 27 was revised in September, 2013 and no longer includes the concept of a “best estimate range”. Instead, the revised standard now requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary’s professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary’s estimate of future experience, the actuary’s observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

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. The following table shows our recommendations followed by detailed discussions of each assumption.

Section II: Economic Assumptions

Item	Current	Proposed
Price Inflation	3.00%	2.50%
Real Rate of Return*	<u>5.00</u>	<u>4.50</u>
Investment Return	8.00%	7.00%
Price Inflation	3.00%	2.50%
Real Wage Growth	<u>0.50</u>	<u>0.50</u>
Wage Inflation	3.50%	3.00%

* net of investment expenses.

Section II: Economic Assumptions

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 long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a more or less level “real return” – the excess of actual investment return over price inflation. If inflation rates are expected to be high, investment return rates are also expected to be high, while low inflation rates are expected to result in lower expected investment returns, at least in the long run.

The current price inflation assumption is an assumed annual rate of 3.00%.

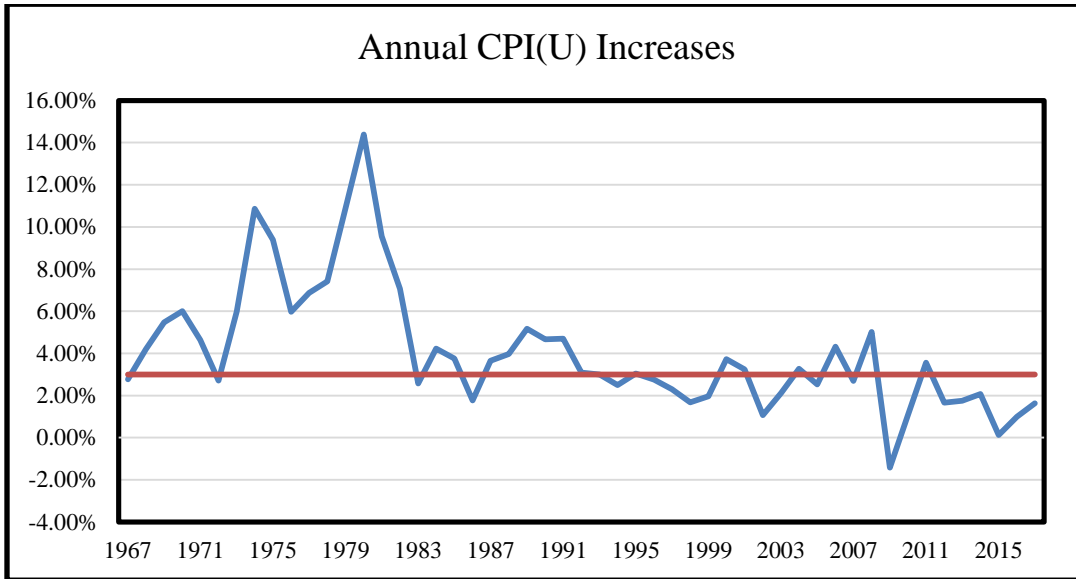
Past Experience

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

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1927 – 2017	90	2.9%	4.1%
1957 – 2017	60	3.7%	2.9%
1967 – 2017	50	4.1%	3.0%
1977 – 2017	40	3.6%	2.9%
1987 – 2017	30	2.6%	1.5%
1997 – 2017	20	2.1%	1.5%
2007 - 2017	10	1.6%	1.9%

The following graph illustrates the historical levels of price inflation measured as of June 30th of each of the last 50 years and compared to the current 3.00% annual rate currently assumed.

Section II: Economic Assumptions



Over the last 50 years, the average annual rate of increase in the CPI-U has been just above 4.00%. However, the period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. 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.

Forecasts

Based upon information contained in the "Survey of Professional Forecasters" for the third quarter of 2018 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.20%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for lower rates of inflation for the near term future.

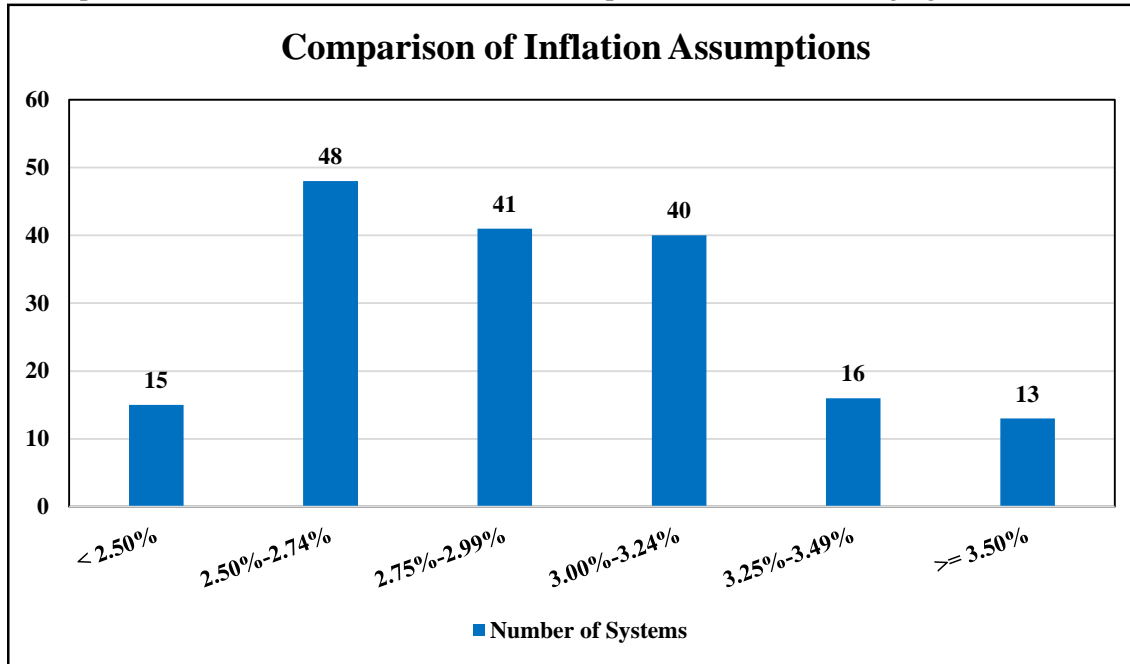
Social Security Administration

Although many economists forecast lower inflation than the assumption used by most retirement plans, they are generally looking at a shorter time horizon than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the most recent report (June, 2018), the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.60%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.00% to 3.20%.

Section II: Economic Assumptions

Peer Comparison

While we do not recommend the selection of any assumption based solely on what other systems use, it does provide another set of relevant information to consider. The following chart shows the inflation rate assumptions of 173 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from the last actuarial valuation reported to the center (ranging from 2016 to 2017).



Recommendation

It is difficult to predict inflation accurately. Inflation's short-term volatility is illustrated by comparing its average rate over the last 10 and 50 years. Although the 10-year average of 1.6% is lower than the Plan's assumed rate of 3.00%, the longer 50-year averages of 4.1% is higher than the Plan's current rate. The reasonableness of the Plan's assumption is, therefore, dependent upon the emphasis one assigns to the short and long-terms.

Current economic forecasts suggest lower inflation but are generally looking at a shorter time period than appropriate for our purposes. We consider the range included in the Social Security Administration of 2.00% to 3.20% to be reasonable and, therefore, **we recommend the inflation assumption for the Plan be lowered from 3.00% to 2.50% at this time.**

Price Inflation Assumption	
Current	3.00%
Reasonable Range	2.00% - 3.20%
Recommended	2.50%

Section II: Economic Assumptions

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 benefit payments for all active, inactive and retired members. Minor changes in this assumption can have a major impact on valuation results. The investment return assumption should reflect the asset allocation target for the funds as established by the Fund's fiduciary, the State Treasurer.

The current assumption is 8.00%, consisting of a price inflation assumption of 3.00% and a real rate of return assumption of 5.00%.

Long Term Perspective

Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider very long periods of time. For example, a newly-hired employee who is 25 years old may work for 35 years, to age 60, and live another 30 years, to age 90 (or longer). The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 30 years. During the entire 65-year period, the system is investing assets related to the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received after the employee retires. In addition, in an open, ongoing system like the Plan, the stream of benefit payments is continually increasing as new hires replace current members who leave covered employment due to death, termination of employment, and retirement. This difference in the time horizon used by actuaries and investment consultants is frequently a source of debate and confusion when setting economic assumptions.

Past Experience

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, the asset allocation can also impact the investment returns so comparing results over long periods when different asset allocations were in place may not be meaningful.

The assets for the Plan are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below.

Section II: Economic Assumptions

Year Ending 6/30	Actuarial Value	Actual Market Value Returns
2012	6.16%	0.62%
2013	6.91%	13.59%
2014	8.28%	10.97%
2015	6.60%	2.41%
2016	6.09%	1.02%
Average	6.81%	5.72%

While important to review and analyze, historical returns over such a short time period are not credible for the purpose of setting the long-term assumed future rate of return.

Future Expectation Analysis

ASOP 27 provides that the actuary may rely on outside experts in setting economic assumptions. The State Treasurer utilizes the services of Meketa Investment Group (Meketa) to assist in the analysis of potential asset strategies and allocations. We were provided the most recent capital market assumptions of Meketa and the current target allocations of the MERS Fund to assist in our analysis of future return expectation and volatility.

We note Meketa's annual rate of inflation assumption is the same as our recommendation of 2.50%. We then use statistical methods to approximate the longer-term expectation of returns based on the capital market assumptions. We consider a reasonable range for this assumption would be between the 25th and 75th percentile of long-term (50-year) expected returns. Our analysis produces a reasonable range for the long-term investment return assumption, net of expenses, between 6.0% and 8.5% and the median return (midpoint of the range) is 7.3% as shown in the table below.

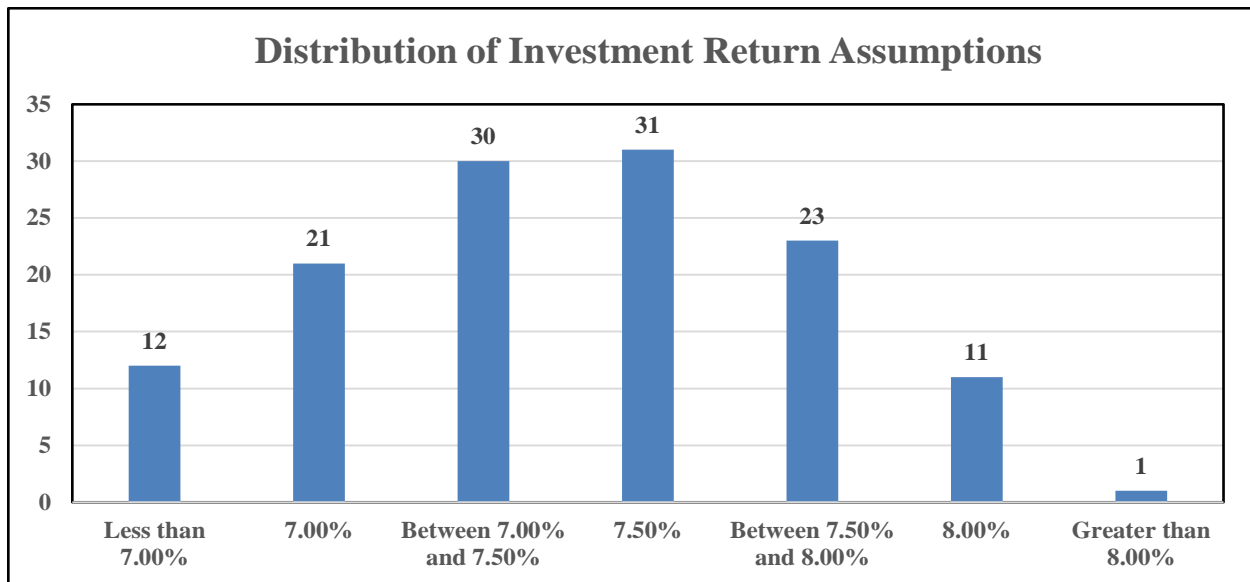
Statistical Analysis of Expected Return Distribution							
Time Span In Years	Mean Rates of Return	Standard Deviation	Rates of Return by Percentile				
			5 th	25 th	50 th	75 th	95 th
1	8.1%	13.2%	-12.2%	-1.2%	7.3%	16.5%	31.1%
5	7.4%	5.9%	-1.9%	3.4%	7.3%	11.3%	17.3%
10	7.3%	4.1%	0.7%	4.5%	7.3%	10.1%	14.3%
20	7.3%	2.9%	2.6%	5.3%	7.3%	9.3%	12.2%
30	7.3%	2.4%	3.4%	5.7%	7.3%	8.9%	11.3%
50	7.3%	1.9%	4.3%	6.0%	7.3%	8.5%	10.3%

Section II: Economic Assumptions

For a broader view of expected returns, we also reviewed the 2017 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently developing for real returns. The Horizon survey includes both 10-year and 20-year timeframe for capital market assumptions. Using the current Plan target asset allocation, we determine the estimated 10-year horizon of nominal returns at the 50th Percentile of 6.3% and 20-year horizon of real returns of 7.3%. The average price inflation assumption in the Horizon Survey is 2.2% and 2.4%, for the 10-year and 20-year timeframe, respectively. Using the plan’s recommended inflation component of 2.50%, the median annual return expected using the Horizon survey data is 6.6% for the 10-year timeframe and 7.4% for the 20-year timeframe.

Peer Comparison

The following chart shows the nominal investment return assumptions of the 127 plans from the National Association of State Retirement Administrators (NASRA) Issue Brief entitled, “Public Pension Plan Investment Return Assumptions”, updated February, 2018. The median nominal investment return from this survey is 7.50%.



Section II: Economic Assumptions

Recommendation

By actuarial standards, we are required to maintain a long-term perspective in setting all assumptions, including the investment return assumption. Therefore, we believe actuaries must be careful not to let recent experience or the short-term expectations excessively impact our judgment regarding the appropriateness of the current assumption over the long term.

This is a particularly challenging time to develop a recommendation for the investment return assumption. Lately, there has been a significant trend in lowering the investment return assumption for pension plans across the country. According to the 2018 NASRA Issue Brief, the average return assumption has decreased from 7.91% in 2010 to 7.36% in 2018. This is consistent with both Meketa’s future expectation analysis of 7.3% and the Horizon Survey’s 20-year period median expected return of approximately 7.4%. This expectation, as well as the clear and continuing trend toward lower discount rates nationally, compels us to favor less than the median rate of return based on current capital market assumptions for the longer timeframes.

Taking all of this information into consideration, we are recommending the Board lower the investment return assumption from 8.00% to 7.00%. Below is a breakdown of the building block approach as recommended under ASOP No. 27.

Investment Return Assumption		
	Current	Recommended
Real Rate of Return*	5.00%	4.50%
Inflation	<u>3.00</u>	<u>2.50</u>
Net Investment Return	8.00%	7.00%

* net of investment expenses.

Section II: Economic Assumptions

Wage Inflation

Background

The wage inflation assumption is composed of the price inflation assumption and an assumption for the real rate of wage increases. The salary increase assumption combines the wage inflation assumption with an assumption for promotion and longevity, often called merit increases. Merit assumptions are generally age and/or service related, and will be dealt with in the demographic assumption section of the report. The excess of wage growth over price inflation is also considered the increase in productivity that labor provides.

The current wage inflation assumption is 3.50%, and is composed of a 3.00% rate of inflation assumption and a 0.50% real rate of wage inflation.

Past Experience

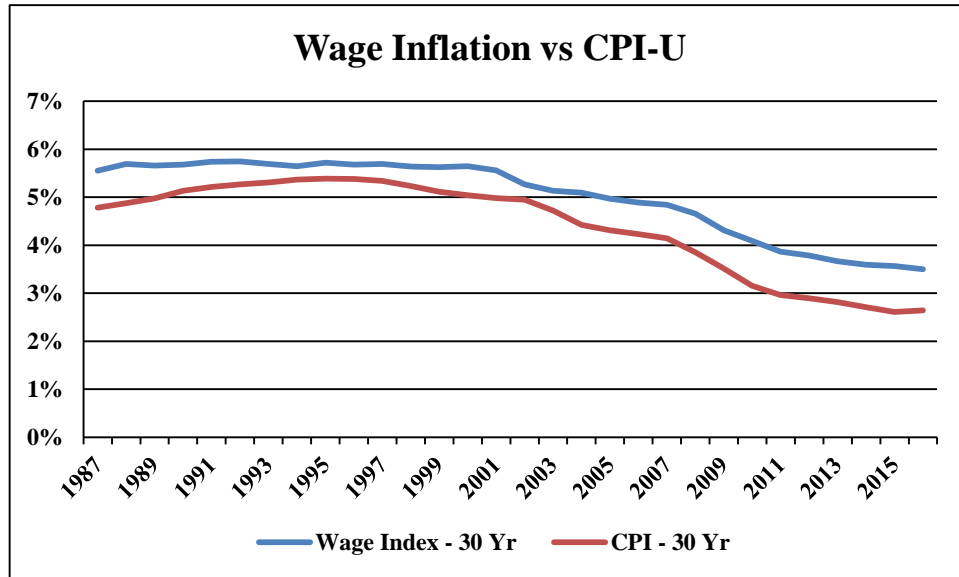
The Social Security Administration publishes data on wage growth in the United States (see Appendix C). While this is the most comprehensive data available, it is based on all wage earners in the country so it can be influenced by the mix of jobs as well as by changes in certain sectors of the workforce that may not be seen by all segments.

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2016. We remove the rate of price inflation for each year from the data to result in the historical real rate of wage inflation.

Period	Wage Inflation	Price Inflation	Real Wage Growth
2006-2016	2.33%	1.81%	0.52%
1996-2006	4.08%	2.44%	1.64%
1986-1996	4.11%	3.68%	0.43%
1976-1986	6.50%	6.62%	(0.12)%
1966-1976	6.45%	5.87%	0.58%
1996-2016	3.20%	2.12%	1.08%
1986-2016	3.50%	2.64%	0.86%
1976-2016	4.24%	3.62%	0.62%
1966-2016	4.68%	4.07%	0.61%

Thus over the last 50 years, annual real wage growth has averaged 0.61%. And over the last 10 years, it has averaged 0.52%.

Section II: Economic Assumptions



Social Security Administration

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In June of 2018, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.8%, 1.2% higher than the Social Security intermediate inflation assumption of 2.6% per year. The range of the assumed real wage inflation in the 2018 Trustees report was 0.6% to 1.8% per year.

Recommendation

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. The MERS experience continues to generate gains on the salary assumption (i.e. actual increases in salary are less than expected). However, since we are recommending a decrease in the price inflation assumption, we are recommending no change in the real wage growth of 0.50%, so therefore, in total, we are recommending a decrease in the wage inflation from 3.50% to 3.00%. Not only will this recommended assumption lower projected salaries in the future, but it will also lower projected liabilities for active members.

Wage Inflation Assumption		
	Current	Recommended
Price Inflation	3.00%	2.50%
Real Wage Growth	<u>0.50%</u>	<u>0.50%</u>
Wage Inflation	3.50%	3.00%

Section III: Actuarial Methods

Actuarial Cost Method

There are various actuarial cost methods, each of which has different characteristics, advantages and disadvantages. However, Governmental Accounting Standard Board (GASB) Statement Numbers 67 and 68 require that the Entry Age Normal cost method be used for financial reporting. Most systems do not want to use a different actuarial cost method for funding and financial reporting. In addition, the Entry Age Normal method has been the most common funding method for public systems for many years. This is the cost method currently used by the Plan.

The rationale of the Entry Age Normal (EAN) cost method is that the cost of each member's benefit is determined to be a level percentage of his salary from date of hire to the end of his employment with the employer. This level percentage multiplied by the member's annual salary is referred to as the normal cost and is that portion of the total cost of the employee's benefit that is allocated to the current year. The portion of the present value of future benefits allocated to the future is determined by multiplying this percentage times the present value of the member's assumed earnings for all future years including the current year. The Entry Age Normal actuarial accrued liability is then developed by subtracting from the present value of future benefits that portion of costs allocated to the future. To determine the unfunded actuarial accrued liability, the value of plan assets is subtracted from the Entry Age Normal actuarial accrued liability. The current year's cost to amortize the unfunded actuarial accrued liability is developed by applying an amortization factor.

It is to be expected that future events will not occur exactly as anticipated by the actuarial assumptions in each year. Actuarial gains/losses from experience under this actuarial cost method can be directly calculated and are reflected as a decrease/increase in the unfunded actuarial accrued liability. Consequently, the gain/loss results in a decrease/increase in the amortization payment, and therefore the contribution rate.

Considering that the Entry Age Normal cost method is the most commonly used cost method by public plans, that it develops a normal cost rate that tends to be less volatile, and is the required cost method under calculations required by GASB disclosures, **we recommend the Entry Age Normal actuarial cost method be retained for the Plan.**

Section III: Actuarial Methods

Actuarial Value of Assets

In preparing an actuarial valuation, the actuary must assign a value to the assets of the fund. An adjusted market value is often used to smooth out the volatility that is reflected in the market value of assets. This is because most employers would rather have annual costs remain relatively smooth, as a percentage of payroll or in actual dollars, as opposed to a cost pattern that is extremely volatile.

The actuary does not have complete freedom in assigning this value. The Actuarial Standards Board also has basic principles regarding the calculation of a smoothed asset value, Actuarial Standard of Practice No. 44 (ASOP 44), *Selection and Use of Asset Valuation Methods for Pension Valuations*.

ASOP 44 provides that the asset valuation method should bear a reasonable relationship to the market value. Furthermore, the asset valuation method should be likely to satisfy both of the following:

- Produce values within a reasonable range around market value, AND
- Recognize differences from market value in a reasonable amount of time.

In lieu of both of the above, the standard will be met if either of the following requirements is satisfied:

- There is a sufficiently narrow range around the market value, OR
- The method recognizes differences from market value in a sufficiently short period.

These rules or principles prevent the asset valuation methodology from being used to manipulate annual funding patterns. No matter what asset valuation method is used, it is important to note that, like a cost method or actuarial assumptions, the asset valuation method does not affect the true cost of the plan; it only impacts the incidence of cost.

The current asset valuation method for MERS, determines the actuarial value of assets at the valuation date as the expected actuarial value at the end of the year adjusted 20% toward the actual market value. If the market value is higher than the expected actuarial value, the adjustment increases the actuarial value by 20% of the difference and vice versa when market value is lower than the expected actuarial value. In our opinion, this method, called the 20% write-up method, is among the least volatile smoothing methods typically in use.

The current 20% write-up method used by MERS is acceptable by ASOP 44 standards and we recommend no change in this methodology.

Section III: Actuarial Methods

Amortization of the Unfunded Actuarial Accrued Liability

The actuarial accrued liability is the portion of the actuarial present value of future benefits that are not included in future normal costs. Thus, it represents the liability that, in theory, should have been funded through normal costs for past service. Unfunded actuarial accrued liability (UAAL) exists when the actuarial accrued liability exceeds the actuarial value of plan assets. These deficiencies can result from:

- (i) plan improvements,
- (ii) experience that is less favorable than expected, or
- (iii) assumption changes that increase liabilities.

There are a variety of different methods that can be used to amortize the UAAL. Each method results in a different payment stream and, therefore, has cost implications. For each methodology, there are three characteristics:

- The period over which the UAAL is amortized,
- The rate at which the amortization payment increases, and
- The number of components of UAAL (separate amortization bases).

Amortization Period: The amortization period can be either closed or open. If it is a closed amortization period, the number of years remaining in the amortization period declines by one in each future year. Alternatively, if the amortization period is an open or rolling period, the amortization period does not decline but is reset to the same number each year. This approach essentially “refinances” the System’s debt (UAAL) every year. **MERS currently utilizes a closed amortization period approach and we recommend no change to this method.**

Amortization Payment: The level dollar amortization method is similar to the method in which a homeowner pays off a mortgage. The liability, once calculated, is financed by a constant fixed dollar amount, based on the amortization period until the liability is extinguished. This results in the liability steadily decreasing while the payments, though remaining level in dollar terms, in all probability decrease as a percentage of payroll. (Even if a plan sponsor’s population is not growing, inflationary salary increases will usually be sufficient to increase the aggregate covered payroll). **MERS currently utilizes a level dollar amortization payment approach and we recommend no change to this method.**

Amortization Bases: The UAAL can be amortized either as one single amount or as components or “layers”, each with a separate amortization base, payment and period. If the UAAL is amortized as one amount, the UAAL is recalculated each year in the valuation and experience gains/losses or other changes in the UAAL are folded into the single UAAL amortization base. The amortization payment is then the total UAAL divided by an amortization factor for the applicable amortization period.

If separate amortization bases are maintained, the UAAL is composed of multiple amortization bases, each with its own payment schedule and remaining amortization period. In each valuation, the unexpected change in the UAAL is established as a new amortization base over the appropriate amortization period beginning on that valuation date. The UAAL is then the sum of all of the outstanding

Section III: Actuarial Methods

amortization bases on the valuation date and the UAAL payment is the sum of all of the amortization payments on the existing amortization bases. This approach provides transparency in that the current UAAL is paid off over a fixed period of time and the remaining components of the UAAL are clearly identified. Adjustments to the UAAL in future years are also separately identified in each future year. One downside of this approach is that it can create some discontinuities in contribution rates when UAAL layers/components are fully paid off. If this occurs, it likely would be far in the future, with adequate time to address any adjustments needed.

Currently, the amortization methodology is based on the level dollar amortization method with a closed period, 23 years remaining as of the June 30, 2016 actuarial valuation. In light of the recommendation to reduce the investment return assumption and the resulting increases to the ADEC rates, we recommend that MERS consider a reset of the amortization period to a closed 30-year period as of the June 30, 2018 actuarial valuation. We also recommend a layered approach for all future experience gains and losses, assumption changes and/or benefit changes with each future annual UAAL change base amortized over a closed 25-year period beginning with the year it is incurred.

Section III: Actuarial Methods

Direct Rate Smoothing

Another actuarial method that many public sector pension plans are considering is the method of direct rate smoothing. This is a method of phasing-in of certain changes in contribution rates, specifically, phasing in the effect of assumption changes over a short period. Contribution rate phase-in can be an effective and reasonable method to address a significant impact of assumption changes.

According to the Conference of Consulting Actuaries Public Plan Community (CCA PPC) White Paper, Direct Rate Smoothing is an acceptable practice with the following conditions:

- The phase-in period should be no longer than the time period until the next review of assumptions. We feel that this period
- The plan and its sponsors should be clearly aware of the additional cost of the phase-in, due to the plan receiving less than the ADEC during the phase-in.
- The phase-in of assumption changes or other cost impacts deemed to be material should be applied symmetrically to both increases and decreases in contribution rates.

Therefore, we recommend the Commission consider a Direct Contribution Rate Smoothing phase-in of the ADECs calculated in the June 30, 2018 actuarial valuation due to the new actuarial assumptions. In our valuation reports, we will provide the impact of future contribution rates on any smoothing technique adopted by the Commission.

Section IV: Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Connecticut Retirement Systems. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Rates of Post-retirement and Pre-Retirement Mortality
- Rates of Salary Increase

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 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. These tabulations look at all active and retired members during the period as well as separately annotating those who experience a demographic event, also referred to as a decrement. In addition the tabulation of all members together with the current assumptions permits the calculation of the number of expected decrements during the study period.

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 early retirement windows, 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.

Section IV: Demographic Assumptions

RATES OF WITHDRAWAL

COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE BASED ON CURRENT RATES

GENERAL EMPLOYEES

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	GENERAL EMPLOYEES					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Less than 5 Years of Service						
20	6	12	0.500	9	6	1.500
25	70	90	0.778	90	102	0.882
30	76	69	1.101	107	88	1.216
35	40	43	0.930	63	59	1.068
40	43	28	1.536	60	60	1.000
45	37	21	1.762	69	58	1.190
50	65	34	1.912	105	54	1.944
55	27	19	1.421	49	30	1.633
60	22	15	1.467	27	17	1.588
65	6	4	1.500	13	6	2.167
70	6	2	3.000	3	2	1.500
TOTAL	398	337	1.181	595	482	1.234
5 or More Years of Service						
25	6	15	0.400	5	6	0.833
30	37	50	0.740	34	58	0.586
35	47	70	0.671	51	93	0.548
40	40	66	0.606	66	96	0.688
45	65	71	0.951	83	126	0.659
50	90	87	1.034	102	121	0.843
55	37	37	1.000	48	57	0.842
TOTAL	322	396	0.813	389	557	0.698

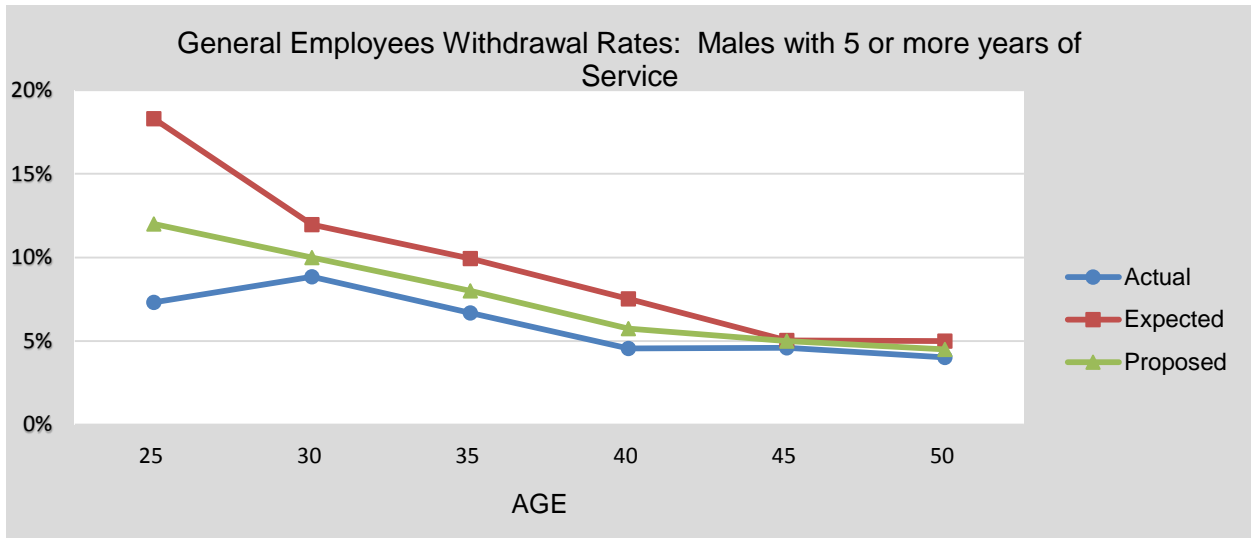
Section IV: Demographic Assumptions

POLICEMEN AND FIREMEN

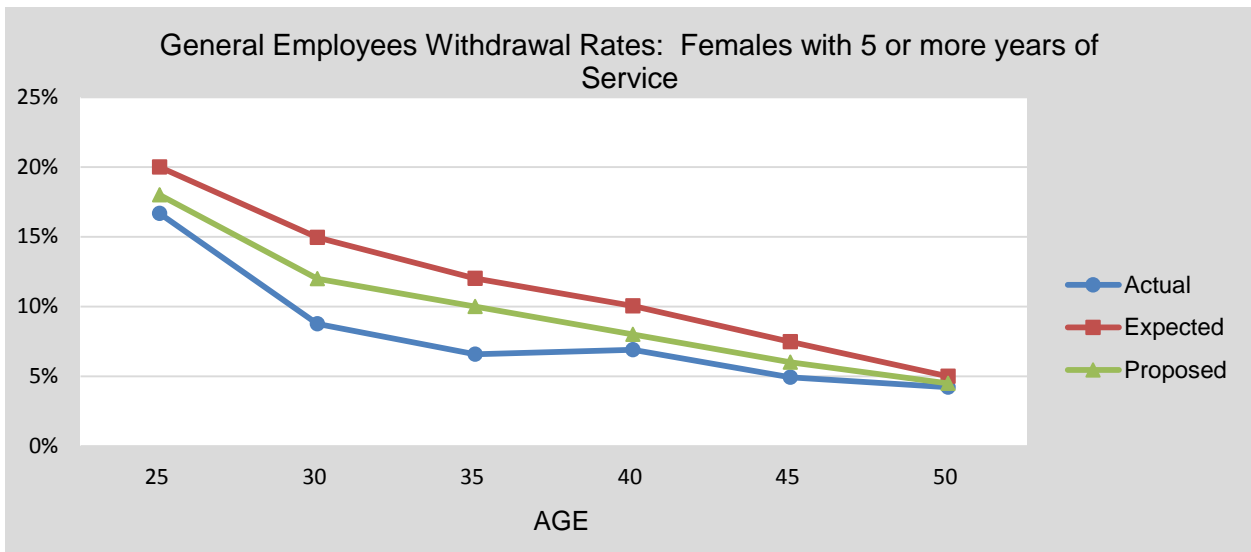
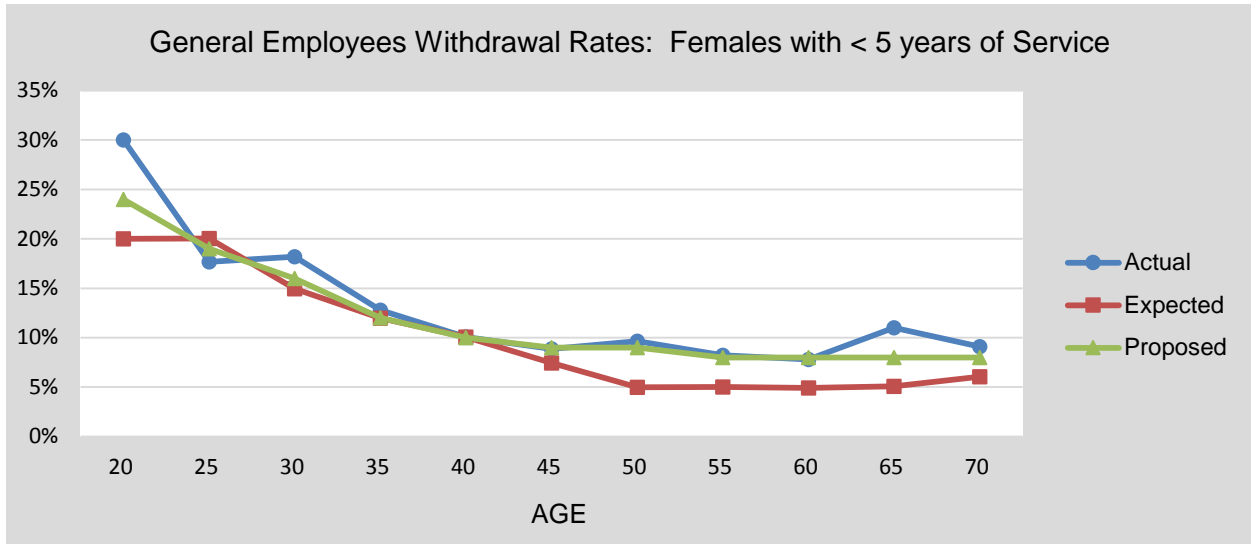
CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS		
	POLICEMEN AND FIREMEN		
	UNISEX		
	Actual	Expected	Ratio of Actual to Expected
Less than 5 Years of Service			
20	1	1	1.000
25	31	36	0.861
30	26	29	0.897
35	7	7	1.000
40	4	2	2.000
45	3	1	3.000
50	9	1	9.000
55	1	0	0.000
60	1	0	0.000
TOTAL	83	77	1.078
5 or More Years of Service			
25	1	4	0.250
30	20	34	0.588
35	13	31	0.419
40	17	21	0.810
45	24	20	1.200
50	21	5	4.200
55	5	0	0.000
TOTAL	101	115	0.878

Section IV: Demographic Assumptions

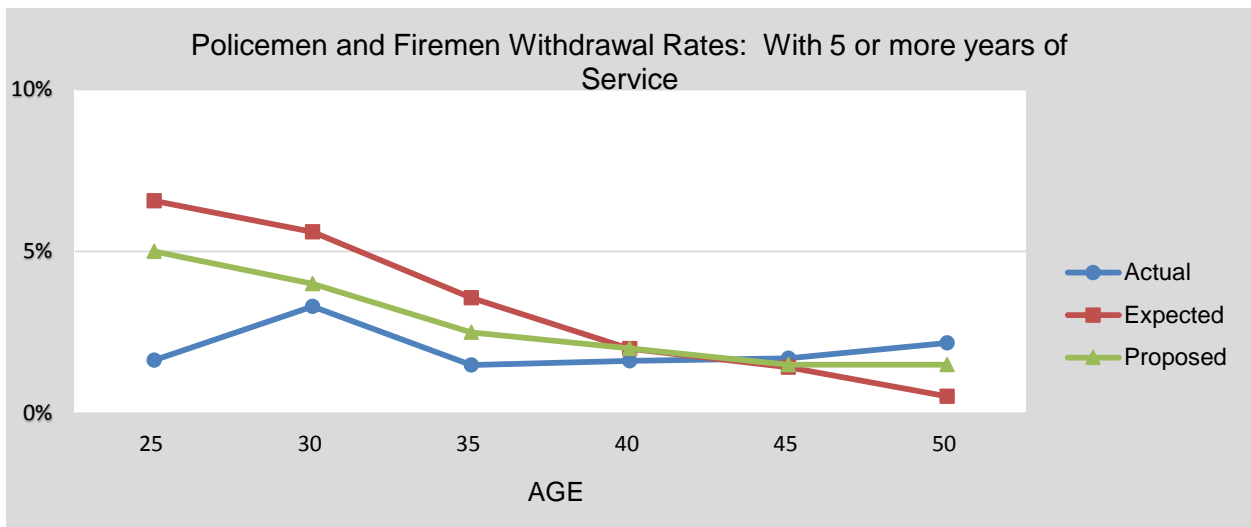
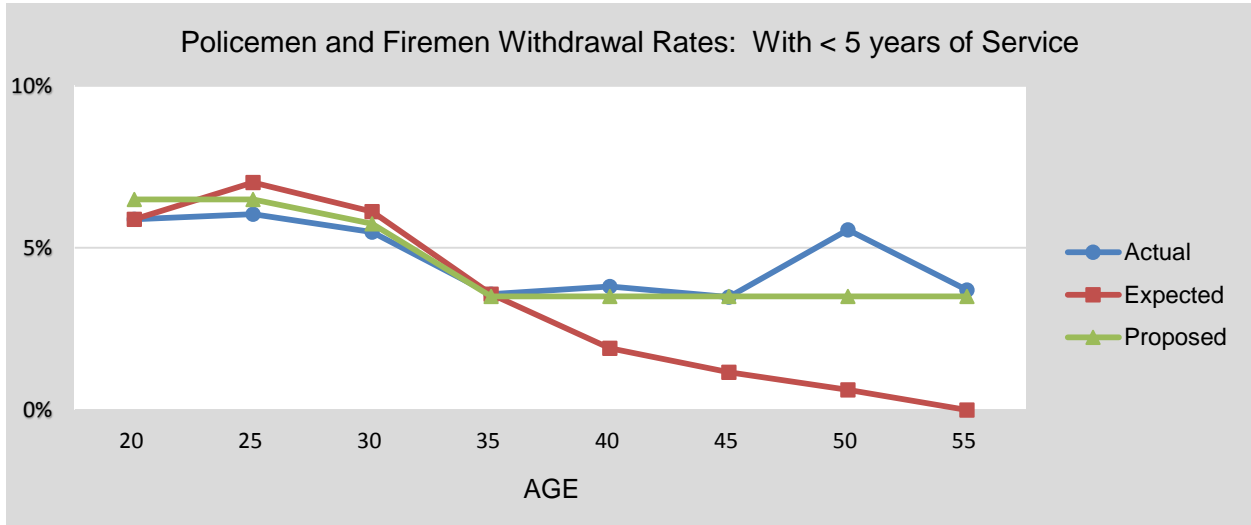
The following graphs show a comparison of the present, actual and proposed rates of withdrawal at each of the service breakdowns.



Section IV: Demographic Assumptions



Section IV: Demographic Assumptions



Section IV: Demographic Assumptions

RATES OF WITHDRAWAL FOR ACTIVE MEMBERS

The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service which will occur as a result of resignation or dismissal.

For General Employees, the preceding results indicate that the actual number of withdrawals that occurred during the study period were higher than expected for service levels less than 5 years and less than expected for service levels of 5 or more years of service. Therefore, we first recommend a split of rates of withdrawal by service and we recommend rates to more closely reflect the experience.

Similar experience was witnessed for the Policemen and Firefighters. Therefore, we recommend a split of rates of withdrawal by service as well and a slight change to the current rates.

Section IV: Demographic Assumptions

The following tables show a comparison between the present withdrawal rates and the proposed withdrawal rates.

COMPARATIVE RATES OF WITHDRAWAL

RATES OF WITHDRAWAL						
GENERAL EMPLOYEES						
Central Age of Group	Present		Proposed			
	Males	Females	Males		Females	
			0 – 4 years	5+ years	0 – 4 years	5+ years
20	18.00%	20.00%	16.00%	12.00%	24.00%	18.00%
25	18.00	20.00	16.00	12.00	19.00	18.00
30	12.00	15.00	12.50	10.00	16.00	12.00
35	10.00	12.00	10.00	8.00	12.00	10.00
40	7.50	10.00	9.50	5.75	10.00	8.00
45	5.00	7.50	8.50	5.00	9.00	6.00
50	5.00	5.00	8.50	4.50	9.00	4.50
55	5.00	5.00	6.50	0.00	8.00	0.00
60	5.00	5.00	6.50	0.00	8.00	0.00
65	5.00	5.00	6.00	0.00	8.00	0.00
70	5.00	5.00	6.00	0.00	8.00	0.00
75	0.00	0.00	0.00	0.00	0.00	0.00

RATES OF WITHDRAWAL			
POLICEMEN AND FIREMEN			
Central Age of Group	Present	Proposed	
		0 – 4 years	5+ years
20	7.00%	6.50%	5.00%
25	7.00	6.50	5.00
30	5.00	5.75	4.00
35	4.00	3.50	2.50
40	2.00	3.50	2.00
45	1.00	3.50	1.50
50	0.00	3.50	0.00
55	0.00	3.50	0.00
60	0.00	3.50	0.00
65	0.00	0.00	0.00

Section IV: Demographic Assumptions

COMPARISON OF ACTUAL AND EXPECTED WITHDRAWALS FROM ACTIVE SERVICE BASED ON PROPOSED RATES

GENERAL EMPLOYEES

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS					
	GENERAL EMPLOYEES					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
Less than 5 Years of Service						
20	6	12	0.500	9	7	1.286
25	70	80	0.875	90	97	0.928
30	76	72	1.056	107	94	1.138
35	40	43	0.930	63	59	1.068
40	43	35	1.229	60	60	1.000
45	37	35	1.057	69	70	0.986
50	65	58	1.121	105	98	1.071
55	27	25	1.080	49	48	1.021
60	22	20	1.100	27	28	0.964
65	6	5	1.200	13	9	1.444
70	6	3	2.000	3	3	1.000
TOTAL	398	388	1.026	595	573	1.038
5 or More Years of Service						
25	6	10	0.600	5	5	1.000
30	37	42	0.881	34	47	0.723
35	47	56	0.839	51	77	0.662
40	40	50	0.800	66	76	0.868
45	65	71	0.915	83	101	0.822
50	90	78	1.154	102	109	0.936
55	37	33	1.121	48	51	0.941
TOTAL	322	340	0.947	389	466	0.835

Section IV: Demographic Assumptions

POLICEMEN AND FIREMEN

CENTRAL AGE OF GROUP	NUMBER OF WITHDRAWALS		
	POLICEMEN AND FIREMEN		
	UNISEX		
	Actual	Expected	Ratio of Actual to Expected
Less than 5 Years of Service			
20	1	1	1.000
25	31	33	0.939
30	26	27	0.963
35	7	7	1.000
40	4	4	1.000
45	3	3	1.000
50	9	6	1.500
55	1	1	1.000
60	1	0	0.000
TOTAL	83	82	1.012
5 or More Years of Service			
25	1	3	0.333
30	20	24	0.833
35	13	22	0.591
40	17	21	0.810
45	24	21	1.143
50	21	14	1.500
55	5	3	1.667
TOTAL	101	108	0.935

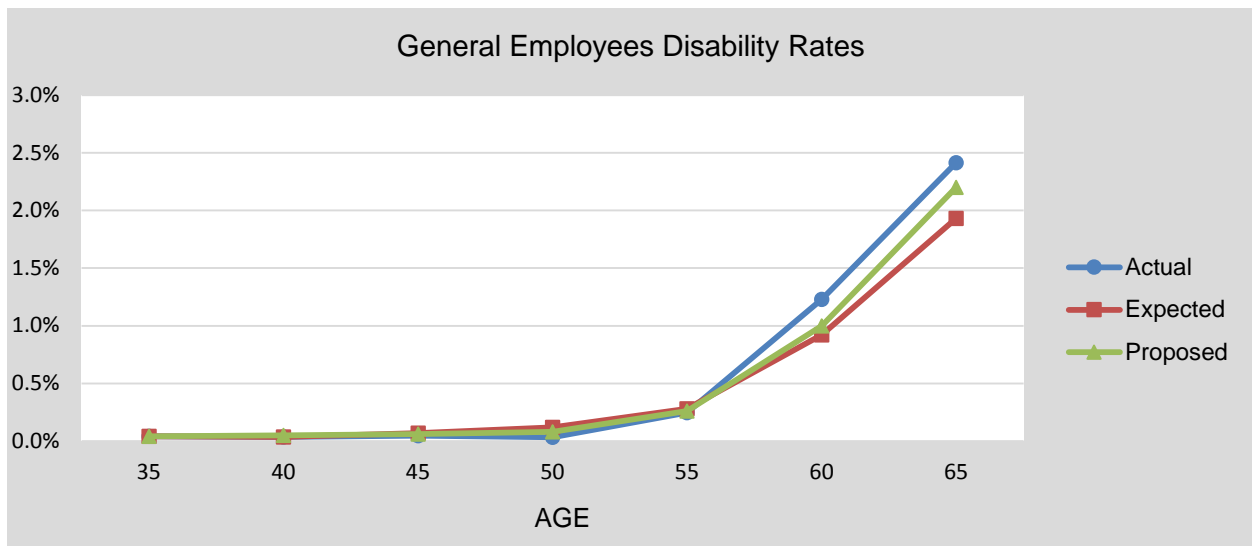
Section IV: Demographic Assumptions

RATES OF DISABILITY RETIREMENT

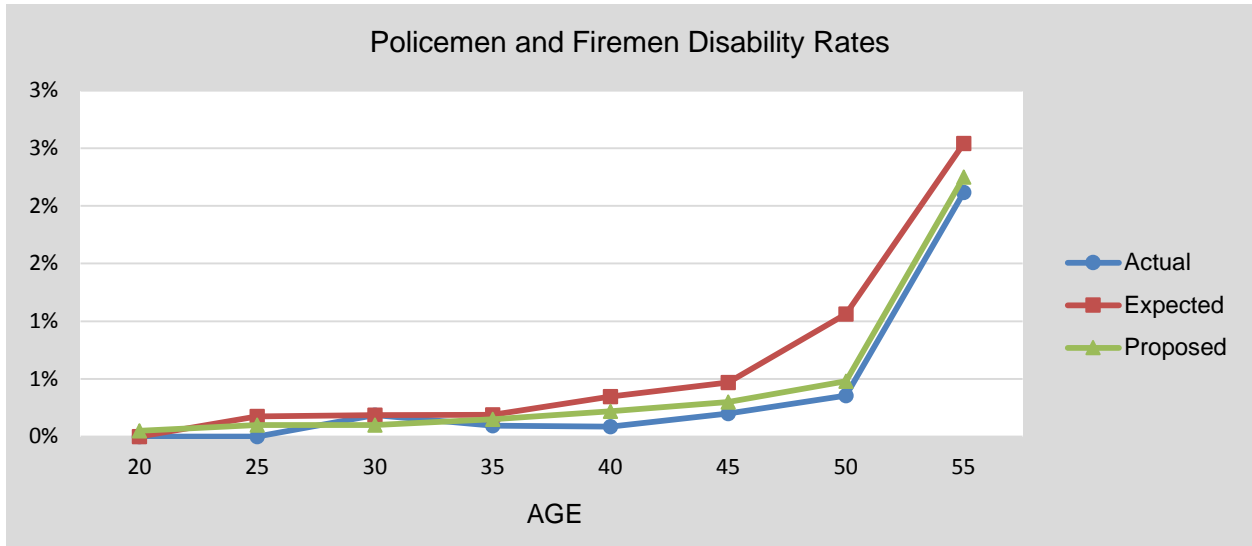
COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	General Employees			Policemen and Firemen		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
30	0	1	0.000	2	3	0.667
35	1	1	1.000	1	2	0.500
40	1	1	1.000	1	4	0.250
45	2	3	0.667	3	7	0.429
50	2	7	0.286	4	12	0.333
55	7	8	0.875	5	6	0.833
60	8	6	1.333	2	0	0.000
65	5	6	0.833	0	0	0.000
TOTAL	26	33	0.788	18	34	0.529

The following graphs show a comparison of the present, actual, and proposed rates of disability retirements.



Section IV: Demographic Assumptions



The preceding results indicate that the actual number of disability retirements was less than expected during the study period over most age groups and for both General Employees and Policemen and Firemen. We recommend decreasing the rates of disability retirement at most ages to more closely reflect the experience.

Section IV: Demographic Assumptions

The following table shows a comparison between the present disability retirement rates and the proposed rates.

COMPARATIVE RATES OF DISABILITY RETIREMENT

CENTRAL AGE OF GROUP	RATES OF DISABILITY RETIREMENT			
	General Employees		Policemen and Firemen	
	Present	Proposed	Present	Proposed
30	0.03%	0.02%	0.15%	0.10%
35	0.04	0.03	0.22	0.14
40	0.05	0.04	0.32	0.22
45	0.07	0.06	0.49	0.30
50	0.12	0.09	1.11	0.64
55	0.44	0.40	3.03	2.40
60	0.86	1.00	6.88	4.80
65	1.84	1.60	N/A	N/A

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS BASED ON PROPOSED RATES

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	General Employees			Policemen and Firemen		
	Actual	Expected (Proposed)	Ratio of Actual to Expected	Actual	Expected (Proposed)	Ratio of Actual to Expected
30	0	0	0.000	2	1	2.000
35	1	1	1.000	1	1	1.000
40	1	1	1.000	1	3	0.333
45	2	2	1.000	3	4	0.750
50	2	4	0.500	4	7	0.571
55	7	6	1.167	5	6	0.833
60	8	8	1.000	2	0	0.000
65	5	7	0.714	0	0	0.000
TOTAL	26	29	0.897	18	22	0.818

Section IV: Demographic Assumptions

RATES OF SERVICE RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS FROM ACTIVE SERVICE BASED ON CURRENT RATES

NUMBER OF SERVICE RETIREMENTS							
GENERAL EMPLOYEES							
Age	Actual	Expected	Ratio of Actual to Expected	Age	Actual	Expected	Ratio of Actual to Expected
45	4	6	0.667	66	116	81	1.432
46	6	7	0.857	67	73	62	1.177
47	10	10	1.000	68	64	47	1.362
48	9	12	0.750	69	53	40	1.325
49	15	14	1.071	70	56	34	1.647
50	10	16	0.625	71	16	22	0.727
51	17	16	1.063	72	28	20	1.400
52	13	17	0.765	73	14	16	0.875
53	11	18	0.611	74	18	14	1.286
54	23	16	1.438	75	12	49	0.245
55	91	79	1.152	76	13	67	0.194
56	97	72	1.347	77	11	37	0.297
57	80	56	1.429	78	3	25	0.120
58	69	55	1.255	79	3	21	0.143
59	75	54	1.389	80	2	19	0.105
60	89	97	0.918	81	4	11	0.364
61	92	95	0.968	82	1	10	0.100
62	99	86	1.151	83	1	10	0.100
63	94	117	0.803	84	0	10	0.000
64	91	105	0.867	85+	11	27	0.407
65	110	125	0.880				
				TOTAL	1,604	1,695	0.946

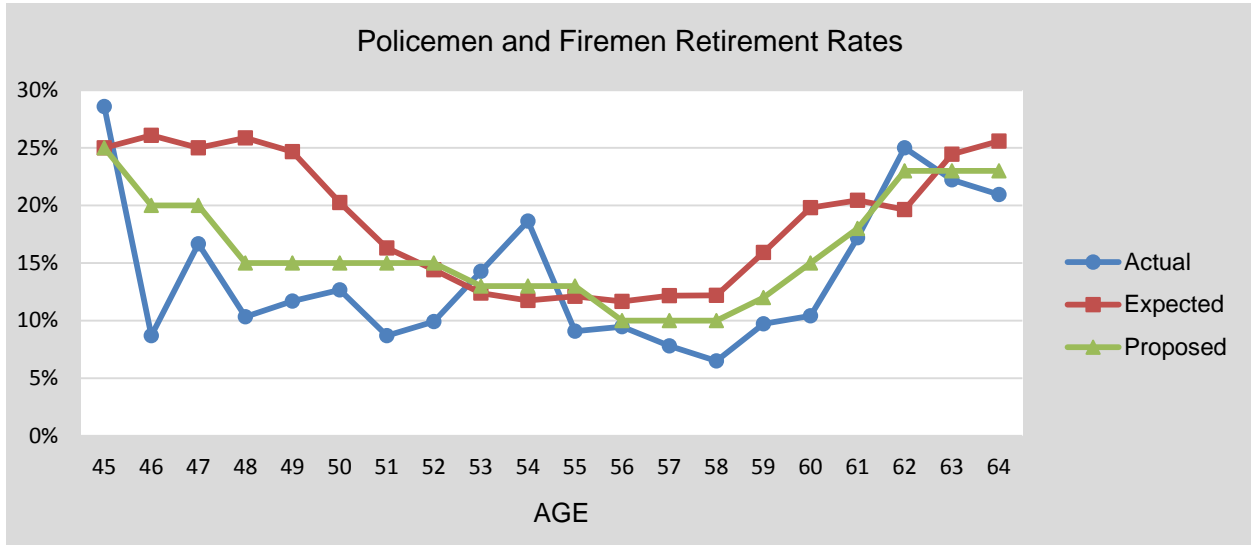
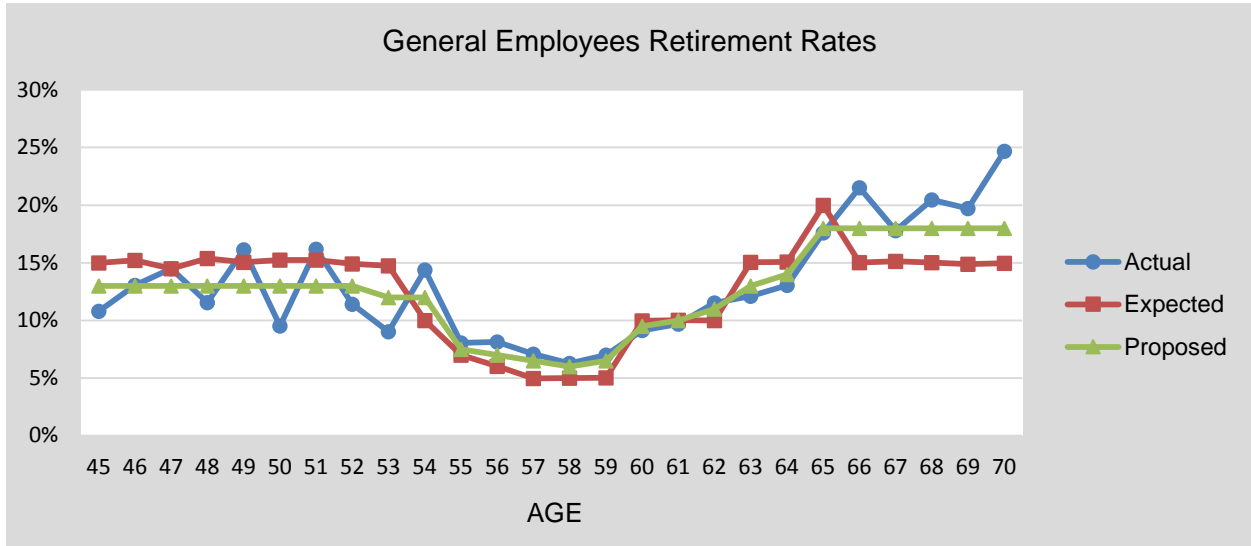
Section IV: Demographic Assumptions

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS FROM ACTIVE SERVICE BASED ON CURRENT RATES

NUMBER OF SERVICE RETIREMENTS			
POLICEMEN AND FIREMEN			
Age	Actual	Expected	Ratio of Actual to Expected
45	4	4	1.000
46	2	6	0.333
47	8	12	0.667
48	6	15	0.400
49	9	19	0.474
50	10	16	0.625
51	8	15	0.533
52	11	16	0.688
53	15	13	1.154
54	19	12	1.583
55	15	20	0.750
56	13	16	0.813
57	9	14	0.643
58	8	15	0.533
59	11	18	0.611
60	10	19	0.526
61	16	19	0.842
62	14	11	1.273
63	10	11	0.909
64	9	11	0.818
65+	19	78	0.244
TOTAL	226	360	0.628

Section IV: Demographic Assumptions

The following graphs show a comparison of the present and actual rates of service retirements.



Section IV: Demographic Assumptions

The preceding results indicate that the actual number of retirements overall was slightly lower than expected for General Employees and significantly lower than expected for Police and Fire. Therefore, we recommend changing the rates to better match the experience of the System.

COMPARATIVE RATES OF PRESENT AND PROPOSED ANNUAL RETIREMENTS

ANNUAL RATES OF SERVICE RETIREMENTS					
GENERAL EMPLOYEES					
Age	Present	Proposed	Age	Present	Proposed
45	15%	13%	66	15%	18%
46	15%	13%	67	15%	18%
47	15%	13%	68	15%	18%
48	15%	13%	69	15%	18%
49	15%	13%	70	15%	18%
50	15%	13%	71	15%	18%
51	15%	13%	72	15%	18%
52	15%	13%	73	15%	18%
53	15%	12%	74	15%	18%
54	10%	12%	75	100%	100%
55	7%	7.5%	76	100%	100%
56	6%	7%	77	100%	100%
57	5%	6.5%	78	100%	100%
58	5%	6%	79	100%	100%
59	5%	6.5%	80	100%	100%
60	10%	9%	81	100%	100%
61	10%	10%	82	100%	100%
62	10%	11%	83	100%	100%
63	15%	13%	84	100%	100%
64	15%	14%	85+	100%	100%
65	20%	18%			

Section IV: Demographic Assumptions

COMPARATIVE RATES OF PRESENT AND PROPOSED ANNUAL RETIREMENTS

ANNUAL RATES OF SERVICE RETIREMENTS					
POLICEMEN AND FIREMEN					
Age	Present	Proposed	Age	Present	Proposed
45	25%	25%	56	12%	10%
46	25%	20%	57	12%	10%
47	25%	20%	58	12%	10%
48	25%	15%	59	16%	12%
49	25%	15%	60	20%	15%
50	20%	15%	61	20%	18%
51	16%	15%	62	20%	23%
52	14%	15%	63	25%	23%
53	12%	13%	64	25%	23%
54	12%	13%	65+	100%	100%
55	12%	13%			

Section IV: Demographic Assumptions

COMPARISON OF ACTUAL AND PROPOSED RETIREMENTS

NUMBER OF SERVICE RETIREMENTS							
GENERAL EMPLOYEES							
Age	Actual	Proposed	Ratio of Actual to Proposed	Age	Actual	Proposed	Ratio of Actual to Proposed
45	4	5	0.800	66	116	108	1.074
46	6	6	1.000	67	73	82	0.890
47	10	9	1.111	68	64	63	1.016
48	9	10	0.900	69	53	54	0.981
49	15	12	1.250	70	56	45	1.244
50	10	14	0.714	71	16	29	0.552
51	17	14	1.214	72	28	27	1.037
52	13	14	0.929	73	14	22	0.636
53	11	13	0.846	74	18	18	1.000
54	23	18	1.278	75	12	10	1.200
55	91	90	1.011	76	13	15	0.867
56	97	96	1.010	77	11	9	1.222
57	80	79	1.013	78	3	6	0.500
58	69	77	0.896	79	3	5	0.600
59	75	75	1.000	80	2	5	0.400
60	89	88	1.011	81	4	3	1.333
61	92	95	0.968	82	1	3	0.333
62	99	95	1.042	83	1	3	0.333
63	94	93	1.011	84	0	3	0.000
64	91	91	1.000	85+	11	27	0.407
65	110	106	1.038				
				TOTAL	1,604	1,637	0.980

Section IV: Demographic Assumptions

COMPARISON OF ACTUAL AND PROPOSED RETIREMENTS

NUMBER OF SERVICE RETIREMENTS			
POLICEMEN AND FIREMEN			
Age	Actual	Expected	Ratio of Actual to Expected
45	4	4	1.000
46	2	3	0.667
47	8	6	1.333
48	6	7	0.857
49	9	8	1.125
50	10	9	1.111
51	8	9	0.889
52	11	11	1.000
53	15	16	0.938
54	19	15	1.267
55	15	25	0.600
56	13	12	1.083
57	9	9	1.000
58	8	9	0.889
59	11	10	1.100
60	10	10	1.000
61	16	16	1.000
62	14	12	1.167
63	10	10	1.000
64	9	9	1.000
65+	19	78	0.244
TOTAL	226	288	0.785

Section IV: Demographic Assumptions

RATES OF MORTALITY

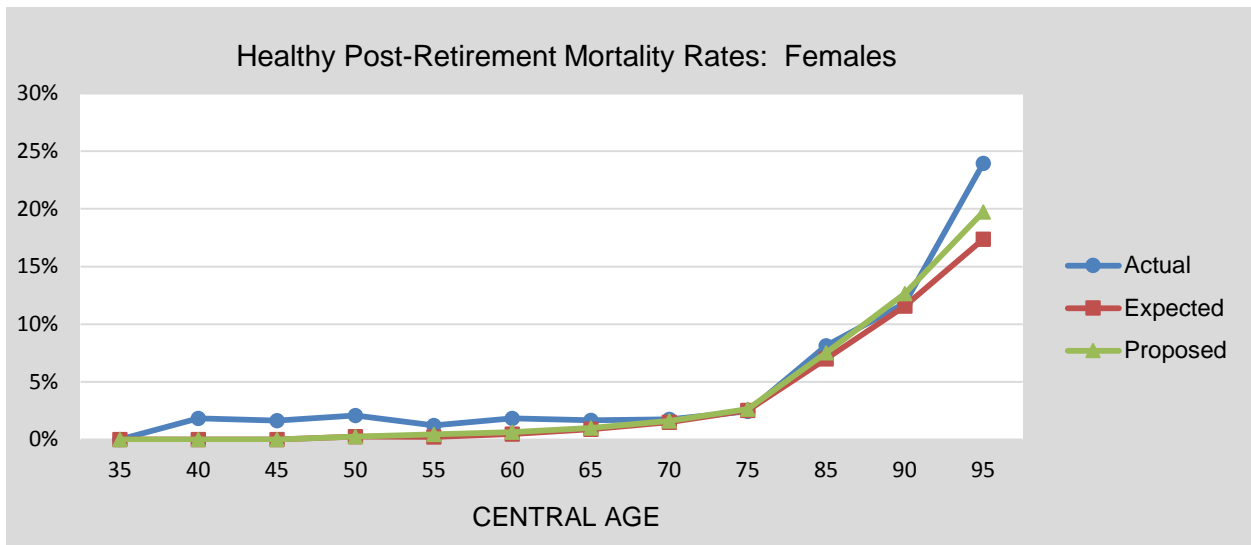
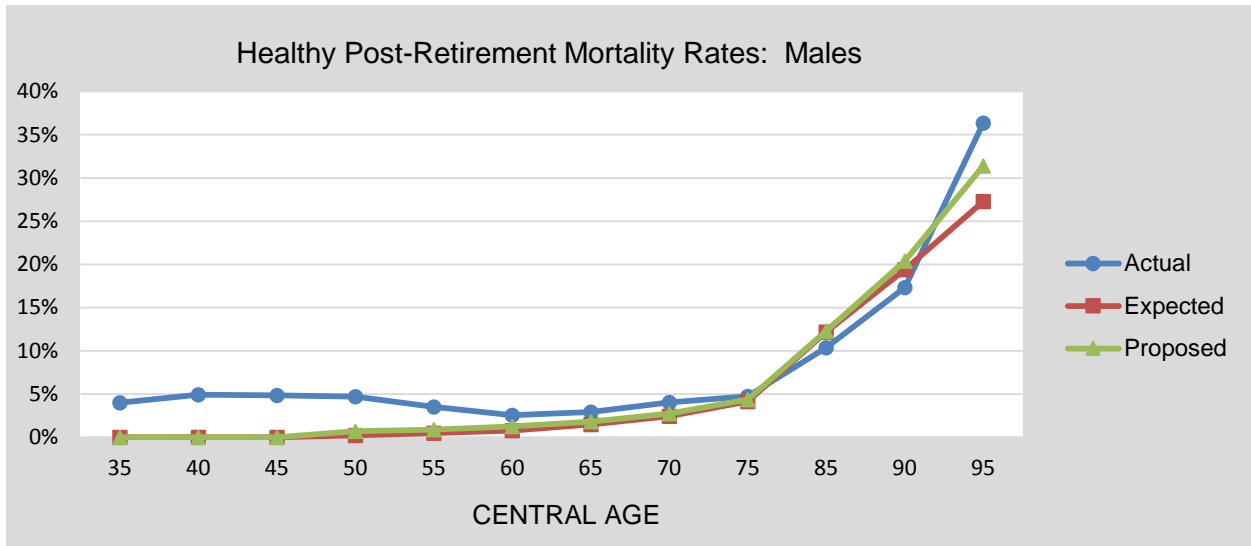
COMPARISON OF ACTUAL AND EXPECTED CASES OF POST-RETIREMENT DEATHS

CENTRAL AGE OF GROUP	NUMBER OF POST-RETIREMENT DEATHS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
SERVICE RETIREMENTS AND BENEFICIARIES						
55 & Under	69	6	11.500	23	3	7.667
60	45	14	3.214	35	9	3.889
65	71	36	1.972	45	24	1.875
70	100	61	1.639	53	46	1.152
75	82	72	1.139	67	69	0.971
80	105	98	1.071	95	92	1.033
85	93	109	0.853	145	125	1.160
90	84	94	0.894	143	140	1.021
95	44	33	1.333	91	66	1.379
98 & Over	9	5	1.800	22	19	1.158
TOTAL	702	528	1.330	719	593	1.212
DISABILITY RETIREMENTS						
47 & Under	3	0	0.000	0	0	0.000
50	2	1	2.000	0	0	0.000
55	7	2	3.500	0	0	0.000
60	8	3	2.667	6	0	0.000
65	14	8	1.750	6	1	6.000
70	25	11	2.273	6	2	3.000
75	16	12	1.333	11	3	3.667
80	9	12	0.750	3	2	1.500
85	6	10	0.600	4	3	1.333
88 & Over	5	8	0.625	7	5	1.400
TOTAL	95	67	1.418	43	16	2.688

Section IV: Demographic Assumptions

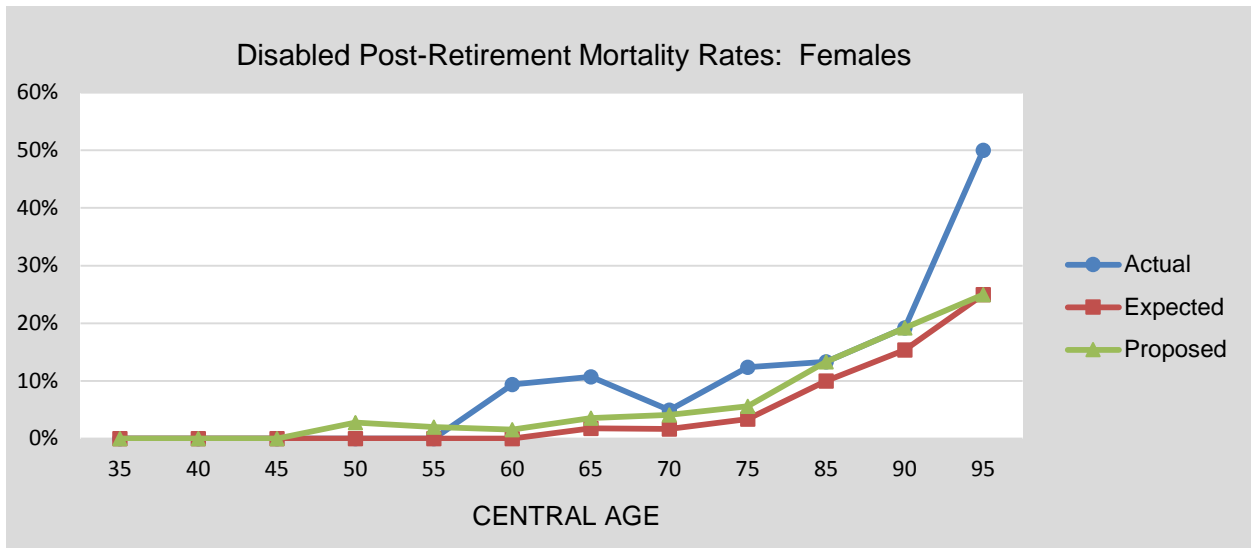
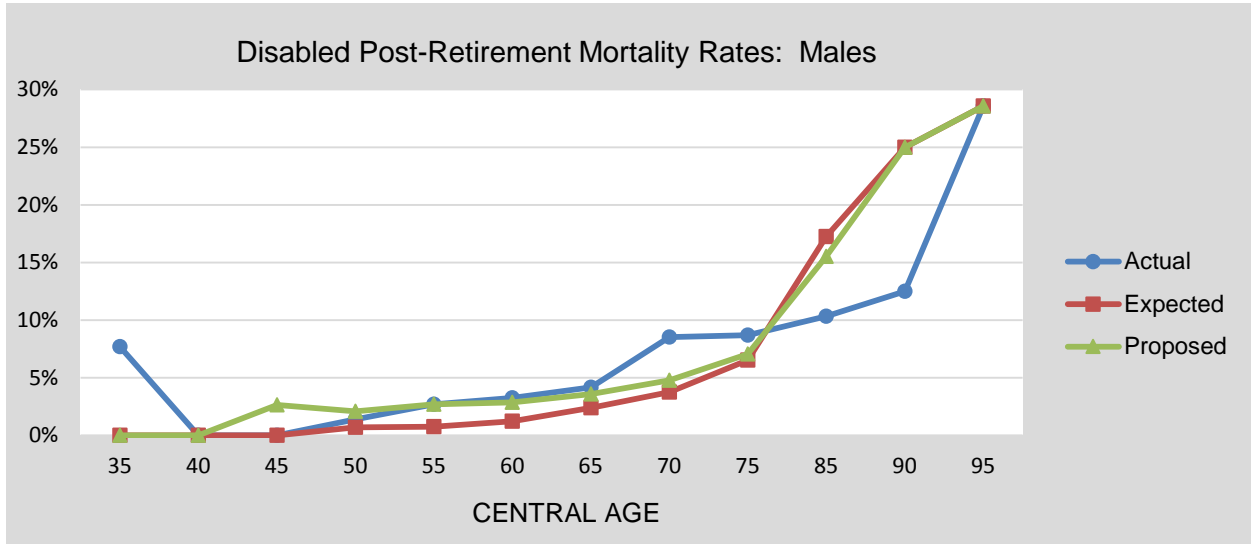
The following graphs show a comparison of the present, actual and proposed rates of post-retirement deaths.

POST-RETIREMENT DEATHS SERVICE RETIREMENTS AND BENEFICIARIES OF DECEASED MEMBERS



Section IV: Demographic Assumptions

POST-RETIREMENT DEATHS DISABILITY RETIREMENTS



Section IV: Demographic Assumptions

The preceding results indicate that the actual number of post-retirement deaths of healthy service retirees and beneficiaries were significantly more than expected overall for both males and females. For disability retirements, the actual mortality rates were again more than expected overall for both males and females. This was surprising given that the State of Connecticut is consistently among the top 5 in national measures of longevity.

Based on our analysis, the data for general employee healthy post-retirement mortality experience was less than 55% credible while the data for police and fire healthy post-retirement experience was less than 30% credible. Due to the limited credibility of the data we recommend the mortality assumption used in MERS measurements be based primarily on the latest mortality tables prepared by the Society of Actuaries. Therefore, we recommend that the rates of retiree and beneficiary mortality be revised to the RP-2014 Combined Mortality Table adjusted to 2006 and projected to 2015 with Scale MP-2017 and projected to 2022 with Scale BB for General Employees. For Police and Fire, we recommend the RP-2014 Blue Collar Mortality Table adjusted to 2006 and projected to 2015 with Scale MP-2017 and projected to 2022 with Scale BB.

Compared to the current mortality table, the proposed mortality table increases the life expectancy for both males and females, but significantly more for males. The following table is the life expectancy of a retiree at age 60.

	Current Mortality Table	Proposed Mortality Table – General Employees	Proposed Mortality Table – Police and Fire
Male, Age 60	80.9	83.5	82.8
Female, Age 60	85.3	85.9	85.4

In addition, we recommend that the rates of disability mortality be revised to the RP-2014 Disabled Retiree Mortality Table projected to 2020 by Scale BB.

For pre-retirement mortality, we recommend that the rates of mortality be revised to the same table as post-retirement mortality.

Section IV: Demographic Assumptions

RATES OF SALARY INCREASE

COMPARISON OF ACTUAL, EXPECTED AND PROPOSED SALARIES OF ACTIVE MEMBERS

SALARIES AT END OF YEAR (Thousands)			
CENTRAL AGE OF GROUP	GENERAL EMPLOYEES		
	Actual	Expected	Ratio of Actual to Expected
20	4,992	5,093	0.980
25	37,374	38,430	0.973
30	72,780	74,038	0.983
35	107,552	108,893	0.988
40	129,851	130,691	0.994
45	223,616	224,615	0.996
50	282,743	283,300	0.998
55	293,762	292,714	1.004
60	227,369	226,080	1.006
65	112,536	112,366	1.002
70	34,366	34,395	0.999
75+	14,090	13,971	1.009
TOTAL	1,541,031	1,544,586	0.998

SALARIES AT END OF YEAR (Thousands)			
CENTRAL AGE OF GROUP	POLICEMEN AND FIREMEN		
	Actual	Expected	Ratio of Actual to Expected
20	3,034	2,530	1.199
25	52,304	50,677	1.032
30	87,535	86,835	1.008
35	97,056	96,007	1.011
40	109,254	107,859	1.013
45	141,327	138,900	1.017
50	118,136	116,065	1.018
55	61,805	60,149	1.028
60	28,295	27,785	1.018
65+	7,347	7,160	1.026
TOTAL	706,093	693,967	1.017

Section IV: Demographic Assumptions

Over this five-year period, we noticed that the preceding results indicate that salary increases were slightly lower than expected for General Employees and significantly higher for Policemen and Firemen. We also noticed that salary increases are more correlated with the member's service than age. This post-great recession period is a difficult period to assess the future trend in salary increases. We relied on the building block approach to develop this assumption for the applicable employee groups and we removed data which, in our judgement, reflected anomalous rates of salary changes during the period. The building block approach utilizes the "across the board" rate of increase determined in the economic section of this study, and then determines the service-based rates of increases, called merit increase rates, that when combined, are reflective of a reasonable trend in future salary increases.

In developing this assumptions, we first analyzed the rates of salary increase by years of service. Then, for General Employees, we recommend a slight adjustment lower, at most levels, in the merit increase rates of salary increase. For Policemen and Firemen, we recommend an increase, at all levels, in the merit increase rates of salary increase.

SERVICE IN YEARS	RATES OF SALARY INCREASES	
	GENERAL EMPLOYEES	POLICEMEN AND FIREMEN
	Proposed	Proposed
Less than 5	6.00%	8.00%
5 – 9	5.00	5.50
10 – 14	4.50	4.50
15 – 19	4.25	4.30
20 – 24	4.00	4.00
25 – 29	3.75	3.50
30 – 34	3.50	3.50
35 – 39	3.50	3.50
40+	3.50	3.50

Section V: Other Assumptions and Methods

COST OF LIVING ADJUSTMENTS: Annually compounded increases are applied to disabled and non-disabled retirement benefits and vary based upon member age and date of retirement.

For members that retired prior to January 1, 2002, increases of 3.25% are currently assumed for those who have reached age 65 and (effective January 1, 2002) increases of 2.50% are assumed for those who have not yet reached age 65.

For members that retire after December 31, 2001, increases of 2.50% are currently assumed, regardless of age. The adjustment for this group is 60% of the annual increase in the CPI up to 6%. The minimum annual COLA is 2.5%; the maximum is 6%.

Since, we are recommending the price inflation be lowered to 2.50% and the minimum of the COLA for members that retire after December 31, 2001 is 2.50%, we recommend no change in this assumption.

PERCENT MARRIED: This assumption is used in the determination of the pre-retirement death benefits. Currently, 80% of active members are assumed to be married with the male three years older than his spouse. This is a very reasonable assumption and since the current data does not include marital information for active members, **we do not recommend a change at this time.**

Appendix A – CPI (U) Index

Historical June CPI (U) Index

Year	CPI (U)	Year	CPI (U)
1962	30.2	1990	129.9
1963	30.6	1991	136.0
1964	31.0	1992	140.2
1965	31.6	1993	144.4
1966	32.4	1994	148.0
1967	33.3	1995	152.5
1968	34.7	1996	156.7
1969	36.6	1997	160.3
1970	38.8	1998	163.0
1971	40.6	1999	166.2
1972	41.7	2000	172.4
1973	44.2	2001	178.0
1974	49.0	2002	179.9
1975	53.6	2003	183.7
1976	56.8	2004	189.7
1977	60.7	2005	194.5
1978	65.2	2006	202.9
1979	72.3	2007	208.352
1980	82.7	2008	218.815
1981	90.6	2009	215.693
1982	97.0	2010	217.965
1983	99.5	2011	225.722
1984	103.7	2012	229.478
1985	107.6	2013	233.504
1986	109.5	2014	238.343
1987	113.5	2015	238.638
1988	118.0	2016	241.018
1989	124.1	2017	244.955

Appendix B – Capital Market Assumptions and Asset Allocation

The tables below and on the following page are extracted from materials provided to us by the Treasurer’s Office prepared by the investment consultant serving that office, Meketa.

Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Real Rate of Return	Standard Deviation
Large Cap U.S. Equities	4.8%	18.0%
Developed Non-U.S. Equities	4.6	20.0
Emerging Market (Non-U.S.)	6.9	25.0
Real Estate	4.2	18.0
Private Equity	6.8	24.0
Natural Resources	6.3	23.0
Fixed Income (Core)	1.1	4.0
High Yield Bonds	2.9	12.5
TIPS	0.8	7.5
Hedge Funds	2.7	8.5

Asset Allocation Targets

Asset Class	Asset Allocation
Large Cap U.S. Equities	16%
Developed Non-U.S. Equities	14
Emerging Market (Non-U.S.)	7
Real Estate	7
Private Equity	10
Natural Resources	8
Fixed Income (Core)	11
High Yield Bonds	14
TIPS	5
Hedge Funds	8

Appendix C – Social Security Administration Wage Index

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1962	4,291.40	5.01%	1990	21,027.98	4.62
1963	4,396.64	2.45	1991	21,811.60	3.73
1964	4,576.32	4.09	1992	22,935.42	5.15
1965	4,658.72	1.80	1993	23,132.67	0.86
1966	4,938.36	6.00	1994	23,753.53	2.68
1967	5,213.44	5.57	1995	24,705.66	4.01
1968	5,571.76	6.87	1996	25,913.90	4.89
1969	5,893.76	5.78	1997	27,426.00	5.84
1970	6,186.24	4.96	1998	28,861.44	5.23
1971	6,497.08	5.02	1999	30,469.84	5.57
1972	7,133.80	9.80	2000	32,154.82	5.53
1973	7,580.16	6.26	2001	32,921.92	2.39
1974	8,030.76	5.94	2002	33,252.09	1.00
1975	8,630.92	7.47	2003	34,064.95	2.44
1976	9,226.48	6.90	2004	35,648.55	4.65
1977	9,779.44	5.99	2005	36,952.94	3.66
1978	10,556.03	7.94	2006	38,651.41	4.60
1979	11,479.46	8.75	2007	40,405.48	4.54
1980	12,513.46	9.01	2008	41,334.97	2.30
1981	13,773.10	10.07	2009	40,711.61	(1.50)
1982	14,531.34	5.51	2010	41,673.83	2.36
1983	15,239.24	4.87	2011	42,979.61	3.13
1984	16,135.07	5.88	2012	44,321.67	3.12
1985	16,822.51	4.26	2013	44,888.16	1.28
1986	17,321.82	2.97	2014	46,481.52	3.55
1987	18,426.51	6.38	2015	48,098.63	3.48
1988	19,334.04	4.93	2016	48,642.15	1.13
1989	20,099.55	3.96			

Appendix D – Proposed Demographic Assumptions

**TABLE 1
RATES OF WITHDRAWAL FROM ACTIVE SERVICE**

GENERAL EMPLOYEES				
Central Age of Group	Males		Females	
	0 – 4 years	5 – 24 years	0 – 4 years	5 – 24 years
20	16.00%	12.00%	24.00%	18.00%
25	16.00	12.00	19.00	18.00
30	12.50	10.00	16.00	12.00
35	10.00	8.00	12.00	10.00
40	9.50	5.75	10.00	8.00
45	8.50	5.00	9.00	6.00
50	8.50	4.50	9.00	4.50
55	6.50	0.00	8.00	0.00
60	6.50	0.00	8.00	0.00
65	6.00	0.00	8.00	0.00
70	6.00	0.00	8.00	0.00
75	0.00	0.00	0.00	0.00

FIREMEN		
Central Age of Group	0 – 4 years	5 – 24 years
20	6.50%	5.00%
25	6.50	5.00
30	5.75	4.00
35	3.50	2.50
40	3.50	2.00
45	3.50	1.50
50	3.50	0.00
55	3.50	0.00
60	3.50	0.00
65	0.00	0.00

Appendix D – Proposed Demographic Assumptions

**TABLE 2
RATES OF SERVICE RETIREMENT FROM ACTIVE SERVICE**

ANNUAL RATES OF SERVICE RETIREMENTS					
Age	General Employees	Policemen and Firemen	Age	General Employees	Policemen and Firemen
45	13%	25%	66	18%	100%
46	13%	20%	67	18%	100%
47	13%	20%	68	18%	100%
48	13%	15%	69	18%	100%
49	13%	15%	70	18%	100%
50	13%	15%	71	18%	100%
51	13%	15%	72	18%	100%
52	13%	15%	73	18%	100%
53	12%	13%	74	18%	100%
54	12%	13%	75	100%	100%
55	7.5%	13%	76	100%	100%
56	7%	10%	77	100%	100%
57	6.5%	10%	78	100%	100%
58	6%	10%	79	100%	100%
59	6.5%	12%	80	100%	100%
60	9.5%	15%	81	100%	100%
61	10%	18%	82	100%	100%
62	11%	23%	83	100%	100%
63	13%	23%	84	100%	100%
64	14%	23%	85+	100%	100%
65	18%	100%			

Appendix D – Proposed Demographic Assumptions

**TABLE 3
RATES OF DISABILITY RETIREMENT FROM ACTIVE SERVICE**

CENTRAL AGE OF GROUP	RATES OF DISABILITY RETIREMENT	
	General Employees	Policemen and Firemen
30	0.02%	0.10%
35	0.03	0.14
40	0.04	0.22
45	0.06	0.30
50	0.09	0.64
55	0.40	2.40
60	1.00	4.80
65	1.60	N/A

**TABLE 4
RATES OF ANTICIPATED SALARY INCREASES**

SERVICE IN YEARS	RATES OF SALARY INCREASES	
	GENERAL EMPLOYEES	POLICEMEN AND FIREMEN
Less than 5	6.00%	8.00%
5 – 9	5.00	5.50
10 – 14	4.50	4.50
15 – 19	4.25	4.30
20 – 24	4.00	4.00
25 – 29	3.75	3.50
30 – 34	3.50	3.50
35 – 39	3.50	3.50
40+	3.50	3.50