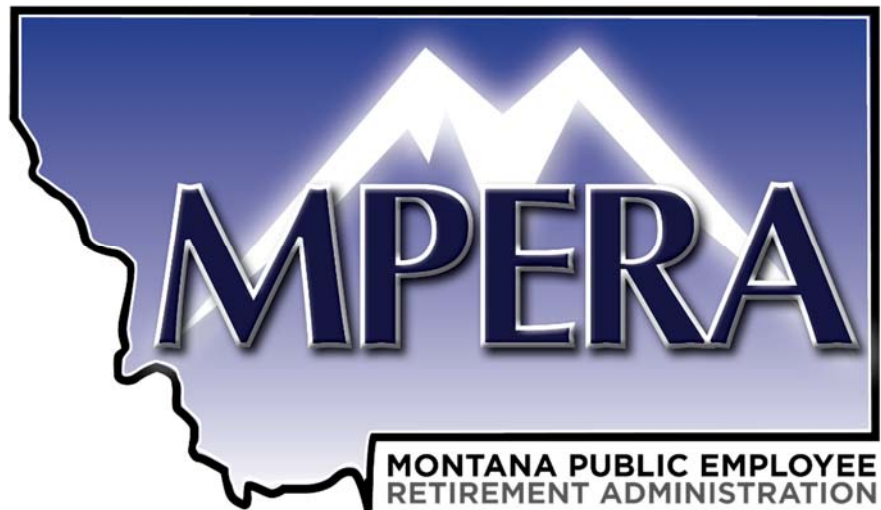




**Cavanaugh Macdonald**  
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**Montana Public Employee Retirement Administration**

**Experience Study**

**For the Six-year Period**

**Ending June 30, 2016**



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# Cavanaugh Macdonald

CONSULTING, LLC

*The experience and dedication you deserve*

May 5, 2017

Board of Trustees  
Montana Public Employee Retirement Administration

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Montana Public Employee Retirement Administration. The purpose of this investigation is to assess the reasonability of the actuarial assumptions for each system. This investigation covers the six-year period ending June 30, 2016. The purpose of the study is to review the most recent experience in order to make judgments about future experience. Typically, the most recent five-year period is sufficient for this purpose. This experience study utilized the previous six years. As a result of the investigation, it is recommended that revised assumptions be adopted by the Board for future use.

The experience studies for each system include all active members, retired members and beneficiaries of deceased members. The mortality experience was studied separately for pre-retirement, post-retirement and disability and also separately for males and females. Incidences of withdrawal, disability, retirement and compensation increases were investigated without regard to gender.

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 decrement rates, the expected decrement rates and, where applicable, the proposed decrement rates.

The newly proposed rates of decrement for all eight systems are shown in Appendix C of this report. In the actuary's judgment, the recommended rates are suitable for use until further experience indicates that modifications are needed.

Actuarial Assumptions are used to measure and budget future costs. Changing assumptions will not change the actual cost of future benefits.

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Board of Trustees  
May 5, 2017  
Page 2

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. The undersigned meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

A handwritten signature in blue ink that reads 'Todd B. Green' followed by a long horizontal flourish.

Todd B. Green ASA, FCA, MAAA  
Principal and Consulting Actuary

A handwritten signature in blue ink that reads 'Joseph A. Nichols'.

Joseph A. Nichols, ASA, EA, FCA, MAAA, MSPA  
Consulting Actuary

JMY\tbg:jan



## SUMMARY OF RESULTS

### Introduction

This investigation covers the six-year period ending June 30, 2016. The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. Actuarial valuations of the Montana Public Employees Retirement Administration (MPERA) eight plans are prepared annually to determine the actuarial recommended contribution, funded status, and amortization periods necessary to achieve a 100% funded status. The valuations require 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 system 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.

At the request of MPERA, Cavanaugh Macdonald Consulting, LLC (CMC), performed a study of the experience for the six-year period ending in 2016. 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 July 1, 2017 actuarial valuations.

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



## Section I: Summary of Results

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recommended changes to certain assumptions. To explain our thought process, we offer a brief summary of our philosophy:

- **Don't 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.
- **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.

Following are summaries of findings and recommendations regarding assumptions utilized by the MPERA plans. Explanations of the recommendations are found in the sections that follow.

### **Recommended Economic Assumption Changes**

The table below lists the three economic assumptions used in all the actuarial valuations and their current and proposed rates. We recommend lowering the assumed rate of price inflation, assumed rate of return on assets and the assumed rate of wage inflation for all eight Systems.

<b>Assumption</b>	<b>Current</b>	<b>Proposed</b>
Price Inflation	3.00%	2.75%
Wage Inflation	4.00%	3.50%
Investment Return	7.75%	7.65%



## Section I: Summary of Results

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### **Recommended Demographic Assumption Changes**

The table below lists the recommended demographic assumption changes based on experience during the last six years.

<b>Retirement Plan</b>	<b>Assumption Changes</b>
Public Employees' Retirement System	Non-Disabled Mortality, Withdrawal, Merit Scale
Public Employees' Retirement System Long-Term Disability Plan	Non-Disabled Mortality, Withdrawal, Merit Scale
Judges' Retirement System	Non-Disabled Mortality
Sheriffs' Retirement System	Non-Disabled Mortality, Withdrawal, Merit Scale
Game Wardens' and Peace Officers' Retirement System	Non-Disabled Mortality, Withdrawal, Merit Scale
Highway Patrol Officers' Retirement System	Non-Disabled Mortality, Merit Scale
Municipal Police Officers' Retirement System	Non-Disabled Mortality, Withdrawal, Merit Scale
Firefighters' United Retirement System	Non-Disabled Mortality, Withdrawal, Merit Scale
Volunteer Firefighters' Compensation Act	Non-Disabled Mortality, Withdrawal



Section I: Summary of Results

**Recommended Method Changes**

To be consistent with the real wage growth change, we recommend that the payroll growth assumption for amortization as a level percent of pay be reduced from 4.00% to 3.50%.

**Financial Impact**

The following tables highlight the impact of recommended changes on the unfunded accrued liabilities (UAL), funded ratios and employer contribution rates for the nine systems.

**Impact of Changes on the Unfunded Accrued Liability**  
(\$ in Thousands)

<b>Retirement Plan</b>	<b>Before Changes</b>	<b>After Changes</b>	<b>Change</b>
Public Employees' Retirement System	\$1,540,238	\$1,884,706	\$344,468
Public Employees' Retirement System Long-Term Disability Plan	473	538	65
Judges' Retirement System	(36,398)	(32,796)	3,602
Sheriffs' Retirement System	62,636	75,730	13,094
Game Wardens' and Peace Officers' Retirement System	30,452	36,910	6,458
Highway Patrol Officers' Retirement System	69,457	77,039	7,582
Municipal Police Officers' Retirement System	161,961	178,090	16,129
Firefighters' United Retirement System	101,413	118,232	16,819
Volunteer Firefighters' Compensation Act	8,708	10,846	2,138





Section I: Summary of Results

**Impact of Changes on the Funding Ratio**

Retirement Plan	Before Changes	After Changes	Change
Public Employees' Retirement System	77.3%	73.6%	(3.7%)
Public Employees' Retirement System Long-Term Disability Plan	86.8%	85.3%	(1.5%)
Judges' Retirement System	166.5%	156.2%	(10.3%)
Sheriffs' Retirement System	83.2%	80.4%	(2.8%)
Game Wardens' and Peace Officers' Retirement System	84.1%	81.3%	(2.8%)
Highway Patrol Officers' Retirement System	65.8%	63.5%	(2.3%)
Municipal Police Officers' Retirement System	68.8%	66.7%	(2.1%)
Firefighters' United Retirement System	78.3%	75.6%	(2.7%)
Volunteer Firefighters' Compensation Act	80.2%	76.5%	(3.7%)

**Impact of Changes on the Amortization Period**

Retirement Plan	Before Changes	After Changes	Change
Public Employees' Retirement System	26	35	9
Public Employees' Retirement System Long-Term Disability Plan	Infinite	15	N/A
Judges' Retirement System	0	0	No Change
Sheriffs' Retirement System	Infinite	Infinite	No Change
Game Wardens' and Peace Officers' Retirement System	Infinite	Infinite	No Change
Highway Patrol Officers' Retirement System	28	36	8
Municipal Police Officers' Retirement System	18	20	2
Firefighters' United Retirement System	9	10	1
Volunteer Firefighters' Compensation Act	7	8	1



### ECONOMIC ASSUMPTIONS

Economic assumptions include:

- the long-term investment return (net of investment expenses),
- price inflation,
- wage inflation (the across-the-board portion of salary increases), and

The salary increase assumption is made up of both wage inflation and a merit salary scale. The merit salary scale is actually a demographic assumption and will be discussed with the demographic assumptions. Unlike demographic assumptions, economic assumptions do not lend themselves to analysis based heavily upon internal historical patterns. Because both general wage increases and investment return are influenced more by external forces which are difficult to accurately predict over the long term. The investment return and general wage increase assumptions are generally selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for price inflation.

Sources of data considered in the analysis and selection of the economic assumptions included:

- Historical observations of price and wage inflation statistics and investment returns
- The 2016 Social Security Trustees Report
- Future expectations of the Board of Investments consultants
- U. S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators.

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. Because no one knows what the future holds, the actuary must use professional judgment to estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment.

### ACTUARIAL STANDARD OF PRACTICE NUMBER 27

Actuarial Standards of Practice are issued by the Actuarial Standards Board to provide guidance to actuaries with respect to certain aspects of performing actuarial work. As mentioned earlier, Actuarial Standard of Practice Number 27 (ASOP 27) is the standard that addresses the selection of economic assumptions for measuring pension obligations. Therefore, our analysis of the expected rate of return, as well as other economic assumptions, was performed following the guidance in ASOP 27.

ASOP 27 applies to the selection of economic assumptions to measure obligations under any defined benefit pension plan that is not a social insurance program (e.g., Social Security).

The standard recommends the actuary review appropriate recent and long-term historical economic data, but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in



## Section II: Economic Assumptions

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developing assumptions for future periods due to changes in the underlying environment. Each economic assumption should individually satisfy this standard. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

ASOP 27 recognizes that economic data and analyses are available from a variety of sources, including representatives of the plan sponsor, investment advisors, economists, and other professionals. The actuary is permitted to incorporate the views of experts, but the selection or advice must reflect the actuary's professional judgment.

Since the last experience study was performed, the Actuarial Standards Board has issued a revised ASOP 27. The prior standard included the use of a "best estimate range" in developing economic assumptions, but this approach is no longer acceptable. The current standard calls for the actuary to select a "reasonable" assumption. For this purpose, an assumption is reasonable if it has the following characteristics:

- a. it is appropriate for the purpose of the measurement;
- b. it reflects the actuary's professional judgment;
- c. it takes into account historical and current economic data that is relevant as of the measurement date;
- d. 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
- e. it has no significant bias (i.e., it is neither significantly optimistic nor pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

The standard goes on to discuss a "range of reasonable assumptions" which in part states "the actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice."

The remaining section of this report will address the relevant types of economic assumptions used in the actuarial valuation to determine the obligations of MPERA. In our opinion, the economic assumptions proposed in this report have been developed in accordance with ASOP No. 27.



## Section II: Economic Assumptions

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The following table summarizes the current and proposed economic assumptions:

Item	Current	Proposed
Price Inflation	3.00%	2.75%
Real Rate of Return	<u>4.75</u>	<u>4.90</u>
Investment Return	7.75%	7.65%
Price Inflation	3.00%	2.75%
Real Wage Growth	<u>1.00</u>	<u>0.75</u>
Wage Inflation	4.00%	3.50%



PRICE INFLATION

**Price Inflation**

**Use in the Valuation:** Future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return, wage growth, and salary increases. The consistency of the price inflation assumption throughout the economic assumptions utilized in an actuarial valuation is required to meet the requirements of ASOP No. 27 and 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 assumption for price inflation is 3.00% per year.

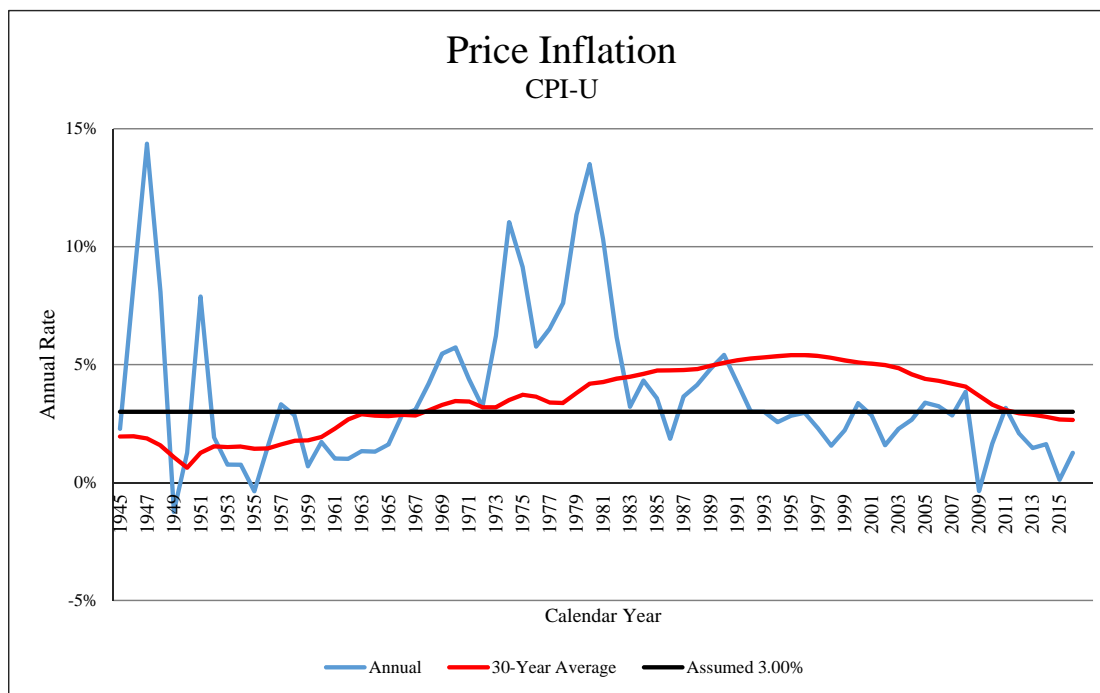
**Past Experience:** Although economic activities, in general, and inflation in particular, do not lend themselves to prediction solely on the basis of historical analysis, historical patterns and long-term trends are factors to be considered in developing the inflation assumption. The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The following table provides historical annualized rates and annual standard deviations of the CPI-U over periods ending June 30<sup>th</sup>.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2016	90	2.92%	4.13%
1956 – 2016	60	3.70	2.87
1966 – 2016	50	4.10	2.97
1976 – 2016	40	3.68	2.93
1986 – 2016	30	2.66	1.48
1996 – 2016	20	2.18	1.48
2006 - 2016	10	1.74	1.79



## Section II: Economic Assumptions

The following graph illustrates the historical annual change in price inflation, measured as of December 31st for each of the last 70 years, as compared to the current assumption.



Over more recent periods, measured from December 31, 2016, the average annual rate of increase in the CPI-U has been 3.00% or lower. The period of high inflation from 1973 to 1981 has a significant impact on the averages over periods which include these rates. Further, the average rate of 2.92% over the entire 90 year period is close to the average rate of 2.66% for the prior 30 years (1986 to 2016). However, the volatility of the annual rates in 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 Fed since the early 1980's to stabilize price inflation.

### ***Forecasts of Inflation:***

Additional information to consider in formulating this assumption is obtained from measuring the spread on Treasury Inflation Protected Securities (TIPS) and from the prevailing economic forecasts. The spread between the nominal 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. Current market prices as of December 2016 suggest that investors expect inflation to be around 1.60% over the next 30 years. The bond market expectations may be heavily influenced by the low interest rate environment created by the Federal Reserve Bank’s manipulation of the bond market. Whether inflation will return to the higher rates observed historically remains to be seen.



## Section II: Economic Assumptions

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Although many economists forecast lower inflation than the assumption used by 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 (May 2016), the projected average annual increase in the CPI over the next 75 years was estimated to be 2.60%, under the intermediate 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%. Additionally, based upon information provided from the “Survey of Professional Forecasters” published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the 10 years beginning January 1, 2017 is 2.30%.

Finally, it is worth noting that RVK, the investment consultant retained by the MPERA, publishes a capital market report, which includes US inflation. Their current long-term inflation assumption is 2.30%, noting their assumption is below historical averages, but above short-term expectations.

**Recommendation:** It is difficult to accurately predict inflation. While actuarial standards caution against too much consideration of recent events, the lower inflation for the last two decades, coupled with the low future inflation anticipated by the bond markets and the Social Security actuary, suggests that there may have been a fundamental change away from the longer term historical norms. Based on the information presented above, **we recommend lowering the inflation assumption to 2.75%.**

Consumer Price Inflation	
Current Assumption	3.00%
Recommended Assumption	2.75%



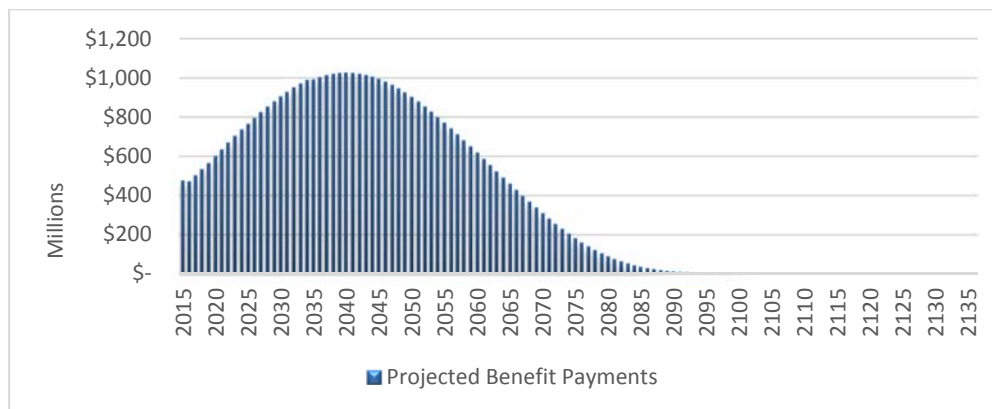
### INVESTMENT RETURN

**Use in the Valuation:** The investment return assumption reflects the anticipated returns on the current and future assets. It is one of the primary determinants in the allocation of the expected cost of MPERA’s benefits, providing a discount of the estimated future benefit payments to reflect the time value of money. Minor changes in this assumption can have a major impact on valuation results. Generally, the investment return assumption should be set with consideration of the asset allocation policy, expected long-term real rates of return on the specific asset classes, the underlying price inflation rate, and investment expenses.

The current investment return assumption is 7.75%, consisting of a price inflation assumption of 3.00% and a real rate of return assumption of 4.75%. The return is net of all investment and administrative expenses.

### 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 (asset allocation). For actuarial calculations, we typically consider very long periods of time as some current employees will still be receiving benefit payments more than 60 years from now. For example, a newly-hired member who is 25 years old may work for 30 years, to age 55, and live another 30 years, to age 85. The retirement system would receive contributions for the first 30 years and then pay out benefits for the next 30 years. During the entire 60-year period, MPERA is investing assets on behalf of the member. In addition, in an open ongoing system like MPERA, 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. The following graph illustrates the long duration of the expected benefit payments for current members on July 1, 2016.







## Section II: Economic Assumptions

### MPERA Historical Perspective

An inherent problem 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 impacts the investment returns so comparing results over long periods when different asset allocations were in place may not be meaningful.

The charts below shows the actual fiscal year (June 30) net returns for the MPERA portfolio for the last 10 years for market and actuarial values of assets. Despite significant volatility in the results from year to year, the actual geometric (compound) return was between 5.73% and 6.12% for market returns and between 6.44% and 6.71% for actuarial value returns.

Market Value Rate of Return								
Year Ending 6/30	PERS	JRS	SRS	GWPORS	HPORS	MPORS	FURS	VFCA
2006	8.98%	8.97%	8.94%	8.61%	9.03%	8.65%	8.66%	8.58%
2007	17.92%	17.94%	17.87%	17.78%	18.07%	17.36%	17.36%	17.52%
2008	(4.91%)	(4.83%)	(4.86%)	(4.87%)	(4.83%)	(4.86%)	(4.80%)	(4.65%)
2009	(20.85%)	(20.61%)	(20.53%)	(20.23%)	(20.98%)	(20.32%)	(20.08%)	(20.69)%
2010	12.91%	12.82%	12.65%	12.21%	13.04%	12.02%	11.99%	12.30%
2011	21.70%	21.65%	21.57%	21.36%	21.79%	20.72%	20.71%	20.98%
2012	2.27%	2.20%	2.32%	2.31%	2.24%	2.40%	2.42%	1.67%
2013	12.99%	12.72%	12.88%	12.69%	12.88%	12.42%	12.43%	12.01%
2014	17.12%	17.03%	17.08%	16.97%	17.10%	16.53%	16.53%	16.23%
2015	4.60%	4.59%	4.60%	4.58%	4.60%	4.52%	4.52%	4.49%
2016	2.02%	2.06%	2.06%	2.11%	2.04%	2.13%	2.15%	1.84%
Average	6.11%	6.10%	6.11%	6.03%	6.12%	5.86%	5.90%	5.73%



## Section II: Economic Assumptions

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Actuarial Value Rate of Return								
Year Ending 6/30	PERS	JRS	SRS	GWPORS	HPORS	MPORS	FURS	VFCA
2006	9.25%	9.38%	9.35%	9.16%	9.39%	9.00%	9.02%	9.10%
2007	11.94%	11.92%	11.88%	11.50%	12.07%	11.41%	11.44%	11.47%
2008	7.62%	7.62%	7.56%	7.31%	7.73%	7.32%	7.31%	7.37%
2009	(0.16%)	(0.11%)	(0.15%)	(0.22%)	(0.15%)	(0.25%)	(0.17%)	(0.37%)
2010	(1.18%)	(0.96%)	(0.92%)	(0.55%)	(1.16%)	(0.96%)	(0.83%)	(1.30%)
2011	(0.08%)	0.42%	0.65%	1.63%	(0.04%)	0.59%	0.84%	(0.14%)
2012	3.28%	3.63%	3.82%	4.43%	3.32%	3.71%	3.87%	2.97%
2013	11.91%	11.60%	11.57%	11.13%	11.86%	11.08%	11.05%	11.11%
2014	13.21%	12.92%	12.96%	12.62%	13.13%	12.46%	12.44%	12.34%
2015	9.63%	9.53%	9.60%	9.47%	9.61%	9.32%	9.32%	8.95%
2016	9.27%	8.64%	8.66%	8.42%	8.76%	8.37%	8.33%	8.30%
Average	6.67%	6.67%	6.70%	6.71%	6.65%	6.44%	6.50%	6.23%



## Section II: Economic Assumptions

### Analysis Using RVK Assumptions

MPERA's assets are invested by the Montana Board of Investments with the guidance of their investment consultant, RVK. Since ASOP 27 allows the actuary to rely on outside experts, it is appropriate to consider the market outlook and expectations provided by RVK. The following analysis relies heavily on the 2016 Capital Markets Assumptions report created by RVK.

Our analysis is based on the target asset allocation as shown below:

Asset Class	Target Allocation	Expected Return	Standard Deviation
Broad US Equity	36.00%	4.55%	17.8%
Broad Intl Equity	18.00%	6.35%	20.6%
Private Equity	12.00%	7.75%	25.5%
Intermediate Bonds	23.40%	1.00%	6.0%
High Yield Bonds	2.60%	4.00%	15.00%
Core Real Estate	4.00%	4.00%	12.50%
Non-Core Real Estate	4.00%	4.00%	12.50%

Using projection results produces an expected range of rates of return over a 50 year time horizon. Looking at one year's results produces an expected real return of 4.37% but with a high standard deviation or measurement of volatility. By expanding the time horizon, the mean return changes very little, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Return	Standard Deviation	Real Returns by Percentile				
			5 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	95 <sup>th</sup>
1	4.37%	13.04%	-15.60%	-4.77%	3.56%	12.63%	27.08%
5	3.72	5.78	-5.49	-0.25	3.56	7.52	13.49
10	3.64	4.08	-2.93	0.85	3.56	6.35	10.49
20	3.60	2.88	-1.07	1.64	3.56	5.53	8.41
30	3.59	2.35	-0.23	1.99	3.56	5.16	7.51
50	3.58	1.82	0.61	2.34	3.56	4.80	6.61

The percentile results are the percentage of random returns over the time span shown that are expected to be less than the amount indicated. Thus for the 10-year time span, 5% of the real rates of return will be below -2.93% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50 year time span, the results indicate a 25% chance that the real returns will be below 2.34% and a 25% chance they will be above 4.80%. There is a 50% chance the real returns will be 3.56% or above and a 50% chance the return will be below 3.56%.



## Section II: Economic Assumptions

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Many investment firms and investment consulting firms produce estimates of future asset returns. While it might seem desirable to directly compare these estimates, there are at least two considerations that we believe weaken the credibility of such efforts. First, most of the estimates of expected returns are produced for five- to ten-year investment horizons. In light of the current interest rate environment, comparison of those results to RVK results, which are intended to reflect a 30+-year time horizon, are not applicable. Second, asset class expectations are dependent on the construction of the portfolio. Other investment consultants may have in mind a different blend of large versus small stocks or growth versus value equities. There are also comparison challenges in certain asset classes such as international stock (emerging or developed markets), bonds (duration and credit quality), and alternatives (a very broadly interpreted category). For these two reasons, we believe trying to compare the expected return developed by RVK with the assumptions of another group of investment professionals may lead to an invalid comparison. Since RVK has qualified professionals on its staff and is in the best position to understand its own portfolio and the reasonable expectations given their investment style, we prefer to rely heavily on their analysis.

While we like the idea of using a forward looking model, the weakness with that approach is that the assumptions being used are set by investment managers and consultants who are typically focusing on a much shorter time period (five to ten years). Therefore, those assumptions may not necessarily be appropriate for the longer timeframe used by actuaries (30 to 50 years). The fact that the capital market assumptions are short-term assumptions is evident by the fact that most investment consulting firms change their capital market assumptions at least annually.

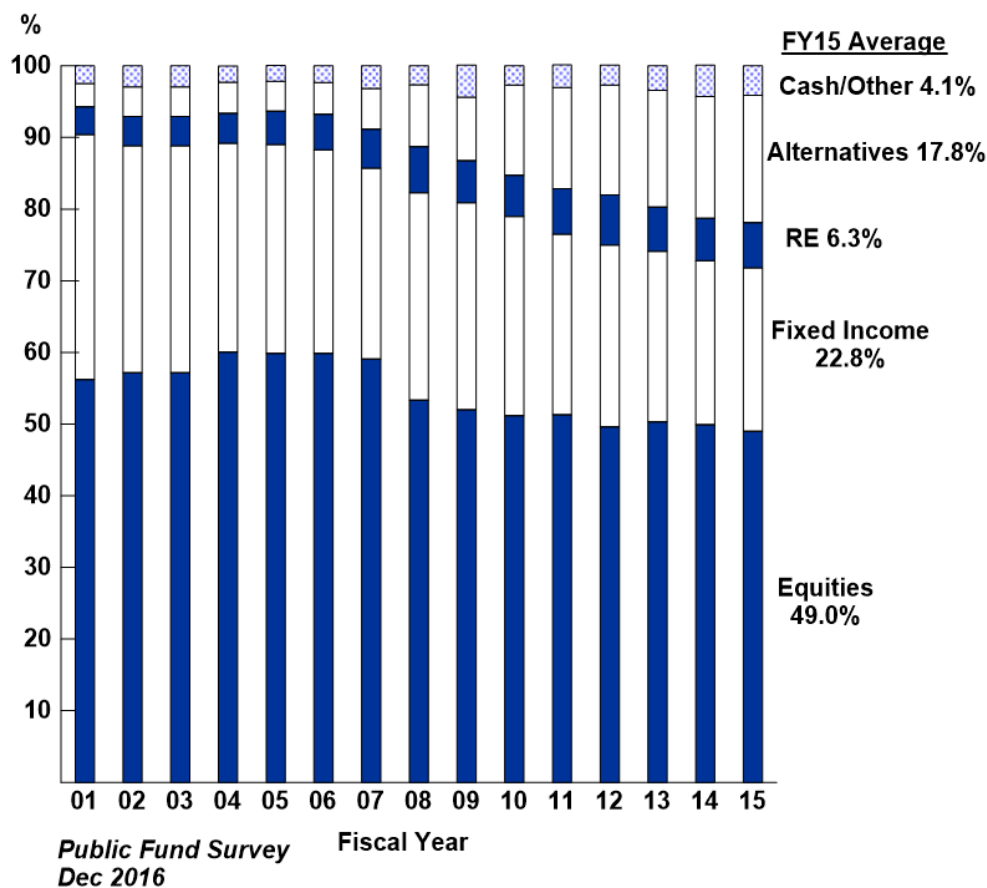
If the investment return assumption was set equal to the expected return based on the capital market assumptions each year or even in every experience study, it could create significant volatility in the funded ratios and amortization periods. Our goal is to choose an assumption that will be reasonable in the long term (30 to 50 years) with adjustment only when there are compelling changes to investment policy or evidence of a change in the long-term trends in the capital markets.



## Section II: Economic Assumptions

### Peer System Comparison

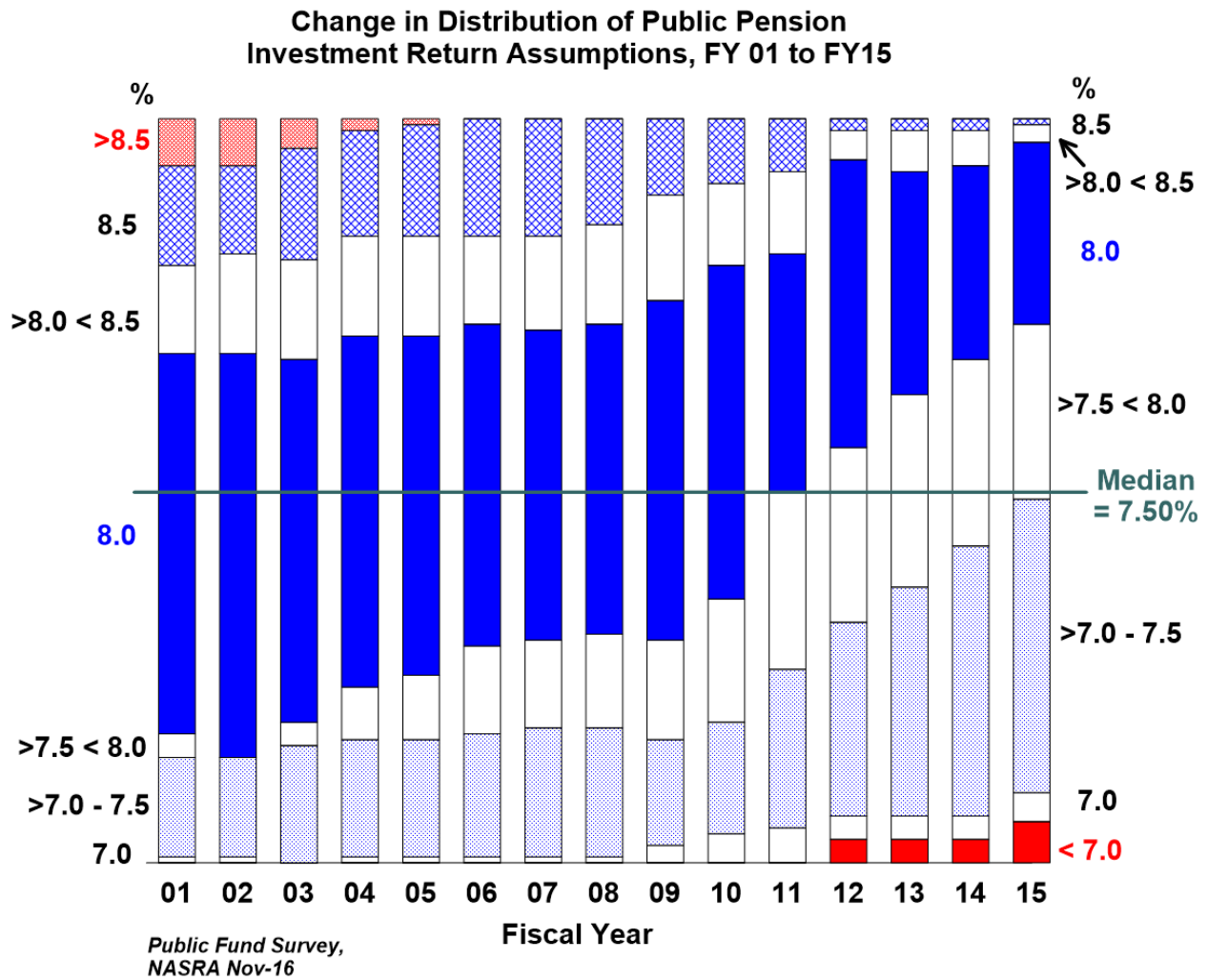
While we do not recommend that the selection of an investment return assumption be based on the assumptions used by other systems, it does provide another set of relevant information to consider. The following graph shows the change in the distribution of the investment return assumption from fiscal year 2001 through 2015 for the 120+ large public retirement systems included in the National Association of State Retirement Administrators (NASRA) Public Fund Survey. It is worth noting that the median investment return assumption is 7.50%. The assumed rate of return is heavily influenced by each Systems' asset allocation. The average asset allocation for the systems in the Public Fund Survey is 4.1% cash, 49.0% equities, 22.8% fixed income, 6.3% real estate, and 17.8% alternative investments which has an impact on the expected return of the systems. Note the increased allocation to alternative investment classes since 2006. The target asset allocation for MPERA is 54% equities, 12% alternatives, 8% real estate and 26% fixed income, which is in line with the portfolio of an average system. As a result, it is reasonable to anticipate that the expected return for RVK could equal that of the median system. The chart below shows the asset allocation for 96 funds surveyed in the *Public Fund Survey* since 2001.





## Section II: Economic Assumptions

Below is a graph published by NASRA in the *Public Fund Survey* that shows the decreases in the investment return assumptions used by public plans over the last several years.



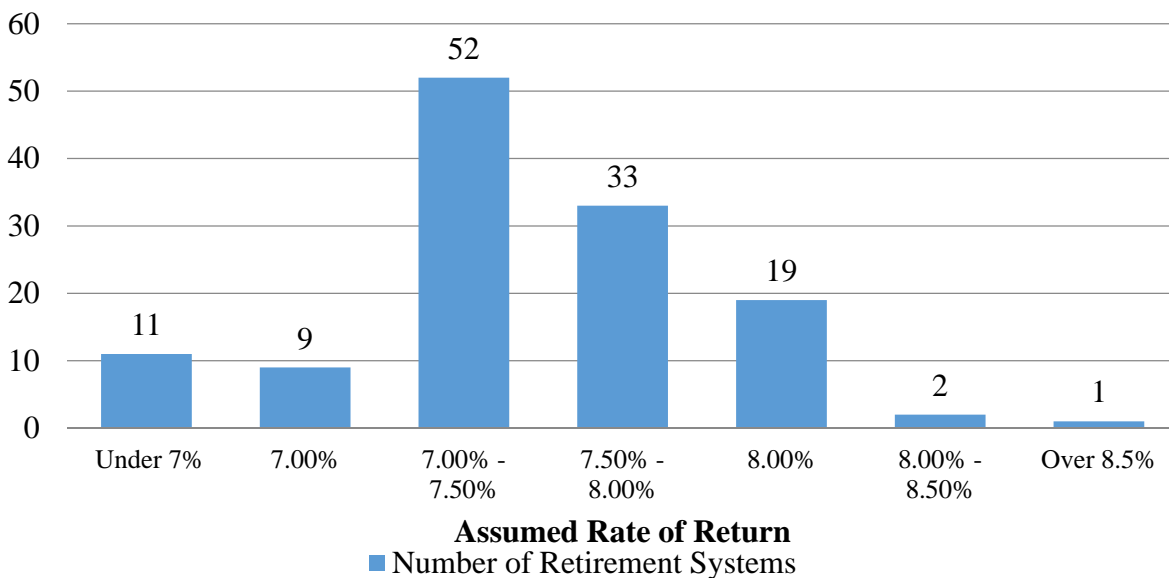


## Section II: Economic Assumptions

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The following table details the number of expected return assumption as stated in the NASRA Issue Brief: Public Pension Plan Investment Return Assumptions. The Average return assumption is 7.52% and the median return assumptions is 7.50%.

### NASRA Issue Brief: Public Pension Plan Investment Return 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 we must be careful not to let recent experience or the short-term expectations impact our judgment regarding the appropriateness of the current assumption over the long term.

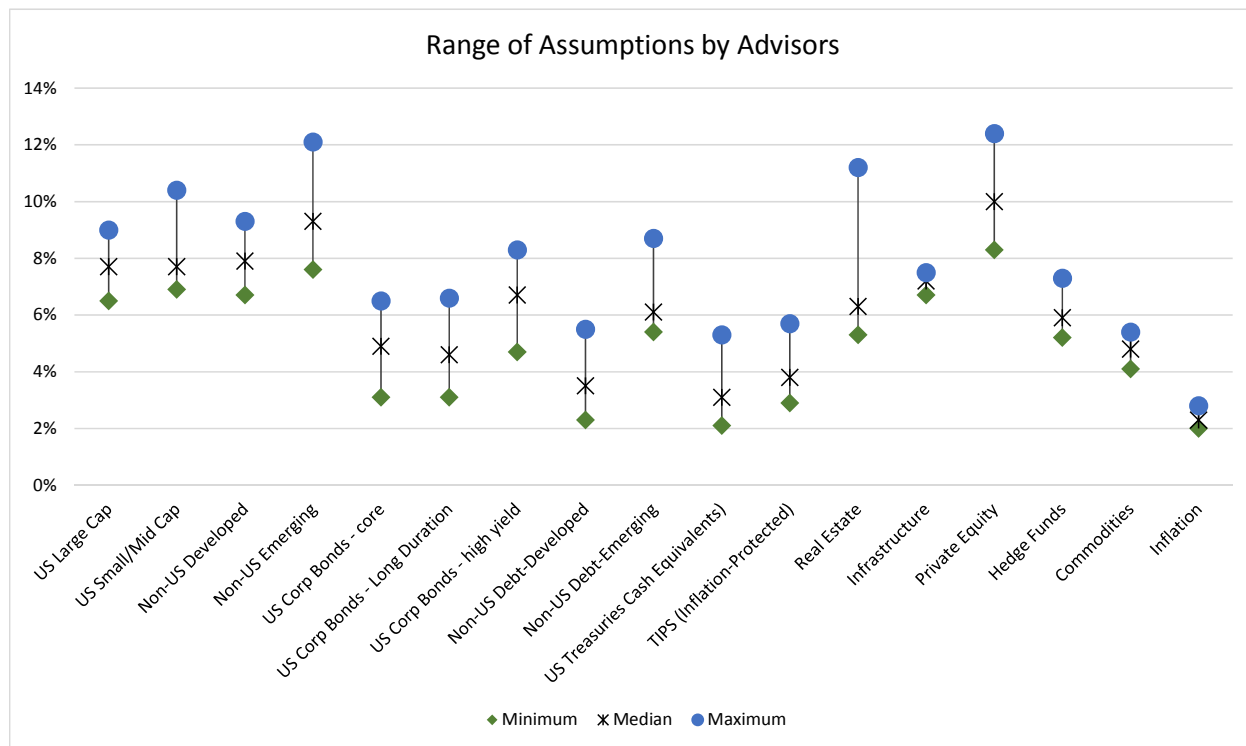
This is a challenging time to develop a recommendation for the investment return assumption. We need to recognize that there is no right answer to the question as no one knows what the future holds. This is evident with the wide range of forward looking capital market assumptions produced by various investment consultants. Horizon Actuarial Services prepares an annual study in which they survey various investment advisors and provide ranges of results as well as averages. The 2016 Survey included a total of 35 investment advisors who provided their capital market assumptions of which 12 provided both short-term and long-term assumptions. It is worth noting that this Survey has historically been prepared for the multiemployer (Taft-Hartley) plan community and initially included assumptions only from investment advisors serving those plans. The Survey has expanded over the years and now includes assumptions from investment advisors outside of the Taft-Hartley community including consultants such as Aon Hewitt, New England Pension Consultants (NEPC), Callan Associates, Willis Towers Watson, JP Morgan, RVK, SEI, UBS, Summit Strategies, Blackrock and PCA who work with public plans.

The graph on the following page shows the minimum, maximum and median return assumption for each asset class for the 12 firms providing long-term assumptions in the Horizon Survey. Expected returns shown below are annualized (geometric).





## Section II: Economic Assumptions



After reviewing all of the available information, **we recommend a 7.65% investment return assumption.** As noted above, there is no consensus amongst the various economic assumptions produced by investment consultants. We do realize that, in general, there is an overall pessimism about the future performance regarding the financial markets. This has been reflected by large public state wide retirement systems lowering the assumed rate of return assumptions - a trend that may continue. As a result, we recommend that the assumed rate of return assumption be reviewed on an annual basis in order to determine if further adjustment of the assumed rate of return is required.

Investment Return	
Current Assumption	7.75%
Recommended Assumption	7.65%



### WAGE INFLATION

**Background:** Wage inflation, thought of as the “across the board” rate of salary increases, is composed of the price inflation assumption, combined with an assumption for the real rate of wage increases. In constructing the salary increase assumption, the wage inflation assumption is further combined with an assumption for service-based salary increases (called a merit scale). The service-based salary increase assumption is discussed in Section III. The current assumption for real rate of wage increase is 1.00% (4.00% wage increase minus 3.00% inflation).

The excess of wage growth over price inflation represents the increase in the standard of living, also called productivity growth. There has been debate on the issue of whether public sector employees will receive, over the long term, the same rewards for productivity as employees in the private sector, where productivity is more readily measurable. To our knowledge, no definitive research has been completed on this topic. Nevertheless, it is our opinion that public sector employees will eventually be rewarded, even if there is a time lag, with the same or nearly the same productivity increases as those participating in the remainder of the economy.

Payment of the unfunded actuarial accrued liability is determined as a level percent of payroll. Therefore, the valuation requires an assumption regarding future annual increases in covered payroll. The wage inflation assumption is used for this purpose.

**Historical Perspective:** We have used statistics from the Social Security System on the National Average Wage back to 1951. Because the National Average Wage is based on all wage earners in the country, it can be influenced by the mix of jobs (full-time vs. part-time, manufacturing vs. service, etc.) as well as by changes in some segments of the workforce that are not seen in all segments (e.g. regional changes or growth in computer technology). Further, if compensation is shifted between wages and benefits, the wage index would not accurately reflect increases in total compensation. However, we feel the National Average Wage is an accurate measure.

There are numerous ways to review this data. For consistency with our observations of CPI, the table below shows the compound annual rates of wage growth for various periods ended in 2015 (most recent available data).

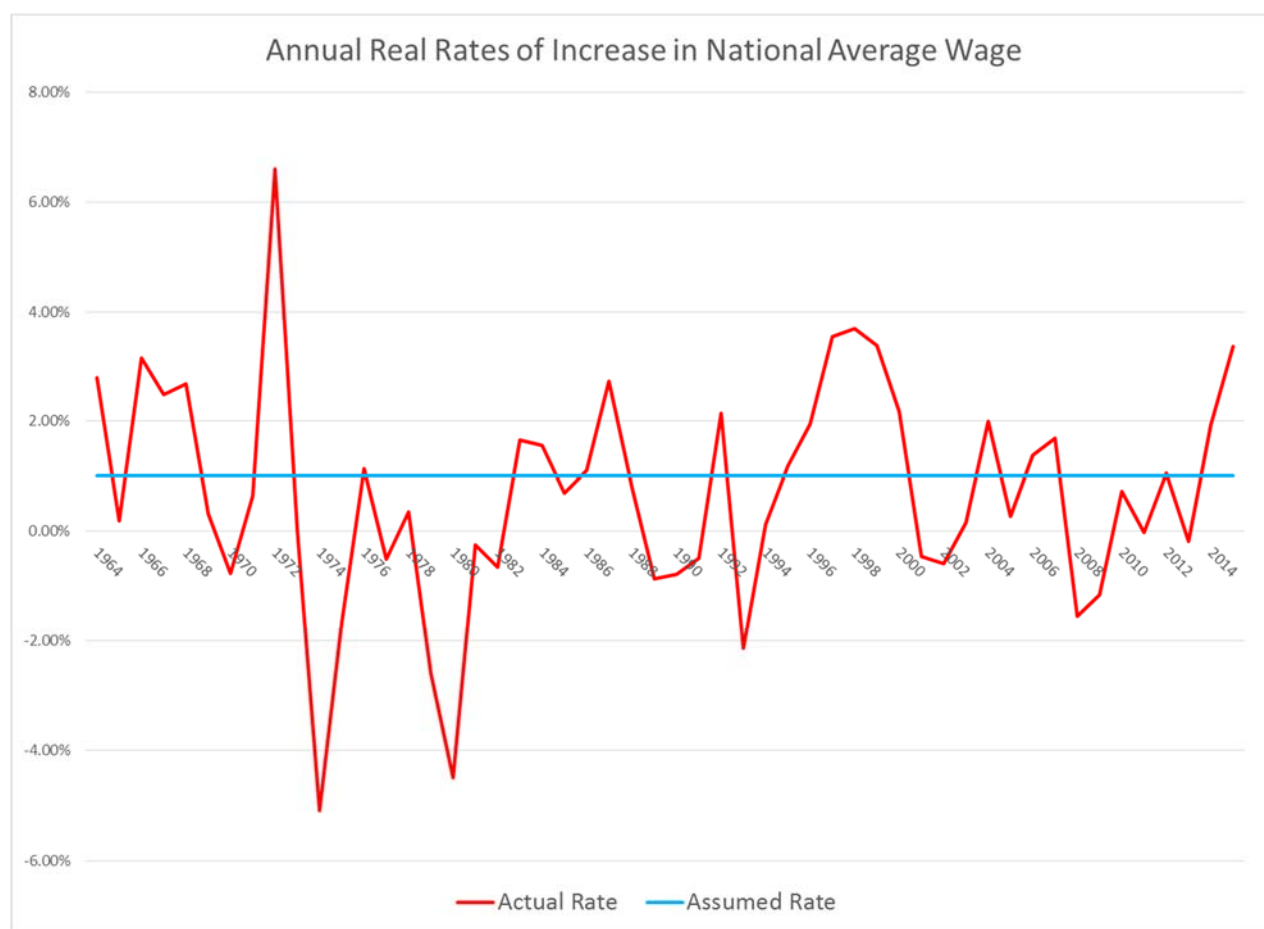
Period	Wage Inflation	Price Inflation	Real Wage Growth
2006-2015	2.5%	1.8%	0.7%
1996-2015	3.3%	2.1%	1.2%
1986-2015	3.6%	2.7%	0.9%
1976-2015	4.4%	3.7%	0.7%
1966-2015	4.8%	4.1%	0.7%
1956-2015	4.6%	3.7%	0.9%



## Section II: Economic Assumptions

The excess of wage growth over price inflation represents the real wage inflation rate. Although real wage inflation has been very low in recent years, likely due to the recovery from the 2008 financial crisis, our focus must remain on the long term. The above table shows the compounded wage growth over various periods, along with the comparable price inflation rate for the same period. The differences represent the real wage inflation rate. The data for each year is documented in Appendix B.

Over the last 50 years, annual real wage growth has averaged 0.70%. The graph below shows the annual increases in real wage growth over the entire 50-year period.





## Section II: Economic Assumptions

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**Recommendation:** As with price inflation, we again look at the 2016 OASDI Trustees Report. The Chief Actuary for Social Security bases the 75-year cost projections on an intermediate national wage growth assumption 1.2% greater than the price inflation assumption of 2.6%. We concur in general with a range of 0.6% - 1.8% and favor the lower end of the range based on the minimal evidence of real wage growth in the salary data we analyzed. We recommend use of a 0.75% per year rate at the current time.

Wage Inflation Assumption	
Current	4.00%
Recommended	3.50%



### DEMOGRAPHIC ASSUMPTIONS

There are several demographic assumptions used in the actuarial valuations performed for systems in the Montana Public Employee Retirement Administration. They are:

- Rates of Post-retirement Mortality
- Rates of Post-retirement Disabled Mortality
- Rates of Pre-Retirement Mortality
- Rates of Service Retirement
- Rates of Disability Retirement
- Rates of Withdrawal
- Rates of Salary Increase for Merit and Promotions

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.

Studies of demographic experience generally involve three steps:

- First, the number of members changing membership status, called decrements, during the study is tabulated by age, duration, gender, group, and membership class (active, retired, etc.).
- Next, the number of members expected to change status is calculated by multiplying certain membership statistics, called exposure, by the expected rates of decrement.
- Finally, the number of actual decrements is compared with the number of expected decrements. The comparison is called the actual to expected ratio (A/E Ratio), and is expressed as a percentage.

In general, 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 duration deviates significantly from the expected pattern, new assumptions are considered. Recommended revisions are normally not an exact representation of the experience during the observation period. Professional judgment is required to set assumptions for future experience from past trends and current evidence, including a determination of the amount of weight to assign to the most recent experience.



The remainder of this section presents the results of the demographic study. We have prepared charts and graphs that show a comparison of the actual and expected decrements and the overall ratio of actual-to-expected results under the current assumptions. If a change is being proposed, the revised actual-to-expected ratios are shown as well.

### **RATES OF MORTALITY**

Mortality tables are a fundamental assumption in actuarial valuations. Benefits are typically paid over a retiree's lifetime so it is important to appropriately reflect what a typical lifetime looks like. In addition, deaths before retirement typically result in the payout of benefits to a spouse or survivor. For valuation purposes, we must consider mortality tables for retirees, beneficiaries of retirees, disabled retirees, and active members.

#### **Retiree and Beneficiary Mortality**

The post-retirement mortality rates used in the actuarial valuation project the percentage of retirees who are expected to die in a given future year. This assumption typically has the most significant impact on liability projections.

Based upon the long term trend of mortality improvement, actuaries seek to account for future improvements in longevity, either by directly projecting future improvements, or by maintaining a sufficient margin in expected rates of mortality to allow for future improvement. We propose that the selected table reflect some degree of future improvement now, thereby providing a margin for improvement. The current table is the RP-2000 Combined Employee and Annuitant Mortality Table projected to 2015 using scale AA. This table is used for all non-disabled members.



### **Retiree, Beneficiary and Active Mortality Experience and Recommendations**

The analysis of the actual post-retirement mortality experience over the six-year study period for all Systems combined yields actual/expected ratios of 94% and 98% respectively for males and females.

Mortality Experience – Current Table

	Actual	Expected	A/E Ratio
Males	2,500	2,654	94.2%
Females	1,769	1,809	97.8

### **Retiree and Beneficiary Mortality Findings and Recommendations**

Experience indicates that overall the aggregate number of deaths for both males and females are less than the numbers expected, therefore the current mortality assumption no longer has a sufficient margin for improvement for continued use. As a result, we recommend updating the mortality assumption to the RP-2000 Combined Employee and Annuitant Mortality Table projected to 2020 using scale BB, set back one year for males. The actual/expected ratios under the proposed mortality assumption is 118% and 113% for males and females respectively. These ratios indicate that sufficient margin is built into the proposed assumption to recognize that there could be some improvement in mortality over the next experience period.

The complete tables of recommended mortality rates are shown in Appendix C.

The following pages contain charts and graphs with detailed results of our mortality analysis.



Section III: Demographic Assumptions

Mortality Experience – Proposed Table

Age Group	Post-Retirement Mortality - Males					
	Current Table			Proposed Table		
	Actual	Expected	Ratio	Actual	Expected	Ratio
			Actual/Expected			Actual/Expected
20 - 24	4	0.02	225.28	4	0.02	189.80
25 - 29	0	0.02	0.00	0	0.02	0.00
30 - 34	1	0.05	22.13	1	0.04	24.30
35 - 39	0	0.07	0.00	0	0.07	0.00
40 - 44	0	0.18	0.00	0	0.19	0.00
45 - 49	4	0.70	5.69	4	0.78	5.13
50 - 54	33	3.84	8.59	33	4.43	7.44
55 - 59	56	19.62	2.85	56	20.70	2.71
60 - 64	136	89.50	1.52	136	82.68	1.64
65 - 69	176	181.22	0.97	176	170.75	1.03
70 - 74	256	271.36	0.94	256	225.97	1.13
75 - 79	340	380.66	0.89	340	306.18	1.11
80 - 84	466	534.73	0.87	466	401.84	1.16
85 - 89	511	595.55	0.86	511	440.22	1.16
90 - 94	366	414.33	0.88	366	326.61	1.12
95 - 99	130	141.24	0.92	130	122.36	1.06
100 - 104	21	21.38	0.98	21	19.59	1.07
<b>TOTAL</b>	<b>2,500</b>	<b>2,654.46</b>	<b>0.94</b>	<b>2,500</b>	<b>2,122</b>	<b>1.18</b>

Age Group	Post-Retirement Mortality - Females					
	Current Table			Proposed Table		
	Actual	Expected	Ratio	Actual	Expected	Ratio
			Actual/Expected			Actual/Expected
20 - 24	0	0.00	0.00	0	0	0.00
25 - 29	0	0.01	0.00	0	0	0.00
30 - 34	1	0.02	61.22	1	0	56.74
35 - 39	3	0.04	81.58	3	0	71.17
40 - 44	0	0.07	0.00	0	0	0.00
45 - 49	0	0.17	0.00	0	0	0.00
50 - 54	1	1.52	0.66	1	2	0.59
55 - 59	15	10.75	1.40	15	10	1.50
60 - 64	45	56.98	0.79	45	49	0.93
65 - 69	117	142.78	0.82	117	121	0.97
70 - 74	151	201.23	0.75	151	174	0.87
75 - 79	231	241.55	0.96	231	212	1.09
80 - 84	300	306.98	0.98	300	268	1.12
85 - 89	352	354.37	0.99	352	297	1.18
90 - 94	367	345.37	1.06	367	299	1.23
95 - 99	154	126.30	1.22	154	117	1.31
100 - 104	32	21.05	1.52	32	20	1.59
<b>TOTAL</b>	<b>1,769</b>	<b>1,809.20</b>	<b>0.98</b>	<b>1,769</b>	<b>1,569</b>	<b>1.13</b>

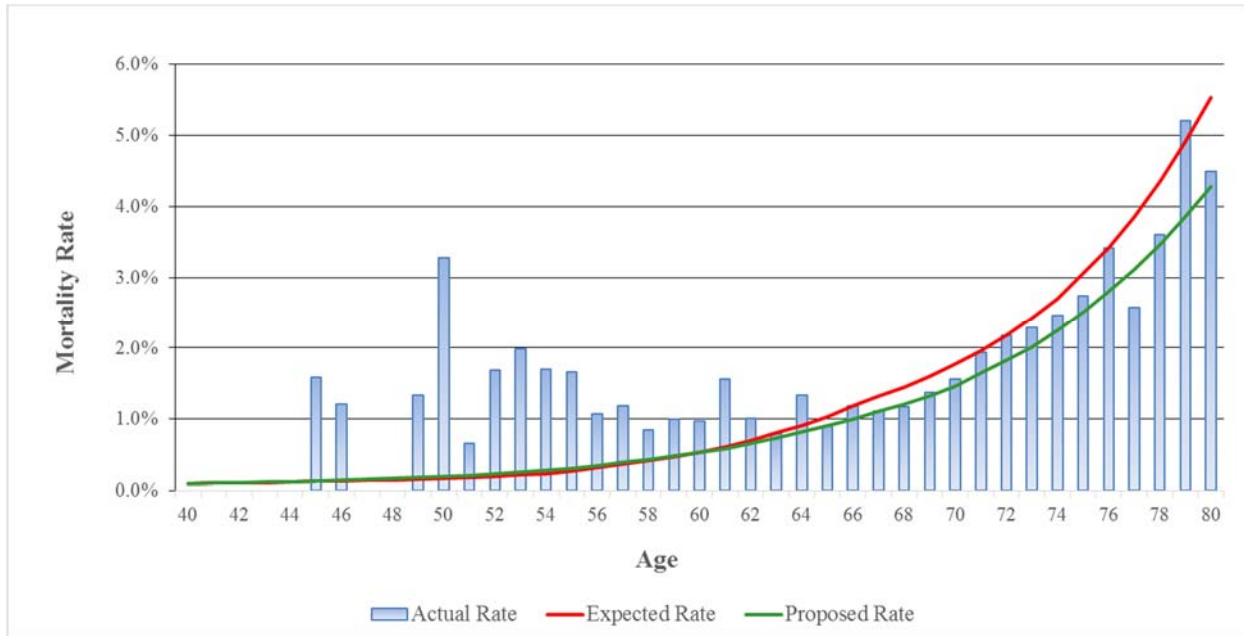




### Section III: Demographic Assumptions

The charts below show (i) the actual rates of mortality for retirees and beneficiaries by age during the past six years, (ii) the current assume rates of mortality and (iii) the recommended assumed rates of mortality.

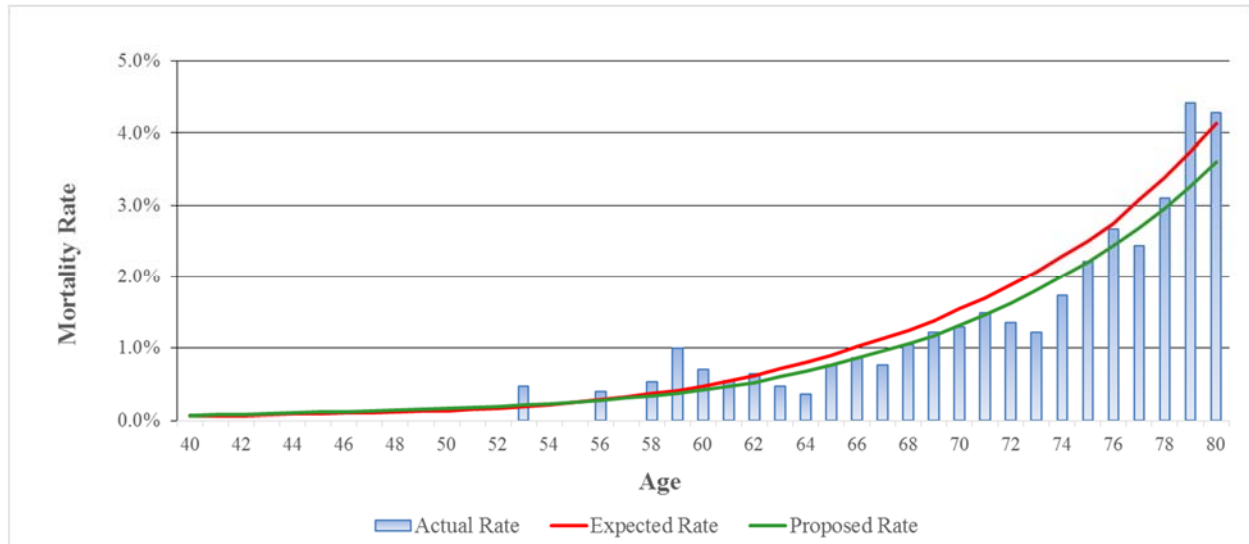
Probability of Death - Healthy Males





Section III: Demographic Assumptions

Probability of Death – Healthy Females



**Disabled Retiree Mortality**

Members who retire under the disability retirement provisions are generally expected to be less healthy than the overall population. Currently, the assumption for this group is based on rates from the RP-2000 Combined Healthy Mortality table for Males and Females without projection. The study period yielded actual/expected ratios for all Systems combined of 177.3% and 234.7% respectively for males and females. These ratios indicate disabled individuals are dying at a rate that is greater rate than as currently assumed.

**Disabled Retiree Mortality Experience under Current Assumptions**

	Actual	Expected	A/E Ratio
Males	156	88	177.3%
Females	115	49	234.7%

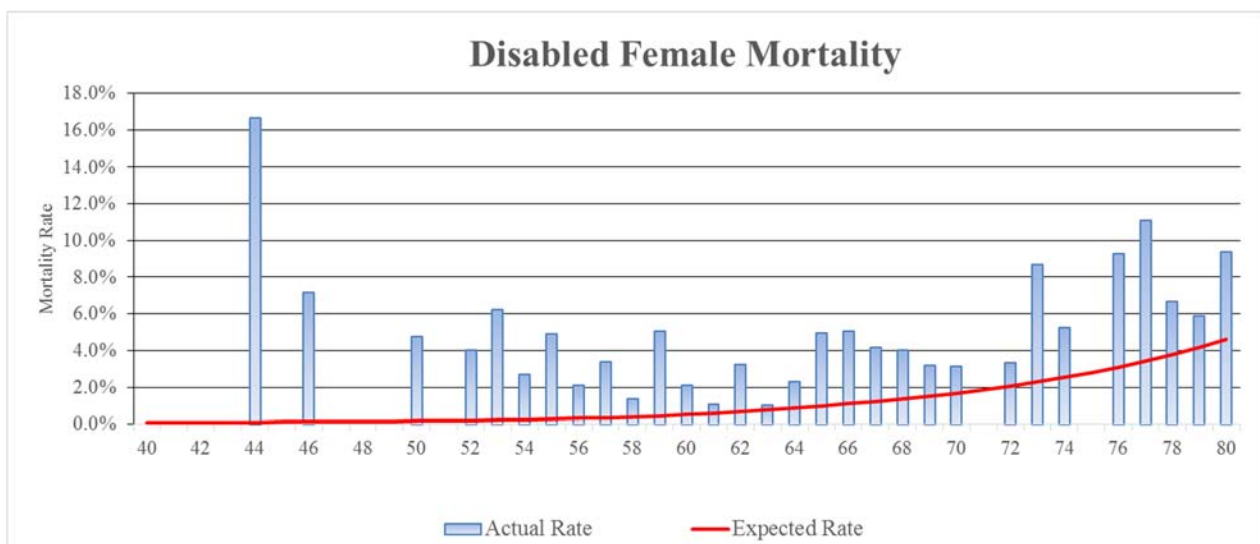
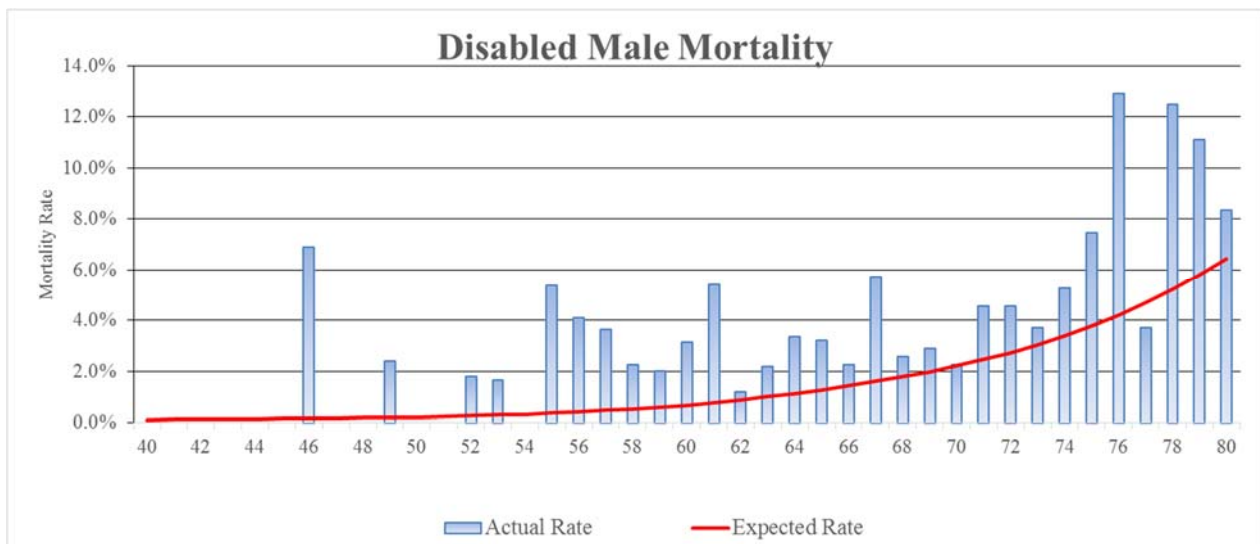


### Section III: Demographic Assumptions

#### Disabled Retiree Mortality Findings and Recommendations

Experience indicates that overall more members have died than expected during the study period. However, the number of actual and expected disabled deaths are not fully credible due to a low number of exposed lives during the experience period. In order to maintain the level of conservatism in the current post-disabled retirement mortality rates, we are not recommending a change to the assumed rate of mortality for disabled lives.

The charts below show (i) the actual rates of mortality for disabled males and females by age during the past six years and (ii) the current assume rates of mortality.





### Rates of Pre-Retirement Mortality

The rates of pre-retirement mortality are used in the actuarial valuation to project the percentage of employees who are expected to terminate due to death.

#### EXPERIENCE UNDER CURRENT ASSUMPTIONS

	Actual	Expected	A/E Ratio
PERS	140	455.71	30.7%
JRS	1	1.84	54.3%
HPORS	1	1.49	67.1%
SRS	10	10.22	97.8%
GWPORS	3	8.40	35.7%
MPORS	2	4.09	48.9%
FURS	3	4.23	70.9%
VFCA	6	32.25	18.6%

#### Findings and Recommendations

As is typical with most large public pension plans, a small number of deaths occur amongst the active member population during the experience period. The data is not sufficient to recommend a change in the actuarial assumption for pre-retirement mortality that would be expected to accurately predict mortality rates in the future for the active membership. As a result, we recommend the assumed rates of pre-retirement mortality reflect an assumption similar to the assumed rates of post-retirement mortality. We recommend updating the mortality assumption to the RP-2000 Combined Employee Mortality Table projected to 2020 using scale BB, set back one year for males. The complete tables of recommended mortality rates are shown in Appendix C.



### RATES OF SERVICE RETIREMENT

The service retirement rates used in the actuarial valuations project the percentage of employees who are expected to retire during a given year. This assumption does not include the retirement patterns of the individuals who terminated from active membership prior to their retirement.

	Actual	Expected	A/E Ratio
PERS	8,068	8,490.52	95.0%
JRS	18	30.25	59.5%
HPORS	45	56.51	79.6%
SRS	108	125.45	86.1%
GWPORS	99	147.50	67.1%
MPORS	89	98.56	90.3%
FURS	73	82.65	88.3%
VFCA	354	543.20	65.2%

#### **PERS Members**

For members who began participation prior to July 1, 2011, PERS provides an unreduced retirement benefit upon obtaining age 60 and with at least five years of membership service, age 65 or any age with 30 or more years of membership service. PERS also provides a reduced benefit to members who retire upon obtaining age 50 with at least 5 years of membership service or any age with at least 25 years of membership service (but below 30 years). The normal retirement benefit is reduced by 6.0% per year for the first five years and 3.6% per year for the next five years for each year the member is younger than age 65 or has less than 30 years of service, whichever is smaller.

For members who began participation on or after July 1, 2011, PERS provides an unreduced retirement benefit upon obtaining age 65 and with at least five years of membership service or age 70. PERS also provides a reduced benefit to members who retire upon obtaining age 55 with at least 5 years of service. The early retirement benefit is the actuarial equivalent benefit of the normal retirement benefit payable at age 65.

Due to lack of experience, the assumed rates of retirement are consistently applied for both the pre and post July 1, 2011 members. We recommend continuing to follow this approach until enough experience is developed for post July 1, 2011, members.

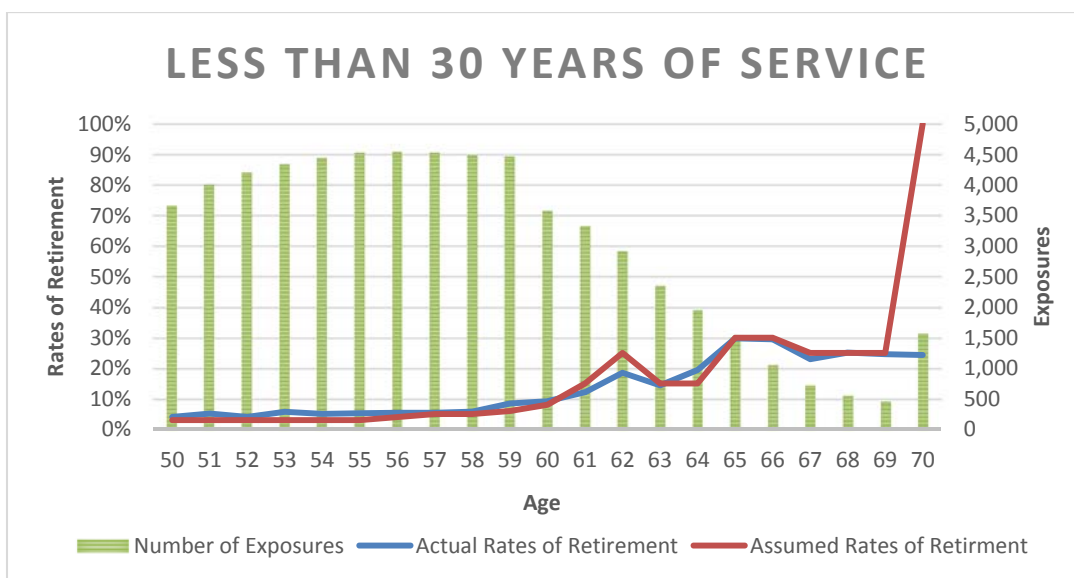


### Section III: Demographic Assumptions

The retirement experience was analyzed for two groups of members who qualified for a retirement benefit during the experience period. The first group included members who had obtained less than 30 years of service. The second group included members who had obtained 30 years of service or had obtained age 60 with 25 years of service. The analysis of the actual retirement experience over the six-year period yielded an actual/expected ratio of 95.0%. An actual/expected ratio that is less than 100% indicates that less than the assumed amount of members have retired during the experience period. We do not recommend changing the assumed rates of retirement for PERS members at this time.

The charts below show a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement and (iii) the number of exposed lives during the experience period.

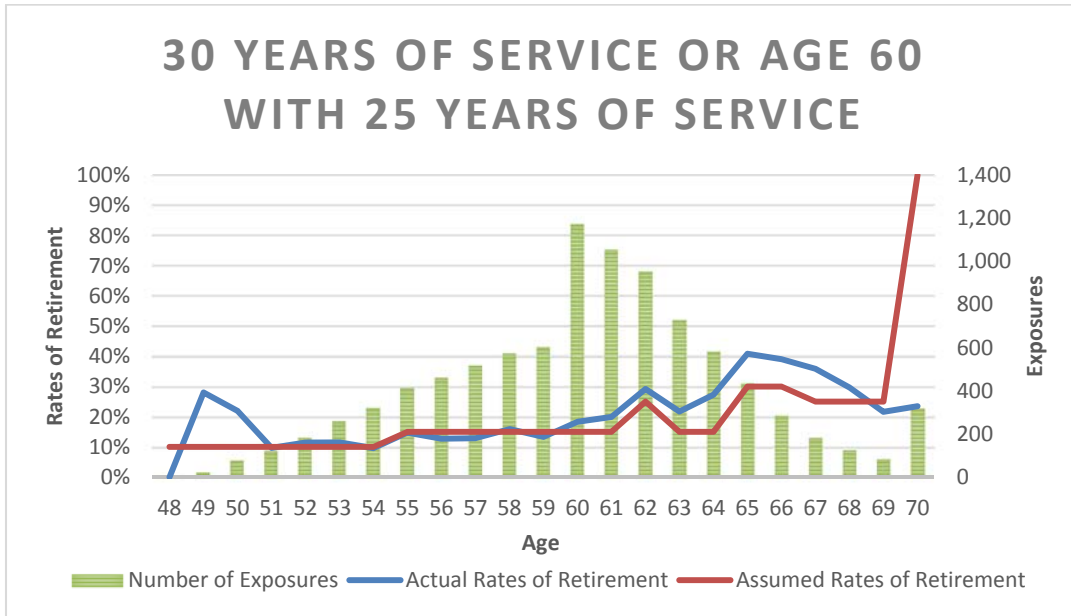
#### Service Retirements





Section III: Demographic Assumptions

Service Retirements





### Section III: Demographic Assumptions

#### **JRS Members**

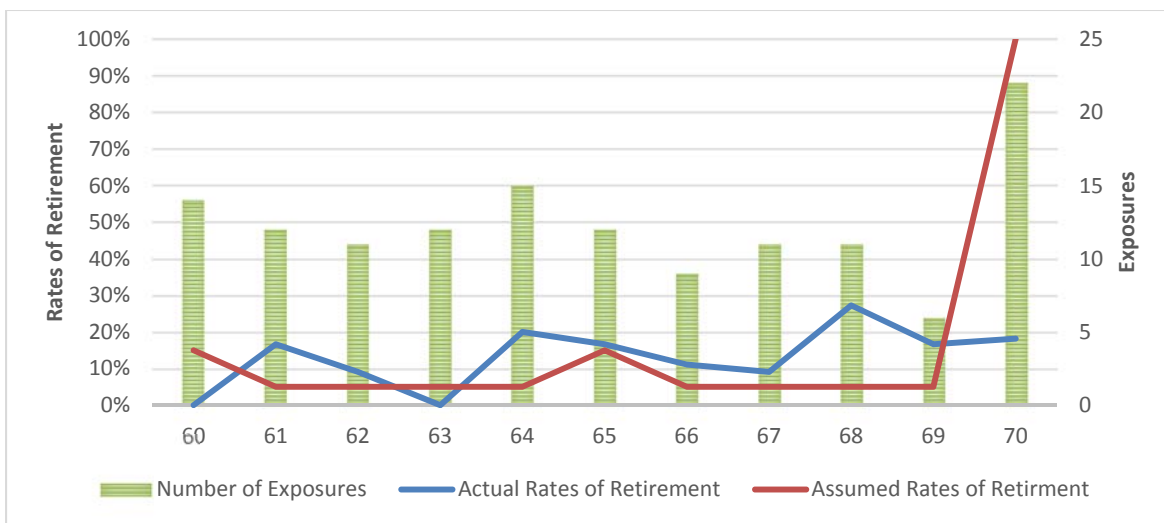
JRS provides an unreduced retirement benefit upon obtaining age 60 with at least five years of membership service.

It is currently assumed these members will begin retiring at the attainment of age 60.

Retirement analysis was based on age for members who qualified for retirement benefit during the experience period. The analysis of the actual retirement experience yields an actual/expected ratio of 59.5%. An actual/expected ratio that is less than 100% indicates that less than the assumed amounts of members have retired during the experience period. We do not recommend changing the assumed rates of retirement for JRS members at this time.

The chart below shows a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement and (iii) the number of exposed lives during the experience period.

**Service Retirements**







### **HPORS Members**

HPORS provides an unreduced retirement benefit upon the completion of 20 years of membership service. HPORS also provides actuarially reduced benefits (from age 60) to members hired before July 1, 2013 who retire before reaching normal retirement age with at least five years of membership service, as well as to members hired after July 1, 2013 who retire before reaching normal retirement age with at least 10 years of membership service.

It is currently assumed that HPORS members will begin retiring upon obtaining any age with 20 years of membership service or upon obtaining age 60 and 5 years of service.

HPORS includes a Deferred Retirement Option Plan (DROP). A member is eligible to enter the DROP upon obtaining 20 years of service. The DROP allows active members to accumulate their retirement benefit with interest while continuing to remain employed for up to 60 months. If a member chooses the DROP, the DROP member's monthly retirement benefit along with the required member contributions are accumulated in a hypothetical DROP account. Upon exiting the DROP, the member will begin receiving directly, their monthly retirement allowance, which was determined on the date they entered the DROP and will receive their DROP account balance accumulated with interest as a lump sum. The assumed rates of retirement are increased for members with 20 up to 26 years of service to account for members choosing to enter the DROP.

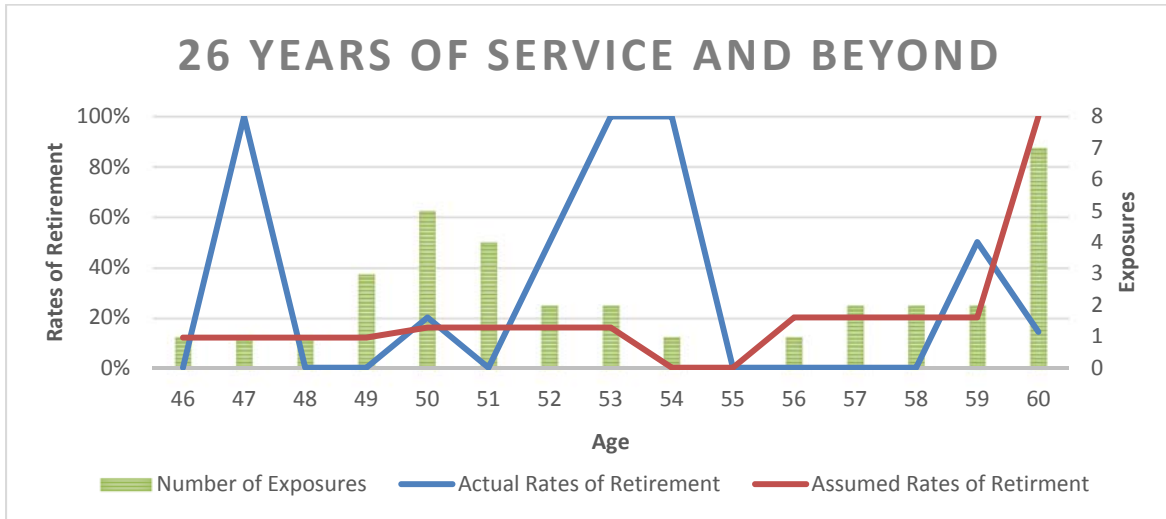
The retirement experience was analyzed for two groups of members who qualified for an unreduced retirement benefit during the experience period. The first group included members with 20 up to 26 years of service and the second group has member with 26 or more years of service. The analysis of the actual retirement experience yields an actual/expected ratio of 79.6%. An actual/expected ratio less than 100% indicates that the current assumption for retirements overestimated the number of retirements during the experience period. We do not recommend changing the assumed rates of retirement for HPORS members at this time.

The charts below show a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement and (iii) the number of exposed lives during the experience period.

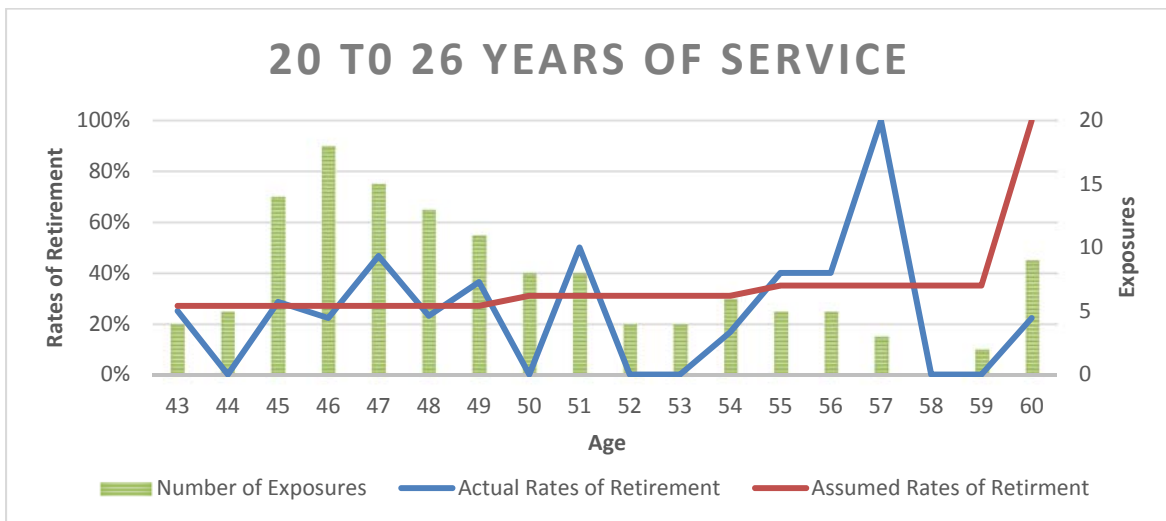


Section III: Demographic Assumptions

Service Retirements



Service Retirements





### Section III: Demographic Assumptions

#### **SRS Members**

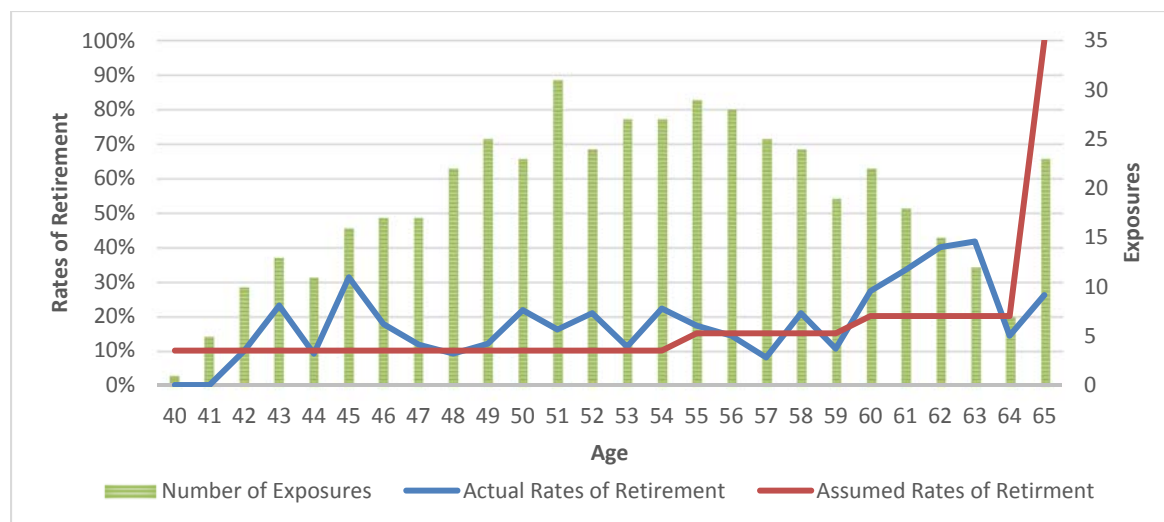
SRS provides an unreduced retirement benefit after 20 years of membership service. SRS also provides an actuarially reduced benefit (from age 60 or the attainment of 20 years of service) to members who retire upon obtaining age 50 with at least five years of membership service.

It is currently assumed that these members will begin retiring upon obtaining any age with 20 years of membership service or upon obtaining age 65 and 5 years of service.

The retirement experience was based on members who obtained 20 years of service or age 65 and 5 years of service during the experience period. The analysis yielded an actual/expected ratio of 86.1%. An actual/expected ratio less than 100% indicates that the current assumptions overestimated the number of retirements during the experience period. We do not recommend changing the assumed rates of retirement for SRS members at this time.

The chart below shows a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement and (iii) the number of exposed lives during the experience period.

**Service Retirements**





## Section III: Demographic Assumptions

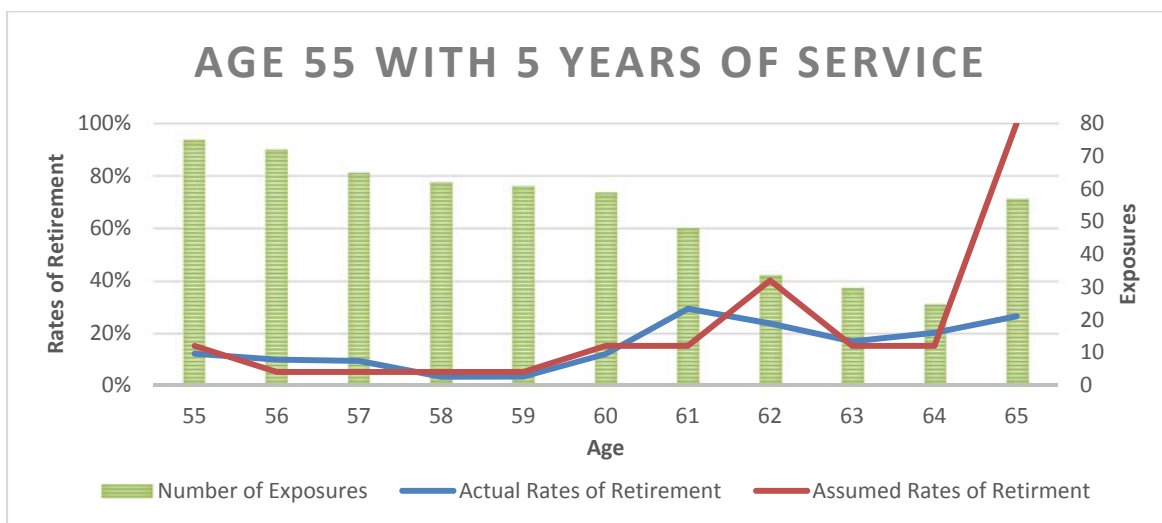
### GWPORS Members

GWPORS provides an unreduced retirement benefit upon obtaining age 50 and with at least 20 years of membership service or obtaining age 55 with at least 5 years of service. It is currently assumed these members will begin retiring upon the earlier of obtaining age 50 with 20 years of membership service or age 55 with 5 years of membership service.

The retirement experience was analyzed for two groups of members who qualified for an unreduced retirement benefit during the experience period. The first group was for members who satisfied obtaining age 55 with 5 years of service and the second group was for members who obtained age 50 with 20 years of service. The analysis of the actual retirement experience yields an actual/expected ratio of 67.1%. An actual/expected ratio that is less than 100% indicates that the current assumption overestimated the number of retirements during the experience period. We do not recommend changing the assumed rates of retirement for GWPORS members at this time.

The charts below show a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement, and (iii) the number of exposed lives during the experience period.

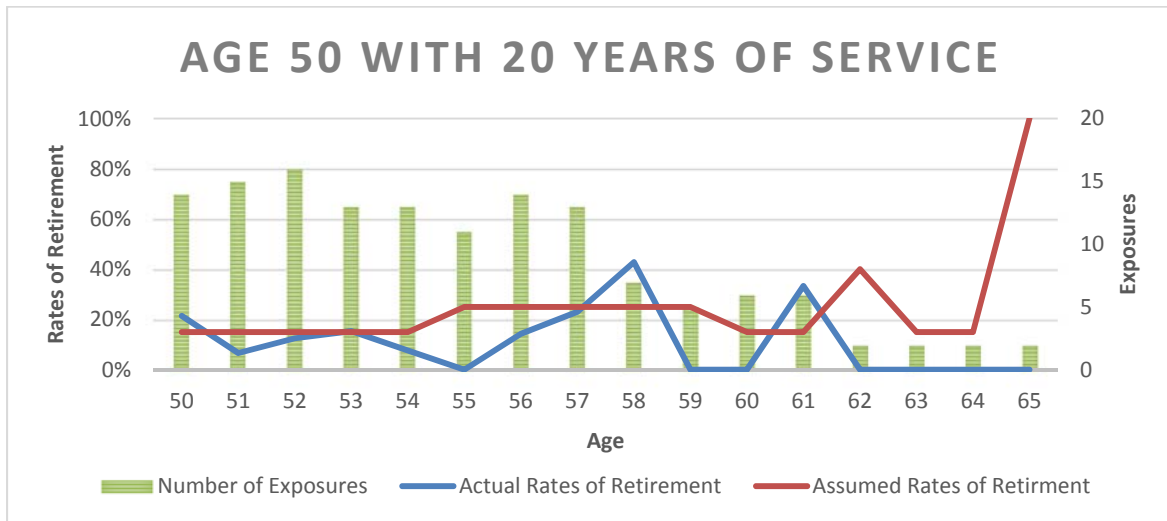
#### Service Retirements





Section III: Demographic Assumptions

Service Retirements





**MPORS Members**

MPORS provides an unreduced retirement benefit upon obtaining age 50 and with at least 5 years of membership service or any age with at least 20 years of membership service. It is currently assumed these members will begin retiring upon the earlier of obtaining 20 years of membership service, regardless of age, or age 65 with at least 5 years of service.

MPORS includes a Deferred Retirement Option Plan (DROP). A member is eligible to enter the DROP upon obtaining 20 years of service. The DROP allows active members to accumulate their retirement benefit with interest while continuing to remain employed for up to 60 months. If a member chooses the DROP, the DROP member's monthly retirement benefit, including cost-of-living increases, are accumulated in a hypothetical DROP account. Upon exiting the DROP, the member will begin receiving directly, their monthly retirement allowance which was determined on the date they entered the DROP, including increases for cost-of-living adjustments, and will receive their DROP account balance accumulated with interest as a lump sum. The assumed rates of retirement are increased for 20 up to 26 years of service to account for members choosing to enter the DROP.

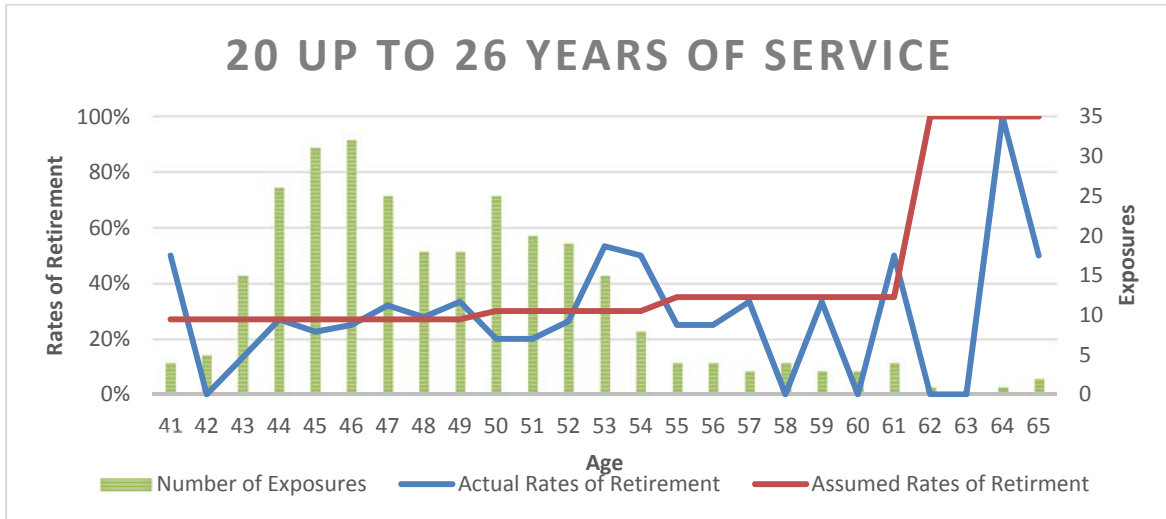
The retirement experience was analyzed for two groups of members who qualified for an unreduced retirement benefit during the experience period. The first group included members with 20 up to 26 years of service and the second group included those members with 26 years of service and beyond for being eligible for a retirement benefit. The analysis of the actual retirement experience yields an actual/expected ratio of 90.3%. An actual/expected ratio less than 100% indicates that the current assumption overestimated the number of retirements during the experience period. We do not recommend changing the assumed rates of retirement for MPORS members at this time.

The charts below show a comparison between (i) the actual rates of retirement, (ii) the current assumed rates of retirement and (iii) the number of exposed lives during the experience period.

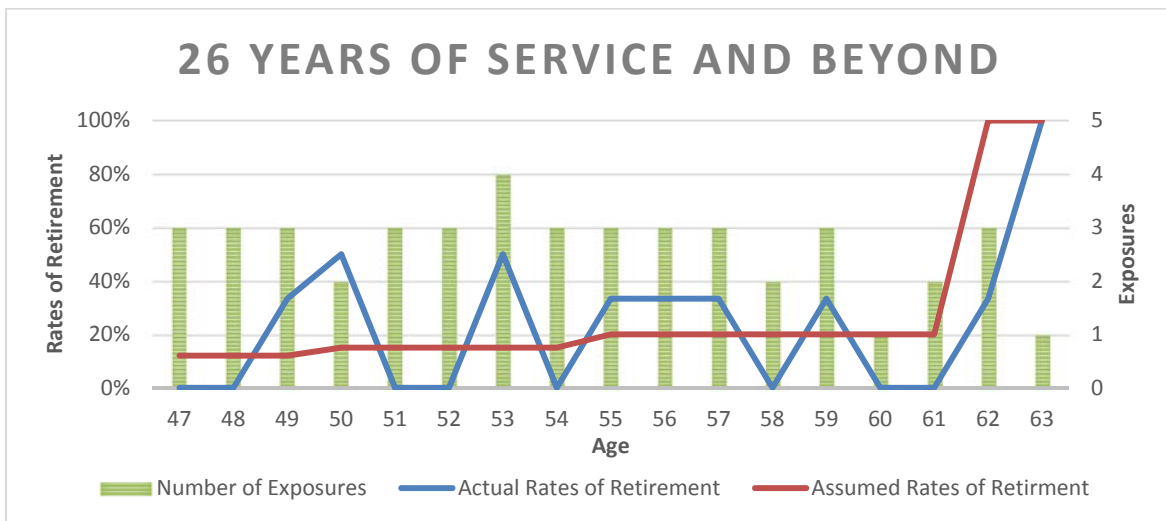


Section III: Demographic Assumptions

Service Retirements



Service Retirements





## Section III: Demographic Assumptions

### FURS Members

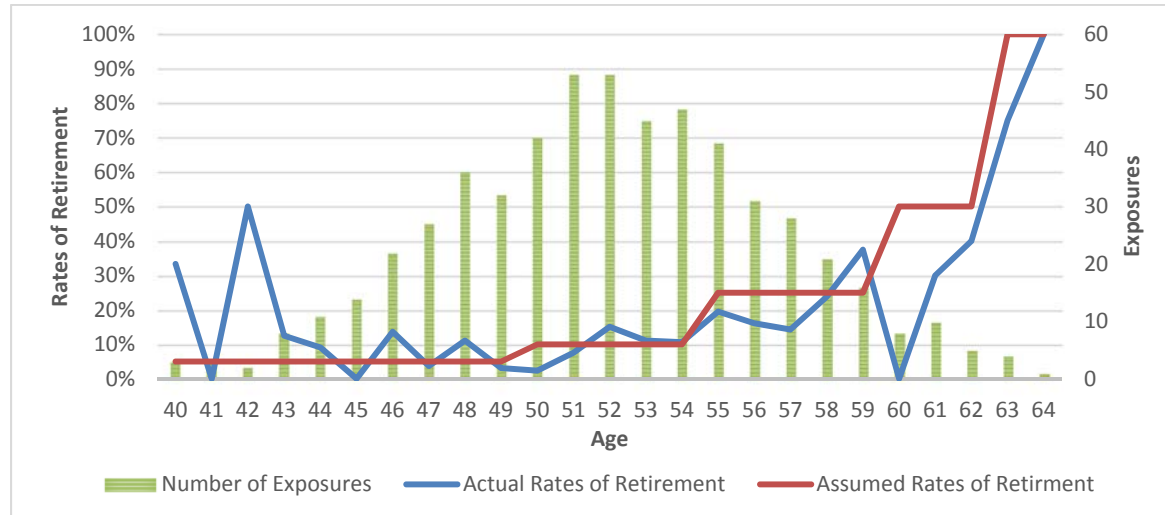
FURS provides an unreduced retirement benefit upon obtaining 20 years of membership service, regardless of age. FURS also provides an unreduced early retirement benefit to members who retire upon obtaining age 50 with at least 5 years of membership service.

It is currently assumed these members will begin retiring upon obtaining 20 years of membership service, regardless of age, or age 63 with 5 years of membership service.

Retirement experience was analyzed by age for members with 20 or more years of service. The analysis of the actual retirement experience yields an actual/expected ratio of 88.3%. An actual/expected ratio that is less than 100% indicates that the current assumption overestimated the number of retirements during the experience period. We do not recommend changing the current assumption for assumed retirements.

The chart below shows (i) the actual rates of retirement for employees by service during the past six years, (ii) the current assume rates of retirement and (iii) the number of exposed lives during the experience period.

**Service Retirements**







## Section III: Demographic Assumptions

### VFCA Members

VFCA provides a retirement benefit upon obtaining age 55 with at least 20 years of membership service or a partial retirement benefit upon obtaining age 60 with at least 10 years of membership service.

It is currently assumed these members will begin retiring upon the earlier of obtaining age 55 with 20 years of membership service or age 60 with 10 years of membership service.

The retirement experience was analyzed for two groups of members who qualified for a retirement benefit during the experience period. The first group included those that retired with less than 20 years of service and the second group included those that retired with 20 or more years of service. The analysis of the actual retirement experience yields an actual/expected ratio of 65.2%. An actual/expected ratio less than 100% indicates that the current assumption overestimated the number of retirements during the experience period. We do not recommend changing the current assumed retirement rates for VFCA.

The charts below show (i) the actual rates of retirement for employees by service during the past six years, (ii) the current assume rates of retirement and (iii) the number of exposed lives during the experience period.

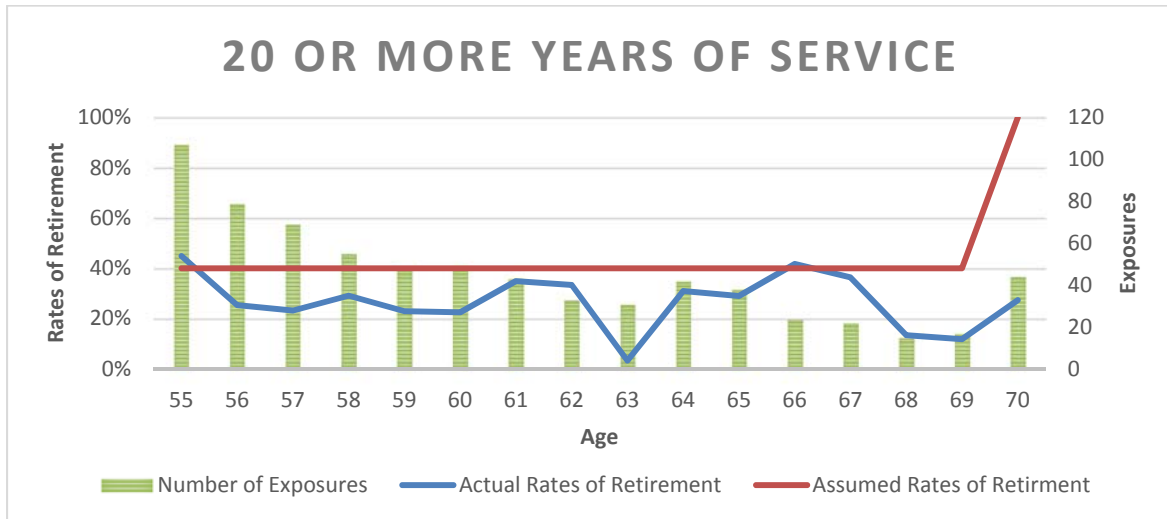
### Service Retirements





### Section III: Demographic Assumptions

#### Service Retirements





### RATES OF DISABILITY RETIREMENT

The rates of disability retirement used in the actuarial valuation project the percentage of employees who are expected to become disabled each year and begin receiving a disability retirement benefit. All members qualify for a disability retirement benefit upon employment, with the exception of PERS members, who must have at least 5 years of service. The table below shows the disability experience for each of the Systems. In general there were less disability retirements during the experience period except for HPORS which experienced more disability retirements than anticipated.

	Actual	Expected	A/E Ratio
PERS	111	240.01	46.2%
JRS	1	0.41	243.9%
HPORS	7	3.57	196.1%
SRS	16	16.85	95.0%
GWPORS	8	13.97	57.3%
MPORS	13	14.74	88.2%
FURS	8	9.96	80.3%
VFCA	0	0.00	N/A

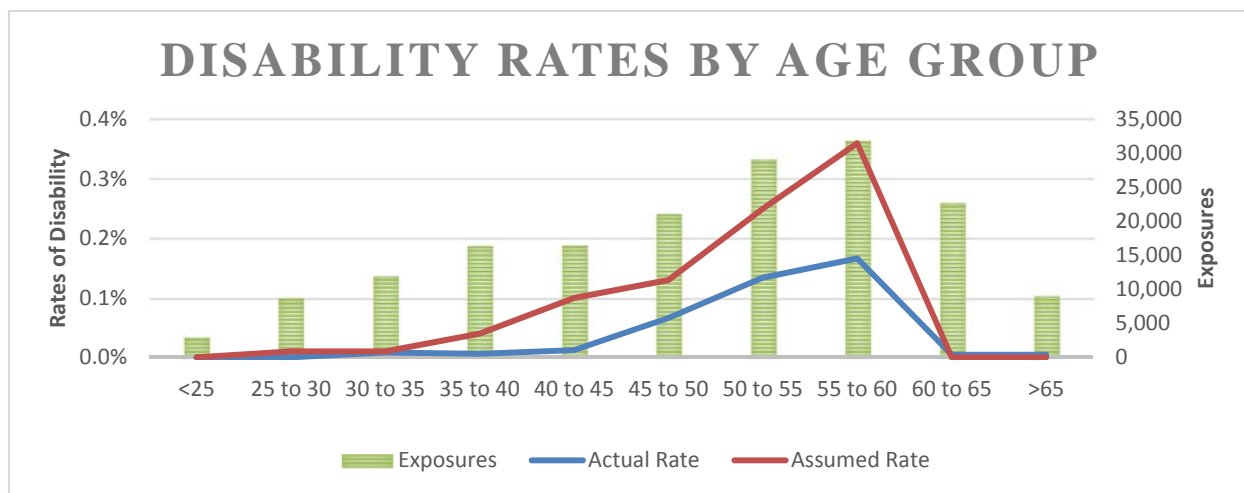


## Section III: Demographic Assumptions

### PERS

The analysis yields an actual/expected ratio of 46.2% over the experience period. A ratio of 46.2% indicates that the current assumption is overestimating the number of disability retirements. This pattern of disability retirements is consistent with the previous experience study in which the assumed rates of disability retirements were reduced based on experience for the six year period ending June 30, 2009, which was performed by a prior actuary. We recommend no change to the assumed rates of disability retirements for PERS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



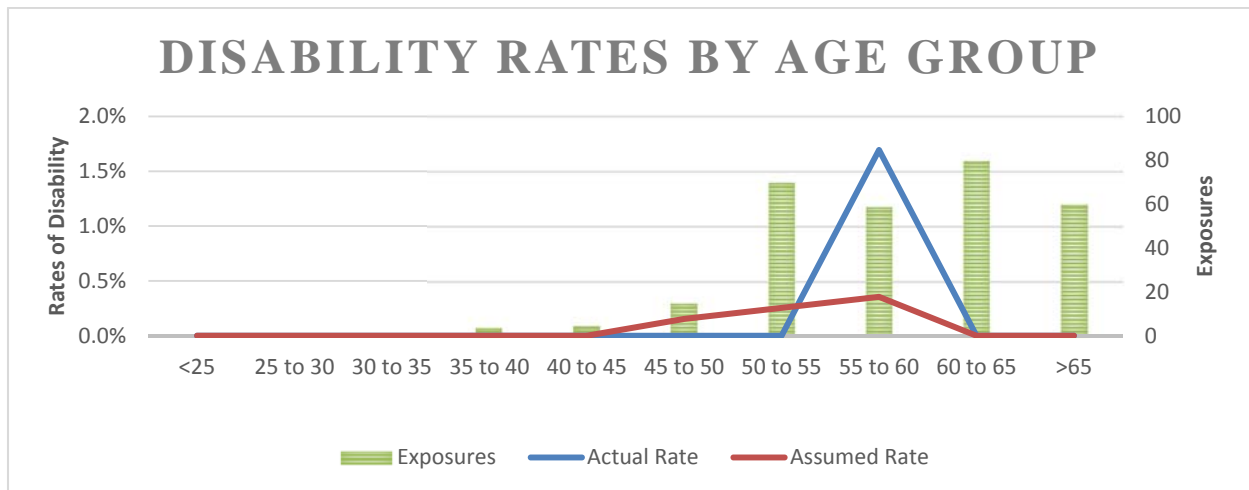


### Section III: Demographic Assumptions

#### **JRS Members**

During the experience period there was one disability retirement in JRS. This pattern of disability was consistent with the prior experience study for the six year period ending June 30, 2009, which was conducted by a prior actuary. At this time, we recommend no change to the assumed rates of disability retirements for JRS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



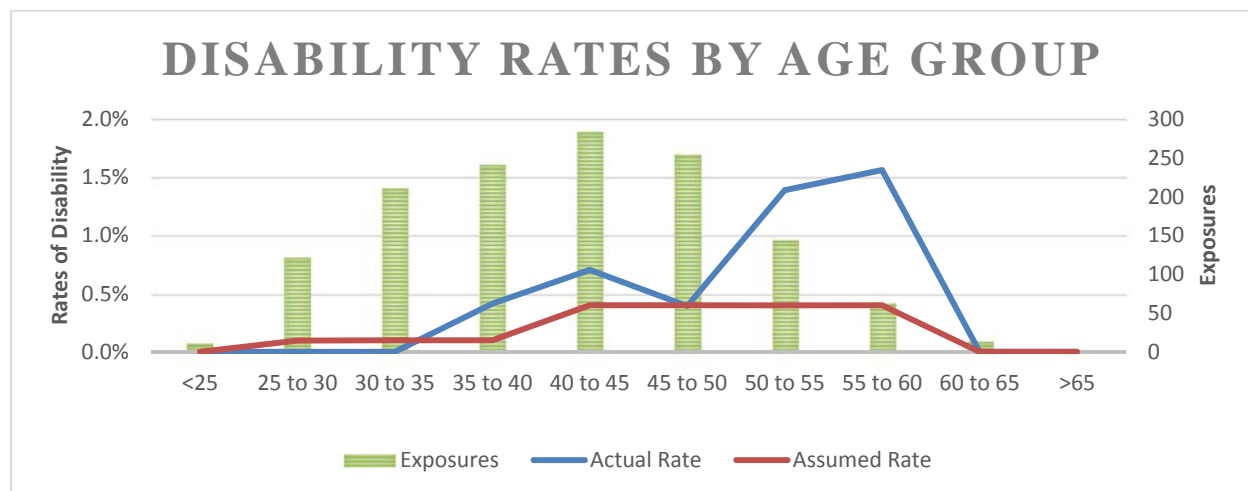


### Section III: Demographic Assumptions

#### **HPORS Members**

The analysis yields an actual/expected ratio of 196.1% over the experience period. A ratio of 196.1% indicates that the current assumption is underestimating the number of disability retirements. This finding is consistent with the last experience study for the six year period ending June 30, 2009, which was conducted by the prior actuary. At this time, we recommend no change to the assumed rates of disability retirements for HPORS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



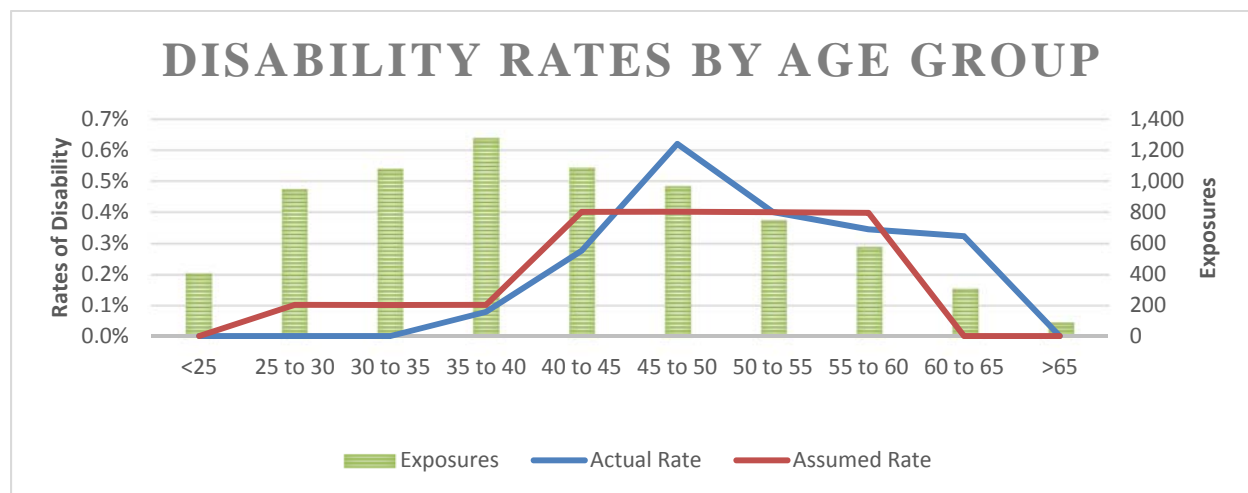


## Section III: Demographic Assumptions

### SRS Members

The analysis yields an actual/expected ratio of 95.0% over the experience period. A ratio of 95.0% indicates that the current assumption is overestimating the number of disability retirements. This finding is inconsistent with the last experience study conducted by a prior actuary in which the actual disability retirement exceeded the assumed number of retirements for the six year experience period ending June 30, 2009. At this time, we recommend no change to the assumed rates of disability retirements for SRS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



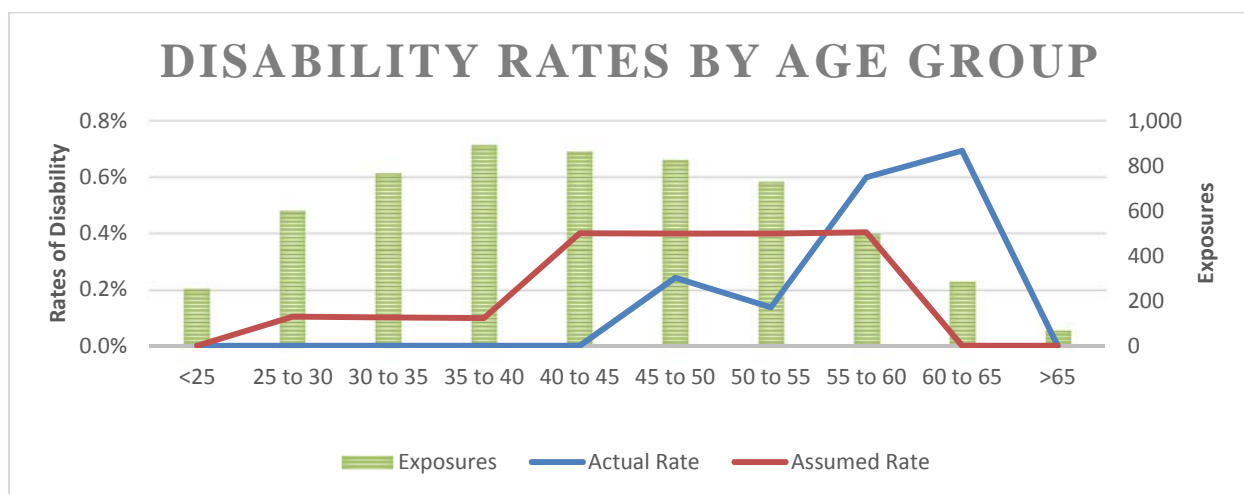


### Section III: Demographic Assumptions

#### **GWPORS Members**

The analysis yields an actual/expected ratio of 57.3% over the experience period. A ratio of 57.3% indicates that the overall current assumption is overestimating the number of disability retirements. This finding is consistent with the last experience study which was conducted by a prior actuary for the six year period ending June 30, 2009. At this time, we recommend no change to the assumed rates of disability retirements for GWPORS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.





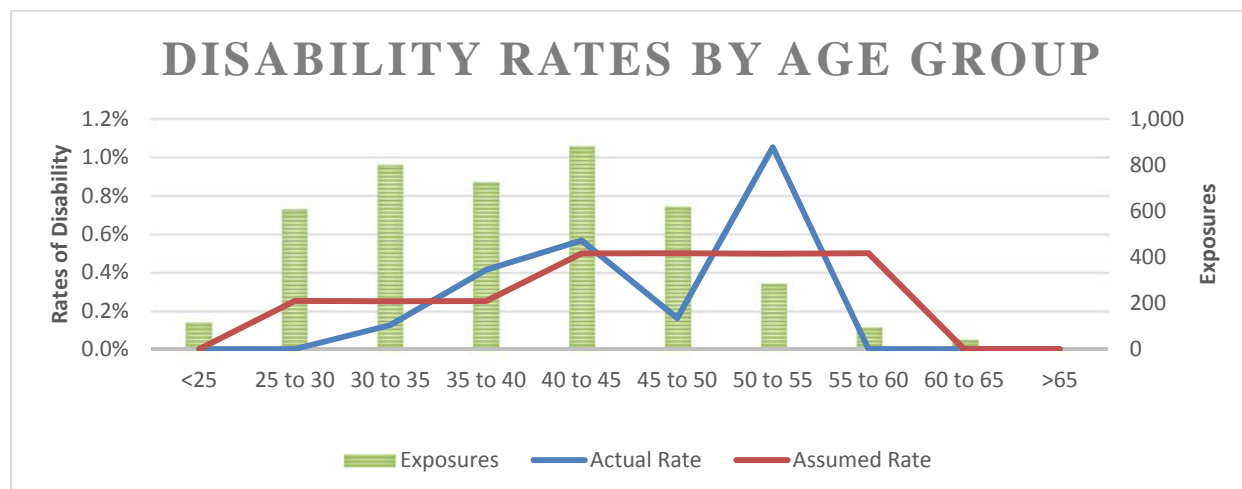


### Section III: Demographic Assumptions

#### **MPORS Members**

The analysis yields an actual/expected ratio of 88.2% over the experience period. A ratio of 88.2% indicates that the current assumption is overestimating the number of disability retirements. This finding is inconsistent with the last experience study prepared by the prior actuary for the six year period ending June 30, 2009, in which the number of disability retirements exceeded the assumed number of retirements. At this time, we recommend no change to the assumed rates of disability retirements for MPORS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



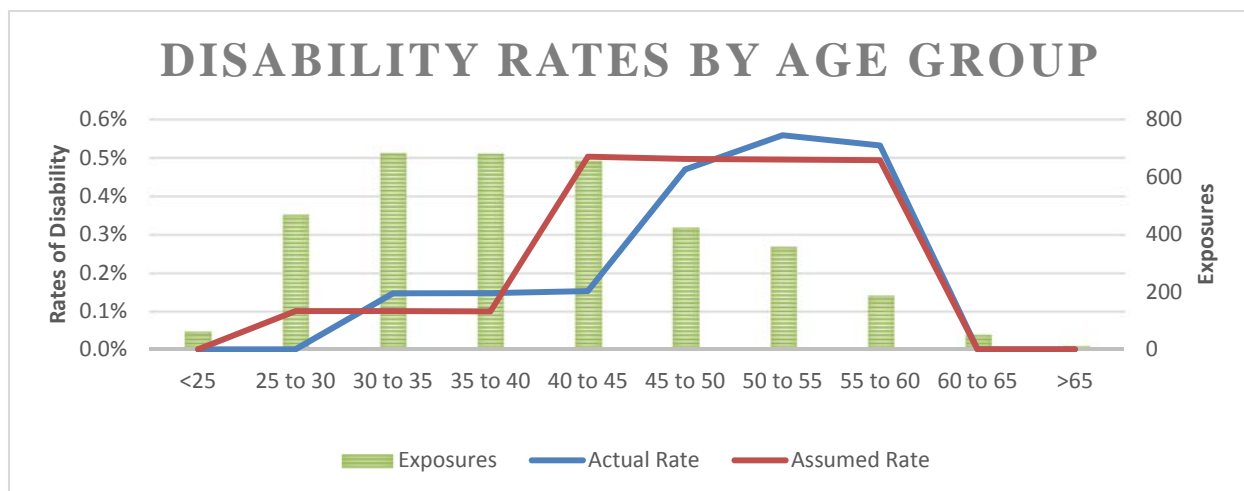


## Section III: Demographic Assumptions

### **FURS Members**

The analysis yields an actual/expected ratio of 80.3% over the experience period. A ratio of 80.3% indicates that the current assumption is overestimating the number of disability retirements. This finding is inconsistent with the last experience study conducted by the prior actuary for the six year period ending June 30, 2009, in which the number of disabled retirements exceeded the assumed number of retirements. At this time, we recommend no change to the assumed rates of disability retirements for FURS. This will allow us to have more experience with the valuation data from year to year and to determine if this behavior pattern will continue to persist or is an anomaly.

The chart below shows (i) the actual rates of disability for employees by age during the past six years, (ii) the current assumed rates of disability and (iii) the number of exposed lives at each age interval over the experience period.



### **VFCA Members**

Currently there is no assumption for the number of members who will become disabled under VFCA. This is consistent in that the VFCA has no disabled retirees in the member census data.



### RATES OF WITHDRAWAL

The rates of withdrawal are used to determine the expected number of separations from active service that will occur prior to attaining the eligibility requirement for a retirement benefit as a result of resignation or dismissal.

The current assumption utilizes a service based approach for all but JRS, which has no withdrawal assumption.

The table below shows the withdrawal experience for each of the Systems. In general there were more withdrawals during the experience periods, except for HPORS, which experienced less withdrawals than anticipated.

	Actual	Expected	A/E Ratio
PERS	14,771	12,221.17	120.9%
JRS	0	0.00	N/A
HPORS	42	53.60	78.4%
SRS	853	597.29	142.8%
GWPORS	676	519.2	130.2%
MPORS	269	230.87	116.5%
FURS	85	61.27	138.7%
VFCA	2,698	1,641.55	164.4%

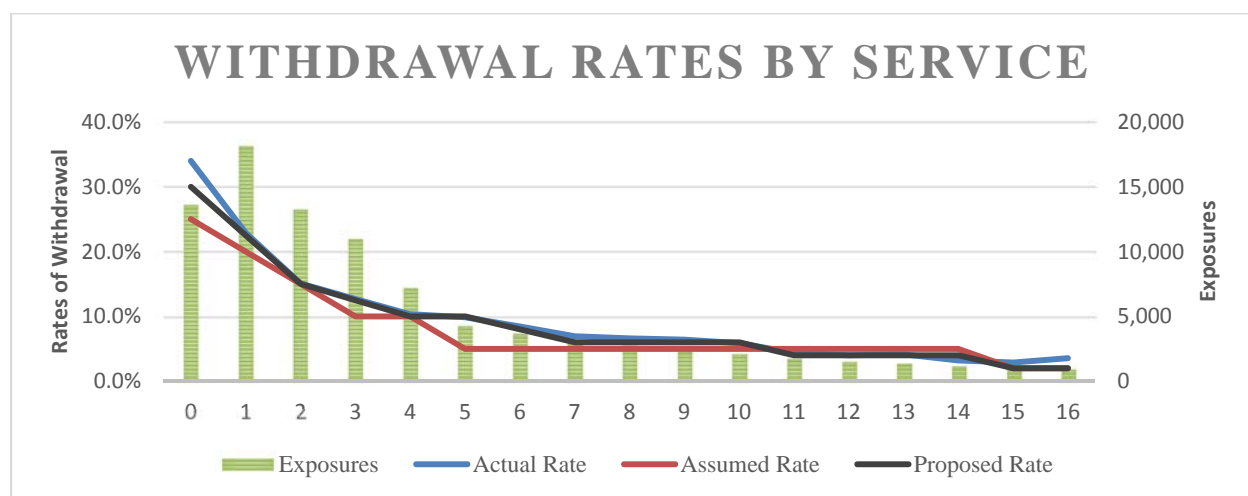


## Section III: Demographic Assumptions

### PERS Members

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 120.9%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. The data reflects a general increase in the rates of withdrawal. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal, (iii) the recommended assumed rates of withdrawal and (iv) the number of exposed lives at each year of service.



The actual/expected ratio based on the recommended assumption is 105.5% compared to 120.9% based on the current assumption.

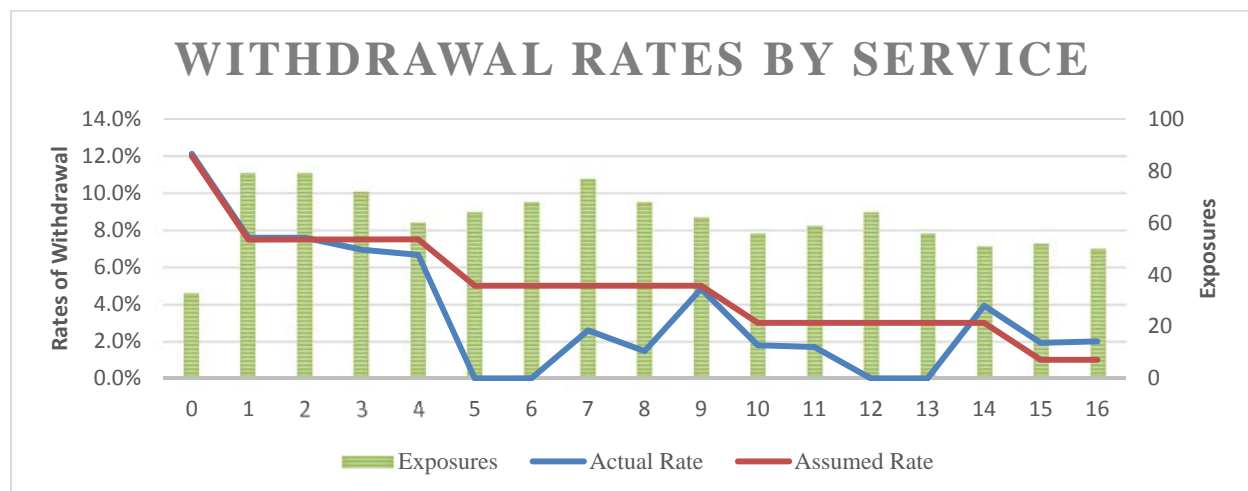


## Section III: Demographic Assumptions

### HPORS Members

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 78.4%. A ratio less than 100% indicates that there were less withdrawals than anticipated by the current assumption. This is consistent with the findings of the experience study conducted by the prior actuary for the six year period ending June 30, 2009. In general, the number of exposed lives at each year of service is relatively small, therefore we conclude the current assumed rates of withdrawal are sufficient in that any assumption for withdrawal for such a small group is likely to be inaccurate. We will continue to monitor withdrawal experience in future experience studies to determine if it warrants a change in the assumed rates of withdrawal for HPORS.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal and (iii) the number of exposed lives.



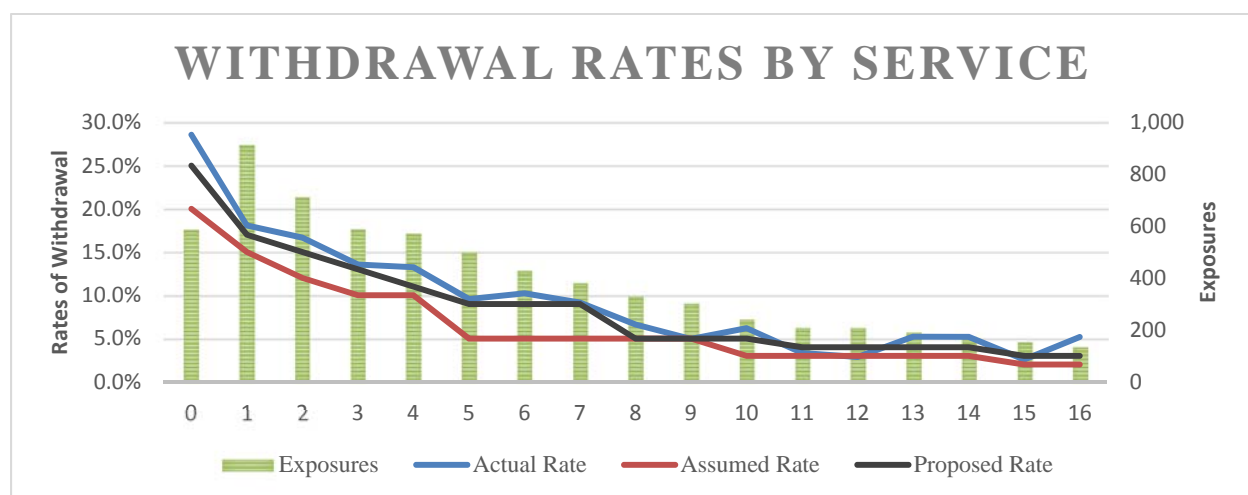


## Section III: Demographic Assumptions

### SRS Members

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 142.8%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. The data reflects a general increase in the rates of withdrawal. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal, (iii) the recommended assumed rates of withdrawal and (iv) the number of exposed lives at each year of service.



The actual/expected ratio based on the recommended assumption is 110.1% compared to 142.8% based on the current assumption.

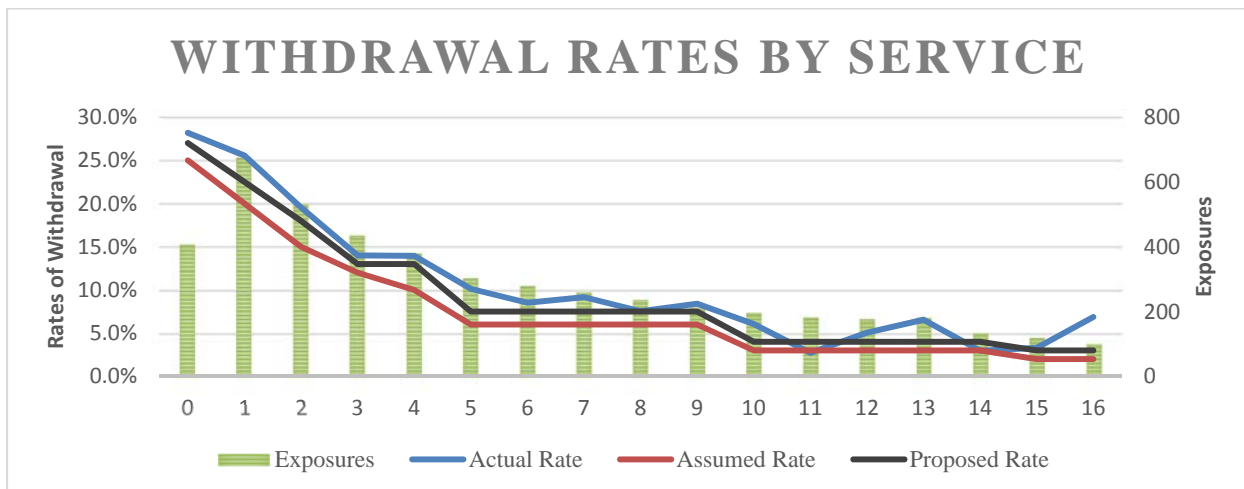


### Section III: Demographic Assumptions

#### **GWPORS Members**

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 130.2%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. The data reflects a general increase in the rates of withdrawal. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal (iii) the recommended assumed rates of withdrawal and (iv) the number of lives exposed to withdrawal.



The actual/expected ratio based on the recommended assumption is 110.8% compared to 130.2% based on the current assumption.

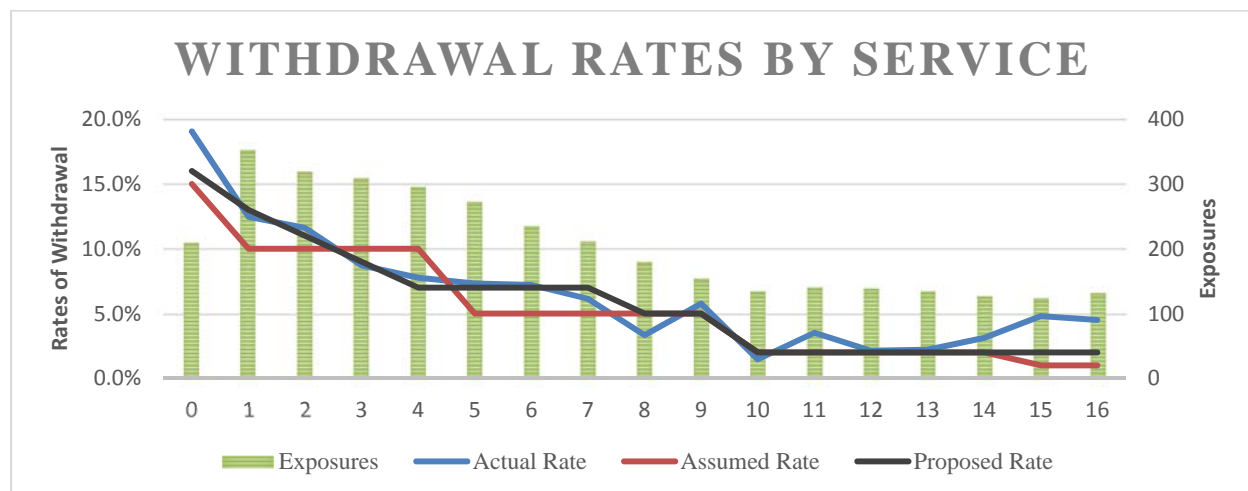


## Section III: Demographic Assumptions

### MPORS Members

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 116.5%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. The data reflects a general increase in the rates of withdrawal. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of termination for employees by service during the past six years, (ii) the current assumed rates of retirement (iii) the recommended assumed rates of withdrawal and (iv) the number of lives exposed to withdrawal.



The actual/expected ratio based on the recommended assumption is 104.9% compared to 116.5% based on the current assumption.



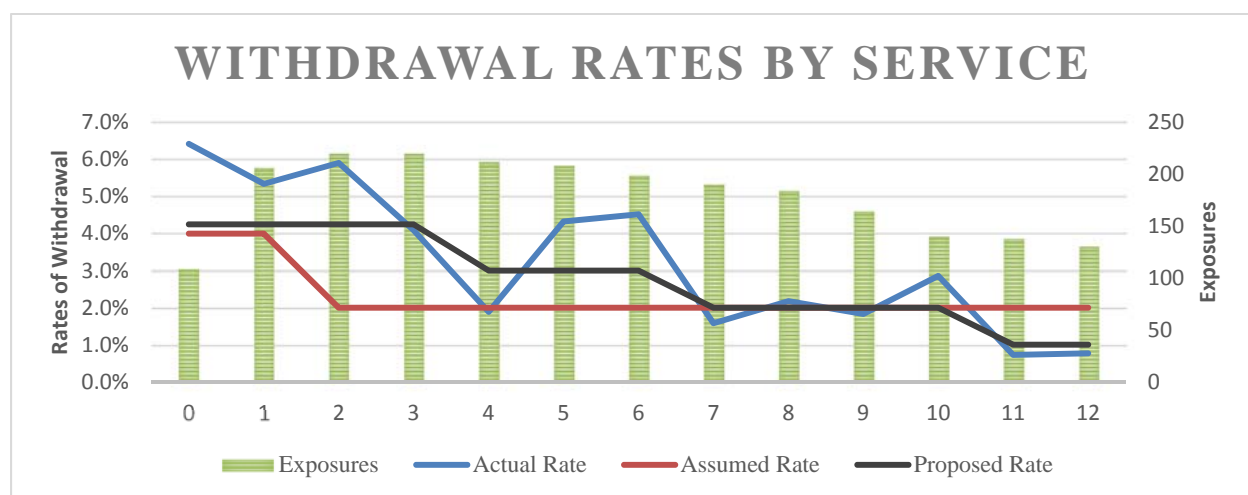


## Section III: Demographic Assumptions

### **FURS Members**

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 138.7%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. The data reflects a general increase in the rates of withdrawal. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal (iii) the recommended assumed rates of withdrawal and (iv) the number of live exposed to withdrawal.



The actual/expected ratio based on the recommended assumption is 114.9% compared to 138.7% based on the current assumption.

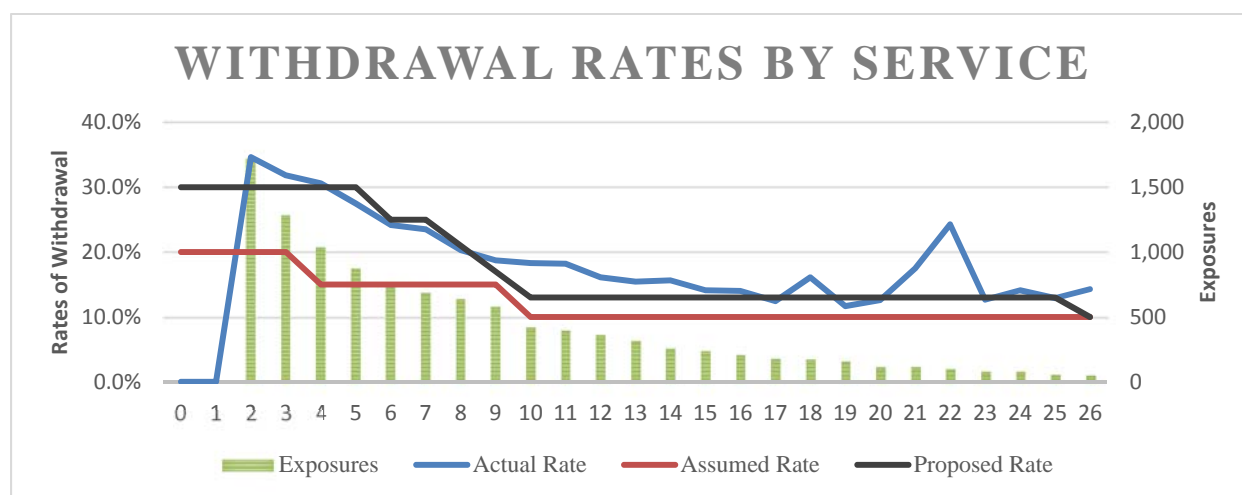


### Section III: Demographic Assumptions

#### **VFCA Members**

The analysis of actual withdrawals from active service yielded an actual/expected ratio of 164.4%. A ratio greater than 100% indicates that there were more withdrawals than anticipated by the current assumption. This is consistent with the findings of the last experience study conducted by the prior actuary for the six year period ending June 30, 2009. In general, the data reflects an increase in the rates of withdrawal. As a result, we recommend adjusting the withdrawal rates to more closely reflect actual experience. The complete tables of recommended withdrawal rates are shown in Appendix C.

The chart below shows (i) the actual rates of withdrawal for employees by service during the past six years, (ii) the current assumed rates of withdrawal, (iii) the recommended assumed rates of withdrawal and (iv) the number of live exposed to withdrawal.



The actual/expected ratio based on the recommended assumption is 106.9% compared to 164.4% based on the current assumption.



### RATES OF SALARY INCREASE

Under the “building block” approach recommended in ASOP 27, the salary increase assumption is composed of three components; inflation, productivity (real wage increases), and merit/promotion. The inflation and productivity components are combined to produce the assumed rates of wage inflation. The rate represents the “across the board” average annual increase in salaries shown in the experience data. The merit component includes the additional increases in salary due to performance, seniority, promotions, etc.

The VFCA is not a salary based benefit structure, therefore there is no assumption for salary increases members of VFCA.

The table below shows the actual/expected ratios for total salary increases over the six-year period. In general salary increases were less than anticipated over the experience period for all the Systems.

	Salaries End of Year (in thousands)		
	Actual	Expected	A/E Ratio
PERS	6,073,960	6,143,174	98.9%
JRS	34,995	35,532	98.5%
HPORS	76,506	77,899	98.2%
SRS	333,321	337,681	98.7%
GWPORS	219,852	223,042	98.6%
MPORS	221,052	222,494	99.4%
FURS	220,620	221,393	99.7%

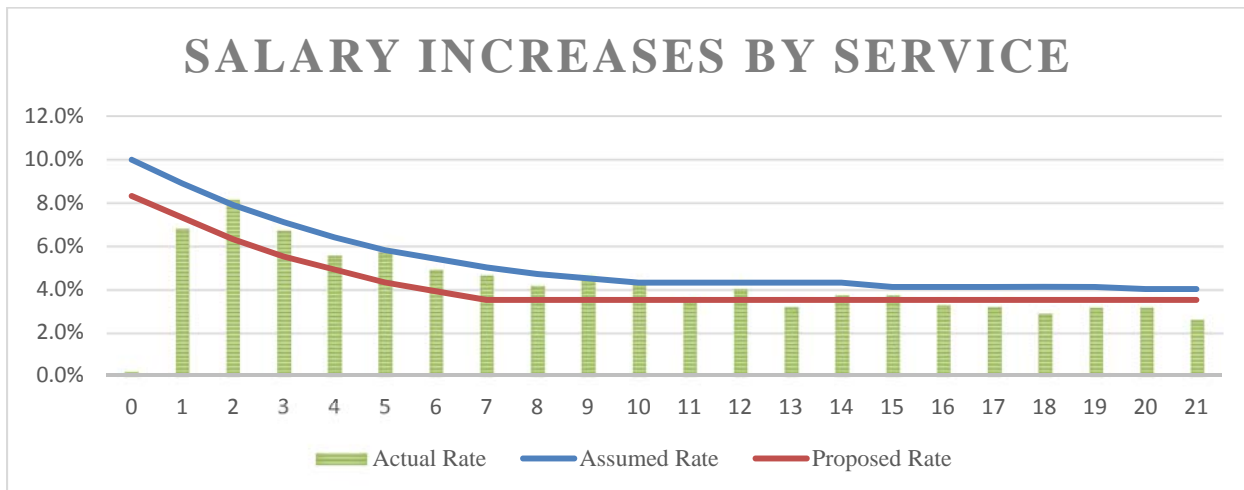


## Section III: Demographic Assumptions

### **PERS Members**

The analysis of salary increases yielded an actual/expected ratio of 98.9%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 99.7% compared to 98.9% based on the current assumption.

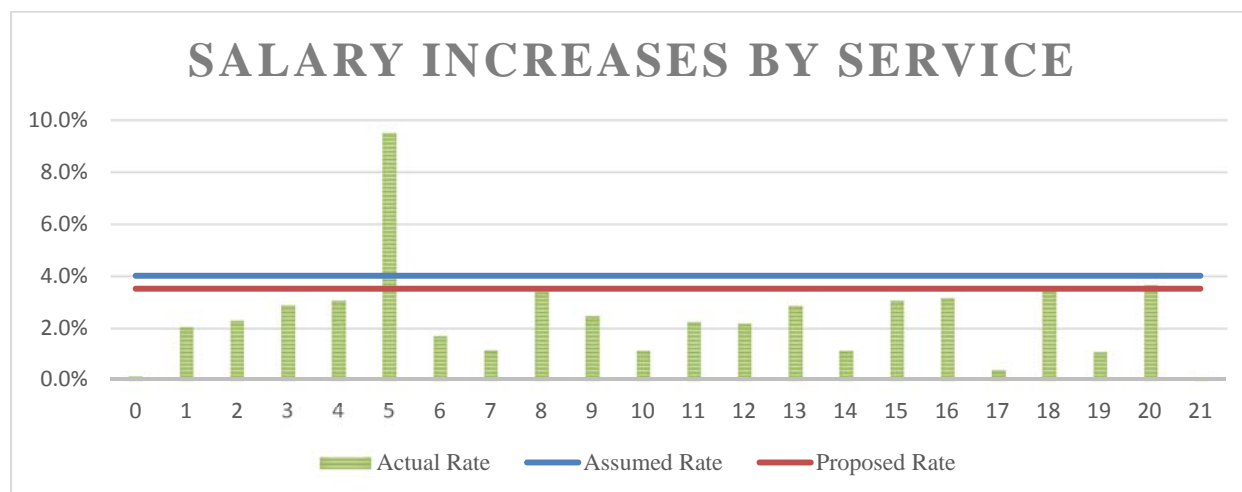


### Section III: Demographic Assumptions

#### **JRS Members**

The JRS assumed salary increase is based on the underlying wage inflation only. The analysis of salary increases yielded an actual/expected ratio of 98.5%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. We make no further recommended changes to the assumed rates of salary increases.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 99.0% compared to 98.5% based on the current assumption.

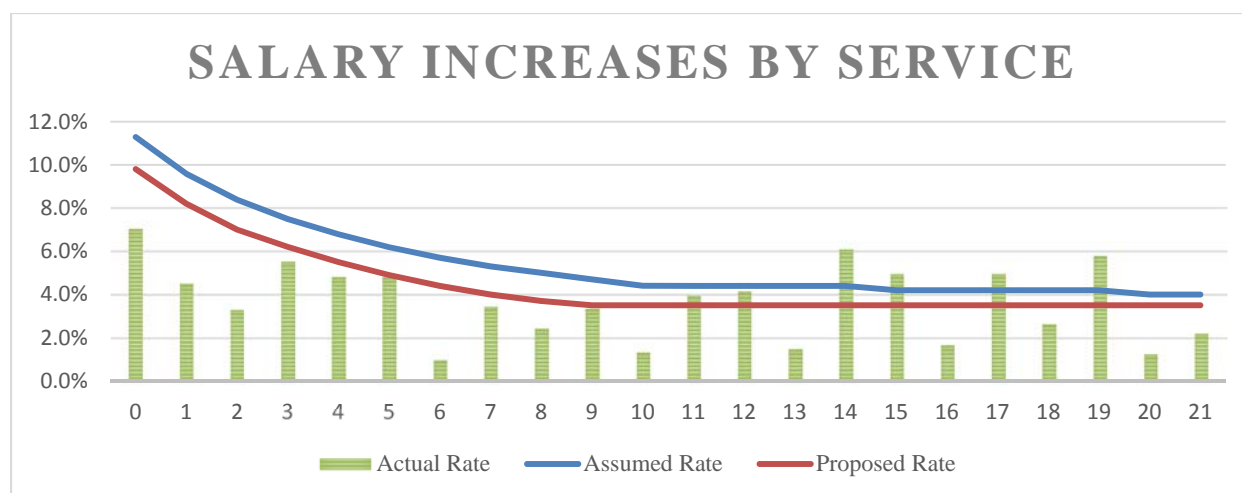


## Section III: Demographic Assumptions

### HPORS Members

The analysis of salary increases yielded an actual/expected ratio of 98.2%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 99.0% compared to 98.2% based on the current assumption.

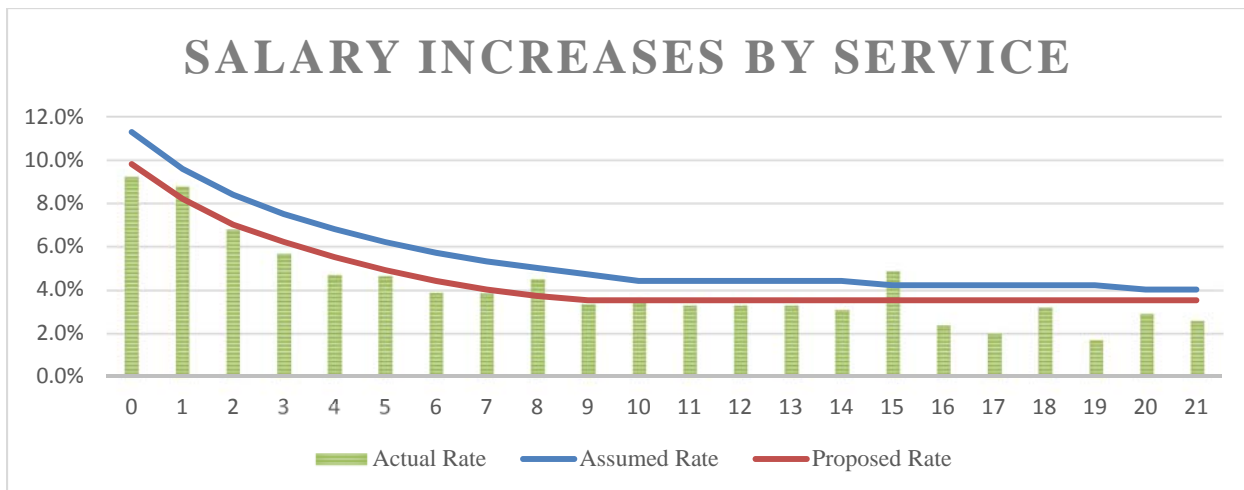


### Section III: Demographic Assumptions

#### **SRS Members**

The analysis of salary increases yielded an actual/expected ratio of 98.7%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 99.6% compared to 98.7% based on the current assumption.

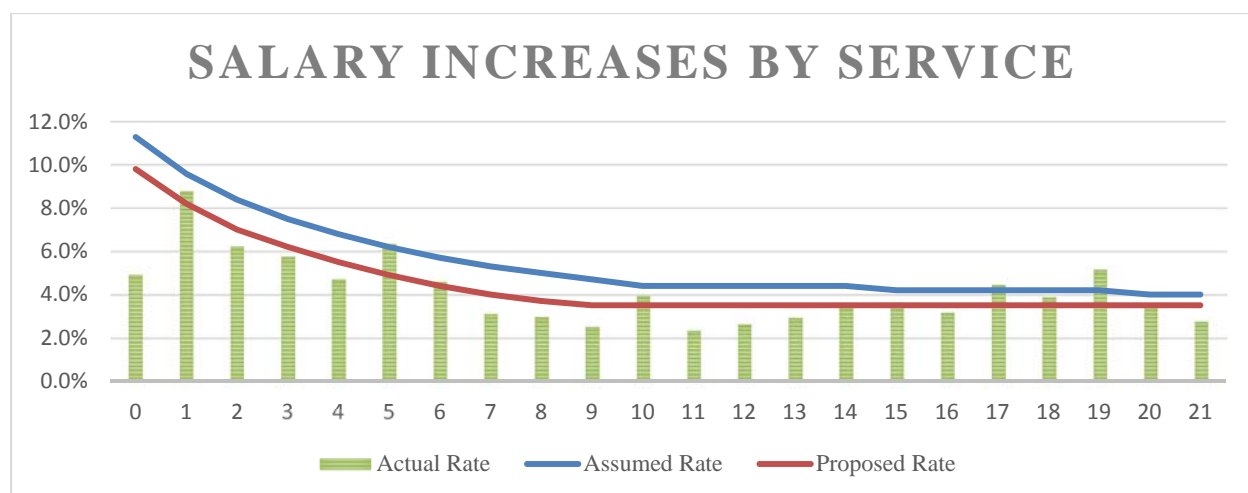


## Section III: Demographic Assumptions

### **GWPORS Members**

The analysis of salary increases yielded an actual/expected ratio of 98.6%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 99.4% compared to 98.6% based on the current assumption.



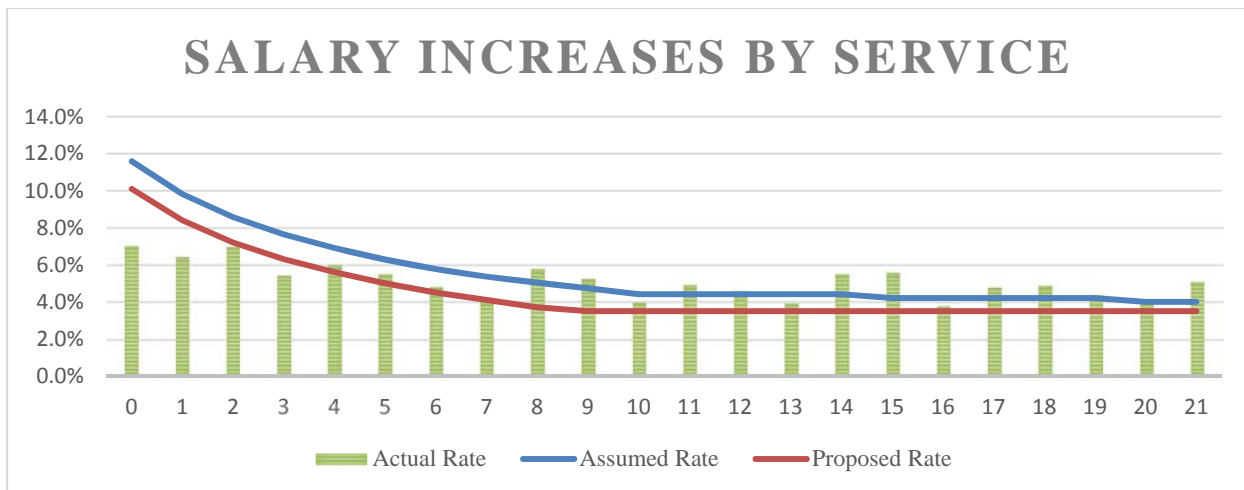


## Section III: Demographic Assumptions

### MPORS Members

The analysis of salary increases yielded an actual/expected ratio of 99.4%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 100.2% compared to 99.4% based on the current assumption.

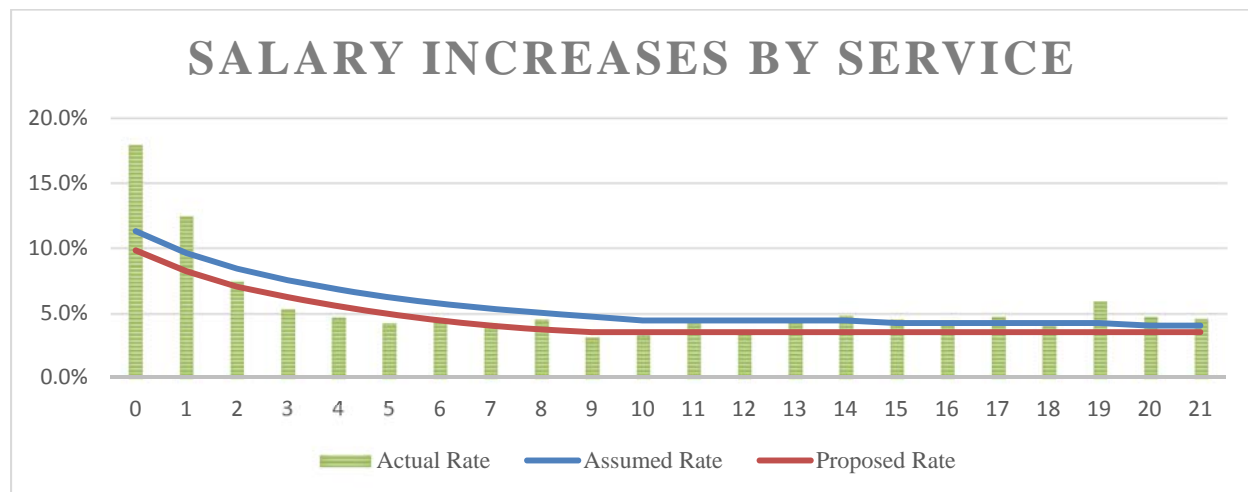


## Section III: Demographic Assumptions

### **FURS Members**

The analysis of salary increases yielded an actual/expected ratio of 99.7%. A ratio less than 100% indicates that salary increases in general were less than anticipated by the current assumption. This is partially due to the low inflation environment. In Section II of this report, we recommended lowering of the wage base component of the total salary increase assumption from 4.00% to 3.50%. In addition, we recommend adjusting the merit component of the salary scale assumption to reflect recent experience.

The chart below shows (i) the actual rates of salary increase for employees by service during the past six years, (ii) the current assumed rates of salary increases and (iii) the recommended assumed rates of salary increases.



The actual/expected ratio based on the recommended assumption is 100.5% compared to 99.7% based on the current assumption.



MISCELLANEOUS ASSUMPTIONS

Percent Married: Currently, 100% of members are assumed to be married with the husband three years older than the wife. This is a common and reasonable assumption and we recommend maintaining this assumption.

Probability of Electing a Refund of Member Contributions upon Termination: It is currently assumed that 100% of non-vested terminations elect a refund of their member contributions upon termination. Members who terminate after becoming vested, but prior to becoming eligible for a retirement benefit, may forfeit their vested right to a future retirement benefit in return for a lump sum payment equal to their accumulated employee contributions with interest. It is assumed that members of JRS who withdraw after becoming vested will not elect a refund of their employee contributions with interest.

The table below shows the withdrawal experience for each System. In general the number of refund requests for vested withdrawal members exceeded the assumption for all systems except for FURS.

At this time we do not recommend changing this assumptions. After comparing current experience with that from the last experience study conducted by the prior actuary for the six year period ending June 30, 2009, it is difficult to determine if the most recent experience is a trend that has been developing over a period of time or if this is a one-time anomaly. As a result, we will continue to monitor this experience in future experience studies to determine if an assumption change is warranted in the future.

	Actual	Expected	A/E Ratio
PERS	1,565	721.3	217.0%
HPORS	4	2.4	166.7%
SRS	108	79.1	136.5%
GWPORS	94	68.4	137.4%
MPORS	39	22.5	173.3%
FURS	5	7.7	64.9%



## ACTUARIAL METHODS

Actuarial valuations utilize methods to determine the liabilities, assets, and costs of the systems. While these are not like other assumptions that may change over time, an experience study is still a good opportunity to review these methods to see if they are still appropriate for systematically funding the promised benefits. Significant methods are described below.

**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 applies the entry age normal 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 in the use of this method.

**Actuarial Value of Assets:** 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 smoothing method that recognizes 25% of the difference between the assumed rate of return on the market value of assets and the actual rate of return on the market value of assets. We recommend no change to the current method at this time.

**Amortization Method:** The unfunded actuarial accrued liability is amortized using a level percentage of payroll method over the amortization period. The payroll growth assumption is used to determine the percentage of payroll required over the remaining amortization period to fully amortize the unfunded liability. The current wage inflation assumption is being changed from 4.00% to 3.50%. We recommend the same change for the payroll growth assumption be made.

**Interest on Member Contributions:** The assumed crediting rate on member contributions is 3.50% per year. We recommend lowering the assumed crediting rate on member contributions to 2.75% per year to be consistent with the proposed inflation assumption.



## Section IV: Actuarial Methods

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**Administrative Expense Load:** The current investment return assumption is net of investment expenses only. As a result, administrative expenses are recognized by an additional amount added to the normal cost contribution rate for all the systems. We recommend these amounts to be independent for each system and vary from year to year based on the prior year's actual administrative expenses of each system. The table below shows the impact of each of the systems as of June 30, 2016.

Retirement Plan	Before Changes	After Changes
Public Employees' Retirement System	0.27%	0.27%
Public Employees' Retirement System Long-Term Disability Plan	0.00%	0.00%
Judges' Retirement System	0.15%	0.17%
Sheriffs' Retirement System	0.17%	0.19%
Game Wardens' and Peace Officers' Retirement System	0.17%	0.17%
Highway Patrol Officers' Retirement System	0.23%	0.28%
Municipal Police Officers' Retirement System	0.20%	0.22%
Firefighters' United Retirement System	0.19%	0.21%
Volunteer Firefighters' Compensation Act	\$65,978	\$89,298



**HISTORICAL JUNE CPI (U) INDEX**

Year	CPI (U)	Year	CPI (U)
1965	31.60	1991	140.20
1966	32.40	1992	144.40
1967	33.30	1993	148.00
1968	34.70	1994	152.50
1969	36.60	1995	156.70
1970	38.80	1996	160.30
1971	40.60	1997	163.00
1972	41.70	1998	166.20
1973	44.20	1999	172.40
1974	49.00	2000	178.00
1975	53.60	2001	179.90
1976	56.80	2002	183.70
1977	60.70	2003	189.70
1978	65.20	2004	194.50
1979	72.30	2005	202.90
1980	82.70	2006	208.35
1981	90.60	2007	218.82
1982	97.00	2008	215.69
1983	99.50	2009	217.96
1984	103.70	2010	217.97
1985	107.60	2011	225.72
1986	109.50	2012	229.48
1987	113.50	2013	233.50
1988	118.00	2014	238.34
1989	124.10	2015	238.64
1990	136.00	2016	241.02

**SOCIAL SECURITY ADMINISTRATION WAGE INDEX**

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1957	\$3,641.72		1987	18,426.51	6.38%
1958	3,673.80	0.88%	1988	19,334.04	4.93
1959	3,855.80	4.95	1989	20,099.55	3.96
1960	4,007.12	3.92	1990	21,027.98	4.62
1961	4,086.76	1.99	1991	21,811.60	3.73
1962	4,291.40	5.01	1992	22,935.42	5.15
1963	4,396.64	2.45	1993	23,132.67	0.86
1964	4,576.32	4.09	1994	23,753.53	2.68
1965	4,658.72	1.80	1995	24,705.66	4.01
1966	4,938.36	6.00	1996	25,913.90	4.89
1967	5,213.44	5.57	1997	27,426.00	5.84
1968	5,571.76	6.87	1998	28,861.44	5.23
1969	5,893.76	5.78	1999	30,469.84	5.57
1970	6,186.24	4.96	2000	32,154.82	5.53
1971	6,497.08	5.02	2001	32,921.92	2.39
1972	7,133.80	9.80	2002	33,252.09	1.00
1973	7,580.16	6.26	2003	34,064.95	2.44
1974	8,030.76	5.94	2004	35,648.55	4.65
1975	8,630.92	7.47	2005	36,952.94	3.66
1976	9,226.48	6.90	2006	38,651.41	4.60
1977	9,779.44	5.99	2007	40,405.48	4.54
1978	10,556.03	7.94	2008	41,334.97	2.30
1979	11,479.46	8.75	2009	40,711.61	-1.51
1980	12,513.46	9.01	2010	41,673.83	2.36
1981	13,773.10	10.07	2011	42,979.61	3.13
1982	14,531.34	5.51	2012	44,321.67	3.12
1983	15,239.24	4.87	2013	44,888.16	1.28
1984	16,135.07	5.88	2014	46,481.52	3.55
1985	\$16,822.51	4.26	2015	48,098.63	3.48
1986	\$17,321.82	2.97			



**MONTANA PUBLIC EMPLOYEE'S RETIREMENT SYSTEM**

**SUMMARY OF RECOMMENDED ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth rate of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	4.8%
1 – 2	3.8
2 – 3	2.8
3 – 4	2.0
4 – 5	1.4
5 – 6	0.8
6 – 7	0.4
7 – 8	0.0
8 & Over	0.0

**Payroll Growth:** 3.50% per year





**MONTANA PUBLIC EMPLOYEE'S RETIREMENT SYSTEM**

**Demographic Assumptions**

**Retirement Rates:**                      Sample rates per 1,000 members

<u>Age</u>	<u>Less than 30 years of service</u>	<u>30 or more years of service or age 60 25 years of service</u>
<50	0	100
50-54	30	100
55	30	150
56	40	150
57	50	150
58	50	150
59	60	150
60	80	150
61	150	150
62	250	250
63	150	150
64	150	150
65	300	300
66	300	300
67	250	250
68	250	250
69	250	250
70 &	1,000	1,000



**MONTANA PUBLIC EMPLOYEE’S RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

**Disability Rates:**

Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	0.1
32	0.1
37	0.4
42	1.0
47	1.3
52	2.5
57	3.6
60	0.0
62	0.0



**MONTANA PUBLIC EMPLOYEE'S RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:**

Sample withdrawal rates per 1000 members

<u>Service</u>	<u>Members</u> <u>Rates of</u>
0 – 1	300
1 – 2	225
2 – 3	150
3 – 4	125
4 – 6	100
6 – 7	80
7 – 11	60
11 – 15	40
15 & Over	20

**Marital Status:**

Percentage Married

100%

Age difference

Males are assumed to be three years older than spouses.

**Form of Payment:**

Participants are assumed to elect a life-only form of payment.



**JUDGES' RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Increase 3.50% yearly (based on an annual inflation rate of 2.75% and 0.75% wage growth) with no increases assumed for merit and seniority.

**Demographic Assumptions**

Retirement Rates: Sample rates per 1,000 members

<u>Age</u>	<u>Rates</u>
60	150
61	50
62	50
63	50
64	50
65	150
66	50
67	50
68	50
69	50
70 & Over	1,000



**JUDGES' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

**Disability Rates:**

Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	0.0
32	0.1
37	0.4
42	1.0
47	1.3
52	2.5
57	3.6
60	0.0
62	0.0



**JUDGES' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:**

No termination are assumed other than for retirement, death or disability.

**Marital Status:**

Percentage Married

100%

Age difference

Males are assumed to be four years older than spouses.

**Form of Payment:**

Participants are assumed to elect a life-only form of payment.



**SHERIFFS' RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	6.3%
1 – 2	4.7
2 – 3	3.5
3 – 4	2.7
4 – 5	2.0
5 – 6	1.4
6 – 7	0.9
7 – 8	0.5
8 – 9	0.2
9 & Over	0.0

**Payroll Growth:** 3.50% per year



**SHERIFFS' RETIREMENT SYSTEM**

**Demographic Assumptions**

Retirement Rates:                      Sample rates per 1,000 members

<u>Age</u>	<u>Rates</u>
< 55	100
55 – 59	150
60 – 64	200
65 & Over	1,000

**Mortality Rates**

Active participants                      RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

Disabled pensioners                      RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.

Retired Healthy pensioners              RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

**Disability Rates:**                      Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	1.0
32	1.0
37	1.0
42	4.0
47	4.0
52	4.0
57	4.0
62	0.0





**SHERIFFS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:** Sample withdrawal rates per 1000 members

<u>Service</u>	<u>Members Rates of Termination</u>
0 – 1	250
1 – 2	170
2 – 3	150
3 – 4	130
4 – 5	110
5 – 8	90
8 – 11	50
11 – 15	40
15 & Over	30

**Marital Status:**

Percentage Married 100%

Age difference Males are assumed to be three years older than spouses.

**Form of Payment:** Participants are assumed to elect a life-only form of payment.



**GAME WARDENS' AND PEACE OFFICERS' RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	6.3%
1 – 2	4.7
2 – 3	3.5
3 – 4	2.7
4 – 5	2.0
5 – 6	1.4
6 – 7	0.9
7 – 8	0.5
8 – 9	0.2
9 & Over	0.0

**Payroll Growth:** 3.50% per year



**GAME WARDENS' AND PEACE OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions**

Retirement Rates:

Sample rates per 1,000 members

<u>Age</u>	<u>Age 55 with 5 years of service</u>	<u>Age 55 with 20 years of service</u>
<50	N/A	0
50 – 54	N/A	150
55	150	250
56 – 59	50	250
60 – 61	150	150
62	400	400
63 – 64	150	150
65 & Over	1,000	1,000

**Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.



**GAME WARDENS' AND PEACE OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Disability Rates:**

Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	1.0
32	1.0
37	1.0
42	4.0
47	4.0
52	4.0
57	4.0
62	0.0



**GAME WARDENS' AND PEACE OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:**

Sample withdrawal rates per 1,000 members

<u>Service</u>	<u>Members Rates of Termination</u>
0 – 1	270
1 – 2	225
2 – 3	180
3 – 5	130
5 – 10	75
10 – 15	40
15 – 20	30
20 & Over	20

**Marital Status:**

Percentage Married

100%

Age difference

Males are assumed to be three years older than spouses.

**Form of Payment:** Participants are assumed to elect a life-only form of payment.



**HIGHWAY PATROL OFFICERS' RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	6.3%
1 – 2	4.7
2 – 3	3.5
3 – 4	2.7
4 – 5	2.0
5 – 6	1.4
6 – 7	0.9
7 – 8	0.5
8 – 9	0.2
9 & Over	0.0

**Payroll Growth:** 3.50% per year



## HIGHWAY PATROL OFFICERS' RETIREMENT SYSTEM

### Demographic Assumptions

Retirement Rates:                      Sample rates per 1,000 members

<u>Age</u>	<u>Rates</u>
< 50	120
50 – 54	160
55 – 59	200
60 & Over	1,000

### **Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.



**HIGHWAY PATROL OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Disability Rates:**

Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	1.0
32	1.0
37	1.0
42	4.0
47	4.0
52	4.0
57	4.0
62	0.0





**HIGHWAY PATROL OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:**

Sample withdrawal rates per 1,000 members

<u>Service</u>	<u>Members Rates of Termination</u>
0 – 1	120
1 – 4	75
4 – 10	50
10 – 15	30
15 & Over	10

**Marital Status:**

Percentage Married

100%

Age difference

Males are assumed to be three years older than spouses.

**Form of Payment:**

Participants are assumed to elect a life-only form of payment.



**MUNICIPAL POLICE OFFICERS' RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	6.6%
1 – 2	4.9
2 – 3	3.7
3 – 4	2.8
4 – 5	2.1
5 – 6	1.5
6 – 7	1.0
7 – 8	0.6
8 – 9	0.2
9 & Over	0.0

**Payroll Growth:** 3.50% per year



**MUNICIPAL POLICE OFFICERS’ RETIREMENT SYSTEM**

**Demographic Assumptions**

Retirement Rates:	Sample rates per 1,000 members		
	<u>Age</u>	<u>Less than 20 years of service</u>	<u>20 or more years of</u>
	<50	0	120
	50 – 54	0	150
	55 – 61	0	200
	62 – 64	0	1,000
	65 & Over	1,000	1,000

**Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.



**MUNICIPAL POLICE OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Disability Rates:**

Sample disability rates per 1000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	2.5
32	2.5
37	5.0
42	5.0
47	5.0
52	5.0
57	5.0
62	0.0



**MUNICIPAL POLICE OFFICERS' RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:**

Sample withdrawal rates per 1000 members

<u>Service</u>	<u>Members Rates of Termination</u>
0 – 1	160
1 – 2	130
2 – 3	110
3 – 4	90
4 – 8	70
8 – 10	50
10 & Over	20

**Marital Status:**

Percentage Married                      100%

Age difference                              Males are assumed to be three years older than spouses.

**Form of Payment:**    Participants are assumed to elect a life-only form of payment.



**FIREFIGHTERS' UNIFIED RETIREMENT SYSTEM**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

**Investment Return:** 7.65% net of investment expenses per annum, compounded annually

**Salary Increases:** Sample rates below, plus an annual inflation rate of 2.75% and wage growth of 0.75%:

<u>Service Years</u>	<u>Annual Merit Increase</u>
0 – 1	6.3%
1 – 2	4.7
2 – 3	3.5
3 – 4	2.7
4 – 5	2.0
5 – 6	1.4
6 – 7	0.9
7 – 8	0.5
8 – 9	0.2
9 &	0.0

**Payroll Growth:** 3.50% per year



## FIREFIGHTERS' UNIFIED RETIREMENT SYSTEM

### Demographic Assumptions

Retirement Rates:

Sample rates per 1,000 members

<u>Age</u>	<u>Rates</u>
< 50	50
50 – 54	100
55 – 59	250
60 – 62	500
63 & Over	1,000



**FIREFIGHTERS’ UNIFIED RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Mortality Rates**

Active participants	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.
Disabled pensioners	RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.
Retired Healthy pensioners	RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

**Disability Rates:**

Sample disability rates per 1,000 members

Nearest	
<u>Age</u>	<u>Male</u>
22	0.0
27	1.0
32	1.0
37	1.0
42	5.0
47	5.0
52	5.0
57	5.0
62	0.0





**FIREFIGHTERS' UNIFIED RETIREMENT SYSTEM**

**Demographic Assumptions (continued)**

**Withdrawal Rates:** Sample withdrawal rates per 1,000 members

<u>Service</u>	<u>Members Rates of</u>
0 – 4	42.5
4 – 7	30
7 – 11	20
11 & Over	10

**Marital Status:**

Percentage Married	100%
Age difference	Males are assumed to be three years older than spouses.

**Form of Payment:** Participants are assumed to elect a life-only form of payment.



**VOLUNTEER FIREFIGHTERS’ COMPENSATION ACT**

**SUMMARY OF ACTUARIAL ASSUMPTIONS**

**Economic Assumptions**

Investment Return: 7.65% net of investment expenses per annum, compounded annually

**Demographic Assumptions**

Retirement Rates: Sample rates per 1,000 members

Age	10 – 19 years of service	20 or more years of
<55	0	0
55 – 59	0	400
60 – 69	200	400
70 & Over	1,000	1,000

**Mortality Rates**

Active participants RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

Disabled pensioners RP-2000 Combined Employee and Annuitant Mortality Tables with no projections.

Retired Healthy pensioners RP-2000 Combined Employee and Annuitant Mortality Projected to 2020 using Scale BB, set back one year for males.

**Disability Rates:** None



## VOLUNTEER FIREFIGHTERS' COMPENSATION ACT

### Demographic Assumptions (continued)

**Withdrawal Rates:** Sample withdrawal rates per 1,000 members

<u>Service</u>	<u>Members Rates of Termination</u>
0 – 6	300
6 – 8	250
8 – 9	210
9 – 10	170
10 – 26	130
26 & Over	100

### **Marital Status:**

Percentage Married	100%
Age difference	Males are assumed to be three years older than spouses.

**Form of Payment:** Participants are assumed to elect a life-only form of payment.