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OKLAHOMA PUBLIC EMPLOYEES RETIREMENT SYSTEM

Experience Study

For the Three-Year Period

Ending June 30, 2016

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April 13, 2017

Board of Trustees
Oklahoma Public Employees Retirement System
5801 N. Broadway Extension, Suite 400
P.O. Box 53007
Oklahoma City, OK 73152-3007

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). The purpose of this investigation is to assess the reasonability of the actuarial assumptions for the System. This investigation covers the three-year period from July 1, 2013 to June 30, 2016. As a result of the investigation, it is recommended that revised assumptions be adopted by the Board for future use.

The experience study includes all active and retired members, including OPERS regular members, elected officials, hazardous duty members, and URSJJ members. The mortality and disability experience was studied separately for males and females. Incidences of retirement and compensation increases were investigated without regard to gender. The withdrawal assumption was studied for males and females, but was concluded to be similar enough that a unisex assumption could be used.

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 recommended decrement tables are shown in Appendix D of this report for OPERS and Appendix E for URSJJ. 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. Once the assumptions have been adopted, the actuarial valuation measures the adequacy of the statutory contribution rates.

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 meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Respectfully submitted,

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Principal and Consulting Actuary

Brent Banister, PhD, FSA, EA, FCA, MAAA
Chief Pension Actuary

Summary of Results

The following summarizes the findings and recommendations with regard to the assumptions utilized by the Oklahoma Public Employees Retirement System. Explanations for the recommendations are found in the sections that follow.

Recommended Economic Assumption Changes

The table below lists the three economic assumptions used in the actuarial valuation and their current and proposed rates. Our investment return assumption as of the last experience study was 7.50%, however the Board recommended a decrease to 7.25% as of the June 30, 2016 actuarial valuation. We are recommending a decrease in the price inflation assumption from 3.00% to 2.75% and, therefore, a decrease in the assumed investment return assumption to 7.00%. We also recommend a change in the real wage growth assumption from 1.00% to 0.75%.

Item	Current	Proposed
Price Inflation	3.00%	2.75%
Investment Return	7.25%	7.00%
Real Wage Growth	1.00%	0.75%

Recommended Demographic Assumption Changes

The table below lists the demographic assumptions that we recommend be changed based on the experience of the last three years.

Assumption Changes
OPERS
Adjust rates of mortality
Adjust rates of withdrawal
Decrease rates of disability retirements
Adjust probability of electing a vested benefit
Adjust salary scale
Adjust rates of retirement
URSJJ
Adjust rates of mortality
Decrease salary scale
Adjust rates of retirement

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Recommended Method Changes

We do not recommend any changes in the actuarial methods.

Financial Impact

The table below highlights the impact on the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ) if the proposed assumptions are adopted. The table shows the change in the unfunded accrued liability (UAL), funded ratio and employer contribution rate for both Plans of the System as of June 30, 2016.

	Before Changes	After Assumption Changes
OPERS		
Unfunded Actuarial Accrued Liability	$636,923,587	$886,691,000
Funded Ratio	93.2%	90.8%
Employer Contribution Rate	10.07%	11.82%
URSJJ		
Unfunded Actuarial Accrued Liability	($29,822,672)	($26,157,912)
Funded Status	110.8%	109.3%
Employer Contribution Rate	10.52%	9.51%

Economic Assumptions

There are three economic assumptions used in performing the actuarial valuation for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). The assumptions are:

- Price Inflation
- Investment Return
- Wage Inflation

Unlike demographic assumptions, economic assumptions do not lend themselves to analysis largely on the basis of internal historical patterns because economic assumptions are impacted by external forces in the economy. The investment return and general wage increase assumptions are selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for inflation, called the "building block" approach.

Sources of data considered in the analysis and selection of the economic assumptions included:
- The 2016 Social Security Trustees Report
- Future expectations of OPERS investment consultant, Verus
- Future expectations of other investment consultants (2016 Horizon Survey)
- 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 (NASRA)
- Historical observations of price and wage growth statistics and investment returns

Actuarial Standard of Practice Number 27

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 best an actuary can do is to use professional judgment to estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment.

ASOP 27 requires 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.

With respect to relevant data, 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 developing assumptions for future periods due to changes in the underlying environment. 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.

The standard also discusses a "range of reasonable assumptions" which in part states "the actuary should also recognize that different actuaries will apply 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 the System. In our opinion, the economic assumptions proposed in this report have been developed in accordance with ASOP No. 27.

The following table summarizes the current and proposed economic assumptions:

	Current Assumptions	Proposed Assumptions
Price Inflation	3.00%	2.75%
Investment Return	7.25%	7.00%
Real Wage Growth	1.00%	0.75%
Payroll Growth	4.00%	3.50%

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, general wage growth (which then impacts individual salary increases), and payroll growth.

Inflation also has a direct impact on the valuation results. 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 which was recommended and adopted in the last experience study.

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 December 31st. More complete data is shown in Appendix A.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2016	90	2.94%	3.83%
1956 – 2016	60	3.70	2.75
1966 – 2016	50	4.09	2.82
1976 – 2016	40	3.66	2.77
1986 – 2016	30	2.65	1.22
1996 – 2016	20	2.15	1.04
2006 - 2016	10	1.76	1.29

The following graph illustrates the historical annual change in price inflation, measured as of December 31 for each of the last 70 years, as well as the thirty year rolling average.

Price Inflation
CPI-U
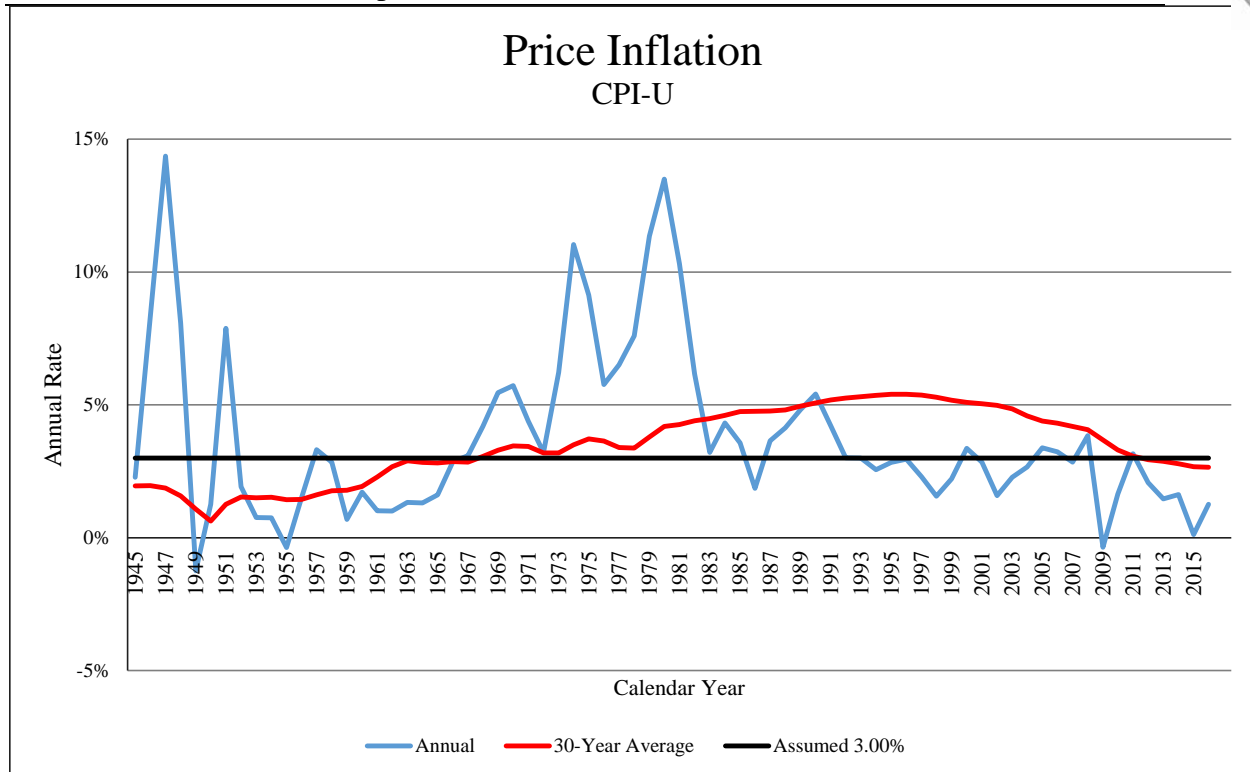
Over more recent periods, measured from December 31, 2016, the average annual rate of increase in the CPI-U has been below the current assumption of 3.00%. The period of high inflation from 1973 to 1982 has a significant impact on the averages over periods which include these rates. It is difficult to ignore the steady decline in inflation shown in the data above.

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 2.1% 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 returns to the higher rates observed historically remains to be seen.

OPERS' investment consultant, Verus, also has an inflation forecast in their capital market assumptions. Their short-term assumption (10 years) is 2.11%.

Social Security Projections

Although many economists forecast lower inflation than the assumptions used by retirement systems, they are generally looking at a shorter time horizon (10 years) 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 2.6%, under the intermediate (best estimate) cost assumption. The range of price inflation used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.0% to 3.2%.

Peer System Comparison

While we do not recommend the selection of any assumption based on what other systems use, it does provide another set of relevant information to consider. According to the Public Plan Database (a survey of over 150 state and local retirement systems maintained by a collaboration between the Center for Retirement Research at Boston College, the Center for State and Local Government Excellence, and the National Association of State Retirement Administrators) the average inflation assumption for statewide systems has been steadily declining. As of the most recent study, the most common assumption is 3.00%, which is consistent with OPERS' current assumption. However, the survey is based on valuations that are almost entirely from 2013 or 2014. Based on our experience we believe that further declines have occurred for many systems in the last two years.

Conclusion: The current inflation assumption is 3.0%. While actuarial standards caution against assigning too much weight to recent experience, multiple factors lead us to believe the current inflation assumption should be reduced. Actual inflation for the last 30 years has been 2.65%. The bond markets reflect an expectation of inflation well below 3.0%, the inflation assumption used by the Chief Actuary of the Social Security Administration in their 75-year projections is 2.6%, Verus's 10-year inflation assumption is 2.11%, and the median long-term inflation assumption in the Horizon Actuarial Survey is 2.31%. We believe that many of these opinions are influenced by the short-term outlook, while we are focused on the longer term. Based on this information, **we recommend a reduction in the inflation assumption from 3.00% 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 anticipated returns on the current and future assets. It is one of the primary determinants in the calculation of the expected cost of the System's benefits, providing a discount of the estimated future benefit payments to reflect the time value of money. This assumption has a direct impact on the calculation of liabilities, normal costs, and contribution rates. 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 inflation rate, and any investment expenses, but is also impacted by the dynamics of the system along with the risk tolerance and preferences of the Board.

The current investment return assumption is 7.25% per year, net of all investment-related and administrative expenses. The investment assumption in our last experience study was 7.50% and the Board recommended a decrease to 7.25% as of the June 30, 2016 actuarial valuation. The 7.25% rate of return is referred to as the nominal rate of return and is composed of two components. The first component is price inflation (previously discussed). Any excess return over price inflation is referred to as the real rate of return. The real rate of return, based on the current set of assumptions, is 4.25% (7.25% nominal return less 3.00% inflation).

ASOP 27 provides guidance to actuaries on the selection of economic assumptions used for measuring pension obligations. Our findings and analysis, following that ASOP, are discussed below.

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 so as to make prudent choices regarding how to invest the trust funds, i.e., 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 80 years from now. For example, a newly-hired employee who is 25 years old may work for 35 years, to age 60, and live another 30 years, to age 90. The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 30 years. During the entire 65-year period, the system is investing assets on behalf of the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received <u>after</u> the employee retires. This difference in time horizon is frequently a source of debate and confusion when setting economic assumptions.

OPERS Historical Perspective

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, asset allocation can also impact the returns so comparing results over long periods when different asset allocations were in place may not be meaningful. The recent experience for the retirement funds over the last eighteen years is shown in the table below.

Year Ending 6/30	Market Value ($ million)	Market Value Rate of Return (Net of fees)	Actuarial Value ($ million)
1999	$ 4,831	9.2%	$ 4,262
2000	5,246	9.9	4,786
2001	4,815	(6.0)	5,110
2002	4,486	(5.3)	5,300
2003	4,619	5.4	5,355
2004	5,126	14.0	5,412
2005	5,504	10.3	5,451
2006	5,817	7.9	5,654
2007	6,640	16.3	6,110
2008	6,255	(4.2)	6,492
2009	5,174	(15.4)	6,208
2010	5,774	13.9	6,348
2011	6,841	21.5	6,599
2012	6,821	2.2	6,682
2013	7,442	12.0	6,979
2014	8,570	18.0	7,759
2015	8,636	3.1	8,420
2016	8,436	0.2	8,791

Clearly there is a significant amount of variation year to year. By considering compound returns over time, we can get some additional sense of the expected return. The following table shows the effective rate of return over various time periods.

Period	Rate of Return (before fees)
5 years	6.89%
10 years	6.17
15 years	6.20

Forward Looking Analysis

We believe the most appropriate analysis to consider in setting the investment return assumption is to model the expected returns given the system's target asset allocation and forward-looking capital market assumptions. However, we are trained as actuaries and not as investment professionals. As such, we rely heavily on professional investment consultants, such as Verus, to provide investment expertise including capital market assumptions.

In performing our analysis, we use the building block approach so the real rate of return of the portfolio is modeled, based on the target asset allocation, and then the expected return is added to the price inflation assumption. Therefore, our analysis focuses on the real rate of return while the analysis of the investment consultants more typically focuses on the nominal return in their asset allocation consulting. OPERS' current target asset allocation, along with their investment consultant's (Verus) long-term capital market assumptions, are shown in the following table (more detail is shown in Appendix B):

OPERS Target Asset Allocation and Verus Assumptions

Asset Class	Target Allocation	Ten Year Return Forecast*	Standard Deviation Forecast
US Large Cap Equity	38.0%	5.9%	15.8%
US Small Cap Equity	6.0%	7.0%	21.8%
Non-US Equity	24.0%	11.3%	18.9%
US Fixed	32.0%	3.5%	6.5%
Total	100.0%		

*Arithmetic mean, assumes 2.11% inflation.

Verus does not provide long-term capital market assumptions, which would be expected to be higher. Based on their 2017 capital market assumptions, Verus' expected one-year arithmetic

mean return is 6.49%. Because of the nature of compounding returns, however, the arithmetic mean is of limited value. A more important measure is the geometric mean, which is the expected long-term compound rate of return. Mathematically, the geometric return will be less than the arithmetic return. Under the Verus assumptions, the geometric mean is 5.86%. If our inflation assumption were used instead of the Verus inflation assumption, the geometric mean would be 6.50%

It should be noted that there is currently a fair amount of variation in expectations among investment professionals. Therefore, it can be beneficial to consider other advisors' expectations when setting the investment return assumption. 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 following graph 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).
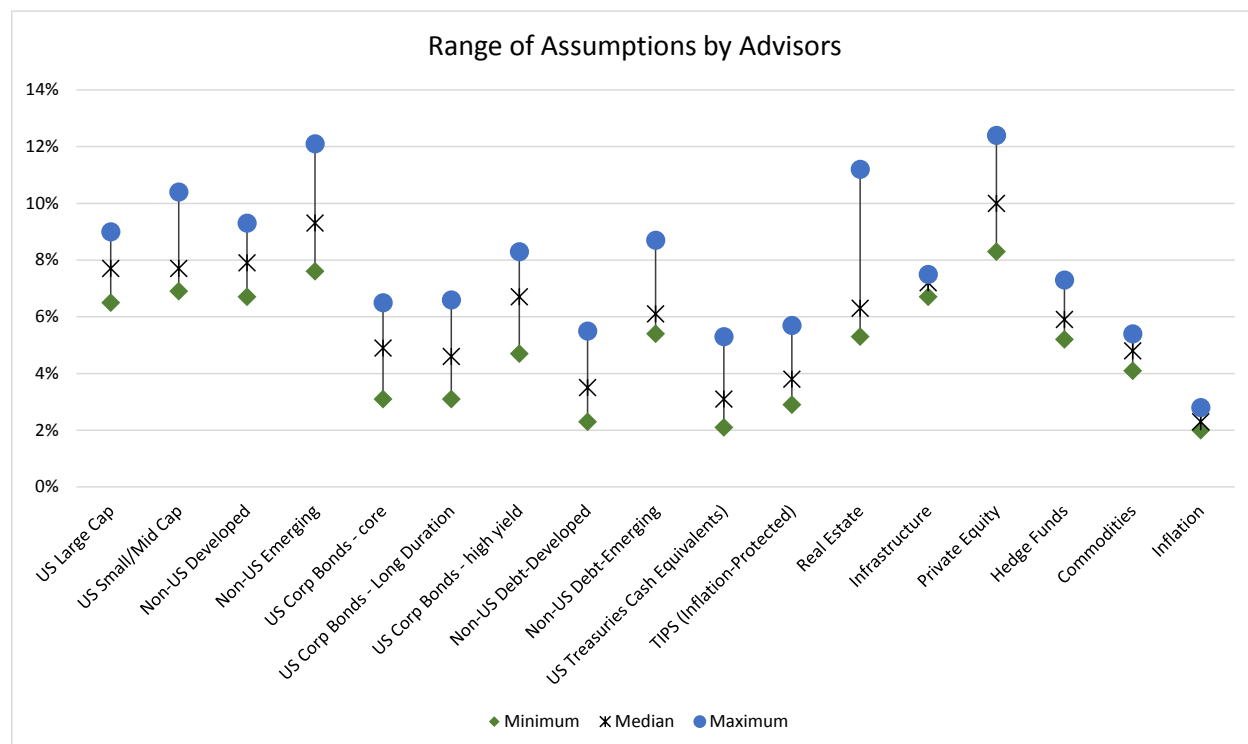
It is important to reemphasize that the assumptions used by most investment consultants are usually intended to assist the Board with determining asset allocations, and thus may be more short-term in nature (10 years) and reflective of the current market conditions more than the investment return assumption developed by the actuary for funding the benefits and measuring liabilities. Although this has always been the case, the significant difference that currently exists in expected returns over the short term versus the long term causes more of a challenge in setting the investment return assumption.

This is evident for the 12 consultants included in the Horizon Survey who provided both short-term (10 years) and long-term (20 years) assumptions. The long-term assumptions from the Horizon Survey provide an additional perspective on the magnitude of the potential difference in expected return over a longer timeframe. The following table provides a sample of the differences in the 10-year and 20-year horizon assumptions for the 12 advisors who provided both short-term and long-term assumption sets in the Survey:

Average Expected Arithmetic Returns: Short-Term vs. Long-Term

Asset Class	10-Year Horizon	20-Year Horizon	Difference
US Equity – Large Cap	7.98%	9.25%	1.27%
US Equity – Small/Mid Cap	9.07%	10.40%	1.33%
Non-US Equity – Developed	8.90%	9.77%	0.87%
Non-US Equity - Emerging	11.68%	12.46%	0.78%
US Corporate Bonds – Core	3.59%	4.75%	1.16%
US Corporate Bonds High Yield	6.49%	7.40%	0.91%
TIPS	3.03%	4.27%	1.24%
Real Estate	7.48%	7.75%	0.27%
Infrastructure	7.52%	8.26%	0.74%
Private Equity	11.77%	12.94%	1.17%
Inflation:	2.16%	2.31%	0.15%

Using the longer term assumptions, the geometric mean return for the OPERS portfolio based on the input of the 12 investment consultants in the Horizon Survey who provided long-term assumptions is 7.77%, when reflecting our 2.75% inflation assumption.

It must be noted that one-year expected returns come with high standard deviations, around 12%, and therefore high volatility. It is helpful to look at expected returns over a longer time horizon as shown in the tables on the following page. The returns shown are real returns (excluding inflation) so that a long term inflation assumption can be incorporated. The first table uses the Verus 10-year assumptions and the second table uses the Horizon 20-year assumptions.

Time Span In Years	Verus 10-year Assumptions Real Returns by Percentile				
	95th	75th	50th	25th	5th
1	24.64%	11.87%	3.76%	-3.77%	-13.68%
5	12.63%	7.31%	3.76%	0.32%	-4.43%
10	9.96%	6.26%	3.76%	1.32%	-2.10%
20	8.11%	5.52%	3.76%	2.03%	-0.42%
30	7.30%	5.19%	3.76%	2.34%	0.34%
50	6.49%	4.87%	3.76%	2.66%	1.10%
75	5.98%	**4.66%**	3.76%	**2.86**%	1.58%

Time Span In Years	Horizon 20-Year Assumptions Real Returns by Percentile				
	95th	75th	50th	25th	5th
1	26.82%	13.48%	5.02%	-2.81%	-13.09%
5	14.27%	8.72%	5.02%	1.45%	-3.49%
10	11.48%	7.63%	5.02%	2.48%	-1.07%
20	9.55%	6.86%	5.02%	3.22%	0.68%
30	8.71%	6.52%	5.02%	3.55%	1.46%
50	7.87%	6.18%	5.02%	3.88%	2.25%
75	7.34%	**5.97%**	5.02%	**4.09%**	2.76%

The charts above shows the percentile rankings for expected returns. Thus for the 20-year time span and using Verus's assumptions, 5% of the resulting real rates of return are expected to be below -0.42% and 95% expected to be above that. As the time span increases, the results begin to merge. Over a 75-year time span, the results indicate there is a 25% chance that the real return will be below 2.86% and a 25% chance it will be above 4.66% using Verus's assumptions. In other words there is a 50% chance the real returns will be between 2.86% and 4.66% using Verus's assumptions. Using the Horizon 20-year assumptions, there is a 50% chance the real returns will be between 4.09% and 5.97%.

Peer System Comparison

Public retirement systems have historically compared their investment performance to their peer group. While we believe there is some merit in assessing the movement in the assumed rate of return for other systems, this is not an appropriate basis for setting this assumption in our opinion. For example, different plans have different plan dynamics which will impact their choice of the assumed investment return. This peer group information merely provides another set of relevant data to consider as long as we recognize that asset allocation varies from system to system.

The graph below shows the change in the distribution of the investment return assumption from fiscal year 2001 through August, 2016 for the 120+ large public retirement systems included in the NASRA Public Fund Survey. As it indicates, the investment return assumptions used by public plans have decreased over the last fifteen years, likely heavily impacted by a corresponding decrease in the underlying inflation assumption from 4.0% to 3.0% over the same period. It is worth noting that the median investment return assumption in fiscal year 2012 dropped from 8.00% to 7.75% and has declined further to 7.50% in 2016. We believe we will continue to see more of the systems who are using an 8.0% or higher assumption move to a lower assumption as future experience studies are completed in the next few years.

Change in distribution of investment return assumptions, FY 01 to present
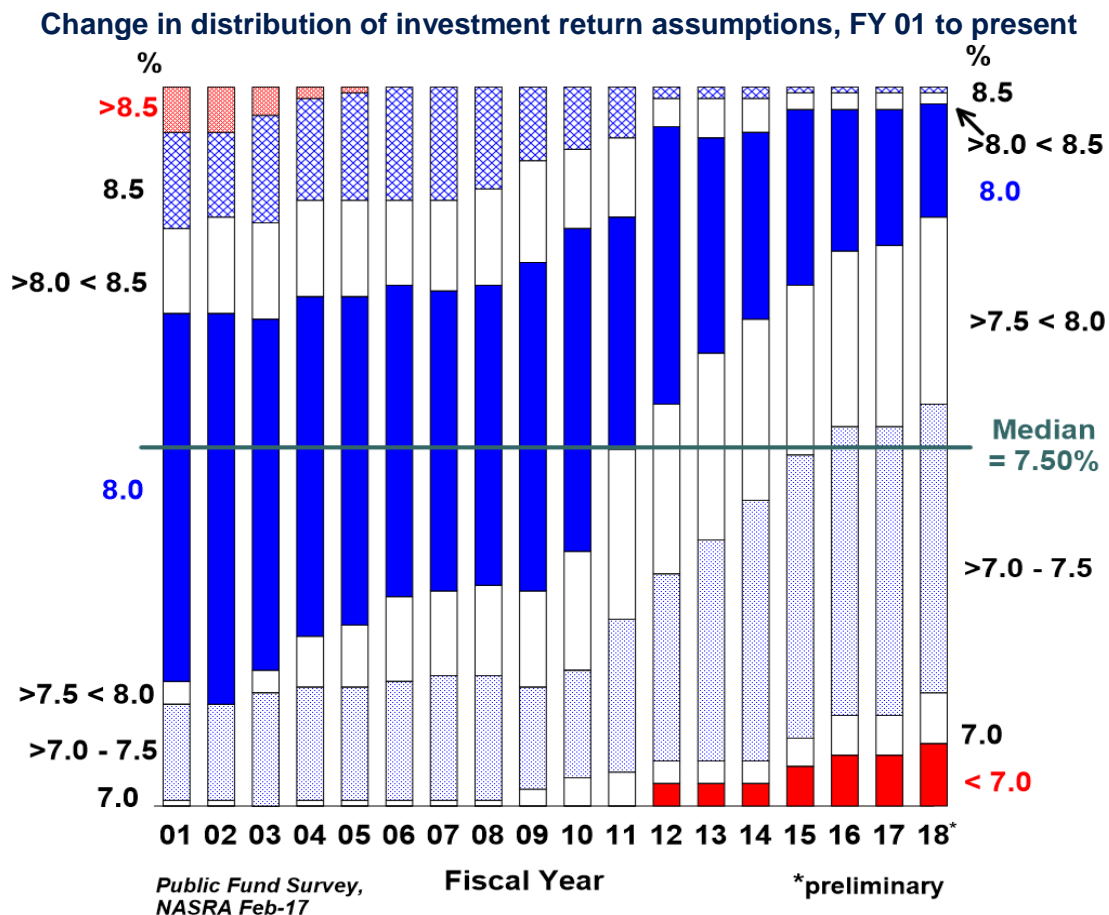
Administrative and Investment Expenses: Budgeted administrative expenses are directly reflected as a separate component in the calculation of the contribution rate, and so no assumption is required. Generally, capital market assumptions are reflective of passive investment strategies where there are minimal investment expenses. Where active management is utilized, it is assumed that the additional return from active management is at least as great as the additional expense, and so no investment expense adjustment is required.

Recommendation: Using the building block approach of ASOP No. 27 and the projection results outlined above, we can develop a range for the investment return assumption of the 25th to 75th percentile real returns over the 75-year time span plus the recommended inflation assumption. The following tables details the ranges using Verus's 10-year assumptions and Horizon's 20-year assumptions.

Verus's 10-Year Assumptions

Item	25th Percentile	50th Percentile	75th Percentile
Real Rate of Return	2.86%	3.76%	4.66%
Inflation	2.75	2.75	2.75
Net Investment Return	5.61%	6.51%	7.41%

Horizon's 20-Year Assumptions

Item	25th Percentile	50th Percentile	75th Percentile
Real Rate of Return	4.09%	5.02%	5.97%
Inflation	2.75	2.75	2.75
Net Investment Return	6.84%	7.77%	8.72%

One additional consideration for OPERS is that the plan is partially closed. Over time, this is anticipated to result in benefit payments being increasingly larger than the contributions from members and employers. This requires the gradual reduction of the investment pool, but is not a cause for concern – this is the very reason the investment pool exists. This drawdown may require some change in asset allocation, however, which could affect the net investment returns shown above. We have discussed this long-term drawdown with OPERS investment staff and believe some degree of caution is in order, although the ultimate impact cannot yet be fully quantified. While the URSJJ portfolio is not subject to these same concerns, the fact that the large OPERS portfolio and the much smaller URSJJ portfolio are invested together argues for a common investment return assumption for the time being.

Considering the different sources discussed above (OPERS experience, historical markets, Verus's short term expectations, Horizon's 20-year expectations), we believe that 7.0% would be a reasonable assumption.

Investment Return Assumption	
Current	7.25%
Recommended	7.00%

GENERAL WAGE GROWTH

Background: General wage growth, thought of as the "across the board" rate of salary increases, is composed of the price inflation assumption and an assumption for the real rate of wage increases/real wage growth. The excess of wage growth over price inflation represents the increase in the standard of living, also called productivity growth.

In constructing the salary increase assumption used to project future salary increases for individual members, the wage growth assumption is combined with an assumption for service-based salary increases (called a merit scale). The service-based salary increase assumption will be addressed when the demographic assumptions are studied. Given the current price inflation assumption of 3.0%, the current wage growth assumption of 4.0% implies an assumed real rate of wage increase or real wage growth assumption of 1.0%.

Historical Perspective: Wage statistics are found in the Social Security System database on the National Average Wage data. This information goes back to 1955 and is the most comprehensive database available. Because the National Average Wage is based on all wage earners in the country who are covered by Social Security, 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). Furthermore, if compensation is shifted between wages and benefits, the wage index would not accurately reflect increases in total compensation. OPERS membership is composed exclusively of governmental employees working in Oklahoma, whose wages and benefits are somewhat linked as a result of state and local tax revenues, funding allocations, and governing policies. Because the competition for workers can, in the long term, extend across industries and geography, the broad national earnings growth will have some impact on OPERS members. In the shorter term, however, the wage growth of OPERS and the nation may be less directly correlated.

The excess of wage growth over price inflation represents the real wage growth rate. The following 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 growth rate. The data for each year is documented in Appendix C.

Years	Period	General Wage Inflation	CPI Increase	Real Wage Inflation
2006-2015	10	2.7%	1.8%	0.9%
1996-2015	20	3.4%	2.2%	1.2%
1986-2015	30	3.6%	2.7%	0.9%
1976-2015	40	4.4%	3.7%	0.7%
1966-2015	50	4.8%	4.1%	0.7%
1956-2015	60	4.6%	3.7%	0.9%

Similar information over rolling thirty year periods is shown in the following graph:
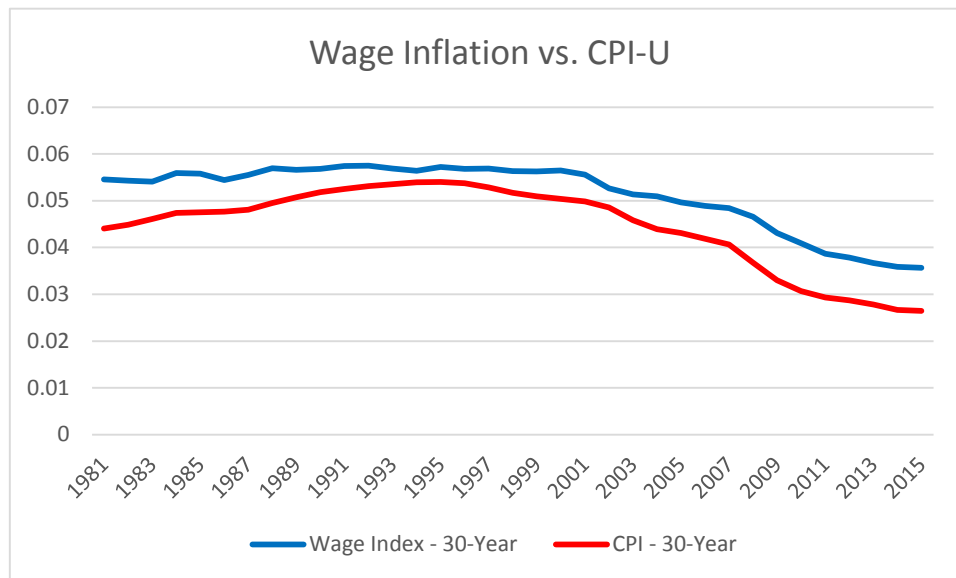
Over the last 30 years, the real wage increase, as measured by the increase in the National Average Wage Index, has been 0.87% per year on average. A somewhat similar, but slight different set of data is available from the Bureau of Labor Statistics, which reports the median weekly wage for full-time employees. Over the last 30 years, this amount (adjusted for inflation) has had an average increase of 0.17% per year. Part of the difference in these results arises from the difference between using an average and a median. There are also technical differences arising from who is included in each measure.

Forecasts of Future Wages: The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In the June, 2016 Trustees Report, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.8%, 1.2% higher than the Social Security Administration's intermediate inflation assumption of 2.6% per year. The range of the assumed real wage growth in the 2016 Trustees report was 0.5% to 1.8% per year.

Analysis and Conclusion: Over the last 30 years, the actual experience on a national basis has been close to the current assumption. However, this is based on SSA data which uses the average wages of all US workers. As mentioned earlier, the median real wage increase has been significantly lower. We believe that wages will continue to grow at a greater rate than prices over the long term, although not at the level projected by Social Security. We also expect wage growth for governmental employees to be lower than the national average, at least in the short term, due to budget challenges still being experienced by both state and local governmental employers.

Based on the available data and our professional judgment, **we recommend that the long-term assumed real wage growth be lowered from 1.00% to 0.75% per year. When coupled with the reduction in the price inflation assumption to 2.75%, the resulting general wage growth assumption decreases from 4.00% to 3.50%.**

PAYROLL GROWTH ASSUMPTION

Senate Bill 2120 and House Bill 2630, in combination, have begun to significantly reduce the number of new members entering the plan after November 1, 2015. While this has had an impact on the valuation results as of June 30, 2016 and will have an impact going forward, the impact is small since it only concerns employees hired after November 1, 2015. However, there are potential ramifications of this legislation that will affect on-going plan funding. In particular, the current amortization of the UAAL is based on the assumption of increasing payroll. The current provision of the new legislation should provide the difference between the defined contribution plan match and the statutory rate for the System. This is expected to provide at least as much toward the UAAL as would have been expected otherwise, so we are comfortable with continuing the methodology of amortizing as a level percentage of payroll. We would encourage the Board to study the long-term impact of this legislation.

Therefore, the valuation requires an assumption regarding future annual increases in covered payroll. The wage growth assumption is typically used for this purpose. The current payroll growth assumption for OPERS is 4.00%, the same as the current wage growth assumption.

Based on the recommended wage growth assumption of 3.5%, we recommend the payroll growth assumption also be set at 3.5%.

SUMMARY

The following table summarizes the current set of economic assumptions along with the recommended set of economic assumptions:

	Current Assumptions	Recommended Assumptions
Price Inflation	3.00%	2.75%
Investment Return	7.25%	7.00%
General Wage Growth	4.00%	3.50%
Payroll Growth	4.00%	3.50%

Demographic Assumptions

There are several demographic assumptions used in the actuarial valuations performed for the Oklahoma Public Employees Retirement System (OPERS) and the Uniform Retirement System for Justices and Judges (URSJJ). They are:

- Rates of Mortality
- Rates of Service Retirement
- Rates of Disability Retirement
- Rates of Withdrawal
- Probability of Electing a Vested Benefit
- 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 (June 30, 2013 through June 30, 2016) with what was expected to happen based on the assumptions used in the most recent actuarial valuations.

Detailed tabulations by age, service and/or gender are performed over the entire study period. These tabulations look at all active and retired members during the period as well as separately identifying those who experience a demographic event, also referred to as a decrement. In addition, the tabulation of all members together with the current assumptions permits the calculation of the number of expected decrements during the study period.

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements by age, gender, or service does not follow the expected pattern, new assumptions are recommended. Recommended changes usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior. In addition non-recurring events, such as early retirement windows, need to be taken into account in determining the weight to give to recent experience.

Because a major purpose of an actuarial valuation is to determine the liability, it is often preferable to measure the events that occurred by the proportion of liability that experience the change rather than simply the proportion of individuals who experienced the change. This "liability weighting" helps reflect that if certain events are connected with the salary or service level of individuals, then we should reflect that by giving more weight to those with greater liability. In some cases, there may be a noticeable difference in the results based upon whether we look at the analysis on a count

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or weighted basis. In these cases, we may select an assumption somewhere in between the two and move over time as the credibility of the liability-weighted results increases.

It is important to note that in the few years prior to this study period, the United States was emerging from a significant recession and turmoil in the financial markets. In the prior study, we were cautious in making significant changes, recognizing that some behavior observed in that time period may have been influenced by these events. As we consider recommending changes in this study, we have attempted to consider the results of the prior study where we are comfortable with the long-term reasonableness of those results.

The remainder of this section presents the results of the demographic study. We have prepared graphs and tables 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. These tables are presented in Appendices F and G.

Mortality Tables

Mortality tables are a fundamental assumption in actuarial valuations. Because benefits are typically paid over a retiree's lifetime, it is important to appropriately reflect what a typical lifetime looks like. In addition, deaths before retirement may also 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 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 of any demographic assumption.

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. While the direct projection – also called generational mortality – may better predict future payouts, it is not an appropriate approach for OPERS. Because the guiding statutes require that actuarial factors for optional form of payments, etc. be the same as the assumptions used in the valuation, the generational approach cannot be used. (It would require a new set of factors each year, something which is not desirable from a member planning perspective and which would be a burdensome administrative challenge.) Consequently, 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 Table, projected to 2010.

Graphs showing actual versus expected post-retirement mortality rates for OPERS members are shown in Appendix F in Table F-1 for males and F-2 for females, and Appendix G Tables G-1 and G-2 have the corresponding numerical data. The analysis of the actual post-retirement mortality experience over the three-year experience study period yields actual/expected ratios of 121% for both males and females on a count basis. The actual/expected ratios in the prior experience study were 121% and 117% respectively for males and females on a count basis. On a liability basis, however, the current ratios are 110% and 114%. This margin, particularly for the males, is low enough that we believe it is time to update the mortality table. In the prior study, we had noted that a change was likely with this study.

In 2014, the Society of Actuaries published a new family of mortality tables based on the most current data available. While the data used for this table was from the private sector rather than the public sector, we believe that it can be used with some adjustments to better fit OPERS experience. We recommend using this RP-2014 Blue Collar Annuitants table with the base rates projected to 2025 using projection scale MP-2016 (a set of mortality improvement factors recently issued by the Society of Actuaries for this purpose). We further recommend scaling the male factors by 95% under age 70 and 105% over age 70, while scaling the female factors by 90% and 115%. On a weighted basis, this results actual/expected ratios of 117% for both males and females. Because we are using weighted experience, we are able to use less margin than if we were performing our analysis solely on a count basis.

Because of the small URSJJ retiree population, we cannot obtain credible analysis of retiree mortality experience. Drawing upon general background on factors affecting mortality, we do anticipate that this group will have better mortality (i.e. live longer) than the broader OPERS membership. This has been recognized by setting the OPERS table back one year, so a 65-year old URSJJ retiree is treated as having the same mortality as a 64-year old OPERS member. We recommend continuing with this approach.

Beneficiary Mortality:
For benefits payable with a joint and survivor option, an assumption is needed regarding the beneficiary's lifetime. Because many members take a lifetime only benefit, there is less data available for beneficiaries. Further, data tracking of beneficiaries is less precise during the years when the member is alive. Consequently, we do not find sufficiently credible data to analyze this group separately. We recommend that for both OPERS and URSJJ that the same table used for retirees also be used for beneficiaries.

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 the same as the regular members with a 15-year age set forward. With the new mortality table being recommended

for healthy mortality, we believe a 12-year age set forward would be a more appropriate adjustment. There is admittedly not a lot of data to draw from, but the disability incidence is also low enough that this assumption is not significant.

Active Member Mortality:

For active members, the mortality assumption is less significant since it is represents only a small portion of cases where employment ends and benefits begin. Further, there is less of a concern compared to retirees with margin for future improvements. We had the following experience over the study period for active members ages 20 to 62:

	Actual Deaths	Expected Deaths	A/E Ratio
Males	106	106	100%
Females	72	107	67%

Because we are recommending a change to the mortality tables for retirees and beneficiaries, we believe it is reasonable to make the corresponding adjustment for actives and use the RP-2014 Blue Collar Employees table base rates projected to 2025 with Scale MP-2016. For hazardous duty members, the current assumption is that the death rates should be 10% higher to reflect an increased risk of death in the line of duty. With the very limited data available, we cannot assess the adequacy of this assumption, but we find it reasonable and recommend its continued use.

Rates of 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.

The System provides for two types of retirements based on different eligibility requirements. The first one is for an unreduced retirement benefit. The second one is for an early retirement benefit which is reduced. Separate assumptions have been developed for each type of retirement benefit.

Regular OPERS Members

OPERS provides for a normal, unreduced retirement benefit upon the earlier of (a) age 62 and six years of service or (b) "Rule of 80" (if hired prior to July 1, 1992) or "Rule of 90" (if hired on or after July 1, 1992). Members hired after October 31, 2011 must be 65 rather than 62 or reach age 60 with "Rule of 90". OPERS also provides for an early, reduced retirement benefit upon reaching age 55 and completing ten years of participating service. Under the provisions for early retirement, the benefit is reduced 1/15th for each of the first five years and 1/30th per year for the next two years.

Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-3, F-4, G-3, and G-4. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 101% for early retirement and 87% for normal retirements.

The early retirement rates were reduced in the last study and are still an appropriate fit. We recommend some slight adjustment to the normal (unreduced) retirement, including decreasing rates at the youngest ages while increasing rates after age 65. This general trend of delaying retirement is a pattern we are observing in many retirement systems, so we are not surprised to observe it in OPERS as well.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no such experience yet exists. These members will begin to become retirement eligible in the next experience study period, but this experience will still be limited. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.

Elected Officials

Elected officials may retire with a normal, unreduced retirement benefit upon the earlier of (a) age 60 and six years of elected service or (b) "Rule of 80". They may also retire with an early, reduced retirement benefit upon reaching age 55 and completing ten years of creditable service. Under the provisions for early retirement, the benefit is reduced 6% per year before age 60. (For those hired after October 31, 2011, the retirement age is 65 with 8 years of service or 62 with 10 years.)

Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-5, F-6, G-5, and G-6. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 62% for early retirement and 78% for unreduced.

Elected members went through one even-year election cycles during the study period, so retirements would be expected to be lower. Early retirement has been low, even in the last study with two election cycles. Consequently, we propose some additional reduction in those rates. With the expected lower number of retirements observed in the unreduced retirement experience, we suggest leaving the rates unchanged.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no such experience yet exists. These members will begin to become retirement eligible in the next experience study period, but this experience will still be limited. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.

Hazardous Duty

Hazardous Duty members may retire with a normal, unreduced retirement benefit upon the earlier of (a) 20 years of hazardous duty service, (b) age 62 with 6 years of service, or (c) "Rule of 80" (if hired prior to July 1, 1992) or "Rule of 90" (if hired on or after July 1, 1992). They may also retire with an early, reduced retirement benefit upon reaching age 55 and completing ten years of creditable service. Under the provisions for early retirement, the benefit is reduced 1/15th for each of the first five years before age 62 and 1/30th per year for the next two years. New rules affect those hired after October 31, 2011.

Graphs and detailed tables showing actual versus expected retirement rates are shown in Appendices F-7 to F-9 and G-7 to G-9. Note that unreduced retirement has an assumption that is split into a service based component (for those eligible for the 20 years of service) and an age based component (for those eligible due to age, but with less than 20 years of service). Early retirement had an actual to expected ratio of 75% and the service-based unreduced component had a ratio of 66%, while the age-based unreduced retirement had a ratio of 101%.

In the last study, the patterns observed for those with less than 20 years of service during this three year period were strikingly dissimilar from those of the prior three years. For those 62 and older, this study period appears consistent, and so we only suggest some very minor adjustments. For early retirement, actual retirements continue to be less than expected, and so we suggest some modest rate adjustments. In the prior study, the service based rates had a 159% actual to expected ratio on the original assumptions and a 129% ratio on the revised assumptions. Not only is the utilization light during this period, the exposures are also down substantially, and so we are hesitant to adjust rates at this point. This assumption will be examined closely in the next study in three years.

Retirement rates for members hired after October 31, 2011 are based upon professional judgment rather than actual experience because no such experience yet exists. These members will begin to become retirement eligible in the next experience study period, but this experience will still be limited. We will continue to base the rates on professional judgment and will monitor actual experience as it becomes available.

URSJJ

URSJJ members may retire with a normal, unreduced retirement benefit upon the earlier of (a) 65 with eight years of service, (b) age 60 with ten years of service or (c) "Rule of 80". For judges taking office after January 1, 2012, retirement age is sixty-seven (67) with eight (8) years of service or age sixty-two (62) with ten (10) years of service. No early retirement option is available for judges.

Detailed tables showing actual versus expected retirement rates are shown in Appendices F-10 and G-10. The analysis of the actual retirement experience over the three-year period yields an actual/expected ratio of 57%.

Since the actual/expected ratio has been low in the past three experience studies, we believe continued changes are worth considering. Because of the relatively small size of the active population, there is a lot of variation in actual experience, so we have considered the patterns of recent studies and suggest moving part way toward these patterns. We recommend some changes to better fit the observed experience. In addition, we recommend using a single set of retirement rates for all judges, whether hired before or after January 1, 2012, since we do not have any reason to anticipate different behavior.

Rates of Disability Retirement

The rates of disability used in the actuarial valuation project the percentage of employees who are expected to become disabled each year and begin to receive a disability retirement benefit. In order to qualify for disability benefits, the member must have at least eight years of service and qualify for Social Security or Railroad Retirement Board disability benefits.

Graphs and detailed tables showing actual versus expected disability rates are shown in Appendices F-11 to F-13 and G-11 to G-13.

OPERS disability experience was investigated separately for males and females. The analysis of the actual disability experience for male and females members over the three-year experience period yields an actual/expected ratio of 31% and 32% respectively. We note that the rates were lowered in each of the prior two studies.

Given the continued experience of actual disabilities below the expected number, we again propose a further reduction in rates. By moving only part way from the current rates toward the observed experience, we may very well make further adjustments in the next study. Our analysis did not indicate significant differences between male and female experience, and so we propose adopting a set of unisex rates for the future.

Over time, we have observed that hazardous duty members have somewhat higher rates than regular OPERS members, although the difference has not been significant enough to warrant separate rates. As we continue to lower the regular membership rates, however, it is no longer the case that the rates are "good enough" for hazardous duty members as well. Consequently, we propose leaving the hazardous duty rates unchanged, using the existing male rates for both males and females. As can be observed in Appendices F-13 and G-13, there were only 6 male disabilities out of approximately 4,500 exposures during the three year period, while female data has only about one-third as many exposures. The limited number of exposures and low incidence rate make this experience very volatile.

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 URSJJ termination rates are 2% for all years of service. Termination from employment for reasons other than death, disability or retirement is uncommon in Judges' systems across the country. Actual experience was close to this over this period, but is based on limited data. We recommend this assumption be maintained.

In the last study, the OPERS assumption was changed to a service based assumption from one that utilizes an age based approach that sets the withdrawal rates based on years of service. We recommend continuing to use this approach, along with the continuation of unisex rates.

In setting the rates last time, we believed that the observed terminations during that period were higher than would be expected long term and intentionally set the rates below the observations. The observed rates in this study are lower than last time, although still higher than the expected rates, and so we suggest some increase in the longer durations to move toward a better match. The complete tables of recommended withdrawal rates are shown in Appendices F-14 and G-14.

Probability of Electing a Vested Benefit

When a vested member terminates employment, the member (eventually) chooses to either take a deferred retirement benefit or to receive a refund of member contributions in lieu of the deferred benefit. An assumption for the frequency of this election is used for OPERS regular members. Because of the benefit structure, retirement eligibility, and demographic make-up of elected officials, hazardous duty members, and URSJJ members, these members are not expected to take a refund.

In the past, this assumption has been based on the age of the member at termination. In reviewing the data, we find a more pronounced correlation with the service the member has, and so we propose probabilities based on duration. Appendices F-15 and G-15 show the analysis of the last three years' experience. We will continue to monitor this experience, adjusting rates as necessary.

Rates of Salary Increase

Under the "building block" approach recommended in ASOP 27, this 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.

In the prior study, salary increases were less than expected, likely influenced by the poor economy. In this study, OPERS increases were generally in the anticipated range of expectation. Since price inflation was less than expected during this period and our wage inflation assumption is being reduced, we would not have been surprised to see actual results less than expected. However, we are also aware that there has been some pressure on wages to catch up for the prior years. As a result, we want to be somewhat cautious in making any adjustments.

Detailed salary increase rates at all ages are shown in Appendices F-26 and G-26. We recommend some changes at the youngers ages (where salary increases have been larger than the assumption) and at the older ages (where we grade the assumption down to assume no merit after age 65).

For URSJJ, a flat 5.00% assumption was used. Since there have been only one pay increase in the past several years, our analysis focused on the methodology by which pay increases are determined, part of which is based on reviewing what other states pay judges. In looking at other judges systems that we work with, we believe that the current assumption still remains high and should be lowered. In general, there is little merit component in judges pay, with all judges at the same level usually receiving the same pay rate, and very little promotion to higher courts. We recommend lowering this to 3.75%, a rate slightly above our assumed wage inflation. There is the potential for some degree of volatility in judge pay, but we anticipate that this assumption should be reasonable over time.

Miscellaneous Assumptions

Percent Married: Currently 85% of members are assumed to be married with the husband four years older than the wife. This is a common and reasonable assumption and we recommend maintaining this assumption.

Missing Data: In preparing the valuation data, certain data items are missing, unavailable, or unreasonable. In such cases, we have developed assumptions for what the data element should be. These assumptions are described in Appendices D and E. We recommend keeping these assumptions.

Actuarial Methods

Actuarial valuations utilize methods to determine the liabilities, assets, and costs. 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 uses 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 the 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 20% of the difference between the market value of assets and the expected actuarial value of assets, based on the assumed rate of return. The actuarial value of assets cannot be less than 80% or more than 120% of market value. We recommend no change in the use of this method.

Amortization Method: The unfunded actuarial accrued liability is amortized using a level percentage of payroll method over the amortization period. The period is a fixed 20 year period, starting July 1, 2007. The payroll growth assumption is used to determine the percentage of payroll required over the remaining amortization period to fully amortize the unfunded liability.

Because the amortization period is now down to 10 years as of the upcoming July 1, 2017 valuation, there will be great volatility in the amortization rate each year as gains or losses must be recognized over an ever-shortening period. Because contributions are not affected by the amortization rate, this does not affect the funding of the plans, but it will create some potential communication challenges. We believe that this method should be changed with the next experience study, allowing three years for the Board to consider what an appropriate method would be.

COLA Reserve: Six years ago, we removed the use of an explicit COLA assumption and the reserve following legislation that would require a COLA to be funded. Since there have been no COLAs granted in the intervening period, we recommend continuing the practice of not valuing of any future COLA contingency. However, this recommendation could change if COLAs or stipends are funded from the plan.

Historical CPI-U Index

December of:	Index	Increase	December of:	Index	Increase
1928	17.1				
1929	17.2	0.6 %	**1973**	46.2	8.7%
1930	16.1	-6.4	**1974**	51.9	12.3
1931	14.6	-9.3	**1975**	55.5	6.9
1932	13.1	-10.3	**1976**	58.2	4.9
1933	13.2	0.8	**1977**	62.1	6.7
1934	13.4	1.5	**1978**	67.7	9.0
1935	13.8	3.0	**1979**	76.7	13.3
1936	14.0	1.4	**1980**	86.3	12.5
1937	14.4	2.9	**1981**	94.0	8.9
1938	14.0	-2.8	**1982**	97.6	3.8
1939	14.0	0.0	**1983**	101.3	3.8
1940	14.1	0.7	**1984**	105.3	3.9
1941	15.5	9.9	**1985**	109.3	3.8
1942	16.9	9.0	**1986**	110.5	1.1
1943	17.4	3.0	**1987**	115.4	4.4
1944	17.8	2.3	**1988**	120.5	4.4
1945	18.2	2.2	**1989**	126.1	4.6
1946	21.5	18.1	**1990**	133.8	6.1
1947	23.4	8.8	**1991**	137.9	3.1
1948	24.1	3.0	**1992**	141.9	2.9
1949	23.6	-2.1	**1993**	145.8	2.7
1950	25.0	5.9	**1994**	149.7	2.7
1951	26.5	6.0	**1995**	153.5	2.5
1952	26.7	0.8	**1996**	158.6	3.3
1953	26.9	0.7	**1997**	161.3	1.7
1954	26.7	-0.7	**1998**	163.9	1.6
1955	26.8	0.4	**1999**	168.3	2.7
1956	27.6	3.0	**2000**	174.0	3.4
1957	28.4	2.9	**2001**	176.7	1.6
1958	28.9	1.8	**2002**	180.9	2.4
1959	29.4	1.7	**2003**	184.3	1.9
1960	29.8	1.4	**2004**	190.3	3.3
1961	30.0	0.7	**2005**	196.8	3.4
1962	30.4	1.3	**2006**	201.8	2.5
1963	30.9	1.6	**2007**	210.0	4.1
1964	31.2	1.0	**2008**	210.2	0.1
1965	31.8	1.9	**2009**	215.9	2.7
1966	32.9	3.5	**2010**	219.2	1.5
1967	33.9	3.0	**2011**	225.7	3.0
1968	35.5	4.7	**2012**	229.6	1.7
1969	37.7	6.2	**2013**	233.0	1.5
1970	39.8	5.6	**2014**	234.8	0.8
1971	41.1	3.3	**2015**	236.5	0.8
1972	42.5	3.4	**2016**	241.4	2.1

Capital Market Assumptions and Asset Allocation

Rates of Return and Standard Deviation by Asset Class

Asset Class	Arithmetic Mean Return	Standard Deviation
US Large Cap Equity	5.9%	15.8%
US Small Cap Equity	7.0%	21.8%
Non-US Equities	11.3%	18.9%
US Fixed	3.5%	6.5%

Asset Class Correlation Coefficients

	US Large	US Small	Non-US	Fixed
US Large Cap	1.00	0.90	0.90	0.00
US Small Cap	0.90	1.00	0.80	-0.10
Non-US	0.90	0.80	1.00	0.10
US Fixed	0.00	-0.10	0.10	1.00

Asset Allocation Targets

Asset Class	Allocation Percentages
US Large Cap Equity	38.0%
US Small Cap Equity	6.0%
Non-US Equities	24.0%
US Fixed	32.0%

National Average Wage Index

	Index	Increase		Index	Increase
1927	$1,159.14				
1928	1,162.53	0.3%	1972	$ 7,133.80	9.8%
1929	1,196.88	3.0	1973	7,580.16	6.3
1930	1,164.95	-2.7	1974	8,030.76	5.9
1931	1,086.09	-6.8	1975	8,630.92	7.5
1932	954.02	-12.2	1976	9,226.48	6.9
1933	892.58	-6.4	1977	9,779.44	6.0
1934	929.34	4.1	1978	10,556.03	7.9
1935	968.53	4.2	1979	11,479.46	8.7
1936	1,008.20	4.1	1980	12,513.46	9.0
1937	1,071.58	6.3	1981	13,773.10	10.1
1938	1,047.39	-2.3	1982	14,531.34	5.5
1939	1,076.41	2.8	1983	15,239.24	4.9
1940	1,106.41	2.8	1984	16,135.07	5.9
1941	1,228.81	11.1	1985	16,822.51	4.3
1942	1,455.70	18.5	1986	17,321.82	3.0
1943	1,661.79	14.2	1987	18,426.51	6.4
1944	1,796.28	8.1	1988	19,334.04	4.9
1945	1,865.46	3.9	1989	20,099.55	4.0
1946	2,009.14	7.7	1990	21,027.98	4.6
1947	2,205.08	9.8	1991	21,811.60	3.7
1948	2,370.53	7.5	1992	22,935.42	5.2
1949	2,430.52	2.5	1993	23,132.67	0.9
1950	2,570.33	5.8	1994	23,753.53	2.7
1951	2,799.16	8.9	1995	24,705.66	4.0
1952	2,973.32	6.2	1996	25,913.90	4.9
1953	3,139.44	5.6	1997	27,426.00	5.8
1954	3,155.64	0.5	1998	28,861.44	5.2
1955	3,301.44	4.6	1999	30,469.84	5.6
1956	3,532.36	7.0	2000	32,154.82	5.5
1957	3,641.72	3.1	2001	32,921.92	2.4
1958	3,673.80	0.9	2002	33,252.09	1.0
1959	3,855.80	5.0	2003	34,064.95	2.4
1960	4,007.12	3.9	2004	35,648.55	4.6
1961	4,086.76	2.0	2005	36,952.94	3.7
1962	4,291.40	5.0	2006	38,651.41	4.6
1963	4,396.64	2.5	2007	40,405.48	4.5
1964	4,576.32	4.1	2008	41,334.97	2.3
1965	4,658.72	1.8	2009	40,711.61	-1.5
1966	4,938.36	6.0	2010	41,673.83	2.4
1967	5,213.44	5.6	2011	42,979.61	3.1
1968	5,571.76	6.9	2012	44,321.67	3.1
1969	5,893.76	5.8	2013	44,888.16	1.3
1970	6,186.24	5.0	2014	46,481.52	3.5
1971	6,497.08	5.0	2015	48,098.63	3.5

Oklahoma Public Employees Retirement System

Actuarial Cost Method

Liabilities and contributions shown in this report are computed using the Individual Entry Age method of funding.

Sometimes called the "funding method," this is a particular technique used by actuaries for establishing the amount of the annual actuarial cost of pension benefits, or normal cost, and the related unfunded actuarial accrued liability. Ordinarily the annual contribution to the System is comprised of (1) the normal cost and (2) an amortization payment on the unfunded actuarial accrued liability.

Under the Entry Age Actuarial Cost Method, the **Normal Cost** is computed as the level percentage of pay which, if paid from the earliest time each member would have been eligible to join the System if it then existed (thus entry age) until his retirement or termination, would accumulate with interest at the rate assumed in the valuation to a fund sufficient to pay all benefits under the System.

The **Actuarial Accrued Liability** under this method, at any point in time, is the theoretical amount of the fund that would have accumulated had annual contributions equal to the normal cost been made in prior years (it does not represent the liability for benefits accrued to the valuation date). The **Unfunded Actuarial Accrued Liability** is the excess of the actuarial accrued liability over the actuarial value of System assets on the valuation date.

Under this method, experience gains or losses, i.e. decreases or increases in actuarial accrued liabilities attributable to deviations in experience from the actuarial assumptions, adjust the unfunded actuarial accrued liability.

Asset Valuation Method

The actuarial value of assets is based on a five-year moving average of expected and actual market values determined as follows:

- at the beginning of each fiscal year, a preliminary expected actuarial asset value is calculated as the sum of the previous year's actuarial value increased with a year's interest at the System valuation rate plus net cash flow adjusted for interest (at the same rate) to the end of the previous fiscal year;

- the expected actuarial asset value is set equal to the preliminary expected actuarial value plus the unrecognized investment gains and losses as of the beginning of the previous fiscal year;

- the difference between the expected actuarial asset value and the market value is the investment gain or loss for the previous year;

- the (final) actuarial asset value is the preliminary value plus 20% of the investment gains and losses for each of the five previous fiscal years, but in no case more than 120% of the market value or less than 80% of the market value.

Oklahoma Public Employees Retirement System

Amortization Method

Effective July 1, 2008, the unfunded actuarial accrued liability is amortized as a level percent of payroll over a 20-year closed period commencing July 1, 2007. For the defined contribution members, the employer sends to OPERS the difference between the OPERS statutorily required rate (16.5% for state members) and the amount required for the employer match in the defined contribution plan. These extra contributions to OPERS allow the use of the level percent of payroll amortization method since they are expected to produce a payment stream that is constant, if not increasing, as a percent of covered payroll.

Valuation Procedures

The actuarial accrued liability held for nonvested, inactive members who have a break in service, or for nonvested members who have quit or been terminated, even if a break in service has not occurred as of the valuation date, is equal to the amount of the individual's unclaimed contributions.

The wages used in the projection of benefits and liabilities are considered earnings for the year ending on the June 30 prior to the valuation date, increased by the salary scale to develop expected earnings for the current valuation year.

Earnings are annualized for members with less than twelve months of reported earnings.

In computing accrued benefits, average earnings are determined using actual pay history provided for valuation purposes.

The calculations for the required employer contribution are determined as of mid-year. This is a reasonable estimate since contributions are made on a monthly basis throughout the year.

We do not value the 415 limit for active participants. The impact was assumed to be *de minimus.*

The compensation limitation under IRC Section 401(a)(17) is considered in this valuation.

Liability is included for members who appear to be deferred vested, but who are not in the vested data provided. An estimated benefit was calculated based on pay and service from prior valuations. A corrected benefit and status will be provided by the System when the actual benefit and status have been finalized.

Members who are contributing to the System, but have not yet filled out an enrollment application, are included as active members. Service for this group was provided by the System.

Oklahoma Public Employees Retirement System

SUMMARY OF ACTUARIALL ASSUMPTIONS

Economic Assumptions

Investment Return: 7.0% net of investment expenses per annum, compounded annually

Salary Increases: Sample rates below (midpoint of range shown):

Nearest Age	% Increase
20 - 24	9.50
25 - 29	7.80
30 – 34	6.30
35 – 39	5.50
40 – 44	5.20
45 – 49	4.80
50 – 54	4.50
55 – 59	4.30
60 – 64	3.80
65+	3.50

Payroll Growth: 3.50% per year

Ad hoc benefit increase assumptions

Monthly benefits   No increases assumed
Medical Supplement   No increases assumed

Projection of 401(a)(17) compensation limit: Projected with inflation at 2.75%

Oklahoma Public Employees Retirement System

Demographic Assumptions

Annual Rates of Retirement Per 100 Eligible Regular Non-Elected Members

	Hired Prior to 11/1/2011		Hired on or After 11/1/2011	
	Those Eligible For Unreduced	Those Eligible For Reduced	Those Eligible For Unreduced	Those Eligible For Reduced
Age	Retirement	Retirement	Retirement	Retirement
50	15	N/A	N/A	N/A
51	15	N/A	N/A	N/A
52	15	N/A	N/A	N/A
53	15	N/A	N/A	N/A
54	15	N/A	N/A	N/A
55	10	3	N/A	N/A
56	10	4	N/A	N/A
57	11	4	N/A	N/A
58	12	5	N/A	N/A
59	13	6	N/A	N/A
60	14	6	30/15*	7
61	20	15	30/15*	7
62	25	N/A	30/15*	20
63	15	N/A	30/15*	15
64	15	N/A	30/15*	15
65	30	N/A	30/15*	N/A
66	25	N/A	20	N/A
67	25	N/A	20	N/A
68	25	N/A	20	N/A
69	25	N/A	25	N/A
70	100	N/A	100	N/A

*30 when first eligible to retire and 15 thereafter

.

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Annual Rates of Retirement Per 100 Eligible Elected Members

Age	Elected Prior to 11/1/2011		Elected on or After 11/1/2011	
	Those Eligible For Unreduced Retirement	Those Eligible For Reduced Retirement	Those Eligible For Unreduced Retirement	Those Eligible For Reduced Retirement
50	25	N/A	N/A	N/A
51	25	N/A	N/A	N/A
52	25	N/A	N/A	N/A
53	25	N/A	N/A	N/A
54	25	N/A	N/A	N/A
55	20	7.0	N/A	N/A
56	20	7.0	N/A	N/A
57	20	7.0	N/A	N/A
58	20	7.0	N/A	N/A
59	20	7.0	N/A	N/A
60	20	N/A	N/A	10
61	20	N/A	N/A	10
62	20	N/A	20	N/A
63	20	N/A	20	N/A
64	20	N/A	20	N/A
65	20	N/A	20	N/A
66	20	N/A	20	N/A
67	35	N/A	35	N/A
68	35	N/A	35	N/A
69-74	35	N/A	35	N/A
75	100	N/A	100	N/A

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Annual Rates of Retirement Per 100 Eligible Hazardous Duty Members

| | Hired Prior to 11/1/2011 | | | | Hired on or After 11/1/2011 | | |
| | Less Than 20 Years of Service | At Least 20 Years of Service | | | Less Than 20 Years of Service | At Least 20 Years of Service | |
Age		Service		Age		Service	
50	N/A	20	25	50	N/A	20	25
51	N/A	21	25	51	N/A	21	25
52	N/A	22	20	52	N/A	22	20
53	N/A	23-24	15	53	N/A	23-34	15
54	N/A	25-29	23	54	N/A	25-29	23
55	4	30-34	25	55	N/A	30-34	25
56	5	35+	100	56	N/A	35+	100
57	5			57	N/A		
58	5			58	N/A		
59	5			59	N/A		
60	5			60	7		
61	20			61	20		
62	40			62	20		
63	22			63	20		
64	25			64	20		
65	40			65	40		
66	25			66	25		
67	25			67	23		
68	25			68	22		
69	25			69	21		
70	100			70	100		

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Mortality Rates

Active participants and
   nondisabled pensioners

RP-2014 Blue Collar Active/Retiree Healthy Mortality Table with base rates projected to 2025 using Scale MP-2016. For retirees, male rates are multiplied by 95% under age 70 and 105% over age 70, while female rates are multiplied by 90% and 115%. (For the multipliers, 5-year geometric smoothing is applied at age 70.)

Disabled pensioners

Nondisabled retiree mortality set forward 12 years for disabled experience.

Hazardous Duty members

For Department of Corrections officers, we assumed the mortality rate is 10% higher than the above table while the participant is active. This 10% is assumed to be in-line-of-duty.

Disability Rates: Graduated rates

Disabled rates per 100 members

Nearest Age	Regular/Elected	Hazardous Duty
20	0.009	0.009
30	0.009	0.027
40	0.022	0.072
50	0.139	0.225
60	0.300	0.500

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Withdrawal Rates:

Service	Rate
1	22.0%
2	18.0%
3	14.0%
4	12.0%
5	10.5%
6	9.0%
7	8.0%
8	7.0%
9	6.5%
10	6.0%
11	5.5%
12	5.0%
13	4.8%
14	4.5%
15	4.3%
16	4.0%
17	3.8%
18	3.5%
19	3.3%
20	3.0%
21	2.8%
22	2.5%
23	2.3%
24	2.0%
25	1.8%
26	1.5%
27	1.3%
28+	1.0%

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Probability of Electing Vested Benefit:

Regular Members Only	
Duration	Rate
8	80%
13	85%
18	90%
23	95%
28	100%

Marital Status:

Percentage Married 85%

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

Children: Special death benefits are provided upon the in-line-of-duty death of Department of Corrections employees who have young children. We have assumed the average age of the youngest child of such employees is nine and that 50% of such children will attend an institution of higher education to age 22.

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

Oklahoma Public Employees Retirement System

Demographic Assumptions (continued)

Assumed age for commencement
of deferred benefits:

Currently active members assumed to terminate in the future prior to retirement eligibility are assumed to commence benefits at age 62 (non-elected members) or age 60 (elected members).

Currently active members hired on or after 11/1/2011 assumed to terminate in the future prior to retirement eligibility are assumed to commence benefits at age 65.

Currently inactive members with deferred benefits are assumed to commence benefits on a date provided by OPERS.

Provision for expenses:

Administrative expenses, as budgeted by the Oklahoma Public Employees Retirement System.

Uniform Retirement System of Justices & Judges

Entry Age Actuarial Cost Method

Liabilities and contributions shown in this report are computed using the individual Entry Age Level Percent of Pay actuarial cost. Sometimes called the "funding method," this is a particular technique used by actuaries for establishing the amount of the annual actuarial cost of pension benefits, or normal cost, and the related unfunded actuarial accrued liability. Ordinarily the annual contribution to the System is comprised of (1) the normal cost and (2) an amortization payment on the unfunded actuarial accrued liability.

Under the Entry Age Actuarial Cost method, the **Normal Cost** is computed as the level percentage of pay which, if paid from the earliest time each member would have been eligible to join the System if it then existed (thus, entry age) until his retirement or termination, would accumulate with interest at the rate assumed in the valuation to a fund sufficient to pay all benefits under the System.

The **Actuarial Accrued Liability** under this method, at any point in time, is the theoretical amount of the fund that would have accumulated had annual contributions equal to the normal cost been made in prior years (it does not represent the liability for benefits accrued to the valuation date). The **Unfunded Actuarial Accrued Liability** is the excess of the actuarial accrued liability over the actuarial value of System assets actually on hand on the valuation date.

Under this method, experience gains or losses, i.e. decreases or increases in actuarial accrued liabilities attributable to deviations in experience from the actuarial assumptions, adjust the unfunded actuarial accrued liability.

Asset Valuation Method

The actuarial value of assets is based on a five-year moving average of expected and actual market values determined as follows:

- at the beginning of each fiscal year, a preliminary expected actuarial asset value is calculated as the sum of the previous year's actuarial value increased with a year's interest at the System valuation rate plus net cash flow adjusted for interest (at the same rate) to the end of the previous fiscal year;
- the expected actuarial asset value is set equal to the preliminary expected actuarial value plus the unrecognized investment gains and losses as of the beginning of the previous fiscal year;
- the difference between the expected actuarial asset value and the market value is the investment gain or loss for the previous fiscal year;
- the (final) actuarial asset value is the preliminary value plus 20% of the investment gains and losses for each of the five previous fiscal years, but in no case more than 120% of the market value or less than 80% of the market value.

Uniform Retirement System of Justices & Judges

Amortization Method

The Unfunded Actuarial Accrued Liability is amortized as a level percentage of payroll over a 20-year period commencing July 1, 2007. Given a stable active workforce, this amortization method is expected to produce a payment stream that remains level as a percent of covered payroll.

Valuation Procedures

The actuarial accrued liability held for nonvested, inactive members who have a break in service, or for nonvested members who have quit or been terminated, even if a break in service has not occurred as of the valuation date, is equal to the amount of the individual's unclaimed contributions.

The wages used in the projection of benefits and liabilities are considered earnings for the year ending on the June 30 prior to the valuation date, increased by the salary scale to develop expected earnings for the current valuation year.

In computing accrued benefits, average earnings are determined using actual pay history provided for valuation purposes.

The calculations for the required employer contribution are determined as of mid-year. This is a reasonable estimate since contributions are made on a monthly basis throughout the year.

We do not value the 415 limit for active participants. The impact was assumed to be *de minimus*.

The compensation limitation under IRC Section 401(a)(17) is considered in this valuation.

Liability is included for members who appear to be deferred vested, but who are not in the vested data provided. An estimated benefit was calculated based on pay and service reported for prior valuations. A corrected benefit and status will be provided by the System when the actual benefit and status have been finalized.

Members who are contributing to the System, but have not yet filled out an enrollment application, are included as active members. Where data elements are missing, reasonable estimates are used. Service is estimated based on hours worked. Age is based on average entry age for other members. Gender is assigned in proportion to the overall group.

State of Oklahoma
Uniform Retirement System of Justices & Judges

Economic Assumptions

Investment Return: 7.0% net of investment expenses per annum, compounded annually

Salary Increases: 3.75% per year

Payroll Growth: 3.50% per year

Ad hoc benefit increase assumption:
    Monthly benefits No increases assumed
    Medical supplement No increases assumed

Projection of 410(a)(17) compensation limit Projected with inflation at 2.75%

Demographic Assumptions

Retirement age:

Attained Age	Annual Rates of Retirement Per 100 Eligible Members
Below 59	7
59 – 61	10
62 – 66	15
67 – 68	20
69 – 74	25
75+	100

Deferred vested members   Participants with deferred benefits are assumed to commence benefits on a date provided by URSJJ. Actives expected to terminate with a vested benefit are expected to commence benefits at age 60.

State of Oklahoma
Uniform Retirement System of Justices & Judges

Mortality Rates:

Active Participants and
   nondisabled pensioners

RP-2014 Blue Collar Active/Retiree Healthy Mortality Table with base rates projected to 2025 using Scale MP-2016. For retirees, male rates are multiplied by 95% under age 70 and 105% over age 70, while female rates are multiplied by 90% and 115%. (For the multipliers, 5-year geometric smoothing is applied at age 70.) After all adjustments, ages are set back one year

Disabled pensioners

Nondisabled retiree mortality set forward 12 years for disabled experience.

Separation Rates:

Separation for all reasons other
   than death

2% for all years of service.

Disability Rates: 0%

Marital Status:

Age difference   Males are assumed to be four years older than spouses.
Percentage married   85%

Other Assumptions:

Provisions for expenses

Administrative expenses, as budgeted for the Oklahoma Uniform Retirement System for Justices and Judges.

Form of payment

Active members who were contributing 8% of pay as of August 31, 2005, are assumed to retire with an unreduced benefit payable as a 50% Joint and Survivor annuity. All other members are assumed to retire with a single life annuity.

Experience Study 2013-2016
Appendix F-1
Probability of Death - Healthy Retirees
OPERS - Males
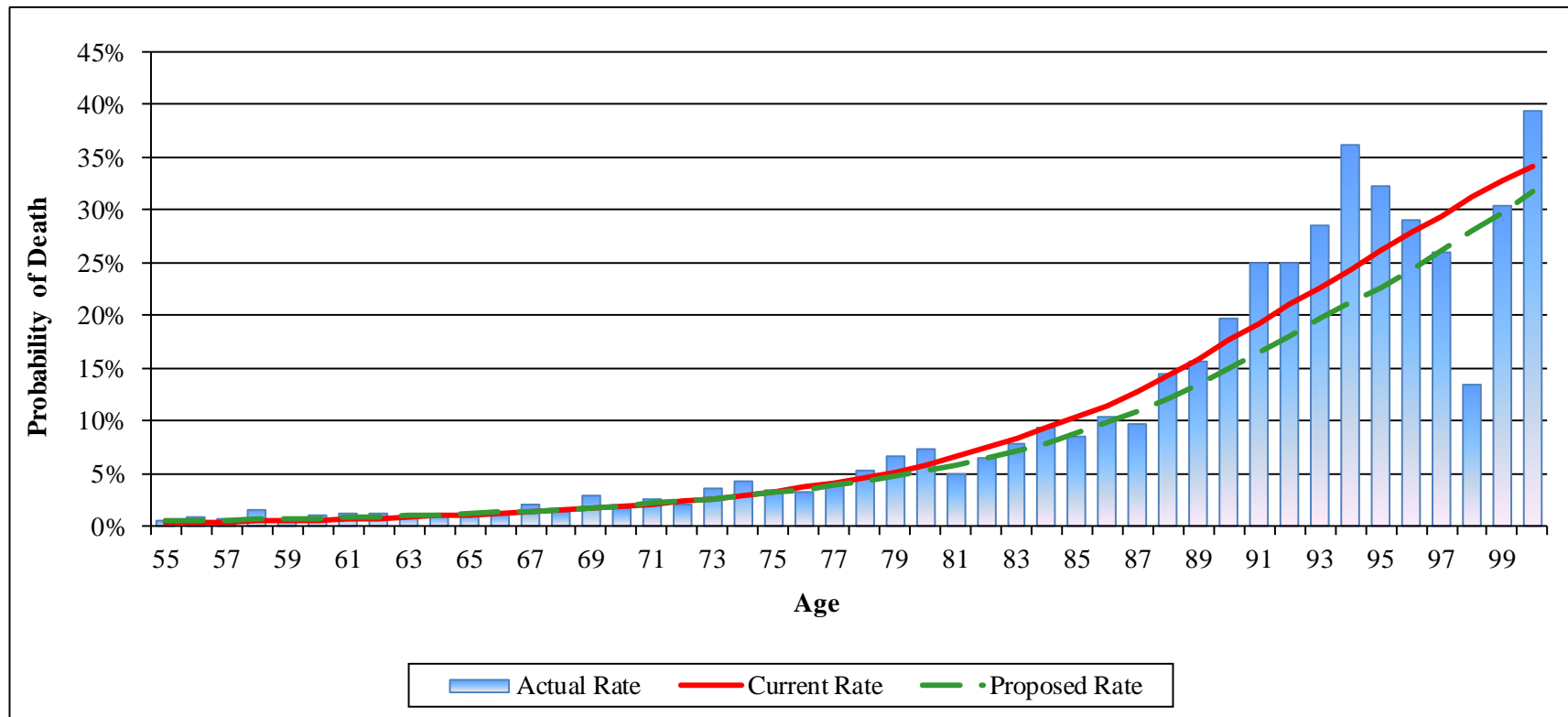
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	1,742,949	1,591,562	1,491,388
Actual/Expected		110%	117%

Experience Study 2013-2016
Appendix F-2
Probability of Death - Healthy Retirees
OPERS - Females
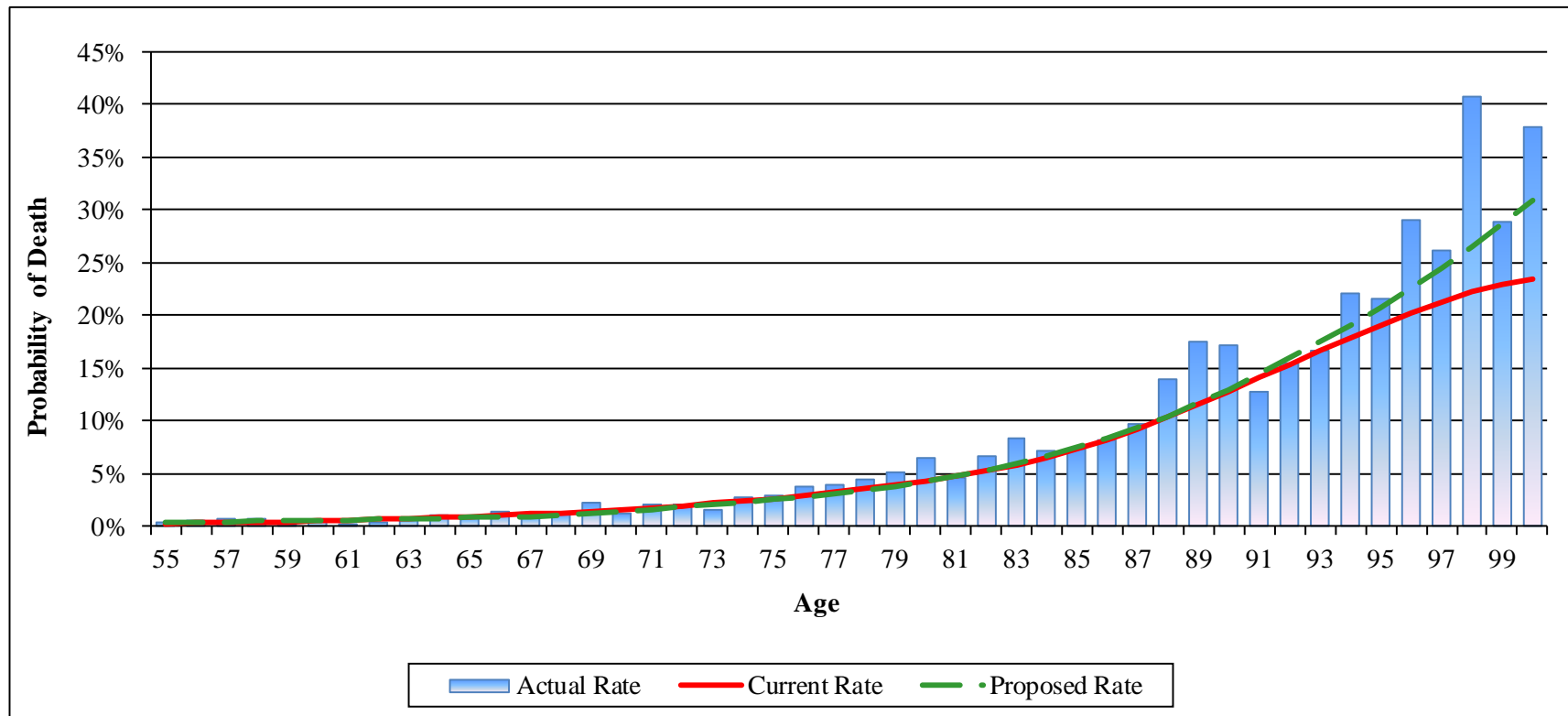
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	1,553,222	1,361,261	1,326,183
Actual/Expected		114%	117%

Experience Study 2013-2016
Appendix F-3
Retirement Rates
Regular - Early
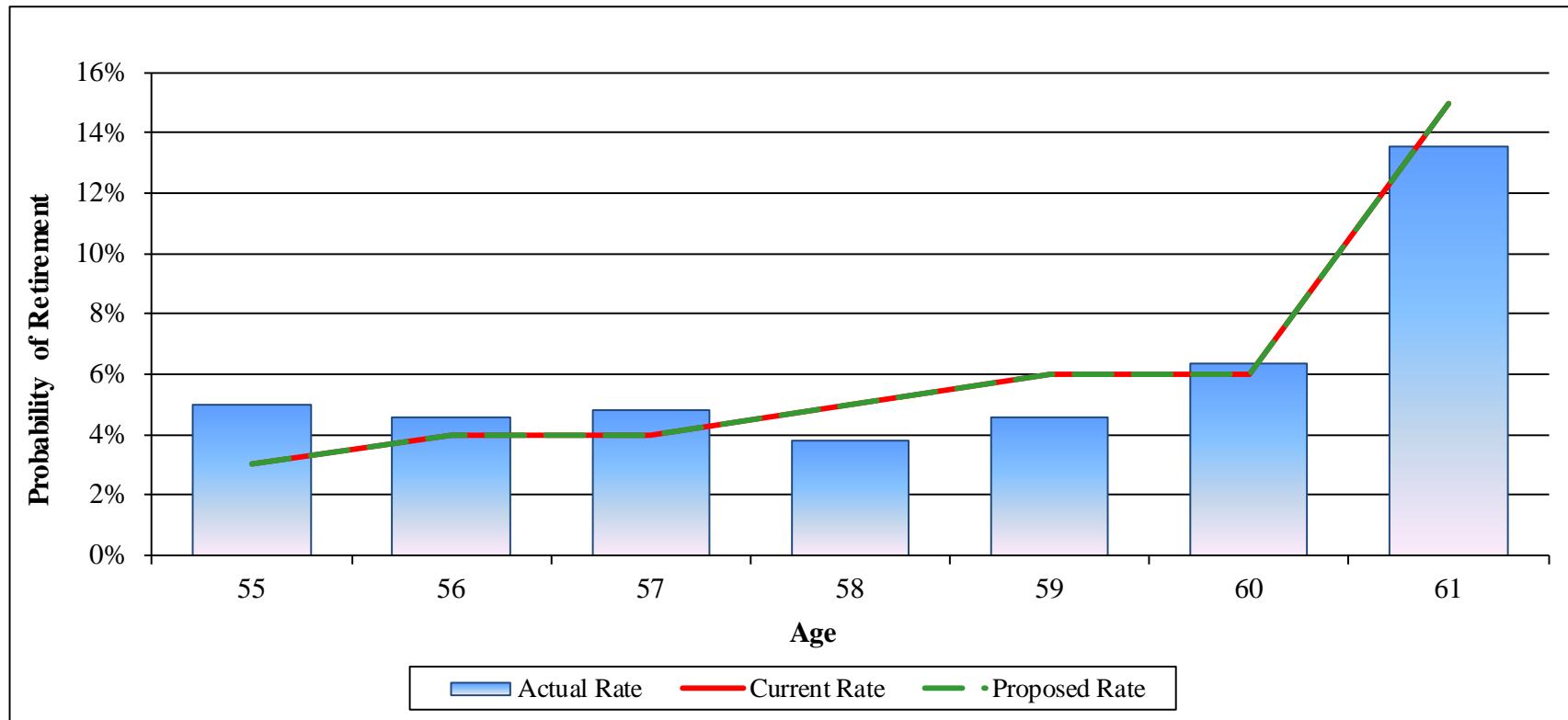
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	346,439	342,136	342,136
Actual/Expected		101%	101%

Experience Study 2013-2016
Appendix F-4
Retirement Rates
Regular-Unreduced
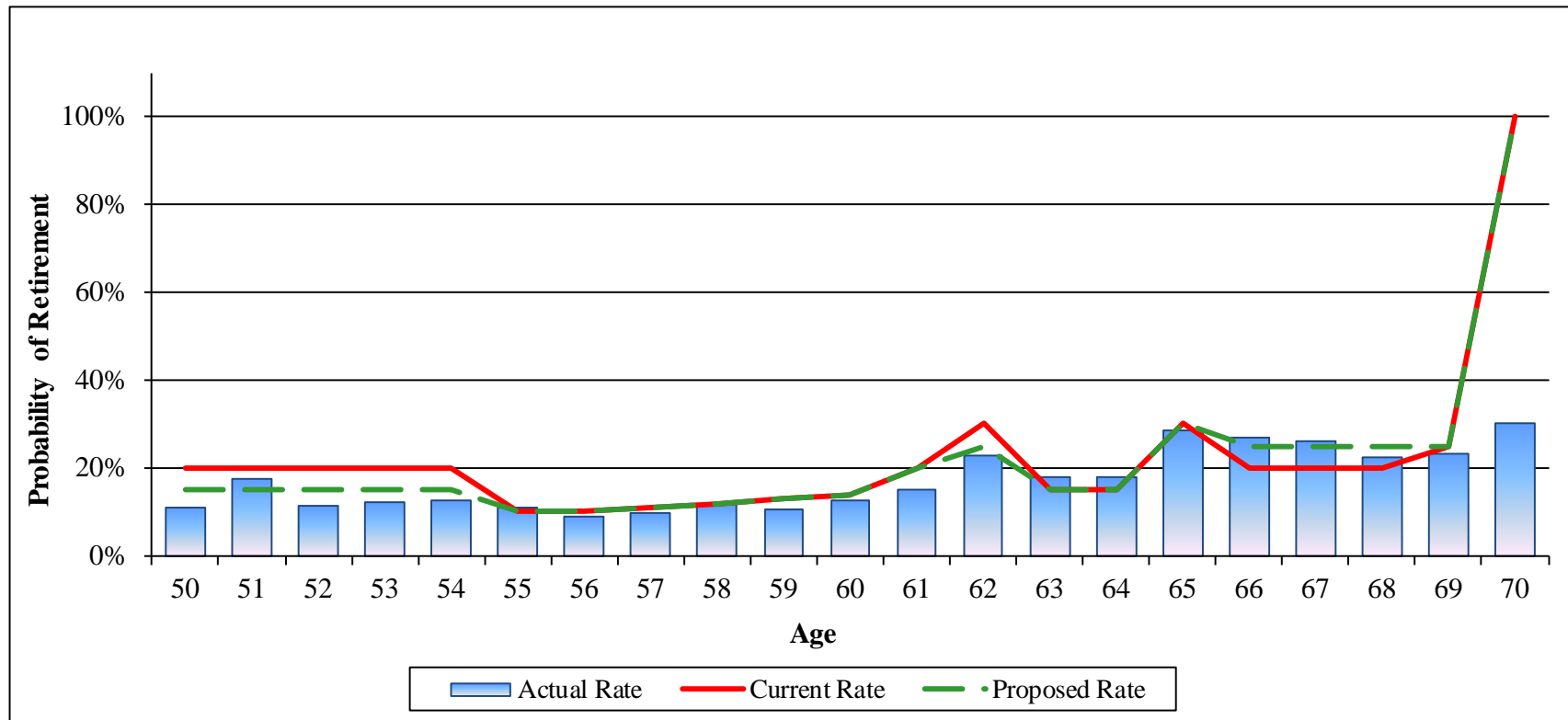
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	3,374,137	3,891,642	3,722,819
Actual/Expected		87%	91%

Experience Study 2013-2016
Appendix F-5
Retirement Rates
Elected Officials - Early
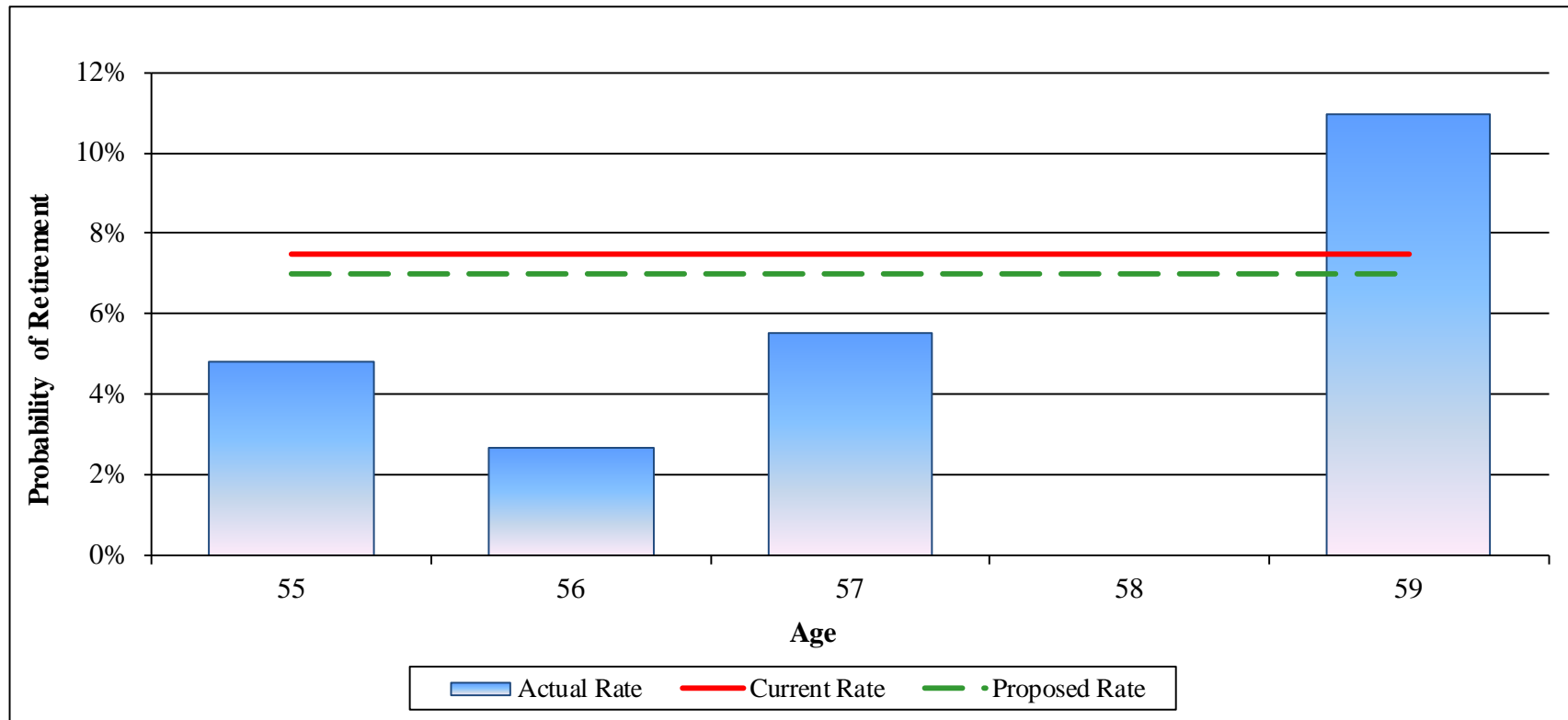
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	4,493	7,784	7,265
Actual/Expected		58%	62%

Experience Study 2013-2016
Appendix F-6
Retirement Rates
Elected Officials - Unreduced
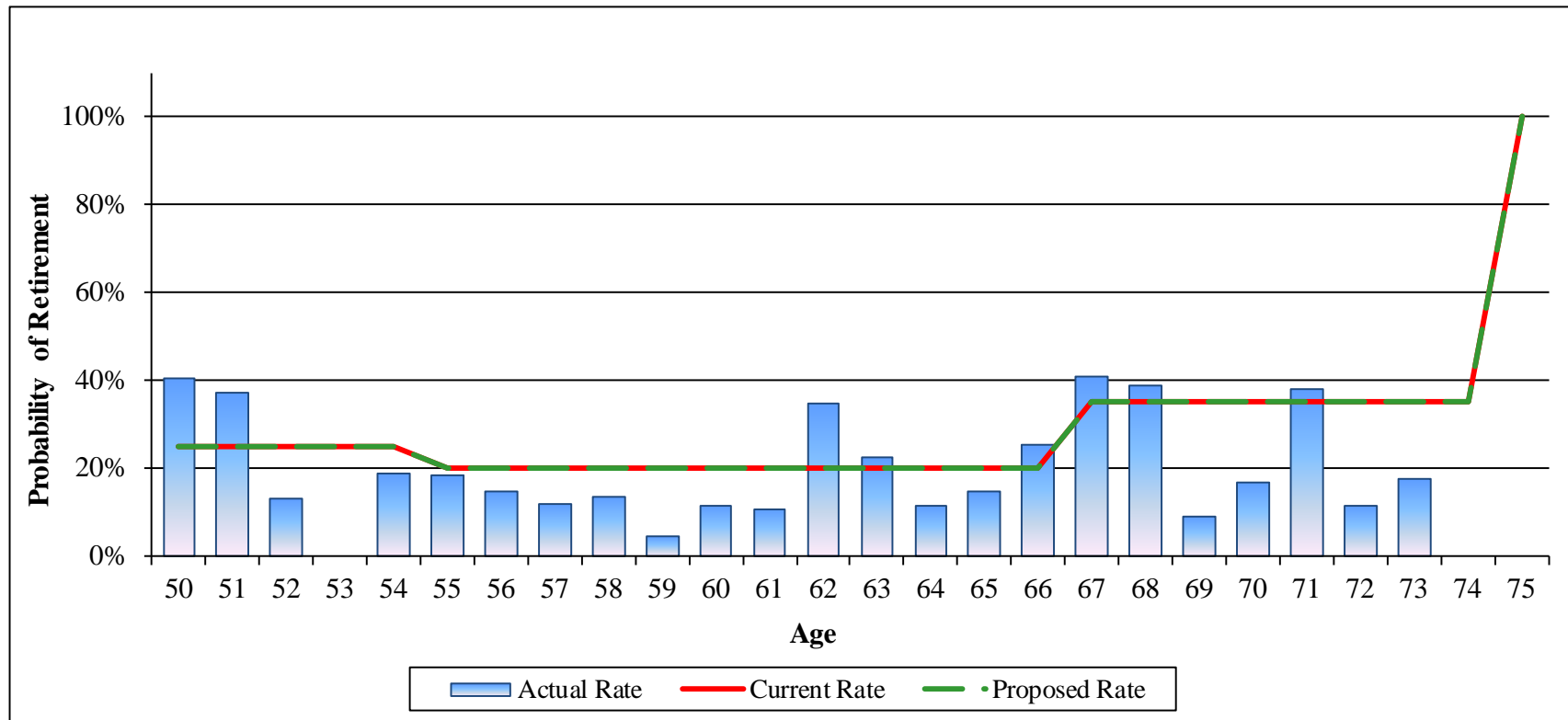
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	144,725	184,801	184,801
Actual/Expected		78%	78%

Experience Study 2013-2016
Appendix F-7
Retirement Rates
Hazardous Duty - Early
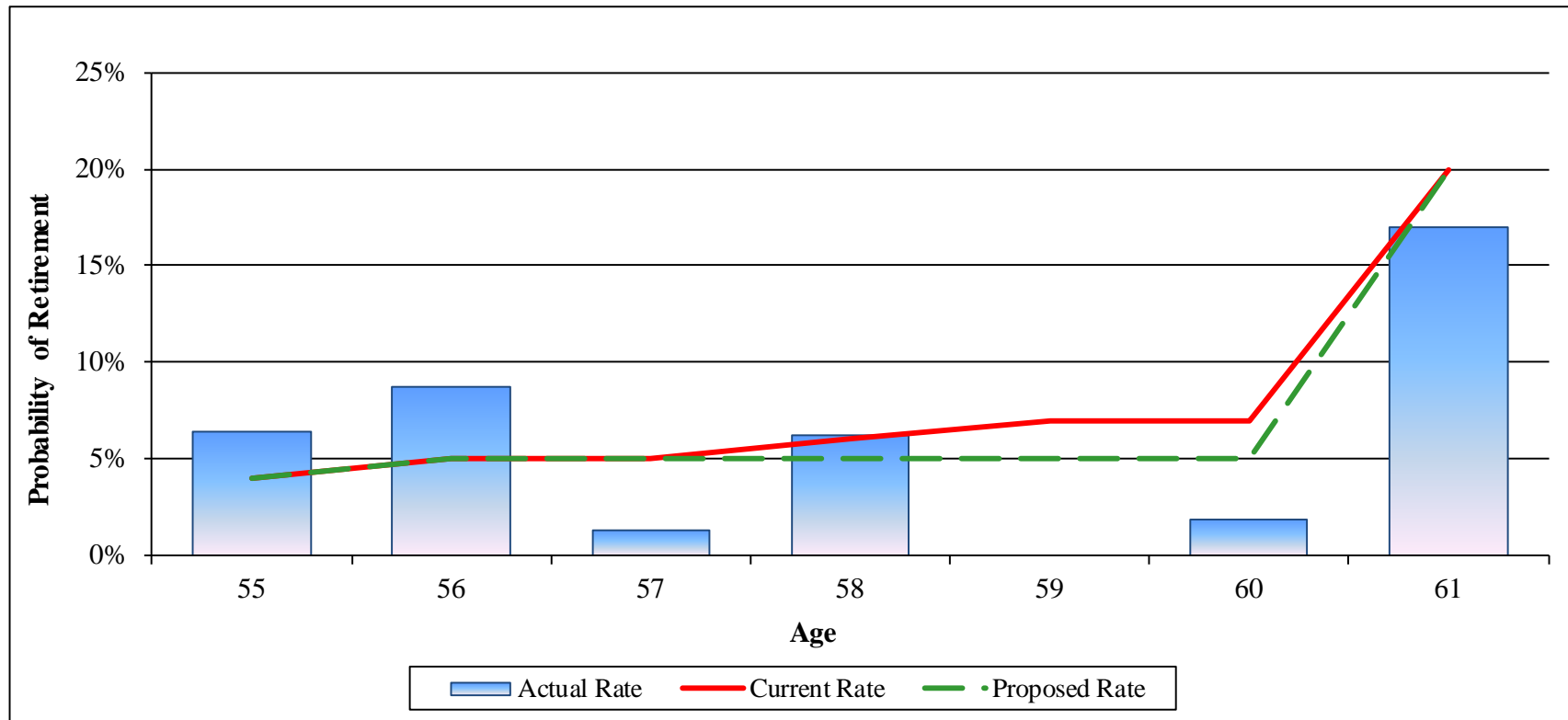
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	9,276	12,341	11,058
Actual/Expected		75%	84%

Experience Study 2013-2016
Appendix F-8
Retirement Rates
Hazardous Duty - Unreduced
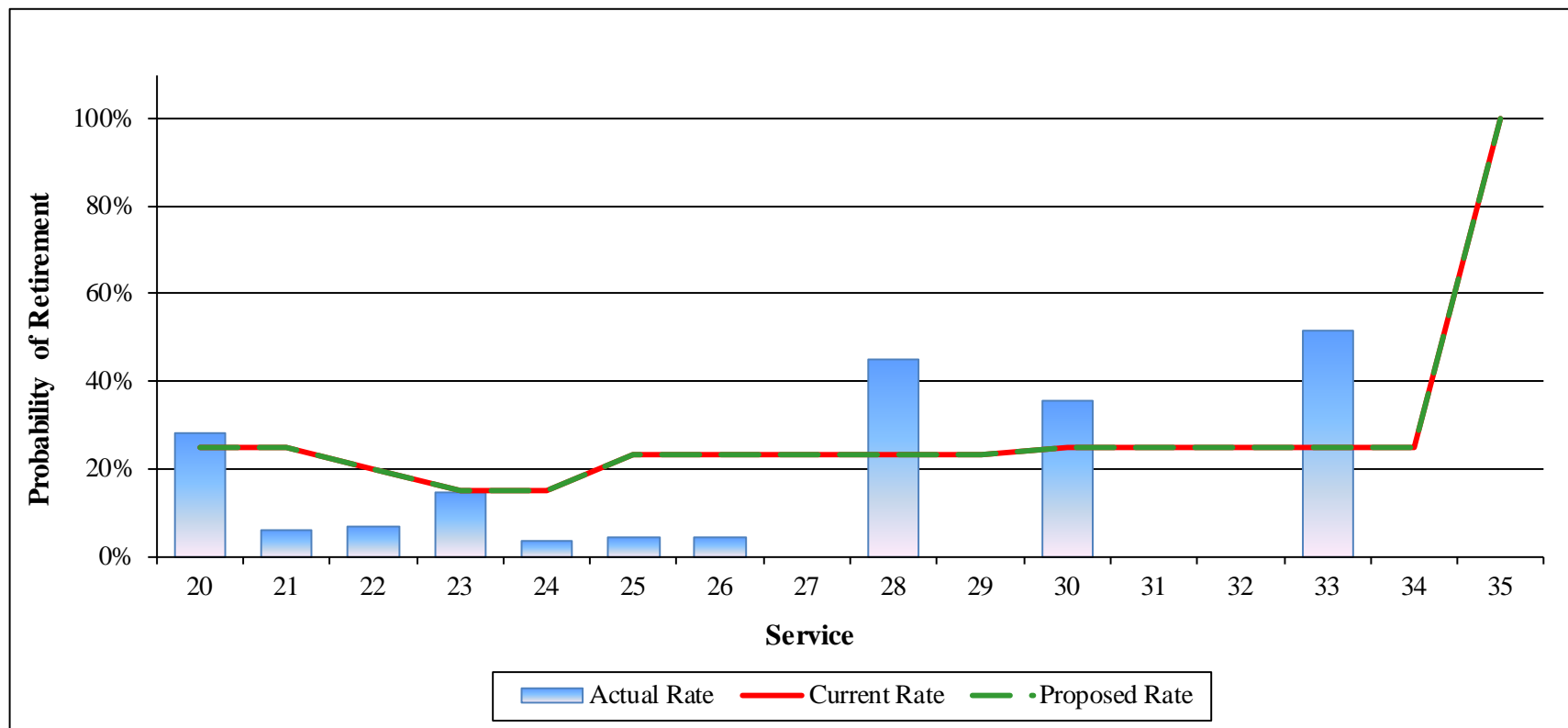
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	49,458.91	75,231	75,231
Actual/Expected		66%	66%

Experience Study 2013-2016
Appendix F-9
Retirement Rates
Hazardous Duty - Unreduced (Age)
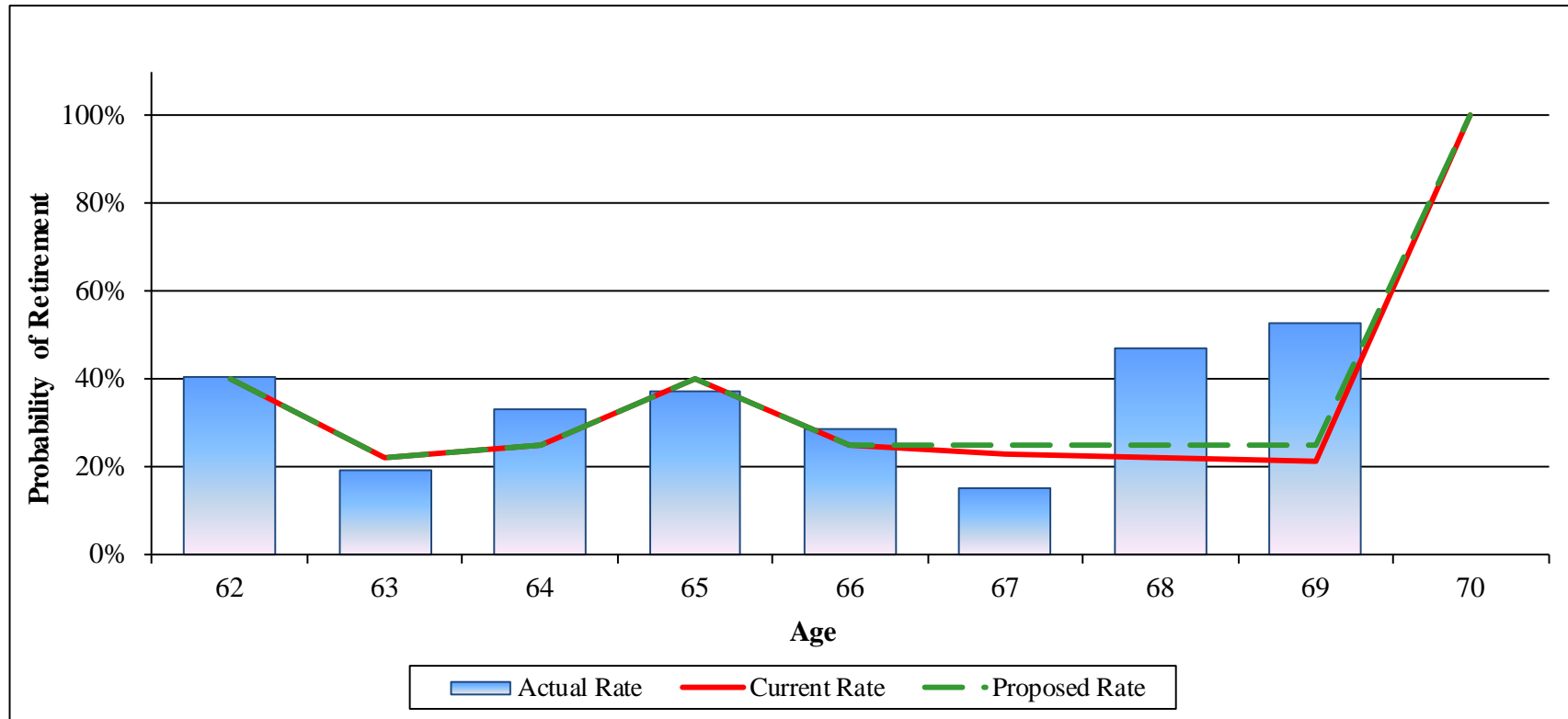
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	14,676	14,505	14,625
Actual/Expected		101%	100%

Experience Study 2013-2016
Appendix F-10
Retirement Rates
URSJJ
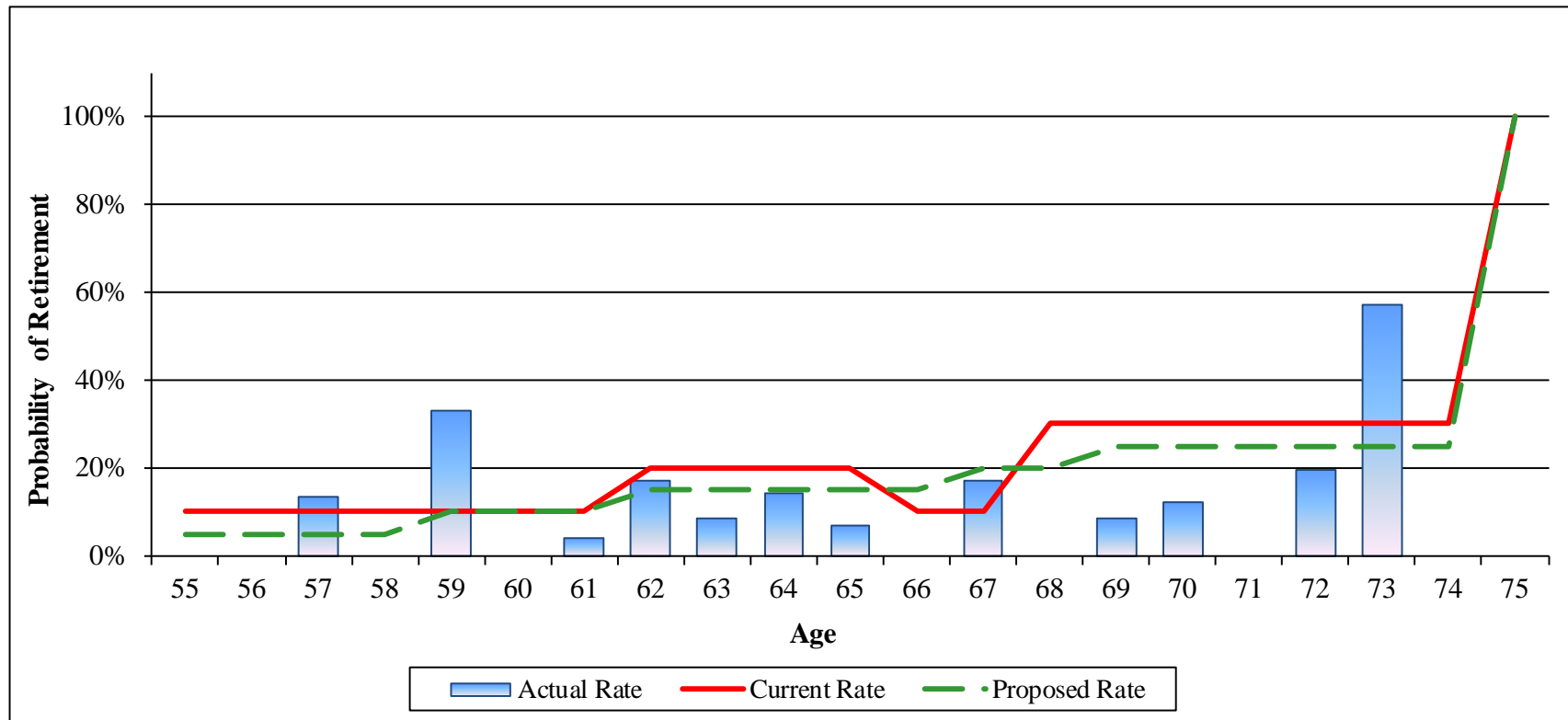
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	68,218	119,909	103,041
Actual/Expected		57%	66%

Experience Study 2013-2016
Appendix F-11
Rate of Disability - Active Lives
OPERS - Males
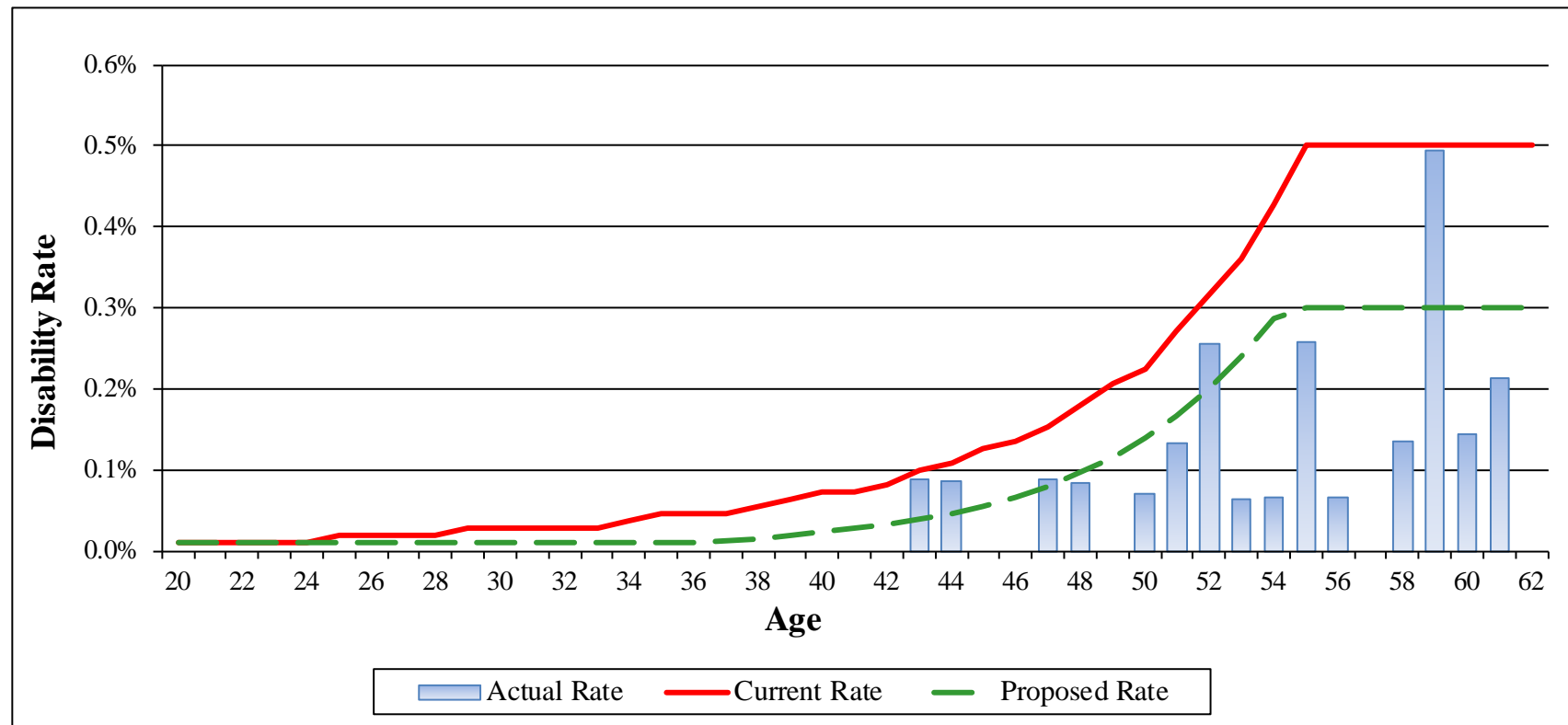
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	32	102	59
Actual/Expected		31%	54%

Experience Study 2013-2016
Appendix F-12
Rate of Disability - Active Lives
OPERS - Females
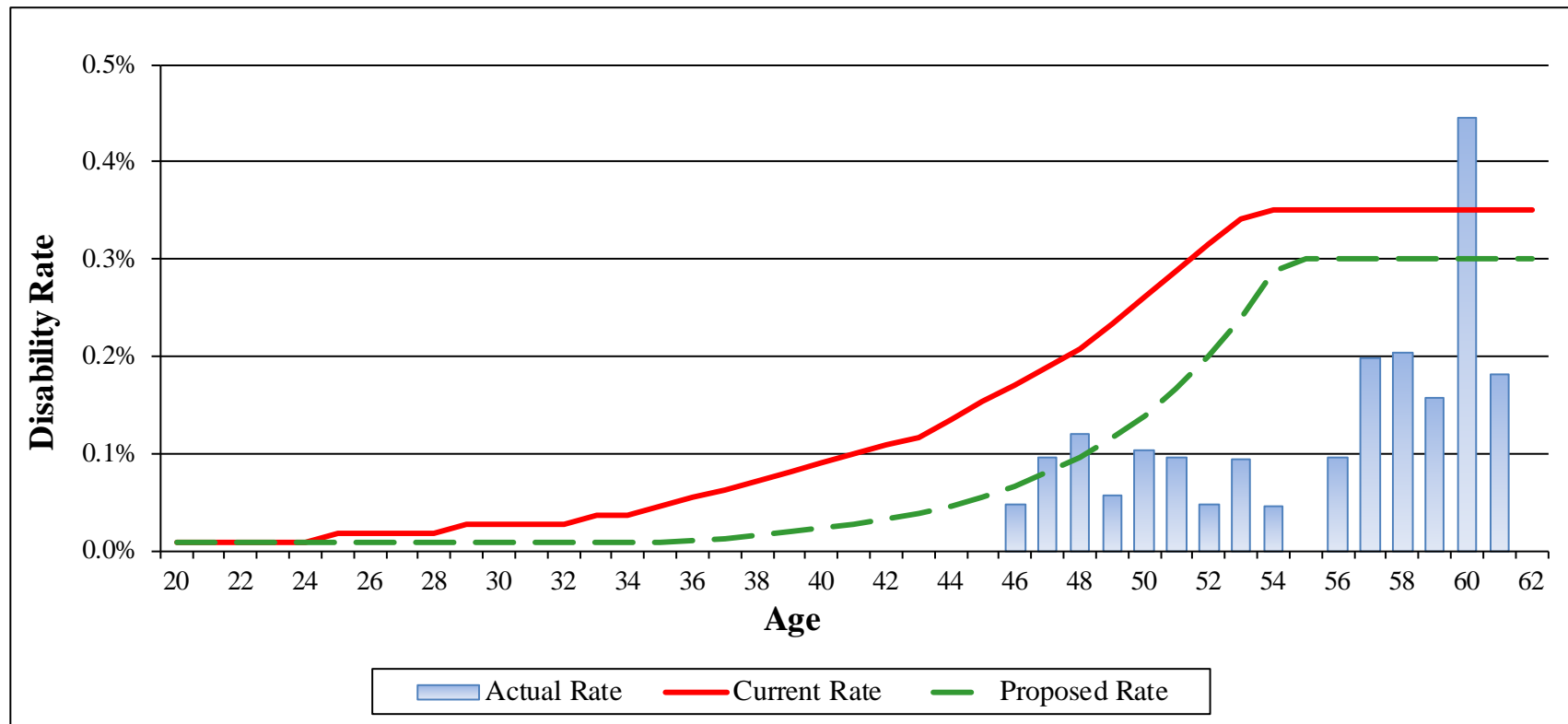
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	38	120	80
Actual/Expected		32%	48%

Experience Study 2013-2016
Appendix F-13
Rate of Disability - Active Lives
Hazardous Duty - Males
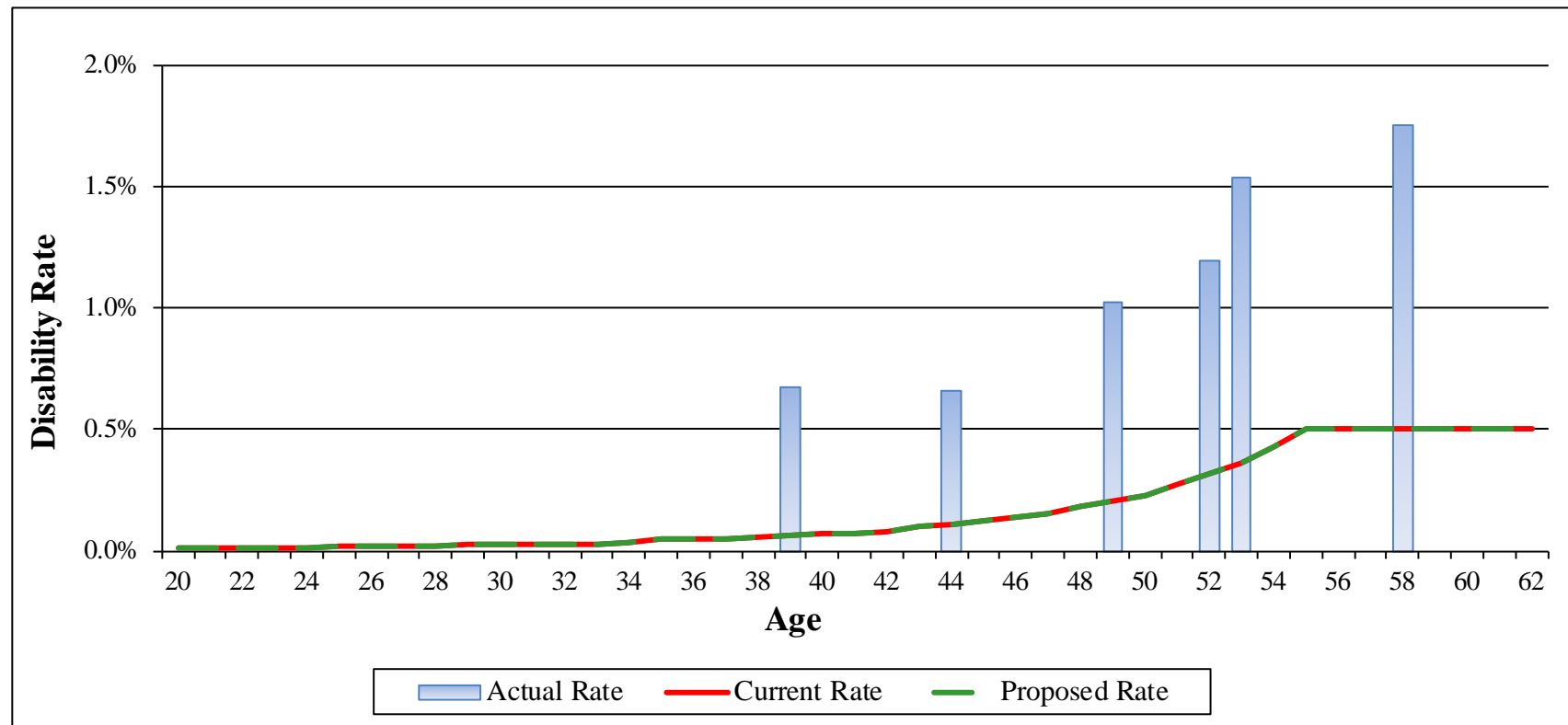
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	6	6	6
Actual/Expected		100%	100%

Experience Study 2013-2016
Appendix F-14
Rate of Termination of Employment
OPERS
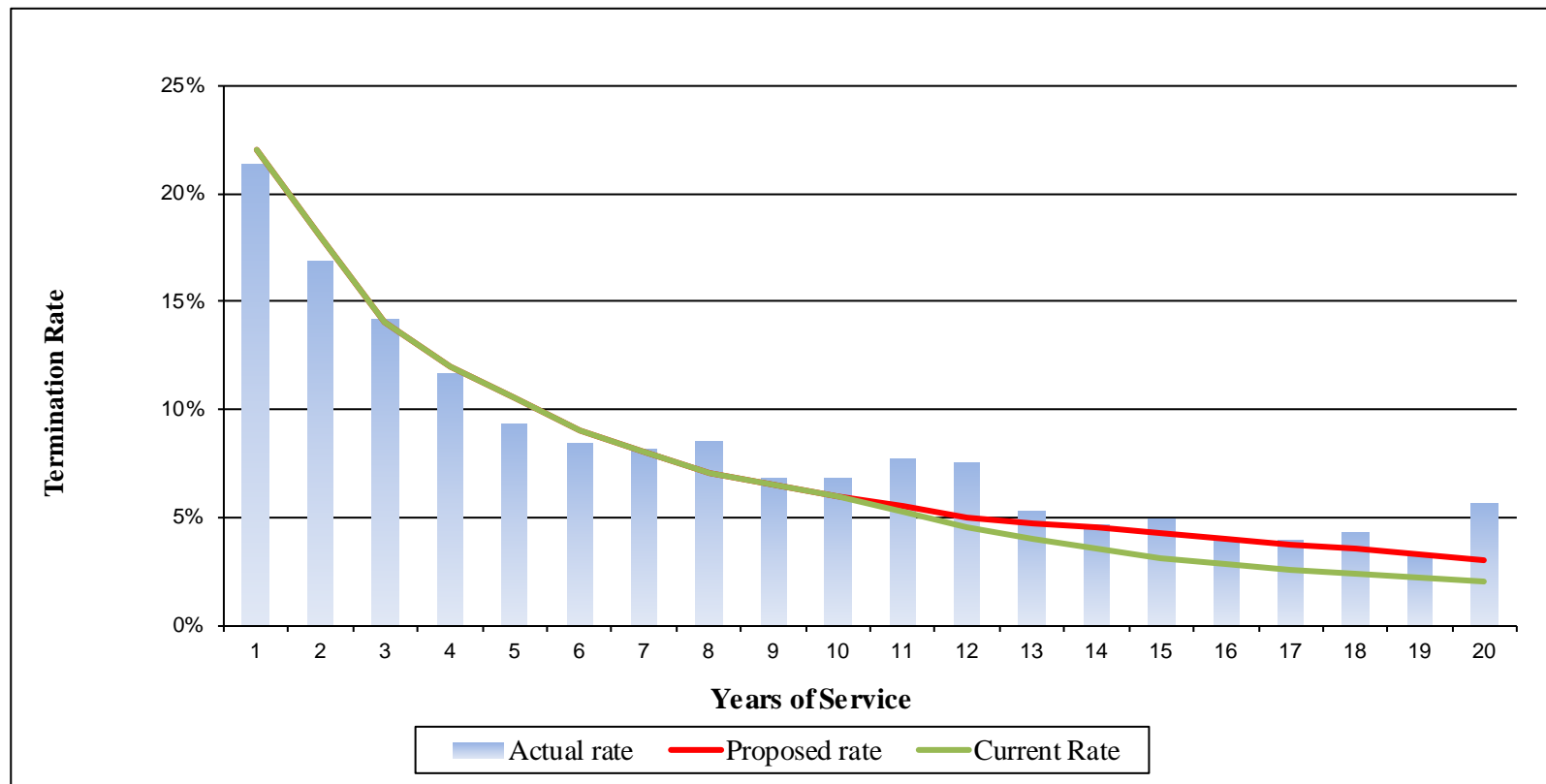
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Weighted Count	165,761	144,069	154,709
Actual/Expected		115%	107%

Experience Study 2013-2016
Appendix F-15
Probability of Contributions Remaining with the System
OPERS - Regular
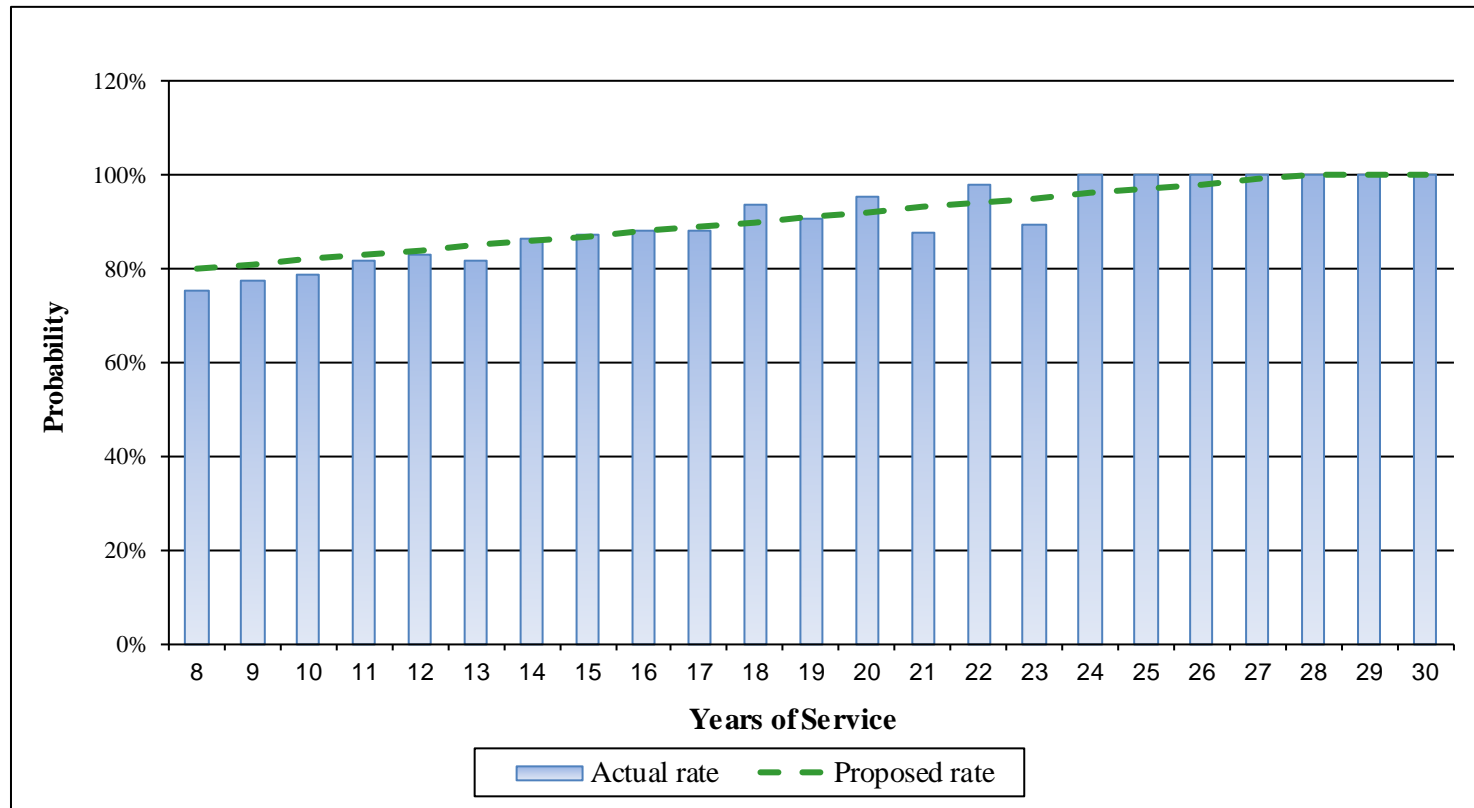
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	100,132	79,445	101,573
Actual/Expected		126%	99%

Experience Study 2013-2016
Appendix F-16
Total Salary Scale
OPERS
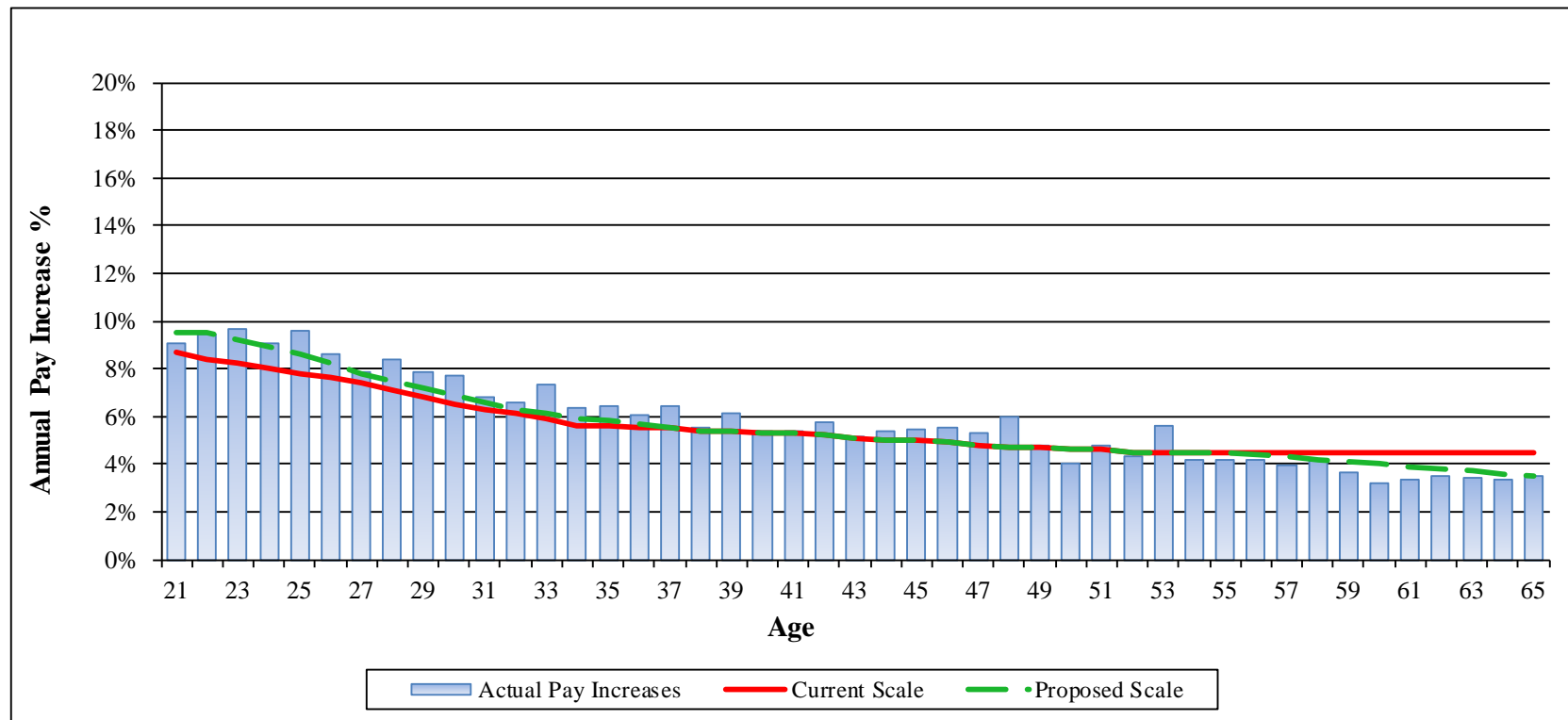
	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Average Increase	5.21%	5.12%	5.05%
Actual/Expected		102%	103%

Appendix G-1
Probability of Death - Healthy Retirees
OPERS - Males

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	569,589	3,037	0.5%	1,703.9	0.3%	2,968.5	0.5%
56	672,266	5,536	0.8%	2,354.5	0.4%	3,776.4	0.6%
57	816,274	5,418	0.7%	3,227.2	0.4%	4,942.0	0.6%
58	987,857	15,090	1.5%	4,433.1	0.4%	6,454.8	0.7%
59	1,150,357	6,052	0.5%	5,820.2	0.5%	8,130.7	0.7%
60	1,325,336	14,624	1.1%	7,610.1	0.6%	10,160.7	0.8%
61	1,495,974	17,670	1.2%	9,872.4	0.7%	12,473.7	0.8%
62	1,766,042	20,283	1.1%	13,295.9	0.8%	16,045.9	0.9%
63	2,100,700	22,839	1.1%	18,266.4	0.9%	20,826.8	1.0%
64	2,272,264	22,926	1.0%	22,260.6	1.0%	24,608.6	1.1%
65	2,527,787	29,377	1.2%	27,962.5	1.1%	29,878.2	1.2%
66	2,864,773	34,762	1.2%	36,215.6	1.3%	36,958.4	1.3%
67	2,988,426	59,434	2.0%	42,146.8	1.4%	42,011.6	1.4%
68	2,835,071	41,186	1.5%	44,003.0	1.6%	43,413.6	1.5%
69	2,546,098	72,561	2.8%	43,787.8	1.7%	43,562.5	1.7%
70	2,423,302	41,780	1.7%	46,263.7	1.9%	46,353.0	1.9%
71	2,275,021	59,890	2.6%	48,056.6	2.1%	48,680.0	2.1%
72	2,138,168	43,199	2.0%	50,149.3	2.3%	51,255.1	2.4%
73	2,011,721	72,726	3.6%	52,555.5	2.6%	52,801.3	2.6%
74	1,958,692	82,052	4.2%	57,085.8	2.9%	56,368.0	2.9%
75	1,790,208	62,340	3.5%	58,824.0	3.3%	56,611.5	3.2%
76	1,624,105	52,703	3.2%	59,480.8	3.7%	56,561.7	3.5%
77	1,483,096	56,834	3.8%	61,033.6	4.1%	56,933.1	3.8%
78	1,365,326	72,256	5.3%	63,071.8	4.6%	57,935.8	4.2%
79	1,243,502	82,668	6.6%	64,489.7	5.2%	58,348.1	4.7%
80	1,093,656	80,154	7.3%	63,665.3	5.8%	56,854.2	5.2%
81	1,000,930	49,762	5.0%	65,874.9	6.6%	57,696.5	5.8%
82	870,567	56,308	6.5%	64,660.5	7.4%	55,719.6	6.4%
83	790,200	61,603	7.8%	65,423.4	8.3%	56,156.4	7.1%
84	651,815	60,827	9.3%	60,625.6	9.3%	51,510.4	7.9%
85	533,297	44,907	8.4%	55,059.5	10.3%	46,862.6	8.8%
86	460,373	48,075	10.4%	52,697.5	11.4%	45,022.1	9.8%
87	407,342	39,703	9.7%	52,179.4	12.8%	44,346.2	10.9%
88	345,418	49,599	14.4%	49,473.4	14.3%	41,830.4	12.1%
89	267,690	41,983	15.7%	42,370.9	15.8%	36,039.3	13.5%
90	223,687	44,136	19.7%	39,414.2	17.6%	33,449.2	15.0%
Total to 100	52,493,703	1,742,949	3.3%	1,591,562.0	3.0%	1,491,387.9	2.8%

Note: Counts are weighted

Appendix G-2
Probability of Death - Healthy Retirees
OPERS - Females

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	759,515	3,065	0.4%	1,904.3	0.3%	2,657.7	0.3%
56	1,010,595	5,166	0.5%	2,940.4	0.3%	3,842.8	0.4%
57	1,184,677	8,417	0.7%	3,918.9	0.3%	4,893.9	0.4%
58	1,479,648	9,148	0.6%	5,520.9	0.4%	6,630.4	0.4%
59	1,681,700	3,023	0.2%	7,103.3	0.4%	8,173.1	0.5%
60	1,868,756	8,634	0.5%	8,984.7	0.5%	9,830.6	0.5%
61	1,966,885	2,932	0.1%	10,876.4	0.6%	11,208.9	0.6%
62	2,241,745	8,587	0.4%	14,193.7	0.6%	13,824.4	0.6%
63	2,633,430	15,978	0.6%	19,155.8	0.7%	17,562.3	0.7%
64	2,802,354	27,670	1.0%	22,972.6	0.8%	20,229.9	0.7%
65	2,902,450	24,149	0.8%	26,793.9	0.9%	22,700.1	0.8%
66	3,069,339	40,506	1.3%	31,977.8	1.0%	26,041.2	0.8%
67	2,958,515	32,074	1.1%	34,225.1	1.2%	27,295.0	0.9%
68	2,663,728	32,314	1.2%	34,062.9	1.3%	26,768.9	1.0%
69	2,487,321	53,171	2.1%	35,154.5	1.4%	29,013.0	1.2%
70	2,486,749	29,626	1.2%	39,597.7	1.6%	33,743.7	1.4%
71	2,403,231	47,777	2.0%	42,041.8	1.7%	38,050.6	1.6%
72	2,232,501	44,128	2.0%	43,440.1	1.9%	41,303.9	1.9%
73	1,987,989	30,357	1.5%	42,566.5	2.1%	40,525.0	2.0%
74	1,854,659	49,541	2.7%	44,013.0	2.4%	41,731.5	2.3%
75	1,701,228	50,199	3.0%	44,124.3	2.6%	42,328.9	2.5%
76	1,485,052	55,909	3.8%	42,436.9	2.9%	40,936.2	2.8%
77	1,329,437	52,016	3.9%	42,264.7	3.2%	40,656.8	3.1%
78	1,260,061	55,256	4.4%	44,158.5	3.5%	42,854.8	3.4%
79	1,171,424	59,792	5.1%	45,322.9	3.9%	44,392.2	3.8%
80	1,092,540	70,892	6.5%	46,724.4	4.3%	46,187.3	4.2%
81	992,339	45,210	4.6%	46,972.7	4.7%	46,908.6	4.7%
82	924,729	61,929	6.7%	48,525.4	5.2%	48,907.5	5.3%
83	822,684	68,705	8.4%	47,934.4	5.8%	48,747.1	5.9%
84	750,891	53,779	7.2%	48,658.7	6.5%	49,879.8	6.6%
85	660,548	48,066	7.3%	48,168.9	7.3%	49,183.0	7.4%
86	595,320	48,716	8.2%	48,907.4	8.2%	49,669.7	8.3%
87	512,945	49,575	9.7%	47,474.2	9.3%	47,931.9	9.3%
88	448,890	62,397	13.9%	46,274.9	10.3%	46,894.8	10.4%
89	357,076	62,517	17.5%	41,287.7	11.6%	41,631.3	11.7%
90	281,699	48,338	17.2%	35,996.8	12.8%	36,604.9	13.0%
Total to 100	58,042,389	1,553,222	2.7%	1,361,260.6	2.3%	1,326,182.8	2.3%

Note: Counts are weighted

Appendix G-3
Retirement Rates
Regular - Early

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	1,026,383	50,892	5.0%	30,791.5	3.0%	30,791.5	3.0%
56	928,070	42,574	4.6%	37,122.8	4.0%	37,122.8	4.0%
57	902,402	43,446	4.8%	36,096.1	4.0%	36,096.1	4.0%
58	835,373	31,909	3.8%	41,768.6	5.0%	41,768.6	5.0%
59	761,816	34,884	4.6%	45,709.0	6.0%	45,709.0	6.0%
60	729,580	46,406	6.4%	43,774.8	6.0%	43,774.8	6.0%
61	712,486	96,329	13.5%	106,872.8	15.0%	106,872.8	15.0%
	5,896,110	346,439	5.9%	342,135.7	5.8%	342,135.7	5.8%

Note: Counts are weighted

Appendix G-4
Retirement Rates
Regular - Unreduced

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
50	161,444	17,527	10.9%	32,288.8	20.0%	24,216.6	15.0%
51	389,638	68,129	17.5%	77,927.7	20.0%	58,445.7	15.0%
52	720,544	80,990	11.2%	144,108.9	20.0%	108,081.7	15.0%
53	938,544	116,256	12.4%	187,708.9	20.0%	140,781.6	15.0%
54	1,116,407	143,003	12.8%	223,281.4	20.0%	167,461.1	15.0%
55	1,216,181	132,679	10.9%	121,618.1	10.0%	121,618.1	10.0%
56	1,293,265	115,395	8.9%	129,326.5	10.0%	129,326.5	10.0%
57	1,303,783	125,726	9.6%	143,416.2	11.0%	143,416.2	11.0%
58	1,318,792	158,021	12.0%	158,255.0	12.0%	158,255.0	12.0%
59	1,350,834	142,645	10.6%	175,608.4	13.0%	175,608.4	13.0%
60	1,373,600	173,601	12.6%	192,304.0	14.0%	192,304.0	14.0%
61	1,367,198	207,653	15.2%	273,439.6	20.0%	273,439.6	20.0%
62	1,979,145	453,386	22.9%	593,743.6	30.0%	494,786.3	25.0%
63	1,528,261	273,588	17.9%	229,239.2	15.0%	229,239.2	15.0%
64	1,242,855	220,740	17.8%	186,428.3	15.0%	186,428.3	15.0%
65	1,066,063	305,057	28.6%	319,819.0	30.0%	319,819.0	30.0%
66	853,433	228,184	26.7%	170,686.5	20.0%	213,358.2	25.0%
67	617,515	162,172	26.3%	123,503.0	20.0%	154,378.8	25.0%
68	458,332	103,403	22.6%	91,666.4	20.0%	114,583.0	25.0%
69	321,286	74,671	23.2%	80,321.4	25.0%	80,321.4	25.0%
70	236,951	71,312	30.1%	236,950.8	100.0%	236,950.8	100.0%
	20,854,072	3,374,137	16.2%	3,891,641.6	18.7%	3,722,819.4	17.9%

Note: Counts are weighted

Appendix G-5
Retirement Rates
Elected Officials - Early

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	26,844	1,289	4.8%	2,013.3	7.5%	1,879.1	7.0%
56	20,315	540	2.7%	1,523.7	7.5%	1,422.1	7.0%
57	20,040	1,109	5.5%	1,503.0	7.5%	1,402.8	7.0%
58	22,410	-	0.0%	1,680.7	7.5%	1,568.7	7.0%
59	14,172	1,555	11.0%	1,062.9	7.5%	992.0	7.0%
	103,782	4,493	4.3%	7,783.6	7.5%	7,264.7	7.0%

Note: Counts are weighted

Appendix G-6
Retirement Rates
Elected Officials - Unreduced

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
50	11,682	4,743	40.6%	2,920.5	25.0%	2,920.5	25.0%
51	13,247	4,910	37.1%	3,311.6	25.0%	3,311.6	25.0%
52	13,928	1,814	13.0%	3,481.9	25.0%	3,481.9	25.0%
53	22,327	-	0.0%	5,581.7	25.0%	5,581.7	25.0%
54	40,679	7,572	18.6%	10,169.8	25.0%	10,169.8	25.0%
55	37,146	6,887	18.5%	7,429.1	20.0%	7,429.1	20.0%
56	40,188	5,912	14.7%	8,037.7	20.0%	8,037.7	20.0%
57	37,524	4,394	11.7%	7,504.9	20.0%	7,504.9	20.0%
58	43,856	5,855	13.4%	8,771.2	20.0%	8,771.2	20.0%
59	42,155	1,843	4.4%	8,431.1	20.0%	8,431.1	20.0%
60	64,813	7,302	11.3%	12,962.6	20.0%	12,962.6	20.0%
61	66,551	7,071	10.6%	13,310.3	20.0%	13,310.3	20.0%
62	76,509	26,489	34.6%	15,301.8	20.0%	15,301.8	20.0%
63	40,389	9,078	22.5%	8,077.7	20.0%	8,077.7	20.0%
64	34,763	4,004	11.5%	6,952.5	20.0%	6,952.5	20.0%
65	32,275	4,719	14.6%	6,455.1	20.0%	6,455.1	20.0%
66	39,832	10,117	25.4%	7,966.4	20.0%	7,966.4	20.0%
67	24,534	10,047	41.0%	8,587.1	35.0%	8,587.1	35.0%
68	12,106	4,694	38.8%	4,237.0	35.0%	4,237.0	35.0%
69	9,514	858	9.0%	3,330.0	35.0%	3,330.0	35.0%
70	20,718	3,490	16.8%	7,251.4	35.0%	7,251.4	35.0%
71	24,351	9,244	38.0%	8,522.8	35.0%	8,522.8	35.0%
72	19,122	2,213	11.6%	6,692.7	35.0%	6,692.7	35.0%
73	8,388	1,467	17.5%	2,935.9	35.0%	2,935.9	35.0%
74	6,078	-	0.0%	2,127.4	35.0%	2,127.4	35.0%
75	4,451	-	0.0%	4,451.3	100.0%	4,451.3	100.0%
	787,127	144,725	18.4%	184,801.5	23.5%	184,801.5	23.5%

Note: Counts are weighted

Appendix G-7
Retirement Rates
Hazardous Duty - Early

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	28,358	1,803	6.4%	1,134.3	4.0%	1,134.3	4.0%
56	21,130	1,845	8.7%	1,056.5	5.0%	1,056.5	5.0%
57	23,743	296	1.2%	1,187.2	5.0%	1,187.2	5.0%
58	25,673	1,595	6.2%	1,540.4	6.0%	1,283.6	5.0%
59	24,905	-	0.0%	1,743.3	7.0%	1,245.2	5.0%
60	26,404	491	1.9%	1,848.2	7.0%	1,320.2	5.0%
61	19,156	3,247	17.0%	3,831.1	20.0%	3,831.1	20.0%
	169,368	9,276	5.5%	12,341.0	7.3%	11,058.1	6.5%

Note: Counts are weighted

Appendix G-8
Retirement Rates
Hazardous Duty - Unreduced

Duration	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
20	89,486	25,185	28.1%	22,371.5	25.0%	22,371.5	25.0%
21	41,175	2,374	5.8%	10,293.8	25.0%	10,293.8	25.0%
22	35,977	2,485	6.9%	7,195.4	20.0%	7,195.4	20.0%
23	30,003	4,352	14.5%	4,500.5	15.0%	4,500.5	15.0%
24	33,750	1,139	3.4%	5,062.4	15.0%	5,062.4	15.0%
25	27,630	1,184	4.3%	6,355.0	23.0%	6,355.0	23.0%
26	29,042	1,297	4.5%	6,679.8	23.0%	6,679.8	23.0%
27	12,733	-	0.0%	2,928.5	23.0%	2,928.5	23.0%
28	16,030	7,173	44.8%	3,686.9	23.0%	3,686.9	23.0%
29	7,367	-	0.0%	1,694.4	23.0%	1,694.4	23.0%
30	7,747	2,754	35.5%	1,936.8	25.0%	1,936.8	25.0%
31	2,712	-	0.0%	677.9	25.0%	677.9	25.0%
32	4,437	-	0.0%	1,109.4	25.0%	1,109.4	25.0%
33	2,953	1,515	51.3%	738.3	25.0%	738.3	25.0%
34	-	-	0.0%	-	25.0%	-	25.0%
35	-	-	0.0%	-	100.0%	-	100.0%
	341,043	49,459	14.5%	75,230.5	22.1%	75,230.5	22.1%

Note: Counts are weighted

Appendix G-9
Retirement Rates
Hazardous Duty - Unreduced (Age)

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
62	13,247	5,372	40.6%	5,298.9	40.0%	5,298.9	40.0%
63	9,475	1,825	19.3%	2,084.6	22.0%	2,084.6	22.0%
64	8,524	2,821	33.1%	2,131.0	25.0%	2,131.0	25.0%
65	6,045	2,248	37.2%	2,418.1	40.0%	2,418.1	40.0%
66	3,200	920	28.7%	799.9	25.0%	799.9	25.0%
67	1,815	275	15.2%	417.3	23.0%	453.6	25.0%
68	1,570	737	46.9%	345.4	22.0%	392.5	25.0%
69	909	478	52.6%	190.9	21.0%	227.2	25.0%
70	819	-	0.0%	818.9	100.0%	818.9	100.0%
	45,604	14,676	32.2%	14,505.1	31.8%	14,624.8	32.1%

Note: Counts are weighted

Appendix G-10
Retirement Rates
URSJJ

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate	
55	3,318	-	0.0%	331.8	10.0%	165.9	5.0%	55
56	6,808	-	0.0%	680.8	10.0%	340.4	5.0%	56
57	20,742	2,807	13.5%	2,074.2	10.0%	1,037.1	5.0%	57
58	10,921	-	0.0%	1,092.1	10.0%	546.0	5.0%	58
59	45,635	15,125	33.1%	4,563.5	10.0%	4,563.5	10.0%	59
60	30,123	-	0.0%	3,012.3	10.0%	3,012.3	10.0%	60
61	53,755	2,119	3.9%	5,375.5	10.0%	5,375.5	10.0%	61
62	66,533	11,480	17.3%	13,306.6	20.0%	9,980.0	15.0%	62
63	74,069	6,253	8.4%	14,813.8	20.0%	11,110.4	15.0%	63
64	74,833	10,612	14.2%	14,966.6	20.0%	11,224.9	15.0%	64
65	47,536	3,232	6.8%	9,507.2	20.0%	7,130.4	15.0%	65
66	43,532	-	0.0%	4,353.2	10.0%	6,529.8	15.0%	66
67	45,215	7,649	16.9%	4,521.5	10.0%	9,043.1	20.0%	67
68	41,921	-	0.0%	12,576.2	30.0%	8,384.1	20.0%	68
69	34,688	2,987	8.6%	10,406.5	30.0%	8,672.0	25.0%	69
70	17,916	2,188	12.2%	5,374.7	30.0%	4,478.9	25.0%	70
71	12,317	-	0.0%	3,695.1	30.0%	3,079.3	25.0%	71
72	11,437	2,236	19.6%	3,431.0	30.0%	2,859.2	25.0%	72
73	2,680	1,530	57.1%	803.9	30.0%	669.9	25.0%	73
74	3,680	-	0.0%	1,103.9	30.0%	919.9	25.0%	74
75	3,919	-	0.0%	3,918.8	100.0%	3,918.8	100.0%	75
	651,577	68,218	10.5%	119,909.2	18.4%	103,041.5	15.8%	

Note: Counts are weighted

Appendix G-11
Rate of Disability - Active Lives
OPERS - Males

Age	Exposure	Actual Disabilities	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
20	205	-	0.000%	0.0	0.009%	0.0	0.009%
21	309	-	0.000%	0.0	0.009%	0.0	0.009%
22	376	-	0.000%	0.0	0.009%	0.0	0.009%
23	509	-	0.000%	0.0	0.009%	0.0	0.009%
24	621	-	0.000%	0.1	0.009%	0.1	0.009%
25	705	-	0.000%	0.1	0.018%	0.1	0.009%
26	777	-	0.000%	0.1	0.018%	0.1	0.009%
27	808	-	0.000%	0.1	0.018%	0.1	0.009%
28	854	-	0.000%	0.2	0.018%	0.1	0.009%
29	888	-	0.000%	0.2	0.027%	0.1	0.009%
30	944	-	0.000%	0.3	0.027%	0.1	0.009%
31	956	-	0.000%	0.3	0.027%	0.1	0.009%
32	995	-	0.000%	0.3	0.027%	0.1	0.009%
33	999	-	0.000%	0.3	0.027%	0.1	0.009%
34	1,006	-	0.000%	0.4	0.036%	0.1	0.009%
35	979	-	0.000%	0.4	0.045%	0.1	0.009%
36	949	-	0.000%	0.4	0.045%	0.1	0.011%
37	930	-	0.000%	0.4	0.045%	0.1	0.013%
38	978	-	0.000%	0.5	0.054%	0.2	0.016%
39	981	-	0.000%	0.6	0.063%	0.2	0.019%
40	988	-	0.000%	0.7	0.072%	0.2	0.022%
41	1,016	-	0.000%	0.7	0.072%	0.3	0.027%
42	1,062	-	0.000%	0.9	0.081%	0.3	0.032%
43	1,144	1	0.087%	1.1	0.099%	0.4	0.039%
44	1,156	1	0.087%	1.2	0.108%	0.5	0.046%
45	1,136	-	0.000%	1.4	0.126%	0.6	0.056%
46	1,133	-	0.000%	1.5	0.135%	0.8	0.067%
47	1,140	1	0.088%	1.7	0.153%	0.9	0.080%
48	1,210	1	0.083%	2.2	0.180%	1.2	0.096%
49	1,264	-	0.000%	2.6	0.207%	1.5	0.116%
50	1,410	1	0.071%	3.2	0.225%	2.0	0.139%
51	1,518	2	0.132%	4.1	0.270%	2.5	0.166%
52	1,566	4	0.255%	4.9	0.315%	3.1	0.200%
53	1,569	1	0.064%	5.6	0.360%	3.8	0.240%
54	1,526	1	0.066%	6.5	0.428%	4.4	0.288%
55	1,554	4	0.257%	7.8	0.500%	4.7	0.300%
56	1,528	1	0.065%	7.6	0.500%	4.6	0.300%
57	1,558	-	0.000%	7.8	0.500%	4.7	0.300%
58	1,492	2	0.134%	7.5	0.500%	4.5	0.300%
59	1,416	7	0.494%	7.1	0.500%	4.2	0.300%
60	1,389	2	0.144%	6.9	0.500%	4.2	0.300%
61	1,409	3	0.213%	7.0	0.500%	4.2	0.300%
62	1,282	-	0.000%	6.4	0.500%	3.8	0.300%
	46,235	32	0.069%	101.5	0.220%	59.0	0.128%

Appendix G-12
Rate of Disability - Active Lives
OPERS - Females

Age	Exposure	Actual Disabilities	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate	
20	197	-	0.000%	0.0	0.009%	0.0	0.009%	20
21	272	-	0.000%	0.0	0.009%	0.0	0.009%	21
22	385	-	0.000%	0.0	0.009%	0.0	0.009%	22
23	679	-	0.000%	0.1	0.009%	0.1	0.009%	23
24	905	-	0.000%	0.1	0.009%	0.1	0.009%	24
25	1,045	-	0.000%	0.2	0.018%	0.1	0.009%	25
26	1,101	-	0.000%	0.2	0.018%	0.1	0.009%	26
27	1,139	-	0.000%	0.2	0.018%	0.1	0.009%	27
28	1,224	-	0.000%	0.2	0.018%	0.1	0.009%	28
29	1,330	-	0.000%	0.4	0.027%	0.1	0.009%	29
30	1,401	-	0.000%	0.4	0.027%	0.1	0.009%	30
31	1,461	-	0.000%	0.4	0.027%	0.1	0.009%	31
32	1,461	-	0.000%	0.4	0.027%	0.1	0.009%	32
33	1,564	-	0.000%	0.6	0.036%	0.1	0.009%	33
34	1,529	-	0.000%	0.6	0.036%	0.1	0.009%	34
35	1,472	-	0.000%	0.7	0.045%	0.1	0.009%	35
36	1,434	-	0.000%	0.8	0.054%	0.2	0.011%	36
37	1,440	-	0.000%	0.9	0.063%	0.2	0.013%	37
38	1,456	-	0.000%	1.0	0.072%	0.2	0.016%	38
39	1,485	-	0.000%	1.2	0.081%	0.3	0.019%	39
40	1,559	-	0.000%	1.4	0.090%	0.3	0.022%	40
41	1,562	-	0.000%	1.5	0.099%	0.4	0.027%	41
42	1,621	-	0.000%	1.8	0.108%	0.5	0.032%	42
43	1,698	-	0.000%	2.0	0.117%	0.7	0.039%	43
44	1,760	-	0.000%	2.4	0.135%	0.8	0.046%	44
45	1,737	-	0.000%	2.7	0.153%	1.0	0.056%	45
46	2,123	1	0.047%	3.6	0.171%	1.4	0.067%	46
47	2,085	2	0.096%	3.9	0.189%	1.7	0.080%	47
48	1,660	2	0.120%	3.4	0.207%	1.6	0.096%	48
49	1,756	1	0.057%	4.1	0.234%	2.0	0.116%	49
50	1,925	2	0.104%	5.0	0.261%	2.7	0.139%	50
51	2,073	2	0.096%	6.0	0.288%	3.4	0.166%	51
52	2,128	1	0.047%	6.7	0.315%	4.2	0.200%	52
53	2,119	2	0.094%	7.2	0.342%	5.1	0.240%	53
54	2,158	1	0.046%	7.6	0.350%	6.2	0.288%	54
55	2,140	-	0.000%	7.5	0.350%	6.4	0.300%	55
56	2,071	2	0.097%	7.2	0.350%	6.2	0.300%	56
57	2,021	4	0.198%	7.1	0.350%	6.1	0.300%	57
58	1,969	4	0.203%	6.9	0.350%	5.9	0.300%	58
59	1,915	3	0.157%	6.7	0.350%	5.7	0.300%	59
60	1,796	8	0.445%	6.3	0.350%	5.4	0.300%	60
61	1,656	3	0.181%	5.8	0.350%	5.0	0.300%	61
62	1,461	-	0.000%	5.1	0.350%	4.4	0.300%	62
	65,973	38	0.058%	120.2	0.182%	79.6	0.121%	

Appendix G-13
Rate of Disability - Active Lives
Hazardous Duty - Males

Age	Exposure	Actual Disabilities	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate	
20	9	-	0.000%	0.0	0.009%	0.0	0.009%	20
21	70	-	0.000%	0.0	0.009%	0.0	0.009%	21
22	92	-	0.000%	0.0	0.009%	0.0	0.009%	22
23	105	-	0.000%	0.0	0.009%	0.0	0.009%	23
24	98	-	0.000%	0.0	0.009%	0.0	0.009%	24
25	123	-	0.000%	0.0	0.018%	0.0	0.018%	25
26	117	-	0.000%	0.0	0.018%	0.0	0.018%	26
27	137	-	0.000%	0.0	0.018%	0.0	0.018%	27
28	143	-	0.000%	0.0	0.018%	0.0	0.018%	28
29	138	-	0.000%	0.0	0.027%	0.0	0.027%	29
30	144	-	0.000%	0.0	0.027%	0.0	0.027%	30
31	121	-	0.000%	0.0	0.027%	0.0	0.027%	31
32	111	-	0.000%	0.0	0.027%	0.0	0.027%	32
33	112	-	0.000%	0.0	0.027%	0.0	0.027%	33
34	115	-	0.000%	0.0	0.036%	0.0	0.036%	34
35	132	-	0.000%	0.1	0.045%	0.1	0.045%	35
36	144	-	0.000%	0.1	0.045%	0.1	0.045%	36
37	157	-	0.000%	0.1	0.045%	0.1	0.045%	37
38	145	-	0.000%	0.1	0.054%	0.1	0.054%	38
39	149	1	0.671%	0.1	0.063%	0.1	0.063%	39
40	143	-	0.000%	0.1	0.072%	0.1	0.072%	40
41	141	-	0.000%	0.1	0.072%	0.1	0.072%	41
42	143	-	0.000%	0.1	0.081%	0.1	0.081%	42
43	143	-	0.000%	0.1	0.099%	0.1	0.099%	43
44	152	1	0.658%	0.2	0.108%	0.2	0.108%	44
45	154	-	0.000%	0.2	0.126%	0.2	0.126%	45
46	129	-	0.000%	0.2	0.135%	0.2	0.135%	46
47	102	-	0.000%	0.2	0.153%	0.2	0.153%	47
48	92	-	0.000%	0.2	0.180%	0.2	0.180%	48
49	98	1	1.020%	0.2	0.207%	0.2	0.207%	49
50	93	-	0.000%	0.2	0.225%	0.2	0.225%	50
51	104	-	0.000%	0.3	0.270%	0.3	0.270%	51
52	84	1	1.190%	0.3	0.315%	0.3	0.315%	52
53	65	1	1.538%	0.2	0.360%	0.2	0.360%	53
54	59	-	0.000%	0.3	0.428%	0.3	0.428%	54
55	59	-	0.000%	0.3	0.500%	0.3	0.500%	55
56	54	-	0.000%	0.3	0.500%	0.3	0.500%	56
57	50	-	0.000%	0.3	0.500%	0.3	0.500%	57
58	57	1	1.754%	0.3	0.500%	0.3	0.500%	58
59	63	-	0.000%	0.3	0.500%	0.3	0.500%	59
60	54	-	0.000%	0.3	0.500%	0.3	0.500%	60
61	41	-	0.000%	0.2	0.500%	0.2	0.500%	61
62	34	-	0.000%	0.2	0.500%	0.2	0.500%	62
	4,476	6	0.134%	5.5	0.123%	5.5	0.123%	

Appendix G-14
Rate of Termination of Employment
OPERS

Duration	Exposure	Actual Terminations	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
1	43,391	9,264	21.4%	9,546	22.0%	9,546	22.0%
2	69,689	11,759	16.9%	12,544	18.0%	12,544	18.0%
3	79,481	11,249	14.2%	11,127	14.0%	11,127	14.0%
4	87,840	10,234	11.7%	10,541	12.0%	10,541	12.0%
5	107,807	10,085	9.4%	11,320	10.5%	11,320	10.5%
6	124,705	10,487	8.4%	11,223	9.0%	11,223	9.0%
7	146,922	11,985	8.2%	11,754	8.0%	11,754	8.0%
8	157,321	13,350	8.5%	11,012	7.0%	11,012	7.0%
9	160,911	10,933	6.8%	10,459	6.5%	10,459	6.5%
10	117,804	8,044	6.8%	7,068	6.0%	7,068	6.0%
11	109,958	8,461	7.7%	5,773	5.3%	6,048	5.5%
12	109,173	8,181	7.5%	4,913	4.5%	5,459	5.0%
13	117,452	6,200	5.3%	4,698	4.0%	5,579	4.8%
14	128,063	6,028	4.7%	4,482	3.5%	5,763	4.5%
15	132,818	6,552	4.9%	4,117	3.1%	5,645	4.3%
16	131,431	5,276	4.0%	3,680	2.8%	5,257	4.0%
17	127,738	5,093	4.0%	3,321	2.6%	4,790	3.8%
18	110,718	4,761	4.3%	2,657	2.4%	3,875	3.5%
19	100,942	3,244	3.2%	2,221	2.2%	3,281	3.3%
20	80,588	4,576	5.7%	1,612	2.0%	2,418	3.0%
	2,244,749	165,761	7.4%	144,069	6.4%	154,709	6.9%

Note: Counts are weighted

Appendix G-15
Probability of Contributions Remaining with the System
OPERS - Regular

Duration	Exposure	Actual Remaining	Actual Rate	Proposed Expected	Proposed Rate
8	12,728	9,566	75.2%	10,182	80.0%
9	10,576	8,190	77.4%	8,567	81.0%
10	9,348	7,344	78.6%	7,665	82.0%
11	8,911	7,269	81.6%	7,396	83.0%
12	9,246	7,660	82.8%	7,767	84.0%
13	7,572	6,198	81.9%	6,436	85.0%
14	6,532	5,642	86.4%	5,617	86.0%
15	8,068	7,053	87.4%	7,019	87.0%
16	5,589	4,931	88.2%	4,918	88.0%
17	5,625	4,950	88.0%	5,006	89.0%
18	5,515	5,153	93.4%	4,964	90.0%
19	3,902	3,532	90.5%	3,551	91.0%
20	5,596	5,333	95.3%	5,148	92.0%
21	3,853	3,383	87.8%	3,583	93.0%
22	3,174	3,107	97.9%	2,983	94.0%
23	2,619	2,340	89.4%	2,488	95.0%
24	2,439	2,439	100.0%	2,341	96.0%
25	1,940	1,940	100.0%	1,882	97.0%
26	1,933	1,933	100.0%	1,895	98.0%
27	771	771	100.0%	763	99.0%
28	901	901	100.0%	901	100.0%
29	313	313	100.0%	313	100.0%
30	185	185	100.0%	185	100.0%
	117,337	100,132	85.3%	101,573	86.6%

Note: Counts are weighted

Appendix G-16
Total Salary Scale
OPERS

Age	Initial Salary (Millions)	Subsequent Salary (Millions)	Actual Rate	Current Expected (Millions)	Current Rate	Proposed Expected (Millions)	Proposed Rate
21	10.0	10.9	9.08%	10.8	8.70%	10.9	9.50%
22	14.2	15.6	9.46%	15.4	8.40%	15.6	9.50%
23	24.0	26.3	9.68%	25.9	8.20%	26.2	9.20%
24	34.2	37.3	9.09%	36.9	8.00%	37.2	8.90%
25	42.8	46.9	9.61%	46.1	7.80%	46.5	8.60%
26	47.6	51.7	8.60%	51.2	7.60%	51.5	8.20%
27	53.1	57.3	7.84%	57.0	7.40%	57.2	7.80%
28	58.8	63.7	8.41%	63.0	7.10%	63.2	7.50%
29	65.7	70.9	7.86%	70.2	6.80%	70.4	7.20%
30	71.1	76.6	7.68%	75.8	6.50%	76.0	6.90%
31	76.1	81.3	6.78%	80.9	6.30%	81.1	6.60%
32	79.7	84.9	6.60%	84.5	6.10%	84.7	6.30%
33	83.8	90.0	7.35%	88.8	5.90%	88.9	6.10%
34	84.1	89.4	6.32%	88.8	5.60%	89.0	5.90%
35	84.1	89.5	6.41%	88.8	5.60%	89.0	5.80%
36	84.6	89.7	6.02%	89.3	5.50%	89.4	5.70%
37	84.9	90.4	6.41%	89.6	5.50%	89.6	5.50%
38	89.4	94.4	5.52%	94.3	5.40%	94.3	5.40%
39	89.0	94.4	6.11%	93.8	5.40%	93.8	5.40%
40	94.1	99.2	5.41%	99.1	5.30%	99.1	5.30%
41	96.2	101.4	5.40%	101.3	5.30%	101.3	5.30%
42	101.2	107.0	5.75%	106.5	5.20%	106.5	5.20%
43	107.9	113.4	5.16%	113.4	5.10%	113.4	5.10%
44	112.1	118.1	5.39%	117.7	5.00%	117.7	5.00%
45	109.9	115.9	5.45%	115.4	5.00%	115.4	5.00%
46	120.6	127.2	5.55%	126.5	4.90%	126.5	4.90%
47	120.3	126.6	5.27%	126.1	4.80%	126.1	4.80%
48	110.6	117.3	6.01%	115.8	4.70%	115.8	4.70%
49	116.3	121.9	4.80%	121.8	4.70%	121.8	4.70%
50	132.6	138.0	4.03%	138.7	4.60%	138.7	4.60%
51	139.8	146.5	4.78%	146.3	4.60%	146.3	4.60%
52	147.2	153.5	4.29%	153.8	4.50%	153.8	4.50%
53	141.6	149.5	5.60%	148.0	4.50%	148.0	4.50%
54	146.6	152.7	4.17%	153.2	4.50%	153.2	4.50%
55	144.0	150.0	4.17%	150.5	4.50%	150.5	4.50%
56	143.6	149.6	4.17%	150.1	4.50%	149.9	4.40%
57	142.2	147.8	3.93%	148.6	4.50%	148.3	4.30%
58	136.3	141.9	4.15%	142.4	4.50%	142.0	4.20%
59	133.1	138.0	3.66%	139.1	4.50%	138.6	4.10%
60	125.9	129.9	3.21%	131.5	4.50%	130.9	4.00%
61	117.8	121.8	3.38%	123.1	4.50%	122.4	3.90%
62	95.6	98.9	3.46%	99.9	4.50%	99.3	3.80%
63	78.6	81.3	3.43%	82.1	4.50%	81.5	3.70%
64	64.9	67.1	3.35%	67.8	4.50%	67.2	3.60%
65	48.0	49.7	3.49%	50.2	4.50%	49.7	3.50%
	4,204.0	4,425.2	5.26%	4,419.7	5.13%	4,418.2	5.09%