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**Experience Study**

**For the Five-Year Period**

**Ending June 30, 2020**





## TABLE OF CONTENTS

| <b><u>Section</u></b>      |  | <b><u>Page</u></b> |
|----------------------------|--|--------------------|
| I                          | Summary of Results                                   | 1                  |
| II                         | Economic Assumptions                                 | 4                  |
| III                        | Demographic Assumptions                              | 17                 |
|                            | Rates of Withdrawal                                  | 18                 |
|                            | Rates of Disability Retirement                       | 22                 |
|                            | Rates of Retirement                                  | 25                 |
|                            | Rates of Post-Retirement Mortality                   | 38                 |
|                            | Rates of Pre-Retirement Mortality                    | 46                 |
|                            | Rates of Salary Increase Due to Merit and Promotion  | 47                 |
| IV                         | Other Actuarial Assumptions and Methods              | 51                 |
| V                          | Other Post-Employment Benefit Assumptions            | 52                 |
| VI                         | Summary and Cost of Changes                          | 59                 |
| <br><b><u>Appendix</u></b> |  |                    |
| A                          | Historical June CPI (W) Index                        | 61                 |
| B                          | Capital Market Assumptions and Asset Allocation      | 62                 |
| C                          | Social Security Administration Wage Index            | 63                 |
| D                          | Recommended Rates of Withdrawal and Salary Increases | 64                 |
|                            | Recommended Rates of Retirements                     | 65                 |
|                            | Recommended Rates of Disability                      | 66                 |



# Cavanaugh Macdonald

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March 31, 2021

Board of Trustees  
School Employees Retirement System of Ohio  
300 East Broad Street  
Suite 100  
Columbus, OH 43215-3746

Dear Members of the Board:

We are pleased to submit the results of a study of the economic and demographic experience for the School Employees Retirement System of Ohio (SERS). The purpose of this investigation is to assess the reasonability of the actuarial assumptions for the System. This investigation covers the five-year period from July 1, 2015 to June 30, 2020. 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 members, retired members, and beneficiaries of deceased members. Mortality and disability rates were studied separately for males and females. Incidences of withdrawal, retirement and compensation increases were investigated without regard to gender. The System's experience was liability weighted for observed incidents of withdrawal, retirement and pre- and post-mortality. For these assumptions specifically, this approach provides a materially different analysis from a headcount only approach. Where experience data is liability weighted, the analysis of trends provide a better measure of the actual and expected impact assumptions have on the System's liability.

This report shows comparisons between the actual and expected cases of separation from active service, actual and expected number of deaths, and actual and expected salary increases. Tables and graphs are used to show the actual rates of separation from service, the expected rates of separation from service, the actual mortality rates, the expected mortality rates, the expected salary increase rates, and the actual salary increase rates. Where changes to assumptions are recommended, the proposed rates of separation from service, rates of mortality, and salary increase rates are provided.

The recommended rates of separation from service, rates of mortality, and salary increase rates are shown in Appendix D of this report. In the actuary's judgment, the recommended rates are suitable for use until further experience indicates that modifications are needed.

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Actuarial assumptions and methods are used to measure and allocate future costs. Changing assumptions or methods will not change the actual cost of future benefits, but rather, the actuarial valuation measures associated with the future payments. This report also provides the adequacy of the contribution rates set in the Ohio Revised Code under the recommendations.

In order to prepare the results in this report we have utilized appropriate actuarial models that were developed for this purpose. These models use assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

We note that as we are preparing this report, the world is in the midst of a pandemic. We have considered available information, but do not believe that there is yet sufficient data to warrant the further modification of any of the assumptions. We will continue to monitor the situation and advise the Board in the future of any adjustments that we believe would be appropriate.

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,

A handwritten signature in blue ink that reads "Todd B. Green" followed by a horizontal line.

Todd B. Green, ASA, EA, FCA, MAAA  
President

A handwritten signature in blue ink that reads "John J. Garrett" in a cursive style.

John J. Garrett, ASA, FCA, MAAA  
Principal and Consulting Actuary

A handwritten signature in blue ink that reads "Alisa Bennett" in a cursive style.

Alisa Bennett, FSA, FCA, EA, MAAA  
President

TBG:JJG\bvb



## Summary of Results

The following summarizes the findings and recommendations with regard to the assumptions utilized by the School Employees Retirement System of Ohio (SERS). 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. We recommend a reduction in the assumed rate of price inflation and an increase in the assumed rate of real wage growth. For the assumed rate of return on assets we recommend a reduction from 7.50% to 7.00%. Since the assets for the Health Care Plan are invested in the same manner as the Basic Benefits Plan, we recommend using 7.00% for funding purposes for both the Basic Benefits Plan and the Health Care Plan.

| Item                       | Current | Proposed |
|----------------------------|---------|----------|
| Price Inflation            | 3.00%   | 2.40%    |
| Investment Return          | 7.50%   | 7.00%    |
| Real Wage Growth           | 0.50%   | 0.85%    |
| Cost-of-Living-Adjustments | 2.50%   | 2.00%    |

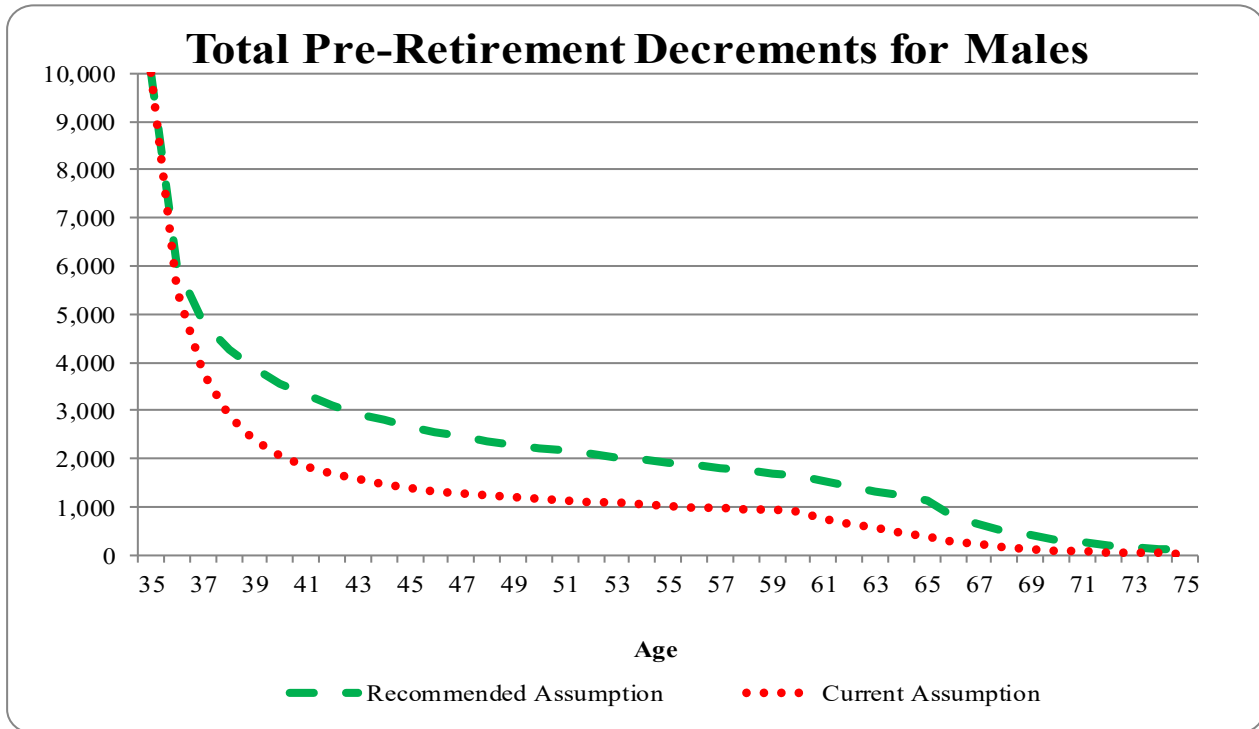
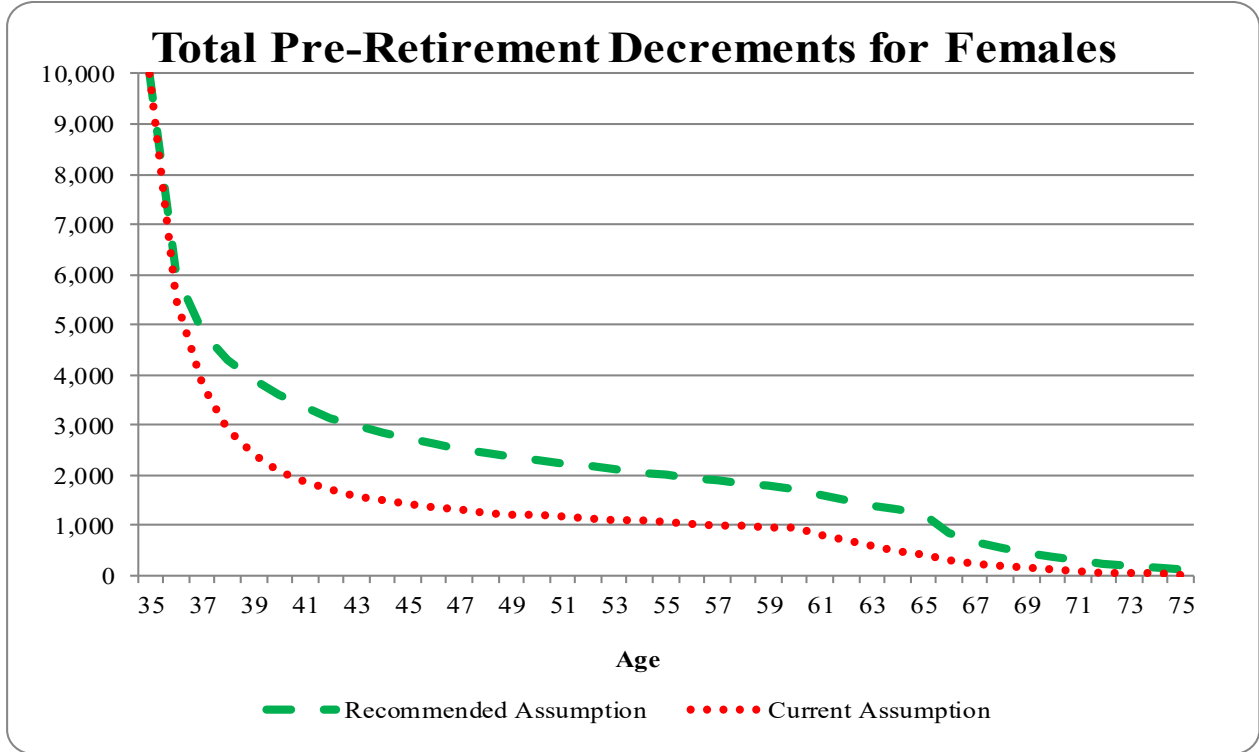
### **Recommended Demographic Assumption Changes**

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

| Assumption Changes   |
|--|
| Adjust rates of withdrawal   |
| Adjust rates of disability retirements                                 |
| Adjust rates of pre-retirement, post-retirement and disabled mortality |
| Adjust rates of service retirement                                     |
| Decrease assumed rates of compensation increase                        |
| Adjust rates of retiree health care participation for retirees         |
| Decrease in retiree health care spouse coverage assumption             |

### **Demographic Impact**

The charts on the following page detail the demographic impact of changing decrements for male and female active participants who are 35 years old at the time they become members of SERS. As one can see, the results of the experience study modify anticipated behavior of the workforce. Overall, the recommendation decreases the withdrawals prior to retirement and increases retirements once members are eligible for retirement.





### **Financial Impact**

The tables below highlight the impact on the Basic Benefits Plan and the Retiree Health Care Plan based on the recommended changes noted on the previous page. The tables show the change in the unfunded accrued liability (UAL) and funded status for both Plans of the System as of June 30, 2020. Further cost impact information is provided in Section VI.

#### **BASIC BENEFITS VALUATION**

| Valuation As of June 30, 2020  | Before Change                     | After Change                      |
|--------------------------------|-----------------------------------|-----------------------------------|
|                                | Current Demographic Assumptions   | Proposed Demographic Assumptions  |
|                                | Investment Rate of Return = 7.50% | Investment Rate of Return = 7.00% |
| UAL                            | \$5,997,074,169                   | \$6,181,950,509                   |
| Funded Status                  |                                   |                                   |
| All Basic Benefits             | 71.49%                            | 70.87%                            |
| Pension Benefits               | 71.90%                            | 71.28%                            |
| Medicare Part B                | 50.66%                            | 49.98%                            |
| Post Retirement Death Benefits | 66.81%                            | 65.11%                            |

#### **HEALTH CARE VALUATION**

| Valuation As of June 30, 2020 | Before Change                     | After Change                      |
|-------------------------------|-----------------------------------|-----------------------------------|
|                               | Current Demographic Assumptions   | Proposed Demographic Assumptions  |
|                               | Investment Rate of Return = 5.25% | Investment Rate of Return = 7.00% |
| UAL                           | \$1,313,892,066                   | \$779,744,146                     |
| Funded Status                 | 26.86%                            | 38.23%                            |
| Solvency Period               | 2053                              | 2049                              |



### Economic Assumptions

There are three economic assumptions used in performing the actuarial valuation for the School Employees Retirement System of Ohio (SERS). The assumptions are:

- Price Inflation
- Investment Return
- Wage Inflation

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 27, “*Selection of Economic Assumptions for Measuring Pension Obligations*,” which provides guidance to actuaries in selecting economic assumptions – primarily, investment return, discount rate, post-retirement benefit increases, inflation, and compensation increases for the purpose of measuring benefit obligations under defined benefit plans. Professional judgment is used to estimate possible future economic outcomes based on a mixture of past experience and future expectations. In setting the assumption, the actuary should consider several factors, including the purpose and nature of the measurement, and appropriate recent and long-term historical economic data, and an estimate of the actuary’s expectation about future experience. Finally, the actuary’s recommendation should have no significant bias. However, the standard explicitly advises the actuary not to give undue weight to recent experience.

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

In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 27. The following table shows our recommendations followed by explanations of each assumption.

| Item                | Current     | Proposed    |
|---------------------|-------------|-------------|
| Price Inflation     | 3.00%       | 2.40%       |
| Real Rate of Return | <u>4.50</u> | <u>4.60</u> |
| Investment Return   | 7.50%       | 7.00%       |
| Price Inflation     | 3.00%       | 2.40%       |
| Real Wage Growth    | <u>0.50</u> | <u>0.85</u> |
| Wage Inflation      | 3.50%       | 3.25%       |





## Price Inflation

**Background:** Price inflation is used as a component for the investment rate of return assumption, the rate of wage inflation assumption, and the rate of payroll growth assumption. It is important that the price inflation assumption be consistently applied throughout the economic assumptions utilized in an actuarial valuation. This is called for in ASOP No. 27 and is also required to meet the parameters for determining pension liabilities and expense under Governmental Accounting Standards Board (GASB) Statements No. 67 and 68.

The current price inflation assumption is 3.00% per year.

**Past Experience:** The Consumer Price Index, US City Average, All Urban Wage Earners and Clerical Workers, CPI (W), has been used as the basis for reviewing historical levels of price inflation. The level of that index in June of each of the last 50 years is provided in Appendix A.

In analyzing this data, average rates of inflation have been determined by measuring the compound growth rate of the CPI (W) over various time periods. The results are as follows:

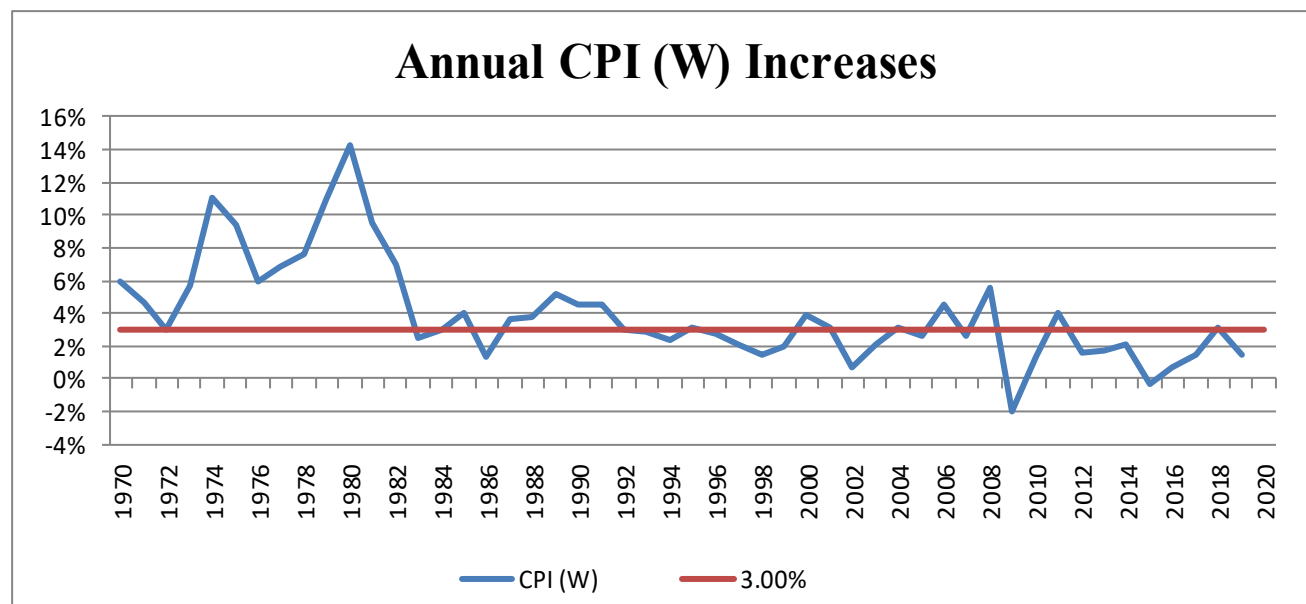
| Period      | Average Annual Rate of Inflation |
|-------------|----------------------------------|
| 2015 – 2020 | 1.44%                            |
| 2010 – 2020 | 1.62%                            |
| 2000 – 2020 | 2.01%                            |
| 1990 – 2020 | 2.27%                            |
| 1980 - 2020 | 2.82%                            |
| 1970 – 2020 | 3.84%                            |
| 1926 - 2020 | 2.92%                            |

Over shorter historic periods, the average annual rate of increase in the CPI (W) has been below 2.00%. The years of high inflation occurring from 1973 to 1982 has a significant impact on the averages over periods which include these rates. We should add that since 1926, the average annual rate of inflation was 2.92%.



## Section II: Economic Assumptions

The graph below shows the annual increases in the CPI (W) over a 50-year period.



Additional information to consider is measuring the spread on inflation-protected treasury bills (TIPS) and from the prevailing economic forecasts. The spread between the nominal yield on treasury securities and the inflation indexed nominal yield on TIPS of the same maturity is referred to as the “breakeven rate of inflation” and represents the bond market’s expectation of inflation over the period to maturity. The table below provides the calculation of the breakeven rate of inflation as of December 31, 2020 over various periods.

| Years to Maturity | Bond Nominal Yield | TIPS Nominal Yield | Breakeven Rate of Inflation |
|-------------------|--------------------|--------------------|-----------------------------|
| 10                | 0.93%              | -1.06%             | 1.99%                       |
| 20                | 1.45%              | -0.61%             | 2.06%                       |
| 30                | 1.65%              | -0.37%             | 2.02%                       |

The bond market’s expectation for the rate of inflation is significantly lower than historical average annual rates. Additionally, based upon information provided from the “Survey of Professional Forecasters” published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the 10 years beginning January 1, 2021 is 2.12%.



## Section II: Economic Assumptions

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**Recommendation:** It is difficult to accurately predict inflation. Current economic forecasts and the bond market suggest lower inflation over the next thirty years (which is a shorter time period than appropriate for our purposes) when compared to the historical averages. In the 2020 OASDI Trustees Report, the Chief Actuary for Social Security bases the 75-year cost projections on an intermediate inflation assumption of 2.40%. We concur in general and recommend use of an inflation rate of 2.40% per year.

| Price Inflation Assumption |       |
|----------------------------|-------|
| Current                    | 3.00% |
| Recommended                | 2.40% |



### Investment Return

**Background:** The assumed investment return is one of the most significant assumptions in the annual actuarial valuation process as it is used to discount the expected benefit payments for all active, inactive, and retired members of the System. Minor changes in this assumption can have a major impact on valuation results. The investment return assumption should reflect the most recent asset allocation target for the funds set by the Board.

The current assumption is 7.50%, consisting of a price inflation assumption of 3.00% and a real rate of return assumption of 4.50%. The return is net of all investment and administrative expenses.

**Past Experience:** The actuarial value of assets of the System are developed using a widely accepted asset-smoothing methodology that fully recognizes investment gains and losses over a four-year period. The recent experience for the retirement funds over the last five years is shown in the table below.

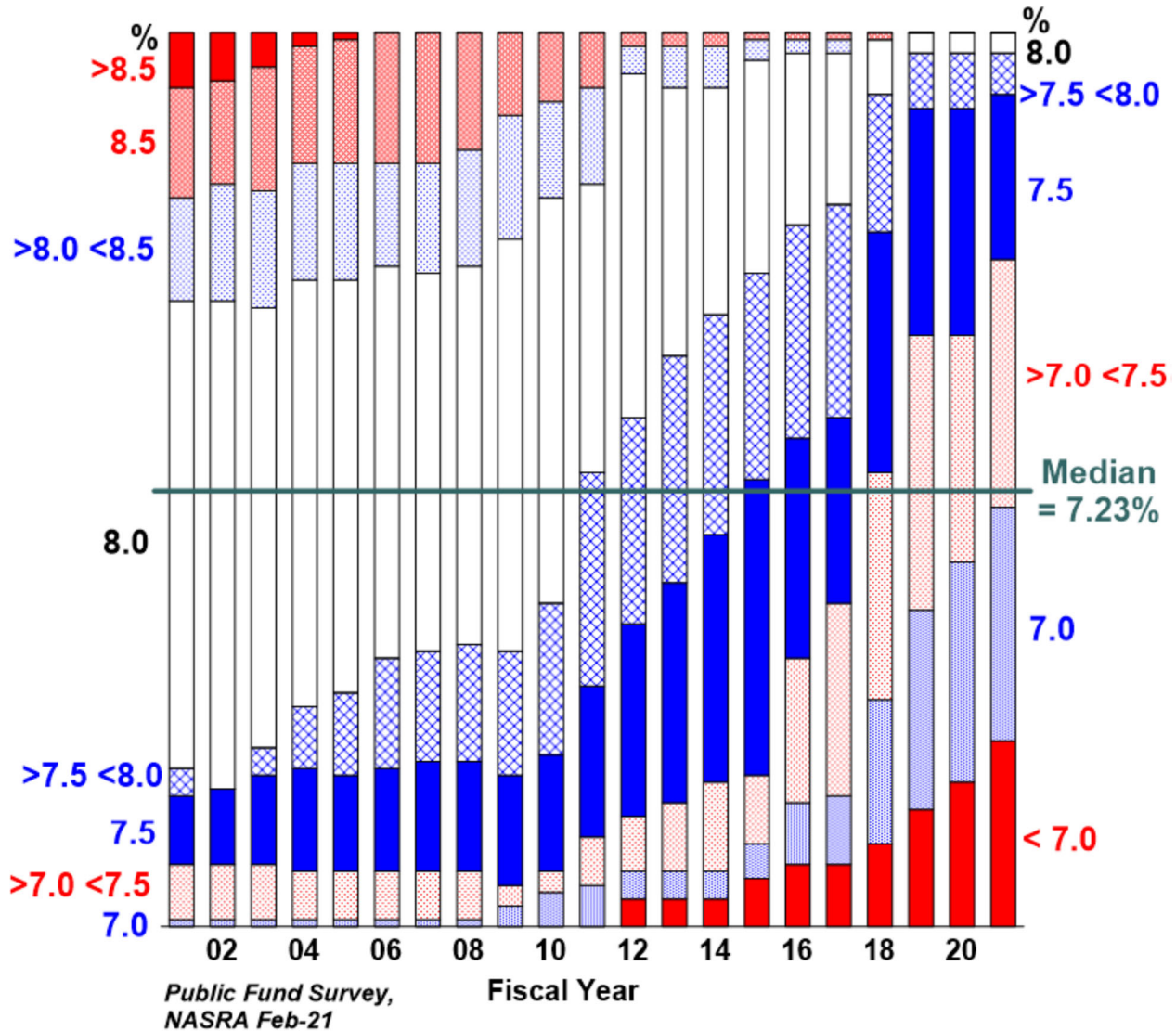
| Nominal Total Rate of Return |              |                 |
|------------------------------|--------------|-----------------|
| Year Ending 6/30             | Market Value | Actuarial Value |
| 2016                         | 0.60%        | 7.90%           |
| 2017                         | 12.98%       | 7.41%           |
| 2018                         | 8.96%        | 6.31%           |
| 2019                         | 5.67%        | 7.09%           |
| 2020                         | 2.67%        | 7.37%           |
| Average                      | 6.17%        | 7.21%           |

Actuaries are guided not to materially rely on short-term historical returns when developing an assumption for expected future returns. We primarily base the development of the investment return assumption on the forward-looking capital market assumptions. We use a “building block” approach which develops an assumed real rate of investment return and adds an assumed rate of inflation and administrative expenses separately to arrive at the nominal investment rate of return recommendation based largely on the Board’s target asset allocation.



### Peer System Comparison

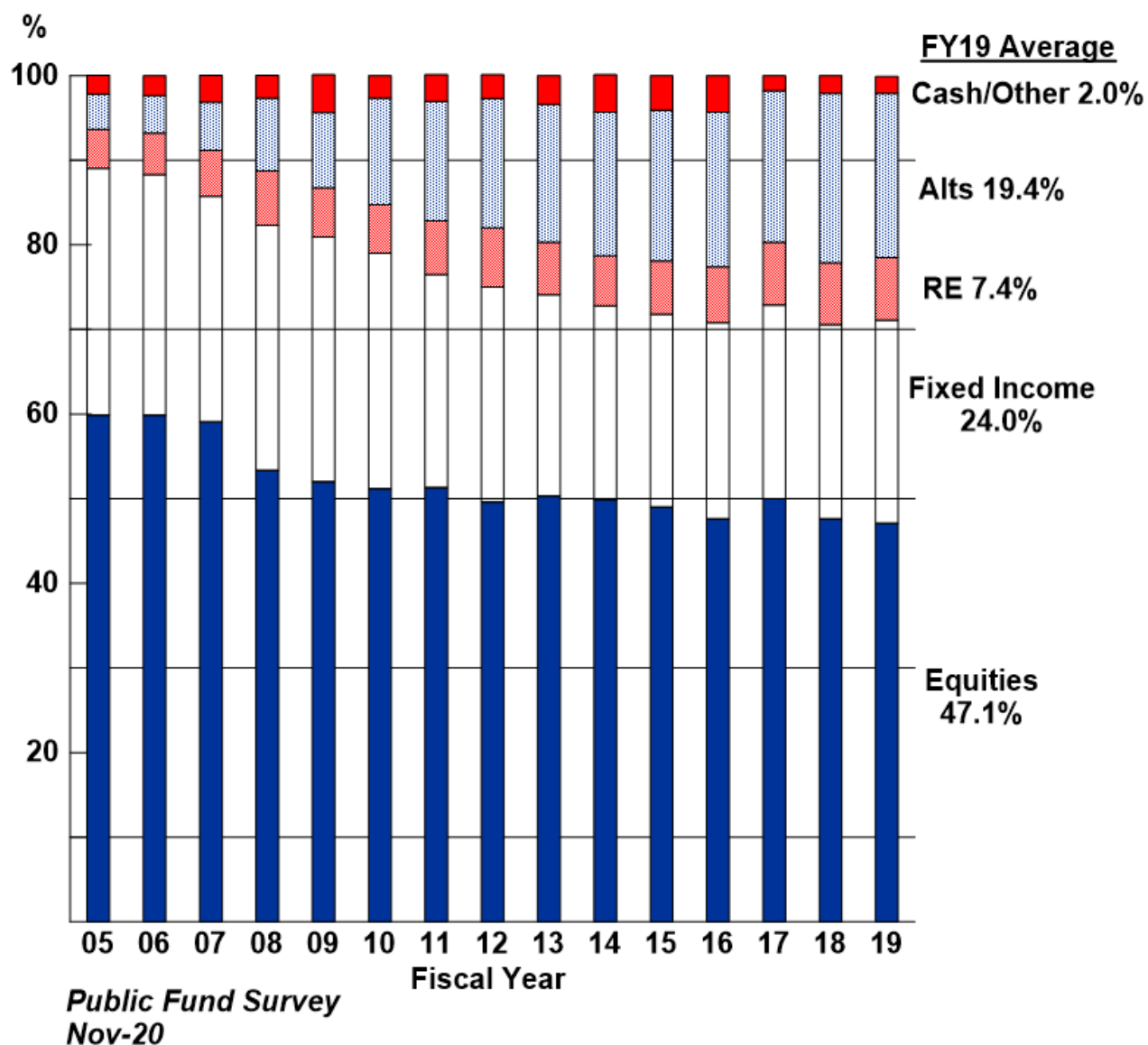
While we do not recommend that the selection of an investment return assumption be based on the assumptions used by other systems, it does provide relevant additional information to consider. The following graph shows the change in the distribution of the investment return assumption from fiscal year 2001 through February of 2021 for 120+ large public retirement systems included in the National Association of State Retirement Administrators (NASRA) Public Fund Survey. It is worth noting that the median investment return assumption is 7.23%.





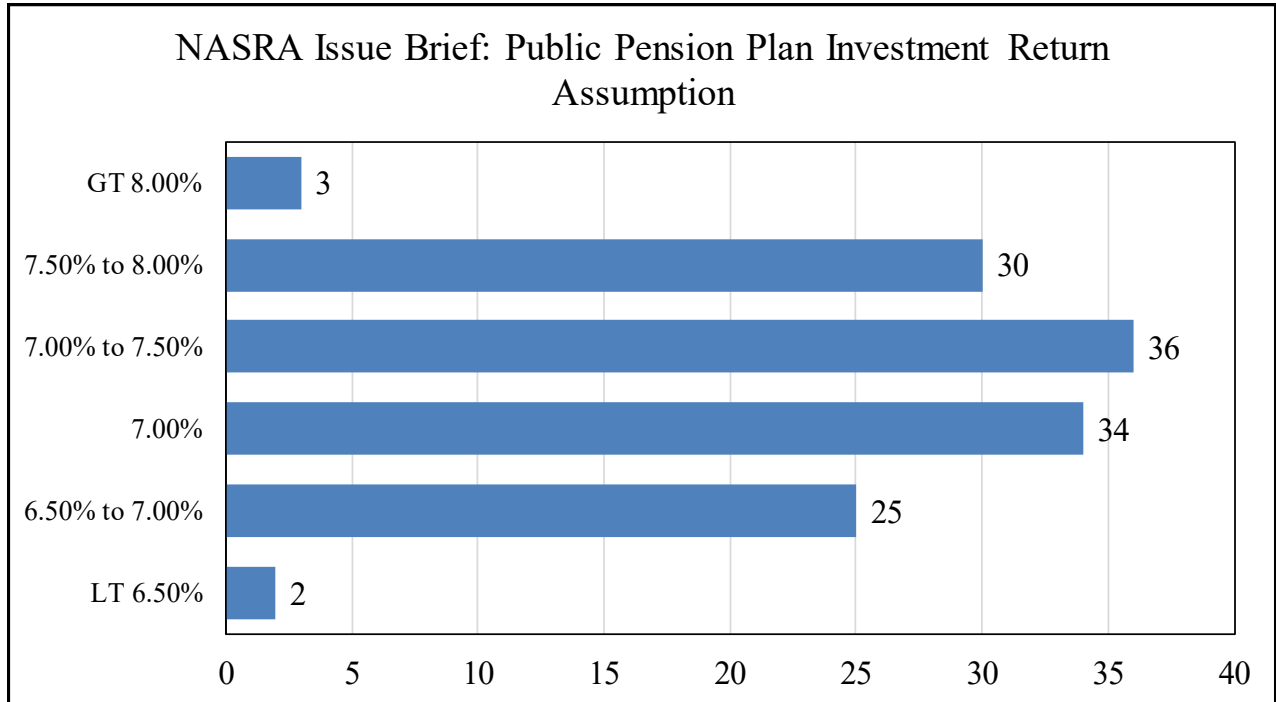
## Section II: Economic Assumptions

The assumed rate of return is heavily influenced by each Systems' asset allocation. The average asset allocation for the systems in the Public Fund Survey is 2.0% cash, 47.1% equities, 24.0% fixed income, 7.4% real estate, and 19.4% alternative investments which has an impact on the expected return of the systems. Note the increased allocation to alternative investment classes since 2006. The target asset allocation for the SERS is 45% equities, 18% alternatives, 16% real estate, 19% fixed income and 2% cash, which is in line with the portfolio of an average system. SERS has a higher exposure to real assets compared to the averages noted in the Survey. The chart below shows the asset allocation for 120+ large public retirement systems included in the NASRA Public Fund Survey since 2005.





Review of the *NASRA Issue Brief: Public Pension Plan Investment Return Assumptions* update as of February 2021 indicates the median assumed return is 7.23% while the mean is 7.15% and demonstrates a continued trend in declining assumed rates of investment return.





## Section II: Economic Assumptions

**Capital Market Analysis:** The current capital market assumptions and target asset allocations are shown in Appendix B. An analysis performed by, the SERS investment consultant Wilshire, produced short-term and long-term results. The results of the Wilshire analysis are shown below.

|                         | SERS Policy Allocation |                   |              |
|-------------------------|------------------------|-------------------|--------------|
|                         | Real Return            | Assumed Inflation | Total Return |
| 10-Year Expected Return | 2.98%                  | 2.33%             | 5.38%        |
| 20-Year Expected Return | 3.68%                  | 2.33%             | 6.10%        |
| 30-Year Expected Return | 4.38%                  | 2.33%             | 6.81%        |

It is important to note that capital market analysis can be quite volatile from year to year and from investment consultant to investment consultant. In the section that follows, a similar analysis using the capital market assumptions in the *Survey of Capital Market Assumptions: 2020 Edition* published by Horizon Actuarial Services, LLC.

Using the capital market assumptions, we performed a statistical analysis which yielded the following percentile ranking of real rates of return over various time horizons. The following table provides a summary of the statistical analysis performed.

| Time Span in Years | Mean Real Return | Standard Deviation | Real Returns by Percentile |                  |                  |                  |                  |
|--------------------|------------------|--------------------|----------------------------|------------------|------------------|------------------|------------------|
|                    |                  |                    | 5 <sup>th</sup>            | 25 <sup>th</sup> | 50 <sup>th</sup> | 75 <sup>th</sup> | 95 <sup>th</sup> |
| 1                  | 5.80%            | 10.67%             | -10.79%                    | -1.64%           | 5.26%            | 12.65%           | 24.20%           |
| 5                  | 5.37             | 4.74               | -2.25                      | 2.11             | 5.26             | 8.50             | 13.35            |
| 10                 | 5.31             | 3.35               | -0.11                      | 3.03             | 5.26             | 7.54             | 10.92            |
| 20                 | 5.29             | 2.37               | 1.44                       | 3.68             | 5.26             | 6.87             | 9.23             |
| 30                 | 5.28             | 1.93               | 2.13                       | 3.97             | 5.26             | 6.57             | 8.49             |
| 40                 | 5.27             | 1.67               | 2.54                       | 4.14             | 5.26             | 6.40             | 8.05             |
| <b>50</b>          | 5.27             | 1.50               | 2.83                       | <b>4.26</b>      | 5.26             | <b>6.28</b>      | 7.75             |

The chart above is based on the capital market assumptions noted in the Survey. We utilize those assumptions to produce the percentile ranks of expected returns over longer future time periods. Focusing on the longer time spans, the analysis indicates that over the next 50 years there is a 25% likelihood that real return will average below 4.26% and a 25% likelihood they will be above 6.28%. In other words, there is a 50% likelihood the real returns will be between 4.26% and 6.28%.





## Section II: Economic Assumptions

**Administrative Expenses (\$ thousands):** The investment return is assumed to be net of administrative and investment expenses. The investment return information we have been provided is net of investment-related expenses. The table below compares, for the last five years, the administrative expense levels during the fiscal year to the market value of assets for the system at the end of the fiscal years. All dollar amounts are in thousands.

| FY Ending June 30 | Administrative Expenses | Market Value of Assets | Expense Ratio |
|-------------------|-------------------------|------------------------|---------------|
| 2016              | \$24,555                | \$12,821,835           | 0.19%         |
| 2017              | 26,985                  | 13,995,748             | 0.19          |
| 2018              | 29,626                  | 14,706,145             | 0.20          |
| 2019              | 34,446                  | 15,007,887             | 0.23          |
| 2020              | 30,879                  | 14,902,210             | 0.21          |

Over the five-year period, the expense ratio averaged approximately 0.20%, but has clearly trended upward. We recommend a long-term administrative expense ratio of 0.22% which is the average of the most recent two years be included in the net investment return assumption.

**Recommendation:** The analysis provided by the investment consultant yielded a median real rate of return of 4.38%. The average long-term capital market assumptions published in the Survey of Capital Market Assumptions 2020 Edition by Horizon Actuarial Services, LLC, yielded a median real return of 5.26%. We recommend the long-term real rate of return assumption of 4.82% which reflects granting each source equal credibility. The table below summarizes our recommended assumed rate of return based on the building block approach which consists of components for the assumed long-term real rate of return combined with the recommended inflation and administrative expenses.

| Item                    | Recommendation |
|-------------------------|----------------|
| Real Rate of Return     | 4.82%          |
| Inflation               | 2.40           |
| Administrative Expenses | (0.22)         |
| Net Investment Return   | 7.00%          |

The impact of this recommendation is shown in more detail in Section VI.



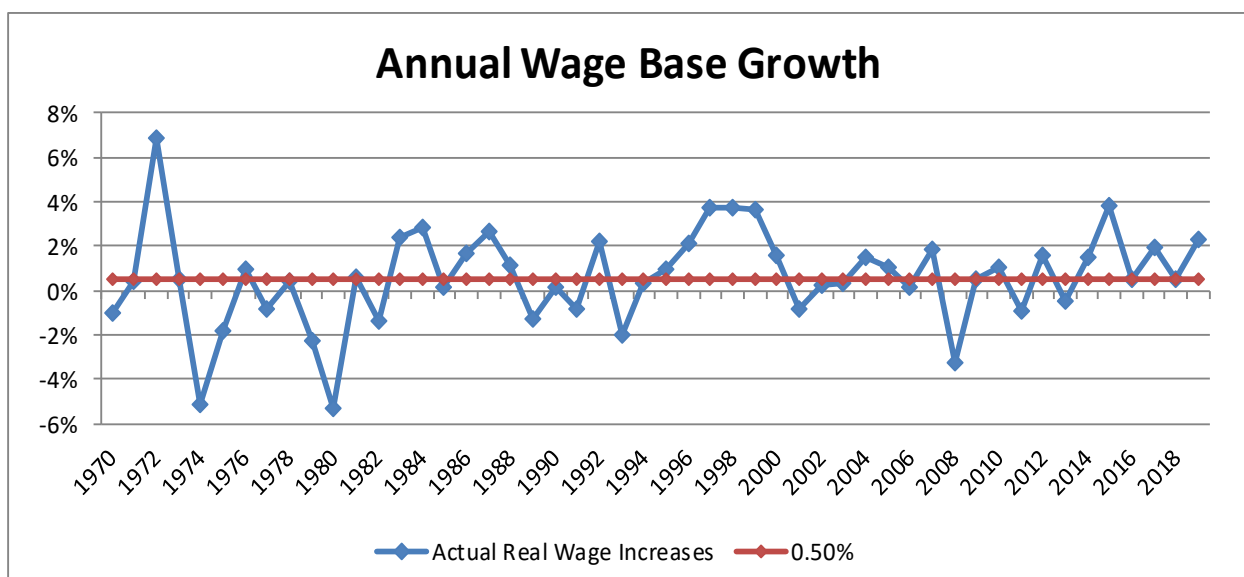
### Wage Inflation

**Background:** The assumed future increases in salaries consist of an inflation component and a component for promotion and longevity, often called merit increases. Merit increases are generally age and/or service-related and will be studied in the demographic assumption section of the report. Wage inflation normally is above price inflation, which reflects the overall return on labor in the economy. The current wage inflation assumption is 3.50%, or 0.50% above price inflation.

**Past Experience:** The Social Security Administration publishes data on wage growth in the United States. Appendix C shows the last 50 calendar years’ data. As we did in our analysis of inflation, in the table below, we show the wage inflation and a comparison with the price inflation over various time periods. Since updated wage data is only available through 2019, we use that year as the end point.

| Period    | Wage Inflation | Price Inflation | Real Wage Growth |
|-----------|----------------|-----------------|------------------|
| 2009-2019 | 2.88%          | 1.70%           | 1.16%            |
| 1999-2019 | 2.91           | 2.16            | 0.73             |
| 1989-2019 | 3.36           | 2.39            | 0.94             |
| 1979-2019 | 3.95           | 3.13            | 0.80             |
| 1969-2019 | 4.53           | 3.90            | 0.61             |

Thus, over the last 50 years, annual real wage growth has averaged 0.61%. The graph below shows the annual increases in real wage growth over the entire 50-year period.





## Section II: Economic Assumptions

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**Recommendation:** As with price inflation, we again look at the 2020 OASDI Trustees Report. The Chief Actuary for Social Security bases the 75-year cost projections on an intermediate national wage growth assumption 1.14% greater than the price inflation assumption of 2.4%. We concur in general with a range of 0.52% - 1.76% and favor the lower end of the range based on the limited evidence of real wage growth in the salary data we analyzed. We recommend use of a 0.85% per year rate at the current time.

| Recommended Wage Inflation Assumption |             |
|---------------------------------------|-------------|
| Real Wage Growth                      | 0.85%       |
| Inflation                             | <u>2.40</u> |
| Total                                 | 3.25%       |



### Cost-of-Living Adjustments

**Background:** Cost-of-Living Adjustments (COLAs) to the monthly benefits provided to eligible retirees and beneficiaries are established by the Board annually in consideration of the actuarial condition of the System. COLAs are provided beginning with the 4<sup>th</sup> anniversary of their retirement at the rate established by the Board for the applicable calendar year. The rate of the annual COLA is determined as the annual rate of increase in the Consumer Price Index, but not less than 0% and capped at 2.5%. The annual COLA rate is applied to the base pension amount to determine the amount of increase in the pension benefit. The current assumption is an annual rate of 2.5% based primarily on the current inflation assumption of 3.0%.

**Past Experience:** The current COLA provisions included a 3-year moratorium on COLAs through year 2020. The Board approved a COLA rate of 0.5% for eligible recipients in 2021 based on the rate of increase in the CPI for the year ending June 2020.

**Recommendation:** In developing a recommended annual COLA rate assumption, we have stochastically modeled the distribution of expected COLA rates under the specific provisions of the System using the current recommended 2.40% assumed rate of inflation with an annual standard deviation in rates of inflation of 1.75%. The modeled average rate of COLA over a 30-year period is 1.85%. We recommend a 2.00% assumed annual rate of COLAs which will maintain a reasonable margin above the modeled average COLA rate.

| Cost of Living Rate Assumption   |       |
|----------------------------------|-------|
| Current COLA rate Assumption     | 2.50% |
| Modeled average COLA rate        | 1.85% |
| Recommended COLA Rate Assumption | 2.00% |



### **Demographic Assumptions**

There are several demographic assumptions used in the actuarial valuations performed for the School Employees Retirement System of Ohio. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Rates of Post-retirement Mortality
- Rates of Post-retirement Disabled Mortality
- Rates of Pre-Retirement Mortality
- 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, 2015 through June 30, 2020) with what was expected to happen based on the assumptions used in the most recent actuarial valuations.

Studies of demographic experience generally involve three steps:

- First, the number of members changing membership status, called decrements, during the study is tabulated by age, duration, sex, group, and membership class (active, retired, etc.).
- Next, the number of members expected to change status is calculated by multiplying certain membership statistics, called exposure, by the expected rates of decrement.
- Finally, for observed incidents of disability the number of actual disability retirements is compared with the number of expected disability retirements. The System's experience was liability weighted for observed incidents of withdrawal, retirement and pre- and post-mortality. When performing a liability weighted analysis, the actuarial liability attributed to the number of actual decrements is compared to the actuarial liability attributed to the number of expected decrements. These comparisons, called the actual to expected ratios (A/E Ratio) and are expressed as a percentages.

In general, if the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, sex, or duration deviates significantly from the expected pattern, new assumptions are considered. Recommended revisions are normally not an exact representation of the experience during the observation period. Professional judgment is required to set assumptions for future experience from past trends, including a determination of the amount of weight to assign to the most recent experience.



The remainder of this section presents the results of the demographic study. We have prepared 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.

### **Rates of Withdrawal**

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

The current assumption utilizes a service-based approach that sets the withdrawal rates based on years of service. Withdrawal experience was investigated without regard to gender.

The analysis of the actual withdrawal experience for all members over the five-year period indicates an overall actual/expected ratio of 67%. This ratio indicates that fewer members withdrew during the study period than expected. The table on the next page shows in detail the actual/expected ratio by years of service and in total.

Higher paid members typically have a greater liability compared to members who are lower paid. As a result, termination rates for members with higher compensation levels will have a greater influence on the liabilities of the System. As a result, we liability weighted the experience to better reflect the impact of the current assumption on liability measures. The liability is approximated by using the member's compensation and years of service to estimate the member's benefit level. The exposure and actual occurrences are then multiplied by the benefit level to provide the liability-weighted experience. We find the liability-weighted experience to better correlate to the impact of actual and expected rates of withdrawal on the valuation results.

The liability-weighted analysis of the actual withdrawal experience over the five-year period indicated that less members withdrew prior to becoming eligible for retirement than anticipated and yielded an actual/expected ratio of 67%. There was a significant deviation from the assumption for members with less than 12 years of service.



### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Years of Service | Liability Weighted Amounts of Withdrawal Experience (in \$) |                      |                 |
|------------------|---|----------------------|-----------------|
|                  | Actual  | Expected             | Ratio           |
|                  |   |                      | Actual/Expected |
| Less than 1      | 332,757,963   | 388,718,391          | 0.86            |
| 1                | 204,799,686   | 372,745,630          | 0.55            |
| 2                | 113,492,927   | 250,428,595          | 0.45            |
| 3                | 78,243,085  | 157,547,523          | 0.50            |
| 4                | 53,512,162  | 101,054,331          | 0.53            |
| 5                | 38,715,896  | 65,440,877           | 0.59            |
| 6                | 27,404,191  | 42,664,690           | 0.64            |
| 7                | 20,185,025  | 31,390,460           | 0.64            |
| 8                | 19,099,453  | 26,089,571           | 0.73            |
| 9                | 17,594,657  | 19,544,555           | 0.90            |
| 10               | 13,792,384  | 16,759,691           | 0.82            |
| 11               | 12,404,446  | 14,234,657           | 0.87            |
| 12               | 12,008,716  | 11,749,141           | 1.02            |
| 13               | 10,182,580  | 9,596,764            | 1.06            |
| 14               | 9,788,796   | 7,893,130            | 1.24            |
| 15               | 9,452,095   | 8,283,474            | 1.14            |
| 16               | 10,131,970  | 8,623,710            | 1.17            |
| 17               | 8,871,136   | 8,663,073            | 1.02            |
| 18               | 7,790,178   | 8,380,464            | 0.93            |
| 19               | 7,647,187   | 7,681,723            | 1.00            |
| 20               | 7,780,890   | 6,763,544            | 1.15            |
| 21               | 6,821,572   | 4,400,398            | 1.55            |
| 22               | 6,190,293   | 3,756,952            | 1.65            |
| 23               | 3,771,991   | 3,201,673            | 1.18            |
| 24 +             | 27,201,791  | 8,125,232            | 3.35            |
| <b>TOTAL</b>     | <b>1,059,641,069</b>  | <b>1,583,738,248</b> | <b>0.67</b>     |

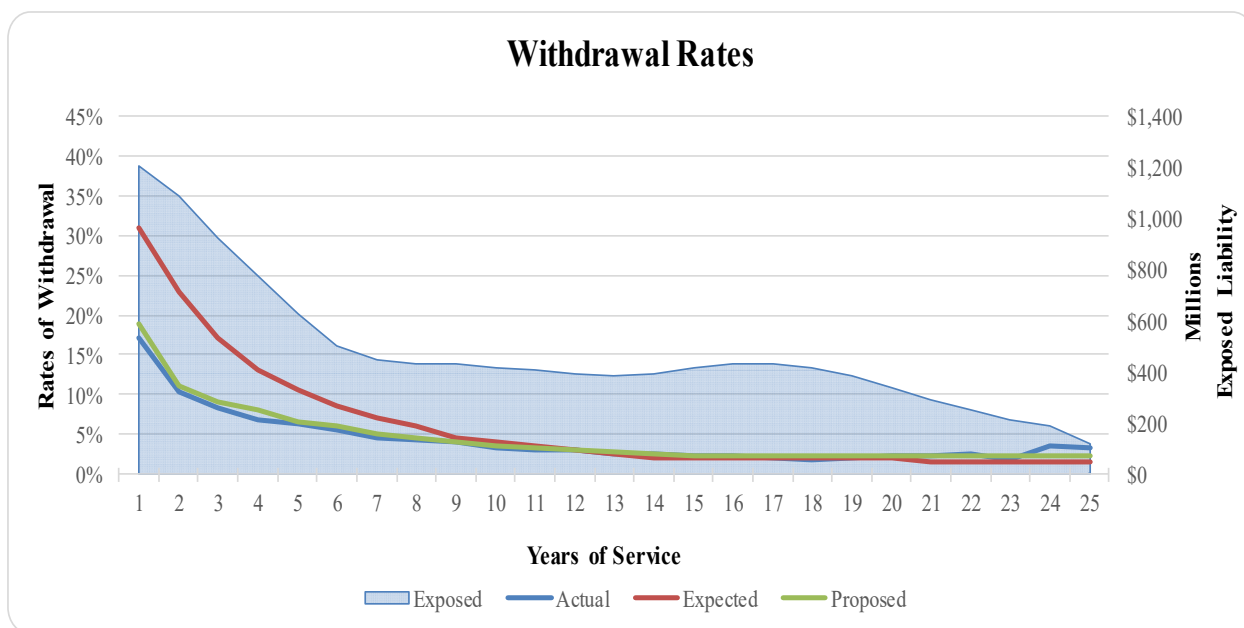


### Findings and Recommendations

The data reflects a general decrease in the rates of withdrawal for members who have less than ten years of service. As a result, we recommend adjusting withdrawal rates to more closely reflect the actual experience. The complete tables of recommended withdrawal rates are shown in Appendix D.

The liability-weighted exposure amounts are the total of individual's compensation who were subject to termination based upon years of service during the experience period. More attention should be given to areas of higher exposures versus areas of lower exposures when recommending changes to the assumed withdrawal rates.

The actual average withdrawal rates by years of service during the past five years, the current assumed withdrawal rates, and the recommended withdrawal rates are shown on the left axis. The right axis provides the liability-weighted exposure.



The actual/expected ratios based on the recommended assumptions are shown in the table on the following page. The overall ratio has been increased from 67% to 96%.





### EXPERIENCE UNDER PROPOSED ASSUMPTIONS

| Years of Service | Liability Weighted Amounts of Withdrawal Experience (in \$) |                      |                 |
|------------------|---|----------------------|-----------------|
|                  | Actual  | Proposed             | Ratio           |
|                  |   |                      | Actual/Proposed |
| Less than 1      | 332,757,963   | 345,527,458          | 0.96            |
| 1                | 204,799,686   | 228,456,999          | 0.90            |
| 2                | 113,492,927   | 119,770,198          | 0.95            |
| 3                | 78,243,085  | 83,407,512           | 0.94            |
| 4                | 53,512,162  | 62,187,281           | 0.86            |
| 5                | 38,715,896  | 40,511,019           | 0.96            |
| 6                | 27,404,191  | 30,116,252           | 0.91            |
| 7                | 20,185,025  | 22,421,757           | 0.90            |
| 8                | 19,099,453  | 19,567,178           | 0.98            |
| 9                | 17,594,657  | 17,372,937           | 1.01            |
| 10               | 13,792,384  | 14,664,729           | 0.94            |
| 11               | 12,404,446  | 13,217,895           | 0.94            |
| 12               | 12,008,716  | 11,749,141           | 1.02            |
| 13               | 10,182,580  | 10,556,441           | 0.96            |
| 14               | 9,788,796   | 9,866,413            | 0.99            |
| 15               | 9,452,095   | 9,318,909            | 1.01            |
| 16               | 10,131,970  | 9,701,674            | 1.04            |
| 17               | 8,871,136   | 9,745,957            | 0.91            |
| 18               | 7,790,178   | 9,428,022            | 0.83            |
| 19               | 7,647,187   | 8,641,938            | 0.88            |
| 20               | 7,780,890   | 7,608,987            | 1.02            |
| 21               | 6,821,572   | 6,600,597            | 1.03            |
| 22               | 6,190,293   | 5,635,428            | 1.10            |
| 23               | 3,771,991   | 4,802,510            | 0.79            |
| 24 +             | 27,201,791  | 4,190,556            | 6.49            |
| <b>TOTAL</b>     | <b>1,059,641,069</b>  | <b>1,105,067,787</b> | <b>0.96</b>     |



### Rates of Disability Retirement

The rates of disability used in the actuarial valuation project the percentage of employees expected to become disabled each year.

Disability experience was investigated separately for males and females on a headcount basis.

The analysis of the actual disability experience for male and female members over the five-year experience period yields an actual/expected ratio of 51% and 65% respectively. The table below details the actual/expected ratio by age group and in total, for males and females separately.

#### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Age Group | Disability Experience |          |                 |         |          |                 |
|-----------|-----------------------|----------|-----------------|---------|----------|-----------------|
|           | Males                 |          |                 | Females |          |                 |
|           | Actual                | Expected | Ratio           | Actual  | Expected | Ratio           |
|           |                       |          | Actual/Expected |         |          | Actual/Expected |
| Under 20  | 0                     | 3.15     | 0.00            | 0       | 1.49     | 0.00            |
| 20 - 24   | 0                     | 8.16     | 0.00            | 0       | 3.16     | 0.00            |
| 25 - 29   | 1                     | 12.94    | 0.08            | 3       | 7.44     | 0.40            |
| 30 - 34   | 1                     | 23.72    | 0.04            | 3       | 20.35    | 0.15            |
| 35 - 39   | 4                     | 43.57    | 0.09            | 21      | 48.87    | 0.43            |
| 40 - 44   | 15                    | 75.77    | 0.20            | 47      | 108.96   | 0.43            |
| 45 - 49   | 52                    | 110.91   | 0.47            | 113     | 222.16   | 0.51            |
| 50 - 54   | 100                   | 145.20   | 0.69            | 251     | 363.92   | 0.69            |
| 55 - 59   | 139                   | 154.68   | 0.90            | 302     | 324.41   | 0.93            |
| 60 - 64   | 36                    | 88.16    | 0.41            | 68      | 113.02   | 0.60            |
| 65 & Over | 8                     | 32.10    | 0.25            | 8       | 34       | 0.24            |
| TOTAL     | 356                   | 698.36   | 0.51            | 816     | 1,247.33 | 0.65            |

#### Findings and Recommendations

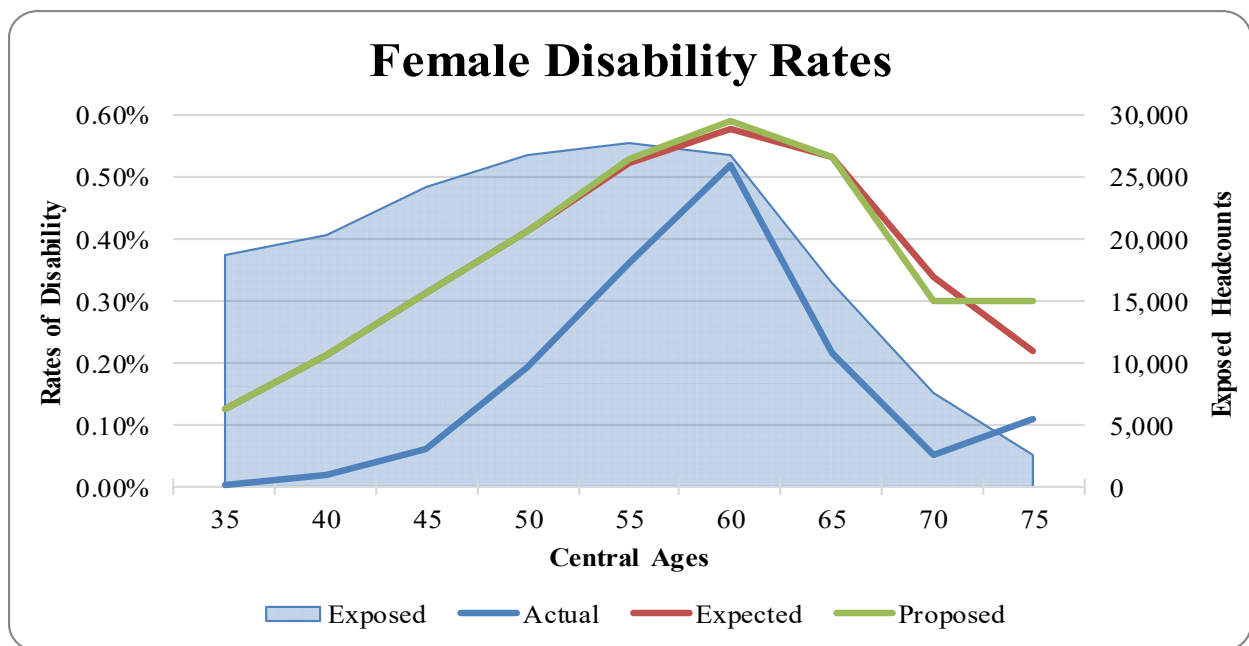
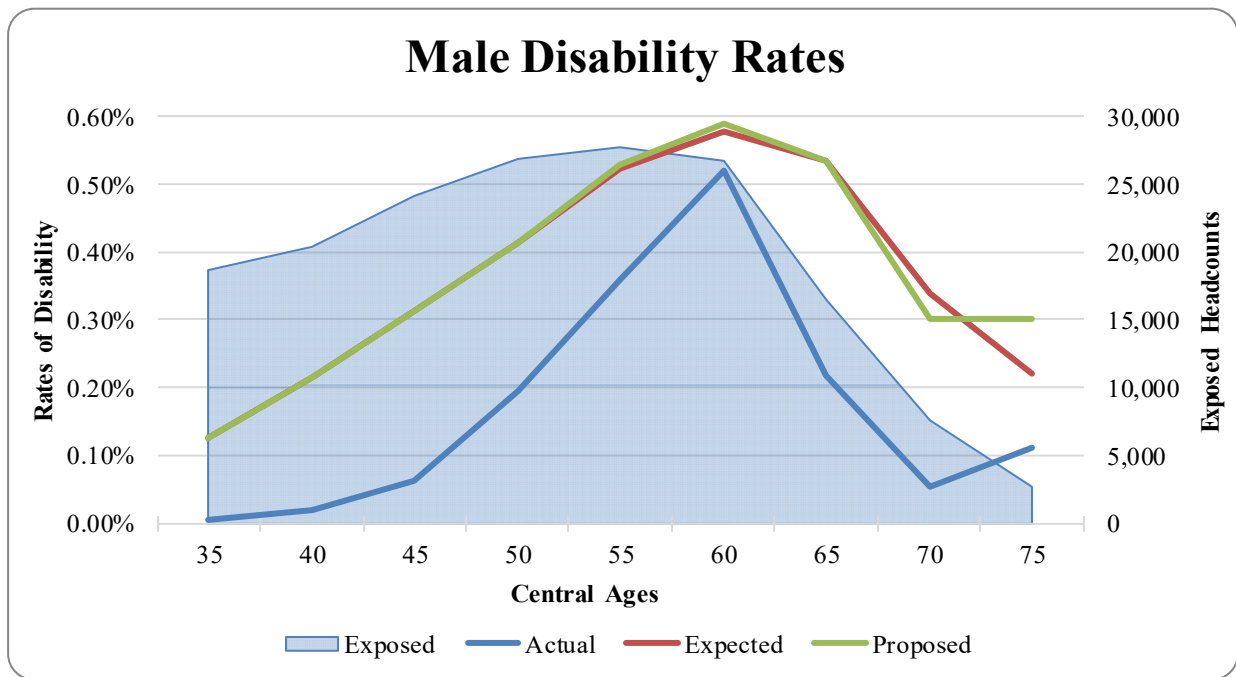
During the period under investigation, the actual rates of disability retirement were less than expected over most age groups. We prefer maintaining a significant margin in these rates the incidence rates are small, but the liability associated with an occurrence can be large. The complete table of recommended disability rates is shown in Appendix D.



### Section III: Demographic Assumptions

The right axis of the charts below represents the number of exposed lives. The exposed lives are the total number of individuals who were subject to disability retirement based upon the member's age during the experience period.

The actual average disability rates by years of service during the past five years, the current assumed disability rates, and the recommended disability rates are shown on the left axis. Headcount exposures are provided on the right axis.





Section III: Demographic Assumptions

The actual/expected ratios based on the recommended assumptions are shown in the table below. The total actual/expected ratio is not materially affected; however, we have smoothed out the rates to more closely match experience at the older ages.

**EXPERIENCE UNDER PROPOSED ASSUMPTIONS**

| Age Group    | Disability Experience |               |                 |            |                 |                 |
|--------------|-----------------------|---------------|-----------------|------------|-----------------|-----------------|
|              | Males                 |               |                 | Females    |                 |                 |
|              | Actual                | Proposed      | Ratio           | Actual     | Proposed        | Ratio           |
|              |                       |               | Actual/Proposed |            |                 | Actual/Proposed |
| Under 20     | 0                     | 3.15          | 0.00            | 0          | 1.48            | 0.00            |
| 20 - 24      | 0                     | 8.16          | 0.00            | 0          | 2.65            | 0.00            |
| 25 - 29      | 1                     | 12.94         | 0.08            | 3          | 7.44            | 0.40            |
| 30 - 34      | 1                     | 23.72         | 0.04            | 3          | 20.35           | 0.15            |
| 35 - 39      | 4                     | 43.57         | 0.09            | 21         | 48.87           | 0.43            |
| 40 - 44      | 15                    | 75.77         | 0.20            | 47         | 108.96          | 0.43            |
| 45 - 49      | 52                    | 110.91        | 0.47            | 113        | 219.39          | 0.52            |
| 50 - 54      | 100                   | 147.20        | 0.68            | 251        | 378.56          | 0.66            |
| 55 - 59      | 139                   | 157.89        | 0.88            | 302        | 335.62          | 0.90            |
| 60 - 64      | 36                    | 88.16         | 0.41            | 68         | 107.36          | 0.63            |
| 65 & Over    | 8                     | 30.96         | 0.26            | 8          | 33.76           | 0.24            |
| <b>TOTAL</b> | <b>356</b>            | <b>702.43</b> | <b>0.51</b>     | <b>816</b> | <b>1,264.43</b> | <b>0.65</b>     |



### Rates of Retirement

The retirement rates used in the actuarial valuation project the percentage of employees expected to retire during the upcoming year. The Plan provides for two types of retirements based on different eligibility requirements. The first one is for a normal retirement benefit. The second one is for an early retirement benefit which is reduced. Separate decrements have been developed for each type of retirement benefit.

Effective August 1, 2017, the age and service requirements for normal and early retirement were increased. Members with 25 years of service at that time are grandfathered and members with less than 25 years of service at that time are non-grandfathered.

Below are the retirement eligibilities for both grandfathered and non-grandfathered members.

| Grandfathered                   | Non-Grandfathered               |
|---------------------------------|---------------------------------|
| Normal Retirement               |                                 |
| Age 65 with 5 Years of Service  | Age 67 with 10 Years of Service |
| 30 Years of Service             | Age 57 with 30 Years of Service |
| Early Retirement                |                                 |
| Age 60 with 5 Years of Service  | Age 62 with 10 Years of Service |
| Age 55 with 25 Years of Service | Age 60 with 25 Years of Service |

In our analysis, we utilized a liability-weighted approach as was used to analyze withdrawal liability. The liability is approximated by using the member's compensation and years of service to estimate the member's benefit level. The exposure and actual occurrences are then multiplied by the benefit level to provide the weighted experience. This approach is particularly insightful as those members who have higher compensation levels are more likely to retire earlier than members who have lower compensation levels. While we reviewed experience on both a count and liability-weighted basis, we have found the liability-weighted experience a better fit for setting the retirement assumption.

Retirement experience was observed for the following categories:

- Normal Retirements – at First Eligibility
- Retirements After First Eligibility
- Reduced Early Retirements with less than 25 Years of Service
- Reduced Early Retirements with 25 or more Years of Service



**Normal Retirement – at First Eligibility**

In this section we analyzed retirement experience on a liability-weighted basis for members who first become eligible to retire upon obtaining age 65 and 5 years of service or 30 years of service regardless of age for those who are grandfathered and age 67 and 10 years of service or age 57 and 30 years of service for those who are non-grandfathered.

The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 142% for those with grandfathered eligibility and 68% for those with non-grandfathered eligibility.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Liability Weighted Amounts of Age Based Retirements (in \$) |                          |            |                          |                              |            |                          |
|---|--------------------------|------------|--------------------------|------------------------------|------------|--------------------------|
| First Eligible for an Unreduced Benefit                     |                          |            |                          |                              |            |                          |
| Age   | Grandfathered Retirement |            |                          | Non-Grandfathered Retirement |            |                          |
|   | Current Rates            |            |                          | Current Rates                |            |                          |
|   | Actual                   | Expected   | Ratio<br>Actual/Expected | Actual                       | Expected   | Ratio<br>Actual/Expected |
| 45 & Under  | 0                        | 0          | 0.00                     | 0                            | 0          | 0.00                     |
| 46  | 0                        | 42,975     | 0.00                     | 0                            | 0          | 0.00                     |
| 47  | 0                        | 24,065     | 0.00                     | 0                            | 0          | 0.00                     |
| 48  | 384,133                  | 336,544    | 1.14                     | 0                            | 0          | 0.00                     |
| 49  | 448,778                  | 513,737    | 0.87                     | 0                            | 0          | 0.00                     |
| 50  | 158,582                  | 448,541    | 0.35                     | 0                            | 0          | 0.00                     |
| 51  | 346,343                  | 669,965    | 0.52                     | 0                            | 0          | 0.00                     |
| 52  | 427,460                  | 904,200    | 0.47                     | 0                            | 0          | 0.00                     |
| 53  | 411,652                  | 1,014,033  | 0.41                     | 0                            | 0          | 0.00                     |
| 54  | 1,003,682                | 1,271,345  | 0.79                     | 0                            | 0          | 0.00                     |
| 55  | 1,499,513                | 1,421,566  | 1.05                     | 0                            | 0          | 0.00                     |
| 56  | 1,427,304                | 1,851,693  | 0.77                     | 0                            | 0          | 0.00                     |
| 57  | 2,137,477                | 2,036,060  | 1.05                     | 0                            | 0          | 0.00                     |
| 58  | 1,711,906                | 2,324,940  | 0.74                     | 0                            | 0          | 0.00                     |
| 59  | 1,933,815                | 2,317,390  | 0.83                     | 0                            | 0          | 0.00                     |
| 60  | 2,487,021                | 2,353,552  | 1.06                     | 0                            | 0          | 0.00                     |
| 61  | 1,987,725                | 2,640,651  | 0.75                     | 0                            | 0          | 0.00                     |
| 62  | 2,907,125                | 2,761,465  | 1.05                     | 0                            | 0          | 0.00                     |
| 63  | 2,923,637                | 2,726,964  | 1.07                     | 0                            | 0          | 0.00                     |
| 64  | 3,101,234                | 2,682,610  | 1.16                     | 0                            | 0          | 0.00                     |
| 65  | 64,459,277               | 35,523,441 | 1.81                     | 0                            | 0          | 0.00                     |
| 66  | 753,177                  | 318,412    | 2.37                     | 0                            | 0          | 0.00                     |
| 67  | 864,789                  | 289,252    | 2.99                     | 6,006,749                    | 8,998,175  | 0.67                     |
| 68  | 348,486                  | 205,035    | 1.70                     | 215,509                      | 217,731    | 0.99                     |
| 69  | 340,024                  | 114,705    | 2.96                     | 271,808                      | 237,128    | 1.15                     |
| 70  | 300,092                  | 121,927    | 2.46                     | 111,898                      | 199,595    | 0.56                     |
| 71  | 335,523                  | 103,182    | 3.25                     | 98,767                       | 184,082    | 0.54                     |
| 72  | 163,044                  | 75,427     | 2.16                     | 44,897                       | 86,586     | 0.52                     |
| 73  | 131,218                  | 63,460     | 2.07                     | 32,391                       | 118,468    | 0.27                     |
| 74  | 169,212                  | 67,802     | 2.50                     | 38,600                       | 33,118     | 1.17                     |
| 75 & Over   | 410,877                  | 667,374    | 0.62                     | 183,010                      | 898,985    | 0.20                     |
| TOTAL   | 93,573,106               | 65,892,313 | 1.42                     | 6,820,620                    | 10,074,883 | 0.68                     |



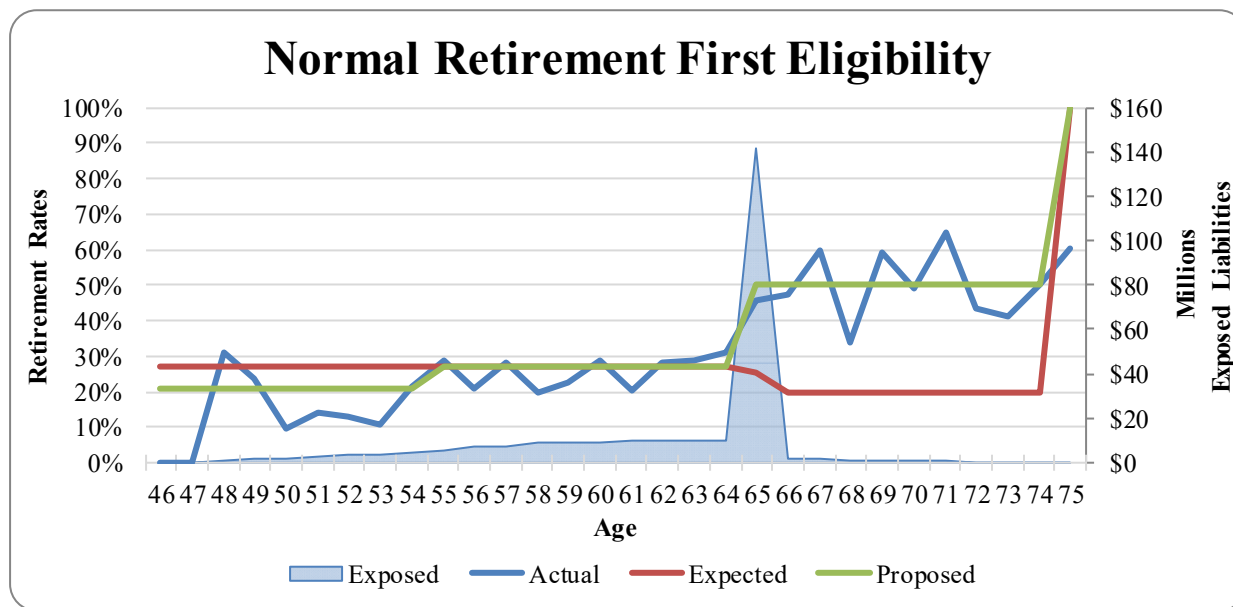
### Findings and Recommendations

We recommend revising the normal retirement rates at first eligibility to more closely reflect actual experience. At this time, there have been no retirements for non-grandfathered members who have obtained age 57 with 30 or more years of service. Due to the lack of observable experience, separate rates have been developed for this group, using professional judgement. The complete tables of recommended retirement rates are shown in Appendix D.

The actual/expected ratios based on the recommended assumptions are 92% compared to 142% for those with grandfathered eligibility under the current assumption and 96% compared to 68% for non-grandfathered eligibility under the current assumptions.

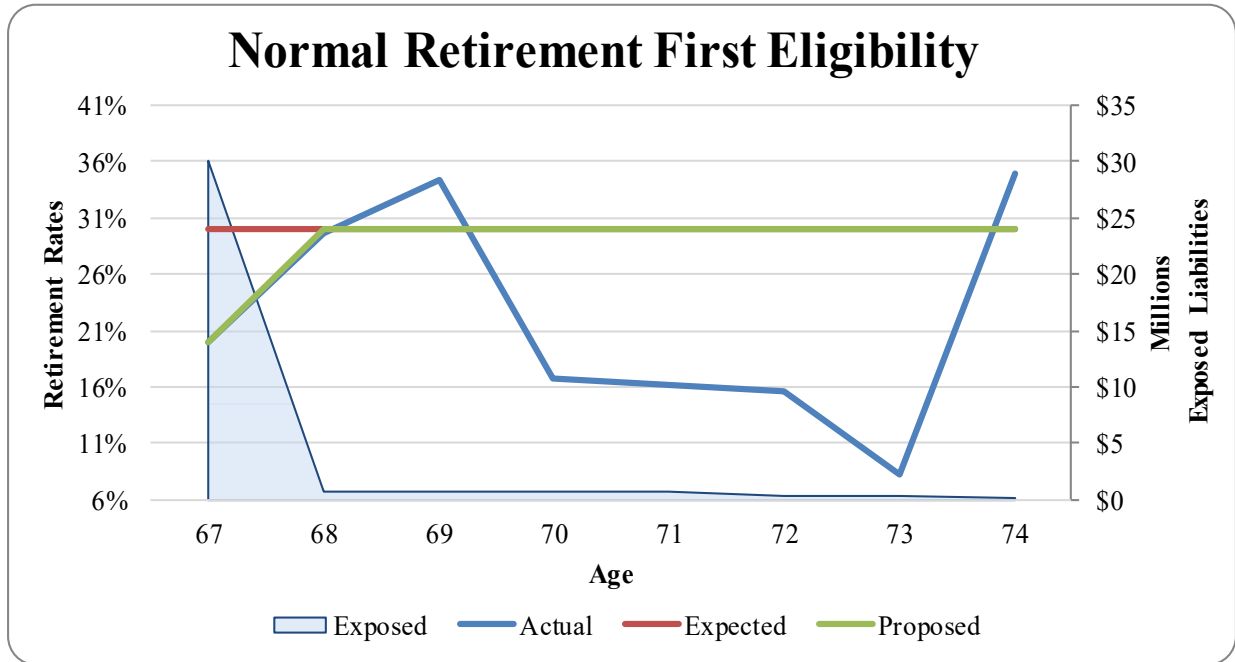
The assumption should provide a better fit to experience, especially at the high exposure ages. The actual average retirement rates by age and years of service during the past five years, the current assumed retirement rates, and the recommended retirement rates are shown on the left axis. The right axis of the charts below and on the following page represents the liability-weighted exposure amounts.

#### GRANDFATHERED PARTICIPANTS





NON-GRANDFATHERED PARTICIPANTS







The following table shows in detail the actual/expected ratios by individual age and total based on the recommended rates of retirement.

**EXPERIENCE UNDER PROPOSED ASSUMPTIONS**

| Annual Benefit Amounts of Age Based Retirements |                          |             |                          |                              |           |                          |
|---|--------------------------|-------------|--------------------------|------------------------------|-----------|--------------------------|
| First Eligible for an Unreduced Benefit         |                          |             |                          |                              |           |                          |
| Age   | Grandfathered Retirement |             |                          | Non-Grandfathered Retirement |           |                          |
|   | Proposed Rates           |             |                          | Proposed Rates               |           |                          |
|   | Actual                   | Proposed    | Ratio<br>Actual/Proposed | Actual                       | Proposed  | Ratio<br>Actual/Proposed |
| 45 & Under                                      | 0                        | 0           | 0.00                     | 0                            | 0         | 0.00                     |
| 46  | 0                        | 33,425      | 0.00                     | 0                            | 0         | 0.00                     |
| 47  | 0                        | 18,717      | 0.00                     | 0                            | 0         | 0.00                     |
| 48  | 384,133                  | 261,756     | 1.47                     | 0                            | 0         | 0.00                     |
| 49  | 448,778                  | 399,573     | 1.12                     | 0                            | 0         | 0.00                     |
| 50  | 158,582                  | 348,865     | 0.45                     | 0                            | 0         | 0.00                     |
| 51  | 346,343                  | 521,084     | 0.66                     | 0                            | 0         | 0.00                     |
| 52  | 427,460                  | 703,267     | 0.61                     | 0                            | 0         | 0.00                     |
| 53  | 411,652                  | 788,692     | 0.52                     | 0                            | 0         | 0.00                     |
| 54  | 1,003,682                | 988,824     | 1.02                     | 0                            | 0         | 0.00                     |
| 55  | 1,499,513                | 1,421,566   | 1.05                     | 0                            | 0         | 0.00                     |
| 56  | 1,427,304                | 1,851,693   | 0.77                     | 0                            | 0         | 0.00                     |
| 57  | 2,137,477                | 2,036,060   | 1.05                     | 0                            | 0         | 0.00                     |
| 58  | 1,711,906                | 2,324,940   | 0.74                     | 0                            | 0         | 0.00                     |
| 59  | 1,933,815                | 2,317,390   | 0.83                     | 0                            | 0         | 0.00                     |
| 60  | 2,487,021                | 2,353,552   | 1.06                     | 0                            | 0         | 0.00                     |
| 61  | 1,987,725                | 2,640,651   | 0.75                     | 0                            | 0         | 0.00                     |
| 62  | 2,907,125                | 2,761,465   | 1.05                     | 0                            | 0         | 0.00                     |
| 63  | 2,923,637                | 2,726,964   | 1.07                     | 0                            | 0         | 0.00                     |
| 64  | 3,101,234                | 2,682,610   | 1.16                     | 0                            | 0         | 0.00                     |
| 65  | 64,459,277               | 70,665,570  | 0.91                     | 0                            | 0         | 0.00                     |
| 66  | 753,177                  | 796,031     | 0.95                     | 0                            | 0         | 0.00                     |
| 67  | 864,789                  | 723,130     | 1.20                     | 6,006,749                    | 5,998,783 | 1.00                     |
| 68  | 348,486                  | 512,589     | 0.68                     | 215,509                      | 217,731   | 0.99                     |
| 69  | 340,024                  | 286,762     | 1.19                     | 271,808                      | 237,128   | 1.15                     |
| 70  | 300,092                  | 304,817     | 0.98                     | 111,898                      | 199,595   | 0.56                     |
| 71  | 335,523                  | 257,955     | 1.30                     | 98,767                       | 184,082   | 0.54                     |
| 72  | 163,044                  | 188,568     | 0.86                     | 44,897                       | 86,586    | 0.52                     |
| 73  | 131,218                  | 158,649     | 0.83                     | 32,391                       | 118,468   | 0.27                     |
| 74  | 169,212                  | 169,506     | 1.00                     | 38,600                       | 33,118    | 1.17                     |
| 75 & Over                                       | 410,877                  | 667,374     | 0.62                     | 183,010                      | 898,985   | 0.20                     |
| TOTAL   | 93,573,106               | 101,912,045 | 0.92                     | 6,820,620                    | 7,075,491 | 0.96                     |



### **Retirement Subsequent to First Eligibility**

In this section we analyzed retirement experience for members beginning the years after becoming eligible to retire upon obtaining age 65 and 5 years of service or 30 years of service regardless of age for those with grandfathered eligibility and obtaining age 67 and 10 years of service or age 57 and 30 years of service for those with non-grandfathered eligibility. For these members, benefit weighting did not materially impact the experience, however, we utilized the weighted approach for consistency.

The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 117% for those with grandfathered eligibility and 82% for those with non-grandfathered eligibility.



### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Liability Weighted Amounts of Age Based Retirements (in \$) |                          |             |                 |                              |            |       |
|---|--------------------------|-------------|-----------------|------------------------------|------------|-------|
| Eligible for an Unreduced Benefit                           |                          |             |                 |                              |            |       |
| Age   | Grandfathered Retirement |             |                 | Non-Grandfathered Retirement |            |       |
|   | Current Rates            |             |                 | Current Rates                |            |       |
|   | Actual                   | Expected    | Ratio           | Actual                       | Expected   | Ratio |
| Actual/Expected   |                          |             | Actual/Expected |                              |            |       |
| 45 & Under  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 46  | 55,024                   | 10,455      | 5.26            | 0                            | 0          | 0.00  |
| 47  | 99,256                   | 18,859      | 5.26            | 0                            | 0          | 0.00  |
| 48  | 38,705                   | 30,692      | 1.26            | 0                            | 0          | 0.00  |
| 49  | 170,369                  | 257,183     | 0.66            | 0                            | 0          | 0.00  |
| 50  | 658,542                  | 713,692     | 0.92            | 0                            | 0          | 0.00  |
| 51  | 1,504,715                | 1,253,819   | 1.20            | 0                            | 0          | 0.00  |
| 52  | 937,138                  | 1,807,495   | 0.52            | 0                            | 0          | 0.00  |
| 53  | 2,598,477                | 2,551,274   | 1.02            | 0                            | 0          | 0.00  |
| 54  | 3,040,839                | 3,460,761   | 0.88            | 0                            | 0          | 0.00  |
| 55  | 4,302,417                | 4,068,412   | 1.06            | 0                            | 0          | 0.00  |
| 56  | 3,816,547                | 4,300,666   | 0.89            | 0                            | 0          | 0.00  |
| 57  | 4,361,843                | 4,847,026   | 0.90            | 0                            | 0          | 0.00  |
| 58  | 4,920,054                | 5,460,617   | 0.90            | 0                            | 0          | 0.00  |
| 59  | 4,864,516                | 5,760,841   | 0.84            | 0                            | 0          | 0.00  |
| 60  | 6,277,530                | 6,079,056   | 1.03            | 0                            | 0          | 0.00  |
| 61  | 6,373,312                | 6,189,186   | 1.03            | 0                            | 0          | 0.00  |
| 62  | 7,041,486                | 6,138,460   | 1.15            | 0                            | 0          | 0.00  |
| 63  | 5,556,962                | 5,865,815   | 0.95            | 0                            | 0          | 0.00  |
| 64  | 6,231,692                | 5,661,134   | 1.10            | 0                            | 0          | 0.00  |
| 65  | 9,474,981                | 5,446,759   | 1.74            | 0                            | 0          | 0.00  |
| 66  | 46,566,263               | 27,007,961  | 1.72            | 0                            | 0          | 0.00  |
| 67  | 35,021,823               | 21,550,307  | 1.63            | 0                            | 0          | 0.00  |
| 68  | 27,716,246               | 17,642,353  | 1.57            | 3,649,391                    | 4,763,146  | 0.77  |
| 69  | 22,265,265               | 13,863,069  | 1.61            | 2,879,770                    | 3,688,514  | 0.78  |
| 70  | 16,975,947               | 10,217,063  | 1.66            | 2,819,997                    | 3,141,369  | 0.90  |
| 71  | 10,994,766               | 7,360,669   | 1.49            | 2,483,937                    | 2,603,820  | 0.95  |
| 72  | 8,938,999                | 5,815,015   | 1.54            | 1,683,400                    | 1,693,873  | 0.99  |
| 73  | 7,217,934                | 4,602,105   | 1.57            | 534,537                      | 998,223    | 0.54  |
| 74  | 5,710,185                | 3,608,581   | 1.58            | 563,047                      | 858,452    | 0.66  |
| 75 & Over   | 18,007,806               | 50,462,280  | 0.36            | 2,913,272                    | 11,576,071 | 0.25  |
| TOTAL   | 271,739,637              | 232,051,601 | 1.17            | 14,614,079                   | 17,747,397 | 0.82  |

### Findings and Recommendations

We recommend revising the normal retirement rates to more closely reflect actual experience. The complete tables of recommended retirement rates are shown in Appendix D.

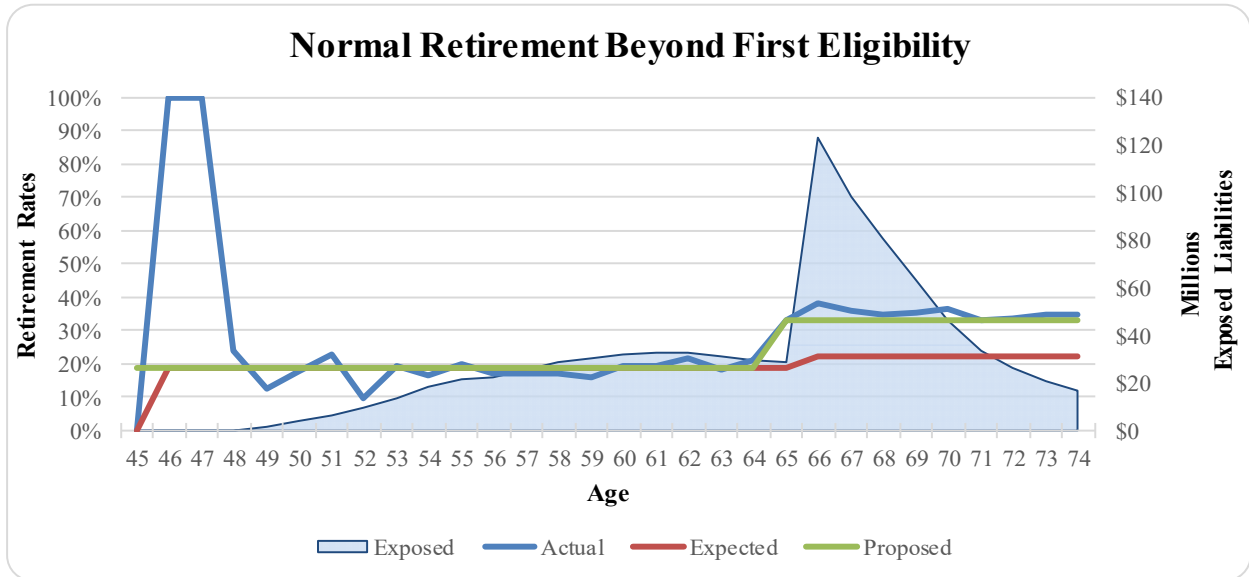
The actual/expected ratios based on the recommended assumptions are 93% compared to 117% for grandfathered eligibility under the current assumption and 101% compared to 82% for non-grandfathered eligibility under the current assumptions.



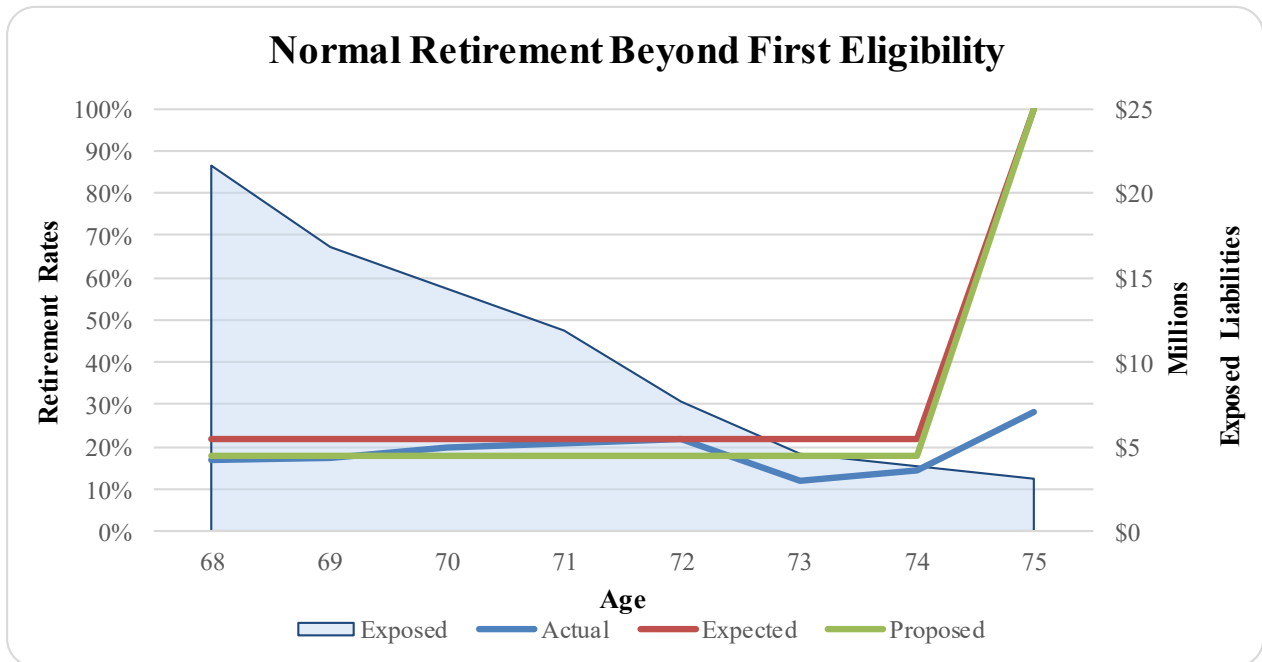
Section III: Demographic Assumptions

The chart shows actual average retirement rates by age and years of service during the past five years, the current assumed retirement rates, and the recommended retirement rates are shown on the left axis. The right axis of the charts below represents the amounts of weighted exposure.

GRANDFATHERED PARTICIPANTS



NON-GRANDFATHERED PARTICIPANTS





The table below shows in detail the actual/expected ratios by individual age and total based on the recommended rates of retirement.

### EXPERIENCE UNDER PROPOSED ASSUMPTIONS

| Annual Benefit Amounts of Age Based Retirements<br>Eligible for an Unreduced Benefit |                          |             |                          |                              |            |                          |
|--|--------------------------|-------------|--------------------------|------------------------------|------------|--------------------------|
| Age  | Grandfathered Retirement |             |                          | Non-Grandfathered Retirement |            |                          |
|  | Proposed Rates           |             |                          | Proposed Rates               |            |                          |
|  | Actual                   | Proposed    | Ratio<br>Actual/Proposed | Actual                       | Proposed   | Ratio<br>Actual/Proposed |
| 45 & Under   | 0                        | 0           | 0.00                     | 0                            | 0          | 0.00                     |
| 46   | 55,024                   | 10,455      | 5.26                     | 0                            | 0          | 0.00                     |
| 47   | 99,256                   | 18,859      | 5.26                     | 0                            | 0          | 0.00                     |
| 48   | 38,705                   | 30,692      | 1.26                     | 0                            | 0          | 0.00                     |
| 49   | 170,369                  | 257,182     | 0.66                     | 0                            | 0          | 0.00                     |
| 50   | 658,542                  | 713,692     | 0.92                     | 0                            | 0          | 0.00                     |
| 51   | 1,504,715                | 1,253,819   | 1.20                     | 0                            | 0          | 0.00                     |
| 52   | 937,138                  | 1,807,495   | 0.52                     | 0                            | 0          | 0.00                     |
| 53   | 2,598,477                | 2,551,274   | 1.02                     | 0                            | 0          | 0.00                     |
| 54   | 3,040,839                | 3,460,761   | 0.88                     | 0                            | 0          | 0.00                     |
| 55   | 4,302,417                | 4,068,412   | 1.06                     | 0                            | 0          | 0.00                     |
| 56   | 3,816,547                | 4,300,666   | 0.89                     | 0                            | 0          | 0.00                     |
| 57   | 4,361,843                | 4,847,026   | 0.90                     | 0                            | 0          | 0.00                     |
| 58   | 4,920,054                | 5,460,617   | 0.90                     | 0                            | 0          | 0.00                     |
| 59   | 4,864,516                | 5,760,841   | 0.84                     | 0                            | 0          | 0.00                     |
| 60   | 6,277,530                | 6,079,056   | 1.03                     | 0                            | 0          | 0.00                     |
| 61   | 6,373,312                | 6,189,186   | 1.03                     | 0                            | 0          | 0.00                     |
| 62   | 7,041,486                | 6,138,460   | 1.15                     | 0                            | 0          | 0.00                     |
| 63   | 5,556,962                | 5,865,815   | 0.95                     | 0                            | 0          | 0.00                     |
| 64   | 6,231,692                | 5,661,134   | 1.10                     | 0                            | 0          | 0.00                     |
| 65   | 9,474,981                | 9,460,160   | 1.00                     | 0                            | 0          | 0.00                     |
| 66   | 46,566,263               | 40,511,941  | 1.15                     | 0                            | 0          | 0.00                     |
| 67   | 35,021,823               | 32,325,460  | 1.08                     | 0                            | 0          | 0.00                     |
| 68   | 27,716,246               | 26,463,530  | 1.05                     | 3,649,391                    | 3,897,120  | 0.94                     |
| 69   | 22,265,265               | 20,794,604  | 1.07                     | 2,879,770                    | 3,017,875  | 0.95                     |
| 70   | 16,975,947               | 15,325,595  | 1.11                     | 2,819,997                    | 2,570,211  | 1.10                     |
| 71   | 10,994,766               | 11,041,003  | 1.00                     | 2,483,937                    | 2,130,398  | 1.17                     |
| 72   | 8,938,999                | 8,722,522   | 1.02                     | 1,683,400                    | 1,385,896  | 1.21                     |
| 73   | 7,217,934                | 6,903,157   | 1.05                     | 534,537                      | 816,728    | 0.65                     |
| 74   | 5,710,185                | 5,412,871   | 1.05                     | 563,047                      | 702,370    | 0.80                     |
| 75 & Over  | 18,007,806               | 50,462,280  | 0.36                     | 2,913,272                    | 11,576,071 | 0.25                     |
| TOTAL  | 271,739,637              | 291,898,563 | 0.93                     | 14,614,079                   | 14,520,598 | 1.01                     |



**Early Retirement**

In this section we analyzed retirement experience for members who were eligible for a reduced retirement upon obtaining age 60 and 5 years of service or obtaining age 55 and 25 years of service for those with grandfathered eligibility and obtaining age 62 and 10 years of service or obtaining age 60 and 25 years of service for those with non-grandfathered but prior to becoming eligible for an unreduced retirement. The analysis was conducted in two categories, the first was members with less than 25 years of service and the second was members with 25 or more years of service. Again, the experience was liability weighted.

The analysis of the actual retirement experience over the five-year period yields an actual/expected ratio of 265% for grandfathered members and 73% for non-grandfathered members.

**EXPERIENCE UNDER CURRENT ASSUMPTIONS**

| Liability Weighted Amounts of Age Based Retirements (in \$) |                          |                    |                          |                              |                   |                          |
|---|--------------------------|--------------------|--------------------------|------------------------------|-------------------|--------------------------|
| Eligible for an Reduced Benefit                             |                          |                    |                          |                              |                   |                          |
| Age   | Grandfathered Retirement |                    |                          | Non-Grandfathered Retirement |                   |                          |
|   | Current Rates            |                    |                          | Current Rates                |                   |                          |
|   | Actual                   | Expected           | Ratio<br>Actual/Expected | Actual                       | Expected          | Ratio<br>Actual/Expected |
| 45 & Under  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 46  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 47  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 48  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 49  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 50  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 51  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 52  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 53  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 54  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 55  | 3,484,400                | 2,418,426          | 1.44                     | 0                            | 0                 | 0.00                     |
| 56  | 4,035,866                | 4,346,270          | 0.93                     | 0                            | 0                 | 0.00                     |
| 57  | 4,804,842                | 4,931,416          | 0.97                     | 0                            | 0                 | 0.00                     |
| 58  | 4,846,410                | 5,141,319          | 0.94                     | 0                            | 0                 | 0.00                     |
| 59  | 6,520,722                | 5,556,544          | 1.17                     | 0                            | 0                 | 0.00                     |
| 60  | 61,654,006               | 21,842,139         | 2.82                     | 449,335                      | 751,888           | 0.60                     |
| 61  | 84,641,090               | 28,863,869         | 2.93                     | 616,365                      | 1,303,780         | 0.47                     |
| 62  | 77,845,425               | 26,087,879         | 2.98                     | 2,620,312                    | 6,818,301         | 0.38                     |
| 63  | 65,999,706               | 22,703,544         | 2.91                     | 4,234,455                    | 9,224,706         | 0.46                     |
| 64  | 61,819,792               | 19,651,285         | 3.15                     | 3,707,470                    | 7,782,443         | 0.48                     |
| 65  | 0                        | 0                  | 0.00                     | 8,452,137                    | 6,699,400         | 1.26                     |
| 66  | 0                        | 0                  | 0.00                     | 7,240,636                    | 4,629,049         | 1.56                     |
| 67  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 68  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 69  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 70  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 71  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 72  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 73  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 74  | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| 75 & Over   | 0                        | 0                  | 0.00                     | 0                            | 0                 | 0.00                     |
| <b>TOTAL</b>  | <b>375,652,259</b>       | <b>141,542,691</b> | <b>2.65</b>              | <b>27,320,709</b>            | <b>37,209,566</b> | <b>0.73</b>              |

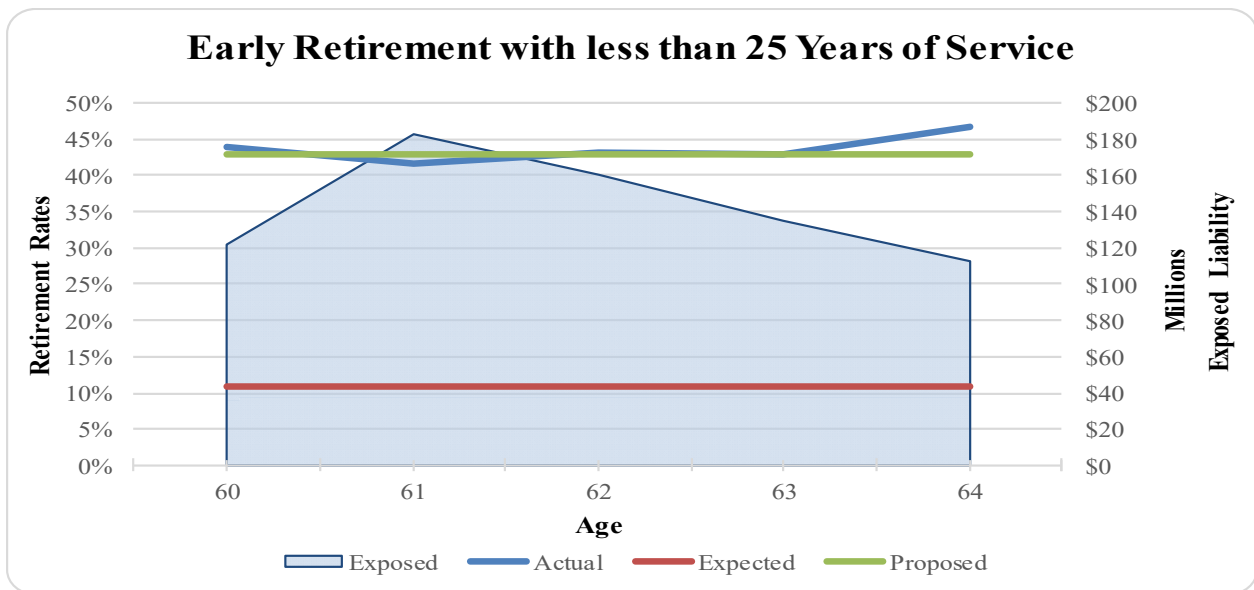


**Findings and Recommendations**

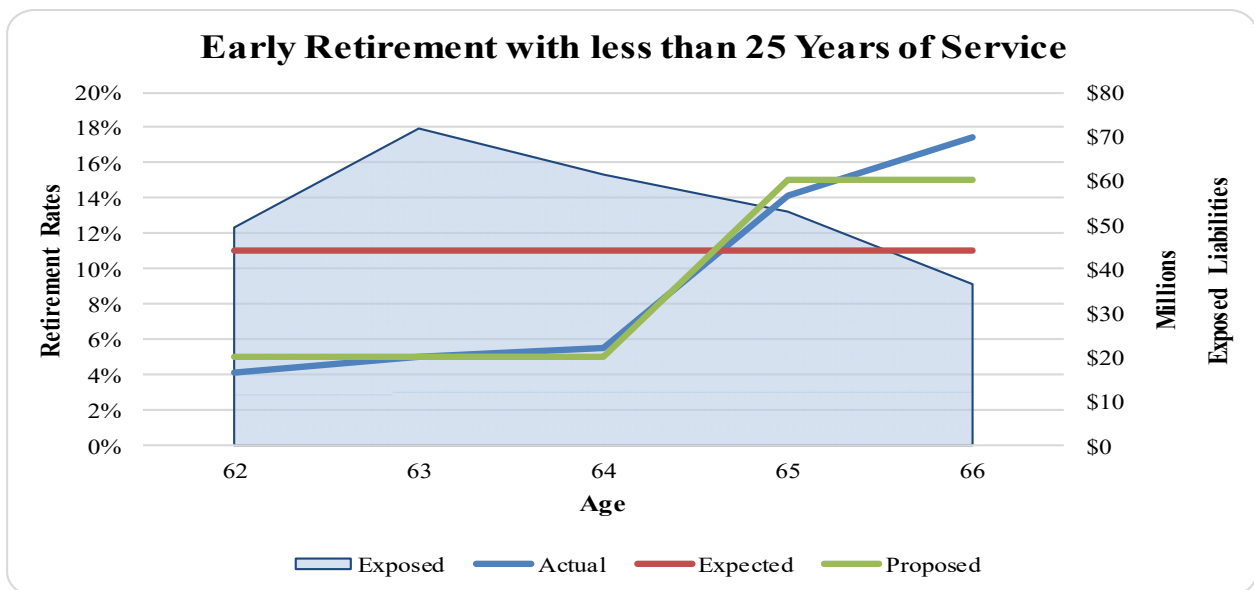
We recommend revising the early retirement rates to more closely reflect actual experience. The complete tables of recommended retirement rates are shown in Appendix D.

The actual average retirement rates by age and years of service during the past five years, the current assumed retirement rates, and the recommended retirement rates are shown on the left axis. The right axis of the charts below represents the amount of weighted exposure.

**GRANDFATHERED PARTICIPANTS**

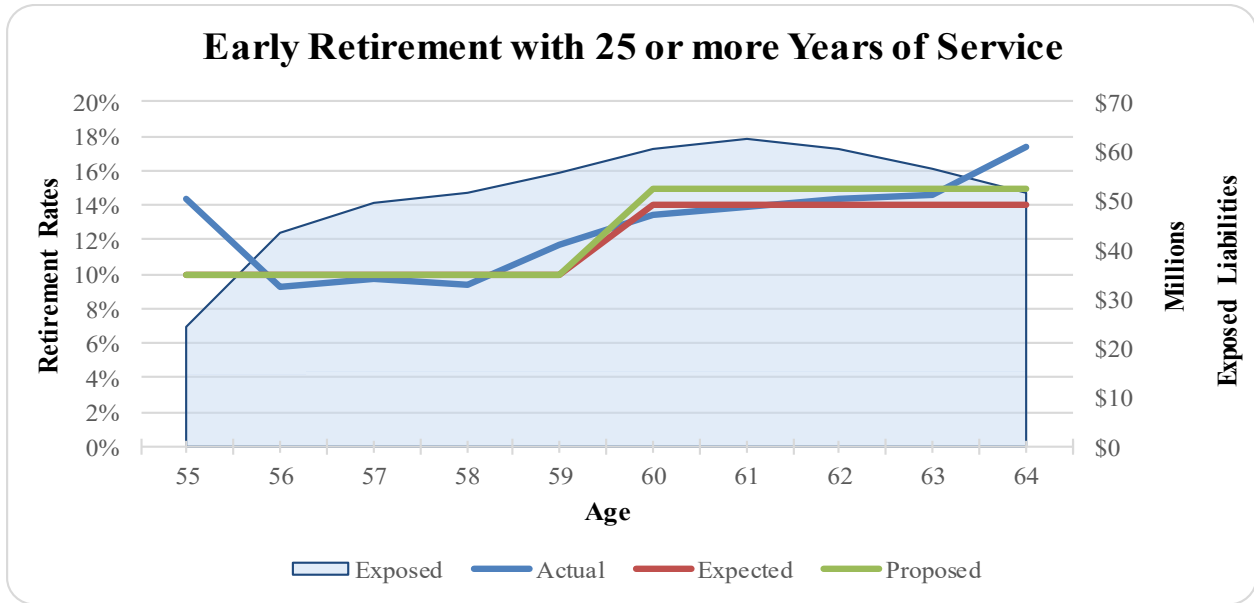


**NON-GRANDFATHERED PARTICIPANTS**

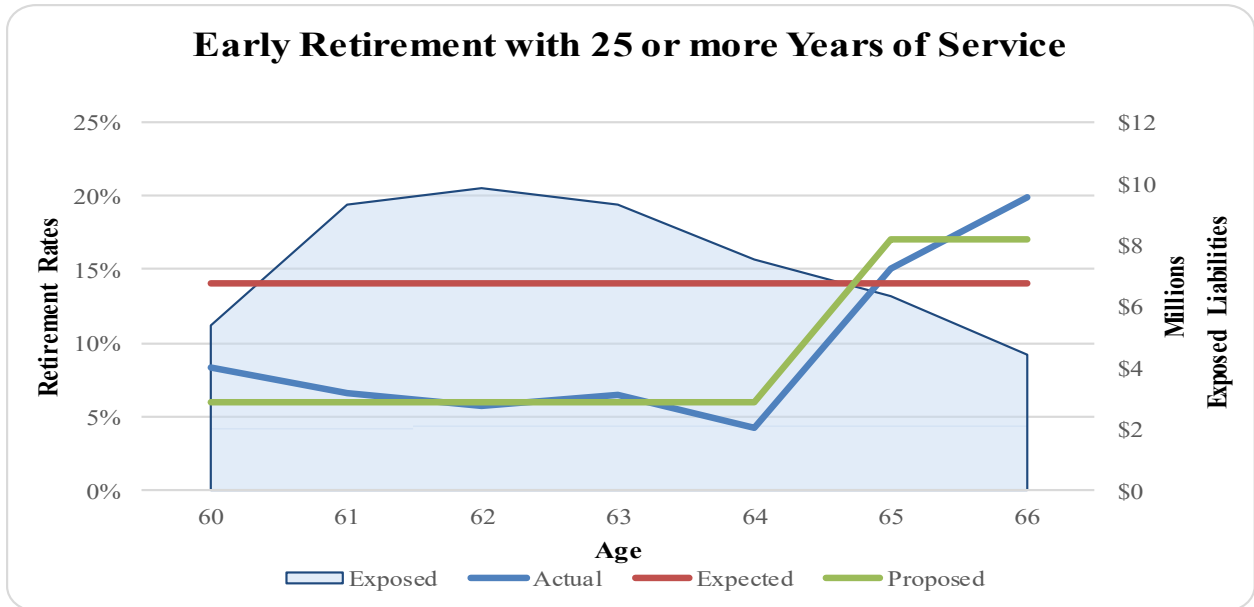




**GRANDFATHERED PARTICIPANTS**



**NON-GRANDFATHERED PARTICIPANTS**



The actual/expected ratios based on the recommended assumptions are 101% for grandfathered eligibility compared to 265% under the current assumptions, and 102% for non-grandfathered compared to 73% under the current assumptions.





The table on the following page details the actual/expected ratios by individual age and total based on the recommended rates of retirement.

**EXPERIENCE UNDER PROPOSED ASSUMPTIONS**

| Annual Benefit Amounts of Age Based Retirements |                          |             |                 |                              |            |       |
|---|--------------------------|-------------|-----------------|------------------------------|------------|-------|
| Eligible for a Reduced Benefit                  |                          |             |                 |                              |            |       |
| Age   | Grandfathered Retirement |             |                 | Non-Grandfathered Retirement |            |       |
|   | Proposed Rates           |             |                 | Proposed Rates               |            |       |
|   | Actual                   | Proposed    | Ratio           | Actual                       | Proposed   | Ratio |
| Actual/Proposed                                 |                          |             | Actual/Proposed |                              |            |       |
| 45 & Under                                      | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 46  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 47  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 48  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 49  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 50  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 51  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 52  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 53  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 54  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 55  | 3,484,400                | 2,418,426   | 1.44            | 0                            | 0          | 0.00  |
| 56  | 4,035,866                | 4,346,270   | 0.93            | 0                            | 0          | 0.00  |
| 57  | 4,804,842                | 4,931,416   | 0.97            | 0                            | 0          | 0.00  |
| 58  | 4,846,410                | 5,141,319   | 0.94            | 0                            | 0          | 0.00  |
| 59  | 6,520,722                | 5,556,544   | 1.17            | 0                            | 0          | 0.00  |
| 60  | 61,654,006               | 61,333,276  | 1.01            | 449,335                      | 322,238    | 1.39  |
| 61  | 84,641,090               | 87,967,343  | 0.96            | 616,365                      | 558,763    | 1.10  |
| 62  | 77,845,425               | 77,937,555  | 1.00            | 2,620,312                    | 3,063,455  | 0.86  |
| 63  | 65,999,706               | 66,435,733  | 0.99            | 4,234,455                    | 4,159,096  | 1.02  |
| 64  | 61,819,792               | 56,366,276  | 1.10            | 3,707,470                    | 3,510,136  | 1.06  |
| 65  | 0                        | 0           | 0.00            | 8,452,137                    | 9,003,409  | 0.94  |
| 66  | 0                        | 0           | 0.00            | 7,240,636                    | 6,220,124  | 1.16  |
| 67  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 68  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 69  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 70  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 71  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 72  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 73  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 74  | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| 75 & Over                                       | 0                        | 0           | 0.00            | 0                            | 0          | 0.00  |
| TOTAL   | 375,652,259              | 372,434,158 | 1.01            | 27,320,709                   | 26,837,220 | 1.02  |



### **Rates of Non-Disabled Post-Retirement Mortality**

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.

The Society of Actuaries periodically publishes mortality tables derived from large, national studies. In recent years, they have tended to publish families of tables, allowing actuaries to select a table that is based on a subset of data most similar to that of the data the actuary is trying to value. In early 2019, the Society released a set of tables based solely on public plan data. This family of tables, called the Pub-2010 tables, includes tables based not only on the gender and status factors already noted, but also on the type of membership (teachers, public safety, and general government), as well as further breakdowns based on those members who were above or below the median benefit amounts. Because most other recent families of tables had excluded public sector data, the Pub-2010 tables are expected to be quite useful for valuing the benefits for public retirement systems like SERS.

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 is a very material assumption and has the most significant impact of all demographic assumptions on liability projections. An important note in the examination of mortality is an observed correlation that life expectancy is greater for retirees with higher benefits than retirees with lower benefits. Because the goal of an actuarial valuation is to model the expected benefit payments to be provided by a system and the liability associated with these payments, actuaries increasingly analyze mortality experience on a benefit-weighted basis rather than simply considering headcounts (number of members dying).

The recommended mortality tables in the analysis on the following pages include adjustments. The adjustments to the standard mortality tables were determined following the procedures outlined in the *Credibility Educational Resource for Pension Actuaries, Application of Credibility Theory to Mortality Assumption* published by the Society of Actuaries. For the credibility analysis, we utilized a 95% confidence interval on the benefit weighted basis.

Based upon the long-term trend of mortality improvement, actuaries seek to account for future improvements in longevity, either by generationally projecting future improvements or by maintaining a sufficient margin in expected rates of mortality to allow for future improvement. Since the prior experience study, the mortality basis for the System has used a generationally projected mortality improvement approach.



The analysis of the actual post-retirement mortality experience over the five-year experience study period yields actual/expected ratios of 96% and 89% respectively for males and females. The table below details the actual/expected ratios by individual age group and total.

### EXPERIENCE UNDER CURRENT ASSUMPTIONS

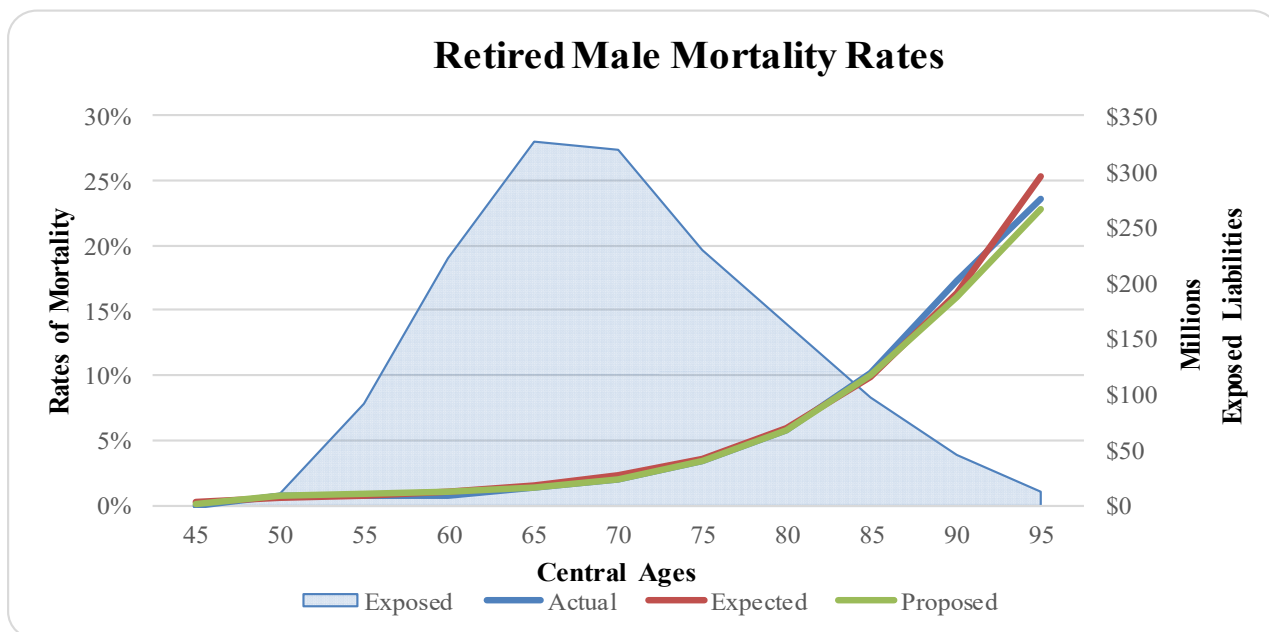
| Age Group  | Annual Benefit Amounts of Post-Retirement Mortality |            |                 |            |            |                 |
|------------|---|------------|-----------------|------------|------------|-----------------|
|            | Males   |            |                 | Females    |            |                 |
|            | Actual  | Expected   | Ratio           | Actual     | Expected   | Ratio           |
|            |   |            | Actual/Expected |            |            | Actual/Expected |
| Under 50   | 0   | 196        | 0.00            | 0          | 40         | 0.00            |
| 50 - 54    | 68,396  | 53,797     | 1.27            | 0          | 27,490     | 0.00            |
| 55 - 59    | 691,606   | 680,229    | 1.02            | 94,926     | 331,770    | 0.29            |
| 60 - 64    | 1,599,941   | 2,263,783  | 0.71            | 941,274    | 1,678,772  | 0.56            |
| 65 - 69    | 4,203,977   | 4,856,732  | 0.87            | 3,441,922  | 5,769,337  | 0.60            |
| 70 - 74    | 6,340,163   | 7,159,174  | 0.89            | 7,882,497  | 11,123,118 | 0.71            |
| 75 - 79    | 7,971,139   | 8,270,567  | 0.96            | 11,252,886 | 14,840,216 | 0.76            |
| 80 - 84    | 9,242,836   | 9,598,320  | 0.96            | 17,293,710 | 18,948,056 | 0.91            |
| 85 - 89    | 9,895,157   | 9,559,848  | 1.04            | 18,572,513 | 19,616,848 | 0.95            |
| 90 - 94    | 7,865,978   | 7,408,140  | 1.06            | 17,418,475 | 16,281,968 | 1.07            |
| 95 - 99    | 2,826,710   | 3,040,655  | 0.93            | 9,160,814  | 8,150,432  | 1.12            |
| 100 & Over | 446,693   | 507,332    | 0.88            | 2,253,777  | 2,058,743  | 1.09            |
| TOTAL      | 51,152,596  | 53,398,775 | 0.96            | 88,312,794 | 98,826,790 | 0.89            |

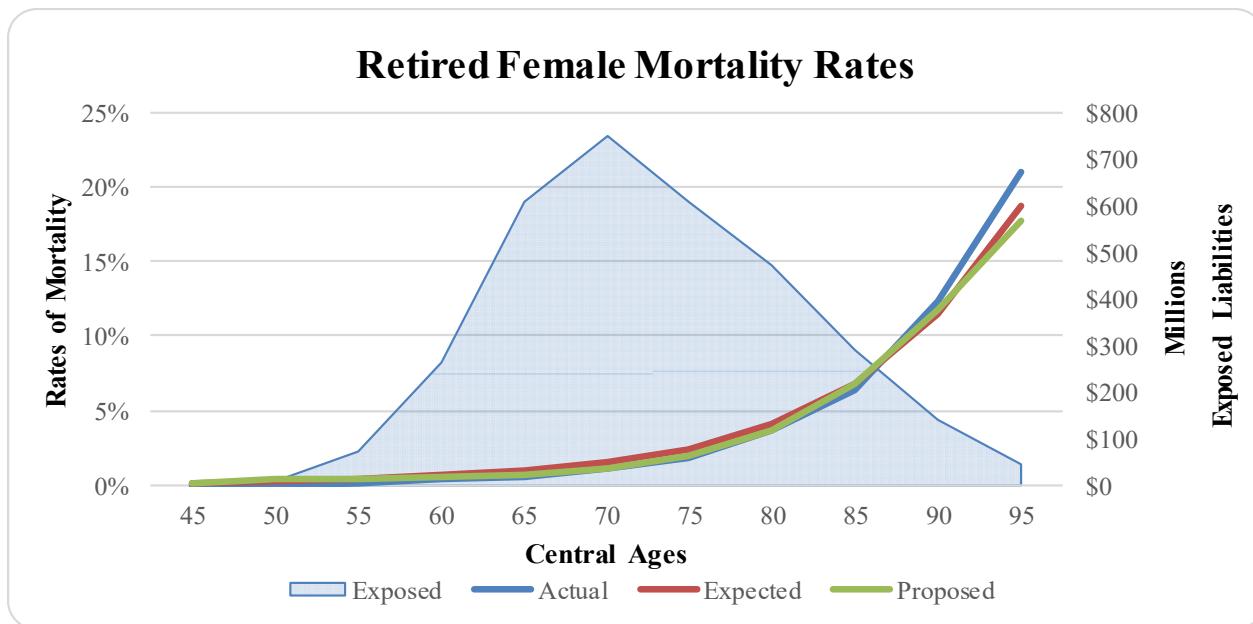


### Findings and Recommendations

Experience indicates that overall, less liability has been released than expected during the study period. The table currently in use is the RP-2014 Blue Collar Mortality Table with fully generational projection with Scale BB, 120% of male rates, and 110% of female rates. As the current assumption anticipated more liability to be released through post-retirement mortality rates than was actually released, we recommend a slight overall reduction to retiree mortality rates for both males and female retirees. Specifically, we recommend use of the PUB-2010 General Employee Amount Weighted Below Median Healthy Retiree mortality table projected to 2017 with ages set forward 1 year and adjusted 94.20% for males and set forward 2 years and adjusted 81.35% for females. Future improvement in mortality rates is reflected by applying the MP-2020 projection scale generationally.

The actual average mortality rates by age during the past five years, the current assumed mortality rates, and the recommended weighted mortality rates are shown on the left axis. The right axis of the charts below represents the weighted exposure. The weighted exposure amounts are the total number of individuals who were subject to mortality rates at specific age weighted by the amount of benefits paid during at that age.





The actual/expected ratios based on the recommended assumptions are 99% for males compared to 96% under the current assumptions and 99% for females compared to 89% under the current assumptions.

The following table details the actual/expected ratios by individual age and total based on the recommended rates of mortality.

#### EXPERIENCE UNDER PROPOSED ASSUMPTIONS

| Age Group    | Annual Benefit Amounts of Post-Retirement Mortality |                   |                 |                   |                   |                 |
|--------------|---|-------------------|-----------------|-------------------|-------------------|-----------------|
|              | Males   |                   |                 | Females           |                   |                 |
|              | Actual  | Proposed          | Ratio           | Actual            | Proposed          | Ratio           |
|              |   |                   | Actual/Proposed |                   |                   | Actual/Proposed |
| Under 50     | 0   | 153               | 0.00            | 0                 | 26                | 0.00            |
| 50 - 54      | 68,396  | 71,840            | 0.95            | 0                 | 31,317            | 0.00            |
| 55 - 59      | 691,606   | 813,728           | 0.85            | 94,926            | 305,359           | 0.31            |
| 60 - 64      | 1,599,941   | 2,439,202         | 0.66            | 941,274           | 1,256,776         | 0.75            |
| 65 - 69      | 4,203,977   | 4,339,601         | 0.97            | 3,441,922         | 3,949,455         | 0.87            |
| 70 - 74      | 6,340,163   | 6,499,151         | 0.98            | 7,882,497         | 8,352,149         | 0.94            |
| 75 - 79      | 7,971,139   | 7,766,173         | 1.03            | 11,252,886        | 12,132,398        | 0.93            |
| 80 - 84      | 9,242,836   | 9,455,861         | 0.98            | 17,293,710        | 17,059,397        | 1.01            |
| 85 - 89      | 9,895,157   | 9,729,455         | 1.02            | 18,572,513        | 19,447,362        | 0.96            |
| 90 - 94      | 7,865,978   | 7,270,358         | 1.08            | 17,418,475        | 16,674,192        | 1.04            |
| 95 - 99      | 2,826,710   | 2,739,406         | 1.03            | 9,160,814         | 7,724,969         | 1.19            |
| 100 & Over   | 446,693   | 448,804           | 1.00            | 2,253,777         | 1,885,691         | 1.20            |
| <b>TOTAL</b> | <b>51,152,596</b>                                   | <b>51,573,732</b> | <b>0.99</b>     | <b>88,312,794</b> | <b>88,819,092</b> | <b>0.99</b>     |



### Rates of Contingent Survivor Post-Retirement Mortality

The contingent survivor mortality rates used in the actuarial valuations project the percentage of survivors who are expected to die in the upcoming year for all members. Mortality for survivors of retirees is expected to differ from that of other retirees. Experience is again weighted by benefit amount.

The analysis of contingent survivor mortality over the five-year experience study period yields actual/expected ratio of 115% and 133% respectively for disabled male and female retirees. The table below shows the actual/expected ratios by age groups and in total.

#### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Age Group  | Annual Benefit Amounts of Contingent Survivor Mortality |           |                 |            |            |                 |
|------------|---|-----------|-----------------|------------|------------|-----------------|
|            | Males   |           |                 | Females    |            |                 |
|            | Actual  | Expected  | Ratio           | Actual     | Expected   | Ratio           |
|            |   |           | Actual/Expected |            |            | Actual/Expected |
| Under 50   | 252,663   | 2,780     | 90.90           | 321,657    | 2,744      | 117.23          |
| 50 - 54    | 131,991   | 11,418    | 11.56           | 208,056    | 14,253     | 14.60           |
| 55 - 59    | 178,941   | 32,087    | 5.58            | 346,706    | 46,087     | 7.52            |
| 60 - 64    | 85,921  | 94,763    | 0.91            | 184,965    | 128,458    | 1.44            |
| 65 - 69    | 281,990   | 236,257   | 1.19            | 314,350    | 307,097    | 1.02            |
| 70 - 74    | 510,517   | 481,678   | 1.06            | 844,436    | 622,220    | 1.36            |
| 75 - 79    | 691,410   | 713,637   | 0.97            | 1,538,518  | 1,091,518  | 1.41            |
| 80 - 84    | 1,389,685   | 1,208,531 | 1.15            | 2,213,397  | 2,064,038  | 1.07            |
| 85 - 89    | 1,766,953   | 1,574,981 | 1.12            | 4,539,472  | 3,359,767  | 1.35            |
| 90 - 94    | 1,415,989   | 1,392,810 | 1.02            | 4,943,810  | 3,865,728  | 1.28            |
| 95 - 99    | 607,616   | 662,756   | 0.92            | 2,772,222  | 2,164,483  | 1.28            |
| 100 & Over | 161,349   | 113,885   | 1.42            | 648,314    | 547,869    | 1.18            |
| TOTAL      | 7,475,026   | 6,525,581 | 1.15            | 18,875,904 | 14,214,262 | 1.33            |

#### Findings and Recommendations

We recommend PUB-2010 General Amount Weighted Below Median Contingent Survivor mortality table projected to 2017 with ages set forward 1 year and adjusted 105.5% for males and adjusted 122.5% for females. Future improvement in mortality rates is reflected by applying the MP-2020 projection scale generationally.



Section III: Demographic Assumptions

The actual/expected ratios based on the recommended assumptions are 106% for males compared to 115% under the current assumptions and 107% for females compared to 133% under the current assumptions.

The following table details the actual/expected ratios by individual age and total based on the recommended rates of mortality.

**EXPERIENCE UNDER PROPOSED ASSUMPTIONS**

| Age Group  | Annual Benefit Amounts of Contingent Survivor Mortality |           |                 |            |            |                 |
|------------|---|-----------|-----------------|------------|------------|-----------------|
|            | Males   |           |                 | Females    |            |                 |
|            | Actual  | Proposed  | Ratio           | Actual     | Proposed   | Ratio           |
|            |   |           | Actual/Proposed |            |            | Actual/Proposed |
| Under 50   | 252,663   | 8,430     | 29.97           | 321,657    | 13,098     | 24.56           |
| 50 - 54    | 131,991   | 24,895    | 5.30            | 208,056    | 33,707     | 6.17            |
| 55 - 59    | 178,941   | 50,073    | 3.57            | 346,706    | 93,216     | 3.72            |
| 60 - 64    | 85,921  | 132,529   | 0.65            | 184,965    | 239,554    | 0.77            |
| 65 - 69    | 281,990   | 294,931   | 0.96            | 314,350    | 476,605    | 0.66            |
| 70 - 74    | 510,517   | 561,921   | 0.91            | 844,436    | 834,210    | 1.01            |
| 75 - 79    | 691,410   | 805,094   | 0.86            | 1,538,518  | 1,363,175  | 1.13            |
| 80 - 84    | 1,389,685   | 1,295,248 | 1.07            | 2,213,397  | 2,512,810  | 0.88            |
| 85 - 89    | 1,766,953   | 1,653,611 | 1.07            | 4,539,472  | 4,107,386  | 1.11            |
| 90 - 94    | 1,415,989   | 1,424,856 | 0.99            | 4,943,810  | 4,729,415  | 1.05            |
| 95 - 99    | 607,616   | 663,543   | 0.92            | 2,772,222  | 2,597,618  | 1.07            |
| 100 & Over | 161,349   | 110,363   | 1.46            | 648,314    | 649,447    | 1.00            |
| TOTAL      | 7,475,026   | 7,025,494 | 1.06            | 18,875,904 | 17,650,239 | 1.07            |



### Rates of Disabled Post-Retirement Mortality

The disability mortality rates used in the actuarial valuations project the percentage of disabled retirees who are expected to die in the upcoming year for all members. Mortality for disabled retirees is expected to be higher than mortality for non-disabled retirees.

The analysis of the actual disabled mortality over the five-year experience study period yields actual/expected ratio of 73% and 103% respectively for disabled male and female retirees. The table below shows the actual/expected ratios by age groups and in total.

#### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Age Group | Annual Benefit Amounts of Post-Disablement Mortality |            |                 |           |           |                 |
|-----------|--|------------|-----------------|-----------|-----------|-----------------|
|           | Males  |            |                 | Females   |           |                 |
|           | Actual   | Expected   | Ratio           | Actual    | Expected  | Ratio           |
|           |  |            | Actual/Expected |           |           | Actual/Expected |
| Under 35  | 0  | 518        | 0.00            | 0         | 166       | 0.00            |
| 35 - 39   | 31,224   | 3,820      | 8.17            | 11,724    | 1,033     | 11.35           |
| 40 - 44   | 10,077   | 17,699     | 0.57            | 13,573    | 6,264     | 2.17            |
| 45 - 49   | 127,391  | 76,774     | 1.66            | 137,353   | 39,765    | 3.45            |
| 50 - 54   | 347,478  | 380,459    | 0.91            | 331,277   | 160,277   | 2.07            |
| 55 - 59   | 614,378  | 1,159,811  | 0.53            | 770,895   | 624,213   | 1.23            |
| 60 - 64   | 1,595,526  | 2,468,911  | 0.65            | 1,679,919 | 1,609,811 | 1.04            |
| 65 - 69   | 1,678,482  | 2,846,803  | 0.59            | 2,010,758 | 1,793,529 | 1.12            |
| 70 - 74   | 1,318,291  | 2,012,926  | 0.65            | 1,354,203 | 1,492,727 | 0.91            |
| 75 - 79   | 1,220,135  | 1,462,334  | 0.83            | 1,225,946 | 1,454,942 | 0.84            |
| 80 - 84   | 765,763  | 850,665    | 0.90            | 1,083,920 | 1,196,766 | 0.91            |
| 85 - 89   | 662,757  | 545,400    | 1.22            | 810,212   | 809,176   | 1.00            |
| 90 - 94   | 396,014  | 306,633    | 1.29            | 344,355   | 323,968   | 1.06            |
| 95 & Over | 105,427  | 68,653     | 1.54            | 172,168   | 136,716   | 1.26            |
| TOTAL     | 8,872,943  | 12,201,407 | 0.73            | 9,946,303 | 9,649,353 | 1.03            |

#### Findings and Recommendations

We recommend adopting the PUB-2010 General Disabled Retiree mortality table projected to 2017 with ages set forward 5 year and adjusted 103.3% for males and set forward 3 years and adjusted 106.8% for females. Future improvement in mortality rates is reflected by applying the MP-2020 projection scale generationally.

The actual/expected ratios based on the recommended assumptions are 105% for males compared to 73% under the current assumptions and 104% for females compared to 103% under the current assumptions.





The following table details the actual/expected ratios by individual age and total based on the recommended rates of mortality.

**EXPERIENCE UNDER PROPOSED ASSUMPTIONS**

| Age Group    | Annual Benefit Amounts of Post-Disablement Mortality |                  |                 |                  |                  |                 |
|--------------|--|------------------|-----------------|------------------|------------------|-----------------|
|              | Males  |                  |                 | Females          |                  |                 |
|              | Actual   | Proposed         | Ratio           | Actual           | Proposed         | Ratio           |
|              |  |                  | Actual/Proposed |                  |                  | Actual/Proposed |
| Under 35     | 0  | 152              | 0.00            | 0                | 99               | 0.00            |
| 35 - 39      | 31,224   | 1,417            | 22.04           | 11,724           | 883              | 13.28           |
| 40 - 44      | 10,077   | 8,176            | 1.23            | 13,573           | 7,392            | 1.84            |
| 45 - 49      | 127,391  | 43,050           | 2.96            | 137,353          | 58,876           | 2.33            |
| 50 - 54      | 347,478  | 244,644          | 1.42            | 331,277          | 220,420          | 1.50            |
| 55 - 59      | 614,378  | 787,069          | 0.78            | 770,895          | 733,775          | 1.05            |
| 60 - 64      | 1,595,526  | 1,642,462        | 0.97            | 1,679,919        | 1,554,988        | 1.08            |
| 65 - 69      | 1,678,482  | 1,836,838        | 0.91            | 2,010,758        | 1,557,375        | 1.29            |
| 70 - 74      | 1,318,291  | 1,301,514        | 1.01            | 1,354,203        | 1,280,291        | 1.06            |
| 75 - 79      | 1,220,135  | 1,011,018        | 1.21            | 1,225,946        | 1,351,051        | 0.91            |
| 80 - 84      | 765,763  | 685,921          | 1.12            | 1,083,920        | 1,265,771        | 0.86            |
| 85 - 89      | 662,757  | 491,065          | 1.35            | 810,212          | 950,968          | 0.85            |
| 90 - 94      | 396,014  | 289,542          | 1.37            | 344,355          | 384,919          | 0.89            |
| 95 & Over    | 105,427  | 86,404           | 1.22            | 172,168          | 216,052          | 0.80            |
| <b>TOTAL</b> | <b>8,872,943</b>                                     | <b>8,429,273</b> | <b>1.05</b>     | <b>9,946,303</b> | <b>9,582,860</b> | <b>1.04</b>     |



### **Rates of Pre-Retirement Mortality**

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

### **Findings and Recommendations**

As is typical with most large public pension plans, a small number of deaths occur amongst the active member population during the experience period. The data is not sufficient to recommend a change in the actuarial assumption for pre-retirement mortality that would be expected to accurately predict mortality rates in the future for the active membership. As a result, we recommend the assumed rates of pre-retirement mortality reflect an assumption similar to the assumed rates of post-retirement mortality. We recommend adopting the PUB-2010 General Amount Weighted Below Median Employee mortality table. Future improvement in mortality rates is reflected by applying the MP-2020 projection scale generationally.



### Rates of Salary Increase Due to Merit and Promotion

Under the “building block” approach recommended in ASOP No. 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.

The table below shows the actual/expected ratios for total salary increases over the five-year period.

#### EXPERIENCE UNDER CURRENT ASSUMPTIONS

| Years of Service | Salaries End of Year (in thousands) |                   |                 |
|------------------|-------------------------------------|-------------------|-----------------|
|                  | Actual                              | Expected          | Ratio           |
|                  |                                     |                   | Actual/Expected |
| Under 1          | 1,555,514                           | 1,806,846         | 0.861           |
| 1                | 1,024,479                           | 1,065,451         | 0.962           |
| 2                | 875,779                             | 905,419           | 0.967           |
| 3                | 744,550                             | 765,070           | 0.973           |
| 4                | 626,115                             | 637,907           | 0.982           |
| 5                | 519,103                             | 529,196           | 0.981           |
| 6                | 475,825                             | 482,165           | 0.987           |
| 7                | 463,465                             | 469,201           | 0.988           |
| 8                | 467,278                             | 470,997           | 0.992           |
| 9                | 467,213                             | 470,998           | 0.992           |
| 10               | 459,520                             | 462,914           | 0.993           |
| 11               | 446,232                             | 449,502           | 0.993           |
| 12               | 441,690                             | 445,113           | 0.992           |
| 13               | 460,390                             | 463,323           | 0.994           |
| 14               | 485,785                             | 488,924           | 0.994           |
| 15               | 507,886                             | 512,296           | 0.991           |
| 16               | 516,660                             | 521,465           | 0.991           |
| 17               | 503,628                             | 509,065           | 0.989           |
| 18 & Up          | 3,633,082                           | 3,676,168         | 0.988           |
| <b>TOTAL</b>     | <b>14,674,194</b>                   | <b>15,132,020</b> | <b>0.970</b>    |



### Section III: Demographic Assumptions

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Utilizing the “building block” approach, the first step in developing the merit-based rates of increase is to remove the wage inflation component experienced during the investigation period from the actual salary rates of increase. The average annual rate of inflation over the five-year period ending June 30, 2020 was 1.56% and the current assumed real rate of wage inflation (wage inflation above price inflation or CPI) was 0.50%. These combined equal an annual rate of wage inflation of 2.06% over the five-year period. This was 1.44% less than the assumed wage inflation of 3.50%.

The table below provides an analysis concerning the development of the merit component of this assumption for all members. In addition to less-than-expected underlying wage inflation, the average merit increases were less than expected at all service points. Based on prior experience and the future outlook, we recommend lowering the merit component of the compensation increase assumption.

| Years of Service | Actual Rate | Actual Merit Increase (Actual Less Wage Inflation) | Assumed Merit Increases |
|------------------|-------------|--|-------------------------|
| Under 1          | 1.76%       | -0.30%   | 14.20%                  |
| 1                | 5.05%       | 2.99%  | 5.56%                   |
| 2                | 3.26%       | 1.20%  | 3.14%                   |
| 3                | 2.91%       | 0.85%  | 2.17%                   |
| 4                | 3.06%       | 1.00%  | 1.45%                   |
| 5                | 2.75%       | 0.69%  | 1.21%                   |
| 6                | 3.13%       | 1.07%  | 0.97%                   |
| 7                | 2.98%       | 0.92%  | 0.72%                   |
| 8                | 3.18%       | 1.12%  | 0.48%                   |
| 9                | 2.92%       | 0.86%  | 0.24%                   |
| 10               | 2.74%       | 0.68%  | 0.00%                   |
| 11               | 2.75%       | 0.69%  | 0.00%                   |
| 12               | 2.70%       | 0.64%  | 0.00%                   |
| 13               | 2.84%       | 0.78%  | 0.00%                   |
| 14               | 2.84%       | 0.78%  | 0.00%                   |
| 15               | 2.61%       | 0.55%  | 0.00%                   |
| 16               | 2.55%       | 0.49%  | 0.00%                   |
| 17               | 2.39%       | 0.33%  | 0.00%                   |
| 18 & Up          | 2.29%       | 0.23%  | 0.00%                   |

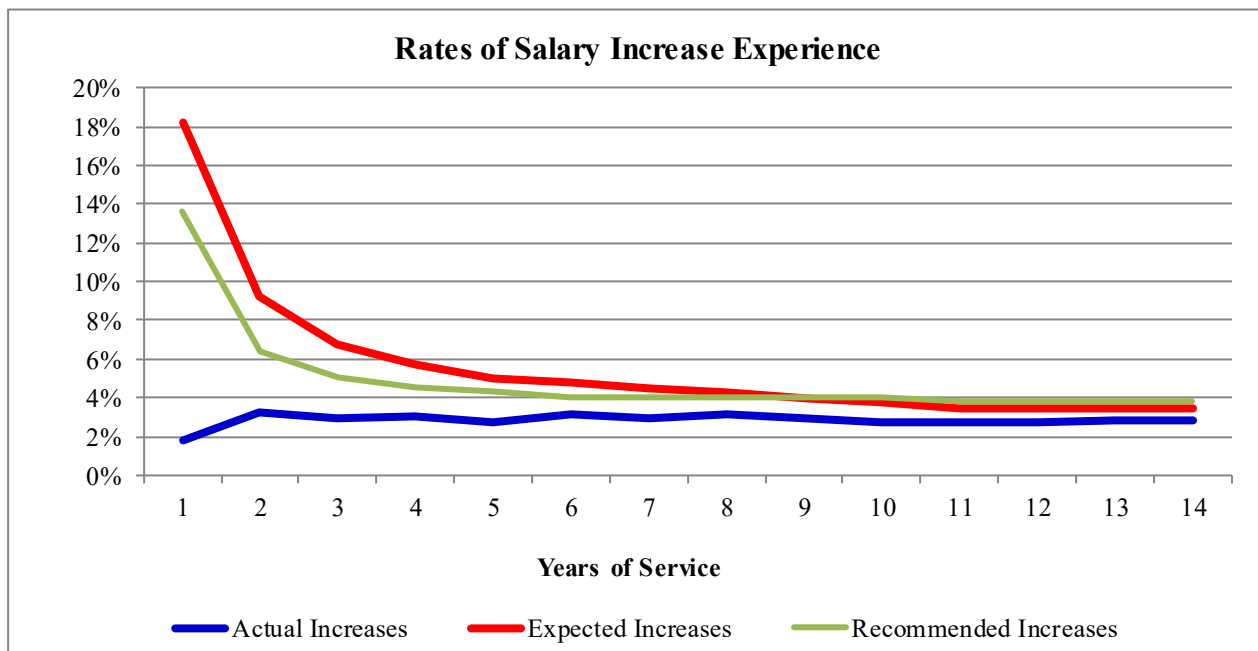
Once the merit scale is developed, the assumed rate of service-based total salary increases is determined by compounding the service-based merit rates with the across-the-board rate of wage inflation, which is recommended to be 3.25%.



### Findings and Recommendations

Based on the analysis above, it appears that the merit component of the salary increases has been lower than expected during the experience period. The complete tables of recommended total compensation increase rates are shown in Appendix D.

The following graph shows a comparison of actual, current (expected), and proposed rates of total salary increases by years of service.





### Section III: Demographic Assumptions

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The actual/expected ratio based on the recommended assumption is shown in the table below. The total actual/expected ratio is 97% compared to 97% under the current assumption.

| Years of Service | Salaries End of Year (in thousands) |            |                 |
|------------------|-------------------------------------|------------|-----------------|
|                  | Actual                              | Proposed   | Ratio           |
|                  |                                     |            | Actual/Proposed |
| Under 1          | 1,555,514                           | 1,736,147  | 0.896           |
| 1                | 1,024,479                           | 1,037,144  | 0.988           |
| 2                | 875,779                             | 891,059    | 0.983           |
| 3                | 744,550                             | 756,320    | 0.984           |
| 4                | 626,115                             | 633,547    | 0.988           |
| 5                | 519,103                             | 525,530    | 0.988           |
| 6                | 475,825                             | 479,971    | 0.991           |
| 7                | 463,465                             | 468,186    | 0.990           |
| 8                | 467,278                             | 471,107    | 0.992           |
| 9                | 467,213                             | 472,244    | 0.989           |
| 10               | 459,520                             | 464,105    | 0.990           |
| 11               | 446,232                             | 450,659    | 0.990           |
| 12               | 441,690                             | 446,258    | 0.990           |
| 13               | 460,390                             | 464,515    | 0.991           |
| 14               | 485,785                             | 490,181    | 0.991           |
| 15               | 507,886                             | 513,614    | 0.989           |
| 16               | 516,660                             | 521,506    | 0.991           |
| 17               | 503,628                             | 509,105    | 0.989           |
| 18 & Up          | 3,633,082                           | 3,667,287  | 0.991           |
| TOTAL            | 14,674,194                          | 14,998,484 | 0.980           |



### Other Actuarial Assumptions and Methods

**Percent Married:** Currently 80% of members are assumed to be married with the husband three years older than the wife. This is a common and reasonable assumption, and we recommend maintaining this assumption.

**Re-hired Retirees:** The number of re-hired retirees has increased over the investigation period from 8,089 to 11,616. This result combined with the fact that a portion of employer contributions on re-hired retiree payroll is used to finance the unfunded accrued liability (UAL) suggests there is no material impact on the payroll growth assumption utilized in the actuarial valuation to determine the UAL contribution rate. Therefore, no specific re-hired retiree assumption is deemed necessary.

**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 four-year smoothing method that recognizes in each year 25% of the difference between the actual market value of assets and the expected market 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 and requires a payroll growth assumption to determine the required stable rate of payroll required to fully amortize the UAAL over the amortization period. The current payroll growth rate is based on the wage inflation assumptions of 3.50%. The System has consistently experienced less than expected payroll growth over the past 10 years. Since 2017, total payroll has grown by only 1.73% per year. Based on our most recent open-group projections of the System, the expected longer-term future rate of growth is also less 2.0% annually. We recommend reducing this assumption to 1.75% to better reflect recent experience and the expected slower growth in future years.



## Other Post-Employment Benefit Assumptions

### I. Economic Assumptions

For the Health Care Plan, we assume the same long-term rate of return as for the Basic Benefits Plan, which we are recommending be lowered from 7.50% to 7.00%. The long-term rate of return is used to project Health Care Fund solvency for both the actuarial valuation and for GASB purposes. GASB 74/75 prescribes a specific methodology for the solvency test that depends on the bond rate as of the measurement date, which changes every year. However, with the implementation of GASB 74/75, accounting standards have been separated from funding. In the past, it was common to use the GASB 43/45 liabilities as the funding liabilities for calculating the Actuarially Required Contribution (ARC) and we utilized a blended rate of 5.25% that recognized that the health care benefits are projected to be primarily pay-as-you-go. Now that GASB has been separated from funding, we calculate an Actuarially Determined Employer Contribution (ADEC) for funding purposes. ASOP 27 states that the investment return assumption should reflect the anticipated returns on the plan's current and future assets. Since the Health Care Fund assets are invested in the same manner as the assets for the Basic Benefits Plan, we recommend that the Health Care Fund use 7.00% as the assumed rate of return for calculating the ADEC for funding purposes. We will continue to apply the applicable bond rate and the GASB crossover test at each measurement date for the GASB Total OPEB liability (TOL), but we recommend the ADEC be calculated at 7.00% as a measure of the contribution that would be necessary if the Fund were to fund actuarially from year to year.

In addition to the three economic assumptions used in all the actuarial valuations performed for Ohio SERS, the Health Care Cost Trend Rates reflect the change in per capita health claims rates over time due to the following factors:

- medical inflation
- utilization
- plan design
- technology improvements

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 6, *"Measuring Retiree Group Benefit Obligations,"* which provides guidance to actuaries in selecting economic assumptions for measuring obligations of post-retirement plans other than pensions. The actuary should not consider aging of the covered population when selecting the trend assumption for projecting future costs, but should consider the following key components in setting the health care cost trend rate as noted in ASOP No. 6:

- inflation
- medical inflation
- definition of covered charges
- frequency of services
- leveraging caused by plan design features not explicitly modeled
- plan participation





## Section V: Other Post-Employment Benefit Assumptions

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When setting assumptions for projecting medical and prescription drug costs, Cavanaugh Macdonald Consulting, LLC (CMC) assumes the health benefit plan cost trend rates will decrease from an initial rate to an ultimate level. CMC’s methodology for setting the initial trend rate includes the use of published annual health care inflation surveys in conjunction with actual plan experience, where credible. The initial trend rate assumption is subject to continued update and review with each valuation performed given the volatile nature of medical and prescription drug costs. There are various approaches used to determine the timing and level of decreases to the ultimate trend rate. The assumed decrease in medical and prescription drug trend rates reflects the belief that health care inflation cannot indefinitely outstrip the growth rate of employer budgets and the overall economy. As a standard of practice, CMC typically assumes a grading period of five to ten years, depending on the level of change (i.e., larger differences between the initial trend rate and the ultimate trend rate are assumed to require a longer reduction period). For the ultimate trend assumption, CMC looks to the “Long-Term Projection Assumptions for Medicare and Aggregate National Health Expenditures” published by Center for Medicare and Medicaid Services on April 22, 2020, which states that:

“One way of analyzing health spending trends is to compare the growth rate of the U.S. health sector with that of the overall economy. Using a definition of “excess cost growth” as the difference between (i) the U.S. per capita growth rate in health-care costs adjusted for demographic factors and (ii) the per capita growth rate in GDP (both in constant dollars), Table 1 shows average excess cost growth rates for selected time periods since 1975. Average excess cost growth rates for national health expenditures (NHE) exhibit some volatility depending on which time periods are used for defining averages, but over the long run this differential has for extended periods been above 2 percent per year or just slightly below this level.”

As a standard of practice, CMC believes the use of a “GDP+1.5%” to “GDP+2.5%” assumption is reasonable and CMC typically assumes an ultimate trend rate of price inflation +2.0%. As with any standard of practice, the specifics of each plan are reviewed to ensure there is nothing unusual that would necessitate a long-term trend rate that is either higher or lower than what is typical. It appears to be reasonable to use an ultimate rate of 4.40%, as there appears to be nothing unusual about Ohio SERS’ medical plans that would necessitate a long-term trend that is either higher or lower than what is typically used for this type of calculation.

**Background:** In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 6. Currently, the short-term health care trend rates are set on an annual basis based on the information and data as previously described, with an ultimate trend rate of price inflation plus excess cost growth that is reached after an appropriate grading period.

**System-Wide Recommendation:** Continue to update the short-term health care trends annually and base the health care trends on Ohio SERS’ experience and demographics while considering the projected trend from external sources. Use an ultimate trend rate of price inflation + 2.0%, or 4.40%.



## Section V: Other Post-Employment Benefit Assumptions

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We are recommending no specific assumption changes attributable to the COVID-19 pandemic at this time due to the level of uncertainty regarding the impact on plan costs going forward. Given the uncertainty regarding COVID-19 (e.g., the impact of routine care being deferred, direct COVID-19 treatment and prevention costs, changes in contribution and budget projections), continued monitoring of the impact on the Plan's liability will be required and changes, if necessary, will be made annually at the time that experience develops.

### II. Coverage Assumptions

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 6, "Measuring Retiree Group Benefit Obligations", which provides guidance to actuaries in selecting coverage assumptions for measuring obligations of post-retirement plans other than pensions. The "Coverage Assumptions" section includes the key components the actuary should consider in setting the coverage assumptions per ASOP No. 6:

- Plan Participation
- Spouse Coverage Eligibility

#### A. Retirement Health Care Participation Rates

**Background:** SERS requires individuals to contribute toward the cost of health care to maintain coverage based on service at retirement, disability status, Medicare eligibility, plan choice, and the coverage tier elected. Some eligible individuals may not elect to be covered, especially if they have coverage available through a spouse or previous employer. The rates of participation are based on experiential data, where available and credible. These rates are considered when selecting the participation assumption for future retirees, as well as the plan eligibility rules, plan choices, and the change in retiree contribution rates over time.

Since plan participation may vary in the future due to anticipated retiree contribution levels and plan choices, the appropriateness of participation rates for both current and future retirees needs to be considered. The availability to opt in and out of the plan at the time of open enrollment also needs to be considered.

Participation rates vary based on type of retirement: service or disability. Thus, the participation rates vary based on this status.



Section V: Other Post-Employment Benefit Assumptions

**Service Retirements**

Pre-65 Participants:

| SERS                  |   |           |           |           |           |       |         |          |
|-----------------------|---|-----------|-----------|-----------|-----------|-------|---------|----------|
| Service at Retirement | Percentage of Members Electing Coverage |           |           |           |           |       |         |          |
|                       | 6/30/2016                               | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Total | Current | Proposed |
| 10-14                 | 0%                                      | 2%        | 4%        | 4%        | 4%        | 3%    | 25%     | 25%      |
| 15-19                 | 1%                                      | 3%        | 5%        | 6%        | 5%        | 4%    | 45%     | 25%      |
| 20-24                 | 18%                                     | 19%       | 21%       | 21%       | 20%       | 20%   | 70%     | 45%      |
| 25-29                 | 49%                                     | 47%       | 45%       | 44%       | 43%       | 46%   | 75%     | 50%      |
| 30-34                 | 65%                                     | 64%       | 62%       | 61%       | 59%       | 62%   | 80%     | 75%      |
| 35 +                  | 75%                                     | 74%       | 74%       | 73%       | 71%       | 73%   | 90%     | 90%      |

Post-65 Participants:

| SERS                  |   |           |           |           |           |       |         |          |
|-----------------------|---|-----------|-----------|-----------|-----------|-------|---------|----------|
| Service at Retirement | Percentage of Members Electing Coverage |           |           |           |           |       |         |          |
|                       | 6/30/2016                               | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Total | Current | Proposed |
| 10-14                 | 26%                                     | 23%       | 20%       | 19%       | 16%       | 21%   | 25%     | 25%      |
| 15-19                 | 44%                                     | 39%       | 36%       | 34%       | 30%       | 36%   | 45%     | 45%      |
| 20-24                 | 62%                                     | 60%       | 58%       | 57%       | 54%       | 58%   | 70%     | 70%      |
| 25-29                 | 78%                                     | 77%       | 75%       | 74%       | 73%       | 75%   | 75%     | 75%      |
| 30-34                 | 84%                                     | 84%       | 83%       | 81%       | 81%       | 83%   | 80%     | 85%      |
| 35 +                  | 87%                                     | 87%       | 86%       | 84%       | 86%       | 86%   | 90%     | 90%      |



Section V: Other Post-Employment Benefit Assumptions

**Disability Retirements**

Pre-65 Participants:

| SERS                  |   |           |           |           |           |       |         |          |
|-----------------------|---|-----------|-----------|-----------|-----------|-------|---------|----------|
| Service at Retirement | Percentage of Members Electing Coverage |           |           |           |           |       |         |          |
|                       | 6/30/2016                               | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Total | Current | Proposed |
| 5-9                   | 19%                                     | 17%       | 17%       | 16%       | 14%       | 17%   | 50%     | 25%      |
| 10-14                 | 27%                                     | 26%       | 25%       | 25%       | 25%       | 26%   | 50%     | 25%      |
| 15-19                 | 33%                                     | 29%       | 30%       | 29%       | 27%       | 30%   | 70%     | 45%      |
| 20-24                 | 55%                                     | 51%       | 47%       | 46%       | 41%       | 48%   | 75%     | 50%      |
| 25-29                 | 71%                                     | 71%       | 70%       | 69%       | 68%       | 70%   | 75%     | 75%      |
| 30-34                 | 77%                                     | 77%       | 74%       | 73%       | 69%       | 74%   | 80%     | 75%      |
| 35-39                 | 84%                                     | 83%       | 82%       | 82%       | 81%       | 83%   | 90%     | 90%      |
| 40 +                  | 91%                                     | 90%       | 89%       | 91%       | 91%       | 90%   | 90%     | 90%      |

Post-65 Participants:

| SERS                  |   |           |           |           |           |       |         |          |
|-----------------------|---|-----------|-----------|-----------|-----------|-------|---------|----------|
| Service at Retirement | Percentage of Members Electing Coverage |           |           |           |           |       |         |          |
|                       | 6/30/2016                               | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Total | Current | Proposed |
| 5-9                   | 58%                                     | 52%       | 54%       | 51%       | 56%       | 55%   | 50%     | 70%      |
| 10-14                 | 73%                                     | 65%       | 67%       | 64%       | 60%       | 66%   | 50%     | 70%      |
| 15-19                 | 70%                                     | 67%       | 64%       | 62%       | 60%       | 65%   | 70%     | 70%      |
| 20-24                 | 75%                                     | 74%       | 72%       | 71%       | 68%       | 72%   | 75%     | 75%      |
| 25-29                 | 75%                                     | 74%       | 73%       | 73%       | 73%       | 74%   | 75%     | 75%      |
| 30-34                 | 82%                                     | 82%       | 83%       | 81%       | 81%       | 82%   | 80%     | 85%      |
| 35-39                 | 86%                                     | 81%       | 82%       | 81%       | 81%       | 82%   | 90%     | 90%      |
| 40 +                  | 100%                                    | 94%       | 95%       | 96%       | 89%       | 94%   | 90%     | 90%      |

Based on the actual participation experience over the last five years, split out by years of service at retirement, we recommend adjusting the current participation assumptions for service retirees and disabled retirees.



**B. Spouse Coverage Rates**

**Background:** SERS requires individuals to contribute toward the cost of spousal health care to maintain coverage based on service at retirement, Medicare eligibility, plan choice, and the coverage tier elected. Participant costs to cover a spouse are significantly higher than for single coverage. Therefore, some eligible individuals may not elect to cover a spouse, even if they choose coverage for themselves.

The schedule below lists the percentage of the spouse premium paid by spouses of retirees:

| Service Retiree,<br>Disability Recipient,<br>or Member's<br>Qualified Service | Spouse Premium<br>Contribution<br>Percentage |
|---|--|
| 1.5 – 24  | 100.0%                                       |
| 25 – 29   | 90.0   |
| 30 and over   | 80.0   |

The rates of participation are based on actual data. These rates are considered when selecting the spouse coverage assumption for future retirees, as well as the plan eligibility rules, plan choices, and the change in retiree contribution rates over time.



Section V: Other Post-Employment Benefit Assumptions

**Spouse Coverage**

Current rates: 50% Male retirees who participate cover a spouse; 30% Female retirees who participate cover a spouse

Proposed rates: 25% Male retirees who participate cover a spouse; 25% Female retirees who participate cover a spouse

Pre-65 Participants:

| SERS           |   |           |           |           |           |         |          |
|----------------|---|-----------|-----------|-----------|-----------|---------|----------|
| Retiree Gender | Percentage of Members Electing Spousal Coverage |           |           |           |           |         |          |
|                | 6/30/2016                                       | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Current | Proposed |
| Male           | 7.73%   | 7.77%     | 8.48%     | 9.01%     | 9.79%     | 50%     | 25%      |
| Female         | 7.74%   | 7.95%     | 8.69%     | 9.05%     | 10.85%    | 30%     | 25%      |

Post-65 Participants:

| SERS           |   |           |           |           |           |         |          |
|----------------|---|-----------|-----------|-----------|-----------|---------|----------|
| Retiree Gender | Percentage of Members Electing Spousal Coverage |           |           |           |           |         |          |
|                | 6/30/2016                                       | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Current | Proposed |
| Male           | 26.50%  | 25.26%    | 23.65%    | 22.66%    | 21.93%    | 50%     | 25%      |
| Female         | 15.58%  | 15.28%    | 14.97%    | 14.61%    | 14.32%    | 30%     | 25%      |

Based on the actual participation experience over the last five years, split out by gender, we recommend changing from the current spouse participation assumption that 50% of participating male retirees cover spouses and 30% of participating female retirees cover spouses to 25% of participating male retirees cover spouses and 25% of participating female retirees cover spouses.



### Summary and Cost of Changes

As a result of the experience investigation, we are recommending revised rates of withdrawal, disability, pre-retirement mortality, service retirement, and assumed compensation increases for active members.

We have also provided recommendations for the economic assumptions to use for the Basic Benefit Plan. Since the assets for the Health Care Plan are invested in the same manner as the Basic Benefits Plan, we recommend using 7.00% for funding purposes for both the Basic Benefits Plan and the Health Care Plan.

When these proposed assumption changes are applied to the June 30, 2020 valuation, the results will change. The change in results represents the financial impact of adopting the proposed assumptions. The impact on the Basic Benefit Plan is shown in the table below. The impact on the Retiree Health Care Plan is shown in the table on the following page.

#### BASIC BENEFIT PLAN

|                                    | Valuation<br>6/30/2020 | Assumption<br>Changes |
|------------------------------------|------------------------|-----------------------|
| <b>Employer Contribution Rate:</b> |                        |                       |
| Normal Rate                        | 0.06%                  | 1.95%                 |
| UAAL                               | <u>10.80%</u>          | <u>11.99%</u>         |
| Total Employer Rate                | 10.86%                 | 13.94%                |
| Actuarial accrued liability        | \$21,033,809,319       | \$21,218,685,659      |
| Actuarial value of assets          | \$15,036,735,150       | \$15,036,735,150      |
| UAAL                               | \$5,997,074,169        | \$6,181,950,509       |
| Amortization Period                | 24                     | 27                    |



**RETIREE HEALTH CARE PLAN**

|                                    | Valuation<br>6/30/2020 | Assumption<br>Changes |
|------------------------------------|------------------------|-----------------------|
| <b>Employer Contribution Rate:</b> |                        |                       |
| Normal Rate                        | 2.09%                  | 1.31%                 |
| UAAL                               | <u>1.58%</u>           | <u>1.44%</u>          |
| Total Required Employer Rate       | 3.67%                  | 2.75%                 |
| Actuarial accrued liability        | \$1,796,503,544        | \$1,262,355,624       |
| Actuarial value of assets          | \$482,611,478          | \$482,611,478         |
| UAAL                               | \$1,313,892,066        | \$779,744,146         |
| Solvency Period                    | 2053                   | 2049                  |
| Amortization Period                | 30                     | 30                    |



**Historical June CPI (W) Index**

| Year | CPI (W) | Year | CPI (W) |
|------|---------|------|---------|
| 1969 | 36.80   | 1995 | 149.90  |
| 1970 | 39.00   | 1996 | 154.10  |
| 1971 | 40.80   | 1997 | 157.40  |
| 1972 | 42.00   | 1998 | 159.70  |
| 1973 | 44.40   | 1999 | 162.80  |
| 1974 | 49.30   | 2000 | 169.20  |
| 1975 | 53.90   | 2001 | 174.60  |
| 1976 | 57.10   | 2002 | 175.90  |
| 1977 | 61.00   | 2003 | 179.60  |
| 1978 | 65.60   | 2004 | 185.30  |
| 1979 | 72.80   | 2005 | 190.10  |
| 1980 | 83.20   | 2006 | 198.60  |
| 1981 | 91.10   | 2007 | 203.91  |
| 1982 | 97.40   | 2008 | 215.22  |
| 1983 | 99.80   | 2009 | 210.97  |
| 1984 | 102.80  | 2010 | 213.84  |
| 1985 | 107.00  | 2011 | 222.52  |
| 1986 | 108.40  | 2012 | 226.04  |
| 1987 | 112.40  | 2013 | 230.00  |
| 1988 | 116.70  | 2014 | 234.70  |
| 1989 | 122.80  | 2015 | 233.80  |
| 1990 | 128.30  | 2016 | 235.29  |
| 1991 | 134.10  | 2017 | 238.81  |
| 1992 | 138.10  | 2018 | 246.20  |
| 1993 | 142.00  | 2019 | 249.75  |
| 1994 | 145.40  | 2020 | 251.05  |



## Capital Market Assumptions and Asset Allocation

### Rates of Return and Standard Deviation by Asset Class\*

| Asset Class                    | Real Return | Standard Deviation |
|--------------------------------|-------------|--------------------|
| US Equity - Large Cap          | 6.19%       | 16.22%             |
| Non US Equity Developed Market | 6.92%       | 18.05%             |
| Non US Equity Emerging Market  | 9.16%       | 2.42%              |
| Private Equity                 | 10.37%      | 21.99%             |
| US Corporate Bonds - Core      | 1.57%       | 5.47%              |
| Real Estate                    | 5.74%       | 16.84%             |
| Infrastructure                 | 6.28%       | 14.58%             |
| Private Debt                   | 6.46%       | 12.06%             |
| Cash Equivalents               | 0.11%       | 1.78%              |

### Asset Class Correlation Coefficients

|                                | US Equity<br>Large Cap | Non-US<br>Equity<br>Developed | Non-US<br>Equity<br>Emerging | Private<br>Equity | US Corporate<br>Bonds -<br>Core | Real<br>Estate | Infrastructure | Private<br>Debt | Cash<br>Equivalents |
|--------------------------------|------------------------|-------------------------------|------------------------------|-------------------|---------------------------------|----------------|----------------|-----------------|---------------------|
| US Equity - Large Cap          | 1.00                   | 0.84                          | 0.73                         | 0.73              | 0.15                            | 0.53           | 0.53           | 0.57            | -0.08               |
| Non US Equity Developed Market | 0.84                   | 1.00                          | 0.80                         | 0.67              | 0.17                            | 0.49           | 0.56           | 0.53            | -0.07               |
| Non US Equity Emerging Market  | 0.73                   | 0.80                          | 1.00                         | 0.59              | 0.16                            | 0.44           | 0.51           | 0.52            | -0.06               |
| Private Equity                 | 0.73                   | 0.67                          | 0.59                         | 1.00              | 0.04                            | 0.46           | 0.51           | 0.56            | -0.06               |
| US Corporate Bonds - Core      | 0.15                   | 0.17                          | 0.16                         | 0.04              | 1.00                            | 0.22           | 0.25           | 0.11            | 0.23                |
| Real Estate                    | 0.53                   | 0.49                          | 0.44                         | 0.46              | 0.22                            | 1.00           | 0.40           | 0.39            | -0.01               |
| Infrastructure                 | 0.53                   | 0.56                          | 0.51                         | 0.51              | 0.25                            | 0.40           | 1.00           | 0.44            | -0.02               |
| Private Debt                   | 0.57                   | 0.53                          | 0.52                         | 0.56              | 0.11                            | 0.39           | 0.44           | 1.00            | -0.09               |
| Cash Equivalents               | -0.08                  | -0.07                         | -0.06                        | -0.06             | 0.23                            | -0.01          | -0.02          | -0.09           | 1.00                |

### Asset Allocation Targets

| Asset Class                    | Allocation Percentage |
|--------------------------------|-----------------------|
| Global Equities                |                       |
| US Equities                    | 24.75%                |
| Non US Equity Developed Market | 13.50%                |
| Non US Equity Emerging Market  | 6.75%                 |
| Global Private Equity          | 11.00%                |
| Global Fixed Income            | 19.00%                |
| Global Real Assets             | 16.00%                |
| Multi-Asset Strategies         | 4.00%                 |
| Global Private Credit          | 3.00%                 |
| Cash Equivalents               | 2.00%                 |

\* Survey of Capital Market Assumptions: 2020 Edition



### Social Security Administration Wage Index

| Year | Wage Index | Annual Increase | Year | Wage Index  | Annual Increase |
|------|------------|-----------------|------|-------------|-----------------|
| 1969 | \$5,893.76 |                 | 1995 | \$24,705.66 | 4.01%           |
| 1970 | 6,186.24   | 4.96%           | 1996 | 25,913.90   | 4.89            |
| 1971 | 6,497.08   | 5.02            | 1997 | 27,426.00   | 5.84            |
| 1972 | 7,133.80   | 9.80            | 1998 | 28,861.44   | 5.23            |
| 1973 | 7,580.16   | 6.26            | 1999 | 30,469.84   | 5.57            |
| 1974 | 8,030.76   | 5.94            | 2000 | 32,154.82   | 5.53            |
| 1975 | 8,630.92   | 7.47            | 2001 | 32,921.92   | 2.39            |
| 1976 | 9,226.48   | 6.90            | 2002 | 33,252.09   | 1.00            |
| 1977 | 9,779.44   | 5.99            | 2003 | 34,064.95   | 2.44            |
| 1978 | 10,556.03  | 7.94            | 2004 | 35,648.55   | 4.65            |
| 1979 | 11,479.46  | 8.75            | 2005 | 36,952.94   | 3.66            |
| 1980 | 12,513.46  | 9.01            | 2006 | 38,651.41   | 4.60            |
| 1981 | 13,773.10  | 10.07           | 2007 | 40,405.48   | 4.54            |
| 1982 | 14,531.34  | 5.51            | 2008 | 41,334.97   | 2.30            |
| 1983 | 15,239.24  | 4.87            | 2009 | 40,711.61   | -1.51           |
| 1984 | 16,135.07  | 5.88            | 2010 | 41,673.83   | 2.36            |
| 1985 | 16,822.51  | 4.26            | 2011 | 42,979.61   | 3.13            |
| 1986 | 17,321.82  | 2.97            | 2012 | 44,321.67   | 3.12            |
| 1987 | 18,426.51  | 6.38            | 2013 | 44,888.16   | 1.28            |
| 1988 | 19,334.04  | 4.93            | 2014 | 46,481.52   | 3.55            |
| 1989 | 20,099.55  | 3.96            | 2015 | 48,098.63   | 3.48            |
| 1990 | 21,027.98  | 4.62            | 2016 | 48,642.15   | 1.13            |
| 1991 | 21,811.60  | 3.73            | 2017 | 50,321.89   | 3.45            |
| 1992 | 22,935.42  | 5.15            | 2018 | 52,145.80   | 3.62            |
| 1993 | 23,132.67  | 0.86            | 2019 | 54,099.99   | 3.75            |
| 1994 | 23,753.53  | 2.68            |      |             |                 |



### Recommended Rates of Withdrawal and Salary Increases

| Years of Service | Rates of Withdrawal | Rates of Salary Increases |
|------------------|---------------------|---------------------------|
| Less than 1      | 40.00%              | 13.58%                    |
| 1                | 19.00%              | 6.35%                     |
| 2                | 11.00%              | 5.06%                     |
| 3                | 9.00%               | 4.54%                     |
| 4                | 8.00%               | 4.28%                     |
| 5                | 6.50%               | 4.02%                     |
| 6                | 6.00%               | 4.02%                     |
| 7                | 5.00%               | 4.02%                     |
| 8                | 4.50%               | 4.02%                     |
| 9                | 4.00%               | 4.02%                     |
| 10               | 3.50%               | 3.77%                     |
| 11               | 3.25%               | 3.77%                     |
| 12               | 3.00%               | 3.77%                     |
| 13               | 2.75%               | 3.77%                     |
| 14               | 2.50%               | 3.77%                     |
| 15               | 2.25%               | 3.77%                     |
| 16               | 2.25%               | 3.51%                     |
| 17               | 2.25%               | 3.51%                     |
| 18               | 2.25%               | 3.25%                     |
| 19               | 2.25%               | 3.25%                     |
| 20               | 2.25%               | 3.25%                     |
| 21               | 2.25%               | 3.25%                     |
| 22               | 2.25%               | 3.25%                     |
| 23               | 2.25%               | 3.25%                     |
| 24+              | 2.25%               | 3.25%                     |



**Recommended Rates of Retirement**

| Age | Grandfathered |                 |                          |                      | Non-Grandfathered |                 |                          |                      |
|-----|---------------|-----------------|--------------------------|----------------------|-------------------|-----------------|--------------------------|----------------------|
|     | Reduced       | Reduced (55/25) | First Eligible Unreduced | Subsequent Unreduced | Reduced           | Reduced (60/25) | First Eligible Unreduced | Subsequent Unreduced |
| 45  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 46  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 47  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 48  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 49  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 50  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 51  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 52  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 53  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 54  |               |                 | 21%                      | 19%                  |                   |                 |                          |                      |
| 55  |               | 10%             | 27%                      | 19%                  |                   |                 |                          |                      |
| 56  |               | 10%             | 27%                      | 19%                  |                   |                 |                          |                      |
| 57  |               | 10%             | 27%                      | 19%                  |                   |                 | 30%                      | 19%                  |
| 58  |               | 10%             | 27%                      | 19%                  |                   |                 | 30%                      | 19%                  |
| 59  |               | 10%             | 27%                      | 19%                  |                   |                 | 30%                      | 19%                  |
| 60  | 43%           | 15%             | 27%                      | 19%                  |                   | 6%              | 30%                      | 19%                  |
| 61  | 43%           | 15%             | 27%                      | 19%                  |                   | 6%              | 30%                      | 19%                  |
| 62  | 43%           | 15%             | 27%                      | 19%                  | 5%                | 6%              | 30%                      | 19%                  |
| 63  | 43%           | 15%             | 27%                      | 19%                  | 5%                | 6%              | 30%                      | 19%                  |
| 64  | 43%           | 15%             | 27%                      | 19%                  | 5%                | 6%              | 30%                      | 19%                  |
| 65  |               |                 | 50%                      | 33%                  | 15%               | 17%             | 30%                      | 19%                  |
| 66  |               |                 | 50%                      | 33%                  | 15%               | 17%             | 30%                      | 19%                  |
| 67  |               |                 | 50%                      | 33%                  |                   |                 | 20%                      | 19%                  |
| 68  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 69  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 70  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 71  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 72  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 73  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 74  |               |                 | 50%                      | 33%                  |                   |                 | 30%                      | 18%                  |
| 75  |               |                 | 100%                     | 100%                 |                   |                 | 100%                     | 100%                 |



### Recommended Rates of Disability

| Rates of Disability |        |         | Rates of Disability |        |         |
|---------------------|--------|---------|---------------------|--------|---------|
| Age                 | Male   | Females | Age                 | Male   | Females |
| 20                  | 0.020% | 0.010%  | 48                  | 0.374% | 0.252%  |
| 21                  | 0.024% | 0.010%  | 49                  | 0.394% | 0.276%  |
| 22                  | 0.028% | 0.010%  | 50                  | 0.414% | 0.300%  |
| 23                  | 0.031% | 0.010%  | 51                  | 0.437% | 0.330%  |
| 24                  | 0.035% | 0.010%  | 52                  | 0.460% | 0.360%  |
| 25                  | 0.039% | 0.010%  | 53                  | 0.483% | 0.390%  |
| 26                  | 0.046% | 0.014%  | 54                  | 0.507% | 0.420%  |
| 27                  | 0.052% | 0.017%  | 55                  | 0.530% | 0.450%  |
| 28                  | 0.058% | 0.021%  | 56                  | 0.542% | 0.450%  |
| 29                  | 0.064% | 0.024%  | 57                  | 0.554% | 0.450%  |
| 30                  | 0.071% | 0.028%  | 58                  | 0.566% | 0.450%  |
| 31                  | 0.082% | 0.034%  | 59                  | 0.578% | 0.450%  |
| 32                  | 0.093% | 0.040%  | 60                  | 0.590% | 0.450%  |
| 33                  | 0.104% | 0.046%  | 61                  | 0.579% | 0.420%  |
| 34                  | 0.116% | 0.052%  | 62                  | 0.567% | 0.390%  |
| 35                  | 0.127% | 0.059%  | 63                  | 0.556% | 0.360%  |
| 36                  | 0.144% | 0.068%  | 64                  | 0.545% | 0.330%  |
| 37                  | 0.162% | 0.077%  | 65                  | 0.533% | 0.300%  |
| 38                  | 0.179% | 0.087%  | 66                  | 0.487% | 0.280%  |
| 39                  | 0.197% | 0.096%  | 67                  | 0.440% | 0.260%  |
| 40                  | 0.214% | 0.106%  | 68                  | 0.393% | 0.240%  |
| 41                  | 0.234% | 0.121%  | 69                  | 0.347% | 0.220%  |
| 42                  | 0.254% | 0.135%  | 70                  | 0.300% | 0.200%  |
| 43                  | 0.274% | 0.150%  | 71                  | 0.300% | 0.200%  |
| 44                  | 0.294% | 0.165%  | 72                  | 0.300% | 0.200%  |
| 45                  | 0.313% | 0.180%  | 73                  | 0.300% | 0.200%  |
| 46                  | 0.333% | 0.204%  | 74                  | 0.300% | 0.200%  |
| 47                  | 0.353% | 0.228%  | 75                  | 0.300% | 0.200%  |