



**Cavanaugh Macdonald**  
CONSULTING, LLC

*The experience and dedication you deserve*



**TEACHERS' RETIREMENT SYSTEM  
OF THE STATE OF KENTUCKY  
STATEMENT OF RESULTS OF THE  
EXPERIENCE INVESTIGATION  
PREPARED AS OF JUNE 30, 2020**





# Cavanaugh Macdonald

CONSULTING, LLC

*The experience and dedication you deserve*

June 21, 2021

Board of Trustees  
Teachers' Retirement System of  
The State of Kentucky  
479 Versailles Road  
Frankfort, KY 40601-3800

Members of the Board:

An investigation of the economic assumptions and the mortality, service, compensation, and healthcare experience of active and retired members of the Teachers' Retirement System of the State of Kentucky (TRS) has been made covering the five-year period from July 1, 2015 to June 30, 2020. The study was based on the data submitted by TRS for the annual valuation. In preparing this report, we relied, without audit, on the data provided.

The purpose of the investigation was to assess the reasonability of the current TRS economic assumptions, demographic, and healthcare actuarial assumptions. As a result of the investigation, it has been determined that revised economic assumptions, demographic tables, and healthcare assumptions should be adopted by the Board for future use.

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

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.



Board of Trustees

June 21, 2021

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We note that as we are preparing this report, the world is in the midst of a pandemic. The impact of the COVID-19 pandemic was considered in this experience review. However, no explicit changes were incorporated mainly due to the level of uncertainty surrounding the effect of the virus on both health care costs and decremental experience such as mortality, retirement, and disability. We have considered available information, but do not believe that there is yet sufficient data to warrant the further modification of any assumptions. We will continue to monitor the situation as data emerges and advise the Board in the future of any adjustments that we believe would be appropriate.

We hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board (ASB) and the Code of Professional Conduct and Qualification Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries.

We further certify that, in our opinion, the assumptions developed in this report satisfy Actuarial Standards of Practice, in particular No. 27 (Selection of Economic Assumptions for Measuring Pension Obligations) and No. 35 (Selection of Demographic and Other Non-economic Assumptions for Measuring Pension Obligations).

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

Respectfully submitted,

A handwritten signature in blue ink that reads 'Edward J. Koebel'.

Edward J. Koebel, EA, FCA, MAAA  
Chief Executive Officer

A handwritten signature in blue ink that reads 'Alisa Bennett'.

Alisa Bennett, FSA, EA, FCA, MAAA  
President



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## Section I – Executive Summary

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

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

Cavanaugh Macdonald Consulting, LLC (CMC) has performed a study of the experience of each of the Plans under the TRS' Board of Trustees purview for the five-year period ending June 30, 2020. This report presents the results, analysis, and resulting determinations of our study. It is anticipated that the changes will first be reflected in the June 30, 2021 actuarial valuations.

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

### **Our Philosophy**

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



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- **Do Not Overreact:** When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically set rates somewhere between the old rates and the new experience. If the experience during the next study period shows similar results, we will likely recognize the trend at that point, or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.
- **Anticipate Trends:** If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.
- **Simplify:** In general, we attempt to identify which factors are significant and eliminate or ignore those that do not materially improve the accuracy of the liability projections.

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

### **Economic Assumption Changes**

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

Most of the economic assumptions used by actuaries are developed through a building-block approach. For example, the expected return on assets is based on the expectation for inflation plus the expected real return on assets. At the core of the economic assumptions is the inflation assumption. As we discuss later in the report, based on the Chief Actuary of the Social Security Administration's view of long-term inflation, **we have determined that the price inflation assumption should be decreased from 3.00% to 2.50%.**



## Section I – Executive Summary

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**We have also determined that there should be a decrease in the Retirement Annuity Trust long-term expected return on assets assumption from 7.50% to 7.10%**, reflecting a 2.50% inflation assumption and a 4.60% real rate of return assumption. This will be discussed in detail later in this report, but a real rate of return of 4.60% is supported by the forecasting models developed using the Horizon Actuarial Services, LLC. Survey conducted in 2020 and the Board's target asset allocation.

As the Health Trust and Life Trust showed similar long-term projections to the Retirement Annuity Trust and because the asset allocation strategy for the Health Trust will be impacted by the lower cash flows due to the State not paying their portion of the shared responsibility contributions, **we have determined that a decrease in the long-term expected return on assets assumption from 8.00% (Health Trust) and 7.50% (Life Trust) to 7.10% should be made at this time.**

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**Finally, we have determined that the general wage inflation (payroll growth) assumption used as the underlying payroll growth for active member and used in the level percent of payroll amortization method should be decreased from 3.50% to 2.75%.**

The following table summarizes the current and proposed economic assumptions:

| Item                            | Current | Proposed |
|---------------------------------|---------|----------|
| Price Inflation                 | 3.00%   | 2.50%    |
| Investment Return*              |         |          |
| Retirement Trust                | 7.50%   | 7.10%    |
| Health Trust                    | 8.00%   | 7.10%    |
| Life Trust                      | 7.50%   | 7.10%    |
| Wage Inflation (Payroll Growth) | 3.50%   | 2.75%    |

\* Net of investment expenses only.

Although we have determined that a change in the set of economic assumptions is necessary, we recognize there may be other sets of economic assumptions that are also reasonable for purposes of funding TRS. For example, we have typically reflected conservatism to the degree we would classify as moderate. Actuarial Standards of Practice allow for this difference in approaches and perspective, as long as the assumptions are reasonable and consistent.



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### Demographic Assumption Changes

In the experience study, actual experience for the study period is compared to that expected based on the current actuarial assumption. Historically, the analysis has most commonly been performed based on counts, i.e., each member is one exposure as to the probability of the event occurring and one occurrence if the event actually occurs. Comparing the actual incidence of the event to what was expected (called the Actual-to-Expected ratio, or A/E ratio) then provides the basis for our analysis. However, for some assumptions, the trend has been to use a liability-weighted methodology if it provides a more accurate fit. Since the cost of a retirement system is determined based on the liability of each member, weighting the decrements based on liability will provide a better correlation to the gains or losses that occur each year. We have used a liability-weighted methodology in analyzing the rates of withdrawal from active service and the rates of post-retirement mortality.

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

There are two widely used approaches for reflecting future improvements in mortality:

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is with the use of a static mortality table with “margin.” Under this approach, the A/E ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. While there is no formal guidance as to the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10 to 14% at the core ages of the retired member. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If that occurs, the assumption will need to be updated.





## Section I – Executive Summary

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Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% since future mortality improvements will be taken into account directly in the actuarial valuation process.

As mentioned previously, for the mortality decrements, we also analyzed the experience using a liability-weighted approach. This is approximated by using the member’s retirement benefit from the data collected. The exposure and actual occurrences are then multiplied by the benefit level to provide the liability-weighted experience. This approach is particularly insightful when analyzing experience from a non-homogenous group. While we reviewed the mortality experience on both a count and liability-weighted basis, we ultimately decided on the liability-weighted results to evaluate experience and develop a new mortality table.

The current post-retirement mortality assumption for healthy lives is a static table, the RP-2000 Combined Mortality Table projected to 2025 with projection scale BB and set forward 2 years for males and set forward 1 year for females. The results of the experience analysis indicate that this table provided a reasonable expectation of mortality for the past five years but there were consistent mortality losses in each of the last five valuations. **Therefore, we have determined that the TRS Board should adopt a generational mortality approach and utilize the mortality assumptions from the recently published Pub-2010 Public Mortality Plans Mortality Tables.**

While prior pension mortality tables have been based solely on private corporate and union retirement plans, these new tables, released in late 2018, are based entirely on public sector plan data. These tables are split by three membership types: Safety, Teachers, and General to reflect the observed differences in mortality patterns related to the three groups. Tables are further split for healthy retirees, disabled retirees, contingent beneficiaries, and employees. There are still other breakdowns in these tables for at, above or below median annuity values. We anticipate that this family of tables will be a good starting point in developing a mortality assumption.

More information will be discussed in the demographic section of this report.



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The following is a general list of the other changes to the demographic assumptions for TRS.

- **Retirement:** Minor adjustments in the rates of retirement to better match experience of the System.
- **Disability:** Decrease rates of disability retirement at all ages for both males and females.
- **Withdrawal:** Minor adjustments in the rates of withdrawal to better match experience of the System.
- **Merit Salary Scale:** Change in the merit salary scale to be based on service rather than age and a slight decreases in the merit salary scale to better match experience of the System.
- **Pre-Retirement Mortality:** Update to the Pub-2010 Teachers' Employee Mortality Table with adjustments.

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

### Actuarial Methods

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

- Actuarial Cost Method – Entry Age Normal
- Asset Valuation Method – 5-year smoothing
- Amortization Method – Level percentage of payroll with closed, separate bases

**Based on our review, discussed in full detail in Section III of this report, no changes are needed in these actuarial methods at this time.**



## Section I – Executive Summary

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### Other Pension Assumptions

Currently for TRS, there is no contribution made to pay the administrative expenses incurred each year. This results in losses to the System due to the expenses paid out each year. **After reviewing the total amount of administrative expenses for the past five years and the percentage of payroll, we have determined that an assumption of 0.32% of payroll should be used in the valuation and added to the total normal cost each year.** The following table shows actual percentages over the past five years:

(\$ in Thousands)

| Year Ending<br>June 30 | Administrative<br>Expenses | Annual Payroll | Percentage |
|------------------------|----------------------------|----------------|------------|
| 2016                   | \$8,636                    | \$3,537,226    | 0.24%      |
| 2017                   | 10,314                     | 3,563,584      | 0.29%      |
| 2018                   | 11,388                     | 3,605,116      | 0.32%      |
| 2019                   | 12,352                     | 3,648,428      | 0.34%      |
| 2020                   | 12,167                     | 3,723,482      | 0.33%      |

Currently, we assume a load of 2.0% to all active liability for all unused sick leave added at retirement. TRS staff has supplied us with average service credits due to unused sick leave for those active members that retired in the last 4 years that were not in Local School Districts. The average unused sick leave credit for these individuals was approximately 0.50 years of service. For those active members retiring from the Local School Districts, Final Average Compensation is increased by the average additional payroll they received from their unused sick leave time. Average additional payroll for these members averaged around \$13,500. Using these figures, we compute that the load for unused sick leave should be 3.0%, therefore, **we have determined that there should be an increase to the load from 2.0% to 3.0% for all active liability at the time of retirement.**



## Section I – Executive Summary

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### **Financial Impact**

The following table highlights the impact of the changes on the Retirement Annuity Trust unfunded accrued liability (UAL), funding ratio and required increase rate for the actuarially determined employer contribution rate.

#### **Pension Results – Retirement Annuity Trust** (\$ in Thousands)

| System                     | Valuation<br>Results 2020 | After<br>Demographic<br>Changes Only | After All<br>Changes |
|----------------------------|---------------------------|--------------------------------------|----------------------|
| Unfunded Accrued Liability | \$14,785,756              | \$16,091,067                         | \$17,737,927         |
| Funding Ratio              | 58.4%                     | 56.4%                                | 54.0%                |
| Required Increase Rate     | 15.78%                    | 18.63%                               | 24.46%               |
| Discount Rate              | 7.50%                     | 7.50%                                | 7.10%                |



## Section I – Executive Summary

In addition, we reviewed the financial impact of the changes on the UAL, funding ratio and employer annual required contribution rate for the Retiree Health and Life Insurance Trusts. Section V in this report lists all the changes to the health assumptions specific to only the Retiree Health Trust and the Life Insurance Trust.

### **OPEB Results – Retiree Health Trust**

(\$ in Thousands)

| System                     | Valuation Results 2020 | After Demographic Changes Only | After All Changes |
|----------------------------|------------------------|--------------------------------|-------------------|
| Unfunded Accrued Liability | \$1,056,685            | \$1,226,558                    | \$1,409,364       |
| Funding Ratio              | 61.7%                  | 58.1%                          | 54.7%             |
| Required Increase Rate     | 3.54%                  | 3.95%                          | 4.52%             |
| Discount Rate              | 8.00%                  | 8.00%                          | 7.10%             |

### **OPEB Results – Life Insurance Trust**

(\$ in Thousands)

| System                     | Valuation Results 2020 | After Demographic Changes Only | After All Changes |
|----------------------------|------------------------|--------------------------------|-------------------|
| Unfunded Accrued Liability | \$29,965               | \$19,301                       | \$25,100          |
| Funding Ratio              | 75.5%                  | 82.7%                          | 78.6%             |
| Required Increase Rate     | 0.08%                  | 0.06%                          | 0.07%             |
| Discount Rate              | 7.50%                  | 7.50%                          | 7.10%             |



## Section II – Economic Assumptions

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There are four economic assumptions used in the actuarial valuations performed for TRS. They are:

- Price Inflation
- Investment Return
- Wage Inflation
- Payroll Growth for Amortization Method

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

Actuarial Standard of Practice (ASOP) No. 27, *“Selection of Economic Assumptions for Measuring Pension Obligations”* provides guidance to actuaries in selecting economic assumptions for measuring obligations under defined benefit plans. ASOP No. 27 requires that each economic assumption selected by the actuary should be reasonable which means it has the following characteristics:

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

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



## Section II – Economic Assumptions

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

| Item                 | Current Assumptions | Proposed Assumptions |
|----------------------|---------------------|----------------------|
| Price Inflation      | 3.00%               | 2.50%                |
| Real Rate of Return* | <u>4.50</u>         | <u>4.60</u>          |
| Investment Return    | 7.50%               | 7.10%                |
| Price Inflation      | 3.00%               | 2.50%                |
| Real Wage Growth     | <u>0.50</u>         | <u>0.25</u>          |
| Wage Inflation       | 3.50%               | 2.75%                |
| Payroll Growth       | 3.50%               | 2.75%                |

\* Net of investment expenses.



## Section II – Economic Assumptions

### Price Inflation

#### ***Background***

As can be seen from the table on the previous page, assumed price inflation is used as the basis for both the investment return assumption and the wage inflation assumption. These latter two assumptions will be discussed in detail in the following sections.

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

The current price inflation assumption is 3.00% per year.

#### ***Past Experience***

The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The table below provides historical annualized rates and annual standard deviation of the CPI-U over periods ending June 30th.

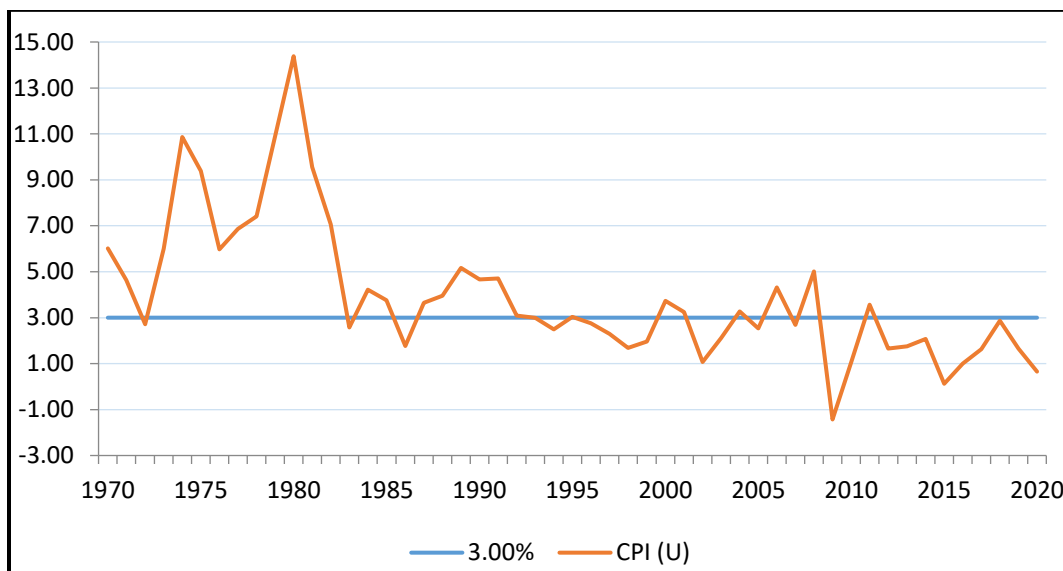
| Period      | Number of Years | Annualized Rate of Inflation | Annual Standard Deviation |
|-------------|-----------------|------------------------------|---------------------------|
| 1926 – 2020 | 94              | 2.87%                        | 4.05%                     |
| 1960 – 2020 | 60              | 3.67                         | 2.88                      |
| 1970 – 2020 | 50              | 3.86                         | 3.02                      |
| 1980 – 2020 | 40              | 2.88                         | 1.89                      |
| 1990 – 2020 | 30              | 2.31                         | 1.36                      |
| 2000 – 2020 | 20              | 2.03                         | 1.48                      |
| 2010 - 2020 | 10              | 1.69                         | 1.00                      |



## Section II – Economic Assumptions

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

**Annual Rate of CPI (U) Increases**



Over the last 30 years, the average annual rate of increase in the CPI-U has been below 2.50%. The volatility of the annual rates in the more recent years has been markedly lower as indicated by the significantly lower annual standard deviations.

### Forecasts

Based upon information contained in the “Survey of Professional Forecasters” for the fourth quarter of 2020 as published by the Philadelphia Federal Reserve Bank, the median expected annual rate of inflation for the next ten years is 2.12%. Although 10 years of future expectation is too short of a period for the basis of our inflation assumption, the information does provide some evidence that the consensus expectations of these experts are for rates of inflation lower than our current assumption of 3.00% for the near-term future.

The latest forecast from the National Association for Business Economics (NABE) released in May 2021 shows its members largely agree that inflation will be moderately higher for the remaining of 2021 and 2022. In fact, the year-to-year CPI-U numbers for the end of April 2021 show an annual inflation rate of 4.2%, its highest one-year increase in years.

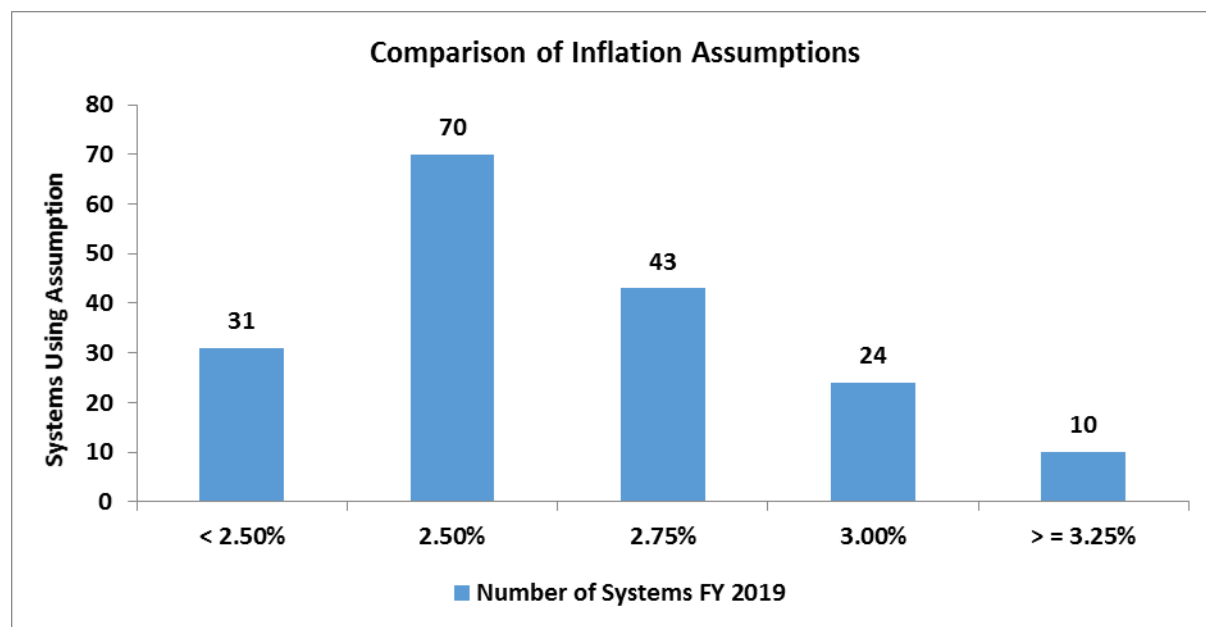
## Section II – Economic Assumptions

### *Social Security Administration*

Although economists have varying opinions on what inflation should be used by most retirement plans, they are generally looking at a shorter time perspective than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the 2020 annual report, the projected ultimate average annual increase in the CPI over the next 75 years was estimated to be 2.40%, under the intermediate (best estimate) cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high-cost scenario, in addition to the intermediate cost projection, was 1.80% to 3.00%.

### *Peer Comparison*

While we do not base the selection of any assumption on what other systems use, it does provide another set of relevant information to consider. The following chart and graph show the inflation rate assumptions of 178 plans in the Public Plan Database of the Center for Retirement Research. The assumptions are from actuarial valuation reported in FYE 2019.





## Section II – Economic Assumptions

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### *Determination*

It is difficult to predict inflation accurately. Inflation's short-term volatility is illustrated by comparing its average rate over the last 10 and 50 years. Although the 10-year average of 1.69% is lower than the System's assumed rate of 3.00%, the longer 40-year average of 2.88% is closer to TRS' current rate but it includes the very high rates of inflation from the early 1980s. Those high rates will not be part of the 40-year average for much longer. The reasonableness of TRS' assumption is, therefore, dependent upon the emphasis one assigns to the short and long-terms.

Current economic forecasts suggest lower inflation but are generally looking at a shorter time period than appropriate for our purposes. We consider the range included in the Social Security Administration of 1.80% to 3.00% with an intermediate assumption of 2.40% to be the most reasonable and have determined that the inflation assumption for TRS should be decreased from 3.00% to 2.50%.

| Price Inflation Assumption |       |
|----------------------------|-------|
| Current                    | 3.00% |
| Determined                 | 2.50% |



## Section II – Economic Assumptions

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### **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. Minor changes in this assumption can have a major impact on valuation results. The investment return assumption should reflect the asset allocation target for the funds set by the Board of Trustees.

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%.

#### ***Long Term Perspective***

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

#### ***Past Experience***

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



## Section II – Economic Assumptions

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

| Year Ending 6/30 | Actuarial Value | Market Value |
|------------------|-----------------|--------------|
| 2020             | 7.0%            | 5.5%         |
| 2019             | 7.1%            | 5.6%         |
| 2018             | 9.1%            | 10.5%        |
| 2017             | 9.3%            | 15.0%        |
| 2016             | 7.6%            | -1.0%        |
| Average          | 8.0%            | 7.1%         |

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

### ***Future Expectation Analysis***

ASOP 27 provides that the actuary may rely on outside experts in setting economic assumptions. TRS utilizes the services of Aon to assist them in developing investment strategies and providing capital market assumptions for the TRS portfolio. As part of their duties, Aon periodically performs asset-liability studies, along with comprehensive reviews of the expected return of the various asset classes in which the TRS portfolio is invested. We believe it is appropriate to consider the results of Aon's work as one factor in assessing expected future returns.

Our forward-looking analysis used the real rates of return in Aon's capital market assumptions for 10-year and 30-year assumptions and TRS' target asset allocation. Using statistical projections that assume investment returns approximately follow a lognormal distribution with no correlation between years, produces an expected range of real rates of return over a 50-year time perspective. Looking at one year's results produces a reasonable mean real return, but also has a high standard deviation or measurement of volatility. By expanding the time perspective, the real return does not change, but the volatility declines significantly.

The tables below provide a summary of the results of Aon's 10-year and 30-year assumptions and TRS' target asset allocation.



## Section II – Economic Assumptions

### Aon 10-year perspective Assumptions

| 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                  | 4.59%            | 13.67%             | -16.29%                    | -5.02%           | 3.70%            | 13.22%           | 28.47%           |
| 5                  | 3.88%            | 6.05%              | -5.77%                     | -0.29%           | 3.70%            | 7.86%            | 14.12%           |
| 10                 | 3.79%            | 4.27%              | -3.09%                     | 0.86%            | 3.70%            | 6.62%            | 10.97%           |
| 20                 | 3.75%            | 3.02%              | -1.15%                     | 1.69%            | 3.70%            | 5.76%            | 8.79%            |
| 30                 | 3.73%            | 2.47%              | -0.27%                     | 2.05%            | 3.70%            | 5.38%            | 7.84%            |
| 40                 | 3.72%            | 2.14%              | 0.25%                      | 2.27%            | 3.70%            | 5.15%            | 7.27%            |
| 50                 | 3.72%            | 1.91%              | 0.61%                      | 2.42%            | 3.70%            | 5.00%            | 6.89%            |

### Aon 30-year perspective Assumptions

| 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                  | 5.27%            | 13.67%             | -15.62%                    | -4.33%           | 4.39%            | 13.91%           | 29.14%           |
| 5                  | 4.57%            | 6.05%              | -5.08%                     | 0.40%            | 4.39%            | 8.54%            | 14.81%           |
| 10                 | 4.48%            | 4.27%              | -2.40%                     | 1.55%            | 4.39%            | 7.31%            | 11.66%           |
| 20                 | 4.43%            | 3.02%              | -0.46%                     | 2.37%            | 4.39%            | 6.45%            | 9.48%            |
| 30                 | 4.42%            | 2.47%              | 0.41%                      | 2.74%            | 4.39%            | 6.07%            | 8.53%            |
| 40                 | 4.41%            | 2.14%              | 0.94%                      | 2.96%            | 4.39%            | 5.84%            | 7.96%            |
| 50                 | 4.41%            | 1.91%              | 1.30%                      | 3.11%            | 4.39%            | 5.69%            | 7.58%            |

The percentile results are the percentages of random returns over the time span shown that are expected to be less than the amount indicated. For example, using the Aon 30-year perspective assumptions, for the 10-year time span, 5% of the resulting real rates of return will be below -2.40% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50-year time span, the results indicate there will be a 25% chance that real returns will be below 3.11% and a 25% chance they will be above 5.69%. In other words, there is a 50% chance the real returns will be between 3.11% and 5.69%.



## Section II – Economic Assumptions

The results of our real return forward looking analysis are very similar to the real rate of return analysis developed by Aon in their first quarter of 2021 analysis, where they developed a real return expectation of 4.30% over a 30-year perspective.

We also recognize that there can be differences of opinion among investment professionals regarding future return expectations. For a broader view of expected returns, we also reviewed the 2020 Survey of Capital Market Assumptions produced by Horizon Actuarial Services, LLC to see what other investment professionals are currently using for capital market assumptions.

The Horizon survey includes both 10-year perspective and 20-year perspective capital market assumptions. We applied the same statistical analysis to these survey results as we did the capital market assumption of TRS investment advisor with the following real return results for the 10-year perspective and 20-year perspective. This information provides an additional perspective on what a broad group of investment experts anticipate for future investment returns.

### Horizon Survey 10-year perspective

| 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                  | 5.12%            | 12.69%             | -14.37%                    | -3.77%           | 4.36%            | 13.18%           | 27.20%           |
| 5                  | 4.51%            | 5.63%              | -4.48%                     | 0.64%            | 4.36%            | 8.22%            | 14.02%           |
| 10                 | 4.44%            | 3.97%              | -1.97%                     | 1.72%            | 4.36%            | 7.07%            | 11.10%           |
| 20                 | 4.40%            | 2.81%              | -0.15%                     | 2.49%            | 4.36%            | 6.27%            | 9.08%            |
| 30                 | 4.39%            | 2.29%              | 0.66%                      | 2.83%            | 4.36%            | 5.92%            | 8.20%            |
| 40                 | 4.38%            | 1.99%              | 1.15%                      | 3.03%            | 4.36%            | 5.71%            | 7.68%            |
| 50                 | 4.38%            | 1.78%              | 1.48%                      | 3.17%            | 4.36%            | 5.57%            | 7.32%            |



## Section II – Economic Assumptions

### Horizon Survey 20-year perspective

| 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                  | 5.78%            | 12.69%             | -13.73%                    | -3.11%           | 5.02%            | 13.84%           | 27.85%           |
| 5                  | 5.17%            | 5.63%              | -3.82%                     | 1.30%            | 5.02%            | 8.88%            | 14.68%           |
| 10                 | 5.10%            | 3.97%              | -1.31%                     | 2.38%            | 5.02%            | 7.74%            | 11.76%           |
| 20                 | 5.06%            | 2.81%              | 0.50%                      | 3.15%            | 5.02%            | 6.93%            | 9.74%            |
| 30                 | 5.05%            | 2.29%              | 1.32%                      | 3.49%            | 5.02%            | 6.58%            | 8.86%            |
| 40                 | 5.04%            | 1.99%              | 1.81%                      | 3.69%            | 5.02%            | 6.37%            | 8.34%            |
| 50                 | 5.04%            | 1.78%              | 2.14%                      | 3.83%            | 5.02%            | 6.23%            | 7.98%            |

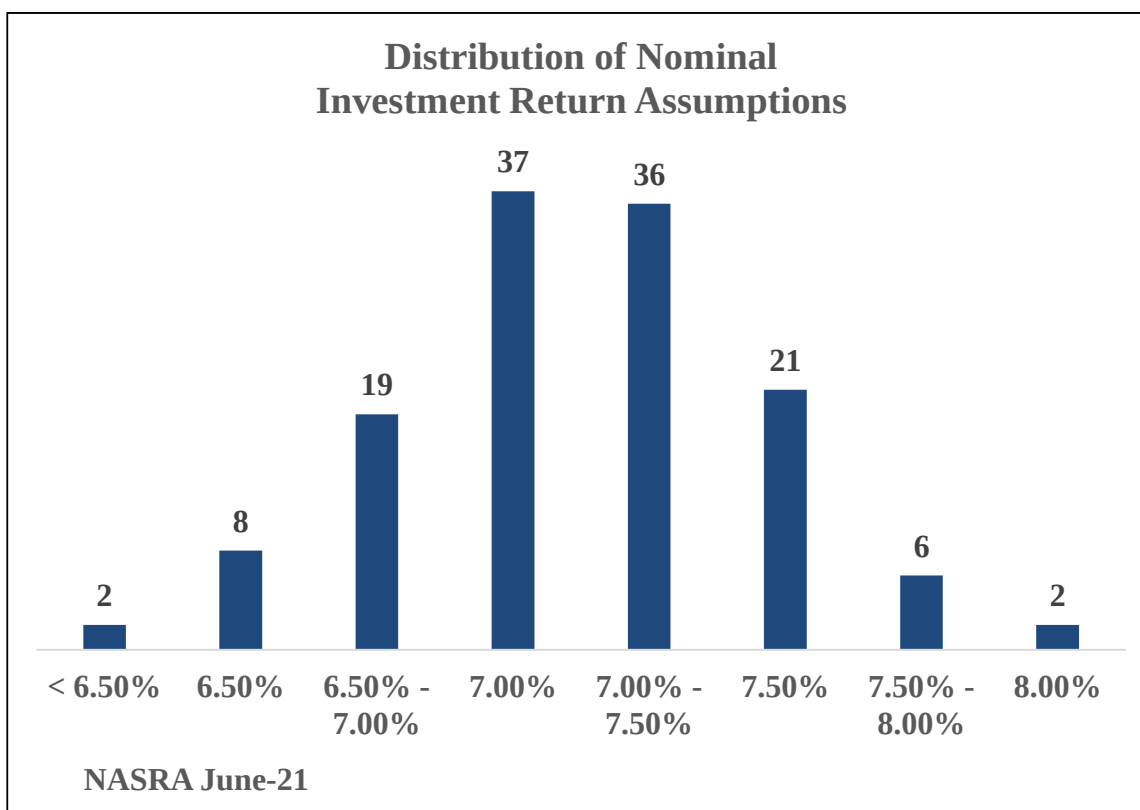
As you can see from the two tables above, setting a real return assumption depends on the time perspective a plan seeks. The 20-year perspective is approximately 0.65% higher at all percentiles than the 10-year perspective. While TRS is a long-term vehicle expected to pay benefits to its retirees for many years in the future, a high percentage of the present value of the benefits is determined within the next ten to fifteen years, so the real return assumption should fall within the bands shown in the 50<sup>th</sup> percentile columns in the four tables above.



## Section II – Economic Assumptions

### Peer Comparison

The following chart shows the nominal investment return assumptions of 131 plans in the National Association of State Retirement Administrators (NASRA). The assumptions shown below are as of June 2021 and are updated frequently by the NASRA staff.





## Section II – Economic Assumptions

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### *Determination*

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

**Based on our analysis of the Board’s target asset allocation and the Horizon Survey capital market assumptions, we have determined a change should be made to the real return assumption from 4.50% to 4.60%.** This assumption of 4.60% is approximately midway between the 10-year perspective (4.36%) and the 20-year perspective (5.02%) from the Horizon Survey. Based on an inflation assumption of 2.50% and real return assumption of 4.60%, we have determined a 7.10% expected long term nominal rate of return assumption.

| Investment Return Assumption |             |             |
|------------------------------|-------------|-------------|
|                              | Current     | Proposed    |
| Real Rate of Return*         | 4.50%       | 4.60%       |
| Inflation                    | <u>3.00</u> | <u>2.50</u> |
| Net Investment Return        | 7.50%       | 7.10%       |

\* Net of investment expenses.



## Section II – Economic Assumptions

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### **Wage Inflation**

#### ***Background***

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

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

#### ***Past Experience***

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

As with our analysis of inflation, we provide below wage inflation and a comparison with price inflation over various time periods. Currently, this wage data is only available through calendar year 2019. We remove the rate of price inflation for each year from the data to result in the historical real rate of wage inflation.

| Period    | Wage Inflation | Price Inflation | Real Wage Growth |
|-----------|----------------|-----------------|------------------|
| 2009-2019 | 2.88%          | 1.75%           | 1.13%            |
| 1999-2019 | 2.91%          | 2.14%           | 0.77%            |
| 1989-2019 | 3.36%          | 2.40%           | 0.96%            |
| 1979-2019 | 3.95%          | 3.07%           | 0.88%            |
| 1969-2019 | 4.53%          | 3.91%           | 0.62%            |

Thus, over the last 50 years, annual real wage growth has averaged 0.62%.



## Section II – Economic Assumptions

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### *Social Security Administration*

The wage index used for the historical analysis is projected forward by the Office of the Chief Actuary of the Social Security Administration in their 75-year projections. In April of 2020, the annual increase in the National Average Wage Index under the intermediate cost assumption (best estimate) was 3.54%, 1.14% higher than the Social Security intermediate inflation assumption of 2.40% per year. The range of the assumed real wage inflation in the 2020 Trustees report was 0.52% to 1.76% per year.

### *Determination*

The data the Social Security Administration collects is nationwide and predominantly from the private sector which includes many collectively bargained employees. It is questionable whether public sector employees can match the productivity rates of the private sector. In addition, the experience of real wage growth for teachers in the State of Kentucky is below the national average. **Therefore, we have determined that the real wage growth inflation assumption should be reduced from 0.50% to 0.25%. This change along with reflecting the decrease in the price inflation assumption results in a reduction to total wage inflation growth from 3.50% to 2.75%.**

| Wage Inflation Assumption |              |              |
|---------------------------|--------------|--------------|
|                           | Current      | Proposed     |
| Price Inflation           | 3.00%        | 2.50%        |
| Real Wage Growth          | <u>0.50%</u> | <u>0.25%</u> |
| Wage Inflation            | 3.50%        | 2.75%        |



## Section II – Economic Assumptions

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### Payroll Growth

#### *Background*

The assumed future rate of payroll growth increase in the total payroll of TRS' active members is an assumption used in the level percentage of payroll amortization method that affects the calculation of the amortization period required to fully amortize the unfunded actuarial accrued liability and the actuarially determined employer contribution. The total payroll growth is impacted by individual member's increases and population growth. The current assumption is 3.50% per year which is equal to the current wage inflation assumption.

#### *Past Experience*

The following table shows the actual TRS' annual payroll growth experienced over different time periods.

| Period      | Number of Years | Annual Payroll Growth |
|-------------|-----------------|-----------------------|
| 1990 – 2020 | 30              | 3.46%                 |
| 2000 – 2020 | 20              | 2.82%                 |
| 2005 – 2020 | 15              | 2.16%                 |
| 2010 – 2020 | 10              | 1.15%                 |
| 2015 – 2020 | 5               | 1.16%                 |

#### *Determination*

The table above shows that since 1990 annual payroll growth has been near assumed levels. However, over the past 10 to 15 years, annual payroll growth has been much lower than assumed. This is a direct result of the financial crisis of 2008/2009. Projections for population growth in the State of Kentucky are encouraging as some counties are growing significantly, including Scott, Warren and Boone counties and one-third of the growth in the state since 2000 has occurred in the Louisville area. The need for attracting and retaining teachers to any state is tied to the population growth and the ability to pay teachers more. **Taking all of this information into account, we have determined that the payroll growth assumption should be set at 2.75%, which is a 0.75% reduction in the current assumption of 3.50%.**



## Section III – Actuarial Methods

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### ACTUARIAL COST METHOD

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

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

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

Considering that the Entry Age Normal cost method is the most commonly used cost method by public plans, that it develops a normal cost rate that tends to be stable and less volatile and is the required cost method under calculations required by GASB Numbers 67 and 68, **we have determined that the Entry Age Normal actuarial cost method should be retained for TRS.**



## Section III – Actuarial Methods

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### ACTUARIAL VALUE OF ASSETS

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

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

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

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

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

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

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

Currently, the actuarial value of assets recognizes a portion of the difference between the market value of assets and the expected market value of assets, based on the assumed valuation rate of return. The amount recognized each year is 20% of the difference between market value and expected market value. **We have determined that there should be no change in this methodology.**



## Section III – Actuarial Methods

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### **AMORTIZATION OF THE UNFUNDED ACTUARIAL ACCRUED LIABILITY**

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

- (i) plan improvements that have not been completely paid for,
- (ii) experience that is less favorable than expected,
- (iii) assumption changes that increase liabilities, or
- (iv) contributions that are less than the actuarial contribution rate.

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

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

**Amortization Period:** The amortization period can be either closed or open. If it is a closed amortization period, the number of years remaining in the amortization period declines by one in each future valuation. Alternatively, if the amortization period is an open or rolling period, the amortization period does not decline but is reset to the same number each year. This approach essentially “refinances” the System’s debt (UAAL) every year.

**Amortization Payment:** The level dollar amortization method is similar to the method in which a homeowner pays off a mortgage. The liability, once calculated, is financed by a constant fixed dollar amount, based on the amortization period until the liability is extinguished. This results in the liability steadily decreasing while the payments, though remaining level in dollar terms, in all probability decrease as a percentage of payroll. (Even if a plan sponsor’s population is not growing, inflationary salary increases will usually be sufficient to increase the aggregate covered payroll).

The rationale behind the level percentage of payroll amortization method is that since normal costs are calculated to be a constant percentage of pay, the unfunded actuarial accrued liability should be paid off in the same manner. When this method of amortizing the unfunded actuarial accrued





## Section III – Actuarial Methods

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liability is adopted, the initial amortization payments are lower than they would be under a level dollar amortization payment method, but the payments increase at a fixed rate each year so that ultimately the annual payment far exceeds the level dollar payment. The expectation is that total payroll will increase at the same rate so that the amortization payments will remain constant, as a percentage of payroll. In the initial years, the level percentage of payroll amortization payment is often less than the interest accruing on the unfunded actuarial accrued liability meaning that even if there are no experience losses, the dollar amount of the unfunded actuarial accrued liability will grow (called negative amortization). This is particularly true if the plan sponsor is paying off the unfunded actuarial accrued liability over a long period, such as 20 or more years.

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

If separate amortization bases are maintained, the UAAL is composed of multiple amortization bases, each with its own payment schedule and remaining amortization period. In each valuation, the unexpected change in the UAAL is established as a new amortization base over the appropriate amortization period beginning on that valuation date. The UAAL is then the sum of all the outstanding amortization bases on the valuation date and the UAAL payment is the sum of all of the amortization payments on the existing amortization bases. This approach provides transparency in that the current UAAL is paid off over a fixed period of time and the remaining components of the UAAL are clearly identified. Adjustments to the UAAL in future years are also separately identified in each future year. One downside of this approach is that it can create some discontinuities in contribution rates when UAAL layers/components are fully paid off. If this occurs, it likely would be far in the future, with adequate time to address any adjustments needed.

### ***Determination***

The methodology in calculating the Actuarially Determined Contribution is as follows:

- Amortization Period – Closed period with maximum period of 20 years for new bases
- Amortization Payment – Level Percentage of Payroll
- Amortization Bases – Separate bases for all experience gains and losses, assumption changes or benefit changes

**We have determined that no changes should be made to these methods.**



## Section IV – Demographic Assumptions

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There are several demographic assumptions used in the actuarial valuations performed for TRS. They are:

- Rates of Withdrawal
- Rates of Disability Retirement
- Rates of Service Retirement
- Rates of Mortality
- Rates of Salary Increase

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

The purpose of a study of demographic experience is to compare what actually happened to the membership during the study period (July 1, 2015 through June 30, 2020) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuations.

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

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, gender, or service does not follow the expected pattern, new assumptions are determined. Changes to assumptions usually do not follow the exact actual experience during the observation period. Judgment is required to extrapolate future experience from past trends and current member behavior.

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



## Section IV – Demographic Assumptions

### RATES OF WITHDRAWAL

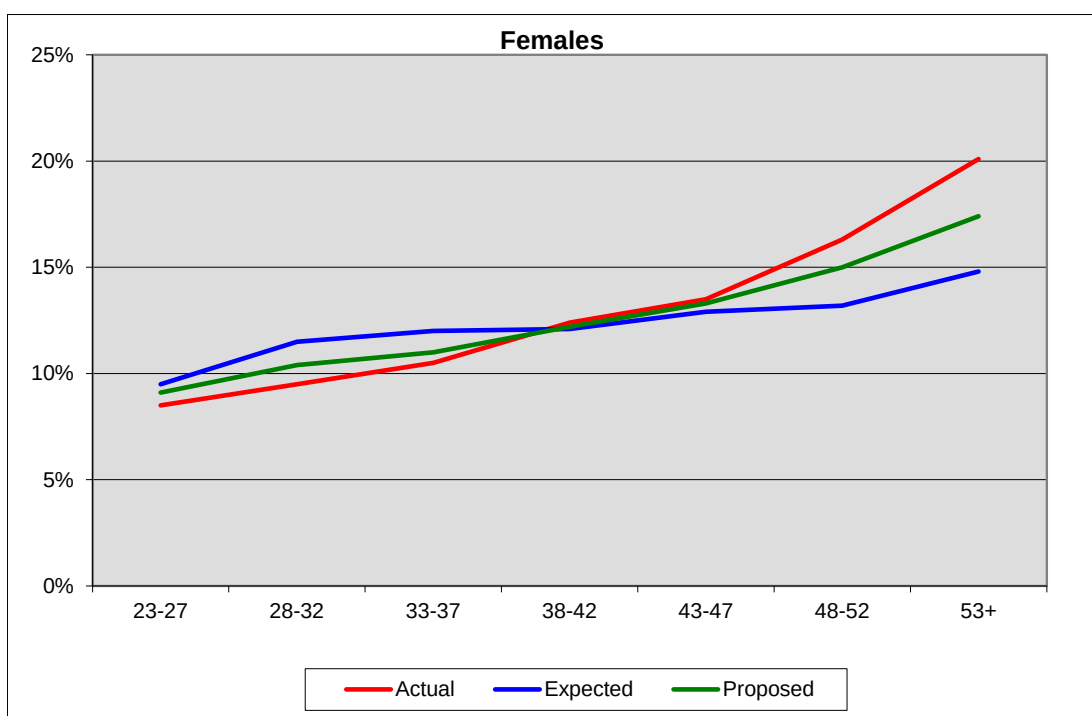
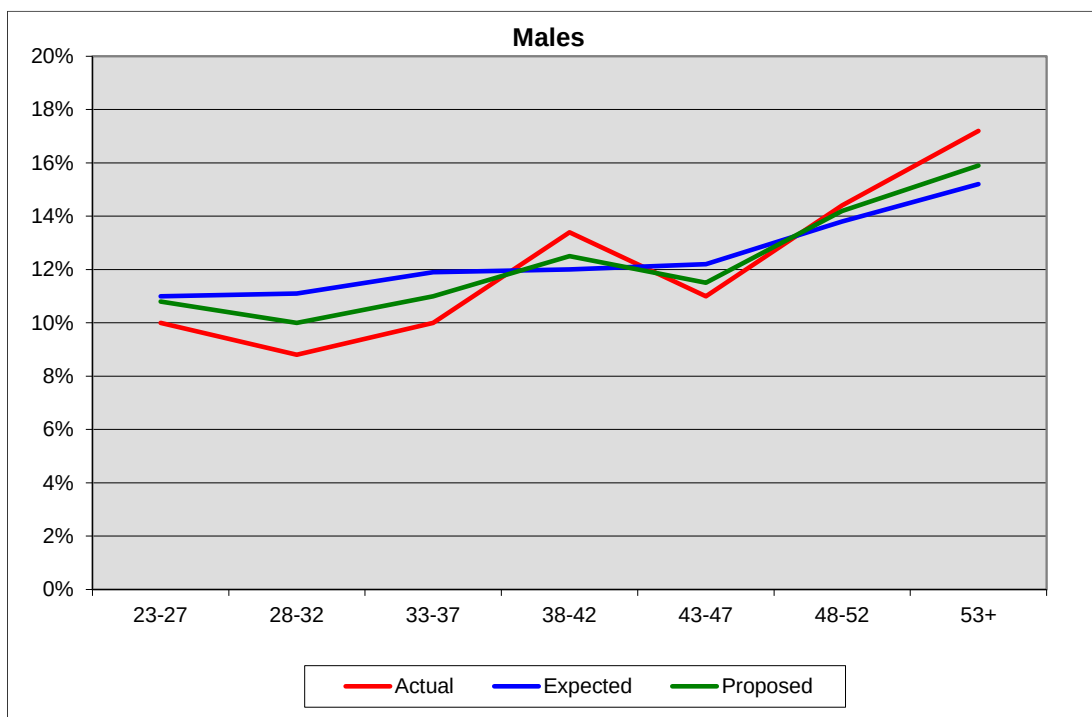
#### COMPARISON OF ACTUAL AND EXPECTED RATES OF WITHDRAWAL FROM ACTIVE SERVICE

| CENTRAL<br>AGE OF<br>GROUP                                    | RATES OF WITHDRAWAL                           |          |                                   |         |          |                                   |
|---------------------------------------------------------------|-----------------------------------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                                                               | MALES                                         |          |                                   | FEMALES |          |                                   |
|                                                               | Actual                                        | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
|                                                               | Withdrawals with less than 5 years of service |          |                                   |         |          |                                   |
| 20                                                            | 0.263                                         | 0.110    | 2.391                             | 0.155   | 0.088    | 1.761                             |
| 25                                                            | 0.100                                         | 0.110    | 0.909                             | 0.085   | 0.095    | 0.895                             |
| 30                                                            | 0.088                                         | 0.111    | 0.793                             | 0.095   | 0.115    | 0.826                             |
| 35                                                            | 0.100                                         | 0.119    | 0.840                             | 0.105   | 0.120    | 0.875                             |
| 40                                                            | 0.134                                         | 0.120    | 1.117                             | 0.124   | 0.121    | 1.025                             |
| 45                                                            | 0.110                                         | 0.122    | 0.902                             | 0.135   | 0.129    | 1.047                             |
| 50                                                            | 0.144                                         | 0.138    | 1.043                             | 0.163   | 0.132    | 1.235                             |
| 53 & OVER                                                     | 0.172                                         | 0.152    | 1.132                             | 0.201   | 0.148    | 1.358                             |
| TOTAL                                                         | 0.111                                         | 0.120    | 0.925                             | 0.107   | 0.113    | 0.947                             |
| Withdrawals with at least 5 but less than 10 years of service |                                               |          |                                   |         |          |                                   |
| 25                                                            | 0.033                                         | 0.030    | 1.100                             | 0.052   | 0.040    | 1.300                             |
| 30                                                            | 0.036                                         | 0.031    | 1.161                             | 0.042   | 0.040    | 1.050                             |
| 35                                                            | 0.036                                         | 0.035    | 1.029                             | 0.034   | 0.040    | 0.850                             |
| 40                                                            | 0.042                                         | 0.044    | 0.955                             | 0.040   | 0.040    | 1.000                             |
| 45                                                            | 0.034                                         | 0.045    | 0.756                             | 0.036   | 0.041    | 0.878                             |
| 50                                                            | 0.044                                         | 0.045    | 0.978                             | 0.047   | 0.049    | 0.959                             |
| 53 & OVER                                                     | 0.075                                         | 0.044    | 1.705                             | 0.057   | 0.050    | 1.140                             |
| TOTAL                                                         | 0.040                                         | 0.038    | 1.053                             | 0.040   | 0.041    | 0.976                             |
| Withdrawals with 10 or more years of service                  |                                               |          |                                   |         |          |                                   |
| 30                                                            | 0.032                                         | 0.025    | 1.280                             | 0.009   | 0.016    | 0.563                             |
| 35                                                            | 0.016                                         | 0.015    | 1.067                             | 0.017   | 0.015    | 1.133                             |
| 40                                                            | 0.013                                         | 0.014    | 0.929                             | 0.012   | 0.013    | 0.923                             |
| 45                                                            | 0.010                                         | 0.014    | 0.714                             | 0.009   | 0.012    | 0.750                             |
| 50                                                            | 0.010                                         | 0.019    | 0.526                             | 0.012   | 0.015    | 0.800                             |
| 53 & OVER                                                     | 0.014                                         | 0.022    | 0.636                             | 0.015   | 0.018    | 0.833                             |
| TOTAL                                                         | 0.012                                         | 0.016    | 0.750                             | 0.012   | 0.014    | 0.857                             |

## Section IV – Demographic Assumptions

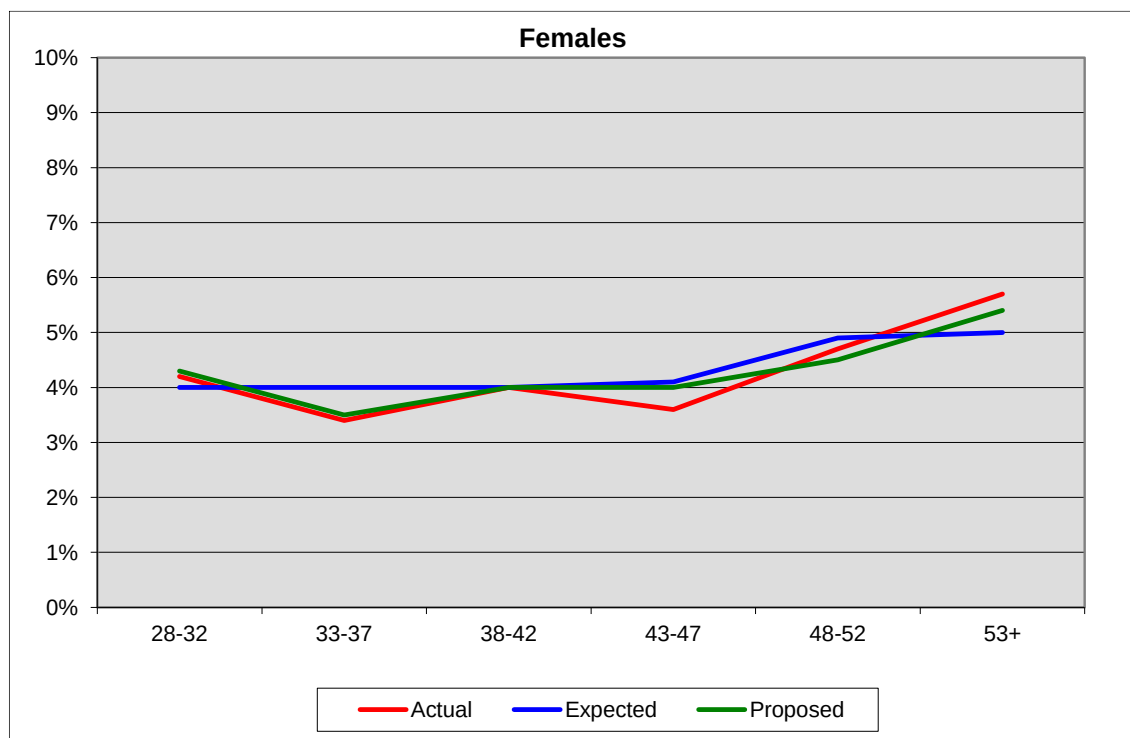
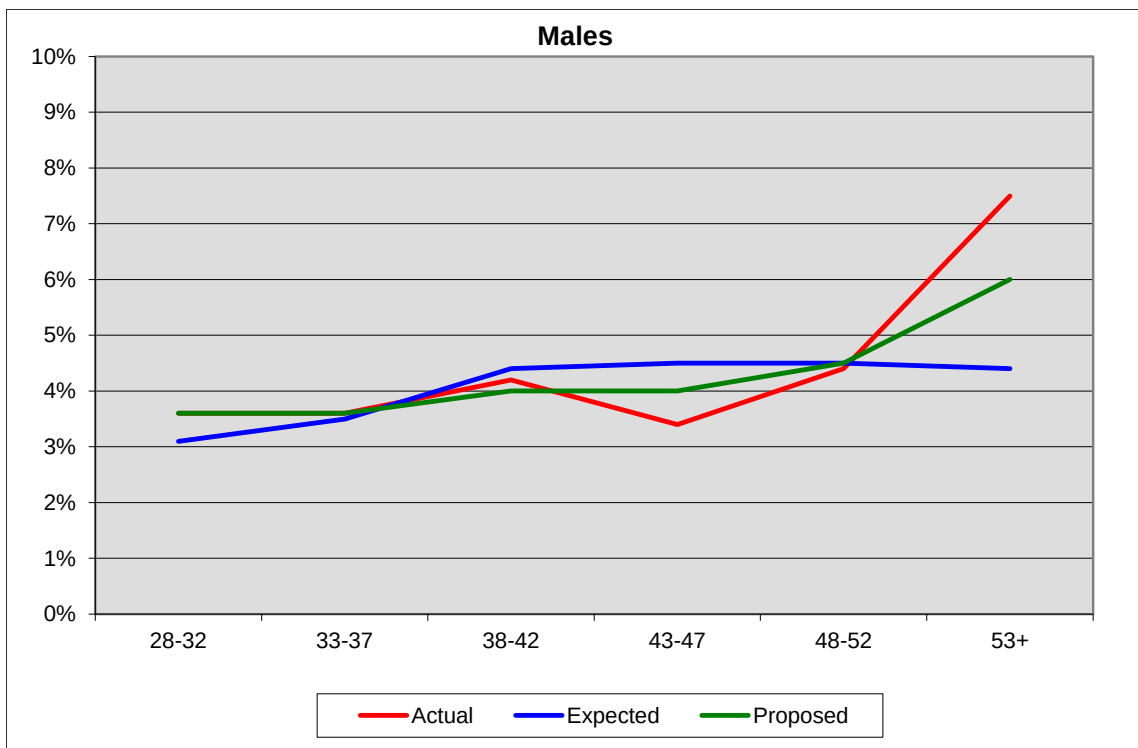
The following graphs show a comparison of the present, actual, and proposed rates of withdrawal for each of the service categories.

**RATES OF WITHDRAWAL FOR ACTIVE MEMBERS  
WITH LESS THAN 5 YEARS OF SERVICE**



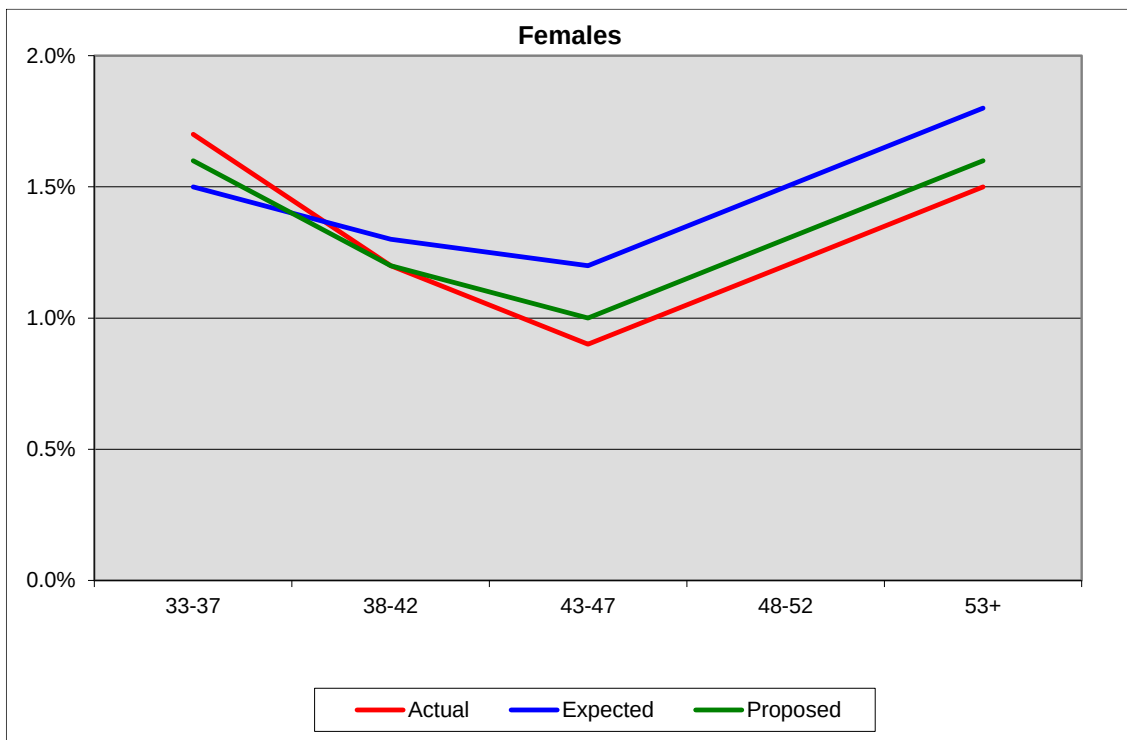
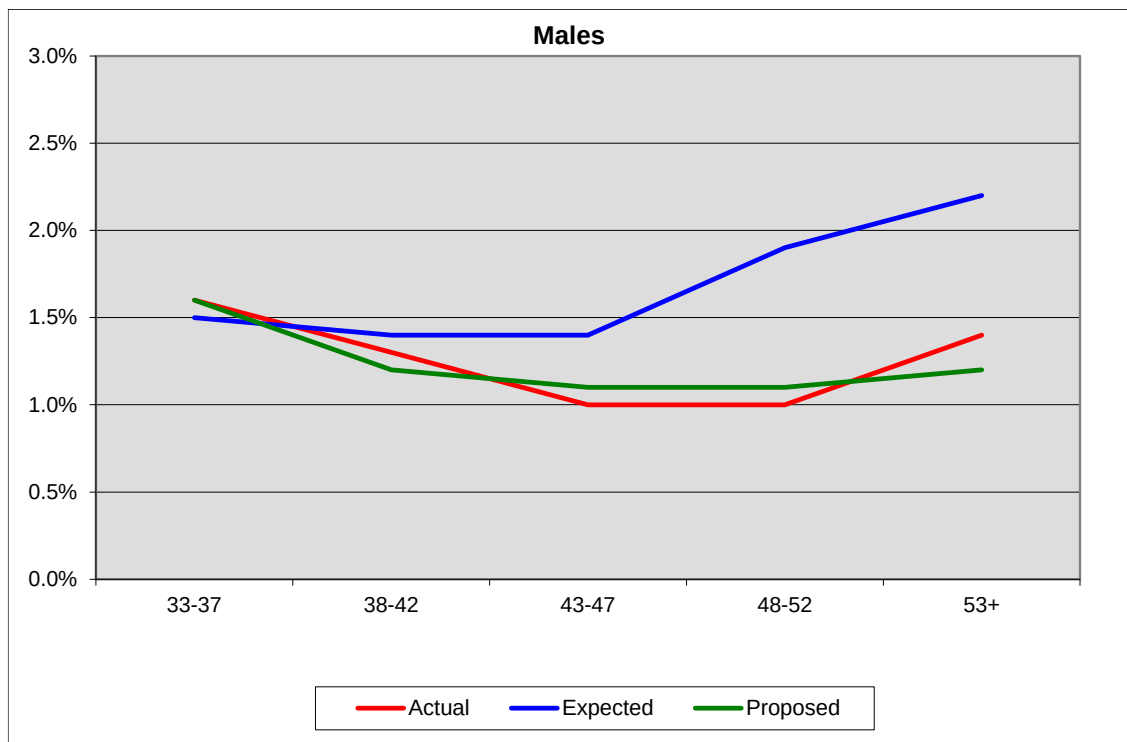
## Section IV – Demographic Assumptions

### RATES OF WITHDRAWAL FOR ACTIVE MEMBERS WITH AT LEAST 5 BUT LESS THAN 10 YEARS OF SERVICE



## Section IV – Demographic Assumptions

### RATES OF WITHDRAWAL FOR ACTIVE MEMBERS WITH 10 OR MORE YEARS OF SERVICE





## Section IV – Demographic Assumptions

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The rates of withdrawal adopted by the Board are used to determine the expected number of separations from active service, which will occur as a result of resignation or dismissal. As discussed in the executive summary, we have used a liability-weighted methodology to study this assumption. The numbers shown in the tables have been weighted by annual salary. The preceding results indicate that for male and female members with less than 5 years of service, the actual weighted withdrawal rates were greater than expected at older ages and less than expected at younger ages and overall.

In addition, the results show that for male and female members with greater than 5 years of service and less than 10 years of service, the actual weighted withdrawal rates show some variations by age category, but were fairly close to the expected rates overall, and for male and female members with greater than 10 years of service, the actual weighted withdrawal rates were less than expected at most ages and in total.

We have determined that the rates of withdrawal should be revised at this time to reflect the experience of the System.

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



## Section IV – Demographic Assumptions

### COMPARATIVE RATES OF WITHDRAWAL FROM ACTIVE SERVICE

| AGE     | RATES OF WITHDRAWAL |       |       |                  |       |       |
|---------|---------------------|-------|-------|------------------|-------|-------|
|         | PRESENT             |       |       | PROPOSED         |       |       |
|         | Years of Service    |       |       | Years of Service |       |       |
|         | 0 - 4               | 5 - 9 | 10+   | 0 - 4            | 5 - 9 | 10+   |
| Males   |                     |       |       |                  |       |       |
| 20      | 11.00%              |       |       | 20.00%           |       |       |
| 25      | 11.00%              | 3.00% |       | 11.00%           | 3.25% |       |
| 30      | 11.00%              | 3.00% | 3.00% | 10.00%           | 3.60% | 2.80% |
| 35      | 12.00%              | 3.50% | 1.40% | 11.00%           | 3.60% | 1.55% |
| 40      | 12.00%              | 4.50% | 1.40% | 12.50%           | 4.00% | 1.25% |
| 45      | 12.00%              | 4.50% | 1.30% | 11.50%           | 4.00% | 1.10% |
| 50      | 14.00%              | 4.50% | 1.90% | 14.25%           | 4.50% | 1.10% |
| 55      | 15.00%              | 4.50% |       | 15.00%           | 6.00% |       |
| Females |                     |       |       |                  |       |       |
| 20      | 9.00%               |       |       | 13.00%           |       |       |
| 25      | 9.00%               | 4.00% |       | 9.00%            | 4.50% |       |
| 30      | 12.00%              | 4.00% | 1.65% | 11.00%           | 4.25% | 1.00% |
| 35      | 12.00%              | 4.00% | 1.50% | 11.00%           | 3.50% | 1.60% |
| 40      | 12.00%              | 4.00% | 1.30% | 12.50%           | 4.00% | 1.20% |
| 45      | 13.00%              | 4.00% | 1.20% | 13.50%           | 4.00% | 1.00% |
| 50      | 13.00%              | 5.00% | 1.50% | 15.00%           | 4.50% | 1.25% |
| 55      | 15.00%              | 5.00% |       | 15.00%           | 5.00% |       |





## Section IV – Demographic Assumptions

The following table shows a comparison of the actual and expected withdrawals from active service based on the new proposed rates of withdrawal.

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

| CENTRAL<br>AGE OF<br>GROUP                                    | RATES OF WITHDRAWAL                           |          |                                   |         |          |                                   |
|---------------------------------------------------------------|-----------------------------------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                                                               | MALES                                         |          |                                   | FEMALES |          |                                   |
|                                                               | Actual                                        | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
|                                                               | Withdrawals with less than 5 years of service |          |                                   |         |          |                                   |
| 20                                                            | 0.263                                         | 0.200    | 1.315                             | 0.155   | 0.127    | 1.220                             |
| 25                                                            | 0.100                                         | 0.108    | 0.926                             | 0.085   | 0.091    | 0.934                             |
| 30                                                            | 0.088                                         | 0.100    | 0.880                             | 0.095   | 0.104    | 0.913                             |
| 35                                                            | 0.100                                         | 0.110    | 0.909                             | 0.105   | 0.110    | 0.955                             |
| 40                                                            | 0.134                                         | 0.125    | 1.072                             | 0.124   | 0.122    | 1.016                             |
| 45                                                            | 0.110                                         | 0.115    | 0.957                             | 0.135   | 0.133    | 1.015                             |
| 50                                                            | 0.144                                         | 0.142    | 1.014                             | 0.163   | 0.150    | 1.087                             |
| 53 & OVER                                                     | 0.172                                         | 0.159    | 1.082                             | 0.201   | 0.174    | 1.155                             |
| TOTAL                                                         | 0.111                                         | 0.116    | 0.957                             | 0.107   | 0.110    | 0.973                             |
| Withdrawals with at least 5 but less than 10 years of service |                                               |          |                                   |         |          |                                   |
| 25                                                            | 0.033                                         | 0.033    | 1.000                             | 0.052   | 0.045    | 1.156                             |
| 30                                                            | 0.036                                         | 0.036    | 1.000                             | 0.042   | 0.043    | 0.977                             |
| 35                                                            | 0.036                                         | 0.036    | 1.000                             | 0.034   | 0.035    | 0.971                             |
| 40                                                            | 0.042                                         | 0.040    | 1.050                             | 0.040   | 0.040    | 1.000                             |
| 45                                                            | 0.034                                         | 0.040    | 0.850                             | 0.036   | 0.040    | 0.900                             |
| 50                                                            | 0.044                                         | 0.045    | 0.978                             | 0.047   | 0.045    | 1.044                             |
| 53 & OVER                                                     | 0.075                                         | 0.060    | 1.250                             | 0.057   | 0.054    | 1.056                             |
| TOTAL                                                         | 0.040                                         | 0.039    | 1.026                             | 0.040   | 0.041    | 0.976                             |
| Withdrawals with 10 or more years of service                  |                                               |          |                                   |         |          |                                   |
| 30                                                            | 0.032                                         | 0.028    | 1.143                             | 0.009   | 0.010    | 0.900                             |
| 35                                                            | 0.016                                         | 0.016    | 1.000                             | 0.017   | 0.016    | 1.063                             |
| 40                                                            | 0.013                                         | 0.012    | 1.083                             | 0.012   | 0.012    | 1.000                             |
| 45                                                            | 0.010                                         | 0.011    | 0.909                             | 0.009   | 0.010    | 0.900                             |
| 50                                                            | 0.010                                         | 0.011    | 0.909                             | 0.012   | 0.013    | 0.923                             |
| 53 & OVER                                                     | 0.014                                         | 0.012    | 1.167                             | 0.015   | 0.016    | 0.938                             |
| TOTAL                                                         | 0.012                                         | 0.012    | 1.000                             | 0.012   | 0.012    | 1.000                             |



## Section IV – Demographic Assumptions

### RATES OF DISABILITY RETIREMENT

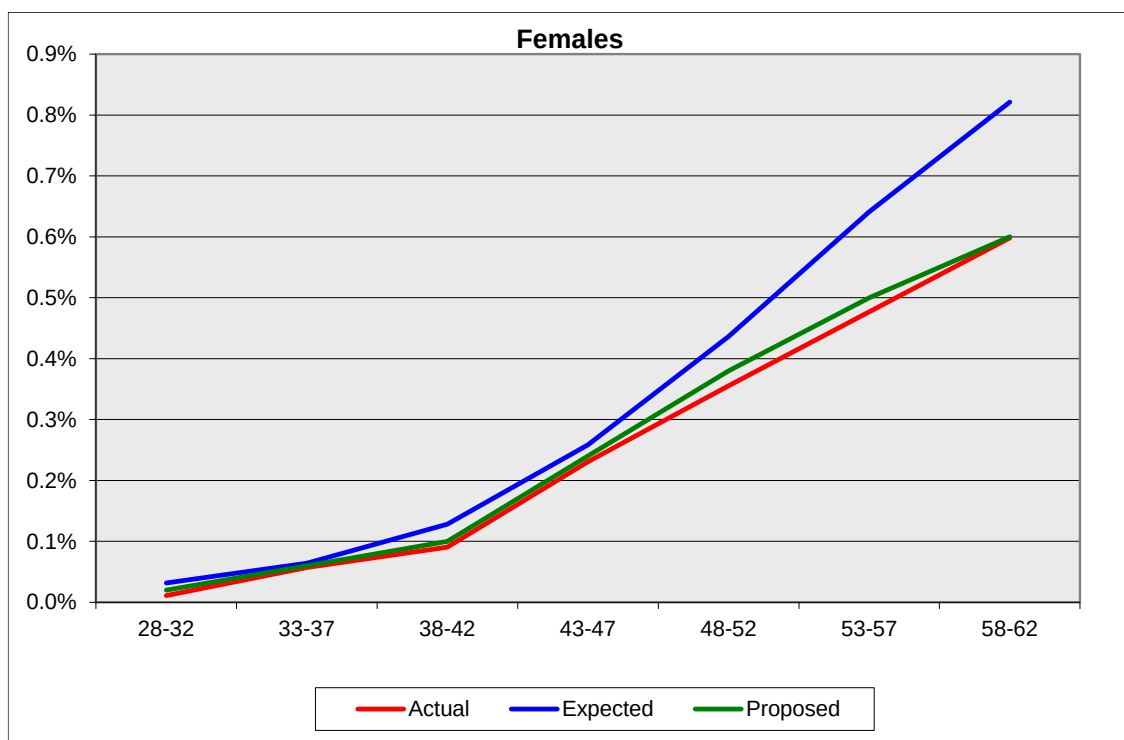
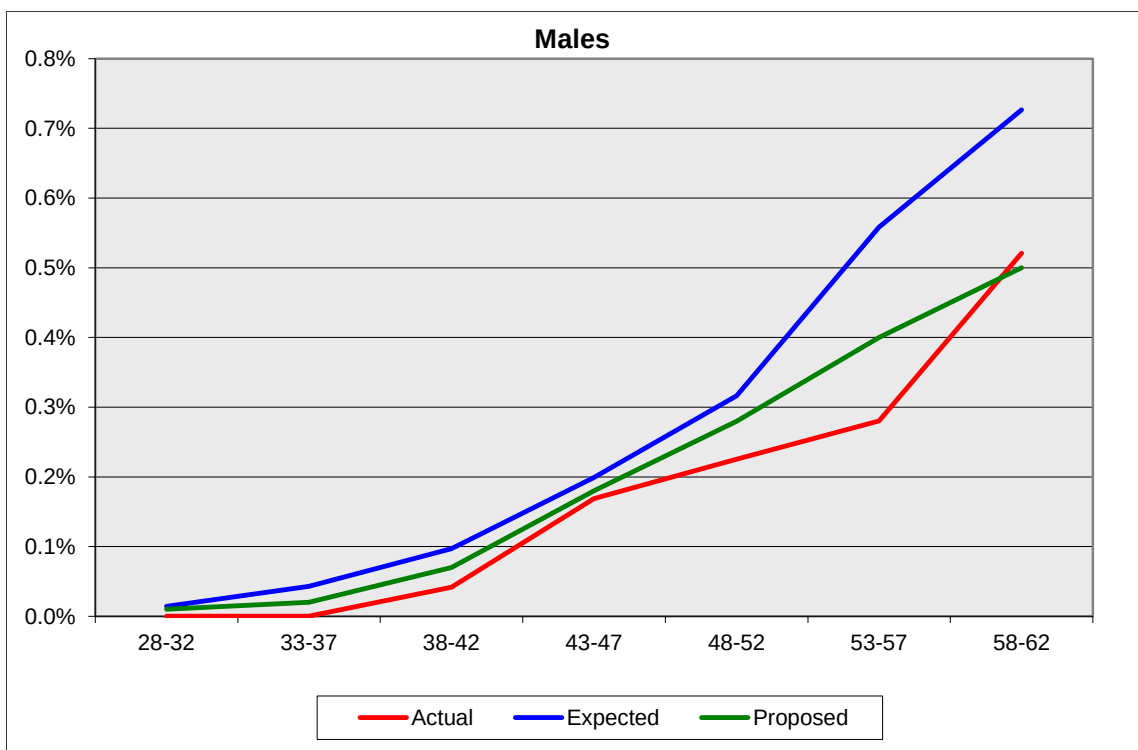
#### COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

| CENTRAL<br>AGE OF<br>GROUP | NUMBER OF DISABILITY RETIREMENTS |          |                                   |         |          |                                   |
|----------------------------|----------------------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                            | MALES                            |          |                                   | FEMALES |          |                                   |
|                            | Actual                           | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 25                         | 0                                | 0.4      | 0.000                             | 0       | 2.2      | 0.000                             |
| 30                         | 0                                | 1.2      | 0.000                             | 3       | 8.8      | 0.341                             |
| 35                         | 0                                | 4.7      | 0.000                             | 19      | 21.4     | 0.888                             |
| 40                         | 5                                | 11.7     | 0.427                             | 32      | 45.4     | 0.705                             |
| 45                         | 21                               | 24.8     | 0.847                             | 85      | 95.2     | 0.893                             |
| 50                         | 24                               | 33.7     | 0.712                             | 118     | 144.8    | 0.815                             |
| 55                         | 21                               | 41.8     | 0.502                             | 103     | 138.4    | 0.744                             |
| 60                         | 23                               | 32.1     | 0.717                             | 73      | 100.3    | 0.728                             |
| 63 & OVER                  | 18                               | 24.4     | 0.738                             | 57      | 53.4     | 1.067                             |
| TOTAL                      | 112                              | 174.8    | 0.641                             | 490     | 609.9    | 0.803                             |

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

## Section IV – Demographic Assumptions

### RATES OF DISABILITY RETIREMENT





## Section IV – Demographic Assumptions

The preceding results indicate that the actual number of disability retirements for both males and females was less than expected at most ages and in aggregate. We have determined that the rates of disability retirements should be revised to reflect more closely the actual experience of the membership.

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

### COMPARATIVE RATES OF DISABILITY RETIREMENTS

| AGE | RATES OF DISABILITY RETIREMENT |          |         |          |
|-----|--------------------------------|----------|---------|----------|
|     | MALES                          |          | FEMALES |          |
|     | Present                        | Proposed | Present | Proposed |
| 20  | 0.01%                          | 0.01%    | 0.01%   | 0.01%    |
| 25  | 0.01%                          | 0.01%    | 0.01%   | 0.01%    |
| 30  | 0.01%                          | 0.01%    | 0.03%   | 0.02%    |
| 35  | 0.04%                          | 0.02%    | 0.06%   | 0.06%    |
| 40  | 0.09%                          | 0.07%    | 0.12%   | 0.10%    |
| 45  | 0.20%                          | 0.18%    | 0.25%   | 0.24%    |
| 50  | 0.30%                          | 0.28%    | 0.44%   | 0.38%    |
| 55  | 0.58%                          | 0.40%    | 0.65%   | 0.50%    |
| 60  | 0.75%                          | 0.50%    | 0.85%   | 0.60%    |



## Section IV – Demographic Assumptions

The following table shows a comparison of the actual and expected disability retirements based on new proposed rates of disability.

### COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS BASED ON PROPOSED RATES OF DISABILITY

| CENTRAL<br>AGE OF<br>GROUP | NUMBER OF DISABILITY RETIREMENTS |          |                                   |         |          |                                   |
|----------------------------|----------------------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                            | MALES                            |          |                                   | FEMALES |          |                                   |
|                            | Actual                           | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 25                         | 0                                | 0.4      | 0.000                             | 0       | 1.3      | 0.000                             |
| 30                         | 0                                | 1.0      | 0.000                             | 2       | 5.2      | 0.385                             |
| 35                         | 0                                | 2.8      | 0.000                             | 14      | 17.0     | 0.824                             |
| 40                         | 5                                | 9.3      | 0.538                             | 27      | 34.1     | 0.792                             |
| 45                         | 21                               | 22.3     | 0.942                             | 73      | 77.1     | 0.947                             |
| 50                         | 24                               | 29.7     | 0.808                             | 120     | 122.9    | 0.976                             |
| 55                         | 21                               | 29.5     | 0.712                             | 102     | 112.3    | 0.908                             |
| 60                         | 23                               | 21.5     | 1.070                             | 83      | 79.1     | 1.049                             |
| 63 & OVER                  | 18                               | 16.2     | 1.111                             | 69      | 51.4     | 1.342                             |
| TOTAL                      | 112                              | 132.7    | 0.844                             | 490     | 500.4    | 0.979                             |



## Section IV – Demographic Assumptions

### RATES OF RETIREMENT

#### COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

#### MEMBERS WITH LESS THAN 27 YEARS OF SERVICE

| CENTRAL<br>AGE OF<br>GROUP   | NUMBER OF RETIREMENTS |          |                                   |         |          |                                   |
|------------------------------|-----------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                              | MALES                 |          |                                   | FEMALES |          |                                   |
|                              | Actual                | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 55                           | 51                    | 46.8     | 1.090                             | 141     | 160.2    | 0.880                             |
| 56                           | 48                    | 41.7     | 1.151                             | 211     | 148.6    | 1.420                             |
| 57                           | 45                    | 41.0     | 1.098                             | 172     | 135.7    | 1.268                             |
| 58                           | 50                    | 36.0     | 1.389                             | 165     | 127.3    | 1.296                             |
| 59                           | 40                    | 34.5     | 1.159                             | 168     | 127.4    | 1.319                             |
| 60                           | 83                    | 83.1     | 0.999                             | 302     | 283.6    | 1.065                             |
| 61                           | 93                    | 74.8     | 1.243                             | 351     | 239.7    | 1.464                             |
| 62                           | 73                    | 76.1     | 0.959                             | 230     | 194.7    | 1.181                             |
| 63                           | 95                    | 62.3     | 1.525                             | 245     | 176.6    | 1.387                             |
| 64                           | 57                    | 60.6     | 0.941                             | 174     | 138.5    | 1.256                             |
| 65                           | 62                    | 67.2     | 0.923                             | 182     | 167.9    | 1.084                             |
| 66                           | 64                    | 54.0     | 1.185                             | 173     | 134.4    | 1.287                             |
| 67                           | 67                    | 44.6     | 1.502                             | 130     | 74.5     | 1.745                             |
| 68                           | 42                    | 31.2     | 1.346                             | 83      | 49.3     | 1.684                             |
| 69                           | 35                    | 23.4     | 1.496                             | 58      | 36.5     | 1.589                             |
| SUBTOTAL                     | 905                   | 777.3    | 1.164                             | 2,785   | 2,194.9  | 1.269                             |
| 70 & OVER                    | 98                    | 117.2    | 0.836                             | 174     | 196.8    | 0.884                             |
| TOTAL                        | 1,003                 | 894.5    | 1.121                             | 2,959   | 2,391.7  | 1.237                             |
| Average<br>Retirement<br>Age | 63.1                  | 63.5     | 0.994                             | 62.0    | 62.3     | 0.995                             |



## Section IV – Demographic Assumptions

### COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

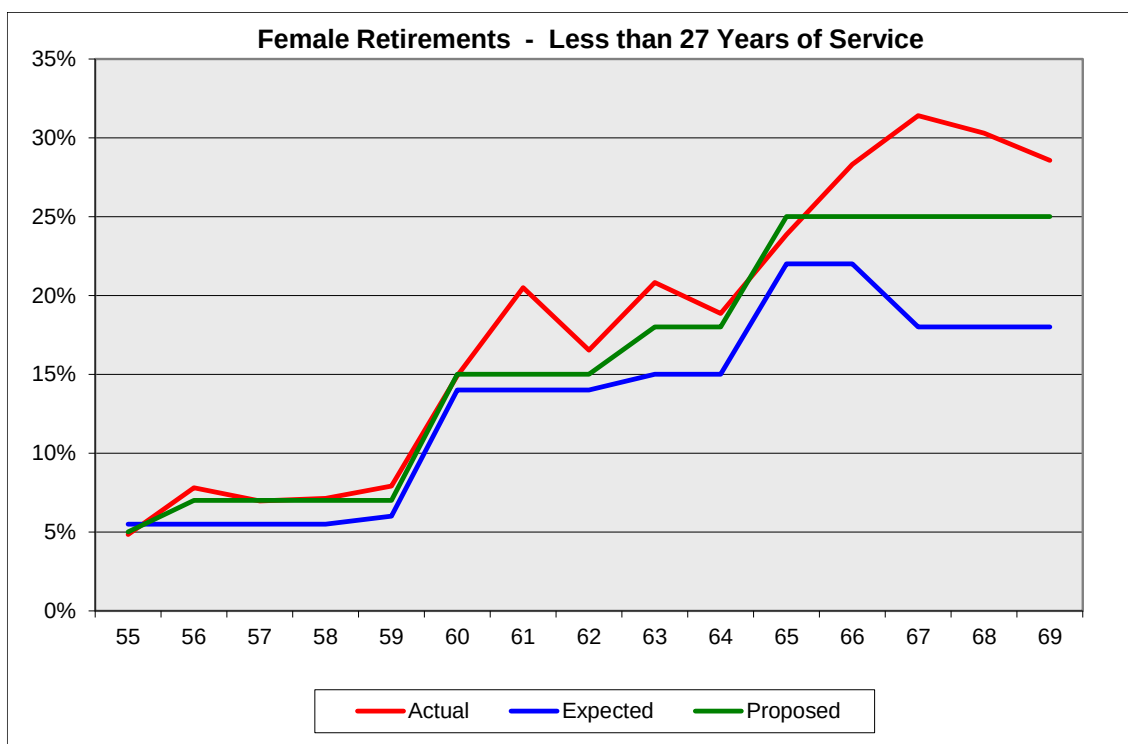
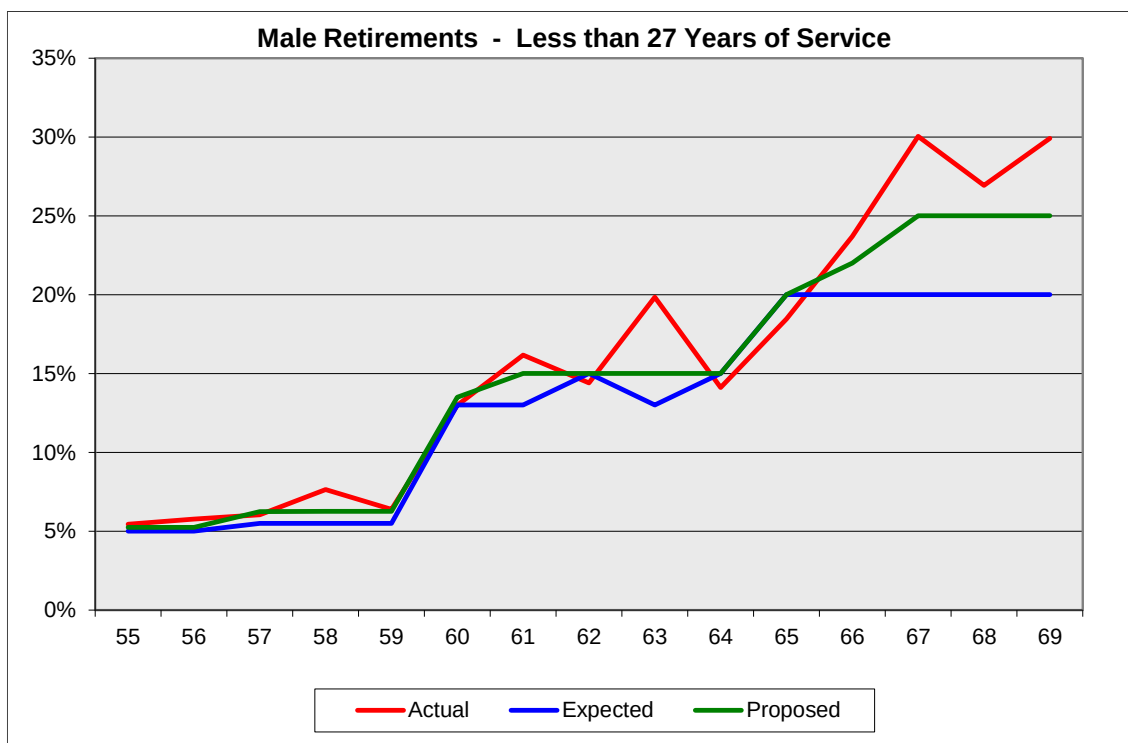
#### MEMBERS WITH 27 OR MORE YEARS OF SERVICE

| CENTRAL<br>AGE OF<br>GROUP   | NUMBER OF RETIREMENTS |          |                                   |         |          |                                   |
|------------------------------|-----------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                              | MALES                 |          |                                   | FEMALES |          |                                   |
|                              | Actual                | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 52 & Under                   | 285                   | 197.6    | 1.442                             | 1,025   | 839.1    | 1.222                             |
| 53                           | 79                    | 58.6     | 1.348                             | 261     | 247.1    | 1.056                             |
| 54                           | 58                    | 69.7     | 0.832                             | 198     | 232.4    | 0.852                             |
| 55                           | 146                   | 184.3    | 0.792                             | 623     | 641.6    | 0.971                             |
| 56                           | 186                   | 128.3    | 1.450                             | 471     | 386.7    | 1.218                             |
| 57                           | 86                    | 80.8     | 1.064                             | 225     | 223.1    | 1.009                             |
| 58                           | 66                    | 76.0     | 0.868                             | 191     | 182.6    | 1.046                             |
| 59                           | 65                    | 51.0     | 1.275                             | 169     | 165.5    | 1.021                             |
| 60                           | 63                    | 67.4     | 0.935                             | 180     | 164.9    | 1.092                             |
| 61                           | 51                    | 52.3     | 0.975                             | 157     | 146.9    | 1.069                             |
| 62                           | 46                    | 38.2     | 1.204                             | 134     | 129.3    | 1.036                             |
| 63                           | 45                    | 31.2     | 1.442                             | 119     | 113.9    | 1.045                             |
| 64                           | 35                    | 27.2     | 1.287                             | 81      | 84.2     | 0.962                             |
| 65                           | 36                    | 28.3     | 1.272                             | 86      | 66.6     | 1.291                             |
| 66                           | 31                    | 28.2     | 1.099                             | 64      | 49.0     | 1.306                             |
| 67                           | 19                    | 17.6     | 1.080                             | 51      | 39.7     | 1.285                             |
| 68                           | 15                    | 15.8     | 0.949                             | 28      | 29.9     | 0.936                             |
| 69                           | 13                    | 10.7     | 1.215                             | 31      | 27.8     | 1.115                             |
| SUBTOTAL                     | 1,325                 | 1,163.2  | 1.139                             | 4,094   | 3,770.3  | 1.086                             |
| 70 & OVER                    | 66                    | 67.0     | 0.985                             | 80      | 101.0    | 0.792                             |
| TOTAL                        | 1,391                 | 1,230.2  | 1.131                             | 4,174   | 3,871.3  | 1.078                             |
| Average<br>Retirement<br>Age | 57.5                  | 58.0     | 0.991                             | 56.4    | 56.7     | 0.995                             |

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

## Section IV – Demographic Assumptions

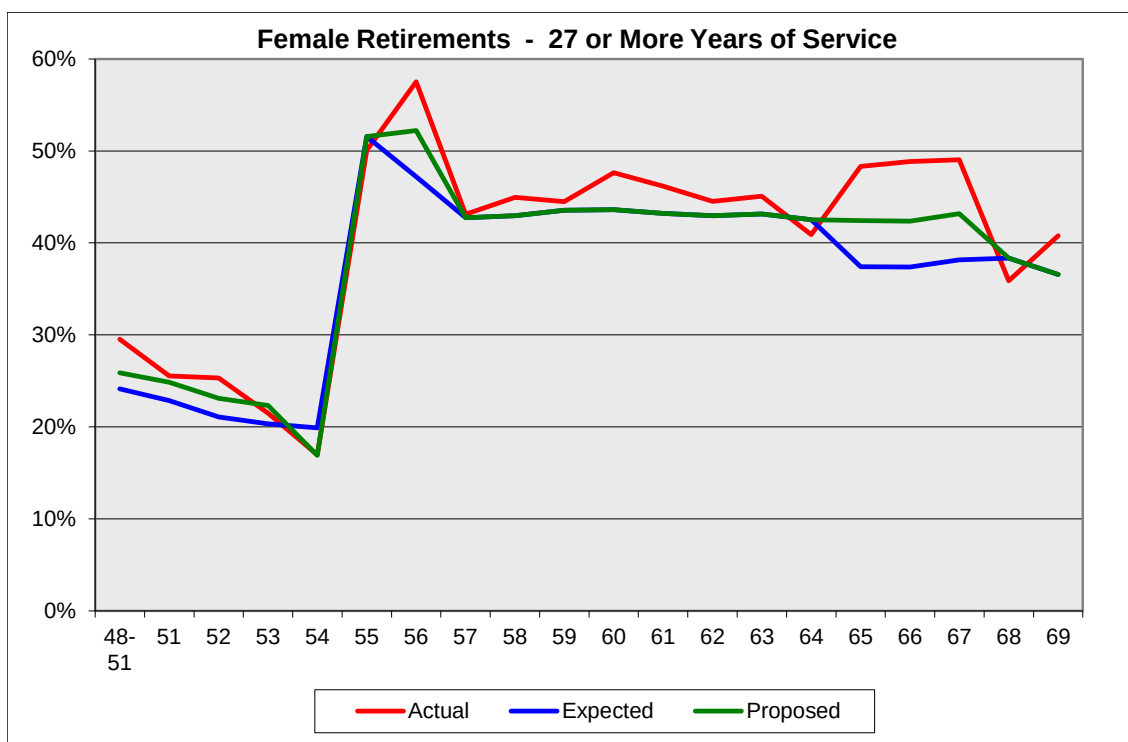
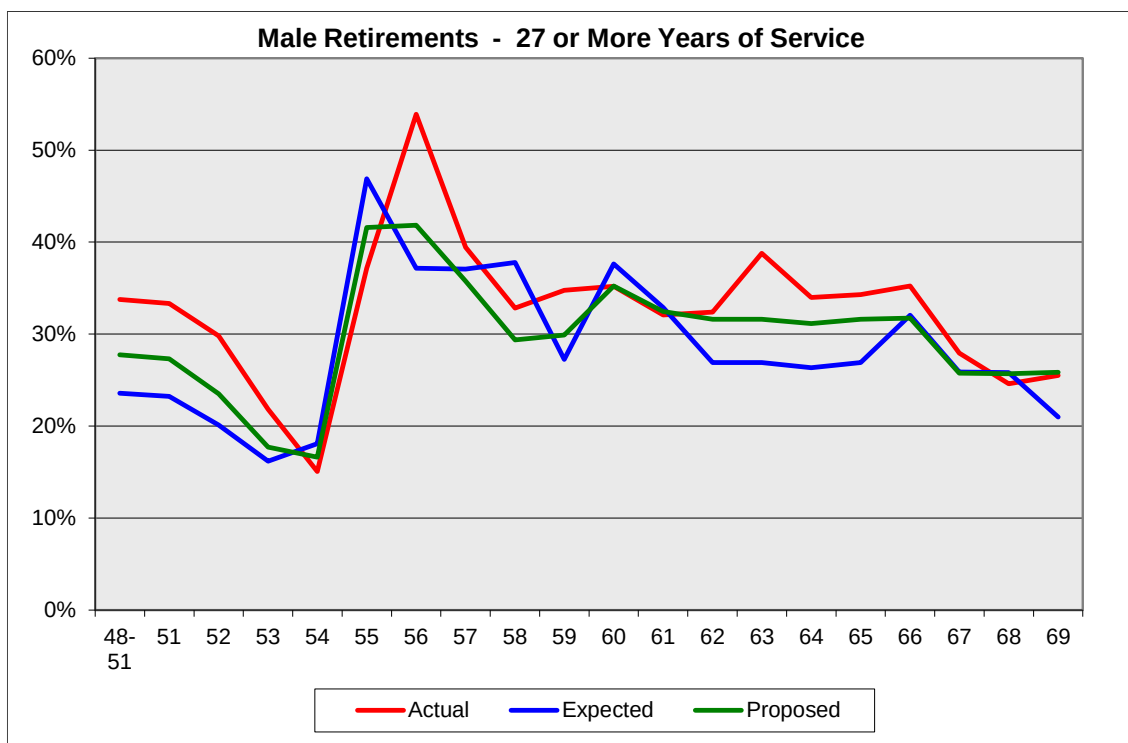
### RATES OF RETIREMENT





## Section IV – Demographic Assumptions

### RATES OF RETIREMENT





## Section IV – Demographic Assumptions

The preceding results indicates that in most age categories and overall, the actual rates of retirement for members with less than 27 years of service for both males and females were greater than expected.

For members with 27 or more years of service, the actual rates of retirement were greater than expected at most ages and overall. On the basis of this experience, we have determined that the rates of retirement need revision in order to reflect actual experience more closely. The following table shows a comparison of the present and proposed rates of service retirement.

### COMPARATIVE RATES OF RETIREMENT

| AGE | RATES OF RETIREMENT                            |                                               |                                                 |                                                 |                                                |                                               |                                                 |                                                  |
|-----|------------------------------------------------|-----------------------------------------------|-------------------------------------------------|-------------------------------------------------|------------------------------------------------|-----------------------------------------------|-------------------------------------------------|--------------------------------------------------|
|     | MALES                                          |                                               |                                                 |                                                 | FEMALES                                        |                                               |                                                 |                                                  |
|     | Present<br>Less than<br>27 Years of<br>Service | Present*<br>27 or More<br>Years of<br>Service | Proposed<br>Less than<br>27 Years of<br>Service | Proposed**<br>27 or More<br>Years of<br>Service | Present<br>Less than<br>27 Years of<br>Service | Present*<br>27 or More<br>Years of<br>Service | Proposed<br>Less than<br>27 Years of<br>Service | Proposed***<br>27 or More<br>Years of<br>Service |
| 48  | 0.00%                                          | 17.00%                                        | 0.00%                                           | 17.00%                                          | 0.00%                                          | 15.00%                                        | 0.00%                                           | 17.00%                                           |
| 49  | 0.00%                                          | 17.00%                                        | 0.00%                                           | 17.00%                                          | 0.00%                                          | 17.00%                                        | 0.00%                                           | 17.00%                                           |
| 50  | 0.00%                                          | 17.00%                                        | 0.00%                                           | 25.00%                                          | 0.00%                                          | 18.00%                                        | 0.00%                                           | 20.00%                                           |
| 51  | 0.00%                                          | 17.00%                                        | 0.00%                                           | 22.00%                                          | 0.00%                                          | 18.00%                                        | 0.00%                                           | 20.00%                                           |
| 52  | 0.00%                                          | 16.00%                                        | 0.00%                                           | 20.00%                                          | 0.00%                                          | 18.00%                                        | 0.00%                                           | 20.00%                                           |
| 53  | 0.00%                                          | 13.00%                                        | 0.00%                                           | 15.00%                                          | 0.00%                                          | 18.00%                                        | 0.00%                                           | 20.00%                                           |
| 54  | 0.00%                                          | 15.00%                                        | 0.00%                                           | 14.00%                                          | 0.00%                                          | 18.00%                                        | 0.00%                                           | 15.00%                                           |
| 55  | 5.00%                                          | 45.00%                                        | 5.25%                                           | 40.00%                                          | 5.50%                                          | 50.00%                                        | 5.00%                                           | 50.00%                                           |
| 56  | 5.00%                                          | 35.00%                                        | 5.25%                                           | 40.00%                                          | 5.50%                                          | 45.00%                                        | 7.00%                                           | 50.00%                                           |
| 57  | 5.50%                                          | 35.00%                                        | 6.25%                                           | 34.00%                                          | 5.50%                                          | 40.00%                                        | 7.00%                                           | 40.00%                                           |
| 58  | 5.50%                                          | 35.00%                                        | 6.25%                                           | 27.00%                                          | 5.50%                                          | 40.00%                                        | 7.00%                                           | 40.00%                                           |
| 59  | 5.50%                                          | 25.00%                                        | 6.25%                                           | 28.00%                                          | 6.00%                                          | 40.00%                                        | 7.00%                                           | 40.00%                                           |
| 60  | 13.00%                                         | 35.00%                                        | 13.50%                                          | 33.00%                                          | 14.00%                                         | 40.00%                                        | 15.00%                                          | 40.00%                                           |
| 61  | 13.00%                                         | 30.00%                                        | 15.00%                                          | 30.00%                                          | 14.00%                                         | 40.00%                                        | 15.00%                                          | 40.00%                                           |
| 62  | 15.00%                                         | 25.00%                                        | 15.00%                                          | 30.00%                                          | 14.00%                                         | 40.00%                                        | 15.00%                                          | 40.00%                                           |
| 63  | 13.00%                                         | 25.00%                                        | 15.00%                                          | 30.00%                                          | 15.00%                                         | 40.00%                                        | 18.00%                                          | 40.00%                                           |
| 64  | 15.00%                                         | 25.00%                                        | 15.00%                                          | 30.00%                                          | 15.00%                                         | 40.00%                                        | 18.00%                                          | 40.00%                                           |
| 65  | 20.00%                                         | 25.00%                                        | 20.00%                                          | 30.00%                                          | 22.00%                                         | 35.00%                                        | 25.00%                                          | 40.00%                                           |
| 66  | 20.00%                                         | 30.00%                                        | 22.00%                                          | 30.00%                                          | 22.00%                                         | 35.00%                                        | 25.00%                                          | 40.00%                                           |
| 67  | 20.00%                                         | 25.00%                                        | 25.00%                                          | 25.00%                                          | 18.00%                                         | 35.00%                                        | 25.00%                                          | 40.00%                                           |
| 68  | 20.00%                                         | 25.00%                                        | 25.00%                                          | 25.00%                                          | 18.00%                                         | 35.00%                                        | 25.00%                                          | 35.00%                                           |
| 69  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 25.00%                                          | 18.00%                                         | 35.00%                                        | 25.00%                                          | 35.00%                                           |
| 70  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 30.00%                                          | 20.00%                                         | 35.00%                                        | 30.00%                                          | 35.00%                                           |
| 71  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 30.00%                                          | 20.00%                                         | 35.00%                                        | 30.00%                                          | 35.00%                                           |
| 72  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 30.00%                                          | 20.00%                                         | 35.00%                                        | 30.00%                                          | 35.00%                                           |
| 73  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 30.00%                                          | 20.00%                                         | 35.00%                                        | 30.00%                                          | 35.00%                                           |
| 74  | 20.00%                                         | 20.00%                                        | 25.00%                                          | 30.00%                                          | 20.00%                                         | 35.00%                                        | 30.00%                                          | 35.00%                                           |
| 75  | 100.00%                                        | 100.00%                                       | 100.00%                                         | 100.00%                                         | 100.00%                                        | 100.00%                                       | 100.00%                                         | 100.00%                                          |

\* Plus 7.5% in year when first eligible for unreduced retirement with 27 years of service.

\*\* Plus 8.5% in year when first eligible for unreduced retirement with 27 years of service.

\*\*\* Plus 10.0% in year when first eligible for unreduced retirement with 27 years of service.



## Section IV – Demographic Assumptions

The following table shows a comparison of actual and expected service retirements based on new proposed rates of retirement.

### COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RETIREMENT RATES

#### MEMBERS WITH LESS THAN 27 YEARS OF SERVICE

| CENTRAL<br>AGE OF<br>GROUP   | NUMBER OF RETIREMENTS |          |                                   |         |          |                                   |
|------------------------------|-----------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                              | MALES                 |          |                                   | FEMALES |          |                                   |
|                              | Actual                | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 55                           | 51                    | 49.1     | 1.039                             | 141     | 145.6    | 0.968                             |
| 56                           | 48                    | 43.7     | 1.098                             | 211     | 189.1    | 1.116                             |
| 57                           | 45                    | 46.6     | 0.966                             | 172     | 172.8    | 0.995                             |
| 58                           | 50                    | 40.9     | 1.222                             | 165     | 162.1    | 1.018                             |
| 59                           | 40                    | 39.2     | 1.020                             | 168     | 148.6    | 1.131                             |
| 60                           | 83                    | 86.3     | 0.962                             | 302     | 303.9    | 0.994                             |
| 61                           | 93                    | 86.3     | 1.078                             | 351     | 256.8    | 1.367                             |
| 62                           | 73                    | 76.1     | 0.959                             | 230     | 208.7    | 1.102                             |
| 63                           | 95                    | 71.9     | 1.321                             | 245     | 211.9    | 1.156                             |
| 64                           | 57                    | 60.6     | 0.941                             | 174     | 166.1    | 1.048                             |
| 65                           | 62                    | 67.2     | 0.923                             | 182     | 190.8    | 0.954                             |
| 66                           | 64                    | 59.4     | 1.077                             | 173     | 152.8    | 1.132                             |
| 67                           | 67                    | 55.8     | 1.201                             | 130     | 103.5    | 1.256                             |
| 68                           | 42                    | 39.0     | 1.077                             | 83      | 68.5     | 1.212                             |
| 69                           | 35                    | 29.3     | 1.195                             | 58      | 50.8     | 1.142                             |
| SUBTOTAL                     | 905                   | 851.4    | 1.063                             | 2,785   | 2,532.0  | 1.100                             |
| 70 & OVER                    | 98                    | 131.0    | 0.748                             | 174     | 237.7    | 0.732                             |
| TOTAL                        | 1,003                 | 982.4    | 1.021                             | 2,959   | 2,769.7  | 1.068                             |
| Average<br>Retirement<br>Age | 63.1                  | 63.6     | 0.992                             | 62.0    | 62.4     | 0.994                             |



## Section IV – Demographic Assumptions

### COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RETIREMENT RATES

#### MEMBERS WITH 27 YEARS OF SERVICE AND MORE

| CENTRAL<br>AGE OF<br>GROUP   | NUMBER OF RETIREMENTS |          |                                   |         |          |                                   |
|------------------------------|-----------------------|----------|-----------------------------------|---------|----------|-----------------------------------|
|                              | MALES                 |          |                                   | FEMALES |          |                                   |
|                              | Actual                | Expected | Ratio of<br>Actual to<br>Expected | Actual  | Expected | Ratio of<br>Actual to<br>Expected |
| 52 & Under                   | 285                   | 231.4    | 1.232                             | 1,025   | 906.0    | 1.131                             |
| 53                           | 79                    | 64.1     | 1.232                             | 261     | 271.4    | 0.962                             |
| 54                           | 58                    | 64.0     | 0.906                             | 198     | 197.4    | 1.003                             |
| 55                           | 146                   | 163.5    | 0.893                             | 623     | 641.6    | 0.971                             |
| 56                           | 186                   | 144.4    | 1.288                             | 471     | 427.6    | 1.101                             |
| 57                           | 86                    | 77.9     | 1.104                             | 225     | 223.1    | 1.009                             |
| 58                           | 66                    | 59.0     | 1.119                             | 191     | 182.6    | 1.046                             |
| 59                           | 65                    | 55.9     | 1.163                             | 169     | 165.5    | 1.021                             |
| 60                           | 63                    | 63.1     | 0.998                             | 180     | 164.9    | 1.092                             |
| 61                           | 51                    | 51.6     | 0.988                             | 157     | 146.9    | 1.069                             |
| 62                           | 46                    | 44.9     | 1.024                             | 134     | 129.3    | 1.036                             |
| 63                           | 45                    | 36.7     | 1.226                             | 119     | 113.9    | 1.045                             |
| 64                           | 35                    | 32.1     | 1.090                             | 81      | 84.2     | 0.962                             |
| 65                           | 36                    | 33.2     | 1.084                             | 86      | 75.5     | 1.139                             |
| 66                           | 31                    | 27.9     | 1.111                             | 64      | 55.5     | 1.153                             |
| 67                           | 19                    | 17.5     | 1.086                             | 51      | 44.9     | 1.136                             |
| 68                           | 15                    | 15.7     | 0.955                             | 28      | 29.9     | 0.936                             |
| 69                           | 13                    | 13.2     | 0.985                             | 31      | 27.8     | 1.115                             |
| SUBTOTAL                     | 1,325                 | 1,196.1  | 1.108                             | 4,094   | 3,888.0  | 1.053                             |
| 70 & OVER                    | 66                    | 80.0     | 0.825                             | 80      | 101.0    | 0.792                             |
| TOTAL                        | 1,391                 | 1,276.1  | 1.090                             | 4,174   | 3,989.0  | 1.046                             |
| Average<br>Retirement<br>Age | 57.5                  | 58.0     | 0.991                             | 56.4    | 56.6     | 0.996                             |



## Section IV – Demographic Assumptions

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### RATES OF MORTALITY

Mortality tables are a fundamental assumption in actuarial valuations. Benefits are paid over a retiree's lifetime, so it is important to appropriately reflect what a typical lifetime is expected to be. In addition, deaths before retirement typically result in the payout of benefits to a spouse or survivor. For this review, we considered the following mortality:

- Post-retirement – project the percentage of healthy participants in pay status expected to die each year
- Contingent Annuitant – project the percentage of spouses or survivors in pay status expected to die each year
- Pre-retirement – project the percentage of active employees expected to die each year
- Disabled – project the percentage of disabled retirees expected to die each year

### **Method**

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

There are two widely used approaches for reflecting future improvements in mortality:

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is with the use of a static mortality table with “margin.” Under this approach, the A/E ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. While there is no formal guidance as to the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10 to 14% at the core ages of the retired member. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If that occurs, the assumption will need to be updated.



## Section IV – Demographic Assumptions

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Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% since future mortality improvements will be taken into account directly in the actuarial valuation process.

For the mortality decrements, we also analyzed the experience using a liability-weighted approach (also referred to as benefit-weighted). This is approximated by using the member’s retirement benefit from the data collected. The exposure and actual occurrences are then multiplied by the benefit level to provide the liability-weighted experience. This approach is particularly insightful when analyzing experience from a non-homogenous group. While we reviewed the mortality experience on both a count and liability-weighted basis, we ultimately decided on the liability-weighted results to evaluate experience and develop a new mortality table.

The current post-retirement mortality assumption for healthy lives is a static table, the RP-2000 Combined Mortality Table projected to 2025 with projection scale BB and set forward 2 years for males and set forward 1 year for females. The results of the experience analysis indicate that this table provided a reasonable expectation of mortality for the past five years but there were consistent mortality losses in each of the last five valuations.

While prior pension mortality tables have been based solely on private corporate and union retirement plans, new tables, released in late 2018, are based entirely on public sector plan data. These new tables are referred to the Pub-2010 Public Mortality Plan Mortality Tables. These tables are split by three membership types: Safety, Teachers, and General to reflect the observed differences in mortality patterns related to the three groups. Tables are further split for healthy retirees, disabled retirees, contingent beneficiaries, and employees. There are still other breakdowns in these tables for at, above or below median annuity values. We anticipate that this family of tables will be a good starting point in developing a mortality assumption.



## Section IV – Demographic Assumptions

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The following steps used to set a new mortality table are as follows:

- 1) Selecting a mortality table based on standard mortality tables published by the Society of Actuaries adjusted using various techniques to provide a better fit to the actual mortality experience, but with no adjustment for expected future mortality improvements. The mortality table selected is determined on a benefit-weighted basis. This means that the ages at death for retirees with larger benefits are weighted more than the ages at death for retirees with smaller benefits. Using this weighting resulted in selecting tables with longer life expectancies than tables that would have been selected based on a head-count weighted basis.
- 2) Applying a “mortality projection” scale which is an explicit assumption that future generations live longer than current generations. Beginning in 2014, the SOA has released an updated mortality improvement scale every year. We are proposing using the most recently released scale, MP-2020, adjusted to 75% of the standard rates. This adjustment results in improvements that are less than those suggested by the MP-2020 scale. We have suggested this adjustment because each year since 2014 the SOA has scaled back the amount of mortality improvement in subsequent mortality projection scales.

Generational mortality tables tend to reflect actual life expectancies of plan members more accurately and since future mortality improvements are built into the tables future updates to the tables tend to be on a smaller scale.

### Experience

This Section summarizes the post-retirement, pre-retirement, disabled, and contingent annuitant mortality experience of the study period. The charts below summarize the experience by showing the ratio of the actual number of benefits released during the study period over the expected number of benefits released over the study period, compiled separately for males and females. In these charts, a ratio greater/(less) than 100% indicates that there were more/(fewer) benefits released than expected by the current assumption.

Post-retirement and contingent annuitant mortality have the most significant impact on mortality experience in the plans.



## Section IV – Demographic Assumptions

The healthy service retiree's post-retirement mortality gains and losses over the study period are as follows and are consistent with our analysis of actual to expected:

| POST-RETIREMENT MORTALITY GAIN/(LOSS) |        |        |        |        |        |                   |
|---------------------------------------|--------|--------|--------|--------|--------|-------------------|
| (In millions)                         | 2016   | 2017   | 2018   | 2019   | 2020   | Total Gain/(Loss) |
| TRS                                   | (71.1) | (45.2) | (58.8) | (51.4) | (73.9) | (300.4)           |

| POST-RETIREMENT MORTALITY |                             |                             |                             |                             |
|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                           | MALES                       |                             | FEMALES                     |                             |
|                           | Ratio of actual to expected | Ratio of actual to proposed | Ratio of actual to expected | Ratio of actual to proposed |
| TRS                       | 0.902                       | 0.981                       | 0.824                       | 0.971                       |

We would have anticipated experience gains over the study period due to using a static table with margin approach. However, experience indicates that the current post-retirement mortality assumption primarily produced losses during the study period.





## Section IV – Demographic Assumptions

The contingent annuitant's post-retirement mortality gains and losses over the study period are as follows and are consistent with our analysis of actual to expected:

| CONTINGENT ANNUITANT MORTALITY GAIN/(LOSS) |      |       |      |       |       |                   |
|--------------------------------------------|------|-------|------|-------|-------|-------------------|
| (In millions)                              | 2016 | 2017  | 2018 | 2019  | 2020  | Total Gain/(Loss) |
| TRS                                        | 0.0  | (2.8) | 1.3  | (6.9) | (5.6) | (14.0)            |

| CONTINGENT ANNUITANT MORTALITY |                             |                             |                             |                             |
|--------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                                | MALES                       |                             | FEMALES                     |                             |
|                                | Ratio of actual to expected | Ratio of actual to proposed | Ratio of actual to expected | Ratio of actual to proposed |
| TRS                            | 1.284                       | 1.011                       | 0.931                       | 0.993                       |

In the past, the same mortality assumption used for post-retirement service retiree's mortality was also used for contingent annuitants. A new feature of the Pub-2010 tables is a contingent annuitant specific table. We propose using these tables for contingent annuitants. In most cases, we have made assumptions that tie closely to the actual experience, but the data is not sufficient enough to be expected to closely predict mortality rates in the future for this group.



## Section IV – Demographic Assumptions

Charts summarizing the pre-retirement and disabled mortality are as follows:

| PRE-RETIREMENT MORTALITY |                             |                             |                             |                             |
|--------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                          | MALES                       |                             | FEMALES                     |                             |
|                          | Ratio of actual to expected | Ratio of actual to proposed | Ratio of actual to expected | Ratio of actual to proposed |
| TRS                      | 0.880                       | 0.990                       | 0.874                       | 0.989                       |

| DISABLED MORTALITY |                             |                             |                             |                             |
|--------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                    | MALES                       |                             | FEMALES                     |                             |
|                    | Ratio of actual to expected | Ratio of actual to proposed | Ratio of actual to expected | Ratio of actual to proposed |
| TRS                | 0.792                       | 0.985                       | 0.558                       | 0.978                       |

As is typical with most large public pension plans, a small number of pre-retirement and disability deaths occur, and thus a small amount of liability is released for the active and disabled member populations during the experience period. We are changing the base tables to the Pub-2010 employee and disabled tables respectively and have applied minimal adjustments to better fit the experience. In most cases we have made assumptions that tie more closely to the actual experience, but the data is not sufficient enough to be expected to closely predict mortality rates in the future for these groups.



## Section IV – Demographic Assumptions

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### Determination

We have determined that TRS should change to a Generational Mortality approach on a benefit-weighted basis.

We are also updating the base mortality table from RP 2014 to the Pub-2010 tables for teachers which is the latest table produced by the Society of Actuaries and adjusting this new base table to better match the experience of TRS.

Finally, we are implementing the MP-2020 mortality improvement scale adjusted to 75% of the standard rates.

Below is a summary of the specific mortality tables and adjustments for each of the groups:

| <u>Group</u>             | <u>Membership<br/>Table</u>  | <u>Set Forward (+)/<br/>Setback (-)</u> | <u>Adjustment to<br/>Rates</u> | <u>Projection Scale</u> |
|--------------------------|------------------------------|-----------------------------------------|--------------------------------|-------------------------|
| Service Retirees         | Teachers<br>Benefit-Weighted | Male: +2<br>Female: +2                  | Male: 102%,<br>Female: 98%     | 75% of MP-2020          |
| Contingent<br>Annuitants | Teachers<br>Benefit-Weighted | Male: +2<br>Female: None                | Male: 101%,<br>Female: 100%    | 75% of MP-2020          |
| Disabled Retirees        | Teachers<br>Benefit-Weighted | Male: +1<br>Female: -2                  | Male: 96%,<br>Female: 94%      | 75% of MP-2020          |
| Actives                  | Teachers<br>Benefit-Weighted | Male: +1<br>Female: -2                  | Male: 100%,<br>Female: 98%     | 75% of MP-2020          |



## Section IV – Demographic Assumptions

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### RATES OF SALARY INCREASE

Estimates of future salaries for each member are based on assumptions for two types of increases:

- Increases in each individual's salary due to promotion or longevity (often called merit scale), and
- Increases in the general wage increase of the membership, which is directly related to price and wage inflation.

Earlier in this report, we determined that the wage inflation assumption be set at 2.75% (2.50% price inflation and 0.25% real wage growth). Therefore, the merit scale will be added to the applicable wage inflation assumption to develop the total individual salary increase assumption.

Analysis of the merit salary scale is complicated by the fact that only total salary is reported to TRS, which includes both the general wage inflation component of salary increases and the merit salary scale. Furthermore, there is often a delay in actual price inflation compared to when it has an impact on salary increases. As a result, it is difficult to isolate the merit scale for purposes of measuring the actual salary experience. One technique we used to help reduce the effect of inflation was to look at the individual salary increases for each of the five years in the study period and adjust the results so that the longer service individuals had increases of approximately 3.00%. This allows us to focus on the shape of the increases and determine the reasonableness of a possible salary merit scale. In addition, salary increases for governmental employees during this study period have been lower than those observed in corporate America. Consequently, the selection of a merit scale has a significant component of professional judgment.

Lastly, the current rates of salary increase for active members are based on the member's age. We have studied rates of salary increase for many statewide plans over the past five years and determined that rates of salary increase for active members are better correlated to the member's service, rather than age. Therefore, we have determined that TRS should change to a service-based table for rates of salary increase for active members.



## Section IV – Demographic Assumptions

### COMPARISON OF ACTUAL AND EXPECTED SALARIES OF ACTIVE MEMBERS

| CENTRAL<br>AGE<br>OF GROUP | RATES OF SALARY INCREASE |          |                                |
|----------------------------|--------------------------|----------|--------------------------------|
|                            | CURRENT RATES            |          |                                |
|                            | Actual                   | Expected | Ratio of Actual to<br>Expected |
| 25                         | 11.78%                   | 6.31%    | 1.867                          |
| 30                         | 5.61%                    | 5.46%    | 1.027                          |
| 35                         | 4.77%                    | 4.75%    | 1.004                          |
| 40                         | 3.91%                    | 4.27%    | 0.916                          |
| 45                         | 3.08%                    | 3.91%    | 0.787                          |
| 50                         | 2.92%                    | 3.72%    | 0.786                          |
| 55                         | 3.39%                    | 3.54%    | 0.958                          |
| 58+                        | 3.80%                    | 3.50%    | 1.086                          |
| TOTAL                      | 4.17%                    | 4.24%    | 0.984                          |

During the period under investigation, the actual rates of salary increase were lower than expected in aggregate but as you can see from the table above, the correlation between salary increases and age is not consistent. The following table uses the same data but is shown using service as the basis. There is slightly better correlation between salary growth and service bands.

| SERVICE<br>OF GROUP | RATES OF SALARY INCREASE |          |                                |
|---------------------|--------------------------|----------|--------------------------------|
|                     | CURRENT RATES            |          |                                |
|                     | Actual                   | Expected | Ratio of Actual to<br>Expected |
| 1                   | 14.51%                   | 5.47%    | 2.652                          |
| 2                   | 5.22%                    | 5.32%    | 0.981                          |
| 3                   | 4.44%                    | 5.18%    | 0.856                          |
| 4                   | 6.42%                    | 5.03%    | 1.276                          |
| 5                   | 4.92%                    | 4.90%    | 1.004                          |
| 6-9                 | 4.02%                    | 4.57%    | 0.880                          |
| 10-19               | 2.83%                    | 4.02%    | 0.703                          |
| 20-29               | 2.89%                    | 3.67%    | 0.786                          |
| TOTAL               | 4.17%                    | 4.24%    | 0.984                          |



## Section IV – Demographic Assumptions

The rates of salary increase consist of wage inflation and a scale for merit and promotion. We determined in the Economic section of this report that the wage inflation assumption should be reduced by 0.75% from 3.50% to 2.75%. The following table is the proposed merit salary scale based on actual experience.

| CENTRAL<br>SERVICE<br>OF GROUP | RATES OF SALARY INCREASE     |                                 |                         |
|--------------------------------|------------------------------|---------------------------------|-------------------------|
|                                | PROPOSED RATES               |                                 |                         |
|                                | Proposed Rate of<br>Increase | Less Expected<br>Wage Inflation | Proposed Merit<br>Scale |
| 1                              | 7.50%                        | 2.75%                           | 4.75%                   |
| 2                              | 5.50%                        | 2.75%                           | 2.75%                   |
| 3                              | 5.00%                        | 2.75%                           | 2.25%                   |
| 4                              | 5.00%                        | 2.75%                           | 2.25%                   |
| 5                              | 5.00%                        | 2.75%                           | 2.25%                   |
| 6-9                            | 4.25%                        | 2.75%                           | 1.50%                   |
| 10-19                          | 3.25%                        | 2.75%                           | 0.50%                   |
| 20-29                          | 3.00%                        | 2.75%                           | 0.25%                   |
| 30+                            | 3.00%                        | 2.75%                           | 0.25%                   |



## Section V – Assumptions Specific to the Health Trust and Life Trust

### Long-Term Rate of Return

#### *Past Experience*

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

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

| Year Ending 6/30 | Health Trust    |              | Life Trust      |              |
|------------------|-----------------|--------------|-----------------|--------------|
|                  | Actuarial Value | Market Value | Actuarial Value | Market Value |
| 2016             | 5.9%            | -1.4%        | 3.8%            | 5.5%         |
| 2017             | 6.6%            | 11.9%        | 2.7%            | 1.0%         |
| 2018             | 6.9%            | 8.7%         | 2.7%            | 1.3%         |
| 2019             | 6.2%            | 6.1%         | 2.7%            | 6.5%         |
| 2020             | 5.8%            | 2.3%         | 3.6%            | 6.3%         |
| Average          | 6.3%            | 5.5%         | 3.1%            | 4.1%         |

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

#### *Determination*

As the Health Trust and Life Trust showed similar long-term projections to the Retirement Trust, and because the asset allocation strategy for the Health Trust will be impacted by the lower cash flows due to the State not paying their portion of the shared responsibility contributions, we have determined that there should be a decrease in the long-term expected return on assets assumption from 8.00% (Health Trust) and 7.50% (Life Trust) to 7.10% as shown in the chart on the following page.



## Section V – Assumptions Specific to the Health Trust and Life Trust

| Investment Return Assumption |                      |                    |                   |
|------------------------------|----------------------|--------------------|-------------------|
|                              | Current Health Trust | Current Life Trust | Proposed For Both |
| Real Rate of Return*         | 5.00%                | 4.50%              | 4.60%             |
| Inflation                    | <u>3.00</u>          | <u>3.00</u>        | <u>2.50</u>       |
| Net Investment Return        | 8.00%                | 7.50%              | 7.10%             |

\* Net of investment expenses.

### Health Care Cost Trend Rates

**Background:** In addition to the economic assumptions used in all of the actuarial valuations performed for the Teachers' Retirement System of the State of Kentucky (System), 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

For the Health Insurance Trust (Health Trust), health care cost trend rates are needed to project the future cost of providing benefits of the Health Trust, including Kentucky Employees' Health Plan (KEHP) premiums, Medicare Eligible Health Plan (MEHP) costs, and Shared Responsibility contributions based upon Medicare Part B premiums.

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 – Assumptions Specific to the Health Trust and Life Trust**

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 4.50%, as there appears to be nothing unusual about the Kentucky Employees’ Health Plan and Medicare Eligible Health Plan that would necessitate a long-term trend that is either higher or lower than what is typically used for this type of calculation.



## Section V – Assumptions Specific to the Health Trust and Life Trust

In projecting the offsets associated with the Federal Supplementary Medical Insurance Trust Fund (Medicare Part B Premiums), projected trends from the CMS actuary in the most recent annual report to the trustees appear to provide a reasonable basis for the projection of these costs. As a standard of practice, CMC typically develops the trend assumptions for these benefits based upon the CMS actuary's most recent estimates.

In our opinion, the economic assumptions determined 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.

**Determination:** In our opinion, the health care cost trend rates determined in each year's valuation report are developed in accordance with ASOP No. 6. We will continue to update and review the initial rates with each year's valuation. Use an ultimate trend rate of price inflation + 2.0%, or 4.50%.

We are not making any 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.



## Section V – Assumptions Specific to the Health Trust and Life Trust

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### Morbidity

**Background:** The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 6, “Measuring Retiree Group Benefit Obligations”, which provides guidance to actuaries when developing benefit cost projection assumptions for measuring obligations of postretirement plans other than pensions. As noted in ASOP No. 6, the actuary should consider the variation in rates by age for the benefits being modeled and use appropriate age bands if the rates vary significantly. The age bands should not be overly broad, based on the expected rate variations within the bands. If rates vary significantly by age, it is inappropriate to assume a single per capita rate that does not vary by age. The relationship between the rates at various ages is an actuarial assumption that may be based on normative databases.

**Determination:** CMC assumes the projected medical and prescription drug costs of MEHP vary significantly by age from the average cost at the central age of the applicable group based upon the paper “Aging Curves for Health Care Costs in Retirements”, The North American Actuarial Journal, July 2005, Jeffrey P. Petertil. Here, the paper’s “Representative Curve for General Use” is used for ages 50 and older, and factors developed from a national average claims and utilization database are used for ages below 50. CMC continuously monitors all available data, publications, and research projects undertaken by actuarial organizations regarding age-related morbidity (e.g., “Health Care Costs—From Birth to Death”, Health Care Cost Institute’s Independent Report Series – Report 2013-1, June 2013, Dale H. Yamamoto) and see no indication of the factors no longer being appropriate.

For the retiree health care liabilities of those under age 65, the current premium charged by the Kentucky Employees’ Health Plan (KEHP) is used as the base cost and is projected forward using the health care trend assumption (i.e., no implicit rate subsidy is calculated or recognized). Under Actuarial Standard of Practice No. 6 (ASOP No. 6), aging subsidies (or implicit rate subsidies) should be recognized, as the differences in health care utilization and cost due to age have been demonstrated and well quantified. The impact of aging on a valuation’s results can be as significant as the use of mortality, trend, and discounting. It has been the long-standing position that the responsibility for compliance with GASB Statement No. 43, when it relates to KEHP implicit subsidies, rests with KEHP, not the System, as the System has no operational authority over KEHP. As such, KEHP implicit subsidies are excluded from the OPEB funding valuation process of the Health Trust. As GASB 74 and 75 prohibit such a deviation from ASOP No. 6, KEHP implicit rate subsidies are included in the GASB Total OPEB Liability (TOL).



## **Section V – Assumptions Specific to the Health Trust and Life Trust**

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### **Coverage Assumptions**

In addition to covering eligible retirees, many plans cover the spouse and dependents of retirees. In addition, plans may offer some or all participants a choice of coverage such as HMOs, PPOs, and POS plans. The magnitude of the retiree group benefit obligation can vary significantly as a result of the coverage assumptions. The actuary should therefore consider historical participation rates and trends in coverage rates when selecting the coverage assumptions.

#### **Member Participation**

**Background:** For plans that require some form of contribution to maintain coverage, some eligible inactive members may not elect to be covered, particularly if they have other coverage available from their most recent employer. Empirical data on plan participation, where available and credible, should be considered when selecting the participation assumption for future covered retirees that retire from an eligible inactive status. When developing the participation rates, how plan eligibility rules, plan choices, or retiree contribution rates have changed over time should be considered.

Furthermore, plan participation may be different in the future due to participants' response to changes in retiree contribution levels and plan choices. For plans that anticipate changes in retiree contributions, the appropriateness of participation rates that vary over the projection period for both current and future retirees should be considered. In addition, plan eligibility rules governing dropping coverage and subsequent re-enrollment when selecting participation rates should be considered.



## Section V – Assumptions Specific to the Health Trust and Life Trust

**Determination:** Historical Health Trust participation levels suggest an adjustment to the current assumption. The use of the historical average is proposed, with adjustments to reflect an increase in participation as the System’s contribution Benefits increases.

| TRS                                                               | Valuation Date |           |           |           |           |           |         |
|-------------------------------------------------------------------|----------------|-----------|-----------|-----------|-----------|-----------|---------|
| Contribution %                                                    | 6/30/2015      | 6/30/2016 | 6/30/2017 | 6/30/2018 | 6/30/2019 | 6/30/2020 | Average |
| <b>Number of Retirees Electing Medical Insurance Coverage</b>     |                |           |           |           |           |           |         |
| 10%                                                               | 63             | 70        | 63        | 53        | 54        | 50        | 59      |
| 25%                                                               | 250            | 278       | 329       | 352       | 388       | 407       | 334     |
| 45%                                                               | 7              | 2         | 4         | 26        | 49        | 80        | 28      |
| 50%                                                               | 712            | 717       | 709       | 689       | 688       | 699       | 702     |
| 65%                                                               | 4              | 0         | 1         | 1         | 0         | 0         | 1       |
| 75%                                                               | 1,297          | 1,404     | 1,523     | 1,611     | 1,665     | 1,687     | 1,531   |
| 90%                                                               | 506            | 470       | 441       | 394       | 359       | 314       | 414     |
| 95%                                                               | 0              | 0         | 0         | 0         | 0         | 0         | 0       |
| 100%                                                              | 34,701         | 35,383    | 35,981    | 36,710    | 37,135    | 37,594    | 36,251  |
| <b>Number of Retirees Eligible for Medical Insurance Coverage</b> |                |           |           |           |           |           |         |
| 10%                                                               | 392            | 427       | 450       | 459       | 491       | 521       | 457     |
| 25%                                                               | 1,514          | 1,685     | 1,819     | 1,939     | 2,059     | 2,168     | 1,864   |
| 45%                                                               | 30             | 4         | 20        | 65        | 141       | 233       | 82      |
| 50%                                                               | 1,767          | 1,831     | 1,834     | 1,805     | 1,806     | 1,834     | 1,813   |
| 65%                                                               | 10             | 0         | 14        | 30        | 50        | 72        | 29      |
| 75%                                                               | 2,000          | 2,223     | 2,395     | 2,526     | 2,601     | 2,666     | 2,402   |
| 90%                                                               | 632            | 595       | 558       | 503       | 464       | 418       | 528     |
| 95%                                                               | 0              | 0         | 1         | 2         | 2         | 5         | 2       |
| 100%                                                              | 37,419         | 38,439    | 39,342    | 40,283    | 41,037    | 41,770    | 39,715  |
| <b>% Electing Medical Insurance Coverage</b>                      |                |           |           |           |           |           |         |
| 10%                                                               | 16%            | 16%       | 14%       | 12%       | 11%       | 10%       | 13%     |
| 25%                                                               | 17%            | 16%       | 18%       | 18%       | 19%       | 19%       | 18%     |
| 45%                                                               | 23%            | 50%       | 20%       | 40%       | 35%       | 34%       | 34%     |
| 50%                                                               | 40%            | 39%       | 39%       | 38%       | 38%       | 38%       | 39%     |
| 65%                                                               | 40%            | n/a       | 7%        | 3%        | 0%        | 0%        | 3%      |
| 75%                                                               | 65%            | 63%       | 64%       | 64%       | 64%       | 63%       | 64%     |
| 90%                                                               | 80%            | 79%       | 79%       | 78%       | 77%       | 75%       | 78%     |
| 95%                                                               | n/a            | n/a       | 0%        | 0%        | 0%        | 0%        | 0%      |
| 100%                                                              | 93%            | 92%       | 91%       | 91%       | 90%       | 90%       | 91%     |



## Section V – Assumptions Specific to the Health Trust and Life Trust

| Summary of Medical Insurance Election Rates |            |         |            |
|---------------------------------------------|------------|---------|------------|
| TRS<br>Contribution %                       | Experience | Current | Proposed   |
| 10%                                         | 13%        | 20%     | <b>20%</b> |
| 25%                                         | 18%        | 20%     | <b>20%</b> |
| 45%                                         | 34%        | 41%     | <b>40%</b> |
| 50%                                         | 39%        | 49%     | <b>40%</b> |
| 65%                                         | 3%         | 61%     | <b>50%</b> |
| 75%                                         | 64%        | 70%     | <b>70%</b> |
| 90%                                         | 78%        | 76%     | <b>80%</b> |
| 95%                                         | 0%         | 84%     | <b>85%</b> |
| 100%                                        | 91%        | 91%     | <b>90%</b> |



## Section V – Assumptions Specific to the Health Trust and Life Trust

### Plan Elections

**Background:** As KEHP costs vary by plan, the future level of participation in the plans for covered members under 65 should be considered based upon historical participation rates, and how plan eligibility rules, plan choices, and retiree contribution rates have changed over time.

**Determination:** Based upon recent experience, plan election options can change, and plan election rates can shift over time. As a result, continued monitoring of experience and annual updating of the KEHP coverage assumption is proposed.

| Valuation Date                           | LivingWell Basic | LivingWell Limited | LivingWell CDHP | LivingWell PPO | Standard PPO | Standard CDHP | Total  |
|------------------------------------------|------------------|--------------------|-----------------|----------------|--------------|---------------|--------|
| <b>KEHP Retiree Coverage Elections</b>   |                  |                    |                 |                |              |               |        |
| 6/30/2016                                | n/a              | n/a                | 4,677           | 5,337          | 757          | 902           | 11,673 |
| 6/30/2017                                | n/a              | n/a                | 4,620           | 4,783          | 298          | 1,246         | 10,947 |
| 6/30/2018                                | n/a              | n/a                | 4,615           | 4,341          | 247          | 1,369         | 10,572 |
| 6/30/2019                                | 295              | 110                | 5,044           | 4,595          | n/a          | n/a           | 10,044 |
| 6/30/2020                                | 271              | 60                 | 5,313           | 4,177          | n/a          | n/a           | 9,821  |
| <b>KEHP Retiree Coverage Election %s</b> |                  |                    |                 |                |              |               |        |
| 6/30/2016                                | n/a              | n/a                | 40%             | 46%            | 6%           | 8%            | 100%   |
| 6/30/2017                                | n/a              | n/a                | 42%             | 44%            | 3%           | 11%           | 100%   |
| 6/30/2018                                | n/a              | n/a                | 44%             | 41%            | 2%           | 13%           | 100%   |
| 6/30/2019                                | 3%               | 1%                 | 50%             | 46%            | n/a          | n/a           | 100%   |
| 6/30/2020                                | 3%               | 1%                 | 53%             | 43%            | n/a          | n/a           | 100%   |



## Section V – Assumptions Specific to the Health Trust and Life Trust

### Spouse Participation

**Background:** Those who are eligible for coverage under the plan should be considered and appropriate assumptions made regarding the coverage of spouses and dependents. Additionally, the impact of plan rules governing changes in coverage after retirement, such as remarriage, if significant should be considered. A review of historical data on spouse and dependent coverage rates when selecting the assumption to be used in the projection should be made.

**Determination:** The percentage of those electing Health Trust coverage for their spouses has remained steady over time and Health Trust's benefits and rules regarding dependent coverage are not anticipated to change. As a result, the use of the historical spouse coverage election average is proposed.

| Valuation Date                                                    | Gender     |            |        |
|-------------------------------------------------------------------|------------|------------|--------|
|                                                                   | Male       | Female     | Total  |
| <b>Number of Pre-Medicare Retirees Electing to Cover a Spouse</b> |            |            |        |
| 6/30/2016                                                         | 649        | 1,608      | 2,257  |
| 6/30/2017                                                         | 608        | 1,964      | 2,572  |
| 6/30/2018                                                         | 708        | 2,060      | 2,768  |
| 6/30/2019                                                         | 671        | 2,009      | 2,680  |
| 6/30/2020                                                         | 755        | 2,076      | 2,831  |
| <b>Number of Pre-Medicare Retirees Electing Coverage</b>          |            |            |        |
| 6/30/2016                                                         | 2,496      | 9,177      | 11,673 |
| 6/30/2017                                                         | 2,289      | 8,658      | 10,947 |
| 6/30/2018                                                         | 2,245      | 8,327      | 10,572 |
| 6/30/2019                                                         | 2,103      | 7,941      | 10,044 |
| 6/30/2020                                                         | 2,152      | 7,669      | 9,821  |
| <b>% Electing Spousal Coverage</b>                                |            |            |        |
| 6/30/2016                                                         | 26%        | 18%        | 19%    |
| 6/30/2017                                                         | 27%        | 23%        | 23%    |
| 6/30/2018                                                         | 32%        | 25%        | 26%    |
| 6/30/2019                                                         | 32%        | 25%        | 27%    |
| 6/30/2020                                                         | 35%        | 27%        | 29%    |
| Current Assumption                                                | 25%        | 15%        |        |
| <b>Proposed %</b>                                                 | <b>30%</b> | <b>25%</b> |        |





## **Section V – Assumptions Specific to the Health Trust and Life Trust**

### **Terminated and Vested Participation**

**Background:** Although eligible inactive members may begin receiving benefits once meeting the age and service requirements for retirement eligibility, some members may withdraw, and those members electing to receive benefits may not begin receiving benefits at the earliest eligibility date. For eligible inactive members, a rate of benefit participation and an average age in which benefits are to begin must be assumed.

**Determination:** Based upon the four most recent years of experience, the rates of withdrawal for those active members under the age of 55 who have less than 27 years of service have remained the same. As the average rate of withdrawal has remained relatively steady over time, the use of the historical average is proposed for members under the age of 55 who have less than 27 years of service. We have determined that continuing to use the same rates of vested and terminated benefit participation is appropriate at this time.



## Section V – Assumptions Specific to the Health Trust and Life Trust

| Rates of Withdrawal for the Initial Termination of an Active Employee                             |                  |            |             |
|---------------------------------------------------------------------------------------------------|------------------|------------|-------------|
| Experience Period                                                                                 | Years of Service |            |             |
|                                                                                                   | 5 - 10           | 10 - 15    | 15 - 27     |
| <b>Number of Active Members Under Age 55 Entering Vested and Terminated Status</b>                |                  |            |             |
| 7/1/2015 - 6/30/2016                                                                              | 516              | 212        | 85          |
| 7/1/2016 - 6/30/2017                                                                              | 424              | 179        | 81          |
| 7/1/2017 - 6/30/2018                                                                              | 398              | 182        | 93          |
| 7/1/2018 - 6/30/2019                                                                              | 367              | 165        | 119         |
| 7/1/2019 - 6/30/2020                                                                              | 314              | 203        | 84          |
| <b>Number of Active Members Under Age 55 Entering Vested and Terminated Status or Withdrawing</b> |                  |            |             |
| 7/1/2015 - 6/30/2016                                                                              | 566              | 226        | 93          |
| 7/1/2016 - 6/30/2017                                                                              | 529              | 223        | 96          |
| 7/1/2017 - 6/30/2018                                                                              | 553              | 232        | 101         |
| 7/1/2018 - 6/30/2019                                                                              | 465              | 221        | 137         |
| 7/1/2019 - 6/30/2020                                                                              | 384              | 244        | 106         |
| <b>% of Active Members Under Age 55 Electing to Retain Membership upon Termination</b>            |                  |            |             |
| 7/1/2015 - 6/30/2016                                                                              | 91%              | 94%        | 91%         |
| 7/1/2016 - 6/30/2017                                                                              | 80%              | 80%        | 84%         |
| 7/1/2017 - 6/30/2018                                                                              | 72%              | 78%        | 92%         |
| 7/1/2018 - 6/30/2019                                                                              | 79%              | 75%        | 87%         |
| 7/1/2019 - 6/30/2020                                                                              | 82%              | 83%        | 79%         |
| Current Assumption                                                                                | 80%              | 85%        | 90%         |
| <b>Proposed %</b>                                                                                 | <b>80%</b>       | <b>85%</b> | <b>90%*</b> |

\*To be used for all other age/service combinations.

| % Receiving a Pension Benefit or Returning to Active Service for an Employee Currently in Deferred Vested Status |                  |            |            |            |
|------------------------------------------------------------------------------------------------------------------|------------------|------------|------------|------------|
|                                                                                                                  | Years of Service |            |            |            |
|                                                                                                                  | 5 - 10           | 10 - 15    | 15 - 27    | 27+        |
| Current Assumption                                                                                               | 75%              | 85%        | 90%        | 75%        |
| <b>Proposed %</b>                                                                                                | <b>75%</b>       | <b>85%</b> | <b>90%</b> | <b>75%</b> |



## Section V – Assumptions Specific to the Health Trust and Life Trust

**Determination:** Based upon the four most recent years of experience, the average age vested participants being receiving a pension benefit has remained the same. As the average age of initial benefit receipt has remained relatively steady over time, the use of the historical average is proposed for the age of initial benefit receipt.

| Experience Period                      | Years of Service |         |         |         |         |         |     |       |
|----------------------------------------|------------------|---------|---------|---------|---------|---------|-----|-------|
|                                        | 5 - 10           | 10 - 15 | 15 - 20 | 20 - 25 | 25 - 26 | 26 - 27 | 27+ | Total |
| Average Age of Initial Pension Benefit |                  |         |         |         |         |         |     |       |
| 7/1/2016 - 6/30/2017                   | 62               | 60      | 59      | 58      | 55      | 58      | 59  | 60    |
| 7/1/2017 - 6/30/2018                   | 63               | 61      | 61      | 58      | 60      | 59      | 60  | 61    |
| 7/1/2018 - 6/30/2019                   | 62               | 61      | 60      | 57      | 60      | 56      | 63  | 61    |
| 7/1/2019 - 6/30/2020                   | 63               | 60      | 59      | 56      | 59      | 53      | 61  | 60    |
| Total                                  | 62               | 60      | 60      | 57      | 59      | 57      | 61  | 60    |
| Average %                              | 62               | 60      | 60      | 57      | 58      | 57      | 61  | 61    |
| Current Assumption                     | 60               |         |         |         |         |         |     |       |
| Proposed                               | 60               |         |         |         |         |         |     |       |



## Section V – Assumptions Specific to the Health Trust and Life Trust

### Spouse Age Difference

**Background:** The actual data for the age of the covered spouse and dependents of retired participants is used. The spouse and dependents of an active employee today may not be the same spouse and dependents covered at retirement; therefore the actuary should generally select an assumed covered spouse age difference for purposes of projecting future spouse coverage and assumed dependents' ages for projecting dependent coverage.

**Determination:** The average age difference between Health Trust covered male and female spouses has remained steady over time. As a result, we have determined that continued use of the historical average is appropriate, which supports maintaining current assumptions.

| Valuation Date                                                        | Gender   |            |       |
|-----------------------------------------------------------------------|----------|------------|-------|
|                                                                       | Male     | Female     | Total |
| <b>Average Age of Pre-Medicare Retiree Electing to Cover a Spouse</b> |          |            |       |
| 6/30/2016                                                             | 60       | 59         | 60    |
| 6/30/2017                                                             | 59       | 60         | 60    |
| 6/30/2018                                                             | 59       | 60         | 60    |
| 6/30/2019                                                             | 59       | 60         | 60    |
| 6/30/2020                                                             | 59       | 59         | 59    |
| <i>Average</i>                                                        | 59       | 60         | 60    |
| <b>Average Age of Coverage Spouse</b>                                 |          |            |       |
| 6/30/2016                                                             | 56       | 60         | 59    |
| 6/30/2017                                                             | 56       | 61         | 60    |
| 6/30/2018                                                             | 57       | 61         | 60    |
| 6/30/2019                                                             | 57       | 61         | 60    |
| 6/30/2020                                                             | 56       | 61         | 60    |
| <i>Average</i>                                                        | 56       | 61         | 60    |
| <b>Age Difference</b>                                                 |          |            |       |
| 6/30/2016                                                             | 4        | (1)        | 1     |
| 6/30/2017                                                             | 3        | (1)        | 0     |
| 6/30/2018                                                             | 2        | (1)        | 0     |
| 6/30/2019                                                             | 2        | (1)        | 0     |
| 6/30/2020                                                             | 3        | (2)        | (1)   |
| <i>Total</i>                                                          | 3        | (1)        | 0     |
| Current Assumption                                                    | 3        | (1)        |       |
| <b>Proposed %</b>                                                     | <b>3</b> | <b>(1)</b> |       |



## Section VI – Other Assumptions and Methods

**ADMINISTRATIVE TOOLS:** Any administrative tools utilized by the Retirement System should be revised to be based on the mortality table and investment rate of return used in the valuation.

**OPTION FACTORS:** The option factors currently used by the Retirement System are based on the mortality tables and investment rate of return (discount rate) used in the valuation. **The factors should be revised to be based on the mortality table determined for the valuation.**

**ADMINISTRATIVE EXPENSE:** Currently for TRS, there is no contribution made to pay the administrative expenses incurred each year. This results in losses to the system due to the expenses paid out each year. **After reviewing the total amount of administrative expenses for the past five years and the percentage of payroll, we have determined that an assumption of 0.32% of payroll should be used in the valuation and added to the total normal cost each year.** The following table shows actual percentages over the past five years:

(\$ in Thousands)

| Year Ending<br>June 30 | Administrative<br>Expenses | Annual Payroll | Percentage |
|------------------------|----------------------------|----------------|------------|
| 2016                   | \$8,636                    | \$3,537,226    | 0.24%      |
| 2017                   | 10,314                     | 3,563,584      | 0.29%      |
| 2018                   | 11,388                     | 3,605,116      | 0.32%      |
| 2019                   | 12,352                     | 3,648,428      | 0.34%      |
| 2020                   | 12,167                     | 3,723,482      | 0.33%      |

**PERCENT MARRIED:** Currently, 100% of all members are assumed to be married with the male three years older than his spouse. This assumption is used to determine if anyone is entitled to a Survivor Benefit from a death in active service. The survivor benefits for members with 10 years of service before death can be paid to either spouses or dependent children or other dependents. An analysis of active members shows that mostly all of all active members have listed either a spouse or a dependent beneficiary on file. Therefore, **we determined that no change in this assumption is necessary at this time.**



## Section VI – Other Assumptions and Methods

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**PART-TIMERS:** Currently, we assume that all part time employees will accrue 0.25 years of service each year while in that status. After review of the data for the past 5 years, part-timers are averaging 0.247 years of service each year, therefore, **we have determined that no change in this assumption is necessary at this**

**UNUSED SICK LEAVE:** Currently, we assume a load of 2.0% to all active liability for all unused sick leave added at retirement. TRS staff has supplied us with average service credits due to unused sick leave for those active members that retired in the last 4 years that were not in Local School Districts. The average unused sick leave credit for these individuals was approximately 0.50 years of service. For those active members retiring from the Local School Districts, Final Average Compensation is increased by the average additional payroll they received from their unused sick leave time. Average additional payroll for these members averaged around \$13,500. Using these figures, we are computing that the load for unused sick leave should be 3.0% and **we have determined that there should be an increase to the load from 2.0% to 3.0% for all active liability at the time of retirement.**



## Appendix A – Historical June CPI (U) Index

| Year | CPI (U) | Year | CPI (U) |
|------|---------|------|---------|
| 1965 | 31.6    | 1993 | 144.4   |
| 1966 | 32.4    | 1994 | 148.0   |
| 1967 | 33.3    | 1995 | 152.5   |
| 1968 | 35.7    | 1996 | 156.7   |
| 1969 | 34.7    | 1997 | 160.3   |
| 1970 | 38.8    | 1998 | 163.0   |
| 1971 | 40.6    | 1999 | 166.2   |
| 1972 | 41.7    | 2000 | 172.4   |
| 1973 | 44.2    | 2001 | 178.0   |
| 1974 | 49.0    | 2002 | 179.9   |
| 1975 | 53.6    | 2003 | 183.7   |
| 1976 | 56.8    | 2004 | 189.7   |
| 1977 | 60.7    | 2005 | 194.5   |
| 1978 | 65.2    | 2006 | 202.9   |
| 1979 | 72.3    | 2007 | 208.352 |
| 1980 | 82.7    | 2008 | 218.815 |
| 1981 | 90.6    | 2009 | 215.693 |
| 1982 | 97.0    | 2010 | 217.965 |
| 1983 | 99.5    | 2011 | 225.722 |
| 1984 | 103.7   | 2012 | 229.478 |
| 1985 | 107.6   | 2013 | 233.504 |
| 1986 | 109.5   | 2014 | 238.343 |
| 1987 | 113.5   | 2015 | 238.638 |
| 1988 | 118.0   | 2016 | 241.018 |
| 1989 | 124.1   | 2017 | 244.955 |
| 1990 | 129.9   | 2018 | 251.989 |
| 1991 | 136.0   | 2019 | 256.143 |
| 1992 | 140.2   | 2020 | 257.797 |



## Appendix B – Capital Market Assumptions and Asset Allocations

### Aon's 30-year Geometric Real Rates of Return and Standard Deviations by Asset Class

| Asset Class                    | Expected Geometric Real Rates of Return | Standard Deviation |
|--------------------------------|-----------------------------------------|--------------------|
| Large Cap U.S. Equity          | 4.2%                                    | 17.0%              |
| Small Cap U.S. Equity          | 4.7%                                    | 23.0%              |
| Developed International Equity | 5.3%                                    | 20.0%              |
| Emerging Markets Equity        | 5.4%                                    | 27.0%              |
| Fixed Income                   | (0.1)%                                  | 4.5%               |
| High Yield Bonds               | 1.7%                                    | 12.5%              |
| Other Additional Categories    | 2.2%                                    | 9.7%               |
| Real Estate                    | 4.0%                                    | 17.4%              |
| Private Equity                 | 6.9%                                    | 25.0%              |
| Cash                           | (0.3)%                                  | 2.0%               |

### Long Term Asset Allocation Targets

| Asset Class                    | Asset Allocation |
|--------------------------------|------------------|
| Large Cap U.S. Equity          | 37.4%            |
| Small Cap U.S. Equity          | 2.6%             |
| Developed International Equity | 16.5%            |
| Emerging Markets Equity        | 5.5%             |
| Fixed Income                   | 15.0%            |
| High Yield Bonds               | 2.0%             |
| Other Additional Categories    | 5.0%             |
| Real Estate                    | 7.0%             |
| Private Equity                 | 7.0%             |
| Cash                           | 2.0%             |





## Appendix C – Social Security Administration Wage Index

| Year | Wage Index | Annual Increase | Year | Wage Index | Annual Increase |
|------|------------|-----------------|------|------------|-----------------|
| 1962 | \$4,291.40 |                 | 1991 | 21,811.60  | 3.73            |
| 1963 | 4,396.64   | 2.45%           | 1992 | 22,935.42  | 5.15            |
| 1964 | 4,576.32   | 4.09            | 1993 | 23,132.67  | 0.86            |
| 1965 | 4,658.72   | 1.80            | 1994 | 23,753.53  | 2.68            |
| 1966 | 4,938.36   | 6.00            | 1995 | 24,705.66  | 4.01            |
| 1967 | 5,213.44   | 5.57            | 1996 | 25,913.90  | 4.89            |
| 1968 | 5,571.76   | 6.87            | 1997 | 27,426.00  | 5.84            |
| 1969 | 5,893.76   | 5.78            | 1998 | 28,861.44  | 5.23            |
| 1970 | 6,186.24   | 4.96            | 1999 | 30,469.84  | 5.57            |
| 1971 | 6,497.08   | 5.02            | 2000 | 32,154.82  | 5.53            |
| 1972 | 7,133.80   | 9.80            | 2001 | 32,921.92  | 2.39            |
| 1973 | 7,580.16   | 6.26            | 2002 | 33,252.09  | 1.00            |
| 1974 | 8,030.76   | 5.94            | 2003 | 34,064.95  | 2.44            |
| 1975 | 8,630.92   | 7.47            | 2004 | 35,648.55  | 4.65            |
| 1976 | 9,226.48   | 6.90            | 2005 | 36,952.94  | 3.66            |
| 1977 | 9,779.44   | 5.99            | 2006 | 38,651.41  | 4.60            |
| 1978 | 10,556.03  | 7.94            | 2007 | 40,405.48  | 4.54            |
| 1979 | 11,479.46  | 8.75            | 2008 | 41,334.97  | 2.30            |
| 1980 | 12,513.46  | 9.01            | 2009 | 40,711.61  | (1.50)          |
| 1981 | 13,773.10  | 10.07           | 2010 | 41,673.83  | 2.36            |
| 1982 | 14,531.34  | 5.51            | 2011 | 42,979.61  | 3.13            |
| 1983 | 15,239.24  | 4.87            | 2012 | 44,321.67  | 3.12            |
| 1984 | 16,135.07  | 5.88            | 2013 | 44,888.16  | 1.28            |
| 1985 | 16,822.51  | 4.26            | 2014 | 46,481.52  | 3.55            |
| 1986 | 17,321.82  | 2.97            | 2015 | 48,098.63  | 3.48            |
| 1987 | 18,426.51  | 6.38            | 2016 | 48,642.15  | 1.13            |
| 1988 | 19,334.04  | 4.93            | 2017 | 50,321.89  | 3.45            |
| 1989 | 20,099.55  | 3.96            | 2018 | 52,145.80  | 3.62            |
| 1990 | 21,027.98  | 4.62            | 2019 | 54,099.99  | 3.75            |



## Appendix D – Determined Rates

**TABLE 1**  
**RATES OF SEPARATION FROM ACTIVE SERVICE – MALES**

|     | RATES OF WITHDRAWAL |        |        |          |            |                                                |                                                |
|-----|---------------------|--------|--------|----------|------------|------------------------------------------------|------------------------------------------------|
|     | Service             |        |        |          |            |                                                |                                                |
| AGE | 0 – 4               | 5 – 9  | 10+    | DEATH    | DISABILITY | RATES OF RETIREMENT BEFORE 27 YEARS OF SERVICE | RATES OF RETIREMENT AFTER 27 YEARS OF SERVICE* |
| 20  | 0.2000              |        |        | 0.000309 | 0.00010    |                                                |                                                |
| 21  | 0.2000              |        |        | 0.000263 | 0.00010    |                                                |                                                |
| 22  | 0.2000              |        |        | 0.000227 | 0.00010    |                                                |                                                |
| 23  | 0.1100              |        |        | 0.000200 | 0.00010    |                                                |                                                |
| 24  | 0.1100              |        |        | 0.000183 | 0.00010    |                                                |                                                |
| 25  | 0.1100              | 0.0325 |        | 0.000200 | 0.00010    |                                                |                                                |
| 26  | 0.1100              | 0.0325 |        | 0.000218 | 0.00010    |                                                |                                                |
| 27  | 0.1100              | 0.0325 |        | 0.000236 | 0.00010    |                                                |                                                |
| 28  | 0.1000              | 0.0360 |        | 0.000267 | 0.00010    |                                                |                                                |
| 29  | 0.1000              | 0.0360 |        | 0.000285 | 0.00010    |                                                |                                                |
| 30  | 0.1000              | 0.0360 | 0.0280 | 0.000315 | 0.00010    |                                                |                                                |
| 31  | 0.1000              | 0.0360 | 0.0280 | 0.000332 | 0.00012    |                                                |                                                |
| 32  | 0.1000              | 0.0360 | 0.0280 | 0.000360 | 0.00014    |                                                |                                                |
| 33  | 0.1100              | 0.0360 | 0.0155 | 0.000373 | 0.00016    |                                                |                                                |
| 34  | 0.1100              | 0.0360 | 0.0155 | 0.000398 | 0.00018    |                                                |                                                |
| 35  | 0.1100              | 0.0360 | 0.0155 | 0.000419 | 0.00020    |                                                |                                                |
| 36  | 0.1100              | 0.0360 | 0.0155 | 0.000436 | 0.00030    |                                                |                                                |
| 37  | 0.1100              | 0.0360 | 0.0155 | 0.000463 | 0.00040    |                                                |                                                |
| 38  | 0.1250              | 0.0400 | 0.0125 | 0.000474 | 0.00050    |                                                |                                                |
| 39  | 0.1250              | 0.0400 | 0.0125 | 0.000494 | 0.00060    |                                                |                                                |
| 40  | 0.1250              | 0.0400 | 0.0125 | 0.000522 | 0.00070    |                                                |                                                |
| 41  | 0.1250              | 0.0400 | 0.0125 | 0.000548 | 0.00092    |                                                |                                                |
| 42  | 0.1250              | 0.0400 | 0.0125 | 0.000582 | 0.00114    |                                                |                                                |
| 43  | 0.1150              | 0.0400 | 0.0110 | 0.000616 | 0.00136    |                                                |                                                |
| 44  | 0.1150              | 0.0400 | 0.0110 | 0.000669 | 0.00158    |                                                |                                                |
| 45  | 0.1150              | 0.0400 | 0.0110 | 0.000722 | 0.00180    |                                                | 0.1700                                         |
| 46  | 0.1150              | 0.0400 | 0.0110 | 0.000786 | 0.00200    |                                                | 0.1700                                         |
| 47  | 0.1150              | 0.0400 | 0.0110 | 0.000863 | 0.00220    |                                                | 0.1700                                         |
| 48  | 0.1425              | 0.0450 | 0.0110 | 0.000942 | 0.00240    |                                                | 0.1700                                         |
| 49  | 0.1425              | 0.0450 | 0.0110 | 0.001045 | 0.00260    |                                                | 0.1700                                         |
| 50  | 0.1425              | 0.0450 | 0.0110 | 0.001153 | 0.00280    |                                                | 0.2500                                         |
| 51  | 0.1425              | 0.0450 | 0.0110 | 0.001266 | 0.00304    |                                                | 0.2200                                         |
| 52  | 0.1425              | 0.0450 | 0.0110 | 0.001403 | 0.00328    |                                                | 0.2000                                         |
| 53  | 0.1500              | 0.0600 | 0.0125 | 0.001547 | 0.00352    |                                                | 0.1500                                         |
| 54  | 0.1500              | 0.0600 | 0.0125 | 0.001697 | 0.00376    |                                                | 0.1400                                         |
| 55  | 0.1500              | 0.0600 | 0.0125 | 0.001871 | 0.00400    | 0.0525                                         | 0.4000                                         |
| 56  | 0.1500              | 0.0600 | 0.0000 | 0.002060 | 0.00420    | 0.0525                                         | 0.4000                                         |
| 57  | 0.1500              | 0.0600 | 0.0000 | 0.002270 | 0.00440    | 0.0625                                         | 0.3700                                         |
| 58  | 0.1500              | 0.0600 | 0.0000 | 0.002499 | 0.00460    | 0.0625                                         | 0.3400                                         |
| 59  | 0.1500              | 0.0600 | 0.0000 | 0.002755 | 0.00480    | 0.0625                                         | 0.2700                                         |
| 60  | 0.1500              | 0.0000 | 0.0000 | 0.003041 | 0.00500    | 0.1350                                         | 0.3300                                         |
| 61  | 0.1500              | 0.0000 | 0.0000 | 0.003344 | 0.00500    | 0.1500                                         | 0.3000                                         |
| 62  | 0.1500              | 0.0000 | 0.0000 | 0.003660 | 0.00500    | 0.1500                                         | 0.3000                                         |
| 63  | 0.2000              | 0.0000 | 0.0000 | 0.004007 | 0.00500    | 0.1500                                         | 0.3000                                         |
| 64  | 0.2000              | 0.0000 | 0.0000 | 0.004385 | 0.00500    | 0.1500                                         | 0.3000                                         |
| 65  | 0.2000              | 0.0000 | 0.0000 | 0.004775 | 0.00500    | 0.2000                                         | 0.3000                                         |
| 66  | 0.2000              | 0.0000 | 0.0000 | 0.005201 | 0.00500    | 0.2200                                         | 0.3000                                         |
| 67  | 0.2000              | 0.0000 | 0.0000 | 0.005657 | 0.00500    | 0.2500                                         | 0.2500                                         |
| 68  | 0.2000              | 0.0000 | 0.0000 | 0.006157 | 0.00500    | 0.2500                                         | 0.2500                                         |
| 69  | 0.2000              | 0.0000 | 0.0000 | 0.006677 | 0.00500    | 0.2500                                         | 0.2500                                         |
| 70  | 0.2000              | 0.0000 | 0.0000 | 0.007232 | 0.00500    | 0.2500                                         | 0.3000                                         |
| 71  | 0.2000              | 0.0000 | 0.0000 | 0.007833 | 0.00500    | 0.2500                                         | 0.3000                                         |
| 72  | 0.2000              | 0.0000 | 0.0000 | 0.008479 | 0.00500    | 0.2500                                         | 0.3000                                         |
| 73  | 0.2000              | 0.0000 | 0.0000 | 0.009174 | 0.00500    | 0.2500                                         | 0.3000                                         |
| 74  | 0.2000              | 0.0000 | 0.0000 | 0.009950 | 0.00500    | 0.2500                                         | 0.3000                                         |
| 75  | 0.2000              | 0.0000 | 0.0000 | 0.011408 | 0.00500    | 1.0000                                         | 1.0000                                         |

\*Plus 8.5% in year when first eligible for unreduced retirement with 27 years of service.



## Appendix D – Determined Rates

**TABLE 2**  
**RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES**

|     | RATES OF WITHDRAWAL |        |        |                |                     |                                                |                                                |
|-----|---------------------|--------|--------|----------------|---------------------|------------------------------------------------|------------------------------------------------|
|     | Service             |        |        |                |                     |                                                |                                                |
| AGE | 0 – 4               | 5 – 9  | 10+    | RATES OF DEATH | RATES OF DISABILITY | RATES OF RETIREMENT BEFORE 27 YEARS OF SERVICE | RATES OF RETIREMENT AFTER 27 YEARS OF SERVICE* |
| 20  | 0.1300              |        |        | 0.000135       | 0.00010             |                                                |                                                |
| 21  | 0.1300              |        |        | 0.000135       | 0.00010             |                                                |                                                |
| 22  | 0.1300              |        |        | 0.000135       | 0.00010             |                                                |                                                |
| 23  | 0.0900              |        |        | 0.000127       | 0.00010             |                                                |                                                |
| 24  | 0.0900              |        |        | 0.000108       | 0.00010             |                                                |                                                |
| 25  | 0.0900              | 0.0450 |        | 0.000099       | 0.00010             |                                                |                                                |
| 26  | 0.0900              | 0.0450 |        | 0.000102       | 0.00012             |                                                |                                                |
| 27  | 0.0900              | 0.0450 |        | 0.000104       | 0.00014             |                                                |                                                |
| 28  | 0.1100              | 0.0425 |        | 0.000118       | 0.00016             |                                                |                                                |
| 29  | 0.1100              | 0.0425 |        | 0.000120       | 0.00018             |                                                |                                                |
| 30  | 0.1100              | 0.0425 | 0.0100 | 0.000134       | 0.00020             |                                                |                                                |
| 31  | 0.1100              | 0.0425 | 0.0100 | 0.000149       | 0.00028             |                                                |                                                |
| 32  | 0.1100              | 0.0425 | 0.0100 | 0.000176       | 0.00036             |                                                |                                                |
| 33  | 0.1100              | 0.0350 | 0.0160 | 0.000190       | 0.00044             |                                                |                                                |
| 34  | 0.1100              | 0.0350 | 0.0160 | 0.000203       | 0.00052             |                                                |                                                |
| 35  | 0.1100              | 0.0350 | 0.0160 | 0.000215       | 0.00060             |                                                |                                                |
| 36  | 0.1100              | 0.0350 | 0.0160 | 0.000238       | 0.00068             |                                                |                                                |
| 37  | 0.1100              | 0.0350 | 0.0160 | 0.000247       | 0.00076             |                                                |                                                |
| 38  | 0.1250              | 0.0400 | 0.0120 | 0.000267       | 0.00084             |                                                |                                                |
| 39  | 0.1250              | 0.0400 | 0.0120 | 0.000284       | 0.00092             |                                                |                                                |
| 40  | 0.1250              | 0.0400 | 0.0120 | 0.000299       | 0.00100             |                                                |                                                |
| 41  | 0.1250              | 0.0400 | 0.0120 | 0.000324       | 0.00128             |                                                |                                                |
| 42  | 0.1250              | 0.0400 | 0.0120 | 0.000335       | 0.00156             |                                                |                                                |
| 43  | 0.1350              | 0.0400 | 0.0100 | 0.000356       | 0.00184             |                                                |                                                |
| 44  | 0.1350              | 0.0400 | 0.0100 | 0.000376       | 0.00212             |                                                |                                                |
| 45  | 0.1350              | 0.0400 | 0.0100 | 0.000405       | 0.00240             |                                                | 0.1700                                         |
| 46  | 0.1350              | 0.0400 | 0.0100 | 0.000425       | 0.00268             |                                                | 0.1700                                         |
| 47  | 0.1350              | 0.0400 | 0.0100 | 0.000455       | 0.00296             |                                                | 0.1700                                         |
| 48  | 0.1500              | 0.0450 | 0.0125 | 0.000495       | 0.00324             |                                                | 0.1700                                         |
| 49  | 0.1500              | 0.0450 | 0.0125 | 0.000538       | 0.00352             |                                                | 0.1700                                         |
| 50  | 0.1500              | 0.0450 | 0.0125 | 0.000584       | 0.00380             |                                                | 0.2000                                         |
| 51  | 0.1500              | 0.0450 | 0.0125 | 0.000633       | 0.00404             |                                                | 0.2000                                         |
| 52  | 0.1500              | 0.0450 | 0.0125 | 0.000687       | 0.00428             |                                                | 0.2000                                         |
| 53  | 0.1500              | 0.0500 | 0.0160 | 0.000754       | 0.00452             |                                                | 0.2000                                         |
| 54  | 0.1500              | 0.0500 | 0.0160 | 0.000834       | 0.00476             |                                                | 0.1500                                         |
| 55  | 0.1500              | 0.0500 | 0.0160 | 0.000908       | 0.00500             | 0.0500                                         | 0.5000                                         |
| 56  | 0.1500              | 0.0500 | 0.0000 | 0.000995       | 0.00520             | 0.0700                                         | 0.5000                                         |
| 57  | 0.1500              | 0.0500 | 0.0000 | 0.001092       | 0.00540             | 0.0700                                         | 0.4000                                         |
| 58  | 0.1750              | 0.0750 | 0.0000 | 0.001188       | 0.00560             | 0.0700                                         | 0.4000                                         |
| 59  | 0.1750              | 0.0750 | 0.0000 | 0.001290       | 0.00580             | 0.0700                                         | 0.4000                                         |
| 60  | 0.1750              | 0.0000 | 0.0000 | 0.001407       | 0.00600             | 0.1500                                         | 0.4000                                         |
| 61  | 0.1750              | 0.0000 | 0.0000 | 0.001526       | 0.00610             | 0.1500                                         | 0.4000                                         |
| 62  | 0.1750              | 0.0000 | 0.0000 | 0.001656       | 0.00620             | 0.1500                                         | 0.4000                                         |
| 63  | 0.2500              | 0.0000 | 0.0000 | 0.001796       | 0.00630             | 0.1800                                         | 0.4000                                         |
| 64  | 0.2500              | 0.0000 | 0.0000 | 0.001955       | 0.00640             | 0.1800                                         | 0.4000                                         |
| 65  | 0.2500              | 0.0000 | 0.0000 | 0.002123       | 0.00650             | 0.2500                                         | 0.4000                                         |
| 66  | 0.2500              | 0.0000 | 0.0000 | 0.002321       | 0.00650             | 0.2500                                         | 0.4000                                         |
| 67  | 0.2500              | 0.0000 | 0.0000 | 0.002541       | 0.00650             | 0.2500                                         | 0.4000                                         |
| 68  | 0.2500              | 0.0000 | 0.0000 | 0.002795       | 0.00650             | 0.2500                                         | 0.3500                                         |
| 69  | 0.2500              | 0.0000 | 0.0000 | 0.003086       | 0.00650             | 0.2500                                         | 0.3500                                         |
| 70  | 0.2500              | 0.0000 | 0.0000 | 0.003435       | 0.00650             | 0.3000                                         | 0.3500                                         |
| 71  | 0.2500              | 0.0000 | 0.0000 | 0.003853       | 0.00650             | 0.3000                                         | 0.3500                                         |
| 72  | 0.2500              | 0.0000 | 0.0000 | 0.004342       | 0.00650             | 0.3000                                         | 0.3500                                         |
| 73  | 0.2500              | 0.0000 | 0.0000 | 0.004922       | 0.00650             | 0.3000                                         | 0.3500                                         |
| 74  | 0.2500              | 0.0000 | 0.0000 | 0.005606       | 0.00650             | 0.3000                                         | 0.3500                                         |
| 75  | 0.2500              | 0.0000 | 0.0000 | 0.006389       | 0.00650             | 1.0000                                         | 1.0000                                         |

\*Plus 10.0% in year when first eligible for unreduced retirement with 27 years of service.



## Appendix D – Determined Rates

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**TABLE 3**

**RATES OF ANTICIPATED MERIT SALARY INCREASES  
(For Both Males and Females)**

| SERVICE | RATE*  |
|---------|--------|
| 1       | 1.0475 |
| 2       | 1.0275 |
| 3       | 1.0225 |
| 4       | 1.0225 |
| 5       | 1.0225 |
| 6       | 1.0150 |
| 7       | 1.0150 |
| 8       | 1.0150 |
| 9       | 1.0150 |
| 10      | 1.0050 |
| 11      | 1.0050 |
| 12      | 1.0050 |
| 13      | 1.0050 |
| 14      | 1.0050 |
| 15      | 1.0050 |
| 16      | 1.0050 |
| 17      | 1.0050 |
| 18      | 1.0050 |
| 19      | 1.0050 |
| 20+     | 1.0025 |

\*Does not include wage inflation assumption at 2.75% per annum.



## Appendix D – Determined Rates

**TABLE 4**

**RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE\***

| AGE | MALES    | FEMALES  | AGE | MALES    | FEMALES  |
|-----|----------|----------|-----|----------|----------|
| 19  | 0.000306 | 0.000118 | 71  | 0.016004 | 0.011015 |
| 20  | 0.000255 | 0.000098 | 72  | 0.018207 | 0.012554 |
| 21  | 0.000214 | 0.000088 | 73  | 0.020716 | 0.014318 |
| 22  | 0.000184 | 0.000088 | 74  | 0.023582 | 0.016346 |
| 23  | 0.000163 | 0.000088 | 75  | 0.026816 | 0.018649 |
| 24  | 0.000173 | 0.000098 | 76  | 0.030457 | 0.021266 |
| 25  | 0.000184 | 0.000098 | 77  | 0.034578 | 0.024245 |
| 26  | 0.000194 | 0.000108 | 78  | 0.039229 | 0.027616 |
| 27  | 0.000214 | 0.000118 | 79  | 0.044503 | 0.031458 |
| 28  | 0.000224 | 0.000137 | 80  | 0.050500 | 0.035819 |
| 29  | 0.000245 | 0.000147 | 81  | 0.057324 | 0.040778 |
| 30  | 0.000255 | 0.000157 | 82  | 0.065066 | 0.046413 |
| 31  | 0.000275 | 0.000167 | 83  | 0.073807 | 0.052783 |
| 32  | 0.000286 | 0.000186 | 84  | 0.083620 | 0.059976 |
| 33  | 0.000306 | 0.000196 | 85  | 0.094585 | 0.068071 |
| 34  | 0.000326 | 0.000216 | 86  | 0.106784 | 0.077165 |
| 35  | 0.000347 | 0.000235 | 87  | 0.120309 | 0.087387 |
| 36  | 0.000377 | 0.000255 | 88  | 0.135252 | 0.098872 |
| 37  | 0.000398 | 0.000284 | 89  | 0.151562 | 0.111769 |
| 38  | 0.000428 | 0.000304 | 90  | 0.169116 | 0.126077 |
| 39  | 0.000469 | 0.000333 | 91  | 0.187772 | 0.141757 |
| 40  | 0.000510 | 0.000363 | 92  | 0.207335 | 0.158682 |
| 41  | 0.000561 | 0.000402 | 93  | 0.227603 | 0.176674 |
| 42  | 0.000612 | 0.000431 | 94  | 0.248370 | 0.195559 |
| 43  | 0.000683 | 0.000470 | 95  | 0.269423 | 0.215110 |
| 44  | 0.000755 | 0.000519 | 96  | 0.290578 | 0.235131 |
| 45  | 0.000836 | 0.000568 | 97  | 0.311681 | 0.255466 |
| 46  | 0.000928 | 0.000617 | 98  | 0.332612 | 0.275968 |
| 47  | 0.001020 | 0.000666 | 99  | 0.353287 | 0.296597 |
| 48  | 0.001132 | 0.000715 | 100 | 0.373728 | 0.317344 |
| 49  | 0.001244 | 0.000774 | 101 | 0.393761 | 0.338041 |
| 50  | 0.001357 | 0.000843 | 102 | 0.413222 | 0.358494 |
| 51  | 0.001489 | 0.000902 | 103 | 0.431990 | 0.378525 |
| 52  | 0.001622 | 0.000970 | 104 | 0.449953 | 0.397968 |
| 53  | 0.002275 | 0.001891 | 105 | 0.467017 | 0.416686 |
| 54  | 0.002499 | 0.002048 | 106 | 0.483113 | 0.434542 |
| 55  | 0.002744 | 0.002215 | 107 | 0.498199 | 0.451457 |
| 56  | 0.003019 | 0.002401 | 108 | 0.510000 | 0.467362 |
| 57  | 0.003315 | 0.002597 | 109 | 0.510000 | 0.482209 |
| 58  | 0.003641 | 0.002813 | 110 | 0.510000 | 0.490000 |
| 59  | 0.004009 | 0.003058 | 111 | 0.510000 | 0.490000 |
| 60  | 0.004427 | 0.003322 | 112 | 0.510000 | 0.490000 |
| 61  | 0.004886 | 0.003626 | 113 | 0.510000 | 0.490000 |
| 62  | 0.005426 | 0.003969 | 114 | 0.510000 | 0.490000 |
| 63  | 0.006038 | 0.004371 | 115 | 0.510000 | 0.490000 |
| 64  | 0.006752 | 0.004822 | 116 | 0.510000 | 0.490000 |
| 65  | 0.007579 | 0.005351 | 117 | 0.510000 | 0.490000 |
| 66  | 0.008537 | 0.005968 | 118 | 1.000000 | 1.000000 |
| 67  | 0.009639 | 0.006693 | 119 | 1.000000 | 1.000000 |
| 68  | 0.010914 | 0.007546 | 120 | 1.000000 | 1.000000 |
| 69  | 0.012383 | 0.008536 |     |          |          |
| 70  | 0.014066 | 0.009682 |     |          |          |

\*Base rates before applying a modified MP-2020 improvement scale projected generationally.



## Appendix D – Determined Rates

**TABLE 5**

**RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY\***

| AGE | MALES    | FEMALES  | AGE | MALES    | FEMALES  |
|-----|----------|----------|-----|----------|----------|
| 19  | 0.003955 | 0.000113 | 71  | 0.041702 | 0.025436 |
| 20  | 0.003706 | 0.002312 | 72  | 0.044150 | 0.026903 |
| 21  | 0.003379 | 0.002303 | 73  | 0.046848 | 0.028567 |
| 22  | 0.003034 | 0.002190 | 74  | 0.049843 | 0.030447 |
| 23  | 0.002774 | 0.002021 | 75  | 0.053155 | 0.032562 |
| 24  | 0.002669 | 0.001824 | 76  | 0.056842 | 0.034949 |
| 25  | 0.002803 | 0.001654 | 77  | 0.060931 | 0.037628 |
| 26  | 0.002938 | 0.001542 | 78  | 0.065491 | 0.040627 |
| 27  | 0.003082 | 0.001542 | 79  | 0.070541 | 0.043973 |
| 28  | 0.003235 | 0.001683 | 80  | 0.076118 | 0.047705 |
| 29  | 0.003398 | 0.001842 | 81  | 0.082224 | 0.051860 |
| 30  | 0.003571 | 0.002021 | 82  | 0.088886 | 0.056466 |
| 31  | 0.003754 | 0.002209 | 83  | 0.096096 | 0.061570 |
| 32  | 0.003946 | 0.002416 | 84  | 0.103824 | 0.067210 |
| 33  | 0.004166 | 0.002641 | 85  | 0.112109 | 0.073423 |
| 34  | 0.004397 | 0.002886 | 86  | 0.121008 | 0.080238 |
| 35  | 0.004666 | 0.003158 | 87  | 0.130589 | 0.087711 |
| 36  | 0.004973 | 0.003450 | 88  | 0.142666 | 0.095532 |
| 37  | 0.005328 | 0.003769 | 89  | 0.156029 | 0.103532 |
| 38  | 0.005731 | 0.004117 | 90  | 0.169738 | 0.111653 |
| 39  | 0.006192 | 0.004503 | 91  | 0.183610 | 0.119916 |
| 40  | 0.006720 | 0.004926 | 92  | 0.197645 | 0.128451 |
| 41  | 0.007325 | 0.005396 | 93  | 0.211949 | 0.137400 |
| 42  | 0.008006 | 0.005913 | 94  | 0.226723 | 0.146969 |
| 43  | 0.008794 | 0.006477 | 95  | 0.242170 | 0.157356 |
| 44  | 0.009667 | 0.007088 | 96  | 0.258470 | 0.168777 |
| 45  | 0.010646 | 0.007755 | 97  | 0.275741 | 0.181401 |
| 46  | 0.011722 | 0.008479 | 98  | 0.293990 | 0.195370 |
| 47  | 0.012883 | 0.009259 | 99  | 0.313046 | 0.210974 |
| 48  | 0.014112 | 0.010086 | 100 | 0.332506 | 0.227724 |
| 49  | 0.015408 | 0.010970 | 101 | 0.351744 | 0.245669 |
| 50  | 0.016435 | 0.011910 | 102 | 0.370598 | 0.264704 |
| 51  | 0.017453 | 0.012906 | 103 | 0.388915 | 0.284491 |
| 52  | 0.018442 | 0.013940 | 104 | 0.406579 | 0.304391 |
| 53  | 0.019392 | 0.014429 | 105 | 0.423485 | 0.324244 |
| 54  | 0.020294 | 0.014918 | 106 | 0.439546 | 0.343861 |
| 55  | 0.021130 | 0.015416 | 107 | 0.454694 | 0.363075 |
| 56  | 0.021888 | 0.015905 | 108 | 0.468893 | 0.381725 |
| 57  | 0.022608 | 0.016375 | 109 | 0.480000 | 0.399679 |
| 58  | 0.023309 | 0.016817 | 110 | 0.480000 | 0.416805 |
| 59  | 0.024029 | 0.017230 | 111 | 0.480000 | 0.433030 |
| 60  | 0.024806 | 0.017616 | 112 | 0.480000 | 0.448286 |
| 61  | 0.025699 | 0.017992 | 113 | 0.480000 | 0.462527 |
| 62  | 0.026736 | 0.018386 | 114 | 0.480000 | 0.470000 |
| 63  | 0.027917 | 0.018800 | 115 | 0.480000 | 0.470000 |
| 64  | 0.029222 | 0.019279 | 116 | 0.480000 | 0.470000 |
| 65  | 0.030653 | 0.019834 | 117 | 0.480000 | 0.470000 |
| 66  | 0.032189 | 0.020473 | 118 | 0.480000 | 0.470000 |
| 67  | 0.033830 | 0.021206 | 119 | 1.000000 | 0.470000 |
| 68  | 0.035578 | 0.022052 | 120 | 1.000000 | 1.000000 |
| 69  | 0.037450 | 0.023030 |     |          |          |
| 70  | 0.039485 | 0.024149 |     |          |          |

\*Base rates before applying a modified MP-2020 improvement scale projected generationally.



## Appendix D – Determined Rates

**TABLE 6**

**RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS\***

| AGE | MALES    | FEMALES  | AGE | MALES    | FEMALES  |
|-----|----------|----------|-----|----------|----------|
| 19  | 0.000303 | 0.000130 | 71  | 0.028391 | 0.014780 |
| 20  | 0.000253 | 0.000130 | 72  | 0.031148 | 0.016190 |
| 21  | 0.000212 | 0.000120 | 73  | 0.034158 | 0.017770 |
| 22  | 0.000182 | 0.000100 | 74  | 0.037431 | 0.019530 |
| 23  | 0.000162 | 0.000090 | 75  | 0.041006 | 0.021510 |
| 24  | 0.000172 | 0.000090 | 76  | 0.044945 | 0.023710 |
| 25  | 0.000182 | 0.000090 | 77  | 0.049288 | 0.026190 |
| 26  | 0.000192 | 0.000100 | 78  | 0.054136 | 0.028980 |
| 27  | 0.000212 | 0.000100 | 79  | 0.059560 | 0.032140 |
| 28  | 0.000222 | 0.000110 | 80  | 0.065630 | 0.035730 |
| 29  | 0.000242 | 0.000120 | 81  | 0.072407 | 0.039850 |
| 30  | 0.000253 | 0.000140 | 82  | 0.079942 | 0.044550 |
| 31  | 0.000273 | 0.000150 | 83  | 0.088304 | 0.049940 |
| 32  | 0.000283 | 0.000160 | 84  | 0.097546 | 0.056110 |
| 33  | 0.000303 | 0.000170 | 85  | 0.107717 | 0.063160 |
| 34  | 0.000323 | 0.000190 | 86  | 0.118857 | 0.071220 |
| 35  | 0.000343 | 0.000200 | 87  | 0.131078 | 0.080300 |
| 36  | 0.000374 | 0.000220 | 88  | 0.145622 | 0.090410 |
| 37  | 0.000394 | 0.000240 | 89  | 0.161065 | 0.101460 |
| 38  | 0.000424 | 0.000260 | 90  | 0.177306 | 0.113290 |
| 39  | 0.000465 | 0.000290 | 91  | 0.194284 | 0.125960 |
| 40  | 0.000505 | 0.000310 | 92  | 0.211959 | 0.139520 |
| 41  | 0.000556 | 0.000340 | 93  | 0.230280 | 0.154010 |
| 42  | 0.000606 | 0.000370 | 94  | 0.249207 | 0.169460 |
| 43  | 0.005545 | 0.000410 | 95  | 0.268670 | 0.185900 |
| 44  | 0.005777 | 0.000440 | 96  | 0.288597 | 0.203320 |
| 45  | 0.006020 | 0.002620 | 97  | 0.308868 | 0.221690 |
| 46  | 0.006272 | 0.002730 | 98  | 0.329351 | 0.240940 |
| 47  | 0.006525 | 0.002840 | 99  | 0.349824 | 0.260970 |
| 48  | 0.007080 | 0.002960 | 100 | 0.370064 | 0.281600 |
| 49  | 0.007312 | 0.003080 | 101 | 0.389900 | 0.302650 |
| 50  | 0.007545 | 0.003200 | 102 | 0.409171 | 0.323820 |
| 51  | 0.007787 | 0.003420 | 103 | 0.427755 | 0.344940 |
| 52  | 0.008050 | 0.003660 | 104 | 0.445541 | 0.365810 |
| 53  | 0.008322 | 0.003910 | 105 | 0.462439 | 0.386250 |
| 54  | 0.008625 | 0.004170 | 106 | 0.478376 | 0.406090 |
| 55  | 0.008959 | 0.004460 | 107 | 0.493314 | 0.425190 |
| 56  | 0.009332 | 0.004760 | 108 | 0.505000 | 0.443410 |
| 57  | 0.009747 | 0.005080 | 109 | 0.505000 | 0.460670 |
| 58  | 0.010221 | 0.005430 | 110 | 0.505000 | 0.476900 |
| 59  | 0.010777 | 0.005810 | 111 | 0.505000 | 0.492050 |
| 60  | 0.011413 | 0.006220 | 112 | 0.505000 | 0.500000 |
| 61  | 0.012140 | 0.006670 | 113 | 0.505000 | 0.500000 |
| 62  | 0.012989 | 0.007170 | 114 | 0.505000 | 0.500000 |
| 63  | 0.013978 | 0.007720 | 115 | 0.505000 | 0.500000 |
| 64  | 0.015120 | 0.008330 | 116 | 0.505000 | 0.500000 |
| 65  | 0.016443 | 0.008990 | 117 | 0.505000 | 0.500000 |
| 66  | 0.017938 | 0.009730 | 118 | 1.000000 | 0.500000 |
| 67  | 0.019624 | 0.010530 | 119 | 1.000000 | 0.500000 |
| 68  | 0.021503 | 0.011430 | 120 | 1.000000 | 1.000000 |
| 69  | 0.023584 | 0.012420 |     |          |          |
| 70  | 0.025876 | 0.013530 |     |          |          |

\*Base rates before applying a modified MP-2020 improvement scale projected generationally.



## Appendix E – Resolutions to the Board

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### ADOPTION OF TABLES HEREIN PRESENTED

In order that the tables herein presented may have the official approval of the Board of Trustees, the following resolutions have been determined for adoption.

WHEREAS, The investigation of the mortality, service and compensation experience of the members of the Teachers' Retirement System of the State of Kentucky which was prepared as of June 30, 2020 indicated that the mortality tables and active service tables previously adopted by the Board of Trustees require modification in order that they may reflect more closely the actual past experience of the membership, and

WHEREAS, The actuary has prepared new tables of rates for adoption, therefore, be it

RESOLVED, That the Board of Trustees, acting in accordance with Section 161.400 of the retirement law and upon the determination of the actuary, hereby discontinues the use in calculating the State's rates of contribution and in valuing the liabilities of the System of the active service tables and mortality tables currently in use, and approves for use instead the attached active service tables, and mortality tables, and be it further

RESOLVED, That the use of the new tables in the valuation as of June 30, 2021 and in all actuarial valuations thereafter, is hereby approved.





## Appendix E – Resolutions to the Board

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The Board of Trustees of the Teachers' Retirement System of the State of Kentucky approved the preceding resolution at a meeting held on September XX, 2021.

KENTUCKY  
BOARD OF TRUSTEES,  
TEACHERS' RETIREMENT SYSTEM OF THE STATE OF

By .....  
Chairperson

Attest:

.....  
Secretary