Cavanaugh Macdonald
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The experience and dedication you deserve

Teachers Retirement Association of Minnesota

Experience Study
Study Period: July 1, 2008 through June 30, 2014

June 5, 2015

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Cavanaugh Macdonald
CONSULTING, LLC
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June 10, 2015

Board of Trustees
Teachers Retirement Association of Minnesota
60 Empire Drive, Suite 400
St. Paul, MN 55103

Dear Members of the Board:

It is a pleasure to submit this report of our investigation of the experience of the Teachers Retirement Association of Minnesota (TRA) for the period beginning July 1, 2008 and ending June 30, 2014. The study was based on the data submitted by TRA for the annual valuations of the system. In preparing our report we relied, without audit, on the data provided.

The purpose of this report is to present the results of our review of the actuarial methods and assumptions used in the actuarial valuation. With the approval of the recommendations in this report from the Board and the Legislative Commission on Pensions and Retirement (LCPR), these assumptions and methods would be used in the July 1, 2016 actuarial valuation.

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 the assumptions developed in this report satisfy ASB 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).

In addition, to the best of our knowledge and belief this study was performed in accordance with the requirements of Minnesota Statues, Section 356.215, and the requirements of the Standards for Actuarial Work established by the State of Minnesota Legislative Commission on Pensions and Retirement (LCPR). We are available to answer any questions on the material contained in the report, or to provide explanations or further details as may be appropriate. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial

opinion contained herein. Also, we meet the requirements of "approved actuary" under Minnesota Statues, Section 356.215, Subdivision 1, Paragraph (c).

We would like to acknowledge the help in the preparation of the data for this investigation given by the TRA staff.

I, Patrice A. Beckham, F.S.A., am a member of the American Academy of Actuaries and a Fellow of the Society of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

I, Brent A. Banister, F.S.A., am a member of the American Academy of Actuaries and a Fellow of the Society of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Sincerely,

Patrice Beckham

Patrice A. Beckham, FSA, EA, FCA, MAAA
Principal and Consulting Actuary

Brent A. Banister

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

Introduction

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system. Actuarial valuations of TRA 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 rates of death, termination of employment, retirement age, and salary changes to estimate the obligations of the system.

The basic purpose of an experience study is to determine whether the actuarial assumptions currently in use have adequately projected 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.

At the request of the Board of Trustees, Cavanaugh Macdonald Consulting, LLC (CMC), performed a study of the experience of the Teachers Retirement Association of Minnesota (TRA), for the period July 1, 2008 through June 30, 2014. This report presents the results and recommendations of our study. Some of these recommendations will require legislation to adopt the changes, while the Board is given statutory authority to adopt the others subject to approval by the Legislative Commission on Pensions and Retirement (LCPR). It is anticipated that the changes, if approved, will first be reflected in the July 1, 2016 actuarial valuation of the System.

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

Our Philosophy

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

- **Don't Overreact**: When we see significant changes in experience, we generally do not adjust our rates to reflect the entire difference. We will typically recommend rates somewhere between the old rates and the new experience. If the experience during the next study period shows the same result, we will probably recognize the trend at that

point in time or at least move further in the direction of the observed experience. On the other hand, if experience returns closer to its prior level, we will not have overreacted, possibly causing volatility in the actuarial contribution rates.

- **Anticipate Trends**: If there is an identified trend that is expected to continue, we believe that this should be recognized. An example is the retiree mortality assumption. It is an established trend that people are living longer. Therefore, we believe the best estimate of liabilities in the valuation should reflect the expected increase in life expectancy.

- **Simplify**: In general, we attempt to identify which factors are significant and eliminate or ignore the ones that do not materially improve the accuracy of the liability projections.

Actuarial Methods

The basic actuarial methodologies used in the valuation process include the actuarial cost method, the asset valuation method and the unfunded actuarial accrued liability (UAAL) amortization methodology. These are set in statute and in the LCPR Standards for Actuarial Work. We recommend that all of the current actuarial methods be retained. However, we have included some discussion on the amortization of the UAAL to lay the foundation for further analysis at a future date.

Summary of Recommendations – Economic Assumptions

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 a 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.

We note that the Minnesota State Board of Investment, the entity who invests and manages TRA's assets, is in the process of conducting a significant review, including an asset-liability study. Part of that review is to assess their current assumptions as well. If the results of their study, anticipate to be completed in 2016, result in significant changes in the portfolio composition or changes in economic assumptions, we may suggest that the recommendations in this study be reviewed as well.

Most of the economic assumptions we use 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 historical trends of inflation, the market pricing of inflation,

and the Chief Actuary of the Social Security Administration's view of inflation, we are recommending a decrease in the inflation assumption from 3.00% to 2.75%. While some might argue that inflation will be even lower in the future, we believe this approach is consistent with our desire to avoid overreacting.

With the change in inflation, other economic assumptions that build upon it will also change. We are recommending that the expected return on assets be changed to 8.00%, reflecting the lower inflation assumption as well as a slightly lower anticipated real return. Likewise, we recommend the payroll growth assumption be decreased to reflect the lower anticipated price inflation.

The following table summarizes the current and proposed economic assumptions:

	Current Assumptions	Proposed Assumptions
Price Inflation	3.00%	2.75%
Long-term Investment Return	8.50%*	8.00%
Wage inflation (above price inflation)	0.75%	0.75%
General Wage Growth (also used for Payroll Growth)	3.75%	3.50%
Total Salary Increase	Varies with service	Minor changes at some durations

*The current investment return assumption is 8.00% per year through June 30, 2017 and 8.50% thereafter.

Although we have recommended a change in the set of economic assumptions, we recognize that there may be other sets of economic assumptions which are also reasonable for purposes of funding TRA.

Summary of Recommendations – Demographic Assumptions

In the experience study, actual experience for the study period is compared to that expected based on the actuarial assumption. The analysis is 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 incidence of the event to what was expected (called the Actual-to-Expected ratio, or A/E ratio) then provides the basis for our analysis.

The following is list of the recommended changes to the demographic assumptions:

- Mortality: Changes to active, retiree, and disabled mortality tables, reflecting improved mortality experience and, therefore, longer life expectancy.

- Retirement: Separate assumptions for those hired before or after July 1, 1989 to better reflect each group's behavior in light of different requirements for retirement eligibility.

- Termination of employment: Change to rates based solely on service in order to better fit observed experience.

- Election of form of payment: Minor adjustments and simplification of the assumption regarding election of optional forms of payment.

Miscellaneous Assumptions

There are other assumptions used in the data and valuation processes for TRA that are less critical in terms of their impact on the System's liabilities. We confirm that all of these other assumptions used in the valuation are reasonable and should be maintained.

Summary of recommendations

The following summarizes our recommendations, split between the entities responsible for approval:

We recommend that the Board adopt changes to the mortality tables including projection scales for future mortality improvements, retirement rates, termination of employment rates, the assumption regarding the election of optional forms of payment, salary increase assumption, and the payroll growth assumption as presented in Appendix B in this report.

We recommend that the Legislature adopt an 8.0% investment return assumption, (2.75% inflation assumption and 5.25% real rate of return assumption).

Financial Impact

The financial impact of the suggested changes was estimated by performing additional valuations using the July 1, 2014 valuation data. The cost impact, illustrated in the table on the following page, is based on the July 1, 2014 valuation using the recommended set of assumptions outlined in this report. Due to the impact of certain key assumptions, the results of those changes are also separately identified.

When this set of assumptions is actually used, likely in the July 1, 2016 valuation, we expect the relative impact to be similar to the results shown here (as a percentage of the actuarial accrued liability and normal cost). However, the actual impact may vary due to underlying changes between valuation dates. Of particular note, the comparability may be affected by the actual investment return experience which in turn affects the anticipated date of the COLA changing from 2% to 2.5%. Further, the merger of the Duluth Teachers' Retirement Fund Association into TRA on June 30, 2015 could also change the cost impact of the recommended assumption changes.

We would also note that for the Actuarial Contribution Rates shown, the amortization period has been extended one year to June 30, 2038 following our interpretation of Minnesota Statute 356.215 Subdivision 11. This is the result of blending the current 23-year amortization payment with a 30-year amortization of the liability change. When the new assumptions are actually implemented for the July 1, 2016 valuation, the remaining amortization period will be 21 years, so the increase in the amortization period may not be one year. The relative size of the UAAL at that time compared to the actual impact of the new assumptions on the UAAL will ultimately determine how long, if at all, the amortization period is extended.

Comparison of Valuation Results and Costs					
	7/1/14 Valuation Baseline	8% Investment Return Change Only	Investment Return And Mortality Changes	Investment Return, Mortality and Salary/Payroll Changes	All Assumption Changes
Actuarial Liability ($M)	24,529	25,367	25,977	26,016	26,030
Actuarial Assets ($M)	18,182	18,182	18,182	18,182	18,182
Unfunded Actuarial Accrued Liability (UAAL) ($M)	6,347	7,185	7,795	7,835	7,849
Normal Cost Rate	8.70%	9.39%	9.74%	9.78%	9.93%
UAAL Amortization Rate	10.23%	11.23%	11.88%	12.23%	12.25%
Expense Rate	0.22%	0.22%	0.22%	0.22%	0.22%
Total Actuarial Rate	19.15%	20.84%	21.84%	22.23%	22.40%
Statutory Contribution Rate	15.68%	15.68%	15.68%	15.68%	15.68%
Sufficiency/(Deficiency)	(3.47%)	(5.16%)	(6.16%)	(6.55%)	(6.72%)
Expected COLA Increase Year	2031	Never	Never	Never	Never

Numbers may not add due to rounding.

ACTUARIAL COST METHOD

The systematic financing of a pension plan requires that contributions be made in an orderly fashion while a member is actively employed, so that the accumulation of these contributions, together with investment earnings should be sufficient to provide promised benefits and cover administration expenses. The actuarial valuation is the process used to determine when money should be contributed; i.e., as part of the budgeting process.

The actuarial valuation will not impact the amount of benefits paid or the actual cost of those benefits. In the long run, actuaries cannot change the costs of the pension plan, regardless of the funding method used or the assumptions selected. However, the choice of actuarial methods and assumptions **will** influence the incidence of costs.

The valuation or determination of the present value of all future benefits to be paid by the System reflects the assumptions that best seem to describe anticipated future experience. The choice of a funding method does not impact the determination of the present value of future benefits. The funding method determines only the incidence or allocation of cost. In other words, the purpose of the funding method is to allocate the present value of future benefits determination into annual costs. In order to do this allocation, it is necessary for the funding method to "break down" the present value of future benefits into two components: (1) that which is attributable to the past (2) and that which is attributable to the future. The excess of that portion attributable to the past over the plan assets is then amortized over a period of years. Actuarial terminology calls the part attributable to the past the "past service liability" or the "actuarial accrued liability". The portion of the present value of future benefits allocated to the future is commonly known as the "present value of future normal costs", with the specific piece of it allocated to the current year being called the "normal cost". The difference between the plan assets and actuarial accrued liability is called the "unfunded actuarial accrued liability".

Two key points should be noted. First, there is no single "correct" funding method. Second, the allocation of the present value of future benefits, and hence cost, to the past for amortization and to the future for annual normal cost payments is not necessarily in a one-to-one relationship with service credits earned in the past and future service credits to be earned.

There are various actuarial cost methods, each of which has different characteristics, advantages and disadvantages. However, Governmental Accounting Standard Board 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 TRA.

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 which 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 Governmental Accounting Standard Numbers 67 and 68, **we recommend the Entry Age Normal actuarial cost method be retained.**

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 distort 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.

TRA values assets, for actuarial valuation purposes, based on the principle that the difference between actual and expected investment returns should be subject to partial recognition to smooth out fluctuations in the total return achieved by the fund from year to year. This philosophy is consistent with the long-term nature of a retirement system. Under the current method in statute, the difference between the actual investment return on the market value of assets and the assumed investment return on the market value of assets is recognized equally over a five-year period. This methodology is the asset smoothing method most commonly used by public plans and we believe that it meets actuarial standards under ASOP 44. **We recommend the current asset valuation method be retained**.

AMORTIZATION OF UAAL

As described earlier, 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 home owner 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 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 either be amortized as one single amount or as components or "layers", each with a separate amortization base, payment and period. If the UAAL is amortized as one amount, the UAAL is recalculated each year in the valuation and experience gains/losses or other changes in the UAAL are folded into the single UAAL amortization base. The amortization payment is then the total UAAL divided by an amortization factor for the applicable amortization period.

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

Current TRA Actuarial Amortization Method: The current amortization method used by TRA includes one amortization base with payments determined as a level percentage of payroll. The amortization period is set by statute to a closed period ending in 2037, subject to adjustment under certain circumstances. Each year, the amortization period is reduced by one year until 2037 when the amortization of the base will be considered completed.

One weakness of a single closed amortization base is that near the end of the amortization period, there can be significant volatility in the actuarial contribution rate. As the amortization period gets shorter every year, the volatility exhibited implies that the amortization period might need to be changed to a layered base approach or retained with a "floor" (minimum number of years applicable to amortizing the UAAL) to address the undesired contribution volatility created by the end of the current amortization period. The amortization period could also be reset to a longer period, although this is our less preferred method to address the concern.

With the layered base approach, the current UAAL would be fully paid off in 2037. Gains and losses which occur after the change in method would be paid off over a specified period of time. This approach allows for a definite payoff date, something not possible with a floor. Because the current UAAL is much larger than a typical year's gain or loss, we would anticipate that the majority of the UAAL payment through 2037 would be for the current UAAL base. New layers would likely be composed of both experience gains and losses (both asset and liability), so the total impact of all these bases would be fairly small as the gains and losses partially offset each other. Note that a gain being "paid off" means recognizing the favorable experience by lowering the amortization payment.

If a layered approach were adopted, we suggest that new experience (gains and losses) bases be paid off over 20 years. This bears some resemblance to the time period from entry to retirement of a typical active member and should span most economic cycles. Using a shorter period, such as 10 years, would pay down the amortization base faster, but create more volatility. Likewise, longer periods reduce contribution rate volatility, but delay recognition of the experience. Changes in the UAAL resulting from other items such as plan amendments or changes in assumptions/methods will be amortized over an appropriate period. For example, assumption changes might be amortized over a longer period of time recognizing that such a change reflects the difference in expected experience many years in the future.

While the current method, set by statute, is not unreasonable, we do note that over the last few years, the Government Finance Officers Association (GFOA) and the Conference of Consulting Actuaries (CCA) have published guidance on public pension plan funding, including the amortization period. Although these recommendations are not binding, they do point to an increased focus on developing amortization policies

that are designed to pay down the UAAL in a meaningful way over a reasonable period. Consequently, we believe a greater understanding of the issues involved would be beneficial to the Board.

We also note that because TRA is funded through a fixed contribution rate, the amortization policy does not directly impact the actual funding of the System. The amortization rate is utilized, however, in the calculation of the contribution sufficiency or deficiency. Given these facts and the current amortization period, it does not appear that there is a compelling reason to make a change at this time, although adopting a layered approach would certainly be reasonable and acceptable. **We are not recommending a change to the amortization method at this time, but believe a change could certainly be reasonable.**

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SECTION 3 – ECONOMIC ASSUMPTIONS

Economic assumptions include the long-term investment return (net of investment expenses), price inflation, and wage inflation (the across-the-board portion of salary increases). The merit salary scale is actually a demographic assumption, but it is being discussed with the economic assumptions because the total salary increase assumption includes the wage inflation assumption. Unlike demographic assumptions, economic assumptions do not lend themselves to analysis based solely upon internal historical patterns, because both salary increases and investment return are influenced more by external forces which are difficult to accurately predict over the long term. The investment return and salary increase assumptions are generally selected on the basis of expectations in an inflation-free environment and then increased by the long-term expectation for price inflation.

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

- Historical observations of price and wage inflation statistics and investment returns
- The 2014 Social Security Trustees Report
- Future expectations of the State Board of Investments (SBI), and their consultants
- U. S. Department of the Treasury bond rates
- Assumptions used by other large public retirement systems, based on the Public Fund Survey, published by the National Association of State Retirement Administrators.

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

ACTUARIAL STANDARD OF PRACTICE NUMBER 27

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

Due to the application of ASOP 27, it may be informative for others to be aware of the basic content of ASOP 27. The standard applies to the selection of economic assumptions to measure obligations under any defined benefit pension plan that is not a social insurance program (e.g., Social Security).

With respect to relevant data, the standard recommends the actuary review appropriate recent and long-term historical economic data, but advises the actuary not to give undue weight to recent experience. Furthermore, it advises the actuary to consider that some historical economic data may not be appropriate for use in developing assumptions for future periods due to changes in the underlying environment. In addition, with respect to any particular valuation, each economic assumption should be consistent with all other economic assumptions over the measurement period.

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

SECTION 3 – ECONOMIC ASSUMPTIONS

Since the last experience study was performed, the Actuarial Standards Board has issued a revised ASOP 27. The prior standard included the use of a "best estimate range" in developing economic assumptions. The current standard calls for the actuary to select a "reasonable" assumption. For this purpose, an assumption is reasonable if it has the following characteristics:

a. it is appropriate for the purpose of the measurement;

b. it reflects the actuary's professional judgment;

c. it takes into account historical and current economic data that is relevant as of the measurement date;

d. it reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and

e. it has no significant bias (i.e., it is neither significantly optimistic nor pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included.

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

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

The following table summarizes the current and proposed economic assumptions:

	Current Assumptions	Proposed Assumptions
Price Inflation	3.00%	2.75%
Investment Return	8.00%/8.50%	8.00%
General Wage Growth	3.75%	3.50%

Price Inflation

Use in the Valuation: Future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return, wage growth, and salary increases.

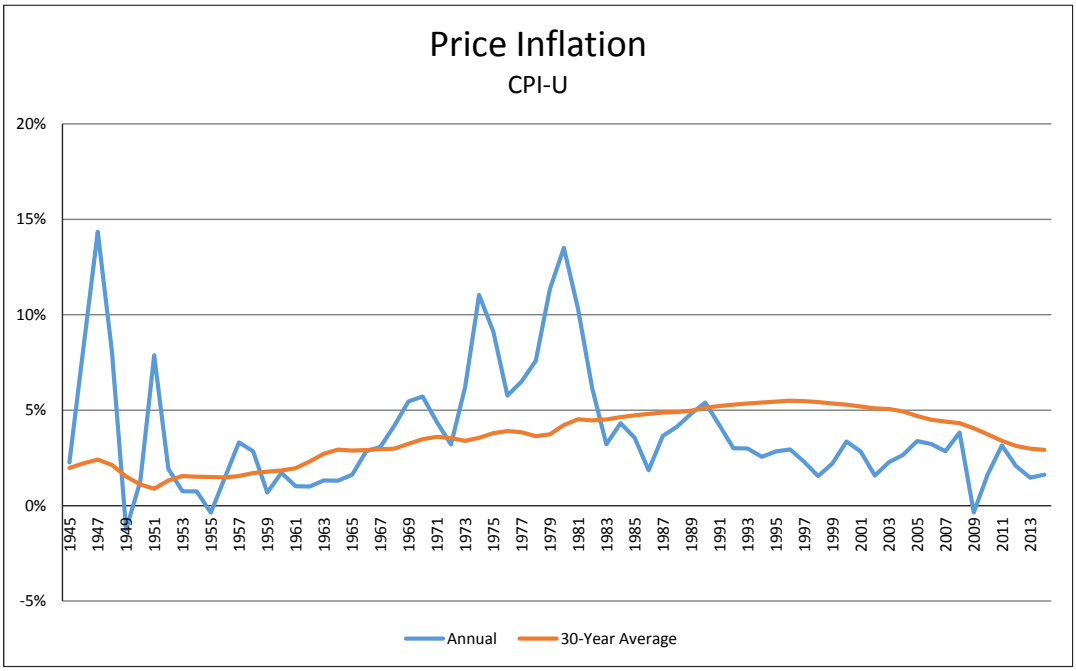
The long-term relationship between price inflation and investment return has long been recognized by economists. The basic principle is that the investor demands a more or less level "real return" – the excess of actual investment return over price inflation. If inflation rates are expected to be high,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

The current assumption for price inflation is 3.00% per year.

Past Experience: Although economic activities, in general, and inflation in particular, do not lend themselves to prediction solely on the basis of historical analysis, historical patterns and long-term trends are factors to be considered in developing the inflation assumption. The Consumer Price Index, US City Average, All Urban Consumers, CPI (U), has been used as the basis for reviewing historical levels of price inflation. The following table provides historical annualized rates and annual standard deviations of the CPI-U over periods ending December 31st.

Period	Number of Years	Annualized Rate of Inflation	Annual Standard Deviation
1926 – 2014	88	2.99%	3.85%
1954 – 2014	60	3.69	2.77
1964 – 2014	50	4.15	2.78
1974 – 2014	40	4.00	2.99
1984 – 2014	30	2.78	1.14
1994 - 2014	20	2.37	0.91
2004 - 2014	10	2.28	1.14

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



Over more recent periods, measured from December 31, 2014, the average annual rate of increase in the CPI-U has been 3.00% or lower. The period of high inflation from 1973 to 1981 has a significant impact on the averages over periods which include these rates. Further, the average rate of 2.99% over the entire 88 year period is close to the average rate of 2.78% for the prior 30 years (1984 to 2014). However, the volatility of the annual rates in more recent years has been markedly lower as indicated by the significantly lower annual standard deviations. Many experts attribute the lower average annual rates and lower volatility to the increased efforts of the Fed since the early 1980's to stabilize price inflation.

Forecasts of Inflation: Additional information to consider in formulating this assumption is obtained from measuring the spread on Treasury Inflation Protected Securities (TIPS) and from the prevailing economic forecasts. The spread between the nominal yield on treasury securities (bonds) and the inflation indexed yield on TIPS of the same maturity is referred to as the "breakeven rate of inflation" and represents the bond market's expectation of inflation over the period to maturity. The table below provides the calculation of the breakeven rate of inflation as of December 31, 2014.

Years to Maturity	Nominal Bond Yield	TIPS Yield	Breakeven Rate of Inflation
10	2.17%	0.49%	1.68%
20	2.47	0.68	1.79
30	2.75	0.83	1.92

As this data indicates, the bond market is anticipating low inflation of under 2% for both the short and long term. However, that expectation may be heavily influenced by the current low interest rate environment created by the Fed's manipulation of the bond market. Whether price inflation returns to the higher rates observed historically and if so, when, remains to be seen.

Although many economists forecast lower inflation than the assumption used by retirement plans, they are generally looking at a shorter time horizon than is appropriate for a pension valuation. To consider a longer, similar time frame, we looked at the expected increase in the CPI by the Office of the Chief Actuary for the Social Security Administration. In the most recent report (May 2014), the projected average annual increase in the CPI over the next 75 years was estimated to be 2.70%, under the intermediate cost assumption. The range of inflation assumptions used in the Social Security 75-year modeling, which includes a low and high cost scenario, in addition to the intermediate cost projection, was 2.00% to 3.40%.

Finally, it is worth noting that the Minnesota State Board of Investment (SBI) has been utilizing a 3% long-term assumption for inflation when developing their estimates of future asset returns, although they are currently reviewing those assumptions as part of an Asset/Liability Study that is being performed. While actuarial standards caution against too much consideration of recent events, the lower inflation for the last two decades, coupled with the low future inflation anticipated by the bond markets, suggests that there may have been a fundamental change away from the longer term historical norms. Based on the information presented above**, we recommend a reduction in the inflation assumption to 2.75%.**

Consumer Price Inflation	
Current Assumption	3.00%
Recommended Assumption	2.75%

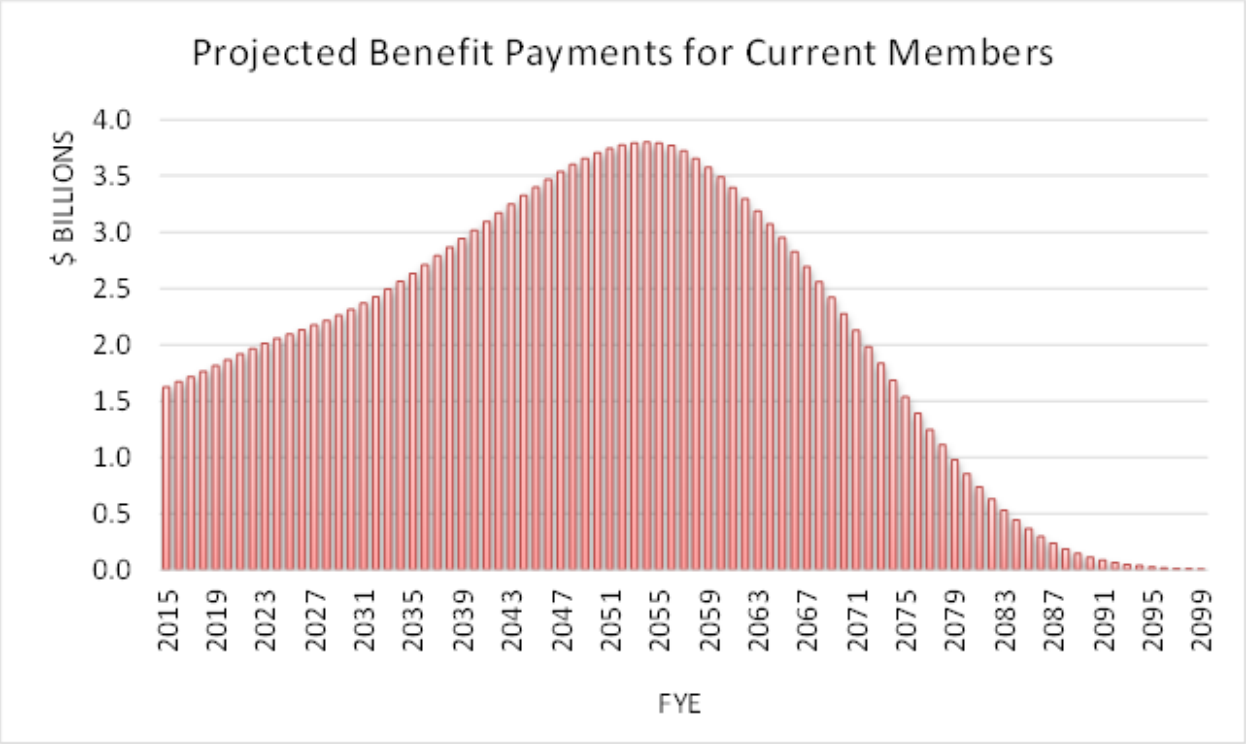
INVESTMENT RETURN

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

The current investment return assumption is 8.00% per year through June 30, 2017 and 8.50% thereafter, net of all investment-related expenses. This approach, called a "select and ultimate rate of return" is the nominal rate of return and is composed of two components. The first component is price inflation (previously discussed). Any excess return over price inflation is referred to as the real rate of return. The real rate of return, based on the current set of assumptions, is 5.00% through June 30, 2017, and 5.50% thereafter (the nominal return less 3.00% inflation).

Long Term Perspective

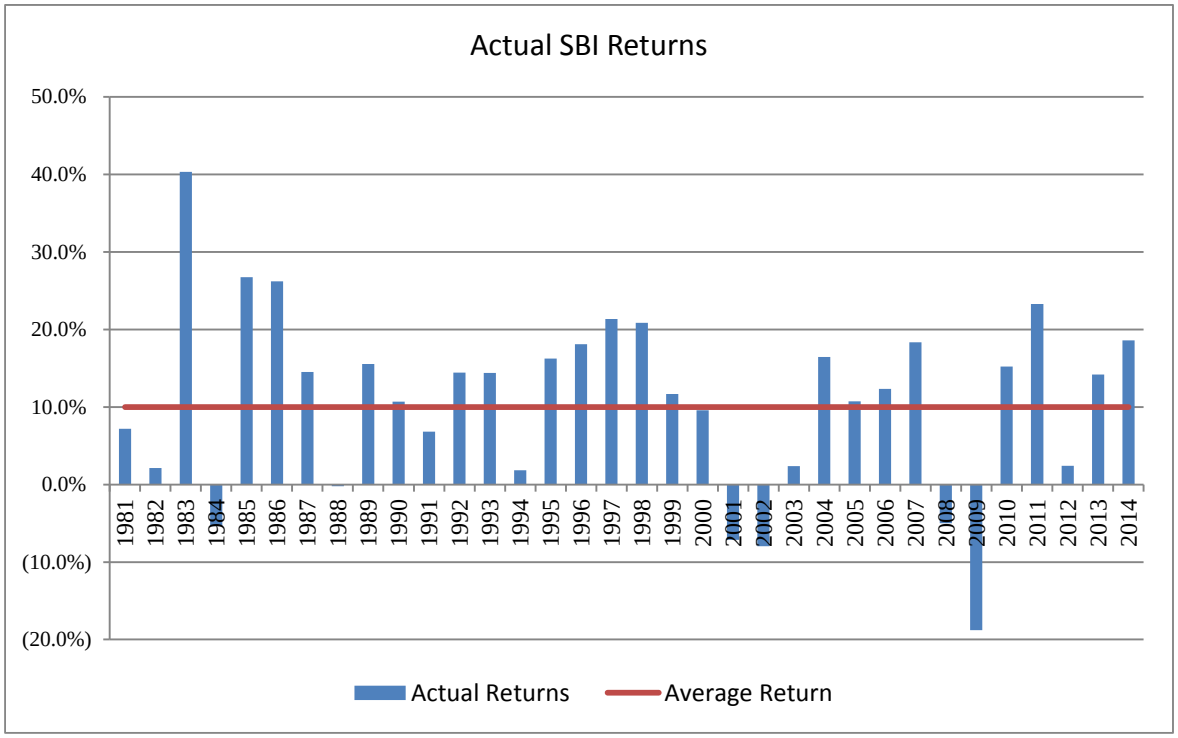
Because the economy is constantly changing, assumptions about what may occur in the near term are volatile. Asset managers and investment consultants usually focus on this near-term horizon in order to make prudent choices regarding how to invest the trust funds. For actuarial calculations, we typically consider very long periods of time as some current employees will still be receiving benefit payments more than 80 years from now. For example, a newly-hired teacher who is 25 years old may work for 35 years, to age 60, and live another 25 years, to age 85. The retirement system would receive contributions for the first 35 years and then pay out benefits for the next 25 years. During the entire 60-year period, the system is investing assets on behalf of the member. For such a typical career employee, more than one-half of the investment income earned on assets accumulated to pay benefits is received after the employee retires. In addition, in an open ongoing plan like TRA, the stream of benefit payments is continually increasing as new hires replace current members who leave covered employment due to death, termination of employment, and retirement. This difference in the time horizon used by actuaries and investment consultants is frequently a source of debate and confusion when setting economic assumptions. The following graph illustrates the long duration of the expected benefit payments for current members on July 1, 2014.



TRA Historical Perspective

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, 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 graph below shows the actual fiscal year (June 30) net returns for the TRA portfolio for the last 34 years. Despite significant volatility in the results from year to year the actual geometric (compound) return was 8.4% for the last 10 years, 9.0% for the last 20 years, and 10.3% for the last 30 years. Note that SBI's actual return for the last 30 years exceeds their current expected return assumption of 8.50% by almost 2%. This means that current expected long-term returns are far lower than those actually earned in the past, reflecting a view of the capital markets that differs markedly from what has been experienced in the past.



ANNUALIZED RETURNS through 6/30/14			
1-Year Return:	18.6%	10-Year Return:	8.4%
3-Year Return:	11.5%	20-Year Return:	9.0%
5-Year Return:	14.5%	30-Year Return:	10.3%

Analysis Using SBI Assumptions

TRA's assets are held and invested by the Minnesota State Board of Investment (SBI). This office has investment professionals who make decisions regarding how the assets are invested, recognizing the long-term nature of the liabilities of the systems. Since ASOP 27 provides that the actuary may rely on outside experts, it seems appropriate to heavily weigh the market outlook and expectations provided by SBI. As part of their duties, SBI performed a comprehensive study of the expected return of the various asset classes in which they invest in 2011. Their results, which are summarized in a July 22, 2014 memo to the directors of the three large Minnesota systems, indicate a long-term expected return of 8.36%, assuming a 3% inflation assumption, i.e., a real return of 5.36%. SBI's analysis and the expected return they developed is based on consideration of the capital market assumptions used by various investment consultants or firms. In that memo, SBI states that "we believe that the assumptions and data used in 2011 remain the appropriate

information for the purpose of this request. We believe nothing has occurred in the past three years which would alter our long-term viewpoint."

We do note that SBI is currently in the early stages of a comprehensive Asset/Liability Study which will include a review of their assumptions as well as the asset allocation. While preliminary results of this study are not yet available, we do anticipate that the view of the short to intermediate time horizon could be more pessimistic than in the past. Additionally, there could be a change in asset allocation that would also affect the expected return. Recognizing that there may be changes ahead, we have proceeded with an analysis of the current portfolio and asset allocation, using SBI's current assumptions as a means to evaluate the current investment return assumption. Changes in either capital market assumptions and/or the asset allocation of the Fund may require us to revisit the recommendation for this assumption.

Our analysis used the real rates of return in SBI's current capital market assumptions and TRA's target asset allocation as shown below:

Asset Class	Target Allocation	Expected Real Return	Standard Deviation
Domestic Equities	45%	5.5%	16.9%
International Equities	15%	6.0%	19.4%
US Fixed Income	18%	1.5%	5.2%
Alternative Investments	20%	6.4%	21.3%
Cash	2%	0.5%	1.4%

Using projection results produces an expected range of real rates of return over a 50 year time horizon. Looking at one year's results produces an expected real return of 5.36% but also has a high standard deviation or measurement of volatility. By expanding the time horizon, the average return does not change much, but the volatility declines significantly. The table below provides a summary of results.

Time Span In Years	Mean Real Return	Standard Deviation	Real Returns by Percentile				
			5th	25th	50th	75th	95th
1	6.20%	13.43%	-14.36%	-3.22%	5.36%	14.71%	29.63%
5	5.53	5.95	-3.96	1.43	5.36	9.44	15.60
10	5.45	4.20	-1.32	2.57	5.36	8.23	12.50
20	5.40	2.97	0.59	3.38	5.36	7.38	10.36
30	5.39	2.42	1.45	3.74	5.36	7.01	9.43
50	5.38	1.88	2.32	4.10	5.36	6.64	8.50

The percentile results are the percentage of random returns over the time span shown that are expected to be less than the amount indicated. Thus for the 10-year time span, 5% of the real rates of return will be below negative 1.32% and 95% will be above that. As the time span increases, the results begin to converge. Over a 50 year time span, the results indicate a 25% chance that real returns will be below 4.10% and a 25% chance they will be above 6.64%. There is a 50% chance the real returns will be 5.36% or above and a 50% chance the real return will be below 5.36%.

We note that in the information provided to us by SBI, they indicated that they are considering a 30-year horizon, which is consistent with our long-term perspective. It should also be noted that SBI's return assumptions are before reflecting estimated investment expenses of 0.11%, so the real rate of return, net of investment expenses, is 5.25%.

Many investment firms or investment consulting firms produce estimates of future asset returns, similar to the expected return analysis developed by SBI. While it might seem desirable to compare these estimates, there are at least two considerations that we believe weaken the credibility of such efforts. First, most of the estimates of expected returns are produced with a five- to ten-year investment horizon being considered. Especially in light of the current interest rate environment, this leads to results which cannot be meaningfully compared to the SBI results which are intended to reflect a 30-year time horizon. Second, when SBI indicates what it believes its domestic equities will return, it does so in the context of knowing the construction of its domestic equities portfolio. Another investment consultant will likely have in mind a different blend of large versus small stocks or growth versus value equities. There are also comparison challenges in certain asset classes such as international stock (emerging or developed markets), bonds (duration and credit quality), and alternatives (a very broadly interpreted category). For these two reasons, we believe trying to compare the expected return developed by SBI with the assumptions of another group of investment professionals may lead to an invalid comparison. Since SBI has qualified professionals on its staff and is in the best position to understand its own portfolio and the reasonable expectations given their investment style, we prefer to rely heavily on their analysis.

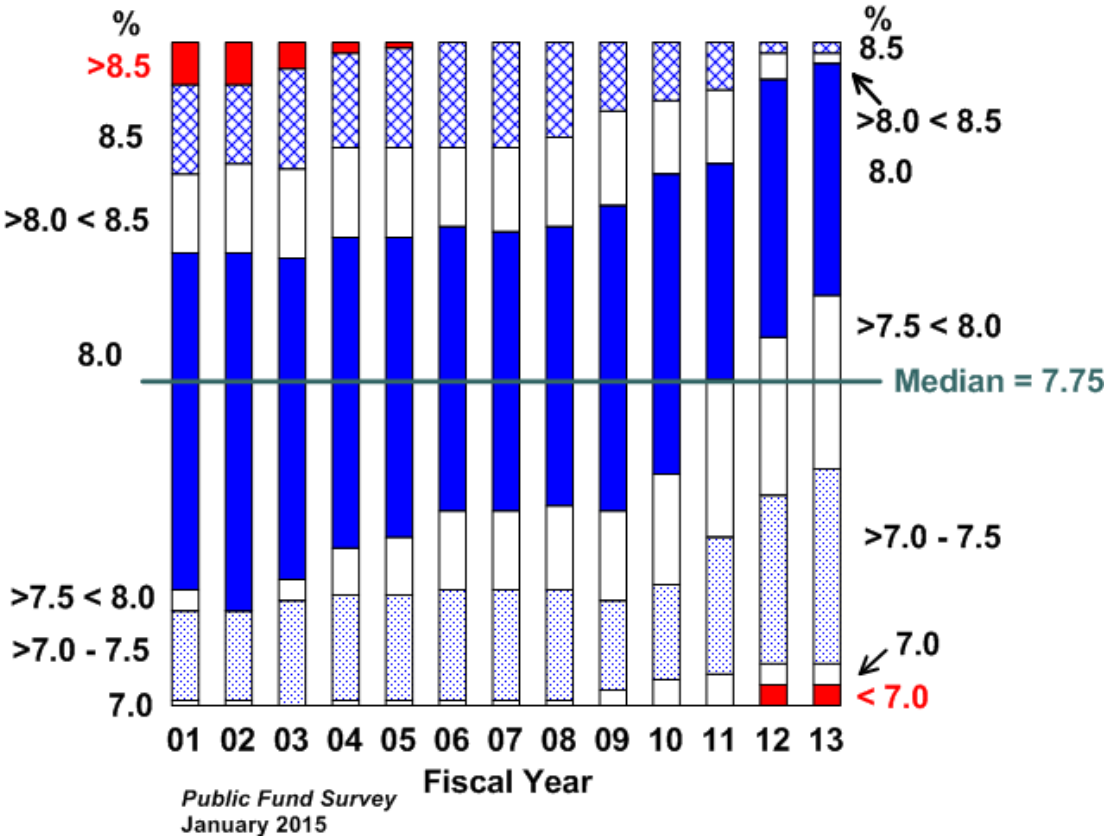
While we like the idea of using a forward looking model, the weakness with that approach is that the assumptions being used are set by investment managers and consultants who are typically focusing on a much shorter time period (five to ten years). Therefore, those assumptions may not necessarily be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

If the investment return assumption was set equal to the expected return based on the capital market assumptions each year or even in every experience study, it could create significant fluctuations in the system's funded ratio and actuarial contribution rate. Our goal is to choose an assumption that will be reasonable in the long term (30 to 50 years) with adjustment only when there are compelling changes to investment policy or evidence of a change in the long-term trends in the capital markets. For instance, in past experience studies when the expected return using the investment consultant's assumptions was above 8.5%, it was not considered completely credible and there was not a recommendation for an increase in the actuarial assumed rate of return based solely upon those results. Likewise, we do not believe that we should automatically recommend lowering the actuarial assumption now that the capital market assumptions produce a rate lower than the current assumption. Additional analysis and discussion are needed before a change is implemented.

Peer System Comparison

While we do not recommend the selection of an investment return assumption be based on the assumptions used by other systems, it does provide another set of relevant information to consider. The following graph shows the change in the distribution of the investment return assumption from fiscal year 2001 through 2013 for the 120+ large public retirement systems included in the National Association of State Retirement Administrators (NASRA) Public Fund Survey. It is worth noting that the median investment return assumption in fiscal year 2012 dropped from 8.00% to 7.75%. The assumed rate of return is heavily influenced by the asset allocation of the system. The average asset allocation for the systems in the Public Fund Survey is 2.9% cash, 51.2% equities, 22.5% fixed income, 8.8% real estate, and 14.5% alternative investments which has an impact on the expected return of the systems. Note that TRA is invested in a portfolio that differs significantly in that the equity allocation is 60% and the fixed income allocation is 18%, a somewhat more aggressive portfolio than the average system. As a result, it is reasonable to anticipate that the expected return for TRA could be higher than that of the median system.

As the graph below indicates, the investment return assumptions used by public plans have been reduced in the last decade. However, an 8.0% assumption is still a commonly used assumption. There are very few systems using an assumed rate of return above 8.0%.



Recommendation:

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

This is a challenging time to develop a recommendation for the investment return assumption. We need to recognize that there is no right answer to the question as no one knows what the future holds. After reviewing all of the available information, **we recommend an 8% investment return assumption**, based on the 2.75% inflation assumption and the 5.25% real rate of return.

Investment Return	
Current Assumption	8.00% through 2017, 8.50% thereafter
Recommended Assumption	8.00%

WAGE INFLATION

Background: Wage inflation, thought of as the "across the board" rate of salary increases, is composed of the price inflation assumption combined with an assumption for the real rate of wage increases. In constructing the salary increase assumption, the wage inflation assumption is further combined with an assumption for service-based salary increases (called a merit scale). The service-based salary increase assumption is discussed later in this section of the report. The current assumption for real rate of wage increase is 0.75%.

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

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

Historical Perspective: We have used statistics from the Social Security System on the National Average Wage back to 1951. Because the National Average Wage is based on all wage earners in the country, it can be influenced by the mix of jobs (full-time vs. part-time, manufacturing vs. service, etc.) as well as by changes in some segments of the workforce that are not seen in all segments (e.g. regional changes or

growth in computer technology). Further, if compensation is shifted between wages and benefits, the wage index would not accurately reflect increases in total compensation. TRA's membership is composed exclusively of teachers and administrators, living in Minnesota, whose wages and benefits are somewhat linked as a result of state funding of education. Because the competition for workers can, in the long term, extend across industries and geography, the broad national earnings growth will have some impact on TRA members. In the shorter term, however, the wage growth of TRA and the nation may be less correlated.

There are numerous ways to review this data. For consistency with our observations of CPI, the table below shows the compound annual rates of wage growth for various 10-year periods, and for longer periods ended in 2013 (most recent available data).

Decade	Wages
2003-2013	2.8%
1993-2003	3.9%
1983-1993	4.3%
1973-1983	7.2%
1963-1973	5.6%
1953-1963	3.4%

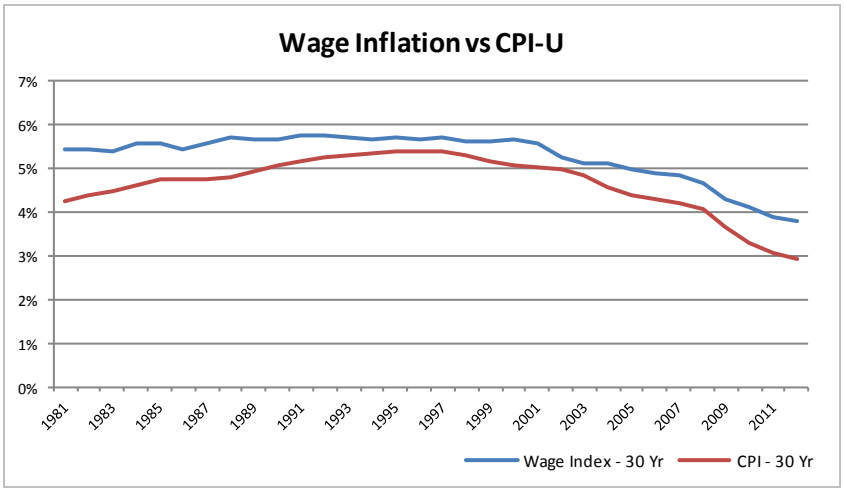
Period	Years	Wages
2003-2013	10	2.8%
1993-2013	20	3.4%
1983-2013	30	3.7%
1973-2013	40	4.5%
1963-2013	50	4.8%
1953-2013	60	4.5%

The excess of wage growth over price inflation represents the real wage inflation rate. Although real wage inflation has been very low in recent years, likely due to the recovery from the 2008 financial crisis, our focus must remain on the long term. The following table shows the compounded wage growth over various periods, along with the comparable price inflation rate for the same period. The differences represent the real wage inflation rate. The data for each year is documented in Exhibit 3.

Decade	General Wage Growth	CPI Incr.	Real Wage Inflation
2003-2013	2.8%	2.4%	0.4%
1993-2003	3.9%	2.4%	1.5%
1983-1993	4.3%	3.8%	0.5%
1973-1983	7.2%	8.4%	(1.2%)
1963-1973	5.6%	3.8%	1.8%
1953-1963	3.4%	1.4%	2.0%

Period	General Wage Growth	CPI Incr.	Real Wage Inflation
2003-2013	2.8%	2.4%	0.4%
1993-2013	3.4%	2.4%	1.0%
1983-2013	3.7%	2.9%	0.8%
1973-2013	4.5%	4.2%	0.3%
1963-2013	4.8%	4.1%	0.7%
1953-2013	4.5%	3.7%	0.8%

Similar information over rolling thirty year periods is shown in the following graph:



TRA supplied us with data that provided a measurement of average starting teacher salaries for the past 30 years. While the results could be somewhat influenced by the Minneapolis school district not being included until recently, we nonetheless believe it provides a useful assessment of wage inflation for TRA members, particularly because the salaries of all levels of teachers tend to move together. For the period covered, the effective increase in starting salaries was 2.99% per year compared with 2.76% annual price inflation. This suggests that real wage inflation for Minnesota teachers has been approximately 0.25% during the same period that national real wage inflation was approximately 0.8%. This general trend was also observed when analyzing the average teacher salary over the last 25 years in a study of national wages by state. In addition, a recent article in the Minneapolis Star Tribune discussed the same salary trend over the last decade, noting that although teacher pay has not kept pace with inflation, much of that is due to the increasing cost of health and pension benefits provided to Minnesota teachers. In other words, employee benefits have become a greater percentage of total compensation (salary plus benefits). Although this is quite insightful when reviewing the data over the recent past, the real question in setting this assumption is whether or not this trend will continue. In our opinion, it seems unlikely to continue for the next 30 to 50 years so we expect the real wage inflation rate to eventually revert back to more normal historical rates.

Forecasts of Future Wages: The wage index we used for the historical analysis has been projected forward by the Office of the Chief Actuary of the Social Security Administration. In a report in May of 2014 the annual increase in the National Average Wage Index over the next 30 years under the intermediate cost assumption was 3.8%, 1.1% higher than the Social Security intermediate inflation assumption of 2.7% per year. The range of the assumed real wage inflation in the 2014 Trustees report was 0.5 to 1.8% per year.

Recommendation: Based on data available and our professional judgment, we believe that a range between 0.50% and 1.25% is reasonable for the real wage inflation. **We recommend that the long-term assumed real wage inflation remain 0.75% per year.**

GROWTH IN MEMBERSHIP/PAYROLL GROWTH ASSUMPTION

We propose continuing the assumption that no future growth in active membership will occur. This assumption affects the amortization payment rate, which is the portion of the total contributions used to liquidate the unfunded actuarial accrued liability. With no assumed growth in membership, future salary growth due only to general wage increases is being anticipated. If increases should occur not only because of wage increases but also because of additional active members, there will be a larger pool of salaries over which to spread the unfunded actuarial accrued liability, which would result in lower UAAL payments as a percent of payroll. The uncertainties in light of current conditions in public employment and the national economy, along with actual experience, argue against anticipating any increase in active membership for funding purposes.

We recommend the payroll growth assumption, used to amortize the UAAL, be lowered from 3.75% to 3.50%, reflecting the lower expected growth in covered payroll.

TOTAL SALARY INCREASE

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

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

Earlier in this report, we recommended a general wage growth assumption of 3.50% (2.75% inflation and 0.75% real wage growth). Therefore, the merit scale will be added to the 3.50% wage inflation assumption to develop the total salary increase assumption.

Analysis of the merit salary scale is complicated by the fact that only total salary is reported to TRA, which includes both the underlying wage inflation component of salary increases and the merit salary scale. Furthermore, there is often a delay in the actual price inflation and wage 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. In addition, the budget challenges for governmental employers during this study period is likely to have impacted the actual salary increases.

For our first step, we compared individual salary increases using total reported salary for all members active in two consecutive periods (e.g. 2008 and 2009, 2009 and 2010, etc.). The overall results of the current study are shown below:

Average Increase in Salaries			
Year	**Actual**	**Expected**	**Difference**
2008-09	6.19%	5.52%	(0.67%)
2009-10	1.18%	5.56%	4.38%
2010-1l	3.24%	5.52%	2.18%
2011-12	2.38%	5.49%	3.11%
2012-13	2.06%	5.49%	3.43%
2013-14	3.87%	5.52%	1.65%
All years	3.13%	5.52%	2.39%

Since inflation is a component of the salary increase assumption, we would expect actual salary increases to be lower than the current assumption when actual price and wage inflation is lower than the assumption. During the study period price inflation was around 1.4%, compared to the current assumption of 3.0%, and the increase in the national average wage index was 1.7% compared to the current assumption of 3.75%. This information suggests that we could expect wage increases to be 1.5% to 2.0% lower than expected, simply as a function of the overall economy. As noted in the table above, the actual increases were about 2.4% lower. Recognizing that government revenues have been significantly lower since the Great Recession, it is not surprising that the actual wage growth slightly lagged what was expected.

Given the economic situation during the study period, it is difficult to assign much credibility to the salary experience observed in the study period. However, based on the observed patterns of salary growth by duration (years of service) and after reviewing the salary schedules of the five largest employers in TRA, we believe it is appropriate to reduce the merit scale at certain durations under 5 years, and increase it at certain points between 20 and 25 years. We believe these adjustments will improve the general fit when differences in inflation and wage growth are ignored.

The current total scale used by TRA has ultimate increases leveling out at 3.50% at 22 years of service, with an overall wage growth assumption of 3.75%. This implies negative merit increases at 22 years of service and beyond. We are generally uncomfortable with the idea of negative merit increases, and propose that this be removed by adding 0.25% to the merit scale at all durations, resulting in an ultimate merit increase of 0%, reflecting a common pattern seen in long-term employment. Coupled with the decrease in the overall wage growth, the total salary scale will bottom out at 3.50% under the proposed assumption as well. The net impact of these changes does not affect the overall A/E ratio.

We recommend some minor changes to the merit salary scale at certain durations to better fit the observed experience, as well as a 0.25% increase in the merit scale at all service durations.

Exhibit 1

U.S. Consumer Price Index

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

Exhibit 2

National Average Wage Index

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

Exhibit 3

Annual Rates of Price and Wage Inflation

Calendar Year Ends	National Wage Index	National Price CPI Index	National Implied Productivity Increase
1985	4.3%	3.8%	0.5%
1986	3.0%	1.1%	1.8%
1987	6.4%	4.4%	2.0%
1988	4.9%	4.4%	0.5%
1989	4.0%	4.6%	-0.7%
1990	4.6%	6.1%	-1.5%
1991	3.7%	3.1%	0.7%
1992	5.2%	2.9%	2.3%
1993	0.9%	2.7%	-1.9%
1994	2.7%	2.7%	0.0%
1995	4.0%	2.5%	1.5%
1996	4.0%	3.3%	1.6%
1997	5.8%	1.7%	4.1%
1998	5.2%	1.6%	3.6%
1999	5.6%	2.7%	2.9%
2000	5.5%	3.4%	2.1%
2001	2.4%	1.5%	0.8%
2002	1.0%	2.4%	-1.4%
2003	2.4%	1.9%	0.6%
2004	4.6%	3.3%	1.4%
2005	3.7%	3.4%	0.3%
2006	4.6%	2.5%	2.1%
2007	4.5%	4.1%	0.4%
2008	2.3%	0.1%	2.2%
2009	-1.5%	2.7%	-4.2%
2010	2.4%	1.5%	0.9%
2011	3.1%	3.0%	0.1%
2012	3.1%	1.7%	1.4%
2013	1.3%	1.5%	-0.2%

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SECTION 4 – DEMOGRAPHIC ASSUMPTIONS

Actuarial Standard of Practice No. 35 (ASOP 35) provides guidance to actuaries regarding the selection of demographic and other non-economic assumptions for measuring pension obligations. ASOP 35 states that the actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment. The actuary should select reasonable demographic assumptions in light of the particular characteristics of the defined benefit plan that is the subject of the measurement. A reasonable assumption is one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period.

The actuary should follow the following steps in selecting the demographic assumptions:

1. Identify the types of assumptions. Types of demographic assumptions include but are not limited to retirement, mortality, termination of employment, disability, election of optional forms of payment, administrative expenses, family composition, and treatment of missing or incomplete data. The actuary should consider the purpose and nature of the measurement, the materiality of each assumption, and the characteristics of the covered group in determining which types of assumptions should be incorporated into the actuarial model.

2. Consider the relevant assumption universe. The relevant assumption universe includes experience studies or published tables based on the experience of other representative populations, the experience of the plan sponsor, the effects of plan design, and general trends.

3. Consider the assumption format. The assumption format includes whether assumptions are based on parameters such as gender, age or service. The actuary should consider the impact the format may have on the results, the availability of relevant information, the potential to model anticipated plan experience, and the size of the covered population.

4. Select the specific assumptions. In selecting an assumption the actuary should consider the potential impact of future plan design as well as the factors listed above.

5. Evaluate the reasonableness of the selected assumption. The assumption should be expected to appropriately model the contingency being measured. The assumption should not be anticipated to produce significant actuarial gains or losses.

ASOP 35 General Considerations and Application

Each individual demographic assumption should satisfy the criteria of ASOP 35. In selecting demographic assumptions the actuary should also consider: the internal consistency between the assumptions, materiality, cost effectiveness, and the combined effect of all assumptions. At each measurement date the actuary should consider whether the selected assumptions continue to be reasonable, but the actuary is not required to do a complete assumption study at each measurement date. In addition, ASOP 35 requires the actuary to include a specific assumption with respect to expected mortality improvements after the measurement date. In our opinion, the demographic assumptions recommended in this report have been developed in accordance with ASOP 35.

Overview of Analysis

The purpose of a study of demographic experience is to compare what actually happened to the individual members of the System during the study period (July 1, 2008 through June 30, 2014) with what was expected to happen based on the actuarial assumptions. Six years is a relatively short observation period for experience given the assumptions are being set with a long-term time horizon in mind. Therefore, we have considered the results of the prior Experience Study when practical to do so. In addition, this study period includes the economic downturn in 2008 and 2009 so the value of using that experience for certain assumptions is limited.

Studies of demographic experience generally involve three steps:

- First, the number of members changing membership status, called decrements, during the study is tabulated by age, duration, gender, group, and membership class as appropriate (active, retired, etc.).

- Next, the number of members expected to change status is calculated by multiplying certain membership statistics, called exposure, by the expected rates of decrement.

- Finally, the number of actual decrements is compared with the number of expected decrements. The comparison is called the actual to expected ratio (A/E Ratio), and is expressed as a percentage.

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

Revised rates of decrement are tested by using them to recalculate the expected number of decrements during the study period, and the results are shown as revised A/E Ratios.

Retiree Mortality

One of the most important demographic assumptions in the valuation is mortality because it projects the length of time benefits will be paid to current and future retirees and beneficiaries. If members live longer than expected, the true cost of future benefit obligations will be understated.

Over the last few generations, rates of mortality have been declining, meaning people are generally living longer. Furthermore, the experience of large, public retirement systems that include school employees indicate that school groups, and teachers in particular, continue to exhibit better mortality than the average working population.

There are distinct differences in the mortality rates of males and females, healthy retired members, disabled retired members and non-retired members. Because of those differences in mortality, we study these groups separately.

The current post-retirement mortality assumptions are shown below:

Males:	RP 2000 Healthy Male Annuitant Generational Mortality Table, White Collar Adjustment, Set Back 2 years
Females:	RP 2000 Healthy Female Annuitant Generational Mortality Table, White Collar Adjustment, Set Back 3 years

Actuaries use various adjustments to standard mortality tables in order to match the observed mortality rates of a specific retirement system. One of these is an age adjustment that can be either a "setback" or a "set forward". The current assumption for TRA incorporates the use of an age setback for both males and females. A two year age setback treats all members as if they were 2 years younger than they truly are when applying the rates in the mortality table. So, a two year set back would treat a 62 year old retiree as if he will exhibit the mortality of a 60 year old in the standard mortality table.

Another adjustment to a standard mortality table that is used to result in mortality rates that are a better fit to those observed is a collar adjustment. There are both "white collar" and "blue collar" variants of the RP 2000 Mortality Table. The current assumption uses the "white collar" variant of the RP 2000 Mortality Table, a variant that reflects lower rates of mortality than the basic table. The "blue collar" variant reflects higher mortality rates. These variants provide options which may result in a better fit of the assumed mortality to actual experience. They are not necessarily limited to populations that have only white or blue collar employees.

ASOP 35 requires the actuary to make a specific recommendation with respect to future improvements in mortality. 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 in some fashion in the future. Therefore, we believe it is appropriate to reflect future mortality improvements in the mortality assumption. The current approach, referred to as generational mortality, anticipates future improvements in mortality by using a different static mortality table for each year of birth, with the tables for later years of birth assuming lower mortality than the tables for earlier years of birth. The table contains "built in" mortality improvements, e.g., that a member that turns age 65 in 2035 has a longer life expectancy than a member that turns age 65 in 2015.

The generational approach is our preferred method for recognizing future mortality improvements in the valuation process because it is more direct and results in longer life expectancy for members who are younger, consistent with what we believe is more likely to occur. This is the method currently used in the TRA valuation and we recommend it continue to be used.

Because we are using generational mortality, the A/E ratios should be near 100% as future mortality improvements will be taken into account directly in the actuarial valuation process.

Healthy Retiree Mortality - Males

The following chart shows the exposures, actual deaths, and expected deaths for ages 55 to 100, along with the actual to expected ratio under the current assumption for each year in the experience study.

CURRENT STUDY PERIOD (2008 TO 2014) - MALES

	Exposure	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	19,075	350	430	81%
July 1, 2009 to June 30, 2010	19,456	400	453	88%
July 1, 2010 to June 30, 2011	19,970	423	489	87%
July 1, 2011 to June 30, 2012	20,279	472	514	92%
July 1, 2012 to June 30, 2013	20,523	468	537	87%
July 1, 2013 to June 30, 2014	20,773	506	566	89%
Total	**120,076**	**2,619**	**2,979**	**88%**

The actual experience indicates that the current assumption for male retirees is predicting too many deaths, i.e., the A/E ratio is less than 100%. While we may not expect a perfect fit with A/E ratios of 100% each year due to the size of the group, the consistent pattern of A/E ratios in the 87 to 92 range is a concern. The current assumption was adopted as a result of the last experience study, so the experience in that study was also reviewed. As the results below illustrate, the overall A/E ratio for the prior study period was 104%, but there was a definite decreasing trend observed in the data over the four-year period, as shown below.

PRIOR STUDY PERIOD (2004 TO 2008) - MALES

	Exposure	Actual	Expected	A/E Ratio
July 1, 2004 to June 30, 2005	16,755	400	333	120%
July 1, 2005 to June 30, 2006	17,222	386	352	110%
July 1, 2006 to June 30, 2007	17,791	370	372	99%
July 1, 2007 to June 30, 2008	18,169	348	389	89%
Total	**69,937**	**1,504**	**1,446**	**104%**

TRA is not large enough to expect total consistency in the actual to expected ratio from year to year. Some variation is to be expected, but the degree of variability we observed in the prior study and the strong downward trend raise concerns about the underlying data and the reliability of those results. Mortality trends tend to unfold very slowly over time so the pattern of dramatically improving mortality observed in the prior experience study is unexpected and likely not genuine. However, the experience in the current study period is fairly consistent with the data observed in the last year of the prior study period (July 1, 2007 to June 30, 2008).

The review of the detailed data from the prior experience study brought to light another concern – a dramatic difference in the "fit" of the assumption over different age groupings. This detailed data from the prior study was only available for the assumption being used at that time which is not the current assumption in this experience study. However, the large variations in the A/E ratio ("fit" of the assumption) at different age groupings was evident regardless of the assumption used. While the overall A/E ratio was 114% indicating more deaths than expected during the period, the fit was poor across the various age groupings.

PRIOR STUDY: Male Mortality Experience by Age

Age Group	Actual	Expected	A/E Ratio
55-59	27	27.73	97%
60-64	88	109.97	80%
65-69	170	172.36	99%
70-74	213	240.78	88%
75-79	319	275.72	116%
80-84	323	254.31	127%
85-89	224	151.62	148%
90-94	106	69.44	153%
95+	34	22.98	148%
Total	**1,504**	**1,324.91**	**114%**

Our analysis indicated the same type of variation occurred in the data observed in the current study period (see table below). The low A/E ratios at ages 60 to 64 and 70 to 74 are a concern because of the number of members, and the associated actuarial accrued liability, at those ages.

CURRENT STUDY: 2008-2014 Male Mortality Experience

		Current Assumption		Proposed Assumption
Age Group	Actual	Expected	A/E Ratio	A/E Ratio
55-59	8	17.85	45%	63%
60-64	80	122.76	65%	94%
65-69	210	299.27	70%	108%
70-74	332	424.67	78%	99%
75-79	503	565.94	89%	95%
80-84	577	641.43	90%	95%
85-89	550	547.70	100%	106%
90-94	267	252.23	106%	106%
95+	72	61.90	116%	100%
Total	**2,599**	**2,933.75**	**89%**	**100%**

Given the experience observed in the current study period and that in the latter part of the prior experience study period, we believe an adjustment to the current mortality assumption for males is necessary even though the assumption was changed in the last experience study.

We attempted to find a standard mortality table with age or collar adjustments that would be a good fit for the observed experience at all ages, with a focus on the key retirement ages of 60 to 80. A new mortality table, denoted as the RP-2014 Mortality Table, was published by the Society of Actuaries (SOA) in October of 2014. It was created to replace the RP-2000 Table as the mortality table standard for use in the valuation of corporate pension plans. A mortality improvement projection scale, MP-2014, was also published with the RP-2014 Mortality Table for use in projecting future mortality improvements. The SOA found that actual mortality improvements since the RP-2000 Table was published were greater than had been anticipated by Scale AA, the mortality improvement projection scale recommended for use with the RP-2000 Table (currently used in the TRA valuation). We would point out that the public plan data submitted to the SOA for purposes of this mortality study was excluded because it was materially different than the rest of the data submitted (corporate plans). This does not necessarily mean the Table is inappropriate for use by public sector plans, but it does suggest that blind adoption of the table may not be wise, either.

Despite our attempts, we did not find a standard published table with age or collar adjustments that would closely match the TRA experience observed during the period at all ages. Yet, we believe any newly recommended mortality assumption should represent a reasonable fit to the observed experience. Ultimately, we modified the RP-2014 Healthy Annuitant White Collar Male Mortality Table by setting ages back three years and then multiplying the rates at ages before 70 by 0.80 and multiplying the rates at ages over 70 by 1.478. Some blending of the mortality rates around age 70 was performed to maintain a smooth progression of mortality rates. The resulting A/E ratio for ages 55 to 80 is 99% (note FY 2009 data was excluded in this analysis as it appeared to be an aberration).

The RP-2014 family of tables is designed to be used with generational projection of future mortality improvements. This means that the mortality rates at each age are reduced (usually) slightly each year in

the valuation projections to model the assumed improvements in mortality. For example, someone who is 65 in 2014, the base year of the table, will be assumed to die with the probability shown in the table. Should they not die, the probability of death the following year (2015) at age 66 will be slightly less than the age 66 value in the base year of the table. The probability of death at age 67 will reflect two years of improvement, and so on. The MP-2014 projection scale was published with the RP-2014 tables for this purpose. This scale varies not only by age, but also by year of birth, increasing the sophistication of the projections to more accurately model the broad mortality improvements observed in the United States.

We believe that mortality will continue to improve, both for TRA members and for the United States population as a whole. Since TRA members exhibit mortality that is noticeably better than the national average, it is possible that the rate of future improvement might be slower than the nation as a whole. However, without any data to confirm this, our preference is to be conservative and use the projection scale published with the RP-2014 Mortality Tables.

We recommend that the RP-2014 White Collar Male Mortality Table, modified as described above, be used along with the MP-2014 projection scale.

Healthy Retiree Mortality- Females

The following chart summarizes the exposures, actual deaths, and expected deaths for ages 55 to 100, along with the actual to expected ratio under the current assumption for each year in the experience study.

CURRENT STUDY PERIOD (2008 to 2014) - FEMALES

	Exposure	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	23,928	466	485	96%
July 1, 2009 to June 30, 2010	24,892	428	500	86%
July 1, 2010 to June 30, 2011	26,149	522	520	100%
July 1, 2011 to June 30, 2012	27,334	515	535	96%
July 1, 2012 to June 30, 2013	28,722	527	556	95%
July 1, 2013 to June 30, 2014	30,089	523	577	91%
Total	**161,114**	**2,981**	**3,167**	**94%**

Although the current assumption was a better estimate of the actual experience in the study period for females as compared to males, the assumption is still predicting too many deaths, i.e., the A/E ratio is less than 100%. While the experience in the year ending June 30, 2010 appears to be an outlier, the mortality experience in the other years is fairly consistent, indicating some adjustment is appropriate.

Again, we reviewed the results of the last experience study which were based on the current assumption. As the results below indicate, the overall A/E ratio for the entire period was 107%, but there was some variability from year to year. We did not observe the dramatic decreasing trend observed in the male data over this same four-year period. Although there is more female data, it is still not large enough to expect the actual to expected ratio to be totally consistent every year. In particular, the year ending June 30, 2005 appears to be very inconsistent with the other experience observed in this study period.

PRIOR STUDY PERIOD (2004 to 2008) - FEMALES

	Exposure	Actual	Expected	A/E Ratio
July 1, 2004 to June 30, 2005	20,047	546	450	121%
July 1, 2005 to June 30, 2006	20,749	463	456	102%
July 1, 2006 to June 30, 2007	22,089	504	477	106%
July 1, 2007 to June 30, 2008	22,869	491	484	101%
Total	**85,754**	**2,004**	**1,867**	**107%**

A review of the detailed data from the prior experience study showed significantly lower A/E ratios at ages 60 to 75, similar to the pattern observed for males. This detailed data in the prior study was only available for the assumption being used at that time which is not the current assumption in this experience study. However, the large variations in the A/E ratio at different age groupings was evident regardless of the assumption being used.

PRIOR STUDY: Female Mortality Experience by Age

Age Group	Actual	Expected	A/E Ratio
55-59	32	21.15	151%
60-64	62	69.73	89%
65-69	104	111.56	93%
70-74	129	150.96	85%
75-79	222	231.50	96%
80-84	285	288.08	99%
85-89	425	351.08	121%
90-94	432	308.84	140%
95+	313	202.60	154%
Total	**2,004**	**1,735.48**	**115%**

Our analysis indicated that this trend also occurred in the current study period (see following table). The low A/E ratios at ages 60 to 74 are a concern because of the number of members, and the associated actuarial accrued liability, at those ages.

CURRENT STUDY: Female Mortality Experience by Age

		Current Assumption		Proposed Assumption
Age Group	Actual	Expected	A/E Ratio	A/E Ratio
55-59	19	26.69	71%	101%
60-64	102	182.58	56%	85%
65-69	200	314.65	64%	93%
70-74	229	349.59	66%	90%
75-79	297	403.09	74%	88%
80-84	457	486.81	94%	95%
85-89	567	520.76	109%	101%
90-94	654	523.67	125%	110%
95+	416	310.96	134%	100%
Total	**2,941**	**3,118.80**	**94%**	**98%**

Given the poor fit with the actual experience observed at ages 60 to 80 in the current study, which appears to be consistent with a similar trend in the prior experience study, we believe an adjustment to the mortality assumption is needed. As discussed earlier for male mortality, we attempted to find a standard mortality table, with age or collar adjustments, that would be a good fit for the observed experience at all ages, with a focus on the key retirement ages of 60 to 80. Despite numerous attempts, we did not find a standard table that we felt was acceptable. Therefore, we used the RP-2014 Healthy Annuitant White Collar Female Mortality Table with ages set back three years and multiplied the mortality rates by .85 at ages before 75 and multiplied the mortality rates by 1.362 at ages over 75. Some blending of the mortality rates around age 70 was performed to maintain a smooth set of rates. The resulting A/E ratio at ages 55 to 80 is 98% (note FY 2010 experience was excluded in this analysis due to its unusual nature). As with the male table, it is appropriate to use the generational projection scale.

We recommend that the RP-2014 White Collar Female Mortality Table, modified as described above, be used along with the MP-2014 projection scale.

Beneficiaries

The mortality of beneficiaries applies to the survivors of members who have elected a joint and survivor option. There are fewer members receiving benefits under the joint and survivor options which can produce more volatility in the observed mortality rates. Based on the limited data, **we recommend standard convention be followed and the same mortality assumption be used for beneficiaries as is used for retired members.**

Post-retirement Mortality for Disabled Members (prior to age 65)

The valuation assumes that disabled members, in general, will not live as long as retired members who met the regular service retirement eligibility. In addition, future life expectancies for disabled members are not expected to increase as significantly as the future life expectancies for healthy retirees.

Once disabled members in TRA reach normal retirement age (65 for most who have reached it), they are no longer identified in the valuation data as disabled. Therefore, we are unable to distinguish them separately in our mortality analysis. Any analysis on disabled mortality can only be performed on experience before age 65, limiting the available analysis. Because of this limitation and the generally small number of exposures and deaths, it makes sense to use the standard disabled table that is the companion to the retiree mortality table. **We recommend the RP-2014 Disabled Lives Table be used without generational improvement.** We note that in the table below, the proposed assumption would appear to be a poorer fit compared to the current assumption. However, for consistency amongst all of the mortality assumptions and because the actual impact of this assumption is negligible, we nonetheless propose making the change.

			Current Assumption		Proposed Assumption
Gender	Exposure	Actual	Expected	A/E Ratio	A/E Ratio
Males	1,002	34	35.4	97%	126%
Females	2,557	79	48.4	165%	188%
Total	**3,559**	**113**	**83.4**	**135%**	**164%**

SECTION 6 – ACTIVE MORTALITY

The active member mortality assumption models eligibility for death benefits prior to retirement. Currently, the assumption is the RP-2000 Employee White Collar Mortality Table, with a 5-year age setback for males and a 7-year age setback for females.

Because the probability of death prior to retirement is very low, this assumption has a much smaller impact on the valuation results than the post-retirement mortality assumption. Further, because it is a comparatively rare event, it is difficult to get meaningful analysis from a study of this size. Consequently, it is common practice to use the same table as is used for retiree mortality, possibly with an adjustment to the age setback. The RP-2014 family of tables has both an annuitant table (used for retirees) and an employee table. **Based on this, we would propose using the RP-2014 Employee White Collar Male Mortality Table with six-year age setback and the RP-2014 Employee White Collar Female Mortality Table with five-year age setback for males and females, respectively.**

The following table shows that the proposed assumption provides a somewhat better estimate of the observed experience than the current assumption. In either case, the assumption has a very minor impact upon the overall cost of the plan.

			Current Assumption		Proposed Assumption
Gender	**Exposure**	**Actual**	**Expected**	**A/E Ratio**	**A/E Ratio**
Males	120,490	75	113.8	66%	93%
Females	335,385	167	215.9	77%	96%
Total	**455,875**	**242**	**329.7**	**73%**	**95%**

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The valuation uses several different assumptions to anticipate when retirement benefits will commence for members. However, the same assumptions apply to members regardless of "tier". They include:

- Retirement from active status under the Rule of 90
- Normal (unreduced) retirement from active status
- Early retirement from active status
- Retirement from inactive vested status

Retirement from Active Status

The eligibility requirement for early, normal or unreduced retirement is dependent on the member's date of hire. Tier 1 members were hired before July 1, 1989 and Tier 2 members were hired on or after July 1, 1989. The specific retirement eligibility provisions for both Tier 1 and 2 are summarized below:

Hire Date	Normal Retirement Age	Early Retirement Age	Unreduced Retirement
Before July 1, 1989	Age 65 and 3 years	Age 55 and 3 years of service, or 30 years of service	Rule of 90 or Age 62 with 30 years of service
July 1, 1989 or later	Social Security Retirement Age, but not later than age 66 with 1 year of service	Age 55 and 3 years of service	N/A

For this discussion, we are going to focus on the type of retirement a member is eligible to receive. Early retirement is the term used when the accrued benefit is reduced by an early retirement factor to reflect the longer payment period. Unreduced retirement occurs when such a factor is not applied. Note that Tier 1 members receive the greater of a reduced Tier 2 benefit or the unreduced Tier 1 benefit. Still, for purposes of setting the retirement assumptions, we consider the member to be eligible for unreduced retirement if they meet any of the criteria for unreduced retirement.

Currently, the same retirement assumptions are applied to members of both Tiers. There are separate retirement rates for members who meet the Rule of 90 (before age 65) and those who don't. For analysis purposes, it is generally easier to summarize the results based on early or unreduced retirement (including Rule of 90).

A summary of the observed and expected experience during the study period for retirement is shown in the table below:

	Both Tier 1 and Tier 2 Members			
	Exposures	**Actual**	**Expected**	**A/E Ratio**
Early retirement	68,027	6,274	7,212	87%
Unreduced retirement	17,102	4,957	7,292	68%
Total	**85,129**	**11,231**	**14,504**	**77%**

Due to the effective date of Tier 2 (July 1, 1989) and the retirement eligibility requirements, there is little actual Tier 2 retirement data under normal retirement. In addition, given the effective date of Tier 2 the demographic profile of active members in each tier has become quite different. Therefore, we further analyzed the retirement experience for Tier 1 and Tier 2 members separately, with the intent of developing separate assumptions for each Tier. As noted below, we found differences in the retirement patterns based on the membership tier and, as a result, we are recommending separate retirement assumptions for each tier.

A discussion of our findings is included below.

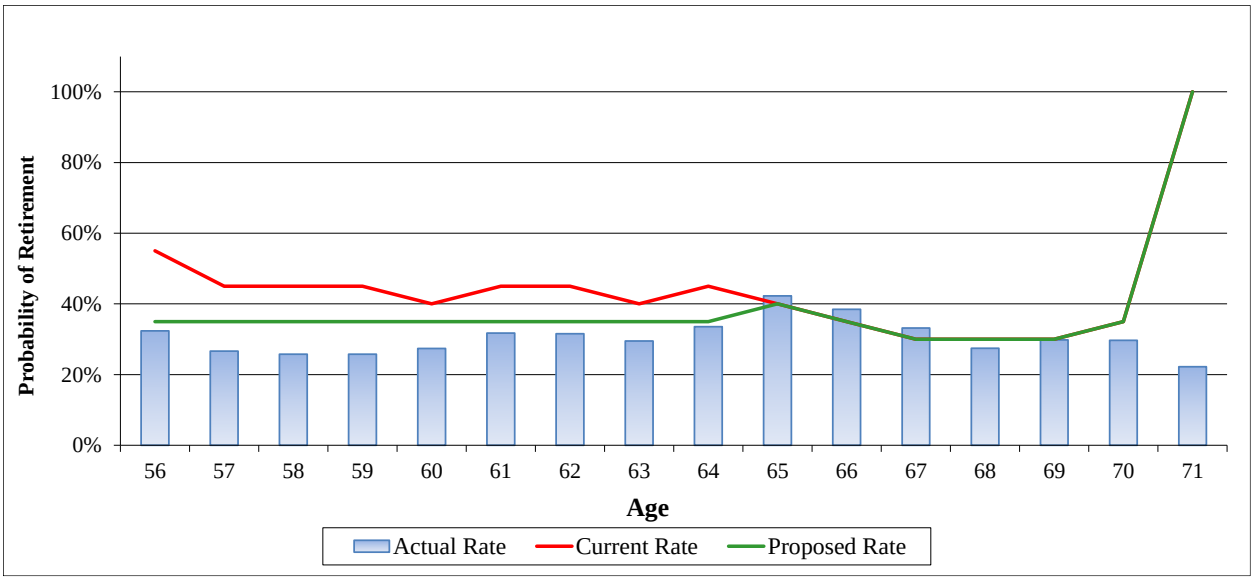
Unreduced Retirement Benefits Including Rule of 90

The following table shows the exposures, actual and expected retirements, and the A/E ratio for Tier 1 members (hired before July 1, 1989) who were eligible to retire with unreduced benefits.

Unreduced Retirements – Tier 1

	Exposures	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	2,474	724	1,084	67%
July 1, 2009 to June 30, 2010	2,577	660	1,118	59%
July 1, 2010 to June 30, 2011	2,709	824	1,171	70%
July 1, 2011 to June 30, 2012	2,652	815	1,149	71%
July 1, 2012 to June 30, 2013	2,549	782	1,105	71%
July 1, 2013 to June 30, 2014	2,419	738	1,045	71%
Total	**15,380**	**4,543**	**6,672**	**68%**

Overall, there were significantly fewer retirements by Tier 1 members who were eligible to receive unreduced retirement benefits than was expected during the study period (A/E ratio of 68%). The pattern was consistent across all years and, as a result, we assign more credibility to the observed experience. Based on the observed data, we recommend the proposed assumption (green line), shown in the graph below, which results in an A/E ratio of 84%.



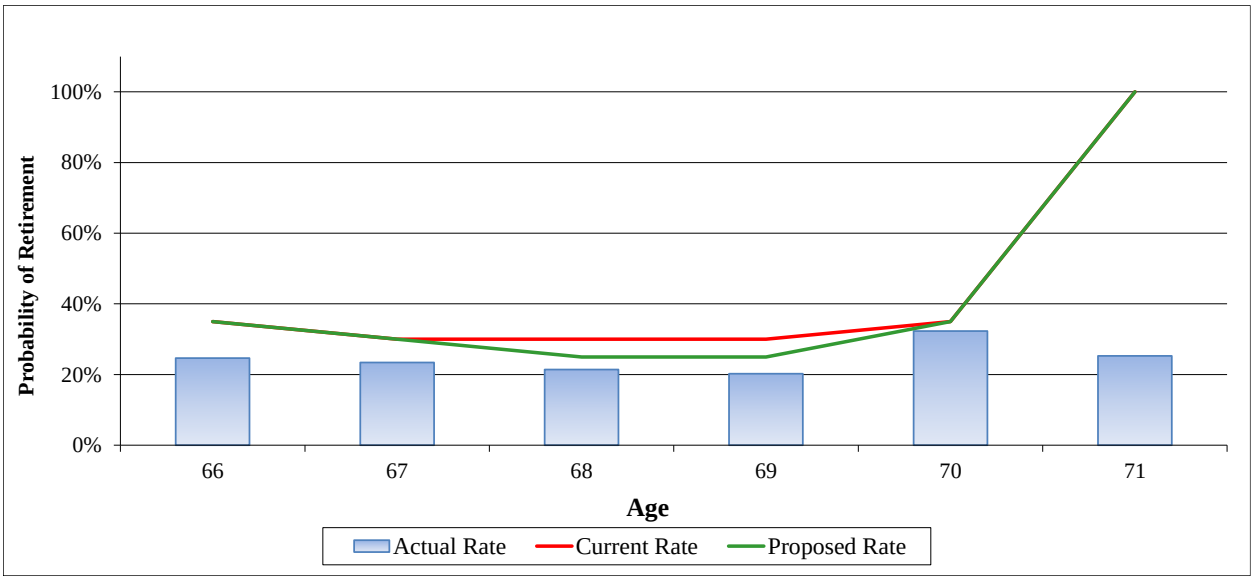
Tier 2 members are those members hired on or after July 1, 1989. The TRA retirement age is contingent on each member's Social Security Retirement Age. For most of the current active group (and likely for future hires), their Social Security Retirement Age is 66 or higher, so unreduced benefits from TRA are available at age 66. In addition, due to the effective date of Tier 2, active members in the study period generally had less than 25 years of service. As we mentioned earlier, there are fewer exposures and, therefore, retirements under normal retirement for Tier 2. The assumption will need to be fine-tuned as additional years of experience unfold and are evaluated.

The following table shows the exposures, actual retirements and expected retirements for Tier 2 members.

Unreduced Retirements – Tier 2

	Exposures	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	208	46	78	59%
July 1, 2009 to June 30, 2010	244	54	87	62%
July 1, 2010 to June 30, 2011	266	55	92	60%
July 1, 2011 to June 30, 2012	292	78	103	76%
July 1, 2012 to June 30, 2013	340	90	126	71%
July 1, 2013 to June 30, 2014	373	91	132	69%
Total	**1,723**	**414**	**618**	**67%**

As stated earlier, we prefer to develop separate assumptions for Tier 1 and Tier 2. Based on the observed data, we recommend the proposed assumption for Tier 2 members (green line), shown in the graph below, which results in an A/E ratio of 69%.



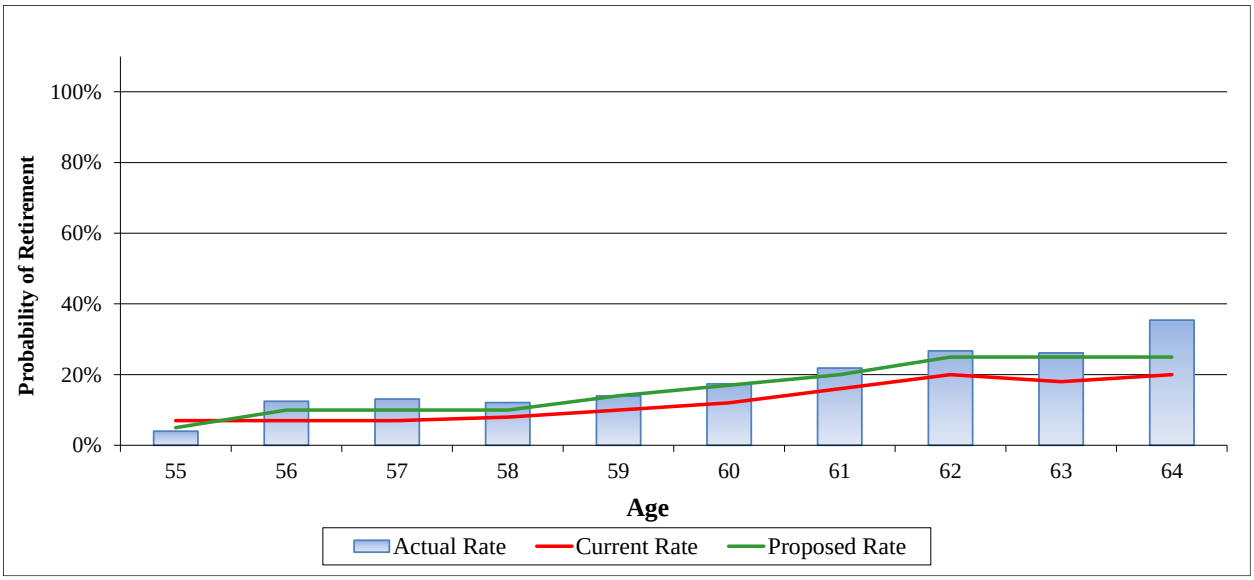
Early Retirement

Again, because the demographics of members in Tier 1 and Tier 2 vary, particularly years of service, and that could impact the retirement patterns, we examined the data separately for the members of each Tier. Our finding are summarized below:

Early Retirements – Tier 1

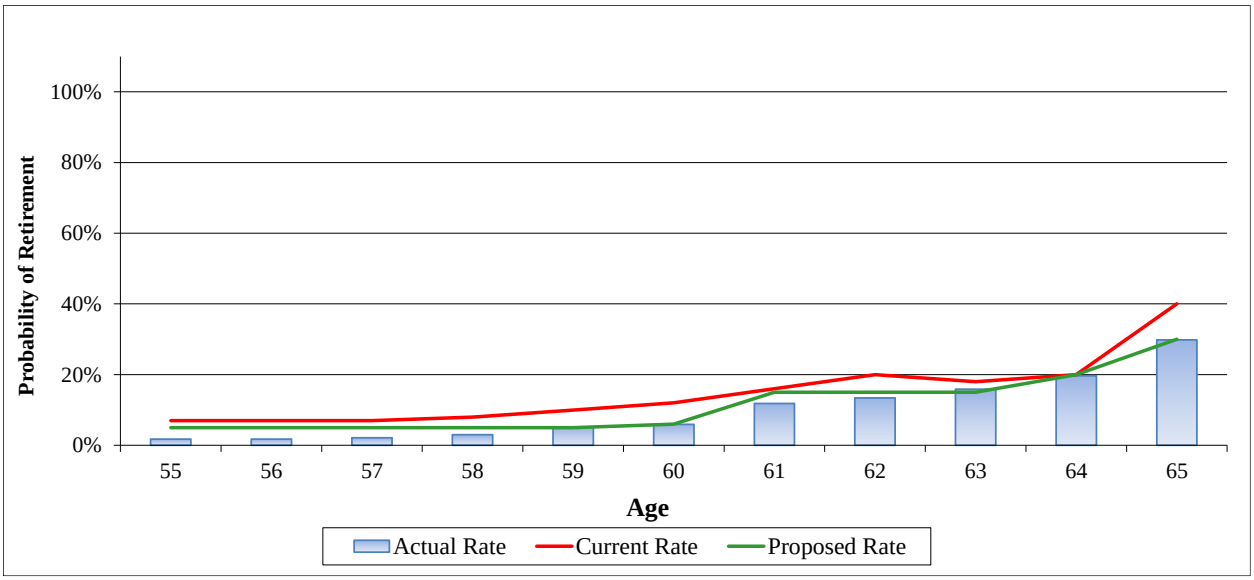
	Exposures	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	5,931	807	538	150%
July 1, 2009 to June 30, 2010	5,356	648	496	131%
July 1, 2010 to June 30, 2011	4,962	585	467	125%
July 1, 2011 to June 30, 2012	4,506	612	423	145%
July 1, 2012 to June 30, 2013	3,932	544	366	149%
July 1, 2013 to June 30, 2014	3,439	469	317	148%
Total	**28,126**	**3,665**	**2,607**	**141%**

There were significantly more early retirements than expected based on the current assumption. The A/E ratio was consistently far above 100% in each of the years. The recommended early retirement assumption for Tier 1 (see graph below) is higher than the current assumption and results in an A/E ratio of 112%.



Early Retirements – Tier 2				
	Exposure	**Actual**	**Expected**	**A/E Ratio**
July 1, 2008 to June 30, 2009	5,693	257	621	41%
July 1, 2009 to June 30, 2010	6,255	328	691	47%
July 1, 2010 to June 30, 2011	6,516	382	739	52%
July 1, 2011 to June 30, 2012	6,872	529	808	65%
July 1, 2012 to June 30, 2013	7,152	536	850	63%
July 1, 2013 to June 30, 2014	7,408	577	895	64%
Total	**39,896**	**2,609**	**4,604**	**57%**

As the table illustrates, there were far fewer early retirements for Tier 2 members during the study period. The overall A/E ratio is 57%, but the pattern of fewer early retirements was clear in all years of the study. Based on our observations, we recommend that the proposed assumption shown in the graph below be adopted for Tier 2 members, which results in an A/E ratio of 78%.



Early Retirement at Age 62 with 30 Years of Service

During the study period, legislation was passed providing Tier 2 members who have reached age 62 and been credited with 30 or more years of service the chance to retire prior to age 66 with a smaller early retirement reduction than would otherwise apply. Because there were no Tier 2 members meeting these conditions during the study period, we cannot evaluate the impact this provision may have on the utilization of early retirement rates. We suggest assuming an increase of 5% in early retirement rates for those who meet these conditions. In the next few experience studies, data will begin to emerge that will to help us refine this assumption.

Inactive Vested Members

Members who terminate employment after becoming vested (three years of service) are entitled to either a refund of their employee contributions with interest, or a deferred retirement benefit that is augmented The valuation currently assumes that members will elect a refund if it is more valuable than the deferred annuity. For those inactive members for whom the deferred retirement benefits is more valuable than a refund, the valuation assumes the benefit will commence at the member's normal retirement age. The LCPR's Standards for Actuarial Work require the actuary to value the termination benefit in this manner. If actual commencement of the benefit is earlier, benefits are reduced actuarially so any cost impact is minor. Consequently, we do not see any reason to recommend a change to this assumption.

Combined Service Annuity Assumption

Currently a 1.4% load is applied to active liability measurements and a 4% load for inactive vested liability to account for members' prior service with other Minnesota retirement systems that may increase benefits or result in earlier commencement of TRA benefits. The combined service annuity assumptions have not been studied since 2002 because such a study would require the coordination of data from all of the major Minnesota retirement systems. As a result, it is difficult to ascertain whether or not the current load provides a reasonable estimate. Without data to support a change in the current assumption, we propose that it remain unchanged. However, given the length of time since any analysis has been performed, we encourage the LCPR and their actuary to collect the Combined Service Annuity data and evaluate the current assumption as soon as possible. We also note that the upcoming merger with the Duluth Teachers Retirement Fund Association is expected to reduce the occurrence of the Combined Service Annuity.

Impact of Changes

Generally speaking, the longer members work (retiring later), the lower the cost of the benefits, while earlier retirement, particularly when eligible for unreduced benefits, tends to increase the cost. The net effect of the recommendations to develop separate assumptions for Tier 1 and Tier 2 which decreased unreduced retirement rates and increased some of the early retirement rates was a very small increase in costs. Therefore, it is reasonable to view this net change as having no meaningful impact on the current costs. Over time, however, the fact that the rates now vary by tier should produce a better measurement of liabilities and costs.

Miscellaneous Assumptions

Form of Payment: In the actuarial valuation process, the liabilities for members are calculated using gender specific mortality rates. Because mortality is significantly different for males and females, this approach provides the best estimate of the present value of benefits to be paid to the member over his/her lifetime. However, when a member elects an optional form of payment at retirement, the benefit payable for the member's lifetime is revised to a different amount based on the form factors found in statute. The form factors applied must be "unisex", i.e. the same factors apply regardless of the gender of the member. As a result, the election of an optional form of payment by an individual member has a small impact on the liabilities. In order to anticipate the impact in advance, an assumption is made regarding the election of optional forms.

At retirement, a member can elect any of the following forms of benefit payment:

- Straight life annuity: benefit is paid for the lifetime of the member. No benefit is payable to a beneficiary upon the member's death.
- 15-Year Certain and Life: a reduced benefit is paid for the lifetime of the member. If the member dies before 180 payments have been made, the benefit continues to be paid to a beneficiary until 180 payments have been made.
- 50% Joint & Survivor: a reduced benefit is paid while both the member and the joint annuitant are alive. If the member dies first, the joint annuitant receives 50% of this benefit for his or her lifetime. If the joint annuitant dies first, the member receives the unreduced (i.e. before reduction for form of payment) benefit for the remainder of his or her lifetime.
- 75% Joint & Survivor: a reduced benefit is paid while both the member and the joint annuitant are alive. If the member dies first, the joint annuitant receives 75% of this benefit for his or her lifetime. If the joint annuitant dies first, the member receives the unreduced (i.e. before reduction for form of payment) benefit for the remainder of his or her lifetime.
- 100% Joint & Survivor: a reduced benefit is paid while both the member and the joint annuitant are alive. If the member dies first, the joint annuitant receives 100% of this benefit for his or her lifetime. If the joint annuitant dies first, the member receives the unreduced (i.e. before reduction for form of payment) benefit for the remainder of his or her lifetime.

The current set of actuarial assumptions used in the valuation assumes that all single members elect a straight life annuity and that married members elect a Joint & Survivor annuity according to the following specific probabilities (with the remainder electing a straight life annuity):

Males (85% Married):	10% elect 50% J&S option 15% elect 75% J&S option 70% elect 100% J&S option
Females (65% Married):	20% elect 50% J&S option 10% elect 75% J&S option 50% elect 100% J&S option

Because retirees are allowed to elect a non-spouse joint annuitant, there is no compelling reason to base the form of payment assumption upon marital status. Mathematically, the current assumption can be rewritten without reference to the probability of marriage as:

Males:	19.25% elect Straight Life Annuity 8.50% elect 50% J&S option 12.75% elect 75% J&S option 59.50% elect 100% J&S option
Females:	48.00% elect Straight Life Annuity 13.00% elect 50% J&S option 6.50% elect 75% J&S option 32.50% elect 100% J&S option

We examined the new retirements for each of the 6 years in the study period and observed the following:

Males	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**Total**
50% J&S	64	67	75	69	76	64	415
75% J&S	64	58	85	74	59	46	386
100%J&S	423	415	449	439	419	435	2,580
Life Annuity	147	134	157	178	168	140	924
Total	698	674	766	760	722	685	4,305

Females	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**Total**
50% J&S	156	218	251	278	264	248	1,415
75% J&S	105	95	107	127	113	130	677
100%J&S	454	561	651	693	728	705	3,792
Life Annuity	595	613	759	810	802	774	4,353
Total	1,310	1,487	1,768	1,908	1,907	1,857	10,237

We compared the observed rates to the assumptions as shown in the table below. Proposed rates are indicated, partly to achieve a better fit and partly to reduce the number of digits that are used in the assumption.

Males	**Observed Election Rate**	**Current Assumption**	**A/E Ratio**	**Proposed Assumption**	**A/E Ratio**
50% J&S	9.6%	8.50%	113%	10%	96%
75% J&S	9.0%	12.75%	70%	10%	90%
100%J&S	59.9%	59.50%	101%	60%	100%
Life Annuity	21.5%	19.25%	111%	20%	107%

Females	Observed Election Rate	Current Assumption	A/E Ratio	Proposed Assumption	A/E Ratio
50% J&S	13.8%	13.00%	106%	13.5%	102%
75% J&S	6.6%	6.50%	102%	6.5%	102%
100%J&S	37.0%	32.50%	114%	35.0%	106%
Life Annuity	42.5%	48.00%	89%	45.0%	94%

Marriage Assumption

The current assumption is that 85% of male members and 65% of female members are married at retirement.

The data provided to us does not include marital status. Beneficiary information is only reported for those retirees that elect a joint and survivor form of payment. In practice, this assumption is only relevant for pre-retirement death benefits where it affects the reduction for commencement prior to Normal Retirement Age. Without sufficient data to analyze the marital status of plan members, and because the assumption does not have a material effect on the actuarial measurements, we recommend the current assumption be retained.

Age of Beneficiary

Joint and survivor annuity benefit amounts are dependent on the member's and beneficiary's age. The current assumption is that males are two years older than females. The following table shows the actual and assumed age difference for members who elected to receive benefits under a joint and survivor annuity option. For purposes of this analysis, records with an age difference of 20 or more were excluded under the assumption that most of those reflected a child, not a spouse, beneficiary.

Average Age Difference

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	All Years
Males	2.2	2.2	2.4	2.6	2.3	2.1	2.3
Females	1.4	1.4	1.4	1.5	1.5	1.3	1.4

Based on this analysis, we believe retaining the 2-year age assumption remains reasonable.

One of the types of benefits provided to members is a disability benefit. Members are eligible for disability benefits if they become totally and permanently disabled after they have completed five years of service, but prior to normal retirement eligibility.

The disability assumption was changed in the last experience study by lowering the rates for males to those being used for female members. As a result, the same disability rates are used for both male and female members. The table below indicates the actual and expected disability experience during the study period and the resulting A/E Ratios.

MALE AND FEMALE

	Exposure	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	75,449	42	57	74%
July 1, 2009 to June 30, 2010	76,063	44	58	76%
July 1, 2010 to June 30, 2011	76,180	53	58	91%
July 1, 2011 to June 30, 2012	75,460	58	58	100%
July 1, 2012 to June 30, 2013	75,237	46	57	81%
July 1, 2013 to June 30, 2014	75,253	60	56	107%
Total		303	344	88%

Since the assumption was recently changed to be non-gender specific, we also analyzed the actual experience separately for males and females. The A/E ratio for males in the current study was 91% compared to 92% in the prior study, using the same assumption. The A/E ratio for females in the current study was 87% compared to 103% in the prior study. Given the low probability of disability for this group, it is common to observe volatility in the results from one study period to another. In our opinion, the current assumption produced reasonable results, especially when considering the results of the prior study, and we recommend it be retained.

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SECTION 9 – TERMINATION OF EMPLOYMENT (WITHDRAWAL)

Not all active members on the valuation date are expected to continue working until retirement. Therefore, a termination of employment assumption is used to anticipate the probability that a member will leave covered employment at any given age. In analyzing the actual results, the number of terminations includes all members reported to have terminated employment. Some of these members subsequently receive refunds of their contributions, some return to active membership and some leave their contributions with the System until retirement. Explicit assumptions are made regarding the elections made by such vested members. Non-vested members are assumed to elect a refund of their employee contribution account balance.

This section of the report summarizes the results of our study of terminations of employment for reasons other than death, retirement, or disability. The current termination of employment assumption varies by gender and age. In addition, because rates of termination tend to be the highest in the earlier years of employment a three-year select assumption applies where the probability of termination in the first three years is 40%, 10% and 8% for females and 45%, 12% and 6% for males.

The following charts show the exposures, actual terminations and expected terminations under the current assumption and the corresponding A/E Ratios for the three-year select period and for all subsequent years:

MALES – Current Assumption

	Exposure	Actual	Expected	A/E Ratio
Year 1	8,706	2,905	3,917.7	74%
Year 2	6,935	1,001	832.2	120%
Year 3	5,536	583	332.2	176%
Year 4 and Beyond	77,299	1,883	1,750.4	108%
Total	**98,476**	**6,372**	**6,832.5**	**93%**

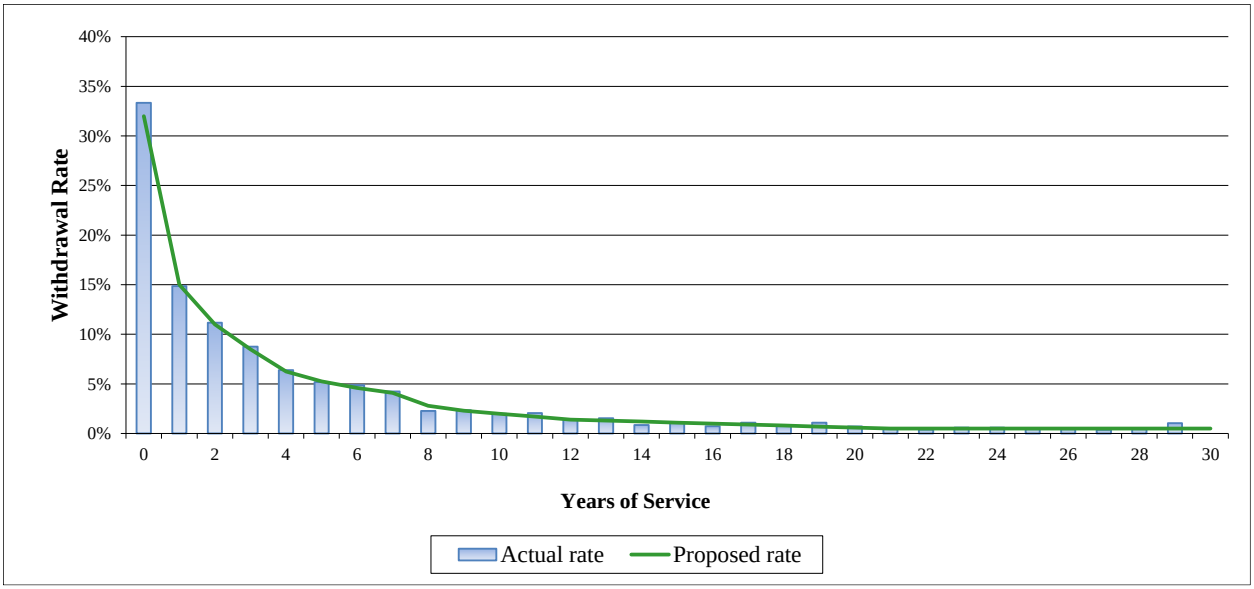
FEMALES – Current Assumption

	Exposure	Actual	Expected	A/E Ratio
Year 1	26,278	7,906	10,511.2	75%
Year 2	22,866	2,980	2,288.6	130%
Year 3	19,143	1,903	1,531.4	124%
Year 4 and Beyond	203,181	5,937	5,930.6	100%
Total	**271,468**	**18,726**	**20,261.8**	**92%**

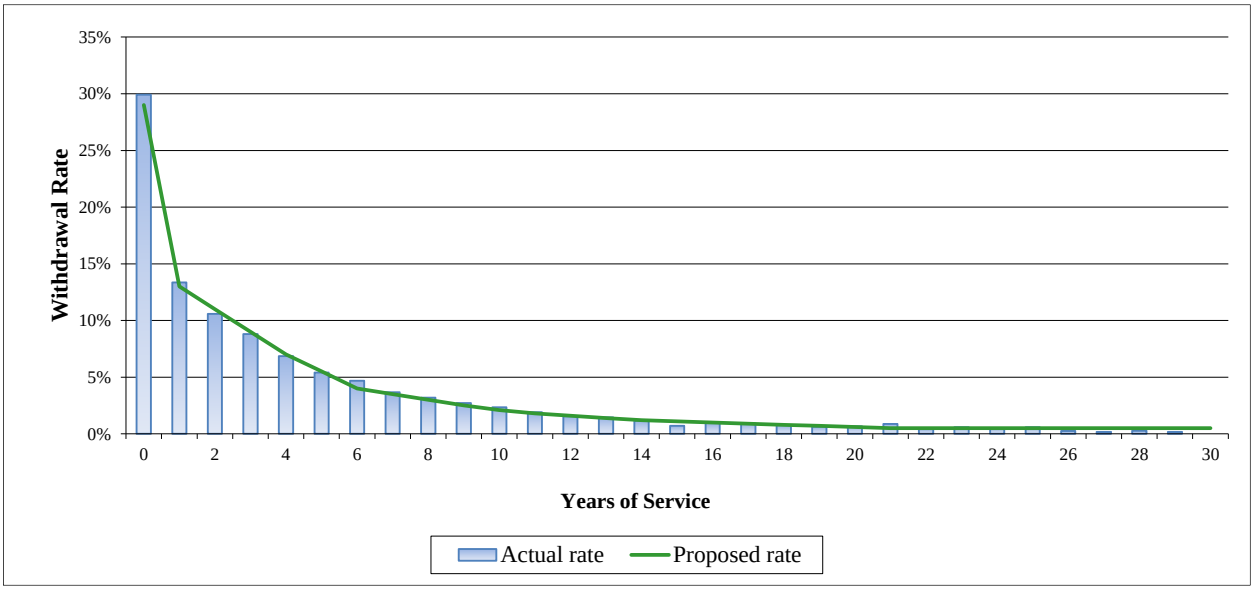
SECTION 9 – TERMINATION OF EMPLOYMENT (WITHDRAWAL)

Service typically has a strong influence on terminations, not only during the first three years of service, but well beyond. As a result, it is more common for the termination assumption to be a service-based assumption than an age-based assumption. Our analysis of the actual experience on a service-based approach indicated a very strong correlation so we are recommending that the termination assumption be changed to a pure service-based assumption (see the green lines in the graphs below).

Termination of Employment - Males



Termination of Employment - Females



The following chart shows the exposures, actual terminations, expected terminations, and actual to expected ratio under the proposed assumption for each year in the experience study.

MALES – Proposed Assumption

	Exposure	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	16,489	1,078	1,078	100%
July 1, 2009 to June 30, 2010	16,614	1,021	1,121	91%
July 1, 2010 to June 30, 2011	16,612	1,118	1,115	100%
July 1, 2011 to June 30, 2012	16,486	1,158	1,087	107%
July 1, 2012 to June 30, 2013	16,484	1,149	1,068	108%
July 1, 2013 to June 30, 2014	16,607	1,063	1,089	98%
Total	**99,292**	**6,587**	**6,558**	**100%**

FEMALES – Proposed Assumption

	Exposure	Actual	Expected	A/E Ratio
July 1, 2008 to June 30, 2009	44,860	3,287	3,216	102%
July 1, 2009 to June 30, 2010	43,327	2,934	3,277	90%
July 1, 2010 to June 30, 2011	45,501	3,262	3,209	102%
July 1, 2011 to June 30, 2012	45,277	3,041	3,129	97%
July 1, 2012 to June 30, 2013	45,658	3,279	3,109	105%
July 1, 2013 to June 30, 2014	46,089	3,207	3,133	102%
Total	**270,712**	**19,010**	**19,073**	**100%**

For both males and females, the experience for fiscal year 2010 appears to be materially different than that observed in other years so it was excluded when developing the new service-based assumption. Given that the new assumption is closely based on the actual experience in this experience study, it may need to be modified and refined in subsequent experience studies.

Some vested members who terminate active employment elect to receive a distribution of their member account balance, forfeiting their right to receive monthly benefits in the future. The Actuarial Standards issued by the Legislative Commission on Pensions and Retirement require that the actuarial valuation assume that the vested member will elect the greater of the refund of their employee account balance or the present value of the deferred monthly benefit.

Although data to analyze actual member behavior regarding the election of a refund was not available in this experience study, such data and the related analysis could be included in the next study if the Board

wishes to consider a different approach. The current approach is a conservative estimate since it values the greater of the two benefits available to the member, thus avoiding the chance of an actuarial loss on the member's election.

Impact of Changes

The proposed change to a termination of employment assumption based solely on years of service results in a slight increase in the normal cost rate and a very small increase in the actuarial accrued liability.

Actuarial Cost Method

Liabilities and contributions in this report are computed using the Individual Entry Age Normal Cost Method. This method is prescribed by Minnesota Statutes.

The objective under this method is to fund each member's benefits under the Plan as payments which are level as a percentage of salary, starting at original participation date (or employment date), and continuing until the assumed date of retirement termination, disability or death. For valuation purposes, entry age for each member is determined as the age at valuation minus years of service as of the valuation date.

At any given date, a liability is calculated equal to the contributions which would have been accumulated if this method of funding had always been used, the current plan provisions had always been in place, and all assumptions had been met. The difference between this liability and the assets (if any) which are held in the fund is the unfunded actuarial accrued liability. The unfunded actuarial accrued liability is typically funded over a chosen period in accordance with the amortization schedule.

A detailed description of the calculation follows: The normal cost for each active member under the assumed retirement age is determined by applying to earnings the level percentage of salary which, if contributed each year from date of entry into the Plan until the assumed retirement (termination, disability or death) date, is sufficient to provide the full value of the benefits expected to be payable.

- The present value of future normal costs is the total of the discounted values of all active members' normal cost, assuming these to be paid in each case from the valuation date until retirement (termination, disability or death) date.

- The present value of projected benefits is calculated as the value of all benefit payments expected to be paid to the Plan's current members, including active and retired members, beneficiaries, and terminated members with vested rights.

- The actuarial accrued liability is the excess of the present value of projected benefits over the present value of future normal costs.

- The unfunded actuarial accrued liability is the excess of the actuarial accrued liability over the assets of the fund, and represents that part of the actuarial accrued liability which has not been funded by accumulated past contributions.

Amortization Method

The unfunded actuarial accrued liability is amortized as a level percentage of payroll each year to the statutory amortization date of June 30, 2037, assuming payroll increases of 3.75% per year (effective with the 2011 valuation). If the unfunded actuarial accrued liability is negative, the surplus amount is amortized over 30 years as a level percentage of payroll. If there is an increase in the unfunded actuarial accrued liability due to a change in the actuarial assumptions, plan provisions, or actuarial cost method, a new amortization period is determined. This new amortization period is determined by blending the period needed to amortize the prior unfunded actuarial accrued liability over the prior amortization period and the increase in unfunded actuarial accrued liability amortized over 30 years. If there is a decrease in the unfunded actuarial accrued liability, no change is made to the amortization period.

Asset Valuation Method

As prescribed in the Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (f), the assets are valued based on a five-year moving average of expected and market values (five-year average actuarial value) determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year net of investment income for the fiscal year;
- The investment gain or (loss) is taken as the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year;
- The asset value is the sum of the market value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four fiscal years.

Entry Age Calculation

As required by the LCPR Standards for Actuarial Work, a member's Entry Age is calculated as the age at the valuation date less years of service. Age on the valuation date is calculated as age nearest birthday. The years of service for each member are provided by TRA.

Decrement Timing

All decrements are assumed to occur in the middle of the plan year. This is the preferred decrement timing in the LCPR Standards for Actuarial Work.

Funding Objective

The fundamental financing objective of the fund is to establish contribution rates which, when expressed as a percentage of active member payroll, will remain approximately level from generation to generation and meet the required deadline for full funding.

Benefits included or excluded

To the best of our knowledge, all material benefits have been included in the liability.

IRC Section 415(b): The limitations of Internal Revenue Code Section 415(b) have been incorporated into our calculations. Annual benefits may not exceed the limits in IRC Section 415. This limit is indexed annually. For 2014, the limit is $210,000.

IRC Section 401(a)(17): The limitations of Internal Revenue Code Section 401(a)(l7) have been incorporated into our calculations. Compensation for any 12-month period used to determine accrued benefits may not exceed the limits in IRC Section 401(a)(17) for the calendar year in which the 12-month period begins. This limit is indexed annually. For 2014, the limit is $260,000. Certain members first hired before July 1, 1995 may have a higher limit.

Summary of Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All assumptions are prescribed by Statutes, the LCPR, or the Board of Trustees. The assumptions prescribed are based on the last experience study, dated October 30, 2009.

The Allowance for Combined Service Annuity was based on the recommendation of a prior actuary. We are unable to judge the reasonableness of this assumption without performing a substantial amount of additional work beyond the scope of this assignment.

Investment Return		For the July 1, 2014 actuarial valuation: 8.41% compounded annually to reflect an 8.0% assumption for three (3) years and 8.5% thereafter.
Future post-retirement adjustments		2% per year, increasing to 2.5% on July 1, 2031. Once the funded ratio reaches 90% on a market value basis for two consecutive years, the COLA is scheduled by statute to revert back from 2.0% to 2.5%. Future assets and liabilities were projected using the 2014 valuation results as a starting point and assuming all actuarial assumptions are met in future years. These assumptions include a rate of return on the market value of assets of 8.0% for the next three years and 8.5% thereafter. Further, there is an assumption that the stabilizer provisions will not be utilized by the Board. Based on this methodology, as of July 1, 2014, the increased COLA is expected to be implemented with the July 1, 2031 valuation.
Salary Increases		Reported salary for prior fiscal year, with new hires annualized, is increased according to the salary increase table shown in the rate table for current fiscal year and annually for each future year. See table of sample rates.
Payroll Growth		3.75% per year
Future Service		Members are assumed to earn future service at a full-time rate.
Mortality:	***Pre-retirement***	RP 2000 non-annuitant generational mortality, white collar adjustment, male rates set back 5 years and female rates set back 7 years.
	Post-retirement	RP 2000 annuitant generational mortality, white collar adjustment, male rates set back 2 years and female rates set back 3 years.
	Post-disability	RP 2000 disabled retiree mortality, without adjustment
Disability		Age-related rates based on experience; see table of sample rates.

Summary of Actuarial Assumptions *(continued)*

Withdrawal

Select and ultimate rates based on actual plan experience. Ultimate rates after the third year are shown in the rate table. Select rates are as follows:

	First Year	Second Year	Third Year
Male	45%	12%	6%
Female	40%	10%	8%

Expenses

Prior year administrative expenses expressed as percentage of prior year payroll.

Retirement Age

Graded rates beginning at age 55 as shown in rate table. Members who have attained the highest assumed retirement age will retire in one year.

Percentage Married

85% of male members and 65% of female members are assumed to be married. Members are assumed to have no children.

Age Difference

Females two years younger than males.

Allowance for Combined Service Annuity

Liabilities for active members are increased by 1.40% and liabilities for former members are increased by 4.00% to account for the effect of some Participants being eligible for a Combined Service Annuity.

Refund of Contributions

All employees withdrawing after becoming eligible for a deferred benefit are assumed to take the larger of their contributions accumulated with interest or the value of their deferred benefit.

Interest on member contributions

Members and former members who are eligible for the money purchase annuity are assumed to receive interest credits equal to the Pre-Retirement interest rate. All other members and former members receive the interest crediting rate as specified in statutes.

Commencement of deferred benefits

Members receiving deferred annuities (including current terminated deferred members) are assumed to begin receiving benefits at unreduced retirement age.

Form of payment

Married members are assumed to elect subsidized joint and survivor form of annuity as follows:

Males:	10% elect 50% J&S option 15% elect 75% J&S option 70% elect 100% J&S option
Females:	20% elect 50% J&S option 10% elect 75% J&S option 50% elect 100% J&S option

Members eligible for deferred annuities (including current terminated deferred members) and future disability benefits are assumed to elect a life annuity.

Summary of Actuarial Assumptions *(continued)*

Missing data for members

Membership data was supplied by TRA as of the valuation date. This information has not been audited by CMC. We have reviewed the information for internal consistency and we have no reason to doubt its substantial accuracy. In the small number of cases where submitted data was missing or incomplete and could not be recovered from prior years, the following assumptions were applied, if needed:

Data for active members:	
Salary, Service, and Date of Birth	Based on current active demographics.
Gender	Female
Data for terminated members:	
Date of birth	July 1, 1964
Average salary	$29,000
Date of termination	Derived from date of birth, original entry age, and service
Data for in-pay members:	
Beneficiary date of birth	Wife two years younger than husband
Gender	Based on first name
Form of payment	Life annuity for retirees and beneficiaries, 100% J&S option for disabled retirees.

	Rate (%)			
	Ultimate Withdrawal		Disability	
Age	Male	Female	Male	Female
20	3.70	4.50	0.00	0.00
25	3.20	4.50	0.00	0.00
30	2.70	4.50	0.00	0.00
35	2.50	3.90	0.01	0.01
40	2.35	2.75	0.03	0.03
45	2.10	2.10	0.05	0.05
50	1.85	1.85	0.10	0.10
55	0.00	0.00	0.16	0.16
60	0.00	0.00	0.25	0.25
65	0.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00
75	0.00	0.00	0.00	0.00

Summary of Actuarial Assumptions *(continued)*

	Mortality Rates (%)					
	Pre-Retirement*		Post-Retirement**		Post-Disability	
Age	Male	Female	Male	Female	Male	Female
20	0.0269	0.0155	0.0316	0.0184	2.2571	0.7450
25	0.0345	0.0188	0.0373	0.0194	2.2571	0.7450
30	0.0376	0.0197	0.0393	0.0223	2.2571	0.7450
35	0.0353	0.0235	0.0481	0.0363	2.2571	0.7450
40	0.0591	0.0401	0.0766	0.0527	2.2571	0.7450
45	0.0890	0.0562	0.1124	0.0763	2.2571	0.7450
50	0.1342	0.0837	0.1711	0.1229	2.8975	1.1535
55	0.1978	0.1344	0.5716	0.2681	3.5442	1.6544
60	0.2747	0.2015	0.5688	0.4253	4.2042	2.1839
65	0.4263	0.3107	0.9232	0.6736	5.0174	2.8026
70	0.6725	0.4979	1.5834	1.1211	6.2583	3.7635
75	0.9823	0.7591	2.6710	1.8784	8.2067	5.2230

* *Rates shown are RP 2000 employee mortality (base), white collar adjustment, set back 5 years for males and 7 years for females.*

** *Rates shown are RP 2000 annuitant mortality (base), white collar adjustment, set back 2 years for males and 3 years for females.*

Summary of Actuarial Assumptions *(continued)*

Salary Scale	
Service	**Salary Increase**
1	12.00%
2	9.00%
3	8.00%
4	7.50%
5	7.25%
6	7.00%
7	6.85%
8	6.70%
9	6.55%
10	6.40%
11	6.25%
12	6.00%
13	5.75%
14	5.50%
15	5.25%
16	5.00%
17	4.75%
18	4.50%
19	4.25%
20	4.00%
21	3.90%
22	3.80%
23	3.70%
24	3.60%
25 or more	3.50%

Summary of Actuarial Assumptions *(continued)*

	Retirement Rate (%)				
Age	**Coordinated Members Eligible for Rule of 90**	**Coordinated Members Not Eligible for Rule of 90**	**Age**	**Basic Members Eligible for 30 and Out Provision**	**Basic Members Not Eligible for 30 and Out Provision**
55 & Under	50	7	55 & Under	40	5
56	55	7	56	40	5
57	45	7	57	40	5
58	45	8	58	40	5
59	45	10	59	40	5
60	40	12	60	25	25
61	45	16	61	25	25
62	45	20	62	25	25
63	40	18	63	25	25
64	45	20	64	25	25
65	40	40	65	40	40
66	35	35	66	40	40
67	30	30	67	40	40
68	30	30	68	40	40
69	30	30	69	40	40
70	35	35	70-74	60	60
71 & Over	100	100	75-79	60	100
			80 & Over	100	100

Actuarial Cost Method

Liabilities and contributions in this report are computed using the Individual Entry Age Normal Cost Method. This method is prescribed by Minnesota Statutes.

The objective under this method is to fund each member's benefits under the Plan as payments which are level as a percentage of salary, starting at original participation date (or employment date), and continuing until the assumed date of retirement termination, disability or death. For valuation purposes, entry age for each member is determined as the age at valuation minus years of service as of the valuation date.

At any given date, a liability is calculated equal to the contributions which would have been accumulated if this method of funding had always been used, the current plan provisions had always been in place, and all assumptions had been met. The difference between this liability and the assets (if any) which are held in the fund is the unfunded actuarial accrued liability. The unfunded actuarial accrued liability is typically funded over a chosen period in accordance with the amortization schedule.

A detailed description of the calculation follows: The normal cost for each active member under the assumed retirement age is determined by applying to earnings the level percentage of salary which, if contributed each year from date of entry into the Plan until the assumed retirement (termination, disability or death) date, is sufficient to provide the full value of the benefits expected to be payable.

- The present value of future normal costs is the total of the discounted values of all active members' normal cost, assuming these to be paid in each case from the valuation date until retirement (termination, disability or death) date.

- The present value of projected benefits is calculated as the value of all benefit payments expected to be paid to the Plan's current members, including active and retired members, beneficiaries, and terminated members with vested rights.

- The actuarial accrued liability is the excess of the present value of projected benefits over the present value of future normal costs.

- The unfunded actuarial accrued liability is the excess of the actuarial accrued liability over the assets of the fund, and represents that part of the actuarial accrued liability which has not been funded by accumulated past contributions.

Amortization Method

The unfunded actuarial accrued liability is amortized as a level percentage of payroll each year to the statutory amortization date of June 30, 2037, assuming payroll increases of 3.50% per year. If the unfunded actuarial accrued liability is negative, the surplus amount is amortized over 30 years as a level percentage of payroll. If there is an increase in the unfunded actuarial accrued liability due to a change in the actuarial assumptions, plan provisions, or actuarial cost method, a new amortization period is determined. This new amortization period is determined by blending the period needed to amortize the prior unfunded actuarial accrued liability over the prior amortization period and the increase in unfunded actuarial accrued liability amortized over 30 years. Please note that the revised amortization date cannot be determined until the valuation using the new assumptions recommended in this report is completed (likely in 2016).

Asset Valuation Method

As prescribed in the Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (f), the assets are valued based on a five-year moving average of expected and market values (five-year average actuarial value) determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year net of investment income for the fiscal year;
- The investment gain or (loss) is taken as the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year;
- The asset value is the sum of the market value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four fiscal years.

Entry Age Calculation

As required by the LCPR Standards for Actuarial Work, a member's Entry Age is calculated as the age at the valuation date less years of service. Age on the valuation date is calculated as age nearest birthday. The years of service for each member are provided by TRA.

Decrement Timing

All decrements are assumed to occur in the middle of the plan year. This is the preferred decrement timing in the LCPR Standards for Actuarial Work.

Funding Objective

The fundamental financing objective of the fund is to establish contribution rates which, when expressed as a percentage of active member payroll, will remain approximately level from generation to generation and meet the required deadline for full funding.

Benefits included or excluded

To the best of our knowledge, all material benefits have been included in the liability.

IRC Section 415(b): The limitations of Internal Revenue Code Section 415(b) have been incorporated into our calculations. Annual benefits may not exceed the limits in IRC Section 415. This limit is indexed annually. For 2014, the limit is $210,000.

IRC Section 401(a)(17): The limitations of Internal Revenue Code Section 401(a)(l7) have been incorporated into our calculations. Compensation for any 12-month period used to determine accrued benefits may not exceed the limits in IRC Section 401(a)(17) for the calendar year in which the 12-month period begins. This limit is indexed annually. For 2014, the limit is $260,000. Certain members first hired before July 1, 1995 may have a higher limit.

Summary of Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All assumptions are prescribed by Statutes, the LCPR, or the Board of Trustees. The assumptions prescribed are based on the last experience study, dated October 30, 2009.

The Allowance for Combined Service Annuity was based on the recommendation of a prior actuary. We are unable to judge the reasonableness of this assumption without performing a substantial amount of additional work beyond the scope of this assignment.

Investment Return		8.00% compounded annually
Future post-retirement adjustments		2% per year Once the funded ratio reaches 90% on a market value basis for two consecutive years, the COLA is scheduled by statute to revert back from 2.0% to 2.5%. Future assets and liabilities were projected using the 2014 valuation results as a starting point and assuming all actuarial assumptions are met in future years. These assumptions include a rate of return on the market value of assets of 8.0% for all years. Further, there is an assumption that the stabilizer provisions will not be utilized by the Board. Based on this methodology, as of July 1, 2014, the increased COLA is not expected to be implemented during the range of the model, and so we assume it will not occur..
Salary Increases		Reported salary for prior fiscal year, with new hires annualized, is increased according to the salary increase table shown in the rate table for current fiscal year and annually for each future year. See table of sample rates.
Payroll Growth		3.50% per year
Future Service		Members are assumed to earn future service at a full-time rate.
Mortality:	***Pre-retirement***	RP 2014 white collar employee table, male rates set back 6 years and female rates set back 5 years. Generational projection uses the MP-2014 scale.
	Post-retirement	RP 2014 white collar annuitant table, male rates set back 3 years and female rates set back 3 years, with further adjustments of the rates. Generational projection uses the MP-2014 scale.
	Post-disability	RP 2014 disabled retiree mortality, without adjustment
Disability		Age-related rates based on experience; see table of sample rates.

Summary of Actuarial Assumptions *(continued)*

Withdrawal	Rates vary by service based on actual plan experience, as shown in the rate table.
Expenses	Prior year administrative expenses expressed as percentage of prior year payroll.
Retirement Age	Graded rates beginning at age 55 as shown in rate table. Members who have attained the highest assumed retirement age will retire in one year.
Percentage Married	85% of male members and 65% of female members are assumed to be married. Members are assumed to have no children.
Age Difference	Females two years younger than males.
Allowance for Combined Service Annuity	Liabilities for active members are increased by 1.40% and liabilities for former members are increased by 4.00% to account for the effect of some Participants being eligible for a Combined Service Annuity.
Refund of Contributions	All employees withdrawing after becoming eligible for a deferred benefit are assumed to take the larger of their contributions accumulated with interest or the value of their deferred benefit.
Interest on member contributions	Members and former members who are eligible for the money purchase annuity are assumed to receive interest credits equal to the Pre-Retirement interest rate. All other members and former members receive the interest crediting rate as specified in statutes.
Commencement of deferred benefits	Members receiving deferred annuities (including current terminated deferred members) are assumed to begin receiving benefits at unreduced retirement age.
Form of payment	Members are assumed to elect subsidized joint and survivor form of annuity as follows:

Males:	10% elect 50% J&S option 10% elect 75% J&S option 60% elect 100% J&S option 20% elect Straight Life option
Females:	13.5% elect 50% J&S option 6.5% elect 75% J&S option 35% elect 100% J&S option 45% elect Straight Life option

Members eligible for deferred annuities (including current terminated deferred members) and future disability benefits are assumed to elect a life annuity.

Summary of Actuarial Assumptions *(continued)*

Missing data for members

Membership data was supplied by TRA as of the valuation date. This information has not been audited by CMC. We have reviewed the information for internal consistency and we have no reason to doubt its substantial accuracy. In the small number of cases where submitted data was missing or incomplete and could not be recovered from prior years, the following assumptions were applied, if needed:

Data for active members:	
Salary, Service, and Date of Birth	Based on current active demographics.
Gender	Female
Data for terminated members:	
Date of birth	July 1, 1964
Average salary	$29,000
Date of termination	Derived from date of birth, original entry age, and service
Data for in-pay members:	
Beneficiary date of birth	Wife two years younger than husband
Gender	Based on first name
Form of payment	Life annuity for retirees and beneficiaries, 100% J&S option for disabled retirees.

Termination Rates

Service	Males	Females
Less than 1	32.00%	29.00%
1	15.00%	13.00%
2	11.00%	11.00%
3	8.50%	9.00%
4	6.25%	7.00%
5	5.25%	5.50%
6	4.60%	4.00%
7	4.10%	3.50%
8	2.80%	3.00%
9	2.30%	2.50%
10	2.00%	2.10%
15	1.10%	1.10%
20	0.60%	0.60%
25 or more	0.50%	0.50%

Summary of Actuarial Assumptions *(continued)*

	Rate (%)			
	Pre-retirement Mortality*		Disability	
Age	Male	Female	Male	Female
20	0.023	0.013	0.00	0.00
25	0.026	0.014	0.00	0.00
30	0.036	0.014	0.00	0.00
35	0.031	0.018	0.01	0.01
40	0.035	0.024	0.03	0.03
45	0.041	0.033	0.05	0.05
50	0.061	0.055	0.10	0.10
55	0.105	0.092	0.16	0.16
60	0.175	0.140	0.25	0.25
65	0.292	0.204	0.00	0.00

**Rates shown are for 2014, the base year of the tables.*

	Annuitant Mortality Rates (%)			
	Retirement *		Disability	
Age	Male	Female	Male	Female
55	0.267	0.196	2.337	1.448
60	0.353	0.267	2.660	1.700
65	0.486	0.430	3.169	2.086
70	0.945	0.706	4.035	2.820
75	2.015	1.352	5.429	4.105
80	4.126	2.682	7.662	6.104
85	7.358	5.456	11.330	9.042
90	13.560	9.947	17.301	13.265
95	24.351	18.062	24.717	19.588
100	38.292	29.731	32.672	27.819

* *Rates shown are for 2014, the base year of the tables.*

Summary of Actuarial Assumptions *(continued)*

Salary Scale	
Service	**Salary Increase**
1	9.50%
2	7.75%
3	7.25%
4	7.00%
5	7.00%
6	6.85%
7	6.70%
8	6.55%
9	6.40%
10	6.25%
11	6.00%
12	5.75%
13	5.50%
14	5.25%
15	5.00%
16	4.75%
17	4.50%
18	4.30%
19	4.20%
20	4.10%
21	4.00%
22	3.90%
23	3.80%
24	3.70%
25	3.60%
26 or more	3.50%

Summary of Actuarial Assumptions *(continued)*

	Retirement Rate (%)					
	Coordinated Members				Basic Members	
Age	Tier 1 Early	Tier 1 Unreduced	Tier 2 Early	Tier 2 Unreduced	Eligible for 30 and Out Provision	Not Eligible for 30 and Out Provision
55	5	35	5		40	5
56	10	35	5		40	5
57	10	35	5		40	5
58	10	35	5		40	5
59	14	35	5		40	5
60	17	35	6		25	25
61	20	35	15		25	25
62	25	35	15		25	25
63	25	35	15		25	25
64	25	35	20		25	25
65		35	30		40	40
66		40		35	40	40
67		35		30	40	40
68		30		25	40	40
69		30		25	40	40
70		35		35	60	60
71-74		100		100	60	60
75-79		100		100	60	100
80 & Over		100		100	100	100

Coordinated Tier 2 Members with 30 or more years of service have 5% added to their early retirement rates.

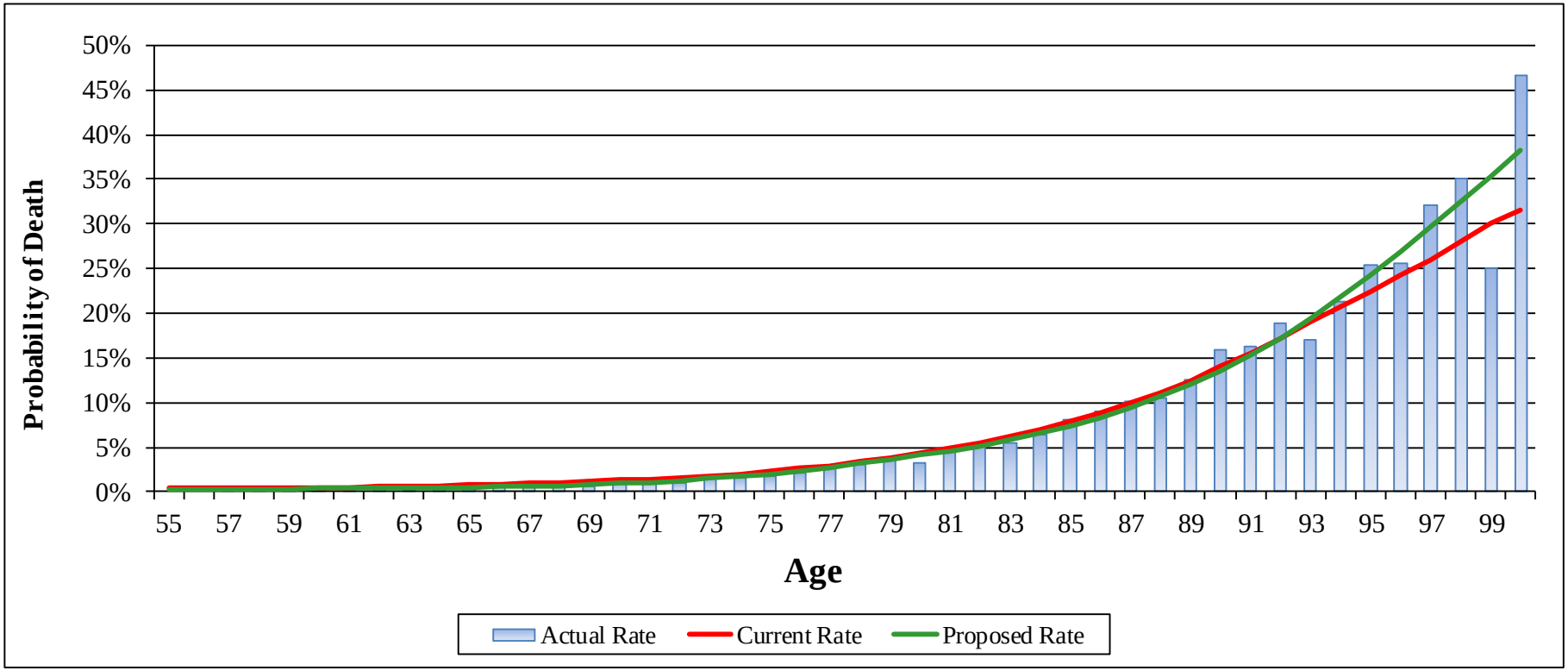
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-1

Probability of Death - Healthy Retirees

Males



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	2,619	2,952	2,627
Actual/Expected		89%	100%

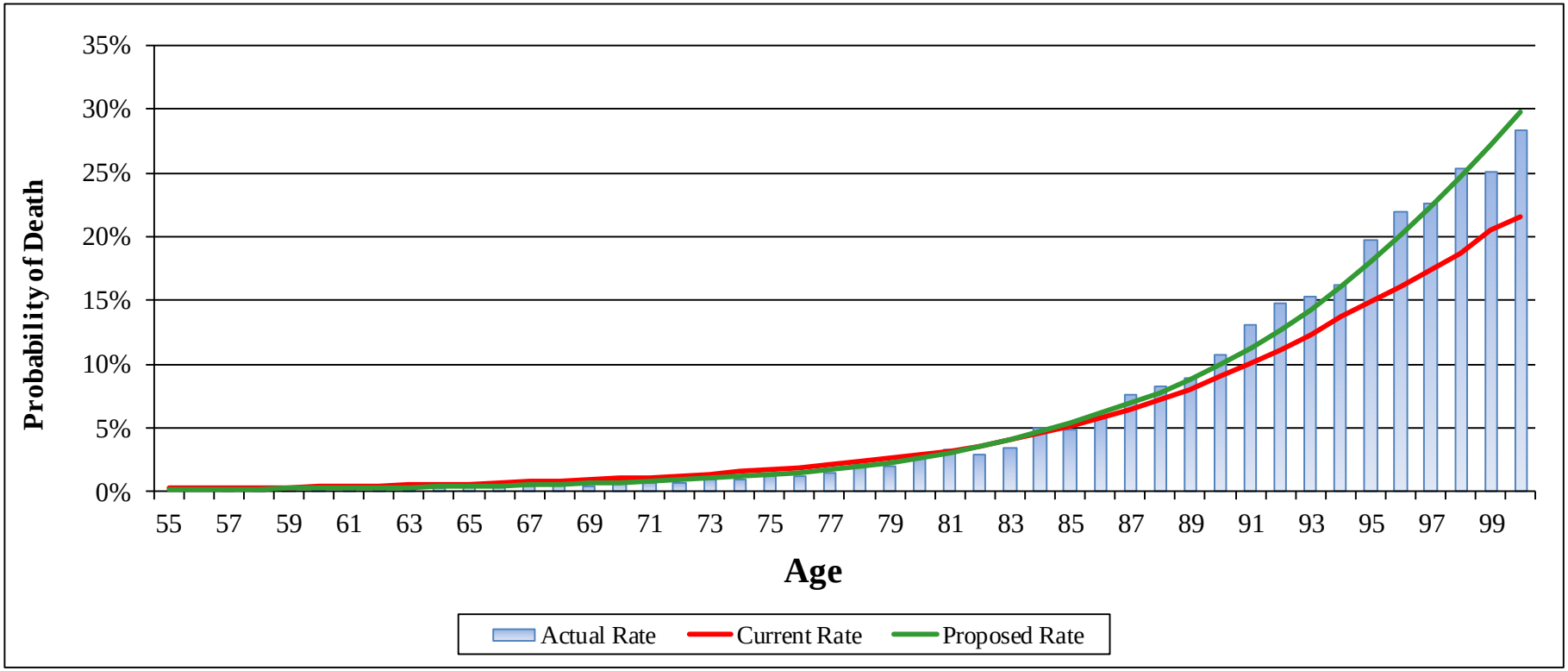
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-2

Probability of Death - Healthy Retirees

Females



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	2,981	3,153	3,027
Actual/Expected		95%	98%

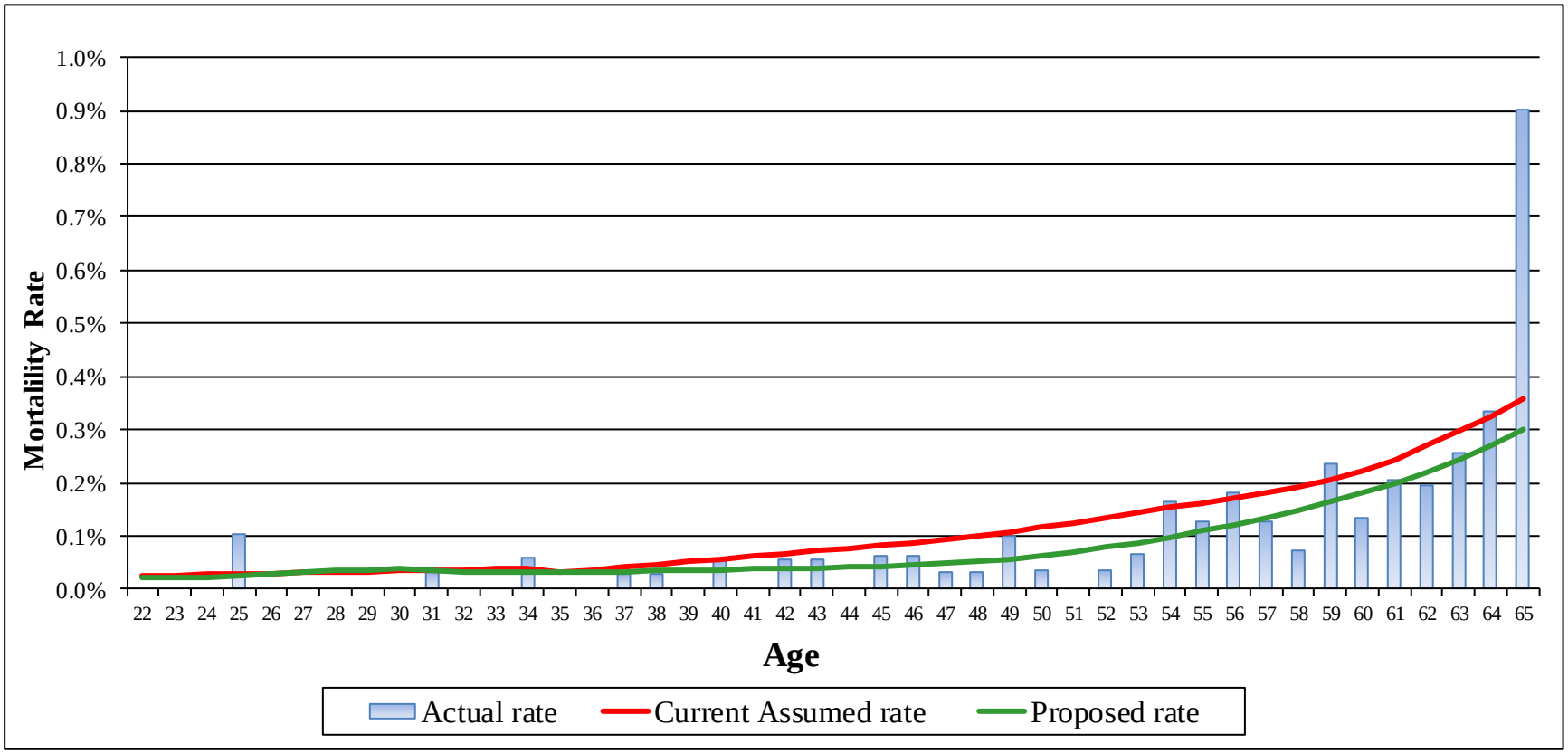
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-3

Probability of Death - Active Lives

Males



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	75	114	81
Actual/Expected		66%	93%

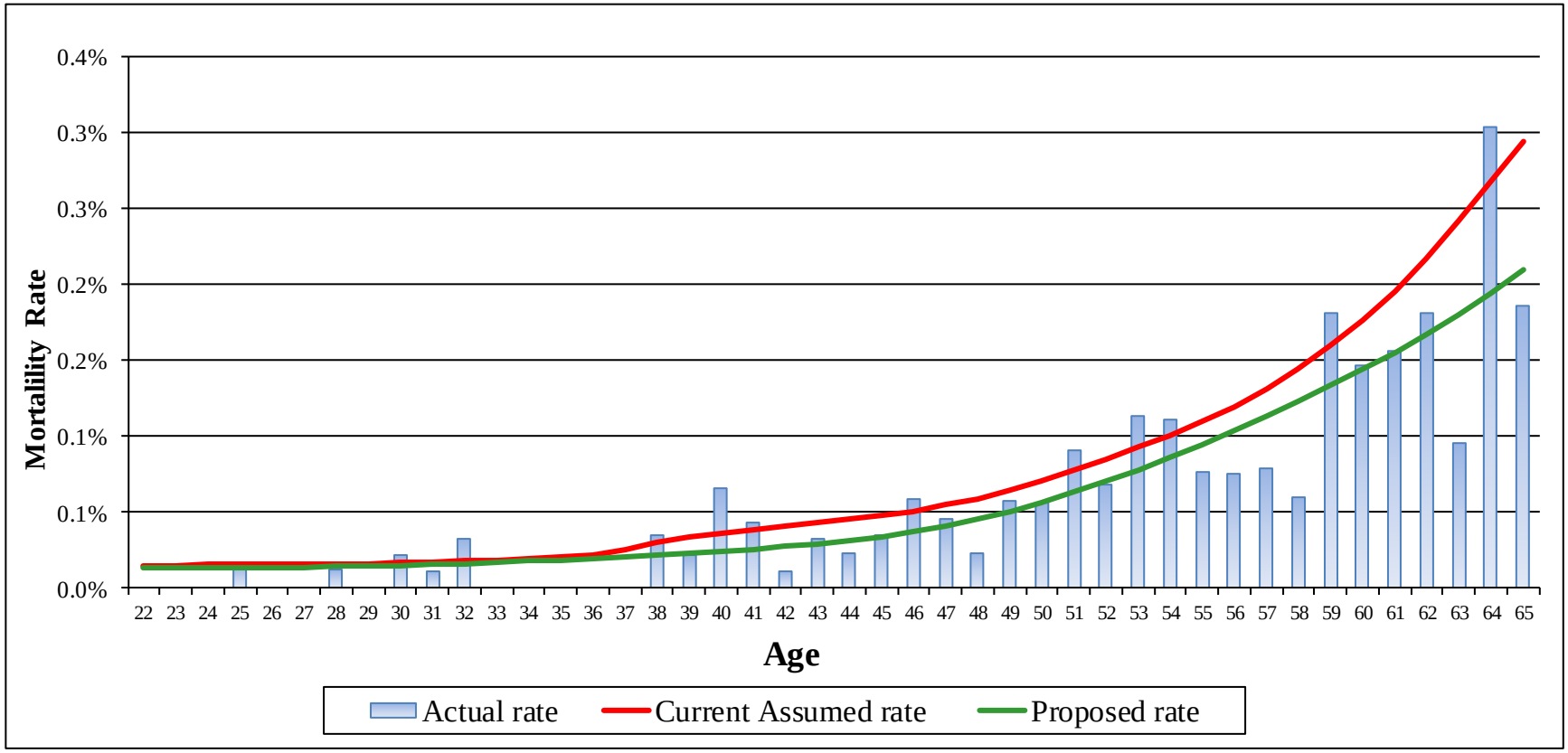
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-4

Probability of Death - Active Lives

Females



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	167	216	174
Actual/Expected		77%	96%

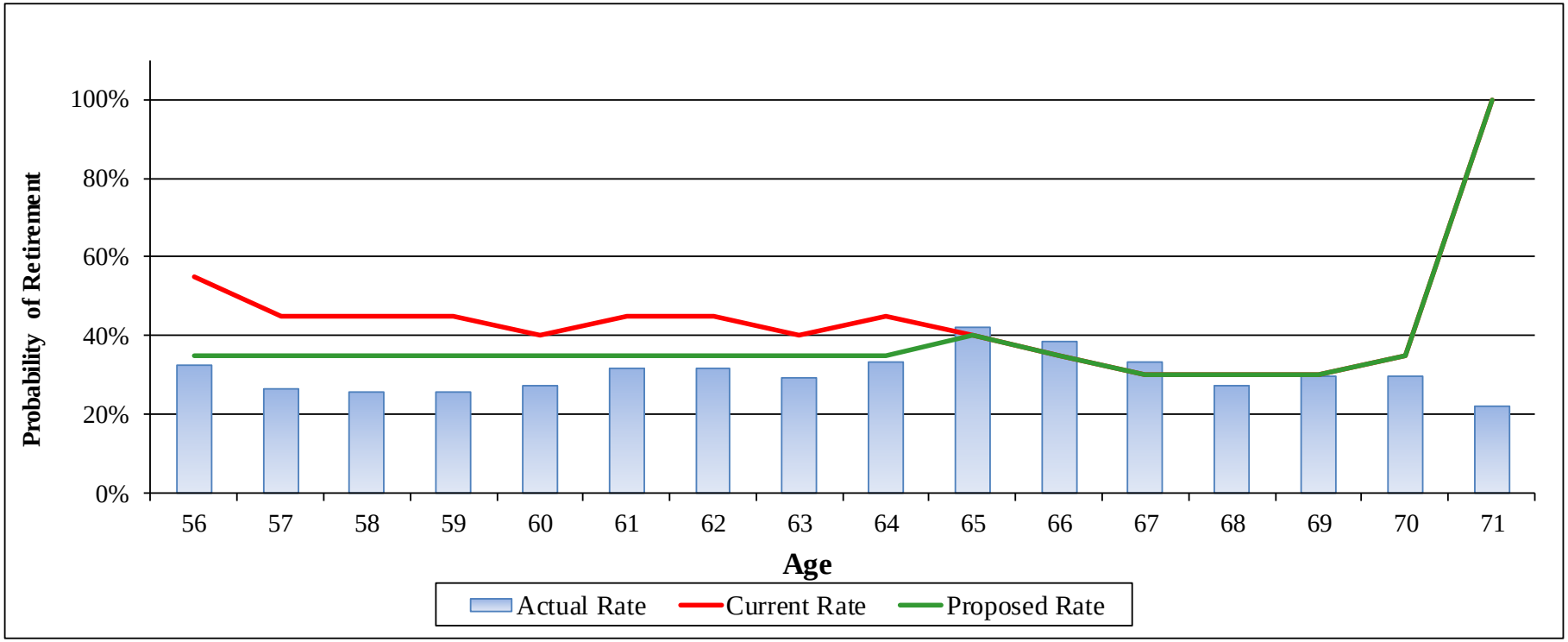
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-5

Retirement Rates

Tier 1 - Unreduced



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	4,542	6,672	5,428
Actual/Expected		68%	84%

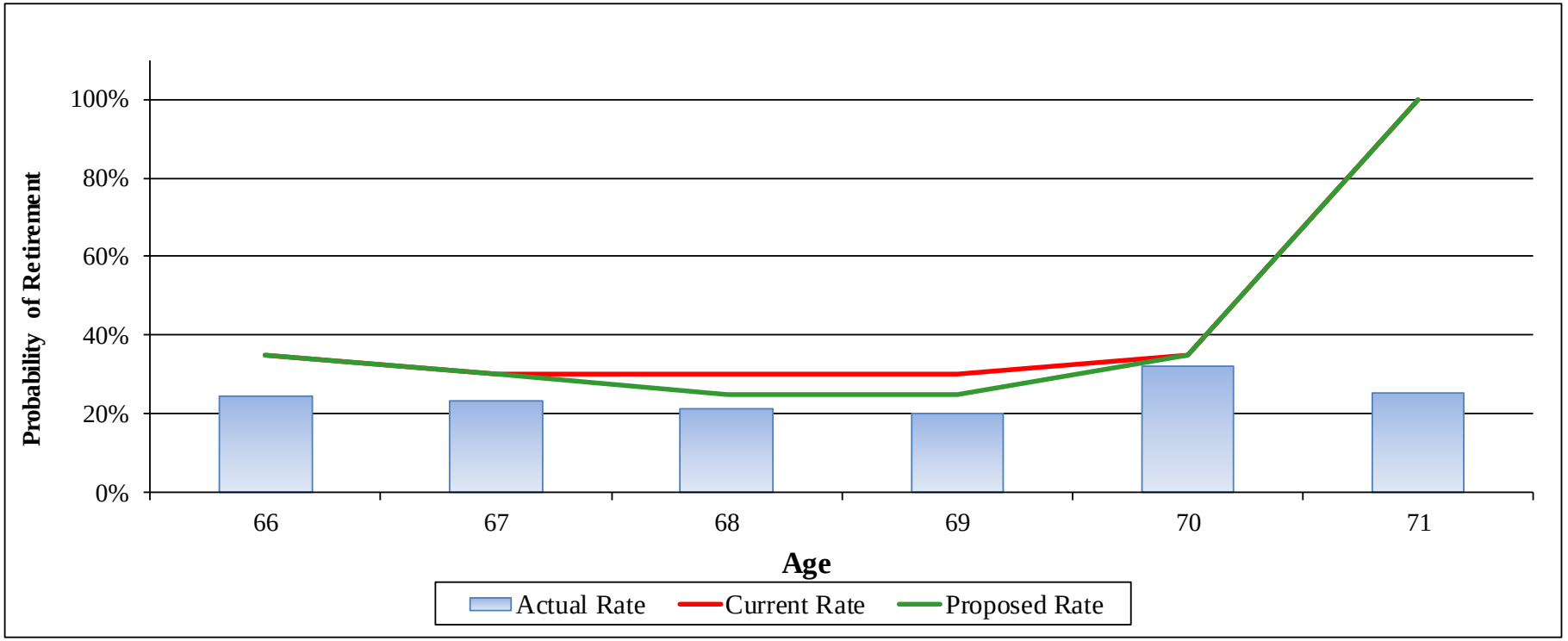
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-6

Retirement Rates

Tier 2 - Unreduced



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	414	619	597
Actual/Expected		67%	69%

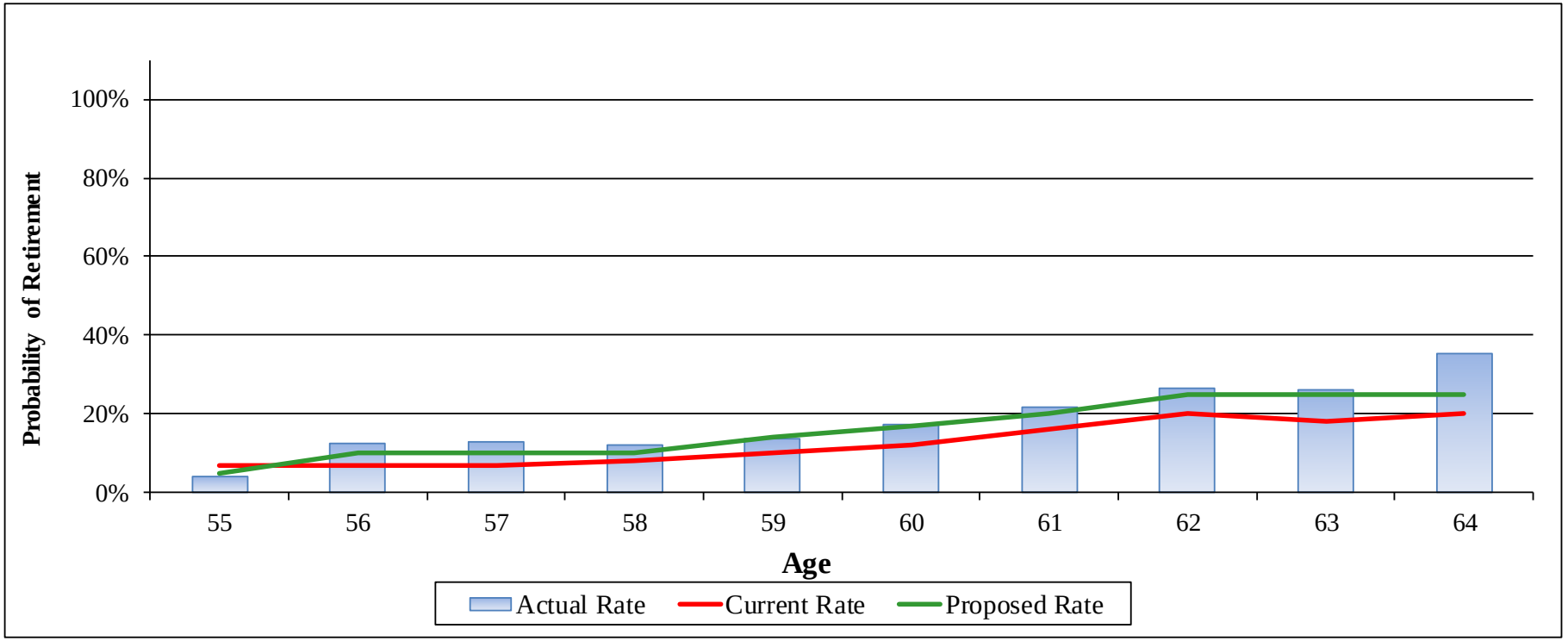
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-7

Retirement Rates

Tier 1 - Early



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	3,665	2,607	3,271
Actual/Expected		141%	112%

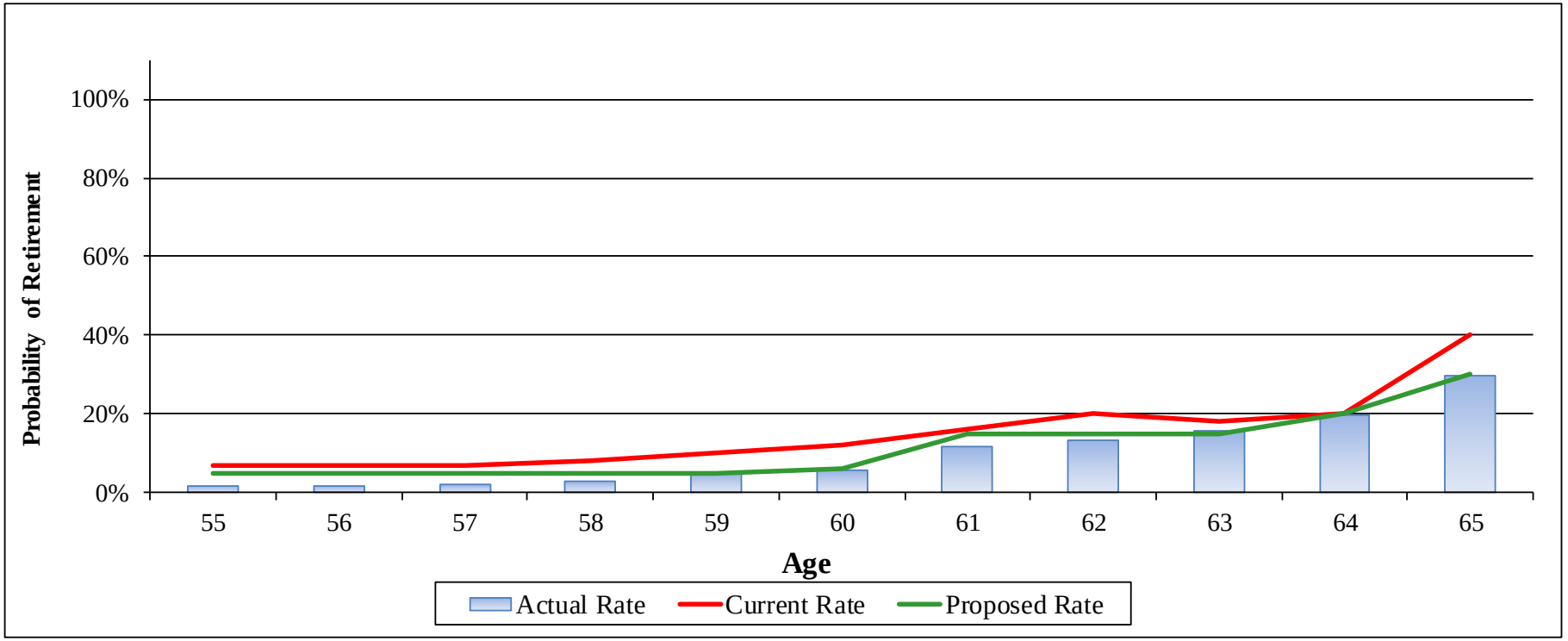
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-8

Retirement Rates

Tier 2 - Early



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Total Count	2,609	4,605	3,343
Actual/Expected		57%	78%

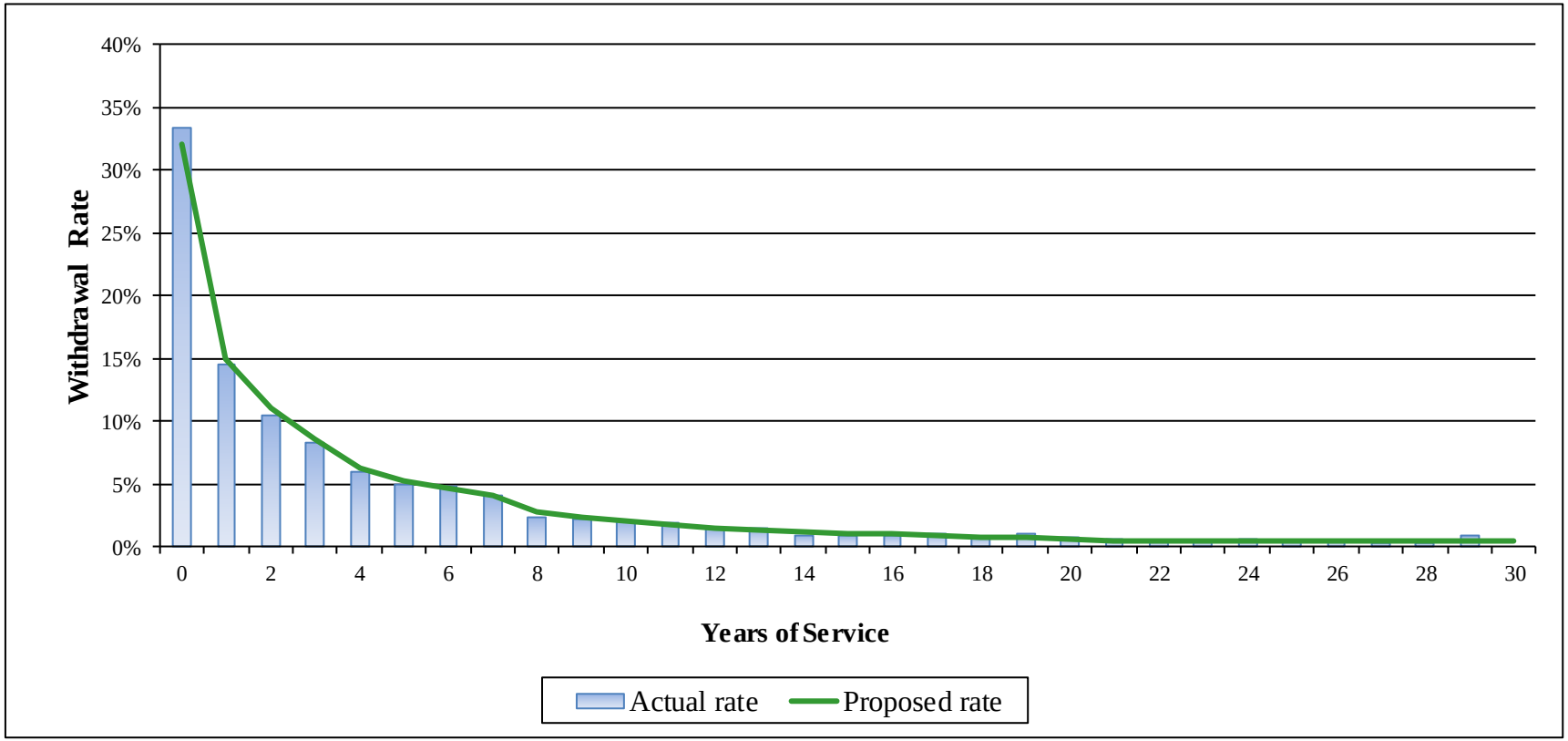
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-9

Rate of Termination of Employment

Males



	Actual	Expected - Proposed Assumptions
Total Count	6,587	6,553
Actual/Expected		101%

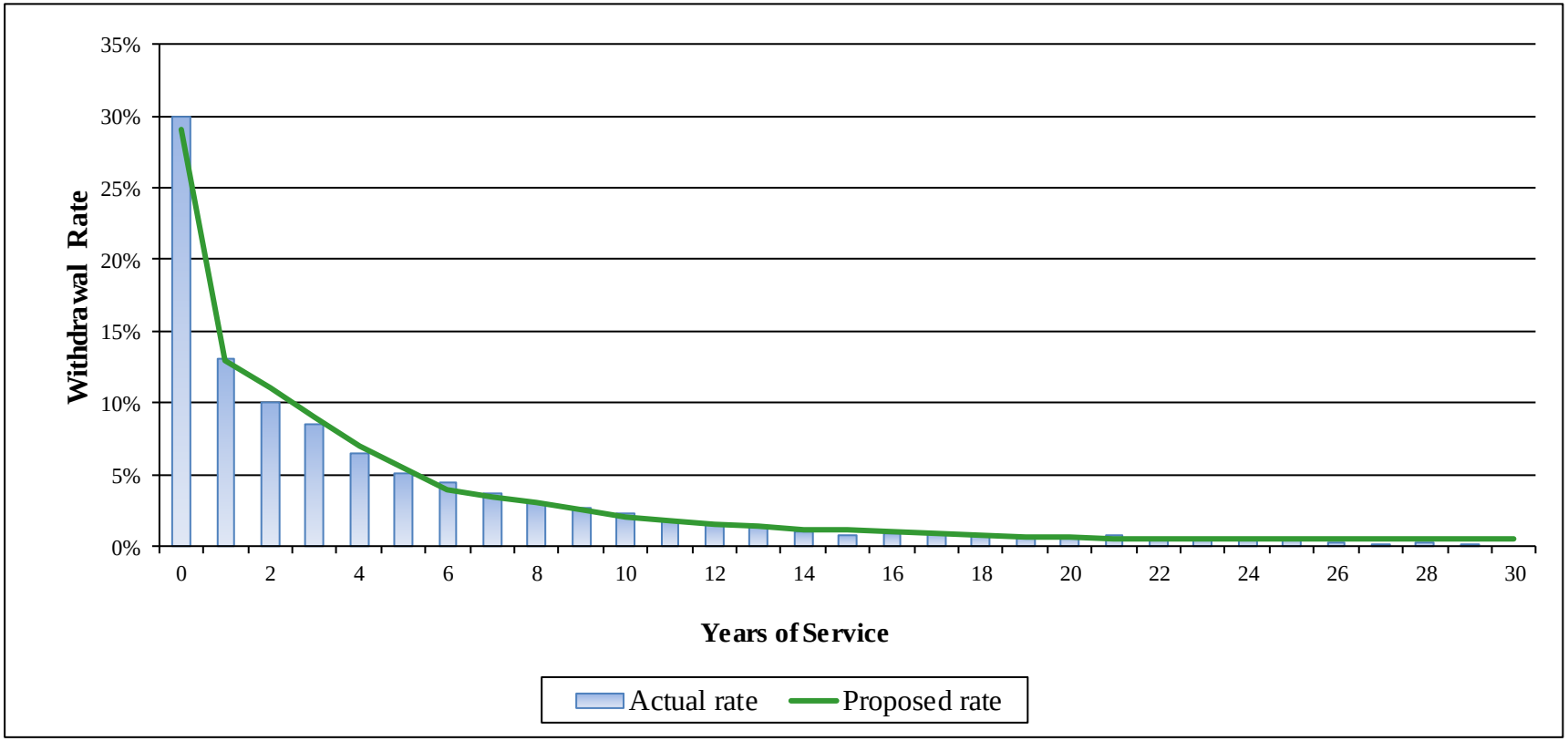
Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-10

Rate of Termination of Employment

Females



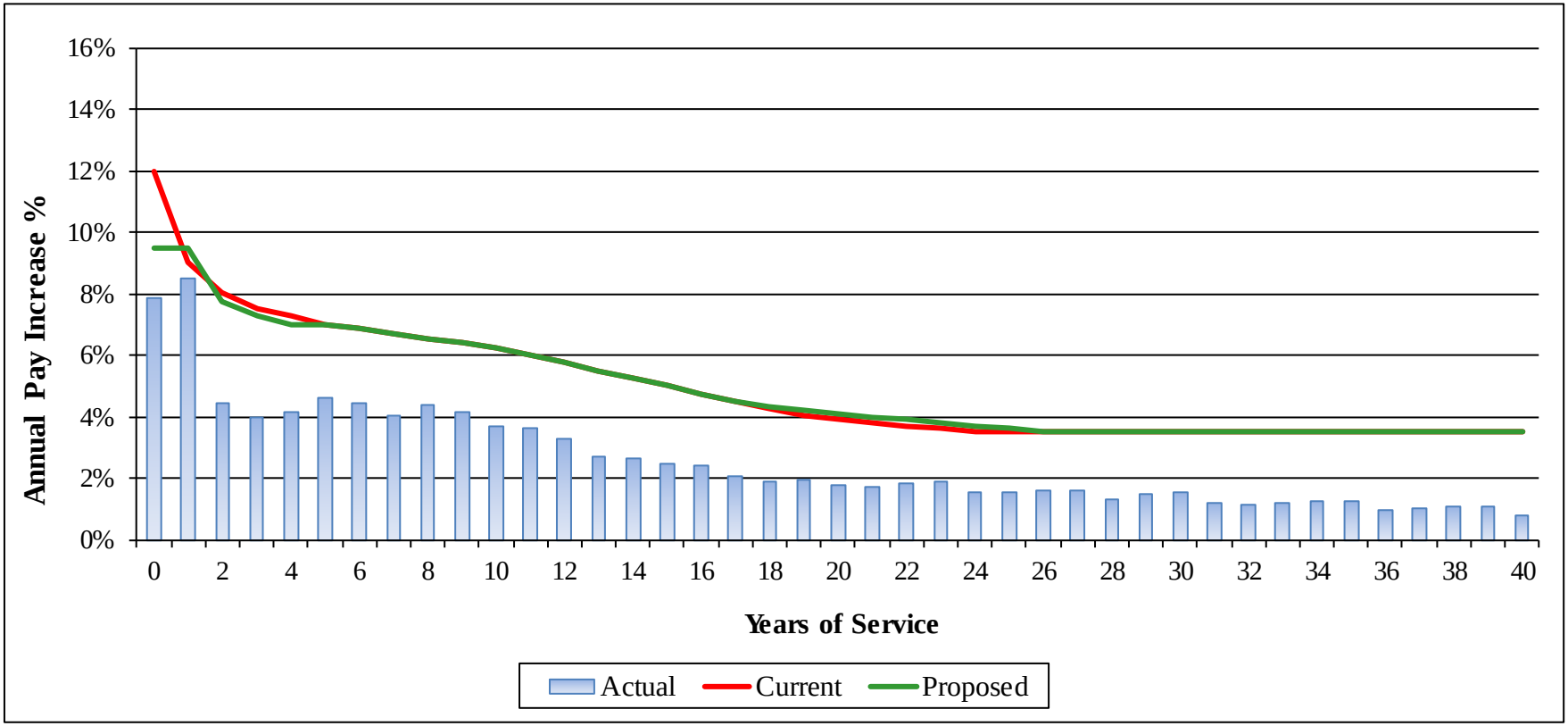
	Actual	Expected - Proposed Assumptions
Total Count	19,010	19,073
Actual/Expected		100%

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit C-11

Total Salary Scale



	Actual	Expected - Current Assumptions	Expected - Proposed Assumptions
Average Increase	3.13%	5.52%	5.50%
Actual/Expected		57%	57%

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Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-1

Probability of Death - Healthy Retirees

Males

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	27	-	0.000%	0.1	0.465%	0.1	0.267%
56	170	-	0.000%	0.8	0.458%	0.5	0.284%
57	635	1	0.157%	2.8	0.448%	1.9	0.301%
58	1,219	3	0.246%	5.4	0.446%	3.9	0.319%
59	1,899	4	0.211%	8.7	0.457%	6.4	0.335%
60	2,652	7	0.264%	12.6	0.474%	9.4	0.353%
61	3,523	14	0.397%	18.0	0.511%	13.1	0.373%
62	4,308	19	0.441%	24.0	0.558%	17.1	0.396%
63	4,916	16	0.325%	30.4	0.618%	20.8	0.422%
64	5,388	24	0.445%	37.8	0.701%	24.4	0.452%
65	5,827	33	0.566%	46.0	0.789%	28.3	0.486%
66	6,253	42	0.672%	54.8	0.877%	34.4	0.550%
67	6,181	42	0.680%	60.7	0.982%	38.6	0.625%
68	6,114	54	0.883%	66.1	1.081%	43.6	0.714%
69	5,983	39	0.652%	71.6	1.197%	49.0	0.819%
70	5,891	63	1.069%	77.8	1.321%	55.7	0.945%
71	5,523	64	1.159%	80.3	1.454%	60.5	1.095%
72	5,254	57	1.085%	84.5	1.608%	66.9	1.273%
73	4,915	76	1.546%	88.8	1.807%	72.9	1.482%
74	4,628	72	1.556%	93.3	2.016%	80.0	1.728%
75	4,335	76	1.753%	99.0	2.283%	87.4	2.015%
76	4,123	86	2.086%	106.9	2.593%	96.9	2.351%
77	3,925	106	2.701%	115.6	2.945%	107.6	2.743%
78	3,584	110	3.069%	120.0	3.349%	114.7	3.200%
79	3,275	125	3.817%	124.5	3.800%	120.9	3.693%
80	2,934	93	3.170%	126.5	4.312%	121.1	4.126%
81	2,666	126	4.726%	128.7	4.829%	123.1	4.616%
82	2,382	125	5.248%	130.1	5.461%	123.2	5.172%
83	2,094	114	5.444%	128.5	6.138%	121.6	5.806%
84	1,852	119	6.425%	127.6	6.887%	120.9	6.530%
85	1,586	127	8.008%	123.9	7.813%	116.7	7.358%
86	1,357	122	8.990%	119.8	8.832%	112.7	8.305%
87	1,132	114	10.071%	111.6	9.855%	106.2	9.385%
88	927	97	10.464%	103.2	11.130%	98.4	10.610%
89	719	90	12.517%	89.2	12.408%	86.3	11.997%
90	555	88	15.856%	77.6	13.974%	75.3	13.560%
91	400	65	16.250%	62.2	15.539%	61.3	15.317%
92	276	52	18.841%	47.5	17.196%	47.7	17.284%
93	183	31	16.940%	34.8	19.035%	35.7	19.488%
94	146	31	21.233%	30.2	20.702%	31.9	21.858%
95	106	27	25.472%	23.7	22.401%	25.8	24.351%
96	78	20	25.641%	19.0	24.349%	21.0	26.949%
97	56	18	32.143%	14.6	26.007%	16.6	29.625%
98	40	14	35.000%	11.2	28.052%	13.0	32.397%
99	24	6	25.000%	7.2	29.985%	8.5	35.287%

Current and proposed rates are projected to the middle of the period.

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-2

Probability of Death - Healthy Retirees

Females

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	105	-	0.000%	0.3	0.252%	0.2	0.196%
56	472	-	0.000%	1.3	0.273%	1.0	0.207%
57	1,358	2	0.147%	4.1	0.298%	3.0	0.219%
58	2,408	5	0.208%	7.9	0.329%	5.6	0.232%
59	3,635	12	0.330%	13.2	0.363%	9.0	0.248%
60	4,960	11	0.222%	19.9	0.400%	13.2	0.267%
61	6,508	19	0.292%	28.7	0.441%	18.8	0.288%
62	7,880	26	0.330%	38.1	0.484%	24.6	0.313%
63	8,538	15	0.176%	45.2	0.529%	29.1	0.341%
64	8,768	31	0.354%	50.7	0.579%	33.7	0.384%
65	8,956	43	0.480%	56.8	0.634%	38.5	0.430%
66	9,028	45	0.498%	63.1	0.699%	43.2	0.478%
67	8,270	38	0.459%	63.9	0.773%	43.8	0.529%
68	7,546	39	0.517%	64.0	0.848%	44.0	0.584%
69	7,108	35	0.492%	66.9	0.941%	45.6	0.642%
70	6,649	49	0.737%	68.5	1.030%	46.9	0.706%
71	6,041	45	0.745%	68.8	1.139%	48.5	0.802%
72	5,539	36	0.650%	69.0	1.245%	50.5	0.912%
73	5,094	51	1.001%	70.2	1.379%	52.9	1.039%
74	4,710	48	1.019%	73.0	1.551%	55.8	1.184%
75	4,310	52	1.206%	74.4	1.727%	58.3	1.352%
76	4,031	49	1.216%	77.4	1.921%	62.3	1.546%
77	3,766	54	1.434%	80.4	2.134%	66.6	1.770%
78	3,557	77	2.165%	84.1	2.364%	72.2	2.029%
79	3,314	65	1.961%	86.8	2.619%	77.2	2.331%
80	3,130	85	2.716%	90.8	2.900%	83.9	2.682%
81	2,994	98	3.273%	96.2	3.214%	92.5	3.091%
82	2,731	79	2.893%	98.5	3.607%	97.4	3.568%
83	2,445	83	3.395%	99.2	4.057%	100.9	4.126%
84	2,236	112	5.009%	102.2	4.569%	106.9	4.780%
85	1,988	97	4.879%	101.1	5.086%	108.5	5.456%
86	1,797	106	5.899%	103.1	5.740%	110.3	6.138%
87	1,632	124	7.598%	104.5	6.404%	112.9	6.916%
88	1,474	121	8.209%	105.5	7.157%	115.0	7.801%
89	1,333	119	8.927%	106.5	7.990%	117.4	8.806%
90	1,238	133	10.743%	111.8	9.029%	123.1	9.947%
91	1,067	140	13.121%	107.3	10.057%	119.9	11.236%
92	928	137	14.763%	103.5	11.156%	117.8	12.689%
93	819	125	15.263%	100.9	12.316%	117.3	14.325%
94	732	119	16.257%	100.2	13.688%	118.0	16.119%
95	603	119	19.735%	90.0	14.920%	108.9	18.062%
96	468	103	22.009%	75.6	16.149%	94.2	20.135%
97	354	80	22.599%	61.4	17.339%	79.1	22.344%
98	265	67	25.283%	49.5	18.692%	65.4	24.675%
99	195	49	25.128%	40.0	20.538%	52.9	27.139%

Current and proposed rates are projected to the middle of the period.

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-3

Probability of Death - Active Lives

Males

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
22	40	-	0.000%	0.0	0.024%	0.0	0.023%
23	522	-	0.000%	0.1	0.026%	0.1	0.023%
24	1,388	-	0.000%	0.4	0.027%	0.3	0.023%
25	1,924	2	0.104%	0.5	0.028%	0.5	0.026%
26	2,293	-	0.000%	0.7	0.029%	0.7	0.029%
27	2,578	-	0.000%	0.8	0.030%	0.8	0.032%
28	2,853	-	0.000%	0.9	0.032%	1.0	0.035%
29	2,960	-	0.000%	1.0	0.033%	1.1	0.036%
30	3,153	-	0.000%	1.1	0.034%	1.2	0.037%
31	3,279	1	0.030%	1.2	0.035%	1.1	0.035%
32	3,334	-	0.000%	1.2	0.036%	1.1	0.033%
33	3,360	-	0.000%	1.2	0.037%	1.1	0.032%
34	3,368	2	0.059%	1.3	0.039%	1.1	0.032%
35	3,452	-	0.000%	1.2	0.033%	1.1	0.032%
36	3,384	-	0.000%	1.2	0.037%	1.1	0.032%
37	3,480	1	0.029%	1.4	0.041%	1.2	0.033%
38	3,541	1	0.028%	1.6	0.046%	1.2	0.034%
39	3,634	-	0.000%	1.8	0.051%	1.3	0.035%
40	3,643	2	0.055%	2.0	0.056%	1.3	0.036%
41	3,672	-	0.000%	2.3	0.061%	1.4	0.037%
42	3,600	2	0.056%	2.4	0.067%	1.4	0.038%
43	3,553	2	0.056%	2.5	0.072%	1.4	0.039%
44	3,420	-	0.000%	2.6	0.077%	1.4	0.041%
45	3,294	2	0.061%	2.7	0.081%	1.4	0.043%
46	3,227	2	0.062%	2.8	0.087%	1.4	0.045%
47	3,158	1	0.032%	2.9	0.093%	1.5	0.048%
48	3,087	1	0.032%	3.1	0.100%	1.6	0.052%
49	3,023	3	0.099%	3.2	0.107%	1.7	0.057%
50	2,933	1	0.034%	3.4	0.116%	1.8	0.063%
51	2,944	-	0.000%	3.7	0.125%	2.0	0.070%
52	2,949	1	0.034%	4.0	0.134%	2.3	0.078%
53	3,028	2	0.066%	4.3	0.143%	2.6	0.087%
54	3,039	5	0.165%	4.6	0.153%	3.0	0.097%
55	3,126	4	0.128%	5.1	0.162%	3.4	0.108%
56	3,326	6	0.180%	5.7	0.171%	4.0	0.121%
57	3,135	4	0.128%	5.6	0.180%	4.2	0.134%
58	2,787	2	0.072%	5.4	0.192%	4.1	0.148%
59	2,554	6	0.235%	5.2	0.205%	4.2	0.164%
60	2,229	3	0.135%	5.0	0.222%	4.0	0.181%
61	1,942	4	0.206%	4.7	0.244%	3.9	0.199%
62	1,549	3	0.194%	4.2	0.269%	3.4	0.220%
63	1,172	3	0.256%	3.5	0.297%	2.9	0.244%
64	893	3	0.336%	2.9	0.325%	2.4	0.270%
65	664	6	0.904%	2.4	0.357%	2.0	0.301%
	120,490	75	0.062%	113.8	0.094%	80.7	0.067%

Current and proposed rates are projected to the middle of the period.

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-4

Probability of Death - Active Lives

Females

Age	Exposure	Actual Deaths	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
22	285	-	0.000%	0.0	0.014%	0.0	0.013%
23	2,585	-	0.000%	0.4	0.015%	0.3	0.013%
24	5,148	-	0.000%	0.8	0.016%	0.7	0.014%
25	6,572	1	0.015%	1.1	0.016%	0.9	0.014%
26	7,451	-	0.000%	1.2	0.016%	1.0	0.014%
27	7,988	-	0.000%	1.3	0.016%	1.1	0.014%
28	8,515	1	0.012%	1.4	0.016%	1.2	0.014%
29	8,874	-	0.000%	1.4	0.016%	1.3	0.015%
30	8,986	2	0.022%	1.5	0.016%	1.3	0.015%
31	9,144	1	0.011%	1.6	0.017%	1.4	0.015%
32	9,072	3	0.033%	1.6	0.018%	1.5	0.016%
33	8,909	-	0.000%	1.7	0.019%	1.5	0.017%
34	8,755	-	0.000%	1.7	0.020%	1.6	0.018%
35	8,535	-	0.000%	1.8	0.021%	1.6	0.019%
36	8,323	-	0.000%	1.8	0.022%	1.7	0.020%
37	8,379	-	0.000%	2.1	0.025%	1.8	0.021%
38	8,650	3	0.035%	2.6	0.030%	1.9	0.022%
39	8,964	2	0.022%	3.0	0.033%	2.1	0.023%
40	9,042	6	0.066%	3.3	0.036%	2.2	0.025%
41	9,183	4	0.044%	3.6	0.039%	2.4	0.026%
42	9,316	1	0.011%	3.8	0.041%	2.5	0.027%
43	9,117	3	0.033%	4.0	0.044%	2.7	0.029%
44	8,811	2	0.023%	4.0	0.046%	2.8	0.031%
45	8,594	3	0.035%	4.1	0.048%	2.9	0.034%
46	8,486	5	0.059%	4.3	0.051%	3.2	0.037%
47	8,689	4	0.046%	4.7	0.055%	3.6	0.041%
48	8,656	2	0.023%	5.1	0.059%	3.9	0.046%
49	8,720	5	0.057%	5.6	0.065%	4.4	0.051%
50	8,811	5	0.057%	6.2	0.071%	5.0	0.057%
51	8,795	8	0.091%	6.9	0.078%	5.5	0.063%
52	8,807	6	0.068%	7.5	0.085%	6.2	0.070%
53	8,811	10	0.113%	8.2	0.093%	6.9	0.078%
54	9,030	10	0.111%	9.1	0.101%	7.8	0.086%
55	9,085	7	0.077%	10.0	0.110%	8.6	0.095%
56	9,252	7	0.076%	11.1	0.120%	9.6	0.104%
57	8,929	7	0.078%	11.7	0.132%	10.1	0.113%
58	8,416	5	0.059%	12.1	0.144%	10.4	0.123%
59	7,704	14	0.182%	12.3	0.160%	10.3	0.133%
60	6,793	10	0.147%	12.0	0.176%	9.8	0.144%
61	5,741	9	0.157%	11.2	0.196%	8.9	0.155%
62	4,402	8	0.182%	9.6	0.217%	7.4	0.168%
63	3,147	3	0.095%	7.6	0.243%	5.7	0.180%
64	2,303	7	0.304%	6.2	0.268%	4.5	0.195%
65	1,610	3	0.186%	4.7	0.294%	3.4	0.210%
	335,385	167	0.050%	215.9	0.064%	173.5	0.052%

Current and proposed rates are projected to the middle of the period.

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-5

Retirement Rates

Tier 1 - Unreduced

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
56	463	150	32.397%	254.7	55.000%	162.1	35.000%
57	1,662	443	26.655%	747.9	45.000%	581.7	35.000%
58	2,081	536	25.757%	936.5	45.000%	728.4	35.000%
59	2,157	556	25.777%	970.7	45.000%	755.0	35.000%
60	2,041	559	27.389%	816.4	40.000%	714.4	35.000%
61	1,823	579	31.761%	820.4	45.000%	638.1	35.000%
62	1,419	448	31.572%	638.6	45.000%	496.7	35.000%
63	1,060	313	29.528%	424.0	40.000%	371.0	35.000%
64	823	276	33.536%	370.4	45.000%	288.1	35.000%
65	757	320	42.272%	302.8	40.000%	302.8	40.000%
66	416	160	38.462%	145.6	35.000%	145.6	35.000%
67	259	86	33.205%	77.7	30.000%	77.7	30.000%
68	175	48	27.429%	52.5	30.000%	52.5	30.000%
69	114	34	29.825%	34.2	30.000%	34.2	30.000%
70	74	22	29.730%	25.9	35.000%	25.9	35.000%
71	54	12	22.222%	54.0	100.000%	54.0	100.000%
	15,378	4,542	29.536%	6,672.0	43.387%	5,427.9	35.296%

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-6

Retirement Rates

Tier 2 - Unreduced

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
66	640	158	24.688%	224.0	35.000%	224.0	35.000%
67	410	96	23.415%	123.0	30.000%	123.0	30.000%
68	266	57	21.429%	79.8	30.000%	66.5	25.000%
69	183	37	20.219%	54.9	30.000%	45.8	25.000%
70	133	43	32.331%	46.6	35.000%	46.6	35.000%
71	91	23	25.275%	91.0	100.000%	91.0	100.000%
	1,723	414	24.028%	619.3	35.940%	596.8	34.637%

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-7

Retirement Rates

Tier 1 - Early

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	5,778	232	4.015%	404.5	7.000%	288.9	5.000%
56	5,784	720	12.448%	404.9	7.000%	578.4	10.000%
57	4,407	576	13.070%	308.5	7.000%	440.7	10.000%
58	3,420	413	12.076%	273.6	8.000%	342.0	10.000%
59	2,777	387	13.936%	277.7	10.000%	388.8	14.000%
60	2,207	384	17.399%	264.8	12.000%	375.2	17.000%
61	1,642	359	21.864%	262.7	16.000%	328.4	20.000%
62	1,107	296	26.739%	221.4	20.000%	276.8	25.000%
63	642	168	26.168%	115.6	18.000%	160.5	25.000%
64	367	130	35.422%	73.4	20.000%	91.8	25.000%
	28,131	3,665	13.028%	2,607.1	9.268%	3,271.4	11.629%

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Data Summary D-8

Retirement Rates

Tier 2 - Early

Age	Exposure	Actual Retirements	Actual Rate	Current Expected	Current Rate	Proposed Expected	Proposed Rate
55	5,450	95	1.743%	381.5	7.000%	272.5	5.000%
56	5,376	94	1.749%	376.3	7.000%	268.8	5.000%
57	5,067	109	2.151%	354.7	7.000%	253.4	5.000%
58	4,778	143	2.993%	382.2	8.000%	238.9	5.000%
59	4,472	228	5.098%	447.2	10.000%	223.6	5.000%
60	3,992	236	5.912%	479.0	12.000%	239.5	6.000%
61	3,469	411	11.848%	555.0	16.000%	520.4	15.000%
62	2,730	365	13.370%	546.0	20.000%	409.5	15.000%
63	2,024	322	15.909%	364.3	18.000%	303.6	15.000%
64	1,485	292	19.663%	297.0	20.000%	297.0	20.000%
65	1,053	314	29.820%	421.2	40.000%	315.9	30.000%
	39,896	2,609	6.540%	4,604.6	11.541%	3,343.0	8.379%

Minnesota Teachers Retirement Association

Experience Study 2009-2013

Data Summary D-9

Rate of Termination of Employment

Males

Duration	Exposure	Actual Terminations	Actual Rate	Proposed Expected	Proposed Rate
0	9,209	3,076	33.402%	2,946.9	32.000%
1	7,147	1,039	14.538%	1,072.1	15.000%
2	5,629	589	10.464%	619.2	11.000%
3	4,579	378	8.255%	389.2	8.500%
4	4,235	251	5.927%	264.7	6.250%
5	4,036	202	5.005%	211.9	5.250%
6	3,967	191	4.815%	182.5	4.600%
7	3,754	152	4.049%	153.9	4.100%
8	3,759	90	2.394%	105.3	2.800%
9	3,957	89	2.249%	91.0	2.300%
10	4,072	86	2.112%	81.4	2.000%
11	4,110	77	1.873%	69.9	1.700%
12	4,048	62	1.532%	56.7	1.400%
13	3,974	56	1.409%	51.7	1.300%
14	3,808	32	0.840%	45.7	1.200%
15	3,589	34	0.947%	39.5	1.100%
16	3,312	30	0.906%	33.1	1.000%
17	3,030	31	1.023%	27.3	0.900%
18	2,830	21	0.742%	22.6	0.800%
19	2,571	28	1.089%	18.0	0.700%
20	2,283	16	0.701%	13.7	0.600%
21	2,000	12	0.600%	10.0	0.500%
22	1,749	7	0.400%	8.7	0.500%
23	1,593	8	0.502%	8.0	0.500%
24	1,398	8	0.572%	7.0	0.500%
25	1,204	5	0.415%	6.0	0.500%
26	1,018	5	0.491%	5.1	0.500%
27	899	3	0.334%	4.5	0.500%
28	812	3	0.369%	4.1	0.500%
29	720	6	0.833%	3.6	0.500%
30	-	-	0.000%	-	0.500%
	99,292	6,587	6.634%	6,553.1	6.600%

Minnesota Teachers Retirement Association

Experience Study 2009-2013

Data Summary D-10

Rate of Termination of Employment

Females

Duration	Exposure	Actual Terminations	Actual Rate	Proposed Expected	Proposed Rate
0	27,026	8,102	29.979%	7,837.5	29.000%
1	23,170	3,038	13.112%	3,012.1	13.000%
2	19,335	1,933	9.997%	2,126.9	11.000%
3	16,055	1,359	8.465%	1,445.0	9.000%
4	14,964	980	6.549%	1,047.5	7.000%
5	13,973	711	5.088%	768.5	5.500%
6	13,122	593	4.519%	524.9	4.000%
7	12,294	451	3.668%	430.3	3.500%
8	11,734	359	3.059%	352.0	3.000%
9	11,309	297	2.626%	282.7	2.500%
10	11,020	247	2.241%	231.4	2.100%
11	10,364	191	1.843%	186.6	1.800%
12	9,792	147	1.501%	156.7	1.600%
13	9,103	128	1.406%	127.4	1.400%
14	8,428	92	1.092%	101.1	1.200%
15	7,587	56	0.738%	83.5	1.100%
16	6,901	60	0.869%	69.0	1.000%
17	6,242	53	0.849%	56.2	0.900%
18	5,704	42	0.736%	45.6	0.800%
19	5,290	32	0.605%	37.0	0.700%
20	4,701	28	0.596%	28.2	0.600%
21	4,119	32	0.777%	20.6	0.500%
22	3,769	18	0.478%	18.8	0.500%
23	3,463	17	0.491%	17.3	0.500%
24	3,068	16	0.522%	15.3	0.500%
25	2,631	14	0.532%	13.2	0.500%
26	2,271	5	0.220%	11.4	0.500%
27	2,029	3	0.148%	10.1	0.500%
28	1,764	4	0.227%	8.8	0.500%
29	1,484	2	0.135%	7.4	0.500%
30	-	-	0.000%	-	0.500%
	272,712	19,010	6.971%	19,073.1	6.994%

Minnesota Teachers Retirement Association

Experience Study 2008-2014

Exhibit D-11

Total Salary Scale

Duration	Initial Salary (Millions)	Subsequent Salary (Millions)	Actual Rate	Current Expected (Millions)	Current Rate	Proposed Expected (Millions)	Proposed Rate
0	357.7	385.9	7.87%	400.7	12.00%	391.7	9.50%
1	746.4	809.7	8.48%	813.6	9.00%	817.4	9.50%
2	754.1	787.4	4.41%	814.4	8.00%	812.6	7.75%
3	744.7	774.1	3.94%	800.6	7.50%	798.7	7.25%
4	758.1	789.6	4.16%	813.1	7.25%	811.2	7.00%
5	774.5	810.3	4.63%	828.7	7.00%	828.7	7.00%
6	787.2	822.0	4.41%	841.2	6.85%	841.2	6.85%
7	794.9	826.8	4.02%	848.1	6.70%	848.1	6.70%
8	819.0	855.0	4.40%	872.6	6.55%	872.6	6.55%
9	857.6	893.2	4.15%	912.5	6.40%	912.5	6.40%
10	895.5	928.7	3.71%	951.5	6.25%	951.5	6.25%
11	911.0	944.0	3.61%	965.7	6.00%	965.7	6.00%
12	917.1	947.3	3.29%	969.9	5.75%	969.9	5.75%
13	909.4	934.1	2.72%	959.4	5.50%	959.4	5.50%
14	881.9	905.3	2.66%	928.2	5.25%	928.2	5.25%
15	841.7	862.3	2.45%	883.8	5.00%	883.8	5.00%
16	799.3	818.7	2.42%	837.3	4.75%	837.3	4.75%
17	759.8	775.5	2.08%	794.0	4.50%	794.0	4.50%
18	730.2	744.0	1.89%	761.3	4.25%	761.6	4.30%
19	691.0	704.4	1.94%	718.6	4.00%	720.0	4.20%
20	641.3	652.8	1.78%	666.4	3.90%	667.6	4.10%
21	587.4	597.3	1.69%	609.7	3.80%	610.9	4.00%
22	548.7	558.8	1.85%	569.0	3.70%	570.1	3.90%
23	517.0	526.7	1.88%	535.6	3.60%	536.6	3.80%
24	482.3	489.7	1.54%	499.2	3.50%	500.1	3.70%
25	434.9	441.6	1.54%	450.1	3.50%	450.5	3.60%
26	389.3	395.5	1.59%	402.9	3.50%	402.9	3.50%
27	360.1	365.8	1.58%	372.8	3.50%	372.8	3.50%
28	340.3	344.8	1.32%	352.2	3.50%	352.2	3.50%
29	316.9	321.5	1.47%	327.9	3.50%	327.9	3.50%
30	297.0	301.5	1.51%	307.4	3.50%	307.4	3.50%
31	273.7	277.0	1.19%	283.3	3.50%	283.3	3.50%
32	231.8	234.4	1.12%	239.9	3.50%	239.9	3.50%
33	174.7	176.8	1.19%	180.8	3.50%	180.8	3.50%
34	135.1	136.8	1.24%	139.8	3.50%	139.8	3.50%
35	104.0	105.3	1.25%	107.6	3.50%	107.6	3.50%
36	76.3	77.0	0.98%	79.0	3.50%	79.0	3.50%
37	56.6	57.2	1.03%	58.6	3.50%	58.6	3.50%
38	41.5	41.9	1.06%	42.9	3.50%	42.9	3.50%
39	27.8	28.1	1.09%	28.8	3.50%	28.8	3.50%
40	18.4	18.6	0.76%	19.1	3.50%	19.1	3.50%
	21,786.3	22,467.6	3.13%	22,988.0	5.52%	22,984.8	5.50%