

TEXAS EMERGENCY SERVICES RETIREMENT SYSTEM

Report of an Actuarial Audit
May 14, 2021





May 14, 2021

Board of Trustees
Texas Emergency Services Retirement System
PO Box 12577
Austin, TX 78711

Members of the Board:

Gabriel, Roeder, Smith & Company (GRS) is pleased to present this report of an actuarial audit of the August 31, 2020 actuarial valuation of the Texas Emergency Services Retirement System (TESRS). We are grateful to the TESRS staff and Rudd and Wisdom, the retained actuary, for their cooperation throughout the actuarial audit process.

This actuarial audit involves an independent verification and analysis of the assumptions, procedures, methods, and conclusions used by the retained actuary for TESRS, in the actuarial valuations of TESRS as of August 31, 2020, to ensure that the conclusions are reasonable and conform to the appropriate Standards of Practice as promulgated by the Actuarial Standards Board.

GRS is pleased to report to the Board, in our professional opinion, the August 31, 2020 actuarial valuation prepared by the retained actuary provides a fair and reasonable assessment of the financial position of TESRS.

Throughout this report we make a number of suggestions for ways to improve the work product. We hope that the retained actuary and TESRS find these items helpful. Thank you for the opportunity to work on this assignment.

Board of Trustees
Texas Emergency Services Retirement System
May 14, 2021
Page 2

Mr. Falls and Ms. Shaw are independent of the plan sponsor. They are Enrolled Actuaries, Members of the American Academy of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries. Finally, the undersigned are experienced in performing valuations for large public retirement systems.

Respectfully submitted,
Gabriel, Roeder, Smith & Company



R. Ryan Falls, FSA, EA, MAAA
Senior Consultant



Janie Shaw, ASA, EA, MAAA
Consultant



Table of Contents

Section I	Executive Summary.....	2
Section II	General Actuarial Audit Procedure	6
Section III	Actuarial Assumptions	9
Section IV	Actuarial Methods.....	24
Section V	Actuarial Valuation Results	29
Section VI	Content of the Valuation Report	35
Section VII	Brief Discussion of Observed Financial Risks	38
Section VIII	Final Remarks.....	41



SECTION I

EXECUTIVE SUMMARY

Executive Summary

The Texas Emergency Services Retirement System (TESRS) engaged Gabriel, Roeder, Smith & Company (GRS) for an actuarial audit of the recent actuarial valuation prepared for TESRS.

The scope of this actuarial audit includes the following:

- An analysis of the appropriateness of the actuarial assumptions;
- A review of the assumptions and methodology for compliance with the funding standards;
- Verification of demographic data;
- Confirmation of the August 31, 2020 valuation results, including a determination of actuarial accrued liability, normal cost, expected employee contributions, and the effects of any recent legislation;
- Review the actuarial assumptions and methodology for compliance with applicable statutes, TESRS' policies, rules and regulations; and for compliance with generally recognized and accepted actuarial principles and practices which are consistent with Actuarial Standards of Practice, the Code of Professional Conduct, Qualifications Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries, and applicable GASB Statements;
- A determination of the accuracy of funding computations;
- A determination of the appropriateness of recommended employer and employee contribution rates;
- An evaluation of actuarial asset methods;
- An evaluation of the test results and reconciliation of any significant discrepancies between the Contractor's findings, assumptions, methodology, rates, and adjustments and those of TESRS' consulting actuary; and
- An assessment of whether the August 31, 2020 valuation appropriately reflects information required to be disclosed under required reporting standards (GASB, etc.).

Summary of Findings

Based on our review of the census data, experience study documents, liability calculations for the entire plan, detailed liability calculations for a sample of members, and the actuarial valuation reports, we believe the August 31, 2020 actuarial valuation of TESRS is reasonable, based on reasonable assumptions and methods, and the reports generally comply with the Actuarial Standards of Practice. However, we recommend a number of enhancements to the application of the actuarial cost method to improve the comparison of the employer monthly contribution amounts to the normal cost.

We offer the following recommendations based on the valuation methods and assumptions used by the retained actuary in the August 31, 2020 actuarial valuation of TESRS.

Actuarial Assumptions

1. We believe that the current termination assumption is reasonable for the TESRS membership. Due to the significant impact the termination rates have on the TESRS liabilities and the notable number of rehires, we recommend the retained actuary consider maintaining a larger margin for



conservatism in future experience studies. We also recommend that the retained actuary closely monitor the termination and rehire experience prior to the next experience study to ensure that the current assumption remains reasonable.

2. We recommend that the retained actuary closely monitor the actual commencement ages of vested terminated benefits in each valuation to ensure the assumed commencement age of 58 continues to be reasonable.
3. In light of the concentration of plan liability in a small number of departments with high contribution levels, we recommend that the retained actuary enhance the next actuarial experience study by adopting an amount-weighted approach for the key demographic assumptions in order to minimize gains and losses associated with the key demographic assumptions. Prior to the next experience study, we recommend that the retained actuary closely monitor the actual experience with each actuarial valuation to ensure that the current headcount-weighted assumptions continue to be reasonable.
4. We believe the current assumed net real rate of return of 4.50% is reasonable. However, we find it very difficult to justify the inflation assumption of 3.00% based on the currently available market and survey data. As a result, we feel the nominal investment return assumption of 7.50% is high. We recommend that the Board and the retained actuary monitor the inflation assumption very closely. If actual inflation remains at the current low levels then the Board and the retained actuary should consider a change to the inflation assumption, and the resulting nominal investment return assumption, prior to the next experience study.

Actuarial Methods

5. We recommend that the retained actuary review the application of the EAN Method and consider the application of the beginning of year decrement timing in the calculation of the expected service for each member over the course of their career.
6. We recommend that the retained actuary review their application of the EAN Method and consider the approach that produces constant normal cost over the member's entire career which would be more appropriate for TESRS based on the fixed contributions TESRS receives from the governing bodies.
7. We recommend the retained actuary consider their application of the EAN Method for GASB purposes in light of Paragraph 32, Item b and Item d, of Statement No. 68.

Actuarial Valuation Results

8. We believe that the valuation results were developed in a reasonable manner based on the current application the methods. However, the current methods may be understating the total normal cost for the upcoming year and the duration of the State contributions. In the next actuarial valuation, the retained actuary should consider enhancing the actuarial valuation results by incorporating the recommendations regarding actuarial methods in the prior sections of this report.

Content of Valuation Report



9. In order to improve the ability of the report to communicate the assumptions, methods and plan provisions incorporated into the actuarial valuation of TESRS, we recommend that the retained actuary incorporate the noted enhancements to future actuarial valuation reports.

Brief Discussion of Observed Financial Risks

10. The long-term financing of TESRS is subject to many risks in the future and the actuary can assist the Board in understanding the impact of each of these risks. We encourage the retained actuary to discuss their perspectives on the risks facing TESRS with the Board on a regular basis so that Stakeholders have a better understanding of potential future demographic and economic scenarios that may occur.

SECTION II

GENERAL ACTUARIAL AUDIT PROCEDURE

General Actuarial Audit Procedure

At the commencement of this engagement, GRS requested the information necessary to thoroughly review the work product of the retained actuary. Specifically, GRS received and reviewed the following items:

- Actuarial valuation report as of August 31, 2020,
- 2020 Experience Study and Review of Assumptions for the six-year period ending August 31, 2018,
- GASB Reporting Information as of August 31, 2020,
- TESRS Investment Policy, dated August 18, 2020,
- A preliminary set of census data for plan participants and beneficiaries as of August 31, 2020 originally provided by TESRS to the retained actuary for the actuarial valuation,
- A final set of census data for plan participants and beneficiaries as of August 31, 2020 used by the retained actuary for the actuarial valuation, and
- Detailed liability calculations from the retained actuary for a sampling of 24 members as of August 31, 2020.

In performing our review, we:

- Reviewed descriptions of member benefits and applicable statutes to understand the benefits provided by TESRS,
- Reviewed the appropriateness of the actuarial assumptions and methods,
- Reviewed actuarial valuation reports,
- Replicated the plan-wide actuarial valuation results and resulting funding period, and
- Reviewed the detailed liability calculation of the sample lives to ensure that the calculations were consistent with the stated plan provisions, actuarial methods and assumptions.

The actuarial audit findings, which follow, are based on our review of this information and subsequent correspondence with the retained actuary for clarification and further documentation.

Key Actuarial Concepts

An actuarial valuation is a detailed statistical simulation of the future operation of a retirement system using the set of actuarial assumptions adopted by the governing board. It is designed to simulate all of the dynamics of such a retirement system for each current participant of the plan, including:

- Accrual of future service,
- Changes in benefits,
- Leaving the plan through retirement, disability, withdrawal, or death, and
- Determination of and payment of benefits from the plan.

This simulated dynamic is applied to each active member in the plan and results in a set of expected future benefit payments for that member. Discounting those future payments for the likelihood of survival at the assumed rate of investment return produces the Total Present Value of Plan Benefits (TPV) for that participant. The actuarial cost method will allocate this TPV between the participant's past service (actuarial accrued liability) and future service (future normal costs).



We believe that an actuarial audit should not focus on finding differences in actuarial processes and procedures utilized by the consulting actuary and the auditing actuary. Rather, our intent is to identify and suggest improvements to the process and procedures utilized by TESRS's retained actuary. In performing this actuarial audit, we attempted to limit our discussions regarding opinion differences and focus our attention on the accuracy of the calculations of the liability and costs, completeness and reliability of reporting, and compliance with the Actuarial Standards of Practice that apply to the work performed by TESRS's retained actuary.

These key actuarial concepts will be discussed in more detail throughout this report.

Actuarial Qualifications

The August 31, 2020 actuarial valuation report for TESRS was signed by Mr. Mark R. Fenlaw, F.S.A. and Ms. Rebecca B. Morris, A.S.A. Based on the information provided by the online actuarial directory sponsored by the Society of Actuaries, Mr. Fenlaw and Ms. Morris have attained the actuarial credentials noted on the signature line of the actuarial valuation report and are compliant with the Society of Actuaries Continuing Professional Development requirement.

SECTION III

ACTUARIAL ASSUMPTIONS

Actuarial Assumptions

Overview

For any pension plan, actuarial assumptions are selected that are intended to provide reasonable estimates of future expected events, such as retirement, turnover, and mortality. These assumptions, along with an actuarial cost method, the employee census data, and the plan's provisions, are used to determine the actuarial liabilities and the overall actuarially determined funding requirements for the plan. The true cost to the plan over time will be the actual benefit payments and expenses required by the plan's provisions for the participant group under the plan. To the extent the actual experience deviates from the assumptions, experience gains and losses will occur. These gains (losses) then serve to reduce (increase) future actuarially determined contributions and increase (reduce) the funded ratio. The actuarial assumptions should be individually reasonable and consistent in the aggregate, and should be reviewed periodically to ensure that they remain appropriate.

The Actuarial Standards Board ("ASB") provides guidance on establishing actuarial assumptions for a retirement program through the following Actuarial Standards of Practices (ASOP):

- (1) ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*
- (2) ASOP No. 23, *Data Quality*
- (3) ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*
- (4) ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*
- (5) ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*
- (6) ASOP No. 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*

We generally reviewed the application of the ASOPs applicable on the valuation date of the August 31, 2020 actuarial valuation report. Subsequent changes to the ASOPs will have to be reflected in future actuarial valuation reports.

The actuarial valuation report for TESRS contains descriptions of the actuarial assumptions which were used in the actuarial valuation as of August 31, 2020. Additionally, the retained actuary published an actuarial experience study report, dated July 23, 2020. We conducted a thorough review of these documents in order to assess the reasonableness of the assumptions used in the actuarial valuation.

Actuarial assumptions for the valuation of retirement programs are of two types: (i) demographic assumptions, and (ii) economic assumptions. We have assessed the reasonableness of both types as part of this actuarial audit.



Demographic Assumptions

General

These assumptions simulate the movement of participants into and out of plan coverage and between status types. Key demographic assumptions are:

- turnover among active members,
- retirement patterns among active members, and
- healthy retiree mortality.

In addition, there are a number of other demographic assumptions with less substantial impact on the results of the process, such as:

- disability incidence and mortality among disabled benefit recipients,
- mortality among active members,
- percent of active members who are married and the relationship of the ages of participants and spouses, and
- benefit elections upon retirement or termination.

Demographic assumptions for retirement programs are normally established by statistical studies of recent actual experience, called experience studies. Such studies underlie the assumptions used in the valuations.

In an experience study, the actuary first determines the number of deaths, retirements, etc. that occurred during the experience period. Then the actuary determines the number “expected” to occur, based on the current actuarial assumptions. Finally, the actuary calculates the A/E ratio, where "A" is the actual number (of retirements, for example) and "E" is the expected number. If the current assumptions were “perfect”, the A/E ratio would be 100%. When it varies much from this figure, it is a sign that new assumptions may be needed. (However, the actuary will generally prefer to set assumptions to produce an A/E ratio a little above or below 100%, in order to introduce some conservatism.)

Once it is determined whether or not an assumption needs adjustment, setting the new assumption depends upon the extent to which the current experience is an indicator of the long-term future.

- Full credibility may be given to the current experience. Under this approach, the new assumptions are set very close to recent experience.
- Alternatively, the recent experience might be given only partial credibility. Thus, the new assumptions may be set by blending the recent experience with the prior assumption.
- If recent experience is believed to be atypical of the future, such knowledge is taken into account.
- Finally, it may be determined that the size of the plan does not provide a large enough sample to make the data credible. In such cases, the experience of the plan may be disregarded and the assumption is set based upon industry standards for similar groups.

Actuarial Standards of Practice (ASOP) No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*, applies to actuaries when they are selecting demographic assumptions. In accordance with ASOP No. 35, an actuary should identify the types of



demographic assumptions to use for a specific measurement. In doing so, the actuary should determine the following:

- a) The purpose and nature of the measurement;
- b) The plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
- c) The characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, and volatility);
- d) The contingencies that give rise to benefits or result in loss of benefits;
- e) The significance of each assumption; and
- f) The characteristics of the covered group.

Not every contingency requires a separate assumption. For example, for a plan that is expected to provide benefits of equal value to employees who voluntarily terminate employment, become disabled, or retire, the actuary may use an assumption that reflects some or all of the above contingencies in combination rather than selecting a separate assumption for each.

Observations on Assumptions

Overall, it appears that the current demographic assumptions are reasonable. Below, we offer general observations and considerations for the retained actuary based on our experiences with similar plans.

Healthy Post-Retirement Mortality

The most important demographic assumption is post-retirement mortality because this assumption is a predictor of how long pension payments will be made. The stated post-retirement mortality assumption is based on the PubS-2010 (public safety) below-median income mortality table. Additionally, the retained actuary utilizes a generational mortality assumption to incorporate future mortality improvements into the actuarial valuation using the MP-2019 mortality improvement scale.

The number of actual deaths for TESRS during the experience period was not sufficient to provide full credibility to the actual plan experience so the retained actuary must rely on industry tables along with facts and circumstances regarding the plan to develop a reasonable assumption. This mortality assumption is a reasonable assumption based on the population covered by TESRS.

Observations on Other Pertinent Assumptions

Retirement – Members are eligible to retire at age 55 with 10 years of service and the rates at which members are assumed to retire are based on the member's age. The current assumption was developed to be consistent with the actual experience over the most recent experience study period.



Based on the Experience Study report, the retained actuary made the following observations and general recommendations:

	Prior Rates	Recommended Rates
Exposures	2,149	2,149
Actual Retirements	328	328
Expected Retirements	331.16	350.31
Actual/Expected	99%	94%

The retained actuary recommended a modest change to the retirement rates that also established a reasonable level of conservatism. Overall, we believe that the current retirement assumption is reasonable for the TESRS membership.

Termination – The rates at which members are assumed to terminate (or withdrawal) prior to eligibility for retirement were reviewed in the experience study based on the member’s age at hire (or, “entry age”) and service.

Based on the Experience Study report, the retained actuary made the following observations and general recommendations:

	Prior Rates	Recommended Rates
Exposures	21,196	21,196
Actual Terminations	3,321	3,321
Expected Terminations	2,885.87	3,238.94
Actual/Expected	115%	103%

This summary indicates that the retained actuary increased the assumed number of terminations prior to retirement (which lowers plan liabilities) by 12%. According to the Experience Study report, this recommended change in assumption was one of the two primary changes that resulted in a notable reduction in the TESRS liabilities.

It should also be noted that the actuarial valuation has observed 25, or more, rehires (members hired with prior service in TESRS) in each of the last three valuations. These “rehires” enter the plan with more liability than a true “new hire” because of their prior service and generate an unexpected increase in the unfunded liability.

Overall, we believe that the current termination assumption is reasonable for the TESRS membership. Due to the significant impact the termination rates have on the TESRS liabilities and the notable number of rehires, we recommend the retained actuary consider maintaining a larger margin for conservatism in future experience studies. We also recommend that the retained actuary closely monitor the termination and rehire experience prior to the next experience study to ensure that the current assumption remains reasonable.

Deferred Retirement Age – The second recommended assumption change that resulted in a notable reduction in the TESRS liabilities was the increase in the assumed commencement age of terminated

vested benefits. During the experience period, the retained actuary observed that the average age at commencement for terminated vested members was over age 58. As a result, the retained actuary recommended an increase in the assumed commencement age from 56 to 58.

We concur with the retained actuary that this is “surprising” that a vested member would wait until age 58 to commence their benefit. Based on discussions with TESRS staff, the system does attempt to contact vested members over age 55 every year but the system has lost contact with many of these terminated members. It is understandable and fully expected that there would be challenges associated with maintaining contact with these terminated members over time. However, it is very reasonable to assume that the prevalence of cell phones and email addresses, which follow people when they move, will only improve the ability of TESRS to maintain contact with future terminated members and facilitate a timelier commencement of their benefit.

The current assumption appears to be reasonable based on recent past experience. However, it anticipates a large number of terminated members will defer receipt of their benefit to the terminated member’s financial detriment. For most public sector pension plans the liability associated with terminated member’s is less than 3% of the total liabilities of the plan. However, for TESRS this liability is more than 13% of the liability of the system. Given the significant number of terminated vested employees and the significant liability they represent, we recommend that the retained actuary closely monitor the actual commencement ages of vested terminated benefits in each valuation to ensure the assumed commencement age of 58 continues to be reasonable.

Disability Incidence – The current assumption for disability incidence is based on a member’s age. The rate of disability incidence is studied during each actuarial experience study but very little plan experience generally exists in order to set a reasonable assumption based on actual plan experience. The current assumption for disability incidence is reasonable for this purpose.

Consideration of “Amount-Weighted” Analysis of Experience

The recommended demographic assumptions resulting from the most recent actuarial experience study were “headcount-weighted” which is a reasonable procedure.

In this context, it should be noted that the size of the active membership and the level of benefits provided by each participating department can vary significantly across the plan. Specifically, 25% of the plan’s total liability is concentrated in only six participating departments, but these departments only comprise 11% of the active membership. In this situation, the behavior/experience of a department where the governing body contributes \$200 per month will have a much larger impact on the plan than a department where the governing body contributes \$36 per month.

In circumstances such as this, the actuary should consider enhancing this process by using an “amount-weighted” experience analysis. An amount-weighted analysis will generally use amounts such as benefits or liabilities to review the experience. From the perspective of the retirement assumption, selecting an assumption based on headcount-weighting is consistent with estimating expected retirements, but selecting an assumption based on amount-weighting is consistent with minimizing gains and losses associated with expected retirements. By weighting the data by benefit amounts, the actuary gives more weight to members who have larger benefits (and thus have larger liabilities). The same concepts apply when the amount-weighted approach is applied to other demographic assumptions such as mortality and termination.



In general, the actuarial assumptions are not expected to correctly predict behavior in every year. However, a reasonable set of assumptions should generate actuarial gains in some years and actuarial losses in other years, with an average close to zero.

In light of the concentration of plan liability in a small number of departments with high contribution levels, we recommend that the retained actuary enhance the next actuarial experience study by adopting an amount-weighted approach for the key demographic assumptions in order to minimize gains and losses associated with the key demographic assumptions. Prior to the next experience study, we recommend that the retained actuary closely monitor the actual experience with each actuarial valuation to ensure that the current headcount-weighted assumptions continue to be reasonable.

Economic Assumptions

General

Economic assumptions simulate the impact of economic forces on the amounts and values of future benefits. Key economic assumptions are the assumed rate of investment return and assumed rates of future salary increase. All economic assumptions are built upon an underlying inflation assumption.

ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*, applies to actuaries when they are selecting economic assumptions. ASOP No. 27 states that each economic assumption selected by the actuary should be reasonable. 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 not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed, or when alternative assumptions are used for the assessment of risk.

Additionally, ASOP No. 27 states that communications regarding actuarial reports subject to this standard should contain the following:

- a) A description of each significant assumption used in the measurement and whether the assumption represents an estimate of future experience, and
- b) A description of the information and analysis used in selecting each economic assumption that has a significant effect on the measurement.

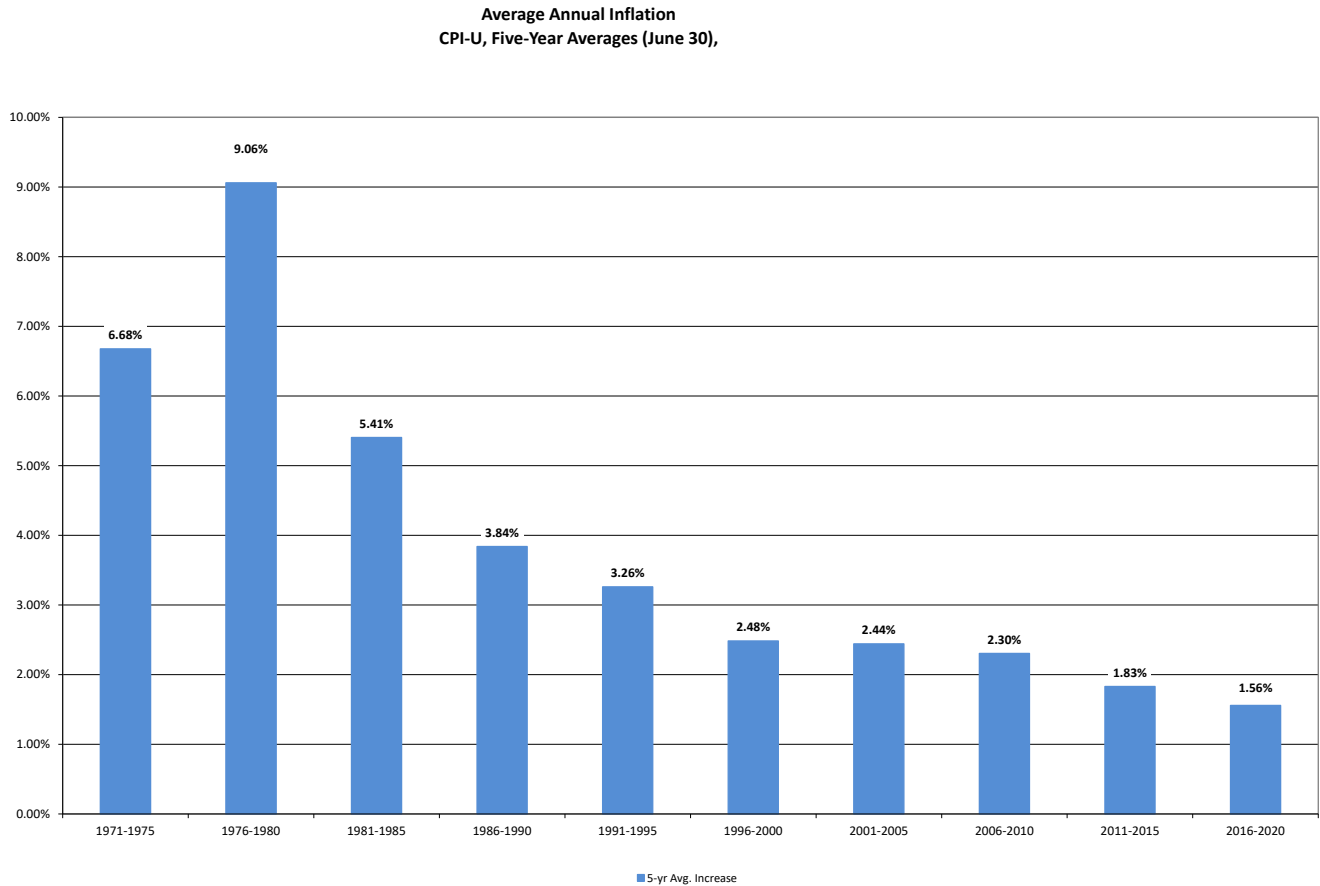
Inflation

By "inflation," we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies most of the other economic assumptions. It primarily impacts



investment return, salary increases, and payroll growth. The current annual inflation assumption for TESRS is 3.00%.

The chart on the next page shows the average annual inflation in each of the ten consecutive five-year periods over the last fifty years:



Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted

The table below shows the average inflation over various periods, ending June 2020:

Periods Ending June 2019	Average Annual Increase in CPI-U
Last five (5) years	1.56%
Last ten (10) years	1.69%
Last fifteen (15) years	1.90%
Last twenty (20) years	2.03%
Last thirty (25) years	2.12%
Last thirty (30) years	2.31%
Since 1913 (first available year)	3.08%

Source: Bureau of Labor Statistics, CPI-U, all items, not seasonally adjusted

As you can see, inflation has been relatively low over the last thirty years.



Most of the investment consulting firms, in setting their capital market assumptions, currently assume that inflation will be less than 2.50%. We examined the 2020 capital market assumption sets for 13 investment consulting firms and the average assumption for inflation was 2.09%, with a range of 1.75% to 2.30%. It should be noted that the majority of these investment consulting firms set their assumptions based on approximately a ten-year outlook. We also examined longer-term (approximately 20 to 30-years) 2020 capital market assumption sets for six investment consulting firms and the average assumption for inflation was 2.27%, with a range of 1.80% to 2.60%.

There are also many other organizations that determine forward-looking expectations for inflation based various market indicators. A summary of these expectations can be found in the following table:

Forward-Looking Price Inflation Forecasts^a	
Congressional Budget Office^b	
5-Year Annual Average	2.46%
10-Year Annual Average	2.38%
Federal Reserve Bank of Philadelphia^c	
5-Year Annual Average	2.00%
10-Year Annual Average	2.14%
Federal Reserve Bank of Cleveland^d	
10-Year Expectation	1.23%
20-Year Expectation	1.58%
30-Year Expectation	1.81%
Federal Reserve Bank of St. Louis^e	
10-Year Breakeven Inflation	1.18%
20-Year Breakeven Inflation	1.55%
30-Year Breakeven Inflation	1.55%
U.S. Department of the Treasury^f	
10-Year Breakeven Inflation	1.24%
20-Year Breakeven Inflation	1.41%
30-Year Breakeven Inflation	1.71%
50-Year Breakeven Inflation	1.84%
100-Year Breakeven Inflation	1.93%
Social Security Trustees^g	
Ultimate Intermediate Assumption	2.40%

^aEnd of the Second Quarter, 2020. Version 2020-07-23 by Gabriel, Roeder, Smith & Company. Revised footnote b on 2020-11-18.

^b*The Budget and Economic Outlook: 2020 to 2030*, Release Date: January 2020, Consumer Price Index (CPI-U), Percentage Change from Year to Year, 5-Year Annual Average (2020 - 2024), 10-Year Annual Average (2020 - 2029).

^c*Survey of Professional Forecasters, Second Quarter 2020*, Release Date: May 15, 2020, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2020 - 2024), 10-Year Annual Average (2020 - 2029).

^dInflation Expectations, Model output date: June 1, 2020.

^eThe breakeven inflation rate represents a measure of expected inflation derived from X-Year Treasury Constant Maturity Securities and X-Year Treasury Inflation-Indexed Constant Maturity Securities. Observation date: June 1, 2020.

^f*The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, June 2020.

^g*The 2020 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds*, April 22, 2020, Long-range (75-year) assumptions, Intermediate, Consumer Price Index (CPI-W), for 2024 and later.

The current explicit inflation assumption for TESRS is 3.00% which remained unchanged as a result of the most recent experience study. Most economists forecast inflation rates below the current 3.00% assumption. We find it very difficult to justify a 3.00% inflation assumption based on the current forward-looking market-based data points. The retained actuary did present a proposed inflation assumption of 2.75% as an alternative to the 3.00% recommendation for the Board's consideration. We believe an inflation assumption of 2.75% is much closer to a reasonable range while still probably sitting on the outer edge of reasonability.

In a traditional pay-based defined benefit pension plan, the impact of the inflation assumption on the actual plan experience can somewhat be mitigated since inflation is a component of the investment return assumption and the assumed salary increase (which are generally offsetting in their effect on the plan liability). However, the inflation is solely a building-block for the investment return assumption for TESRS (with no offsetting factors) so over-estimating the inflation will only serve to overstate the anticipated future investment returns that will be available to pay the benefits of TESRS.

We recommend that the retained actuary monitor this assumption closely. If actual inflation remains at the current low levels then the retained actuary will need to consider recommending a change to this assumption prior to the next experience study.

Administrative and Investment-Related Expenses

Since the trust fund pays investment and administrative expenses from plan assets, it is necessary to incorporate the expected expenses into the actuarial valuation. Plan expenses may be explicitly assumed as a direct increase to the annual normal cost or implicitly assumed by developing an investment return assumption as a net return after payment of plan expenses. The current actuarial valuation includes an explicit expense assumption for administrative expenses and an implicit expense assumption for investment expenses. We believe that these are appropriate methods for the actuarial valuation of TESRS.

The following section will analyze how the investment expenses are incorporated into the investment return assumption.



Investment Return

The investment return assumption is one of the principal assumptions in any actuarial valuation. It is used to discount future expected benefit payments to the valuation date to determine the liabilities of the retirement system. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates.

The current investment return assumption for TESRS is 7.50% which is based on a 3.00% inflation assumption plus an annual real rate of return of 4.50%, net of investment expenses paid from the trust.

We believe an appropriate approach to reviewing an investment return assumption is to determine the median expected portfolio return given the retirement system's target allocation and a given set of capital market assumptions. Per the target asset allocation stated in the TESRS Investment Policy, dated August 18, 2020, the target asset allocation for TESRS is:

Asset Class	Target
U.S. Market Equities – Large Cap (Value)	10%
U.S. Market Equities – Large Cap (Growth)	10%
U.S. Market Equities – Small/Mid Cap (Value)	5%
U.S. Market Equities – Small/Mid Cap (Growth)	5%
International Equity – Developed Markets	15%
International Equity – Emerging Markets	5%
Core Fixed Income	20%
Non-Core Fixed Income	10%
Cash and Equivalents	0%
Global Infrastructure	5%
U.S. Core Real Estate	10%
Multi Asset Investments	5%
Total	100%

Because GRS is a benefits consulting firm and does not develop or maintain its own capital market assumptions, we reviewed assumptions developed and published by the following investment consulting firms:

- JP Morgan
- NEPC
- Callan
- Mercer
- Wilshire
- Meketa
- Verus
- RV Kuhns
- Blackrock
- BNY Mellon
- Aon
- Cambridge
- VOYA

These investment consulting firms issue reports that describe their capital market assumptions, which include their estimates of expected returns, volatility, and correlations. While these assumptions are developed based upon historical analysis, many of these firms also incorporate forward-looking adjustments to better reflect near-term expectations.



Given the current strategic target asset allocation set for TESRS and the investment firms' capital market assumptions for 2020, the development of the average nominal return, net of investment expenses paid from the trust, is provided in the table below:

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)-(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	4.52%	2.20%	2.32%	3.00%	5.32%	11.51%
2	5.92%	2.21%	3.71%	3.00%	6.71%	11.89%
3	5.81%	2.25%	3.56%	3.00%	6.56%	10.15%
4	5.70%	2.10%	3.60%	3.00%	6.60%	9.20%
5	6.39%	2.30%	4.09%	3.00%	7.09%	12.10%
6	5.77%	1.80%	3.97%	3.00%	6.97%	10.74%
7	6.36%	2.20%	4.16%	3.00%	7.16%	11.17%
8	6.12%	1.75%	4.37%	3.00%	7.37%	11.59%
9	6.64%	2.26%	4.38%	3.00%	7.38%	11.60%
10	6.24%	1.90%	4.34%	3.00%	7.34%	10.67%
11	6.30%	2.01%	4.29%	3.00%	7.29%	10.03%
12	6.78%	2.18%	4.60%	3.00%	7.60%	11.61%
13	6.98%	2.00%	4.98%	3.00%	7.98%	11.72%
Average	6.12%	2.09%	4.03%	3.00%	7.03%	11.07%

We determined, for each firm, the expected nominal return rate based on TESRS's target allocation and then subtracted that investment consulting firm's expected inflation to arrive at their expected real return in column (4). Then we added back TESRS's current 3.00% inflation to arrive at an expected nominal return, net of investment expenses. As the table shows, the resulting average arithmetic one-year return of the 13 firms is 7.03%.

It should be noted that the majority of these investment consulting firms set their assumptions based on approximately a ten-year outlook. We also examined longer-term (approximately 20 to 30-years) 2020 capital market assumption sets for six of the investment consulting firms note above. When these longer-term expectations are incorporated into the analysis above, the average expected nominal return was 7.36%.

The forward-looking capital market assumptions and return forecasts developed by investment consulting firms already reflect expected investment expenses. Their return estimates for core investments (i.e., fixed income, equities, and real estate) are generally based on anticipated returns produced by passive index funds that are net of investment related fees. Investment return expectations for the alternative asset class such as private equity and hedge funds are also net of investment expenses. Therefore, we did not make any additional adjustments to account for investment related expenses. This analysis also assumes that investment managers will generate enough alpha to at least cover the cost of the active management. No additional alpha for active management has been considered.

In addition to examining the expected one-year return, it is important to review anticipated volatility of the investment portfolio and understand the range of long-term net returns that could be expected to be produced by the investment portfolio. Therefore, the following table provides the 40th, 50th, and 60th percentiles of the 20-year geometric average of the expected nominal return, net of investment expenses paid from the trust, as well as the probability of exceeding the current 7.50% assumption.

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of exceeding 7.50%
	40th	50th	60th	
(1)	(2)	(3)	(4)	(5)
1	4.05%	4.69%	5.34%	14%
2	5.51%	6.08%	6.65%	27%
3	5.69%	6.21%	6.73%	27%
4	6.10%	6.75%	7.41%	39%
5	6.11%	6.76%	7.41%	39%
6	6.21%	6.81%	7.41%	39%
7	6.26%	6.82%	7.39%	38%
8	6.18%	6.85%	7.52%	40%
9	6.68%	7.31%	7.94%	47%
10	6.70%	7.38%	8.06%	48%
11	6.80%	7.46%	8.12%	49%
12	6.82%	7.47%	8.12%	50%
13	7.06%	7.66%	8.26%	53%
Average	6.17%	6.79%	7.41%	39%

The table above shows that the resulting 20-year geometric average of the expected nominal return is 6.79%. Additionally, the table above documents that the average probability of exceeding the current 7.50% investment return assumption over a 20-year period is 39% based on this analysis.

As a point of reference, the 2020 TESRS Experience Study report presented a benchmark summary of the investment return assumptions for peer public retirements in Texas where the average nominal return assumption was 7.36%. When reviewing peer group information like this, it is important to keep in mind the potential timing lag between experience studies and the reporting lag until the new assumptions are actually reflected in actuarial valuations. We looked back at the same peer group, just one year later, and the investment return assumption for seven of systems has been lowered and the average is now 7.21%. A summary of the benchmark study is shown below:

System Name	2020 Experience Study		Actuarial Audit (One-Year Later)	
	Valuation Date	Investment	Valuation Date	Investment
		Return Assumption		Return Assumption
Austin Employees	12/31/2018	7.50	12/31/2019	7.00
Austin Fire	12/31/2018	7.70	12/31/2019	7.50
Austin Police	12/31/2018	7.25	12/31/2019	7.25
Dallas Employees	12/31/2018	7.75	12/31/2019	7.25
Dallas Police and Fire	01/01/2019	7.25	01/01/2020	7.00
El Paso Employees	09/01/2018	7.50	09/01/2020	7.25
El Paso Fire	01/01/2018	7.75	01/01/2020	7.75
El Paso Police	01/01/2018	7.75	01/01/2020	7.75
Fort Worth Employees	12/31/2019	7.00	12/31/2019	7.00
Houston Fire	07/01/2019	7.00	07/01/2020	7.00
Houston Municipal	07/01/2019	7.00	07/01/2020	7.00
Houston Police	07/01/2019	7.00	07/01/2020	7.00
San Antonio Fire and Police	01/01/2019	7.25	01/01/2020	7.25
Employees Retirement System	08/31/2019	7.50	08/31/2020	7.00
Teacher Retirement System	08/31/2019	7.25	08/31/2020	7.25
Texas County and District System	12/31/2019	8.00	12/31/2020	7.50
Texas Municipal Retirement System	12/31/2019	6.75	12/31/2019	6.75
Average		7.36		7.21

There could certainly be reasons for peer systems to have different investment return assumption. If a retirement system is different from peers then the key is for that retirement system to be able to articulate the reasons why they are different from peers.

Finally, the Experience Study report notes that the investment consultant for TESRS provided input during the Experience Study that indicated their expected portfolio annual net real rate of return was 4.60%. A pension fund's investment consultant provides an important perspective when setting the investment return assumption since they generally understand the fund's investment strategy the best. Based on the results of our broad survey of 13 investment consultants as well as the perspective of the TESRS investment consultant, we believe the assumed net real rate of return of 4.50% is reasonable.

We believe the current assumed net real rate of return of 4.50% is reasonable. However, we find it very difficult to justify the inflation assumption of 3.00% based on the currently available market and survey data. As a result, we feel the nominal investment return assumption of 7.50% is high. We recommend that the Board and the retained actuary monitor the inflation assumption very closely. If actual inflation remains at the current low levels then the Board and the retained actuary should consider a change to the inflation assumption, and the resulting nominal investment return assumption, prior to the next experience study.

Summary

The set of actuarial assumptions and methods, taken in combination, is reasonable and generally established in accordance with ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension*



We have the following recommendations regarding the actuarial assumptions:

- We believe that the current termination assumption is reasonable for the TESRS membership. Due to the significant impact the termination rates have on the TESRS liabilities and the notable number of rehires, we recommend the retained actuary consider maintaining a larger margin for conservatism in future experience studies. We also recommend that the retained actuary closely monitor the termination and rehire experience prior to the next experience study to ensure that the current assumption remains reasonable.
- We recommend that the retained actuary closely monitor the actual commencement ages of vested terminated benefits in each valuation to ensure the assumed commencement age of 58 continues to be reasonable.
- In light of the concentration of plan liability in a small number of departments with high contribution levels, we recommend that the retained actuary enhance the next actuarial experience study by adopting an amount-weighted approach for the key demographic assumptions in order to minimize gains and losses associated with the key demographic assumptions. Prior to the next experience study, we recommend that the retained actuary closely monitor the actual experience with each actuarial valuation to ensure that the current headcount-weighted assumptions continue to be reasonable.
- We believe the current assumed net real rate of return of 4.50% is reasonable. However, we find it very difficult to justify the inflation assumption of 3.00% based on the currently available market and survey data. As a result, we feel the nominal investment return assumption of 7.50% is high. We recommend that the Board and the retained actuary monitor the inflation assumption very closely. If actual inflation remains at the current low levels then the Board and the retained actuary should consider a change to the inflation assumption, and the resulting nominal investment return assumption, prior to the next experience study.

SECTION IV

ACTUARIAL METHODS

Actuarial Methods

The ultimate cost of the retirement program administered by TESRS is equal to the benefits paid plus the expenses related to operating TESRS. This cost is funded through contributions to TESRS plus the investment return on accumulated contributions which are not immediately needed to pay benefits or expenses. The projected level and timing of the contributions needed to fund the ultimate cost are determined by the actuarial assumptions, plan provisions, participant characteristics, investment experience, and the actuarial cost method.

Actuarial Cost Methods

An actuarial cost method is a mathematical process for allocating the dollar amount of the total present value of plan benefits (TPV) between future normal costs and actuarial accrued liability (AAL). The retained actuary uses the Entry Age Normal actuarial cost method (EAN Method), characterized by:

- (1) Normal Cost – the level dollar contribution, paid from each participant’s date of hire to date of retirement, which will accumulate enough assets at retirement to fund the participant’s projected benefits from retirement to death.
- (2) Actuarial Accrued Liability – the assets which would have accumulated to date had contributions been made at the level of the normal cost since the date of the first benefit accrual, if all actuarial assumptions had been exactly realized, and there had been no benefit changes.

The EAN Method is the most prevalent funding method in the public sector. It is appropriate for the public sector because it produces costs that remain stable over time, resulting in intergenerational equity for taxpayers. Therefore, the retained actuary’s stated methods for allocating the liabilities of TESRS are certainly in line with national trends.

According to the August 31, 2020 actuarial valuation report, the retained actuary provides the following description of the calculation of the normal cost.

The System’s normal cost is the current contribution in a series of annual contributions determined as a level dollar amount. The normal cost is the portion of the cost which is allocated to a plan year by the entry age actuarial cost method. The normal cost is determined as a level dollar amount for each active participant as the actuarial present value at entry of projected benefits divided by the actuarial present value at entry of anticipated future service. These individual normal cost contribution amounts are the level dollar amounts which, if contributed throughout a participant’s qualified service career, would fund his projected qualified service benefits.

Determining Expected Service for Calculating Normal Cost

In applying this EAN Method, an actuary must calculate the TPV at the beginning of each member’s career and allocate liability over the expected service for each member over their entire career. The TPV is divided by the expected service to produce a level contribution (or “normal cost”) that, if paid over the member’s career, would fully fund their projected retirement benefits.



We believe the retained actuary’s stated assumptions and methods are being applied correctly to the TPV calculation. However, we think there is a much more appropriate way to calculate a member’s expected service over their career. Specifically, all members are currently assumed to earn a full year of service during the first year for the purpose of the expected service calculation, whereas a large number of members are assumed to leave service at the beginning of the year for the purpose of the TPV calculation.

As an example, if a member has a 50% chance of terminating at the very beginning of the year, under current procedures, the member is assumed to earn a full year of service. Alternatively, a more appropriate method would be to anticipate the member only earns an average of 0.50 years of service in the first year (50% earned zero and 50% earned one full year).

The retained actuary’s current approach artificially inflates the future qualified service for members, which will understate the annual normal cost. We believe it is more appropriate to reflect the decrements consistently between the TPV and expected service calculation by first reflecting the assumed decrement and then anticipating a year of service for the portion of the members assumed to survive the decrement. Below is a hypothetical example to illustrate the differences in the approach.

Age	Percent Assumed to Retire at BOY	Percent Assumed to Remain Active Through the Year	Current Valuation Procedures	Proposed Enhancement to Procedures
57	25%	75%	1.00	0.75
58	25%	56%	0.75	0.56
59	25%	42%	0.56	0.42
60	100%	0%	0.00	0.00
<i>Expected Qualified Service (Years)</i>			2.31	1.73

It is important to reiterate that we believe the beginning of year decrement timing is being correctly applied for the TPV calculation. We recommend that the retained actuary review the application of the EAN Method and consider the application of the beginning of year decrement timing in the calculation of the expected service for each member over the course of their career.

“Level” Normal Cost

The most common application of the EAN Method will produce a normal cost that is expected to remain a constant amount throughout each member’s working lifetime. That is, the cost of all plan benefits is evenly allocated across each member’s expected career. This is a desirable feature for TESRS because it allows for comparison of the Normal Cost to the expected contributions from the governing body which should be expected to remain constant over time.

The retained actuary applies the EAN Method in a slightly different manner. Specifically, the normal cost is calculated independently for each benefit such that the normal cost for each benefit will only extend through the last age at which that benefit is payable.

For example, TESRS members are only eligible for a vested termination benefit if they stop participating prior to age 55. Under the most common application of the EAN Method, the anticipated cost associated with providing the vested termination benefit is evenly allocated across each member’s expected career. Alternatively, the retained actuary’s application will produce a normal cost for the vested termination



benefit prior to the member reaching age 55 (with 10 years of service) and then the normal cost associated with the vested termination benefit will go to zero for the remainder of their expected career.

In general, the retained actuary's application of the EAN Method is reasonable; however, it is not the method described in the valuation report and it may not be the most appropriate method for TESRS because the normal cost rate will certainly decrease over the course of each member's career. This decrease in the normal cost also presents the possibility that the relationship between the normal cost and the contribution from the governing body could change over time, impacting the projected elimination of the UAAL.

We believe that the retained actuary's application of the EAN Method is reasonable. However, we believe that the application of the EAN Method that produces constant normal cost over the member's entire career would be more appropriate for TESRS based on the fixed contributions TESRS receives from the governing bodies. We recommend that the retained actuary review their application of the EAN Method and consider the most appropriate application for TESRS.

Actuarial Cost Method for GASB Statements No. 67 and No. 68

While we note that the retained actuary's current application of the EAN Method is generally reasonable for funding purposes, we believe a modification is necessary to comply with the requirements under GASB Statements Nos. 67 and 68.

Paragraph 32 of GASB Statement No. 68 states, *"The entry age actuarial cost method should be used to attribute the actuarial present value of projected benefit payments of each employee to periods in conformity with the following:*

- a) Attribution should be made on an individual employee-by-employee basis.*
- b) Each employee's service costs should be level as a percentage of that employee's projected pay. For purposes of this calculation, if an employee does not have projected pay, the projected inflation rate should be used in place of the projected rate of change in salary.*
- c) The beginning of the attribution period should be the first period in which the employee's service accrues pensions under the benefit terms, notwithstanding vesting or other similar terms.*
- d) The service costs of all pensions should be attributed through all assumed exit ages, through retirement. In pension plans in which the benefit terms include a deferred retirement option program (DROP), for purposes of this Statement, the date of entry into the DROP should be considered to be the employee's retirement date."*
- e) Each employee's service costs should be determined based on the same benefit terms reflected in that employee's actuarial present value of projected benefit payments.*

We believe the retained actuary is correctly reflecting items (a), (c), and (e). Item (d) has already been discussed earlier in this section (see "Level" Normal Cost discussion). While we would suggest the retained actuary consider this discussion for both funding and GASB purposes, we believe it is a necessary change for GASB purposes in order to comply with applicable standards.

The retained actuary's current application of the EAN Method does not calculate the normal cost as a percentage of pay, but rather as a level amount over a member's expected service. We agree this is the most appropriate application of the cost method for funding purposes, however, it is our interpretation that the GASB standards require a member's normal (service) cost to be calculated as a percentage of pay (or inflation) for accounting purposes (see item (b) above). We recommend the retained actuary consider



their application of the EAN Method for GASB purposes in light of Paragraph 32, Item b and Item d, of Statement No. 68.

Asset Valuation Method

The market value of assets can experience significant short-term swings, which can cause large fluctuations in the development of the contributions necessary to eliminate the UAAL. Thus, many systems use an asset valuation method which dampens these short-term volatilities to achieve more stability in the employer contribution. A good asset valuation method places value on a retirement system's assets which are related to the current market value, but which will also produce a smoother pattern of costs.

ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*, provides a framework for the determination of the actuarial value of assets (AVA), emphasizing that the method should: (1) bear a reasonable relationship to the market value of assets (MVA), (2) recognize investment gains and losses over an appropriate time period, and (3) avoid systematic bias that would overstate or understate the AVA in comparison to MVA.

The actuarial valuation of TESRS currently utilizes a smoothed asset valuation method that immediately recognizes income equal to the expected return on market value of assets, based on the assumed investment returns. Differences between the assumed investment return and the actual market investment return are recognized over a five-year period. Further, the AVA cannot exceed 120% or be less than 80% of the market value of assets.

The smoothing method used for the actuarial valuation of TESRS is common among public employee retirement systems. We feel that this method complies with ASOP No. 44. Additionally, this method is reasonable and appropriately applied for the valuation.

Summary

We have the following recommendations regarding the actuarial methods:

- We recommend that the retained actuary review the application of the EAN Method and consider the application of the beginning of year decrement timing in the calculation of the expected service for each member over the course of their career.
- We recommend that the retained actuary review their application of the EAN Method and consider the approach that produces constant normal cost over the member's entire career which would be more appropriate for TESRS based on the fixed contributions TESRS receives from the governing bodies.
- We recommend the retained actuary consider their application of the EAN Method for GASB purposes in light of Paragraph 32, Item b and Item d, of Statement No. 68.

SECTION V

ACTUARIAL VALUATION RESULTS

Actuarial Valuation Results

Benefits

Every employer is different and every employer's plan is different. Each employer has a set of workforce and financial needs that dictate the type of retirement benefit that is most appropriate for their employees. Additionally, the amount of resources available to allocate to the plan will dictate the level of benefits provided by the plan. Regardless of the reasons for the benefit design, the employer must understand the liability and contribution requirements associated with the benefits promised. As a result, the actuarial valuation and the resulting funding policy contribution must properly reflect the benefit structure of the plan.

In general, the benefits promised by TESRS were reasonably incorporated in the actuarial valuation of TESRS. During the actuarial audit process, the retained actuary determined that the August 31, 2020 actuarial valuation only incorporated a lump sum duty-death benefit of \$60,000 and the lump sum should have been \$100,000. This item has a very small liability impact and the retained actuary indicates this would be updated as part of the next actuarial valuation.

Data

As part of our actuarial audit, we received a preliminary set of census data for plan participants and beneficiaries as of August 31, 2020 originally provided by TESRS to the retained actuary for the actuarial valuation. Additionally, we received a final set of census data for plan participants and beneficiaries as of August 31, 2020 used by the retained actuary for the actuarial valuation.

We used this data, along with the census summaries included in the valuation report, to review the valuation data process. In total, we believe that the final valuation data used by the retained actuary is reasonable and valid for its purpose.

Review of Sample Liability Calculations

As part of the actuarial audit, we requested sample member calculations from the retained actuary to ensure that the retained actuary valued the correct benefit levels, used the correct assumptions, and calculated the liabilities correctly on an individual basis.

Generally accepted actuarial standards and practices provide actuaries with the basic mathematics and framework for calculating the actuarial results. When it comes to applying those actuarial standards to complex calculations, differences may exist due to individual opinion on the best way to make those complex calculations or other differences may occur due to nuances in the valuation software programming. This may lead to differences in the calculated results, but these differences should not be material.



Active Participants. At the onset of the review, we requested that the retained actuary provide sample liability calculations for 10 active members with enough detail to verify the calculation of the liability for each member. The retained actuary provided all of the information requested.

In order to review the liability calculations, we used the census data provided for the valuation, utilized the appropriate benefit provisions, and applied the actuarial assumptions and methods summarized in the valuation report. Based on the application of the actuarial cost method used by the retained actuary, we were able to closely match the liability calculated by the retained actuary for the August 31, 2020 actuarial valuation. Below is a summary of our replication:

Sum of Ten (10) Active Test Lives Reviewed			
	Present Value of Future Benefits	Actuarial Accrued Liability	Normal Cost
August 31, 2020 Valuation	\$ 331,341	\$ 285,920	\$ 9,330
GRS Replication	330,963	285,423	9,354
Difference	-0.1%	-0.2%	0.3%

Vested Terminations and Annuitants. At the onset of the review, we requested that the retained actuary provide sample liability calculations for six vested terminations and eight annuitants with enough detail to verify the calculation of the liability for each member. The retained actuary provided all of the information we requested regarding the vested terminations and annuitants.

In order to review the liability calculations, we used the census data provided for the valuation, utilized the appropriate benefit provisions, and applied the actuarial assumptions and methods summarized in the valuation report. We were able to exactly match the liability calculated by the retained actuary for the August 31, 2020 actuarial valuation.

Below is a summary of our replication:

Present Value of Future Benefits Comparison		
	Sum of Six (6) Inactive Test Lives	Sum of Eight (8) Retiree Test Lives
August 31, 2020 Valuation	\$ 58,197	\$ 195,227
GRS Replication	58,197	195,227
Difference	0.0%	0.0%

Initial Replication of Actuarial Valuation Results

As a final step, we utilized the entire census data files and replicated the valuation results and the contribution development for the entire plan. Using the assumptions and methods used by the retained actuary for the August 31, 2020 actuarial valuation, we were able to replicate the results very closely.

Replication of August 31, 2020 Valuation Results			
	Original August 31, 2020 Valuation	Initial GRS Replication	Difference
(1)	(2)	(3)	(4)
1. Present Value of Future Benefits	\$ 159,464,115	\$ 159,715,216	0.2%
2. Present Value of Future Normal Cost	7,565,119	7,739,039	
3. Reimbursement Funded Liability	<u>1,458,453</u>	<u>1,458,313</u>	
4. Actuarial Accrued Liability (AAL) [(1) - (2) - (3)]	\$ 150,440,543	\$ 150,517,864	0.1%
5. Actuarial Value of Assets	<u>125,366,915</u>	<u>125,366,915</u>	
6. Unfunded AAL (UAAL) [(4) - (5)]	\$ 25,073,628	\$ 25,150,949	
<u>With State Appropriations</u>			
7. Expected Part One Contributions	\$ 3,053,388	\$ 3,053,388	0.0%
8. Normal Cost Contribution ¹	1,652,739	1,693,378	2.5%
9. Administrative Expenses ¹	<u>371,681</u>	<u>371,681</u>	0.0%
10. UAAL Contribution Available [(7) - (8) - (9)]	\$ 1,028,968	\$ 988,329	-3.9%
11. Estimated State Appropriation ²	\$ 1,200,000	\$ 1,200,000	
12. Years Required for State Contribution	19 Years	21 Years	
13. Part Two Contributions Required (% of Part One)	0.0%	0.0%	

¹ Includes interest adjustment, assuming employer payments are made 7 months and 13 months after the valuation date. Administrative expenses are net expected State Appropriation of \$675,000.

² Beginning FYE 2024. Retained actuary's estimation of Part One contributions for the purposes of the estimated State Appropriation was reviewed and appears reasonable.

Enhanced Replication of Actuarial Valuation Results

As discussed in prior sections of this actuarial audit report, we believe there are more appropriate methods that would enhance the Board's understanding of the liabilities associated with TESRS.

Specifically, these enhancements include:

1. Estimate the service over a member's career consistently with the assumption that members terminate and retire at the beginning of the year,
2. Apply the EAN Method so that a constant normal cost is determined over the member's entire career, and
3. Increase Normal Cost to be more comparable to the Expected Part One Contributions for the year.

The following summary provides an illustration of how the valuation results could possibly look if these recommendations were adopted.

Illustrations of GRS Recommendations on August 31, 2020 Valuation Results		
	Initial GRS Replication	GRS Replication incorporating Items (1) - (3)
(1)	(2)	(3)
1. Present Value of Future Benefits	\$ 159,715,216	\$ 159,715,216
2. Present Value of Future Normal Cost	7,739,039	8,556,977
3. Reimbursement Funded Liability	<u>1,458,313</u>	<u>1,458,313</u>
4. Actuarial Accrued Liability (AAL) [(1) - (2) - (3)]	\$ 150,517,864	\$ 149,699,926
5. Actuarial Value of Assets	<u>125,366,915</u>	<u>125,366,915</u>
6. Unfunded AAL (UAAL) [(4) - (5)]	\$ 25,150,949	\$ 24,333,011
<u>With State Appropriations</u>		
7. Expected Part One Contributions	\$ 3,053,388	\$ 3,053,388
8. Normal Cost Contribution ¹	1,693,378	2,115,448
9. Administrative Expenses ¹	<u>371,681</u>	<u>371,681</u>
10. UAAL Contribution Available [(7) - (8) - (9)]	\$ 988,329	\$ 566,259
11. Estimated State Appropriation ²	\$ 1,200,000	\$ 1,200,000
12. Years Required for State Contribution	21 Years	>30 Years
13. Part Two Contributions Required (% of Part One)	0.0%	6.3%

¹ Includes interest adjustment, assuming employer payments are made 7 months and 13 months after the valuation date. Administrative expenses are net expected State Appropriation of \$675,000

² Beginning FYE 2024. Retained actuary's estimation of Part One contributions for the purposes of the estimated State Appropriation was reviewed and appears reasonable.

Note, the normal cost shown above in column (3) includes the normal cost associated with new members that are expected to be hired during the upcoming year. The Expected Part One Contribution of \$3,053,388 for the 2020 plan year is based on the annual contribution rate for all 3,634 of the active members. However, the retained actuary's current methodology values a normal cost that is only based on the active members that are assumed to survive (not decrement) through the upcoming year. Since



the Expected Part One Contributions are calculated on a larger group of members than the Normal Cost, the contribution available to pay down the UAAL is overstated.

Stated another way, the Expected Part One Contributions for the year anticipate new members are brought in to replace those members that terminate or retire during the year. As a result, the Normal Cost should also be increased to anticipate the Normal Cost associated with the new members that are expected to be hired during the upcoming year.

We recommend that the retained actuary increase the Normal Cost so that the Expected Part One Contributions and the Normal Cost are based on the same number of active members.

Summary

We believe that the valuation results were developed in a reasonable manner based on the current application the methods. However, the current methods may be understating the total normal cost for the upcoming year and the duration of the State contributions. In the next actuarial valuation, the retained actuary should consider enhancing the actuarial valuation results by incorporating the recommendations regarding actuarial methods in the prior sections of this report.

SECTION VI

CONTENT OF THE VALUATION REPORT

Content of the Valuation Report

ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, and ASOP No. 41, *Actuarial Communications*, provide guidance for measuring pension obligations and communicating the results. These Standards list specific elements to be included, either directly or by references to prior communication, in pension actuarial communications. The pertinent items that should be included in an actuarial valuation report on a pension plan should include:

- The name of the person or firm retaining the actuary and the purposes that the communication is intended to serve.
- A statement as to the effective date of the calculations, the date as of which the participant and financial information were compiled, and the sources and adequacy of such information.
- An outline of the benefits being discussed or valued and of any significant benefits not included in the actuarial determinations.
- A summary of the participant information, separated into significant categories such as active, retired, and terminated with future benefits payable. Actuaries are encouraged to include a detailed display of the characteristics of each category and reconciliation with prior reported data.
- A description of the actuarial assumptions, the cost method and the asset valuation method used. Changes in assumptions and methods from those used in previous communications should be stated and their effects noted. If the actuary expects that the long-term trend of costs resulting from the continued use of present assumptions and methods would result in a significantly increased or decreased cost basis, this should also be communicated.
- A summary of asset information and derivation of the actuarial value of assets. Actuaries are encouraged to include an asset summary by category of investment and reconciliation with prior reported assets showing total contributions, benefits, investment return, and any other reconciliation items.
- A statement of the findings, conclusions, or recommendations necessary to satisfy the purpose of the communication and a summary of the actuarial determinations upon which these are based. The communication should include applicable actuarial information regarding financial reporting. Actuaries are encouraged to include derivation of the items underlying these actuarial determinations.
- A disclosure of any facts which, if not disclosed, might reasonably be expected to lead to an incomplete understanding of the communication.

We have reviewed the actuarial valuation report prepared by the retained actuary and we have noted a few modifications to the report that would allow the report to adhere more closely with ASOP Nos. 4, 41, and 51.

Actuarial Standard of Practice No. 51 (ASOP 51) – When actuaries are performing a funding valuation of a pension plan, ASOP 51 guides actuaries to provide certain assessments and disclosures in the actuarial communication associated with risk that actual future measurements may differ significantly from expected future measurements. The additional disclosures required by this standard are intended to help users of the actuarial valuation gain a better understanding of risks inherent in the measurements of pension obligations and actuarially determined pension plan contributions. ASOP 51 provides a list of examples of risks to assess, including: investment risk, asset/liability mismatch risk, interest rate risk, longevity and other demographic risks, and contribution risk.



Actuarial Standard of Practice No. 56 (ASOP 56) – The Actuarial Standards Board very recently adopted ASOP 56, titled *Modeling*. We recommend that the retained actuary review ASOP 56 prior to the next actuarial valuation to determine whether the actuarial valuation report requires any additional disclosures regarding the models used to prepare the actuarial valuation.

We were not able to identify a section of the August 31, 2020 actuarial valuation report that was intended to satisfy the requirements of ASOP 51. We encourage the retained actuary to consider adding additional assessments and disclosures of risks associated with the financing of TESRS.

Section 4, Actuarial Methods and Assumptions

The presentation of actuarial methods and assumptions is generally complete and understandable. The methods described in this section are reasonable and appropriate for public retirement plans.

We do have the following suggestions to improve the overall communication of the valuation assumptions.

Procedures for “Unknown” Marital Status – A small number of records are reported each year for the actuarial valuation with a marital status of “unknown”. The actuarial valuation report states that these records are assumed to be married. However, a review of the individual test cases during the actuarial audit revealed that the general marital assumptions (90% of males and 50% of females) are assumed for this purpose. This procedure is completely appropriate and we recommend that the retained actuary update the description of the assumption in the next actuarial valuation report.

Assumed Decrement Timing – The retained actuary currently assumes that all members leave active service (e.g., termination, retirement, etc.) at the beginning of the year (essentially, on the valuation date). This is a reasonable procedure. We recommend the retained actuary disclose the assumed timing of the decrements in the next actuarial valuation report.

Section 5, Outline of Principal Eligibility, Benefit, and Contribution Provisions

Disability Benefits – The actuarial valuation report states that the disability benefit for members who become disabled during the performance of emergency service duties is \$300 a month (subject to additional increases based on the employer monthly contributions). Based on a review of individual test cases, we believe the retained actuary is valuing a \$400 a month minimum benefit, which we believe is correct based on current plan provisions. We recommend that the retained actuary update the description of the disability benefit in the next actuarial valuation report.

Summary

In general, the actuarial valuation report complied with the applicable Actuarial Standards of Practice. In order to improve the ability of the report to communicate the assumptions, methods and plan provisions incorporated into the actuarial valuation, we recommend that the retained actuary incorporate the noted enhancements in future actuarial valuation reports.



SECTION VII

BRIEF DISCUSSION OF OBSERVED FINANCIAL RISKS

Brief Discussion of Observed Financial Risks

While conducting the actuarial audit of TESRS, there were certain aspects of the actuarial valuation, funding policy and benefit policy that we felt warranted additional discussion to potentially help the Board better understand the retirement program they oversee.

TESRS is a cost sharing plan. This means that all of the departments participating in TESRS are pooled together for all demographic and investment risks. Theoretically, whatever happens at one department will affect all of the units.

Our approach to complex situations like this is to start with the understanding that there is a future reality that we will have to live with, but at the same time there are obvious limitations in our ability to predict what that reality will be. Further, we attempt to narrow the range of possible future outcomes by getting right what we can get right and developing defensive, unbiased starting points (assumptions, methods, etc.). Then we work with retirement systems to implement responsive strategies that will provide an appropriate and sustainable path to the eventual outcome(s).

A risk analysis and stress test could show that there is a likely chance that Part Two Contributions will need to be paid in the future even though they are not immediately payable. With this understanding, TESRS could consider adopting slightly more conservative assumptions and methods in order to increase the likelihood that the future outcome is more likely to be a positive (or, better than expected) result. This approach may result in small Part Two Contributions in the short-term (accompanied by the associated increase State contributions) but could reduce the likelihood that there will be large Part Two Contributions in the future (e.g., “small and steady” versus “large and unexpected”).

With this consideration in mind, the following section provides a brief discussion of certain risks facing TESRS.

Fixed Contribution for Each Year of Service

Each governing body contributes a fixed amount to TESRS for each year of service their members earn in TESRS. This fixed contribution is intended to finance both the normal cost for the member and also help eliminate the UAAL. Further, there are a number of factors that impact how much of the contribution is available to eliminate the UAAL.

It is important for the Board to understand what factors impact the allocation of the contribution between normal cost and UAAL.

Impact of Assumptions – Actuarial assumptions are not static. As the actuarial valuation assumptions change, the allocation of the contribution between normal cost and eliminating the UAAL also changes. For example, lower assumed investment returns or longer life expectancies would both increase the overall cost of the plan and a larger portion of the contribution would be needed to pay for the normal cost. If national trends continue and these assumptions continue to get more and more conservative (i.e., even lower assumed investment returns and even longer life expectancies), it is possible that the Part One contribution will not be big enough to pay for the entire normal cost and the Part Two contributions would be required just to help pay for the normal cost.



Approximately 65% of expected Part One contributions were allocated to the normal cost in the August 31, 2020 Valuation. If the methodology changes were adopted, as recommended in this report, this allocation is increased to 80%, leaving only 20% of Expected Part One contributions to pay off the existing unfunded liability.

Impact of Increasing Contribution Amounts – The actuarial valuation currently assumes that the contribution amount (and resulting benefit accrual) in effect for each department on the valuation date will remain at that amount for every year in the future. However, there are departments every year that increase their contribution amount to TESRS. From 2014 to 2020, benefit changes by the departments increased the UAAL of TESRS by \$4.4 million. However, these benefit changes also came with increased contributions to help pay for the increased liabilities. It is important the retained actuary monitor these increasing employer contributions to ensure that the entire cost is being offset by the increased contributions.

The Power of Projections

The actuarial valuation assumptions generally predict a single path for a retirement system's funding. Projections and sensitivity testing can help the Board and the governing bodies understand the impact certain risks have on long-term financing of TESRS.

Alternate Investment Returns – The valuation currently assumes TESRS will earn exactly 7.50% on investments each year. Projections with different investment returns can help the Board understand the impact of unexpected market cycles and which scenarios may require Part Two contributions.

Increasing Contribution Amounts – Based on our modeling, it appears that regularly increasing contribution amounts by the governing bodies do not significantly impact the projected number of years that the State contribution will be required. However, increasing contribution amounts can have a significant impact on contributions from the State and the overall liabilities of the plan. Preparing projections that incorporate future contribution increases could provide important information for the Board and the governing bodies.

Future Number of Units – In order to calculate the number of years the State will be required to contribute to TESRS, the actuarial valuation incorporates a modest number of new units joining TESRS every few years. It may provide the Board with important information to understand the impact to the State contribution if fewer than expected units (or no units) join TESRS over time.

Summary

The long-term financing of TESRS is subject to many risks in the future and the actuary can assist the Board in understanding the impact of each of these risks. We encourage the retained actuary to discuss their perspectives on the risks facing TESRS with the Board on a regular basis so that Stakeholders have a better understanding of potential future demographic and economic scenarios that may occur.



SECTION VIII

FINAL REMARKS

Final Remarks

The auditing actuarial firm, Gabriel, Roeder, Smith & Company (GRS), is independent of the retained actuarial firm. The auditing actuaries are not aware of any conflict of interest that would impair the objectivity of this work.

We have presented many suggestions for areas where we believe the product can be improved. The retained actuary has access to information and a long history of retirement systems similar to TESRS. We understand that the retained actuary may agree with some of our recommendations, while rejecting others. We ask that the retained actuary and TESRS consider our recommendations carefully. We hope that the retained actuary and TESRS find these suggestions useful.

