



Tennessee Consolidated Retirement System

Hybrid Pension Plans:

Teacher Retirement Plan

State and Higher Education Employee Retirement Plan

Actuarial Valuation and Report (for cash funding purposes)

June 30, 2019

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Summary

Funding Requirements

An actuarial valuation of the Hybrid Pension Plan was conducted as of June 30, 2019 for the Tennessee Consolidated Retirement System. The purpose of the valuation was to determine the funding requirements of the various components of the pension plan, with the intention that the funding requirements indicated by the valuation would be used as the basis for contributions commencing on July 1, 2020.

The Actuarially Determined Contribution Rates shown below represent the recommended contributions as a percentage of payroll for the current and previous valuations, based on the actuarial methods and assumptions as documented in the Basis for Valuation section of each applicable report.

Actuarially Determined Contribution Rates

Valuation Date	Teacher Retirement Plan	State and Higher Education Employee Retirement Plan		
		General Employees	State Judges	Public Safety Officer Bridge Payments
June 30, 2019	2.02%	1.80%	7.25%	0.85%
June 30, 2018	2.03%	1.73%	7.31%	0.84%

The assets and liabilities of the Teacher Retirement Plan are legally separate from the assets of the State and Higher Education Employee Retirement Plan.

For allocation of pension cost related to differing benefit structure and eligibility, the State and Higher Education Employee Retirement Plan is comprised of three components: General Employees, State Judges and Public Safety Officer (PSO) bridge payments. There is no legal separation of assets within the State and Higher Education Employee Retirement Plan.

Hereafter, in this report, the Teacher Retirement Plan will be referenced as “Teachers” and the State and Higher Education Employee Retirement Plan will be referenced as “State Plan”.

Analysis of Cost Controls and Unfunded Liability Controls

The hybrid plan was established pursuant to Public Chapter 259, Acts of 2013. The hybrid plan was designed with provisions to control employer pension costs and unfunded liability. A requirement of the annual actuarial valuation process is to determine if the two hybrid plans are within the control limits established by the governing statute. Each plan is evaluated separately. If a plan is not within the control limits, then this actuarial report shall include the adjustments that must occur to bring the plans within the statutory requirements.

The cost control provision is that the actuarially determined contribution rate shall not exceed 4% of payroll. The provision to control unfunded liability is that the maximum unfunded liability shall not exceed 12.5% of the five year average of the state's long-term indebtedness.

The state has established a stabilization reserve account and plans to contribute to the stabilization reserve account when the actuarially determined contribution rate is less than 4% of payroll.

If the control provisions are exceeded, the adjustments will automatically occur in the following sequence:

1. Utilize funds in the stabilization reserve, if any
2. Reduce or suspend the 3% retiree COLA benefit
3. Shift some or all of the employer contributions from the defined contribution plan to the hybrid defined benefit plan
4. Increase employee contributions by 1% of salary
5. Reduce future service accrual below 1%
6. Freeze the plan, no future service accrual

When the employer cost is restored to 4% and the unfunded liabilities do not exceed the maximum level, then the adjustments previously made are restored on a prospective basis. The sequence is in reverse order.

Since the actuarially determined contribution rate is less than 4% and since the unfunded liability limits are not exceeded, then no adjustments are necessary as a result of the June 30, 2019 actuarial valuation.

Report Summary

The table below presents selected information as of the valuation date.

	State Plan		
	Teachers	General Employees & PSO	State Judges
Number of Members			
Active Members	23,345	22,230	49
Former Members	7,103	12,876	6
Retired Members	12	16	0
Total	30,460	35,122	55
Active Participant Statistics			
Average Age	34.6	38.6	53.4
Average Service	2.6	2.1	3.5
Plan Assets (excluding stabilization reserve)			
Market Value of Assets (MVA)	\$245,763,588	\$174,351,063	\$4,335,779
Actuarial Value of Assets (AVA)	243,623,661	172,832,943	4,298,027
Plan Liability at Beginning of Year			
Actuarial Liability	\$244,717,822	\$180,989,109	\$4,519,092
Funded Ratios			
MVA / Actuarial Liability	100.4%	96.3%	95.9%
AVA / Actuarial Liability	99.6%	95.5%	95.1%
Annual Funding Levels			
Normal Cost	\$19,688,662	\$14,331,959	\$578,321
Actuarially Determined Contribution Rate	2.02%	1.81%	7.25%
General Employees	n/a	1.80%	n/a
Public Safety Officer Bridge Payments	n/a	0.85%	n/a

Risk Discussion – Actuarial Standards of Practice No. 51

Effective November 1, 2018, actuarial funding valuation reports are required to include a discussion of the risk associated with measuring pension obligations and determining pension plan contributions. The risks that may reasonably be anticipated to significantly affect the plan's future financial condition are discussed below. It is recommended that the plan sponsor continues to monitor these risks. Further analysis will be provided as requested separate from this report.

Cost Controls and Unfunded Liability Controls

As discussed earlier in this report, the hybrid plan was designed with provisions to control employer pension costs and unfunded liability. The cost control provision is that the actuarially determined contribution rate shall not exceed 4% of payroll. The provision to control unfunded liability is that the maximum unfunded liability shall not exceed 12.5% of the five year average of the state's long-term indebtedness. These provisions drastically reduce the effect that the risks below ultimately have on the plan's future financial condition, but these risks are still significant to the plan as they are primary factors in determining if or when any of the cost control adjustments will be required to occur in the future.

Investment Risk

The investment risk is expected to be the single most important factor in determining the future cost of the plan. Due to the plan's significant equity exposure and low correlation between fixed income assets and liabilities, there is risk that the funded status (and required cash contributions) of the plan could be very volatile. The history of annual investment returns (on a market value basis) is shown below.

<u>Year Ending</u>	<u>Investment Return</u>
June 30, 2019	7.45 %
June 30, 2018	8.19
June 30, 2017	11.42
June 30, 2016	2.79
June 30, 2015	3.33

The historical returns above highlight the substantial volatility from year to year.

Interest Rate Risk

Related to the investment risk section above, the assumed future returns implied in the interest rate used to value the liabilities is a significant factor in determining the plan's funded status. Due to the plan's liability duration (a measurement of how sensitive the liability is to a change in the interest rate) of around 30, a 1% decrease in the assumed interest rate would increase the liability by approximately 30%. The plan's liability duration is currently very high due to the relatively young population with projected benefit payments deferred many years into the future. The duration will decrease over time as the plan matures.

Inflation Risk

Since benefit amounts are pay-related, pay increases in excess of the valuation assumption will result in an increase in the liabilities (and required cash contributions) of the plan. An increase in inflation is one factor that could lead to higher pay increases. Further, an increase in inflation will also result in a higher COLA to retirees, which will increase the liabilities of the plan. However, the inflation risk is dampened due to inflation

being a component of the interest rate used to value the liabilities. An increase in inflation would likely result in an increase in the interest rate, which could mitigate the pay and COLA increases.

Mortality Risk

Since the primary benefits of the plan are paid as annuities, the plan is sensitive to changes in the longevity of the population. As a result, the liabilities (and required cash contributions) of the plan will increase if the participants live longer than expected and decrease if they live shorter than expected. The current mortality assumption projects future longevity improvements, which generally dampens the mortality risk.

Contribution Risk

The required contributions calculated in this report are based on the actuarial methods and assumptions as documented in the Summary of Actuarial Methods and Assumptions section of the appendix. The required contribution includes the normal cost for new benefits being earned during the year, plus an amortization to cover any unfunded accrued liability over a period of 20 years or less. Based on this contribution method, all plan benefits are projected to be systematically funded. This method is not expected to cause additional volatility in the required contribution beyond the underlying risk factors discussed above.

Certification

Purpose and Use

This report has been prepared exclusively for the Tennessee Consolidated Retirement System to determine the funding level of the plan based on the June 30, 2019 valuation, and may not be appropriate for other purposes. A separate report will provide the financial disclosure items required by the Governmental Accounting Standards Board. Findley is not responsible for consequences resulting from the use of any part of this report without prior authorization or approval. This report provides actuarial advice and does not constitute legal, accounting, tax or investment advice. Determinations for other purposes, such as bond ratings or judging benefit security, may be significantly different from the results shown in this report.

Actuarial findings in this report are based on actuarial assumptions which reflect expected plan experience. Although the deviation of the actual future plan experience and the expected experience inherently creates some uncertainty with the results, in our opinion the actuarial assumptions reasonably reflect the expected future experience of the plan. Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of the assignment, we did not perform an analysis of the potential range of such future measurements.

Data

The calculations shown in this report have been prepared using employee data and plan documentation furnished by the Tennessee Consolidated Retirement System as of June 30, 2019 and plan assets furnished by the Tennessee Consolidated Retirement System for the twelve month period ending June 30, 2019. While we have not audited the data, we have reviewed it for reasonableness and internal consistency, and to the best of our knowledge, there are no material limitations to the data provided.

Subsequent Events

We are unaware of any subsequent event after the dates above which would have a material effect on the results presented in this report.

Assumptions, Methods and Procedures

The actuarial calculations contained in the report are built on deterministic actuarial modeling, making a single determination of liabilities and costs. Further, these actuarial calculations are based on a combination of demographic and asset data, as well as assumptions concerning future changes in these data. As such, the actuarial calculations contained herein are an estimate of projected future occurrences.

Changes in Plan Provisions, Actuarial Assumptions and Methods

The mortality improvement assumption adopted with the 2016 experience study utilizes the most current projection scale published by the Society of Actuaries as of the actuarial valuation date. As of June 30, 2019, the projection scale was updated from Scale MP-2017 to Scale MP-2018. This change resulted in a decrease in the liabilities and contribution rates.

The load included in the Actuarially Determined Contribution Rates for administrative expenses was decreased from 0.22% to 0.21% effective June 30, 2019.

The eligibility condition for pre-retirement death benefits for active employees was updated from 10 years of service to the date the participant is first vested (5 years of service in most cases).

No other changes were made to the plan provisions, actuarial assumptions and methods effective June 30, 2019.

Summaries of the plan provisions, actuarial assumptions and methods can be found in the Basis for Valuation section of this report.

TCRS Funding Policy

This report was prepared in accordance with the funding policy adopted by the TCRS Board of Trustees.

Professional Qualifications

This report has been prepared under the supervision of Justin C. Thacker, a member of the American Academy of Actuaries, a Fellow of the Society of Actuaries, and a consulting actuary with Findley, who has met the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions herein. To the best of our knowledge this report has been prepared in accordance with generally accepted actuarial standards, including the overall appropriateness of the analysis, assumptions, and results and conforms to appropriate Standards of Practice as promulgated from time to time by the Actuarial Standards Board, which standards form the basis for the actuarial report. We are not aware of any direct or material indirect financial interest or relationship, including investment management or other services that could create, or appear to create, a conflict of interest that would impair the objectivity of our work. The undersigned are available to provide supplemental information or explanation.



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May 18, 2020

Date



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Date

Funding Calculations

Unfunded Actuarial Liability (UAL)

For this purpose, the Unfunded Actuarial Liability (UAL) is the excess of the Actuarial Liability over the Actuarial Value of Assets as shown below.

		State Plan		
	Teachers	General Employees & PSO	State Judges	Total State
1. Actuarial Value of Assets	\$243,623,661	\$172,832,943	\$4,298,027	\$177,130,970
2. Actuarial Liability	244,717,822	180,989,109	4,519,092	185,508,201
Unfunded Actuarial Liability (2 - 1)	1,094,161	8,156,166	221,065	8,377,231

Pre-Existing UAL Amortizations

Date Established	Maximum Remaining Years	Contributory Teachers			Consolidated State			State Judges & Attorneys General		
		Present			Present			Present		
		<u>Value</u>	<u>Years</u>	<u>Amortization</u>	<u>Value</u>	<u>Years</u>	<u>Amortization</u>	<u>Value</u>	<u>Years</u>	<u>Amortization</u>
June 30, 2000	1.00	---	---	---	---	---	---	---	---	---
June 30, 2001	2.00	---	---	---	---	---	---	---	---	---
June 30, 2002	3.00	---	---	---	---	---	---	---	---	---
June 30, 2003	4.00	---	---	---	---	---	---	---	---	---
June 30, 2004	5.00	---	---	---	---	---	---	---	---	---
June 30, 2005	6.00	---	---	---	---	---	---	---	---	---
June 30, 2006	7.00	---	---	---	---	---	---	---	---	---
June 30, 2007	8.00	---	---	---	---	---	---	---	---	---
June 30, 2008	9.00	---	---	---	---	---	---	---	---	---
June 30, 2009	10.00	---	---	---	---	---	---	---	---	---
June 30, 2010	11.00	---	---	---	---	---	---	---	---	---
June 30, 2011	12.00	---	---	---	---	---	---	---	---	---
June 30, 2012	13.00	---	---	---	---	---	---	---	---	---
June 30, 2013	14.00	---	---	---	---	---	---	---	---	---
June 30, 2014	15.00	---	---	---	---	---	---	---	---	---
June 30, 2015	16.00	---	---	---	---	---	---	---	---	---
June 30, 2016	17.00	---	---	---	---	---	---	---	---	---
June 30, 2017	18.00	2,194,197	18.00	207,070	3,220,120	18.00	303,888	0	18.00	0
June 30, 2018	19.00	5,858,377	19.00	538,449	4,513,652	19.00	414,854	0	19.00	0
Total		8,052,574		745,519	7,733,772		718,742	0		0

Total UAL Amortization

As of each valuation date, the plan establishes a new UAL Amortization Base equal to the excess of the UAL over the total present value (PV) of the pre-existing UAL Amortizations. The new Amortization Base is amortized over a period up to 20 years, and this amount is payable each year during the established period, unless it is deemed fully amortized earlier.

	Teachers	State Plan	
		General Employees & PSO	State Judges
1. Unfunded Actuarial Liability (not less than zero)	\$1,094,161	\$8,156,166	\$221,065
2. PV of Pre-Existing UAL Amortizations	8,052,574	7,733,772	0
3. New UAL Amortization Base (1 - 2)	(6,958,413)	422,394	221,065
4. New UAL Amortization (3 amortized over 20 years)	(624,375)	37,901	19,836
5. Pre-existing UAL Amortizations	745,519	718,742	0
6. Total UAL Amortization (4 + 5)	121,144	756,643	19,836
7. Projected Payroll	1,130,014,762	983,641,070	8,815,380
Total UAL Amortization as % of Pay (6 / 7)	0.01%	0.08%	0.23%

Actuarially Determined Contribution Rate

The Actuarially Determined Contribution Rates shown below represent the recommended contributions as a percentage of payroll, based on the actuarial methods and assumptions as documented in the Basis for Valuation section of this report.

	Teachers	State Plan	
		General Employees & PSO	State Judges
1. Normal Cost	\$19,688,662	\$14,331,959	\$578,321
2. Projected Payroll	1,130,014,762	983,641,070	8,815,380
3. Normal Cost as % of Pay (1 / 2)	1.74%	1.46%	6.56%
4. Total UAL Amortization as % of Pay	0.01%	0.08%	0.23%
Actuarially Determined Contribution Rate ([3 + 4] x 1.03625 + 0.21%)	2.02%	1.81%	7.25%

Plan Assets

Change in Market Value of Assets

The change in the Market Value of Assets for the twelve months ending on the valuation date is shown below. The market value of assets used for the actuarial funding valuation excludes assets in the stabilization reserve.

	State Plan				Grand Total
	Teachers	General Employees & PSO	State Judges	Total State	
1. Market Value of Assets as of June 30, 2018	\$161,979,325	\$109,674,243	\$3,051,122	\$112,725,365	\$274,704,690
2. Employer Contributions	20,529,151	14,959,164	611,974	15,571,138	36,100,289
3. Employee Contributions	52,912,529	44,692,362	411,825	45,104,187	98,016,716
4. Investment Income	14,635,327	10,194,668	265,141	10,459,809	25,095,136
5. Benefit Payments	(18,170)	(56,978)	0	(56,978)	(75,148)
6. Refund of Employee Contributions	(2,257,311)	(3,249,584)	0	(3,249,584)	(5,506,895)
7. Administrative Expense	(2,017,263)	(1,862,812)	(4,283)	(1,867,095)	(3,884,358)
8. Net Transfers	0	0	0	0	0
Market Value of Assets as of June 30, 2019 (1 + 2 + 3 + 4 + 5 + 6 + 7 + 8)	245,763,588	174,351,063	4,335,779	178,686,842	424,450,430

Net transfers within a given year may not reconcile to zero due to timing

History of Investment Gains/Losses

The investment gain or loss for each year is determined by comparing the expected investment return to the actual investment earnings as shown below. The result is then used in the development of the Actuarial Value of Assets on the following page.

Year Ending	Actual Investment Return	Expected Investment Return	Investment Gain/(Loss)	Recognized as of June 30, 2019	Deferred as of June 30, 2019
June 30, 2019	\$25,095,136	\$24,434,674	\$660,462	\$66,046	\$594,416
June 30, 2018	17,331,564	15,137,943	2,193,621	438,724	1,754,897
June 30, 2017	12,739,958	8,423,718	4,316,240	1,294,872	3,021,368
June 30, 2016	1,312,088	3,687,933	(2,375,845)	(950,340)	(1,425,505)
June 30, 2015	347,529	846,281	(498,752)	(249,375)	(249,377)
June 30, 2014	n/a	n/a	n/a	n/a	n/a
June 30, 2013	n/a	n/a	n/a	n/a	n/a
June 30, 2012	n/a	n/a	n/a	n/a	n/a
June 30, 2011	n/a	n/a	n/a	n/a	n/a
June 30, 2010	n/a	n/a	n/a	n/a	n/a
				Total Deferred Gain/(Loss):	\$3,695,799

Actuarial Value of Assets

The development of the Actuarial Value of Assets as of the valuation date is shown below.

	<u>June 30, 2019</u>
1. Market Value of Assets	\$424,450,430
2. Total Deferred Gain/(Loss)	3,695,799
3. Preliminary Actuarial Value of Assets (1 - 2)	420,754,631
4. Actuarial Value of Assets (3 but not less than 80% of 1 or greater than 120% of 1)	420,754,631
Ratio of Actuarial Value to Market Value (4 / 1)	99.13%

	<u>State Plan</u>				<u>Grand Total</u>
	<u>Teachers</u>	<u>General Employees & PSO</u>	<u>State Judges</u>	<u>Total State</u>	
1. Market Value of Assets as of June 30, 2019	\$245,763,588	\$174,351,063	\$4,335,779	\$178,686,842	\$424,450,430
2. Ratio of Actuarial Value to Market Value	99.13%	99.13%	99.13%	99.13%	99.13%
Actuarial Value of Assets as of June 30, 2019 (1 x 2)	243,623,661	172,832,943	4,298,027	177,130,970	420,754,631

Actuarial Balance Sheet

As of June 30, 2019

	State Plan			
	Teachers	General Employees & PSO	State Judges	Total State
ASSETS				
Present assets creditable to:				
State Accumulation Fund	\$75,992,562	\$45,827,350	\$2,627,934	\$48,455,284
Members' Fund	167,631,099	127,005,593	1,670,093	128,675,686
Total Present Assets	\$243,623,661	\$172,832,943	\$4,298,027	\$177,130,970
Present value of prospective contributions payable to:				
State Accumulation Fund:				
Normal Cost	\$189,082,774	\$95,027,439	\$4,821,702	\$99,849,141
Accrued Liability	1,094,161	8,156,166	221,065	8,377,231
Total	\$190,176,935	\$103,183,605	\$5,042,767	\$108,226,372
Members' Fund	733,389,446	546,509,648	3,995,910	550,505,558
Total Prospective Contributions	\$923,566,381	\$649,693,253	\$9,038,677	\$658,731,930
Total Assets	\$1,167,190,042	\$822,526,196	\$13,336,704	\$835,862,900
LIABILITIES				
Present value of prospective benefits payable on accounts of:				
Present retired members and contingent annuitants	\$292,444	\$363,827	\$0	\$363,827
Present active members	1,144,213,527	801,733,468	13,316,797	815,050,265
Former members	22,684,071	20,428,901	19,907	20,448,808
Total Liabilities	\$1,167,190,042	\$822,526,196	\$13,336,704	\$835,862,900

Basis for Valuations

Summary of Plan Provisions

Eligibility

All employees included in the census data provided by the Tennessee Consolidated Retirement System were considered to be eligible members.

Definitions

Credited Service: Credited Service means the period of a member's continuous service since his last date of employment with the employer, and may also include service prior thereto.

Normal Retirement Date: Teachers and State General Employees

The first day of the month coincident with or next following the earlier of the date the member has attained age 65 and 5 years of Credited Service, or the date the member's age and years of Credited Service sum to 90.

Public Safety Officers are eligible upon attainment of age 60 and 5 years of Credited Service (or age 55 and 25 years of Credited Service) or at any age upon completion of 30 years of service.

General Assembly members are eligible upon attainment of age 60 and 4 years of Credited Service.

State Judges

The first day of the month coincident with or next following the earlier of the date the member has attained age 60 and 8 years of Credited Service, or the date the member has attained age 55 and 24 years of Credited Service.

Early Retirement Date: A vested member may terminate employment and receive a reduced early retirement benefit upon attaining age 60, or the date the member's age and years of Credited Service sum to 80.

Late Retirement Date: A participant may defer retirement beyond the Normal Retirement Date.

Average Earnings: The average annual earnings of a member for the five consecutive years of Credited Service which produce the highest average.

Accrued Benefit: One-twelfth of the annual benefit amount below, but not to exceed one-twelfth of the lesser of \$80,000 (indexed annually from July 1, 2014) or 90% of Average Earnings:

Teachers and State General Employees

1% of Average Earnings multiplied by the number of years of Creditable Service.

Public Safety Officers are eligible for a supplemental bridge benefit beginning at the latter of age 55 or the date of retirement and continuing until the earlier of death or age 62. The service retirement bridge is equal to 0.75% of the Average Earnings multiplied by the Credited Service. The initial supplemental benefit may not exceed 22.5% of the member's Average Earnings.

State Judges

1.6% of Average Earnings multiplied by the number of years of Creditable Service.

Benefits Paid Upon the Following Events

Normal Retirement Benefit:	Monthly amount equal to the participant's Accrued Benefit.
Early Retirement Benefit:	Accrued Benefit actuarially reduced from the Normal Retirement Date to the Early Retirement Date.
Late Retirement Benefit:	Monthly amount equal to the participant's Accrued Benefit determined as of the Late Retirement Date.
Termination Benefit:	The Accrued Benefit is 100% vested after 5 years of service (8 years for State Judges), payable at the Normal Retirement Date. A reduced benefit may commence at the Early Retirement Date.
Disability Benefits:	The disability retirement benefit, commencing on the first day of the month immediately following determination of disability and payable during the continuance of disability, is equal to 90% of the service retirement benefit that would have been payable.
Death Benefits:	Death benefits available are as follows: <ul style="list-style-type: none">- Lump Sum Refund- Line-of-Duty Benefit- 100% Joint and Survivor Annuity for Spouse after Vesting- 100% Joint and Survivor Annuity for Any Beneficiary After Reaching Early Retirement Eligibility
Refund of Contributions:	If employment is otherwise terminated before a vested retirement benefit is available, no benefits are provided under the plan, and the member will receive a refund of his contributions (if any) to the plan with interest.

Forms of Payment

Normal Form:	Life Annuity
Optional Forms:	Subject to plan conditions, a member may select an optional method of benefit payment, in lieu of the normal form, which is actuarially equivalent thereto. The purpose of the optional method is to provide a continued life income to a surviving beneficiary after the death of a member.

Other Plan Provisions

- Cost of Living Adjustments:** Each year the retirement benefits being paid are subject to an increase determined by applying a formula based on the increase in the Consumer Price Index. The maximum increase is 3% of the current benefit amount.
- Member Contributions:** Each member contributes an amount equal to 5% of compensation each year.
- Minimum Benefit:** General Assembly members will receive a minimum benefit allowance of \$55 per month for each year of Credited Service (indexed annually from July 1, 2014).

Summary of Actuarial Assumptions

Unless noted below, all assumptions are a combination of estimated future experience and estimates inherent in market data or plan experience.

Interest Rate

7.25% per annum

Salary Increases

Age	Rate
20	8.72%
30	6.48%
40	5.10%
50	4.02%
60	3.54%
65	3.46%

Increase in Social Security Wage Base:

3.00% annual increase

Cost of Living Adjustment

2.25% per annum

Inflation

2.50% annual rate of inflation is assumed in establishing economic assumptions

Marital Status:

(a) Percent married --

Eligible for service retirement – 80%

Ineligible for service retirement – 75%

(b) Age difference – males are assumed to be four years older than spouse

Post-Retirement Mortality Rates (Base Rates)

- (a) Service Retirement – base rates developed in the 2016 experience study as follows:
 - 1. Teachers and State Judges –
 - Males – 111% of RP-2014 White Collar Mortality Table for Healthy Annuitants
 - Females – 98% of RP-2014 White Collar Mortality Table for Healthy Annuitants
 - 2. Other Employees –
 - Males – 102% of RP-2014 Blue Collar Mortality Table for Healthy Annuitants
 - Females – 97% of RP-2014 Blue Collar Mortality Table for Healthy Annuitants
- (b) Disability Retirement – 110% of the mortality rates published in IRS Revenue Ruling 96-7 for disabilities occurring before January 1, 1995

Post-Retirement Mortality Improvement

The mortality tables for service retirement include generational projection of mortality improvements after year 2014 using the most current projection scale published by the Society of Actuaries as of the actuarial valuation date (Scale MP-2018 as of June 30, 2019).

Pre-Retirement Mortality Rates and Mortality Improvement

RP-2014 Mortality Table for Employees with generational projection of mortality improvements after year 2014 using the most current projection scale published by the Society of Actuaries as of the actuarial valuation date (Scale MP-2018 as of June 30, 2019)

Withdrawal and Disability Rates – Teachers and State Judges

Male

Age	Withdrawal Rates			Disability Rates
	First Year	Second Year	Later	
20	18.00%	13.50%	9.99%	0.01%
25	18.00%	13.50%	8.47%	0.01%
30	18.00%	13.50%	6.01%	0.01%
35	18.00%	13.50%	3.62%	0.03%
40	18.00%	13.50%	2.00%	0.08%
45	18.39%	13.50%	1.46%	0.14%
50	19.74%	14.18%	1.97%	0.17%
55	22.05%	16.77%	3.14%	0.17%
60	25.49%	21.64%	5.00%	0.00%
65	28.00%	23.50%	0.00%	0.00%

Female

Age	Withdrawal Rates			Disability Rates
	First Year	Second Year	Later	
20	18.00%	13.50%	10.50%	0.01%
25	18.00%	13.50%	9.99%	0.01%
30	18.00%	13.50%	7.58%	0.01%
35	18.00%	13.50%	4.65%	0.03%
40	18.00%	13.50%	2.25%	0.08%
45	18.39%	13.50%	1.11%	0.14%
50	19.74%	14.18%	1.62%	0.17%
55	22.05%	16.77%	3.85%	0.17%
60	25.49%	21.64%	5.00%	0.00%
65	28.00%	23.50%	0.00%	0.00%

Withdrawal and Disability Rates – Other Employees

Male

Age	Withdrawal Rates			Disability Rates
	First Year	Second Year	Later	
20	29.99%	24.63%	17.75%	0.06%
25	25.37%	21.36%	14.45%	0.06%
30	22.98%	18.58%	9.58%	0.07%
35	20.80%	16.07%	5.24%	0.11%
40	18.61%	13.82%	2.58%	0.16%
45	16.48%	12.03%	1.81%	0.22%
50	14.81%	11.08%	2.17%	0.27%
55	15.28%	11.60%	2.60%	0.27%
60	17.91%	14.39%	4.25%	0.00%
65	24.04%	20.48%	0.00%	0.00%

Female

Age	Withdrawal Rates			Disability Rates
	First Year	Second Year	Later	
20	29.99%	24.63%	18.32%	0.03%
25	25.37%	21.36%	14.82%	0.03%
30	22.98%	18.58%	10.34%	0.04%
35	20.80%	16.07%	6.30%	0.06%
40	18.61%	13.82%	3.42%	0.14%
45	16.48%	12.03%	2.25%	0.24%
50	14.81%	11.08%	2.34%	0.33%
55	15.28%	11.60%	3.41%	0.38%
60	17.91%	14.39%	4.90%	0.00%
65	24.04%	20.48%	0.00%	0.00%

Rates of Retirement

Credible experience is not yet available for the Hybrid Pension Plans. The following rates were developed from TCRS experience and are applied at each age at which a member is eligible for an unreduced service retirement benefit (which will result in different retirement patterns for each plan based on the applicable eligibility requirements):

Age	Teachers		Other Employees	
	Male	Female	Male	Female
50	6.5%	6.5%	6.0%	7.5%
51	7.0%	7.0%	6.0%	7.5%
52	7.0%	8.0%	6.0%	7.5%
53	8.5%	9.0%	6.0%	7.5%
54	9.0%	10.0%	6.5%	7.5%
55	10.0%	10.0%	6.5%	7.5%
56	12.0%	12.0%	7.0%	8.0%
57	12.0%	14.0%	7.0%	8.0%
58	13.0%	14.0%	7.5%	8.0%
59	14.0%	15.0%	8.0%	8.0%
60	15.0%	17.0%	8.5%	9.0%
61	16.0%	20.0%	11.0%	12.0%
62	22.0%	26.0%	16.0%	18.0%
63	16.0%	19.5%	12.0%	12.0%
64	18.0%	24.0%	14.0%	14.0%
65	35.0%	37.5%	22.0%	22.0%
66	16.0%	24.0%	15.5%	17.0%
67	16.0%	24.0%	15.5%	17.0%
68	16.0%	24.0%	15.5%	17.0%
69	16.0%	24.0%	15.5%	17.0%
70	16.0%	34.0%	15.5%	17.0%
71	17.0%	40.0%	15.5%	17.0%
72	17.0%	40.0%	15.5%	17.0%
73	17.0%	40.0%	15.5%	17.0%
74	17.0%	40.0%	15.5%	17.0%
75	100.0%	100.0%	100.0%	100.0%

Additional increments for retirees who have fifteen or more years of service at retirement on or after age 60:

8.0%	8.0%	2.0%	2.0%
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Additional increments for retirees in the year in which they are first eligible for unreduced retirement prior to age 60:

12.5%	12.5%	7.5%	7.5%
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Commencement Dates and Forms of Payment

Retiring participants are assumed to elect the normal form of payment commencing immediately.

Terminating participants and inactive participants who are entitled to future benefits are assumed to elect the normal form of payment commencing at the age at which a member is eligible for an unreduced service retirement benefit.

Expenses

The assumed Interest Rate disclosed above is net of investment expenses. A 0.21% load is included in the Actuarially Determined Contribution Rates for administrative expenses.

Selection of Assumptions

The TCRS Board of Trustees selected the assumptions described above based on the review of TCRS experience in conjunction with an experience study conducted as of June 30, 2016. A complete plan experience study is conducted every four years.

Summary of Actuarial Methods

Actuarial Cost Method

Entry Age Normal

Asset Valuation Method

Assets are valued using a 10-year smoothing method based on fair market value as of the valuation date. Gains and losses relative to the assumed interest rate are phased in 10% each year, with the result constrained to be within 20% of market value.

Amortization Method

Layered amortization method in which each new UAL Amortization Base is amortized over a closed period not to exceed 20 years. Level dollar amortization is utilized.

Effect of Revised Actuarial Methods and Assumptions on Key Valuation Results

There were no changes in actuarial methods and assumptions since the previous valuation that impacted results.

Summary of Participant Data

Subject to approval by the Tennessee Consolidated Retirement System, a summary of the participant data is available upon request.

Summary of Asset Allocation

As of June 30, 2019, plan assets were allocated as follows.

Asset Class	Allocation
Domestic Equity	30.9%
Domestic Fixed Income	28.6%
International Equity	14.6%
International Fixed Income	0.1%
Short-Term Securities	6.3%
Real Estate	8.2%
Private Equity & Strategic Lending	11.3%
Total	100.0%