



Public School Retirement System of the City of St. Louis, Missouri

Public School Retirement System of the City of St. Louis Retirement Plan

Actuarial Valuation Report

Plan Year

January 1, 2020 – December 31, 2020

June 2020

BUCK



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June 2020

Mr. Andrew Clark
Executive Director
PSRS of the City of St. Louis
3641 Olive Street, Suite 300
St. Louis, MO 63108-3601

Re: Actuarial Certification of January 1, 2020 Valuation

Dear Members of the Public School Retirement System of the City of St. Louis Board:

The annual actuarial valuation required for the Public School Retirement System of the City of St. Louis ("System") has been prepared as of January 1, 2020 by Buck. The purposes of the valuation are to:

- (1) determine the required annual contributions from the board of education, the retirement system, and the charter schools; and
- (2) present the valuation results of the System as of January 1, 2020.

This report is submitted in accordance with Section 169.450-16 Revised Statutes of Missouri (R.S. Mo.). The required contribution to the System from the board of education, the retirement system, and the charter schools is computed in accordance with Section 169.490 R.S. Mo. The amount of the required contribution is stated in Section 1.3 of this report. Information with respect to financial disclosures under GASB 67 and 68 may be found in a separate report.

In preparing this valuation, we have employed generally accepted actuarial methods and assumptions, in conjunction with employee data and financial information provided to us by the System, to determine a reasonable and sound value for the System liability. The employee data has not been audited, but it has been reviewed and found to be consistent, both internally and with prior years' data. The validity of the valuation results is dependent upon the accuracy of the data and financial information provided.

In my opinion, the actuarial assumptions used are reasonable, taking into account the experience of the System and reasonable long-term expectations, and represent my best estimate of the anticipated long-term experience under the System. The actuary performs an analysis of System experience periodically and recommends changes if, in the opinion of the actuary, assumption changes are needed to more accurately reflect expected future experience. The Experience Study for the period January 1, 2011 to December 31, 2015 was prepared by Buck and approved by the Board for use beginning with the January 1, 2017 actuarial valuation and will remain in effect for valuation purposes until such time as the Board adopts revised assumptions. The next Experience Study will be based on the period from January 1, 2016 to December 31, 2020 and upon approval by the Board will be the basis of valuations performed from January 1, 2022 through January 1, 2026. A summary of all assumptions and methods is presented in Section 3.8 of this report.

Where presented, references to “funded ratio” and “unfunded accrued liability” typically are measured on an actuarial value of assets basis. It should be noted that the same measurements using market value of assets would result in different funded ratios and unfunded accrued liabilities. Moreover, the funded ratio presented is appropriate for evaluating the need and level of future contributions but makes no assessment regarding the funded status of the plan if the plan were to settle (i.e. purchase annuities) for a portion or all of its liabilities.

Future actuarial measurements and contribution requirements may differ from those determined in the valuation because of:

- (1) differences between actual experience and anticipated experience based on the assumptions;
- (2) changes in actuarial assumptions or methods;
- (3) changes in statutory provisions;
- (4) differences between actuarially required contributions and actual contributions.

Buck prepared this report for use by the Retirement System and its auditors in reviewing the operation of the System, including the determination of contributions to be made to the System. Use of this report by other parties or for any other purpose may not be appropriate and may result in mistaken conclusions due to failure to understand applicable assumptions, methodologies, or the inapplicability of the report for that purpose. Because of the risk of misinterpretation of actuarial results, Buck recommends requesting its advance review of any statement, document, or filing to be based on information contained in this report. Buck will accept no liability for any such statement, document or filing made without its prior review.

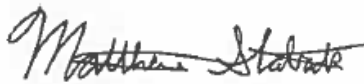
The undersigned meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein, and is available to answer questions regarding this report.

We believe that the assumptions and methods used for funding purposes are individually and in aggregate, reasonable and in combination represent a best estimate of anticipated experience under the plan. We believe that this report conforms with the requirements of the Missouri statutes, and where applicable, other federal and accounting laws, regulations and rules, as well as actuarial principles and practices in accordance with all applicable Actuarial Standards of Practice (ASOPs).

Sincerely,



Troy Jaros, FSA, EA, MAAA, FCA
Director, Retirement Actuary



Matthew Staback, ASA, EA, CERA, MAAA
Consultant, Retirement Actuary

Buck Global, LLC (Buck)

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Report Highlights

This report has been prepared by Buck to:

- Present the results of a valuation of the Public School Retirement System of the City of St. Louis (“System”) as of January 1, 2020; and
- Determine the required annual contribution for 2021.

This report is divided into three sections. Section 1 contains the results of the valuation. It includes the experience of the System during the 2019 plan year, the actuarially required costs, and funded levels.

Section 2 contains asset information. It includes market value of assets, the calculation of actuarial value of assets, the contingency reserve, and asset returns.

Section 3 describes the basis of the valuation. It summarizes the System provisions, provides information relating to the System members, and describes the funding methods and actuarial assumptions used in determining liabilities and costs. Also included is historical information about the System.

Experience Gains and Losses

Under the actuarial funding method used to determine the contribution, actuarial gains (or losses) result in a decrease (or increase) in the normal cost rate. Actuarial gains (or losses) result from differences between the actual experience of the System and the expected experience based upon the actuarial assumptions. Annual gains (or losses) should be expected because short-term deviations from expected long-term average experience are common.

For the 2019 plan year, total (net) actuarial losses due to plan experience were \$44.1 million. Approximately \$6.4 million is a loss attributable to the System’s actuarial rate of return on assets which was 6.6%, or 0.9% lower than the assumed rate of return of 7.5% for plan year 2019. By comparison, the rate of return on the market value of assets during plan year 2019 was 16.1%. The difference in these returns is due to the asset smoothing. Market value returns were higher than expected, but these returns are smoothed over 5 years in the actuarial value, rather than realized immediately. As of January 1, 2020, the actuarial value of assets of \$888.8 million is above market value of assets (excluding the expense and contingency reserve) by approximately \$25.7 million.

An actuarial loss of approximately \$37.7 million attributable to demographic experience is included in the above total (net) actuarial loss of \$44.1 million.

Assumption Changes

For the 2020 valuation, no assumptions were changed. A detailed description of the assumptions appears in section 3.8.

Plan Changes

For the 2020 valuation, no plan changes were changed.

Normal cost rate

The normal cost is determined annually and equals the product of the normal cost rate times covered payroll. For plan year 2020, the annual normal cost contribution is \$23,166,568, as compared to \$23,671,923 for plan year 2019. This decrease is primarily due to the legislative changes in future employee contributions, along with the new tier of employees coming into the plan with a 1.75% pension multiplier. The annual normal cost rate decreased from 8.65% to 8.18% due to the legislative changes. Covered payroll increased from \$263.8 million to \$272.9 million.

Accrued liability amortization

The actuarial accrued liability contribution is determined as the amount necessary to amortize the remaining Unfunded Frozen Actuarial Accrued Liability (UFAAL) over a period of 30 years from January 1, 2006, when the Board of Trustees acted to redetermine the UFAAL. This portion of the contribution only changes to reflect changes in benefits, changes in actuarial assumptions and methods, and variations in the remaining UFAAL due to deviations between actual and expected contributions. Employer contributions for 2019 were \$3.2 million lower than the annual required contribution, which increased the UFAAL more than expected. As a result, the net amortization payment increased from \$25,757,940 to \$26,456,158 while the amortization payment component of the contribution rate decreased from 9.8% to 9.7% of covered payroll.

Required contribution and timing

In 2001, the Board of Education agreed to institute a one-year lag for payments of the annual required contributions due from SLPS for future years. Therefore, this actuarial valuation is used to determine the annual required contribution (ARC) payment from SLPS for plan year 2020, due to the Plan no later than December 31, 2021. Due to legislation passed August 28, 2017, the contribution rate is set as a fixed percentage rather than an actuarially determined percentage. Because of the statutory required contribution rate, the dollar amount of the ARC due from SLPS no later than December 31, 2021, decreased to \$29,106,335 for plan year 2020 from \$29,884,664 for plan year 2019.

As a percentage of covered payroll in plan year 2020, the contribution rate for plan year 2020 decreased to 15.00% from 15.50% for plan year 2019. Charter Schools pay both employer and employee contributions as they occur shortly after each payroll period; therefore, this actuarial valuation is used to determine the contribution rate of 15.00% that Charter Schools should be paying beginning with payroll periods ending on or after January 1, 2020.

According to the 2020 Actuarial Valuation Results and timing of payments found in this report, it is important to note that on an actuarially determined and sound basis, SLPS and the Charter Schools should be paying an annual contribution rate of 18.18% versus the 15.00% contribution rate for plan year 2020 as required by statute. The effects on the System's actuarial soundness due to the decreasing statutory required contribution rate schedule will be presented in future annual actuarial valuation reports as they occur.

Summary and Comparison of Principal Valuation Results

Annual Required Contribution

	Board of Education	Retirement System	Charter Schools	Total
2020				
Normal cost contribution	\$ 16,467,879	\$ 42,945	\$ 6,655,744	\$ 23,166,568
Actuarial accrued liability contribution	<u>18,806,274</u>	<u>49,043</u>	<u>7,600,841</u>	<u>26,456,158</u>
Actuarially determined contribution (ADC)	\$ 35,274,153	\$ 91,988	\$ 14,256,585	\$ 49,622,726
Covered payroll	194,042,234	506,024	78,425,119	272,973,377
ADC as % of covered payroll	18.18%	18.18%	18.18%	18.18%
Statutory required contribution rate	15.00%	15.00%	15.00%	15.00%
Statutory annual required contribution (ARC)	\$ 29,106,335	\$ 75,904	\$ 11,763,768	\$ 40,946,007
2019				
Normal cost contribution	\$ 17,304,137	\$ 36,134	\$ 6,331,652	\$ 23,671,923
Actuarial accrued liability contribution	<u>18,829,013</u>	<u>39,318</u>	<u>6,889,609</u>	<u>25,757,940</u>
Actuarially determined contribution (ADC)	\$ 36,133,150	\$ 75,452	\$ 13,221,261	\$ 49,429,863
Covered payroll	192,817,182	402,634	70,552,564	263,772,380
ADC as % of covered payroll	18.74%	18.74%	18.74%	18.74%
Statutory required contribution rate	15.50%	15.50%	15.50%	15.50%
Statutory annual required contribution (ARC)	\$ 29,884,664	\$ 64,408	\$ 10,935,647	\$ 40,884,719

	January 1, 2020	January 1, 2019
System Assets		
Expense and contingency reserve	\$ 30,244,590	\$ 30,776,068
Market value, excluding expense & contingency reserve	863,051,012	788,673,825
Actuarial value	888,759,194	886,156,011
System liabilities		
Unfunded actuarial accrued liability	\$ 241,849,149	\$ 242,999,368
Projected Unit Credit (PUC) Actuarial Accrued Liability	\$1,241,617,244	\$1,238,153,321
Entry Age Normal (EAN) Actuarial Accrued Liability	\$1,274,573,564	\$1,268,885,279
PUC Funding Ratio		
Actuarial value funding ratio	71.6%	71.6%
Market value funding ratio	69.5%	63.7%
EAN Funding Ratio		
Actuarial value funding ratio	69.7%	69.8%
Market value funding ratio	67.7%	62.2%

Analysis of the Valuation

(1) Investment Experience

Our actuarial calculations were based upon the assumption that the System's assets earn 7.50%. The approximate market value rate of return during 2019 was 16.10%. The approximate actuarial value rate of return was 6.56%.

(2) Demographic Experience

The number of active members increased from 5,050 to 5,108 for the period. The average service of active members decreased slightly, the average age increased slightly, and the average annual salary increased by \$1,208 (2.3%). There were small changes in the inactive statistics. The membership statistics are provided in Sections 3.3 through 3.7 of this report.

(3) Salary Increases

The average annual salary increased by 2.3% between January 1, 2019 and January 1, 2020. Total annual covered payroll increased by 3.5% between January 1, 2019 and January 1, 2020.

(4) Changes in Methods from the Prior Valuation

There have been no changes in methods since the prior valuation.

(5) Changes in Assumptions from the Prior Valuation

There have been no changes in assumptions since the prior valuation.

(6) Changes in Benefit Provisions from the Prior Valuation

There have been no changes in assumptions since the prior valuation.

(7) Other Changes

There have been no other changes since the prior valuation.

(8) Summary

The overall effect of experience during the period resulted in no change in the PUC funding ratio utilizing the actuarial value of assets, which remained at 71.6%. The total actuarially determined contribution rate decreased from 18.74% to 18.18% of covered payroll.

Section 1 - Valuation Results

This section sets forth the results of the actuarial valuation.

- Section 1.1 Develops the actuarial accrued liability contribution
- Section 1.2 Develops the normal cost contribution
- Section 1.3 Develops the required annual contribution
- Section 1.4 Actuarial balance sheet as of January 1, 2020
- Section 1.5 Projected Unit Credit funding ratios
- Section 1.6 Projected Unit Credit funded status
- Section 1.7 Prioritized solvency test

Section 1 (continued)

1.1 Determination of the Unfunded Frozen Actuarial Accrued Liability

1. Unfunded frozen actuarial accrued liability as of January 1, 2019	\$ 242,999,368
2. Normal cost due January 1, 2019	22,816,311
3. Interest on (1) and (2) at 7.50% to December 31, 2019	19,936,176
4. Employer contributions in 2019	43,902,706
5. Interest on (4) at 7.50% to December 31, 2019	0
6. Supplement for changes in actuarial assumptions or benefits	<u>0</u>
7. Unfunded frozen actuarial accrued liability as of January 1, 2020, (1) + (2) + (3) – (4) – (5) + (6)	241,849,149
8. Actuarial accrued liability contribution for 2020 End of year amortization payment of (7) over 16 years	26,456,158

Section 1 (continued)

1.2 Determination of Normal Cost Contribution

1. Actuarial present value of future benefits		
a. Active participants		
i. Retirement benefits	\$ 408,759,780	
ii. Vested withdrawal benefits	53,803,300	
iii. Refund of contributions	10,530,063	
iv. Survivor benefits	4,513,975	
v. Disability benefits	<u>11,256,509</u>	
Total		\$ 488,863,627
b. Retired participants and beneficiaries		891,935,875
c. Inactive participants		
i. Vested participants	31,942,590	
ii. Nonvested participants	<u>10,987,140</u>	
Total		<u>42,929,730</u>
d. Total actuarial present value of future benefits		1,423,729,232
2. Unfunded frozen actuarial accrued liability as of January 1, 2020		241,849,149
3. Actuarial value of assets as of January 1, 2020		888,759,194
4. Actuarial present value of future participant contributions		<u>147,598,649</u>
5. Actuarial present value of future employer normal costs, (1)(d) – (2) – (3) – (4), not less than \$0		145,522,240
6. Actuarial present value of future covered payroll of current participants		1,779,957,769
7. Employer normal cost rate, (5) / (6)		8.18%
8. Total covered payroll		272,973,377
9. Normal cost for 2020, (7) x (8)		22,329,222
10. Normal cost contribution due by December 31, 2020, (9) x [1 + (0.075 x 0.5)]		23,166,568

Section 1 (continued)

1.3 Required Annual Contribution

Actuarially Determined Contribution (ADC):

	Board of Education	Retirement System	Charter Schools	Total
Normal cost contribution	\$ 16,467,879	\$ 42,945	\$ 6,655,744	\$ 23,166,568
Actuarial accrued liability contribution	<u>18,806,274</u>	<u>49,043</u>	<u>7,600,841</u>	<u>26,456,158</u>
Actuarially determined contribution (ADC)	35,274,153	91,988	14,256,585	\$ 49,622,726
Covered payroll	194,042,234	506,024	78,425,119	272,973,377
ADC as % of covered payroll	18.18%	18.18%	18.18%	18.18%

Statutory Annual Required Contribution (ARC):

	Board of Education	Retirement System	Charter Schools	Total
Covered payroll	\$ 194,042,234	\$ 506,024	\$ 78,425,119	\$ 272,973,377
ARC as % of covered payroll	15.00%	15.00%	15.00%	15.00%
Statutory annual required contribution (ARC)	29,106,335	75,904	11,763,768	\$ 40,946,007

Section 1 (continued)

1.4 Actuarial Balance Sheet as of January 1, 2020

Actuarial assets

Actuarial value of current assets		\$ 888,759,194
Actuarial present value of future participant contributions		147,598,649
Actuarial present value of future employer contributions for:		
Normal costs		145,522,240
Unfunded actuarial accrued liability		<u>241,849,149</u>
Total current and future assets		\$ 1,423,729,232

Actuarial liabilities

Actuarial present value of benefits now payable		\$ 891,935,875
Actuarial present value of benefits payable in the future:		
Active participants	\$ 488,863,627	
Terminated vested participants	31,942,590	
Terminated non-vested participants	<u>10,987,140</u>	
Total payable in the future		<u>531,793,357</u>
Total liabilities for benefits		\$ 1,423,729,232
Surplus / (deficit)		0

Section 1 (continued)

1.5 Projected Unit Credit Funding Ratios

The funding objective of the System is to meet long-term benefit promises through contributions that remain approximately level from year to year as a percentage of covered payroll.

Funding ratios provide a measure of how much progress has been made towards achieving this objective. For this purpose, the System's liabilities are determined using the projected unit credit cost method. Under this method, liabilities are determined for each participant using only service already performed, but anticipating the impact of future salary growth on the benefits attributable to current active participants.

Section 1.6 provides a comparison of this liability measure to the value of assets to produce a snapshot measure of the System's funding ratio.

Another way to check the funding progress of the System is through a prioritized solvency test. Section 1.7 illustrates the history of the System's funding progress under this test.

In a prioritized solvency test, the plan's present assets (cash and investments) are sequentially allocated and compared to three priorities of liabilities as follows:

- Liability 1: Active participant contributions, accumulated with interest;
- Liability 2: The liabilities for future benefits to current inactive participants and beneficiaries; and
- Liability 3: The liabilities for future benefits to current active participants for prior service.

Ideally, progress in funding of these liability groups will normally be exhibited with Liability 1 attaining 100% coverage first, then Liability 2, and finally Liability 3. Note that 100% funding of Liability 3 does not mean that the System has completed its funding of benefits since additional benefits typically are expected to be earned in the future.

Section 1 (continued)

1.6 Projected Unit Credit Funded Status

As of January 1, 2020 the Projected Unit Credit Actuarial Accrued Liability was:

1. Retired members and beneficiaries currently receiving benefits and terminated members not yet receiving benefits	\$ 934,865,605
a. Current active participants	
i. Accumulated member contributions, including interest	130,619,480
ii. Employer-financed benefits	<u>176,132,159</u>
Total Projected Unit Credit Actuarial Accrued Liability	\$ 1,241,617,244

As of January 1, 2020 the Projected Unit Credit AAL was funded as follows:

2. Net assets available for benefits at actuarial value	\$ 888,759,194
3. Unfunded Projected Unit Credit AAL	352,858,050
4. Actuarial value funding ratio, (2) / (1)	71.6%
5. Net assets available for benefits at market value	\$ 863,051,012
6. Unfunded Projected Unit Credit AAL	378,566,232
7. Market value funding ratio, (5) / (1)	69.5%

Section 1 (continued)

1.7 Prioritized Solvency Test

Valuation date January 1	Active participants' accumulated contributions	Retirees, beneficiaries and inactive participants	Active participants (employer-financed)	Valuation assets	Percent covered by valuation assets		
	(1)	(2)	(3)		(1)	(2)	(3)
1999	130,705,014	276,290,128	303,953,494	694,250,672	100%	100%	95%
2000	129,398,364	353,852,977	288,213,016	770,090,498	100%	100%	100%
2001	127,086,325	414,052,293	269,590,438	828,097,298	100%	100%	100%
2002	116,506,785	476,104,516	372,221,726	861,128,076	100%	100%	72%
2003	115,570,837	492,633,382	361,818,972	873,260,102	100%	100%	73%
2004	106,021,476	528,287,121	364,459,284	901,996,455	100%	100%	73%
2005	89,710,662	518,880,414	368,306,240	935,328,638	100%	100%	89%
2006	90,001,111	661,353,685	319,920,373	983,828,243	100%	100%	73%
2007	96,223,413	712,467,372	305,409,824	1,003,428,983	100%	100%	64%
2008	98,112,123	781,006,957	249,244,208	1,014,923,381	100%	100%	54%
2009	104,576,264	801,995,237	187,035,147	963,851,408	100%	100%	31%
2010	110,054,510	805,831,292	195,185,151	950,709,944	100%	100%	18%
2011	103,178,297	842,643,351	169,510,764	944,356,735	100%	100%	0%
2012	116,268,566	850,498,527	189,084,439	925,389,359	100%	95%	0%
2013	120,355,959	849,412,565	190,553,739	914,494,335	100%	93%	0%
2014	114,092,991	896,477,122	164,014,835	922,922,386	100%	90%	0%
2015	116,755,946	892,626,625	156,682,397	926,905,797	100%	91%	0%
2016	120,507,482	887,757,927	157,501,063	915,391,079	100%	90%	0%
2017	122,746,557	933,916,821	166,666,305	901,076,683	100%	83%	0%
2018	122,241,799	935,005,411	178,661,824	899,816,911	100%	83%	0%
2019	126,636,422	932,068,226	179,448,673	886,156,011	100%	81%	0%
2020	130,619,480	934,865,605	176,132,159	888,759,194	100%	81%	0%

Section 2 - Valuation of the System's Assets

This section of the report shows the development of the actuarial value of the assets of the System and provides information regarding the expense and contingency reserve, investment results and the various assets of the System.

The amount of assets used in the actuarial valuation is known as the "actuarial value of assets." The method is discussed in the summary of methods and assumptions, section 3.8. The development of the actuarial value of assets is shown in section 2.1. An important element in the development of the actuarial value of assets is the expense and contingency reserve. The amount of the reserve is determined pursuant to a policy adopted by the Board of Trustees. The history of the reserve is presented in section 2.2.

As shown in section 2.3, the fund had a rate of return of 6.56% on an actuarial value basis, which is 0.94% below the assumed rate of return of 7.50% for plan year 2019. The rate of return on an actuarial value basis is intended to be a more stable rate of return and fluctuate less than rates of return on a market value basis. Thus, the rate of return on an actuarial basis is not always a fair measure of the annual investment performance of the fund. Another indicator of actual performance during the year is the rate of return on a market value basis which was 16.10% for plan year 2019, also presented in section 2.3.

Section 2 (continued)

2.1 Development of the Actuarial Value of Assets

1. Actuarial value of assets as of January 1, 2019	\$ 886,156,011
2. Participant contributions	17,019,685
3. Employer contributions	43,902,706
4. Benefit payments and expenses	114,691,183
5. Investment increment at 7.50%, $7.50\% \times \{(1) + .5 \times [(2) - (4)]\}$	<u>62,799,020</u>
6. Expected actuarial value on January 1, 2020, (1) + (2) + (3) - (4) + (5)	895,186,239
7. Market value of assets on January 1, 2020	893,295,602
8. Expense and contingency reserve on January 1, 2020, prior to adjustment	30,244,590
9. Adjustment to the investment contingency reserve	<u>0</u>
10. Excess of market value over expected actuarial value, (7) - (6) - (8) - (9)	(32,135,227)
11. Market value adjustment, $20\% \times (10)$	<u>(6,427,045)</u>
12. Actuarial value of assets as of January 1, 2020, (6) + (11)	888,759,194

Section 2 (continued)

2.2 The Expense and Contingency Reserve

Effective January 1, 1996, the Board of Trustees revised Rule X, which governs the determination of the amount of the expense and contingency reserve. The expense portion of the reserve is the sum of:

1. The estimated annual operating expenses for the ensuing year;
2. An amount equal to the liability for non-insurance supplements;
3. An amount equal to the liability for insurance supplements for those participants participating in the program on January 1; and
4. The estimated amount of insurance supplements to be paid for participants expected to retire and participate in the program during the ensuing year.

The investment contingency portion of the reserve is intended to help cover significant shortfalls in the actuarial rate of return. When a shortfall of more than 1% occurs, a portion of the reserve is released equal to one half of the amount of the shortfall up to 2% plus any remaining shortfall. When the rate of return exceeds the assumed rate of return by more than 1%, the reserve is increased subject to a maximum reserve of 5% of the market value of the Retirement Fund. The addition equals one half of the amount of the excess up to 2% plus any remaining excess.

The actuarial return on assets was within 1% of 7.50% during plan year 2020; therefore, no adjustments were made to the actuarial value of assets.

Below is a history of the expense and contingency reserve:

January 1	Expense reserve	Investment contingency reserve	Total expense and contingency reserve
1998	\$30,891,555	\$24,100,041	\$54,991,596
1999	22,142,759	45,972,067	68,114,826
2000	27,992,032	50,003,862	77,995,894
2001	29,837,776	50,003,743	79,841,519
2002	23,527,529	50,003,743	73,531,272
2003	24,952,255	37,759,976	62,712,231
2004	26,028,780	37,759,976	63,788,756
2005	27,170,188	45,115,876	72,286,064
2006	32,534,770	45,115,876	77,650,646
2007	29,864,946	50,732,410	80,597,356
2008	31,987,370	57,234,574	89,221,944
2009	30,555,388	0	30,555,388
2010	29,903,107	0	29,903,107
2011	29,480,465	0	29,480,465
2012	29,564,563	0	29,564,563
2013	29,181,897	0	29,181,897
2014	30,439,781	0	30,439,781
2015	29,868,370	0	29,868,370
2016	29,537,454	0	29,537,454
2017	30,921,897	0	30,921,897
2018	30,751,247	0	30,751,247
2019	30,776,068	0	30,776,068
2020	30,244,590	0	30,244,590

Section 2 (continued)

2.3 Investment Performance

There are several different methods of approximating the rates of return on investments of the trust fund. Following is a brief comparison of the actuarial assumed rate of return as compared with rates of return on market and actuarial value bases:

a. Market Value Basis

The rate of return on a market value basis is the ratio of the appreciation (or depreciation) of assets less contributions plus disbursements to the market value at the beginning of the year plus the average of the receipts and disbursements made during the year. This may be approximated as follows:

i.	A = Market value of assets as of January 1, 2019	\$	819,449,893
ii.	B = Market value of assets as of January 1, 2020		893,295,602
iii.	C = Contributions during the period		60,922,391
iv.	D = Disbursements during the period		114,691,183
v.	Rate of return: $\frac{B - A + D - C}{A + \frac{1}{2}(C - D)}$		16.10%
vi.	Actuarial assumed rate of return for 2019		7.50%
vii.	Difference between actual and assumed rates of return, (v) – (vi)		8.60%

b. Actuarial Value Basis

The rate of return on an actuarial value basis is approximated using the same method:

i.	A = Actuarial value of assets as of January 1, 2019	\$	886,156,011
ii.	B = Actuarial value of assets as of January 1, 2020		888,759,194
iii.	C = Contributions during the period		60,922,391
iv.	D = Disbursements during the period		114,691,183
v.	Rate of return: $\frac{B - A + D - C}{A + \frac{1}{2}(C - D)}$		6.56%
vi.	Actuarial assumed rate of return for 2019		7.50%
vii.	Difference between actual and assumed rates of return, (v) – (vi)		-0.94%

Section 3 - Basis of the Valuation

In this section, the basis of the valuation is presented and described. This information – the provisions of the System and the census of members – is the foundation of the valuation, since these are the present facts upon which benefit payments will depend.

The effects of administering the System’s plan provisions have a direct impact on actuarial costs. The System uses the projected unit credit actuarial cost method discussed on page 10 for actuarial funding purposes, and the frozen entry age normal actuarial cost method discussed on page 34 for actuarial financial reporting purposes.

A summary of the System’s provisions is provided in Section 3.1, the legislative history of the System is provided in Section 3.2, and member census information is shown in Section 3.3 to Section 3.7.

The valuation is based upon the premise that the System will continue in existence, so that future events must also be considered. These future events are assumed to occur in accordance with the actuarial assumptions and concern such events as the earnings of the fund; the number of members who will retire, die or terminate their services; their ages at such termination and their expected benefits.

The actuarial assumptions and the actuarial cost method, or funding method, which have been adopted to guide the sponsor in funding the System in a reasonable and acceptable manner, are described in Section 3.8.

A guide to actuarial terminology used in this report is included as Section 3.9.

Section 3 (continued)

3.1 Summary of Plan Provisions

Participants

All persons regularly employed by the board of education, charter schools, and employees of the board of trustees are in the System.

Retirement age

Normal

Age 65 or any age if age plus the years of credited service equals or exceeds 80 (Rule of 80).

If the employee terminated prior to August 28, 2017, then Age 65 or any age if age plus the years of credited service equals or exceeds 85 (Rule of 85).

Early

Age 60 with 5 years of service

Service retirement allowance

- a. 2.00% (1.25% if terminated prior to July 1, 1999 or 1.75% if hired on or after January 1, 2018) times years of credited service, subject to a maximum of 60%
- b. Times average final compensation (AFC)
- c. Subject to a maximum of 60% of AFC.
 - i. AFC is the highest average compensation for any three consecutive years of the last 10 years of service.
 - ii. Compensation is the regular wages plus what the employer pays towards the participant's health and welfare benefits.
 - iii. Minimum monthly benefit is \$10.00 for each year of credited service, up to 15 years, retirement age 65 and over.
 - iv. Unused sick leave is added to a participant's credited service and age.

Early retirement benefit

Service retirement allowance reduced five-ninths of one percent for each month of commencement prior to age 65 or the age at which the Rule of 80 (Rule of 85 if terminated prior to August 28, 2017) would have been satisfied had the employee continued working until that age, if earlier.

Disability benefit

Service retirement allowance using actual service, or 25% of AFC if larger, provided that in no case will the benefit exceed that payable if service had continued to age 65.

- a. Disability must be incurred while an employee as determined by the medical board and approved by the board of trustees.
- b. The participant must have a minimum of five years of credited service and not be eligible for normal retirement.

Continued disability is subject to routine verification.

Withdrawal benefit

Accumulated contributions of participant with interest credited to the participant's account.

Section 3 (continued)

3.1 Summary of Plan Provisions

Vested benefit

Full vesting on termination of employment after at least five years of service is provided if contributions are left with the System. The full accrued benefit is payable at age 65 or a reduced early retirement benefit prior to age 65.

Retirement options

In lieu of the benefit paid only over the lifetime of the participant, a reduced benefit payable for life of participant with:

- Option 1 Same retirement allowance continued after death to the beneficiary.
- Option 2 One-half of the retirement allowance continued after death to the beneficiary.
- Option 3 Same retirement allowance continued after death to the beneficiary. If the beneficiary predeceases the participant, the retirement allowance is adjusted back to the unreduced allowance.
- Option 4 One-half of retirement allowance continued after death to the beneficiary. If the beneficiary predeceases the participant, the retirement allowance is adjusted back to the unreduced allowance.
- Option 5 Increased retirement allowance is provided up to age 62, such that benefit provided prior to age 62 is approximately equal to the sum of the reduced retirement allowance paid after age 62 and Social Security.
- Option 6 Options 1 and 5 combined.
- Option 7 Options 2 and 5 combined.

Survivor benefits

If an active participant dies after completing 18 months of service, leaving a surviving spouse or other dependent beneficiaries, survivor benefits are payable. The widow or dependent beneficiary may elect to receive either a refund of accumulated contributions, or:

- a. A survivor who is the widow at least age 62 and married to a participant for at least one year receives \$60 per month.
- b. A widow with dependent, unmarried children under age 22 receives \$60 per month plus \$60 per dependent child, not to exceed \$180 per month. The benefit ceases when youngest child is age 22 and resumes again under (a) at age 62.
- c. If no benefits are payable under (a) or (b), minor children may receive a benefit of \$60 per child or \$180 divided among them if more than three children.
- d. If no benefits are payable under (a), (b) or (c), a dependent parent or parents may receive or share \$60 per month upon attaining age 62.

If an active participant dies after completing 5 years of service, the widow or dependent beneficiary may elect to receive either a refund of accumulated contributions or:

- a. If the survivor is the widow, a survivor benefit calculated as if the participant had been age 60 at death and elected Option 1, plus \$60 per dependent child not to exceed \$180 per month.
- b. If there is no widow, a survivor benefit calculated as if the participant had been age 60 at death and elected Option 1.

Section 3 (continued)

3.1 Summary of Plan Provisions

Return of contributions upon death

If after the death of a participant, no further monthly are payable to a beneficiary under an optional form of payment, or under the survivor benefit provisions, the participant's beneficiary shall be paid the excess, if any, of the participant's accumulated contributions over all payments made to or on behalf of the deceased participant.

DROP

Effective July 1, 2001, active participants may elect to enter the deferred retirement option plan (DROP) for up to four years. Upon entering the DROP, the participant's retirement benefit is frozen and credited to the participant's DROP account. At the end of the DROP, or upon earlier termination of employment, the DROP account is paid in a lump sum or installments, at the participant's option. During the DROP, the participant continues as an active participant, but does not pay contributions. To enter the DROP the participant must be age 65 or meet the Rule of 85. The DROP program is no longer available, ending June 30, 2008.

Contributions by participants

Participants hired before January 1, 2018 contribute 5.50% of compensation in 2018. This rate increases 0.50% per year until it reaches 9.00%. After this, the contribution rate will remain at 9.00% of compensation.

Participants hired on or after January 1, 2018 contribute 9.00% of compensation.

Accumulated contributions are credited at the rate of interest established by the board of trustees. The current crediting rate is 5% per year.

Contributions by employers

The employer contribution rate will be set at a flat 16.00% of covered payroll for Plan year 2018. This contribution rate shall be decreased by 0.50% in each subsequent Plan year until reaching 9.00% of covered payroll. After this, the employer contribution rate will remain at 9.00% of covered payroll.

Expenses

Administrative expenses are paid out of investment income.

Section 3 (continued)

3.2 Legislative History of the Retirement System

On and after January 1, 1944, all persons employed by the board of education on a full-time permanent basis are participants of the System as a condition of employment. In 1961, provisions regarding benefits and employee contribution levels were revised for all future employees of the board of education. Participants of the System at that time were granted the right to remain under the "old plan" and have their membership governed by the provisions of the law in effect prior to 1961. These old plan participants have both benefits and contributions based on a \$3,000 maximum annual compensation. Old plan participants have been given the option to transfer into the revised plan at various times since 1961.

Effective October 13, 1969, legislation permitted the reinstatement of credited service lost during the years 1944 to 1947 inclusive when the married women teachers rule was in effect.

Effective August 31, 1972, legislation resulted in the following changes:

- Purchase of past service credit by paying contributions for service claimed plus interest.
- Service as extended substitute teacher.
- Service of re-employed participants lost on prior terminations.
- Service out-state Missouri and outside the state of Missouri.
- Service lost by those who elected to stay out of the retirement plan either temporarily or to date.
- Old plan participants who wished to become new plan participants could do so by paying the differential in participant contributions under the new and old plans, plus interest.
- Dependent beneficiary on death of participant before retirement but after age 60 or age 55 with 30 years service may receive option 1 benefit as if participant had retired under such option.
- A participant with five or more years of service and prior to age 65 may be retired with a disability benefit if the medical board certifies that such participant is mentally or physically totally incapacitated for further performance of duty.
- Minimum retirement benefit at age 65 or after 10 years service is \$50.00 per month.

On February 10, 1975, the Missouri Supreme Court handed down a decision supporting HB 613 (Section 169.585 of state statutes), which granted increased benefits to retired teachers. The increases apply to those teachers who retired after June 30, 1957, and prior to January 1, 1971. Technically, those retirees are retained as "advisors and supervisor" and receive a "salary" of \$5 per month for each year of service, with a maximum of \$75. This salary plus the regular retirement benefit cannot exceed \$150 per month. To the extent that assets are depleted because of this law, future district contributions will increase. Because these benefits are paid as "salaries," coming out of investment income along with other expenses of operation, there will be less money available for crediting of interest to the various funds at the end of the year.

Section 3 (continued)

3.2 Legislative History of the Retirement System

Effective August 13, 1978 legislation resulted in the following changes:

- The service retirement allowance and projected service retirement allowance was changed to 1-1/4% of average final compensation per year of credited service. The participant's allowance plus his Social Security primary insurance amount could not exceed 80% of his average final compensation. Participants born before 1917 receive the larger of the allowances calculated under the new formula and the formula in effect immediately before it.
- Credited service no longer limited to a maximum of 35 years.
- Two new joint and survivor optional forms of payment were added which provide for the participant's pension to be adjusted back to his unreduced pension in the event his spouse predeceases him.
- Contributions from participants shall be 3% of compensation.
- End of period for purchasing prior service or outside service extended from December 31, 1973 to December 31, 1980. Deleted requirement of electing to purchase out-state or outside the state of Missouri service within one year of completing five years of credited service.
- Gives board of trustees the power to establish regulations, methods and factors that may be needed to calculate primary Social Security benefits.
- Dependent beneficiary on death of participant before retirement with five or more years of credited service may receive option 1 benefit as if the participant had retired under that option as of the date of his death.
- Allow retired educational secretaries to serve as part-time or temporary substitute educational secretary up to a maximum of 360 hours per school year without a reduction in the retired employee's retirement allowance or requiring the retired employees to contribute to the retirement system.

Effective September 28, 1979, legislation resulted in the following changes:

- Accumulated and unused days of sick leave shall be included in computing a participant's age and credited service at retirement.
- Participants who have attained age 62 and who have 30 or more years of credited service may retire and receive a service retirement allowance without reduction for early retirement. The early retirement reduction for participants who retire with 30 or more years of credited service but who have not attained age 62 on their retirement date shall be determined on the basis of the number of months by which their age at retirement is less than age 62.
- Benefits to survivors of a participant who dies while an employee and after having at least 18 months of credited service are as follows:
 - (a) Surviving spouse age 62 or over: \$60 per month.
 - (b) Surviving spouse with unmarried dependent children under age 22: \$60 per month, plus \$30 per month for each eligible child, with a maximum of \$150 per month.
 - (c) Unmarried dependent children under age 22: \$60 per month for each eligible child, with a maximum of \$120 per month. This benefit is payable if the benefit in (b) is not payable.
 - (d) Dependent parent(s): \$60 per month, provided no benefits are payable under (a), (b) or (c) above.

Section 3 (continued)

3.2 Legislative History of the Retirement System

Effective September 28, 1981, legislation resulted in the following changes:

- The provision limiting service retirement and projected service retirement allowances to 80% of average final compensation less Social Security was removed for future retirees.
- The minimum monthly benefit payable to participants retiring on or after age 65 with 10 or more years of service was increased to \$75.
- Old plan participants were extended the option to transfer into the current System by paying the difference in participant contributions plus interest. Such election to be made on or before December 31, 1984. Retired participants who retired prior to January 1, 1955, may be consultants at a "salary" equal to \$4 for each year of retirement prior to January 1, 1982. Total "salaries" as a "school consultant" and "special school advisor and supervisor" are limited to \$250 per month.
- The retirement system may contribute as part of its administrative expenses toward health, life and similar insurance for retirees.
- The actuarial cost method was changed from the "entry age cost method" to the "frozen entry age cost method." The period for amortizing "supplements" to the unfunded actuarial accrued liability was set at 50 years from the time the "supplement" is created.
- Several changes were made dealing with the administration and operation of the System.
- Investment powers were broadened.

Effective September 28, 1984, legislation resulted in the following changes:

- Dependent beneficiary on death of employed, active participant before retirement with five or more years of service may receive option 1 benefit as if the participant had attained age 55 (if less than 55 at his death) and had retired under option 1 as of the date of his death.
- In addition to the option 1 death benefit, a surviving spouse may receive \$30 per month for each unmarried dependent child, provided that the total benefit does not exceed the greater of \$150 or the option 1 benefit.
- Surviving spouse benefits do not cease on remarriage.
- Dependent children's benefits do not require that the child remain a full-time student.
- Participants retired on disability may elect to receive an actuarial equivalent benefit under options 1 through 4.
- Retired participants who retired on or after January 1, 1976, may be employed as school consultants and receive a salary and insurance benefits provided other retirants.

Section 3 (continued)

3.2 Legislative History of the Retirement System

Effective August 13, 1986, legislation resulted in the following changes:

- A participant with 30 years of credited service who is between the ages of 55 and 62, upon certification by the board of education, is eligible for a supplemental early retirement benefit payable to age 62. This provision remains in effect until December 31, 1991.
- Benefits to a surviving spouse for dependent children are increased from \$30 to \$60 per month, with a maximum of \$240 per month, including the \$60 for the surviving spouse.
- Supplemental pay to retired participants employed as "school consultants" is increased by \$2 per month for each year between the participant's date of retirement and December 31, 1986

Effective June 19, 1987, legislation resulted in the following changes:

- Reinstated the option for "old plan" participants to elect "new plan" membership by paying the difference in contributions accumulated with interest.
- Increased the minimum benefit for participants retiring on or after age 65 to \$10 per month for each year of credited service, up to a maximum of 15 years.
- Several changes were made dealing with the accounting, administration, and operation of the System.

Effective August 13, 1988, legislation resulted in the following changes:

- Made provisions for children's benefits uniform, providing \$60 per month per child, up to a maximum of \$180 per month, under both subsections 169.460(13) and (15) survivor benefits.
- Supplemental pay to retired participants of \$2 per month for each year of retirement up to December 31, 1988.

Effective June 14, 1989, legislation resulted in the following changes:

- The maximum on compensation was removed.
- Average final compensation is based on the highest three consecutive years, rather than the highest five consecutive years.
- Participants may retire with unreduced benefits at any age, if their age plus credited service equals or exceeds 85 (the "Rule of 85").

Effective May 31, 1990, legislation resulted in the following change:

- Supplemental pay of \$2 per month for each year of retirement up to December 31, 1990.

Effective August 28, 1993, legislation resulted in the following change:

- Supplemental pay of \$3 per month for each year of retirement up to December 31, 1993.

Section 3 (continued)

3.2 Legislative History of the Retirement System

Effective August 28, 1996, legislation resulted in the following changes:

- Provision was added for the purchase of service for certain periods of layoff.
- The investment trustee position was eliminated and the position of school administrator trustee was added.
- Cost-of-living increases for participants who retired prior to August 28, 1996, with at least 15 years of credited service. The cost-of-living increases are up to 3% in one year, with a cumulative maximum of 10%.
- The board of education is authorized to increase retirement benefits and the participant contribution rate, subject to several conditions.

Effective August 28, 1997, legislation resulted in the following change:

- Cost-of-living increases extended to participants who retired prior to August 28, 1997, with at least 15 years of credited service. The cost-of-living increases are up to 3% in one year, with a cumulative maximum of 10%.

In accordance with the statutory authority granted the board of education in 1996, the board of education made the following changes:

- Participant contributions were increased to 4.5%, effective July 1, 1998; to 5.0%, effective July 1, 1999; and, if necessary to 5.5%, effective July 1, 2000.
- The service retirement allowance was changed to 2.00% of average final compensation per year of credited service, subject to a maximum of 60% of average final compensation, effective for participants who retired after June 29, 1999.
- A “catch-up” cost-of-living adjustment (COLA) is provided for participants who retired prior to June 30, 1999, and survivors of participants who retired or died prior to June 30, 1999. The amount of the “catch-up” COLA is equal to 65% of the amount by which the participant’s original benefit would have increased due to increases in the CPI, in excess of any supplements or COLA increases being received by the participant. The “catch-up” COLA is effective July 1, 2000.
- The board of education agreed to contribute 8.03% of covered payroll for 1998, 1999, and 2000, in order to fund the benefit increase and the “catch-up” COLA.

In accordance with the statutory authority granted the board of education in 1996, the board of education made the following changes:

- Effective January 1, 2001, all participants who retired prior to January 1, 2000, received a 3% cost-of-living increase.
- Effective July 1, 2001, a DROP was made available until June 30, 2005, at which time the program will be evaluated to determine whether or not it should be extended. Eligible participants may elect to enter the DROP for up to four years.
- In conjunction with the DROP, employers will contribute at 8.00% of covered payroll for 2001. The contribution rate for subsequent years will be based on the rate determined by the actuarial valuation for the January 1 of the year preceding the year the contribution is due.

Section 3 (continued)

3.2 Legislative History of the Retirement System

Effective August 28, 2002, legislation resulted in the following changes:

- Purchase of service rules were updated.
- The System may accept qualified transfers of funds for the purchase of service.
- Clarified provisions relating to charter school participation in the System.
- Option 5, the level income option is added.
- Replaced the specific actuarial cost method in the statutes with a provision that the method adopted by the board of trustees may be any method in accordance with generally accepted actuarial standards. The amortization period for the UAAL may not exceed 30 years.

Effective August 28, 2017, legislation resulted in the following changes:

- Replaced the normal pension eligibility requirement where a member's age plus credited service equals not less than eighty-five (the "Rule of 85") with not less than eighty (the "Rule of 80").
- For members hired for the first time on or after January 1, 2018, the multiplier in the annual pension benefit formula (credited service x pension multiplier x average final compensation) was reduced from two percent (2%) to one and three-fourths percent (1.75%).
- Beginning January 1, 2018, the employee contribution rate of five percent (5%) of compensation shall increase by one-half of one percent (0.5%) annually until such time as the percentage equals nine percent (9%).
- For member's hired for the first time on or after January 1, 2018, the employee contribution rate shall be nine percent (9%) of compensation.
- For calendar year 2018, the actuarially determined annual employer contribution rate shall be replaced with sixteen percent (16%) of total employee compensation for each employer which, for each calendar year thereafter, shall decrease by one-half of one percent (0.5%) until calendar year 2032, when the annual employer contribution rate shall equal nine percent (9%) of total employee compensation for each employer for that year and all subsequent years.

Section 3 (continued)

3.3 Changes in System Participation

	Active	Retirees	Beneficiaries	Disabled	Total In Pay Status	Deferred Vested	Nonvested with Balance	Total Terminated Records	Total
Total as of January 1, 2019	5,050	3,955	300	245	4,500	566	2,320	2,886	12,436
New Entrants	909						133	133	1,042
Rehires/Transfers	39					(8)	(31)	(39)	0
Retirements	(125)	148			148	(22)	(1)	(23)	0
Disabilities	(6)			6	6				0
Beneficiaries			10		10				10
Deaths	(12)	(150)	(22)	(11)	(183)	(9)	(2)	(11)	(206)
Deferred Vested	(143)					133		133	(10)
Nonvested Terminations - Account Balance	(411)						313	313	(98)
Refunds Paid in 2019	(185)		(1)		(1)	(14)	(94)	(108)	(294)
Nonvested Termination	(8)						(9)	(9)	(17)
Data Adjustments		(1)	(2)		(3)	1	(2)	(1)	(4)
Total as of January 1, 2020	5,108	3,952	285	240	4,477	647	2,627	3,274	12,859

Section 3 (continued)

3.4 Member Census Information

As of January 1	2019	2020
Active Members		
Number	5,050	5,108
Average Age	43.53	43.57
Average Service	7.71	7.47
Average Annual Base Pay	\$ 52,232	\$ 53,440
Vested Terminated Members		
Number	566	647
Average Account Balance	\$ 32,522	\$ 32,914
Non-vested Terminated Members		
Number	2,320	2,627
Average Account Balance	\$ 4,085	\$ 4,182
Benefit Recipients		
Number	4,500	4,477
Average Age	74.51	74.74
Average Monthly Benefit	\$ 1,963	\$ 1,978

Section 3 (continued)

3.5 Distributions of Active Members

Years of Service By Age Charter Schools

Age	Years of Service									Total
	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40+	
Under 25	76	0	0	0	0	0	0	0	0	76
25 - 29	305	26	0	0	0	0	0	0	0	331
30 - 34	223	84	9	0	0	0	0	0	0	316
35 - 39	120	57	22	2	0	0	0	0	0	201
40 - 44	93	33	22	16	2	0	0	0	0	166
45 - 49	77	38	13	6	0	0	0	0	0	134
50 - 54	59	30	8	0	1	2	0	0	0	100
55 - 59	48	18	10	4	2	0	0	0	0	82
60 - 64	30	14	12	4	0	0	0	0	0	60
65 - 69	11	5	3	1	0	0	0	0	0	20
70 & Up	0	1	0	0	0	0	0	0	0	1
Total	1,042	306	99	33	5	2	0	0	0	1,487

Years of Service By Age School District

Age	Years of Service									Total
	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40+	
Under 25	147	0	0	0	0	0	0	0	0	147
25 - 29	358	25	0	0	0	0	0	0	0	383
30 - 34	279	114	9	0	0	0	0	0	0	402
35 - 39	217	116	58	6	1	0	0	0	0	398
40 - 44	180	86	61	57	13	1	0	0	0	398
45 - 49	151	84	61	72	74	8	0	0	0	450
50 - 54	128	79	50	70	55	24	2	0	0	408
55 - 59	109	90	58	61	53	23	28	1	0	423
60 - 64	92	81	38	59	47	25	33	21	6	402
65 - 69	24	33	19	18	20	13	9	8	9	153
70 & Up	12	7	6	11	5	3	2	3	1	50
Total	1,697	715	360	354	268	97	74	33	16	3,614

Section 3 (continued)

3.5 Distributions of Active Members

Years of Service By Age

Total

Age	Years of Service									Total
	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40+	
Under 25	223	0	0	0	0	0	0	0	0	223
25 - 29	663	51	0	0	0	0	0	0	0	714
30 - 34	502	198	18	0	0	0	0	0	0	718
35 - 39	337	173	80	8	1	0	0	0	0	599
40 - 44	273	119	83	73	15	1	0	0	0	564
45 - 49	228	122	74	78	74	8	0	0	0	584
50 - 54	188	109	58	70	56	26	2	0	0	509
55 - 59	158	108	70	65	55	23	28	1	0	508
60 - 64	123	96	51	63	47	25	33	21	6	465
65 - 69	35	38	22	19	20	13	9	8	9	173
70 & Up	12	8	6	11	5	3	2	3	1	51
Total	2,742	1,022	462	387	273	99	74	33	16	5,108

Section 3 (continued)

3.6 Distributions of Inactive Members

Deferred Vested and Nonvested

Account Balance	Vested	Non-Vested	Total
0-1,000	17	584	601
1,000-5,000	6	1,238	1,244
5,000-10,000	12	565	577
10,000-25,000	251	222	473
25,000-50,000	244	16	260
50,000-75,000	86	2	88
75,000-100,000	25	0	25
100,000+	6	0	6
Total	647	2,627	3,274

Retirees, Beneficiaries and Disabled

Option	Service benefit	Disability benefit	Survivor benefit	All
0	3,338	192	285	3,815
1	134	14	0	148
2	80	5	0	85
3	186	17	0	203
4	176	6	0	182
5	22	1	0	23
6	13	5	0	18
7	3	0	0	3
Total	3,952	240	285	4,477

Annual Benefit

Option	Service benefit	Disability benefit	Survivor benefit	All
0	85,407,357	\$ 2,877,817	\$ 3,482,422	\$ 91,767,596
1	2,411,304	184,112	0	2,595,416
2	1,894,243	117,333	0	2,011,576
3	3,922,696	238,317	0	4,161,013
4	4,653,421	133,370	0	4,786,791
5	543,686	9,911	0	553,597
6	262,947	48,317	0	311,264
7	72,357	0	0	72,357
Total	\$ 99,168,011	\$ 3,609,177	\$ 3,482,422	\$106,259,610

Section 3 (continued)

3.7 Schedule of Retirees and Beneficiaries Added/Removed From Rolls

Plan Year	Added to Payroll		Removed from Payroll		Payroll Year-End		% Increase in Annual Allowances	Average Annual Allowance
	No.	Annual Allowances	No.	Annual Allowances	No.	Annual Allowances		
2009	N/A		N/A		N/A		N/A	N/A
2010	N/A		N/A		4,370		N/A	N/A
2011	373		156		4,587	\$ 98,927,501	N/A	\$ 21,567
2012	135	\$ 2,606,505	182	\$ 2,793,752	4,540	\$ 98,768,933	-0.16%	\$ 21,755
2013	164	\$ 3,544,756	188	\$ 2,699,920	4,516	\$ 99,629,314	0.87%	\$ 22,061
2014	313	\$ 7,711,256	140	\$ 2,288,004	4,689	\$ 105,061,832	5.45%	\$ 22,406
2015	163	\$ 3,774,578	228	\$ 3,783,237	4,624	\$ 105,066,268	0.00%	\$ 22,722
2016	151	\$ 3,279,162	188	\$ 3,058,449	4,587	\$ 105,295,884	0.22%	\$ 22,955
2017	145	\$ 3,114,108	171	\$ 2,978,925	4,561	\$ 105,434,220	0.13%	\$ 23,116
2018	158	\$ 4,044,180	193	\$ 3,526,969	4,526	\$ 105,976,561	0.51%	\$ 23,415
2019	162	\$ 3,400,180	188	\$ 3,450,225	4,500	\$ 105,995,116	0.02%	\$ 23,554
2020	161	\$ 3,739,591	184	\$ 2,728,795	4,477	\$ 106,259,608	0.25%	\$ 23,735

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Interest

7.5% per annum, which includes a 2.75% allowance for inflation.

Participant account interest crediting rate

5.0% per annum.

Expenses

The rate of interest assumed is net of expenses.

Mortality – Healthy Lives

Mortality tables issued by the SOA, the RP-2014 Combined Healthy Mortality Table (rolled back to 2006), projected fully generationally using projection scale MP-2015. The mortality assumption for Inactive participants receiving benefits is increased by 10% to account for the higher mortality experienced by the Plan. Rates are shown for pre-commencement in Table 1 and post-commencement in Table 2.

Disability Mortality

RP-2014 Disabled Mortality Table (rolled back to 2006) for disabled retired Members, projected fully generationally using projection scale MP-2015. Rates are shown in Table 6.

Withdrawal

Withdrawals are assumed to occur at rates based on actual experience of the retirement system. During the first five years of membership, withdrawals are assumed to occur at the following rates:

Year of Membership	Non-charter school employees	Charter school employees
1 st	25.0%	35.0%
2 nd	20.0%	35.0%
3 rd	20.0%	35.0%
4 th	20.0%	25.0%
5 th	15.0%	15.0%

The rates used after the first five years of membership are shown in Table 3.

Salary scale

Salaries are assumed to increase at the rate of 5.0% per year for the first 5 years of employment and 3.50% thereafter.

Disability

Disabilities are assumed to occur at rates based on the actual experience of the retirement system. The rates used are shown in Table 5.

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Retirement

Retirements occur at rates based on the actual experience of the retirement system. The age-related rates used are shown in Table 4. The rates are different for those eligible to retire under the Rule of 80 and those not eligible to retire under the Rule of 80.

Family Structure

The probability of a participant being married and the probable number of children are based on a table constructed by the Social Security Administration, modified to reflect the experience of the retirement system. The rates used are shown in Table 7. For married participants, husbands are assumed to be 3 years older than their wives.

Gender

Members with no gender provided in the employee data by the System are assumed to be female.

Usage of Cash-out Option

Participants terminating in vested status are given the option of taking a refund of their accumulated participant contributions instead of a deferred retirement benefit. Active members who terminate in the future with a vested benefit are assumed to take a deferred vested annuity, unless a refund of contributions and interest is greater than the actuarial present value of their vested deferred benefit.

Future Benefit Increases or Additional Benefits

When funding is adequate, the Board may authorize cost of living adjustments (COLAs), as noted in the summary of plan provisions. This valuation assumes that no future COLAs will be awarded.

Actuarial Method – Frozen Entry Age

The actuarial cost method used by the System is the "frozen entry age actuarial cost method." Under this method, on the initial actuarial valuation date for which the cost method is used, the annual cost accruals (individual normal costs for each participant) are determined as a level percentage of pay for each year from entry age until retirement or termination. The initial Unfunded Frozen Actuarial Accrued Liability (UFAAL) was originally determined as of January 1, 1981. Entry age is determined at the date each participant would have entered the System. The sum of these individual normal costs for all active participants whose attained ages are under the assumed retirement age is the normal cost for the initial plan year. The excess of all normal costs falling due prior to the initial actuarial valuation date, accumulated with interest, over the plan assets establishes the UFAAL.

The UFAAL is only frozen in that it is not adjusted due to experience gains and losses. Instead, gains and losses are reflected through changes in the normal cost accrual rate. The UFAAL does change, increasing due to interest and additional normal costs, and decreasing due to contributions. Any changes to plan provisions or actuarial assumptions results in a change to the UFAAL. The amount of the change is determined by computing the impact in the actuarial accrued liability as of the valuation date coincident with or next following the change.

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Normal costs are calculated as the level percentage of pay required to fund the excess of the actuarial present value of future benefits over the sum of the actuarial value of current assets and the remaining UFAAL.

Effective January 1, 2006, UFAAL was reestablished to better reflect an appropriate relationship between the normal cost and the actuarial accrued liability.

The funding requirement for each plan year is the sum of the "normal cost contribution" (equal to the normal cost for that year), plus the "actuarial accrued liability contribution." The "actuarial accrued liability contribution" is the payment required to amortize the UFAAL over 30 years, from January 1, 2006, the date that it was reestablished.

Valuation of Assets

The actuarial value of assets is determined using the assumed yield method of valuing assets. Under the assumed yield asset valuation method, the prior year's actuarial value is increased at the assumed rate of return with appropriate adjustments for contributions and disbursements to produce an expected actuarial value of assets at the end of the year. The expected actuarial value is compared to the market value of assets less the expense and contingency reserve, and 20% of the difference is added to the expected actuarial value. The actuarial value of assets was "fresh-started" as of January 1, 2006 and set equal to the market value of assets as of that date.

Changes in Methods and Assumptions from the Prior Valuation

There were no method or assumption changes made since the prior valuation.

Effective August 28, 2017, legislation passed by the Missouri General Assembly and signed into law by then Governor Eric Greitens changed several of the System's Plan Provisions. A detailed description of these changes appears at the end of Section 3.2.

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 1
Mortality Rates for Pre-Commencement
Annual Rates Per 1,000 Members

Age	Rate		Age	Rate	
	Male	Female		Male	Female
20	0.190	0.116	60	2.959	3.365
21	0.203	0.113	61	3.369	3.668
22	0.215	0.114	62	3.704	3.986
23	0.233	0.119	63	4.180	4.314
24	0.251	0.126	64	4.540	4.648
25	0.275	0.134	65	4.892	4.983
26	0.314	0.147	66	5.398	5.314
27	0.327	0.153	67	5.731	5.636
28	0.336	0.162	68	5.858	5.945
29	0.353	0.171	69	6.143	6.240
30	0.380	0.193	70	6.210	6.517
31	0.427	0.239	71	7.026	7.108
32	0.481	0.273	72	8.658	8.290
33	0.540	0.298	73	11.106	10.064
34	0.601	0.319	74	14.369	12.429
35	0.662	0.337	75	18.448	15.385
36	0.720	0.354	76	23.343	18.932
37	0.774	0.369	77	29.054	23.071
38	0.800	0.386	78	35.581	27.801
39	0.821	0.406	79	42.924	33.122
40	0.841	0.442	80	51.083	39.034
41	0.863	0.484	81	58.516	43.204
42	0.890	0.533	82	66.910	47.896
43	0.922	0.586	83	74.584	53.181
44	0.961	0.644	84	84.893	59.146
45	1.005	0.682	85	94.233	67.435
46	1.044	0.719	86	104.477	76.970
47	1.085	0.755	87	118.458	87.853
48	1.128	0.817	88	134.192	97.854
49	1.172	0.883	89	148.298	111.198
50	1.217	0.985	90	167.257	122.890
51	1.262	1.100	91	182.177	134.949
52	1.309	1.271	92	202.142	147.094
53	1.401	1.468	93	218.060	162.763
54	1.503	1.700	94	233.954	174.573
55	1.671	1.969	95	255.453	185.756
56	1.883	2.287	96	271.129	196.137
57	2.132	2.577	97	286.358	210.344
58	2.424	2.817	98	308.123	218.852
59	2.677	3.081	99	322.695	226.123

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 2
Mortality Rates for Post-Commencement
Annual Rates Per 1,000 Members

Age	Rate		Age	Rate	
	Male	Female		Male	Female
20	0.190	0.116	60	5.656	5.525
21	0.203	0.113	61	6.358	6.166
22	0.215	0.114	62	7.004	6.852
23	0.233	0.119	63	7.918	7.582
24	0.251	0.126	64	8.761	8.372
25	0.275	0.134	65	9.703	9.235
26	0.314	0.147	66	11.004	10.170
27	0.327	0.153	67	12.182	11.175
28	0.336	0.162	68	13.160	12.271
29	0.353	0.171	69	14.537	13.503
30	0.380	0.193	70	15.686	14.919
31	0.427	0.239	71	17.356	16.177
32	0.481	0.273	72	19.271	17.994
33	0.540	0.298	73	21.465	19.543
34	0.601	0.319	74	23.946	21.660
35	0.662	0.337	75	27.356	23.365
36	0.720	0.354	76	30.490	25.743
37	0.774	0.369	77	34.715	29.017
38	0.800	0.386	78	39.486	31.986
39	0.821	0.406	79	44.915	35.314
40	0.841	0.442	80	51.083	39.034
41	0.890	0.484	81	58.516	43.204
42	0.987	0.533	82	66.910	47.896
43	1.133	0.586	83	74.584	53.181
44	1.328	0.644	84	84.893	59.146
45	1.572	0.689	85	94.233	67.435
46	1.864	0.778	86	104.477	76.970
47	2.205	0.912	87	118.458	87.853
48	2.595	1.090	88	134.192	97.854
49	3.034	1.313	89	148.298	111.198
50	3.521	1.580	90	167.257	122.890
51	3.556	1.697	91	182.177	134.949
52	3.546	1.914	92	202.142	147.094
53	3.595	2.193	93	218.060	162.763
54	3.643	2.532	94	233.954	174.573
55	3.798	2.935	95	255.453	185.756
56	4.033	3.418	96	271.129	196.137
57	4.344	3.908	97	286.358	210.344
58	4.758	4.385	98	308.123	218.852
59	5.165	4.929	99	322.695	226.123

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 3
Withdrawal Rates
Annual Rates Per 1,000 Members

Age	Rate	Age	Rate
20	204.0	45	44.0
21	197.0	46	41.0
22	190.0	47	37.0
23	184.0	48	34.0
24	177.0	49	31.0
25	171.0	50	28.0
26	161.0	51	26.0
27	151.0	52	25.0
28	141.0	53	24.0
29	131.0	54	23.0
30	121.0	55	22.0
31	117.0	56	21.0
32	112.0	57	20.0
33	108.0	58	19.0
34	103.0	59	18.0
35	99.0	60	17.0
36	96.0	61	0.0
37	92.0	62	0.0
38	89.0	63	0.0
39	86.0	64	0.0
40	83.0		
41	75.0		
42	67.0		
43	59.0		
44	52.0		

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 4
Retirement Rates
Annual Rates Per 1,000 Members

Age	Rule of 80 Rate	Not Rule of 80 Rate
50-51	200.0	N/A
52-59	150.0	N/A
60	200.0	100.0
61	200.0	100.0
62	250.0	150.0
63	250.0	150.0
64	250.0	200.0
65	300.0	350.0
66	300.0	200.0
67	300.0	200.0
68	300.0	200.0
69	300.0	200.0
70 - 71	300.0	300.0
72	1,000.0	1,000.0

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 5
Disability Rates
Annual Rates Per 1,000 Members

Age	Rate		Age	Rate	
	Males	Females		Males	Females
20	0.00	0.00	45	1.50	1.00
21	0.00	0.00	46	1.60	1.10
22	0.00	0.00	47	1.70	1.20
23	0.00	0.00	48	1.80	1.30
24	0.00	0.00	49	1.90	1.40
25	0.00	0.00	50	2.00	1.50
26	0.00	0.00	51	2.50	1.70
27	0.00	0.00	52	3.00	1.90
28	0.00	0.00	53	3.50	2.10
29	0.00	0.00	54	4.00	2.30
30	0.40	0.40	55	4.50	2.50
31	0.40	0.40	56	4.70	2.60
32	0.40	0.40	57	4.90	2.75
33	0.40	0.40	58	5.10	2.85
34	0.40	0.40	59	5.30	3.00
35	0.40	0.40	60	5.50	3.25
36	0.45	0.45	61	6.00	3.50
37	0.50	0.50	62	6.50	3.50
38	0.60	0.60	63	7.00	3.50
39	0.70	0.70	64	7.50	3.50
40	0.80	0.75	65	0.00	0.00
41	0.95	0.80			
42	1.10	0.85			
43	1.25	0.90			
44	1.40	0.95			

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 6
Post-Disability Mortality Rates
Annual Rates Per 1,000 Members

Age	Rate		Age	Rate	
	Male	Female		Male	Female
20	0.000	0.000	60	42.042	21.839
21	22.571	7.450	61	43.474	22.936
22	22.571	7.450	62	44.981	24.080
23	22.571	7.450	63	46.584	25.293
24	22.571	7.450	64	48.307	26.600
25	22.571	7.450	65	50.174	28.026
26	22.571	7.450	66	52.213	29.594
27	22.571	7.450	67	54.450	31.325
28	22.571	7.450	68	56.909	33.234
29	22.571	7.450	69	59.613	35.335
30	22.571	7.450	70	62.583	37.635
31	22.571	7.450	71	65.841	40.140
32	22.571	7.450	72	69.405	42.851
33	22.571	7.450	73	73.292	45.769
34	22.571	7.450	74	77.512	48.895
35	22.571	7.450	75	82.067	52.230
36	22.571	7.450	76	86.951	55.777
37	22.571	7.450	77	92.149	59.545
38	22.571	7.450	78	97.640	63.545
39	22.571	7.450	79	103.392	67.793
40	22.571	7.450	80	109.372	72.312
41	22.571	7.450	81	115.544	77.135
42	22.571	7.450	82	121.877	82.298
43	22.571	7.450	83	128.343	87.838
44	22.571	7.450	84	134.923	93.794
45	22.571	7.450	85	141.603	100.203
46	23.847	8.184	86	148.374	107.099
47	25.124	8.959	87	155.235	114.512
48	26.404	9.775	88	162.186	122.464
49	27.687	10.634	89	169.233	130.972
50	28.975	11.535	90	183.408	140.049
51	30.268	12.477	91	199.769	149.698
52	31.563	13.456	92	216.605	159.924
53	32.859	14.465	93	233.662	170.433
54	34.152	15.497	94	250.693	182.799
55	35.442	16.544	95	267.491	194.509
56	36.732	17.598	96	283.905	205.379
57	38.026	18.654	97	299.852	215.240
58	39.334	19.710	98	315.296	223.941
59	40.668	20.768	99	330.207	231.387

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 7
Family Structure

Male	Age		Age of youngest child	Average number of children	Probability of being married	Probability of children if married
	Female					
20	17		2	.90	.30	.50
21	18		2	.90	.35	.50
22	19		2	.98	.40	.50
23	20		2	.98	.46	.53
24	21		3	1.05	.53	.56
25	22		3	1.13	.60	.59
26	23		4	1.20	.67	.62
27	24		4	1.28	.74	.65
28	25		4	1.35	.76	.67
29	26		5	1.43	.78	.69
30	27		5	1.50	.80	.71
31	28		6	1.58	.82	.73
32	29		6	1.65	.84	.75
33	30		7	1.80	.85	.76
34	31		7	1.95	.86	.77
35	32		8	2.10	.87	.78
36	33		8	2.10	.87	.79
37	34		9	2.10	.87	.80
38	35		9	2.30	.87	.79
39	36		10	1.95	.87	.78
40	37		10	1.88	.87	.77
41	38		11	1.80	.87	.76
42	39		11	1.73	.87	.75
43	40		11	1.73	.87	.72
44	41		12	1.65	.87	.69
45	42		12	1.65	.86	.66
46	43		12	1.58	.86	.63
47	44		12	1.58	.86	.60
48	45		12	1.50	.85	.56
49	46		12	1.43	.85	.52
50	47		13	1.43	.85	.48
51	48		13	1.35	.85	.44
52	49		13	1.35	.85	.40
53	50		13	1.35	.85	.37
54	51		13	1.35	.84	.34

Section 3 (continued)

3.8 Summary of Methods and Assumptions

Table 7
Family Structure
(continued)

Male	Age		Age of youngest child	Average number of children	Probability of being married	Probability of children if married
	Male	Female				
55	52		13	1.28	.84	.31
56	53		13	1.28	.83	.28
57	54		13	1.28	.83	.25
58	55		13	1.28	.83	.23
59	56		13	1.20	.82	.21
60	57		13	1.20	.81	.19
61	58		13	1.20	.80	.17
62	59		13	1.20	.79	.15
63	60		13	1.20	.78	.13
64	61		13	1.20	.77	.11
65	62		13	1.13	.76	.09
66	63		13	1.13	.75	.07
67	64		13	1.13	.74	.05
68	65		13	1.13	.73	.04
69	66		13	1.05	.72	.03
70	67		13	1.05	.71	.02
71	68		13	1.05	.70	.01

Section 3 (continued)

3.9 Definition of Actuarial Terms

Accrued benefit

The benefit earned by a participant as of the date at which the determination is made payable in the form of an annual benefit commencing at normal retirement age. The accrued benefit is payable for the member's lifetime only, however if the total monthly payments at the member's death are less than contributions accumulated with interest, the remaining employee contribution balance will be paid to the member's beneficiary.

Accumulated plan benefits

The accrued benefits and any other benefits, whether vested or not, that have been earned by the participants covered by the plan as of the date at which the determination is made. These other benefits include any death, early retirement or disability benefits provided under the plan.

Actuarial accrued liability

Equal to the actuarial present value of future benefits less the present value of future annual normal costs.

Actuarial cost method

The method for allocating the actuarial present value of a pension plan's benefits and expenses to various time periods. An actuarial cost method is also referred to as a funding method.

Actuarial gain/(loss)

The difference between the plan's actual experience and that expected based upon a set of actuarial assumptions. A gain occurs when the experience of the plan is more favorable (in terms of cost) than the assumptions projected; a loss occurs when experience is less favorable. May also be referred to as experience gains/(losses).

Actuarial present value

See present value.

Actuarial valuation

The determination, as of a valuation date, of the annual normal cost, actuarial accrued liability, actuarial value of assets and related actuarial present values for a pension plan.

Actuarial value of assets

The value of cash, investments and other property belonging to a pension plan determined by the actuary for the purpose of an actuarial valuation. Actuarial asset methods are generally designed to reduce fluctuations in asset value due to large variations in returns from year to year. Actuarial values are generally a smoothed market value that recognize gains and losses over time.

Amortization

The spreading of a present value or a cost over a period of years. A plan's unfunded actuarial accrued liability is amortized over a period of years.

Section 3 (continued)

3.9 Definition of Actuarial Terms

Fiscal year

The year on which the plan sponsor maintains its financial records.

Funded

Provided by plan assets. A liability is fully funded when assets exceed or equal the liability.

Normal cost

That portion of the actuarial present value of pension plan benefits and expenses which is allocated to a valuation year by the actuarial cost method.

Normal retirement age

An age defined in the plan for purposes of establishing when a terminated participant is entitled to an accrued benefit.

Normal retirement benefit

The benefit payable when it commences at the normal retirement age.

Participant

A person covered by a pension plan in accordance with its terms including active participants, retired participants and beneficiaries, vested terminations and vested transfers.

Plan year

The year on which the plan maintains its financial records.

Present value

The value of an amount or series of amounts payable at various times, determined as of a given date by the application based on a particular set of actuarial assumptions. It is a single sum which reflects the time value of money and the probabilities of payment.

Rate of return

The actual or expected investment income as a percentage of a plan's average assets.

System

Public School Retirement System of the City of St. Louis, Missouri.

Unfunded actuarial accrued liability

The excess of the actuarial accrued liability over the actuarial value of assets.

Vested benefit

A benefit that is not forfeited if the participant terminates employment.

Section 4 – ASOP 51 Disclosures

Funding future retirement benefits prior to when those benefits become due involves assumptions regarding future economic and demographic experience. These assumptions are applied to calculate actuarial liabilities, current contribution requirements and the funded status of the system. However, to the extent future experience deviates from the assumptions used, variations will occur in these calculated values. These variations create risk to the system. Understanding the risks to the funding of the system is important. Therefore, a new Actuarial Standard of Practice (ASOP) has been adopted. Actuarial Standard of Practice No. 51 (“ASOP 51”) requires certain disclosures of potential risks to the system and provides useful information for intended users of actuarial reports that determine system contributions or evaluate the adequacy of specified contribution levels to support benefit provisions.

Under ASOP 51, risk is defined as the potential of actual future measurements deviating from expected future measurements resulting from actual future experience deviating from actuarially assumed experience.

It is important to note that not all risk is negative, but all risk should be understood and accepted based on knowledge, judgement and educated decisions. Future measurements may deviate in ways that produce positive or negative financial impacts to the system.

In the actuary’s professional judgment, the following risks may reasonably be anticipated to significantly affect the system’s future financial condition.

- Investment risk – potential that the investment return will be different than the 7.50% expected in the actuarial valuation
- Longevity risk – potential that participants live longer than expected from the valuation mortality assumptions
- Contribution risk – potential that the contribution will be different than the recommended contribution in the actuarial valuation

The following information is provided to comply with ASOP 51 and furnish beneficial information on potential risks to the system. This list is not all-inclusive; it is an attempt to identify the most significant risks and how those risks might affect the results shown in this report.

Section 4 (continued)

Note that ASOP 51 does not require the actuary to evaluate the ability or willingness of the system sponsor to make contributions to the system when due, or to assess the likelihood or consequences of potential future changes in law. In addition, this valuation report is not intended to provide investment advice or to provide guidance on the management or reduction of risk. Buck welcomes the opportunity to assist in such matters as part of a separate project or projects utilizing the appropriate staff and resources for those objectives.

Investment Risk

System costs are very sensitive to the market return. Any lower than assumed return on assets will increase costs:

- The lower market return will cause the market value of assets to be lower than expected.
- The plan uses an actuarial value of assets that adjusts the value by 20% of the excess of the market value of assets and the expected actuarial value as of the valuation date. This methodology helps to control some of the volatility in costs due to investment risk.
- Historical experience of market returns is shown in Schedule D: Summary of Investment Yield Performance. This historical experience illustrates how returns can vary over time.

Longevity Risk

System costs will be increased as participants are expected to live longer. This is because:

- Benefits are paid over a longer lifetime when life expectancy is expected to increase. The longer duration of payments leads to higher liabilities.
- Health care has been improving which increases the life expectancy of participants. As health care improves, costs to the system will increase.
- The mortality assumption for the System does assume future improvement in mortality. Any improvement in future mortality greater than that expected by the current mortality assumption would lead to increased costs for the System.

Contribution Risk

There is a risk associated with the employer's contribution when the actual amount and recommended amount differ. This is because:

- When the actual contribution is lower than the recommended contribution the System may not be sustainable in the long term.
- Any underpayment of the contribution will increase future contribution amounts to help pay off the additional Unfunded Actuarial Accrued Liability associated with any lower than recommended contribution amounts.
- Because of the legislative changes made to the employer contribution amounts, this is a significant risk to the plan. The actuarially determined contribution in this valuation is 18.17% of covered payroll. However, the annual required contribution due to the changes is only 15.00% of covered payroll.

Section 4 (continued)

System Maturity Measures:

There are certain measures that may aid in understanding the significant risks to the system.

Ratio of Retired Liability to Total Liability	January 1, 2018	January 1, 2019	January 1, 2020
1. Retirees and Beneficiaries	901,926,852	897,846,332	891,935,875
2. Total Accrued Liability	1,411,197,070	1,414,382,087	1,423,729,232
3. Ratio [(1) / (2)]	63.9%	63.5%	62.6%

A mature system will often have a ratio above 60 - 65 percent. A higher percentage will generally indicate an increased need for asset / liability matching.

Ratio of Cash Flow to Assets	December 31, 2017	December 31, 2018	December 31, 2019
1. Contributions	53,668,896	63,029,522	60,922,391
2. Benefit Payments	112,950,471	114,010,652	113,101,170
3. Cash Flow [(1) – (2)]	(59,281,575)	(50,981,130)	(52,178,779)
4. Market Value of Assets	914,082,259	819,449,893	893,295,602
5. Ratio [(3) / (4)]	(6.49%)	(6.22%)	(5.84%)

Section 4 (continued)

When this cash flow ratio is negative more cash is being paid out than deposited in the fund. Negative cash flow means the fund needs to rely on investment returns to cover benefit payments and at the same time may need to invest in more liquid assets to cover the benefit payments. More liquid assets may not garner the same returns as less liquid assets and therefore increase the investment risk. However, the low magnitude of the ratio implies there may already be enough liquid assets to cover the benefit payments, less investment return is needed to cover the shortfall, or only a small portion of assets will need to be converted to cash. Therefore, the investment risk is likely not amplified at this time. This maturity measure should be monitored for continual negative trend with greater magnitude.

Contribution Volatility	January 1, 2018	January 1, 2019	January 1, 2020
1. Market Value of Assets	914,082,259	819,449,893	893,295,602
2. Payroll	265,773,659	263,772,380	272,973,377
3. Asset Volatility Ratio (AVR) [(1) / (2)]	3.44	3.11	3.27
4. Accrued Liability	1,411,197,070	1,414,382,087	1,423,729,232
5. Liability Volatility Ratio (LVR) [(4) / (2)]	5.31	5.36	5.22

Systems that have higher asset-to-payroll ratios experience more volatile employer contributions (as a percentage of payroll) due to investment return. For example, a system with an asset-to-payroll ratio of 10 may experience twice the contribution volatility due to investment return volatility than a system with an asset-to-payroll ratio of 5. Systems that have higher liability-to-payroll ratios experience more volatile employer contributions (as a percentage of payroll) due to changes in liability. For example, if an assumption change increases the liability of two systems by the same percent the system with a liability-to-payroll ratio of 10 may experience twice the contribution volatility than a system with a liability-to-payroll ratio of 5.