State Police Retirement System (SPRS)

Actuarial Valuation Report
as of June 30, 2021

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December 2, 2021

Board of Trustees
Kentucky Retirement System
Perimeter Park West
1260 Louisville Road
Frankfort, KY 40601

Subject: Actuarial Valuation as of June 30, 2021

Dear Trustees of the Board:

This report describes the current actuarial condition of the State Police Retirement System (SPRS) and provides the actuarially determined employer contribution rates for fiscal years ending June 30, 2023 and June 30, 2024. In addition, the report analyzes changes in SPRS's financial condition and provides various summaries of the data.

Separate reports are issued with regard to valuation results determined in accordance with Governmental Accounting Standards Board (GASB) Statements 67, 68, 74 and 75. Results of this report should not be used for any other purpose without consultation with the undersigned. Valuations are prepared annually as of June 30, the first day of the plan year for SPRS. This report was prepared at the request of the Board of Trustees of the Kentucky Retirement System (Board) and is intended for use by the Kentucky Public Pensions Authority (KPPA) staff and those designated or approved by the Board.

FINANCING OBJECTIVES AND FUNDING POLICY

The contribution rates determined by these actuarial valuations are intended to become effective twelve months after the valuation date and, as such, are intended to be used by the Board for recommending required contribution rates effective July 1, 2022, as well as the subsequent fiscal year beginning July 1, 2023 and ending June 30, 2024.

The employer contribution rate is determined in accordance with Section 61.565 of Kentucky Statute. As specified by the Statute, the employer contribution is comprised of a normal cost contribution and an actuarial accrued liability contribution. The actuarial accrued liability contribution is calculated by amortizing the unfunded accrued liability as of June 30, 2019 over a closed 30-year amortization period (28 years remaining as of June 30, 2021). Gains and losses incurring in years after June 30, 2019 are amortized as separate closed 20-year amortization bases.

Assumptions and Methods

The Board of Trustees, in consultation with the actuary, sets the actuarial assumptions and methods used in the actuarial valuation. Except where noted in this report, the assumptions used in this actuarial valuation were adopted by the Board for first use in the June 30, 2019 actuarial valuation and are based on an experience study conducted with experience through June 30, 2018. There were no changes in actuarial assumptions or methods since the prior valuation.

The results of the actuarial valuation are dependent on the actuarial assumptions used. Actual results can, and almost certainly will, differ as actual experience deviates from the assumptions. Even seemingly minor changes in the assumptions can materially change the liabilities, calculated contribution rate, and funding periods. The actuarial calculations are intended to provide information for rational decision making.

This report was prepared using our proprietary valuation model and related software which in our professional judgment has the capability to provide results that are consistent with the purposes of the valuation. We performed tests to ensure that the model reasonably represents that which is intended to be modeled.

Benefit Provisions

The benefit provisions reflected in these valuations are those which were in effect on June 30, 2021. Senate Bill 169 passed during the 2021 legislative session and increased the disability benefits for certain members who become “totally and permanently disabled” in the line of duty or as a result of a duty-related disability. There were no other material benefit provision changes since the prior valuation.

Data

Member data for retired, active and inactive members was supplied as of June 30, 2021, by KPPA staff. The staff also supplied asset information as of June 30, 2021. We did not audit this data, but we did apply a number of tests to the data, and we concluded that it was reasonable and consistent with the prior year's data. GRS is not responsible for the accuracy or completeness of the information provided to us by KPPA.

CERTIFICATION

We certify that the information presented herein is accurate and fairly portrays the actuarial position of SPRS as of June 30, 2021.

All of our work conforms with generally accepted actuarial principles and practices, and is in conformity with the Actuarial Standards of Practice issued by the Actuarial Standards Board. In our opinion, our calculations also comply with the requirements of Kentucky Code of Laws and, where applicable, the Internal Revenue Code, ERISA, and the Statements of the Governmental Accounting Standards Board.

The undersigned are independent actuaries and consultants. Both of the undersigned are Enrolled Actuaries, Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. Both of the undersigned are experienced in performing valuations for large public retirement systems. This communication shall not be construed to provide tax advice, legal advice or investment advice.

Sincerely,

Gabriel, Roeder, Smith & Company

Daniel J. White, FSA, EA, MAAA
Senior Consultant

Janie Shaw, ASA, EA, MAAA
Consultant

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SECTION 1

EXECUTIVE SUMMARY

Summary of Principal Results

(Dollar amounts expressed in thousands)

	SPRS	
	June 30, 2021	June 30, 2020
Actuarially Determined Contribution:		
Retirement	126.40%	127.99%
Insurance	14.11%	18.07%
Total	140.51%	146.06%
Contribution Rate for Next Fiscal Year[1]	140.51%	146.06%
Assets:		
Retirement		
• Actuarial value (AVAR)	$323,250	$296,126
• Market value (MVAR)	$356,346	$293,949
• Ratio of actuarial to market value of assets	90.7%	100.7%
Insurance		
• Actuarial value (AVAI)	$223,251	$207,018
• Market value (MVAI)	$247,318	$201,340
• Ratio of actuarial to market value of assets	90.3%	102.8%
Funded Status:		
Retirement		
• Actuarial accrued liability	$1,053,259	$1,053,158
• Unfunded accrued liability on AVAR	$730,009	$757,032
• Funded ratio on AVAR	30.7%	28.1%
• Unfunded accrued liability on MVAR	$696,913	$759,209
• Funded ratio on MVAR	33.8%	27.9%
Insurance		
• Actuarial accrued liability	$272,406	$276,144
• Unfunded accrued liability on AVAI	$49,155	$69,126
• Funded ratio on AVAI	82.0%	75.0%
• Unfunded accrued liability on MVAI	$25,088	$74,804
• Funded ratio on MVAI	90.8%	72.9%
Membership:		
• Number of		
- Active Members	775	798
- Retirees and Beneficiaries	1,673	1,669
- Inactive Members	634	589
- Total	3,082	3,056
• Projected payroll of active members	$45,338	$46,145
• Average salary of active members	$58,501	$57,826

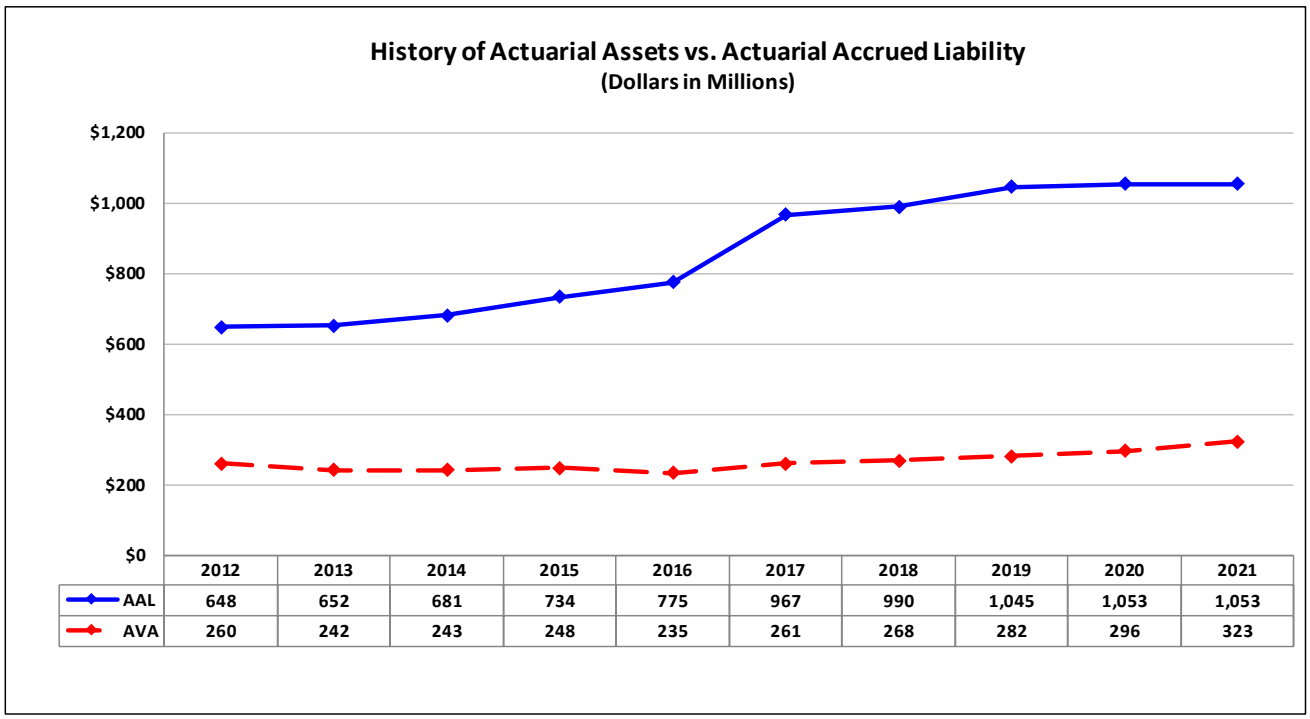
[1] Contribution rates calculated with the June 30, 2021 valuation are effective for fiscal years ending June 30, 2023 and June 30 2024. Rates calculated with the June 30, 2020 valuation are effective for fiscal year ending June 30, 2022.

Executive Summary (Continued)

Retirement Fund

The unfunded actuarial accrued liability of the retirement fund decreased by $27 million since the prior year's valuation to $730 million. This decrease was approximately $13.5 million more than expected, primarily due to favorable investment experience in the past year.

Below is a chart with the historical actuarial value of assets and actuarial accrued liability. The divergence in the assets and liability over the last ten years has generally been due to: (1) actual contributions being insufficient to finance the unfunded actuarial accrued liability, and (2) decreases in the assumed rate of return between 2015 and 2017.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AAL	648	652	681	734	775	967	990	1,045	1,053	1,053
AVA	260	242	243	248	235	261	268	282	296	323

Executive Summary (Continued)

Summary of Change in Financial Condition of the Insurance Fund

Both the 2022 non-Medicare and Medicare premiums were lower than expected based on the prior year's actuarial assumptions, which resulted in lower than expected accrued liability for the insurance fund.

Specifically, the non-Medicare premiums were expected to increase by 6.4% from calendar year 2021 to calendar year 2022 (i.e. the medical trend assumption for non-Medicare premiums used) and the actual premiums increased by approximately 2.4%. The Medicare premiums were expected to increase by 2.9% from calendar year 2021 to calendar year 2022, which was based on the "Not to Exceed" 2022 Medicare premiums that Humana provided in 2021. Actual Medicare premiums increased by approximately 2.0%.

Since the prior year's valuation, the unfunded actuarial accrued liability of the insurance fund decreased by $20 million since the prior year's valuation to $49 million. This decrease was approximately $18 million more than expected, which includes a $8 million gain due to favorable investment experience and a $6 million gain due to the favorable premium experience. The corresponding funded ratio increased from 75.0% at June 30, 2020 to 82.0% at June 30, 2021.

SECTION 2

DISCUSSION

Discussion

The State Police Retirement System (SPRS) is a defined benefit pension plan that provides coverage for uniformed state police officers. SPRS includes hazardous duty benefits only. This report presents the results of the June 30, 2021 actuarial funding valuation for both the Retirement Fund and Insurance Fund.

The primary purposes of the valuation report are to describe the current actuarial condition of SPRS and provide the actuarially determined employer contribution rates for fiscal years ending June 30, 2023 and June 30, 2024. In addition, the report analyzes changes in SPRS's financial condition and provides various summaries of the data.

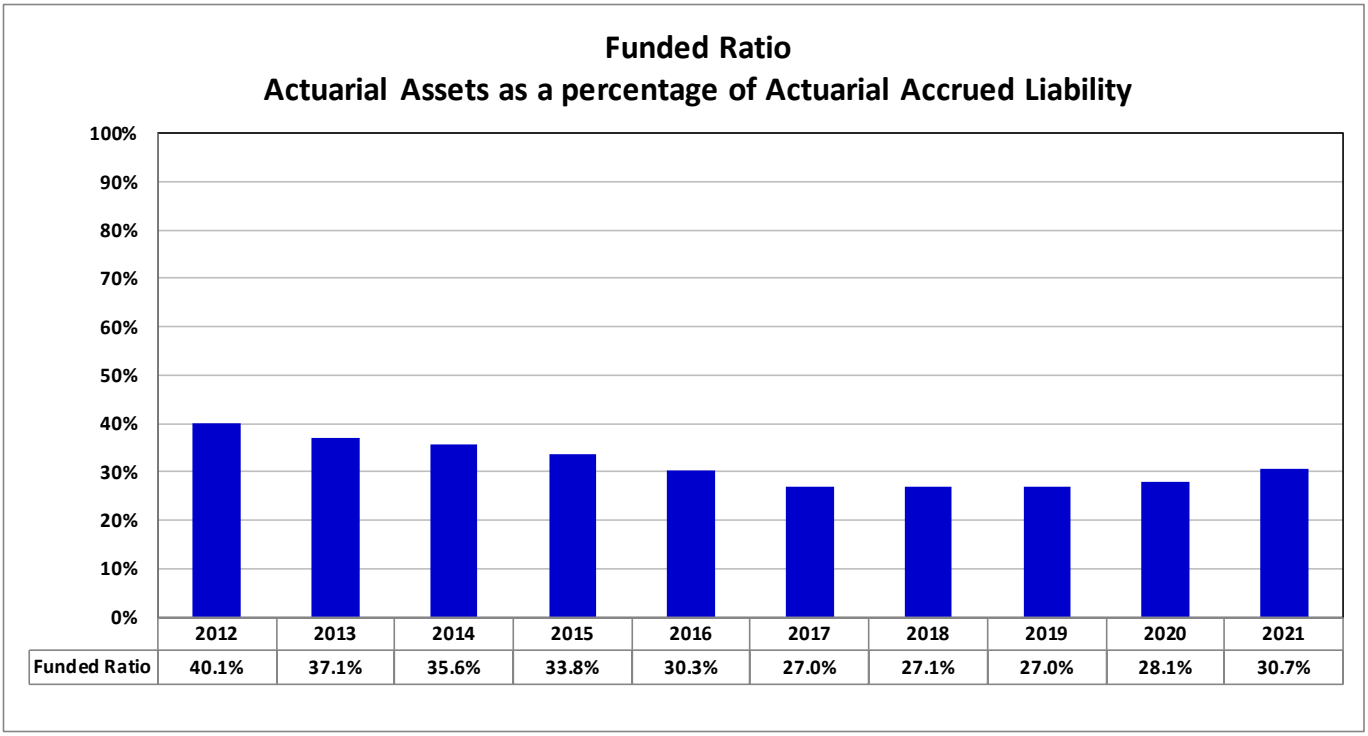
The actuarially determined contribution consist of two components: a normal cost rate and an amortization cost to finance the unfunded actuarial accrued liability. The normal cost rate is the theoretical amount which would be required to pay the members' benefits, based on the current plan provisions, if this amount had been contributed from each member's entry date and if the fund's experience exactly followed the actuarial assumptions. This is the amount that it should cost to provide the benefits for an average member. Since members contribute to the fund, only the excess of the normal rate over the member contribution rate is included in the employer contribution. The amortization cost is the amount necessary to amortize the unfunded actuarial accrued liability. The payroll growth rate and discount rate assumptions are selected by the Board. The funding period is specified in Section 61.565 of Kentucky Statute.

All of the actuarial and financial tables referenced by the other sections of this Report appear in Section 3. Section 4 provides additional details related to the calculation of the amortization of the unfunded actuarial accrued liability. Section 5 provides member data and statistical information. Section 6 provides a discussion of various risk measures, which are intended to aid stakeholders in understanding the effects of future experience differing from the assumptions used in performing an actuarial valuation. Appendices A and B provide summaries of the principle actuarial assumptions and methods and plan provisions. Finally, Appendix C provides a glossary of technical terms that are used throughout this report.

Funding Progress

The following chart provides a ten-year history of the retirement fund's funded ratio (i.e. the Actuarial Value of Assets divided by the Actuarial Accrued Liability). The decline in the funded ratio over the last ten years has generally been due to: (1) actual contributions being insufficient to finance the unfunded actuarial accrued liability, and (2) decreases in the assumed rate of return between 2015 and 2017.

The funded ratio increased from 2020 to 2021 for the retirement fund. Assuming the full actuarially determined contributions are paid in future years and absent future unfavorable experience, the funded ratio is expected to continue improving. Also, the dollar amount of the unfunded actuarial accrued liability, or the difference between the actuarial accrued liability and the actuarial value of assets, is expected to continue decreasing. Table 9, Schedule of Funding Progress, in the following section of the report provides additional detail regarding the funding progress of the Retirement Funds.



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Funded Ratio	40.1%	37.1%	35.6%	33.8%	30.3%	27.0%	27.1%	27.0%	28.1%	30.7%

Asset Gains/ (Losses)

The actuarial value of assets ("AVA") is based on a smoothed market value of assets, using a systematic approach to phase-in the difference between the actual and expected investment return on the market value of assets (adjusted for receipts and disbursements during the year). This is appropriate because it dampens the short-term volatility inherent in investment markets. The return is computed net of investment expenses.

Retirement Fund

The actuarial value of assets for the retirement fund increased from $296 million to $323 million since the prior valuation. The rate of return on the market value of assets on a dollar-weighted basis for the prior fiscal year was 21.0% which is greater than the 5.25% expected annual return. The return on an actuarial (smoothed) asset value was 8.9%, which resulted in a $10.9 million gain for the fiscal year. This difference in the estimated return on market value and actuarial value illustrates the smoothing effect of the asset valuation method. The market value of assets is $33 million greater than the actuarial value of assets, which signifies that the retirement fund is in a position of deferred gains to be realized in future years.

Table 6 in the following section of this report provides asset information that was included in the annual financial statements of the funds, as well as the estimated yield on a market value basis. Table 7 provides the development of the actuarial value of assets and the estimated yield on an actuarial value basis.

Actuarial Gains/ (Losses)

The annual actuarial valuation is a snapshot analysis of the benefit liabilities, assets and funded position of the funds as of the first day of the plan year. In any one fiscal year, the experience can be better or worse from that which is assumed or expected. The actuarial assumptions do not necessarily attempt to model what the experience will be for any one given fiscal year, but instead try to model the overall experience over many years. Therefore, as long as the actual experience of a retirement system is reasonably close to the current assumptions, the long-term funding requirements of the system will remain relatively consistent.

Below is a table that separately shows a reconciliation of the unfunded liability since the prior actuarial valuation for the retirement and health insurance funds, which include the effect of asset and liability gains and losses, changes in assumptions, and changes in plan provisions.

Experience Gain or (Loss)
(Dollar amounts expressed in thousands)

	Retirement	Insurance
A. Calculation of total actuarial gain or loss		
1. Unfunded actuarial accrued liability (UAAL), previous year	$ 757,032	$ 69,126
2. Normal cost and administrative expenses	12,478	3,618
3. Less: contributions for the year	(64,402)	(9,494)
4. Interest accrual	38,381	4,137
5. Expected UAAL (Sum of Items 1 - 4)	$ 743,489	$ 67,387
6. Actual UAAL as of June 30,2021	$ 730,009	$ 49,155
7. Total gain (loss) for the year (Item 5 - Item 6)	$ 13,480	$ 18,232
B. Source of gains and losses		
8. Asset gain (loss) for the year	$ 10,893	$ 7,740
9. Liability experience gain (loss) for the year	2,622	10,591
10. Plan Change	(35)	(99)
11. Assumption change	—	—
12. Total	$ 13,480	$ 18,232

The accrued liability was approximately 0.2% less than expected for the retirement fund, resulting in the liability experience gain shown above. This experience was primarily due to lower than expected salary increases for active members and more terminations of vested active members than expected. The liability experience gain shown above for the insurance fund includes a $6.5 million gain due to the fund's favorable premium experience. See the discussion in the Executive Summary for additional information.

Actuarial Assumptions and Methods

In determining costs and liabilities, actuaries use assumptions about the future, such as rates of salary increase, probabilities of retirement, termination, death and disability, and an annual investment return assumption. The Board of Trustees, in consultation with the actuary, sets the actuarial assumptions and methods used in the actuarial valuation.

In conjunction with the review of the healthcare per capita claims cost, the assumed increase in future healthcare costs, or trend assumption, is reviewed on an annual basis. The trend assumption was last updated at the June 30, 2020 valuation. All other assumptions were adopted by the Board for first use in the June 30, 2019 actuarial valuation and are based on an experience study conducted based on experience through June 30, 2018. There were no changes in actuarial assumptions or methods since the prior valuation.

It is our opinion that the assumptions are internally consistent, reasonable, and reflect anticipated future experience of the System. Appendix A includes a summary of the actuarial assumptions and methods used in this valuation.

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. This report does not include a more robust assessment of the risks of future experience not meeting the actuarial assumptions. Additional assessment of risks was outside the scope of this assignment.

Benefit Provisions

Appendix B of this report includes a summary of the major benefit provisions for System.

Senate Bill 169 passed during the 2021 legislative session and increased the disability benefits for qualified members who become "totally and permanently disabled" in the line of duty or as a result of a duty-related disability. The minimum disability benefit increased from 25% of the member's monthly final rate of pay to 75% of the member's monthly average pay. The insurance premium for the member, the member's spouse, and the member's dependent children shall also be paid in full by the System.

There were no other material plan provision changes since the prior valuation.

SECTION 3

ACTUARIAL TABLES

Actuarial Tables

Development of Unfunded Actuarial Accrued Liability

(Dollar amounts expressed in thousands)

		June 30, 2021	
		Retirement (1)	Insurance (2)
1.	Projected payroll of active members	$ 45,338	$ 45,338
2.	Present value of future pay	$ 440,256	$ 408,099
3.	Normal cost rate		
	a. Total normal cost rate	26.13%	7.35%
	b. Less: member contribution rate	-8.00%	-0.46%
	c. Employer normal cost rate	18.13%	6.89%
4.	Actuarial accrued liability for active members		
	a. Present value of future benefits	$ 293,928	$ 86,466
	b. Less: present value of future normal costs	(101,470)	(20,767)
	c. Actuarial accrued liability	$ 192,458	$ 65,699
5.	Total actuarial accrued liability		
	a. Retirees and beneficiaries	$ 850,336	$ 202,737
	b. Inactive members	10,465	3,970
	c. Active members (Item 4c)	192,458	65,699
	d. Total	$ 1,053,259	$ 272,406
6.	Actuarial value of assets	$ 323,250	$ 223,251
7.	Unfunded actuarial accrued liability (UAAL) (Item 5d - Item 6)	$ 730,009	$ 49,155
8.	Funded Ratio	30.7%	82.0%

Actuarial Present Value of Future Benefits

(Dollar amounts expressed in thousands)

		June 30, 2021	
		Retirement (1)	Insurance (2)
1.	Active members		
	a. Service retirement	$ 280,002	
	b. Deferred termination benefits and refunds	3,244	
	c. Survivor benefits	2,115	
	d. Disability benefits	8,567	
	e. Total	$ 293,928	$ 86,466
2.	Retired members		
	a. Service retirement	$ 768,875	
	b. Disability retirement	12,197	
	c. Beneficiaries	69,264	
	d. Total	$ 850,336	$ 202,737
3.	Inactive members		
	a. Vested terminations	$ 10,003	$ 3,970
	b. Nonvested terminations	462	N/A
	c. Total	$ 10,465	$ 3,970
4.	Total actuarial present value of future benefits	$ 1,154,729	$ 293,173

Development of Actuarially Determined Contribution Rate

		June 30, 2021	
		Retirement (1)	Insurance (2)
1.	Total normal cost rate		
	a. Service retirement	23.53%	
	b. Deferred termination benefits and refunds	1.04%	
	c. Survivor benefits	0.33%	
	d. Disability benefits	1.23%	
	e. Total	26.13%	7.35%
2.	Less: member contribution rate	-8.00%	-0.46%
3.	Total employer normal cost rate	18.13%	6.89%
4.	Administrative expenses	0.47%	0.20%
5.	Net employer normal cost rate	18.60%	7.09%
6.	UAAL amortization contribution rate	107.80%	7.02%
7.	Total calculated employer contribution	126.40%	14.11%

Actuarial Balance Sheet

Retirement Benefits

(Dollar amounts expressed in thousands)

		June 30, 2021 (1)	June 30, 2020 (2)
1.	Assets - Present and Expected Future Resources		
	a. Current assets (actuarial value)	$ 323,250	$ 296,126
	b. Present value of future member contributions	$ 35,221	$ 36,457
	c. Present value of future employer contributions		
	i. Normal cost contributions	$ 66,249	$ 71,416
	ii. Unfunded accrued liability contributions	730,009	757,032
	iii. Total future employer contributions	$ 796,258	$ 828,448
	d. Total assets	$ 1,154,729	$ 1,161,031
2.	Liabilities - Present Value of Expected Future Benefit Payments		
	a. Active members		
	i. Present value of future normal costs	$ 101,470	$ 107,873
	ii. Accrued liability	192,458	189,578
	iii. Total present value of future benefits	$ 293,928	$ 297,451
	b. Present value of benefits payable on account of current retired members and beneficiaries	$ 850,336	$ 854,711
	c. Present value of benefits payable on account of current inactive members	$ 10,465	$ 8,869
	d. Total liabilities	$ 1,154,729	$ 1,161,031

Actuarial Balance Sheet

Insurance Benefits

(Dollar amounts expressed in thousands)

		June 30, 2021 (1)	June 30, 2020 (2)
1.	Assets - Present and Expected Future Resources		
	a. Current assets (actuarial value)	$ 223,251	$ 207,018
	b. Present value of future member contributions	$ 2,970	$ 2,921
	c. Present value of future employer contributions		
	i. Normal cost contributions	$ 17,797	$ 19,361
	ii. Unfunded accrued liability contributions	49,155	69,126
	iii. Total future employer contributions	$ 66,952	$ 88,487
	d. Total assets	$ 293,173	$ 298,426
2.	Liabilities - Present Value of Expected Future Benefit Payments		
	a. Active members		
	i. Present value of future normal costs	$ 20,767	$ 22,282
	ii. Accrued liability	65,699	68,506
	iii. Total present value of future benefits	$ 86,466	$ 90,788
	b. Present value of benefits payable on account of current retired members and beneficiaries	$ 202,737	$ 203,813
	c. Present value of benefits payable on account of current inactive members	$ 3,970	$ 3,825
	d. Total liabilities	$ 293,173	$ 298,426

Reconciliation of Net Assets

(Dollar amounts expressed in thousands)[1]

	Year Ending June 30, 2021 (1) Retirement	Year Ending June 30, 2021 (2) Insurance
1. Value of assets at beginning of year	$ 293,949	$ 201,340
2. Revenue for the year		
a. Contributions		
i. Member contributions	$ 4,752	$ 209
ii. Employer contributions	59,263	9,285
iii. Other contributions (less 401h)	388	0
iv. Total	$ 64,402	$ 9,494
b. Income		
i. Interest, dividends, and other income	$ 8,243	$ 5,846
ii. Investment expenses	(2,357)	(2,785)
iii. Net	$ 5,886	$ 3,061
c. Net realized and unrealized gains (losses)	55,843	47,228
d. Total revenue	$ 126,131	$ 59,782
3. Expenditures for the year		
a. Disbursements		
i. Refunds	$ 273	$ 0
ii. Regular annuity benefits / Healthcare premiums	63,249	14,487
iii. Other benefit payments[2]	0	(772)
iv. Transfers to other systems	0	0
v. Total	$ 63,523	$ 13,715
b. Administrative expenses and depreciation	212	89
c. Total expenditures	$ 63,734	$ 13,804
4. Increase in net assets (Item 2. - Item 3.)	$ 62,396	$ 45,978
5. Value of assets at end of year (Item 1. + Item 4.)	$ 356,346	$ 247,318
6. Net external cash flow		
a. Dollar amount	$ 667	$ (4,310)
b. Percentage of market value	0.2%	-1.9%
7. Estimated annual return on net assets	21.0%	25.2%

[1] Amounts may not add due to rounding. Retirement assets exclude 401h assets. Insurance assets include 401h assets

[2] Insurance benefit payments have been offset by Medicare Drug Reimbursements, Insurance Premiums, and Humana Gain Share Payments

Development of Actuarial Value of Assets

Retirement Benefits

(Dollar amounts expressed in thousands)*

	Year Ending	June 30, 2021
1.	Actuarial value of assets at beginning of year	$ 296,126
2.	Market value of assets at beginning of year	$ 293,949
3.	Net new investments	
	a. Contributions	$ 64,402
	b. Benefit payments	(63,523)
	c. Administrative expenses	(212)
	d. Subtotal	$ 667
4.	Market value of assets at end of year	$ 356,346
5.	Net earnings (Item 4. - Item 2. - Item 3.d.)	$ 61,729
6.	Assumed investment return rate for fiscal year	5.25%
7.	Expected return for immediate recognition	$ 15,450
8.	Excess return for phased recognition	$ 46,279
9.	Phased-in recognition, 20% of excess return on assets for prior years:	

	Fiscal Year Ending June 30,	Excess Return	Recognized Amount
a.	2021	$ 46,279	$ 9,256
b.	2020	(8,720)	(1,744)
c.	2019	669	134
d.	2018	5,183	1,037
e.	2017	11,623	2,325
f.	Total		$ 11,007

10.	Actuarial value of assets as of June 30, 2021 (Item 1. + Item 3.d. + Item 7.+ Item 9.f.)	$ 323,250
11.	Ratio of actuarial value to market value	90.7%
12.	Estimated annual return on actuarial value of assets	8.9%

* Amounts may not add due to rounding

Development of Actuarial Value of Assets

Insurance Benefits

(Dollar amounts expressed in thousands)*

	Year Ending	June 30, 2021
1.	Actuarial value of assets at beginning of year	$ 207,018
2.	Market value of assets at beginning of year	$ 201,340
3.	Net new investments	
	a. Contributions	$ 9,494
	b. Benefit payments	(13,715)
	c. Administrative expenses	(89)
	d. Subtotal	$ (4,310)
4.	Market value of assets at end of year	$ 247,318
5.	Net earnings (Item 4. - Item 2. - Item 3.d.)	$ 50,289
6.	Assumed investment return rate for fiscal year	6.25%
7.	Expected return for immediate recognition	$ 12,449
8.	Excess return for phased recognition	$ 37,840
9.	Phased-in recognition, 20% of excess return on assets for prior years:	

	Fiscal Year Ending June 30,	Excess Return	Recognized Amount
a.	2021	$ 37,840	$ 7,568
b.	2020	(11,419)	(2,284)
c.	2019	(1,099)	(220)
d.	2018	5,431	1,086
e.	2017	9,723	1,945
f.	Total		$ 8,095

10.	Actuarial value of assets as of June 30, 2021 (Item 1. + Item 3.d. + Item 7.+ Item 9.f.)	$ 223,251
11.	Ratio of actuarial value to market value	90.3%
12.	Estimated annual return on actuarial value of assets	10.0%

* Amounts may not add due to rounding

Schedule of Funding Progress

(Dollar amounts expressed in thousands)

June 30, (1)	Actuarial Value of Assets (AVA) (2)	Actuarial Accrued Liability (AAL) (3)	Unfunded Actuarial Accrued Liability (UAAL) (3) - (2) (4)	Funded Ratio (2)/(3) (5)	Annual Covered Payroll (6)	UAAL as % of Payroll (4)/(6) (7)
			Retirement			
2012	$ 259,792	$ 647,689	$ 387,897	40.1%	$ 48,373	801.9%
2013	241,800	651,581	409,781	37.1%	45,256	905.5%
2014	242,742	681,118	438,376	35.6%	44,616	982.6%
2015	248,388	734,156	485,768	33.8%	45,765	1061.4%
2016	234,568	775,160	540,592	30.3%	45,551	1186.8%
2017	261,320	967,145	705,825	27.0%	48,598	1452.4%
2018	268,259	989,528	721,269	27.1%	48,808	1477.8%
2019	282,162	1,045,318	763,156	27.0%	47,752	1598.2%
2020	296,126	1,053,158	757,032	28.1%	46,145	1640.6%
2021	323,250	1,053,259	730,009	30.7%	45,338	1610.1%
			Insurance			
2012	$ 124,372	$ 333,904	$ 209,532	37.2%	$ 48,373	433.2%
2013	136,321	222,327	86,006	61.3%	45,256	190.0%
2014	155,595	234,271	78,676	66.4%	44,616	176.3%
2015	167,775	254,839	87,064	65.8%	45,765	190.2%
2016	172,704	257,197	84,493	67.1%	45,551	185.5%
2017	180,464	276,641	96,177	65.2%	48,598	197.9%
2018	187,535	262,088	74,553	71.6%	48,808	152.7%
2019	197,395	276,809	79,414	71.3%	47,752	166.3%
2020	207,018	276,144	69,126	75.0%	46,145	149.8%
2021	223,251	272,406	49,155	82.0%	45,338	108.4%

Summary of Principal Assumptions and Methods

Below is a summary of the principal economic assumptions, cost method, and the method for financing the unfunded actuarial accrued liability:

Valuation date:	June 30, 2021
Actuarial cost method:	Entry Age Normal
Amortization method:	Level percentage of payroll (0% payroll growth assumed)
Amortization period for contribution rate:	30-year closed period at June 30, 2019 Gains/losses incurring after 2019 will be amortized over separate closed 20-year amortization bases
Asset valuation method:	5-Year Smoothed Market
Actuarial assumptions:	
Investment rate of return, retirement	5.25%
Investment rate of return, insurance	6.25%
Projected salary increases	3.55% to 16.05% (varies by service)
Inflation	2.30%
Post-retirement pension benefit adjustments	0.00%
Retiree Mortality	System-specific mortality table based on mortality experience from 2013-2018, projected with the ultimate rates from MP-2014 mortality improvement scale using a base year of 2019.

Solvency Test

(Dollar amounts expressed in thousands)

June 30,	Actuarial Accrued Liability: Active Member Contributions	Actuarial Accrued Liability: Retired Members & Beneficiaries	Actuarial Accrued Liability: Active Members (Employer Financed)	Valuation Assets	Portion of Aggregate Accrued Liabilities Covered by Assets: Active	Portion of Aggregate Accrued Liabilities Covered by Assets: Retired	Portion of Aggregate Accrued Liabilities Covered by Assets: ER Financed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Retirement							
2012	$ 41,139	$ 523,017	$ 83,533	$ 259,792	100.0%	41.8%	0.0%
2013	39,788	535,720	76,072	241,800	100.0%	37.7%	0.0%
2014	41,831	563,011	76,276	242,742	100.0%	35.7%	0.0%
2015	41,567	605,855	86,734	248,388	100.0%	34.1%	0.0%
2016	41,871	636,499	96,791	234,568	100.0%	30.3%	0.0%
2017	44,798	773,982	148,365	261,320	100.0%	28.0%	0.0%
2018	43,835	800,788	144,905	268,259	100.0%	28.0%	0.0%
2019	41,948	848,397	154,973	282,162	100.0%	28.3%	0.0%
2020	40,831	863,580	148,747	296,126	100.0%	29.6%	0.0%
2021	42,035	860,801	150,423	323,250	100.0%	32.7%	0.0%
Insurance							
2012	$ -	$ 190,259	$ 143,645	$ 124,372	100.0%	65.4%	0.0%
2013	-	139,509	82,818	136,321	100.0%	97.7%	0.0%
2014	-	143,402	90,869	155,595	100.0%	100.0%	13.4%
2015	-	170,447	84,392	167,775	100.0%	98.4%	0.0%
2016	-	177,094	80,103	172,704	100.0%	97.5%	0.0%
2017	-	186,390	90,251	180,464	100.0%	96.8%	0.0%
2018	-	183,151	78,937	187,535	100.0%	100.0%	5.6%
2019	-	199,959	76,850	197,395	100.0%	98.7%	0.0%
2020	-	207,638	68,506	207,018	100.0%	99.7%	0.0%
2021	-	206,707	65,699	223,251	100.0%	100.0%	25.2%

SECTION 4

AMORTIZATION BASES

Amortization of Unfunded Liability

Retirement

Valuation Year Base Established	Original Amortization Base	Remaining at June 30, 2021	Payments for FYE 2023	Funding Period at June 30, 2021
June 30, 2019	$ 763,156	$ 741,687	$ 49,853	28
June 30, 2020	3,748	5,105	420	19
June 30, 2021	(16,783)	(16,783)	(1,397)	20
Total		$ 730,009	$ 48,876	
Projected Payroll for FYE 2023			$ 45,338	
Amortization Payments as a Percentage of Payroll			107.80%	

Insurance

Valuation Year Base Established	Original Amortization Base	Remaining at June 30, 2021	Payments for FYE 2023	Funding Period at June 30, 2021
June 30, 2019	$ 79,414	$ 74,045	$ 5,496	28
June 30, 2020	(5,896)	(6,445)	(571)	19
June 30, 2021	(18,445)	(18,445)	(1,742)	20
Total		$ 49,155	$ 3,183	
Projected Payroll for FYE 2023			$ 45,338	
Amortization Payments as a Percentage of Payroll			7.02%	

Note:
Budgeted contribution rates for FYE 2022 were known at the time of the June 30, 2021 Valuation.
Amortization bases established at this valuation date were adjusted accordingly.

SECTION 5

MEMBERSHIP INFORMATION

Membership Tables

Summary of Membership Data

(Total dollar amounts expressed in thousands)

		June 30, 2021 (1)	June 30, 2020 (4)
1.	Active members		
a.	Males	758	781
b.	Females	17	17
c.	Total members	775	798
d.	Total annualized prior year salaries	$ 45,338	$ 46,145
e.	Average salary[2]	$ 58,501	$ 57,826
f.	Average age	37.7	37.5
g.	Average service	11.1	10.7
h.	Member contributions with interest	$ 42,035	$ 40,831
i.	Average contributions with interest[2]	$ 54,239	$ 51,167
2.	Vested inactive members[1]		
a.	Number	313	300
b.	Total annual deferred benefits	$ 1,134	$ 966
c.	Average annual deferred benefit[2]	$ 3,623	$ 3,221
d.	Average age at the valuation date	44.2	43.9
3.	Nonvested inactive members[1]		
a.	Number	321	289
b.	Total member contributions with interest	$ 459	$ 372
c.	Average contributions with interest[2]	$ 1,430	$ 1,286
4.	Service retirees		
a.	Number	1,375	1,383
b.	Total annual benefits	$ 54,771	$ 54,996
c.	Average annual benefit[2]	$ 39,833	$ 39,766
d.	Average age at the valuation date	63.5	63.0
5.	Disabled retirees		
a.	Number	54	53
b.	Total annual benefits	$ 913	$ 927
c.	Average annual benefit[2]	$ 16,907	$ 17,498
d.	Average age at the valuation date	57.0	57.9
6.	Beneficiaries		
a.	Number	244	233
b.	Total annual benefits	$ 7,016	$ 6,509
c.	Average annual benefit[2]	$ 28,754	$ 27,936
d.	Average age at the valuation date	67.4	67.1

[1] Vested inactive member section includes Tier 1 members eligible for a benefit equal to the actuarially equivalent of two times the member's contribution balance.

[2] Average dollar amounts shown are expressed to the dollar.

Summary of Historical Active Membership

	Active Members		Covered Payroll[1]		Average Annual Pay	
June 30,	Number	Percent Increase /(Decrease)	Amount in Thousands	Percent Increase /(Decrease)	Amount	Percent Increase /(Decrease)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012	907		$ 48,373		$ 53,332	
2013	902	-0.6%	45,256	-6.4%	50,173	-5.9%
2014	855	-5.2%	44,616	-1.4%	52,182	4.0%
2015	937	9.6%	45,765	2.6%	48,842	-6.4%
2016	908	-3.1%	45,551	-0.5%	50,167	2.7%
2017	903	-0.6%	48,598	6.7%	53,819	7.3%
2018	886	-1.9%	48,808	0.4%	55,088	2.4%
2019	883	-0.3%	47,752	-2.2%	54,079	-1.8%
2020	798	-9.6%	46,145	-3.4%	57,826	6.9%
2021	775	-2.9%	45,338	-1.7%	58,501	1.2%

[1] Covered payroll is the annualized, projected compensation for the following year and does not include payroll attributable to working retirees.

Distribution of Active Members by Age and by Years of Service

SPRS Members

Attained Age	Years of Credited Service												
	0 Count & Avg. Comp.	1 Count & Avg. Comp.	2 Count & Avg. Comp.	3 Count & Avg. Comp.	4 Count & Avg. Comp.	5-9 Count & Avg. Comp.	10-14 Count & Avg. Comp.	15-19 Count & Avg. Comp.	20-24 Count & Avg. Comp.	25-29 Count & Avg. Comp.	30-34 Count & Avg. Comp.	35 & Over Count & Avg. Comp.	Total Count & Avg. Comp.
Under 20	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
20-24	24	2	14	0	0	0	0	0	0	0	0	0	40
	$38,359	$37,824	$45,308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$40,764
25-29	12	2	36	25	0	31	0	0	0	0	0	0	106
	$38,112	$41,765	$44,977	$45,434	$0	$51,516	$0	$0	$0	$0	$0	$0	$46,159
30-34	3	4	12	6	23	74	27	0	0	0	0	0	149
	$37,989	$45,136	$44,938	$45,760	$49,364	$53,665	$55,963	$0	$0	$0	$0	$0	$51,852
35-39	1	0	6	1	9	44	65	25	0	0	0	0	151
	$38,046	$0	$45,237	$43,984	$48,349	$54,261	$57,720	$68,286	$0	$0	$0	$0	$57,186
40-44	0	1	0	0	2	22	31	83	20	2	0	0	161
	$0	$43,793	$0	$0	$52,071	$55,576	$56,783	$67,793	$79,647	$83,643	$0	$0	$65,329
45-49	0	0	1	1	0	13	13	35	32	7	2	0	104
	$0	$0	$43,418	$45,221	$0	$56,583	$58,993	$67,927	$77,698	$87,443	$100,990	$0	$69,894
50-54	0	0	0	0	1	0	3	17	12	10	2	0	45
	$0	$0	$0	$0	$49,347	$0	$57,562	$65,646	$78,948	$84,127	$80,044	$0	$73,039
55-59	0	0	0	0	0	0	3	7	2	3	1	0	16
	$0	$0	$0	$0	$0	$0	$59,507	$65,027	$76,241	$90,599	$99,241	$0	$72,327
60-64	0	0	0	0	0	0	1	0	1	0	0	0	2
	$0	$0	$0	$0	$0	$0	$53,395	$0	$67,836	$0	$0	$0	$60,616
65 & Over	0	0	0	0	0	0	0	0	0	0	0	1	1
	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$101,381	$101,381
Total	40	9	69	33	35	184	143	167	67	22	5	1	775
	$38,249	$42,612	$45,037	$45,443	$49,257	$53,880	$57,305	$67,561	$78,313	$86,020	$92,261	$101,381	$58,501

Distribution of Annuitant Monthly Benefit by Status and Age
Retirees and Beneficiaries
(Dollar amounts expressed in thousands)

	Retirement		Disability		Survivors & Beneficiaries		Total	
Current Age	Number of Annuitants	Total Annual Benefit Amount	Number of Annuitants	Total Annual Benefit Amount	Number of Annuitants	Total Annual Benefit Amount	Number of Annuitants	Total Annual Benefit Amount
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Under 50	173	$ 6,532	18	$ 294	35	$ 560	226	$ 7,387
50 - 54	208	8,194	8	192	12	227	228	8,613
55 - 59	188	7,777	7	95	12	235	207	8,107
60 - 64	154	6,209	4	74	18	528	176	6,811
65 - 69	214	9,008	8	94	27	687	249	9,789
70 - 74	249	10,087	5	93	49	1,684	303	11,863
75 - 79	104	3,745	3	46	37	1,174	144	4,965
80 - 84	55	2,031	1	24	21	752	77	2,807
85 - 89	22	810	0	0	21	733	43	1,543
90 And Over	8	379	0	0	12	435	20	814
Total	**1,375**	**$ 54,771**	**54**	**$ 913**	**244**	**$ 7,016**	**1,673**	**$ 62,700**

*Amounts may not add due to rounding

Retired Lives Summary

Form of Payment	Male Lives Number	Male Lives Monthly Benefit Amount	Female Lives Number	Female Lives Monthly Benefit Amount	Total Number	Total Monthly Benefit Amount
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Basic	160	$ 478,955	17	$ 47,149	177	$ 526,104
Joint & Survivor:						
100% to Beneficiary	174	536,198	1	4,814	175	541,011
66 2/3% to Beneficiary	84	315,288	2	7,542	86	322,830
50% to Beneficiary	76	280,687	2	7,515	78	288,202
Pop-up Option	669	2,345,074	6	11,214	675	2,356,287
Social Security Option:						
Age 62 Basic	27	68,315	0	0	27	68,315
Age 62 Survivorship	105	197,461	1	4,416	106	201,876
Partial Deferred (Old Plan)	0	0	0	0	0	0
Widows Age 60	0	0	0	0	0	0
5 Years Certain	0	0	0	0	0	0
10 Years Certain	8	26,954	0	0	8	26,954
10 Years Certain & Life	37	125,330	3	6,759	40	132,089
15 Years Certain & Life	17	50,621	1	3,919	18	54,539
20 Years Certain & Life	37	118,126	2	3,979	39	122,105
Total:	1,394	$ 4,543,008	35	$ 97,305	1,429	$ 4,640,314

Beneficiary Lives Summary

Form of Payment	Male Lives		Female Lives		Total	
	Number	Monthly Benefit Amount	Number	Monthly Benefit Amount	Number	Monthly Benefit Amount
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Basic	2	$ 820	9	$ 11,392	11	$ 12,213
Joint & Survivor:						
100% to Beneficiary	8	12,812	61	170,619	69	183,431
66 2/3% to Beneficiary	2	1,206	17	43,475	19	44,681
50% to Beneficiary	0	0	20	30,914	20	30,914
Pop-up Option	2	843	60	178,584	62	179,427
Social Security Option:						
Age 62 Basic	0	0	2	2,281	2	2,281
Age 62 Survivorship	2	934	48	100,222	50	101,157
Partial Deferred (Old Plan)	0	0	0	0	0	0
Widows Age 60	0	0	0	0	0	0
5 Years Certain	0	0	0	0	0	0
10 Years Certain	1	2,038	2	14,018	3	16,056
10 Years Certain & Life	0	0	0	0	0	0
15 Years Certain & Life	0	0	1	721	1	721
20 Years Certain & Life	1	6,686	6	7,092	7	13,778
Total:	18	$ 25,340	226	$ 559,319	244	$ 584,659

Schedule of Retirees Added to And Removed from Rolls

(Dollar amounts except average allowance expressed in thousands)

Year Ended	Added to Rolls	Removed from Rolls	Rolls End of the Year		% Increase in Annual Benefit	Average Annual Benefit
	Number	Number	Number	Annual Benefits		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012	52	16	1,299	$ 49,887		$ 38,404
2013	63	16	1,346	50,906	2.0%	37,820
2014	95	28	1,413	53,432	5.0%	37,815
2015	62	15	1,460	54,930	2.8%	37,624
2016	65	10	1,515	56,650	3.1%	37,393
2017	30	9	1,536	57,253	1.1%	37,274
2018	81	17	1,600	59,626	4.1%	37,266
2019	74	27	1,647	61,404	3.0%	37,282
2020	61	39	1,669	62,432	1.7%	37,407
2021	55	51	1,673	62,700	0.4%	37,477

SECTION 6

ASSESSMENT AND DISCLOSURE OF RISK

Risks Associated with Measuring the Accrued Liability And Actuarially Determined Contribution

(As Required by ASOP No. 51)

The determination of SPRS's accrued liability and actuarially determined contribution requires the use of assumptions regarding future economic and demographic experience. The risk measures illustrated in this section are intended to aid stakeholders in understanding the effects of future experience differing from the assumptions used in performing an actuarial valuation. These risk measures may also help with illustrating the potential volatility in the funded status and actuarially determined contributions that result from differences between actual experience and the expected experience based on the actuarial assumptions.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience (economic and demographic) differing from the assumptions, changes in assumptions due to changing conditions, changes in contribution requirements due to modifications to the funding policy, and changes in the liability and cost due to changes in plan provisions or applicable law. The scope of this actuarial valuation does not include any analysis of the potential range of such future measurements.

Examples of risk that may reasonably be anticipated to significantly affect the System's future financial condition include:

- Investment risk – actual investment returns may differ from expected returns;
- Longevity risk – members may live longer or shorter than expected and receive pensions for a time period different than assumed;
- Other demographic risks – members may terminate, retire or become disabled at times or with benefits other than assumed resulting in actual future contributions differing from expected;
- Salary and payroll risk – actual salaries and total payroll may differ from expected, resulting in actual future accrued liabilities or contributions differing from expected;
- Asset/Liability mismatch – changes in assets may be inconsistent with changes in liabilities, thereby altering the relative difference between the assets and liabilities which may alter the funded status and contribution requirements;
- Contribution risk – actual contributions may differ from expected future contributions (for example, actual contributions not being paid in accordance with the System's funding policy, withdrawal liability assessments or other anticipated payments to the plan are not being paid, or material changes occurring in the anticipated number of covered employees, covered payroll, or another relevant contribution base).

Effects of certain experience can generally be anticipated. For example, if investment returns since the most recent actuarial valuation are less (or more) than the assumed rate of return, then the funded status of the plan can be expected to decrease (or increase) more than anticipated.

The required contributions in this report were established in accordance with applicable Statutes and assumptions adopted by the Board. However, stakeholders should be aware that the scheduled contributions specified in State Code do not necessarily guarantee that the contribution requirements will not increase in a future year.

Employer Risk with Contribution Rates

Currently contributions are collected from the Commonwealth based on the total payroll of employees who are earning benefits in SPRS (i.e. covered payroll). The actuarially determined contribution rate is comprised of two components - the normal cost rate (to pay for the benefits accruing in the next year) and the unfunded amortization (to pay for the benefits accrued by members in previous years). The unfunded amortization is calculated by first determining the dollar amount necessary to pay for the unfunded liability based on SPRS's funding policy, and then by dividing that dollar amount by expected covered payroll to convert that contribution requirement to a percentage of payroll (i.e. a contribution rate).

As the contribution requirement, as a percentage of payroll, increases then there is increased incentive for participating employers to make deliberate business action to reduce their payroll reported to the System in order to reduce their pension cost.

Plan Specific Risk Measures

Risks faced by a pension plan evolve over time. A relatively new plan with virtually no assets and paying few benefits will experience lower investment risk than a mature plan with a significant amount of assets and large number of members receiving benefits. There are a few measures that can assist stakeholders in understanding and comparing the maturity of a plan to other systems, which include:

- Ratio of market value of assets to payroll: The relationship between assets and payroll is a useful indicator of the potential volatility of contributions. If assets are approximately the same as covered payroll, an investment return that is 5% different than assumed would equal 5% of payroll. In another example, if the assets are approximately twice as large as covered payroll, an investment return that is 5% different than assumed would equal 10% of payroll. A ratio that increases over time generally indicates the potential of an increasing volatility in employer contribution rates as a percentage of payroll.
- Ratio of actuarial accrued liability to payroll: The ratio of actuarial accrued liability to payroll can be used as a measure to indicate the potential volatility of contributions due to volatility in the liability experience. For instance, if the actuarial accrued liability is 5 times the size of the covered payroll, then a change in the liability that is 2% different than expected would be a change in magnitude that is 10% of payroll. A ratio that increases over time generally indicates the potential of an increasing volatility in employer contribution rates as a percentage of payroll.
- Percentage of Expected Contributions Actually Received: This measure identifies the percentage difference between the contributions the fund expects to receive during the fiscal year to and actual contributions received by the fund during the fiscal year. A percentage that is less than 100% means that actual contributions the fund received were less than the expected contributions determined by a prior actuarial valuation. On the other hand, a percentage that is greater than 100% means that actual contributions the fund received were more than the expected contributions.

- Ratio of active to retired members: A relatively mature open plan is likely to have close to the same number of actives to retirees resulting in a ratio that is around 1.0. On the other hand, a super-mature plan, or a plan that is closed to new entrants will have more retirees than active members resulting in a ratio below 1.0. As this ratio declines, a larger portion of the total actuarial accrued liability in the System is attributable to retirees. This metric also typically moves in tandem with the liability to payroll metric, which provides an indication of potential contribution volatility.

The following tables provide a summary of these measures for SPRS for the current year and the prior four years so stakeholders can identify how these measures are trending. While ASOP No. 51 requires this disclosure with respect to only the retirement fund, we have included this information for the insurance fund for completeness.

SPRS

	Retirement Fund					Insurance Fund				
	June 30,					June 30,				
	2021	2020	2019	2018	2017	2021	2020	2019	2018	2017
Ratio of the market value of assets to total payroll	7.86	6.37	5.99	5.48	5.26	5.45	4.36	4.21	3.91	3.68
Ratio of actuarial accrued liability to payroll	23.23	22.82	21.89	20.27	19.90	6.01	5.98	5.80	5.37	5.69
Ratio of net cash flow to market value of assets	0.2%	0.5%	1.4%	-2.5%	4.8%	-1.9%	-0.5%	-0.2%	-2.4%	-2.5%
Percentage of Expected Contribution Actually Received	104% [1]	103%	101%	101%	121%	102% [1]	101%	100%	103%	103%
Ratio of actives to retirees and beneficiaries	0.46	0.48	0.54	0.55	0.59					

[1] Expected contribution for FYE2021 based on the actuarially determined contribution rate of 143.48% from the June 30, 2019 valuation as amended by SB249, which reset the amortization period to 30 years, and expected compensation based on census data from the June 30, 2020 valuation.

APPENDIX A

ACTUARIAL ASSUMPTIONS AND METHODS

Summary of Actuarial Methods and Assumptions

The following presents a summary of the actuarial assumptions and methods used in the valuation of the State Police Retirement System.

In general, the assumptions and methods used in the valuation are based on the actuarial experience study for the five-year period ending June 30, 2018 and adopted by the Board in April 2019.

Investment return rate:

Assumed annual rate of 5.25% net of investment expenses for the retirement fund

Assumed annual rate of 6.25% net of investment expenses for the insurance fund

Price Inflation:

Assumed annual rate of 2.30%

Payroll Growth Assumption (used for amortization of unfunded accrued liabilities):

Assumed annual rate of 0.00%

Rates of Annual Salary Increase:

Assumed rates of annual salary increases are shown below.

Service Years	Annual Rates of Salary Increases		
	Merit & Seniority	Price Inflation & Productivity	Total Increase
0	12.50%	3.55%	16.05%
1	5.00%	3.55%	8.55%
2	4.00%	3.55%	7.55%
3	2.00%	3.55%	5.55%
4	2.00%	3.55%	5.55%
5	2.00%	3.55%	5.55%
6	2.00%	3.55%	5.55%
7	1.00%	3.55%	4.55%
8	1.00%	3.55%	4.55%
9	0.00%	3.55%	3.55%
10 & Over	0.00%	3.55%	3.55%

Retirement rates:

Assumed annual rates of retirement are shown below. Rates are only applicable for members who are eligible for a service retirement.

Service	Members participating Before 9/1/2008[1]	Members participating on or after 9/1/2008[2]	Members participating after 1/1/2014[2]
20	22.0%		
21	22.0%		
22	22.0%		
23	28.0%		
24	28.0%		
25	28.0%	17.6%	16.0%
26	28.0%	17.6%	16.0%
27	28.0%	17.6%	16.0%
28	44.0%	22.4%	16.0%
29	44.0%	22.4%	16.0%
30	44.0%	22.4%	100.0%
31	58.0%	22.4%	
32	58.0%	22.4%	
33	58.0%	35.2%	
34	58.0%	35.2%	
35	58.0%	35.2%	
36	58.0%	46.4%	
37	58.0%	46.4%	
38	58.0%	46.4%	
39	58.0%	46.4%	
40+	58.0%	46.4%	

[1] The annual rate of service retirement is 100% at age 55.

[2] The annual rate of service retirement is 100% at age 60.

For members hired after 7/1/2003 and prior to 9/1/2008, the rates shown above are multiplied by 80% if the member is under the age of 55 to reflect the different retiree health insurance benefit.

Disability rates:

An abbreviated table with assumed rates of disability is show below.

Age	Annual Rates of Disability	
	Male	Female
20	0.05%	0.05%
30	0.09%	0.09%
40	0.20%	0.20%
50	0.56%	0.56%
60	1.46%	1.46%

Withdrawal rates (for causes other than disability and retirement):

Assumed annual rates of withdrawal are shown below and include pre-retirement mortality rates as described on the next page.

Service	Annual Rates of Withdrawal
1	15.00%
2	4.82%
3	3.76%
4	3.15%
5	2.71%
6	2.37%
7	2.09%
8	1.86%
9	1.66%
10	1.48%
11	1.32%
12	1.17%
13	1.04%
14	0.92%
15	0.80%
16	0.70%
17	0.60%
18	0.51%
19	0.42%
20	0.34%
21 & Over	0.00%

Mortality Assumption:

Pre-retirement mortality: PUB-2010 Public Safety Mortality, projected with the ultimate rates from the MP-2014 mortality improvement scale using a base year of 2010.

Post-retirement mortality (non-disabled): System-specific mortality table based on mortality experience from 2013-2018, projected with the ultimate rates from the MP-2014 mortality improvement scale using a base year of 2019.

The following table provides the life expectancy for a non-disabled retiree in future years based on the assumption with full generational projection:

Life Expectancy for an Age 65 Retiree in Years					
Gender	**Year of Retirement**				
	2020	**2025**	**2030**	**2035**	**2040**
Male	21.0	21.4	21.8	22.2	22.6
Female	24.0	24.4	24.8	25.2	25.6

Post-retirement mortality (disabled): PUB-2010 Disabled Mortality table, with a 4-year set-forward for both male and female rates, projected with the ultimate rates from the mortality improvement scale using a base year of 2010.

Marital status:

100% of employees are assumed to be married, with the female spouse 3 years younger than the male spouse.

Line of Duty Disability

70% of disabilities are assumed to occur in the line of duty (10% of which are assumed to be "total and permanent")

Line of Duty Death

25% of deaths are assumed to occur in the line of duty

Dependent Children:

For members who receive a duty-related death or disability benefit, the member is assumed to be survived by two dependent children, each age 6 with payments for 15 years.

Form of Payment:

Members are assumed to elect a life-only annuity at retirement.

Actuarial Cost Method:

Entry Age Normal, Level Percentage of Pay. The Entry Age Normal actuarial cost method allocates the System's actuarial present value of future benefits to various periods based upon service. The portion of the present value of future benefits allocated to years of service prior to the valuation date is the actuarial accrued liability, and the portion allocated to years following the valuation date is the present value of future normal costs. The normal cost is determined for each active member as the level percent of pay necessary to fully fund the expected benefits to be earned over the career of each individual active member. The normal cost is partially funded with active member contributions with the remainder funded by employer contributions.

Health Care Age Related Morbidity/Claims Utilization:

To model the impact of aging on the underlying health care costs for Medicare retirees, the valuation relied on the Society of Actuaries' 2013 Study "Health Care Costs – From Birth to Death". Table 4 (Development of Plan Specific Medicare Age Curve) was used to model the impact of aging for ages 65 and over.

Health Care Cost Trend Rates:

Year	Non-Medicare Plans[1]	Medicare Plans[1]	Dollar Contribution[2]
2023	6.30%	6.30%	1.50%
2024	6.20%	6.20%	1.50%
2025	6.10%	6.10%	1.50%
2026	6.00%	6.00%	1.50%
2027	5.80%	5.80%	1.50%
2028	5.60%	5.60%	1.50%
2029	5.40%	5.40%	1.50%
2030	5.20%	5.20%	1.50%
2031	5.00%	5.00%	1.50%
2032	4.80%	4.80%	1.50%
2033	4.60%	4.60%	1.50%
2034	4.40%	4.40%	1.50%
2035	4.20%	4.20%	1.50%
2036 & Beyond	4.05%	4.05%	1.50%

[1]All increases are assumed to occur on January 1. The 2022 premiums were known at the time of the valuation and were incorporated into the liability measurement
[2]Applies to members participating on or after July 1, 2003. All increases are assumed to occur on July 1.

Health care trend assumptions are based on the model issued by the Society of Actuaries "Getzen model of Long-Run Medical Cost Trends for the SOA; Thomas E. Getzen, iHEA and Temple University 2014 © Society of Actuaries.

The underlying assumptions used to develop the health care trend rates include:

- A short run period-this is a period for which anticipated health care trend rates are manually set based on local information as well as plan-specific and carrier information.
- Long term real GDP growth – 1.75%
- Long term rate of inflation – 2.30%
- Long term nominal GDP growth – 4.05%
- Year that excess rate converges to 0 – 2036

Health care trend rates are thus the manually set rates for the short run period and rates which decline to an ultimate trend rate which equals the assumed nominal long-term GDP growth rate.

Health Care Participation Assumptions:

- Active members are assumed to elect health coverage at retirement at the following participation rates.

Service at Retirement	Members participating before 7/1/2003*	Members participating after 7/1/2003
Under 10	100%	100%
10-14	100%	100%
15-19	100%	100%
Over 20	100%	100%

* 100% of members with a duty disability or a duty death (in service) benefit are assumed to elect coverage at retirement.

- Future retirees are assumed to have a similar distribution by plan type as the current retirees.

Medicare Plan	Participation Percentage
Medical Only[1]	6%
Essential Plan	8%
Premium Plan	86%

[1] Includes Medicare Advantage Mirror Plans

Non-Medicare Plan	Participation Percentage
LivingWell Limited	4%
LivingWell Basic	2%
LivingWell CDHP	33%
LivingWell PPO	61%

- 100% of deferred vested members participating are assumed to elect health coverage at retirement.

- Deferred vested members are assumed to begin health coverage at age 50 for members participating before January 1, 2014 and at age 60 for members participating on or after January 1, 2014.

- 75% of future retirees, with hazardous service, are assumed to elect spouse health care coverage. 100% of spouses with health care coverage are assumed to continue coverage after the member's death.

Other Assumptions

1. Valuation payroll (used for determining the amortization contribution rate): Current fiscal year payroll.

2. Individual salaries used to project benefits: For salary amounts prior to the valuation date, the salary from the last fiscal year is projected backward with the valuation salary scale assumption. For future salaries, the salary from the last fiscal year is projected forward with one year's salary scale.

3. Pay increase timing: Beginning of (fiscal) year. This is equivalent to assuming that reported salaries represent amounts paid to members during the year ending on the valuation date.

4. Current active members that terminated employment (for reasons other than retirement, disability, or death) are assumed to commence their retirement benefits at first unreduced retirement eligibility. Members are assumed to elect a refund of member contributions if the value of their account balance exceeds the present value of the deferred benefit. Members participating in the Cash Balance plan are assumed to elect to receive a lump sum of their cash balance account if their account balance exceeds the present value of the deferred benefit and the member is not eligible for insurance benefits at termination.

5. The beneficiaries of current active members that die while active are assumed to commence their survivor benefits at the member's first unreduced retirement eligibility. Beneficiaries are assumed to elect a refund of member contributions if the value of the member's account balance exceeds the present value of the survivor benefit. Beneficiaries of active members that die while in the line of duty are assumed to commence their survivor benefits immediately at the death of the member.

6. There will be no recoveries once disabled.

7. Cash Balance Provisions: The cash balance interest crediting rate while a member is an active employee is assumed to equal 4.9375% (based upon the 5.25% assumed investment return). The interest crediting rate after a member terminates employment is 4%.

8. Decrement timing: Decrements of all types are assumed to occur mid-year. Decrement rates are used as described in this report, without adjustment for multiple decrement table effects.

9. Service: All members are assumed to accrue 1 year of benefit and eligibility service each year.

10. Eligibility testing: Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

11. Incidence of Contributions: Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in this report, and the actual payroll payable at the time contributions are made.

12. Current Inactive Population (Retirement Fund): All non-vested members are assumed to take an immediate refund of member contributions. Vested members are assumed to elect an immediate refund of member contributions at the valuation date if the value of their account balance exceeds the present value of their deferred benefit. Members hired prior to September 1, 2008 are assumed to retire at age 55 and members hired on or after September 1, 2008 are assumed to retire at age 60.

Participant Data

Participant data was supplied in electronic text files. There were separate files for (i) active and inactive members, and (ii) members and beneficiaries receiving benefits.

The data for active and terminated members included date of birth, gender, date of participation, benefit tier indicator, service with the current system, total vesting service, salary, employee contribution account balances, and employer pay credits for members participating in the cash balance plan. For retired members and beneficiaries, the data included date of birth, gender, spouse's date of birth (where applicable), amount of monthly benefit, date of retirement, and form of payment code.

Assumptions were made to correct for missing, bad, or inconsistent data. These had no material impact on the results presented.

Changes in assumptions since the prior valuation:

None

Development of Baseline Claims Cost

For non-Medicare retirees, the initial per capita costs were based on the plan premiums effective January 1, 2022, and are used for both current and future retirees. An inherent assumption in this methodology is that the projected future retirees will have a similar distribution by plan type as the current retirees. The spouse/dependent premium of $926.73 for non-Medicare retirees is based on a blending of Family and Couple premiums for the current retirees that have over 4 years of hazardous service. The fully-insured premiums paid to the Kentucky Employees' Health Plan (KEHP) are blended rates based on the combined experience of active and retired members. Because the average cost of providing health care benefits to retirees under age 65 is higher than the average cost of providing health care benefits to active employees, there is an implicit rate subsidy for the non-Medicare eligible retirees. Actuarial Standard of Practice No. 6 (ASOP No. 6) requires aging subsidies (or implicit rate subsidies) to be recognized. However, the health insurance trusts are only used to reimburse KEHP for the employer's portion of the blended premiums. Said another way, the trusts are not used to fund the difference between the underlying retiree claims and the blended KEHP premiums. As a result, the retiree health care liabilities developed in this report for the non-Medicare retirees are based solely on the premiums charged by KEHP, without any age-adjustment. GASB Statements No. 74 and No. 75 prohibit such a deviation from ASOP No. 6. The liabilities developed in this report are solely for the purpose of funding the benefits paid by the health insurance funds and are not appropriate for financial statement disclosures required by GASB. GRS provides separate GASB reports which include the liabilities associated with the implicit rate subsidy.

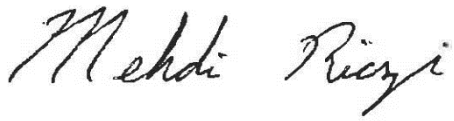
For those not eligible for Medicare		
Age	Member	Spouse/Dependents
<65	$758.99	$926.73

For Medicare retirees, the initial per capita costs were estimated based on the plan premiums effective January 1, 2022, and are used for both current and future retirees. An inherent assumption in this methodology is that the projected future retirees will have a similar distribution by plan type as the current retirees. Age graded and sex distinct premiums are utilized for retirees over the age of 65. These costs are appropriate for the unique age and sex distribution currently existing. Over the future years covered by this valuation, the age and sex distribution will most likely change. Therefore, our process "distributes" the average premium over all age/sex combinations and assigns a unique premium for each combination. The age/sex specific costs more accurately reflect the health care utilization and cost at that age.

For those eligible for Medicare		
Age	Male	Female
65	$188.91	$178.18
75	221.03	215.67
85	233.72	236.47

Appendix B of the report provides a full schedule of premiums.

Mehdi Riazi is a Member of the American Academy of Actuaries (MAAA) and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.



Mehdi Riazi, FSA, EA, FCA, MAAA

APPENDIX B

BENEFIT PROVISIONS

Summary of Benefit Provisions for State Police Retirement System (SPRS)

SPRS Employees

Retirement: Tier 1, Participation before 9/1/2008

Normal Retirement Eligibility	Age 55 with at least 1 month of service credit; or Any age with at least 20 years of service
Benefit Amount	If a member has at least 60 months of service, the monthly benefit is 2.50% times final average compensation times years of service. If a member has less than 60 months of service, the monthly benefit is the actuarial equivalent of two times the member's contributions with interest. Final average compensation is based on the member's highest 3 years of compensation.
Early Retirement Eligibility	Age 50 with at least 15 years of service
Early Retirement Reduction	Normal Retirement benefit reduced 6.5% per year for the first five years and 4.5% per year for the next five years for each year the member's retirement eligibility precedes the member's normal retirement date.

SPRS Employees (continued)

Retirement: Tier 2, Participation on or after 9/1/2008 but before 1/1/2014

Normal Retirement Eligibility	Age 60 with at least 5 years of service; or Any age with at least 25 years of service
Benefit Amount	The monthly benefit is equal to the applicable benefit multiplier times final average compensation times years of service.

Years of Service	Benefit Multiplier
10 or less	1.30%
10-20	1.50%
20-25	2.25%
Greater than 25	2.50%

Final compensation is based on the member's highest 3 years of compensation.

Early Retirement Eligibility	Age 50 with at least 15 years of service
Early Retirement Reduction	Normal Retirement benefit reduced 6.5% per year for the first five years and 4.5% per year for the next five years for each year the member's retirement date precedes the member's normal retirement eligibility.

Retirement: Tier 3, Participation on or after 1/1/2014

Normal Retirement Eligibility	Age 60 with at least 5 years of service; or Any age with at least 25 years of service
Benefit Amount	Each year that the member is active, a 7.50% employer pay credit and the employee's 8.00% contribution will be credited to each member's hypothetical cash balance account. The hypothetical account will earn interest at a minimum rate of 4%, annually. If the System's geometric average net investment return for the previous five years exceeds 4%, then the hypothetical account will be credited with an additional amount of interest in that year equal to 75% of the amount of the return which exceeds 4%. All interest credits will be applied to the hypothetical account balance on June 30 based on the account balance as of June 30 of the previous year. At retirement, the member's hypothetical account balance may be converted into an annuity based on an actuarial factor.
Early Retirement Eligibility	N/A

SPRS Employees (continued)

Deferred Vested Benefit: Tier 1, Participation before 9/1/2008

Eligibility	At least 1 month of service credit
Benefit Amount	Normal retirement benefit deferred to normal retirement age, or a reduced retirement benefit at an early retirement age

Deferred Vested Benefit: Tier 2, Participation on or after 9/1/2008 but before 1/1/2014

Eligibility	5 years of service
Benefit Amount	Normal retirement benefit deferred to normal retirement age, or a reduced retirement benefit at an early retirement age

Deferred Vested Benefit Tier 3, Participation on or after 1/1/2014

Eligibility	5 years of service
Benefit Amount	At termination of employment, members may choose to leave their account balance with the System and retire once they are eligible. The hypothetical account balance will earn 4% annual interest after termination. Members may also choose to withdrawal their entire accumulated balance. If a member does not have 5 years of service at termination, the member is eligible to receive a partial refund of their account balance. This refund includes the member's contributions with interest.

Disability Retirement: Participation before 8/1/2004

Eligibility	60 months of service (requirement is waived if line of duty disability)
Disability Benefit	Disability benefits are calculated in the same manner as the normal retirement benefit with years of service and final compensation being determined as of the date of disability, except that if the member has less than 20 years of service at disability, service credit shall be added to the person's total service beginning with the last date of paid employment and continuing to the member's 55th birthday, with total service not exceeding 20 years. Total service credit added shall not be greater than the member's actual service at disability.

SPRS Employees (continued)

Disability Retirement: Participation on or after 8/1/2004 but before 1/1/2014

Eligibility	60 months of service (requirement is waived if line of duty disability)
Disability Benefit	The higher of 25% of the member's final monthly rate of pay or the member's normal retirement benefit (without reduction for early retirement) with years and final compensation being determined as of the date of disability.

Disability Retirement: Participation on or after 1/1/2014

Eligibility	60 months of service (requirement is waived if line of duty disability)
Disability Benefit	The higher of 25% of the member's final monthly rate of pay or the member's retirement benefit calculated at the member's normal retirement date.

Line of Duty Disability Benefit

Disability Benefit	If the disability is a direct result of an act in the line of duty, the benefit shall not be less than 25% of the member's final monthly final rate of pay. If the disability is deemed to be Total and Permanent, then this benefit shall not be less than 75% of the member's monthly average pay.
Child Benefit	Additionally, each eligible dependent child will receive 10% of the member's monthly average pay up to a maximum of 40%. Member and dependent payment shall not exceed 100% of member's monthly average pay.

Pre-Retirement Death Benefit

Eligibility	Eligible for early or normal retirement; or Under age 55 with at least 60 months of service and actively working at the time of death; or At least 144 months of service, if no longer actively working
Spouse Benefit	The member's retirement benefit calculated in the same manner as if the member had retired on the day of the member's death and elected a 100% joint and survivor benefit. The benefit is actuarially reduced if the member dies prior to their normal retirement age.

SPRS Employees (continued)

Pre-Retirement Death Benefit (Death in the Line of Duty)

Eligibility	One month of service credit
Spouse Benefit	A $10,000 lump sum payment plus a monthly payment of 75% of the deceased member's final monthly average pay. Each dependent child will receive 10% of the final monthly average pay (not to exceed a total child benefit of 25% while the spouse is alive). A spouse may also elect the non-line of duty death benefit.
Non-Spouse Benefit	If the beneficiary is only one person who is a dependent receiving at least 50% of his or her support from the member, the beneficiary may elect a lump sum payment of $10,000.
Child Benefit	In the event there is no surviving spouse, the benefit is 50% of final monthly average pay for one child, 65% of final average pay for two children, or 75% of final average pay for three or more eligible children.

Post-Retirement Death Benefit

Eligibility	48 months of service, and in receipt of retirement benefits
Death Benefit	A $5,000 lump sum payment

Member Contributions

Tier 1, Participation before 9/1/2008	8% of creditable compensation. Members who do not receive a retirement benefit are entitled to a full refund of contributions with interest. The annual interest rate is set by the Board, not less than 2.0%.
Tier 2, Participation on or after 9/1/2008 but before 1/1/2014	8% of creditable compensation plus 1% of creditable compensation, which is deposited into the 401(h) account and is not refundable. Members who do not receive a retirement benefit are entitled to a refund of non-401(h) contributions with interest. The annual interest rate is 2.5%.
Tier 3, Participation after 1/1/2014	8% of creditable compensation plus 1% of creditable compensation, which is deposited into the 401(h) account and is not refundable. Members who do not receive a retirement benefit are entitled to a refund of non-401(h) contributions with interest.

Changes since the Prior Valuation

Senate Bill 169 passed during the 2021 legislative session and increased the disability benefits for qualified members who become "totally and permanently disabled" in the line of duty. The minimum disability benefit increased from 25% of the member's monthly final rate of pay to 75% of the member's monthly average pay.

Summary of Main Retiree Insurance Benefit Provisions

Insurance Tier 1: Participation began before 7/1/2003

Benefit Eligibility Recipient of a retirement allowance

Benefit Amount

Non-Hazardous Service	Percentage of Member Premium Paid by Retirement System	Hazardous Service	Percentage of Member & Dependent Premium Paid by Retirement System
Less than 4 years	0%	Less than 4 years	0%
4 – 9 years	25%	4 – 9 years	25%
10 – 14 years	50%	10 – 14 years	50%
15 – 19 years	75%	15 – 19 years	75%
20 or more years	100%	20 or more years	100%

The percentage paid by the retirement system is applied to the 'contribution' plan selected by the Board.

Duty Disability Retirement If disability was a result of injuries sustained while in the line of duty, the member receives 100% of the maximum contribution for the member and dependents.

Duty Death in Service If an active employee's death was a result of injuries sustained while in the line of duty, the member's spouse and children receive a fully subsidized health insurance benefit.

Non-Duty Death in Service If the surviving spouses is in receipt of a pension allowance, he or she is eligible for continued health coverage. The percentage of the premium paid for by the retirement system is based on the member's years of hazardous service at the time of death.

Surviving Spouse of a Retiree A surviving spouse of a retiree, who is in receipt of a pension allowance, will receive a premium subsidy based on the member's years of hazardous service.

Hazardous employees who retired prior to August 1, 1998 System's contribution for spouse and dependents is based on total service.

Insurance Tier 2: Participation began on or after 7/1/2003, but before 9/1/2008

Benefit Eligibility	Recipient of a retirement allowance with at least 120 months of service at retirement
Non-Hazardous Subsidy	Monthly contribution of $10 for each year of earned non-hazardous service. The monthly contribution is increased by 1.5% each July 1. As of July 1, 2021, the Non-Hazardous monthly contribution was $13.99/year of service. Upon the retiree's death, the surviving spouse may continue coverage (if in receipt of a retirement allowance) but will be 100% responsible for the premiums.
Hazardous Subsidy	Monthly contribution of $15 for each year of earned hazardous service. The monthly contribution is increased by 1.5% each July 1. As of July 1, 2021, the Hazardous monthly contribution was $20.99/year of service. Upon the retiree's death, the surviving spouse of a hazardous duty member will receive a monthly contribution of $10 ($13.99 as of July 1, 2021) for each year of hazardous service.
Duty Disability Retirement	If disability was a result of injuries sustained while in the line of duty or was duty-related, the member receives a benefit based on at least 20 years of service. This benefit is provided to members in the Non-Hazardous and Hazardous plans alike. If the disability is deemed to be Total and Permanent, the insurance premium for the member, the member's spouse, and the member's dependent children shall also be paid in full by the System. For non-hazardous members to be eligible for this benefit, they must be working in a position that could be certified as a hazardous position.
Duty Death in Service	If an active employee's death was a result of injuries sustained while in the line of duty, the member's spouse and children receive a fully subsidized health insurance benefit.
Non-Duty Death in Service	If the surviving spouse is in receipt of a pension allowance, he or she is eligible for continued health coverage. The percentage of the premium paid for by the retirement system is based on the member's years of hazardous service at the time of death.

Insurance Tier 3: Participation began on or after 9/1/2008

Tier 3 insurance benefits are identical to Tier 2, except Tier 3 members are required to have at least 180 months of service in order to be eligible.

Monthly Health Plan Premiums – Effective January 1, 2022

Non-Medicare Plan Options					
Plan Option	Single	Parent Plus	Couple	Family	Family X-Ref
LivingWell PPO[1]	$772.16	$1,101.08	$1,691.64	$1,883.60	$929.70
LivingWell CDHP	750.30	1,036.40	1,453.30	1,623.94	866.72
LivingWell Basic	721.54	994.72	1,537.72	1,713.58	846.38
Living Well Limited	642.02	914.78	1,407.32	1,566.78	772.32

Medicare Plan Options	
Medical Only Plan	$186.87
Medicare Advantage Mirror Essential Plan	228.12
Medicare Advantage Mirror Premium Plan	327.97
Kentucky Retirement Systems – Essential Plan[2]	49.25
Kentucky Retirement Systems – Premium Plan[3]	227.03

[1] Contribution plan selected by the Board was the LivingWell PPO plan option for non-Medicare retirees.
[2] Contribution rate for retirees selected by the Board remains at $75.56.
[3] Contribution rate for retirees selected by the Board remains at $252.51.

Dollar Contribution Amount for Insurance Tier 2 and Tier 3

Monthly contribution amounts per year of service as of July 1, 2021.

Non-Hazardous Service	Hazardous Service
$13.99	$20.99

Note: Non-Hazardous benefits are applicable to SPRS members with prior service in a Non-Hazardous System.

Changes since the Prior Valuation

Senate Bill 169 passed during the 2021 legislative session and increased the disability benefits for qualified members who become "totally and permanently disabled" in the line of duty or as a result of a duty-related disability. The insurance premium for the member, the member's spouse, and the member's dependent children shall be paid in full by the System.

APPENDIX C

GLOSSARY

Glossary

Actuarial Accrued Liability (AAL): That portion, as determined by a particular Actuarial Cost Method, of the Actuarial Present Value of Future Plan Benefits which is not provided for by future Normal Costs. It is equal to the Actuarial Present Value of Future Plan Benefits minus the actuarial present value of future Normal Costs.

Actuarial Assumptions: Assumptions as to future experience under the Fund. These include assumptions about the occurrence of future events affecting costs or liabilities, such as:

- mortality, withdrawal, disablement, and retirement;
- future increases in salary;
- future rates of investment earnings and future investment and administrative expenses;
- characteristics of members not specified in the data, such as marital status;
- characteristics of future members;
- future elections made by members; and
- other relevant items.

Actuarial Cost Method or ***Funding Method:*** A procedure for allocating the Actuarial Present Value of Future Benefits to various time periods; a method used to determine the Normal Cost and the Actuarial Accrued Liability. These items are used to determine the ADC.

Actuarial Gain or ***Actuarial Loss:*** A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. Through the actuarial assumptions, rates of decrements, rates of salary increases, and rates of fund earnings have been forecasted. To the extent that actual experience differs from that assumed, Actuarial Accrued Liabilities emerge which may be the same as forecasted, or may be larger or smaller than projected. Actuarial gains are due to favorable experience, e.g., the fund's assets earn more than projected, salaries do not increase as fast as assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, actuarial losses are the result of unfavorable experience, i.e., actual results that produce actuarial liabilities which are larger than projected. Actuarial gains will shorten the time required for funding of the actuarial balance sheet deficiency while actuarial losses will lengthen the funding period.

Actuarially Equivalent: Of equal actuarial present value, determined as of a given date and based on a given set of Actuarial Assumptions.

Actuarial Present Value (APV): The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions. For purposes of this standard, each such amount or series of amounts is:

a. adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.)

b. multiplied by the probability of the occurrence of an event (such as survival, death, disability, termination of employment, etc.) on which the payment is conditioned, and

c. discounted according to an assumed rate (or rates) of return to reflect the time value of money.

Actuarial Present Value of Future Plan Benefits: The Actuarial Present Value of those benefit amounts which are expected to be paid at various future times under a particular set of Actuarial Assumptions, taking into account such items as the effect of advancement in age and past and anticipated future compensation and service credits. The Actuarial Present Value of Future Plan Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive, non-retired members either entitled to a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would provide sufficient assets to pay all projected benefits and expenses when due.

Actuarial Valuation: The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial valuation for a governmental retirement system typically also includes calculations that provide the financial information of the plan, such as the funded ratio, unfunded actuarial accrued liability and the ADC.

Actuarial Value of Assets or ***Valuation Assets:*** The value of the Fund's assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets, but commonly actuaries use a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the ADC.

Actuarially Determined: Values which have been determined utilizing the principles of actuarial science. An actuarially determined value is derived by application of the appropriate actuarial assumptions to specified values determined by provisions of the law.

Actuarially Determined Contribution (ADC): The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation. The ADC consists of the Employer Normal Cost and the Amortization Payment.

Amortization Method: A method for determining the Amortization Payment. The most common methods used are level dollar and level percentage of payroll. Under the Level Dollar method, the Amortization Payment is one of a stream of payments, all equal, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the Amortization payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay

method, the stream of payments increases at the assumed rate at which total covered payroll of all active members will increase.

Amortization Payment: The portion of the pension plan contribution or ADC which is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability.

Closed Amortization Period: A specific number of years that is counted down by one each year, and therefore declines to zero with the passage of time. For example if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc. See Funding Period and Open Amortization Period.

Decrements: Those causes/events due to which a member's status (active-inactive-retiree-beneficiary) changes, that is: death, retirement, disability, or termination.

Defined Benefit Plan: A retirement plan that is not a Defined Contribution Plan. Typically a defined benefit plan is one in which benefits are defined by a formula applied to the member's compensation and/or years of service.

Defined Contribution Plan: A retirement plan, such as a 401(k) plan, a 403(b) plan, or a 457 plan, in which the contributions to the plan are assigned to an account for each member, and the plan's earnings are allocated to each account, and each member's benefits are a direct function of the account balance.

Employer Normal Cost: The portion of the Normal Cost to be paid by the employers. This is equal to the Normal Cost less expected member contributions.

Experience Study: A periodic review and analysis of the actual experience of the Fund which may lead to a revision of one or more actuarial assumptions. Actual rates of decrement and salary increases are compared to the actuarially assumed values and modified as deemed appropriate by the Actuary.

Funded Ratio: The ratio of the actuarial value of assets (AVA) to the actuarial accrued liability (AAL). Plans sometimes calculate a market funded ratio, using the market value of assets (MVA), rather than the AVA.

Funding Period or ***Amortization Period:*** The term "Funding Period" is used two ways. In the first sense, it is the period used in calculating the Amortization Payment as a component of the ADC. This funding period is specified in State statute. In the second sense, it is a calculated item: the number of years in the future that will theoretically be required to amortize (i.e., pay off or eliminate) the Unfunded Actuarial Accrued Liability, based on a statutory employer contribution rate, and assuming no future actuarial gains or losses.

GASB: Governmental Accounting Standards Board.

GASB 67 and ***GASB 68***: Governmental Accounting Standards Board Statements No. 67 and No. 68. These are the governmental accounting standards that set the accounting and reporting rules for public retirement systems and the employers that sponsor, participate in, or contribute to them. Statement No. 67 sets the accounting rules for the financial reporting of the retirement systems, while Statement No. 68 sets the rules for the employers that sponsor, participate in, or contribute to public retirement systems.

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. Any payment in respect of an Unfunded Actuarial Accrued Liability is not part of Normal Cost (see Amortization Payment). For pension plan benefits which are provided in part by employee contributions, Normal Cost refers to the total of employee contributions and employer Normal Cost unless otherwise specifically stated. Under the entry age normal cost method, the Normal Cost is intended to be the level cost (when expressed as a percentage of pay) needed to fund the benefits of a member from hire until ultimate termination, death, disability or retirement.

Open Amortization Period: An open amortization period is one which is used to determine the Amortization Payment but may not decrease by exactly one year in the subsequent year's actuarial valuation. For instance, if the initial period is set as 30 years, the same 30-year period is used in determining the Amortization Period each year.

Unfunded Actuarial Accrued Liability: The excess of the Actuarial Accrued Liability over the Actuarial Value of Assets. This value may be negative in which case it may be expressed as a negative Unfunded Actuarial Accrued Liability, also called the Funding Surplus.

Valuation Date or Actuarial Valuation Date: The date as of which the value of assets is determined and as of which the Actuarial Present Value of Future Plan Benefits is determined. The expected benefits to be paid in the future are discounted to this date.

P: 469.524.0000 | www.grsconsulting.com

December 2, 2021

Board of Trustees
Kentucky Retirement System
Perimeter Park West
1260 Louisville Road
Frankfort, KY 40601

Re: Sensitivity Analysis Based on Results of the June 30, 2021 Actuarial Valuation

Dear Members of the Board:

Per Kentucky State Statute 61.670, we are providing this supplemental information regarding the sensitivity of the valuation results to changes in some of the economic assumptions. Specifically, the attached tables show the impact for the **State Police Retirement System (SPRS)** due to changes in the investment return assumption, the inflation rate assumption, and the payroll growth rate assumption.

Background

Investment Assumption

The investment return assumption is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plans. The lower the investment return assumption, the less the benefit payments are discounted and the higher the valuation liability. The current investment return assumption is 5.25% for the SPRS retirement fund and 6.25% for the SPRS insurance fund. The sensitivity analysis shows the financial impact of a 1.00% increase and a 1.00% decrease in the investment return assumption. For purposes of this sensitivity analysis, the inflation assumption and payroll growth assumption remain unchanged from the valuation assumption.

Inflation Assumption

The inflation assumption underlies most of the other economic assumptions, including the investment return, salary increases, and payroll growth rate. This is a macroeconomic assumption and as such the same assumption is used in the valuation of each of the retirement systems. The current assumption is 2.30% for all funds. The sensitivity analysis shows the financial impact of a 0.25% increase and a 0.25% decrease in the inflation assumption. Note, the change in the inflation assumption results in a corresponding change in the investment return assumption, the individual salary increase assumption for projecting members' benefit amounts, the payroll growth rate assumption, and the healthcare trend assumption that is used in the valuation of the health insurance funds.

Payroll Growth Assumption

Participating employers of SPRS make contributions to the system as a percentage of the covered payroll. Therefore, as payroll changes over time these amortization payments will also change. If actual covered payroll increases at a rate that is less than assumed, then the retirement system receives fewer contribution dollars than expected to finance the unfunded liability, which means the contribution rates in future years will be required to increase in order to finance the unfunded liability over the same time period. The current payroll growth assumption is 0.00% for the SPRS retirement and insurance funds. The analysis shows the impact of a 1.00% increase and a 1.00% decrease in the payroll growth assumption.

Please note that the payroll growth assumption does not impact the valuation liabilities, unfunded liability, or funded status of the system. Rather, this assumption only impacts the amortization rate for financing the existing unfunded actuarial accrued liability and the actuarially determined employer contribution. For purposes of this analysis, the investment return assumption and the inflation assumption are held at their current valuation assumptions.

Certification

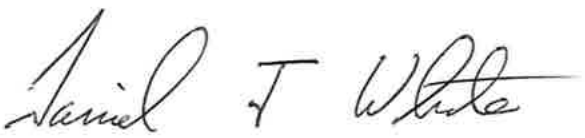
The information provided in this letter compliments the information provided in the June 30, 2021 actuarial valuation report. Please refer to the June 30, 2021 actuarial valuation report for additional discussion of the actuarial valuation, including the nature of actuarial calculations and more information related to participant data, economic and demographic assumptions, and benefit provisions.

Actual results can, and almost certainly will, differ as actual experience deviates from the assumptions. Even seemingly minor changes in the assumptions can materially change the liabilities, calculated contribution rate, and funding periods. The actuarial calculations are intended to provide information for rational decision making. The purpose of this information is to provide stakeholders the financial sensitivity of the unfunded liability and contribution rates to changes in the inflation, assumed rate of return, and payroll growth assumption.

The undersigned are independent actuaries and consultants. Both of the undersigned are Enrolled Actuaries, Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. Both of the undersigned are experienced in performing valuations for large public retirement systems. This communication shall not be construed to provide tax advice, legal advice or investment advice.

Sincerely,

Gabriel, Roeder, Smith & Company



Daniel J. White, FSA, EA, MAAA
Senior Consultant

Janie Shaw, ASA, EA, MAAA
Consultant

Sensitivity Analysis - Discount Rate

(Dollar amounts expressed in thousands)

(1)	Decrease Discount Rate (2)	Valuation Results (3)	Increase Discount Rate (4)
Payroll Growth Rate	0.00%	0.00%	0.00%
Inflation Rate	2.30%	2.30%	2.30%
Discount Rate - Retirement	4.25%	5.25%	6.25%
Discount Rate - Insurance	5.25%	6.25%	7.25%
Retirement			
Actuarial Accrued Liability	$ 1,190,256	$ 1,053,259	$ 941,901
Actuarial Value of Assets	323,250	323,250	323,250
Unfunded Actuarial Accrued Liability	867,006	730,009	618,651
Funded Ratio	27.2%	30.7%	34.3%
Actuarially Determined Contribution Rate	146.86%	126.40%	109.55%
Insurance			
Actuarial Accrued Liability	$ 307,759	$ 272,406	$ 243,660
Actuarial Value of Assets	223,251	223,251	223,251
Unfunded Actuarial Accrued Liability	84,508	49,155	20,409
Funded Ratio	72.5%	82.0%	91.6%
Actuarially Determined Contribution Rate	22.37%	14.11%	6.74%
Combined			
Actuarial Accrued Liability	$ 1,498,015	$ 1,325,665	$ 1,185,561
Actuarial Value of Assets	546,501	546,501	546,501
Unfunded Actuarial Accrued Liability	951,514	779,164	639,060
Funded Ratio	36.5%	41.2%	46.1%
Actuarially Determined Contribution Rate	169.23%	140.51%	116.29%

Sensitivity Analysis - Inflation Rate

(Dollar amounts expressed in thousands)

(1)	Decrease Inflation Rate (2)	Valuation Results (3)	Increase Inflation Rate (4)
Payroll Growth Rate	-0.25%	0.00%	0.25%
Inflation Rate	2.05%	2.30%	2.55%
Discount Rate - Retirement	5.00%	5.25%	5.50%
Discount Rate - Insurance	6.00%	6.25%	6.50%
Retirement			
Actuarial Accrued Liability	$ 1,083,871	$ 1,053,259	$ 1,024,174
Actuarial Value of Assets	323,250	323,250	323,250
Unfunded Actuarial Accrued Liability	760,621	730,009	700,924
Funded Ratio	29.8%	30.7%	31.6%
Actuarially Determined Contribution Rate	133.37%	126.40%	119.79%
Insurance			
Actuarial Accrued Liability	$ 273,930	$ 272,406	$ 270,960
Actuarial Value of Assets	223,251	223,251	223,251
Unfunded Actuarial Accrued Liability	50,679	49,155	47,709
Funded Ratio	81.5%	82.0%	82.4%
Actuarially Determined Contribution Rate	14.66%	14.11%	13.59%
Combined			
Actuarial Accrued Liability	$ 1,357,801	$ 1,325,665	$ 1,295,134
Actuarial Value of Assets	546,501	546,501	546,501
Unfunded Actuarial Accrued Liability	811,300	779,164	748,633
Funded Ratio	40.2%	41.2%	42.2%
Actuarially Determined Contribution Rate	148.03%	140.51%	133.38%

Sensitivity Analysis - Payroll Growth

(Dollar amounts expressed in thousands)

(1)	Decrease Payroll Growth (2)	Valuation Results (3)	Increase Payroll Growth (4)
Payroll Growth Rate	-1.00%	0.00%	1.00%
Inflation Rate	2.30%	2.30%	2.30%
Discount Rate - Retirement	5.25%	5.25%	5.25%
Discount Rate - Insurance	6.25%	6.25%	6.25%
Retirement			
Actuarial Accrued Liability	$ 1,053,259	$ 1,053,259	$ 1,053,259
Actuarial Value of Assets	323,250	323,250	323,250
Unfunded Actuarial Accrued Liability	730,009	730,009	730,009
Funded Ratio	30.7%	30.7%	30.7%
Actuarially Determined Contribution Rate	138.72%	126.40%	114.92%
Insurance			
Actuarial Accrued Liability	$ 272,406	$ 272,406	$ 272,406
Actuarial Value of Assets	223,251	223,251	223,251
Unfunded Actuarial Accrued Liability	49,155	49,155	49,155
Funded Ratio	82.0%	82.0%	82.0%
Actuarially Determined Contribution Rate	14.99%	14.11%	13.28%
Combined			
Actuarial Accrued Liability	$ 1,325,665	$ 1,325,665	$ 1,325,665
Actuarial Value of Assets	546,501	546,501	546,501
Unfunded Actuarial Accrued Liability	779,164	779,164	779,164
Funded Ratio	41.2%	41.2%	41.2%
Actuarially Determined Contribution Rate	153.71%	140.51%	128.20%

Kentucky Retirement System
SPRS Retirement Fund
($ in Millions)

Fiscal Year Beginning July 1,	Actuarial Accrued Liability	Actuarial Value of Assets	Unfunded Actuarial Accrued Liability	Funded Ratio	Employer Contribution	Member Contribution	Covered Payroll	Employer Contribution as % of Covered Payroll	Employer Actuarially Determined Contribution
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2021	$ 1,053	$ 323	$ 730	31%	$ 58	$ 4	$ 45	127.99%	127.99%
2022	1,055	348	707	33%	57	4	45	126.40%	126.40%
2023	1,055	371	684	35%	57	4	45	126.40%	123.44%
2024	1,054	392	662	37%	55	4	45	120.71%	120.71%
2025	1,051	413	638	39%	55	4	45	120.71%	118.30%
2026	1,046	424	622	41%	52	4	45	115.39%	115.39%
2027	1,040	432	608	42%	52	4	45	115.39%	114.66%
2028	1,034	441	593	43%	52	4	45	113.93%	113.93%
2029	1,026	448	578	44%	52	4	45	113.93%	113.26%
2030	1,018	457	561	45%	51	4	45	112.61%	112.61%
2031	1,009	465	544	46%	51	4	45	112.61%	112.16%
2032	1,000	474	526	47%	51	4	45	111.75%	111.75%
2033	990	483	507	49%	51	4	45	111.75%	111.46%
2034	981	494	487	50%	50	4	45	111.19%	111.19%
2035	972	506	466	52%	50	4	45	111.19%	110.91%
2036	962	518	444	54%	50	4	45	110.54%	110.54%
2037	952	531	421	56%	50	4	45	110.54%	110.14%
2038	942	545	397	58%	50	4	45	109.66%	109.66%
2039	931	560	371	60%	50	4	45	109.66%	109.17%
2040	920	576	344	63%	49	4	45	107.78%	107.78%
2041	908	592	316	65%	49	4	45	107.78%	110.49%
2042	896	609	287	68%	51	4	45	112.45%	112.45%
2043	883	630	253	71%	51	4	45	112.45%	114.18%
2044	871	652	219	75%	52	4	45	115.75%	115.75%
2045	857	678	179	79%	52	4	45	115.75%	117.70%
2046	844	704	140	83%	53	4	45	117.76%	117.76%
2047	830	734	96	88%	53	4	45	117.76%	117.73%
2048	816	766	50	94%	53	4	45	117.70%	117.70%
2049	801	801	-	100%	4	4	45	7.77%	7.77%
2050	787	787	-	100%	4	4	45	7.77%	7.77%

Notes and assumptions:

The projection is based on the results of the June 30, 2021 actuarial valuation and assumes that all actuarial assumptions are realized, including the assumed annual asset return of 5.25%.

New active members are assumed to be hired as current active members are assumed to terminate employment or retire.

The total active population is assumed to decrease 2% each year for each of the next 30 years.

Covered payroll is assumed to remain level throughout the entire projection.

The contribution rate established in the Commonwealth's biennium budget is assumed to be equal to the full actuarially determined contribution rate.

Kentucky Retirement System
SPRS Insurance Fund
($ in Millions)

Fiscal Year Beginning July 1,	Actuarial Accrued Liability	Actuarial Value of Assets	Unfunded Actuarial Accrued Liability	Funded Ratio	Employer Contribution	Member Contribution	Covered Payroll	Employer Contribution as % of Covered Payroll	Employer Actuarially Determined Contribution
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2021	$ 272	$ 223	$ 49	82%	$ 8	$ -	$ 45	18.07%	18.07%
2022	278	238	40	86%	6	-	45	14.11%	14.11%
2023	282	250	32	89%	6	-	45	14.11%	11.65%
2024	285	261	24	92%	4	-	45	9.42%	9.42%
2025	286	271	15	95%	4	-	45	9.42%	7.54%
2026	287	273	14	95%	2	-	45	5.17%	5.17%
2027	287	272	15	95%	2	-	45	5.17%	4.75%
2028	286	271	15	95%	2	-	45	4.39%	4.39%
2029	284	268	16	94%	2	-	45	4.39%	4.12%
2030	282	265	17	94%	2	-	45	3.88%	3.88%
2031	279	262	17	94%	2	-	45	3.88%	3.73%
2032	275	258	17	94%	2	-	45	3.59%	3.59%
2033	272	253	19	93%	2	-	45	3.59%	3.51%
2034	268	249	19	93%	2	-	45	3.46%	3.46%
2035	264	244	20	92%	2	-	45	3.46%	3.41%
2036	261	239	22	92%	2	-	45	3.37%	3.37%
2037	258	235	23	91%	2	-	45	3.37%	3.35%
2038	255	231	24	91%	2	-	45	3.33%	3.33%
2039	252	227	25	90%	2	-	45	3.33%	3.31%
2040	250	224	26	90%	2	-	45	4.56%	4.56%
2041	248	221	27	89%	2	-	45	4.56%	8.39%
2042	247	219	28	89%	5	-	45	10.40%	10.40%
2043	246	220	26	89%	5	-	45	10.40%	11.96%
2044	246	221	25	90%	6	-	45	13.40%	13.40%
2045	246	224	22	91%	6	-	45	13.40%	15.27%
2046	246	228	18	93%	7	-	45	15.45%	15.45%
2047	246	233	13	95%	7	-	45	15.45%	15.50%
2048	246	238	8	97%	7	-	45	15.50%	15.50%
2049	246	246	-	100%	2	-	45	3.39%	3.39%
2050	246	246	-	100%	2	-	45	3.37%	3.37%

Notes and assumptions:

The projection is based on the results of the June 30, 2021 actuarial valuation and assumes that all actuarial assumptions are realized, including the assumed annual asset return of 6.25%.

New active members are assumed to be hired as current active members are assumed to terminate employment or retire.

The total active population is assumed to decrease 2% each year for each of the next 30 years.

Covered payroll is assumed to remain level throughout the entire projection.

The contribution rate established in the Commonwealth's biennium budget is assumed to be equal to the full actuarially determined contribution rate.