State Police Retirement System of New Jersey

Actuarial Experience Study for July 1, 2014 through June 30, 2018

Produced by Cheiron

January 2020

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January 17, 2020

Board of Trustees
State Police Retirement System of New Jersey
State of New Jersey
Department of the Treasury
Division of Pension and Benefits, CN 295
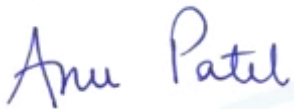Trenton, NJ 08625-0295

Dear Board Members:

The purpose of this report is to present an Actuarial Experience Study of the State Police Retirement System of New Jersey (SPRS, the System) in accordance with Title 53, Chapter 5A-32 of the NJ State Statute. This Statute requires the actuary to conduct an actuarial investigation into the mortality, service and salary experience of the members and beneficiaries of the System at least once in every three year period. This experience study covers the actuarial experience from July 1, 2014 through June 30, 2018. The report includes analyses and results of our study as well as recommended assumptions for consideration by the Board for changes to several of the actuarial assumptions to be used beginning with the July 1, 2019 actuarial valuation. It also includes the estimated financial impact of these assumption changes.

If you have any questions about the report or would like additional information, please let us know.
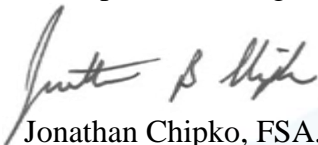
Sincerely,
Cheiron

Janet Cranna, FSA, FCA, MAAA, EA
Principal Consulting Actuary

Anu Patel, FSA, MAAA, EA
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cc: Kenneth Kent, FSA, FCA, MAAA, EA

SECTION I – EXECUTIVE SUMMARY

Actuarial assumptions (economic and demographic) are intended to be long-term in nature, and should be both individually reasonable and consistent in the aggregate. The purpose of this experience study is to evaluate whether or not the current assumptions adequately reflect the long-term expectations for SPRS, and if not, to recommend adjustments. It is important to note that frequent and significant changes in the actuarial assumptions are not typically recommended, unless there are known fundamental changes in expectations of the economy, or with respect to SPRS's membership or assets that would warrant such frequent or significant changes.

SUMMARY OF ASSUMPTION ANALYSIS

This experience study specifically analyzes and makes the following recommendations for the demographic assumptions.

- **Retirement rates** – Modify rates based on recent experience.
- **Termination rates** – Update to use a service based termination rate table.
- **Disability rates** – Continue with the current assumption.
- **Mortality rates** – Update to use newly published Pub-2010 mortality tables with generational mortality improvements using SOA's Scale MP-2018.
- **Price and wage inflation rates** – Decrease the inflation assumptions based on recent experience.
- **Salary increases rates** – Continue with the current salary increase assumptions.

The recommended changes to the assumptions in the aggregate will slightly decrease the actuarial liability and the Statutory Contributions.

Further information about the impact of these changes to overall contribution rates can be found on the next page:

SECTION I – EXECUTIVE SUMMARY

Table I-1 Cost Impact of Assumption Changes		
	Current Assumptions	**Recommended Assumptions**
Assets and Liabilities		
Actuarial Liability	$ 3,430,821,762	$ 3,429,193,715
Actuarial Value of Assets (AVA)[1]	1,939,304,839	1,939,304,839
Unfunded Actuarial Liability/(Surplus)	$ 1,491,516,923	$ 1,489,888,876
Funded Ratio	56.5%	56.6%
Contribution Amounts		
State Normal Cost at End of Year	$ 39,287,598	$ 38,694,863
Amortization Payment of UAL	126,288,581	126,150,732
Total Statutory Contribution for FYE	$ 165,576,179	$ 164,845,595
Difference due to assumption changes		
Actuarial Liability		$ (1,628,047)
Actuarial Value of Assets (AVA)[1]		0
Unfunded Actuarial Liability/(Surplus)		$ (1,628,047)
Funded Ratio		0.1%
State Normal Cost at End of Year		$ (592,735)
Amortization Payment of UAL		(137,849)
Total Statutory Contribution for FYE		$ (730,584)

[1] Includes discounted State appropriations receivable

The body of this report provides details and support for our conclusions and recommendations for the assumptions.

SECTION II – CERTIFICATION

The purpose of this report is to provide the results of an Actuarial Experience Study of the State Police Retirement System of New Jersey (SPRS) covering actuarial experience over a four year period from July 1, 2014 through June 30, 2018. This report is for the use of the Division of Pensions and Benefits and the SPRS Board of Trustees in selecting assumptions to be used in actuarial valuations beginning July 1, 2019. This experience study was completed in accordance with the provisions of Title 53, Chapter 5A-32 of the NJ State Statute which requires periodic review of the experience of the System.

In preparing our report, we relied on information (some oral and some written) supplied by the Division of Pensions and Benefits. This information includes, but is not limited to, the plan provisions, employee data, and financial information. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standard of Practice No. 23.

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

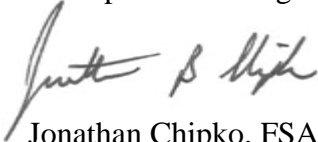This report was prepared for the State Police Retirement System of New Jersey for the purposes described herein. This report is not intended to benefit any other party, and Cheiron assumes no duty or liability to any such party.

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SECTION III – DEMOGRAPHIC ASSUMPTIONS

Demographic assumptions are used to predict membership behavior, including rates of retirement, termination, disability, and mortality. These assumptions are based primarily on the historical experience of SPRS, with some adjustments where future experience is expected to differ from historical experience and with deference to standard tables where SPRS experience is not fully credible and a standard table is available.

ANALYSIS OF DEMOGRAPHIC ASSUMPTIONS

For all of the demographic assumptions, we determined the ratio of the actual number of decrements for each membership group compared to the expected number of decrements (A/E ratio or actual-to-expected ratio). Generally, the goal is to get as close as possible to an A/E ratio of 100%. Appropriate assumptions are often dependent on the amount of data available, and if there is insufficient data, then the best assumption may be a reflection of standard tables. For example, there are typically relatively low incidences of pre-retirement deaths so using standard mortality tables may be more appropriate. This could result in the A/E ratio moving further away from 100%. Also, we aggregate members for demographic assumptions review when the data at individual ages is no longer credible. For example, we may reduce the number of service bands for an assumption with low incidences, if those service bands do not materially improve the quality of the results.

We also calculate an r-squared statistic for each assumption. R-squared measures how well the assumption fits the actual data and can be thought of as the percentage of the variation in actual data explained by the assumption. Ideally, r-squared would equal 100%, although this is never the case in reality. Any recommended assumption change should increase the r-squared compared to the current assumption making it closer to 100% unless the pattern of future decrements is expected to be different from the pattern experienced during the period of study.

In addition, we calculated the 90% confidence interval, which represents the range within which the true decrement rate during the experience study period fell with a range anticipated to cover 90% of likely results. (If there is insufficient data to calculate a confidence interval, the confidence interval is shown as the entire range of the graph.) We generally propose assumption changes when the current assumption is outside the 90% confidence interval of the observed experience. However, adjustments are made to account for differences between future expectations and historical experience, to account for the past experience represented by the current assumption, and to maintain a neutral to slight conservative bias in the selection of the assumption. For mortality rates, we compare SPRS's experience to that of a standard table.

RETIREMENT RATES

The current retirement rates vary by age and service and are applied to all members who are eligible to retire. As a result, a state police officer who is age 50 with 20 years of service, for example, is assumed to be less likely to retire than a police officer who is age 50 with 25 years of service. In reviewing the data for SPRS, we find that at many ages, members are most likely to retire with 25 years of service, and those with more or less than 25 years of service are less likely to retire. Mandatory retirement is age 55. SPRS is not large enough to justify assumptions for each age and service combination, so we propose separate assumptions by service groups:

- Members with 20 to 24 years of service,
- Members with 25 years of service, and
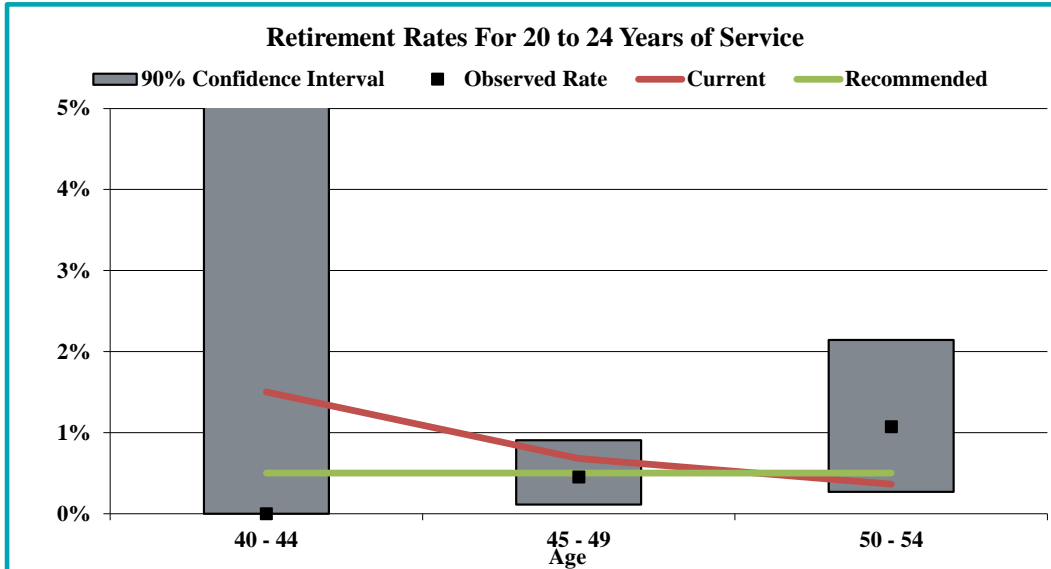- Members with 26 or more years of service.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

In Table III-R1 we show the calculation of actual-to-expected ratios and the r-squared statistic for members with 20 to 24 years of service, and Chart III-R1 shows the information graphically along with the 90% confidence interval. The previous retirement assumption had separate retirement rates for 20 years of service, 21 years of service and 22 to 24 years of service. Since the number of retirements with less than 25 years of service is small, we recommend having one retirement rate for members with 20 to 24 years of service as shown in the table below.

Table III-R1

Retirement Rates For 20 to 24 Years of Service								
Age Band	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
40 - 44	137	0	2.1	0.7	0.00%	1.50%	0.50%	0%	0%
45 - 49	882	4	6.0	4.4	0.45%	0.68%	0.50%	67%	91%
50 - 54	373	4	1.4	1.9	1.07%	0.36%	0.50%	294%	214%
Total	**1,392**	**8**	**9.4**	**7.0**	**0.57%**	**0.68%**	**0.50%**	**85%**	**115%**
R-squared			**0.002**	**0.153**					

Chart III-R1

SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Table III-R2 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 25 years of service, and Chart III-R2 shows the information graphically along with the 90% confidence interval. The data shows that the actual retirement rates for ages 45 through 48 are lower than expected, so we recommend decreasing the retirement rates at these ages and maintaining the current assumption for ages 49 through 54.

Table III-R2

| Retirement Rates For 25 Years of Service								
Age Band	Exposures	Retirements			Retirement Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
45 - 46	3	0	1.5	0.8	0.00%	50.00%	25.00%	0%	0%
47 - 48	12	1	6.0	3.0	8.33%	50.00%	25.00%	17%	33%
49 - 50	26	9	13.0	13.0	34.62%	50.00%	50.00%	69%	69%
51 - 52	35	19	17.5	17.5	54.29%	50.00%	50.00%	109%	109%
53 - 54	22	14	11.0	11.0	63.64%	50.00%	50.00%	127%	127%
Total	98	43	49.0	45.3	43.88%	50.00%	46.17%	88%	95%
R-squared			0.811	0.858					

Chart III-R2
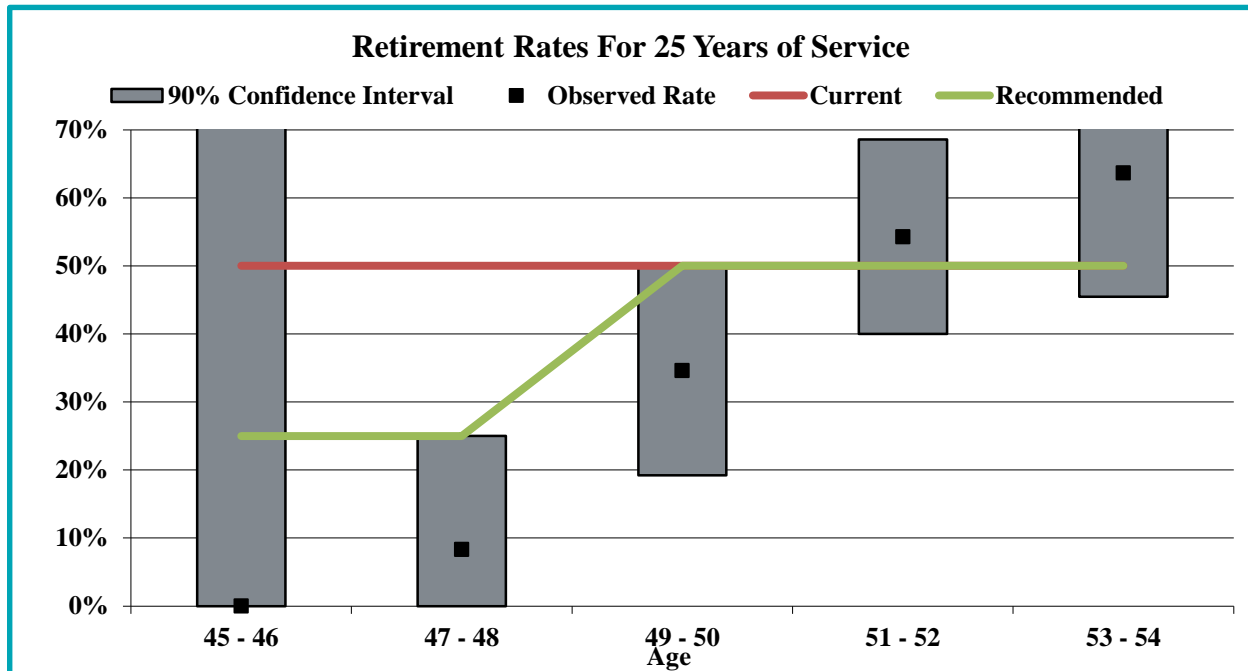
SECTION III – DEMOGRAPHIC ASSUMPTIONS
RETIREMENT RATES

Table III-R3 shows the calculation of actual-to-expected ratios and the r-squared statistic for members with 26 or more years of service, and Chart III-R3 shows the information graphically along with the 90% confidence interval. For retirements with 26 or more years of service, we recommend a flat rate of 35% for all ages.

Table III-R3

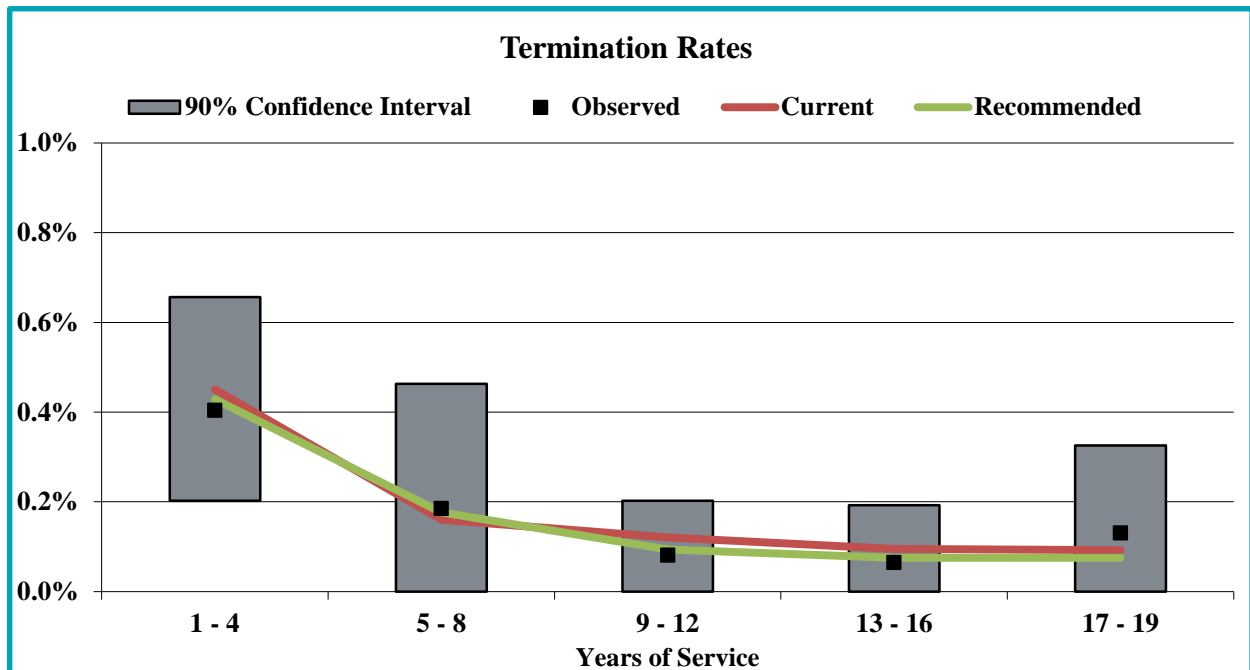|		Retirements			Retirement Rates			A/E Ratios	
Age	Exposures	Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
46	4	1	1.1	1.4	25.00%	28.00%	35.00%	89%	71%
47	12	3	3.4	4.2	25.00%	28.00%	35.00%	89%	71%
48	37	10	12.2	13.0	27.03%	33.00%	35.00%	82%	77%
49	62	25	20.5	21.7	40.32%	33.00%	35.00%	122%	115%
50	77	26	25.4	27.0	33.77%	33.00%	35.00%	102%	96%
51	90	27	29.7	31.5	30.00%	33.00%	35.00%	91%	86%
52	88	28	29.0	30.8	31.82%	33.00%	35.00%	96%	91%
53	88	33	29.0	30.8	37.50%	33.00%	35.00%	114%	107%
54	64	25	39.0	22.4	39.06%	61.00%	35.00%	64%	112%
Total	**522**	**178**	**189.4**	**182.7**	**34.10%**	**36.28%**	**35.00%**	**94%**	**97%**
R-squared			**0.826**	**0.947**					

Chart III-R3
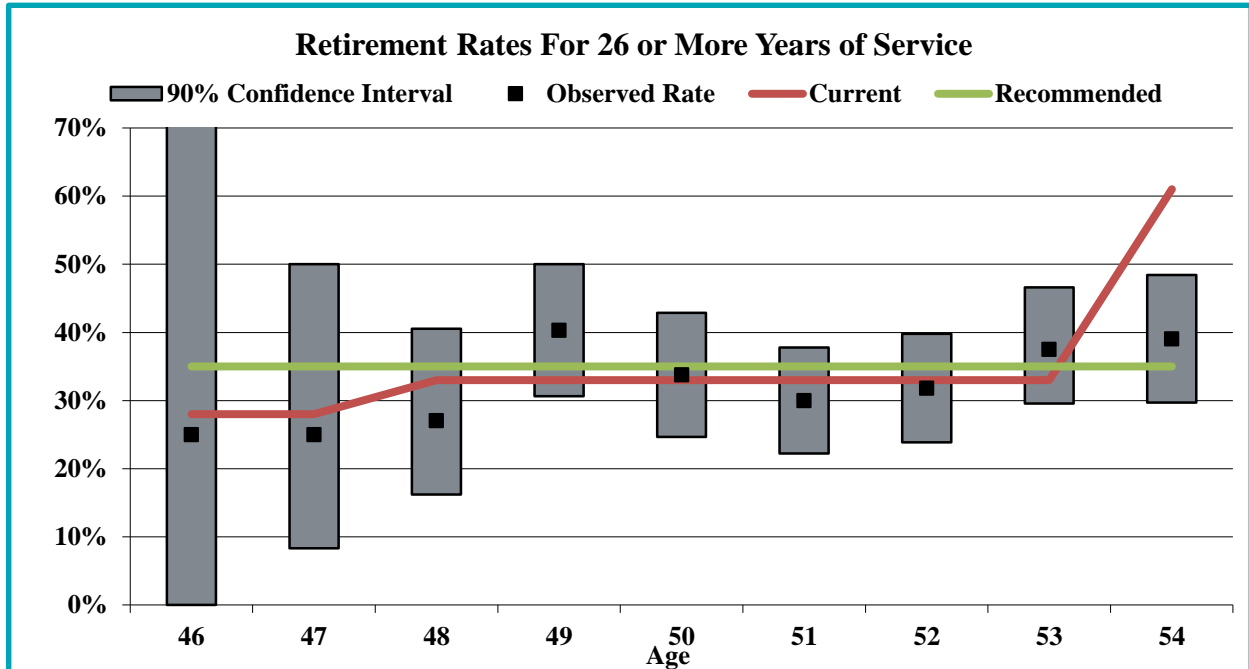
SECTION III – DEMOGRAPHIC ASSUMPTIONS
TERMINATION RATES

Termination rates reflect the frequency at which active members leave employment for reasons other than retirement, death, or disability. The current assumption varies by age and service, and the current rates imply very few members terminate. The experience shows that of the 8,624 exposures in the four years of experience, there were only 15 terminations. We propose using a service based table instead of an age based table because the rates of termination are more consistent with the years of service. Termination rates decrease as service increases, ultimately reaching 0 when members reach 20 years of service and become retirement eligible.

Table III-T1

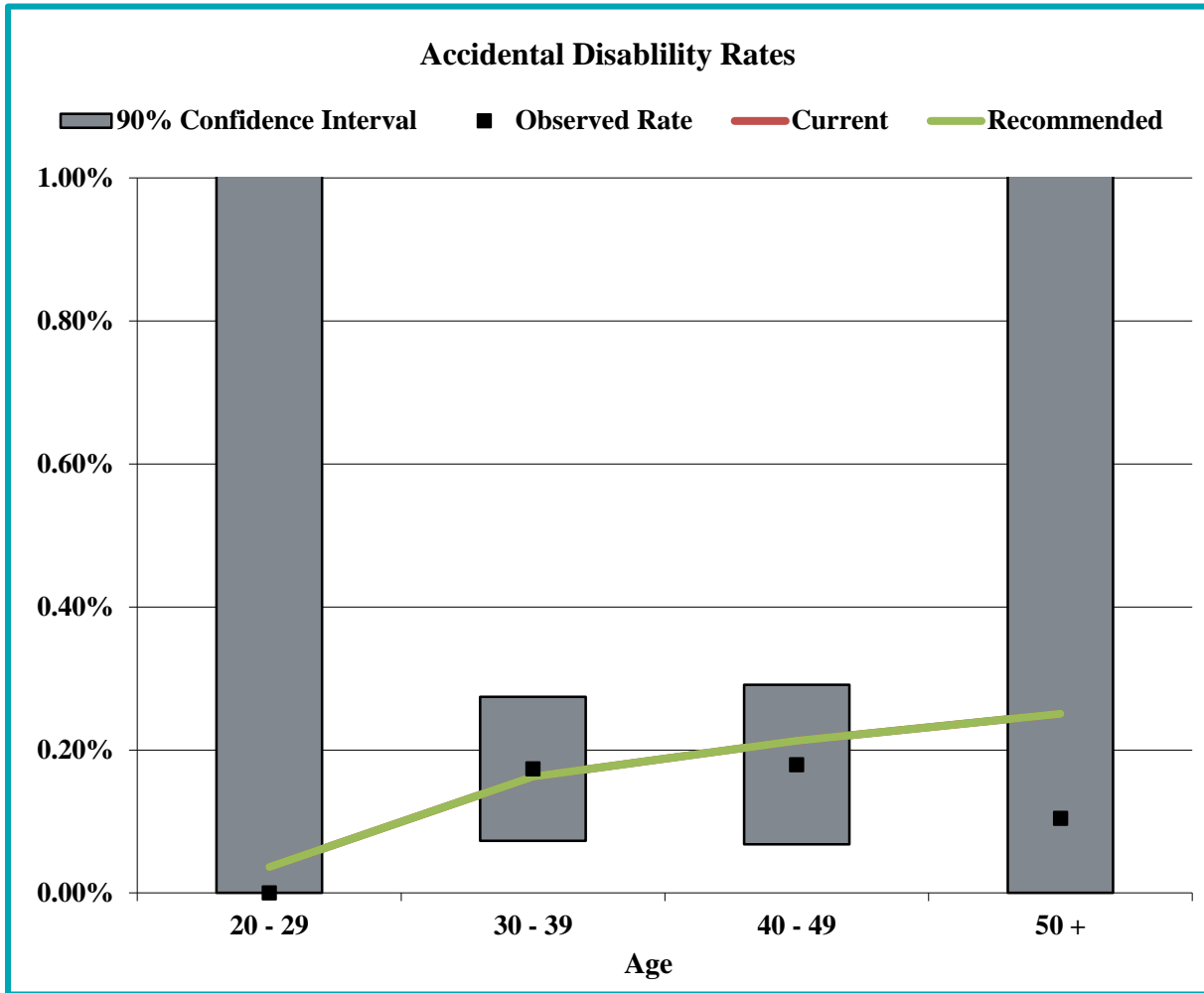| Termination Rates									
Service Band	Exposures	Terminations			Termination Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
1 - 4	1,981	8	8.9	8.5	0.40%	0.45%	0.43%	90%	94%
5 - 8	1,080	2	1.7	1.9	0.19%	0.16%	0.18%	115%	105%
9 - 12	2,470	2	3.0	2.3	0.08%	0.12%	0.09%	67%	86%
13 - 16	2,049	2	1.9	1.5	0.10%	0.09%	0.08%	105%	130%
17 - 19	1,044	1	1.0	0.8	0.10%	0.09%	0.08%	102%	128%
Total	8,624	15	16.5	15.0	0.17%	0.19%	0.17%	91%	100%
R-squared			0.281	0.240					

Chart III-T1

SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES

The following table shows the calculation of actual-to-expected ratios and the r-squared statistic for terminations due to accidental disability. The experience shows very low incidence of accidental disability and therefore we propose continuing with the current assumption without any changes.

Table III-D1

| Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
20 - 29	1,175	0	0.4	0.4	0.00%	0.04%	0.04%	0%	0%
30 - 39	4,608	8	7.5	7.5	0.17%	0.16%	0.16%	107%	107%
40 - 49	3,898	7	8.3	8.3	0.18%	0.21%	0.21%	84%	84%
50 +	956	1	2.4	2.4	0.10%	0.25%	0.25%	42%	42%
Total	**10,637**	**16**	**18.6**	**18.6**	**0.15%**	**0.17%**	**0.17%**	**86%**	**86%**
R-squared			**0.2969**	**0.2969**					

Chart III-D1

SECTION III – DEMOGRAPHIC ASSUMPTIONS
DISABILITY RATES

Table III-D2 shows the calculation of actual-to-expected ratios and the r-squared statistic for terminations due to ordinary disability, and Chart III-D2 shows the information graphically along with the 90% confidence interval. The experience shows very low incidence of ordinary disability and therefore we propose continuing with the current rates without any changes. Currently, these rates apply prior to 25 years of service. We recommend also applying a four year service requirement based on the eligibility for ordinary disability retirement.

Table III-D2

Age Band	Exposures	Disabilities			Disability Rates			A/E Ratios	
		Actual	Current	Recommended	Actual	Current	Recommended	Current	Recommended
25 - 34	1,602	0	1.4	1.4	0.00%	0.09%	0.09%	0%	0%
35 - 44	4,537	5	7.9	7.9	0.11%	0.17%	0.17%	64%	64%
45 - 54	2,180	4	6.6	6.6	0.18%	0.30%	0.30%	60%	60%
Total	**8,319**	**9**	**15.9**	**15.9**	**0.11%**	**0.19%**	**0.19%**	**57%**	**57%**
R-squared			**0.1830**	**0.1830**					

Chart III-D2
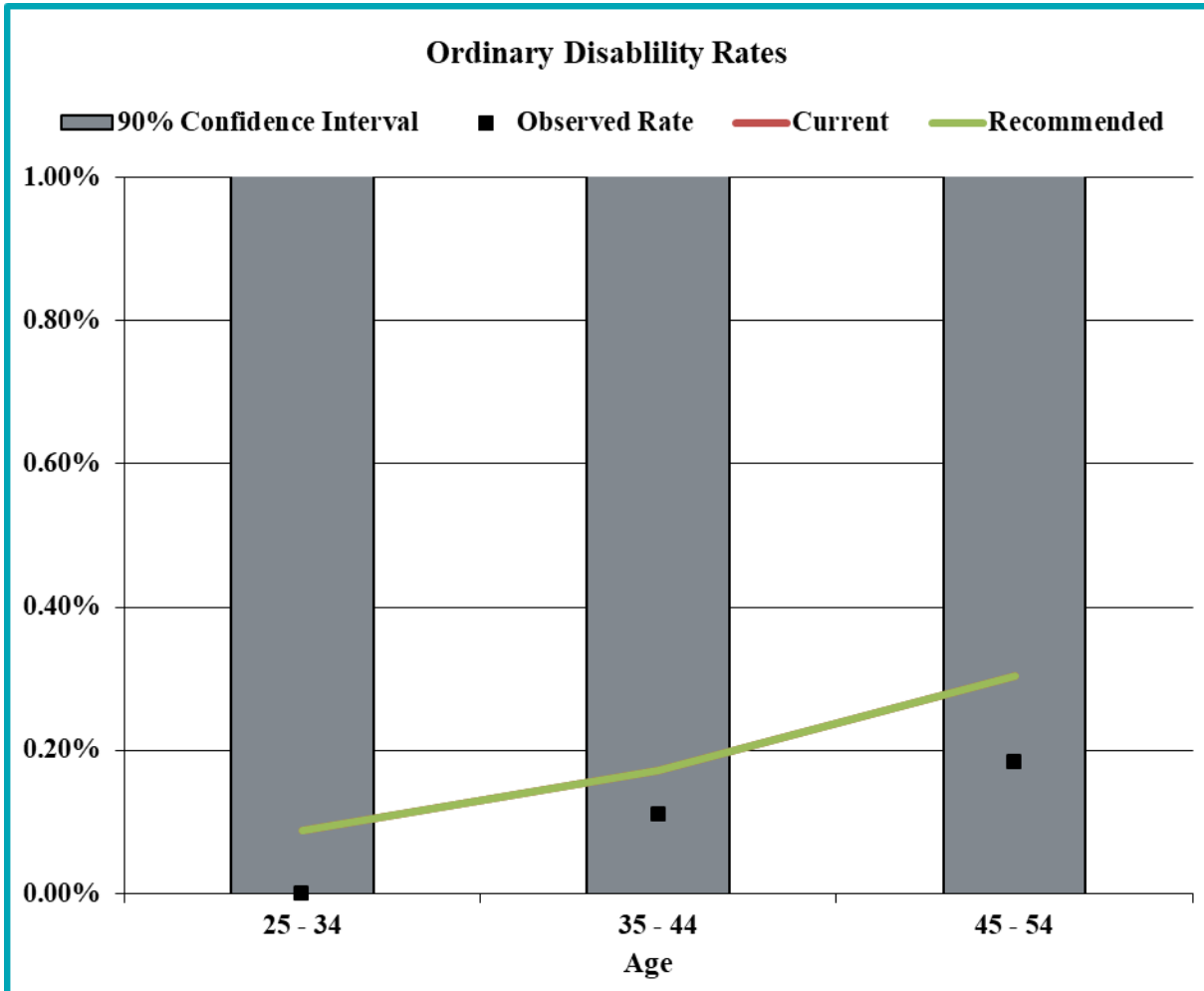
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Mortality assumptions are typically developed separately by gender. Unlike most of the other demographic assumptions that rely exclusively on the experience of the plan, for mortality, standard mortality tables and projection scales serve as the primary basis for the assumption which is then modified to better reflect the System's experience.

The Society of Actuaries (SOA) recently completed an extensive mortality study of public pension plan experience and issued a set of mortality tables named the Pub-2010 mortality tables which provide new insights into the composition of gender-specific pension mortality by factors such as job category (e.g. General Employees, Teachers, Public Safety), salary/benefit amount, health status (e.g. healthy or disabled), geographic region and duration since event.

In addition, there has been a long history of mortality improvement among pensioners in the U.S., and there is an expectation that mortality rates will continue to improve in the future. The recently completed project by the SOA concluded that mortality improvement in the U.S over the recent past "differed quite noticeably" from the prior standard projection scales (Scales AA and BB). As a result, we recommend using the MP-2018 scale, which was the most recent mortality improvement projection scale at the time this analysis was prepared.

The steps in our analysis of the mortality assumptions are as follows:

1. Select a standard mortality table that reflects the anticipated experience of the System.
2. Compare actual experience of the System to what would have been predicted by the selected standard table for the period of the experience study.
3. Adjust the standard table either fully or partially depending on the level of credibility for the System's experience. This adjusted table is called the base table.
4. Select an appropriate standard mortality improvement projection scale and apply it to the base table.

Similar to the methodology used to develop the Pub-2010 tables, when actual experience of the System is compared to that of the standard table, the experience is weighted based on the amount of income (salary for pre-retirement mortality and pension benefit for post-retirement mortality). Mortality studies in the U.S. have consistently shown that individuals with higher salaries if active or higher benefit income if retired have longer life expectancies than individuals with lower income. It is important for a pension plan to use assumptions that are weighted by income to reflect not just the incidence of a decrement but the impact on liabilities.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

In the prior study, SPRS adopted the following assumptions:

Active members:
- Ordinary Death: RP-2000 Combined Healthy Mortality Tables (unadjusted for females and set back 3 years for males) projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection scale thereafter.
- Accidental Death: Representative mortality rates as follows. No mortality improvement is assumed for this purpose.

Age	Rates
25	0.040%
30	0.050
35	0.050
40	0.050
45	0.060
50	0.090

Healthy retirees and beneficiaries: RP-2000 Combined Healthy Mortality Tables (unadjusted for females and set back 3 years for males) projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection scale thereafter.

Disabled members: RP-2000 Disability Mortality Tables (set forward 5 years for males and females) without projection.

Deaths among active and inactive lives for SPRS in a four-year period represent a relatively small sample size and does not provide meaningful statistics. For healthy retirees there were 164 deaths over this period, for survivors there were 83 deaths, for disabled retirees there were four deaths, and for active members there were six deaths. For reference, a fully credible sample would include 1,082 deaths. We therefore recommend using a standard Pub-2010 table without any adjustments to the standard table.

We recommend the following base mortality table assumptions:

Active members (Non-Annuitants): The standard Pub-2010 Public Safety Above-Median Income Employee mortality table *[PubS-2010(A) Employee]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. 35% of the deaths are assumed to be accidental.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Healthy Retirees (Healthy Annuitants): The standard Pub-2010 Public Safety Above-Median Income Healthy Retiree mortality table *[PubS-2010(A) Healthy Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Beneficiaries (Contingent Annuitants): The standard Pub-2010 General Above-Median Income Healthy Retiree mortality table *[PubG-2010(A) Healthy Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018. Mortality tables specifically designed for public safety employees may reflect higher mortality rates than expected for beneficiaries of public safety employees. We therefore recommend using mortality tables designed for general employees for the beneficiaries of safety employees.

Disabled retirees (Disabled Annuitants): The Pub-2010 Public Safety Disabled Retiree mortality table *[PubS-2010 Disabled Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from a base year of 2010 on a generational basis using SOA's Scale MP-2018.
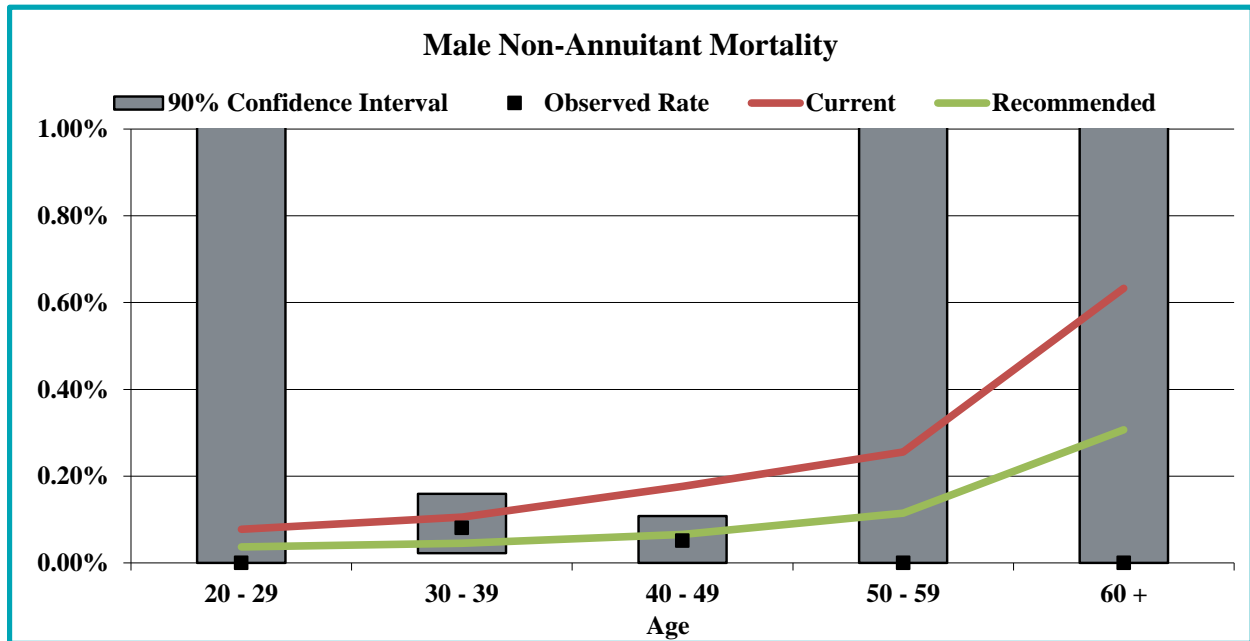
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M1 – Pre-Retirement Males

Non-Annuitant Mortality - Base Table for Males							
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
Age Band	Exposures	Actual Deaths	Weighted Exposures	Actual	Current	Recommended	Current	Recommended
20 - 29	1,096	0	80,009,139	0	62,114	30,378	0%	0%
30 - 39	4,401	4	412,649,843	333,271	436,368	196,345	76%	170%
40 - 49	3,705	2	431,868,628	221,433	763,112	291,022	29%	76%
50 - 59	1,012	0	127,521,556	0	325,879	146,867	0%	0%
60 +	10	0	1,350,361	0	8,544	4,203	0%	0%
Total	**10,224**	**6**	**1,053,399,527**	**554,704**	**1,596,017**	**668,816**	**35%**	**83%**
R-Squared					**0.042**	**0.046**		

Chart III-M1

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M2 – Active Females

Non-Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
20 - 29	79	0	5,784,368	0	3,768	1,312	0%	0%
30 - 39	207	0	18,862,754	0	17,759	6,673	0%	0%
40 - 49	193	0	22,495,755	0	36,083	12,192	0%	0%
50 +	31	0	4,100,646	0	10,538	3,637	0%	0%
Total	**510**	**0**	**51,243,523**	**0**	**68,149**	**23,813**	**0%**	**0%**
R-Squared				**0.000**	**0.000**			

Chart III-M2

Female Non-Annuitant Mortality
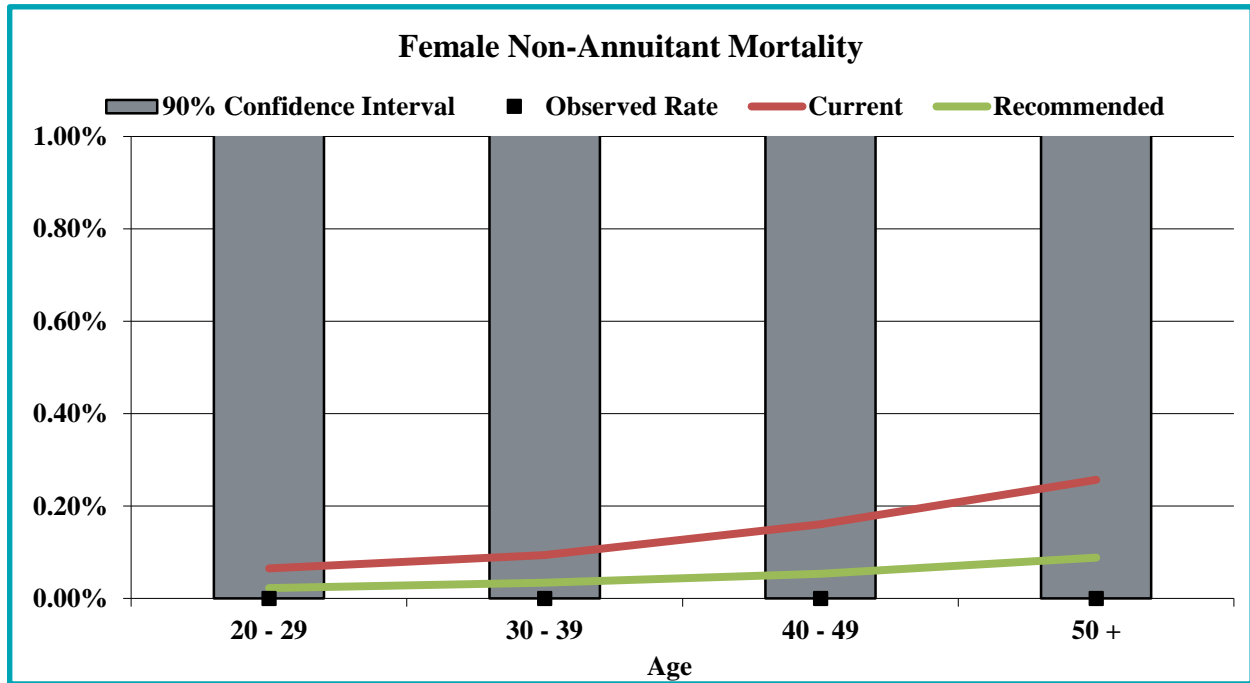
During the four-year period, there were six deaths in active service. Of these deaths, three were accidental. Historically, the percentage of accidental deaths has been somewhat lower. As of June 30, 2018, there were 35 survivors receiving ordinary death benefits and 21 survivors receiving accidental death benefits. We recommend assuming that 35% of the deaths in active service are accidental deaths.
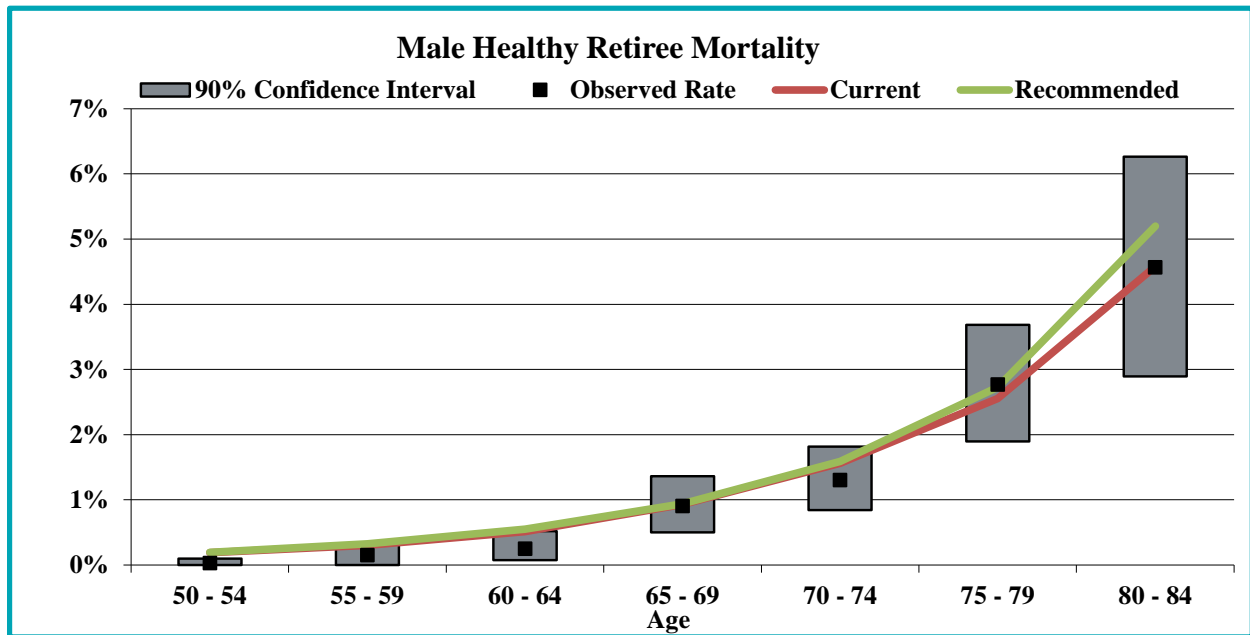
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M3 – Healthy Retiree Males

Healthy Retiree Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
50 - 54	2,060	1	169,366,342	50,514	319,592	327,546	16%	15%
55 - 59	1,882	3	150,941,759	227,994	455,364	489,154	50%	47%
60 - 64	1,349	3	101,683,946	251,866	523,364	564,956	48%	45%
65 - 69	1,396	13	93,623,298	844,371	869,286	894,362	97%	94%
70 - 74	1,542	21	88,708,471	1,152,911	1,385,901	1,429,654	83%	81%
75 - 79	896	27	46,063,658	1,274,678	1,175,682	1,269,386	108%	100%
80 - 84	415	18	18,862,315	860,702	863,809	988,491	100%	87%
85 - 89	360	44	14,403,442	1,835,253	1,111,983	1,290,003	165%	142%
90 - 94	97	25	3,102,663	823,772	407,600	456,055	202%	181%
95 +	12	8	461,637	300,087	102,123	112,582	294%	267%
Total	**10,009**	**163**	**687,217,531**	**7,622,148**	**7,214,704**	**7,822,191**	**106%**	**97%**
R-Squared					0.533	0.569		

Chart III-M3

With mandatory retirement at age 55, we focused our analysis on ages 50 to 84, the age range encompassing most of the retirees.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M4 – Healthy Retiree Females

Healthy Retiree Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
50 - 54	64	0	5,338,121	0	10,548	10,031	0%	0%
55 - 59	76	0	6,126,226	0	18,772	19,173	0%	0%
60 - 64	27	1	2,016,741	82,162	9,699	9,495	847%	865%
65 - 69	7	0	389,380	0	3,862	3,325	0%	0%
70 +	1	0	40,284	0	548	470	0%	0%
Total	**175**	**1**	**13,910,752**	**82,162**	**43,429**	**42,494**	**189%**	**193%**
R-Squared					**0.012**	**0.011**		

Chart III-M4

Female Healthy Retiree Mortality
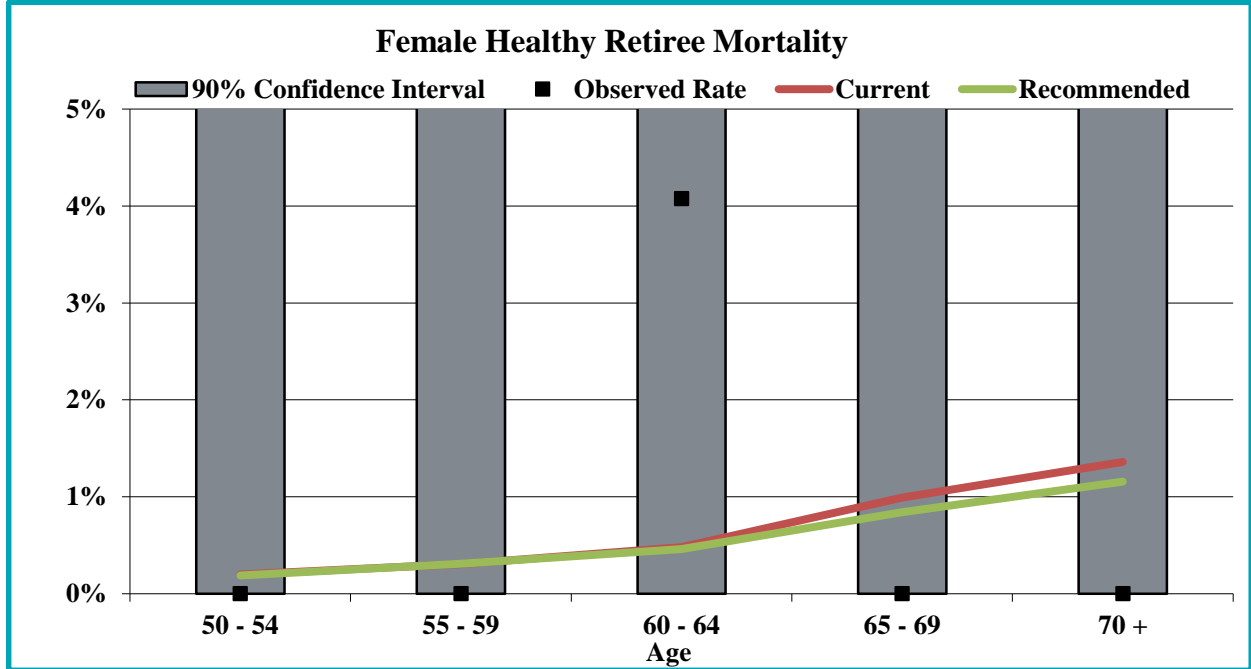
There is relatively little mortality data available for female healthy retirees. Therefore, we recommend the same table recommended for male healthy retirees.

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

The Contingent Annuitant mortality assumption is used for beneficiaries both before and after retiree death. However, reliable mortality data is only available for survivors (i.e. those receiving a benefit after retiree death). We analyzed the survivor data using both the current and recommended assumptions for reasonability, but we did not rely solely on this data in setting the assumption. We do not necessarily expect to see an A/E ratio of 1.0 when comparing survivor data to the Contingent Annuitant mortality assumption. We have also considered the data for healthy retirees when recommending this assumption.

Table III-M5 – Male Survivors

Survivors Mortality - Base Table for Males								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
50 - 54	0	0	0	0	0	0	0%	0%
55 - 59	0	0	0	0	0	0	0%	0%
60 - 64	2	0	126,240	0	619	804	0%	0%
65 - 69	0	0	0	0	0	0	0%	0%
70+	4	0	165,224	0	3,036	3,208	0%	0%
Total	**6**	**0**	**291,464**	**0**	**3,655**	**4,012**	**0%**	**0%**
R-Squared					**0.000**	**0.000**		

Mortality tables specifically designed for public safety employees may reflect higher mortality rates than expected for beneficiaries of public safety employees. We therefore recommend using mortality tables designed for general employees for the beneficiaries of public safety employees.

Given the limited data, we have omitted the chart.

Table III-M6 –Female Survivor

Suvivors Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
< 50	39	0	2,289,919	0	2,003	0	0%	0%
50 - 54	41	0	2,356,504	0	4,571	5,680	0%	0%
55 - 59	62	0	3,198,616	0	10,366	10,517	0%	0%
60 - 64	73	2	3,364,816	109,618	19,470	15,351	563%	714%
65 - 69	187	6	7,614,878	213,285	78,218	55,301	273%	386%
70 - 74	274	4	10,828,398	152,170	186,244	134,832	82%	113%
75 - 79	241	2	8,704,088	90,554	238,800	187,449	38%	48%
80 - 84	251	14	7,745,513	438,872	370,297	326,250	119%	135%
85 - 89	287	23	8,412,735	673,011	648,564	620,505	104%	108%
90 - 94	110	21	3,002,327	617,698	379,694	380,549	163%	162%
95 +	32	11	687,383	247,964	127,972	137,990	194%	180%
Total	1,597	83	58,205,177	2,543,172	2,066,200	1,874,423	123%	136%
R-Squared					0.657	0.678		

Chart III-M6
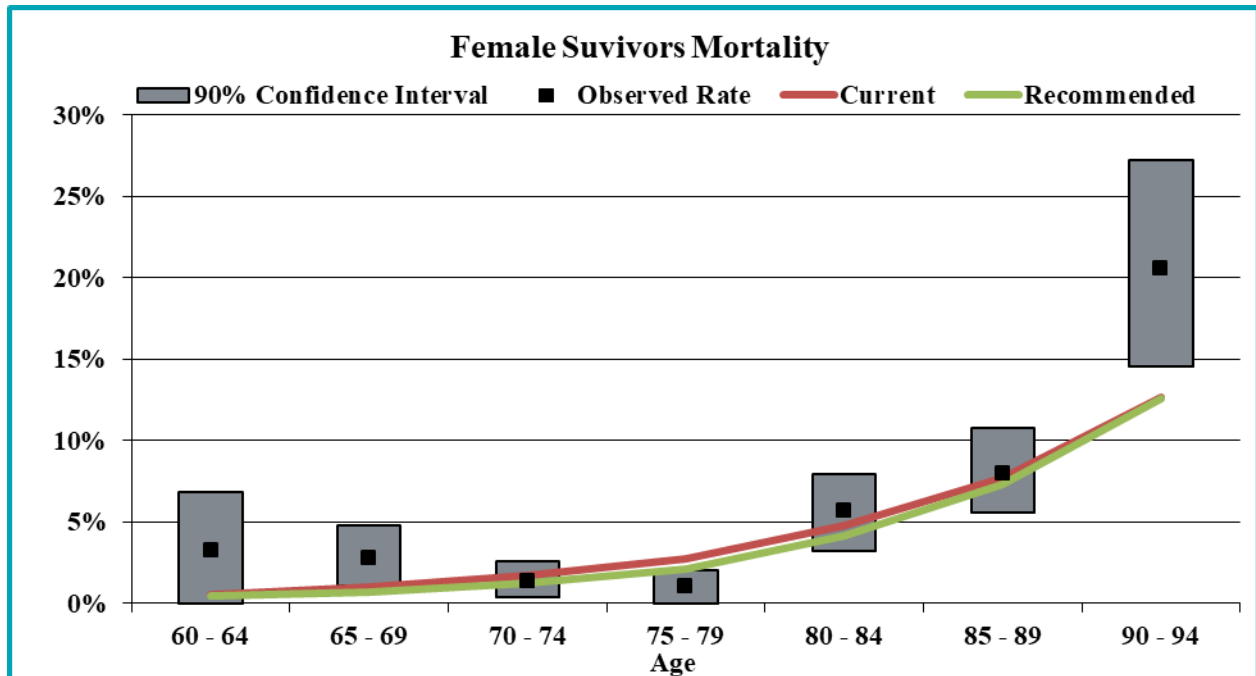
Mortality tables specifically designed for public safety employees may reflect higher mortality rates than expected for beneficiaries of public safety employees. We therefore recommend using mortality tables designed for general employees for the beneficiaries of public safety employees.
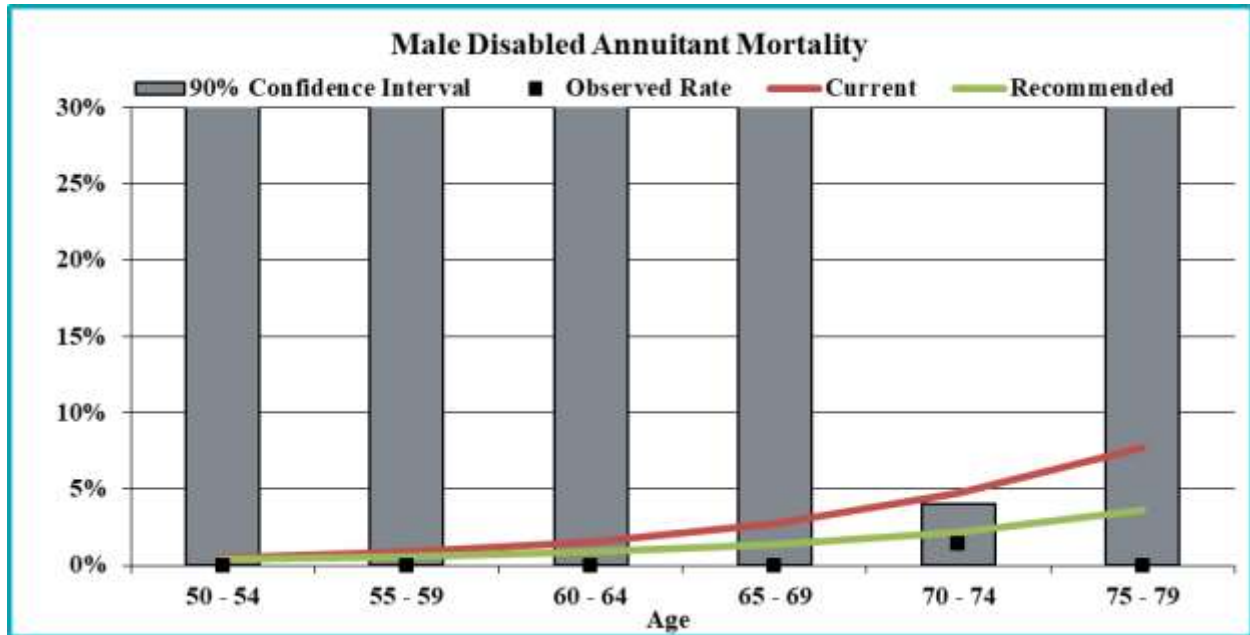
SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M7 – Disabled Retiree Males

Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
50 - 54	256	0	13,447,871	0	63,315	50,986	0%	0%
55 - 59	146	0	7,909,694	0	67,792	44,324	0%	0%
60 - 64	87	0	4,506,904	0	70,562	40,434	0%	0%
65 - 69	50	0	2,023,437	0	54,828	28,144	0%	0%
70 - 74	74	1	2,419,877	33,329	114,994	54,069	29%	62%
75 - 79	64	0	1,949,960	0	149,915	71,006	0%	0%
80 - 84	3	1	99,712	29,096	12,203	5,785	238%	503%
85 - 89	2	0	51,620	0	12,941	7,021	0%	0%
90 +	5	2	119,522	51,620	33,345	19,464	155%	265%
Total	**687**	**4**	**32,528,597**	**114,045**	**579,895**	**321,234**	**20%**	**36%**
R-Squared					0.013	0.007		

Chart III-M7

Chart III-M7 — Male Disabled Annuitant Mortality

SECTION III – DEMOGRAPHIC ASSUMPTIONS
MORTALITY RATES

Table III-M8 – Disabled Retiree Females

Disabled Annuitant Mortality - Base Table for Females								
Age Band	Exposures	Actual Deaths	Weighted Exposures	Weighted Deaths			A/E Ratios	
				Actual	Current	Recommended	Current	Recommended
50 - 54	38	0	1,792,537	0	6,387	6,595	0%	0%
55 - 59	32	0	1,250,348	0	8,374	7,164	0%	0%
60 - 64	4	0	215,461	0	2,358	1,674	0%	0%
65 +	7	0	285,618	0	6,064	3,445	0%	0%
Total	**81**	**0**	**3,543,964**	**0**	**23,184**	**18,879**	**0%**	**0%**
R-Squared					**0.000**	**0.000**		

Chart III-M8
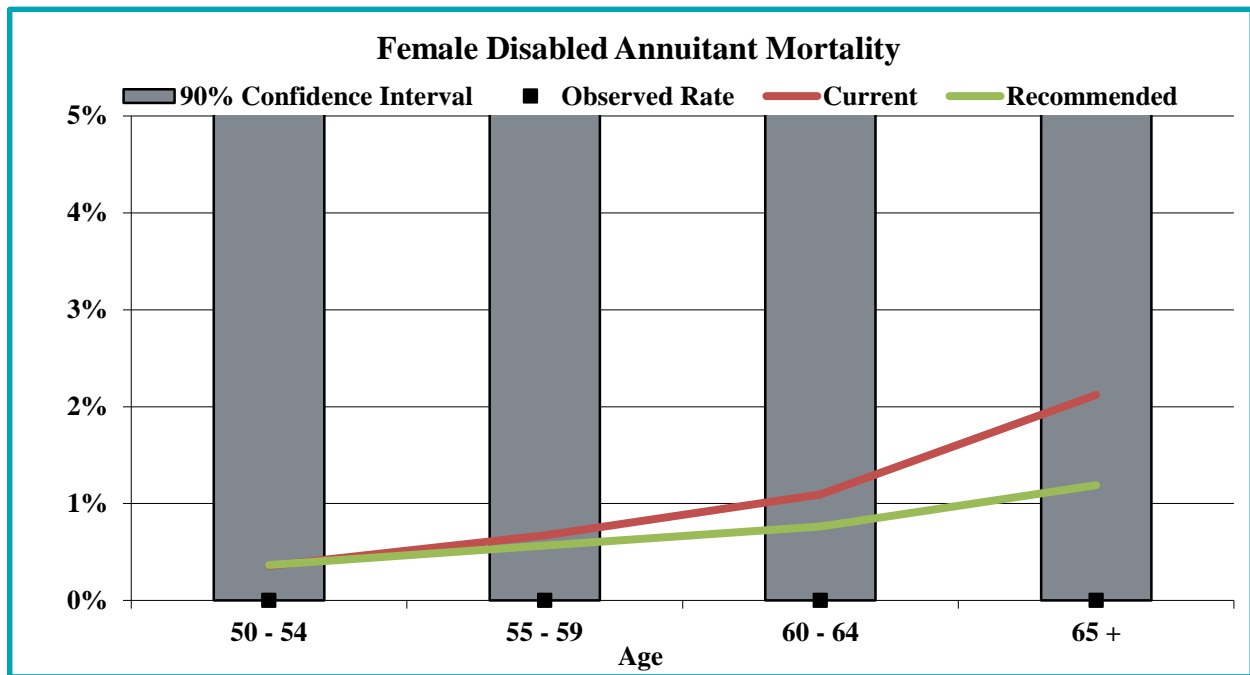
Female Disabled Annuitant Mortality

SECTION IV – ECONOMIC ASSUMPTIONS

The economic assumptions used in actuarial valuations are intended to be long-term in nature, and should be both individually reasonable and consistent with each other. The specific assumptions analyzed in this report are:

- **Price inflation** – used to project increases in the 401(a)(17) pay limit. This assumption is also used indirectly as an underlying component of other economic assumptions.

- **Wage inflation** – across the board wage growth which is used to project the Social Security Wage Base.

- **Salary increase rate** – used to project expected increases in pay for active members in determining liabilities and costs of the System.

In order to develop recommendations for each of these assumptions, we considered historical data, both nationally and for the System, expectations for the future and assumptions used by other public sector plans.

PRICE INFLATION

Long-term price inflation rates are the foundation of other economic assumptions and needs to be reviewed within this study. In a growing economy, wages and investments are expected to grow at the underlying inflation rate plus an additional real growth rate, whether it reflects productivity in terms of wages, or risk premiums in terms of investments.

Historical Data

Chart IV-1 below shows the CPI-U inflation for the U.S. from 1950 through 2019.

Chart IV-1
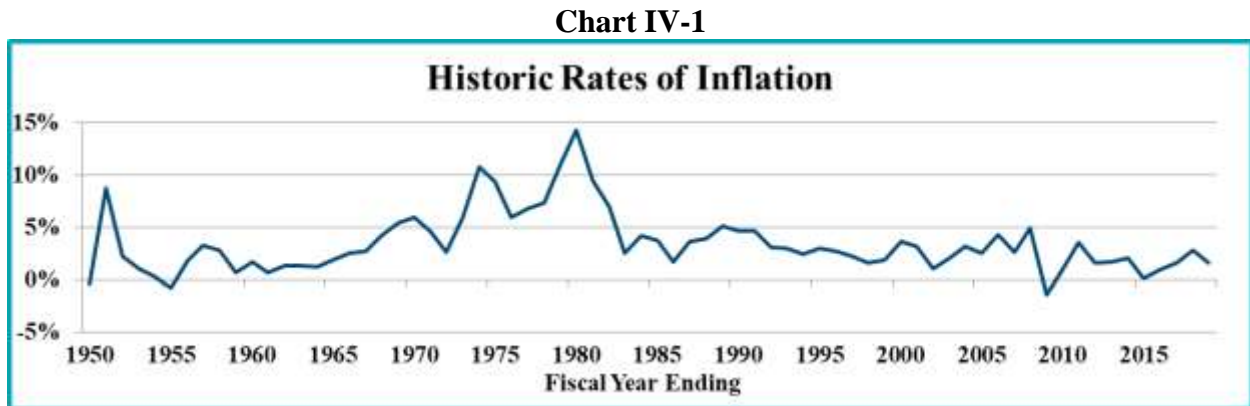
Over the 50 years ending June 2019, the geometric average inflation rate for the U.S. has been about 4.0%, but this average is heavily influenced by the high inflation rates in the 1970s and early 1980s. Over the last 30 years, the geometric average inflation rate has been 2.5%, and it has been only 1.7% over the last ten years.

SECTION IV – ECONOMIC ASSUMPTIONS

Future Expectations

A measure of the market consensus of expected future inflation rates is the difference in yields between conventional Treasury bonds and Treasury inflation-protected securities (TIPS) at the same maturity. Table IV-1 shows the yields on both types of bonds and the break-even inflation rate as of August 2019. Break-even inflation is the level of inflation needed for an investment in TIPS to "break even" with an investment in conventional treasury bonds of the same maturity.

Table IV-1

Break-Even Inflation Based on Treasury Bond Yields			
Time to Maturity	Conventional Yield	TIPS Yield	Break Even Inflation
5 Years	1.83%	0.25%	1.58%
10 Years	2.06%	0.31%	1.75%
20 Years	2.36%	0.54%	1.82%

Data Source: Federal Reserve, Constant Maturity Yields, Monthly Series

The Federal Reserve Bank of Philadelphia publishes a quarterly survey of professional economic forecasters that includes their forecasts of inflation over the next 10 years. The survey for the third quarter of 2019 shows a median inflation forecast of 2.2%, a minimum forecast of about 1.9%, and a maximum forecast of 3.1%.

The National Conference on Public Employee Retirement Systems (NCPERS) January 2019 Public Retirement Systems Study includes the following graphic of respondents' inflation assumptions:

SECTION IV – ECONOMIC ASSUMPTIONS

<u>Chart IV-2</u>
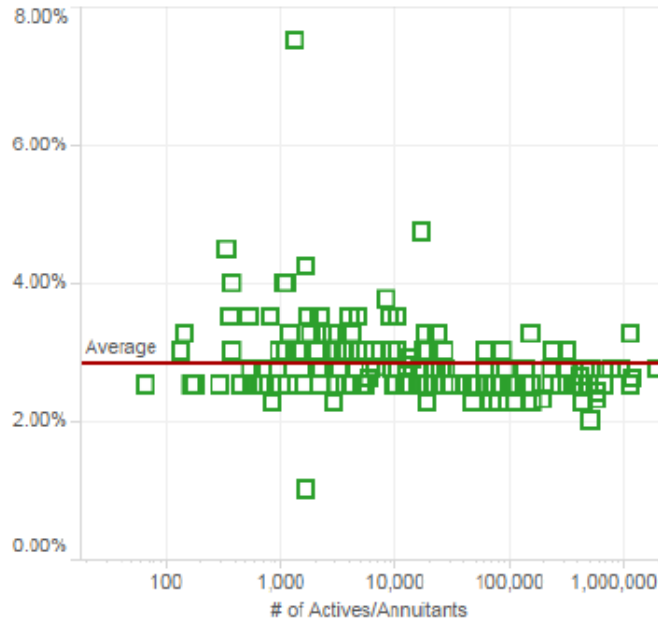
The average inflation assumption among the 167 systems that responded to this study was 2.80%.

Based on all of these considerations, we believe a reasonable range for long-term price inflation for use in the System's actuarial valuations is between 2.0% and 3.0%. Given the lower expected inflation, we recommend reducing the assumption from 3.00% to 2.75%. If, at the time of the next review of economic assumptions, the markets and forecasters continue to indicate lower expectations of future inflation, further reductions in the assumption could be considered.

WAGE INFLATION

Wage inflation can be thought of as the annual across-the-board increase in wages. Individuals often receive salary increases in excess of the wage inflation rate, and we study these increases as a part of the merit salary scale assumption. Wage inflation generally exceeds price inflation by some margin reflecting the history of increased purchasing power.
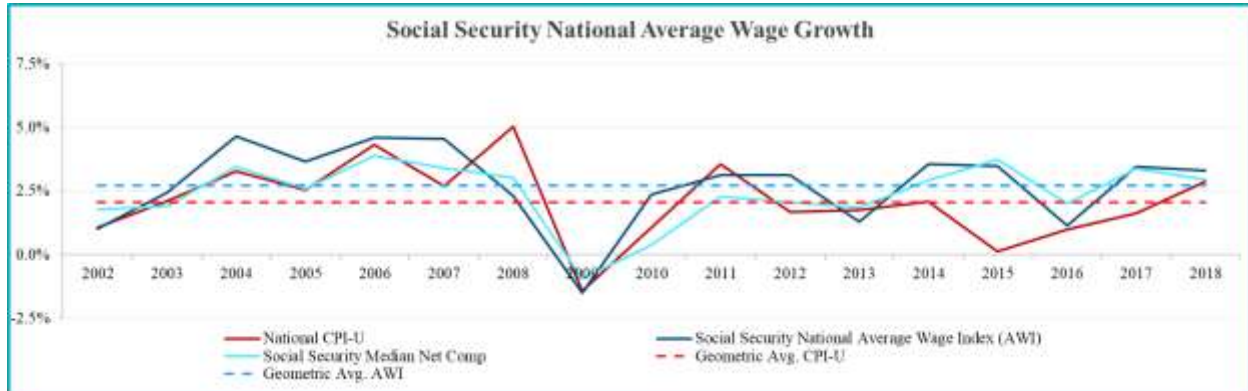
Wage inflation is used in the actuarial valuation to project the Social Security Wage Base in determining the actuarial liability.

Chart IV-3 shows the increase in national average wages (as reported by the Social Security Administration) compared to inflation from 2002 through 2018.

SECTION IV – ECONOMIC ASSUMPTIONS

Chart IV-3

Over this period, national wage inflation averaged approximately 2.7% compared to annual price inflation of 2.00%, making real wage increases about 0.7% above inflation. However, over the same time period, the increase in the median real wage was only 0.3% per year, as much of the growth in wages was clustered at the top end of the wage scale.

It is acceptable to assume some additional level of base payroll increase beyond general inflation. Potential reasons contributing to the increase may include the presence of strong union representation in the collective bargaining process, competition in hiring among other similar employers, and regional factors – such as the local inflation index exceeding the national average. Also, the Social Security Administration projects real wage growth of 0.6% - 1.8% going forward in their Social Security solvency projections. However, governmental entities remain under financial stress, and other areas of employee compensation – most notably health care costs and pension contributions – have continued to increase faster than the CPI.

We recommend maintaining a small non-inflationary base payroll growth assumption of 0.5% annually. As a result, after factoring in inflation, the annual expected wage base increase assumption is expected to be 3.25%.

SALARY INCREASE RATE

The salary increase rate represents the year over year increase in pay of continuing actives. Salary increases consist of three components: Increases due to cost of living maintenance (inflation), increases related to non-inflationary pressures on base pay (such as productivity increases), and increases in individual pay due to merit, promotion, and longevity.

The current assumption is 2.95% per year through fiscal year 2025 and 3.95% per year for fiscal years 2026 and thereafter. Salary increases are assumed to occur on January 1.

Generally, newer employees are more likely to earn a longevity increase or receive a promotion, so their salary increases tend to be greater than those for longer service employees. Chart IV-1 shows the salary increases based on years of service for continuing active members for FYE 2015 through FYE 2018.

SECTION IV – ECONOMIC ASSUMPTIONS
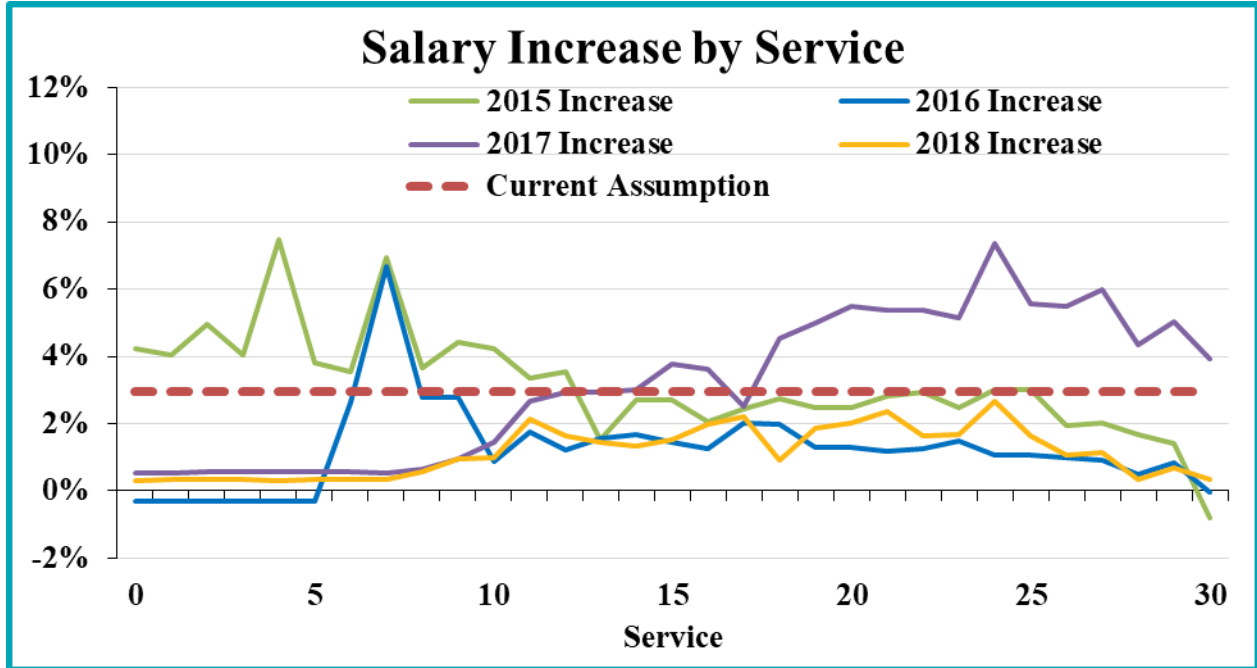
Chart IV-4

As can be seen from the chart, in general, salaries have been lower than expected. Salaries, on average, have increased 3.11%, 1.54%, 2.97% and 1.35%, for FYE 2015, FYE 2016, FYE 2017 and FYE 2018, respectively. Additionally, we do not observe a consistent relationship between salary increases and years of service. We understand that some union contracts have expired in 2017. Given that we do not have current union contract information for SPRS, we recommend continuing the current salary increase assumption. We can provide an updated analysis and may recommend changes to the salary increase assumption when additional salary information becomes available.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

The demographic assumptions are based on an experience study covering the period July 1, 2014 through June 30, 2018.

1. Salary Increases   Salaries are assumed to increase by 2.95% per year through fiscal year 2025 and 3.95% per year for fiscal years 2026 and thereafter.

Salary increases are assumed to occur on January 1.

2. 401(a)(17) Pay Limit $275,000 in 2018 increasing 2.75% per annum, compounded annually.

3. Social Security Wage Base $128,400 in 2018 increasing 3.25% per annum, compounded annually.

4. Termination   Termination rates are as follows:

Service	Rates
0	0.450%
1	0.450
2	0.450
3	0.450
4	0.300
5	0.225
6	0.200
7	0.175
8	0.150
9	0.125
10	0.100
11	0.075
12	0.075
13	0.075
14	0.075
15	0.075
16	0.075
17	0.075
18	0.075
19	0.075
20	0.000

No termination is assumed after attainment of retirement eligibility.

All members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

5. Disability   Disability rates are as follows:

Age	Ordinary Disability	Accidental Disability
20	0.027%	0.015%
21	0.027	0.015
22	0.035	0.020
23	0.035	0.020
24	0.035	0.020
25	0.041	0.025
26	0.041	0.025
27	0.048	0.025
28	0.048	0.045
29	0.055	0.045
30	0.061	0.053
31	0.061	0.053
32	0.069	0.060
33	0.102	0.188
34	0.136	0.191
35	0.169	0.194
36	0.170	0.196
37	0.171	0.199
38	0.172	0.202
39	0.172	0.205
40	0.172	0.208
41	0.172	0.209
42	0.172	0.210
43	0.172	0.211
44	0.191	0.212
45	0.218	0.214
46	0.252	0.215
47	0.281	0.216
48	0.314	0.217
49	0.342	0.218
50	0.375	0.220
51	0.410	0.240
52	0.443	0.260
53	0.470	0.275
54	0.505	0.295

No ordinary disability is assumed prior to attainment of ordinary disability retirement eligibility at four years of service or after attainment of special retirement eligibility at 25 years of service.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

Accidental disability rates apply at all ages until the mandatory retirement age of 55.

Members retiring under the ordinary disability decrement with 20 or more years of service are assumed to receive the involuntary disability retirement benefit.

Members are assumed to receive the greater of the applicable disability benefit or the service or special retirement benefit, depending on eligibility.

6. Mortality

Pre-Retirement**:** The standard Pub-2010 Public Safety Above-Median Income Employee mortality table *[PubS-2010(A) Employee]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

35% of the deaths are assumed to be accidental.

For purposes of pre-retirement accidental death benefits based on Adjusted Final Compensation, the benefit is assumed to increase at the same rate as active salaries.

Healthy Retirees (Healthy Annuitants): The standard Pub-2010 Public Safety Above-Median Income Healthy Retiree mortality table *[PubS-2010(A) Healthy Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Beneficiaries (Contingent Annuitants): The standard Pub-2010 General Above-Median Income Healthy Retiree mortality table *[PubG-2010(A) Healthy Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from the base year of 2010 on a generational basis using SOA's Scale MP-2018.

Disabled Retirees (Disabled Annuitants): The Pub-2010 Public Safety Disabled Retiree mortality table *[PubS-2010 Disabled Retiree]* as published by the Society of Actuaries, unadjusted, and with future improvement from a base year of 2010 on a generational basis using SOA's Scale MP-2018.

APPENDIX A – SUMMARY OF RECOMMENDED ASSUMPTIONS

7. Retirement

For those with 24 years of service or less: 0.50%

For those with 25 years of service:

Age	Rates
48 or younger	25.00%
49-54	50.00

For those with 26 or more years of service: 35.00%

Mandatory retirement at age 55.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

The following are the assumptions used in the actuarial valuation as of July 1, 2018. The economic and demographic assumptions and methods for that valuation were determined in the Actuarial Experience Study performed by the prior actuary covering the period July 1, 2011 – June 30, 2014 and adopted by the Board on January 26, 2016.

1. Salary Increases — Salaries are assumed to increase by 2.95% per year through fiscal year 2025 and 3.95% per year for fiscal years 2026 and thereafter.

2. 401(a)(17) Pay Limit — $275,000 in 2018 increasing 3.00% per annum, compounded annually.

3. Social Security Wage Base — $128,400 in 2018 increasing 4.00% per annum, compounded annually.

4. Termination — Representative termination rates are as follows:

Age	Less Than 5 Years of Service	Between 5 and 19 Years of Service
25	0.375%	0.000%
30	0.375	0.200
35	0.825	0.140
40	0.000	0.075
45	0.000	0.100
50	0.000	0.000

No termination is assumed after attainment of retirement eligibility.

All members with 10 or more years of service at termination are assumed to elect a deferred retirement benefit.

5. Disability — Representative disability rates are as follows:

Age	Ordinary Disability	Accidental Disability
25	0.041%	0.025%
30	0.061	0.053
35	0.169	0.194
40	0.172	0.208
45	0.218	0.214
50	0.375	0.220

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

No ordinary disability is assumed after attainment of special retirement eligibility at 25 years of service.

Accidental disability rates apply at all ages until the mandatory retirement age of 55.

Members retiring under the ordinary disability decrement with less than four years of service are assumed to receive a return of aggregate contributions.

Members retiring under the ordinary disability decrement with 20 or more years of service are assumed to receive the involuntary disability retirement benefit.

Members are assumed to receive the greater of the applicable disability benefit or the service or special retirement benefit, depending on eligibility.

6. Mortality

Healthy Mortality: RP-2000 Combined Healthy Mortality Tables (unadjusted for females and set back 3 years for males) projected on a generational basis from the base year of 2000 to 2013 using Projection Scale BB and the Conduent Modified 2014 Projection scale thereafter. These tables are also used for purposes of the pre-retirement ordinary death benefit.

Disabled Mortality: RP-2000 Combined Healthy Mortality Tables (set forward 5 years for males and females) without projection.

Representative mortality rates for purposes of the pre-retirement accidental death benefit are as follows:

Age	Rates
25	0.040%
30	0.050
35	0.050
40	0.050
45	0.060
50	0.090

No mortality improvement is assumed for purposes of the pre-retirement accidental death benefit.

For purposes of pre-retirement accidental death benefits based on Adjusted Final Compensation, the benefit is assumed to increase at the same rate as active salaries.

APPENDIX B – SUMMARY OF CURRENT ASSUMPTIONS

7. Retirement

For those with 25 years of service or less:

Service	Rates
20	2.000%
21	0.500
22	0.000
23	0.000
24	0.000
25	50.000

For those with more than 25 years of service:

Age	Rates
42 or younger	5.000%
43-47	28.000
48-53	33.000
54	61.000

Mandatory retirement at age 55.