

Section IV – Demographic Assumptions

RATES OF DISABILITY RETIREMENT

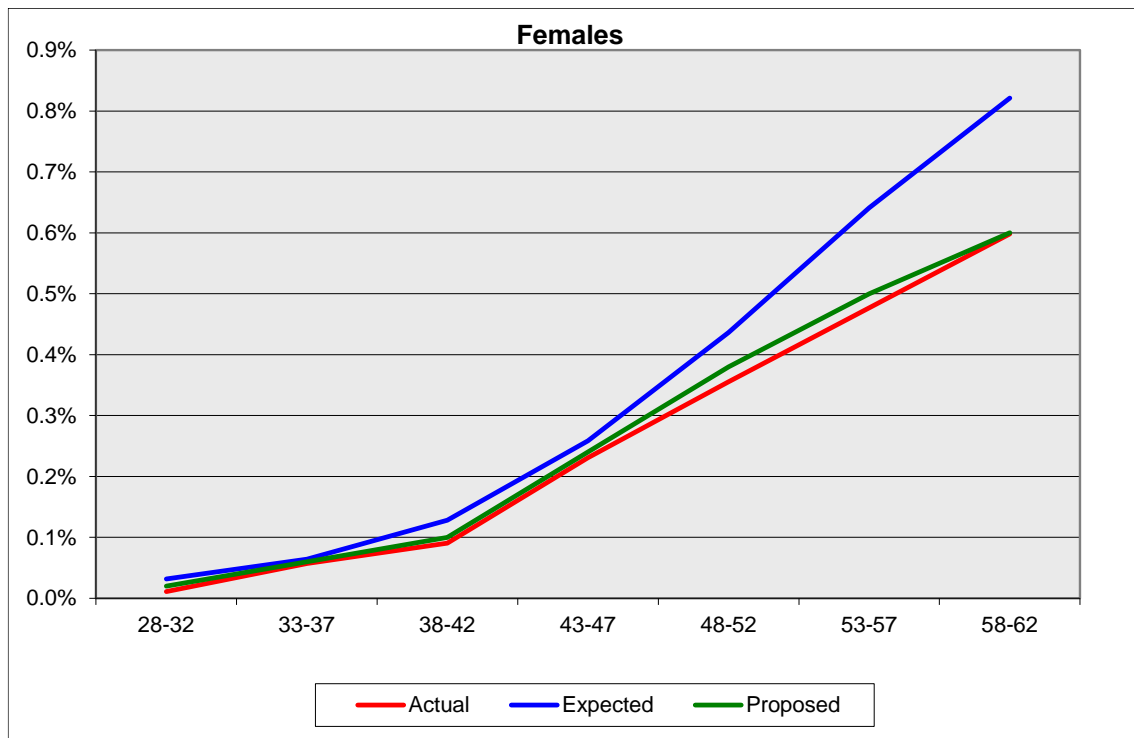
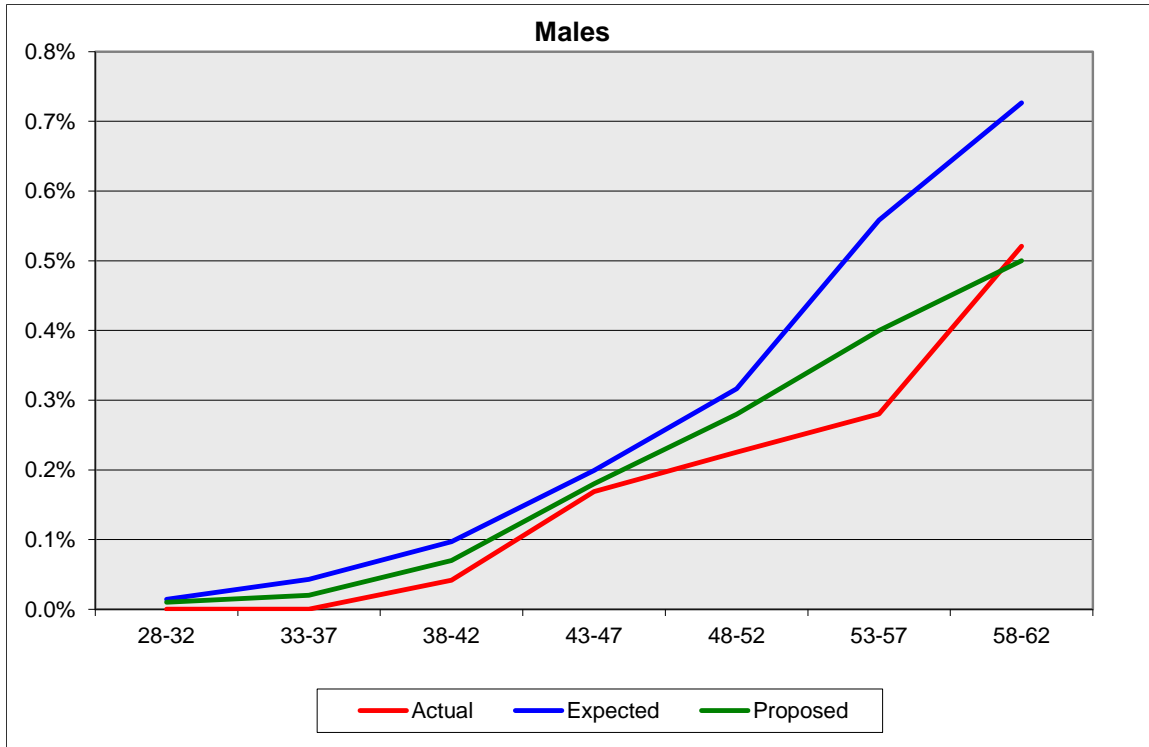
COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
25	0	0.4	0.000	0	2.2	0.000
30	0	1.2	0.000	3	8.8	0.341
35	0	4.7	0.000	19	21.4	0.888
40	5	11.7	0.427	32	45.4	0.705
45	21	24.8	0.847	85	95.2	0.893
50	24	33.7	0.712	118	144.8	0.815
55	21	41.8	0.502	103	138.4	0.744
60	23	32.1	0.717	73	100.3	0.728
63 & OVER	18	24.4	0.738	57	53.4	1.067
TOTAL	112	174.8	0.641	490	609.9	0.803

The following graphs show a comparison of the present, actual, and proposed rates of disability retirement.

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RATES OF DISABILITY RETIREMENT



Section IV – Demographic Assumptions

The preceding results indicate that the actual number of disability retirements for both males and females was less than expected at most ages and in aggregate. We have determined that the rates of disability retirements should be revised to reflect more closely the actual experience of the membership.

The following table shows a comparison between the present and proposed rates of disability retirements.

COMPARATIVE RATES OF DISABILITY RETIREMENTS

AGE	RATES OF DISABILITY RETIREMENT			
	MALES		FEMALES	
	Present	Proposed	Present	Proposed
20	0.01%	0.01%	0.01%	0.01%
25	0.01%	0.01%	0.01%	0.01%
30	0.01%	0.01%	0.03%	0.02%
35	0.04%	0.02%	0.06%	0.06%
40	0.09%	0.07%	0.12%	0.10%
45	0.20%	0.18%	0.25%	0.24%
50	0.30%	0.28%	0.44%	0.38%
55	0.58%	0.40%	0.65%	0.50%
60	0.75%	0.50%	0.85%	0.60%

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The following table shows a comparison of the actual and expected disability retirements based on new proposed rates of disability.

COMPARISON OF ACTUAL AND EXPECTED DISABILITY RETIREMENTS BASED ON PROPOSED RATES OF DISABILITY

CENTRAL AGE OF GROUP	NUMBER OF DISABILITY RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
25	0	0.4	0.000	0	1.3	0.000
30	0	1.0	0.000	2	5.2	0.385
35	0	2.8	0.000	14	17.0	0.824
40	5	9.3	0.538	27	34.1	0.792
45	21	22.3	0.942	73	77.1	0.947
50	24	29.7	0.808	120	122.9	0.976
55	21	29.5	0.712	102	112.3	0.908
60	23	21.5	1.070	83	79.1	1.049
63 & OVER	18	16.2	1.111	69	51.4	1.342
TOTAL	112	132.7	0.844	490	500.4	0.979

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RATES OF RETIREMENT

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

MEMBERS WITH LESS THAN 27 YEARS OF SERVICE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
55	51	46.8	1.090	141	160.2	0.880
56	48	41.7	1.151	211	148.6	1.420
57	45	41.0	1.098	172	135.7	1.268
58	50	36.0	1.389	165	127.3	1.296
59	40	34.5	1.159	168	127.4	1.319
60	83	83.1	0.999	302	283.6	1.065
61	93	74.8	1.243	351	239.7	1.464
62	73	76.1	0.959	230	194.7	1.181
63	95	62.3	1.525	245	176.6	1.387
64	57	60.6	0.941	174	138.5	1.256
65	62	67.2	0.923	182	167.9	1.084
66	64	54.0	1.185	173	134.4	1.287
67	67	44.6	1.502	130	74.5	1.745
68	42	31.2	1.346	83	49.3	1.684
69	35	23.4	1.496	58	36.5	1.589
SUBTOTAL	905	777.3	1.164	2,785	2,194.9	1.269
70 & OVER	98	117.2	0.836	174	196.8	0.884
TOTAL	1,003	894.5	1.121	2,959	2,391.7	1.237
Average Retirement Age	63.1	63.5	0.994	62.0	62.3	0.995

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COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS

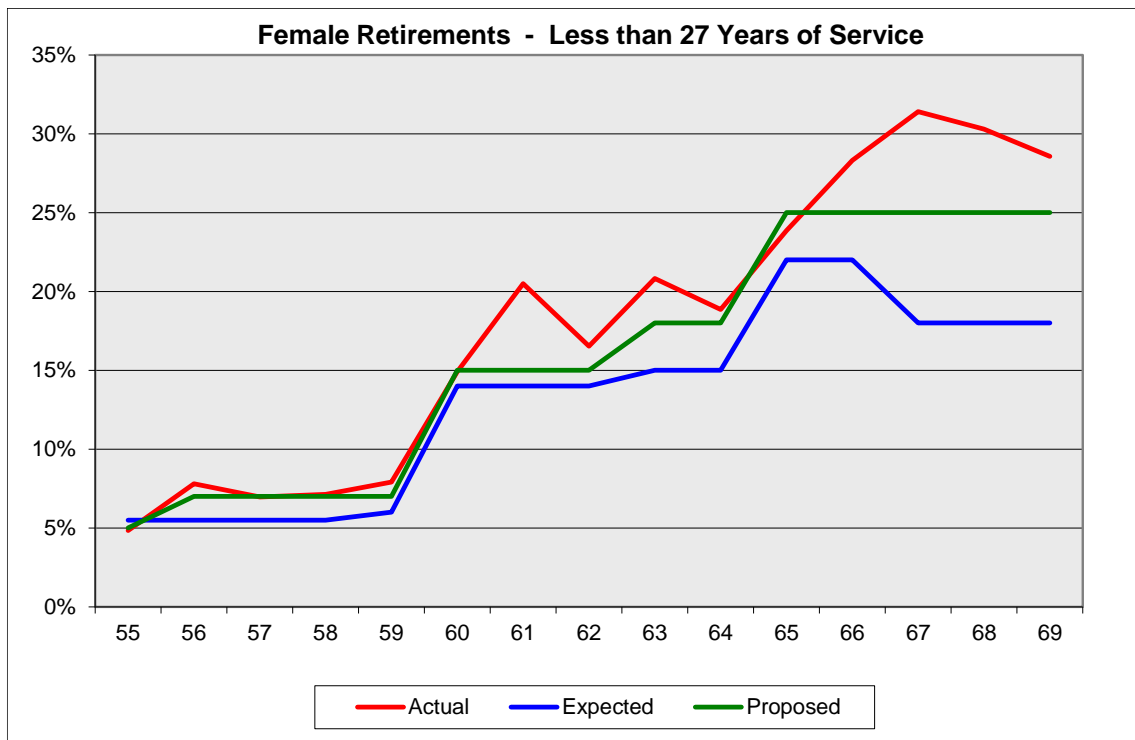
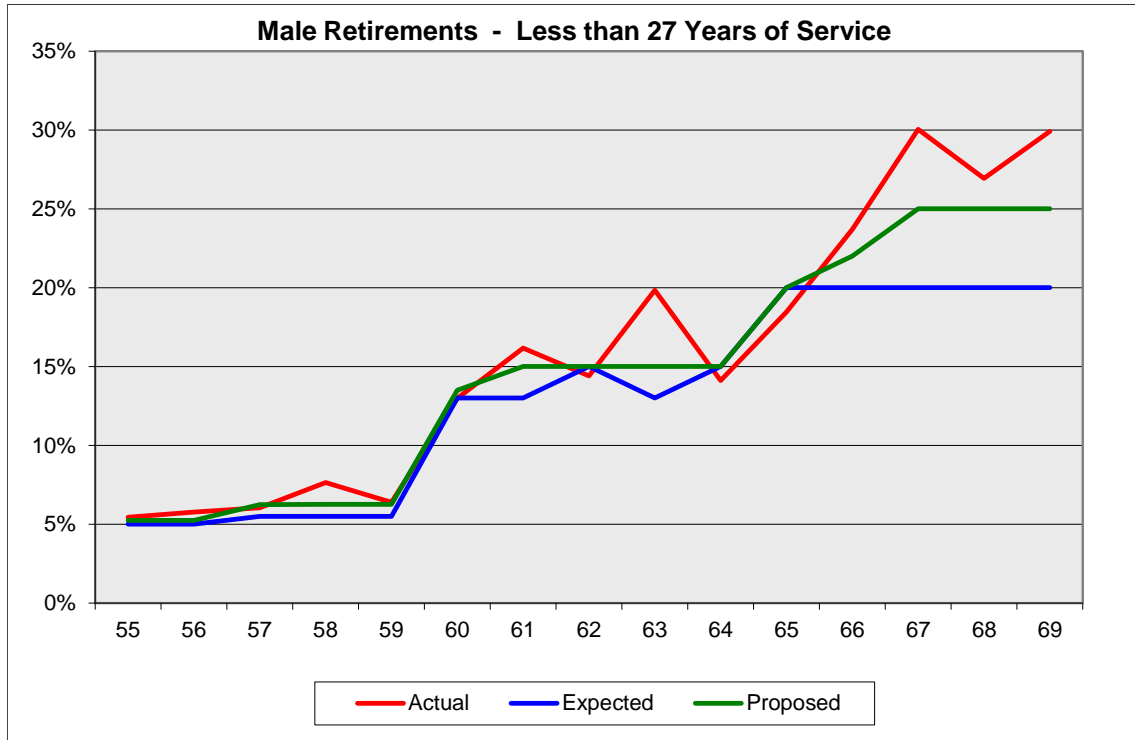
MEMBERS WITH 27 OR MORE YEARS OF SERVICE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
52 & Under	285	197.6	1.442	1,025	839.1	1.222
53	79	58.6	1.348	261	247.1	1.056
54	58	69.7	0.832	198	232.4	0.852
55	146	184.3	0.792	623	641.6	0.971
56	186	128.3	1.450	471	386.7	1.218
57	86	80.8	1.064	225	223.1	1.009
58	66	76.0	0.868	191	182.6	1.046
59	65	51.0	1.275	169	165.5	1.021
60	63	67.4	0.935	180	164.9	1.092
61	51	52.3	0.975	157	146.9	1.069
62	46	38.2	1.204	134	129.3	1.036
63	45	31.2	1.442	119	113.9	1.045
64	35	27.2	1.287	81	84.2	0.962
65	36	28.3	1.272	86	66.6	1.291
66	31	28.2	1.099	64	49.0	1.306
67	19	17.6	1.080	51	39.7	1.285
68	15	15.8	0.949	28	29.9	0.936
69	13	10.7	1.215	31	27.8	1.115
SUBTOTAL	1,325	1,163.2	1.139	4,094	3,770.3	1.086
70 & OVER	66	67.0	0.985	80	101.0	0.792
TOTAL	1,391	1,230.2	1.131	4,174	3,871.3	1.078
Average Retirement Age	57.5	58.0	0.991	56.4	56.7	0.995

The following graphs show a comparison of the present, actual, and proposed rates of service retirements.

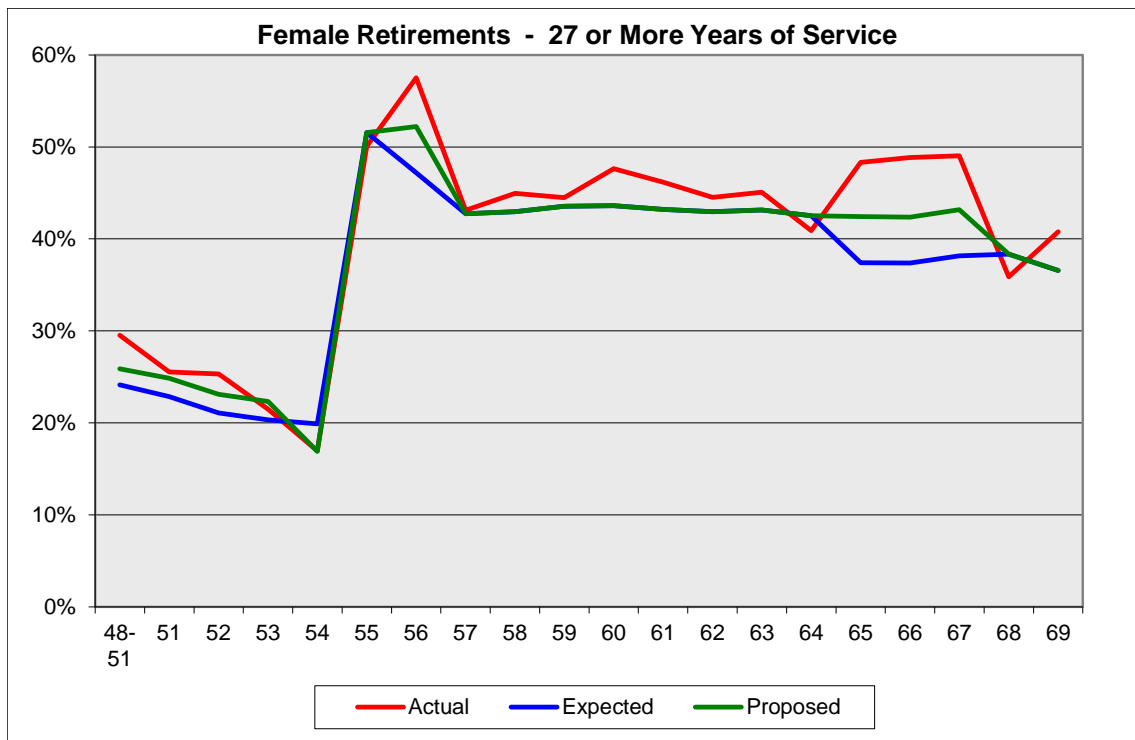
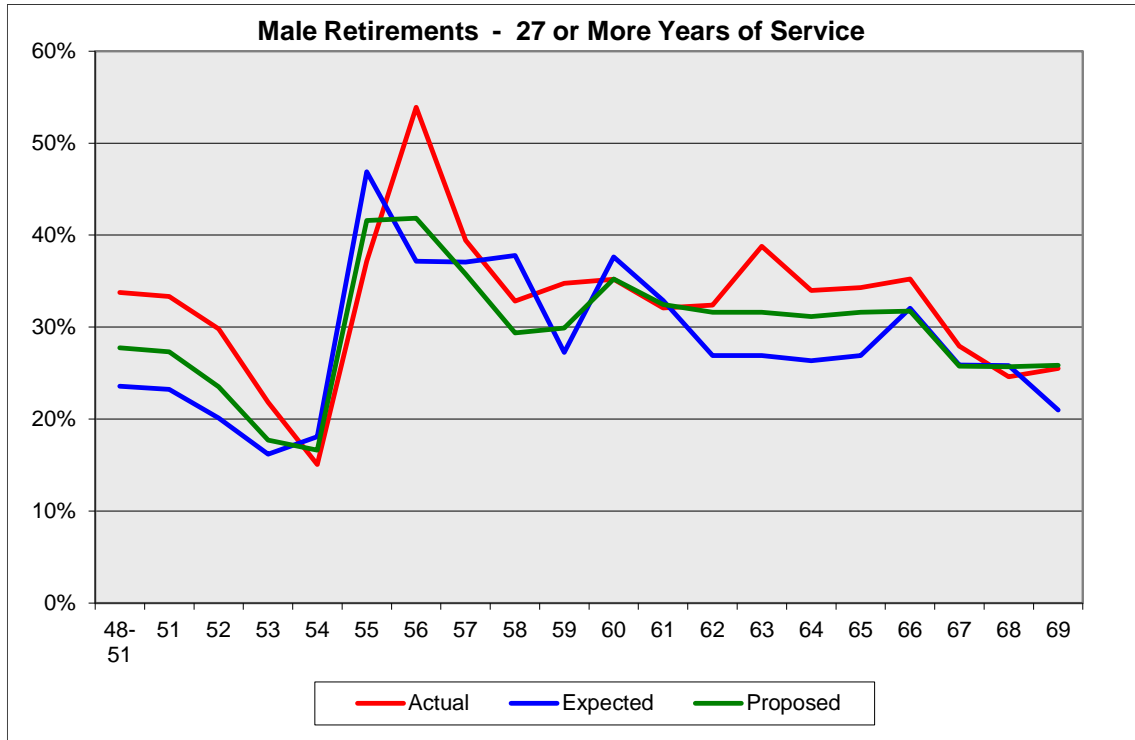
Section IV – Demographic Assumptions

RATES OF RETIREMENT



Section IV – Demographic Assumptions

RATES OF RETIREMENT



Section IV – Demographic Assumptions

The preceding results indicates that in most age categories and overall, the actual rates of retirement for members with less than 27 years of service for both males and females were greater than expected.

For members with 27 or more years of service, the actual rates of retirement were greater than expected at most ages and overall. On the basis of this experience, we have determined that the rates of retirement need revision in order to reflect actual experience more closely. The following table shows a comparison of the present and proposed rates of service retirement.

COMPARATIVE RATES OF RETIREMENT

AGE	RATES OF RETIREMENT							
	MALES				FEMALES			
	Present Less than 27 Years of Service	Present* 27 or More Years of Service	Proposed Less than 27 Years of Service	Proposed** 27 or More Years of Service	Present Less than 27 Years of Service	Present* 27 or More Years of Service	Proposed Less than 27 Years of Service	Proposed*** 27 or More Years of Service
48	0.00%	17.00%	0.00%	17.00%	0.00%	15.00%	0.00%	17.00%
49	0.00%	17.00%	0.00%	17.00%	0.00%	17.00%	0.00%	17.00%
50	0.00%	17.00%	0.00%	25.00%	0.00%	18.00%	0.00%	20.00%
51	0.00%	17.00%	0.00%	22.00%	0.00%	18.00%	0.00%	20.00%
52	0.00%	16.00%	0.00%	20.00%	0.00%	18.00%	0.00%	20.00%
53	0.00%	13.00%	0.00%	15.00%	0.00%	18.00%	0.00%	20.00%
54	0.00%	15.00%	0.00%	14.00%	0.00%	18.00%	0.00%	15.00%
55	5.00%	45.00%	5.25%	40.00%	5.50%	50.00%	5.00%	50.00%
56	5.00%	35.00%	5.25%	40.00%	5.50%	45.00%	7.00%	50.00%
57	5.50%	35.00%	6.25%	34.00%	5.50%	40.00%	7.00%	40.00%
58	5.50%	35.00%	6.25%	27.00%	5.50%	40.00%	7.00%	40.00%
59	5.50%	25.00%	6.25%	28.00%	6.00%	40.00%	7.00%	40.00%
60	13.00%	35.00%	13.50%	33.00%	14.00%	40.00%	15.00%	40.00%
61	13.00%	30.00%	15.00%	30.00%	14.00%	40.00%	15.00%	40.00%
62	15.00%	25.00%	15.00%	30.00%	14.00%	40.00%	15.00%	40.00%
63	13.00%	25.00%	15.00%	30.00%	15.00%	40.00%	18.00%	40.00%
64	15.00%	25.00%	15.00%	30.00%	15.00%	40.00%	18.00%	40.00%
65	20.00%	25.00%	20.00%	30.00%	22.00%	35.00%	25.00%	40.00%
66	20.00%	30.00%	22.00%	30.00%	22.00%	35.00%	25.00%	40.00%
67	20.00%	25.00%	25.00%	25.00%	18.00%	35.00%	25.00%	40.00%
68	20.00%	25.00%	25.00%	25.00%	18.00%	35.00%	25.00%	35.00%
69	20.00%	20.00%	25.00%	25.00%	18.00%	35.00%	25.00%	35.00%
70	20.00%	20.00%	25.00%	30.00%	20.00%	35.00%	30.00%	35.00%
71	20.00%	20.00%	25.00%	30.00%	20.00%	35.00%	30.00%	35.00%
72	20.00%	20.00%	25.00%	30.00%	20.00%	35.00%	30.00%	35.00%
73	20.00%	20.00%	25.00%	30.00%	20.00%	35.00%	30.00%	35.00%
74	20.00%	20.00%	25.00%	30.00%	20.00%	35.00%	30.00%	35.00%
75	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

* Plus 7.5% in year when first eligible for unreduced retirement with 27 years of service.

** Plus 8.5% in year when first eligible for unreduced retirement with 27 years of service.

*** Plus 10.0% in year when first eligible for unreduced retirement with 27 years of service.

Section IV – Demographic Assumptions

The following table shows a comparison of actual and expected service retirements based on new proposed rates of retirement.

COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RETIREMENT RATES

MEMBERS WITH LESS THAN 27 YEARS OF SERVICE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
55	51	49.1	1.039	141	145.6	0.968
56	48	43.7	1.098	211	189.1	1.116
57	45	46.6	0.966	172	172.8	0.995
58	50	40.9	1.222	165	162.1	1.018
59	40	39.2	1.020	168	148.6	1.131
60	83	86.3	0.962	302	303.9	0.994
61	93	86.3	1.078	351	256.8	1.367
62	73	76.1	0.959	230	208.7	1.102
63	95	71.9	1.321	245	211.9	1.156
64	57	60.6	0.941	174	166.1	1.048
65	62	67.2	0.923	182	190.8	0.954
66	64	59.4	1.077	173	152.8	1.132
67	67	55.8	1.201	130	103.5	1.256
68	42	39.0	1.077	83	68.5	1.212
69	35	29.3	1.195	58	50.8	1.142
SUBTOTAL	905	851.4	1.063	2,785	2,532.0	1.100
70 & OVER	98	131.0	0.748	174	237.7	0.732
TOTAL	1,003	982.4	1.021	2,959	2,769.7	1.068
Average Retirement Age	63.1	63.6	0.992	62.0	62.4	0.994

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COMPARISON OF ACTUAL AND EXPECTED RETIREMENTS BASED ON PROPOSED RETIREMENT RATES

MEMBERS WITH 27 YEARS OF SERVICE AND MORE

CENTRAL AGE OF GROUP	NUMBER OF RETIREMENTS					
	MALES			FEMALES		
	Actual	Expected	Ratio of Actual to Expected	Actual	Expected	Ratio of Actual to Expected
52 & Under	285	231.4	1.232	1,025	906.0	1.131
53	79	64.1	1.232	261	271.4	0.962
54	58	64.0	0.906	198	197.4	1.003
55	146	163.5	0.893	623	641.6	0.971
56	186	144.4	1.288	471	427.6	1.101
57	86	77.9	1.104	225	223.1	1.009
58	66	59.0	1.119	191	182.6	1.046
59	65	55.9	1.163	169	165.5	1.021
60	63	63.1	0.998	180	164.9	1.092
61	51	51.6	0.988	157	146.9	1.069
62	46	44.9	1.024	134	129.3	1.036
63	45	36.7	1.226	119	113.9	1.045
64	35	32.1	1.090	81	84.2	0.962
65	36	33.2	1.084	86	75.5	1.139
66	31	27.9	1.111	64	55.5	1.153
67	19	17.5	1.086	51	44.9	1.136
68	15	15.7	0.955	28	29.9	0.936
69	13	13.2	0.985	31	27.8	1.115
SUBTOTAL	1,325	1,196.1	1.108	4,094	3,888.0	1.053
70 & OVER	66	80.0	0.825	80	101.0	0.792
TOTAL	1,391	1,276.1	1.090	4,174	3,989.0	1.046
Average Retirement Age	57.5	58.0	0.991	56.4	56.6	0.996

Section IV – Demographic Assumptions

RATES OF MORTALITY

Mortality tables are a fundamental assumption in actuarial valuations. Benefits are paid over a retiree’s lifetime, so it is important to appropriately reflect what a typical lifetime is expected to be. In addition, deaths before retirement typically result in the payout of benefits to a spouse or survivor. For this review, we considered the following mortality:

- Post-retirement – project the percentage of healthy participants in pay status expected to die each year
- Contingent Annuitant – project the percentage of spouses or survivors in pay status expected to die each year
- Pre-retirement – project the percentage of active employees expected to die each year
- Disabled – project the percentage of disabled retirees expected to die each year

Method

The issue of future mortality improvement is one that the actuarial profession has become increasingly focused on studying in recent years. This has resulted in changes to the relevant Actuarial Standard of Practice, ASOP 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations. This ASOP requires the pension actuary to make and disclose a specific recommendation with respect to future improvements in mortality after the valuation date. There have been significant improvements in longevity in the past, although there are different opinions about future expectations. We believe it is prudent to anticipate that the trend will continue to some degree in the future. Therefore, we believe it is appropriate to reflect future mortality improvement as part of the mortality assumption.

There are two widely used approaches for reflecting future improvements in mortality:

- (1) Static table with “margin”
- (2) Generational mortality

The first approach to reflecting mortality improvements is with the use of a static mortality table with “margin.” Under this approach, the A/E ratio is intentionally targeted to be over 100% so that mortality can improve without creating actuarial losses. While there is no formal guidance as to the amount of margin required (how far above 100% is appropriate for the A/E ratio), we typically prefer to have a margin of around 10 to 14% at the core ages of the retired member. The goal is still for the general shape of the curve to be a reasonable fit to the observed experience. Depending on the magnitude and duration of actual mortality improvements in the future, the margin may decrease and eventually become insufficient. If that occurs, the assumption will need to be updated.

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Another approach, referred to as generational mortality, directly anticipates future improvements in mortality by using a different set of mortality rates for each year of birth, with the rates for later years of birth assuming lower mortality than the rates for earlier years of birth. The varying mortality rates by year of birth create a series of tables that contain “built-in” mortality improvements, e.g., a member who turns age 65 in 2035 has a longer life expectancy than a member who turns age 65 in 2020. When using generational mortality, the A/E ratios for the observed experience are set near 100% since future mortality improvements will be taken into account directly in the actuarial valuation process.

For the mortality decrements, we also analyzed the experience using a liability-weighted approach (also referred to as benefit-weighted). This is approximated by using the member’s retirement benefit from the data collected. The exposure and actual occurrences are then multiplied by the benefit level to provide the liability-weighted experience. This approach is particularly insightful when analyzing experience from a non-homogenous group. While we reviewed the mortality experience on both a count and liability-weighted basis, we ultimately decided on the liability-weighted results to evaluate experience and develop a new mortality table.

The current post-retirement mortality assumption for healthy lives is a static table, the RP-2000 Combined Mortality Table projected to 2025 with projection scale BB and set forward 2 years for males and set forward 1 year for females. The results of the experience analysis indicate that this table provided a reasonable expectation of mortality for the past five years but there were consistent mortality losses in each of the last five valuations.

While prior pension mortality tables have been based solely on private corporate and union retirement plans, new tables, released in late 2018, are based entirely on public sector plan data. These new tables are referred to the Pub-2010 Public Mortality Plan Mortality Tables. These tables are split by three membership types: Safety, Teachers, and General to reflect the observed differences in mortality patterns related to the three groups. Tables are further split for healthy retirees, disabled retirees, contingent beneficiaries, and employees. There are still other breakdowns in these tables for at, above or below median annuity values. We anticipate that this family of tables will be a good starting point in developing a mortality assumption.

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The following steps used to set a new mortality table are as follows:

- 1) Selecting a mortality table based on standard mortality tables published by the Society of Actuaries adjusted using various techniques to provide a better fit to the actual mortality experience, but with no adjustment for expected future mortality improvements. The mortality table selected is determined on a benefit-weighted basis. This means that the ages at death for retirees with larger benefits are weighted more than the ages at death for retirees with smaller benefits. Using this weighting resulted in selecting tables with longer life expectancies than tables that would have been selected based on a head-count weighted basis.
- 2) Applying a “mortality projection” scale which is an explicit assumption that future generations live longer than current generations. Beginning in 2014, the SOA has released an updated mortality improvement scale every year. We are proposing using the most recently released scale, MP-2020, adjusted to 75% of the standard rates. This adjustment results in improvements that are less than those suggested by the MP-2020 scale. We have suggested this adjustment because each year since 2014 the SOA has scaled back the amount of mortality improvement in subsequent mortality projection scales.

Generational mortality tables tend to reflect actual life expectancies of plan members more accurately and since future mortality improvements are built into the tables future updates to the tables tend to be on a smaller scale.

Experience

This Section summarizes the post-retirement, pre-retirement, disabled, and contingent annuitant mortality experience of the study period. The charts below summarize the experience by showing the ratio of the actual number of benefits released during the study period over the expected number of benefits released over the study period, compiled separately for males and females. In these charts, a ratio greater/(less) than 100% indicates that there were more/(fewer) benefits released than expected by the current assumption.

Post-retirement and contingent annuitant mortality have the most significant impact on mortality experience in the plans.

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The healthy service retiree's post-retirement mortality gains and losses over the study period are as follows and are consistent with our analysis of actual to expected:

POST-RETIREMENT MORTALITY GAIN/(LOSS)						
(In millions)	2016	2017	2018	2019	2020	Total Gain/(Loss)
TRS	(71.1)	(45.2)	(58.8)	(51.4)	(73.9)	(300.4)

POST-RETIREMENT MORTALITY				
	MALES		FEMALES	
	Ratio of actual to expected	Ratio of actual to proposed	Ratio of actual to expected	Ratio of actual to proposed
TRS	0.902	0.981	0.824	0.971

We would have anticipated experience gains over the study period due to using a static table with margin approach. However, experience indicates that the current post-retirement mortality assumption primarily produced losses during the study period.

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The contingent annuitant’s post-retirement mortality gains and losses over the study period are as follows and are consistent with our analysis of actual to expected:

CONTINGENT ANNUITANT MORTALITY GAIN/(LOSS)						
(In millions)	2016	2017	2018	2019	2020	Total Gain/(Loss)
TRS	0.0	(2.8)	1.3	(6.9)	(5.6)	(14.0)

CONTINGENT ANNUITANT MORTALITY				
	MALES		FEMALES	
	Ratio of actual to expected	Ratio of actual to proposed	Ratio of actual to expected	Ratio of actual to proposed
TRS	1.284	1.011	0.931	0.993

In the past, the same mortality assumption used for post-retirement service retiree’s mortality was also used for contingent annuitants. A new feature of the Pub-2010 tables is a contingent annuitant specific table. We propose using these tables for contingent annuitants. In most cases, we have made assumptions that tie closely to the actual experience, but the data is not sufficient enough to be expected to closely predict mortality rates in the future for this group.

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Charts summarizing the pre-retirement and disabled mortality are as follows:

PRE-RETIREMENT MORTALITY				
	MALES		FEMALES	
	Ratio of actual to expected	Ratio of actual to proposed	Ratio of actual to expected	Ratio of actual to proposed
TRS	0.880	0.990	0.874	0.989

DISABLED MORTALITY				
	MALES		FEMALES	
	Ratio of actual to expected	Ratio of actual to proposed	Ratio of actual to expected	Ratio of actual to proposed
TRS	0.792	0.985	0.558	0.978

As is typical with most large public pension plans, a small number of pre-retirement and disability deaths occur, and thus a small amount of liability is released for the active and disabled member populations during the experience period. We are changing the base tables to the Pub-2010 employee and disabled tables respectively and have applied minimal adjustments to better fit the experience. In most cases we have made assumptions that tie more closely to the actual experience, but the data is not sufficient enough to be expected to closely predict mortality rates in the future for these groups.

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Determination

We have determined that TRS should change to a Generational Mortality approach on a benefit-weighted basis.

We are also updating the base mortality table from RP 2014 to the Pub-2010 tables for teachers which is the latest table produced by the Society of Actuaries and adjusting this new base table to better match the experience of TRS.

Finally, we are implementing the MP-2020 mortality improvement scale adjusted to 75% of the standard rates.

Below is a summary of the specific mortality tables and adjustments for each of the groups:

<u>Group</u>	<u>Membership Table</u>	<u>Set Forward (+)/ Setback (-)</u>	<u>Adjustment to Rates</u>	<u>Projection Scale</u>
Service Retirees	Teachers Benefit-Weighted	Male: +2 Female: +2	Male: 102%, Female: 98%	75% of MP-2020
Contingent Annuitants	Teachers Benefit-Weighted	Male: +2 Female: None	Male: 101%, Female: 100%	75% of MP-2020
Disabled Retirees	Teachers Benefit-Weighted	Male: +1 Female: -2	Male: 96%, Female: 94%	75% of MP-2020
Actives	Teachers Benefit-Weighted	Male: +1 Female: -2	Male: 100%, Female: 98%	75% of MP-2020

Section IV – Demographic Assumptions

RATES OF SALARY INCREASE

Estimates of future salaries for each member are based on assumptions for two types of increases:

- Increases in each individual's salary due to promotion or longevity (often called merit scale), and
- Increases in the general wage increase of the membership, which is directly related to price and wage inflation.

Earlier in this report, we determined that the wage inflation assumption be set at 2.75% (2.50% price inflation and 0.25% real wage growth). Therefore, the merit scale will be added to the applicable wage inflation assumption to develop the total individual salary increase assumption.

Analysis of the merit salary scale is complicated by the fact that only total salary is reported to TRS, which includes both the general wage inflation component of salary increases and the merit salary scale. Furthermore, there is often a delay in actual price inflation compared to when it has an impact on salary increases. As a result, it is difficult to isolate the merit scale for purposes of measuring the actual salary experience. One technique we used to help reduce the effect of inflation was to look at the individual salary increases for each of the five years in the study period and adjust the results so that the longer service individuals had increases of approximately 3.00%. This allows us to focus on the shape of the increases and determine the reasonableness of a possible salary merit scale. In addition, salary increases for governmental employees during this study period have been lower than those observed in corporate America. Consequently, the selection of a merit scale has a significant component of professional judgment.

Lastly, the current rates of salary increase for active members are based on the member's age. We have studied rates of salary increase for many statewide plans over the past five years and determined that rates of salary increase for active members are better correlated to the member's service, rather than age. Therefore, we have determined that TRS should change to a service-based table for rates of salary increase for active members.

Section IV – Demographic Assumptions

COMPARISON OF ACTUAL AND EXPECTED SALARIES OF ACTIVE MEMBERS

CENTRAL AGE OF GROUP	RATES OF SALARY INCREASE		
	CURRENT RATES		
	Actual	Expected	Ratio of Actual to Expected
25	11.78%	6.31%	1.867
30	5.61%	5.46%	1.027
35	4.77%	4.75%	1.004
40	3.91%	4.27%	0.916
45	3.08%	3.91%	0.787
50	2.92%	3.72%	0.786
55	3.39%	3.54%	0.958
58+	3.80%	3.50%	1.086
TOTAL	4.17%	4.24%	0.984

During the period under investigation, the actual rates of salary increase were lower than expected in aggregate but as you can see from the table above, the correlation between salary increases and age is not consistent. The following table uses the same data but is shown using service as the basis. There is slightly better correlation between salary growth and service bands.

SERVICE OF GROUP	RATES OF SALARY INCREASE		
	CURRENT RATES		
	Actual	Expected	Ratio of Actual to Expected
1	14.51%	5.47%	2.652
2	5.22%	5.32%	0.981
3	4.44%	5.18%	0.856
4	6.42%	5.03%	1.276
5	4.92%	4.90%	1.004
6-9	4.02%	4.57%	0.880
10-19	2.83%	4.02%	0.703
20-29	2.89%	3.67%	0.786
TOTAL	4.17%	4.24%	0.984

Section IV – Demographic Assumptions

The rates of salary increase consist of wage inflation and a scale for merit and promotion. We determined in the Economic section of this report that the wage inflation assumption should be reduced by 0.75% from 3.50% to 2.75%. The following table is the proposed merit salary scale based on actual experience.

CENTRAL SERVICE OF GROUP	RATES OF SALARY INCREASE		
	PROPOSED RATES		
	Proposed Rate of Increase	Less Expected Wage Inflation	Proposed Merit Scale
1	7.50%	2.75%	4.75%
2	5.50%	2.75%	2.75%
3	5.00%	2.75%	2.25%
4	5.00%	2.75%	2.25%
5	5.00%	2.75%	2.25%
6-9	4.25%	2.75%	1.50%
10-19	3.25%	2.75%	0.50%
20-29	3.00%	2.75%	0.25%
30+	3.00%	2.75%	0.25%

Section V – Assumptions Specific to the Health Trust and Life Trust

Long-Term Rate of Return

Past Experience

One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the timeframe used, especially if the year-to-year results vary widely. In addition, the asset allocation can also impact the investment returns so comparing results over long periods when different asset allocations were in place may not be meaningful.

The assets for TRS are valued using a widely accepted asset-smoothing methodology that fully recognizes the expected investment income and also recognizes 20% of each year's investment gain or loss (the difference between actual and expected investment income). The recent experience over the last five years is shown in the table below for the Health Trust and Life Trust.

Year Ending 6/30	Health Trust		Life Trust	
	Actuarial Value	Market Value	Actuarial Value	Market Value
2016	5.9%	-1.4%	3.8%	5.5%
2017	6.6%	11.9%	2.7%	1.0%
2018	6.9%	8.7%	2.7%	1.3%
2019	6.2%	6.1%	2.7%	6.5%
2020	5.8%	2.3%	3.6%	6.3%
Average	6.3%	5.5%	3.1%	4.1%

While important to review and analyze, historical returns over such a short time period are not credible for the purpose of setting the long-term assumed future rate of return.

Determination

As the Health Trust and Life Trust showed similar long-term projections to the Retirement Trust, and because the asset allocation strategy for the Health Trust will be impacted by the lower cash flows due to the State not paying their portion of the shared responsibility contributions, we have determined that there should be a decrease in the long-term expected return on assets assumption from 8.00% (Health Trust) and 7.50% (Life Trust) to 7.10% as shown in the chart on the following page.

Section V – Assumptions Specific to the Health Trust and Life Trust

Investment Return Assumption			
	Current Health Trust	Current Life Trust	Proposed For Both
Real Rate of Return*	5.00%	4.50%	4.60%
Inflation	<u>3.00</u>	<u>3.00</u>	<u>2.50</u>
Net Investment Return	8.00%	7.50%	7.10%

* Net of investment expenses.

Health Care Cost Trend Rates

Background: In addition to the economic assumptions used in all of the actuarial valuations performed for the Teachers' Retirement System of the State of Kentucky (System), the health care cost trend rates reflect the change in per capita health claims rates over time due to the following factors:

- medical inflation
- utilization
- plan design
- technology improvements

For the Health Insurance Trust (Health Trust), health care cost trend rates are needed to project the future cost of providing benefits of the Health Trust, including Kentucky Employees' Health Plan (KEHP) premiums, Medicare Eligible Health Plan (MEHP) costs, and Shared Responsibility contributions based upon Medicare Part B premiums.

The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 6, "Measuring Retiree Group Benefit Obligations," which provides guidance to actuaries in selecting economic assumptions for measuring obligations of post-retirement plans other than pensions. The actuary should not consider aging of the covered population when selecting the trend assumption for projecting future costs, but should consider the following key components in setting the health care cost trend rate as noted in ASOP No. 6:

- inflation
- medical inflation
- definition of covered charges
- frequency of services
- leveraging caused by plan design features not explicitly modeled
- plan participation

Section V – Assumptions Specific to the Health Trust and Life Trust

When setting assumptions for projecting medical and prescription drug costs, Cavanaugh Macdonald Consulting, LLC (CMC) assumes the health benefit plan cost trend rates will decrease from an initial rate to an ultimate level. CMC’s methodology for setting the initial trend rate includes the use of published annual health care inflation surveys in conjunction with actual plan experience, where credible. The initial trend rate assumption is subject to continued update and review with each valuation performed given the volatile nature of medical and prescription drug costs. There are various approaches used to determine the timing and level of decreases to the ultimate trend rate. The assumed decrease in medical and prescription drug trend rates reflects the belief that health care inflation cannot indefinitely outstrip the growth rate of employer budgets and the overall economy. As a standard of practice, CMC typically assumes a grading period of five to ten years, depending on the level of change (i.e., larger differences between the initial trend rate and the ultimate trend rate are assumed to require a longer reduction period). For the ultimate trend assumption, CMC looks to the “Long-Term Projection Assumptions for Medicare and Aggregate National Health Expenditures” published by Center for Medicare and Medicaid Services on April 22, 2020, which states that:

“One way of analyzing health spending trends is to compare the growth rate of the U.S. health sector with that of the overall economy. Using a definition of “excess cost growth” as the difference between (i) the U.S. per capita growth rate in health-care costs adjusted for demographic factors and (ii) the per capita growth rate in GDP (both in constant dollars), Table 1 shows average excess cost growth rates for selected time periods since 1975. Average excess cost growth rates for national health expenditures (NHE) exhibit some volatility depending on which time periods are used for defining averages, but over the long run this differential has for extended periods been above 2 percent per year or just slightly below this level.”

As a standard of practice, CMC believes the use of a “GDP+1.5%” to “GDP+2.5%” assumption is reasonable and CMC typically assumes an ultimate trend rate of price inflation +2.0%. As with any standard of practice, the specifics of each plan are reviewed to ensure there is nothing unusual that would necessitate a long-term trend rate that is either higher or lower than what is typical. It appears to be reasonable to use an ultimate rate of 4.50%, as there appears to be nothing unusual about the Kentucky Employees’ Health Plan and Medicare Eligible Health Plan that would necessitate a long-term trend that is either higher or lower than what is typically used for this type of calculation.

Section V – Assumptions Specific to the Health Trust and Life Trust

In projecting the offsets associated with the Federal Supplementary Medical Insurance Trust Fund (Medicare Part B Premiums), projected trends from the CMS actuary in the most recent annual report to the trustees appear to provide a reasonable basis for the projection of these costs. As a standard of practice, CMC typically develops the trend assumptions for these benefits based upon the CMS actuary's most recent estimates.

In our opinion, the economic assumptions determined in this report have been developed in accordance with ASOP No. 6. Currently, the short-term health care trend rates are set on an annual basis based on the information and data as previously described, with an ultimate trend rate of price inflation plus excess cost growth that is reached after an appropriate grading period.

Determination: In our opinion, the health care cost trend rates determined in each year's valuation report are developed in accordance with ASOP No. 6. We will continue to update and review the initial rates with each year's valuation. Use an ultimate trend rate of price inflation + 2.0%, or 4.50%.

We are not making any specific assumption changes attributable to the COVID-19 pandemic at this time due to the level of uncertainty regarding the impact on plan costs going forward. Given the uncertainty regarding COVID-19 (e.g., the impact of routine care being deferred, direct COVID-19 treatment and prevention costs, changes in contribution and budget projections), continued monitoring of the impact on the Plan's liability will be required and changes, if necessary, will be made annually at the time that experience develops.

Section V – Assumptions Specific to the Health Trust and Life Trust

Morbidity

Background: The Actuarial Standards Board has issued Actuarial Standard of Practice (ASOP) No. 6, “Measuring Retiree Group Benefit Obligations”, which provides guidance to actuaries when developing benefit cost projection assumptions for measuring obligations of postretirement plans other than pensions. As noted in ASOP No. 6, the actuary should consider the variation in rates by age for the benefits being modeled and use appropriate age bands if the rates vary significantly. The age bands should not be overly broad, based on the expected rate variations within the bands. If rates vary significantly by age, it is inappropriate to assume a single per capita rate that does not vary by age. The relationship between the rates at various ages is an actuarial assumption that may be based on normative databases.

Determination: CMC assumes the projected medical and prescription drug costs of MEHP vary significantly by age from the average cost at the central age of the applicable group based upon the paper “Aging Curves for Health Care Costs in Retirements”, The North American Actuarial Journal, July 2005, Jeffrey P. Petertil. Here, the paper’s “Representative Curve for General Use” is used for ages 50 and older, and factors developed from a national average claims and utilization database are used for ages below 50. CMC continuously monitors all available data, publications, and research projects undertaken by actuarial organizations regarding age-related morbidity (e.g., “Health Care Costs—From Birth to Death”, Health Care Cost Institute’s Independent Report Series – Report 2013-1, June 2013, Dale H. Yamamoto) and see no indication of the factors no longer being appropriate.

For the retiree health care liabilities of those under age 65, the current premium charged by the Kentucky Employees’ Health Plan (KEHP) is used as the base cost and is projected forward using the health care trend assumption (i.e., no implicit rate subsidy is calculated or recognized). Under Actuarial Standard of Practice No. 6 (ASOP No. 6), aging subsidies (or implicit rate subsidies) should be recognized, as the differences in health care utilization and cost due to age have been demonstrated and well quantified. The impact of aging on a valuation’s results can be as significant as the use of mortality, trend, and discounting. It has been the long-standing position that the responsibility for compliance with GASB Statement No. 43, when it relates to KEHP implicit subsidies, rests with KEHP, not the System, as the System has no operational authority over KEHP. As such, KEHP implicit subsidies are excluded from the OPEB funding valuation process of the Health Trust. As GASB 74 and 75 prohibit such a deviation from ASOP No. 6, KEHP implicit rate subsidies are included in the GASB Total OPEB Liability (TOL).

Section V – Assumptions Specific to the Health Trust and Life Trust

Coverage Assumptions

In addition to covering eligible retirees, many plans cover the spouse and dependents of retirees. In addition, plans may offer some or all participants a choice of coverage such as HMOs, PPOs, and POS plans. The magnitude of the retiree group benefit obligation can vary significantly as a result of the coverage assumptions. The actuary should therefore consider historical participation rates and trends in coverage rates when selecting the coverage assumptions.

Member Participation

Background: For plans that require some form of contribution to maintain coverage, some eligible inactive members may not elect to be covered, particularly if they have other coverage available from their most recent employer. Empirical data on plan participation, where available and credible, should be considered when selecting the participation assumption for future covered retirees that retire from an eligible inactive status. When developing the participation rates, how plan eligibility rules, plan choices, or retiree contribution rates have changed over time should be considered.

Furthermore, plan participation may be different in the future due to participants' response to changes in retiree contribution levels and plan choices. For plans that anticipate changes in retiree contributions, the appropriateness of participation rates that vary over the projection period for both current and future retirees should be considered. In addition, plan eligibility rules governing dropping coverage and subsequent re-enrollment when selecting participation rates should be considered.

Section V – Assumptions Specific to the Health Trust and Life Trust

Determination: Historical Health Trust participation levels suggest an adjustment to the current assumption. The use of the historical average is proposed, with adjustments to reflect an increase in participation as the System’s contribution Benefits increases.

TRS Contribution %	Valuation Date						Average
	6/30/2015	6/30/2016	6/30/2017	6/30/2018	6/30/2019	6/30/2020	
Number of Retirees Electing Medical Insurance Coverage							
10%	63	70	63	53	54	50	59
25%	250	278	329	352	388	407	334
45%	7	2	4	26	49	80	28
50%	712	717	709	689	688	699	702
65%	4	0	1	1	0	0	1
75%	1,297	1,404	1,523	1,611	1,665	1,687	1,531
90%	506	470	441	394	359	314	414
95%	0	0	0	0	0	0	0
100%	34,701	35,383	35,981	36,710	37,135	37,594	36,251
Number of Retirees Eligible for Medical Insurance Coverage							
10%	392	427	450	459	491	521	457
25%	1,514	1,685	1,819	1,939	2,059	2,168	1,864
45%	30	4	20	65	141	233	82
50%	1,767	1,831	1,834	1,805	1,806	1,834	1,813
65%	10	0	14	30	50	72	29
75%	2,000	2,223	2,395	2,526	2,601	2,666	2,402
90%	632	595	558	503	464	418	528
95%	0	0	1	2	2	5	2
100%	37,419	38,439	39,342	40,283	41,037	41,770	39,715
% Electing Medical Insurance Coverage							
10%	16%	16%	14%	12%	11%	10%	13%
25%	17%	16%	18%	18%	19%	19%	18%
45%	23%	50%	20%	40%	35%	34%	34%
50%	40%	39%	39%	38%	38%	38%	39%
65%	40%	n/a	7%	3%	0%	0%	3%
75%	65%	63%	64%	64%	64%	63%	64%
90%	80%	79%	79%	78%	77%	75%	78%
95%	n/a	n/a	0%	0%	0%	0%	0%
100%	93%	92%	91%	91%	90%	90%	91%

Section V – Assumptions Specific to the Health Trust and Life Trust

Summary of Medical Insurance Election Rates			
TRS Contribution %	Experience	Current	Proposed
10%	13%	20%	20%
25%	18%	20%	20%
45%	34%	41%	40%
50%	39%	49%	40%
65%	3%	61%	50%
75%	64%	70%	70%
90%	78%	76%	80%
95%	0%	84%	85%
100%	91%	91%	90%

Section V – Assumptions Specific to the Health Trust and Life Trust

Plan Elections

Background: As KEHP costs vary by plan, the future level of participation in the plans for covered members under 65 should be considered based upon historical participation rates, and how plan eligibility rules, plan choices, and retiree contribution rates have changed over time.

Determination: Based upon recent experience, plan election options can change, and plan election rates can shift over time. As a result, continued monitoring of experience and annual updating of the KEHP coverage assumption is proposed.

Valuation Date	LivingWell Basic	LivingWell Limited	LivingWell CDHP	LivingWell PPO	Standard PPO	Standard CDHP	Total
KEHP Retiree Coverage Elections							
6/30/2016	n/a	n/a	4,677	5,337	757	902	11,673
6/30/2017	n/a	n/a	4,620	4,783	298	1,246	10,947
6/30/2018	n/a	n/a	4,615	4,341	247	1,369	10,572
6/30/2019	295	110	5,044	4,595	n/a	n/a	10,044
6/30/2020	271	60	5,313	4,177	n/a	n/a	9,821
KEHP Retiree Coverage Election %s							
6/30/2016	n/a	n/a	40%	46%	6%	8%	100%
6/30/2017	n/a	n/a	42%	44%	3%	11%	100%
6/30/2018	n/a	n/a	44%	41%	2%	13%	100%
6/30/2019	3%	1%	50%	46%	n/a	n/a	100%
6/30/2020	3%	1%	53%	43%	n/a	n/a	100%

Section V – Assumptions Specific to the Health Trust and Life Trust

Spouse Participation

Background: Those who are eligible for coverage under the plan should be considered and appropriate assumptions made regarding the coverage of spouses and dependents. Additionally, the impact of plan rules governing changes in coverage after retirement, such as remarriage, if significant should be considered. A review of historical data on spouse and dependent coverage rates when selecting the assumption to be used in the projection should be made.

Determination: The percentage of those electing Health Trust coverage for their spouses has remained steady over time and Health Trust’s benefits and rules regarding dependent coverage are not anticipated to change. As a result, the use of the historical spouse coverage election average is proposed.

Valuation Date	Gender		
	Male	Female	Total
Number of Pre-Medicare Retirees Electing to Cover a Spouse			
6/30/2016	649	1,608	2,257
6/30/2017	608	1,964	2,572
6/30/2018	708	2,060	2,768
6/30/2019	671	2,009	2,680
6/30/2020	755	2,076	2,831
Number of Pre-Medicare Retirees Electing Coverage			
6/30/2016	2,496	9,177	11,673
6/30/2017	2,289	8,658	10,947
6/30/2018	2,245	8,327	10,572
6/30/2019	2,103	7,941	10,044
6/30/2020	2,152	7,669	9,821
% Electing Spousal Coverage			
6/30/2016	26%	18%	19%
6/30/2017	27%	23%	23%
6/30/2018	32%	25%	26%
6/30/2019	32%	25%	27%
6/30/2020	35%	27%	29%
Current Assumption	25%	15%	
Proposed %	30%	25%	

Section V – Assumptions Specific to the Health Trust and Life Trust

Terminated and Vested Participation

Background: Although eligible inactive members may begin receiving benefits once meeting the age and service requirements for retirement eligibility, some members may withdraw, and those members electing to receive benefits may not begin receiving benefits at the earliest eligibility date. For eligible inactive members, a rate of benefit participation and an average age in which benefits are to begin must be assumed.

Determination: Based upon the four most recent years of experience, the rates of withdrawal for those active members under the age of 55 who have less than 27 years of service have remained the same. As the average rate of withdrawal has remained relatively steady over time, the use of the historical average is proposed for members under the age of 55 who have less than 27 years of service. We have determined that continuing to use the same rates of vested and terminated benefit participation is appropriate at this time.

Section V – Assumptions Specific to the Health Trust and Life Trust

Rates of Withdrawal for the Initial Termination of an Active Employee			
Experience Period	Years of Service		
	5 - 10	10 - 15	15 - 27
Number of Active Members Under Age 55 Entering Vested and Terminated Status			
7/1/2015 - 6/30/2016	516	212	85
7/1/2016 - 6/30/2017	424	179	81
7/1/2017 - 6/30/2018	398	182	93
7/1/2018 - 6/30/2019	367	165	119
7/1/2019 - 6/30/2020	314	203	84
Number of Active Members Under Age 55 Entering Vested and Terminated Status or Withdrawing			
7/1/2015 - 6/30/2016	566	226	93
7/1/2016 - 6/30/2017	529	223	96
7/1/2017 - 6/30/2018	553	232	101
7/1/2018 - 6/30/2019	465	221	137
7/1/2019 - 6/30/2020	384	244	106
% of Active Members Under Age 55 Electing to Retain Membership upon Termination			
7/1/2015 - 6/30/2016	91%	94%	91%
7/1/2016 - 6/30/2017	80%	80%	84%
7/1/2017 - 6/30/2018	72%	78%	92%
7/1/2018 - 6/30/2019	79%	75%	87%
7/1/2019 - 6/30/2020	82%	83%	79%
Current Assumption	80%	85%	90%
Proposed %	80%	85%	90%*

*To be used for all other age/service combinations.

% Receiving a Pension Benefit or Returning to Active Service for an Employee Currently in Deferred Vested Status				
	Years of Service			
	5 - 10	10 - 15	15 - 27	27+
Current Assumption	75%	85%	90%	75%
Proposed %	75%	85%	90%	75%

Section V – Assumptions Specific to the Health Trust and Life Trust

Determination: Based upon the four most recent years of experience, the average age vested participants being receiving a pension benefit has remained the same. As the average age of initial benefit receipt has remained relatively steady over time, the use of the historical average is proposed for the age of initial benefit receipt.

Experience Period	Years of Service							Total
	5 - 10	10 - 15	15 - 20	20 - 25	25 - 26	26 - 27	27+	
Average Age of Initial Pension Benefit								
7/1/2016 - 6/30/2017	62	60	59	58	55	58	59	60
7/1/2017 - 6/30/2018	63	61	61	58	60	59	60	61
7/1/2018 - 6/30/2019	62	61	60	57	60	56	63	61
7/1/2019 - 6/30/2020	63	60	59	56	59	53	61	60
Total	62	60	60	57	59	57	61	60
Average %	62	60	60	57	58	57	61	61
Current Assumption	60							
Proposed	60							

Section V – Assumptions Specific to the Health Trust and Life Trust

Spouse Age Difference

Background: The actual data for the age of the covered spouse and dependents of retired participants is used. The spouse and dependents of an active employee today may not be the same spouse and dependents covered at retirement; therefore the actuary should generally select an assumed covered spouse age difference for purposes of projecting future spouse coverage and assumed dependents’ ages for projecting dependent coverage.

Determination: The average age difference between Health Trust covered male and female spouses has remained steady over time. As a result, we have determined that continued use of the historical average is appropriate, which supports maintaining current assumptions.

Valuation Date	Gender		
	Male	Female	Total
Average Age of Pre-Medicare Retiree Electing to Cover a Spouse			
6/30/2016	60	59	60
6/30/2017	59	60	60
6/30/2018	59	60	60
6/30/2019	59	60	60
6/30/2020	59	59	59
<i>Average</i>	59	60	60
Average Age of Coverage Spouse			
6/30/2016	56	60	59
6/30/2017	56	61	60
6/30/2018	57	61	60
6/30/2019	57	61	60
6/30/2020	56	61	60
<i>Average</i>	56	61	60
Age Difference			
6/30/2016	4	(1)	1
6/30/2017	3	(1)	0
6/30/2018	2	(1)	0
6/30/2019	2	(1)	0
6/30/2020	3	(2)	(1)
<i>Total</i>	3	(1)	0
Current Assumption	3	(1)	
Proposed %	3	(1)	

Section VI – Other Assumptions and Methods

ADMINISTRATIVE TOOLS: Any administrative tools utilized by the Retirement System should be revised to be based on the mortality table and investment rate of return used in the valuation.

OPTION FACTORS: The option factors currently used by the Retirement System are based on the mortality tables and investment rate of return (discount rate) used in the valuation. **The factors should be revised to be based on the mortality table determined for the valuation.**

ADMINISTRATIVE EXPENSE: Currently for TRS, there is no contribution made to pay the administrative expenses incurred each year. This results in losses to the system due to the expenses paid out each year. **After reviewing the total amount of administrative expenses for the past five years and the percentage of payroll, we have determined that an assumption of 0.32% of payroll should be used in the valuation and added to the total normal cost each year.** The following table shows actual percentages over the past five years:

(\$ in Thousands)

Year Ending June 30	Administrative Expenses	Annual Payroll	Percentage
2016	\$8,636	\$3,537,226	0.24%
2017	10,314	3,563,584	0.29%
2018	11,388	3,605,116	0.32%
2019	12,352	3,648,428	0.34%
2020	12,167	3,723,482	0.33%

PERCENT MARRIED: Currently, 100% of all members are assumed to be married with the male three years older than his spouse. This assumption is used to determine if anyone is entitled to a Survivor Benefit from a death in active service. The survivor benefits for members with 10 years of service before death can be paid to either spouses or dependent children or other dependents. An analysis of active members shows that mostly all of all active members have listed either a spouse or a dependent beneficiary on file. Therefore, **we determined that no change in this assumption is necessary at this time.**

Section VI – Other Assumptions and Methods

PART-TIMERS: Currently, we assume that all part time employees will accrue 0.25 years of service each year while in that status. After review of the data for the past 5 years, part-timers are averaging 0.247 years of service each year, therefore, **we have determined that no change in this assumption is necessary at this**

UNUSED SICK LEAVE: Currently, we assume a load of 2.0% to all active liability for all unused sick leave added at retirement. TRS staff has supplied us with average service credits due to unused sick leave for those active members that retired in the last 4 years that were not in Local School Districts. The average unused sick leave credit for these individuals was approximately 0.50 years of service. For those active members retiring from the Local School Districts, Final Average Compensation is increased by the average additional payroll they received from their unused sick leave time. Average additional payroll for these members averaged around \$13,500. Using these figures, we are computing that the load for unused sick leave should be 3.0% and **we have determined that there should be an increase to the load from 2.0% to 3.0% for all active liability at the time of retirement.**

Appendix A – Historical June CPI (U) Index

Year	CPI (U)	Year	CPI (U)
1965	31.6	1993	144.4
1966	32.4	1994	148.0
1967	33.3	1995	152.5
1968	35.7	1996	156.7
1969	34.7	1997	160.3
1970	38.8	1998	163.0
1971	40.6	1999	166.2
1972	41.7	2000	172.4
1973	44.2	2001	178.0
1974	49.0	2002	179.9
1975	53.6	2003	183.7
1976	56.8	2004	189.7
1977	60.7	2005	194.5
1978	65.2	2006	202.9
1979	72.3	2007	208.352
1980	82.7	2008	218.815
1981	90.6	2009	215.693
1982	97.0	2010	217.965
1983	99.5	2011	225.722
1984	103.7	2012	229.478
1985	107.6	2013	233.504
1986	109.5	2014	238.343
1987	113.5	2015	238.638
1988	118.0	2016	241.018
1989	124.1	2017	244.955
1990	129.9	2018	251.989
1991	136.0	2019	256.143
1992	140.2	2020	257.797

Appendix B – Capital Market Assumptions and Asset Allocations

Aon's 30-year Geometric Real Rates of Return and Standard Deviations by Asset Class

Asset Class	Expected Geometric Real Rates of Return	Standard Deviation
Large Cap U.S. Equity	4.2%	17.0%
Small Cap U.S. Equity	4.7%	23.0%
Developed International Equity	5.3%	20.0%
Emerging Markets Equity	5.4%	27.0%
Fixed Income	(0.1)%	4.5%
High Yield Bonds	1.7%	12.5%
Other Additional Categories	2.2%	9.7%
Real Estate	4.0%	17.4%
Private Equity	6.9%	25.0%
Cash	(0.3)%	2.0%

Long Term Asset Allocation Targets

Asset Class	Asset Allocation
Large Cap U.S. Equity	37.4%
Small Cap U.S. Equity	2.6%
Developed International Equity	16.5%
Emerging Markets Equity	5.5%
Fixed Income	15.0%
High Yield Bonds	2.0%
Other Additional Categories	5.0%
Real Estate	7.0%
Private Equity	7.0%
Cash	2.0%

Appendix C – Social Security Administration Wage Index

Year	Wage Index	Annual Increase	Year	Wage Index	Annual Increase
1962	\$4,291.40		1991	21,811.60	3.73
1963	4,396.64	2.45%	1992	22,935.42	5.15
1964	4,576.32	4.09	1993	23,132.67	0.86
1965	4,658.72	1.80	1994	23,753.53	2.68
1966	4,938.36	6.00	1995	24,705.66	4.01
1967	5,213.44	5.57	1996	25,913.90	4.89
1968	5,571.76	6.87	1997	27,426.00	5.84
1969	5,893.76	5.78	1998	28,861.44	5.23
1970	6,186.24	4.96	1999	30,469.84	5.57
1971	6,497.08	5.02	2000	32,154.82	5.53
1972	7,133.80	9.80	2001	32,921.92	2.39
1973	7,580.16	6.26	2002	33,252.09	1.00
1974	8,030.76	5.94	2003	34,064.95	2.44
1975	8,630.92	7.47	2004	35,648.55	4.65
1976	9,226.48	6.90	2005	36,952.94	3.66
1977	9,779.44	5.99	2006	38,651.41	4.60
1978	10,556.03	7.94	2007	40,405.48	4.54
1979	11,479.46	8.75	2008	41,334.97	2.30
1980	12,513.46	9.01	2009	40,711.61	(1.50)
1981	13,773.10	10.07	2010	41,673.83	2.36
1982	14,531.34	5.51	2011	42,979.61	3.13
1983	15,239.24	4.87	2012	44,321.67	3.12
1984	16,135.07	5.88	2013	44,888.16	1.28
1985	16,822.51	4.26	2014	46,481.52	3.55
1986	17,321.82	2.97	2015	48,098.63	3.48
1987	18,426.51	6.38	2016	48,642.15	1.13
1988	19,334.04	4.93	2017	50,321.89	3.45
1989	20,099.55	3.96	2018	52,145.80	3.62
1990	21,027.98	4.62	2019	54,099.99	3.75

Appendix D – Determined Rates

**TABLE 1
RATES OF SEPARATION FROM ACTIVE SERVICE – MALES**

AGE	RATES OF WITHDRAWAL			DEATH	DISABILITY	RATES OF RETIREMENT BEFORE 27 YEARS OF SERVICE	RATES OF RETIREMENT AFTER 27 YEARS OF SERVICE*
	Service						
	0 – 4	5 – 9	10+				
20	0.2000			0.000309	0.00010		
21	0.2000			0.000263	0.00010		
22	0.2000			0.000227	0.00010		
23	0.1100			0.000200	0.00010		
24	0.1100			0.000183	0.00010		
25	0.1100	0.0325		0.000200	0.00010		
26	0.1100	0.0325		0.000218	0.00010		
27	0.1100	0.0325		0.000236	0.00010		
28	0.1000	0.0360		0.000267	0.00010		
29	0.1000	0.0360		0.000285	0.00010		
30	0.1000	0.0360	0.0280	0.000315	0.00010		
31	0.1000	0.0360	0.0280	0.000332	0.00012		
32	0.1000	0.0360	0.0280	0.000360	0.00014		
33	0.1100	0.0360	0.0155	0.000373	0.00016		
34	0.1100	0.0360	0.0155	0.000398	0.00018		
35	0.1100	0.0360	0.0155	0.000419	0.00020		
36	0.1100	0.0360	0.0155	0.000436	0.00030		
37	0.1100	0.0360	0.0155	0.000463	0.00040		
38	0.1250	0.0400	0.0125	0.000474	0.00050		
39	0.1250	0.0400	0.0125	0.000494	0.00060		
40	0.1250	0.0400	0.0125	0.000522	0.00070		
41	0.1250	0.0400	0.0125	0.000548	0.00092		
42	0.1250	0.0400	0.0125	0.000582	0.00114		
43	0.1150	0.0400	0.0110	0.000616	0.00136		
44	0.1150	0.0400	0.0110	0.000669	0.00158		
45	0.1150	0.0400	0.0110	0.000722	0.00180		0.1700
46	0.1150	0.0400	0.0110	0.000786	0.00200		0.1700
47	0.1150	0.0400	0.0110	0.000863	0.00220		0.1700
48	0.1425	0.0450	0.0110	0.000942	0.00240		0.1700
49	0.1425	0.0450	0.0110	0.001045	0.00260		0.1700
50	0.1425	0.0450	0.0110	0.001153	0.00280		0.2500
51	0.1425	0.0450	0.0110	0.001266	0.00304		0.2200
52	0.1425	0.0450	0.0110	0.001403	0.00328		0.2000
53	0.1500	0.0600	0.0125	0.001547	0.00352		0.1500
54	0.1500	0.0600	0.0125	0.001697	0.00376		0.1400
55	0.1500	0.0600	0.0125	0.001871	0.00400	0.0525	0.4000
56	0.1500	0.0600	0.0000	0.002060	0.00420	0.0525	0.4000
57	0.1500	0.0600	0.0000	0.002270	0.00440	0.0625	0.3700
58	0.1500	0.0600	0.0000	0.002499	0.00460	0.0625	0.3400
59	0.1500	0.0600	0.0000	0.002755	0.00480	0.0625	0.2700
60	0.1500	0.0000	0.0000	0.003041	0.00500	0.1350	0.3300
61	0.1500	0.0000	0.0000	0.003344	0.00500	0.1500	0.3000
62	0.1500	0.0000	0.0000	0.003660	0.00500	0.1500	0.3000
63	0.2000	0.0000	0.0000	0.004007	0.00500	0.1500	0.3000
64	0.2000	0.0000	0.0000	0.004385	0.00500	0.1500	0.3000
65	0.2000	0.0000	0.0000	0.004775	0.00500	0.2000	0.3000
66	0.2000	0.0000	0.0000	0.005201	0.00500	0.2200	0.3000
67	0.2000	0.0000	0.0000	0.005657	0.00500	0.2500	0.2500
68	0.2000	0.0000	0.0000	0.006157	0.00500	0.2500	0.2500
69	0.2000	0.0000	0.0000	0.006677	0.00500	0.2500	0.2500
70	0.2000	0.0000	0.0000	0.007232	0.00500	0.2500	0.3000
71	0.2000	0.0000	0.0000	0.007833	0.00500	0.2500	0.3000
72	0.2000	0.0000	0.0000	0.008479	0.00500	0.2500	0.3000
73	0.2000	0.0000	0.0000	0.009174	0.00500	0.2500	0.3000
74	0.2000	0.0000	0.0000	0.009950	0.00500	0.2500	0.3000
75	0.2000	0.0000	0.0000	0.011408	0.00500	1.0000	1.0000

*Plus 8.5% in year when first eligible for unreduced retirement with 27 years of service.

Appendix D – Determined Rates

**TABLE 2
RATES OF SEPARATION FROM ACTIVE SERVICE – FEMALES**

AGE	RATES OF WITHDRAWAL			RATES OF DEATH	RATES OF DISABILITY	RATES OF RETIREMENT BEFORE 27 YEARS OF SERVICE	RATES OF RETIREMENT AFTER 27 YEARS OF SERVICE*
	Service						
	0 – 4	5 – 9	10+				
20	0.1300			0.000135	0.00010		
21	0.1300			0.000135	0.00010		
22	0.1300			0.000135	0.00010		
23	0.0900			0.000127	0.00010		
24	0.0900			0.000108	0.00010		
25	0.0900	0.0450		0.000099	0.00010		
26	0.0900	0.0450		0.000102	0.00012		
27	0.0900	0.0450		0.000104	0.00014		
28	0.1100	0.0425		0.000118	0.00016		
29	0.1100	0.0425		0.000120	0.00018		
30	0.1100	0.0425	0.0100	0.000134	0.00020		
31	0.1100	0.0425	0.0100	0.000149	0.00028		
32	0.1100	0.0425	0.0100	0.000176	0.00036		
33	0.1100	0.0350	0.0160	0.000190	0.00044		
34	0.1100	0.0350	0.0160	0.000203	0.00052		
35	0.1100	0.0350	0.0160	0.000215	0.00060		
36	0.1100	0.0350	0.0160	0.000238	0.00068		
37	0.1100	0.0350	0.0160	0.000247	0.00076		
38	0.1250	0.0400	0.0120	0.000267	0.00084		
39	0.1250	0.0400	0.0120	0.000284	0.00092		
40	0.1250	0.0400	0.0120	0.000299	0.00100		
41	0.1250	0.0400	0.0120	0.000324	0.00128		
42	0.1250	0.0400	0.0120	0.000335	0.00156		
43	0.1350	0.0400	0.0100	0.000356	0.00184		
44	0.1350	0.0400	0.0100	0.000376	0.00212		
45	0.1350	0.0400	0.0100	0.000405	0.00240		0.1700
46	0.1350	0.0400	0.0100	0.000425	0.00268		0.1700
47	0.1350	0.0400	0.0100	0.000455	0.00296		0.1700
48	0.1500	0.0450	0.0125	0.000495	0.00324		0.1700
49	0.1500	0.0450	0.0125	0.000538	0.00352		0.1700
50	0.1500	0.0450	0.0125	0.000584	0.00380		0.2000
51	0.1500	0.0450	0.0125	0.000633	0.00404		0.2000
52	0.1500	0.0450	0.0125	0.000687	0.00428		0.2000
53	0.1500	0.0500	0.0160	0.000754	0.00452		0.2000
54	0.1500	0.0500	0.0160	0.000834	0.00476		0.1500
55	0.1500	0.0500	0.0160	0.000908	0.00500	0.0500	0.5000
56	0.1500	0.0500	0.0000	0.000995	0.00520	0.0700	0.5000
57	0.1500	0.0500	0.0000	0.001092	0.00540	0.0700	0.4000
58	0.1750	0.0750	0.0000	0.001188	0.00560	0.0700	0.4000
59	0.1750	0.0750	0.0000	0.001290	0.00580	0.0700	0.4000
60	0.1750	0.0000	0.0000	0.001407	0.00600	0.1500	0.4000
61	0.1750	0.0000	0.0000	0.001526	0.00610	0.1500	0.4000
62	0.1750	0.0000	0.0000	0.001656	0.00620	0.1500	0.4000
63	0.2500	0.0000	0.0000	0.001796	0.00630	0.1800	0.4000
64	0.2500	0.0000	0.0000	0.001955	0.00640	0.1800	0.4000
65	0.2500	0.0000	0.0000	0.002123	0.00650	0.2500	0.4000
66	0.2500	0.0000	0.0000	0.002321	0.00650	0.2500	0.4000
67	0.2500	0.0000	0.0000	0.002541	0.00650	0.2500	0.4000
68	0.2500	0.0000	0.0000	0.002795	0.00650	0.2500	0.3500
69	0.2500	0.0000	0.0000	0.003086	0.00650	0.2500	0.3500
70	0.2500	0.0000	0.0000	0.003435	0.00650	0.3000	0.3500
71	0.2500	0.0000	0.0000	0.003853	0.00650	0.3000	0.3500
72	0.2500	0.0000	0.0000	0.004342	0.00650	0.3000	0.3500
73	0.2500	0.0000	0.0000	0.004922	0.00650	0.3000	0.3500
74	0.2500	0.0000	0.0000	0.005606	0.00650	0.3000	0.3500
75	0.2500	0.0000	0.0000	0.006389	0.00650	1.0000	1.0000

*Plus 10.0% in year when first eligible for unreduced retirement with 27 years of service.

Appendix D – Determined Rates

TABLE 3

**RATES OF ANTICIPATED MERIT SALARY INCREASES
(For Both Males and Females)**

SERVICE	RATE*
1	1.0475
2	1.0275
3	1.0225
4	1.0225
5	1.0225
6	1.0150
7	1.0150
8	1.0150
9	1.0150
10	1.0050
11	1.0050
12	1.0050
13	1.0050
14	1.0050
15	1.0050
16	1.0050
17	1.0050
18	1.0050
19	1.0050
20+	1.0025

*Does not include wage inflation assumption at 2.75% per annum.

Appendix D – Determined Rates

TABLE 4

RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF SERVICE*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000306	0.000118	71	0.016004	0.011015
20	0.000255	0.000098	72	0.018207	0.012554
21	0.000214	0.000088	73	0.020716	0.014318
22	0.000184	0.000088	74	0.023582	0.016346
23	0.000163	0.000088	75	0.026816	0.018649
24	0.000173	0.000098	76	0.030457	0.021266
25	0.000184	0.000098	77	0.034578	0.024245
26	0.000194	0.000108	78	0.039229	0.027616
27	0.000214	0.000118	79	0.044503	0.031458
28	0.000224	0.000137	80	0.050500	0.035819
29	0.000245	0.000147	81	0.057324	0.040778
30	0.000255	0.000157	82	0.065066	0.046413
31	0.000275	0.000167	83	0.073807	0.052783
32	0.000286	0.000186	84	0.083620	0.059976
33	0.000306	0.000196	85	0.094585	0.068071
34	0.000326	0.000216	86	0.106784	0.077165
35	0.000347	0.000235	87	0.120309	0.087387
36	0.000377	0.000255	88	0.135252	0.098872
37	0.000398	0.000284	89	0.151562	0.111769
38	0.000428	0.000304	90	0.169116	0.126077
39	0.000469	0.000333	91	0.187772	0.141757
40	0.000510	0.000363	92	0.207335	0.158682
41	0.000561	0.000402	93	0.227603	0.176674
42	0.000612	0.000431	94	0.248370	0.195559
43	0.000683	0.000470	95	0.269423	0.215110
44	0.000755	0.000519	96	0.290578	0.235131
45	0.000836	0.000568	97	0.311681	0.255466
46	0.000928	0.000617	98	0.332612	0.275968
47	0.001020	0.000666	99	0.353287	0.296597
48	0.001132	0.000715	100	0.373728	0.317344
49	0.001244	0.000774	101	0.393761	0.338041
50	0.001357	0.000843	102	0.413222	0.358494
51	0.001489	0.000902	103	0.431990	0.378525
52	0.001622	0.000970	104	0.449953	0.397968
53	0.002275	0.001891	105	0.467017	0.416686
54	0.002499	0.002048	106	0.483113	0.434542
55	0.002744	0.002215	107	0.498199	0.451457
56	0.003019	0.002401	108	0.510000	0.467362
57	0.003315	0.002597	109	0.510000	0.482209
58	0.003641	0.002813	110	0.510000	0.490000
59	0.004009	0.003058	111	0.510000	0.490000
60	0.004427	0.003322	112	0.510000	0.490000
61	0.004886	0.003626	113	0.510000	0.490000
62	0.005426	0.003969	114	0.510000	0.490000
63	0.006038	0.004371	115	0.510000	0.490000
64	0.006752	0.004822	116	0.510000	0.490000
65	0.007579	0.005351	117	0.510000	0.490000
66	0.008537	0.005968	118	1.000000	1.000000
67	0.009639	0.006693	119	1.000000	1.000000
68	0.010914	0.007546	120	1.000000	1.000000
69	0.012383	0.008536			
70	0.014066	0.009682			

*Base rates before applying a modified MP-2020 improvement scale projected generationally.

Appendix D – Determined Rates

TABLE 5

RATES OF MORTALITY FOR MEMBERS RETIRED ON ACCOUNT OF DISABILITY*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.003955	0.000113	71	0.041702	0.025436
20	0.003706	0.002312	72	0.044150	0.026903
21	0.003379	0.002303	73	0.046848	0.028567
22	0.003034	0.002190	74	0.049843	0.030447
23	0.002774	0.002021	75	0.053155	0.032562
24	0.002669	0.001824	76	0.056842	0.034949
25	0.002803	0.001654	77	0.060931	0.037628
26	0.002938	0.001542	78	0.065491	0.040627
27	0.003082	0.001542	79	0.070541	0.043973
28	0.003235	0.001683	80	0.076118	0.047705
29	0.003398	0.001842	81	0.082224	0.051860
30	0.003571	0.002021	82	0.088886	0.056466
31	0.003754	0.002209	83	0.096096	0.061570
32	0.003946	0.002416	84	0.103824	0.067210
33	0.004166	0.002641	85	0.112109	0.073423
34	0.004397	0.002886	86	0.121008	0.080238
35	0.004666	0.003158	87	0.130589	0.087711
36	0.004973	0.003450	88	0.142666	0.095532
37	0.005328	0.003769	89	0.156029	0.103532
38	0.005731	0.004117	90	0.169738	0.111653
39	0.006192	0.004503	91	0.183610	0.119916
40	0.006720	0.004926	92	0.197645	0.128451
41	0.007325	0.005396	93	0.211949	0.137400
42	0.008006	0.005913	94	0.226723	0.146969
43	0.008794	0.006477	95	0.242170	0.157356
44	0.009667	0.007088	96	0.258470	0.168777
45	0.010646	0.007755	97	0.275741	0.181401
46	0.011722	0.008479	98	0.293990	0.195370
47	0.012883	0.009259	99	0.313046	0.210974
48	0.014112	0.010086	100	0.332506	0.227724
49	0.015408	0.010970	101	0.351744	0.245669
50	0.016435	0.011910	102	0.370598	0.264704
51	0.017453	0.012906	103	0.388915	0.284491
52	0.018442	0.013940	104	0.406579	0.304391
53	0.019392	0.014429	105	0.423485	0.324244
54	0.020294	0.014918	106	0.439546	0.343861
55	0.021130	0.015416	107	0.454694	0.363075
56	0.021888	0.015905	108	0.468893	0.381725
57	0.022608	0.016375	109	0.480000	0.399679
58	0.023309	0.016817	110	0.480000	0.416805
59	0.024029	0.017230	111	0.480000	0.433030
60	0.024806	0.017616	112	0.480000	0.448286
61	0.025699	0.017992	113	0.480000	0.462527
62	0.026736	0.018386	114	0.480000	0.470000
63	0.027917	0.018800	115	0.480000	0.470000
64	0.029222	0.019279	116	0.480000	0.470000
65	0.030653	0.019834	117	0.480000	0.470000
66	0.032189	0.020473	118	0.480000	0.470000
67	0.033830	0.021206	119	1.000000	0.470000
68	0.035578	0.022052	120	1.000000	1.000000
69	0.037450	0.023030			
70	0.039485	0.024149			

*Base rates before applying a modified MP-2020 improvement scale projected generationally.

Appendix D – Determined Rates

TABLE 6

RATES OF MORTALITY FOR BENEFICIARIES OF DECEASED MEMBERS*

AGE	MALES	FEMALES	AGE	MALES	FEMALES
19	0.000303	0.000130	71	0.028391	0.014780
20	0.000253	0.000130	72	0.031148	0.016190
21	0.000212	0.000120	73	0.034158	0.017770
22	0.000182	0.000100	74	0.037431	0.019530
23	0.000162	0.000090	75	0.041006	0.021510
24	0.000172	0.000090	76	0.044945	0.023710
25	0.000182	0.000090	77	0.049288	0.026190
26	0.000192	0.000100	78	0.054136	0.028980
27	0.000212	0.000100	79	0.059560	0.032140
28	0.000222	0.000110	80	0.065630	0.035730
29	0.000242	0.000120	81	0.072407	0.039850
30	0.000253	0.000140	82	0.079942	0.044550
31	0.000273	0.000150	83	0.088304	0.049940
32	0.000283	0.000160	84	0.097546	0.056110
33	0.000303	0.000170	85	0.107717	0.063160
34	0.000323	0.000190	86	0.118857	0.071220
35	0.000343	0.000200	87	0.131078	0.080300
36	0.000374	0.000220	88	0.145622	0.090410
37	0.000394	0.000240	89	0.161065	0.101460
38	0.000424	0.000260	90	0.177306	0.113290
39	0.000465	0.000290	91	0.194284	0.125960
40	0.000505	0.000310	92	0.211959	0.139520
41	0.000556	0.000340	93	0.230280	0.154010
42	0.000606	0.000370	94	0.249207	0.169460
43	0.005545	0.000410	95	0.268670	0.185900
44	0.005777	0.000440	96	0.288597	0.203320
45	0.006020	0.002620	97	0.308868	0.221690
46	0.006272	0.002730	98	0.329351	0.240940
47	0.006525	0.002840	99	0.349824	0.260970
48	0.007080	0.002960	100	0.370064	0.281600
49	0.007312	0.003080	101	0.389900	0.302650
50	0.007545	0.003200	102	0.409171	0.323820
51	0.007787	0.003420	103	0.427755	0.344940
52	0.008050	0.003660	104	0.445541	0.365810
53	0.008322	0.003910	105	0.462439	0.386250
54	0.008625	0.004170	106	0.478376	0.406090
55	0.008959	0.004460	107	0.493314	0.425190
56	0.009332	0.004760	108	0.505000	0.443410
57	0.009747	0.005080	109	0.505000	0.460670
58	0.010221	0.005430	110	0.505000	0.476900
59	0.010777	0.005810	111	0.505000	0.492050
60	0.011413	0.006220	112	0.505000	0.500000
61	0.012140	0.006670	113	0.505000	0.500000
62	0.012989	0.007170	114	0.505000	0.500000
63	0.013978	0.007720	115	0.505000	0.500000
64	0.015120	0.008330	116	0.505000	0.500000
65	0.016443	0.008990	117	0.505000	0.500000
66	0.017938	0.009730	118	1.000000	0.500000
67	0.019624	0.010530	119	1.000000	0.500000
68	0.021503	0.011430	120	1.000000	1.000000
69	0.023584	0.012420			
70	0.025876	0.013530			

*Base rates before applying a modified MP-2020 improvement scale projected generationally.

Appendix E – Resolutions to the Board

ADOPTION OF TABLES HEREIN PRESENTED

In order that the tables herein presented may have the official approval of the Board of Trustees, the following resolutions have been determined for adoption.

WHEREAS, The investigation of the mortality, service and compensation experience of the members of the Teachers' Retirement System of the State of Kentucky which was prepared as of June 30, 2020 indicated that the mortality tables and active service tables previously adopted by the Board of Trustees require modification in order that they may reflect more closely the actual past experience of the membership, and

WHEREAS, The actuary has prepared new tables of rates for adoption, therefore, be it

RESOLVED, That the Board of Trustees, acting in accordance with Section 161.400 of the retirement law and upon the determination of the actuary, hereby discontinues the use in calculating the State's rates of contribution and in valuing the liabilities of the System of the active service tables and mortality tables currently in use, and approves for use instead the attached active service tables, and mortality tables, and be it further

RESOLVED, That the use of the new tables in the valuation as of June 30, 2021 and in all actuarial valuations thereafter, is hereby approved.

Appendix E – Resolutions to the Board

The Board of Trustees of the Teachers' Retirement System of the State of Kentucky approved the preceding resolution at a meeting held on September XX, 2021.

KENTUCKY
BOARD OF TRUSTEES,
TEACHERS' RETIREMENT SYSTEM OF THE STATE OF

By
Chairperson

Attest:

.....
Secretary