Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)

Actuarial Valuation Report

June 30, 2018

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September 19, 2018

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Ladies and Gentlemen:

The results of the regular annual actuarial valuation as of June 30, 2018 of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System, as established by Chapter 104 of the Missouri Revised Statutes, are presented in this report. Reports providing accounting and financial reporting information that are intended to comply with the Governmental Accounting Standards Board Statements No. 67 and No. 68 will be provided separately. The purposes of this valuation were:

- to measure the System's funding progress;
- to determine the employer contribution rate for Fiscal Year 2020; and
- to provide certain supplemental schedules for use in the System's CAFR.

Your attention is directed particularly to the summary of the results on pages 1-13.

This report was prepared at the request of the Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board. This report should not be relied on for any purpose other than the purpose described. GRS is not responsible for unauthorized use of this report.

The member statistical data required for the valuation together with pertinent data on financial operations was furnished by your Executive Director and his staff. Member data was reviewed for reasonableness, but was not audited by the actuary. Financial data was received in aggregate and reviewed for reasonableness. Individual investments were not reviewed. Assets are not audited by the actuary. We are not responsible for the accuracy or completeness of the data provided by MPERS.

The cooperation of the Executive Director and the staff in furnishing materials requested for this valuation, and the complete and excellent condition of the records, is acknowledged with appreciation.

The valuation results summarized in this report involve actuarial calculations that require assumptions about future events. The assumptions are established by the Board after consulting with the actuary. We believe that the assumptions and methods used in this report are reasonable and appropriate for the purpose for which they have been used. However, other assumptions and methods could also be reasonable and could result in materially different results. In addition, because it is not possible or practical to consider every possible contingency, we may use summary information, estimates or simplifications of calculations to facilitate the modeling of future events. We may also exclude factors or data that are deemed to be immaterial.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements; and changes in plan provisions or applicable law. This report does not contain an analysis of the potential range of such future measurements.

To the best of our knowledge, this report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board. The actuarial assumptions used for the valuation produce results which, individually and in the aggregate, are reasonable. The actuarial assumptions used in making the valuation are shown in Section E of this report.

The employer contributions determined in this report are based on Board funding policy. This policy is discussed on page 4 of this report. We commend the Board for its aggressive monitoring and updating of the funding policy over the recent past. However, continued employer contributions at the current level do not guarantee benefit security. We therefore encourage the Board to continue to routinely monitor and update its funding policy and to continue to consider benefit security when doing so.

This report has been prepared by individuals who have substantial experience valuing public employee retirement systems. Heidi G. Barry is a Member of the American Academy of Actuaries (MAAA) and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing individuals are independent of the plan sponsor.

Respectfully submitted,

Heidi G Barry

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Summary

This report contains the results of the June 30, 2018 valuation. The table below shows a summary of the data used in the valuation as well as the unfunded actuarial accrued liability for the two experience rated groups. This data was the basis for determining valuation results and recommended employer contribution rates.

	Non-Uniformed				
	Patrol Employees	**MoDOT Employees**	**Non-Uniformed Total**	**Uniformed Patrol**	**Total**
Participants					
Active Members					
Closed Plan	284	1,605	1,889	534	2,423
Year 2000 Plan (also closed)	423	1,649	2,072	383	2,455
Year 2011 Tier (open)	407	1,792	2,199	314	2,513
Total Active Members	1,114	5,046	6,160	1,231	7,391
Total Active Members Prior Year	*1,119*	*5,073*	*6,192*	*1,264*	*7,456*
Retiree -- Regular Pensioners					
Closed Plan	488	3,426	3,914	942	4,856
Year 2000 Plan (also closed)	566	3,343	3,909	6	3,915
Year 2011 Tier (open)	1	0	1	0	1
Total Regular Pensioners	1,055	6,769	7,824	948	8,772
Self Insured Disability Pensioners	3	43	46	3	49
Fully Insured Disability Pensioners	13	77	90	5	95
Terminated Vested Members	218	1,604	1,822	158	1,980
Total	**2,403**	**13,539**	**15,942**	**2,345**	**18,287**
Active Member Valuation Payroll	$47,859,971	$219,664,025	$ 267,523,996	$ 83,972,559	$ 351,496,555
Active Mem. Val. Payroll Prior Year	*$46,882,549*	*$216,529,976*	*$ 263,412,525*	*$ 85,566,687*	*$ 348,979,212*
Unfunded Actuarial Accrued Liability	N/A	N/A	$1,247,028,653	$460,562,166	$1,707,590,819

The June 30, 2018 valuation results are used to determine the contribution rate for the plan year beginning July 1, 2019. A summary of valuation results and recommended contribution rates follows.

Summary (Continued)

The **total contribution rate** for the plan year beginning July 1, 2019 is shown below:

	FY 2020 Employer Contribution Rates Expressed as % of Active Payroll for Total Benefits				
	Non-Uniformed				
	Civilian Patrol Employees	MoDOT Employees	Total	Uniformed Patrol Total	Combined Rate (System Total)
Benefit Normal Cost	8.69%	8.69%	8.69%	16.32%	10.55%
Expenses	1.26%	1.26%	1.26%	1.26%	1.26%
Disability Insurance	0.53%	0.53%	0.53%	0.53%	0.53%
Total Normal Cost	10.48%	10.48%	10.48%	18.11%	12.34%
Unfunded Liability	47.52%	47.52%	47.52%	39.89%	45.66%
Total	58.00%	58.00%	58.00%	58.00%	58.00%
Projected $	$29,449,293	$135,164,107	$164,613,400	$51,670,163	$216,283,563
Prior Year Projected $	*$29,128,620*	*$134,532,347*	*$163,660,967*	*$53,163,481*	*$216,824,448*

The projected dollar amounts are the total employer rate multiplied by the valuation payroll projected to the fiscal year the rate is effective. The projection factor is 1.0609 for Non-Uniformed and 1.0609 for Uniformed. Actual contributions will be based on the actual payroll during the 2020 Fiscal Year. The total contribution is based on a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities from July 1, 2019 in accordance with Board policy adopted September 17, 2009. In accordance with Board Policy adopted September 26, 2014, a minimum Employer contribution of 58% of payroll was included to establish a Contribution Stabilization Reserve Fund.

The contributions above are Employer contributions only. In addition, Employee contributions are estimated to be (on average) 1.21% for Non-Uniformed members and 0.76% for Uniformed members.

The combined contribution rate (58% of active payroll) is less than the actual benefit payout rate (68% of active payroll). The difference is intended to be made up by investment return. The ability to contribute less than the benefit payout is one of the advantages of a funded retirement plan.

Prior year projected dollars (FY 2019) are based on rates of 58.00% for Non-Uniform and 58.00% for Uniform.

Summary (Continued)

Benefit, Assumptions and Methods for the June 30, 2018 valuation: The assumptions and methods used were those adopted by the Board from the July 1, 2012 through June 30, 2017 Experience Study and titled Alternate 3 in that report. The Board formally adopted these new assumptions at the February 14, 2018 Board meeting. Updated assumptions include the following:

- Assumed rates of withdrawal, disability, retirement and wage increases due to merit and longevity were adjusted to more closely track experience.
- Mortality tables were updated to use the RP-2014 Healthy Annuitant, Employee and Disabled Retiree Annuitant tables projected to 2022 using scale MP-2017.
- Economic assumptions lowered to 7.00% investment return, 3.00% wage inflation and 2.25% price inflation.
- Other miscellaneous loads for potential survivor benefits, sick leave, etc.

These changes increased the Actuarial Accrued Liability (AAL) by approximately $142 million. The next Experience Study is scheduled to follow the June 30, 2022 valuation. The change in assumptions resulted in a change in the actuarial accrued liability that was less than the contribution stabilization fund. As a result, the contribution stabilization fund has decreased this year (in spite of the experience gains) and the employer contribution rate is unchanged from last year.

The vesting requirement for 2011 Tier members was lowered from 10 to 5 years. In addition, the spouses of a deferred vested member who dies after accruing 5 years of service is entitled to a joint and 100% survivor benefit on the date the member would have attained normal retirement eligibility. Although this law was effective last fiscal year, it was signed into law too late to be included in the prior valuation. Our previous supplemental report evaluating this change showed that it did not increase the accrued liabilities under the valuation assumptions that were effective when the change was adopted.

Experience: System assets earned a 9.2% return on a market basis, although the fund recognized a 7.1% rate of return on an actuarial basis after accounting for the smoothing of the 2016 loss and 2017 gain (please see page C-2). In aggregate, there was an experience gain of $24 million (approximately 1.0% of beginning of year liabilities). This gain was made up of a $13 million investment loss and a $37 million liability gain and contributed to an increase in funding status from 57.1% to 59.2% (before assumption and plan provision changes). Pages A-9 and A-10 show the derivation of the gain/(loss) in aggregate and by division.

The main sources of the liability gain for the Non-Uniformed group was due to the retiree COLA (the COLA was less than expected) and post-retirement deaths (more deaths than expected). The main source for the liability gain for the Uniformed group was due to the retiree COLA (the COLA was less than expected) and individual pay increases less than expected. The table on the following page shows a comparison of actual demographic activity versus expected activity (based on the prior year's valuation assumptions).

Summary (Continued)

Demographic Experience

	Non-Uniformed				Uniformed			
	Number Count			General	Number Count			General
	Actual	Expected	A/E%	Direction	Actual	Expected	A/E%	Direction
Retirement	200	248.1	81%	Gain	28	28.2	99%	Gain
Death	2	4.9	41%	Loss	0	0.7	0%	Gain
Disability	13	13.7	95%	Loss	1	0.9	111%	Gain
Vested Terminations	120	79.3	151%	Loss	15	9.1	165%	Gain
Other Terminations	299	230.5	130%	Gain	15	12.4	121%	Gain
Post-Retirement Death	300	246.2	122%	Gain	27	26.4	102%	Gain

For both the Uniformed and Non-Uniformed division, liability gains more than offset recognized investment losses resulting in an experience gain of $11 million and $13 million in aggregate, respectively.

Funding Policy:

Permanent Policy: The total contribution will be based on normal cost plus a 17-year amortization of unfunded actuarial accrued liabilities. The amortization period is a closed 17-year period starting July 1, 2019.

Temporary Accelerated Policy: The total contribution is based on normal cost plus a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2019.

In accordance with RSMo 105.684, an accelerated amortization schedule was prepared and presented to the Board. This temporary accelerated policy was adopted by the Retirement Board on September 17, 2009 and will remain in effect until such time as the retiree liability becomes 100% funded or the permanent policy produces a higher contribution rate.

In September 2014, the Board adopted a contribution stabilization reserve fund from experience gains in an effort to keep the employer contribution rate at or near 58%, in the near term. In February 2015, the Board established a maximum of $250 million in the contribution stabilization reserve fund. The contribution stabilization reserve fund is expected to result in the fund becoming more than 100% funded by the end of the amortization period, if experience is exactly as assumed.

Summary (Continued)

Rate Reconciliation: The table below shows the computed rate last year and the approximate effect of the changes that occurred during the year.

	Non-Uniform	Uniform
Computed employer contribution rate, prior valuation	58.00%	58.00%
Effects of:		
Change in disability premiums	0.00%	0.00%
Change in plan provisions	0.00%	0.00%
Change in assumptions and methods	2.80%	3.96%
Phase-in of 2011 Tier members	(0.35)%	(0.23)%
17/18 recognized investment loss/(gain)	0.63%	0.75%
17/18 liability experience loss/(gain)	(1.51)%	(3.01)%
Change in administrative expenses	0.05%	0.05%
Change due to payroll increase other than expected	1.03%	3.95%
Misc (demographic, payroll weighting, component interaction, etc.)	(0.22)%	0.88%
Change in Contribution Stabilization Reserve Fund	(2.43)%	(6.35)%
Computed employer contribution rate, current valuation	58.00%	58.00%

Funded Status of Retiree Liability: The chart below indicates the funding status of retiree liabilities on a funding value asset basis and a market value asset basis:

	June 30, 2018			June 30, 2017
Asset Basis	Non-Uniformed	Uniformed	Total	Total
Funding Value	83.0%	98.9%	87.1%	87.0%
Market Value	84.5%	100.0%	88.7%	86.9%

Total Plan Funded Status: The plan is currently 57.12% funded on an actuarial value of assets basis or 58.13% funded on a market value of assets basis.

If not for the minimum contribution rate and the contribution stabilization reserve, the permanent funding policy would have resulted in a higher employer contribution for the Uniformed division and the temporary policy would have resulted in a higher employer contribution for the Non-Uniformed division, using current valuation assumptions.

Plan Provisions: There were no plan provisions intentionally excluded from the valuation that were in effect on the valuation date. However, certain disability benefits are funded through third party insurance. The premiums for this insurance are included in the normal cost. The liabilities for these disability benefits are not included in the accrued liabilities of the plan, since they are liabilities of the insurance carrier.

Summary (Concluded)

Look Forward: Before recognizing any fiscal year 2019 activity, the fund is positioned to recognize an investment gain of approximately $30 million next year (see page C-2). Since this gain (by itself) will not increase the contribution stabilization reserve fund above $250 million (currently the contribution stabilization reserve is $158 million), the employer contribution rate is not expected to decrease under the current funding policy. However, this gain, if not offset by other experience losses, will put upward pressure on the funded status of the plan. Should experience gains, in total, exceed $92 million in fiscal year 2019, there will be downward pressure on employer contribution rates.

Recommendation: In accordance with changes in actuarial standards along with more recent changes in forecasts of future economic conditions, we recommend that economic assumptions be reviewed annually each spring before the next valuation cycle begins.

Conclusion: Based upon the results of the June 30, 2018 regular annual actuarial valuation, it is our opinion that the Missouri Department of Transportation and Highway Patrol Employees' Retirement System continues to be financed in accordance with actuarial principles of level percent-of-payroll financing. This statement is based upon the fact that the employer is contributing to the System based upon actuarially determined rates and presumes a continuation of payment of actuarially determined contributions. In addition, we commend the 2009 Board in its decision to more aggressively address the unfunded retiree liability issue, the 2011 Board in its decision to reflect the near term downsizing of MoDOT, and the 2014 Board for establishing the contribution stabilization reserve fund, which effectively accelerated the funding of the UAAL.

Other Observations

General Implications of Contribution Allocation Procedure or Funding Policy on Future Expected Plan Contributions and Funded Status

Given the plan's contribution allocation procedure, if all actuarial assumptions are met (including the assumption of the plan earning 7.00% on the actuarial value of assets), it is expected that:

1) The unfunded actuarial accrued liabilities will be fully amortized after 17 years, based on the permanent funding policy;
2) The funded status of the plan will increase gradually towards a 100% funded ratio and then slightly exceed 100%; and
3) The unfunded accrued liability will follow the pattern shown on page A-5.

Limitations of Funded Status Measurements

Unless otherwise indicated, a funded status measurement presented in this report is based upon the actuarial accrued liability and the actuarial value of assets. Unless otherwise indicated, with regard to any funded status measurements presented in this report:

1) The measurement is inappropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations, in other words, of transferring the obligations to an unrelated third party in an arm's length market value type transaction.
2) The measurement is dependent upon the actuarial cost method which, in combination with the plan's amortization policy, affects the timing and amounts of future contributions. A funded status measurement in this report of 100% is not synonymous with no required future contributions. If the funded status were 100%, the plan would still require future normal cost contributions (i.e., contributions to cover the cost of the active membership accruing an additional year of service credit).
3) The measurement would produce a different result if the market value of assets were used instead of the actuarial value of assets, unless the market value of assets is used in the measurement.

Limitations of Project Scope

Actuarial standards do not require the actuary to evaluate the ability of the plan sponsor or other contributing entity to make required contributions to the plan when due. Such an evaluation was not within the scope of this project and is not within the actuary's domain of expertise. Consequently, the actuary performed no such evaluation.

Risks to Future Employer Contribution Requirements

There are ongoing risks to future employer contribution requirements to which the Retirement System is exposed, such as:

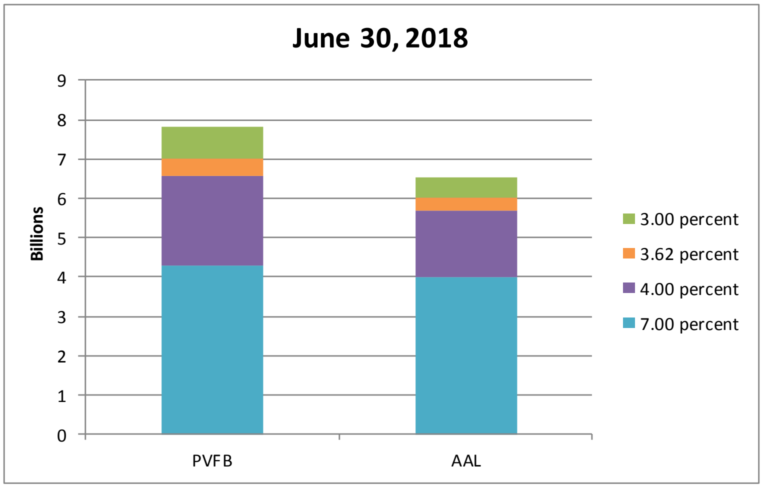
- Actual and Assumed Investment Rate of Return
- Actual and Assumed Mortality Rates
- Amortization Policy

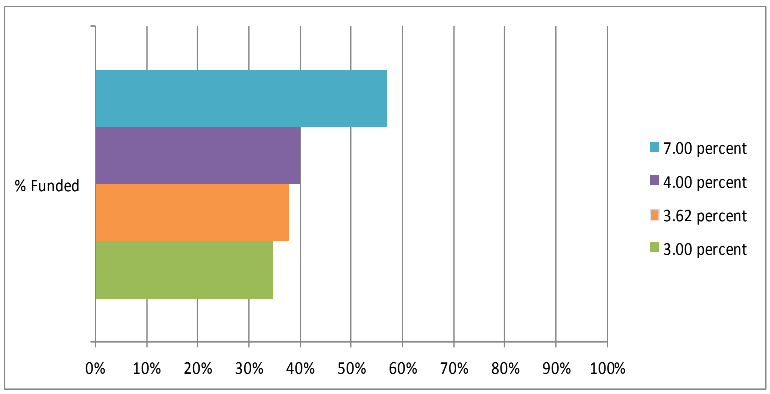
Summary of Key Valuation Results

Actuarial Present Value	June 30, 2018 (1) Actuarial Present Value	June 30, 2018 (2) Portion Covered By Future Normal Cost Contributions	June 30, 2018 (3) Actuarial Accrued Liabilities (1) - (2)	June 30, 2017 Actuarial Accrued Liabilities
Active Members				
Service retirement benefits based on service rendered before and likely to be rendered after valuation date	$ 1,488,855,697	$ 255,006,995	$ 1,233,848,702	$ 1,176,801,428
Disability benefits likely to be paid to present active members who become totally and permanently disabled*	29,126,193	17,216,299	11,909,894	10,012,032
Survivor benefits likely to be paid to widows and children of present active members who die before retiring	15,926,139	5,325,279	10,600,860	10,703,798
Separation benefits likely to be paid to present active members	58,163,672	30,999,249	27,164,423	20,737,299
Active Member Totals	$ 1,592,071,701	$ 308,547,822	$ 1,283,523,879	$ 1,218,254,557
Terminated Vested Members	99,889,190		99,889,190	96,137,842
Retired Lives	2,598,425,872		2,598,425,872	2,488,051,331
Total Actuarial Accrued Liability	$ 4,290,386,763	$ 308,547,822	$ 3,981,838,941	$ 3,802,443,730
Actuarial Value of Assets			2,274,248,122	2,172,787,144
Unfunded Actuarial Accrued Liability			$ 1,707,590,819	$ 1,629,656,586
Contribution Stabilization Reserve Fund			$ 157,556,374	$ 219,560,390
Total Amount Financed			$ 1,865,147,193	$ 1,849,216,976

* *The amounts presented for this category represent liabilities for retirement benefits for active members that may become participants of the long-term disability plan until they reach normal retirement eligibility. These are not liabilities for active members currently on long-term disability.*

Summary of Key Valuations Results – (Concluded)





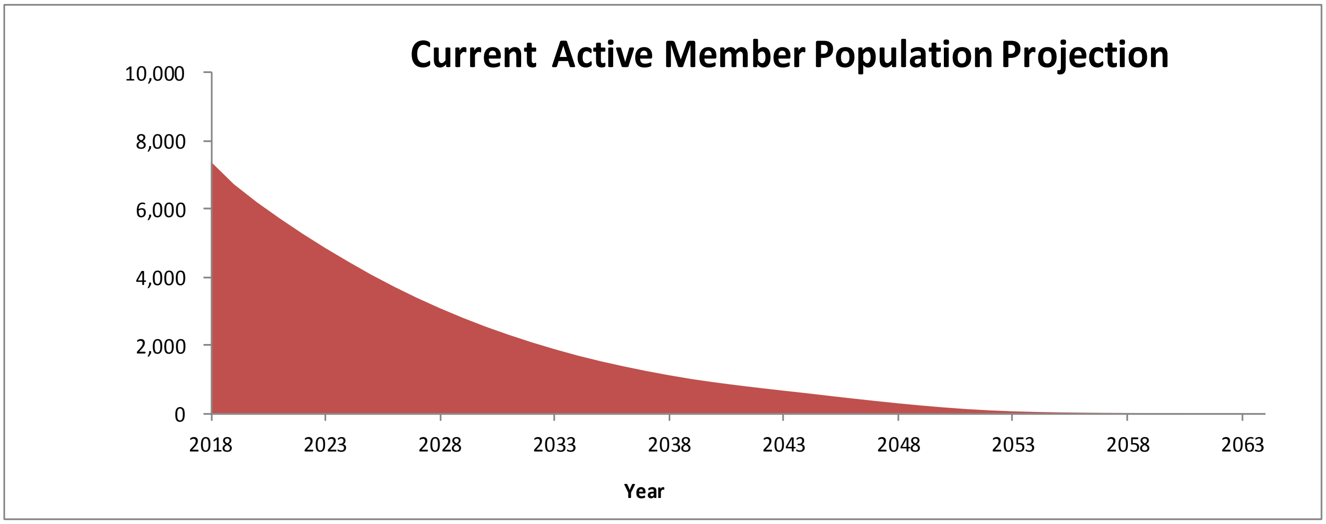
The first chart, above, shows the Present Value of Future Benefits (PVFB) and the Actuarial Accrued Liability (AAL) at four different interest rates. Using an interest rate of 3.00%, we obtain a value of $7.8 billion PVFB and $6.5 billion AAL. This is akin to the cost (in uninflated or 2018 dollars) of all future expected benefit payments to current members of the System (PVFB) and the portion that is allocated to the post AAL.

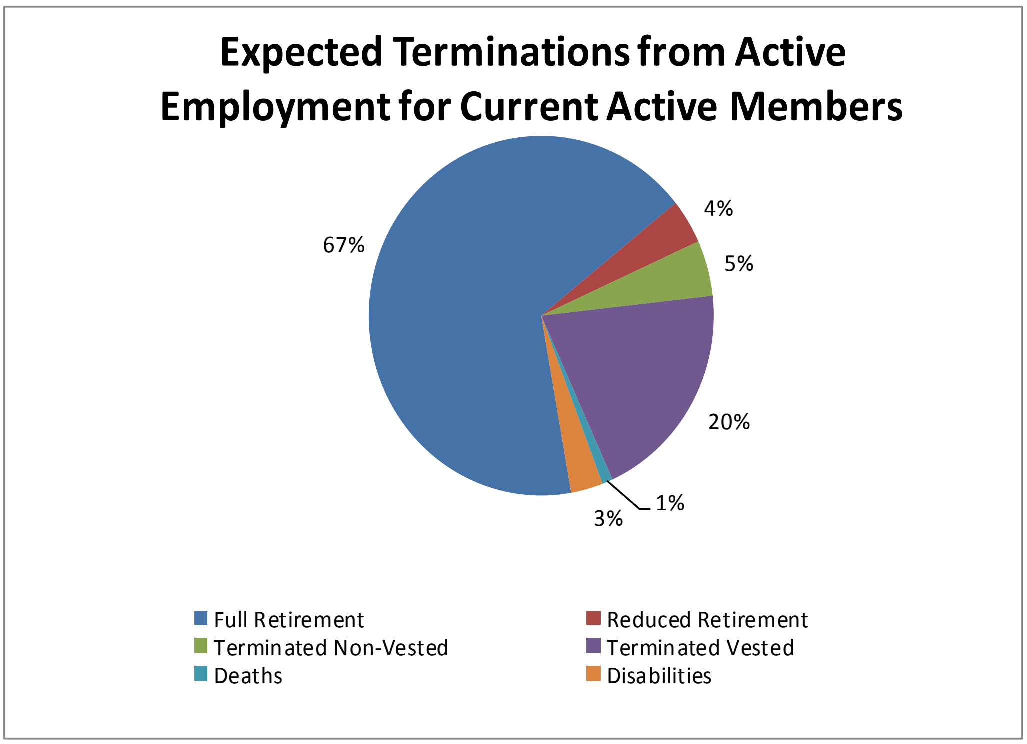
Using an interest rate of 3.62%, the PVFB is $7.0 billion, the AAL is $6.0 billion. The 3.62% interest rate is shown as an estimate of the return that might be achieved with "risk free" investments (U.S. Treasuries and their "safe" fixed income securities) in a 2.25% inflationary environment. The difference between these first two measurements is an estimate of the value of pre-funding the System with little to no investment risk. (Note: this is intended to show the risk defeasement calculation that is expected to be required by actuarial standards, in the future). Also for comparison, using an interest rate of 4.00% we obtain a value of $6.6 billion PVFB and $5.7 billion AAL.

Using an investment return of 7.00% (the current valuation assumed investment return based on the current investment portfolio), the PVFB is $4.3 billion and the AAL is $4.0 billion. The difference between the 2nd and 3rd measures (3.62% interest and 7.00% interest) is the estimate of the reward the System expects to receive as a result of investing in a balanced portfolio instead of "risk free" securities.

The second chart shows the funded status (AAL/Actuarial Value of Assets) at each interest rate. This illustration was not intended to satisfy the recommended actuarial standards regarding solvency measures.

Expected Development of Present Populations as of June 30, 2018

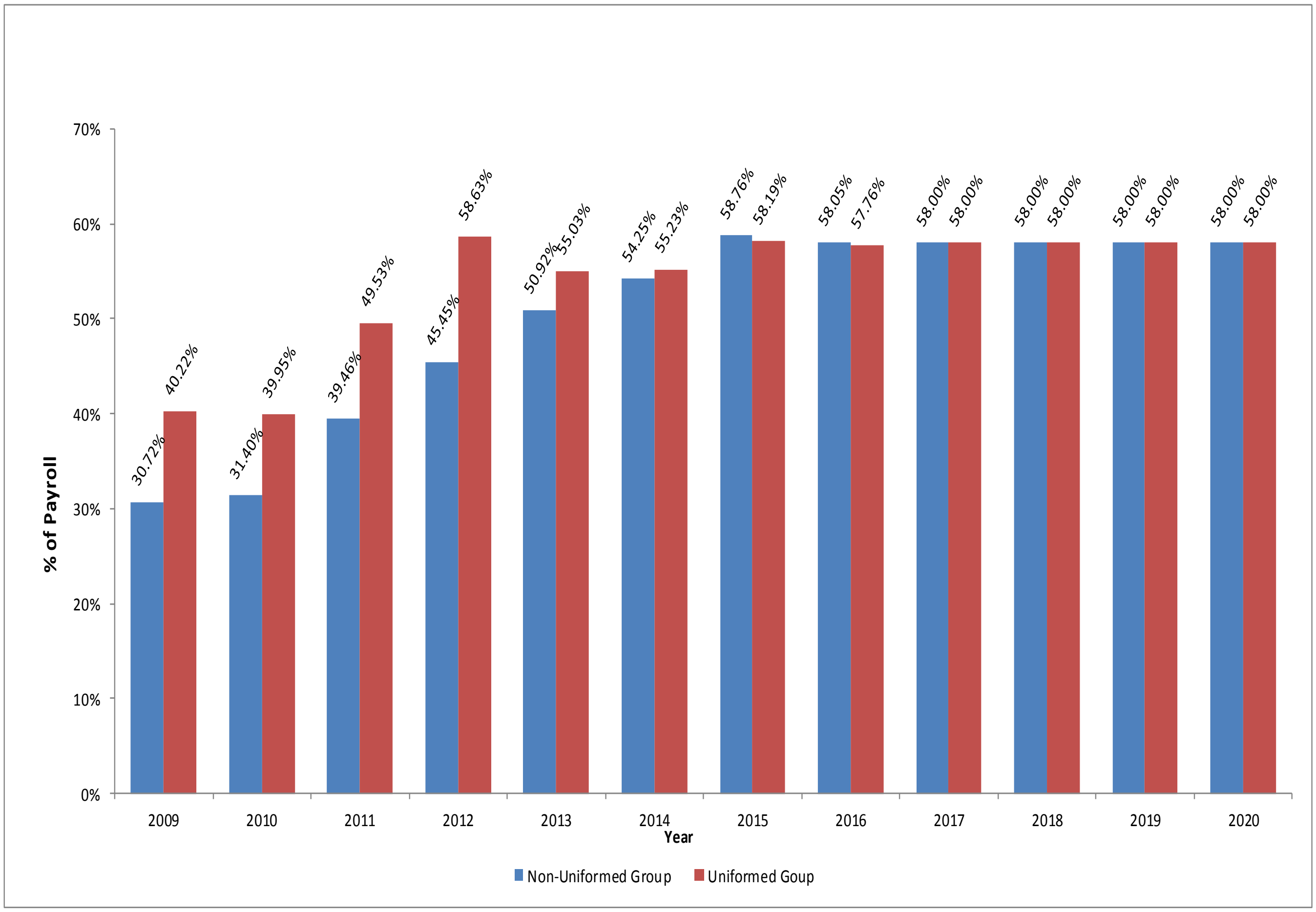




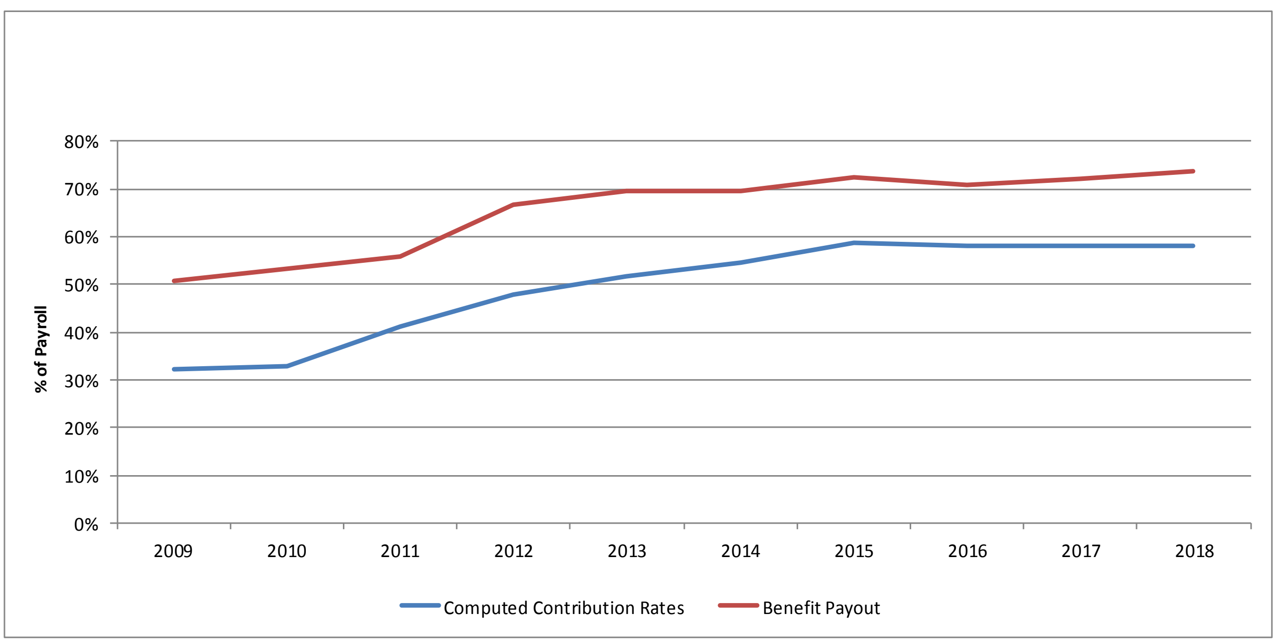
The charts above show the expected future development of the present population in simplified terms. The Retirement System presently covers 7,391 active members. Eventually, 5% of the population is expected to terminate covered employment prior to retirement and forfeit eligibility for an employer provided benefit. Of the present population, 91% is expected to receive monthly retirement benefits either by retiring directly from active service, or by separating from service with a vested benefit, and 4% of the present population is expected to become eligible for death-in-service or disability benefits. Within 10 years, over half of the covered membership is expected to consist of new hires.

Historical Contribution Rates and Benefit Payouts

Computed Contribution Rates

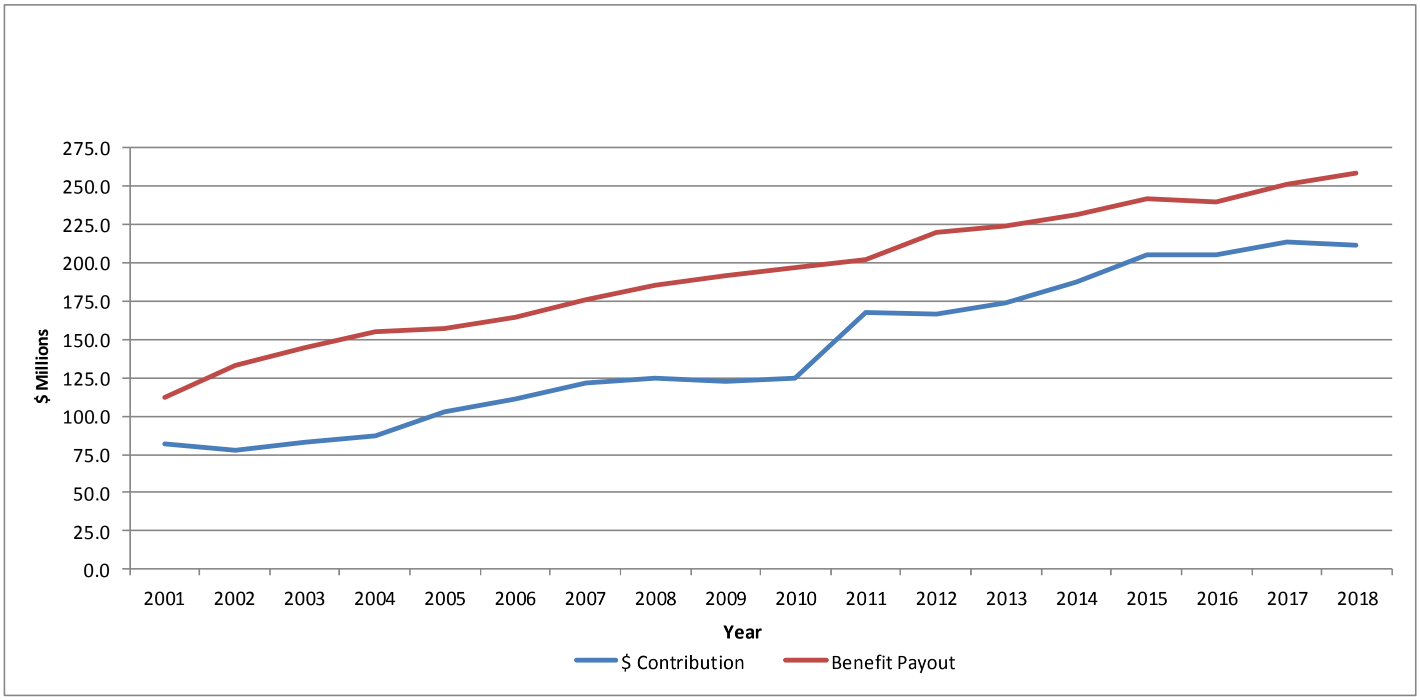


Contribution Rates vs. Benefit Payout



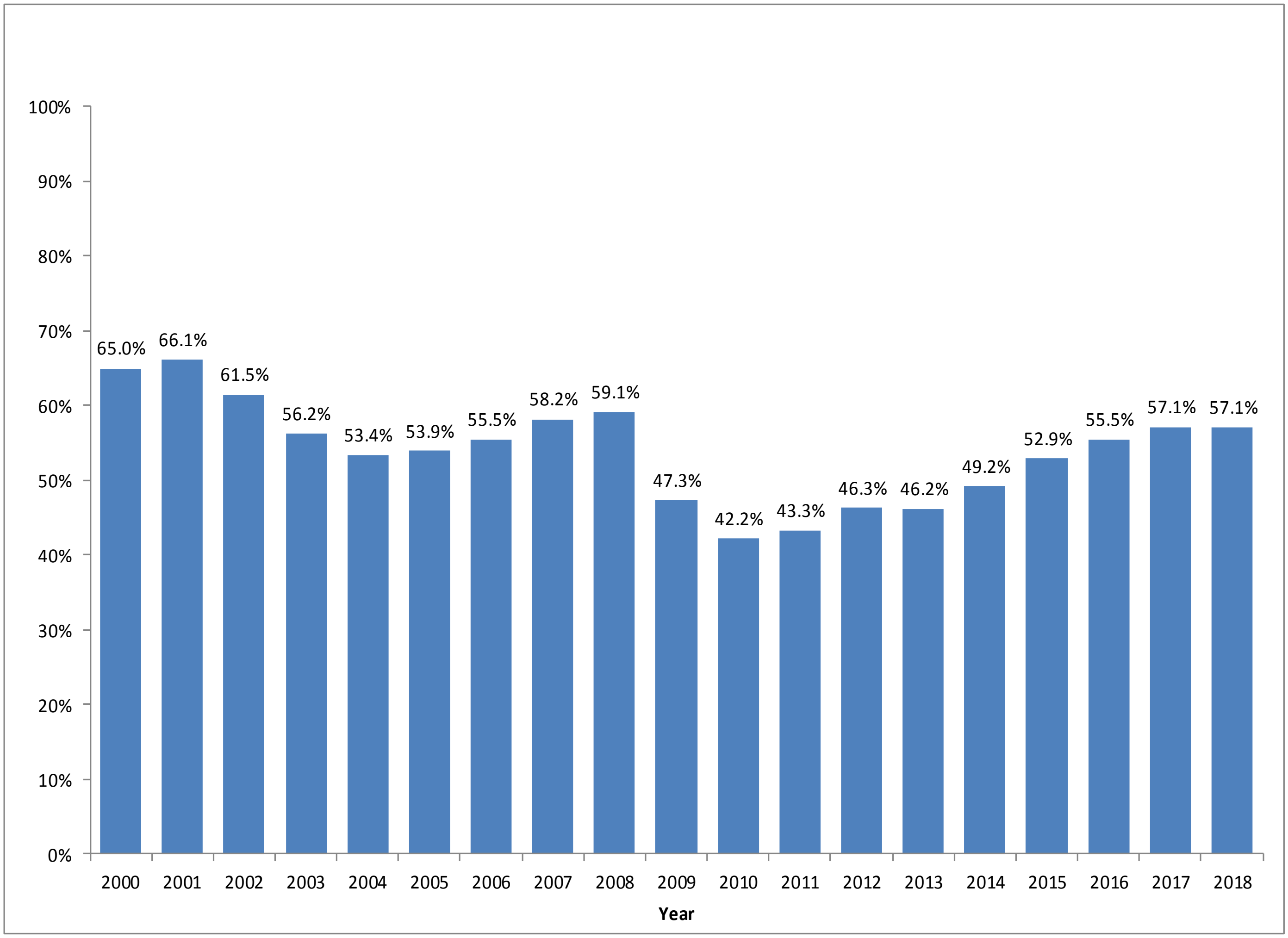
Historical Contribution Rates and Benefit Payouts (Concluded)

Contribution Dollars vs. Benefit Payout Dollars
(in millions)



Historical Funded Ratios

Actuarial Value of Assets as Percents of Accrued Liabilities
(Funded Ratio)



The funded status shown herein is not appropriate to assess the sufficiency of plan assets to cover the estimated cost of settling the Plan's benefit obligations. A funded status below 100% is an indication that additional contributions will be needed in the future, if experience is exactly as assumed. However, a funded status at or above 100% (by itself) cannot be used to determine the need for future contributions.

SECTION A

VALUATION RESULTS

Computed Contributions to Support Benefits
for Fiscal Year 2020
Contributions Computed as of June 30, 2018

Contributions for	Non-Uniformed Employees: Closed & Year 2000	Non-Uniformed Employees: 2011 Tier	Non-Uniformed Employees: Total	Uniformed Patrol: Closed & Year 2000	Uniformed Patrol: 2011 Tier	Uniformed Patrol: Total	MPERS Total
Normal Cost							
Age & service benefits	8.16%	6.29%	7.60%	16.62%	12.18%	15.78%	9.59%
Disability benefits #	0.64%	0.93%	0.73%	0.39%	0.29%	0.37%	0.64%
Survivor benefits	0.16%	0.22%	0.18%	0.26%	0.20%	0.25%	0.20%
Separation benefits	1.45%	1.24%	1.39%	0.76%	0.29%	0.68%	1.22%
Total Normal Cost	10.41%	8.68%	9.90%	18.03%	12.96%	17.08%	11.65%
Member Contributions	0.00%	4.00%	1.21%	0.00%	4.00%	0.76%	1.10%
Employer Normal Cost	10.41%	4.68%	8.69%	18.03%	8.96%	16.32%	10.55%
Unfunded Actuarial Accrued Liabilities*			47.52%			39.89%	45.66%
Expense Provision			1.26%			1.26%	1.26%
Subtotal			57.47%			57.47%	57.47%
Disability Insurance			0.53%			0.53%	0.53%
Total Contribution Rate			58.00%			58.00%	58.00%
Projected Dollar Contribution			$ 164,613,400			$ 51,670,163	$ 216,283,563
Prior Year							
Total Contribution Rate			58.00%			58.00%	58.00%
Projected Dollar Contribution			$ 163,660,967			$ 53,163,481	$ 216,824,448

Includes costs for benefits payable after conversion to normal retirement and/or benefits payable to survivors. Costs for disability benefits payable prior to conversion are shown under Disability Insurance which is outsourced.

* *Amortized as a level-percentage of payroll over a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities from July 1, 2019 and then increased to achieve a 58% total employer contribution rate.*

Development of Contribution Stabilization Reserve Fund as of June 30, 2018

	Non-Uniformed Employees	Uniformed Patrol	Total
Beginning of Year Contribution Stabilization Reserve Fund	$ 158,092,318	$ 61,468,072	$ 219,560,390
Growth (to maintain contribution rate)	-	-	-
Reduction (to match contribution rate)	(34,056,579)	(27,947,437)	(62,004,016)
End of Year Contribution Stabilization Reserve Fund	$ 124,035,739	$ 33,520,635	$ 157,556,374

At the September 25, 2014 Board meeting, the Board adopted the use of a contribution stabilization reserve fund that would result in an MPERS employer contribution of 58.00% of pay.

At the February 19, 2015 Board meeting, the Board adopted to cap the contribution stabilization reserve fund at $250 million. Furthermore, the Board adopted a motion that if MPERS experienced a loss, MPERS would deplete the entire reserve fund if a loss of that magnitude were to be realized.

In order to determine the current amount of the contribution stabilization reserve fund for the separate groups, we determined the amount of growth needed to achieve a 58.00% contribution rate for each group.

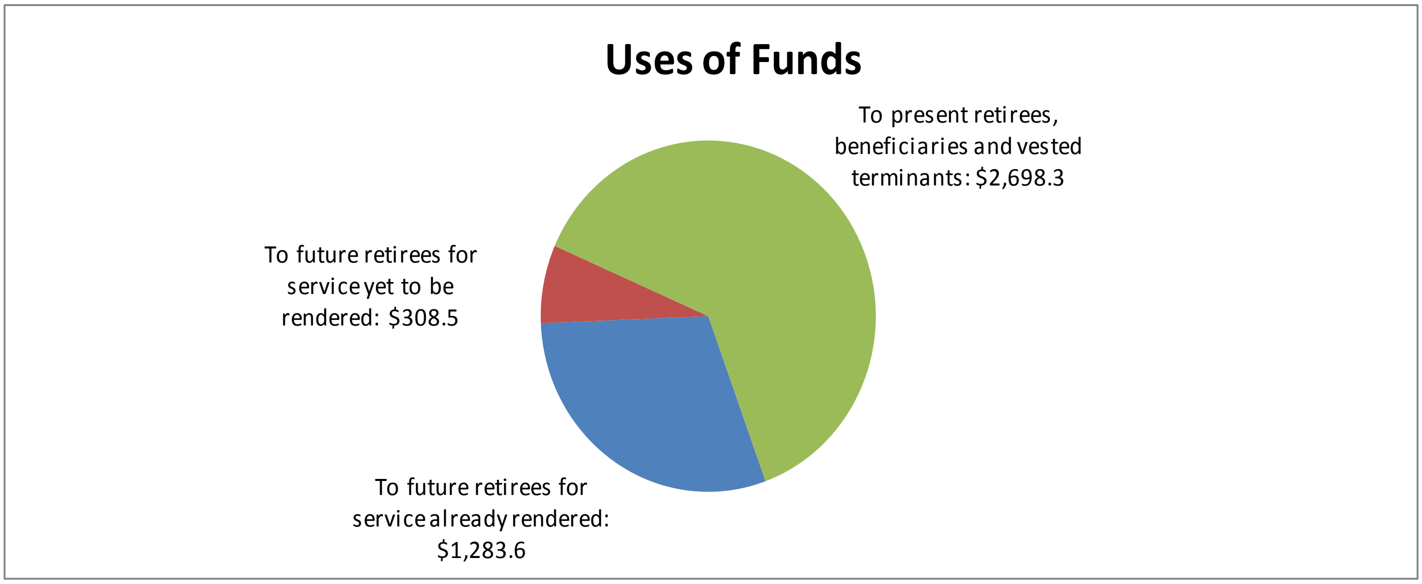
Development of Liabilities
as of June 30, 2018

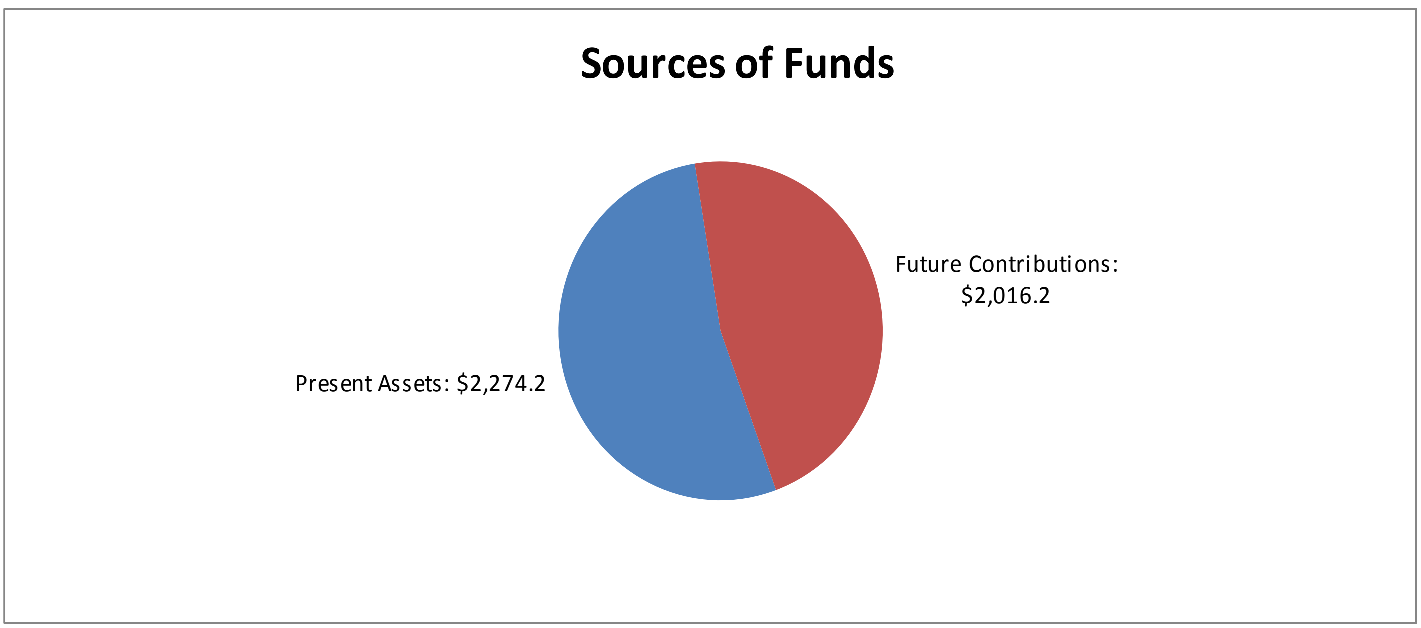
	Non-Uniformed Employees	Uniformed Patrol	Total
Present Value of Future Benefits - Inactives			
Retirees and Survivors	$1,910,688,192	$ 665,898,981	$2,576,587,173
Disability Pensioners	19,172,467	2,666,232	21,838,699
Vested Terminated Employees	84,740,756	15,148,434	99,889,190
Subtotal PVFB - Inactives	2,014,601,415	683,713,647	2,698,315,062
Present Value of Future Benefits - Actives			
Age & Service benefits	937,202,471	551,653,226	1,488,855,697
Normal and Work Related Disability benefits	25,652,238	3,473,955	29,126,193
Survivor benefits	11,001,624	4,924,515	15,926,139
Separation benefits	53,006,680	5,156,992	58,163,672
Subtotal PVFB - Actives	1,026,863,013	565,208,688	1,592,071,701
Total Present Value of Future Benefits	3,041,464,428	1,248,922,335	4,290,386,763
Less Present Value of Future Entry Age Normal Costs	183,941,376	124,606,446	308,547,822
Equals Actuarial Accrued Liability	2,857,523,052	1,124,315,889	3,981,838,941
Less Actuarial Value of Assets	1,610,494,399	663,753,723	2,274,248,122
Equals Unfunded Actuarial Accrued Liability	1,247,028,653	460,562,166	1,707,590,819
Plus Contribution Stabilization Reserve Fund	124,035,739	33,520,635	157,556,374
Equals Total Amount Financed	1,371,064,392	494,082,801	1,865,147,193
Amortization Payment on UAAL*	$ 134,869,462	$ 35,536,599	$ 170,406,061
as a % of Projected Payroll	47.52%	39.89%	45.66%

* *Amortized as a level-percentage of payroll over a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities from July 1, 2019 and then increased to achieve a 58% total employer contribution rate.*

System Resources and Obligations
Sources and Uses of $4,290.4 Million
as of June 30, 2018

($ Millions)





Financing Unfunded Actuarial Accrued Liabilities (UAAL) Which Were Calculated Using a Wage Inflation Assumption of 3.00%* and an Investment Return Assumption of 7.00% Compounded Annually 6/21 Year Amortization*

Fiscal Year Ending June 30	Active Employee Payroll	Unfunded Actuarial Accrued Liability at End of Year	Annual UAAL Contributions During Fiscal Year		UAAL at Year End as % of Payroll
			Dollars	% of Payroll	
2018	$ 351,496,555	$ 1,707,590,819			
2019	362,041,452	1,656,093,503	$ 165,308,127	45.66%	457.4%
2020	372,902,696	1,595,860,514	170,267,371	45.66%	428.0%
2021	384,089,777	1,526,126,430	175,375,392	45.66%	397.3%
2022	395,612,470	1,446,067,631	180,636,654	45.66%	365.5%
2023	407,480,844	1,354,798,087	186,055,753	45.66%	332.5%
2024	419,705,269	1,251,364,846	191,637,426	45.66%	298.2%
2025	432,296,427	1,134,743,205	197,386,549	45.66%	262.5%
2026	445,265,320	1,086,660,627	123,249,509	27.68%	244.0%
2027	458,623,280	1,031,386,830	126,946,995	27.68%	224.9%
2028	472,381,978	968,303,666	130,755,405	27.68%	205.0%
2029	486,553,437	896,746,273	134,678,067	27.68%	184.3%
2030	501,150,040	815,999,703	138,718,409	27.68%	162.8%
2031	516,184,541	725,295,309	142,879,961	27.68%	140.5%
2032	531,670,077	623,806,878	147,166,359	27.68%	117.3%
2033	547,620,179	510,646,483	151,581,350	27.68%	93.2%
2034	564,048,784	384,860,054	156,128,791	27.68%	68.2%
2035	580,970,248	245,422,625	160,812,654	27.68%	42.2%
2036	598,399,355	91,233,246	165,637,034	27.68%	15.2%
2037	616,351,336	-78,890,458	170,606,145	27.68%	-12.8%
2038	634,841,876	-250,000,023	160,048,691	25.21%	-39.4%
2039	653,887,132	-250,000,025	-16,914,662	-2.59%	-38.2%
2040	673,503,746	-250,000,027	-16,914,662	-2.51%	-37.1%

* *Amortized as a level-percentage of payroll over a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities from July 1, 2019 and then increased to achieve a 58% total employer contribution rate. Growth of the stabilization fund was capped at $250 million. Payroll was assumed to increase 3.00%.*

Historical Funding Progress
June 30, 2018

Year Ending June 30	Actuarial Asset Value	Entry Age Accrued Liability	Unfunded Accrued Liability (UAAL)	Funded Ratio	Estimated Covered Payroll**	UAAL as a Percentage of Covered Payroll
2009	$ 1,471,496,660	$ 3,113,393,645	$ 1,641,896,985	47.26%	$ 379,590,273	432.54%
2010#	1,375,844,573	3,258,866,925	1,883,022,352	42.22%	378,063,006	498.07%
2011	1,427,290,718	3,297,589,869	1,870,299,151	43.28%	362,654,376	515.72%
2012#	1,531,033,613	3,306,278,671	1,775,245,058	46.31%	341,637,559	519.63%
2013#	1,657,402,393	3,583,975,559	1,926,573,166	46.24%	329,481,506	584.73%
2014	1,795,264,291	3,650,241,741	1,854,977,450	49.18%	336,590,797	551.11%
2015	1,967,001,509	3,715,845,651	1,748,844,142	52.94%	342,264,593	510.96%
2016	2,086,654,348	3,761,733,004	1,675,078,656	55.47%	344,275,147	486.55%
2017	2,172,787,144	3,802,443,730	1,629,656,586	57.14%	356,142,973	457.58%
2018	**2,274,248,122**	**3,839,282,832**	**1,565,034,710**	**59.24%**	**353,371,000**	**442.89%**
2018#	**2,274,248,122**	**3,981,838,941**	**1,707,590,819**	**57.12%**	**353,371,000**	**483.23%**

** *Values are estimated from contribution rate and amount.*

New assumptions and/or methods adopted.

Historical Employer Contributions
Non-Uniformed Group
June 30, 2018

Valuation Date	Fiscal Year Ending June 30,	Estimated Covered Payroll**	Actual Employer Contributions	Actual Employer Contribution %	Annually Determined Employer Contribution (ADEC) %	Annually Determined Employer Contribution (ADEC) $	Percentage of ADEC Contributed
June 30, 2007	2009	$ 311,718,239	$ 95,759,843	30.72%	30.72%	$ 95,759,843	100.00%
June 30, 2008	2010#	310,637,016	97,540,023	31.40%	31.40%	97,540,023	100.00%
June 30, 2009	2011	294,637,164	116,263,825	39.46%	39.46%	116,263,825	100.00%
June 30, 2010	2012#	268,722,565	122,134,406	45.45%	45.45%	122,134,406	100.00%
June 30, 2011	2013	254,928,368	129,809,525	50.92%	50.92%	129,809,525	100.00%
June 30, 2012	2014#	259,720,022	140,898,112	54.25%	54.25%	140,898,112	100.00%
June 30, 2013	2015	258,737,537	152,034,177	58.76%	58.76%	152,034,177	100.00%
June 30, 2014	2016	260,714,141	151,344,559	58.05%	58.05%	151,344,559	100.00%
June 30, 2015	2017	269,522,202	156,322,877	58.00%	58.00%	156,322,877	100.00%
June 30, 2016	**2018#**	**269,229,112**	**156,152,885**	**58.00%**	**58.00%**	**156,152,885**	**100.00%**

** *Values are estimated from contribution rate and amount.*

New assumptions and/or methods adopted.

Includes non-uniformed employees of MoDOT, Patrol, and MPERS.

This information is presented in draft form for review by the System's auditor. Please let us know if there are any items that the auditor changes so that we may maintain consistency with the System's financial statements.

Historical Employer Contributions
Uniformed Patrol Group
June 30, 2018

Valuation Date	Fiscal Year Ending June 30,	Estimated Covered Payroll**	Actual Employer Contributions	Actual Employer Contribution %	Annually Determined Employer Contribution (ADEC) %	Annually Determined Employer Contribution (ADEC) $	Percentage of ADEC Contributed
June 30, 2007	2009	$ 67,872,034	$ 27,298,132	40.22%	40.22%	$ 27,298,132	100.00%
June 30, 2008	2010#	67,425,990	26,936,683	39.95%	39.95%	26,936,683	100.00%
June 30, 2009	2011	68,017,212	33,688,925	49.53%	49.53%	33,688,925	100.00%
June 30, 2010	2012#	72,914,994	42,750,061	58.63%	58.63%	42,750,061	100.00%
June 30, 2011	2013	74,553,138	41,026,592	55.03%	55.03%	41,026,592	100.00%
June 30, 2012	2014#	76,870,775	42,455,729	55.23%	55.23%	42,455,729	100.00%
June 30, 2013	2015	83,527,056	48,604,394	58.19%	58.19%	48,604,394	100.00%
June 30, 2014	2016	83,561,006	48,264,837	57.76%	57.76%	48,264,837	100.00%
June 30, 2015	2017	86,620,771	50,240,047	58.00%	58.00%	50,240,047	100.00%
June 30, 2016	**2018#**	**84,141,888**	**48,802,295**	**58.00%**	**58.00%**	**48,802,295**	**100.00%**

** *Values are estimated from contribution rate and amount.*

\# *New assumptions and/or methods adopted.*

This information is presented in draft form for review by the System's auditor. Please let us know if there are any items that the auditor changes so that we may maintain consistency with the System's financial statements.

Development of Gain/(Loss)
July 1, 2017 to June 30, 2018

	UAAL =	AAL -	Assets
Beginning of Year Values (at July 1)	$ 1,629,656,586	$ 3,802,443,730	$ 2,172,787,144
Normal Cost	50,991,818	50,991,818	0
Contributions	(211,824,044)	0	211,824,044
Disbursements	0	(263,752,355)	(263,752,355)
Interest	120,066,137	286,444,918	166,378,781
Expected Value Before Any Changes	1,588,890,497	3,876,128,111	2,287,237,614
Effect of Benefit Changes	0	0	0
Effect of Changes in Assumptions & Methods	142,556,109	142,556,109	0
Effect of Adjustment	0	0	0
Expected Value After Changes	1,731,446,606	4,018,684,220	2,287,237,614
End of Year Values (at June 30)	1,707,590,819	3,981,838,941	2,274,248,122
Gain/(Loss) for Year	$ 23,855,787	$ 36,845,279	$ (12,989,492)

Development of Gain/(Loss)
July 1, 2017 to June 30, 2018

	Total	Non-Uniformed	Uniformed
Beginning of Year UAAL (at July 1)	$ 1,629,656,586	$ 1,206,542,635	$ 423,113,951
Normal Cost	50,991,818	34,678,786	16,313,032
Contributions	(211,824,044)	(161,331,168)	(50,492,876)
Interest	120,066,137	88,599,275	31,466,862
Net Change in LTD Assets	0	0	0
Expected Value Before Any Changes	1,588,890,497	1,168,489,528	420,400,969
Effect of Benefit Changes	0	0	0
Effect of Changes in Assumptions & Methods	142,556,109	91,749,895	50,806,214
Effect of Adjustment	0	0	0
Expected Value After Changes	1,731,446,606	1,260,239,423	471,207,183
End of Year UAAL (at June 30)	1,707,590,819	1,247,028,653	460,562,166

Aggregate Gain/(Loss) for Year	$ 23,855,787	$ 13,210,770	$ 10,645,017
Gain/(Loss) as a % of Beginning of Year Liabilities	0.63%	0.48%	1.01%

Asset Gain/(Loss) for Year	$ (12,989,492)	$ (9,451,922)	$ (3,537,570)
Liability Gain/(Loss) for Year	36,845,279	22,662,692	14,182,587
Aggregate Gain/(Loss) for Year	$ 23,855,787	$ 13,210,770	$ 10,645,017

Risk Measures

($ Thousands)

Valuation Date June 30	(1) Accrued Liabilities (AAL)	(2) Market Value of Assets	(3) Unfunded AAL (1)-(2)	(4) Valuation Payroll	(5) Funded Ratio (2)/(1)	(6) Liability/ Payroll (1)/(4)	(7) Assets/ Payroll (2)/(4)	(8) Unfunded/ Payroll (3)/(4)	(9) Portfolio Rate of Return	(10) 10-Year Trailing Average	(11) Non-Investment Net Cash Flow	(12) Non-Investment Net Cash Flow Percent of Beginning of Year Assets (11)/(12[Prior Year])
2016	$3,761,733	$1,992,074	$ 1,769,659	$ 339,799	53.0%	1,107.0%	586.2%	520.8%	1.1%	N/A	$ (38,725)	(1.9)%
2017	3,802,444	2,169,775	1,632,669	348,979	57.1%	1,089.6%	621.8%	467.8%	11.2%	N/A	(42,601)	(2.1)%
2018	3,981,839	2,314,530	1,667,309	351,497	58.1%	1,132.8%	658.5%	474.3%	9.2%	N/A	(51,928)	(2.4)%

(5) The funded ratio is the most widely known measure of a plan's financial strength, but the trend in the funded ratio is much more important than the absolute ratio. The funded ratio should trend to 100%. As it approaches 100%, it is important to re-evaluate the level of investment risk in the portfolio and potentially to re-evaluate the assumed rate of return.

(6) and (7) the ratio of liabilities and assets to payroll gives an indication of both maturity and volatility. Many systems have values between 500% and 700%. Values significantly above that range may indicate difficulty in supporting the benefit level as a level % of payroll.

(8) The ratio of unfunded liability to payroll gives an indication of the plan’s sensitivity to differences between assumed and actual experience related to the employer contributions. A value above approximately 300% or 400% may indicate high volatility relative to small gains and losses.

(9) and (10) Investment return is probably the largest single risk that most systems face. The year-by-year return and the 10-year geometric average give an indicator of the realism of the System’s assumed return.

(11 and 12) Non-Divestment Net Cash Flow is a measure of both risk and maturity. For a mature plan the absolute value of (12) should be in the order of the assumed real rate of return over wage inflation (currently assumed to be 4.00%). A more negative number indicates a plan that is more at risk of fund depletion and more sensitive to annual gains and losses.

SECTION B

SUMMARY OF BENEFITS

Missouri Department of Transportation and Highway Patrol Employees' Retirement System Summary of Benefit Provisions Evaluated as of June 30, 2018

Closed Plan

Participation

Participants include:

All MPERS active members, vested terminated members, disability recipients, retirees and survivors who first became members prior to July 1, 2000 and who do not elect to transfer to the Year 2000 Plan at retirement.

Year 2000 Plan

Participation

Participants include:

1. All active employees who first became members on or after July 1, 2000 but prior to January 1, 2011.
2. Closed Plan active members and vested former members who elect to transfer to the Year 2000 Plan at retirement.
3. Closed Plan retirees who elected to transfer to the Year 2000 Plan during the election window from July 1, 2000 through July 1, 2001, and their survivors.
4. Closed Plan members who left state employment prior to becoming vested (not eligible for a future retirement benefit) and return to work in a benefit eligible position on or after July 1, 2000.

2011 Tier

Participation

Participants include:

1. All employees who first become members on or after January 1, 2011.

Closed Plan	Year 2000 Plan	2011 Tier
Normal Retirement Eligibility (unreduced benefit)	**Normal Retirement Eligibility (unreduced benefit)**	**Normal Retirement Eligibility (unreduced benefit)**
Non-Uniformed Employees: The earlier of attaining: 1. Age 65 with at least 4 years of creditable service. 2. Age 60 with at least 15 years of creditable service. 3. Age 48 with age plus creditable service equal to 80 or more. 4. Age 65 with at least 5 years of service (deferred).*	***Non-Uniformed Employees:*** The earlier of attaining: 1. Age 62 with at least 5 years of creditable service. 2. Age 48 with age plus creditable service equal to 80 or more.	***Non-Uniformed Employees:*** The earlier of attaining: 1. Age 67 with at least 5 years of creditable service. 2. Age 55 with age plus creditable service equal to 90 or more.
Uniformed Patrol Employees Only: The earlier of attaining: 1. Age 55 with at least 4 years of creditable service. 2. Mandatory retirement at age 60. 3. Age 48 with age plus creditable service equal to 80 or more.	***Uniformed Patrol Employees Only:*** The earlier of attaining: 1. Mandatory retirement at age 60. 2. Age 48 with age plus creditable service equal to 80 or more.	***Uniformed Patrol Employees Only:*** The earlier of attaining: 1. Age 55 with at least 5 years of creditable service. 2. Mandatory retirement at age 60.
Final Average Pay Used for Benefit Determination	**Final Average Pay Used for Benefit Determination**	**Final Average Pay Used for Benefit Determination**
Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). Employees terminating after reaching retirement eligibility will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility).	Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). All vested members will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility).	Final Average Pay is the average annual pay of a member for the three consecutive years of service during which pay was highest (overtime pay is included for purposes of determining average pay). Employees terminating after reaching retirement eligibility will receive 1/12 of a year of creditable service for every 168 hours of unused sick leave (usable only for benefit computation, not eligibility).

**See Chapter 104.010.1(32) RSMo*

Closed Plan	Year 2000 Plan	2011 Tier
Normal Retirement Benefit Amount	**Normal Retirement Benefit Amount**	**Normal Retirement Benefit Amount**
Non-Uniformed Employees: Life Benefit: 1.6% of final average pay times years of creditable service. ***Uniformed Patrol Employees:*** Life Benefit: 2.1333% of final average pay times years of creditable service. Special Benefit: $90 per month payable until age 65. Offset by any amount earned from gainful employment. This benefit does not apply to uniformed members hired on or after January 1, 1995.	***All Employees:*** Life Benefit: 1.7% of final average pay times years of creditable service. Temporary Benefit: If member retires between ages 48 and 62 with age plus creditable service equal to 80 or more, a temporary benefit is payable in the amount of 0.8% of final average pay times years of creditable service until attainment of age 62 or death, whichever occurs first. All Uniformed Patrol members are eligible for the temporary benefit until age 62.	***All Employees:*** Life Benefit: 1.7% of final average pay times years of creditable service. Temporary Benefit: If member retires between ages 55 and 62 with age plus creditable service equal to 90 or more, a temporary benefit is payable in the amount of 0.8% of final average pay times years of creditable service until attainment of age 62 or death, whichever occurs first. All Uniformed Patrol members are eligible for the temporary benefit until age 62.
Early Retirement (reduced benefit)	**Early Retirement (reduced benefit)**	**Early Retirement (reduced benefit)**
Eligibility: Non-Uniformed Employees Age 55 with at least 10 years of creditable service. ***Amount:*** Normal retirement amount reduced by 0.6% for each month that retirement precedes eligibility for normal retirement. ***Uniformed Patrol*** members are not eligible for early retirement.	***Eligibility: All Employees*** Age 57 with at least 5 years of creditable service. ***Amount:*** Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement.	***Eligibility: All Active Non-Uniformed Employees*** Age 62 with at least 5 years of creditable service. ***Amount:*** Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement. ***Uniformed Patrol*** members are not eligible for early retirement.

Closed Plan	Year 2000 Plan	2011 Tier
Vested Deferred Benefits	**Vested Deferred Benefits**	**Vested Deferred Benefits**
Eligibility: All Employees Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for early or normal retirement, considering years of creditable service.	***Eligibility: All Employees*** Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for early or normal retirement considering years of creditable service. Normal retirement eligibility begins at age 62.	***Eligibility: All Employees*** Fully vested in accrued pension with 5 years of creditable service. The benefit will commence at the age the individual is eligible for normal retirement considering years of creditable service. Normal retirement eligibility begins at age 67.
Minimum Base Benefit	**Minimum Base Benefit**	**Minimum Base Benefit**
Receive a monthly base benefit of no less than $15 for each full year of creditable service. Must be eligible to receive a normal or early retirement benefit the first of the month immediately following the date you leave state employment. Not required to immediately start drawing a benefit.	Same.	Same.
Death Prior to Retirement	**Death Prior to Retirement**	**Death Prior to Retirement**
The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity. If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21. If the member has 3 or more, but less than 5 years of creditable service, the surviving spouse may elect to receive an annuity equal to 25% of the accrued benefit. If the death is duty-related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children.	The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity. If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21. If the death is duty related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children.	**Actives:** The spouse of the member who dies after accruing 5 years of creditable service may elect to receive an annuity as if the employee had retired on the date of death and elected a joint and 100% survivor annuity. **Deferred:** The spouse of a vested former member who dies after accruing 5 years of creditable service may elect to receive an annuity on the date the member would have attained normal retirement eligibility based on a joint and 100% survivor annuity election. If no eligible spouse survives or upon the death of the spouse, 80% of the member's accrued annuity will be paid to eligible children until age 21. If the death is duty related, there is no service requirement and the minimum annuity is 50% of the final average pay (FAP) to the surviving spouse or eligible children.

Closed Plan	Year 2000 Plan	2011 Tier
Death After Retirement	**Death After Retirement**	**Death After Retirement**
The benefit payable is 50% of the benefit the retired member was receiving on the date of death (the normal form of payment), or the benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement. A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage. For period certain annuities, beneficiaries may be changed at any time.	The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement. A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage. For period certain annuities, beneficiaries may be changed at any time.	The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional form of payment at time of retirement. A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse the member was married to at the date of retirement. The election must be completed within one year of the date of marriage. For period certain annuities, beneficiaries may be changed at any time.
Pop-Up Provision	**Pop-Up Provision**	**Pop-Up Provision**
Benefits to members who choose a reduced survivor form of payment and whose spouse precedes the member in death, will “pop-up” or revert to the amount the member would have received had he/she not elected a reduced survivor option.	Same.	Same.

Closed Plan	Year 2000 Plan	2011 Tier
$5,000 Death Benefit	**$5,000 Death Benefit**	**$5,000 Death Benefit**
MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for normal or work-related disability benefits after September 28, 1985. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire on or after September 28, 1985 are eligible to receive this benefit.	MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for work-related disability benefits. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire are eligible to receive this benefit.	MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or were approved for work-related disability benefits. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit. Long-term disability recipients who retire are eligible to receive this benefit.
Purchase of Service	**Purchase of Service**	**Purchase of Service**
Military: Prior to retirement, qualifying members may purchase up to a maximum of 4 years military service that includes active service, and/or active and inactive duty training from which they were honorably discharged. All months the member is eligible for must be purchased. This service credit ***can*** be used to satisfy the vesting requirement. Periods of military service cannot coincide with employment in a state agency.	**Military:** Prior to retirement, qualifying members may purchase up to a maximum of 4 years military service that includes active service from which they were honorably discharged. All months the member is eligible for must be purchased. This service credit ***cannot*** be used to satisfy the vesting requirement. Periods of military service cannot coincide with employment in a state agency.	**Military:** Not available.
Police Service: Prior to retirement, uniformed patrol members only, may purchase up to a maximum of 4 years police service. Members must purchase all months of service they are eligible for.	**Police Service:** Not available.	**Police Service:** Not available.

Closed Plan	Year 2000 Plan	2011 Tier
Portability: Section 105.691 allows vested members to acquire (purchase/transfer) service credit for any non-federal, full-time public sector employment within Missouri. Service may be purchased/transferred by using the member's own money and/or using the value of the retirement benefit in the prior retirement plan if that plan has an agreement with MPERS. Any non-federal public employment **not covered** by a retirement plan must be purchased.	**Portability:** Same as Closed Plan Section 105.691.	**Portability:** Same as Closed Plan Section 105.691.
Public Employment Prior Service (Subsidized Purchase)	**Public Employment Prior Service (Subsidized Purchase)**	**Public Employment Prior Service (Subsidized Purchase)**
Section 104.040.6 allows, prior to retirement, members may purchase up to a maximum of 4 years full-time "public employment." Public employment refers to employment with a city, county, municipality, public school, or other political subdivision. Federal and out-of-state employment is not eligible. Members must purchase all months of service they are eligible for up to 4 years.	Not available.	Not available.
Disability	**Disability**	**Disability**
Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation. Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability.	Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation. Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability increased by 80% of CPI to the retirement date.	Benefits that may be payable during the period of disability (whether Normal, Work-related, or LTD) are administered through a separate program and were not considered for purposes of the valuation. Normal retirement benefits become payable at the time a disabled member becomes eligible for normal retirement, and are computed based on: i) the service that would have accrued to the member if active employment had continued; and ii) the member's rate of pay at the time of disability increased by 80% of CPI to the retirement date.

Closed Plan	Year 2000 Plan	2011 Tier

Closed Plan

Post-Retirement Benefit Adjustments

For active and inactive employees hired prior to August 28, 1997 and current retirees, the benefits of pensioners and their beneficiaries are increased annually by 80% of the increase in the Consumer Price Index (subject to a maximum increase of 5% and a minimum of 4%). These increases are made until the total of the increases reaches 65% of initial benefit at which time the increases will have the minimum removed.

For employees hired on or after August 28, 1997 the annual percentage increase is equal to the lesser of:

i) 80% of the CPI-U increase, or
ii) 5%.

Member Contributions

None.

Year 2000 Plan

Post-Retirement Benefit Adjustments

Benefits are increased to retired members (including survivors) annually in accordance with the following:

Annual benefit percentage increase equal to the lesser of:

i) 80% of the CPI-U increase, or
ii) 5%.

Member Contributions

None.

2011 Tier

Post-Retirement Benefit Adjustments

Benefits are increased to retired members (including survivors) annually* in accordance with the following:

Annual benefit percentage increase equal to the lesser of:

i) 80% of the CPI-U increase, or
ii) 5%.

** Vested former members and their survivor benefits are increased beginning on the second anniversary of retirement.*

Member Contributions

4% contributions with interest credited annually at a rate equal to the investment rate published by the US Department of Treasury for 52-week treasury bill, nearest the preceding July 1st. The state of Missouri employer shall pick up and pay the contributions. A deduction shall be made from each member's compensation equal to the amount of the member's contributions picked up by the employer.

The Closed Plan and Year 2000 Plan
BackDROP Option

Legislation effective January 1, 2002 provides a Deferred Retirement Option Provision (BackDROP) to members of MPERS. It is available in both the Closed Plan and the Year 2000 Plan.

To be eligible to participate in the BackDROP, a member must have been eligible to retire under normal age and/or service conditions for at least two years. A retroactive starting date is established for BackDROP purposes which is the later of: 1) the member's normal retirement date; or 2) five years prior to the annuity starting date under the retirement plan selected by the member.

The BackDROP period for the accumulation of the BackDROP amount is from the retroactive starting date to the annuity starting date. This results in a BackDROP period of one to five years depending upon the individual situation.

A theoretical BackDROP account is accumulated that includes 90% of the value of the benefit payments that would have been paid during the BackDROP period had the member retired at the retroactive starting date. These payments include applicable post-retirement benefit increases. These payments do not include any reduction for spouse options during the BackDROP period. The member may choose the BackDROP period in twelve-month increments or their maximum period, not to exceed 60 months.

The member is paid the resulting lump sum value of the BackDROP account as of the annuity starting date or as three equal annual installments beginning at the annuity starting date.

The annuity benefit payable from the actual retirement date is computed with years of service and final average pay as of the retroactive starting date for the BackDROP. Post-retirement benefit increases that occurred during the BackDROP period are applied in the calculation of the monthly annuity.

Sample Benefit Computation for Closed Plan Members
Retiring July 1, 2018
Non-Uniformed Employee

	Data	Description
A.	$40,000	Final Average Pay
B.	20	Years of Creditable Service
C.	60	Age of Retiree
D.	50%	Automatic percentage to continue to spouse after retirant's death

Sample Computation Steps

E.	Retirement Benefit Formula:	0.016 x 20 x $40,000 = $12,800
	Benefit payable to:	
F.	Retiree while spouse is alive (E)	$ 12,800
G.	Spouse after retiree's death (D x E)	$ 6,400
H.	Retiree after spouse's death	$ 12,800

Year Ended June 30	Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8%
2018	$12,800
2019	13,030
2020	13,265
2021	13,504
2022	13,747
2023	13,994
2024	14,246
2025	14,503
2026	14,764
2027	15,029

Sample Benefit Computation for Closed Plan Members
Retiring July 1, 2018
Uniformed Patrol

	Data	Description
A.	$40,000	Final Average Pay
B.	20	Years of Creditable Service
C.	60	Age of Retiree
D.	50%	Automatic percentage to continue to spouse after retirant's death

Sample Computation Steps

E. Retirement Benefit Formula: 0.021333 x 20 x $40,000 = $17,066

Benefit payable to:

F.	Retiree while spouse is alive (E)	$ 17,066
G.	Spouse after retiree's death (D x E)	$ 8,533
H.	Retiree after spouse's death	$ 17,066

Amounts shown below do not include the $1,080 annual supplementary benefit payable to age 65.

Year Ended June 30	Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8%
2018	$17,066
2019	17,373
2020	17,686
2021	18,004
2022	18,328
2023	18,658
2024	18,994
2025	19,336
2026	19,684
2027	20,038

Sample Benefit Computation for Year 2000 Plan Members
Retiring July 1, 2018

	Data	Description
A.	$40,000	Final Average Pay
B.	20	Years of Creditable Service
C.	60 (67 for 2011 Tier)	Age of Retiree
D.	0%	Automatic percentage to continue to spouse after retirant's death

E1. Retirement Benefit Formula:	0.017 x 20 x $40,000 = $13,600
E2. Supplemental Benefit Formula:	.008 x 20 x $40,000 = $6,400

Benefit payable to:

F1. Retiree prior to age 62 (E1+E2)	$ 20,000
F2. Retiree after age 62 (E1)	$ 13,600
G. Spouse after retiree's death (D x E)	$ 0

Year Ended June 30	Annual Amount Payable if Price Inflation is 2.25% and Post-Retirement Increases are 1.8%
2018	$20,000
2019	20,360
2020	14,094
2021	14,348
2022	14,606
2023	14,869
2024	15,137
2025	15,409
2026	15,686
2027	15,969

SECTION C

FINANCIAL INFORMATION

Summary of Fund Operations

	2018	2017
Market Value of Fund Beginning of Fiscal Year	$2,169,775,040	$1,992,073,946
Post Valuation Audit Adjustment	(936,419)	0
Contributions		
Employer	204,955,180	206,562,924
Employee	3,721,984	3,238,502
Transfer from MOSERS	1,922,187	1,744,107
Service Purchase (Employee)	1,224,692	1,653,430
Total Contributions	$ 211,824,043	$ 213,198,963
Investment Return		
Interest	$ 25,440,798	$ 26,033,764
Dividends	8,046,447	6,297,805
Real Estate	37,238,083	30,697,647
Realized Capital Gains	320,023,862	316,321,752
Realized Capital Losses	(207,190,689)	(190,575,101)
Miscellaneous Income	11,007	20,295
Securities Lending Income	192,433	277,561
Other	1,424	30,080
Total Investment Return	$ 183,763,365	$ 189,103,803
Other Income (Rental Income and Misc)	472	614
Increase (Decrease) in Unrealized Appreciation	44,342,908	61,658,198
Benefit Payments		
Retirement Payments	$ 238,675,488	$ 228,814,921
Retirement Payments - BackDROP	14,546,108	16,887,349
Death Benefits	860,000	855,153
Long-Term Disability Payments	49,613	60,352
Insured Disability Program	1,601,605	1,620,418
Employee Contribution Refunds	503,007	321,328
Service Transfer Payments - Employer	2,823,042	2,724,631
Total Benefit Payments	$ 259,058,863	$ 251,284,152
Expenses		
Investment	$ 30,486,906	$ 30,460,874
Other	4,693,492	4,515,458
Total Expenses	$ 35,180,398	$ 34,976,332
Market Value of Fund End of Fiscal Year	$2,314,530,148	$2,169,775,040

Missouri MPERS
Development of Actuarial Value of Assets

Valuation Date of June 30	2014	2015	2016	2017	2018	2019	2020
A. Actuarial value at beginning of year	$1,657,402,393	$1,795,264,291	$1,967,001,509	$2,086,654,348	$2,172,787,144		
B. Market value at end of year	1,937,268,639	2,009,367,134	1,992,073,946	2,169,775,040	2,314,530,148		
C. Market value at beginning of year	1,681,869,871	1,937,268,639	2,009,367,134	1,992,073,946	2,169,775,040		
D. Cash flow							
D1. Contributions	187,398,786	205,047,170	205,821,588	213,198,963	211,824,043		
D2. Benefit Payments	(231,384,708)	(241,714,875)	(240,176,011)	(251,284,152)	(259,058,863)		
D3. Administrative Expenses	(3,753,702)	(4,066,944)	(4,370,860)	(4,515,458)	(4,693,492)		
D4. Non-Investment Net Cash Flow	(47,739,624)	(40,734,649)	(38,725,283)	(42,600,647)	(51,928,312)		
E. Investment income							
E1. Market Total (B - C - D4)	303,138,392	112,833,144	21,432,095	220,301,741	196,683,420		
E2. Assumed Rate of Return	7.75%	7.75%	7.75%	7.75%	7.75%	7.00%	
E3. Amount for Immediate Recognition (A+.5xD4)xE2	126,598,775	137,554,515	150,942,012	160,064,937	166,378,782		
E4. Amount for Phased-In Recognition	176,539,617	(24,721,371)	(129,509,917)	60,236,804	30,304,638		
F. Phased-in recognition of investment income							
F1. Current Year (33 1/3% of E4)	58,846,539	(8,240,457)	(43,169,972)	20,078,935	10,101,546		
F2. First Prior Year	24,311,269	58,846,539	(8,240,457)	(43,169,972)	20,078,935	$10,101,546	
F3. Second Prior Year	(24,155,061)	24,311,270	58,846,539	(8,240,457)	(43,169,973)	20,078,934	$10,101,546
F4. Total Recognized Investment Gain (F1 + F2 + F3)	59,002,747	74,917,352	7,436,110	(31,331,494)	(12,989,492)	30,180,480	10,101,546
G. Actuarial value at end of year (A + D4 + E3 + F4)	1,795,264,291	1,967,001,509	2,086,654,348	2,172,787,144	2,274,248,122		
Less LTD Assets	0	0	0	0	0		
H. Preliminary Plan AVA	1,795,264,291	1,967,001,509	2,086,654,348	2,172,787,144	2,274,248,122		
I. Corridor (Maximum of 120% of Market Value)	2,324,722,367	2,411,240,561	2,390,488,735	2,603,730,048	2,777,436,178		
J. Corridor (Minimum of 80% of Market Value)	1,549,814,911	1,607,493,707	1,593,659,157	1,735,820,032	1,851,624,118		
K. Additional Investment Gain/(Loss) recognized due to corridor	0	0	0	0	0		
L. Final Plan AVA after corridor adjustment, if any	1,795,264,291	1,967,001,509	2,086,654,348	2,172,787,144	2,274,248,122		
difference between market and actuarial values	142,004,348	42,365,625	(94,580,402)	(3,012,104)	40,282,026		
Market Rate of Return	18.28%	5.89%	1.08%	11.18%	9.17%		
Ratio of Funding Value to Market Value	92.67%	97.89%	104.75%	100.14%	98.26%		
Funding Value Rate of Return	11.36%	11.97%	8.13%	6.23%	7.14%		

Allocation of Assets Between Groups

The division between the Uniformed Patrol and Non-Uniformed Employee groups is in proportion to their market value of assets, as shown below:

Allocation of Funding Value of Assets	June 30 2018	June 30 2017
1. Funding Value of Assets	$2,274,248,122	$2,172,787,144
2. Reported Market Value of Assets		
a) Uniformed Patrol	675,510,288	625,518,429
b) Non-Uniformed Employees	1,639,019,860	1,544,256,611
c) Total	2,314,530,148	2,169,775,040
3. Funding Value of Assets Split		
a) Uniformed Patrol		
(2a) / (2c) x (1)	663,753,723	626,386,780
b) Non-Uniformed Employees		
(2b) / (2c) x (1)	1,610,494,399	1,546,400,364
4. Total Assets Allocated	2,274,248,122	2,172,787,144

SECTION D

SUMMARY OF MEMBER DATA

Civilian Patrol Closed Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29									
30-34									
35-39			1	3	2			6	$ 236,724
40-44			1	14	17			32	1,571,474
45-49		2	1	10	31	11		55	2,721,382
50-54		1	2	10	38	27	13	91	4,561,381
55-59		3		8	21	17	20	69	3,321,879
60				3	4			7	251,452
61					3	1	2	6	256,936
62				1	1	1		3	139,792
63				1	1	1	1	4	238,095
64					3			3	163,300
65				1			2	3	122,471
66							1	1	91,621
67									
68									
69					1		1	2	64,512
70						1		1	35,329
Over 70					1			1	37,620
Totals		**6**	**5**	**51**	**123**	**59**	**40**	**284**	**$13,813,968**

Average Age: 52.1 years
Average Service: 24.0 years
Average Pay: $48,641

Civilian Patrol Year 2000 Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29	1	4						5	$ 187,798
30-34	2	34	16	1				53	2,390,971
35-39	2	17	50	19				88	4,676,793
40-44	4	8	34	19				65	3,143,001
45-49	1	13	22	17	1			54	2,356,077
50-54	3	9	28	18				58	2,526,415
55-59	2	17	14	20	3			56	2,367,807
60			5	4				9	371,488
61			2	1				3	99,780
62		2	3	1				6	224,893
63		3	3	1				7	248,468
64				2				2	78,422
65	1	2	1	2				6	203,169
66		1		2				3	110,688
67		1		1				2	77,040
68				2				2	76,189
69									
70				1				1	60,029
Over 70		1	1	1				3	79,496
Totals	**16**	**112**	**179**	**112**	**4**			**423**	**$19,278,524**

Average Age: 45.9 years
Average Service: 12.2 years
Average Pay: $45,576

Civilian Patrol 2011 Tier Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24	38							38	$ 1,218,998
25-29	74	14						88	3,363,449
30-34	46	30						76	3,074,154
35-39	33	7						40	1,450,101
40-44	21	10						31	1,119,410
45-49	32	10						42	1,440,302
50-54	30	9						39	1,398,991
55-59	20	5						25	822,282
60	3	2						5	135,816
61	5	2						7	232,162
62	1	2						3	94,463
63	2	1						3	101,926
64	2	1						3	86,184
65	2	1						3	92,622
66	1							1	30,323
67	1	2						3	106,296
68									
69									
70									
Over 70									
Totals	**311**	**96**						**407**	**$14,767,479**

Average Age: 38.4 years
Average Service: 3.2 years
Average Pay: $36,284

MoDOT Closed Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29									
30-34									
35-39				26	2			28	$ 1,203,653
40-44				121	72	2		195	9,751,318
45-49		2	2	76	237	93	5	415	22,306,864
50-54		1	3	74	149	183	55	465	24,647,078
55-59		2	1	53	123	69	85	333	16,871,929
60				6	11	13	11	41	2,063,284
61				6	16	10	5	37	1,835,268
62				6	11	10	4	31	1,479,255
63				5	12	2	6	25	1,267,823
64				3	5	4	2	14	683,344
65				1	4	1		6	308,575
66				2	1	2	2	7	342,493
67				1	1		2	4	213,338
68				1				1	45,994
69									
70							2	2	235,453
Over 70							1	1	84,348
Totals		**5**	**6**	**381**	**644**	**389**	**180**	**1,605**	**$83,340,017**

Average Age: 51.4 years
Average Service: 24.0 years
Average Pay: $51,925

MoDOT Year 2000 Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29	1	9						10	$ 369,099
30-34	7	59	84	1				151	6,637,135
35-39	3	55	185	78				321	14,761,419
40-44	14	52	125	99	1			291	12,886,106
45-49	8	52	118	77	2			257	10,977,039
50-54	3	29	97	84	1			214	8,847,843
55-59	9	36	113	94		3		255	10,363,803
60	1	7	20	6				34	1,314,093
61		4	23	9	1			37	1,453,423
62	1	4	10	7				22	884,992
63		5	9	5				19	825,413
64	1	3	8	3				15	603,309
65		1	8	2			1	12	508,317
66		1	3	3				7	275,068
67	1							1	7,208
68									
69			1	1				2	94,248
70									
Over 70			1					1	35,593
Totals	**49**	**317**	**805**	**469**	**5**	**3**	**1**	**1,649**	**$70,844,108**

Average Age: 46.3 years
Average Service: 12.8 years
Average Pay: $42,962

MoDOT 2011 Tier Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20	5							5	$ 150,158
20-24	185							185	6,579,889
25-29	377	27						404	15,528,474
30-34	261	49						310	11,527,509
35-39	220	34						254	8,824,008
40-44	152	14						166	6,100,305
45-49	149	15						164	5,983,853
50-54	111	21						132	4,682,669
55-59	89	27						116	4,069,221
60	11	1						12	391,327
61	8	2						10	362,221
62	7	3						10	394,757
63	7	1						8	255,089
64	1	4						5	212,154
65									
66	1	1						2	66,227
67	2	1						3	138,142
68	1							1	29,765
69	1							1	31,777
70	1							1	31,586
Over 70	2	1						3	120,769
Totals	**1,591**	**201**						**1,792**	**$65,479,900**

Average Age: 36.9 years
Average Service: 2.7 years
Average Pay: $36,540

Uniformed Patrol Closed Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29									
30-34									
35-39		1		2				3	$ 209,147
40-44				27	45			72	5,773,527
45-49			1	17	170	23		211	17,231,903
50-54	1			5	74	85	17	182	15,092,677
55-59				1	14	21	29	65	5,546,480
60						1		1	77,256
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
Over 70									
Totals	**1**	**1**	**1**	**52**	**303**	**130**	**46**	**534**	**$43,930,990**

Average Age: 49.2 years
Average Service: 24.2 years
Average Pay: $82,268

Uniformed Patrol Year 2000 Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24									
25-29		3						3	$ 173,374
30-34		57	45					102	5,951,663
35-39		15	92	25				132	8,504,481
40-44		8	25	63				96	6,606,409
45-49		4	12	23				39	2,550,046
50-54			5	5				10	646,040
55-59						1		1	75,300
60									
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
Over 70									
Totals		**87**	**179**	**116**		**1**		**383**	**$24,507,313**

Average Age: 38.3 years
Average Service: 12.7 years
Average Pay: $63,988

Uniformed Patrol 2011 Tier Active Members
as of June 30, 2018
by Attained Age and Years of Service

Attained Age	Count by Complete Years of Service to Valuation Date							Totals	
	0-4	5-9	10-14	15-19	20-24	25-29	30+	No.	Valuation Payroll
Under 20									
20-24	37							37	$ 1,765,864
25-29	101	50						151	7,358,632
30-34	33	52						85	4,361,705
35-39	14	12						26	1,284,767
40-44	4	4						8	404,555
45-49	1	5						6	307,713
50-54		1						1	51,020
55-59									
60									
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
Over 70									
Totals	**190**	**124**						**314**	**$15,534,256**

Average Age: 29.5 years
Average Service: 4.1 years
Average Pay: $49,472

Growth of Active Member Payroll

Actuarial Valuation for June 30,	Number	Covered Payroll	Average Pay	% Change in Average Pay from Prior Year
1989	8,181	$194,452,400	$23,769	(0.5)%
1990	8,256	211,414,753	25,607	7.7 %
1991	8,308	220,856,988	26,584	3.8 %
1992	8,591	228,503,592	26,598	0.1 %
1993	8,658	236,236,082	27,285	2.6 %
1994	8,849	242,864,780	27,445	0.6 %
1995	8,904	250,529,253	28,137	2.5 %
1996	9,023	264,196,115	29,280	4.1 %
1997	8,997	280,209,116	31,145	6.4 %
1998	8,871	284,889,796	32,115	3.1 %
1999	9,140	298,673,247	32,678	1.8 %
2000	9,171	312,532,009	34,078	4.3 %
2001	9,087	327,049,257	35,991	5.6 %
2002	8,695	312,747,492	35,969	(0.1)%
2003	8,892	318,744,192	35,846	(0.3)%
2004	9,002	328,210,887	36,460	1.7 %
2005	9,193	345,695,867	37,604	3.1 %
2006	9,033	348,614,699	38,593	2.6 %
2007	8,640	360,842,421	41,764	8.2 %
2008	8,599	369,424,653	42,961	2.9 %
2009	8,784	377,652,245	42,993	0.1 %
2010	8,457	369,911,252	43,740	1.7 %
2011	8,231	361,639,001	43,936	0.4 %
2012	7,458	329,293,168	44,153	0.5 %
2013	7,319	323,205,767	44,160	0.0 %
2014	7,390	332,085,689	44,937	1.8 %
2015	7,358	334,400,980	45,447	1.1 %
2016	7,441	339,799,379	45,666	0.5 %
2017	7,456	348,979,212	46,805	2.5 %
2018	7,391	351,496,555	47,557	1.6 %
			Ten-Year Average:	1.0 %

Count and Total Monthly Benefits
Civilian Patrol Closed Retired (Non-Disabled)
Members and Survivors
as of June 30, 2018
by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20		
20-24		
25-29		
30-34		
35-39		
40-44		
45-49		
50-54	6	$ 11,944
55-59	34	59,957
60-64	54	83,595
65-69	82	133,049
70-74	73	101,693
75-79	69	136,957
80-84	81	147,757
85-89	67	113,990
90-94	16	25,781
95-99	5	5,127
100-104	1	1,289
105 & Over		
TOTAL	**488**	**$ 821,139**

Count and Total Monthly Benefits of Civilian Patrol Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20		
20-24		
25-29		
30-34		
35-39		
40-44		
45-49		
50-54	10	$ 27,666
55-59	72	158,101
60-64	138	240,635
65-69	162	228,106
70-74	129	177,369
75-79	49	74,955
80-84	4	1,891
85-89	1	2,227
90-94		
95-99	1	1,018
100-104		
105 & Over		
TOTAL	**566**	**$ 911,968**

Count and Total Monthly Benefits of Civilian Patrol 2011 Tier Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20		
20-24		
25-29		
30-34		
35-39		
40-44		
45-49		
50-54		
55-59		
60-64		
65-69	1	$ 282
70-74		
75-79		
80-84		
85-89		
90-94		
95-99		
100-104		
105 & Over		
TOTAL	**1**	**$ 282**

Count and Total Monthly Benefits of MoDOT Closed Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20	2	$ 612
20-24	2	3,191
25-29		
30-34		
35-39		
40-44	5	2,858
45-49	10	8,469
50-54	40	62,418
55-59	175	268,532
60-64	307	447,095
65-69	383	566,614
70-74	387	671,113
75-79	625	1,426,111
80-84	766	1,861,155
85-89	467	1,019,150
90-94	208	387,664
95-99	43	47,499
100-104	5	4,291
105 & Over	1	146
TOTAL	**3,426**	**$ 6,776,918**

Count and Total Monthly Benefits of MoDOT Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20	8	$ 1,673
20-24	2	1,100
25-29	1	230
30-34	1	754
35-39	1	119
40-44	4	3,862
45-49	7	4,723
50-54	122	368,668
55-59	558	1,539,002
60-64	816	1,517,040
65-69	827	1,270,446
70-74	678	1,189,377
75-79	257	460,202
80-84	26	33,929
85-89	14	19,114
90-94	16	28,851
95-99	4	3,157
100-104	1	2,390
105 & Over		
TOTAL	**3,343**	**$ 6,444,637**

Count and Total Monthly Benefits of Uniformed Patrol Closed Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20	3	$ 4,101
20-24		
25-29		
30-34		
35-39	2	3,130
40-44	5	13,164
45-49	6	14,796
50-54	19	79,897
55-59	125	542,303
60-64	153	777,067
65-69	163	800,311
70-74	164	781,848
75-79	135	666,249
80-84	89	441,289
85-89	47	190,618
90-94	26	94,052
95-99	5	18,747
100-104		
105 & Over		
TOTAL	**942**	**$ 4,427,572**

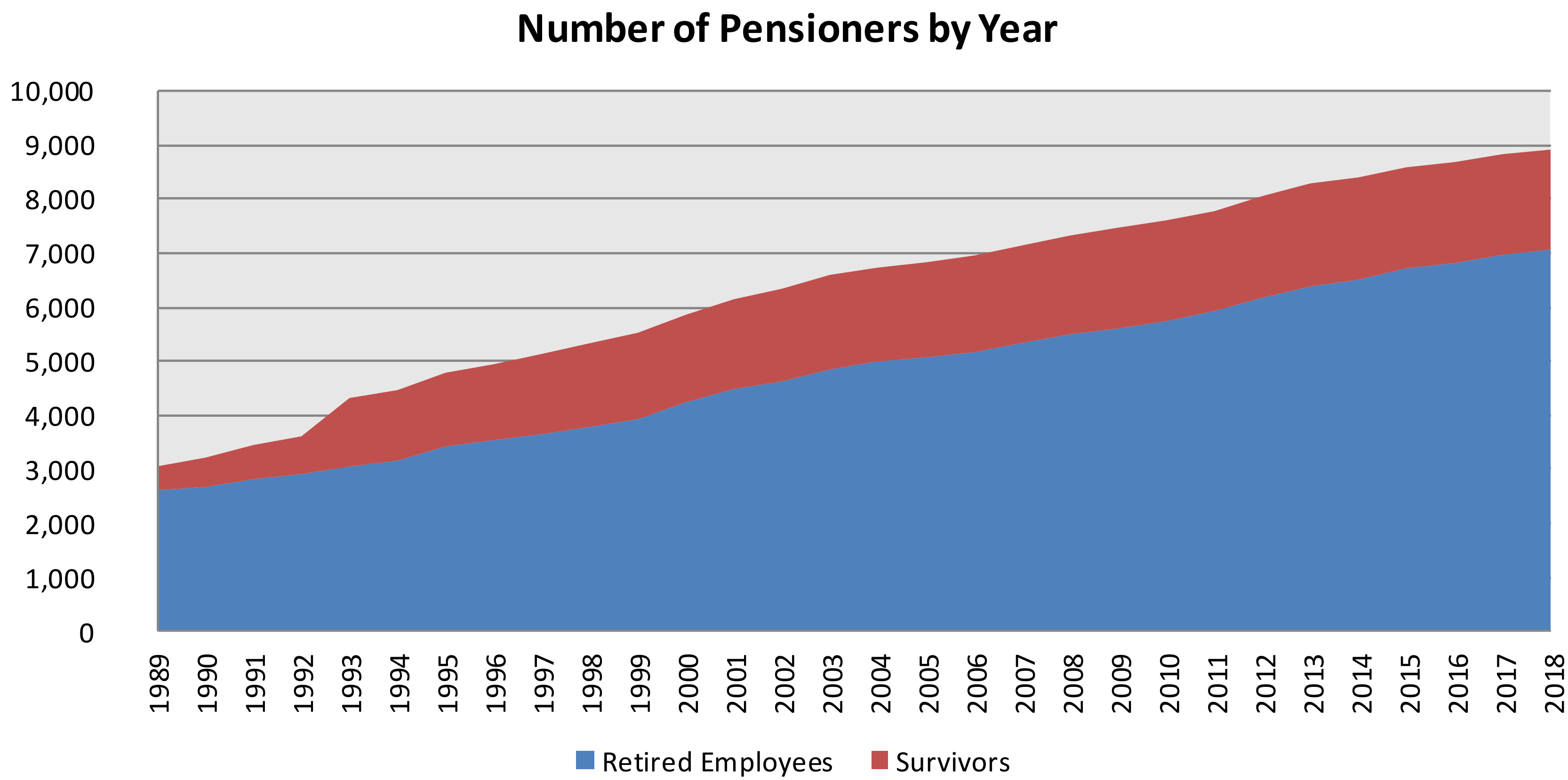
Count and Total Monthly Benefits of Uniformed Patrol Year 2000 Retired (Non-Disabled) Members and Survivors as of June 30, 2018 by Attained Age

Age	Number	Monthly Benefit Amount
Less than 20	2	$ 402
20-24		
25-29		
30-34		
35-39		
40-44	2	2,573
45-49		
50-54		
55-59	1	4,466
60-64	1	903
65-69		
70-74		
75-79		
80-84		
85-89		
90-94		
95-99		
100-104		
105 & Over		
TOTAL	**6**	**$ 8,344**

Growth of Pension Population by Year

Year	Retired Employees	Survivors	Total	% Increase	Annual Benefits	Active Payroll	Benefits as a % of Payroll
1989	2,610	441	3,051	8.2%			
1990	2,669	543	3,212	5.3%			
1991	2,814	632	3,446	7.3%			
1992	2,908	699	3,607	4.7%			
1993	3,047	1,269	4,316	19.7%			
1994	3,156	1,307	4,463	3.4%			
1995	3,419	1,365	4,784	7.2%			
1996	3,536	1,405	4,941	3.3%			
1997	3,646	1,486	5,132	3.9%			
1998	3,781	1,549	5,330	3.9%	$ 80,686,152	$284,889,796	28.3%
1999	3,924	1,600	5,524	3.6%	91,512,311	298,673,247	30.6%
2000	4,236	1,621	5,857	6.0%	100,794,676	312,532,009	32.3%
2001	4,482	1,663	6,145	4.9%	115,998,915	327,049,257	35.5%
2002	4,623	1,716	6,339	3.2%	125,623,460	312,747,492	40.2%
2003	4,845	1,751	6,596	4.1%	136,320,125	318,744,192	42.8%
2004	4,996	1,735	6,731	2.0%	142,359,307	328,210,887	43.4%
2005	5,068	1,761	6,829	1.5%	148,340,170	345,695,867	42.9%
2006	5,164	1,790	6,954	1.8%	155,230,301	348,614,699	44.5%
2007	5,336	1,805	7,141	2.7%	164,048,455	360,842,421	45.5%
2008	5,496	1,829	7,325	2.6%	172,112,941	369,424,653	46.6%
2009	5,604	1,866	7,470	2.0%	179,850,466	377,652,245	47.6%
2010	5,739	1,867	7,606	1.8%	187,267,535	369,911,252	50.6%
2011	5,926	1,849	7,775	2.2%	191,892,660	361,639,001	53.1%
2012	6,172	1,883	8,055	3.6%	201,906,768	329,293,168	61.3%
2013	6,382	1,908	8,290	2.9%	210,904,464	323,205,767	65.3%
2014	6,507	1,894	8,401	1.3%	217,149,528	332,085,689	65.4%
2015	6,720	1,868	8,588	2.2%	223,021,512	334,400,980	66.7%
2016	6,814	1,870	8,684	1.1%	227,218,908	339,799,379	66.9%
2017	6,969	1,862	8,831	1.7%	231,168,516	348,979,212	66.2%
2018	7,064	1,852	8,916	1.0%	235,395,456	351,496,555	67.0%

Growth of Pension Population by Year



Self-Insured Disabled Retired Members
as of June 30, 2018

Age	Number	Monthly Benefit Amount
Less than 20		
20-24		
25-29		
30-34		
35-39		
40-44	2	$ 4,772
45-49	2	2,639
50-54	5	5,731
55-59	12	16,751
60-64	8	14,785
65-69	8	9,807
70-74	7	10,241
75-79	4	5,879
80-84		
85-89	1	111
90-94		
95-99		
100-104		
105 & Over		
TOTAL	**49**	**$ 70,716**

These members became disabled prior to outsourcing disability claims. Liabilities for these members include benefits payable during and after the period of disability.

Fully Insured Disabled Retired Members
as of June 30, 2018

Age	Number	Monthly Benefit Amount
Less than 20		
20-24		
25-29		
30-34	3	$ 6,038
35-39		
40-44	12	26,761
45-49	12	29,629
50-54	27	45,530
55-59	30	35,972
60-64	11	10,782
65-69		
70-74		
75-79		
80-84		
85-89		
90-94		
95-99		
100-104		
105 & Over		
TOTAL	**95**	**$ 154,712**

These members became disabled after disability claims became outsourced. Liabilities for these members during the period of disability are an obligation of the insurance company and not included in this valuation. Liabilities for these members after the period of disability are included in the valuation.

Data Reconciliation
as of June 30, 2018

Non-Uniformed	Active Members	Vested Terminated Members	Retired *
Number at Start of Year	6,192	2,159	7,888
Increase (Decrease) From			
New Entrants/Rehires	602	(15)	
Service Retirement	(200)	(65)	265
Vested Terminations	(120)	129	(6)
Deaths/Removals	(2)	(386)	(200)
Disability Retirement	(13)		13
Non-Vested Terminations	(299)		
Number at End of Year	**6,160**	**1,822**	**7,960**

Uniformed	Active Members	Vested Terminated Members	Retired *
Number at Start of Year	1,264	165	943
Increase (Decrease) From			
New Entrants/Rehires	26		
Service Retirement	(28)	(6)	34
Vested Terminations	(15)	17	(2)
Deaths/Removals	0	(18)	(20)
Disability Retirement	(1)		1
Non-Vested Terminations	(15)		
Number at End of Year	**1,231**	**158**	**956**

* *Including disability participants.*

SECTION E

ASSUMPTIONS USED IN THE VALUATION AND GLOSSARY

Summary of Valuation Method and Assumptions
June 30, 2018

The actuarial assumptions used in the valuation are shown in this Section of the report unless stated otherwise. The assumptions were established for the June 30, 2018 actuarial valuation, following a five-year actuarial investigation covering the period July 1, 2012 through June 30, 2017. They were adopted by the Board.

An actuarial valuation is based upon an actuarial cost method, an asset valuation method, and actuarial assumptions. These methods and assumptions are chosen by the Board of Trustees after consultation with the Actuary and other advisors.

The actuarial cost method is called the Entry Age Actuarial Cost Method. This method is consistent with the Board's level percent-of-payroll funding objective. With this method, the level percent-of-payroll is determined that will fund a member's retirement benefit over the member's entire working lifetime, from date of hire (Entry Age) to date of exit from the active member population. Differences in the past between assumed and actual experience become part of unfunded actuarial accrued liabilities and are amortized with level percent-of-payroll contributions. This cost method was first used in the ***June 30, 1999*** valuation.

The asset valuation method is a three-year smoothed market value method in which assumed investment return is recognized immediately each year and differences between actual and assumed investment return are phased-in over a closed three-year period. This asset valuation method is intended to give recognition to the long term accuracy of market values while filtering out and dampening short term market swings. This method was first used in the ***June 30, 1999*** valuation.

Economic Assumptions

The investment return rate used in making the valuations was 7.00% per year, compounded annually (net after investment expenses). The ***wage inflation rate*** was assumed to be 3.00%. The real rate of return over wage growth is defined to be the portion of total investment return, which is more than the rate of wage inflation. The 7.00% investment return rate and 3.00% wage inflation rate translates to an assumed real rate of return over wage growth net of expenses of 4.00%. Based upon other assumptions, the net real rate of return over price inflation is 4.75%.

Pay increase assumptions for merit and seniority for individual active members are shown on page E-5. Part of the total assumed pay increase at each age is for merit and/or seniority, and the other 3.00% recognizes wage inflation. ***The active member payroll*** for all members is assumed to increase 3.00% annually for all years.

The price inflation rate is assumed to be 2.25% annually. This is the inflation rate upon which the post-retirement increases are based. The difference between wage and price inflation of 0.75% is attributable to overall productivity increases and macroeconomic factors.

The total number of active members is assumed to continue at the present total number.

Summary of Valuation Method and Assumptions
June 30, 2018 (Continued)

Reviewing the Investment Return Assumption

The review of the investment return assumptions in this report are forward-looking measures of likely investment return outcomes for the asset classes in the current investment policy. For purposes of this analysis, we have analyzed the System's investment policy with the capital market assumptions from eight nationally recognized investment consultants.

The investment consultants who have shared their capital market assumptions with us are (in alphabetical order) BNY Mellon, JPMorgan, Marquette, Mercer, NEPC, PCA, RVK, and VOYA. It is important to understand that, in general, no two investment consultants will consider the same asset classes. Moreover, there are differences in investment horizons, price inflation, the treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages, and other technical differences.

We have incorporated the assumptions of these eight consultants into our Capital Market Assumption Modeler (CMAM). To the best of our ability, we have adapted the System's investment policy to fit with the eight consultants' assumptions adjusting for these known differences in assumptions and methodology. In the following charts, all returns are net of investment expenses only and have no assumption for excess manager performance (alpha).

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	5.88%	2.00%	3.88%	2.25%	6.13%	0.00%	6.13%
2	6.09%	2.20%	3.89%	2.25%	6.14%	0.00%	6.14%
3	6.57%	2.26%	4.31%	2.25%	6.56%	0.00%	6.56%
4	6.87%	2.50%	4.37%	2.25%	6.62%	0.00%	6.62%
5	6.89%	2.50%	4.39%	2.25%	6.64%	0.00%	6.64%
6	7.33%	2.25%	5.08%	2.25%	7.33%	0.00%	7.33%
7	7.55%	2.25%	5.30%	2.25%	7.55%	0.00%	7.55%
8	7.56%	2.21%	5.35%	2.25%	7.60%	0.00%	7.60%
Average	**6.84%**	**2.27%**	**4.57%**	**2.25%**	**6.82%**	**0.00%**	**6.82%**

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of Exceeding 7.75%	Probability of Exceeding 7.25%	Probability of Exceeding 7.00%
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(6)
1	5.20%	5.72%	6.25%	16.57%	23.15%	26.93%
2	4.79%	5.46%	6.14%	19.73%	25.25%	28.30%
3	5.61%	6.14%	6.67%	22.34%	29.96%	34.18%
4	5.32%	5.98%	6.64%	25.03%	31.40%	34.83%
5	5.38%	6.03%	6.68%	25.16%	31.70%	35.23%
6	5.85%	6.57%	7.29%	33.99%	40.56%	43.97%
7	6.76%	7.23%	7.70%	39.03%	49.58%	54.94%
8	6.30%	6.96%	7.63%	38.19%	45.61%	49.42%
Average	**5.65%**	**6.26%**	**6.87%**	**27.51%**	**34.65%**	**38.47%**

Based on the current asset allocation policy as well as the current price inflation assumption, the investment return assumption is reasonable. Both the price inflation assumption and the investment return assumption were reviewed in the Plan's most recent experience study. While we have stated that the assumptions are reasonable for this valuation, that may not continue in the future if recent trends in forward looking expectations continue.

Investment Return

With Policy Allocation

CMAM Year	Mean	Median
2015	6.84%	6.28%
2016	7.28%	6.70%
2017	6.82%	6.26%

Generally, we recommend an investment return assumption between the arithmetic mean and the geometric median of our most recent capital market assumption modeler. However, because the results of the three most recent CMAMs are not trending in a single direction, we have broadened our range slightly.

Summary of Valuation Method and Assumptions
June 30, 2018 (Concluded)

Non-Economic Assumptions

Post-Retirement Healthy Mortality Rates are used to measure the probabilities of members dying after retirement. The rates currently in use are from the RP-2014 Healthy Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown on page E-6.

Post-Retirement Disabled Mortality Rates. The rates currently in use for disabled lives are from the RP-2014 Disabled Retiree Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown on page E-7.

Pre-Retirement Mortality Rates. The rates currently in use for active lives are the RP-2014 Employee Mortality Table projected to 2022 using projection scale MP-2017 and multiplied by a factor of 65%, shown on page E-8.

The probabilities of age and service retirement are shown on page E-10. Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability.

The probabilities of disability are shown on page E-11.

The probabilities of withdrawal from service are shown on page E-12.

Employer contributions were assumed to be ***paid in equal installments*** throughout the employer fiscal year.

Present assets (cash & investments) were used with a market value adjustment. Assets may be used in the valuation prior to the final audit. The exact method is shown on page C-2.

The data about persons now covered and about present assets were furnished by the System's administrative staff. Although examined for general reasonableness, the data was not audited by the Actuary. Data was furnished as of May 31 and assumed to be statistically equivalent to June 30.

The actuarial valuation computations were made by or under the supervision of a Member of the American Academy of Actuaries (MAAA) who has experience performing public plan valuations.

Service Based Salary Scale

	% Merit Increases in Salaries Next Year	
Service Index	**Uniformed Members**	**Non-Uniformed Members**
1	9.45%	6.80%
2	5.00%	4.50%
3	2.75%	2.80%
4	2.50%	1.50%
5	2.00%	1.00%
6	1.50%	0.80%
7	1.25%	0.00%
8	1.25%	0.00%
9	1.00%	0.00%
10	0.75%	0.00%
11	0.75%	0.00%
12	0.75%	0.00%
13	0.50%	0.00%
14	0.50%	0.00%
15	0.25%	0.00%
16	0.25%	0.00%
17	0.25%	0.00%
18	0.25%	0.00%
19	0.25%	0.00%
20	0.25%	0.00%
21	0.00%	0.00%
22	0.00%	0.00%
23	0.00%	0.00%
24	0.00%	0.00%
25	0.00%	0.00%

Post-Retirement Mortality

Retired Lives Mortality Rates

Age	% Dying Next Year		Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female		Male	Female
20	0.0369%	0.0174%	60	0.7938%	0.5667%	100	31.3381%	28.0166%
21	0.0408%	0.0195%	61	0.8547%	0.6147%	101	33.3774%	30.0266%
22	0.0449%	0.0223%	62	0.9205%	0.6657%	102	35.3995%	32.0621%
23	0.0492%	0.0256%	63	0.9918%	0.7196%	103	37.3951%	34.0941%
24	0.0538%	0.0295%	64	1.0684%	0.7773%	104	39.3487%	36.0900%
25	0.0588%	0.0340%	65	1.1511%	0.8398%	105	41.2343%	38.0614%
26	0.0641%	0.0388%	66	1.2408%	0.9085%	106	43.0470%	39.9941%
27	0.0700%	0.0441%	67	1.3387%	0.9850%	107	44.7813%	41.8213%
28	0.0764%	0.0499%	68	1.4472%	1.0710%	108	46.4200%	43.5827%
29	0.0836%	0.0567%	69	1.5680%	1.1678%	109	47.9720%	45.2475%
30	0.0916%	0.0644%	70	1.7034%	1.2770%	110	49.4044%	46.8213%
31	0.1004%	0.0731%	71	1.8549%	1.4005%	111	49.9809%	48.2854%
32	0.1098%	0.0828%	72	2.0259%	1.5392%	112	49.9755%	49.6513%
33	0.1201%	0.0933%	73	2.2187%	1.6965%	113	49.9953%	50.2110%
34	0.1300%	0.1047%	74	2.4366%	1.8727%	114	49.9851%	50.0952%
35	0.1405%	0.1166%	75	2.6823%	2.0723%	115	50.0000%	50.0000%
36	0.1519%	0.1291%	76	2.9606%	2.2975%	116	50.0000%	50.0000%
37	0.1638%	0.1413%	77	3.2770%	2.5540%	117	50.0000%	50.0000%
38	0.1766%	0.1532%	78	3.6348%	2.8455%	118	50.0000%	50.0000%
39	0.1899%	0.1644%	79	4.0410%	3.1769%	119	50.0000%	50.0000%
40	0.2035%	0.1750%	80	4.5024%	3.5553%	120	100.0000%	100.0000%
41	0.2169%	0.1838%	81	5.0252%	3.9869%			
42	0.2307%	0.1918%	82	5.6159%	4.4782%			
43	0.2453%	0.1994%	83	6.2866%	5.0381%			
44	0.2609%	0.2070%	84	7.0474%	5.6722%			
45	0.2779%	0.2146%	85	7.9002%	6.3897%			
46	0.2964%	0.2231%	86	8.8634%	7.1988%			
47	0.3167%	0.2325%	87	9.9417%	8.1051%			
48	0.3394%	0.2424%	88	11.1427%	9.1109%			
49	0.3644%	0.2533%	89	12.4767%	10.2194%			
50	0.3922%	0.2660%	90	13.9500%	11.4522%			
51	0.4231%	0.2806%	91	15.4968%	12.7799%			
52	0.4563%	0.2986%	92	17.0856%	14.1857%			
53	0.4885%	0.3200%	93	18.6789%	15.6544%			
54	0.5223%	0.3449%	94	20.2575%	17.1685%			
55	0.5582%	0.3734%	95	21.8007%	18.7264%			
56	0.5971%	0.4054%	96	23.6045%	20.4458%			
57	0.6398%	0.4409%	97	25.4442%	22.2335%			
58	0.6865%	0.4797%	98	27.3578%	24.1013%			
59	0.7377%	0.5218%	99	29.3232%	26.0345%			

Post-Retirement Mortality (Disability)

Disabled Retired Lives Mortality Rates

	% Dying Next Year	
Age	Male	Female
20	0.0438%	0.0203%
21	0.0612%	0.0284%
22	0.0856%	0.0397%
23	0.1168%	0.0547%
24	0.1553%	0.0728%
25	0.2005%	0.0940%
26	0.2533%	0.1174%
27	0.3130%	0.1436%
28	0.3801%	0.1725%
29	0.4543%	0.2051%
30	0.5358%	0.2419%
31	0.6235%	0.2828%
32	0.7158%	0.3281%
33	0.8114%	0.3776%
34	0.9026%	0.4306%
35	0.9943%	0.4864%
36	1.0858%	0.5436%
37	1.1751%	0.6006%
38	1.2617%	0.6557%
39	1.3443%	0.7078%
40	1.4204%	0.7560%
41	1.4852%	0.7965%
42	1.5449%	0.8333%
43	1.6000%	0.8677%
44	1.6518%	0.9006%
45	1.7022%	0.9338%
46	1.7528%	0.9691%
47	1.8036%	1.0081%
48	1.8561%	1.0486%
49	1.9108%	1.0931%
50	1.9679%	1.1445%
51	2.0285%	1.2025%
52	2.0949%	1.2677%
53	2.1519%	1.3387%
54	2.2110%	1.4144%
55	2.2745%	1.4929%
56	2.3451%	1.5721%
57	2.4253%	1.6494%
58	2.5146%	1.7227%
59	2.6124%	1.7921%

	% Dying Next Year	
Age	Male	Female
60	2.7176%	1.8560%
61	2.8283%	1.9166%
62	2.9435%	1.9759%
63	3.0631%	2.0367%
64	3.1849%	2.1023%
65	3.3118%	2.1768%
66	3.4447%	2.2633%
67	3.5855%	2.3662%
68	3.7399%	2.4882%
69	3.9098%	2.6317%
70	4.0984%	2.7988%
71	4.3081%	2.9925%
72	4.5436%	3.2128%
73	4.8065%	3.4648%
74	5.1008%	3.7463%
75	5.4281%	4.0624%
76	5.7929%	4.4139%
77	6.2011%	4.8052%
78	6.6529%	5.2368%
79	7.1550%	5.7097%
80	7.7133%	6.2278%
81	8.3320%	6.7925%
82	9.0153%	7.4046%
83	9.7759%	8.0682%
84	10.6221%	8.7816%
85	11.5504%	9.5490%
86	12.5809%	10.3728%
87	13.7130%	11.2504%
88	14.9503%	12.1767%
89	16.2983%	13.1470%
90	17.7578%	14.1809%
91	19.1980%	15.3068%
92	20.6246%	16.5148%
93	22.0177%	17.7919%
94	23.3675%	19.1177%
95	24.6544%	20.4885%
96	26.2066%	22.0265%
97	27.7603%	23.6241%
98	29.3541%	25.2910%
99	30.9669%	27.0120%

	% Dying Next Year	
Age	Male	Female
100	32.6085%	28.7749%
101	34.2769%	30.5690%
102	35.9695%	32.4095%
103	37.6945%	34.2784%
104	39.4530%	36.1549%
105	41.2343%	38.0614%
106	43.0470%	39.9941%
107	44.7813%	41.8213%
108	46.4200%	43.5827%
109	47.9720%	45.2475%
110	49.4044%	46.8213%
111	49.9809%	48.2854%
112	49.9755%	49.6513%
113	49.9953%	50.2110%
114	49.9851%	50.0952%
115	50.0000%	50.0000%
116	50.0000%	50.0000%
117	50.0000%	50.0000%
118	50.0000%	50.0000%
119	50.0000%	50.0000%
120	100.0000%	100.0000%

Pre-Retirement Mortality

Death-in-Service Mortality Rates

Age	% Dying Next Year	
	Male	Female
20	0.0239%	0.0106%
21	0.0268%	0.0108%
22	0.0295%	0.0109%
23	0.0313%	0.0112%
24	0.0324%	0.0116%
25	0.0309%	0.0119%
26	0.0302%	0.0122%
27	0.0300%	0.0127%
28	0.0303%	0.0133%
29	0.0311%	0.0140%
30	0.0322%	0.0150%
31	0.0337%	0.0161%
32	0.0352%	0.0174%
33	0.0368%	0.0187%
34	0.0382%	0.0200%
35	0.0393%	0.0214%
36	0.0402%	0.0227%
37	0.0412%	0.0242%
38	0.0423%	0.0258%
39	0.0437%	0.0276%
40	0.0456%	0.0296%
41	0.0478%	0.0317%
42	0.0506%	0.0340%
43	0.0543%	0.0367%
44	0.0588%	0.0398%
45	0.0640%	0.0434%
46	0.0705%	0.0474%
47	0.0777%	0.0521%
48	0.0860%	0.0571%
49	0.0954%	0.0626%
50	0.1058%	0.0688%
51	0.1174%	0.0757%
52	0.1305%	0.0835%
53	0.1442%	0.0922%
54	0.1594%	0.1017%
55	0.1764%	0.1121%
56	0.1960%	0.1233%
57	0.2187%	0.1351%
58	0.2452%	0.1474%
59	0.2759%	0.1602%

Age	% Dying Next Year	
	Male	Female
60	0.3113%	0.1733%
61	0.3515%	0.1870%
62	0.3965%	0.2013%
63	0.4467%	0.2166%
64	0.5019%	0.2329%
65	0.5624%	0.2506%
66	0.6210%	0.2753%
67	0.6844%	0.3028%
68	0.7539%	0.3335%
69	0.8303%	0.3680%
70	0.9147%	0.4070%
71	1.0083%	0.4510%
72	1.1130%	0.5006%
73	1.2299%	0.5572%
74	1.3608%	0.6207%
75	1.5071%	0.6928%
76	1.6706%	0.7741%
77	1.8540%	0.8664%
78	2.0582%	0.9704%
79	2.2859%	1.0874%
80	2.5398%	1.2190%
81	2.8770%	1.4450%
82	3.2941%	1.7633%
83	3.7903%	2.1715%
84	4.3640%	2.6658%
85	5.0073%	3.2435%
86	5.7229%	3.9007%
87	6.5034%	4.6310%
88	7.3429%	5.4253%
89	8.2360%	6.2734%
90	9.1736%	7.1761%
91	10.1429%	8.1223%
92	11.1417%	9.1047%
93	12.1542%	10.1144%
94	13.1696%	11.1381%
95	14.1705%	12.1722%
96	15.3429%	13.2898%
97	16.5387%	14.4518%
98	17.7826%	15.6658%
99	19.0601%	16.9224%

Age	% Dying Next Year	
	Male	Female
100	20.3698%	18.2108%
101	21.6953%	19.5173%
102	23.0097%	20.8404%
103	24.3068%	22.1612%
104	25.5767%	23.4585%
105	26.8023%	24.7399%
106	27.9806%	25.9962%
107	29.1078%	27.1838%
108	30.1730%	28.3288%
109	31.1818%	29.4109%
110	32.1129%	30.4338%
111	32.4876%	31.3855%
112	32.4841%	32.2733%
113	32.4969%	32.6372%
114	32.4903%	32.5619%
115	32.5000%	32.5000%
116	32.5000%	32.5000%
117	32.5000%	32.5000%
118	32.5000%	32.5000%
119	32.5000%	32.5000%
120	100.0000%	100.0000%

Joint Life Retirement Values
(7.00% Interest)

Sample Attained Ages	Single Life Retirement Values					
	Present Value of $1 Monthly for Life		Percent Dying Next Year		Future Life Expectancy (years)	
	Men	Women	Men	Women	Men	Women
50	$149.37	$153.84	0.3922%	0.2660%	32.36	34.85
55	142.00	147.02	0.5582%	0.3734%	28.05	30.34
60	132.97	138.52	0.7938%	0.5667%	23.89	25.97
65	122.06	128.13	1.1511%	0.8398%	19.90	21.76
70	109.01	115.45	1.7034%	1.2770%	16.11	17.74
75	93.80	100.44	2.6823%	2.0723%	12.58	13.97
80	76.99	83.55	4.5024%	3.5553%	9.41	10.56

The present values shown above are for illustrative purposes only and include a 50% survivor benefit but do not include the value of future post-retirement increases. Males are assumed to be 3 years older than their spouses.

Rates of Retirement

	% of Active Participants Retiring								
	Closed and Year 2000 Plans					2011 Tier			
	Non-Uniformed Members					Non-Uniformed			
	Male		Female		Uniformed	Normal			Uniformed
Age	Normal	Early	Normal	Early	Normal	Age & Service	Rule of 90	Early	Normal
50	40%		25%		45%				
51	30%		20%		15%				
52	26%		20%		15%				
53	26%		20%		16%				
54	24%		24%		16%				
55	27%	3%	32%	3%	25%		30%		30%
56	25%	3%	35%	3%	30%		30%		30%
57	26%	4%	29%	4%	20%		30%		30%
58	22%	2%	25%	4%	30%		30%		30%
59	25%	4%	30%	5%	40%		30%		30%
60	19%	5%	22%	5%	100%		30%		100%
61	18%	5%	22%	5%	100%		30%		100%
62	40%	40%	36%	30%	100%		30%	10%	100%
63	35%	35%	22%	30%	100%		30%	10%	100%
64	25%	30%	20%	25%	100%		30%	10%	100%
65	35%		35%		100%		30%	10%	100%
66	40%		45%		100%		30%	10%	100%
67	45%		40%		100%	50%	30%		100%
68	30%		40%		100%	50%	30%		100%
69	30%		40%		100%	50%	30%		100%
70	40%		50%		100%	100%	100%		100%
71	50%		50%		100%	100%	100%		100%
72	50%		100%		100%	100%	100%		100%
73	50%		100%		100%	100%	100%		100%
74	100%		100%		100%	100%	100%		100%

Rates of Disability

All Plan Participants

Age	% of Active Participants Becoming Disabled			
	Uniformed Members		Non-Uniformed Members	
	Male	Female	Male	Female
20	0.10%	0.10%	0.06%	0.06%
21	0.10%	0.10%	0.06%	0.06%
22	0.10%	0.10%	0.07%	0.07%
23	0.10%	0.10%	0.07%	0.07%
24	0.10%	0.10%	0.07%	0.07%
25	0.10%	0.10%	0.08%	0.08%
26	0.10%	0.10%	0.08%	0.08%
27	0.10%	0.10%	0.09%	0.09%
28	0.10%	0.10%	0.09%	0.09%
29	0.10%	0.10%	0.09%	0.09%
30	0.10%	0.10%	0.10%	0.10%
31	0.10%	0.10%	0.10%	0.10%
32	0.10%	0.10%	0.11%	0.11%
33	0.10%	0.10%	0.11%	0.11%
34	0.10%	0.10%	0.12%	0.12%
35	0.10%	0.10%	0.13%	0.13%
36	0.10%	0.10%	0.13%	0.13%
37	0.10%	0.10%	0.14%	0.14%
38	0.10%	0.10%	0.14%	0.14%
39	0.10%	0.10%	0.15%	0.15%
40	0.10%	0.10%	0.17%	0.17%
41	0.10%	0.10%	0.19%	0.19%
42	0.10%	0.10%	0.21%	0.21%
43	0.10%	0.10%	0.23%	0.23%
44	0.10%	0.10%	0.24%	0.24%
45	0.10%	0.10%	0.27%	0.27%
46	0.10%	0.10%	0.30%	0.30%
47	0.10%	0.10%	0.32%	0.32%
48	0.10%	0.10%	0.36%	0.36%
49	0.10%	0.10%	0.41%	0.41%
50	0.10%	0.10%	0.46%	0.46%
51	0.10%	0.10%	0.52%	0.52%
52	0.10%	0.10%	0.59%	0.59%
53	0.10%	0.10%	0.68%	0.68%
54	0.10%	0.10%	0.77%	0.77%
55	0.10%	0.10%	0.86%	0.86%
56	0.10%	0.10%	0.97%	0.97%
57	0.10%	0.10%	1.09%	1.09%
58	0.10%	0.10%	1.22%	1.22%
59	0.10%	0.10%	1.35%	1.35%
60	0.10%	0.10%	1.49%	1.49%
61	0.10%	0.10%	1.64%	1.64%
62	0.10%	0.10%	1.80%	1.80%
63	0.10%	0.10%	1.97%	1.97%
64	0.10%	0.10%	2.15%	2.15%
65	0.10%	0.10%	0.00%	0.00%
66	0.10%	0.10%	0.00%	0.00%
67	0.10%	0.10%	0.00%	0.00%
68	0.10%	0.10%	0.00%	0.00%
69	0.10%	0.10%	0.00%	0.00%
70	0.10%	0.10%	0.00%	0.00%
71	0.10%	0.10%	0.00%	0.00%
72	0.10%	0.10%	0.00%	0.00%

Rates of Separation from Active Employment

All Plan Participants

Age	Service	% of Active Participants Withdrawing			
		Uniformed Members		Non-Uniformed Members	
		Male	Female	Male	Female
	0-1	12.00%	12.00%	30.00%	20.00%
	1-2	6.00%	6.00%	16.00%	14.00%
	2-3	2.50%	2.50%	9.00%	11.00%
	3-4	2.50%	2.50%	7.00%	9.00%
	4-5	2.50%	2.50%	5.50%	6.00%
25	5 & Up	1.89%	1.89%	5.60%	6.00%
26		1.89%	1.89%	5.60%	6.00%
27		1.89%	1.89%	5.60%	6.00%
28		1.89%	1.89%	5.60%	6.00%
29		1.89%	1.89%	5.60%	6.00%
30		1.89%	1.89%	5.60%	6.00%
31		1.89%	1.89%	5.53%	6.00%
32		1.83%	1.83%	5.46%	6.00%
33		1.65%	1.65%	5.39%	6.00%
34		1.49%	1.49%	5.32%	6.00%
35		1.34%	1.34%	5.25%	6.00%
36		1.19%	1.19%	5.18%	6.00%
37		1.06%	1.06%	5.11%	6.00%
38		0.95%	0.95%	5.04%	6.00%
39		0.86%	0.86%	4.97%	5.78%
40		0.79%	0.79%	4.90%	5.54%
41		0.74%	0.74%	4.48%	5.29%
42		0.69%	0.69%	4.06%	5.05%
43		0.64%	0.64%	3.64%	4.81%
44		0.60%	0.60%	3.22%	4.56%
45		0.55%	0.55%	2.80%	4.32%
46		0.50%	0.50%	2.66%	4.12%
47		0.46%	0.46%	2.52%	3.92%
48		0.41%	0.41%	2.38%	3.72%
49		0.36%	0.36%	2.24%	3.36%
50		0.32%	0.32%	2.10%	3.00%
51		0.27%	0.27%	1.96%	3.00%
52		0.23%	0.23%	1.82%	3.00%
53		0.21%	0.21%	1.68%	3.00%
54		0.19%	0.19%	1.54%	3.00%
55		0.16%	0.16%	1.40%	3.00%
56		0.17%	0.17%	1.40%	3.00%
57		0.13%	0.13%	1.40%	3.00%
58		0.13%	0.13%	1.40%	3.00%
59		0.13%	0.13%	1.40%	3.00%
60		0.12%	0.12%	1.40%	3.00%

Miscellaneous and Technical Assumptions

Administrative Expenses:	1.26% of payroll, based upon actual results from previous year.
Disability Expenses:	0.53% of payroll included in contribution. Retirement system pays premium directly to an outside insurance company or TPA.
Marriage Assumption:	90% of participants are assumed to be married for purposes of death-in-service benefits. Applies to disabled members entitled to future retirement benefits also. Male spouses are assumed to be 3 years older than females if beneficiary information is not available. For purposes of valuing the 50% death after retirement benefit, 100% of closed active members are assumed to be married.
Pay Increase Timing:	Beginning of (Fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.
Decrement Timing:	Decrements of all types are assumed to occur mid-year.
Eligibility Testing:	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.
Benefit Service:	Exact fractional service is used to determine the amount of benefit payable.
Decrement Relativity:	Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.
Normal Form of Benefit:	The assumed normal form of benefit is a 50% joint & survivor benefit for married members in the Closed Plan and a straight life benefit for all other members.
Optional Benefit Factors:	Optional Benefit Factors are in accordance with tables adopted by the Board. We believe these factors are reasonably close to actuarial equivalence based on valuation assumptions. The reduction for the Y2K and 2011 Tier benefits was calculated in accordance with 104.1027 RSMo.
Deferred Joint and Survivor:	It was assumed that all deferred members eligible for the Closed plan would choose Closed plan benefits at retirement.
Other:	Turnover decrements do not operate during retirement eligibility.
Miscellaneous Adjustments:	The calculated normal and early retirement benefits for the Closed and Year 2000 plans were increased by 3.75% for Uniformed and 2.6% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. The calculated normal and early retirement benefits for the 2011 Tier plan were increased by 1.5% for Uniformed and 1.0% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. Post disability benefit liabilities were increased by 50% for all future disabilities to account for potential survivor benefits payable by the retirement system during the period of disability. Current self-insured disability retirant liabilities are increased by 12% to account for future survivor benefits.

Miscellaneous and Technical Assumptions

Contribution Stabilization

Reserve Fund:	The contribution stabilization reserve fund affects the total amount of UAAL financed and is assumed to grow at the investment return rate.
Death Prior to Retirement:	100% of deaths in service are assumed to be non-duty.
Gainful Employment Offset:	30% of the $90 per month special benefit is assumed to be offset by gainful employment.
Minimum Benefit Eligibility:	Deferred benefits and death prior to retirement benefits are assumed to be eligible for the minimum base benefit along with normal and early retirement benefits.
Active Plan Choice:	It was assumed that active members eligible for the Closed plan would choose the Closed plan benefits at retirement.
Member Contribution Interest:	Member contributions are assumed to be credited with 3.0% interest.

Data

Active and retired member data was reported as of May 31. It was brought forward to June 30 by adding one month of service for all active members and otherwise making no other adjustments. It was assumed that the population as of May 31 was statistically equivalent to the population as of June 30. Financial information is reported as of June 30.

Salary Adjustments: Salary from data as provided in prior valuations was used for two active members on leave. Salary for new hires was annualized. Last year's salary as provided in the current valuation data was used if current year's salary was less than 100.

Disabled Member Data: Y2K and 2011 Tier data as provided are increased by 80% of CPI from date of disability to the valuation date and projected increases from the valuation date to the retirement date at 2.0% annually. For purposes of valuing these benefits, the 2.0% projected annual increases are backed out and replaced with 1.8% (80% of the current 2.25% CPI assumption) projected annual increases.

Reconciliation and Review: Reported data was reconciled to data reported for the prior year and reviewed for completeness and reasonableness. Any questions arising from this review were discussed with System staff. Upon completion of the review control totals (see page 1), were shared with the Executive Director and discussed to ensure MPERS also agreed that the data was reasonable.

Method of Financing Future Benefits for Present Active Members

The valuation was prepared in accordance with Section 104.1066 of the Missouri Revised Statutes, which requires the use of the entry-age normal actuarial cost method for determining normal cost and level percent-of-payroll financing of unfunded actuarial accrued liabilities. Details of the application of these methods are described below.

Normal cost and the allocation of present values between service rendered before and after the valuation date were determined using an individual entry-age actuarial cost method having the following characteristics:

(i) the annual normal cost for each individual active member, payable from the date of employment to the date of retirement, is sufficient to accumulate the value of the member's benefit at the time of retirement; and

(ii) each annual normal cost is a constant percentage of the member's year by year projected covered pay.

The ***Value of Future Benefits*** was calculated using the benefits assumed to be payable in the future to current active, terminated vested and retired members. It was assumed that current active and retired Uniformed Patrol members hired prior to July 1, 2000 would elect to retain the benefits under the current plan. Computed costs were increased in accordance with the adjustments described on page E-13.

The ***Present Value of Future Normal Costs*** was defined as the average normal cost rate multiplied by the present value of future payroll for the group.

The ***Actuarial Accrued Liabilities*** were defined as the difference between the present value of future benefits and the present value of future normal costs.

The ***Contribution Stabilization Reserve Fund (CSR)*** is set by the Board based on deferred recognition of gains in an effort to stabilize employer contributions from year to year. The fund is capped at $250,000,000.

Actuarial Accrued Liabilities, less pension assets as of June 30, 2018, resulted in ***Unfunded Actuarial Accrued Liabilities (UAAL).*** The UAAL plus the CSR was amortized using the following funding policy.

Permanent Policy: The total contribution will be based on normal cost plus a 17-year amortization of unfunded actuarial accrued liabilities. The amortization period is a closed 17-year period starting July 1, 2019.

Temporary Accelerated Policy: The total contribution is based on normal cost plus a 6-year amortization period for unfunded retiree liabilities and a 21-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2019.

This temporary accelerated policy was adopted by the Retirement Board on September 17, 2009 and will remain in effect until such time as the retiree liability becomes 100% funded or the permanent policy produces a higher contribution rate.

Post-Valuation Date Activity: No other adjustments were made to the valuation results to reflect other post-valuation date activity.

June 30, 2018 Actuarial Valuation
Glossary

Actuarial Accrued Liability. The difference between (i) the actuarial present value of future plan benefits, and (ii) the actuarial present value of future normal cost. Sometimes referred to as "accrued liability" or "past service liability."

Accrued Service. The service credited under the plan which was rendered before the date of the actuarial valuation.

Actuarial Assumptions. Estimates of future plan experience with respect to rates of mortality, disability, turnover, retirement, rate or rates of investment income and salary increases. Decrement assumptions (rates of mortality, disability, turnover and retirement) are generally based on past experience, often modified for projected changes in conditions. Economic assumptions (salary increases and investment income) consist of an underlying rate in an inflation-free environment plus a provision for a long-term average rate of inflation.

Actuarial Cost Method. A mathematical budgeting procedure for allocating the dollar amount of the "actuarial present value of future plan benefits" between the actuarial present value of future normal cost and the actuarial accrued liability. Sometimes referred to as the "actuarial funding method."

Actuarial Equivalent. A series of payments is called an actuarial equivalent of another series of payments if the two series have the same actuarial present value.

Actuarial Present Value. The amount of funds presently required to provide a payment or series of payments in the future. It is determined by discounting the future payments at a predetermined rate of interest, taking into account the probability of payment.

Actuarial value of Assets. Also referred to as funding value of assets, smoothed market value of assets, or valuation assets.

Valuation assets recognize assumed investment return fully each year. Differences between actual and assumed investment return are phased-in over a closed 3-year period. This treatment helps remove the timing of investment activities from the valuation process. During periods when investment performance exceeds the assumed rate, valuation assets will tend to be less than market value. During periods when investment performance is less than the assumed rate, valuation assets will tend to be greater than market value. If assumed rates are exactly realized for 3 consecutive years, valuation assets will become equal to market value.

Actuary. A person who is trained in the applications of probability and compound interest to problems in business and finance that involve payment of money in the future, contingent upon the occurrence of future events. Most actuaries in the United States are Members of the American Academy of Actuaries. The Society of Actuaries is an international research, education and membership organization for actuaries in the life and health insurance, employee benefits, and pension fields. It administers a series of examinations leading initially to Associateship and the designation ASA and ultimately to Fellowship with the designation FSA.

June 30, 2018 Actuarial Valuation
Glossary (Concluded)

Amortization. Paying off an interest-bearing liability by means of periodic payments of interest and principal, as opposed to paying it off with a lump sum payment.

Experience Gain (Loss). A measure of the difference between actual experience and that expected based upon a set of actuarial assumptions during the period between two actuarial valuation dates, in accordance with the actuarial cost method being used.

Normal Cost. The annual cost assigned, under the actuarial funding method, to current and subsequent plan years. Sometimes referred to as “current service cost.” Any payment toward the unfunded actuarial accrued liability is not part of the normal cost.

Plan Termination Liability. The actuarial present value of future plan benefits based on the assumption that there will be no further accruals for future service and salary. The termination liability will generally be less than the liabilities computed on a “going concern” basis and is not normally determined in a routine actuarial valuation.

Reserve Account. An account used to indicate that funds have been set aside for a specific purpose and are not generally available for other uses.

Unfunded Actuarial Accrued Liability. The difference between the actuarial accrued liability and actuarial value of assets. Sometimes referred to as “unfunded accrued liability.”

The existence of unfunded actuarial accrued liabilities is not in itself bad, any more than a mortgage on a house is bad. Unfunded actuarial accrued liabilities do not represent a debt that is payable today. What is important is the ability to amortize the unfunded actuarial accrued liabilities and the trend in their amount (after due allowance for devaluation of the dollar).

Valuation Payroll. Active member payroll that is intended to reflect the annual salary considered as covered compensation for Retirement System benefits.

SECTION F

FINANCIAL PRINCIPLES AND OPERATIONAL TECHNIQUES

Financial Principles and Operational Techniques of the Retirement System

Promises Made, and To Be Paid For. As each year is completed, the Retirement System in effect hands an "IOU" to each member then acquiring a year of service credit -- the "IOU" says: "The Missouri Department of Transportation and Highway Patrol Employees' Retirement System owes you one year's worth of retirement benefits, payments in cash commencing when you qualify for retirement."

The principal related financial question is: When shall the money required to cover the "IOU" be contributed? This year, when the benefit of the member's service is received? Or, some future year when the "IOU" becomes a cash demand?

The objective of level percent-of-payroll financing is that this year's taxpayers contribute the money to cover the IOUs being handed out this year. By following this objective, ***the employer contribution rate will remain approximately level from year to year*** --- and will not have to be increased for future generations of taxpayers. However, "Level percent-of-payroll" does NOT mean "Fixed percent-of-payroll." The level percent-of-payroll is an estimate that may change from one year to the next.

(There are systems which have a design for deferring contributions to future taxpayers, lured by a lower contribution rate now and putting aside the consequence that the contribution rate must then relentlessly grow much greater over decades of time.)

An inevitable by-product of the level-cost design is the accumulation of reserve assets, for decades, and the income produced when the assets are invested. ***Invested assets are a by-product and not the objective.*** Investment income becomes the 3rd contributor for benefits to employees, and is interlocked with the contribution amounts required from employees and employer.

Financial Principles and Operational Techniques of the Retirement System (Concluded)

Translated to actuarial terminology, this level-cost objective means that the contribution rates must total at least the following:

Normal Cost (the value assigned to service being rendered this year)

. . . plus . . .

Interest on Unfunded Actuarial Accrued Liabilities (the difference between liabilities for service already rendered and the accrued assets of the Retirement System).

Computing Contributions to Support System Benefits. From a given schedule of benefits and from the employee data and asset data furnished by the system, the actuary determines the contribution rates to support the benefits, by means of ***an actuarial valuation.***

An actuarial valuation has a number of ingredients such as: the rate of investment return which plan assets will earn; the rates of withdrawal of active members who leave covered employment; the rates of mortality; the rates of disability; the rates of pay increases and the assumed age or ages at actual retirement.

In an actuarial valuation the actuary must assume what the above rates will be, for the next year and for decades in the future. Only the subsequent actual experience of the plan can indicate the degree of accuracy of the assumptions.

Reconciling Differences Between Assumed Experience and Actual Experience. Once actual experience has occurred and has been observed, it will not coincide exactly with assumed experience, regardless of the skill of the actuary and the many calculations made. Most retirement systems cope with such differences by having annual actuarial valuations. Each actuarial valuation is a complete recalculation of assumed future experience, taking into account all past differences between assumed and actual experience. The result is ***continuing adjustments to the financial position.***

Actuarial Valuation Process

The ***actuarial valuation*** is the mathematical process by which the contribution rate is determined, and the flow of activity constituting the valuation may be summarized as follows:

A . ***Covered people data*** furnished by plan administrator, including:

Retired lives now receiving benefits

Former employees with vested benefits not yet payable

Active employees

B . + ***Asset data*** (cash & investments), furnished by the plan administrator

C . + ***Benefit provisions*** which specify eligibility and amounts of pensions

D . + ***Assumptions concerning future experience in various risk areas,*** which are established by the Retirement Board after consulting with the actuary

E . + ***The funding method*** for employer contributions (the long-term, planned pattern for employer contributions)

F . + ***Mathematically combining the assumptions, the funding method, and the data***

G . = Determination of:

Plan Financial Position and/or

New Employer Contribution Rate

Meaning of "Unfunded Actuarial Accrued Liabilities"

"Actuarial accrued liabilities" are the portion of the present value of plan promises to pay benefits in the future that are not covered by future normal cost contributions. A liability has been established ("accrued") because the service has been rendered but the resulting monthly cash benefit may not be payable until years in the future. Actuarial accrued liabilities are the result of complex mathematical calculations, which are made by the plan's actuary.

If "actuarial accrued liabilities" exceed the plan's accrued assets (cash & investments), the difference is ***"unfunded actuarial accrued liabilities."*** This is the usual condition. If the plan's assets equaled the plan's "actuarial accrued liabilities," then the plan would be termed "fully funded." This is an unusual condition.

Each time a plan adds a new benefit, which applies to service already rendered, an "actuarial accrued liability" is created, which is also an "unfunded actuarial accrued liability" because the plan can't print instant cash to cover the value of the new benefit promises. Payment for such unfunded actuarial accrued liabilities is spread over a period of years, commonly in the 20-30 year range.

Unfunded actuarial accrued liabilities can occur in another way: if actual plan experience is less favorable than assumed plan experience, the difference is added to unfunded actuarial accrued liabilities. In plans where benefits are directly related to an employee's pay near time of retirement, unfunded actuarial accrued liabilities rose dramatically during the 1970's. Unexpected rates of pay increase created additional actuarial accrued liabilities, which could not be matched by reasonable investment results. More recent experience has generally been more favorable with some reductions in unfunded actuarial accrued liabilities.

The existence of unfunded actuarial accrued liabilities is not bad, but the changes from year to year in the amount of unfunded actuarial accrued liabilities are important, --- "bad" or "good" or somewhere in between.

Even though unfunded actuarial accrued liabilities don't constitute a bill payable immediately, it is important that policy-makers prevent the amount from becoming unreasonably high and ***it is vital for plans to have a sound method for making payments toward them*** so that they are controlled.

SECTION G

SUPPLEMENTAL INFORMATION FOR COMPREHENSIVE ANNUAL FINANCIAL REPORTING

GRS Retirement Consulting
800.521.0498 | P: 248.799.9000 | F: 248.799.9020 | www.grsconsulting.com

September 19, 2018

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Ladies and Gentlemen:

This report was prepared at the request of the Board and is intended for use by the Retirement System and those designated or approved by the Board. This report may be provided to parties other than the System only in its entirety and only with the permission of the Board. GRS is not responsible for unauthorized use of this report. This report should not be relied on for any purpose other than the purpose described.

The basic financial objective of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS) is to establish and receive contributions which:

(1) when expressed in terms of percents of active member payroll, will remain approximately level from generation to generation of Missouri citizens; and

(2) when combined with present assets and future investment returns, will be sufficient to meet the present and future financial obligations of MPERS.

In order to measure progress toward this fundamental objective, MPERS has annual actuarial valuations performed. The valuations (i) measure the present financial position, and (ii) establish contribution rates that provide for the current cost and level percent-of-payroll amortization of unfunded actuarial liabilities over a reasonable period. An actuarial valuation was performed based upon benefit conditions, data and assumptions as of June 30, 2018. This valuation indicates that contribution rates for the period beginning July 1, 2019 that are at least equal to the calculated contribution rates will meet the Board's financial objective. The calculated contribution rates are 58.00% of payroll for the 6,160 Non-Uniformed employees and 58.00% of payroll for the 1,231 Uniformed patrol employees.

The plan administrative staff provides the actuary with data for the actuarial valuation. The actuary relies on the data after reviewing it for internal and year to year consistency. Member data was not audited by the actuary. The actuary summarizes and tabulates population data in order to analyze longer term trends. We are not responsible for the accuracy or completeness of the data provided by MPERS.

Gabriel, Roeder, Smith & Company was responsible for the following schedules found in the Actuarial Section:

- Summary of Actuarial Assumptions and Methods
  - Probabilities of Separation from Active Employment
  - Individual Salary Increases
  - Joint Life Retirement Values
  - Probabilities of Retirement for Members
  - Probabilities of Disability for Members
- Summary of Member Data Included in Valuations
  - Active Members by Attained Age and Years of Service
  - Schedule of Active Member Valuation Data
- Solvency Test
- Derivation of Financial Experience
- Schedule of Retirees and Beneficiaries Added and Removed
- Summary of Plan Provisions
- Legislative Changes

Gabriel, Roeder, Smith & Company was responsible for the following schedules found in the Financial Section:

- Schedule of Changes in the Employer's Net Pension Liability
- Schedule of Employer's Net Pension Liability
- Schedule of Employer Contributions
- Schedule of the Actuarially Determined Contributions

Actuarial valuations are based upon assumptions regarding future activity in specific risk areas including the rates of investment return and payroll growth, eligibility for the various classes of benefits, and longevity among retired lives. These assumptions are adopted by the Board. The assumptions and the methods comply with the requirements of the Governmental Accounting Standards Board. Each actuarial valuation takes into account all prior differences between actual and assumed experience in each risk area and adjusts the contribution rates as needed. Actuarial methods and assumptions were adopted by the Board pursuant to the June 30, 2017 Experience Study. Gabriel, Roeder, Smith & Company has produced the following reports as of June 30, 2018:

- Annual Actuarial Valuation Report
- GASB Nos. 67 and 68 Valuation Report

In order to gain a full understanding of the condition of this plan, these reports should be read in their entirety.

To the best of our knowledge, the report is complete and accurate and was made in accordance with standards of practice promulgated by the Actuarial Standards Board. The assumptions and methods used for funding purposes meet the parameters set by Actuarial Standards of Practice. The actuarial assumptions used for the valuation produce results which, individually and in the aggregate, are reasonable.

The employer contributions determined in this report are based on Board funding policy. This policy is discussed on page 4 of the annual actuarial valuation report. We commend the Board for its aggressive monitoring and updating of the funding policy over the recent past. However, continued employer contributions at the current level do not guarantee benefit security. We therefore encourage the Board to continue to routinely monitor and update its funding policy and to continue to consider benefit security when doing so.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.

This report has been prepared by individuals who have substantial experience valuing public employee retirement systems. Heidi G. Barry is a Member of the American Academy of Actuaries (MAAA) and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

The signing individuals are independent of the plan sponsor.

Based upon the valuation results, it is our opinion that the Missouri Department of Transportation and Highway Patrol Employees' Retirement System continues to operate in accordance with actuarial principles of level percent-of-payroll financing. It is important to the well-being of the System that it continues to receive contributions at the actuarially determined levels. It is also important to continue to monitor both the total funded status and the funded status of the retiree liabilities to ensure that the funding policy is consistent with the expected life span of the respective unfunded obligation.

Respectfully submitted,

Heidi G. Barry

Heidi G. Barry, ASA, FCA, MAAA

Kenneth G. Alberts

Kenneth G. Alberts

Solvency Test

The MPERS funding objective is to meet long term benefit promises through contributions that remain approximately level from year-to-year as a percent of member payroll. If the contributions to the System are level in concept and soundly executed, the System will ***pay all promised benefits when due – the ultimate test of financial soundness.***

A solvency test is one means of checking a system's progress under its funding program. In a solvency test for a non-contributory plan, the plan's present assets (cash and investments) are compared with: 1) The liabilities for future benefits to present retired lives, and 2) The liabilities for service already rendered by members. In a system that has been following the discipline of level percent-of-payroll financing, the liabilities for future benefits to present retired lives (liability 1) will be fully covered by present assets (except in rare circumstances). In addition, the liabilities for service already rendered by members (liability 2) will be partially covered by the remainder of present assets. The larger the funded portion of liability 2, the stronger the condition of the system.

The schedule below illustrates the history of liability 2 of the System.

Val. Date June 30	(1) Member Contributions	(2) Retirees and Benef.	(3) Active and Inactive Members	Present Valuation Assets	Portion of Present Values Covered by Present Assets			
					(1)	(2)	(3)	Total
	--------------------$ Millions------------------------							
2009	0	1,947	1,166	1,471	100%	76%	0%	47%
2010#	0	2,034	1,225	1,376	100%	68%	0%	42%
2011	0	2,045	1,253	1,427	100%	70%	0%	43%
2012#	0	2,133	1,173	1,531	100%	72%	0%	46%
2013#	1	2,333	1,250	1,657	100%	71%	0%	46%
2014	2	2,384	1,264	1,795	100%	75%	0%	49%
2015	3	2,444	1,269	1,967	100%	80%	0%	53%
2016	5	2,470	1,287	2,087	100%	84%	0%	55%
2017	8	2,488	1,306	2,173	100%	87%	0%	57%
2018#	11	2,598	1,373	2,274	100%	87%	0%	57%

 # New assumptions and/or methods adopted.

Derivation of Experience Gain/(Loss)

Actual experience will never coincide exactly with assumed experience (except by coincidence). Gains and losses may offset each other over a period of years, but sizeable year-to-year variations from assumed experience are common. Detail on the derivation of the experience gain/(loss) is shown below:

	$ Millions
UAAL Beginning of Year (at July 1)	$ 1,629,656,586
Normal Cost	50,991,818
Contributions	(211,824,044)
Interest	120,066,137
Net Change in LTD Assets	-
Expected UAAL Before Any Changes	1,588,890,497
Effect of Benefit Changes	-
Effect of Changes in Assumptions & Methods	142,556,109
Effect of Adjustment	-
Expected UAAL After Changes	1,731,446,606
End of Year UAAL (at June 30)	$ 1,707,590,819
Gain/(Loss) for Year	$ 23,855,787
Gain/(Loss) as a percent of actuarial accrued liabilities at start of year ($3,802.4 million)	0.6%

Valuation Date June 30	Experience Gain/(Loss) as % of Beginning Accrued Liability
2009	(12.6)%
2010	(3.8)%
2011	2.2 %
2012	3.2 %
2013	2.1 %
2014	2.1 %
2015	2.4 %
2016	1.1 %
2017	0.1 %
2018	**0.6 %**

Summary of Actuarial Assumptions and Methods

Valuation Date:	June 30, 2018
Actuarial Cost Method:	Entry Age
Amortized Method:	Closed, level percent-of-payroll
Remaining Amortization Period:	14 years#
Asset Valuation Method:	3-year smoothing
Actuarial Assumptions:	
Investment Rate of Return:	7.00%
Projected Salary Increase:	3.00% to 12.45%
Cost-of-Living Adjustments:	1.80% Compound
Includes Wage Inflation at:	3.00%

 # Single equivalent period.

An actuarial valuation is based upon an actuarial cost method, an asset valuation method, and actuarial assumptions. These methods and assumptions are chosen by the Board of Trustees after consultation with the Actuary and other advisors.

The actuarial cost method is called the Entry Age Actuarial Cost Method. This method is consistent with the Board's level percent-of-payroll funding objective. With this method, the level percent-of-payroll is determined that will fund a member's retirement benefit over the member's entire working lifetime, from date of hire (Entry Age) to date of exit from the active member population. Differences in the past between assumed and actual experience become part of unfunded actuarial accrued liabilities and are amortized with level percent-of-payroll contributions. This cost method was first used in the ***June 30, 1999*** valuation.

The asset valuation method is a three-year smoothed market value method in which assumed investment return is recognized immediately each year and differences between actual and assumed investment return are phased-in over a closed three-year period. This asset valuation method is intended to give recognition to the long term accuracy of market values while filtering out and dampening short term market swings. This method was first used in the ***June 30, 1999*** valuation.

The actuarial assumptions used in producing the valuation fall into two broad classes: economic assumptions, and demographic assumptions. Economic assumptions refer to long term rates of investment return, wage growth, covered population growth, and inflation. Demographic assumptions refer to retirement rates, turnover rates, disability rates, merit and seniority pay increases, and mortality rates. The current assumptions are based upon a 2012-2017 study of experience of the MPERS. The assumptions are reviewed from time to time to keep them reasonably current with expected experience. The next experience study is scheduled to follow the June 30, 2022 valuation.

Economic Assumptions

The investment return rate used in making the valuation was 7.00% per year, compounded annually (net after administrative expenses). This rate of return is not the assumed real rate of return. The real rate of return over wage inflation is defined to be the portion of investment return which is more than the wage inflation rate. Considering wage inflation recognition of 3.00%, the 7.00% rate translates to an assumed real rate of return over wage inflation of 4.00%. This rate was first used for the ***June 30, 2018*** valuation.

Summary of Actuarial Assumptions and Methods (Concluded)

Pay increase assumptions for individual active members are shown on Table I. Part of the assumption for each year of service is for a merit and/or seniority increase, and the other 3.00% recognizes wage inflation. These rates were first used for the **June 30, 2018** valuation.

Price Inflation is assumed to be 2.25%. This results in a 1.8% annual COLA assumption. It is assumed that the 1.8% COLA will always be paid.

The Active Member Group size is assumed to remain constant at its present level.

The active member payroll for all members is assumed to increase 3.00% annually.

Non-Economic Assumptions

The mortality table used to measure Post-Retirement Healthy Mortality Rates are from the RP-2014 Healthy Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown in Table II. Post-Retirement Disabled Mortality Rates use the RP-2014 Disabled Retiree Annuitant Mortality Tables projected to 2022 using projection scale MP-2017, shown in Table III. Pre-Retirement Mortality Rates use the RP-2014 Employee Mortality Tables projected to 2022 using projection scale MP-2017 and multiplied by a factor of 65%, shown in Table IV. These tables were first used for the **June 30, 2018** valuation.

The probabilities of retirement for members eligible to retire are shown on Table VI. The rates for full retirement were first used in the **June 30, 2018** valuation. The rates for reduced retirement were first used in the **June 30, 2018** valuation. Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability.

The probabilities of disability for members eligible to retire are shown on Table VII. The rates for disability were first used in the **June 30, 2018** valuation.

The probabilities of withdrawal from service, death-in-service and disability are shown for sample ages on Table VIII. The death-in-service and disability rates were first used in the **June 30, 2018** valuation. The withdrawal rates were first used in the **June 30, 2018** valuation.

The data about persons now covered and about present assets was furnished by the System's administrative staff. Although examined for general reasonableness, the data was not audited by the Actuary. Data was furnished as of May 31 and assumed to be statistically equivalent to June 30.

The actuarial valuation computations were made by or under the supervision of a Member of the American Academy of Actuaries (MAAA).

Table I
Service Based Salary Scale

	% Merit Increases in Salaries Next Year	
Service Index	Uniformed Members	Non-Uniformed Members
1	9.45%	6.80%
2	5.00%	4.50%
3	2.75%	2.80%
4	2.50%	1.50%
5	2.00%	1.00%
6	1.50%	0.80%
7	1.25%	0.00%
8	1.25%	0.00%
9	1.00%	0.00%
10	0.75%	0.00%
11	0.75%	0.00%
12	0.75%	0.00%
13	0.50%	0.00%
14	0.50%	0.00%
15	0.25%	0.00%
16	0.25%	0.00%
17	0.25%	0.00%
18	0.25%	0.00%
19	0.25%	0.00%
20	0.25%	0.00%
21	0.00%	0.00%
22	0.00%	0.00%
23	0.00%	0.00%
24	0.00%	0.00%
25	0.00%	0.00%

Table II
Post-Retirement Mortality

Retired Lives Mortality Rates

Age	% Dying Next Year	
	Male	Female
20	0.0369%	0.0174%
21	0.0408%	0.0195%
22	0.0449%	0.0223%
23	0.0492%	0.0256%
24	0.0538%	0.0295%
25	0.0588%	0.0340%
26	0.0641%	0.0388%
27	0.0700%	0.0441%
28	0.0764%	0.0499%
29	0.0836%	0.0567%
30	0.0916%	0.0644%
31	0.1004%	0.0731%
32	0.1098%	0.0828%
33	0.1201%	0.0933%
34	0.1300%	0.1047%
35	0.1405%	0.1166%
36	0.1519%	0.1291%
37	0.1638%	0.1413%
38	0.1766%	0.1532%
39	0.1899%	0.1644%
40	0.2035%	0.1750%
41	0.2169%	0.1838%
42	0.2307%	0.1918%
43	0.2453%	0.1994%
44	0.2609%	0.2070%
45	0.2779%	0.2146%
46	0.2964%	0.2231%
47	0.3167%	0.2325%
48	0.3394%	0.2424%
49	0.3644%	0.2533%
50	0.3922%	0.2660%
51	0.4231%	0.2806%
52	0.4563%	0.2986%
53	0.4885%	0.3200%
54	0.5223%	0.3449%
55	0.5582%	0.3734%
56	0.5971%	0.4054%
57	0.6398%	0.4409%
58	0.6865%	0.4797%
59	0.7377%	0.5218%

Age	% Dying Next Year	
	Male	Female
60	0.7938%	0.5667%
61	0.8547%	0.6147%
62	0.9205%	0.6657%
63	0.9918%	0.7196%
64	1.0684%	0.7773%
65	1.1511%	0.8398%
66	1.2408%	0.9085%
67	1.3387%	0.9850%
68	1.4472%	1.0710%
69	1.5680%	1.1678%
70	1.7034%	1.2770%
71	1.8549%	1.4005%
72	2.0259%	1.5392%
73	2.2187%	1.6965%
74	2.4366%	1.8727%
75	2.6823%	2.0723%
76	2.9606%	2.2975%
77	3.2770%	2.5540%
78	3.6348%	2.8455%
79	4.0410%	3.1769%
80	4.5024%	3.5553%
81	5.0252%	3.9869%
82	5.6159%	4.4782%
83	6.2866%	5.0381%
84	7.0474%	5.6722%
85	7.9002%	6.3897%
86	8.8634%	7.1988%
87	9.9417%	8.1051%
88	11.1427%	9.1109%
89	12.4767%	10.2194%
90	13.9500%	11.4522%
91	15.4968%	12.7799%
92	17.0856%	14.1857%
93	18.6789%	15.6544%
94	20.2575%	17.1685%
95	21.8007%	18.7264%
96	23.6045%	20.4458%
97	25.4442%	22.2335%
98	27.3578%	24.1013%
99	29.3232%	26.0345%

Age	% Dying Next Year	
	Male	Female
100	31.3381%	28.0166%
101	33.3774%	30.0266%
102	35.3995%	32.0621%
103	37.3951%	34.0941%
104	39.3487%	36.0900%
105	41.2343%	38.0614%
106	43.0470%	39.9941%
107	44.7813%	41.8213%
108	46.4200%	43.5827%
109	47.9720%	45.2475%
110	49.4044%	46.8213%
111	49.9809%	48.2854%
112	49.9755%	49.6513%
113	49.9953%	50.2110%
114	49.9851%	50.0952%
115	50.0000%	50.0000%
116	50.0000%	50.0000%
117	50.0000%	50.0000%
118	50.0000%	50.0000%
119	50.0000%	50.0000%
120	100.0000%	100.0000%

Table III
Post-Retirement Mortality

Disabled Retired Lives Mortality Rates

Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
20	0.0438%	0.0203%	60	2.7176%	1.8560%	100	32.6085%	28.7749%
21	0.0612%	0.0284%	61	2.8283%	1.9166%	101	34.2769%	30.5690%
22	0.0856%	0.0397%	62	2.9435%	1.9759%	102	35.9695%	32.4095%
23	0.1168%	0.0547%	63	3.0631%	2.0367%	103	37.6945%	34.2784%
24	0.1553%	0.0728%	64	3.1849%	2.1023%	104	39.4530%	36.1549%
25	0.2005%	0.0940%	65	3.3118%	2.1768%	105	41.2343%	38.0614%
26	0.2533%	0.1174%	66	3.4447%	2.2633%	106	43.0470%	39.9941%
27	0.3130%	0.1436%	67	3.5855%	2.3662%	107	44.7813%	41.8213%
28	0.3801%	0.1725%	68	3.7399%	2.4882%	108	46.4200%	43.5827%
29	0.4543%	0.2051%	69	3.9098%	2.6317%	109	47.9720%	45.2475%
30	0.5358%	0.2419%	70	4.0984%	2.7988%	110	49.4044%	46.8213%
31	0.6235%	0.2828%	71	4.3081%	2.9925%	111	49.9809%	48.2854%
32	0.7158%	0.3281%	72	4.5436%	3.2128%	112	49.9755%	49.6513%
33	0.8114%	0.3776%	73	4.8065%	3.4648%	113	49.9953%	50.2110%
34	0.9026%	0.4306%	74	5.1008%	3.7463%	114	49.9851%	50.0952%
35	0.9943%	0.4864%	75	5.4281%	4.0624%	115	50.0000%	50.0000%
36	1.0858%	0.5436%	76	5.7929%	4.4139%	116	50.0000%	50.0000%
37	1.1751%	0.6006%	77	6.2011%	4.8052%	117	50.0000%	50.0000%
38	1.2617%	0.6557%	78	6.6529%	5.2368%	118	50.0000%	50.0000%
39	1.3443%	0.7078%	79	7.1550%	5.7097%	119	50.0000%	50.0000%
40	1.4204%	0.7560%	80	7.7133%	6.2278%	120	100.0000%	100.0000%
41	1.4852%	0.7965%	81	8.3320%	6.7925%			
42	1.5449%	0.8333%	82	9.0153%	7.4046%			
43	1.6000%	0.8677%	83	9.7759%	8.0682%			
44	1.6518%	0.9006%	84	10.6221%	8.7816%			
45	1.7022%	0.9338%	85	11.5504%	9.5490%			
46	1.7528%	0.9691%	86	12.5809%	10.3728%			
47	1.8036%	1.0081%	87	13.7130%	11.2504%			
48	1.8561%	1.0486%	88	14.9503%	12.1767%			
49	1.9108%	1.0931%	89	16.2983%	13.1470%			
50	1.9679%	1.1445%	90	17.7578%	14.1809%			
51	2.0285%	1.2025%	91	19.1980%	15.3068%			
52	2.0949%	1.2677%	92	20.6246%	16.5148%			
53	2.1519%	1.3387%	93	22.0177%	17.7919%			
54	2.2110%	1.4144%	94	23.3675%	19.1177%			
55	2.2745%	1.4929%	95	24.6544%	20.4885%			
56	2.3451%	1.5721%	96	26.2066%	22.0265%			
57	2.4253%	1.6494%	97	27.7603%	23.6241%			
58	2.5146%	1.7227%	98	29.3541%	25.2910%			
59	2.6124%	1.7921%	99	30.9669%	27.0120%			

Table IV
Pre-Retirement Mortality

Death-in-Service Mortality Rates

Age	% Dying Next Year Male	% Dying Next Year Female
20	0.0239%	0.0106%
21	0.0268%	0.0108%
22	0.0295%	0.0109%
23	0.0313%	0.0112%
24	0.0324%	0.0116%
25	0.0309%	0.0119%
26	0.0302%	0.0122%
27	0.0300%	0.0127%
28	0.0303%	0.0133%
29	0.0311%	0.0140%
30	0.0322%	0.0150%
31	0.0337%	0.0161%
32	0.0352%	0.0174%
33	0.0368%	0.0187%
34	0.0382%	0.0200%
35	0.0393%	0.0214%
36	0.0402%	0.0227%
37	0.0412%	0.0242%
38	0.0423%	0.0258%
39	0.0437%	0.0276%
40	0.0456%	0.0296%
41	0.0478%	0.0317%
42	0.0506%	0.0340%
43	0.0543%	0.0367%
44	0.0588%	0.0398%
45	0.0640%	0.0434%
46	0.0705%	0.0474%
47	0.0777%	0.0521%
48	0.0860%	0.0571%
49	0.0954%	0.0626%
50	0.1058%	0.0688%
51	0.1174%	0.0757%
52	0.1305%	0.0835%
53	0.1442%	0.0922%
54	0.1594%	0.1017%
55	0.1764%	0.1121%
56	0.1960%	0.1233%
57	0.2187%	0.1351%
58	0.2452%	0.1474%
59	0.2759%	0.1602%

Age	% Dying Next Year Male	% Dying Next Year Female
60	0.3113%	0.1733%
61	0.3515%	0.1870%
62	0.3965%	0.2013%
63	0.4467%	0.2166%
64	0.5019%	0.2329%
65	0.5624%	0.2506%
66	0.6210%	0.2753%
67	0.6844%	0.3028%
68	0.7539%	0.3335%
69	0.8303%	0.3680%
70	0.9147%	0.4070%
71	1.0083%	0.4510%
72	1.1130%	0.5006%
73	1.2299%	0.5572%
74	1.3608%	0.6207%
75	1.5071%	0.6928%
76	1.6706%	0.7741%
77	1.8540%	0.8664%
78	2.0582%	0.9704%
79	2.2859%	1.0874%
80	2.5398%	1.2190%
81	2.8770%	1.4450%
82	3.2941%	1.7633%
83	3.7903%	2.1715%
84	4.3640%	2.6658%
85	5.0073%	3.2435%
86	5.7229%	3.9007%
87	6.5034%	4.6310%
88	7.3429%	5.4253%
89	8.2360%	6.2734%
90	9.1736%	7.1761%
91	10.1429%	8.1223%
92	11.1417%	9.1047%
93	12.1542%	10.1144%
94	13.1696%	11.1381%
95	14.1705%	12.1722%
96	15.3429%	13.2898%
97	16.5387%	14.4518%
98	17.7826%	15.6658%
99	19.0601%	16.9224%

Age	% Dying Next Year Male	% Dying Next Year Female
100	20.3698%	18.2108%
101	21.6953%	19.5173%
102	23.0097%	20.8404%
103	24.3068%	22.1612%
104	25.5767%	23.4585%
105	26.8023%	24.7399%
106	27.9806%	25.9962%
107	29.1078%	27.1838%
108	30.1730%	28.3288%
109	31.1818%	29.4109%
110	32.1129%	30.4338%
111	32.4876%	31.3855%
112	32.4841%	32.2733%
113	32.4969%	32.6372%
114	32.4903%	32.5619%
115	32.5000%	32.5000%
116	32.5000%	32.5000%
117	32.5000%	32.5000%
118	32.5000%	32.5000%
119	32.5000%	32.5000%
120	100.0000%	100.0000%

Table V
Joint Life Retirement Values
(7.00% Interest)

Sample Attained Ages	Single Life Retirement Values					
	Present Value of $1 Monthly for Life		Percent Dying Next Year		Future Life Expectancy (years)	
	Men	Women	Men	Women	Men	Women
50	$149.37	$153.84	0.3922%	0.2660%	32.36	34.85
55	142.00	147.02	0.5582%	0.3734%	28.05	30.34
60	132.97	138.52	0.7938%	0.5667%	23.89	25.97
65	122.06	128.13	1.1511%	0.8398%	19.90	21.76
70	109.01	115.45	1.7034%	1.2770%	16.11	17.74
75	93.80	100.44	2.6823%	2.0723%	12.58	13.97
80	76.99	83.55	4.5024%	3.5553%	9.41	10.56

The present values shown above are for illustrative purposes only and include a 50% survivor benefit but do not include the value of future post-retirement increases. Males are assumed to be 3 years older than their spouses.

Table VI
Rates of Retirement

	% of Active Participants Retiring								
	Closed and Year 2000 Plans					2011 Tier			
	Non-Uniformed Members					Non-Uniformed			
	Male		Female		Uniformed	Normal			Uniformed
Age	Normal	Early	Normal	Early	Normal	Age & Service	Rule of 90	Early	Normal
50	40%		25%		45%				
51	30%		20%		15%				
52	26%		20%		15%				
53	26%		20%		16%				
54	24%		24%		16%				
55	27%	3%	32%	3%	25%		30%		30%
56	25%	3%	35%	3%	30%		30%		30%
57	26%	4%	29%	4%	20%		30%		30%
58	22%	2%	25%	4%	30%		30%		30%
59	25%	4%	30%	5%	40%		30%		30%
60	19%	5%	22%	5%	100%		30%		100%
61	18%	5%	22%	5%	100%		30%		100%
62	40%	40%	36%	30%	100%		30%	10%	100%
63	35%	35%	22%	30%	100%		30%	10%	100%
64	25%	30%	20%	25%	100%		30%	10%	100%
65	35%		35%		100%		30%	10%	100%
66	40%		45%		100%		30%	10%	100%
67	45%		40%		100%	50%	30%		100%
68	30%		40%		100%	50%	30%		100%
69	30%		40%		100%	50%	30%		100%
70	40%		50%		100%	100%	100%		100%
71	50%		50%		100%	100%	100%		100%
72	50%		100%		100%	100%	100%		100%
73	50%		100%		100%	100%	100%		100%
74	100%		100%		100%	100%	100%		100%

Table VII
Rates of Disability

All Plan Participants

Age	% of Active Participants Becoming Disabled			
	Uniformed Members		Non-Uniformed Members	
	Male	Female	Male	Female
20	0.10%	0.10%	0.06%	0.06%
21	0.10%	0.10%	0.06%	0.06%
22	0.10%	0.10%	0.07%	0.07%
23	0.10%	0.10%	0.07%	0.07%
24	0.10%	0.10%	0.07%	0.07%
25	0.10%	0.10%	0.08%	0.08%
26	0.10%	0.10%	0.08%	0.08%
27	0.10%	0.10%	0.09%	0.09%
28	0.10%	0.10%	0.09%	0.09%
29	0.10%	0.10%	0.09%	0.09%
30	0.10%	0.10%	0.10%	0.10%
31	0.10%	0.10%	0.10%	0.10%
32	0.10%	0.10%	0.11%	0.11%
33	0.10%	0.10%	0.11%	0.11%
34	0.10%	0.10%	0.12%	0.12%
35	0.10%	0.10%	0.13%	0.13%
36	0.10%	0.10%	0.13%	0.13%
37	0.10%	0.10%	0.14%	0.14%
38	0.10%	0.10%	0.14%	0.14%
39	0.10%	0.10%	0.15%	0.15%
40	0.10%	0.10%	0.17%	0.17%
41	0.10%	0.10%	0.19%	0.19%
42	0.10%	0.10%	0.21%	0.21%
43	0.10%	0.10%	0.23%	0.23%
44	0.10%	0.10%	0.24%	0.24%
45	0.10%	0.10%	0.27%	0.27%
46	0.10%	0.10%	0.30%	0.30%
47	0.10%	0.10%	0.32%	0.32%
48	0.10%	0.10%	0.36%	0.36%
49	0.10%	0.10%	0.41%	0.41%
50	0.10%	0.10%	0.46%	0.46%
51	0.10%	0.10%	0.52%	0.52%
52	0.10%	0.10%	0.59%	0.59%
53	0.10%	0.10%	0.68%	0.68%
54	0.10%	0.10%	0.77%	0.77%
55	0.10%	0.10%	0.86%	0.86%
56	0.10%	0.10%	0.97%	0.97%
57	0.10%	0.10%	1.09%	1.09%
58	0.10%	0.10%	1.22%	1.22%
59	0.10%	0.10%	1.35%	1.35%
60	0.10%	0.10%	1.49%	1.49%
61	0.10%	0.10%	1.64%	1.64%
62	0.10%	0.10%	1.80%	1.80%
63	0.10%	0.10%	1.97%	1.97%
64	0.10%	0.10%	2.15%	2.15%
65	0.10%	0.10%	0.00%	0.00%
66	0.10%	0.10%	0.00%	0.00%
67	0.10%	0.10%	0.00%	0.00%
68	0.10%	0.10%	0.00%	0.00%
69	0.10%	0.10%	0.00%	0.00%
70	0.10%	0.10%	0.00%	0.00%
71	0.10%	0.10%	0.00%	0.00%
72	0.10%	0.10%	0.00%	0.00%

Table VIII
Table Rates of Separation from Active Employment

All Plan Participants

		% of Active Participants Withdrawing			
		Uniformed Members		Non-Uniformed Members	
Age	Service	Male	Female	Male	Female
	0-1	12.00%	12.00%	30.00%	20.00%
	1-2	6.00%	6.00%	16.00%	14.00%
	2-3	2.50%	2.50%	9.00%	11.00%
	3-4	2.50%	2.50%	7.00%	9.00%
	4-5	2.50%	2.50%	5.50%	6.00%
25	5 & Up	1.89%	1.89%	5.60%	6.00%
26		1.89%	1.89%	5.60%	6.00%
27		1.89%	1.89%	5.60%	6.00%
28		1.89%	1.89%	5.60%	6.00%
29		1.89%	1.89%	5.60%	6.00%
30		1.89%	1.89%	5.60%	6.00%
31		1.89%	1.89%	5.53%	6.00%
32		1.83%	1.83%	5.46%	6.00%
33		1.65%	1.65%	5.39%	6.00%
34		1.49%	1.49%	5.32%	6.00%
35		1.34%	1.34%	5.25%	6.00%
36		1.19%	1.19%	5.18%	6.00%
37		1.06%	1.06%	5.11%	6.00%
38		0.95%	0.95%	5.04%	6.00%
39		0.86%	0.86%	4.97%	5.78%
40		0.79%	0.79%	4.90%	5.54%
41		0.74%	0.74%	4.48%	5.29%
42		0.69%	0.69%	4.06%	5.05%
43		0.64%	0.64%	3.64%	4.81%
44		0.60%	0.60%	3.22%	4.56%
45		0.55%	0.55%	2.80%	4.32%
46		0.50%	0.50%	2.66%	4.12%
47		0.46%	0.46%	2.52%	3.92%
48		0.41%	0.41%	2.38%	3.72%
49		0.36%	0.36%	2.24%	3.36%
50		0.32%	0.32%	2.10%	3.00%
51		0.27%	0.27%	1.96%	3.00%
52		0.23%	0.23%	1.82%	3.00%
53		0.21%	0.21%	1.68%	3.00%
54		0.19%	0.19%	1.54%	3.00%
55		0.16%	0.16%	1.40%	3.00%
56		0.17%	0.17%	1.40%	3.00%
57		0.13%	0.13%	1.40%	3.00%
58		0.13%	0.13%	1.40%	3.00%
59		0.13%	0.13%	1.40%	3.00%
60		0.12%	0.12%	1.40%	3.00%