Missouri Department of Transportation and Highway Patrol Employees' Retirement System

GASB Statement Nos. 67 and 68 Accounting and Financial Reporting for Pension Plans

June 30, 2018

GRS Retirement Consulting

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September 27, 2018

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65109

Dear Board Members:

This report provides accounting and financial reporting information that is intended to comply with the Governmental Accounting Standards Board (GASB) Statement Nos. 67 and 68 for the Missouri Department of Transportation and Highway Patrol Employees' Retirement System ("MPERS"). These calculations have been made on a basis that is consistent with our understanding of these accounting standards.

GASB Statement No. 67 is the accounting standard that applies to the stand-alone financial reports issued by retirement systems. GASB Statement No. 68 establishes accounting and financial reporting for State and local government employers who provide their employees (including former employees) pension benefits through a trust.

Our calculation of the liability associated with the benefits described in this report was performed for the purpose of providing reporting and disclosure information that satisfies the requirements of GASB Statement Nos. 67 and 68. The calculation of the plan's liability for this report may not be applicable for funding purposes of the plan. A calculation of the plan's liability for purposes other than satisfying the requirements of GASB No. 67 may produce significantly different results. This report may be provided to parties other than MPERS only in its entirety and only with the permission of the Retirement Board. GRS is not responsible for unauthorized use of this report.

This report is based upon information, furnished to us by Retirement System staff, concerning retirement and ancillary benefits, active members, deferred vested members, retirees and beneficiaries, and financial data. If your understanding of this information is different, please let us know. This information was checked for internal consistency, but it was not audited.

To the best of our knowledge, this report is complete, accurate, and in accordance with generally recognized actuarial methods. Heidi G. Barry is a Member of the American Academy of Actuaries (MAAA) and meets the Qualification Standards of the Academy of Actuaries to render the actuarial opinions herein.

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

Respectfully submitted,

Heidi G Barry

Heidi G. Barry, ASA, FCA, MAAA

Kenneth G. Alberts

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KGA/HGB:dj

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SECTION A

EXECUTIVE SUMMARY

Executive Summary
as of June 30, 2018

Actuarial Valuation Date	June 30, 2018
Measurement Date of the Net Pension Liability	June 30, 2018
Employer's Fiscal Year Ending Date (Employer's Reporting Date)	June 30, 2019
Plan's Fiscal Year Ending Date (Plan's Reporting Date)	June 30, 2018

Membership		
Number of		
- Retirees and Beneficiaries		8,916
- Inactive, Nonretired Members		1,980
- Active Members		7,391
- Total		18,287
Valuation Payroll	$	351,496,555
Covered Payroll (Reported Fiscal Year Payroll Paid)	$	353,751,292
Net Pension Liability		
Total Pension Liability	$	3,981,838,941
Plan Fiduciary Net Position		2,314,530,148
Net Pension Liability	$	1,667,308,793
Plan Fiduciary Net Position as a Percentage of Total Pension Liability		58.13%
Net Pension Liability as a Percentage of Covered Payroll		471.32%
Development of the Single Discount Rate		
Single Discount Rate		7.00%
Long-Term Expected Rate of Investment Return		7.00%
Long-Term Municipal Bond Rate*		3.62%
Last year ending June 30 in the 2019 to 2118 projection period for which projected benefit payments are fully funded		2118
Total Pension Expense	$	147,661,118

Deferred Outflows and Deferred Inflows of Resources by Source to be Recognized in Future Pension Expenses

	Deferred Outflows of Resources	Deferred Inflows of Resources
Difference between expected and actual experience	$ -	$ 62,156,394
Changes in assumptions	109,949,497	-
Net difference between projected and actual earnings on pension plan investments	64,613,062	65,748,696
Total	$ 174,562,559	$ 127,905,090

*Source: *Fixed-income municipal bonds with 20 years to maturity that include only federally tax-exempt municipal bonds as reported in Fidelity Index's "20-Year Municipal GO AA Index" as of June 29, 2018. In describing this index, Fidelity notes that the municipal curves are constructed using option-adjusted analytics of a diverse population of over 10,000 tax exempt securities.*

Discussion

Accounting Standard

For pension plans that are administered through trusts or equivalent arrangements, Governmental Accounting Standards Board (GASB) Statement No. 67 establishes standards of financial reporting for separately issued financial reports and specifies the required approach for measuring the pension liability. Similarly, GASB Statement No. 68 establishes standards for state and local government employers (as well as non-employer contributing entities) to account for and disclose the net pension liability, pension expense, and other information associated with providing retirement benefits to their employees (and former employees) on their basic financial statements.

The following discussion provides a summary of the information that is required to be disclosed under these accounting standards. A number of these disclosure items are provided in this report. However, certain information, such as notes regarding accounting policies and investments, is not included in this report and the retirement system and/or plan sponsor will be responsible for preparing and disclosing that information to comply with these accounting standards.

Financial Statements

GASB Statement No. 68 requires State or local governments to recognize the net pension liability and the pension expense on their financial statements. The net pension liability is the difference between the total pension liability and the plan's fiduciary net position. In traditional actuarial terms, this is analogous to the accrued liability less the market value of assets (not the smoothed actuarial value of assets that is often encountered in actuarial valuations performed to determine the employer's contribution requirement).

The pension expense recognized each fiscal year is equal to the change in the net pension liability from the beginning of the year to the end of the year, adjusted for deferred recognition of the liability and investment experience.

Pension plans that prepare their own, stand-alone financial statements are required to present two financial statements – a statement of fiduciary net position and a statement of changes in fiduciary net position in accordance with GASB Statement No. 67. The *statement of fiduciary net position* presents the assets and liabilities of the pension plan at the end of the pension plan's reporting period. The *statement of changes in fiduciary net position* presents the additions, such as contributions and investment income, and deductions, such as benefit payments and expenses, and net increase or decrease in the fiduciary net position.

Notes to Financial Statements

GASB Statement No. 68 requires the notes of the employer's financial statements to disclose the total pension expense, the pension plan's liabilities and assets, and deferred outflows and inflows of resources related to pensions.

Discussion

Both GASB Statements, No. 67 and No. 68 require the notes of the financial statements for the employers and pension plans to include certain additional information. The list of disclosure items should include:

- a description of benefits provided by the plan;
- the type of employees and number of members covered by the pension plan;
- a description of the plan's funding policy, which includes member and employer contribution requirements;
- the pension plan's investment policies;
- the pension plan's fiduciary net position, net pension liability, and the pension plan's fiduciary net position as a percentage of the total pension liability;
- the net pension liability using a discount rate that is 1% higher and 1% lower than used to calculate the total pension liability and net pension liability for financial reporting purposes;
- significant assumptions and methods used to calculate the total pension liability;
- inputs to the discount rates; and
- certain information about mortality assumptions and the dates of experience studies.

Retirement Systems that issue stand-alone financial statements are required to disclose additional information in accordance with GASB Statement No. 67. This information includes:

- the composition of the pension plan's Board and the authority under which benefit terms may be amended;
- a description of how fair value is determined; and
- information regarding certain reserves and investments, which include concentrations of investments greater than or equal to 5%, receivables, and insurance contracts excluded from plan assets.

Required Supplementary Information

GASB Statement No. 67 requires a 10-year fiscal history of:

- sources of changes in the net pension liability;
- information about the components of the net pension liability and related ratios, including the pension plan's fiduciary net position as a percentage of the total pension liability, and the net pension liability as a percent of covered-employee payroll; and
- comparison of the actual employer contributions to the actuarially determined contributions based on the plan's funding policy.

Timing of the Valuation

An actuarial valuation to determine the total pension liability is required to be performed at least every two years. The net pension liability and pension expense should be measured as of the pension plan's fiscal year end (measurement date) on a date that is within the employer's prior fiscal year. If the actuarial valuation used to determine the total pension liability is not calculated as of the measurement date, the Total Pension Liability (TPL) is required to be rolled forward from the actuarial valuation date to the measurement date.

Discussion

The total pension liability shown in this report is based on an actuarial valuation performed as of June 30, 2018 and a measurement date of June 30, 2018.

Single Discount Rate

Projected benefit payments are required to be discounted to their actuarial present values using a single discount rate that reflects: 1) a long-term expected rate of return on pension plan investments (to the extent that the plan's fiduciary net position is projected to be sufficient to pay benefits); and 2) tax-exempt municipal bond rate based on an index of 20-year general obligation bonds with an average AA credit rating (which is published by the Fidelity Index) as of the measurement date (to the extent that the contributions for use with the long-term expected rate of return are not met).

For the purpose of this valuation, the expected rate of return on pension plan investments is 7.00%; the municipal bond rate is 3.62% (based on the daily rate closest to but not later than the measurement date of the 20-Year Municipal GO AA Index as published by the Fidelity Index); and the resulting single discount rate is 7.00%.

Under the Board's current funding policy, the plan is expected to exceed a 100% funded status if future experience is exactly as assumed due to the Contribution Stabilization Reserve Fund that became part of the funding policy in 2014.

Asset Adjustment

There was a beginning of period asset adjustment reported to us this year. We understand the adjustment was related to proportionate share calculations under GASB 75 from another plan. We have recognized that adjustment immediately in the development of the Pension Expense.

Plan Changes

A plan change was made last year that provided for 5-year vesting for Tier 2011 members and deferred benefits for future survivors of Tier 2011 vested former members who died prior to retirement (benefits are deferred to the date the member would have been eligible to receive benefits). Although this change was effective July 1, 2017, it was enacted in late-summer after the valuation reports had been mostly completed. Given the de minimus magnitude of the change on accrued liability (and TPL), it was decided to recognize this change effective with the June 30, 2018 valuation. This resulted in a change in the TPL of $(7,684).

SECTION B

FINANCIAL STATEMENTS

Statement of Pension Expense Under GASB Statement No. 68
Fiscal Year Ended June 30, 2018

A. Expense		
1. Service Cost	$	46,621,377
2. Interest on the Total Pension Liability		286,457,436
3. Current-Period Benefit Changes		(7,684)
4. Member Contributions (made negative for addition here)#		(3,721,984)
5. Projected Earnings on Plan Investments (made negative for addition here)		(166,109,057)
6. Pension Plan Administrative Expense		4,693,492
7. Other Changes in Plan Fiduciary Net Position#		(2,210,461)
8. Recognition of Outflow (Inflow) of Resources due to Liabilities		1,829,242
9. Recognition of Outflow (Inflow) of Resources due to Assets		(19,891,243)
10. Total Pension Expense	**$**	**147,661,118**

 # Employee payments for service purchase of $1,279,434 and reciprocal transfers of $1,867,445 were included in line 7. Moving the amount to line 4 would have no effect on results. Includes beginning-of-year adjustment of $(936,418) in the Fiduciary Net Position.

Statement of Outflows and Inflows Arising from Current Reporting Period Fiscal Year Ended June 30, 2018

A. Outflows (Inflows) of Resources due to Liabilities		
1. Difference between expected and actual experience of the Total Pension Liability (gains) or losses	$	(37,173,164)
2. Assumption Changes (gains) or losses	$	142,556,109
3. Recognition period for Liabilities: Average of the expected remaining service lives of all employees {in years}		4.3720
4. Outflow (Inflow) of Resources to be recognized in the current pension expense for the difference between expected and actual experience of the Total Pension Liability	$	(8,502,554)
5. Outflow (Inflow) of Resources to be recognized in the current pension expense for Assumption Changes	$	32,606,612
6. Outflow (Inflow) of Resources to be recognized in the current pension expense due to Liabilities	$	24,104,058
7. Deferred Outflow (Inflow) of Resources to be recognized in future pension expenses for the difference between expected and actual experience of the Total Pension Liability	$	(28,670,610)
8. Deferred Outflow (Inflow) of Resources to be recognized in future pension expenses for Assumption Changes	$	109,949,497
9. Deferred Outflow (Inflow) of Resources to be recognized in future pension expenses due to Liabilities	$	81,278,887
B. Outflows (Inflows) of Resources due to Assets		
1. Net difference between projected and actual earnings on pension plan investments (gains) or losses	$	(31,510,781)
2. Recognition period for Assets {in years}		5
3. Outflow (Inflow) of Resources to be recognized in the current pension expense due to Assets	$	(6,302,156)
4. Deferred Outflow (Inflow) of Resources to be recognized in future pension expenses due to Assets	$	(25,208,625)

Statement of Outflows and Inflows Arising from Current and Prior Reporting Periods Fiscal Year Ended June 30, 2018

A. Outflows and Inflows of Resources due to Liabilities and Assets to be Recognized in Current Pension Expense

	Outflows of Resources	Inflows of Resources	Net Outflows of Resources
1. Due to Liabilities	$ 32,606,612	$ 30,777,370	$ 1,829,242
2. Due to Assets	38,054,415	57,945,658	(19,891,243)
3. Total	$ 70,661,027	$ 88,723,028	$ (18,062,001)

B. Outflows and Inflows of Resources by Source to be Recognized in Current Pension Expense

	Outflows of Resources	Inflows of Resources	Net Outflows of Resources
1. Differences between expected and actual experience	$ -	$ 30,777,370	$ (30,777,370)
2. Assumption Changes	32,606,612	-	32,606,612
3. Net Difference between projected and actual earnings on pension plan investments	38,054,415	57,945,658	(19,891,243)
4. Total	$ 70,661,027	$ 88,723,028	$ (18,062,001)

C. Deferred Outflows and Deferred Inflows of Resources by Source to be Recognized in Future Pension Expenses

	Deferred Outflows of Resources	Deferred Inflows of Resources	Net Deferred Outflows of Resources
1. Differences between expected and actual experience	$ -	$ 62,156,394	$ (62,156,394)
2. Assumption Changes	109,949,497	-	109,949,497
3. Net Difference between projected and actual earnings on pension plan investments	64,613,062	65,748,696	(1,135,634)
4. Total	$ 174,562,559	$ 127,905,090	$ 46,657,469

D. Deferred Outflows and Deferred Inflows of Resources by Year to be Recognized in Future Pension Expenses

Year Ending June 30	Net Deferred Outflows of Resources
2019	$ 23,742,750
2020	19,036,436
2021	1,213,727
2022	2,664,556
2023	-
Thereafter	-
Total	$ 46,657,469

Statement of Fiduciary Net Position
as of June 30, 2018

Assets		
Repurchase Agreements-Cash	$	539,497
Receivables		
Investment Sales	$	6,843,573
Accrued Investment Interest and Income		6,383,098
Contributions		8,686,626
Other		-
Total Receivables	$	21,913,297
Investments		
Equities	$	470,017,822
Fixed Income		656,008,238
Limited partnerships		981,543,412
Hedge		147,595,231
Short Term Securities		51,777,948
Real Estate		-
Absolute Return		-
Venture Capital & Partnerships		-
Total Investments	$	2,306,942,651
Securities Lending Collateral	$	133,616,409
Prepaid Accounts	$	-
Capial Assets		
Land (not depreciated)	$	84,000
Equipment		3,504,218
Building		581,619
Accumulated Depreciation		(3,311,291)
Total Capital Assets	$	858,546
Deferred Outflows - OPEB Related Items	$	34,090
Total Assets	$	2,463,904,490
Liabilities		
Investment Purchases Payable	$	7,057,400
OPEB Obligations		1,545,180
Security Lending Collateral		138,840,857
Deferred Inflows - OPEB Related Items		199,219
Accounts Payable - Other		1,731,686
Total Liabilities	$	149,374,342
Net Position Restricted for Pensions	$	2,314,530,148

Statement of Changes in Fiduciary Net Position for Year Ended June 30, 2018

Additions		
Contributions		
Employer	$	204,955,180
Employee		3,721,984
Reciprocal Transfer		1,867,445
Service Purchase		1,279,434
Total Contributions	$	211,824,043
Investment Income		
Total net appreciation and gains	$	157,187,087
Total interest and dividends		70,726,752
Less total investment expenses		(30,486,906)
Net Investment Income	$	197,426,933
Income From Securities Lending Activities		
Securities Lending Income	$	985,860
Less Total Securities Lending Expenses		(793,427)
Net Income from Securities Lending Activities	$	192,433
Other	$	472
Total Additions	$	409,443,881
Deductions		
Benefit Payments, Including Refunds	$	259,058,863
Administrative Expenses		4,693,492
Total Deductions	$	263,752,355
Net Increase in Net Position	$	145,691,526
Net Position Restricted for Pensions		
Beginning of Year	$	2,169,775,040
Post Valuation Audit Adjustment	$	(936,418)
End of Year	$	2,314,530,148

Schedule of Proportionate Employer Share
for Year Ended June 30, 2018

				Deferred Outflows of Resources					Deferred Inflows of Resources					Pension Expense		
Contributions#	Employer	Prop. Share	Net Pension Liability	Differences Between Expected and Actual Experience	Net Difference Between Projected and Actual Investment Earnings on Pension Plan Investments	Changes of Assum.	Changes in Proportion and Differences Between Employer Cont. and Share of Cont.	Total Deferred Outflows of Resources	Differences Between Expected and Actual Experience	Net Difference Between Projected and Actual Investment Earnings on Pension Plan Investments	Changes of Assum.	Changes in Proportion and Differences Between Employer Cont. and Share of Cont.	Total Deferred Inflows of Resources	Prop. Share of Plan Pension Expense	Net Amortization of Deferred Amounts from Changes in Proportion and Differences Between Employer Contributions and Proportionate Share of Contributions	Total Employer Pension Expense
$ 127,168,503	MoDOT	62.39%	$ 1,040,233,956	$ -	$ 40,312,089	$ 68,597,491	$ 4,658,947	$ 113,568,527	$ 38,779,374	$ 41,020,611	$ -	$ 3,266,165	$ 83,066,150	$ 92,125,772	$ (6,211,702)	$ 85,914,070
76,659,171	Highway Patrol	37.61%	627,074,837	-	24,300,973	41,352,006	3,266,165	68,919,144	23,377,020	24,728,085	-	4,658,947	52,764,052	55,535,346	6,211,702	61,747,048
$ 203,827,674	***Total for All Employers***	**100.0000%**	**$ 1,667,308,793**	**$ -**	**$ 64,613,062**	**$ 109,949,497**	**$ 7,925,112**	**$ 182,487,671**	**$ 62,156,394**	**$ 65,748,696**	**$ -**	**$ 7,925,112**	**$ 135,830,202**	**$ 147,661,118**	**$ -**	**$ 147,661,118**

 # Excludes $1,127,506 in contributions for Retirement System members. Retirement System members' cost were spread proportionately to the other two employers.

		Schedule of Deferred (Inflows)/Outflows						
Employer	**Employer Allocation Percentage**	**2019**	**2020**	**2021**	**2022**	**2023**	**Thereafter**	**Total**
MoDOT	62.39%	$ 13,331,365	$ 12,884,554	$ 2,110,065	$ 2,176,392	$ -	$ -	$ 30,502,376
Highway Patrol	37.61%	10,411,385	6,151,882	(896,338)	488,164	-	-	16,155,093
TOTAL	100.00%	$ 23,742,750	$ 19,036,436	$ 1,213,727	$ 2,664,556	$ -	$ -	$ 46,657,469

SECTION C

REQUIRED SUPPLEMENTARY INFORMATION

Schedule of Changes in Net Pension Liability and Related Ratios Current Period Fiscal Year Ended June 30, 2018

A. Total Pension Liability		
1. Service Cost	$	46,621,377
2. Interest on the Total Pension Liability		286,457,436
3. Changes of Benefit Terms		(7,684)
4. Difference between expected and actual experience of the Total Pension Liability		(37,173,164)
5. Changes of Assumptions		142,556,109
6. Benefit Payments, including Refunds of Employee Contributions		(254,634,216)
7. Disability Premiums		(1,601,605)
8. Transfers to Other Retirement Systems		(2,823,042)
9. Net change in Total Pension Liability	$	179,395,211
10. Total Pension Liability – Beginning		3,802,443,730
11. Total Pension Liability – Ending	**$**	**3,981,838,941**
B. Plan Fiduciary Net Position		
1. Contributions – employer	$	204,955,180
2. Contributions – employee		5,001,418
3. Net investment income		197,619,838
4. Benefit payments, including refunds of employee contributions		(254,634,216)
5. Disability Premiums		(1,601,605)
6. Pension Plan Administrative Expense		(4,693,492)
7. Net Transfers to Other Retirement Systems		(955,597)
8. Other		-
9. Net change in Plan Fiduciary Net Position	$	145,691,526
10. Plan Fiduciary Net Position – Beginning		2,169,775,040
11. Post Valuation Audit Adjustment		(936,418)
12. Plan Fiduciary Net Position – Ending	**$**	**2,314,530,148**
C. Net Pension Liability	**$**	**1,667,308,793**
D. Plan Fiduciary Net Position as a percentage of the Total Pension Liability		**58.13%**
E. Covered Payroll (Reported Fiscal Year Payroll Paid) #	**$**	**353,751,292**
F. Net Pension Liability as a percentage of covered-employee payroll		**471.32%**

 # Valuation Payroll was $351,496,555.

Schedules of Required Supplementary Information
Schedule of Changes in Net Pension Liability and Related Ratios (Multiyear)

(Ultimately 10 Fiscal Years Will Be Displayed)

Fiscal year ending June 30,	2018	2017	2016	2015	2014	2013*
Total Pension Liability						
Service Cost	$ 46,621,377	$ 45,713,403	$ 45,441,305	$ 45,358,095	$ 44,739,603	$ 44,446,279
Interest on the Total Pension Liability	286,457,436	283,568,441	280,432,068	275,284,910	270,525,608	265,339,848
Benefit Changes	(7,684)	-	-	-	-	-
Difference between Expected and Actual Experience	(37,173,164)	(37,286,966)	(39,810,009)	(13,324,219)	(17,614,321)	(13,690,794)
Assumption Changes	142,556,109	-	-	-	-	204,396,180
Benefit Payments	(254,131,209)	(246,617,775)	(236,488,629)	(236,905,323)	(227,958,108)	(220,623,394)
Refunds	(503,007)	(321,328)	(198,106)	(107,395)	(18,686)	(29,300)
Disability Premiums	(1,601,605)	(1,620,418)	(1,567,825)	(1,554,676)	(1,531,578)	(1,512,685)
Transfers to Other Retirement Systems	(2,823,042)	(2,724,631)	(1,921,451)	(3,147,482)	(1,876,336)	(629,246)
Net Change in Total Pension Liability	179,395,211	40,710,726	45,887,353	65,603,910	66,266,182	277,696,888
Total Pension Liability - Beginning	3,802,443,730	3,761,733,004	3,715,845,651	3,650,241,741	3,583,975,559	3,306,278,671
Total Pension Liability - Ending (a)	$ 3,981,838,941	$ 3,802,443,730	$ 3,761,733,004	$ 3,715,845,651	$ 3,650,241,741	$3,583,975,559
Plan Fiduciary Net Position						
Contributions - Employer	$ 204,955,180	$ 206,562,924	$ 199,609,396	$ 200,638,571	$ 183,353,841	$ 170,836,117
Contributions - Member	5,001,418	4,891,932	3,482,513	3,294,162	2,260,563	1,139,450
Pension Plan Net Investment Income	197,619,838	220,301,741	21,432,095	92,645,571	319,445,780	198,141,088
Benefit Payments	(254,131,209)	(246,617,775)	(236,488,629)	(236,905,323)	(227,958,108)	(220,619,035)
Refunds	(503,007)	(321,328)	(198,106)	(107,395)	(18,686)	(29,300)
Disability Premiums	(1,601,605)	(1,620,418)	(1,567,825)	(1,554,676)	(1,531,578)	(1,512,685)
Pension Plan Administrative Expense	(4,693,492)	(4,515,458)	(4,370,860)	(4,066,944)	(3,736,355)	(2,997,225)
Net Transfers	(955,597)	(980,524)	808,228	(2,033,045)	(91,954)	(629,246)
Other	-	-	-	-	-	-
Net Change in Plan Fiduciary Net Position	145,691,526	177,701,094	(17,293,188)	51,910,921	271,723,503	144,329,164
Plan Fiduciary Net Position - Beginning	2,169,775,040	1,992,073,946	2,009,367,134	1,957,456,213	1,685,732,710	1,541,403,546
Post Valuation Audit Adjustment	(936,418)	-	-	-	-	-
Plan Fiduciary Net Position - Ending (b)	$ 2,314,530,148	$ 2,169,775,040	$ 1,992,073,946	$ 2,009,367,134	$ 1,957,456,213	$1,685,732,710
Net Pension Liability - Ending (a) - (b)	1,667,308,793	1,632,668,690	1,769,659,058	1,706,478,517	1,692,785,528	1,898,242,849
Plan Fiduciary Net Position as a Percentage of Total Pension Liability	58.13 %	57.06 %	52.96 %	54.08 %	53.63 %	47.04 %
Covered-Employee Payroll	$ 353,751,292	$ 356,515,416	$ 344,635,441	$ 342,264,593	$ 336,590,797	$ 323,205,767
Net Pension Liability as a Percentage of Covered-Employee Payroll	471.32 %	457.95 %	513.49 %	498.58 %	502.92 %	587.32 %
Notes to Schedule:	N/A	N/A	N/A	N/A	N/A	N/A

* *After post-"June 30, 2013 valuation" adjustments.*

Schedules of Required Supplementary Information
Schedule of the Net Pension Liability (Multiyear)

(Ultimately 10 Fiscal Years Will Be Displayed)

FY Ending June 30,	Total Pension Liability	Plan Net Position	Net Pension Liability	Plan Net Position as a % of Total Pension Liability	Covered Payroll	Net Pension Liability as a % of Covered Payroll
2013	$ 3,583,975,559	$ 1,681,869,871	$ 1,902,105,688	46.93%	$ 323,205,767	588.51%
2014	3,650,241,741	1,957,456,213	1,692,785,528	53.63%	336,590,797	502.92%
2015	3,715,845,651	2,009,367,134	1,706,478,517	54.08%	342,264,593	498.58%
2016	3,761,733,004	1,992,073,946	1,769,659,058	52.96%	344,635,441	513.49%
2017	3,802,443,730	2,169,775,040	1,632,668,690	57.06%	356,515,416	457.95%
2018	3,981,838,941	2,314,530,148	1,667,308,793	58.13%	353,751,292	471.32%

Schedule of Contributions (Multiyear)

Last 10 Fiscal Years

FY Ending June 30,	Actuarially Determined Contribution	Actual Contribution	Contribution Deficiency (Excess)	Covered Payroll *	Actual Contribution as a % of Covered Payroll
2009	$ 122,613,975	$ 122,613,975	$ -	$ 379,140,306	32.34%
2010	124,052,534	124,052,534	-	376,258,823	32.97%
2011	149,952,750	149,952,750	-	363,345,651	41.27%
2012	164,884,467	164,884,467	-	344,514,139	47.86%
2013	170,836,117	170,836,117	-	329,863,134	51.79%
2014	183,353,841	183,353,841	-	336,799,855	54.44%
2015	200,638,571	200,638,571	-	342,211,446	58.63%
2016	199,609,396	199,609,396	-	344,154,131	58.00%
2017	206,562,924	206,562,924	-	356,142,972	58.00%
2018	204,955,180	204,955,180	-	353,371,000	58.00%

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

Notes to Schedule of Contributions

Valuation Date:	June 30, 2016
Notes	Actuarially determined contribution rates are calculated as of June 30, for the fiscal year ending 2 years thereafter.

Methods and Assumptions Used to Determine FY 2018 Contribution Rates:

Actuarial Cost Method	Entry-Age
Amortization Method	Level Percentage of Payroll, Closed #
Remaining Amortization Period	Permanent Policy: The total contribution will be based on normal cost plus a 19-year amortization of UAAL. The amortization period is a closed 19-year period starting July 1, 2017. Temporary Accelerated Policy: The total contribution is based on normal cost plus an 8-year amortization period for unfunded retiree liabilities and a 23-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2017. 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.
Asset Valuation Method	3-Year smoothed market; 20% corridor
Inflation	3.0% (price inflation)
Salary Increases	3.50% to 11.00% (including 3.50% wage inflation)
Investment Rate of Return	7.75%
Retirement Age	Experience-based table of rates that are specific to the type of eligibility condition. Last updated for the 2013 valuation pursuant to an experience study of the period July 1, 2007 - June 30, 2012.
Mortality	The mortality tables, for post-retirement mortality, used in evaluating allowances to be paid to non-disabled pensioners were the RP-2000 Combined Healthy Mortality Tables projected 16 years and set back 1 year for males and females. Pre-retirement mortality used was 70% for males and 50% for females of the post-retirement tables set back 1 year for males and set back 1 year for females. Disabled pension mortality was based on PBGC Disabled Mortality tables. The healthy mortality tables include a margin for mortality improvement. The margin is in the 16-year projection. The disabled mortality tables do not include a margin for mortality improvement.

Other Information:

Notes	There were no benefit changes during the year.

 # A Contribution Stabilization Reserve Fund of approximately $157.6 million was added to the unfunded for purposes of determining the FY 20 contribution rate.

SECTION D

NOTES TO FINANCIAL STATEMENTS

Single Discount Rate

A single discount rate of 7.00% was used to measure the total pension liability. This single discount rate was based on the expected rate of return on pension plan investments of 7.00%. The projection of cash flows used to determine this single discount rate assumed that plan member contributions will be made at the current contribution rate and that employer contributions will be made at rates equal to the difference between actuarially determined contribution rates and the member rate. Based on these assumptions, the pension plan's fiduciary net position was projected to be available to make all projected future benefit payments of current plan members. Therefore, the long-term expected rate of return on pension plan investments was applied to all periods of projected benefit payments to determine the total pension liability.

Regarding the sensitivity of the net pension liability to changes in the single discount rate, the following presents the plan's net pension liability, calculated using a single discount rate of 7.00%, as well as what the plan's net pension liability would be if it were calculated using a single discount rate that is 1-percentage-point lower or 1-percentage-point higher:

Sensitivity of Net Pension Liability to the Single Discount Rate Assumption

	1% Decrease 6.00%	Current Single Discount Rate Assumption 7.00%	1% Increase 8.00%
Total Pension Liability	$4,455,159,488	$3,981,838,941	$3,586,985,232
Plan Fiduciary Net Position	2,314,530,148	2,314,530,148	2,314,530,148
Net Pension Liability	$2,140,629,340	$1,667,308,793	$1,272,455,084

The inclusion of discount rates in the schedule above is not an indication of the reasonableness of the discount rate as an assumption.

Reconciliation of DROP Accounts

Disclosure Regarding the Contribution Stabilization Reserve Fund

At the September 26, 2014 Board meeting, the Board adopted the use of a Contribution Stabilization Reserve Fund that would result in an MPERS employer contribution rate similar to the Fiscal Year 2015 rates. The Contribution Stabilization Reserve Fund is intended to keep the contribution relatively level over time and may be used if the market experiences a downturn in the future. The Board further adopted (in February 2015) that the employer contribution rate would not fall below 58% unless 1) the fund became fully funded or 2) the Contribution Stabilization Reserve Fund reached $250 million. The balance of the Contribution Stabilization Reserve Fund as of June 30, 2018 is $157,556,374.

Disclosure Regarding the Deferred Retirement Option Program

MPERS currently provides a BackDROP option. This is an election made at the time of actual retirement. In effect, it provides members an option to elect to receive a portion of their benefits as cash. Since the election is not made until the member actually retires, the option is not treated as a DROP provision as defined in GASB Statement No. 67.

Summary of Population Statistics

Inactive Plan Members or Beneficiaries Currently Receiving Benefits	8,916
Inactive Plan Members Entitled to But Not Yet Receiving Benefits	1,980
Active Plan Members	7,391
Total Plan Members	18,287

SECTION E

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 | **Year 2000 Plan** | **2011 Tier**

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

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.

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.

Year 2000 Plan

Normal Retirement Benefit Amount

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.

Early Retirement (reduced benefit)

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.

2011 Tier

Normal Retirement Benefit Amount

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)

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

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 & 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.

SECTION F

ACTUARIAL COST METHOD AND ACTUARIAL ASSUMPTIONS

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 32. 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).

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

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.

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 33.

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 34.

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 35.

The probabilities of age and service retirement are shown on page 37. 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 38.

The probabilities of withdrawal from service are shown on page 39.

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

Present assets (cash & investments) were used at market value.

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	
	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%

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%
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%
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	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female	Age	% Dying Next Year Male	% Dying Next Year Female
20	0.0239%	0.0106%	60	0.3113%	0.1733%	100	20.3698%	18.2108%
21	0.0268%	0.0108%	61	0.3515%	0.1870%	101	21.6953%	19.5173%
22	0.0295%	0.0109%	62	0.3965%	0.2013%	102	23.0097%	20.8404%
23	0.0313%	0.0112%	63	0.4467%	0.2166%	103	24.3068%	22.1612%
24	0.0324%	0.0116%	64	0.5019%	0.2329%	104	25.5767%	23.4585%
25	0.0309%	0.0119%	65	0.5624%	0.2506%	105	26.8023%	24.7399%
26	0.0302%	0.0122%	66	0.6210%	0.2753%	106	27.9806%	25.9962%
27	0.0300%	0.0127%	67	0.6844%	0.3028%	107	29.1078%	27.1838%
28	0.0303%	0.0133%	68	0.7539%	0.3335%	108	30.1730%	28.3288%
29	0.0311%	0.0140%	69	0.8303%	0.3680%	109	31.1818%	29.4109%
30	0.0322%	0.0150%	70	0.9147%	0.4070%	110	32.1129%	30.4338%
31	0.0337%	0.0161%	71	1.0083%	0.4510%	111	32.4876%	31.3855%
32	0.0352%	0.0174%	72	1.1130%	0.5006%	112	32.4841%	32.2733%
33	0.0368%	0.0187%	73	1.2299%	0.5572%	113	32.4969%	32.6372%
34	0.0382%	0.0200%	74	1.3608%	0.6207%	114	32.4903%	32.5619%
35	0.0393%	0.0214%	75	1.5071%	0.6928%	115	32.5000%	32.5000%
36	0.0402%	0.0227%	76	1.6706%	0.7741%	116	32.5000%	32.5000%
37	0.0412%	0.0242%	77	1.8540%	0.8664%	117	32.5000%	32.5000%
38	0.0423%	0.0258%	78	2.0582%	0.9704%	118	32.5000%	32.5000%
39	0.0437%	0.0276%	79	2.2859%	1.0874%	119	32.5000%	32.5000%
40	0.0456%	0.0296%	80	2.5398%	1.2190%	120	100.0000%	100.0000%
41	0.0478%	0.0317%	81	2.8770%	1.4450%			
42	0.0506%	0.0340%	82	3.2941%	1.7633%			
43	0.0543%	0.0367%	83	3.7903%	2.1715%			
44	0.0588%	0.0398%	84	4.3640%	2.6658%			
45	0.0640%	0.0434%	85	5.0073%	3.2435%			
46	0.0705%	0.0474%	86	5.7229%	3.9007%			
47	0.0777%	0.0521%	87	6.5034%	4.6310%			
48	0.0860%	0.0571%	88	7.3429%	5.4253%			
49	0.0954%	0.0626%	89	8.2360%	6.2734%			
50	0.1058%	0.0688%	90	9.1736%	7.1761%			
51	0.1174%	0.0757%	91	10.1429%	8.1223%			
52	0.1305%	0.0835%	92	11.1417%	9.1047%			
53	0.1442%	0.0922%	93	12.1542%	10.1144%			
54	0.1594%	0.1017%	94	13.1696%	11.1381%			
55	0.1764%	0.1121%	95	14.1705%	12.1722%			
56	0.1960%	0.1233%	96	15.3429%	13.2898%			
57	0.2187%	0.1351%	97	16.5387%	14.4518%			
58	0.2452%	0.1474%	98	17.7826%	15.6658%			
59	0.2759%	0.1602%	99	19.0601%	16.9224%			

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

		% 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%

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 (Concluded)

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 of the valuation report), 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 40.

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.

SECTION G

CALCULATION OF THE SINGLE DISCOUNT RATE

Calculation of the Single Discount Rate

GASB Statement No. 67 includes a specific requirement for the discount rate that is used for the purpose of the measurement of the Total Pension Liability. This rate considers the ability of the fund to meet benefit obligations in the future. To make this determination, employer contributions, employee contributions, benefit payments, expenses and investment returns are projected into the future. The Plan Net Position (assets) in future years can then be determined and compared to its obligation to make benefit payments in those years. As long as assets are projected to be on hand in a future year, the assumed valuation discount rate is used. In years where assets are not projected to be sufficient to meet benefit payments, the use of a "risk-free" rate is required, as described in the following paragraph.

The Single Discount Rate (SDR) is equivalent to applying these two rates to the benefits that are projected to be paid during the different time periods. The SDR reflects (1) the long-term expected rate of return on pension plan investments (during the period in which the fiduciary net position is projected to be sufficient to pay benefits) and (2) tax-exempt municipal bond rate based on an index of 20-year general obligation bonds with an average AA credit rating (which is published by the Fidelity Index) as of the measurement date (to the extent that the contributions for use with the long-term expected rate of return are not met).

For the purpose of this valuation, the expected rate of return on pension plan investments is 7.00%; the municipal bond rate is 3.62%; and the resulting single discount rate is 7.00%.

The tables in this section provide background for the development of the single discount rate.

The **Projection of Contributions** table shows the development of expected contributions in future years. Normal Cost contributions for future hires are not included (nor are their liabilities).

The **Projection of Plan Fiduciary Net Position** table shows the development of expected asset levels in future years.

The **Present Values of Projected Benefit Payments** table shows the development of the Single Discount Rate (SDR). It breaks down the benefit payments into present values for funded and unfunded portions and shows the equivalent total at the SDR.

The table on page 44 shows the projected contributions on behalf of the current members. This contribution is based on the current funding policy. The amortization of UAL is similar to the amortization schedule shown in the June 30, 2018 valuation report and includes the effects of the $157,556,374 Contribution Stabilization Reserve Fund. However, the schedule was adjusted for the use of market value of assets instead of actuarial value of assets and to allow the Contribution Stabilization Reserve Fund to grow until reaching $250 million. Once the maximum Contribution Stabilization Reserve Fund was reached, contributions were reduced, but not below $0.

The tables shown on pages 47 and 48 show that the present value of projected unfunded benefit payments using the municipal bond rate is $0. Therefore, we used the market rate of assumed investment return for all periods in the valuation.

The Projected Total Contributions shown are based on a closed group projection and are therefore not applicable for funding purposes of the open group.

Single Discount Rate Development
Projection of Contributions Ending June 30, 2068

Year	Valuation Payroll for Current Employees	Contributions from Current Employees	Service Cost and Expense Contributions	UAL Contributions	Total Contributions
0	$ 351,496,554				
1	349,183,610	$ 3,850,070	$ 41,195,738	$ 159,669,134	$ 204,714,942
2	331,492,003	3,693,601	39,081,429	164,459,208	207,234,238
3	315,618,338	3,606,630	37,073,336	169,392,984	210,072,950
4	299,845,448	3,541,833	34,989,916	174,474,774	213,006,523
5	283,919,436	3,486,114	32,831,082	179,709,017	216,026,213
6	268,050,475	3,432,494	30,660,204	185,100,288	219,192,985
7	252,049,473	3,378,221	28,456,345	190,653,297	222,487,862
8	236,242,143	3,325,593	26,270,161	119,045,220	148,640,973
9	221,134,062	3,271,680	24,185,520	122,616,577	150,073,778
10	206,614,221	3,216,607	22,201,742	126,295,075	151,713,424
11	192,707,271	3,163,601	20,328,192	130,083,927	153,575,720
12	179,430,324	3,112,739	18,568,780	133,986,445	155,667,964
13	166,939,815	3,065,077	16,946,522	138,006,038	158,017,636
14	155,067,379	3,018,405	15,431,586	142,146,218	160,596,209
15	143,715,425	2,970,254	14,000,994	146,410,605	163,381,852
16	132,965,397	2,921,737	12,668,390	150,802,924	166,393,051
17	122,909,593	2,873,312	11,435,517	155,327,011	169,635,839
18	113,731,400	2,824,908	10,323,098	159,986,821	173,134,828
19	105,136,284	2,773,965	9,289,687	164,786,426	176,850,078
20	96,991,748	2,719,061	8,313,896	154,589,108	165,622,065
21	89,379,835	2,659,773	7,405,420	(7,405,420)	2,659,773
22	82,579,969	2,595,555	6,602,586	(6,602,586)	2,595,555
23	76,595,185	2,524,386	5,912,004	-	8,436,389
24	70,999,997	2,438,009	5,289,630	-	7,727,639
25	65,511,375	2,327,483	4,711,853	-	7,039,336
26	59,971,348	2,190,184	4,166,333	-	6,356,517
27	54,068,681	2,017,768	3,629,110	-	5,646,878
28	47,712,585	1,811,851	3,088,744	-	4,900,595
29	41,191,992	1,586,685	2,571,514	-	4,158,200
30	34,577,758	1,347,340	2,079,037	-	3,426,377
31	28,113,548	1,103,916	1,627,681	-	2,731,597
32	22,020,231	867,638	1,230,361	-	2,097,999
33	16,454,889	649,593	886,799	-	1,536,392
34	11,751,526	464,478	611,004	-	1,075,482
35	8,101,611	320,537	404,215	-	724,752
36	5,441,253	215,460	257,772	-	473,232
37	3,616,511	143,326	161,288	-	304,614
38	2,393,274	94,943	100,533	-	195,476
39	1,573,415	62,491	61,710	-	124,201
40	1,054,325	41,935	39,633	-	81,568
41	710,023	28,280	26,319	-	54,599
42	469,157	18,710	17,045	-	35,755
43	303,326	12,109	10,830	-	22,939
44	190,453	7,609	6,786	-	14,395
45	115,232	4,606	4,029	-	8,635
46	62,574	2,502	2,111	-	4,613
47	29,651	1,186	889	-	2,075
48	12,651	506	406	-	912
49	5,156	206	163	-	369
50	1,790	72	28	-	99

Single Discount Rate Development
Projection of Plan Fiduciary Net Position Ending June 30, 2118

Year	Projected Beginning Plan Net Position	Projected Total Contributions	Projected Benefit Payments	Projected Administrative Expenses	Projected Investment Earnings at 7.00%	Projected Ending Plan Net Position
	(a)	(b)	(c)	(d)	(e)	(f)=(a)+(b)-(c)-(d)+(e)
1	$ 2,314,530,148	$ 204,714,942	$ 250,131,576	$ 4,399,713	$ 160,303,027	$ 2,425,016,829
2	2,425,016,829	207,234,238	256,121,821	4,176,799	167,925,336	2,539,877,784
3	2,539,877,784	210,072,950	262,808,333	3,976,791	175,840,090	2,659,005,699
4	2,659,005,699	213,006,523	269,727,162	3,778,053	184,048,757	2,782,555,765
5	2,782,555,765	216,026,213	277,234,349	3,577,385	192,549,761	2,910,320,004
6	2,910,320,004	219,192,985	285,022,877	3,377,436	201,341,112	3,042,453,788
7	3,042,453,788	222,487,862	293,423,234	3,175,823	210,421,744	3,178,764,337
8	3,178,764,337	148,640,973	301,956,094	2,976,651	217,135,810	3,239,608,375
9	3,239,608,375	150,073,778	310,215,304	2,786,289	221,166,559	3,297,847,119
10	3,297,847,119	151,713,424	317,335,611	2,603,339	225,060,987	3,354,682,580
11	3,354,682,580	153,575,720	324,380,331	2,428,112	228,867,182	3,410,317,039
12	3,410,317,039	155,667,964	330,571,489	2,260,822	232,626,314	3,465,779,006
13	3,465,779,006	158,017,636	335,905,419	2,103,442	236,411,385	3,522,199,166
14	3,522,199,166	160,596,209	341,253,696	1,953,849	240,270,643	3,579,858,474
15	3,579,858,474	163,381,852	345,719,743	1,810,814	244,253,897	3,639,963,666
16	3,639,963,666	166,393,051	349,996,776	1,675,364	248,422,366	3,703,106,944
17	3,703,106,944	169,635,839	352,366,680	1,548,661	252,876,789	3,771,704,231
18	3,771,704,231	173,134,828	354,120,885	1,433,016	257,742,613	3,847,027,771
19	3,847,027,771	176,850,078	354,910,055	1,324,717	263,119,668	3,930,762,745
20	3,930,762,745	165,622,065	354,998,547	1,222,096	268,595,268	4,008,759,435
21	4,008,759,435	2,659,773	354,311,971	1,126,186	268,474,747	3,924,455,798
22	3,924,455,798	2,595,555	351,752,754	1,040,508	262,662,288	3,836,920,380
23	3,836,920,380	8,436,389	348,659,115	965,099	256,844,821	3,752,577,376
24	3,752,577,376	7,727,639	344,155,423	894,600	251,073,813	3,666,328,805
25	3,666,328,805	7,039,336	339,211,076	825,443	245,185,235	3,578,516,857
26	3,578,516,857	6,356,517	333,910,104	755,639	239,199,702	3,489,407,333
27	3,489,407,333	5,646,878	328,864,824	681,265	233,113,775	3,398,621,897
28	3,398,621,897	4,900,595	324,120,938	601,179	226,899,100	3,305,699,476
29	3,305,699,476	4,158,200	319,288,346	519,019	220,538,093	3,210,588,404
30	3,210,588,404	3,426,377	314,334,210	435,680	214,028,467	3,113,273,358
31	3,113,273,358	2,731,597	308,634,418	354,231	207,391,429	3,014,407,736
32	3,014,407,736	2,097,999	302,722,495	277,455	200,655,094	2,914,160,879
33	2,914,160,879	1,536,392	296,172,127	207,332	193,846,288	2,813,164,100
34	2,813,164,100	1,075,482	288,643,000	148,069	187,021,757	2,712,470,269
35	2,712,470,269	724,752	279,841,212	102,080	180,265,555	2,613,517,285
36	2,613,517,285	473,232	270,111,031	68,560	173,666,142	2,517,477,067
37	2,517,477,067	304,614	259,603,662	45,568	167,299,854	2,425,432,305
38	2,425,432,305	195,476	248,557,504	30,155	161,233,572	2,338,273,695
39	2,338,273,695	124,201	237,348,210	19,825	155,516,063	2,256,545,923
40	2,256,545,923	81,568	226,157,160	13,284	150,178,939	2,180,635,986
41	2,180,635,986	54,599	214,960,201	8,946	145,249,730	2,110,971,168
42	2,110,971,168	35,755	203,838,372	5,911	140,755,329	2,047,917,969
43	2,047,917,969	22,939	192,845,939	3,822	136,719,464	1,991,810,612
44	1,991,810,612	14,395	181,836,424	2,400	133,170,520	1,943,156,702
45	1,943,156,702	8,635	170,754,445	1,452	130,145,890	1,902,555,330
46	1,902,555,330	4,613	159,669,348	788	127,685,095	1,870,574,902
47	1,870,574,902	2,075	148,703,150	374	125,823,717	1,847,697,171
48	1,847,697,171	912	137,962,814	159	124,591,797	1,834,326,906
49	1,834,326,906	369	127,513,674	65	124,015,398	1,830,828,934
50	1,830,828,934	99	117,424,267	23	124,117,689	1,837,522,432

Single Discount Rate Development
Projection of Plan Fiduciary Net Position Ending June 30, 2118
(Concluded)

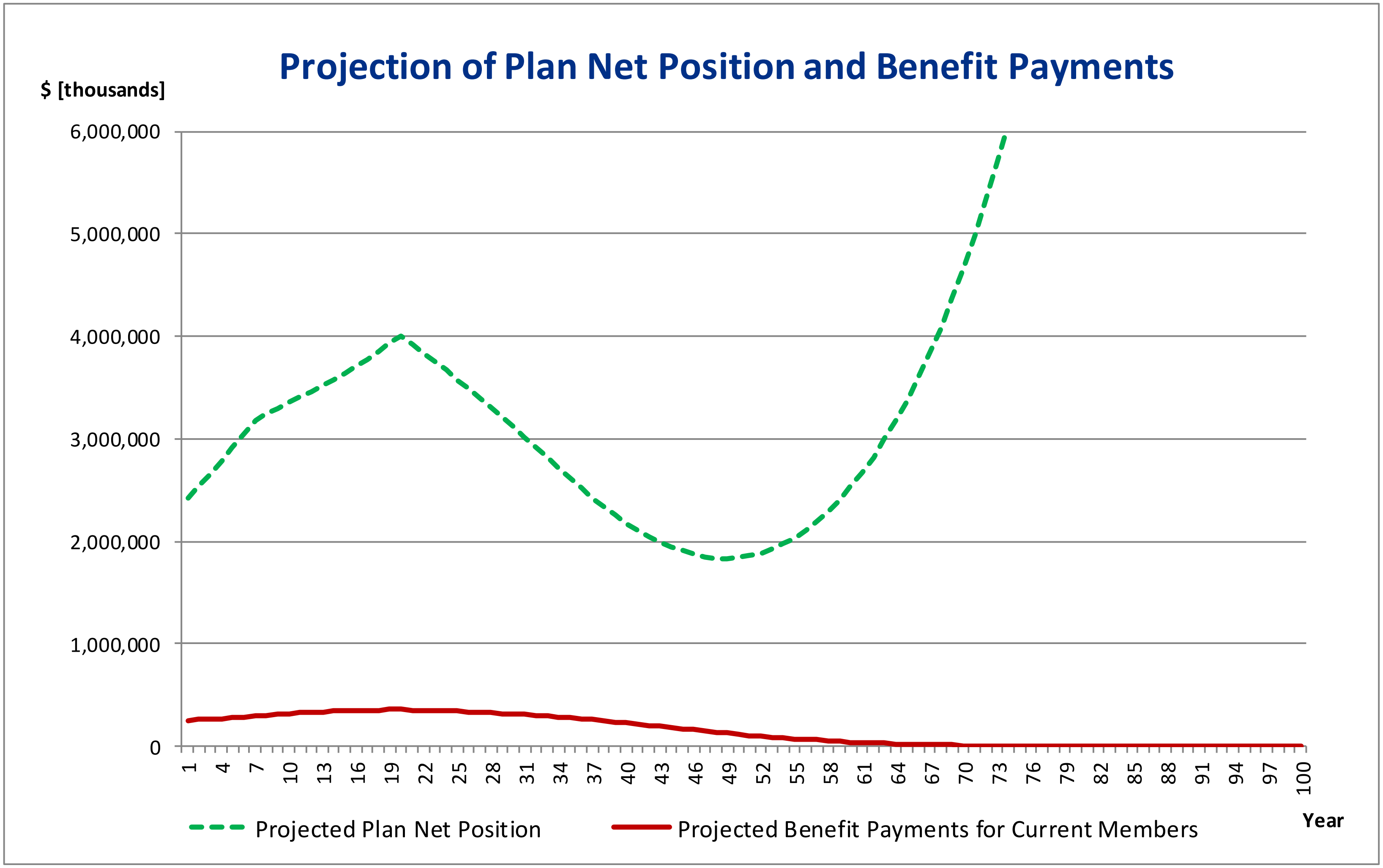
Year	Projected Beginning Plan Net Position	Projected Total Contributions	Projected Benefit Payments	Projected Administrative Expenses	Projected Investment Earnings at 7.00%	Projected Ending Plan Net Position
51	$ 1,837,522,432	$ 19	$ 107,752,192	$ 5	$ 124,919,029	$ 1,854,689,283
52	1,854,689,283	-	98,526,207	-	126,438,156	1,882,601,232
53	1,882,601,232	-	89,767,584	-	128,693,359	1,921,527,007
54	1,921,527,007	-	81,489,405	-	131,703,000	1,971,740,601
55	1,971,740,601	-	73,696,643	-	135,486,085	2,033,530,043
56	2,033,530,043	-	66,387,246	-	140,062,848	2,107,205,645
57	2,107,205,645	-	59,553,215	-	145,455,286	2,193,107,716
58	2,193,107,716	-	53,181,899	-	151,687,655	2,291,613,472
59	2,291,613,472	-	47,257,888	-	158,786,892	2,403,142,476
60	2,403,142,476	-	41,764,862	-	166,782,926	2,528,160,540
61	2,528,160,540	-	36,686,894	-	175,708,914	2,667,182,559
62	2,667,182,559	-	32,009,396	-	185,601,398	2,820,774,562
63	2,820,774,562	-	27,719,504	-	196,500,445	2,989,555,503
64	2,989,555,503	-	23,805,833	-	208,449,773	3,174,199,443
65	3,174,199,443	-	20,258,066	-	221,496,921	3,375,438,297
66	3,375,438,297	-	17,066,374	-	235,693,460	3,594,065,383
67	3,594,065,383	-	14,220,601	-	251,095,274	3,830,940,056
68	3,830,940,056	-	11,709,514	-	267,762,902	4,086,993,445
69	4,086,993,445	-	9,519,825	-	285,761,983	4,363,235,602
70	4,363,235,602	-	7,635,385	-	305,163,774	4,660,763,991
71	4,660,763,991	-	6,036,813	-	326,045,764	4,980,772,942
72	4,980,772,942	-	4,701,373	-	348,492,341	5,324,563,911
73	5,324,563,911	-	3,603,597	-	372,595,481	5,693,555,794
74	5,693,555,794	-	2,716,441	-	398,455,438	6,089,294,791
75	6,089,294,791	-	2,012,325	-	426,181,395	6,513,463,862
76	6,513,463,862	-	1,464,051	-	455,892,095	6,967,891,907
77	6,967,891,907	-	1,045,613	-	487,716,456	7,454,562,750
78	7,454,562,750	-	732,891	-	521,794,175	7,975,624,034
79	7,975,624,034	-	504,197	-	558,276,334	8,533,396,172
80	8,533,396,172	-	340,612	-	597,326,012	9,130,381,572
81	9,130,381,572	-	226,179	-	639,118,928	9,769,274,321
82	9,769,274,321	-	147,873	-	683,844,114	10,452,970,562
83	10,452,970,562	-	95,419	-	731,704,656	11,184,579,799
84	11,184,579,799	-	60,973	-	782,918,488	11,967,437,314
85	11,967,437,314	-	38,750	-	837,719,279	12,805,117,843
86	12,805,117,843	-	24,615	-	896,357,402	13,701,450,630
87	13,701,450,630	-	15,716	-	959,101,003	14,660,535,917
88	14,660,535,917	-	10,136	-	1,026,237,165	15,686,762,947
89	15,686,762,947	-	6,629	-	1,098,073,178	16,784,829,496
90	16,784,829,496	-	4,401	-	1,174,937,913	17,959,763,009
91	17,959,763,009	-	2,962	-	1,257,183,309	19,216,943,355
92	19,216,943,355	-	2,013	-	1,345,185,966	20,562,127,308
93	20,562,127,308	-	1,372	-	1,439,348,864	22,001,474,800
94	22,001,474,800	-	932	-	1,540,103,204	23,541,577,072
95	23,541,577,072	-	627	-	1,647,910,373	25,189,486,818
96	25,189,486,818	-	416	-	1,763,264,063	26,952,750,465
97	26,952,750,465	-	271	-	1,886,692,523	28,839,442,717
98	28,839,442,717	-	173	-	2,018,760,984	30,858,203,529
99	30,858,203,529	-	108	-	2,160,074,243	33,018,277,664
100	33,018,277,664	-	66	-	2,311,279,434	35,329,557,033

Single Discount Rate Development
Present Values of Projected Benefits Ending June 30, 2118

Year	Projected Beginning Plan Net Position	Projected Benefit Payments	Funded Portion of Benefit Payments	Unfunded Portion of Benefit Payments	Present Value of Funded Benefit Payments using Expected Return Rate (v)	Present Value of Unfunded Benefit Payments using Municipal Bond Rate (vf)	Present Value of Benefit Payments using Single Discount Rate (sdr)
(a)	(b)	(c)	(d)	(e)	(f)=(d)*v^((a)-.5)	(g)=(e)*vf ^((a)-.5)	(h)=((c)/(1+sdr)^(a-.5)
1	$ 2,314,530,148	$ 250,131,576	$ 250,131,576	$ -	$ 241,811,321	$ -	$ 241,811,321
2	2,425,016,829	256,121,821	256,121,821	-	231,404,028	-	231,404,028
3	2,539,877,784	262,808,333	262,808,333	-	221,911,438	-	221,911,438
4	2,659,005,699	269,727,162	269,727,162	-	212,853,826	-	212,853,826
5	2,782,555,765	277,234,349	277,234,349	-	204,465,500	-	204,465,500
6	2,910,320,004	285,022,877	285,022,877	-	196,457,649	-	196,457,649
7	3,042,453,788	293,423,234	293,423,234	-	189,016,599	-	189,016,599
8	3,178,764,337	301,956,094	301,956,094	-	181,788,106	-	181,788,106
9	3,239,608,375	310,215,304	310,215,304	-	174,542,466	-	174,542,466
10	3,297,847,119	317,335,611	317,335,611	-	166,867,947	-	166,867,947
11	3,354,682,580	324,380,331	324,380,331	-	159,413,408	-	159,413,408
12	3,410,317,039	330,571,489	330,571,489	-	151,828,028	-	151,828,028
13	3,465,779,006	335,905,419	335,905,419	-	144,184,903	-	144,184,903
14	3,522,199,166	341,253,696	341,253,696	-	136,897,767	-	136,897,767
15	3,579,858,474	345,719,743	345,719,743	-	129,616,236	-	129,616,236
16	3,639,963,666	349,996,776	349,996,776	-	122,635,298	-	122,635,298
17	3,703,106,944	352,366,680	352,366,680	-	115,388,493	-	115,388,493
18	3,771,704,231	354,120,885	354,120,885	-	108,376,577	-	108,376,577
19	3,847,027,771	354,910,055	354,910,055	-	101,512,241	-	101,512,241
20	3,930,762,745	354,998,547	354,998,547	-	94,894,908	-	94,894,908
21	4,008,759,435	354,311,971	354,311,971	-	88,515,308	-	88,515,308
22	3,924,455,798	351,752,754	351,752,754	-	82,127,062	-	82,127,062
23	3,836,920,380	348,659,115	348,659,115	-	76,079,215	-	76,079,215
24	3,752,577,376	344,155,423	344,155,423	-	70,183,632	-	70,183,632
25	3,666,328,805	339,211,076	339,211,076	-	64,649,842	-	64,649,842
26	3,578,516,857	333,910,104	333,910,104	-	59,476,202	-	59,476,202
27	3,489,407,333	328,864,824	328,864,824	-	54,745,360	-	54,745,360
28	3,398,621,897	324,120,938	324,120,938	-	50,425,847	-	50,425,847
29	3,305,699,476	319,288,346	319,288,346	-	46,424,304	-	46,424,304
30	3,210,588,404	314,334,210	314,334,210	-	42,713,997	-	42,713,997
31	3,113,273,358	308,634,418	308,634,418	-	39,195,764	-	39,195,764
32	3,014,407,736	302,722,495	302,722,495	-	35,929,874	-	35,929,874
33	2,914,160,879	296,172,127	296,172,127	-	32,852,726	-	32,852,726
34	2,813,164,100	288,643,000	288,643,000	-	29,922,955	-	29,922,955
35	2,712,470,269	279,841,212	279,841,212	-	27,112,611	-	27,112,611
36	2,613,517,285	270,111,031	270,111,031	-	24,457,846	-	24,457,846
37	2,517,477,067	259,603,662	259,603,662	-	21,968,628	-	21,968,628
38	2,425,432,305	248,557,504	248,557,504	-	19,657,814	-	19,657,814
39	2,338,273,695	237,348,210	237,348,210	-	17,543,269	-	17,543,269
40	2,256,545,923	226,157,160	226,157,160	-	15,622,521	-	15,622,521
41	2,180,635,986	214,960,201	214,960,201	-	13,877,622	-	13,877,622
42	2,110,971,168	203,838,372	203,838,372	-	12,298,699	-	12,298,699
43	2,047,917,969	192,845,939	192,845,939	-	10,874,266	-	10,874,266
44	1,991,810,612	181,836,424	181,836,424	-	9,582,670	-	9,582,670
45	1,943,156,702	170,754,445	170,754,445	-	8,409,960	-	8,409,960
46	1,902,555,330	159,669,348	159,669,348	-	7,349,532	-	7,349,532
47	1,870,574,902	148,703,150	148,703,150	-	6,396,973	-	6,396,973
48	1,847,697,171	137,962,814	137,962,814	-	5,546,674	-	5,546,674
49	1,834,326,906	127,513,674	127,513,674	-	4,791,192	-	4,791,192
50	1,830,828,934	117,424,267	117,424,267	-	4,123,451	-	4,123,451

Single Discount Rate Development
Present Values of Projected Benefits Ending June 30, 2118
(Concluded)

Year	Projected Beginning Plan Net Position	Projected Benefit Payments	Funded Portion of Benefit Payments	Unfunded Portion of Benefit Payments	Present Value of Funded Benefit Payments using Expected Return Rate (v)	Present Value of Unfunded Benefit Payments using Municipal Bond Rate (vf)	Present Value of Benefit Payments using Single Discount Rate (sdr)
(a)	(b)	(c)	(d)	(e)	(f)=(d)*v^((a)-.5)	(g)=(e)*vf ^((a)-.5)	(h)=((c)/(1+sdr)^(a-.5)
51	$ 1,837,522,432	$ 107,752,192	$ 107,752,192	$ -	$ 3,536,269	$ -	$ 3,536,269
52	1,854,689,283	98,526,207	98,526,207	-	3,021,950	-	3,021,950
53	1,882,601,232	89,767,584	89,767,584	-	2,573,186	-	2,573,186
54	1,921,527,007	81,489,405	81,489,405	-	2,183,077	-	2,183,077
55	1,971,740,601	73,696,643	73,696,643	-	1,845,151	-	1,845,151
56	2,033,530,043	66,387,246	66,387,246	-	1,553,406	-	1,553,406
57	2,107,205,645	59,553,215	59,553,215	-	1,302,332	-	1,302,332
58	2,193,107,716	53,181,899	53,181,899	-	1,086,918	-	1,086,918
59	2,291,613,472	47,257,888	47,257,888	-	902,658	-	902,658
60	2,403,142,476	41,764,862	41,764,862	-	745,549	-	745,549
61	2,528,160,540	36,686,894	36,686,894	-	612,058	-	612,058
62	2,667,182,559	32,009,396	32,009,396	-	499,086	-	499,086
63	2,820,774,562	27,719,504	27,719,504	-	403,924	-	403,924
64	2,989,555,503	23,805,833	23,805,833	-	324,200	-	324,200
65	3,174,199,443	20,258,066	20,258,066	-	257,836	-	257,836
66	3,375,438,297	17,066,374	17,066,374	-	203,004	-	203,004
67	3,594,065,383	14,220,601	14,220,601	-	158,087	-	158,087
68	3,830,940,056	11,709,514	11,709,514	-	121,656	-	121,656
69	4,086,993,445	9,519,825	9,519,825	-	92,436	-	92,436
70	4,363,235,602	7,635,385	7,635,385	-	69,288	-	69,288
71	4,660,763,991	6,036,813	6,036,813	-	51,198	-	51,198
72	4,980,772,942	4,701,373	4,701,373	-	37,264	-	37,264
73	5,324,563,911	3,603,597	3,603,597	-	26,694	-	26,694
74	5,693,555,794	2,716,441	2,716,441	-	18,806	-	18,806
75	6,089,294,791	2,012,325	2,012,325	-	13,020	-	13,020
76	6,513,463,862	1,464,051	1,464,051	-	8,853	-	8,853
77	6,967,891,907	1,045,613	1,045,613	-	5,909	-	5,909
78	7,454,562,750	732,891	732,891	-	3,871	-	3,871
79	7,975,624,034	504,197	504,197	-	2,489	-	2,489
80	8,533,396,172	340,612	340,612	-	1,571	-	1,571
81	9,130,381,572	226,179	226,179	-	975	-	975
82	9,769,274,321	147,873	147,873	-	596	-	596
83	10,452,970,562	95,419	95,419	-	359	-	359
84	11,184,579,799	60,973	60,973	-	215	-	215
85	11,967,437,314	38,750	38,750	-	127	-	127
86	12,805,117,843	24,615	24,615	-	76	-	76
87	13,701,450,630	15,716	15,716	-	45	-	45
88	14,660,535,917	10,136	10,136	-	27	-	27
89	15,686,762,947	6,629	6,629	-	17	-	17
90	16,784,829,496	4,401	4,401	-	10	-	10
91	17,959,763,009	2,962	2,962	-	6	-	6
92	19,216,943,355	2,013	2,013	-	4	-	4
93	20,562,127,308	1,372	1,372	-	3	-	3
94	22,001,474,800	932	932	-	2	-	2
95	23,541,577,072	627	627	-	1	-	1
96	25,189,486,818	416	416	-	1	-	1
97	26,952,750,465	271	271	-	0	-	0
98	28,839,442,717	173	173	-	0	-	0
99	30,858,203,529	108	108	-	0	-	0
100	33,018,277,664	66	66	-	0	-	0
				Totals	$ 4,290,386,763	$ -	$ 4,290,386,763



Note the Net Plan Position is currently projected to grow since the Board has adopted a funding policy goal of more than 100% funded; therefore, even in the absence of contributions from the current active member population, the negative unfunded will continue to accrue interest.

SECTION H

GLOSSARY OF TERMS

Glossary of Terms

Accrued Service	Service credited under the system which was rendered before the date of the actuarial valuation.
Actuarial Accrued Liability (AAL)	The AAL is the difference between the actuarial present value of all benefits and the actuarial value of future normal costs. The definition comes from the fundamental equation of funding which states that the present value of all benefits is the sum of the Actuarial Accrued Liability and the present value of future normal costs. The AAL may also be referred to as accrued liability or actuarial liability.
Actuarial Assumptions	These assumptions are estimates of future experience with respect to rates of mortality, disability, turnover, retirement, rate or rates of investment income and compensation increases. Actuarial assumptions are generally based on past experience, often modified for projected changes in conditions. Economic assumptions (compensation increases, payroll growth, inflation and investment return) consist of an underlying real rate of return plus an assumption for a long-term average rate of inflation.
Actuarial Equivalent	A single amount or series of amounts of equal actuarial value to another single amount or series of amounts, computed on the basis of appropriate actuarial assumptions.
Actuarial Cost Method	A mathematical budgeting procedure for allocating the dollar amount of the actuarial present value of the pension trust benefits between future normal cost and actuarial accrued liability. The actuarial cost method may also be referred to as the actuarial funding method.
Actuarial Gain/(Loss)	The difference in liabilities between actual experience and expected experience during the period between two actuarial valuations is the gain/(loss) on the accrued liabilities.
Actuarial Present Value (APV)	The amount of funds currently required to provide a payment or series of payments in the future. The present value is determined by discounting future payments at predetermined rates of interest and probabilities of payment.
Actuarial Valuation	The actuarial valuation report determines, as of the actuarial valuation date, the service cost, total pension liability, and related actuarial present value of projected benefit payments for pensions.
Actuarial Valuation Date	The date as of which an actuarial valuation is performed.
Actuarially Determined Contribution (ADC) or Annual Required Contribution (ARC)	A calculated contribution into a defined benefit pension plan for the reporting period, most often determined based on the funding policy of the plan. Typically the Actuarially Determined Contribution has a normal cost payment and an amortization payment.

Glossary of Terms

Amortization Method	The method used to determine the periodic amortization payment may be a level dollar amount, or a level percent of pay amount. The period will typically be expressed in years, and the method will either be "open" (meaning, reset each year) or "closed" (the number of years remaining will decline each year).
Amortization Payment	The amortization payment is the periodic payment required to pay off an interest-discounted amount with payments of interest and principal.
Cost-of-Living Adjustments	Postemployment benefit changes intended to adjust benefit payments for the effects of inflation.
Cost-Sharing Multiple-Employer Defined Benefit Pension Plan (cost-sharing pension plan)	A multiple-employer defined benefit pension plan in which the pension obligations to the employees of more than one employer are pooled and pension plan assets can be used to pay the benefits of the employees of any employer that provides pensions through the pension plan.
Covered-Employee Payroll	The payroll of covered employees, which is typically only the pensionable pay and does not include pay above any pay cap.
Deferred Inflows and Outflows	The deferred inflows and outflows of pension resources are amounts used under GASB Statement No. 68 in developing the annual pension expense. Deferred inflows and outflows arise with differences between expected and actual experiences; changes of assumptions. The portion of these amounts not included in pension expense should be included in the deferred inflows or outflows of resources.
Deferred Retirement Option Program (DROP)	A program that permits a plan member to elect a calculation of benefit payments based on service credits and salary, as applicable, as of the DROP entry date. The plan member continues to provide service to the employer and is paid for the service by the employer after the DROP entry date; however, the pensions that would have been paid to the plan member are credited to an individual member account within the defined benefit pension plan until the end of the DROP period. Other variations for DROP exist and will be more fully detailed in the plan provision section of the valuation report.
Discount Rate	For GASB purposes, the discount rate is the single rate of return that results in the present value of all projected benefit payments to be equal to the sum of the funded and unfunded projected benefit payments, specifically: 1. The benefit payments to be made while the pension plans' fiduciary net position is projected to be greater than the benefit payments that are projected to be made in the period; and 2. The present value of the benefit payments not in (1) above, discounted using the municipal bond rate.

Glossary of Terms

Entry Age Actuarial Cost Method (EAN)	The EAN is a funding method for allocating the costs of the plan between the normal cost and the accrued liability. The actuarial present value of the projected benefits of each individual included in an actuarial valuation is allocated on a level basis (either level dollar or level percent of pay) over the earnings or service of the individual between entry age and assumed exit ages(s). The portion of the actuarial present value allocated to a valuation year is the normal cost. The portion of this actuarial present value not provided for at a valuation date by the actuarial present value of future normal costs is the actuarial accrued liability. The sum of the accrued liability plus the present value of all future normal costs is the present value of all benefits.
Fiduciary Net Position	The fiduciary net position is the value of the assets of the trust.
GASB	The Governmental Accounting Standards Board is an organization that exists in order to promulgate accounting standards for governmental entities.
Long-Term Expected Rate of Return	The long-term rate of return is the expected return to be earned over the entire trust portfolio based on the asset allocation of the portfolio.
Money-Weighted Rate of Return	The money-weighted rate of return is a method of calculating the returns that adjusts for the changing amounts actually invested. For purposes of GASB Statement No. 67, money-weighted rate of return is calculated as the internal rate of return on pension plan investments, net of pension plan investment expense.
Multiple-Employer Defined Benefit Pension Plan	A multiple-employer plan is a defined benefit pension plan that is used to provide pensions to the employees of more than one employer.
Municipal Bond Rate	The Municipal Bond Rate is the discount rate to be used for those benefit payments that occur after the assets of the trust have been depleted.
Net Pension Liability (NPL)	The NPL is the liability of employers and non-employer contribution entities to plan members for benefits provided through a defined benefit pension plan.
Non-Employer Contribution Entities	Non-employer contribution entities are entities that make contributions to a pension plan that is used to provide pensions to the employees of other entities. For purposes of the GASB Accounting Statement, plan members are not considered non-employer contribution entities.
Normal Cost	The actuarial present value of the pension trust benefits allocated to the current year by the actuarial cost method.

Glossary of Terms

Other Postemployment Benefits (OPEB) All postemployment benefits other than retirement income (such as death benefits, life insurance, disability, and long-term care) that are provided separately from a pension plan, as well as postemployment healthcare benefits regardless of the manner in which they are provided. Other post-employment benefits do not include termination benefits.

Real Rate of Return The real rate of return is the rate of return on an investment after adjustment to eliminate inflation.

Service Cost The service cost is the portion of the actuarial present value of projected benefit payments that is attributed to a valuation year.

Total Pension Expense The total pension expense is the sum of the following items that are recognized at the end of the employer's fiscal year:

1. Service Cost
2. Interest on the Total Pension Liability
3. Current-Period Benefit Changes
4. Employee Contributions (made negative for addition here)
5. Projected Earnings on Plan Investments (made negative for addition here)
6. Pension Plan Administrative Expense
7. Other Changes in Plan Fiduciary Net Position
8. Recognition of Outflow (Inflow) of Resources due to Liabilities
9. Recognition of Outflow (Inflow) of Resources due to Assets

Total Pension Liability (TPL) The TPL is the portion of the actuarial present value of projected benefit payments that is attributed to past periods of member service.

Unfunded Actuarial Accrued Liability (UAAL) The UAAL is the difference between actuarial accrued liability and valuation assets.

Valuation Assets The valuation assets are the assets used in determining the unfunded liability of the plan. For purposes of the GASB Statement No. 67, the valuation asset is equal to the market value of assets.

GRS Retirement Consulting

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September 27, 2018

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65109

Dear Board Members:

Please find enclosed five copies of the GASB Statement Nos. 67 and 68 Accounting and Financial Reporting for Pensions report of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS).

We will be happy to meet with the Board to discuss the results of this report.

Respectfully submitted,

Heidi G. Barry, ASA, FCA, MAAA

Kenneth G. Alberts

HGB/KGA:dj
Enclosures