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

Actuarial Audit as of June 30, 2011

Produced by Cheiron

April 2012

Classic Values, Innovative Advice

Table of Contents

April 18, 2012

The Retirement Board
MoDOT and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Dear Members of the Board:

Cheiron is pleased to present the results of our June 30, 2011 Actuarial Audit of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS). We direct your attention to the summary section of our report which highlights the key findings of our review of the actuarial valuation. The balance of the report provides details in support of these findings along with supplemental data, background information and discussion of the process taken in the evaluation of the work performed by the System's actuary.

In performing this audit, Cheiron used actuarial assumptions and methods recommended by the actuary and adopted by the Board of Trustees (the Board) based upon the most recent review of the experience of the retirement plan completed in 2010.

The results of this audit report reflect a full replication of the System's June 30, 2011 Actuarial Valuation, which is dependent upon future experience conforming to these assumptions. It is certain that actual experience will not conform exactly to these assumptions. Actual amounts will differ from projected amounts to the extent actual experience differs from expected experience.

In preparing our report, we relied, without audit, on information (some oral and some written) supplied by the MoDOT and Highway Patrol Employees' Retirement System and the System's actuary. This information includes, but is not limited to, plan provisions, employee census data and financial information. A detailed description of all information provided for this audit is included in the body of our report.

While the data was not explicitly audited, we did review the census data for reasonableness and for consistency.

We would like to take this opportunity to thank the members of MoDOT and Highway Patrol Employees' Retirement System staff and Gabriel, Roeder, Smith & Company (GRS) for their assistance in providing the data and addressing our questions during this audit process.

We hereby certify that, to the best of our knowledge, this report and its contents, which are based on the information and data supplied by MPERS and GRS, are work products of Cheiron, Inc. These work products are complete and have been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

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This actuarial audit report was prepared solely for MPERS for the purposes described herein, except that the plan auditor may rely on this report solely for the purpose of completing an audit related to the matters herein. This actuarial audit report is not intended to benefit any third party, and Cheiron assumes no duty or liability to any such party.

Finally, it's important to note that this valuation, which was prepared using census data and financial information as of June 30, 2011, does not reflect any changes in the membership or the assets that may have occurred subsequent to that date.

Sincerely,
Cheiron

Stephen T. McElhaney, FSA, FCA, MAAA, EA
Principal Consulting Actuary

Michael Noble, FSA, FCA, MAAA, EA
Consulting Actuary

SECTION I
AUDIT SUMMARY

Cheiron performed an audit of the June 30, 2011 Actuarial Valuation of the Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS). We present below our key findings and recommendations in summarized fashion. In the sections that follow, we present the details that explain and support these findings and recommendations.

Using all the same actuarial assumptions and methods from the 2011 valuation report we have attempted to replicate GRS's valuation results, including the following:

- Present value of future benefits
- Actuarial accrued liability
- Unfunded actuarial accrued liability
- Normal cost
- Contribution rates as a percentage of payroll

GRS Valuation Replication

In general our results were not significantly different from GRS's results. However, there were a few issues in the provisions and assumptions that GRS used to develop their valuation results that we would like to bring to the System's attention. These issues are discussed further below.

Discount Rate Assumption

The current assumption of 8.25% falls near the top of an acceptable range of expected investment return among large public sector plans. There has been a recent trend for Systems to consider reduction of their investment return rate given the recent market meltdown and concern that future long-term return rates may not be the same for a similar diversified portfolio as they once were. The effect of using a high discount rate assumption is to increase the probability that the return will not be realized, thus resulting in a greater risk that required contributions will increase in the future.

Assumption Disclosure

Based on discussion and correspondence with GRS we understand the following represent some additional assumptions used in their valuation processing which were not identified in their valuation report:

- The healthy mortality tables were blended (50% male/50% female) before being set forward two years for males and set back three years for females. This was reflected in actual mortality rates in the valuation report, but it was not clear in the description of the tables that this process had been used.

SECTION I
AUDIT SUMMARY

- Actuarial Standard of Practice No. 35 requires for all actuarial communications with a valuation on or after June 30, 2011 that a specific disclosure of the extent to which mortality improvement has been assumed in the selection of the mortality tables. This disclosure does not appear in the valuation report.

- The disabled mortality table was provided to GRS by a prior actuary of the System. The valuation report states that it is based on PBGC Disabled Mortality tables. However, we were not able to match these tables to any current PBGC table.

- Different retirement rates were used for the Tier 2011 Plan and not shown in the valuation report. GRS provided us the rates and they are included in Appendix A of this report.

- The sick leave load for actives in the Tier 2011 Plan is 1.5% for Uniformed and 1.0% for Non-Uniformed. The loads are applied to the actuarial liability and present value of future benefits. These loads are not stated in the valuation report and were provided to us by GRS.

- Termination rates after age 60 used for the Tier 2011 Plan are not shown in the valuation report and were provided to us by GRS.

- The post disability survivor benefits are not explicitly valued in the valuation. Instead, to account for not valuing these benefits, GRS loads the disability benefits otherwise calculated by 50% for active participants and 23% for disabled participants. Due to the size of these loads we believe the post disability survivor benefits should be explicitly valued.

<u>Technical Valuation Issues</u>

There were a few areas in which we believe the valuation should be calculated in a manner different than done by GRS. For our analysis we modified the following four items. After modification the contribution rate increased by about 0.29%, which equates to about $1.2 million based on the current projected payroll.

- The eligibility for the temporary benefit for the Uniformed Patrol Employees under the Year 2000 Plan and Tier 2011 Plan should be set to the earliest normal retirement age, not the mandatory retirement age of 60. By waiting until the mandatory retirement age the valuation is under-valuing this benefit for participants who are eligible to begin receiving this benefit prior to age 60.

- The 90% marriage assumption was counted twice for the Tier 2011 Plan liabilities and for the Closed and Year 2000 Plan normal cost. (In effect, the marriage assumption became 81%, i.e., 90% times 90%.)

SECTION I
AUDIT SUMMARY

- According to Section 104.410, item 6, of the statue, the salary used in the calculation of the disability benefit payable at normal retirement should be projected at 80% of the consumer price index. The GRS valuation has been produced using 100% of the consumer price index.

- The allocation of actuarial value of assets between the Uniformed and Non-Uniformed groups should be equal to the ratio of market value of assets for each group. The ratio of actuarial value of assets in the GRS Report was not equal to the ratio of market value of assets.

Compliance with Professional Standards

With the exception of our comment with respect to disclosure of mortality improvement, we believe that the valuation complies with all applicable Actuarial Standards of Practice, including No. 4 (*Measuring Pension Obligations*), No. 23 (*Data Quality*), No. 27 (*Selection of Economic Actuarial Assumptions*), No. 35 (*Selection of Demographic Actuarial Assumptions*), No. 41 (*Actuarial Communications*), and No. 44 (*Selection and Use of Asset Valuation Methods*).

The valuation was prepared by the firm of Gabriel Roeder Smith & Company which has extensive experience and good reputation for performing valuations for public sector retirement systems. The actuary signing the report is Heidi G. Barry, an Associate of the Society of Actuaries (ASA) and a Member of the American Academy of Actuaries (MAAA). The actuarial directory located on the website of the Society of Actuaries indicates that Ms. Barry is compliant with the Continuing Professional Development Requirement for the last two years.

We understand that for most meetings with the Board, the only person attending for GRS is Kenneth Alberts, who is not a credentialed actuary and who is the primary contact at GRS for MPERS. We do not question Mr. Alberts' competence. However, we believe that best practice would be for a credentialed actuary to assist in presenting actuarial results to the Board.

SECTION II
VALUATION RECONCILIATION

Valuation Reconciliation

Based on review and comparison of results for each of the Plans we looked to see if the overall results were within generally acceptable ranges when we attempted to replicate results using similar methods and assumptions.

When testing against different valuation systems there is a generally acceptable tolerance of plus/minus 5.0%. With a larger plan minor differences in actuarial procedures have a smaller impact on the key results. Given the size of MPERS plan, we anticipated our results would be much closer than 5.0%.

The results for the Closed Plan and Year 2000 Plan fall within generally acceptable tolerances.

The results for the Tier 2011 Non-Uniformed Employees Plan differed more than the typical 5.0%, but were within the typical range for the Uniformed Patrol Plan. For the Tier 2011 plans our initial valuation of the present value of future benefits is approximately 2.9% higher than GRS's value for the Uniformed Patrol Plan and approximately 9.9% higher than GRS's value for the Non-Unformed Employees Plan. Since the actuarial accrued liability is equal to the difference between the present value of future benefits (PVFB) and present value of future normal costs (PVFNC), the percentage difference for the actuarial accrued liability is larger. This is due to the leveraging effect of small differences in PVFB and PVFNC on the very small accrued liability.

The reason for this discrepancy may be due to the different liability systems being used. The normally small differences caused by calculation methods within a liability system are magnified with plans that have few participants and where all participants have less than a year of service, as in the case of the Tier 2011 Plan. We have reviewed test lives on Tier 2011 employees from GRS and they have reviewed test lives from us. These reviews did not uncover any material differences.

Although the differences for the Tier 2011 Non-Uniformed Employees Plan are larger than normal tolerances, the System in total falls within generally acceptable tolerances.

Data Review

A review of the valuation data can be found in Section III of this report.

Assumptions and Methods Review

A review of the assumptions and methods used in the valuation can be found in Section IV of this report.

SECTION II
VALUATION RECONCILIATION

Results

On the next page we show a comparison of the present value of future benefit (PVFB), actuarial liability (AL), actuarial value of assets (AVA) and the unfunded actuarial liability (UAL) for Non-Uniformed Employees and Uniformed Patrol Members. We also show the comparison of the calculated contribution rate for each Plan. In addition, we show the results before and after the modifications suggested by Cheiron. The after modification runs include:

- The eligibility for the temporary benefit for the Uniformed Patrol Employees under the Year 2000 Plan and Tier 2011 Plan.

- The marriage assumption for the Tier 2011 Plan liabilities and for the Closed and Year 2000 Plan normal cost.

- The projection rate for the salary used in the calculation of the disability benefit payable at normal retirement age.

- The allocation of actuarial value of assets between Uniformed and Non-Uniformed using the ratio of market value of assets for each group.

SECTION II
VALUATION RECONCILIATION

Table II-1
June 30, 2011 Missouri Department of Transportation and
Highway Patrol Employees' Retirement System (MPERS)
Development of Liabilities
(In Thousands)

	Valuation Results under GRS Methodology							Valuation Results under Cheiron Modifications						
	Non-Uniformed Employees			Uniformed Patrol				Non-Uniformed Employees			Uniformed Patrol			
	Closed & Year 2000	2011 Tier	Total	Closed & Year 2000	2011 Tier	Total	Total	Closed & Year 2000	2011 Tier	Total	Closed & Year 2000	2011 Tier	Total	Total
Present Value of Future Benefits														
GRS	$ 2,736,052	$1,075	$2,737,128	$ 919,343	$ 2,981	$922,324	$3,659,452	$2,736,052	$1,075	$2,737,128	$ 919,343	$ 2,981	$922,324	$3,659,452
Cheiron	2,721,385	1,193	2,722,578	934,187	3,070	937,257	3,659,834	2,721,047	1,193	2,722,240	943,880	3,535	947,415	3,669,655
(GRS-Cheiron)	$ 14,668	$ (118)	$ 14,550	$ (14,844)	$ (89)	$(14,932)	$ (382)	$ 15,005	$ (117)	$ 14,888	$ (24,537)	$ (554)	$(25,091)	$ (10,203)
(GRS/Cheiron) %	0.5%	-9.9%	0.5%	-1.6%	-2.9%	-1.6%	0.0%	0.6%	-9.8%	0.5%	-2.6%	-15.7%	-2.6%	-0.3%
Actuarial Accrued Liability (AAL)														
GRS	$ 2,468,768	$ 53	$2,468,821	$ 828,663	$ 106	$828,769	$3,297,590	$2,468,768	$ 53	$2,468,821	$ 828,663	$ 106	$828,769	$3,297,590
Cheiron	2,446,561	70	2,446,630	831,545	173	831,719	3,278,349	2,446,620	70	2,446,689	825,453	200	825,653	3,272,343
(GRS-Cheiron)	$ 22,207	$ (17)	$ 22,190	$ (2,882)	$ (67)	$ (2,949)	$ 19,241	$ 22,148	$ (17)	$ 22,131	$ 3,210	$ (94)	$ 3,116	$ 25,247
(GRS-Cheiron) %	0.9%	-24.1%	0.9%	-0.3%	-38.8%	-0.4%	0.6%	0.9%	-24.2%	0.9%	0.4%	-47.1%	0.4%	0.8%
Less Actuarial Value of Assets			$1,063,663			$363,627	$1,427,291			$1,051,031			$376,260	$1,427,291
Equals Unfunded AAL														
GRS			$1,405,157			$465,142	$1,870,299			$1,417,790			$452,509	$1,870,299
Cheiron			1,382,967			468,091	1,851,058			1,395,659			449,393	1,845,052
(GRS-Cheiron)			$ 22,190			$ (2,949)	$ 19,241			$ 22,131			$ 3,116	$ 25,247
(GRS-Cheiron) %			1.6%			-0.6%	1.0%			1.6%			0.7%	1.4%
Amortization Payment on UAAL														
GRS			$ 112,344			$ 32,512	$ 144,856			$ 112,344			$ 32,512	$ 144,856
Cheiron			110,555			33,194	143,749			112,029			31,391	143,421
(GRS-Cheiron)			$ 1,789			$ (682)	$ 1,107			$ 315			$ 1,121	$ 1,435
(GRS-Cheiron) %			1.6%			-2.1%	0.8%			0.3%			3.6%	1.0%
as a % of Projected Payroll														
GRS			38.41%			41.71%	39.11%			38.41%			41.71%	39.11%
Cheiron			37.80%			42.58%	38.81%			38.30%			40.27%	38.72%
(GRS-Cheiron)			0.61%			-0.87%	0.30%			0.11%			1.44%	0.39%

SECTION II
VALUATION RECONCILIATION

Table II-2
Table Ia. June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)
FY 2013 Employer Contribution Rates
As % of Active Payroll

	Valuation Results under GRS Methodology							Valuation Results under Cheiron Modifications						
	Non-Uniformed			Uniformed Patrol				Non-Uniformed			Uniformed Patrol			
Contributions for	Closed & Year 2000	2011 Tier	Total	Closed & Year 2000	2011 Tier	Total	TOTAL	Closed & Year 2000	2011 Tier	Total	Closed & Year 2000	2011 Tier	Total	TOTAL
Normal Cost														
GRS	11.27%	8.87%	11.26%	12.14%	12.03%	12.13%	11.44%	11.27%	8.87%	11.26%	12.14%	12.03%	12.13%	11.44%
Cheiron	10.51%	8.40%	10.50%	12.95%	11.58%	12.92%	10.99%	10.50%	8.37%	10.49%	14.89%	13.31%	14.87%	11.37%
(GRS-Cheiron)	0.76%	0.47%	0.76%	-0.81%	0.45%	-0.79%	0.45%	0.77%	0.50%	0.77%	-2.75%	-1.28%	-2.74%	0.07%
Member Contribution (GRS and Cheiron)	0.00%	4.00%	0.01%	0.00%	4.00%	0.07%	0.02%	0.00%	4.00%	0.01%	0.00%	4.00%	0.07%	0.02%
Employer Normal Cost														
GRS	11.27%	4.87%	11.25%	12.14%	8.03%	12.06%	11.42%	11.27%	4.87%	11.25%	12.14%	8.03%	12.06%	11.42%
Cheiron	10.51%	4.40%	10.49%	12.95%	7.58%	12.85%	10.97%	10.50%	4.37%	10.48%	14.89%	9.31%	14.80%	11.35%
(GRS-Cheiron)	0.76%	0.47%	0.76%	-0.81%	0.45%	-0.79%	0.45%	0.77%	0.50%	0.77%	-2.75%	-1.28%	-2.74%	0.07%
Unfunded Actuarial Accrued Liabilities														
GRS			38.41%			41.71%	39.11%			38.41%			41.71%	39.11%
Cheiron			37.80%			42.58%	38.81%			38.30%			40.27%	38.72%
(GRS-Cheiron)			0.61%			-0.87%	0.30%			0.11%			1.44%	0.39%
Expenses (GRS and Cheiron)			0.73%			0.73%	0.73%			0.73%			0.73%	0.73%
Disability Insurance (GRS and Cheiron)			0.53%			0.53%	0.53%			0.53%			0.53%	0.53%
Total Contribution Rate														
GRS			50.92%			55.03%	51.79%			50.92%			55.03%	51.79%
Cheiron			49.55%			56.69%	51.04%			50.04%			56.33%	51.33%
(GRS-Cheiron)			1.37%			-1.66%	0.75%			0.88%			-1.30%	0.46%
Illustrative Dollar Contribution (in thousands)														
GRS			149,051			40,424	189,475			149,051			40,424	189,475
Cheiron			145,055			41,647	186,702			146,478			41,376	187,854
(GRS-Cheiron)			3,996			(1,222)	2,773			2,573			(951)	1,621
(GRS-Cheiron) %			2.8%			-2.9%	1.5%			1.8%			-2.3%	0.9%

SECTION III
DATA REVIEW

As part of the valuation process the actuary takes the *raw data* from the System and performs reasonability tests. These tests look for missing or inconsistent data elements and result in subsequent questions and data file adjustments. In addition there are often certain data elements that require adjustment before the valuation is run. The result of these changes either in correcting the file or adding fields together results in what is often referred to as the *processed or scrubbed data file* which represents the input information for valuation processing.

GRS provided us with a *processed data file*. When compared to the *raw data*, we found no significant differences. No parameters or assumptions were used to fill in missing data.

The following tables provide a summary comparing the demographic statistics between our valuation and GRS's. There were no differences in the statistics that appeared to be questionable.

Table III-1
June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)
(Active Members Only)

	Firm	Count	Average Age	Average Service	Total Salary
Civilian Patrol Employees					
Closed Plan	MPERS	530	49.7	19.9	
	GRS	530	49.6	19.9	$ 22,022,146
	Cheiron	530	49.7	19.9	$ 22,021,520
	(GRS-Cheiron)	0	(0.1)	0	0.0%
Year 2000 Plan	MPERS	576	40.8	6.0	
	GRS	576	40.8	6.0	$ 19,922,516
	Cheiron	576	40.8	6.0	$ 19,919,924
	(GRS-Cheiron)	0	0	0	0.0%
Year 2011 Tier	MPERS	40	33.7	0.3	
	GRS	40	33.7	0.3	$ 848,611
	Cheiron	40	33.7	0.3	$ 846,667
	(GRS-Cheiron)	0	0	0	0.2%
Total	MPERS	1,146			
	GRS	1,146			$ 42,793,273
	Cheiron	1,146			$ 42,788,111
	(GRS-Cheiron)	0			0.0%

SECTION III
DATA REVIEW

Table III-2
June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)
(Active Members Only)

	Firm	Count	Average Age	Average Service	Total Salary
MoDOT Employees					
Closed Plan	MPERS	3,203	48.3	19.7	
	GRS	3,203	48.3	19.7	$ 150,838,635
	Cheiron	3,203	48.3	19.6	$ 150,838,633
	(GRS-Cheiron)	0	0	0.1	0.0%
Year 2000 Plan	MPERS	2,662	40.0	6.1	
	GRS	2,662	40.0	6.1	$ 95,440,669
	Cheiron	2,662	40.0	6.1	$ 95,435,168
	(GRS-Cheiron)	0	0	0	0.0%
Year 2011 Tier	MPERS	7	29.9	0.3	
	GRS	7	29.9	0.3	$ 145,823
	Cheiron	7	29.9	0.3	$ 144,960
	(GRS-Cheiron)	0	0	0	0.6%
Total	MPERS	5,872			
	GRS	5,872			$ 246,425,127
	Cheiron	5,872			$ 246,418,761
	(GRS-Cheiron)	0			0.0%

Table III-3
June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)
(Active Members Only)

	Firm	Count	Average Age	Average Service	Total Salary
Uniformed Patrol					
Closed Plan	MPERS	754	44.9	19.7	
	GRS	754	44.9	19.7	$ 51,864,888
	Cheiron	754	44.9	19.7	$ 51,864,888
	(GRS-Cheiron)	0	0	0	0.0%
Year 2000 Plan	MPERS	422	31.4	5.7	
	GRS	422	31.4	5.7	$ 19,221,137
	Cheiron	422	31.4	5.7	$ 19,213,465
	(GRS-Cheiron)	0	0	0	0.0%
Year 2011 Tier	MPERS	37	25.8	0.5	
	GRS	37	25.8	0.5	$ 1,334,576
	Cheiron	37	25.8	0.5	$ 1,342,654
	(GRS-Cheiron)	0	0	0	-0.6%
Total	MPERS	1,213			
	GRS	1,213			$ 72,420,601
	Cheiron	1,213			$ 72,421,007
	(GRS-Cheiron)	0			0.0%

SECTION III
DATA REVIEW

Table III-4
June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)

	Firm	Civilian Patrol	MoDOT	Uniformed Patrol	Total
Retiree Members	MPERS	681	4,431	647	5,759
	GRS*	681	4,431	647	5,759
	Cheiron	681	4,431	647	5,759
	(GRS-Cheiron)	0	0	0	0
Survivor Members	MPERS	131	1,565	153	1,849
	GRS*	131	1,565	153	1,849
	Cheiron	131	1,565	153	1,849
	(GRS-Cheiron)	0	0	0	0
Deferred Vested Members	MPERS	223	1,466	158	1,847
	GRS	222	1,466	158	1,846
	Cheiron	222	1,466	158	1,846
	(GRS-Cheiron)	0	0	0	0
Fully-Insured Disabled Members	MPERS	8	86	1	95
	GRS	8	86	1	95
	Cheiron	8	86	1	95
	(GRS-Cheiron)	0	0	0	0
Self-Insured Disabled Members	MPERS	6	63	3	72
	GRS	6	63	3	72
	Cheiron	6	63	3	72
	(GRS-Cheiron)	0	0	0	0

* The June 30, 2011 Actuarial Valuation Report produced by GRS misstated the total count of Retirees and Survivors as 5,388 and 2,387, respectively (page D-17). The actual count in their data that was used in the valuation of liabilites was 5,759 Retirees and 1,849 Survivors.

Table III-5
June 30, 2011 Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)

	Firm	Civilian Patrol	MoDOT	Uniformed Patrol	Total	Monthly Benefit
Retired and Survivor Members						
Closed Plan	MPERS	429	3,711	799	4,939	10,475,259
	GRS	429	3,711	799	4,939	10,475,259
	Cheiron	429	3,711	799	4,939	10,475,259
	(GRS-Cheiron)	0	0	0	0	0.0%
Year 2000 Plan	MPERS	383	2,285	1	2,669	4,332,569
	GRS	383	2,285	1	2,669	4,332,569
	Cheiron	383	2,285	1	2,669	4,332,569
	(GRS-Cheiron)	0	0	0	0	0.0%
Total	MPERS	812	5,996	800	7,608	14,807,828
	GRS	812	5,996	800	7,608	14,807,828
	Cheiron	812	5,996	800	7,608	14,807,828
	(GRS-Cheiron)	0	0	0	0	0.0%

SECTION IV
ASSUMPTION AND METHOD REVIEW

The overall assumption set seems to be reasonable. Our review of the actuarial assumptions has drawn heavily from the analysis performed by GRS for the Five-Year Experience Study, July 1, 2004 through June 30, 2009. It should be noted the setting of actuarial assumptions involves a great deal of professional judgment and that setting such assumptions is both art and science. Two actuaries reviewing the same experience may reach different conclusions with respect to recommendations of actuarial assumptions. It is not our intent to substitute our judgment for the judgment of the consulting actuary to MPERS. Rather it is our intent to determine whether the actuarial assumptions are reasonable based upon all of the data available.

Generally our review of the experience study and resulting recommendations was made somewhat difficult by the lack of commentary around the demographic assumption recommendations. While we believe that the choices of assumptions are reasonable, it would have been helpful to understand GRS's rationale for the particular assumptions being recommended.

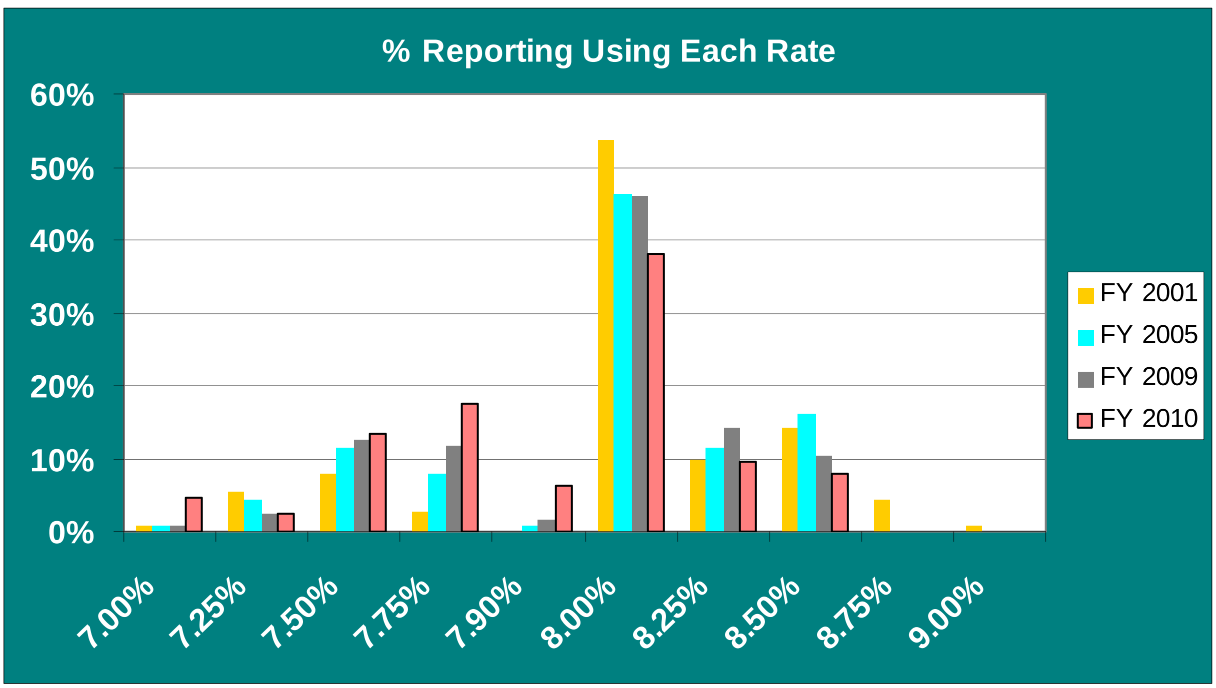
Specific comments regarding each assumption follow.

SECTION IV
ASSUMPTION AND METHOD REVIEW

ECONOMIC ASSUMPTIONS

Investment Return Rate

The current assumption of 8.25% is above the national average among large public sector plans. There has been a recent trend for Systems to consider reduction of their investment return rate given the recent market meltdown and concern that future long-term return rates may not be the same for a similar diversified portfolio as they once were. The following graph is based upon surveys performed by the National Association of State Retirement Administrators (NASRA) and shows the results of the most recent survey (for fiscal year 2010) compared to the results for several earlier surveys. The graph shows the percentage of systems reporting each level of investment return rate assumption.



The average rate has remained near 8.00% throughout the period from 2001 to 2010. However there is a clear trend of systems adopting lower rates. In fact, there was more of a shift to lower rates from 2009 to 2010 than occurred during the four-year period from 2005 to 2009. It also should be noted that based on the most recent survey only about 18% of funds are using an assumption of 8.25% or higher.

It is also useful to review expected returns developed by the fund's investment consultant. MPERS provided us with two reports of capital market assumptions from its investment consultants. The first was prepared by Summit Strategies Group (MPERS' prior investment consultant) in June 2010 and determined an expected return of 7.3%. The second report was prepared by NEPC (MPERS' current investment consultant) in February 2012 and determined an expected rate of return of 7.9% over a 5-7 year period and a return of 8.4% over a 30-year period. In evaluating the current assumed rate of 8.25% compared to the investment consultant reports, we note the following:

- The assumed rate is significantly higher than the Summit expected return.
- The assumed rate falls between NEPC's short-term and long-term expected returns.
- There can be relatively large differences in capital market assumptions used by various investment consulting firms.
- Adjustments should be made for assumed investment expenses to the extent that the expected returns are shown gross of fees.
- The projections are time-weighted returns. Dollar weighted returns would result in a different result to the fund. Dollar weighted returns are influenced by whether the plan's cash flow (i.e. contributions minus benefits) is positive or negative. MPERS is currently experiencing negative cash flow, which generally results in lower dollar weighted returns compared to time weighted returns.

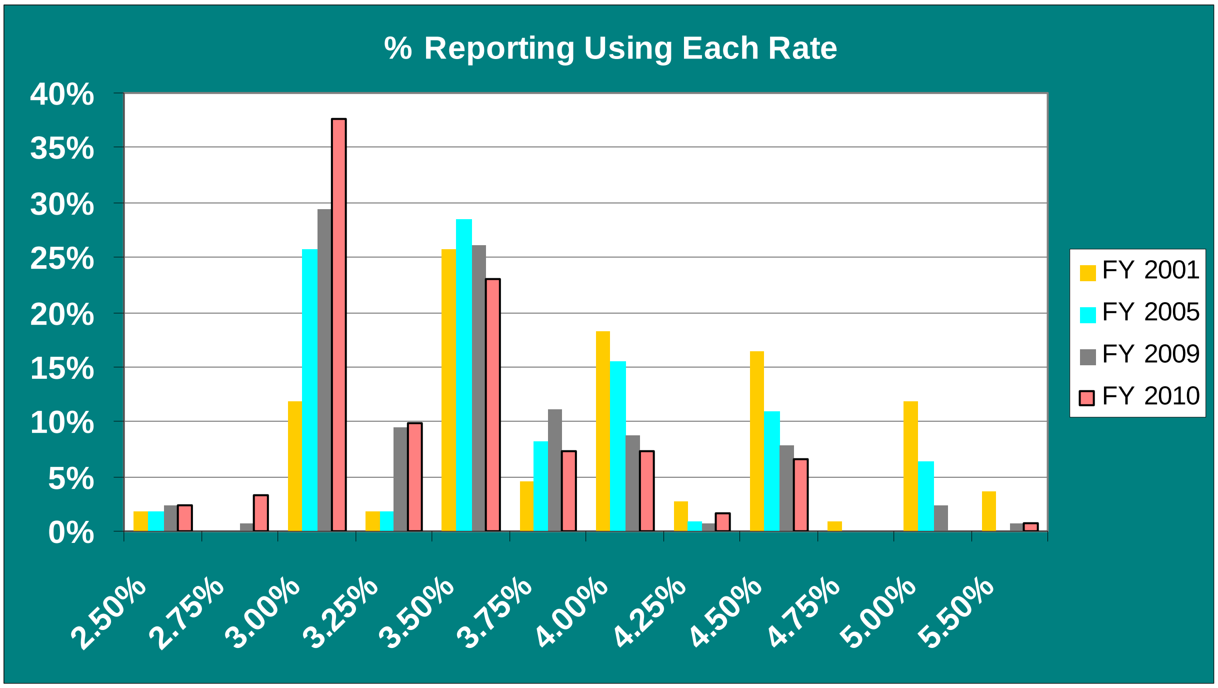
While the assumed rate of 8.25% is consistent with NEPC's expected return projection, when compared to other large public retirement systems, the assumption is toward the higher end. Our opinion is the assumption is near the top of an acceptable range. It should be noted that even using NEPC's expected return as a benchmark, there is only about a 50% probability that such return will be achieved. It should be noted that the System's greatest risk is that contribution rates in the future will increase to a level that cannot be supported by the employer. Continued use of a discount rate assumption at 8.25% compared to adopting a lower rate means a greater risk that the assumption will not be achieved, thus increasing the risk that required contributions will need to be increased in the future.

Active Member Payroll

For MoDOT members the assumed payroll increase is 0.0% for fiscal years 2012, 2013 and 2014 and then 3.75% thereafter. For other members the assumed payroll increase is 3.75% for all future years. The 3.75% rate essentially assumes a real wage increase of 0.50% over the assumed inflation rate of 3.25%. The assumption for 0.0% in the first three years for MoDOT members was based upon specific input from MPERS regarding expected payrolls over the short term. We believe these assumptions are reasonable.

Inflation

Underlying all the economic assumptions is inflation. It is the building block for the long-term investment return which is made up of the "real return rate" plus inflation. It is also the building block for the salary scale. The current assumption is 3.25% which is close to the average inflation assumption for large public retirement systems. The following graph is based upon surveys performed by the National Association of State Retirement Administrators (NASRA) and shows the results of the most recent survey (for fiscal year 2010) compared to the results for several earlier surveys. The graph shows the percentage of systems reporting each level of investment return rate assumption.



You will note that there has been a trend among public retirement systems to lower their inflation assumptions over the past several years. Since 2005, the average inflation assumption has been reduced by approximately 0.25%. Even so, the average exceeds the inflation rates that have been experienced over the last several years as well as most economic forecasts of inflation. However, we consider the current assumption to be reasonable as a long term assumption for the actuarial valuation.

Administrative Expenses

For administrative expenses, GRS makes an addition to the normal cost rate as based upon the prior year expense level as a percentage of payroll, which is a commonly accepted method for reflecting administrative expenses. For 2011 this rate is 0.73% of payroll.

DEMOGRAPHIC ASSUMPTIONS

Mortality Assumptions

The postretirement mortality tables used for all except disabled retirees are the 1994 Group Annuity Mortality Tables projected to the year 2002, set forward two years for males and set back three years for females. In conversations with GRS we understand that the sex distinct tables were blended (50% male and 50% female) before they were set forward/back. These tables were selected based upon the five-year experience study and include a margin that may allow for future improvements in mortality. Pre-retirement mortality is assumed to be 70% of the postretirement rates for males and 50% of the post-retirement rates for females.

It should be noted that typical practice in selecting mortality tables is to select a male table for the male rates and a female table for the female rates. GRS has constructed a unisex mortality table by blending male and female mortality tables and then using age set forwards and set backs to adjust for the differences in female mortality. This is not a standard approach; however, we consider these assumptions to be reasonable. We were able to match the tables constructed by GRS.

Actuarial Standard of Practice No. 35 (ASOP 35) was revised for valuations occurring on or after June 30, 2011. As revised, an actuary is required to consider the effect of future mortality improvement in selection of the mortality assumption. Since ASOP 35 requires a disclosure of the specific assumption made with regard to future mortality improvement, we believe that the description of the mortality assumption in the report should be expanded to include such disclosure.

For disabled retiree lives, the valuation report indicates that mortality is based upon the PBGC Disabled Mortality Tables. The source of the PBGC table could not be found. GRS informed us that the table was provided to them by the plan's prior actuary. The number of disabled retirees is relatively small and in this instance does not have a significant affect on the valuation. However, we would recommend changing to a standard disabled mortality table for future valuations.

For employees whose death is duty related there is a specific benefit paid. However, GRS does not disclose their assumption for the percentage of active deaths which are duty related, nor was this issue addressed in the experience study. In conversations with GRS we understand that they assume 0% of active deaths are duty related. We believe that this assumption should be reviewed based upon actual experience, or at least, that it be disclosed in the report.

SECTION IV
ASSUMPTION AND METHOD REVIEW

Withdrawal Assumptions

The withdrawal assumptions use a five-year select period that varies only by service and ultimate rates after the five-year period that varies only by age. Separate rates are used for males and females and for non-uniformed and uniformed members. We believe the assumptions are reasonable.

Disability Assumptions

The disability assumptions vary by age with the rates increasing as employees get older. Separate rates are used for males and females and for Non-Uniformed and Uniformed members. We believe the assumptions are reasonable

Rates of Retirement

The retirement rates vary by age. Separate rates are used for males and females and for Non-Uniformed and Uniformed. Additionally, for Uniformed employees there are separate rates for early retirement compared to normal retirement. We believe the assumptions are reasonable.

Different retirement rates were used for the Tier 2011 Plan. They were used by GRS, but not included in the appendices of their valuation report. The rates used can be found in Appendix A of this report, and should be included in future valuation reports.

Salary Increases

The salary increase rates are based upon the age of the member, except for Non-uniformed members in the first four years; the rates are based upon service. In each instance the salary increase rate is the sum of the wage inflation rate of 3.75% and a merit and seniority rate that decreases by service and age. We believe that the merit and seniority assumptions are reasonable.

BackDROP Assumptions

Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability. We replicated this coding and believe that this assumption is reasonable.

SECTION IV
ASSUMPTION AND METHOD REVIEW

Other Demographic Assumptions

The following additional assumptions were made:

- Marriage assumption: 90% of participants assumed to be married.

- Sick leave:
  - *Closed and Year 2000 Plan*: Normal and early retirement benefits loaded by 3.0% for uniformed and 2.6% for Non-Uniformed to account for inclusion of unused sick leave in calculation of average pay.

  - *Tier 2011 Plan*: Normal and early retirement benefits loaded by 1.5% for Uniformed and 1.0% for Non-Uniformed to account for inclusion of unused sick leave in calculation of average pay. These loads were not included in GRS's valuation report, but were communicated to us.

- Post disability survivor benefits:
  - Active participants: Post disability benefit liabilities were loaded by 50% to account for potential survivor benefits. GRS describes this as a 150% load, but we believe they mean a 50% load. Loads are a method to estimate liability that is not explicitly valued within a valuation process. However, 50% is a very large load and indicates these benefits should be explicitly valued rather than estimated.

  - Disabled participants: Disability benefit liabilities were loaded by 23% to account for potential survivor benefits. This load was not included in GRS's valuation report, but was communicated to us. Again, due to the size of the post disability survivor benefit liability relative to the standard disability liability, it should be explicitly valued rather than estimated with a load.

None of these assumptions were addressed in the Experience Study so we have no basis to evaluate them. However, based upon our experience with similar plans, these assumptions would be likely to produce reasonable valuation results.

SECTION IV
ASSUMPTION AND METHOD REVIEW

ACTUARIAL METHODS

Actuarial Asset Method

The market value of assets represents a "snap-shot" value as of the last day of the fiscal year that provides the principal basis for measuring financial performance from one year to the next. Market values, however, can fluctuate widely with corresponding swings in the marketplace. Because these fluctuations would cause volatility in employer contributions, an actuarial value of assets is developed.

The actuarial value of assets typically represents an asset value based on averaging or smoothing year-to-year market value returns for purposes of reducing the resulting volatility on contributions.

The actuarial value is calculated by adjusting the market value to remove two-thirds of the prior year's investment gain or loss, and one-third of the gain or loss from two years ago. The gain or loss is measured by comparing actual returns on a market value basis to the expected return on actuarial value based on the 8.25% assumed investment return. The actuarial value of assets is further constrained to be between 80% or 120% of the market value of assets. Based on our review this method is being applied accurately.

During our review of the calculations of the actuarial value of assets we noted one exception with regard to the calculation. In the allocation of the asset value between Uniformed and Non-Uniformed, the ratios were not applied correctly. The ratio of actuarial value of assets for each group should equal the ratio of the market value of assets for each group. The following shows the values as shown in the report and as recalculated by Cheiron:

Market Value of Assets	GRS Report	Percent of Total
Uniformed Patrol	$ 409,227,547	26.4%
Non-Uniformed	$1,143,120,445	73.6%
Total	$1,552,347,992	

Actuarial Value of Assets	GRS Report	Percent	Cheiron Calculation	Percent
Uniformed Patrol	$ 363,627,238	25.5%	$ 376,260,144	26.4%
Non-Uniformed	$1,063,663,480	74.5%	$1,051,030,574	73.6%
Total	$1,427,290,718		$1,427,290,718	

Correcting the allocation would slightly decrease the contribution rate for Uniformed and slightly increase the contribution rate for Non-Uniformed.

SECTION IV
ASSUMPTION AND METHOD REVIEW

Funding Method

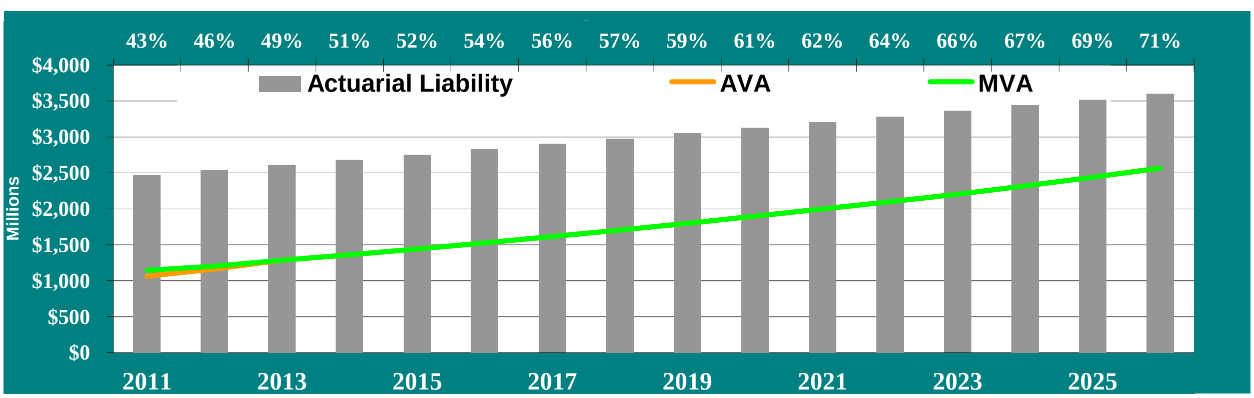
The Entry Age Normal Cost Funding method is used. For members of the Closed and Y2K Plans, a variation of the entry age method known as the ultimate entry age method is used. Under the ultimate entry age method the normal cost for all members, including closed plan members, is based upon the benefits under the Y2K Plan. This method is used to maintain a level normal cost as more and more members are covered under the Y2K Plan. For members being covered under the 2011 Tier, a separate normal cost calculated based upon the benefits of the 2011 Tier. We believe that the method used and the rationale for the method is reasonable.

In the valuation report, GRS notes that GASB has indicated that the ultimate entry age method will not be able to be used for accounting disclosures if the current Exposure Draft is adopted. Therefore, GRS has recommended that the Board adopt the individual entry age method for funding of all system benefits. We concur with this recommendation.

Funding Policy Including Amortization Method

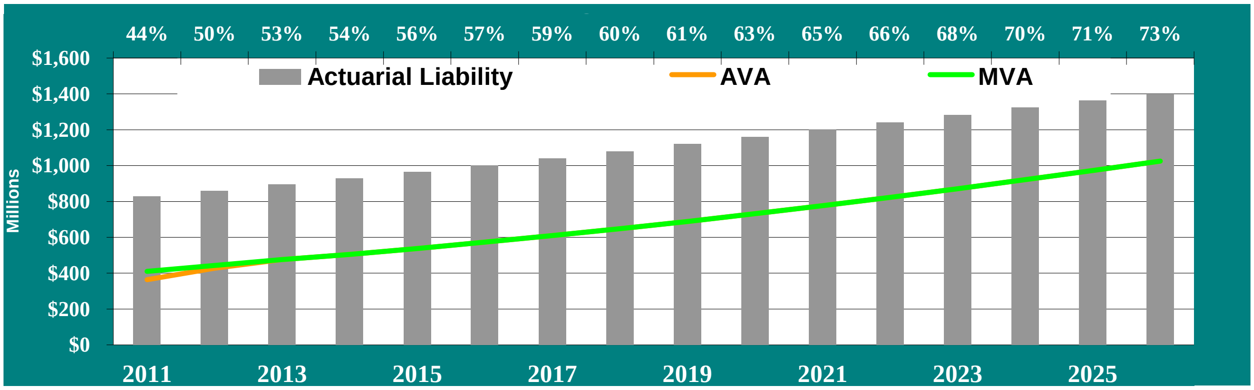
The following charts show projections of funded status over the next 15 years following the current funding policy if all actuarial assumptions are exactly realized including the 8.25% annual return. In the charts the bars represent the actuarial accrued liability, the green line is the market value of assets and the orange line is the actuarial value of assets. The funded ratio (actuarial value of assets divided by actuarial accrued liability) is shown at the top.

Non-Uniformed Employees:



SECTION IV
ASSUMPTION AND METHOD REVIEW

Uniformed Employees:



We believe that the funding policy, including the amortization method, is reasonable in that it is expected to result in steadily increasing funded ratios for both Uniformed and Non-Uniformed, with both groups' funded ratios projected to exceed 70% in 15 years.

The amortization of the unfunded actuarial accrued liability is based upon the greater of the calculations from the Permanent Policy and the Temporary Accelerated Policy. Both calculations are based upon closed amortization periods and a level percentage of future payroll using the payroll growth assumptions previously mentioned.

Under the Permanent Policy the amortization is over a closed 24-year period from July 1, 2012. Under the Temporary Policy, the unfunded retiree liabilities are based upon a closed 13-year period from July 1, 2012 and the other unfunded liabilities over a 28-year period from July 1, 2012.

However, it should be noted in the application of these methods that GRS applies the entire amortization payment to the retiree unfunded liability and none to the other unfunded liability. This will have the effect of actually amortizing the retiree liability over less than 13 years. For Uniformed we estimate the effective period at about five years and for Non-Uniformed at about nine years.

SECTION V
PROCESS DESCRIPTION

An actuarial audit of an annual valuation of a retirement system provides key confirmation of results. For the Board of Trustees, these results may otherwise be viewed as a *black-box* process because of the complex computation and program systems customarily used to arrive at actuarial liabilities and costs. This audit process addresses:

- Review of the census data used in determining the Systems cost. There are typical and anticipated adjustments made to the data in preparing the valuation that impact the final results, that treatment should logically be consistent and rational, and explicitly defined in the valuation reporting. By comparing summary statistics from our treatment with the GRS valuation report we can highlight differences in the underlying processed data and the likely impact on cost.

- Review of the financial data and how it is addressed under that actuarial asset methodology in determining the System cost. There are adjustments made to the financial data provided by the State to determine the actuarial value of assets. These adjustments impact the final results and future results and thus should be consistent with the prior years' calculations.

- Replication of the liability and costs values by separately programming our independent valuation system for the same benefits, using the same census data, valuation cost methods and assumption as reported in the 2011 valuation. We can compare and contrast the results presented by the Systems actuary. This provides an explicit check of that *black-box* process.

- Consider the reasonableness of the body of actuarial assumptions which are in part the result of actual experience of the System measured through explicit experience analysis and in part a reflection of judgment of the actuary and the Board. Our process provides additional insight into the trends, standard and emerging practice for future consideration.

- Comment on the effectiveness of the actuarial funding method, designed to provide a systematic and smooth scheme for the funding of the benefit obligations of the System.

The actual process for the audit ran through a number of steps identical to preparing the actuarial valuation.

1. We collected the same financial and demographic census data as to perform the same processes for a valuation.

2. We programmed our system to value the liabilities and costs of all benefits provided by the MPERS.

3. We applied the same set of assumptions as disclosed by the Systems' actuary to best replicate results.

4. We also requested and reviewed *sample lives* runs which represent year by year, benefit by benefit analysis of a single participant which demonstrates how the assumptions are applied

SECTION V
PROCESS DESCRIPTION

and the liabilities are determined through the participant's career and thereafter through retirement.

This process is conducted in accordance with generally accepted actuarial principles and methods.

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

In our audit process we applied the following assumptions which are the same as those applied in the June 30, 2011 valuation by GRS.

A. Actuarial Assumptions

1. Investment Return Assumption

8.25% compounded annually, net of expenses

2. Inflation

Wage inflation: 3.75% compounded annually
Consumer Price Inflation: 3.25% compounded annually

3. Cost-of-Living Increase in Benefits

Closed Plan*	2.60% per year
Year 2000 Plan	2.60% per year
2011 Tier Plan	2.60% per year

* For employees hired prior to August 28, 1997, the cost-of-living increase is 4.00% until the total increase of the initial benefit reaches 65%, at which time the cost-of-living increases becomes 2.60%

4. Administrative Expenses

0.73% of payroll, based upon actual results from previous year.

5. Disability Expenses

0.53% of payroll included in contribution. Retirement system pays premium directly to an outside insurance company or TPA.

6. Family Composition

90% of participants are assumed to be married for purposes of death-in-service benefits. Also applies to disabled members entitled to future retirement benefits. Spouses of male members are assumed to be three years younger than the member and spouses of female members are assumed to be three years older than the member.

7. Salary Increase Rate

Wage inflation component: 3.75%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

The additional merit component:

Service Based Salary Merit Increases Non-Uniformed	
Service	**Rate**
1	11.00%
2	10.50%
3	5.00%
4	4.50%

Age Based Salary Merit Increases					
Age	**Uniformed**	**Non-Uniformed**	**Age**	**Uniformed**	**Non-Uniformed**
20	8.50%	8.00%	39	2.05%	1.55%
21	8.50%	8.00%	40	1.95%	1.45%
22	8.50%	8.00%	41	1.85%	1.35%
23	7.80%	7.30%	42	1.75%	1.25%
24	7.02%	6.52%	43	1.65%	1.15%
25	6.16%	5.66%	44	1.55%	1.05%
26	5.22%	4.72%	45	1.45%	0.95%
27	5.00%	4.50%	46	1.35%	0.85%
28	4.60%	4.10%	47	1.25%	0.75%
29	4.20%	3.70%	48	1.20%	0.70%
30	3.80%	3.30%	49	1.15%	0.65%
31	3.40%	2.90%	50	1.10%	0.60%
32	3.00%	2.50%	51	1.05%	0.55%
33	2.85%	2.35%	52	1.00%	0.50%
34	2.70%	2.20%	53	0.96%	0.46%
35	2.55%	2.05%	54	0.92%	0.42%
36	2.40%	1.90%	55	0.88%	0.38%
37	2.25%	1.75%	56	0.84%	0.34%
38	2.15%	1.65%	57+	0.80%	0.30%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

8. Rates of Termination

Rates of Termination Less than 5 Years of Service				
	Uniformed		Non-Uniformed	
Service	Male	Female	Male	Female
0-1	14.00%	14.00%	30.00%	19.00%
1-2	6.50%	6.50%	16.00%	13.00%
2-3	3.50%	3.50%	8.00%	9.00%
3-4	3.00%	3.00%	6.50%	8.00%
4-5	3.00%	3.00%	5.00%	5.00%

Rates of Termination 5 Years of Service or more									
	Uniformed		Non-Uniformed			Uniformed		Non-Uniformed	
Age	Male	Female	Male	Female	Age	Male	Female	Male	Female
25	3.14%	3.14%	4.93%	5.10%	48	0.55%	0.55%	1.71%	2.38%
26	3.08%	3.08%	4.93%	5.10%	49	0.49%	0.49%	1.61%	2.21%
27	3.02%	3.02%	4.93%	5.10%	50	0.44%	0.44%	1.51%	2.04%
28	2.97%	2.97%	4.75%	5.10%	51	0.39%	0.39%	1.42%	1.87%
29	2.86%	2.86%	4.57%	5.10%	52	0.33%	0.33%	1.33%	1.70%
30	2.75%	2.75%	4.39%	5.10%	53	0.27%	0.27%	1.25%	1.53%
31	2.64%	2.64%	4.22%	5.10%	54	0.22%	0.22%	1.17%	1.36%
32	2.48%	2.48%	4.04%	5.10%	55	0.17%	0.17%	1.10%	1.19%
33	2.37%	2.37%	3.87%	4.93%	56	0.11%	0.11%	1.05%	1.02%
34	2.20%	2.20%	3.70%	4.76%	57	0.11%	0.11%	1.00%	0.85%
35	2.09%	2.09%	3.53%	4.59%	58	0.11%	0.11%	0.95%	0.68%
36	1.93%	1.93%	3.37%	4.42%	59	0.11%	0.11%	0.92%	0.51%
37	1.81%	1.81%	3.21%	4.25%	60	0.11%	0.11%	0.89%	0.34%
38	1.65%	1.65%	3.05%	4.08%	61			0.87%	0.17%
39	1.54%	1.54%	2.90%	3.91%	62			0.86%	0.00%
40	1.43%	1.43%	2.75%	3.74%	63			0.86%	0.00%
41	1.32%	1.32%	2.60%	3.57%	64			0.87%	0.00%
42	1.21%	1.21%	2.46%	3.40%	65			0.89%	0.00%
43	1.10%	1.10%	2.32%	3.23%	66			0.92%	0.00%
44	0.99%	0.99%	2.19%	3.06%	67			0.95%	0.00%
45	0.88%	0.88%	2.06%	2.89%	68			0.95%	0.00%
46	0.77%	0.77%	1.94%	2.72%	69			0.95%	0.00%
47	0.66%	0.66%	1.82%	2.55%					

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

9. Rates of Disability

Rates of Disability									
	Uniformed		Non-Uniformed			Uniformed		Non-Uniformed	
Age	Male	Female	Male	Female	Age	Male	Female	Male	Female
21	0.00%	0.00%	0.02%	0.03%	41	0.06%	0.06%	0.13%	0.22%
22	0.00%	0.00%	0.02%	0.03%	42	0.06%	0.06%	0.15%	0.24%
23	0.00%	0.00%	0.02%	0.03%	43	0.07%	0.07%	0.16%	0.27%
24	0.00%	0.00%	0.02%	0.05%	44	0.08%	0.08%	0.19%	0.29%
25	0.01%	0.01%	0.02%	0.05%	45	0.09%	0.09%	0.23%	0.32%
26	0.01%	0.01%	0.02%	0.05%	46	0.11%	0.11%	0.28%	0.35%
27	0.01%	0.01%	0.03%	0.06%	47	0.12%	0.12%	0.33%	0.37%
28	0.02%	0.02%	0.03%	0.08%	48	0.14%	0.14%	0.37%	0.38%
29	0.02%	0.02%	0.03%	0.10%	49	0.16%	0.16%	0.40%	0.40%
30	0.02%	0.02%	0.03%	0.10%	50	0.19%	0.19%	0.42%	0.42%
31	0.02%	0.02%	0.04%	0.11%	51	0.22%	0.22%	0.43%	0.45%
32	0.02%	0.02%	0.04%	0.13%	52	0.24%	0.24%	0.44%	0.48%
33	0.02%	0.02%	0.05%	0.14%	53	0.28%	0.28%	0.47%	0.53%
34	0.02%	0.02%	0.05%	0.14%	54	0.31%	0.31%	0.50%	0.59%
35	0.02%	0.02%	0.06%	0.14%	55	0.35%	0.35%	0.54%	0.66%
36	0.02%	0.02%	0.06%	0.16%	56	0.39%	0.39%	0.59%	0.70%
37	0.03%	0.03%	0.06%	0.16%	57	0.43%	0.43%	0.64%	0.77%
38	0.03%	0.03%	0.07%	0.18%	58	0.48%	0.48%	0.73%	0.82%
39	0.04%	0.04%	0.08%	0.18%	59	0.52%	0.52%	0.83%	0.85%
40	0.05%	0.05%	0.10%	0.19%	60	0.58%	0.58%	1.00%	0.90%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

10. Rates of Mortality for Healthy Lives

Postretirement mortality rates are based on the 1994 Group Annuity Mortality Tables projected to year 2002, blended 50% male and 50% female, then set forward two years for males and set back three years for females.

The table below provides a sample of the postretirement rates.

Postretirement Rates of Mortality Healthy Lives at Select Ages		
Age	**Male**	**Female**
20	0.0396%	0.0324%
25	0.0523%	0.0396%
30	0.0633%	0.0523%
35	0.0727%	0.0633%
40	0.1014%	0.0727%
45	0.1422%	0.1014%
50	0.2302%	0.1422%
55	0.4124%	0.2302%
60	0.7846%	0.4124%
65	1.4291%	0.7846%
70	2.2026%	1.4291%
75	3.6288%	2.2026%
80	6.3064%	3.6288%
85	10.3014%	6.3064%
90	17.0190%	10.3014%
95	25.9380%	17.0190%
100	35.8830%	25.9380%

Pre-retirement mortality rates are 70% for males and 50% for females of the postretirement mortality rates.

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

11. Rates of Mortality for Disabled Lives

Disabled mortality rates are based on a table provided by GRS.

The table below provides a sample of these rates.

Rates of Mortality for Disabled Lives Disabled Lives at Select Ages		
Age	**Male**	**Female**
20	4.5890%	2.6300%
25	4.5890%	2.6300%
30	3.4390%	2.3700%
35	2.6410%	2.1400%
40	2.6790%	2.0900%
45	3.0590%	2.2400%
50	3.6390%	2.5700%
55	4.5790%	2.9500%
60	5.7290%	3.3100%
65	6.4410%	3.7000%
70	7.0200%	4.1100%
75	7.9990%	4.9200%
80	10.7160%	7.4600%
85	15.9690%	11.2800%
90	23.9870%	16.8200%
95	35.9950%	25.2500%
100	49.8080%	37.8900%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

12. Rates of Retirement

2011 Tier Plan Rates of Retirement

	Non-Uniformed				Uniformed	
Age	Normal Age & Service	Normal Rule of 90 Service<30	Normal Rule of 90 Service>=30	Early	Normal Service<25	Normal Service>=25
55		30%	50%		30%	50%
56		30%	50%		30%	50%
57		30%	50%		30%	50%
58		30%	50%		30%	50%
59		30%	50%		30%	50%
60		30%	50%		100%	100%
61		30%	50%		100%	100%
62		30%	50%	10%	100%	100%
63		30%	50%	10%	100%	100%
64		30%	50%	10%	100%	100%
65		30%	50%	10%	100%	100%
66		30%	50%	10%	100%	100%
67	50%	30%	50%		100%	100%
68	50%	30%	50%		100%	100%
69	50%	30%	50%		100%	100%
70	100%	100%	100%		100%	100%

Rates of Early Retirement
Non-Uniformed

Age	Male	Female
55	3%	3%
56	3%	3%
57	4%	3%
58	4%	3%
59	5%	3%
60	10%	5%
61	4%	6%
62	40%	40%
63	40%	30%
64	40%	30%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

Rates of Normal Retirement

	Uniformed		Non-Uniformed	
Age	**Male**	**Female**	**Male**	**Female**
50	40%	40%	30%	30%
51	20%	20%	25%	18%
52	15%	15%	25%	18%
53	15%	15%	20%	18%
54	15%	15%	20%	25%
55	25%	25%	20%	30%
56	25%	25%	30%	30%
57	30%	30%	25%	30%
58	35%	35%	20%	30%
59	50%	50%	25%	30%
60	100%	100%	20%	20%
61	100%	100%	15%	20%
62	100%	100%	50%	35%
63	100%	100%	40%	25%
64	100%	100%	30%	25%
65	100%	100%	40%	40%
66	100%	100%	45%	40%
67	100%	100%	25%	40%
68	100%	100%	25%	40%
69	100%	100%	25%	40%
70	100%	100%	50%	50%
71	100%	100%	50%	50%
72	100%	100%	100%	100%

Upon retirement, members are assumed to pick the BackDROP period that when combined with the remaining annuity produces the highest liability.

13. Miscellaneous Loading

Normal and Early Retirement Benefits for unused sick days:

Uniformed Closed Plan and Year 2000 Plan	3.00%
Non-uniformed Closed Plan and Year 2000 Plan	2.60%
Uniformed 2011 Tier Plan	1.50%
Non-uniformed 2011 Tier Plan	1.00%

Post disability benefit liabilities for potential survivor benefits payable by the retirement system during the period of disability:

Active participants	50.0%
Currently disabled participants	23.0%

APPENDIX A
ACTUARIAL ASSUMPTIONS AND METHODS

B. Actuarial Methods

1. Asset Valuation Method

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

2. Actuarial Funding Method

The Entry Age Normal actuarial funding method is used for active employees, whereby the normal cost is computed as the level annual percentage of pay required to fund the retirement benefits between each member's date of hire and assumed retirement. The actuarial liability is the difference between the present value of future benefits and the present value of future normal cost. The unfunded actuarial liability is the difference between the actuarial liability and the actuarial value of assets.

For members of the Closed and Y2K Plans, a variation of the entry age method known as the ultimate entry age method is used. Under the ultimate entry age method, the normal cost for all members, including closed plan members is based upon the benefits under the Y2K Plan. This method is used to maintain a level normal cost as more and more members are covered under the Y2K Plan. For members being covered under the 2011 Tier, a separate normal cost is calculated based upon the benefits of the 2011 Tier.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
CLOSED PLAN

CLOSED PLAN

1. Participation

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.

2. Normal Retirement Eligibility (unreduced benefit)

Non-Uniformed Employees:

The earlier of:
1. Age 65 with at least four 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.

Uniformed Patrol Employees:

The earlier of:
1. Age 55 with at least four years of creditable service.
2. Mandatory retirement at age 60 with five or more years of creditable service.
3. Age 48 with age plus creditable service equal to 80 or more.

3. 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 retiring from active service 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).

4. 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.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
CLOSED PLAN

5. Early Retirement (reduced benefit)

Non-Uniformed Employees:

Eligibility:	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 Employees:

Uniformed Patrol members are not eligible for early retirement.

6. Vested Deferred Benefits

All Employees:

Fully vested in accrued pension with five 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.

7. Minimum Base Benefit

Receive a monthly 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.

8. Death Prior to Retirement

A death benefit is payable to the surviving spouse or eligible children of the member who dies after earning three years of creditable service. The survivor annuity shall be the total monthly payment equal to 25% of the deceased member's accrued annuity calculated as if the member was of normal retirement age as of the date of death.

The spouse of a member who dies after accruing five 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 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 to the surviving spouse or eligible children.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
CLOSED PLAN

9. 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 the time of retirement.

A member who is not married at retirement but marries thereafter may designate a spouse as beneficiary within one year of the marriage. Additionally, a member may designate a new spouse as beneficiary in the event of the death of the spouse to which the member was married at the date of retirement.

For period certain annuities, beneficiaries may be changed at any time.

10. 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.

11. $5,000 Death Benefit

MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of the members who retire from service or elect 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 for this benefit.

12. Purchase of Service

Military:

Prior to retirement, qualifying members may purchase up to a maximum of four years military service that includes active service, and/or active and inactive duty training from which they were honorably discharged. This service credit *can* be used to satisfy the vesting requirement. Periods of military service cannot coincide with employment in a state agency.

Police Service:

Prior to retirement, uniformed patrol members only may purchase up to a maximum of four years police service. Members must purchase all months of service for which they are eligible .

APPENDIX B
SUMMARY OF PLAN PROVISIONS
CLOSED PLAN

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 sector employment **not covered** by a retirement plan must be purchased.

13. Public Employment Prior Service (Subsidized purchase)

Section 104.040.6 allows, prior to retirement, uniformed patrol members only, may purchase up to a maximum of four 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 four years.

14. 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 available 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.

15. 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 increase annually by 80% of the increase in the Consumer Price Index (subject to a maximum increase of 5% and a minimum increase of 4%). These increases are made until the total of the increase 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:
1. 80% of the CPI-U increase, or
2. 5%

16. Contributions

None.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
YEAR 2000 PLAN

YEAR 2000 PLAN

1. Participation

Participants Include:

1. All active employees who first became members on or after July 1, 2000 but prior to January 1, 2011.
2. MPERS active members and vested former members who elect to transfer to the Year 2000 Plan at retirement.
3. MPERS 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. MPERS 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 but prior to July 1, 2011.

2. Normal Retirement Eligibility (unreduced benefit)

Non-Uniformed Employees:

The earlier of:

1. Age 62 with at least four years of creditable service.
2. Age 48 with age plus creditable service equal to 80 or more.

Uniformed Patrol Employees:

The earlier of:

1. Mandatory retirement at age 60 with five or more years of creditable service.
2. Age 48 with age plus creditable service equal to 80 or more.

3. 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). All 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).

4. Normal Retirement Benefit Amount

All Employees:

Life Benefit: 1.7% of final average pay times years of creditable service.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
YEAR 2000 PLAN

Temporary benefit:	If member retires between age 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 the minimum age at which reduced Social Security benefits are payable or death, whichever comes first. All Uniformed Patrol members are eligible for the temporary benefit.

5. Early Retirement (reduced benefit)

All employees:

Eligibility:	Age 57 with at least five years of creditable service.
Amount:	Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement.

6. Vested Deferred Benefits

All Employees

Fully vested in accrued pension with five 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.

7. Minimum Base Benefit

Same as the Closed Plan.

8. Death Prior to Retirement

The spouse of a member who dies after accruing five 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 to the surviving spouse or eligible children.

9. Death After Retirement

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.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
YEAR 2000 PLAN

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 to which the member married 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.

10. Pop-Up Provision

Same as the Closed Plan.

11. $5,000 Death Benefit

MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or elect 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 on or after September 28, 1985 are eligible to receive this benefit.

12. Purchase of Service

Military:

Prior to retirement, qualifying members may purchase up to a maximum of four years of 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 requirements. Periods of military service cannot coincide with employment in a state agency.

Police Service:

Not available.

Portability:

Same as Closed Plan Section 105.691.

In addition, Section 104.1090 provides that in-state vested service with another retirement system may be granted after 10 years of state service if the other retirement plan agrees to transfer assets equal to the accrued liability to MPERS.

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 sector employment **not covered** by a retirement plan must be purchased.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
YEAR 2000 PLAN

13. Public Employment Prior Service (Subsidized purchase)

Not available.

14. Disability

Same as the Closed Plan.

15. Post-Retirement Benefit Adjustments

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

Annual benefit percentage increase is equal to the lesser of:
1. 80% of the CPI-U increase, or
2. 5%

16. Contributions

None.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
BackDROP OPTION

BackDROP Option (Closed Plan and Year 2000 Plan)

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.

1. Eligibility

A member must have been eligible to retire under normal age and/or service conditions for at least two years.

2. Retroactive Start Date

The later of:
1. The member's normal retirement date.
2. Five years prior to the annuity start date selected by the member.

3. BackDROP Period

The period from the retroactive start date to the annuity start date. The BackDROP period must be in 12 month increments and cannot exceed five years.

4. BackDROP Account

90% of the value of the benefits that would have been paid during the BackDROP period. These benefits include post-retirement benefit increases, but do not include any spousal option reductions.

The member is paid the value of the BackDROP account as a lump sum as of the annuity start date or as three equal annual installments.

5. Benefit Amount

The annuity benefit payable at the annuity start date is calculated with service and final average pay as of the retroactive start date. Post-retirement benefit increases are applied to the benefit from the retroactive start date.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
2011 TIER PLAN

2011 Tier Plan

1. Participation

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

2. Normal Retirement Eligibility (unreduced benefit)

Non-Uniformed Employees:

The earlier of:
1. Age 67 with at least 10 years of creditable service.
2. Age 55 with age plus creditable service equal to 90 or more.

Uniformed Patrol Employees:

The earlier of:
1. Age 55 with at least 10 years of creditable service.
2. Mandatory retirement at age 60.

3. 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). All 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).

4. 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 age 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 the minimum age at which reduced social security benefits are payable or death, whichever comes first. Uniformed Patrol members are eligible for the temporary benefit when they reach mandatory retirement age (currently age 60) or they reach age 55 and have 10 years of creditable service.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
2011 TIER PLAN

5. Early Retirement (reduced benefit)

Non-Uniformed Employees:

Eligibility:	Age 62 with at least 10 years of creditable service.
Amount:	Normal retirement amount reduced by 0.5% for each month that retirement precedes eligibility for normal retirement.

6. Vested Deferred Benefits

All Employees

Fully vested in accrued pension with 10 years of creditable service. The benefit will commence at the age 67 for non-uniformed individuals and at age 55 for uniformed individuals

7. Minimum Base Benefit

Same as the Closed Plan.

8. Death Prior to Retirement

The spouse of a member who dies after accruing 10 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 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 to the surviving spouse or eligible children.

9. Death After Retirement

The benefit payable under the joint and survivor or period certain form of payment, if the member elected an optional for 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.

APPENDIX B
SUMMARY OF PLAN PROVISIONS
2011 TIER PLAN

10. Pop-Up Provision

Same as the Closed Plan.

11. $5,000 Death Benefit

MPERS provides a $5,000 death benefit for a designated beneficiary(ies) of members who retire from service or elect work-related disability benefits. Members who die while on terminated vested status or long-term disability status do not qualify for this benefit.

12. Purchase of Service

Military: Not Available.

Police Service: Not Available.

Portability: Same as Closed Plan Section 105.691.

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 sector employment **not covered** by a retirement plan must be purchased.

13. Public Employment Prior Service (Subsidized purchase)

Not Available.

14. Disability

Same as the Closed Plan.

15. Post-Retirement Benefit Adjustments

Same as the Year 2000 Plan.

16. Contributions

4% contributions with interest credited to the account annually at 4%. 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 compensation picked up by the employer.

APPENDIX C
GLOSSARY OF TERMS

1. Actuarial Liability

The Actuarial Liability is the difference between the present value of all future system benefits and the present value of total future normal costs. This is also referred to by some actuaries as the "accrued liability" or "actuarial accrued liability".

2. Actuarial Assumptions

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

3. Accrued Service

Service credited under the System which was rendered before the date of the actuarial valuation.

4. 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.

5. Actuarial Funding Method

A mathematical budgeting procedure for allocating the dollar amount of the actuarial present value of a retirement system benefit between future normal cost and actuarial accrued liability. Sometimes referred to as the "actuarial funding method".

6. Actuarial Gain (Loss)

The difference between actual experience and actuarial assumption anticipated experience during the period between two actuarial valuation dates.

7. Actuarial Present Value

The amount of funds currently required to provide a payment or series of payments in the future. It is determined by discounting future payments at predetermined rates of interest, and by probabilities of payment.

APPENDIX C
GLOSSERY OF DEFINITIONS

8. Amortization

Paying off an interest-discounted amount with periodic payments of interest and principal—as opposed to paying off with a lump sum payment.

9. Annual Required Contribution (ARC) under GASB 25

The Governmental Accounting Standards Board (GASB) Statement No. 25 defines the Plan Sponsor's "Annual Required Contribution" (ARC) that must be disclosed annually.

10. Normal Cost

The actuarial present value of retirement system benefits allocated to the current year by the actuarial funding method.

11. Set back/Set forward

Set back is a period of years that a standard published table (i.e. mortality) is referenced backwards in age. For instance, if the set back period is 2 years and the participant's age is currently 40, then the table value for age 38 is used from the standard published table. It is the opposite for set forward. A system would use set backs or set forwards to compensate for mortality experience in their work force.

12. Unfunded Actuarial Liability (UAL)

The unfunded actuarial liability represents the difference between actuarial liability and valuation assets. This value is sometimes referred to as "unfunded actuarial accrued liability".

Most retirement systems have unfunded actuarial liabilities. They typically arise each time new benefits are added and each time experience losses are realized.

The existence of unfunded actuarial accrued liability is not in itself an indicator of poor funding, Also, unfunded actuarial liabilities do not represent a debt that is payable today. What is important is the ability of the plan sponsor to amortize the unfunded actuarial liability and the trend in its amount (after due allowance for devaluation of the dollar).