Gabriel Roeder Smith & Company
Consultants & Actuaries

MINNESOTA STATE RETIREMENT SYSTEM
STATE PATROL RETIREMENT FUND
ACTUARIAL VALUATION REPORT AS OF JULY 1, 2016

GRS
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December 14, 2016

Minnesota State Retirement System
State Patrol Retirement Fund
St. Paul, Minnesota

Dear Board of Directors:

The results of the July 1, 2016 annual actuarial valuation of the State Patrol Retirement Fund are presented in this report. This report was prepared at the request of the Board and is intended for use by the Board and staff and those designated or approved by the Board. This report may be provided to parties other than the Fund only in its entirety. GRS is not responsible for the consequences of any unauthorized use of this report by persons other than intended users as described above.

The purpose of the valuation is to measure the Fund's funding progress and to determine the required contribution rate for the fiscal year beginning July 1, 2016. Note that we have not attempted to quantify the impact of GASB Statements No. 67 and No. 68 in this report. Please see the separate report dated December 1, 2016.

The required contribution rate shown on page one was designed to comply with Minnesota Statutes. Users of this report should be aware that contributions made at that rate do not guarantee benefit security. Given the importance of benefit security to any retirement system, we suggest that contributions to the System in excess of those presented in this report be considered.

The contribution rate in this report is determined using the actuarial assumptions and methods disclosed in the Actuarial Basis of this report. This report includes risk metrics on page five, but does not include a more robust assessment of the risks of future experience differing materially from the actuarial assumptions. Additional assessment of risks was outside the scope of this assignment. We encourage a review and assessment of investment and other significant risks that may have a material effect on the plan's financial condition.

The valuation was based upon information furnished by the Minnesota State Retirement System (MSRS), concerning benefits, financial transactions, plan provisions and active members, terminated members, retirees and beneficiaries. We checked for internal and year-to-year consistency, but did not audit the data. We are not responsible for the accuracy or completeness of the information provided by MSRS.

Actuarial assumptions, including discount rates, mortality tables and others identified in this report, are prescribed by Minnesota Statutes Section 356.215, the Legislative Commission on Pensions and Retirement (LCPR), and the Board of Directors. These parties are responsible for selecting the plan's funding policy, actuarial valuation methods, asset valuation methods, and assumptions. The policies,

methods and assumptions used in this valuation are those that have been so prescribed and are described in the Actuarial Basis of this report. MSRS is solely responsible for communicating to GRS any changes required thereto.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of such future measurements.

This report should not be relied on for any purpose other than the purpose described herein. Determinations of the financial results associated with the benefits described in this report in a manner other than the intended purpose may produce significantly different results.

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

Brian B. Murphy and Bonita J. Wurst are Members of the American Academy of Actuaries (MAAA) and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein. In addition, Mr. Murphy meets the requirements of "approved actuary" under Minnesota Statutes Section 356.215, Subdivision 1, Paragraph (c).

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report is accurate and fairly presents the actuarial position of the State Patrol Retirement Fund as of the valuation date and was performed in accordance with the requirements of Minnesota Statutes Section 356.215, and the requirements of the Standards for Actuarial Work established by the LCPR. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board and with applicable statutes.

We are available to answer any questions or provide further details.

Respectfully submitted,

Brian B. Murphy, FSA, EA, MAAA, FCA

Bonita J. Wurst, ASA, EA, MAAA, FCA

BBM/BJW:sc

Other Observations

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

Given the plan's contribution allocation procedure, if there are no changes in benefits or contributions and all actuarial assumptions are met (including the assumption of the plan earning 8.00%), it is expected that:

(1) The unfunded actuarial accrued liabilities will be fully amortized after approximately 35 years,
(2) The funded status of the plan will increase gradually towards a 100% funding ratio, and
(3) The unfunded liability will grow initially as a dollar amount before beginning to decline.

Limitations of Funded Status Measurements

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

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

Limitations of Project Scope

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

Discount Rate Assumption

In a 2015 analysis of long-term rate of investment return and inflation assumptions, GRS suggested that an investment return assumption in the range of 7.00% to 8.00% would be reasonable. The current assumed rate, which is mandated by Minnesota Statutes, is 8.00% and is at the upper end of the reasonable range. This report also concluded that the probability of exceeding the current 8.00% assumption over 20 years is only 37%. Please see the report, *Minnesota State Employees Retirement Fund 6-Year Experience Study*, dated June 30, 2015 for additional information.

Professional standards require GRS to evaluate this assumption each year. If an assumption is deemed unreasonable based on current information, we would have to qualify the work that we do for MSRS.

In May 2016, the Minnesota State Board of Investment (SBI) affirmed that the 8.00% return rate is attainable in the long-term, while acknowledging short term challenges. Also in May 2016, the LCPR's Actuary supported the reasonableness of the current rate by reviewing historical returns by investment class, projected returns from other investment consultants, and considering the SBI's projections. GRS believes the 8.00% return rate is within the reasonable range for this valuation as of July 1, 2016, but cautions MSRS that declining capital market and inflation expectations may result in 8.00% being deemed unreasonable for future valuations. In such an instance, we would still comply with statutes and produce the valuation based upon 8.00%, but Actuarial Standards would require us to issue a "qualified" report.

If a discount rate of 7.50% were used in this valuation instead of 8.00%, we estimate that the unfunded liability would be approximately $39 million higher than estimated herein. This estimate incorporates lower salary scale rates due to lower inflation expectations as well as a delay in the assumed payment of 1.5% or 2.5% postretirement benefit increases.

Contents

Summary of Valuation Results

Contributions

The following table summarizes important contribution information as described in the Development of Costs section.

	Actuarial Valuation as of	
Contributions	**July 1, 2016**	**July 1, 2015**
Statutory Contributions - Chapter 352B (% of Payroll)	37.37%	34.93%
Required Contributions - Chapter 356 (% of Payroll)	40.45%	42.91%
Sufficiency / (Deficiency)	(3.08)%	(7.98)%

The contribution deficiency decreased from 7.98% of payroll to 3.08% of payroll. The primary reasons for the decreased contribution deficiency are additional member and employer contributions and the decrease in liability due to an assumed delay in the 1.50% and 2.50% postretirement benefit increases (see page 4 for detailed information). On a market value of assets basis, contributions are deficient by 5.51% of payroll.

Based on the actuarial value of assets, statutory contributions are not sufficient to fully amortize the unfunded actuarial accrued liability over the statutory amortization period of 22 years. Based on current statutory contributions, the actuarial value of assets, and other methods and assumptions described in this report, the unfunded liability will be eliminated in approximately 35 years.

The Plan Assets section provides detail on the plan assets used for the valuation including a development of the Actuarial Value of Assets (AVA). The Market Value of Assets (MVA) earned approximately -0.2% for the plan year ending June 30, 2016. The AVA earned approximately 7.8% for the plan year ending June 30, 2016 as compared to the assumed rate of 8.00%. The assumed rate is a prescribed assumption mandated by Minnesota Statutes. The assumed rate is a prescribed assumption mandated by Minnesota Statutes, and is at the very upper end of the reasonable range. According to the NASRA survey, the most common assumption for statewide plans is currently 7.50%. Use of a 7.50% return assumption would produce a deficiency greater than shown above.

Participant reconciliation and statistics are detailed in the Membership Data section. The Actuarial Basis section includes a summary of plan provisions and actuarial methods and assumptions used for the calculations in this report.

Accounting and financial reporting information prepared according to GASB Statements No. 67 and No. 68 has been provided in a separate report dated December 1, 2016.

Summary of Valuation Results

A summary of principal valuation results from the current valuation and the prior valuation follows. Any changes in plan provisions, actuarial assumptions or valuation methods and procedures between the two valuations are described after the summary.

	Actuarial Valuation as of	
	July 1, 2016	**July 1, 2015**
Contributions (*% of Payroll*)		
Statutory - Chapter 352B	37.37%	34.93%
Required - Chapter 356	40.45%	42.91%
Sufficiency / (Deficiency)	(3.08)%	(7.98)%
Funding Ratios (*dollars in thousands*)		
Assets		
- Current assets (AVA)	$ 654,842	$ 639,863
- Current assets (MVA)	629,992	664,530
Accrued Benefit Funding Ratio		
- Current benefit obligations	$ 812,659	$ 810,894
- Funding ratio (AVA)	80.58%	78.91%
- Funding ratio (MVA)	77.52%	81.95%
Accrued Liability Funding Ratio		
- Actuarial accrued liability	$ 833,886	$ 833,033
- Funding ratio (AVA)	78.53%	76.81%
- Funding ratio (MVA)	75.55%	79.77%
Projected Benefit Funding Ratio		
- Current and expected future assets	$ 955,976	$ 899,720
- Current and expected future benefit obligations	987,460	979,772
- Projected benefit funding ratio (AVA)	96.81%	91.83%
Participant Data		
Active members		
- Number	892	843
- Annual valuation earnings *(000s)*	69,663	66,535
- Projected annual earnings *(000s)*	73,134	69,857
- Average projected annual earnings	81,989	82,867
- Average age	40.7	41.3
- Average service	11.1	11.9
Service retirements	844	816
Survivors	151	154
Disability retirements	53	57
Deferred retirements	55	52
Terminated other non-vested	20	17
Total	**2,015**	**1,939**

Summary of Valuation Results

Effects of Changes

The following changes in plan provisions, actuarial assumptions, and methods were recognized as of July 1, 2016:

- The assumed post-retirement benefit increase rate was changed from 1.00% per year through 2029, 1.50% from 2030 through 2048 and 2.50% thereafter to 1.00% through 2044, 1.50% from 2045 through 2061 and 2.50% thereafter.

Refer to the Actuarial Basis section of this report for a complete description of these changes.

The combined impact of the above changes was to decrease the accrued liability by $14.5 million and decrease the required contribution by 2.5% of pay, as follows:

	Before Changes	Reflecting Assumption Changes
Normal Cost Rate, % of Pay	23.7%	22.6%
Amortization of Unfunded Accrued Liability, % of Pay	18.9%	17.5%
Expenses (% of Pay)	0.3%	0.3%
Total Required Contribution, % of Pay	42.9%	40.4%
Accrued Liability Funding Ratio	77.2%	78.5%
Projected Benefit Funding Ratio	94.4%	96.8%
Unfunded Accrued Liability (in millions)	$193.5	$179.0

Summary of Valuation Results

Valuation of Future Annual Post-Retirement Benefit Increases

Benefit recipients receive a future annual compounding 1.00% post-retirement benefit increase. If the accrued liability funding ratio (determined on a market value of assets basis) reaches or exceeds 85% (based on a 1.50% post-retirement increase assumption) for two consecutive years, the benefit increase will revert to 1.50%. Similarly, if the accrued liability funding ratio reaches or exceeds 90% (based on a 2.50% post-retirement increase assumption) for two consecutive years, the benefit increase will revert to 2.50%. If, after reverting to a 1.50% benefit increase, the accrued liability funding ratio declines to 75% or less for one year or 80% or less for two consecutive years, the benefit increase rate will decrease to 1.00%. Benefit increases already granted, however, will not be affected.

To determine an assumption regarding future changes in the post-retirement benefit increase, we performed a projection of liabilities and market value of assets based on the following methods and assumptions:

- Future investment returns and liability discount rates of 8.00%;
- Open group; stable active population (new member profile based on average new members hired in recent years);
- The post-retirement benefit increase rate is assumed to be 1.00% per year until the accrued liability funding ratio threshold required to pay a 1.50% post-retirement benefit increase is reached; and similarly, the post-retirement benefit increase is assumed to be 1.50% per year until the accrued liability funding ratio threshold required to pay a 2.50% post-retirement benefit increase is reached.
- Current statutory contribution levels (i.e., not including potential contribution increases under the contribution stabilizer statutes).

Based on these assumptions and methods, the projection indicates this plan is expected to attain the accrued liability funding ratio threshold to pay the 1.50% benefit increase in the year 2044 and the plan would begin paying 1.50% benefit increases on January 1, 2045. Similarly, the projection indicates this plan is expected to attain the accrued liability funding ratio threshold to pay the 2.50% benefit increase in the year 2061 and the plan would begin paying 2.50% benefit increases on January 1, 2062. This assumption is reflected in our calculations. This is only an assumption; actual timing will depend on actual experience.

Summary of Valuation Results

Risk Measures *(Dollars in Thousands)*

Valuation Date (July 1)	(1) Accrued Liabilities (AAL)	(2) Market Value of Assets	(3) Market Value Unfunded AAL (1) - (2)	(4) Valuation Payroll	(5) Market Value Funded Ratio (2) / (1)	(6) Retiree Liabilities	(7) RetLiab/ AAL (6) / (1)	(8) AAL/ Payroll (1) / (4)	(9) Assets/ Payroll (2) / (4)
2010	$683,360	$488,870	$194,490	$63,250	71.5%	$441,901	64.7%	1080.4%	772.9%
2011	700,898	568,279	132,619	63,250	81.1%	454,811	64.9%	1108.1%	898.5%
2012	760,955	549,956	210,999	62,524	72.3%	513,106	67.4%	1217.1%	879.6%
2013	741,850	593,201	148,649	62,121	80.0%	507,005	68.3%	1194.2%	954.9%
2014	800,421	667,340	133,081	63,952	83.4%	537,866	67.2%	1251.6%	1043.5%
2015	833,033	664,530	168,503	68,463	79.8%	570,541	68.5%	1216.8%	970.6%
2016	833,886	629,992	203,894	69,343	75.6%	581,343	69.7%	1202.6%	908.5%

Valuation Date (July 1)	(10) Portfolio StdDev	(11) Std Dev % of Pay (9) x (10)	(12) Unfunded / Payroll (3) / (4)	(13) Non-Investment Cash Flow (NICF)	(14) NICF/ Assets (13) / (2)	(15) SBI Market Rate of Return	(16) SBI 5-year Average
2010			307.5%	$(29,374)	-6.0%	15.2%	3.4%
2011			209.7%	(31,499)	-5.5%	23.3%	5.3%
2012			337.5%	(31,067)	-5.6%	2.4%	2.3%
2013			239.3%	(33,070)	-5.6%	14.2%	6.2%
2014			208.1%	(31,713)	-4.8%	18.6%	14.5%
2015	14.1%	136.9%	246.1%	(31,713)	-4.8%	4.4%	12.3%
2016	14.1%	128.1%	294.0%	(33,764)	-5.4%	-0.1%	7.7%

Notes pertaining to numbered columns:

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

(6) and (7). The ratio of Retiree liabilities to total accrued liabilities gives an indication of the maturity of the system. As the ratio increases, cash flow needs increase, and the liquidity needs of the portfolio change. A ratio on the order of 50% indicates a maturing system.

(8) and (9). The ratios of liabilities and assets to payroll gives an indication of both maturity and volatility. Many systems have ratios between 500% and 700%. Ratios significantly above that range may indicate difficulty in supporting the benefit level as a level % of payroll.

(10) and (11). The portfolio standard deviation measures the volatility of investment return. When multiplied by the ratio of assets to payroll it gives the effect of a one standard deviation asset move as a percent of payroll. This figure helps users understand the difficulty of dealing with investment volatility and the challenges volatility brings to sustainability.

(12) The ratio of unfunded liability to payroll gives an indication of the plan sponsor's ability to actually pay off the unfunded liability. A ratio above approximately 300% or 400% may indicate difficulty in discharging the unfunded liability within a reasonable time frame.

(13) The ratio of non-investment cash flow to assets is an important measure of sustainability. Negative ratios are common and expected for a maturing system. In the longer term, this ratio should be on the order of approximately -4%. A ratio that is significantly more negative than that for an extended period could be a leading indicator of potential exhaustion of assets.

(15) and (16). Investment return is probably the largest single risk that most systems face. The year by year return and the 5-year geometric average give an indicator of the realism of the systems assumed return. Of course, past performance is not a guarantee of future results. The performance data for the Combined Funds (pooled investments of major Minnesota Public Retirement Systems) is presented in these columns. The source of this data is the Minnesota State Board of Investment.

Information prior to 2012 provided by prior actuary. See prior reports for additional detail.

Supplemental Information

The remainder of the report includes information supporting the results presented in the previous sections.

- **Plan assets** presents information about the plan's assets as reported by the Minnesota State Retirement System. The assets represent the portion of total fund liabilities that has been funded.
- **Membership data** presents and describes the membership data used in the valuation.
- **Development of costs** shows the liabilities for plan benefits and the derivation of the contribution amount.
- **Actuarial basis** describes the plan provisions, as well as the methods and assumptions used to value the plan. The valuation is based on the premise that the plan is ongoing.
- **Additional Schedules** includes a summary of funding progress and contributions over the long term.
- **Glossary** defines the terms used in this report.

Plan Assets

Statement of Fiduciary Net Position *(Dollars in Thousands)*

	Market Value	
Assets	**June 30, 2016**	**June 30, 2015**
Cash, equivalents, short term securities	$ 14,684	$ 12,692
Fixed income	155,056	156,362
Equity	459,515	494,996
Other*	89,099	67,725
Total cash, investments, and other assets	**$ 718,354**	**$ 731,775**
Amounts receivable	1,136	876
Total Assets	**$ 719,490**	**$ 732,651**
Amounts payable*	(89,498)	(68,121)
Net Position Restricted for Pensions	**$ 629,992**	**$ 664,530**

** Includes $89,099 in Securities Lending Collateral as of June 30, 2016 and $67,725 as of June 30, 2015.*

Plan Assets

Reconciliation of Plan Assets *(Dollars in Thousands)*

The following exhibit shows the revenue, expenses and resulting assets of the Fund as reported by the Minnesota State Retirement System for the Plan's prior two fiscal years.

Change in Assets	**Market Value**	
Year Ending	**June 30, 2016**	**June 30, 2015**
1. Fund balance at market value at beginning of year	**$ 664,530**	**$ 667,340**
2. Contributions		
a. Member	9,292	9,174
b. Employer	13,938	13,763
c. Other sources - Supplemental State Aid	1,000	1,000
d. Total contributions	$ 24,230	$ 23,937
3. Investment income		
a. Investment income/(loss)	73	29,833
b. Investment expenses	(847)	(930)
c. Net investment income/(loss)	(774)	28,903
4. Other	0	0
5. Total income: *(2.d.) + (3.c.) + (4.)*	**$ 23,456**	**$ 52,840**
6. Benefits Paid		
a. Annuity benefits	(57,695)	(55,465)
b. Refunds	(79)	(15)
c. Total benefits paid	(57,774)	(55,480)
7. Expenses		
a. Other	0	0
b. Administrative	(220)	(170)
c. Total expenses	(220)	(170)
8. Total disbursements: *(6.c.) + (7.c.)*	**(57,994)**	**(55,650)**
9. Fund balance at market value at end of year: *(1.) + (5.) + (8.)*	**$ 629,992**	**$ 664,530**
10. State Board of Investment calculated investment return	-0.1%	4.4%

Plan Assets

Actuarial Asset Value *(Dollars in Thousands)*

	June 30, 2016	June 30, 2015
1. Market value of assets available for benefits	**$ 629,992**	**$ 664,530**
2. Determination of average balance		
a. Total assets available at beginning of year	664,530	667,340
b. Total assets available at end of year	629,992	664,530
c. Net investment income for fiscal year	(774)	28,903
d. Average balance *[a. + b. - c.] / 2*	647,648	651,484
3. Expected return *[8.0% x 2.d.]*	51,812	52,119
4. Actual return	(774)	28,903
5. Current year asset gain/(loss) *[4. - 3.]*	(52,586)	(23,216)
6. Unrecognized asset returns		

	Original Amount	Unrecognized Amount %	Unrecognized Amount $	Unrecognized Amount %	Unrecognized Amount $
a. Year ended June 30, 2016	$(52,586)	80%	$ (42,069)	N/A	N/A
b. Year ended June 30, 2015	(23,216)	60%	(13,930)	80%	(18,573)
c. Year ended June 30, 2014	61,053	40%	24,421	60%	36,632
d. Year ended June 30, 2013	33,641	20%	6,728	40%	13,456
e. Year ended June 30, 2012	(34,239)		N/A	20%	(6,848)
f. Unrecognized return adjustment			**(24,850)**		**$ 24,667**
7. **Actuarial value at end of year** *(1. - 6.f.)*			**$ 654,842**		**$ 639,863**
8. Approximate return on actuarial value of assets during fiscal year			7.8%		12.7%
9. Ratio of actuarial value of assets to market value of assets			1.04		0.96

Membership Data

Distribution of Active Members

	Years of Service as of June 30, 2016									
Age	**<3***	**3 - 4**	**5 - 9**	**10 - 14**	**15 - 19**	**20 - 24**	**25 - 29**	**30 - 34**	**35+**	**Total**
< 25	27									**27**
Avg. Earnings	49,487									**49,487**
25 - 29	69	15	15							**99**
Avg. Earnings	52,866	70,852	73,701							**58,748**
30 - 34	38	25	46	8						**117**
Avg. Earnings	56,554	67,452	75,452	81,593						**68,024**
35 - 39	29	11	33	58	8					**139**
Avg. Earnings	58,909	76,323	75,882	87,567	95,744					**78,395**
40 - 44	17	5	25	64	72	2				**185**
Avg. Earnings	65,780	72,841	81,752	85,942	87,026	78,267				**83,508**
45 - 49	8	3	15	28	78	16	15			**163**
Avg. Earnings	62,837	78,618	83,808	84,349	86,579	85,899	86,225			**84,530**
50 - 54	5	1	7	12	41	16	32	9		**123**
Avg. Earnings	84,878	101,904	83,570	85,789	90,971	89,290	88,751	93,841		**89,299**
55 - 59	3	1	3	4	5	10	6	3		**35**
Avg. Earnings	84,568	82,680	93,287	90,066	92,593	83,653	82,996	105,883		**88,332**
60 - 64			2	1	1					**4**
Avg. Earnings			89,355	92,515	80,524					**87,937**
65 - 69										
Avg. Earnings										
70+										
Avg. Earnings										
Total	**196**	**61**	**146**	**175**	**205**	**44**	**53**	**12**		**892**
Avg. Earnings	**56,839**	**71,693**	**78,253**	**86,148**	**88,089**	**86,275**	**87,384**	**96,851**		**78,097**

* *This exhibit does not reflect service earned in other MSRS or Combined Service Annuity benefits. It should not be relied upon as an indicator of non-vested status.*

In each cell, the top number is the count of active participants for the age/service combination and the bottom number is average valuation earnings for the fiscal year ending on the valuation date.

Membership Data

Distribution of Service Retirements

	Years Retired as of June 30, 2016							
Age	**<1**	**1 - 4**	**5 - 9**	**10 - 14**	**15 - 19**	**20 - 24**	**25+**	**Total**
<50	2							**2**
Avg. Benefit	15,775							**15,775**
50 - 54	10	23						**33**
Avg. Benefit	55,004	49,453						**51,135**
55 - 59	29	98	20					**147**
Avg. Benefit	59,332	58,505	45,072					**56,840**
60 - 64	2	42	100	22				**166**
Avg. Benefit	27,487	52,017	56,772	47,630				**54,004**
65 - 69		3	27	89	24			**143**
Avg. Benefit		28,227	48,769	56,865	54,965			**54,417**
70 - 74	1		4	22	114	3		**144**
Avg. Benefit	34,437		33,472	58,104	63,510	45,213		**61,267**
75 - 79			1	1	28	53	1	**84**
Avg. Benefit			57,282	55,543	66,529	67,003	50,347	**66,395**
80 - 84					4	17	36	**57**
Avg. Benefit					76,758	78,019	70,730	**73,327**
85 - 89						1	40	**41**
Avg. Benefit						44,051	66,676	**66,124**
90+							27	**27**
Avg. Benefit							72,614	**72,614**
Total	**44**	**166**	**152**	**134**	**170**	**74**	**104**	**844**
Avg. Benefit	**54,355**	**55,062**	**53,201**	**55,542**	**63,113**	**68,340**	**69,464**	**59,327**

In each cell, the top number is the count of retired participants for the age/years retired combination and the bottom number is the average annual benefit amount.

Membership Data

Distribution of Survivors

	Years Since Death as of June 30, 2016							
Age	**<1**	**1 - 4**	**5 - 9**	**10 - 14**	**15 - 19**	**20 - 24**	**25+**	**Total**
<45			2	6	3			**11**
Avg. Benefit			12,836	18,840	6,171			**14,293**
45 - 49								
Avg. Benefit								
50 - 54	1			1	1			**3**
Avg. Benefit	44,382			16,237	32,495			**31,038**
55 - 59			1	1	2			**4**
Avg. Benefit			26,830	14,264	39,371			**29,959**
60 - 64	1	3	1	4	1			**10**
Avg. Benefit	67,087	26,904	54,539	32,729	38,995			**37,225**
65 - 69	2	2	2	8	3			**17**
Avg. Benefit	45,794	30,391	55,072	19,210	36,635			**30,947**
70 - 74	1	5		6	7	1	1	**21**
Avg. Benefit	28,775	32,293		31,651	45,654	30,071	32,761	**36,312**
75 - 79	1		5	5	1	2	2	**16**
Avg. Benefit	44,395		42,546	44,590	32,580	56,962	10,954	**40,530**
80 - 84	1	10	2	3	5	3	1	**25**
Avg. Benefit	34,844	36,796	23,405	30,699	45,326	32,943	41,504	**36,347**
85 - 89		4	4	7	3	4	4	**26**
Avg. Benefit		28,727	36,652	38,264	49,031	31,208	36,523	**36,438**
90+		4	7	1	5	1		**18**
Avg. Benefit		31,283	31,270	11,188	31,007	31,577		**30,101**
Total	**7**	**28**	**24**	**42**	**31**	**11**	**8**	**151**
Avg. Benefit	**44,439**	**32,534**	**35,093**	**28,860**	**37,405**	**36,294**	**30,283**	**33,625**

In each cell, the top number is the count of survivors for the age/years since death combination and the bottom number is the average annual benefit amount.

Membership Data

Distribution of Disability Retirements

	Years Disabled as of June 30, 2016							
Age	**<1**	**1 - 4**	**5 - 9**	**10 - 14**	**15 - 19**	**20 - 24**	**25+**	**Total**
< 45		1	1					**2**
Avg. Benefit		50,263	30,901					**40,582**
45 - 49		3	1	1				**5**
Avg. Benefit		41,438	37,824	30,772				**38,582**
50 - 54		6	4	2	1			**13**
Avg. Benefit		54,584	45,876	53,594	30,966			**49,936**
55 - 59		2	3	2				**7**
Avg. Benefit		35,378	50,143	48,644				**45,496**
60 - 64				5	3	2		**10**
Avg. Benefit				49,021	31,331	45,714		**43,053**
65 - 69				4	2	1		**7**
Avg. Benefit				30,911	37,695	50,204		**35,606**
70 - 74				3	1	2		**6**
Avg. Benefit				34,696	75,630	60,731		**50,197**
75+							3	**3**
Avg. Benefit							53,532	**53,532**
Total		**12**	**9**	**17**	**7**	**5**	**3**	**53**
Avg. Benefit		**47,736**	**44,740**	**41,652**	**39,426**	**52,619**	**53,532**	**44,967**

In each cell, the top number is the count of disabled participants for the age/years since disability combination and the bottom number is the average annual benefit amount.

Membership Data

Reconciliation of Members

		Terminated		Recipients			
	Actives	Deferred Retirement	Other Non-Vested	Service Retirement	Disability Retirement	Survivor	Total
Members on 7/1/2015	**843**	**52**	**17**	**816**	**57**	**154**	**1,939**
New members	94	0	0	0	0	0	**94**
Return to active	1	(1)	0	0	0	0	**0**
Terminated non-vested	(4)	0	4	0	0	0	**0**
Service retirements	(35)	(2)	0	37	0	0	**0**
Terminated deferred	(5)	5	0	0	0	0	**0**
Terminated refund/transfer	(2)	0	(2)	0	0	0	**(4)**
Deaths	0	0	0	(16)	(4)	(9)	**(29)**
New beneficiary	0	0	0	0	0	7	**7**
Disabled	0	0	0	0	0	0	**0**
Unexpected status change	0	1	1	7	0	(1)	**8**
Net change	49	3	3	28	(4)	(3)	**76**
Members on 6/30/2016	**892**	**55**	**20**	**844**	**53**	**151**	**2,015**

Terminated Member Statistics on June 30, 2016	Deferred Retirement	Other Non-Vested	Total
Number	55	20	75
Average age	44.5	33.9	41.7
Average service	7.7	0.4	5.8
Average annual benefit, with augmentation to Normal Retirement Date and 30% CSA load	$ 27,668	N/A	$ 27,668
Average refund value, with 30% CSA load	$ 98,397	$ 3,199	$ 73,011

Development of Costs

Actuarial Valuation Balance Sheet *(Dollars in Thousands)*

The actuarial balance sheet is based on the principle that the long-term projected benefit obligations of the plan should be ideally equal to the long-term resources available to fund those obligations. **A Projected Benefit Funding Ratio less than 100% indicates that contributions are insufficient.** The resources available to meet projected obligations for current members consist of current fund assets plus the present value of anticipated future contributions intended to fund benefits for current members. In the exhibit below, B.2 is the estimated present value of contributions to fund the normal cost rate for current members until their respective termination dates. Item B.1 is the present value of the total 37.37% statutory contribution net of normal cost and anticipated plan expenses during the period from the valuation date to the statutory unfunded amortization date.

The contributions made in excess of amounts required for current benefit payments are accumulated as a reserve to help meet benefit payments in later years. It is this reserve system which permits the establishment of a level rate of contribution each year.

					June 30, 2016
A. Actuarial Value of Assets					$ 654,842
B. Expected Future Assets					
1. Present value of expected future statutory supplemental contributions*					$ 147,560
2. Present value of future normal cost contributions					153,574
3. Total expected future assets: *(1.) + (2.)*					$ 301,134
C. Total Current and Expected Future Assets					$ 955,976
D. Current Benefit Obligations**					
1. Benefit recipients	**Non-Vested**		**Vested**		**Total**
a. Service retirements	$	0	$ 514,929		$ 514,929
b. Disability retirements		0	28,530		28,530
c. Survivors		0	37,884		37,884
2. Deferred retirements with augmentation		0	9,501		9,501
3. Former members without vested rights***		28	0		28
4. Active members		3,208	218,579		221,787
5. Total Current Benefit Obligations	$	3,236	$ 809,423		$ 812,659
E. Expected Future Benefit Obligations					174,801
F. Total Current and Expected Future Benefit Obligations****					987,460
G. Unfunded Current Benefit Obligations: *(D.5.) - (A.)*					157,817
H. Unfunded Current and Future Benefit Obligations: *(F.) - (C.)*					31,484
I. Accrued Benefit Funding Ratio: *(A.)/(D.5.)*					80.58%
J. Projected Benefit Funding Ratio: *(C.)/(F.)*					96.81%

* *Per the LCPR Standards for Actuarial Work, calculated assuming the current contribution toward the unfunded liability continues for the entire amortization period. Includes $1,000,000 state contribution.*

** *Present value of credited projected benefits (projected compensation, current service).*

*** *Former members who have not satisfied vesting requirements and have not collected a refund of member contributions as of the valuation date.*

**** *Present value of projected benefits (projected compensation, projected service).*

Development of Costs

Determination of Unfunded Actuarial Accrued Liability and Supplemental Contribution Rate (*Dollars in Thousands)*

	Actuarial Present Value of Projected Benefits	Actuarial Present Value of Future Normal Costs	Actuarial Accrued Liability
A. Determination of Actuarial Accrued Liability (AAL)			
1. Active members			
a. Retirement annuities	$ 366,054	$ 133,335	$ 232,719
b. Disability benefits	20,509	12,101	8,408
c. Survivor's benefits	4,918	3,522	1,396
d. Deferred retirements	4,516	3,808	708
e. Refunds*	591	808	(217)
f. Total	$ 396,588	$ 153,574	$ 243,014
2. Deferred retirements with future augmentation	9,501	0	9,501
3. Former members without vested rights	28	0	28
4. Benefit recipients	581,343	0	581,343
5. Total	$ 987,460	$ 153,574	$ 833,886
B. Determination of Unfunded Actuarial Accrued Liability (UAAL)			
1. Actuarial accrued liability			$ 833,886
2. Current assets (AVA)			654,842
3. Unfunded actuarial accrued liability			$ 179,044
C. Determination of Supplemental Contribution Rate**			
1. Present value of future payrolls through the amortization date of June 30, 2038			$ 1,023,298
2. Supplemental contribution rate: *(B.3.) / (C.1.)*			17.50% ***

* *Includes non-vested refunds and non-married survivor benefits only.*

** *The amortization of the Unfunded Actuarial Accrued Liability (UAAL) using the current amortization method results in initial payments less than the "interest only" payment on the UAAL. Payments less than the interest only amount will result in the UAAL increasing for an initial period of time.*

*** *The amortization factor as of June 30, 2016 is 13.99209.*

Development of Costs

Changes in Unfunded Actuarial Accrued Liability (UAAL) *(Dollars in Thousands)*

	Year Ending June 30, 2016		
	Actuarial Accrued Liability	Current Assets	Unfunded Actuarial Accrued Liability
A. Unfunded Actuarial Accrued Liability at beginning of year	$ 833,033	$ 639,863	$ 193,170
B. Changes due to interest requirements and current rate of funding			
1. Normal cost, including expenses	$ 16,573	$ 0	$ 16,573
2. Benefit payments	(57,774)	(57,774)	0
3. Contributions	0	24,230	(24,230)
4. Interest on A., B.1., B.2. and B.3.	64,995	49,847	15,148
5. Total *(B.1. + B.2. + B.3. + B.4.)*	23,794	16,303	7,491
C. Expected Unfunded Actuarial Accrued Liability at end of year *(A. + B.5.)*	$ 856,827	$ 656,166	$ 200,661
D. Increase (decrease) due to actuarial losses (gains) because of experience deviations from expected			
1. Age and service retirements			$ 714
2. Disability retirements			(653)
3. Death-in-service benefits			(180)
4. Withdrawals			(223)
5. Salary increases			(6,388)
6. Investment income			1,324
7. Mortality of annuitants			(3,027)
8. Other items			1,311
9. Total			(7,122)
E. Unfunded Actuarial Accrued Liability at end of year before plan amendments and changes in actuarial assumptions *(C. + D.9.)*			$ 193,539
F. Change in Unfunded Actuarial Accrued Liability due to changes in plan provisions			0
G. Change in Unfunded Actuarial Accrued Liability due to changes in actuarial assumptions			(14,495)
H. Change in Unfunded Actuarial Accrued Liability due to changes in methodology			0
I. Unfunded Actuarial Accrued Liability at end of year *(E. + F. + G. + H.)**			$ 179,044

** The Unfunded Actuarial Accrued Liability on a market value of assets basis is $203,894.*

Development of Costs

Determination of Contribution Sufficiency/(Deficiency) *(Dollars in Thousands)*

The required contribution is defined in Minnesota Statutes as the sum of normal cost, a supplemental contribution to amortize the UAAL, and an allowance for expenses. The dollar amounts shown are for illustrative purposes and equal percent of payroll multiplied by projected annual payroll.

	Percent of Payroll	Dollar Amount
A. Statutory contributions - Chapter 352B		
1. Employee contributions	14.40%	$ 10,531
2. Employer contributions	21.60%	15,797
3. State contributions***	1.37%	1,000
4. Total	37.37%	$ 27,328
B. Required contributions - Chapter 356		
1. Normal cost		
a. Retirement benefits	19.62%	$ 14,349
b. Disability benefits	1.83%	1,338
c. Survivors	0.55%	402
d. Deferred retirement benefits	0.53%	388
e. Refunds*	0.11%	80
f. Total	22.64%	$ 16,557
2. Supplemental contribution amortization of Unfunded Actuarial Accrued Liability by June 30, 2038	17.50%	$ 12,798
3. Allowance for expenses	0.31%	$ 227
4. Total	40.45% **	$ 29,582
C. Contribution Sufficiency/(Deficiency) *(A.4. - B.4.)*	(3.08)%	$ (2,254)

Note: Projected annual payroll for fiscal year beginning on the valuation date: $73,134.

* *Includes non-vested refunds and non-married survivor benefits only.*

** *The required contribution on a Market Value of Assets basis is 42.88% of payroll.*

*** *Contributions paid until both the Public Employees Retirement Association Police and Fire Plan and the State Patrol Retirement Fund reach 90% funding (on a Market Value of Assets basis).*

Actuarial Basis

Actuarial Methods

All actuarial methods are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement, or the MSRS Board of Directors. Different methodologies may also be reasonable and results based on other methodologies would be different.

Actuarial Cost Method

Actuarial Accrued Liability and required contributions in this report are computed using the Entry Age Normal Cost Method. This method is prescribed by Minnesota Statute. Under this method, a normal cost is developed by amortizing the actuarial value of benefits expected to be received by each active participant (as a level percentage of pay) over the total working lifetime of that participant, from hire to termination. Age as of the valuation date was calculated based on the dates of birth provided by the Fund. Entry age for valuation purposes was calculated as the age on the valuation date minus the provided years of service on the valuation date.

To the extent that current assets and future normal costs do not support participants' expected future benefits, an Unfunded Actuarial Accrued Liability ("UAAL") develops. The UAAL is amortized over the statutory amortization period using level percent of payroll assuming payroll increases. The total contribution developed under this method is the sum of normal cost, expenses, and the payment toward the UAAL.

Valuation of Future Post-Retirement Benefit Increases

If the plan has reached the accrued liability funding ratio threshold (determined on a market value of assets basis) required to pay a 1.50% or 2.50% benefit increase, Minnesota Statutes require the 1.50% or 2.50% benefit increase rate to be reflected in the liability calculations. If the plan has not yet reached the accrued liability funding ratio threshold required to pay a 1.50% or 2.50% benefit increase, Minnesota Statutes require a projection to be performed to determine the expected attainment of the accrued liability funding ratio thresholds, and the expected payment of 1.50% or 2.50% benefit increases must be reflected in the liability calculations.

Funding Objective

The fundamental financing objective of the Fund is to establish contribution rates which, when expressed as a percentage of active member payroll, will remain approximately level from generation to generation and meet the required deadline for full funding.

Actuarial Basis

Actuarial Methods (Concluded)

Asset Valuation Method

The assets are valued based on a five-year moving average of expected and market values (five-year average actuarial value) determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year net of investment income for the fiscal year;
- The investment gain or (loss) is taken as the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year; and
- The asset value is the sum of the market asset value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four fiscal years.

Payment on the Unfunded Actuarial Accrued Liability

Payment equals a level percentage of payroll each year to the statutory amortization date of June 30, 2038 assuming payroll increases of 3.50% per annum. If there is a negative Unfunded Actuarial Accrued Liability, the surplus amount is amortized over 30 years as a level percentage of payroll. If the unfunded liability increases due to changes in benefits, assumptions, or methods, the statutory amortization date will be re-determined. Projected payroll is multiplied by 0.959 in the determination of the present value of future payroll to account for timing differences (as required by the Standards for Actuarial Work).

Changes in Methods since Prior Valuation

There have been no changes in actuarial methods since the prior valuation.

Actuarial Basis

Summary of Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All actuarial assumptions are prescribed by Minnesota Statutes, the Legislative Commission on Pensions and Retirement (LCPR), or the MSRS Board of Directors. These parties are responsible for selecting the assumptions used for this valuation. The assumptions prescribed are based on the last experience study, dated February 2012, prepared by a former actuary, and a review of inflation and investment return assumptions dated September 11, 2014. An experience study for the 2011-2015 period was issued on July 26, 2016. This report recommended many changes to demographic assumptions, expected to be effective at a future date.

The Allowance for Combined Service Annuity was also based on a recommendation by a former actuary. We are unable to judge the reasonableness of this assumption without performing a substantial amount of additional work beyond the scope of the assignment. We note that the LCPR has recently completed a review of this assumption. This review recommended changes to this assumption, expected to be effective at a future date.

Investment return	8.00% per annum.
Benefit increases after retirement	1.00% per annum through 2044, 1.50% per annum from 2045 to 2061, and 2.50% per annum thereafter.
Salary increases	Reported salary at valuation date increased according to the rate table, to current fiscal year and annually for each future year. Prior fiscal year salary is annualized for members with less than one year of service.
Inflation	2.75% per year.
Payroll growth	3.50% per year.
Mortality rates	
Healthy Pre-retirement	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment.
Healthy Post-retirement	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back two years for males and set forward one year for females. The RP-2000 employee mortality table as published by the Society of Actuaries (SOA) contains mortality rates for ages 15 to 70 and the annuitant mortality table contains mortality rates for ages 50 to 95. We have applied the annuitant mortality table for active members beyond age 70 until the assumed retirement age and the employee mortality table for annuitants younger than age 50.
Disabled	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back two years for males and set forward one year for females.
Retirement	Members retiring from active status are assumed to retire according to the age related rates shown in the rate table. Members who have attained the highest assumed retirement age are assumed to retire in one year.

Actuarial Basis

Summary of Actuarial Assumptions (Continued)

Withdrawal	Select and Ultimate rates based on actual experience. Ultimate rates after the third year are shown in rate table. Select rates in the first three years are: Year — Select Withdrawal Rates 1 — 5% 2 — 2% 3 — 2%
Disability	Age-related rates based on experience; see table of sample rates. All incidences are assumed to be duty-related.
Allowance for combined service annuity	Liabilities for former members are increased by 30.00% to account for the effect of some participants having eligibility for a Combined Service Annuity.
Administrative expenses	Prior year administrative expenses expressed as percentage of prior year projected payroll.
Refund of contributions	All employees withdrawing after becoming eligible for a deferred benefit take the larger of their contributions accumulated with interest or the value of their deferred benefit. Account balances for deferred members accumulate interest until normal retirement date and are discounted back to the valuation date.
Commencement of deferred benefits	Members receiving deferred annuities (including current terminated deferred members) are assumed to begin receiving benefits at age 55.
Percentage married	85% of active members are assumed to be married. Actual marital status is used for members in payment status.
Age of spouse	Females are assumed to be two years younger than their spouses, and males are assumed to be two years older than their spouses.
Eligible children	Each member may have two dependent children depending on member's age. Assumed first born child born at member's age 28 and second born child at member's age 31.
Form of payment	Married members retiring from active status are assumed to elect subsidized joint and survivor form of annuity as follows: Males: 15% elect 50% Joint & Survivor option 25% elect 75% Joint & Survivor option 35% elect 100% Joint & Survivor option Females: 25% elect 50% Joint & Survivor option 30% elect 75% Joint & Survivor option 5% elect 100% Joint & Survivor option Remaining married members and unmarried members are assumed to elect the Straight Life option.
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.
Decrement operation	Withdrawal decrements do not operate during retirement eligibility. Decrements are assumed to occur mid-fiscal year.
Service credit accruals	It is assumed that members accrue one year of service credit per year.

Actuarial Basis

Summary of Actuarial Assumptions (Continued)

Pay increases	Pay increases are assumed to happen at the beginning of the fiscal year. This is equivalent to assuming that reported earnings are pensionable earnings for the year ending on the valuation date.
Unknown data for certain members	To prepare this report, GRS has used and relied on participant data supplied by the Fund. Although GRS has reviewed the data in accordance with Actuarial Standards of Practice No. 23, GRS has not verified or audited any of the data or information provided. There are no members reported with missing birth dates. In cases where submitted data was missing or incomplete, the following assumptions were applied: Data for active members: There were 2 members reported with missing salary and no members reported with missing service. We used prior year salary (2 members). There were no members reported with a missing or invalid date of birth or gender. Data for terminated members: There was 1 member reported without a benefit. We calculated benefits for this member using the reported Credited Service and Termination Date. Average Salary was not reported, so we assumed a value of $35,000. Data for members receiving benefits: There were 2 members reported with a missing gender. We assumed male gender. There was 1 member reported without a benefit. Due to the small number of members with missing benefits, we made no adjustment to the reported data for members receiving benefits. There were no survivors reported with an expired benefit. There were no retirees reported with a bounce back annuity and an unreasonable reduction factor. There were 10 retirees reported with a survivor option and a survivor date of death. We assumed no benefit was payable to the survivor, and the member benefit already reflected the increase to the life annuity value (i.e. “bounce back”), if applicable. For retirees that elected a survivor benefit option, we used the valuation assumptions if the survivor date of birth was missing or invalid (209 members) and/or the survivor gender was missing or invalid (225 members).
Changes in actuarial assumptions	The assumed post-retirement benefit increase rate was changed from 1.00% per year through 2029, 1.50% per year from 2030 through 2048, and 2.50% thereafter to 1.00% per year through 2044, 1.50% per year from 2045 through 2061, and 2.50% thereafter.

Actuarial Basis

Summary of Actuarial Assumptions (Continued)

	Percent of Members Dying Each Year*					
	Healthy Post-Retirement Mortality**		Healthy Pre-Retirement Mortality**		Disability Mortality**	
Age	Male	Female	Male	Female	Male	Female
20	0.03%	0.02%	0.03%	0.02%	0.03%	0.02%
25	0.04	0.02	0.04	0.02	0.04	0.02
30	0.04	0.03	0.04	0.03	0.04	0.03
35	0.05	0.05	0.06	0.05	0.05	0.05
40	0.08	0.07	0.09	0.06	0.08	0.07
45	0.11	0.11	0.13	0.10	0.11	0.11
50	0.17	0.25	0.20	0.16	0.17	0.25
55	0.57	0.39	0.27	0.24	0.57	0.39
60	0.57	0.61	0.43	0.38	0.57	0.61
65	0.92	1.01	0.67	0.59	0.92	1.01
70	1.58	1.69	0.98	0.88	1.58	1.69

* *Generally, mortality rates are expected to increase as age increases. These standard mortality rates have been adjusted slightly to prevent decreasing mortality rates. If the rates were not adjusted as described, we would not expect the valuation results to be materially different.*

*** These rates were adjusted for mortality improvements using projection scale AA.*

	Percent of Members Decrementing Each Year			
	Termination (Withdrawal) Rates After Third Year		Disability Retirement	
Age	Male	Female	Male	Female
20	1.47%	1.47%	0.03%	0.03%
25	1.13	1.13	0.05	0.05
30	0.80	0.80	0.06	0.06
35	0.47	0.47	0.09	0.09
40	0.40	0.40	0.14	0.14
45	0.40	0.40	0.23	0.23
50	0.00	0.00	0.40	0.40
55	0.00	0.00	0.70	0.70
60	0.00	0.00	1.13	1.13
65	0.00	0.00	0.00	0.00

Actuarial Basis

Summary of Actuarial Assumptions (Concluded)

	Percent	Salary Scale	
Age	Retiring	Year	Increase
50	7 %	1	7.75%
51	6	2	7.25
52	6	3	6.75
53	6	4	6.50
54	3	5	6.25
55	65	6	6.00
56	50	7	5.75
57	30	8	5.60
58	20	9	5.45
59	20	10	5.30
60+	100	11	5.15
		12	5.00
		13	4.85
		14	4.70
		15	4.55
		16	4.40
		17	4.25
		18	4.10
		19	3.95
		20	3.80
		21+	3.75

Actuarial Basis

Summary of Plan Provisions

Following is a summary of the major plan provisions used in the valuation of this report. MSRS is solely responsible for the validity, accuracy and comprehensiveness of this information. If any of the plan provisions shown below are not accurate and complete, the valuation results may differ significantly from those shown in this report and may require a revision of this report.

Plan year	July 1 through June 30
Eligibility	State troopers, conservation officers, certain crime bureau and gambling enforcement officers, and certain other persons listed in Minnesota Statutes 352B.011 subdivision 10.
Contributions	Percent of Salary Effective Date — Member — Employer July 1, 2014 – June 30, 2016 — 13.40% — 20.10% July 1, 2016 and later — 14.40% — 21.60% Member contributions are "picked up" according to the provisions of Internal Revenue Code 414(h).
State Contributions	$1 million paid annually on October 1 until both the Public Employees Retirement Association Police and Fire Plan and the State Patrol Retirement Fund become 90% funded (on a Market Value of Assets basis).
Allowable service	Service during which member contributions were deducted. Includes period receiving temporary Worker's Compensation and reduced salary from employer. See Normal Retirement benefit definition below for information about service limits.
Salary	Salaries excluding lump sum payments at separation.
Average salary	Average of the five highest years of Salary. Average Salary is based on all Allowable Service if less than five years. Average Salary is based on all years without regard to any service limits.
Retirement	
Normal retirement benefit	
Age/Service requirement	Age 55 and three years (ten years if first hired after June 30, 2013) of Allowable Service.
Amount	3.00% of Average Salary for each year of Allowable Service up to 33 years. Members with at least 28 years of service as of July 1, 2013 are not subject to this service limit. Member contributions made after the service cap will be refunded at retirement.
Early retirement benefit	
Age/Service requirement	Age 50 and three years (ten years if first hired after June 30, 2013) of Allowable Service.
Amount	Normal Retirement Benefit based on Allowable Service and Average Salary at retirement reduced by 1/10% for each month that the member is under age 55. If the effective date of retirement is after June 30, 2015, the reduction is 0.34% for each month that the member is under age 55 at the time of retirement.

Actuarial Basis

Summary of Plan Provisions (Continued)

Retirement (Concluded)	
Form of payment	Life annuity. Actuarially equivalent options are: 50%, 75%, or 100% Joint and Survivor, or 15-year certain. If a Joint and Survivor benefit is elected and the beneficiary predeceases the annuitant, the annuitant's benefit increases to the Life Annuity amount. This "bounce back" is subsidized by the plan.
Benefit increases	Since January 1, 2014, benefit recipients receive annual 1.00% benefit increases. When the accrued liability funding ratio (determined on a market value of assets basis) reaches or exceeds 85% for two consecutive years, the benefit increase will increase to 1.50%; the benefit will revert to 2.50% when the accrued liability funding ratio (determined on a market value of assets basis) reaches or exceeds 90% for two consecutive years. If, after reverting to a 1.50% increase, the accrued liability funding ratio declines to 75% or less for the most recent valuation year or 80% or less for two consecutive years, the benefit increase will decrease to 1.00%. A benefit recipient who has been receiving a benefit for at least 12 full months as of the June 30 of the calendar year immediately before the adjustment will receive a full increase. Members receiving benefits for at least one month but less than 12 full months as of the June 30 of the calendar year immediately before the adjustment will receive a pro rata increase.
Disability	
Occupational disability benefit	
Age/Service requirement	Member who cannot perform his duties as a direct result of a disability relating to an act of duty.
Amount	60% of Average Salary plus 3.00% of Average Salary for each year in excess of 20 years of Allowable Service (pro rata for completed months). Payments cease at age 65 (age 55 if disabled after June 30, 2015) or the 5-year anniversary of the effective date of the disability benefit, whichever is later. Payments stop earlier if disability ceases or death occurs. Benefits may be paid upon re-employment but salary plus benefit cannot exceed current salary of position held at time of disability.
Non-duty disability benefit	
Age/Service requirement	At least one year of Allowable Service and disability not related to covered employment.
Amount	Normal Retirement Benefit based on Allowable Service (minimum of 15 years) and Average Salary at disability without reduction for commencement before age 55. Payments cease at age 65 (age 55 if disabled after June 30, 2015) or earlier if disability ceases or death occurs. Benefits may be paid upon re-employment but salary plus benefit cannot exceed current salary of position held at time of disability.

Actuarial Basis

Summary of Plan Provisions (Continued)

Disability (continued)

Retirement after disability	
Age/Service requirement	Age 65 (age 55 if disabled after June 30, 2015) with continued disability.
Amount	Optional annuity continues. Otherwise, normal retirement benefit equal to the disability benefit paid, or an actuarially equivalent option.
Form of payment	Same as for retirement.
Benefit increases	Same as for retirement.

Death

Surviving spouse benefit	
Age/Service requirement	Member who is active or receiving a disability benefit or former member.
Amount	50% of Average Salary if member was active or occupational disability and either had less than three years (five years if first hired after June 30, 2013) of Allowable Service or was under age 55. Annuity is paid for life. Surviving spouse receives the 100% joint and survivor benefit commencing on the member's 55th birthday if member was active or a disability with three years (five years if first hired after June 30, 2013) of Allowable Service. A spouse who had been receiving the 50% benefit shall be entitled to the greater benefit. The surviving spouse of a former member receives the 100% joint and survivor benefit commencing on the member's 55th birthday if former member had three years (five years if first hired after June 30, 2013) of Allowable Service.
Benefit increases	Same as for retirement.
Surviving dependent children's benefit	
Age/Service requirement	Member who is active or receiving a disability benefit. Child must be unmarried, under age 18 (or 23 if full-time student) and dependent upon the member.
Amount	10% of Average Salary for each child and $20 per month prorated among all dependent children. Benefit must not be less than 50% nor exceed 70% of Average Salary.
Benefit increases	Same as for retirement.
Refund of contributions	
Age/Service requirement	Member dies before receiving any retirement benefits and survivor benefits are not payable.
Amount	Member contributions with 6.00% interest compounded daily until June 30, 2011, and 4.00% thereafter.

Actuarial Basis

Summary of Plan Provisions (Continued)

Termination	
Refund of contributions	
Age/service requirement	Termination of state service.
Amount	Member contributions with 6.00% interest compounded daily to June 30, 2011, and 4.00% thereafter. If a member is vested, a deferred annuity may be elected in lieu of a refund.
Deferred benefit	
Age/service requirement	Three years (ten years if first hired after June 30, 2013) of Allowable Service.
Amount	Benefit is computed under law in effect at termination and increased by the following annual augmentation percentage: (a.) 0.00% before July 1, 1971; (b.) 5.00% from July 1, 1971 to January 1, 1981; (c.) 3.00% thereafter (2.50% if hired after June 30, 2006) until January 1, 2012; and (d.) 2.00% after December 31, 2011 until the annuity begins. Amount is payable at normal or early retirement. If a member terminated employment prior to July 1, 1997, but was not eligible to commence their pension before July 1, 1997, an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
Optional form conversion factors	Actuarially equivalent factors based on RP-2000 for healthy annuitants, white collar adjustment, projected to 2027 using scale AA, set back two years for males and set forward one year for females, blended 95% males, 6.50% post-retirement interest, and 8.50% pre-retirement interest.
Combined service annuity	Members are eligible for combined service benefits if they: (a.) Have sufficient allowable service in total that equals or exceeds the applicable service credit vesting requirement of the retirement plan with the longest applicable service credit vesting requirement; and (b.) Have at least six months of allowable service credit in each plan worked under; and (c.) Are not in receipt of a benefit from another plan, or have applied for benefits with an effective date within one year. Members who meet the above requirements must have their benefit based on the following: (a.) Allowable service in all covered plans are combined in order to determine eligibility for early retirement. (b.) Average salary is based on the high five consecutive years during their entire service in all covered plans.

Actuarial Basis

Summary of Plan Provisions (Concluded)

Contribution stabilizer	The following is a summary of the contribution stabilizer provisions in Minnesota Statute 352.045: • If a contribution sufficiency of at least 2.00% exists, member and employer contributions may be adjusted by the MSRS Board of Directors to a level necessary to maintain a 2.00% sufficiency. Member and employer contributions may not be less than the sum of normal cost and administrative expenses. Employer contributions must be equal to 60% of the sum of member and employer contributions. • If a contribution deficiency of at least 0.50% exists, member and employer contribution rates may be increased by the MSRS Board of Directors to eliminate the deficiency. Employer contributions must be equal to 60% of the sum of member and employer contributions. • Any adjustment to the contribution rates must be reported to the Legislative Commission on Pensions and Retirement (LCPR) by January 15 following the most recent valuation report. If the LCPR does not recommend against or alter the change in rates, the adjustment becomes effective on the first day of the first full payroll period of the next fiscal year.
Changes in plan provisions	There have been no changes in plan provisions since the prior valuation.

Additional Schedules

Schedule of Funding Progress[1] *(Dollars in Thousands)*

Actuarial Valuation Date	Actuarial Value of Assets (a)	Actuarial Accrued Liability (AAL) (b)	Unfunded (Overfunded) AAL (UAAL) (b) - (a)	Funded Ratio (a)/(b)	Actual Covered Payroll (Previous FY) (c)	UAAL as a Percentage of Covered Payroll [(b)-(a)]/(c)
7-1-1991	$ 200,068	$ 224,033	$ 23,965	89.30%	$ 32,365	74.05 %
7-1-1992	222,314	233,656	11,342	95.15	32,882	34.49
7-1-1993	244,352	258,202	13,850	94.64	35,765	38.73
7-1-1994	262,570	275,377	12,807	95.35	35,341	36.24
7-1-1995	284,918	283,078	(1,840)	100.65	37,518	(4.90)
7-1-1996	323,868	303,941	(19,927)	106.56	41,476	(48.04)
7-1-1997	375,650	332,427	(43,223)	113.00	41,996	(102.92)
7-1-1998	430,011	371,369	(58,642)	115.79	43,456	(134.95)
7-1-1999	472,687	406,215	(66,472)	116.36	45,333	(146.63)
7-1-2000	528,573	458,384	(70,189)	115.31	48,167	(145.72)
7-1-2001	572,815	489,483	(83,332)	117.02	48,935	(170.29)
7-1-2002	591,383	510,344	(81,039)	115.88	49,278	(164.45)
7-1-2003	591,521	538,980	(52,541)	109.75	54,175	(96.98)
7-1-2004	594,785	545,244	(49,542)	109.09	51,619	(95.98)
7-1-2005	601,220	566,764	(34,456)	106.08	55,142	(62.49)
7-1-2006	618,990	641,479	22,489	96.49	57,765	38.93
7-1-2007	617,901	673,444	55,543	91.75	61,498	90.32
7-1-2008	595,082	693,686	98,604	85.79	60,029	164.26
7-1-2009	584,501	725,334	140,833	80.58	61,511	228.96
7-1-2010	567,211	683,360	116,149	83.00	63,250	183.63
7-1-2011	563,046	700,898	137,852	80.33	63,250	217.95
7-1-2012	554,244	760,955	206,711	72.84	62,524 [2]	330.61
7-1-2013	552,319	741,850	189,531	74.45	62,121 [2]	305.10
7-1-2014	597,870	800,421	202,551	74.69	63,952 [2]	316.72
7-1-2015	639,863	833,033	193,170	76.81	68,463 [3]	282.15
7-1-2016	654,842	833,886	179,044	78.53	69,343 [3]	258.20

[1] Information prior to 2012 provided by prior actuary. See prior reports for additional detail.
[2] Assumed equal to actual member contributions divided by 12.4%.
[3] Assumed equal to actual member contributions divided by 13.4%.

Additional Schedules

Schedule of Contributions from the Employer and Other Contributing Entities[1]

(Dollars in Thousands)

Plan Year Ended June 30	Actuarially Required Contribution Rate (a)	Actual Covered Payroll (b)	Actual Member Contributions (c)	Annual Required Contributions [(a)x(b)] - (c) = (d)	Actual Employer Contributions[2] (e)	Percentage Contributed (e)/(d)
1991	22.15%	$ 32,365	$ 2,751	$ 4,418	$ 4,825	109.21%
1992	22.58	32,882	2,795	4,630	4,893	105.68
1993	22.27	35,765	3,040	4,925	5,288	107.37
1994	21.94	35,341	3,004	4,750	5,159	108.61
1995	21.79	37,518	3,189	4,986	5,583	111.97
1996	21.34	41,476	3,484	5,367	5,742	106.99
1997	21.33	41,996	3,746	5,212	6,151	118.02
1998	15.67	43,456	3,634	3,176	5,475	172.39
1999	14.14	45,333	3,850	2,560	5,712	223.13
2000	15.17	48,167	4,044	3,263	6,069	185.99
2001	15.48	48,935	4,145	3,430	6,166	179.77
2002	14.00	49,278	4,215	2,684	6,209	231.33
2003	14.34	54,175	4,555	3,214	6,826	212.38
2004	17.81	51,619	4,493	4,700	6,504	138.39
2005	18.15	55,142	4,517	5,491	6,670	121.47
2006	19.84	57,765	4,719	6,741	7,055	104.66
2007	26.69	61,498	4,987	11,427	7,461	65.30
2008	29.90	60,029	5,594	12,355	8,279	67.01
2009	34.49	61,511	6,216	14,999	9,178	61.19
2010	38.16	63,250	6,726	17,410	10,104	58.04
2011	33.84	63,250	6,578	14,826	9,873	66.59
2012	36.25	62,524 [3]	7,753	14,912	11,620	77.92
2013	42.52	62,121 [3]	7,703	18,711	11,482	61.37
2014	41.24	63,952 [3]	7,930	18,444	12,894	69.91
2015	43.56	68,463 [4]	9,174	20,648	14,763	71.50
2016	42.91	69,343 [4]	9,292	20,463	14,938	73.00
2017	40.45	N/A	N/A	N/A	N/A	N/A

[1] *Information prior to 2012 provided by prior actuary. See prior reports for additional detail.*

[2] *Includes contributions from other sources (if applicable).*

[3] *Assumed equal to actual member contributions divided by 12.4%.*

[4] *Assumed equal to actual member contributions divided by 13.4%.*

Glossary of Terms

Accrued Benefit Funding Ratio	The ratio of assets to Current Benefit Obligations.
Accrued Liability Funding Ratio	The ratio of assets to Actuarial Accrued Liability.
Actuarial Accrued Liability (AAL)	The difference between the Actuarial Present Value of Future Benefits, and the Actuarial Present Value of Future Normal Costs.
Actuarial Assumptions	Assumptions about future plan experience that affect costs or liabilities, such as: mortality, withdrawal, disablement, and retirement; future increases in salary; future rates of investment earnings; future investment and administrative expenses; characteristics of members not specified in the data, such as marital status; characteristics of future members; future elections made by members; and other items.
Actuarial Cost Method	A procedure for allocating the Actuarial Present Value of Future Benefits between the Actuarial Present Value of future Normal Costs and the Actuarial Accrued Liability.
Actuarial Equivalent	Of equal Actuarial Present Value, determined as of a given date and based on a given set of Actuarial Assumptions.
Actuarial Present Value (APV)	The amount of funds required to provide a payment or series of payments in the future. It is determined by discounting the future payments with an assumed interest rate and with the assumed probability each payment will be made.
Actuarial Present Value of Projected Benefits	The Actuarial Present Value of amounts which are expected to be paid at various future times to active members, retired members, beneficiaries receiving benefits, and inactive, non-retired members entitled to either a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would provide sufficient assets to pay all projected benefits and expenses when due.
Actuarial Valuation	The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial Valuation for a governmental retirement system typically also includes calculations of items needed for developing and monitoring a retirement system's funding policy, such as the Funded Ratio and the Annual Required Contribution (ARC).
Actuarial Value of Assets	The value of the assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets or a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the actuarially required contribution (ARC).

Glossary of Terms (Continued)

Amortization Method A method for determining the Amortization Payment. Under the Level Percentage of Pay method, the Amortization payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. The stream of payments increases at the rate at which total covered payroll of all active members is assumed to increase.

Amortization Payment That portion of the plan contribution or ARC which is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability.

Amortization Period The period used in calculating the Amortization Payment.

Annual Required Contribution (ARC) The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation. The ARC consists of the Employer Normal Cost and Amortization Payment.

Augmentation Annual increases to deferred benefits.

Closed Amortization Period A specific number of years that is reduced by one each year, and declines to zero with the passage of time. For example if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc.

Current Benefit Obligations The present value of benefits earned to the valuation date, based on current service and including future salary increases to retirement.

Employer Normal Cost The portion of the Normal Cost to be paid by the employer. This is equal to the Normal Cost less expected member contributions.

Expected Assets The present value of anticipated future contributions intended to fund benefits for current members.

Experience Gain/Loss A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two actuarial valuations. To the extent that actual experience differs from that assumed, Unfunded Actuarial Accrued Liabilities emerge which may be larger or smaller than projected. Gains are due to favorable experience, e.g., the assets earn more than projected, salaries do not increase as fast as assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, losses are the result of unfavorable experience, i.e., actual results that produce Unfunded Actuarial Accrued Liabilities which are larger than projected.

Glossary of Terms (Concluded)

GASB	Governmental Accounting Standards Board.
GASB Statements No. 25 and No. 27	These are the governmental accounting standards that set the accounting and financial reporting rules for public retirement systems and the employers that sponsor or contribute to them. Statement No. 27 sets the accounting and financial reporting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 25 sets the rules for the systems themselves. These statements remain in effect only for pension plans that are not administered as trusts or equivalent arrangements. Please refer to the definition for GASB Statements No. 67 and No. 68 below.
GASB Statement No. 50	The accounting standard governing a state or local governmental employer's accounting for pensions. This statement remains in effect for pension plans that are not administered as trusts. Please refer to the definition of GASB Statements No. 67 and No. 68 below.
GASB Statements No. 67 and No. 68	Statements No. 67 and No. 68, issued in June 2012, replace the requirements of Statements No. 25, No. 27 and No. 50, respectively, for pension plans administered as trusts. Statement No. 68 sets the accounting and financial reporting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 67 sets the rules for the systems themselves. Accounting and financial reporting information prepared according to Statements No. 67 and No. 68 is provided in a separate report beginning with the June 30, 2014 actuarial valuation.
GASB Statement No. 82	Statement No. 82, issued in March 2016, is an amendment to Statements No. 67, No. 68, and No. 73, and is intended to improve consistency in the application of the accounting statements.
Normal Cost	The annual cost assigned, under the Actuarial Cost Method, to the current plan year.
Projected Benefit Funding Ratio	The ratio of the sum of Actuarial Value of Assets and Expected Assets to the Actuarial Present Value of Projected Benefits. A Ratio less than 100% indicates that contributions are insufficient.
Unfunded Actuarial Accrued Liability	The difference between the Actuarial Accrued Liability and Actuarial Value of Assets.
Valuation Date	The date as of which the Actuarial Present Value of Future Benefits is determined. The benefits expected to be paid in the future are discounted to this date.