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January 31, 2017

CONFIDENTIAL

Ms. Erin Leonard
Executive Director
Minnesota State Retirement System
60 Empire Drive, Suite 300
St. Paul, MN 55103

Re: Projection of Contributions and Funding Status – State Patrol Retirement Fund

Dear Erin:

Attached are 30-year projections of estimated funded status, required contributions, and statutory contributions under three asset return scenarios for the State Patrol Retirement Fund (SPRF). Unless noted otherwise, the estimates are based on participant data, assumptions, methods, and plan provisions as detailed in the State Patrol Retirement Fund Actuarial Valuation Report for funding purposes as of July 1, 2016.

An experience study was completed in 2016. In the report, GRS recommended many changes to the valuation assumptions. The recommended assumptions were used to determine the enclosed results. The recommended demographic assumptions are summarized in the *Minnesota State Patrol Retirement Fund, 4-Year Experience Study*, dated July 26, 2016.

Additionally, the proposed Allowance for Combined Service Annuity assumption change is reflected in this report. The liabilities for former vested members are increased by 13% to account for the effect of some participants having eligibility for a Combined Service Annuity.

As required by the Minnesota Standards for Actuarial Work, the projections reflect three asset return scenarios. The statutory investment return assumption is 8.0%. The scenarios assume future investment returns of 1.5% more than the assumed rate, the assumed rate, and 1.5% less than the assumed rate. Note that we believe the 9.5% rate of return assumption is outside of the range of reasonable expected returns for this plan. In fact, according to the *Minnesota State Employees Retirement Fund 6-Year Experience Study*, dated June 30, 2015, the probability of achieving the 8.0% assumption is only 37%. The study further indicates that in order to have a 50% chance of achieving the assumed earnings rate, the rate would have to be lowered to 7.0%. Please see the aforementioned experience study report for additional information.

Note that as funding ratios decline, as they are expected to in one of the investment return scenarios shown in this letter, it will be increasingly difficult for the plan to attain the assumed investment return. Each year, a larger proportion of assets is paid out in benefits, and less capital is available to invest.

The estimates are based on the market value of assets with no smoothing of investment gains or losses. In all scenarios, the valuation interest rate used to discount liabilities 8.0%. Payroll is assumed to increase approximately 3.50% per year over the long-term, consistent with the valuation assumption for total payroll growth.

The projection is an open group projection; meaning, active members projected to retire or otherwise terminate in the future are replaced with new active members so that the total active membership of the fund remains at 892 members. The profile of these new members is the same as new members hired between July 1, 2010 and July 1, 2015:

- Average age at hire is 31.0;
- Average salary at hire is $61,900; and
- Approximately 9% female, 91% male.

If actuarial accrued liability exceeds assets, the unfunded actuarial accrued liability is amortized through June 30, 2038 per Minnesota Statute 356.215, Subdivision 11. As directed by MSRS, the statutory amortization date is assumed to be changed to June 30, 2068 once the current period expires in 2038. Per Minnesota Statute 356.215, Subdivision 11 (l), a negative unfunded actuarial accrued liability (i.e., when assets exceed liability) is amortized over a rolling 30-year period.

The State of Minnesota provides a $1,000,000 contribution to the State Patrol Fund each October 1 until both the State Patrol Fund and the PERA Police and Fire Fund become 90% funded (on a Market Value basis). For purposes of this projection, the $1,000,000 contribution is assumed to continue until the State Patrol Fund reaches the threshold required to pay a 2.5% benefit increase.

Post-Retirement Benefit Increases

A very significant assumption affecting the projected estimates is the expectation of annual increases in the benefits being paid to retirees and beneficiaries. The current benefit increase rate is 1.0%. If the plan reaches a funding ratio of 85% (based on a 1.5% post-retirement benefit increase assumption) on a market value of assets basis for two consecutive years in the future, post-retirement increases will increase from 1.0% to 1.5%. Similarly, if the plan reaches a funding ratio of 90% (based on a 2.5% post-retirement benefit increase assumption) on a market value of assets basis for two consecutive years in the future, post-retirement increases will increase from 1.5% to 2.5%.

An actuarial projection was performed to estimate when this plan is expected to attain the threshold required to pay a 1.5% or 2.5% post-retirement benefit increase. The projection indicated that if all assumptions were met, the funding ratio threshold to pay the 1.5% benefit increase is expected to be attained January 1, 2052 and the funding ratio threshold to pay the 2.5% benefit increase is expected to be attained January 1, 2072.

Under the 9.5% rate of return scenario, the funded status of the plan is expected to improve. Based on present expectations, the 9.5% rate of return scenario is a very low probability outcome. As the plan experiences greater than expected investment return each year, the assumed 1.5% benefit increase date of January 1, 2052 and the assumed 2.5% benefit increase date of January 1, 2072 are accelerated. We performed a projection to estimate when the plan is expected to attain these thresholds if future investment returns are 9.5%. This projection indicated the plan would begin paying a 1.5% benefit increase on January 1, 2028 and would begin paying a 2.5% benefit increase on January 1, 2035. To approximate the acceleration of the assumed benefit increase dates from 2052/2072 to 2028/2035, we assumed the accrued liability and normal cost would increase by a proportionate amount between 2016 and 2028.

Under the 6.5% rate of return scenario, the funded status of the plan is expected to deteriorate. Based on present expectations, this is the only scenario that has a greater than 50% chance of being achieved. As the plan experiences lower than expected investment returns each year, the assumed 1.5% and 2.5% benefit increase dates become later each year until they are no longer projected to be attained. We assumed for purposes of this projection that this transition from the current assumption (that the benefit increase will change from 1.0% to 1.5% on January 1, 2052 and from 1.5% to 2.5% on January 1, 2072) to an assumption that the benefit increase will remain at 1.0% for all years would occur by July 1, 2022.

Comments

To the best of our knowledge and belief, the calculations were completed in accordance with the requirements of Minnesota Statutes, Section 356.215, and the requirements of the Standards for Actuarial Work established by the Legislative Commission on Pensions and Retirement.

This report should not be relied upon 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. GRS is not responsible for the consequences of any unauthorized use.

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.

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 the valuation report, except as noted. 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.

Professional Qualifications

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

Bonita J. Wurst and Brian B. Murphy 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 Correctional Employees 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.

Sincerely,

Bonita J. Wurst

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

Brian B. Murphy

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

BJW/BBM:ah
Enclosures

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 8.0% on the market value of assets), it is expected that:

(1) The unfunded actuarial accrued liabilities will be fully amortized after approximately 60 years,
(2) The funded status of the plan will increase gradually towards a 100% funded 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 market 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 actuarial value of assets were used instead of the market 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.

Other Observations

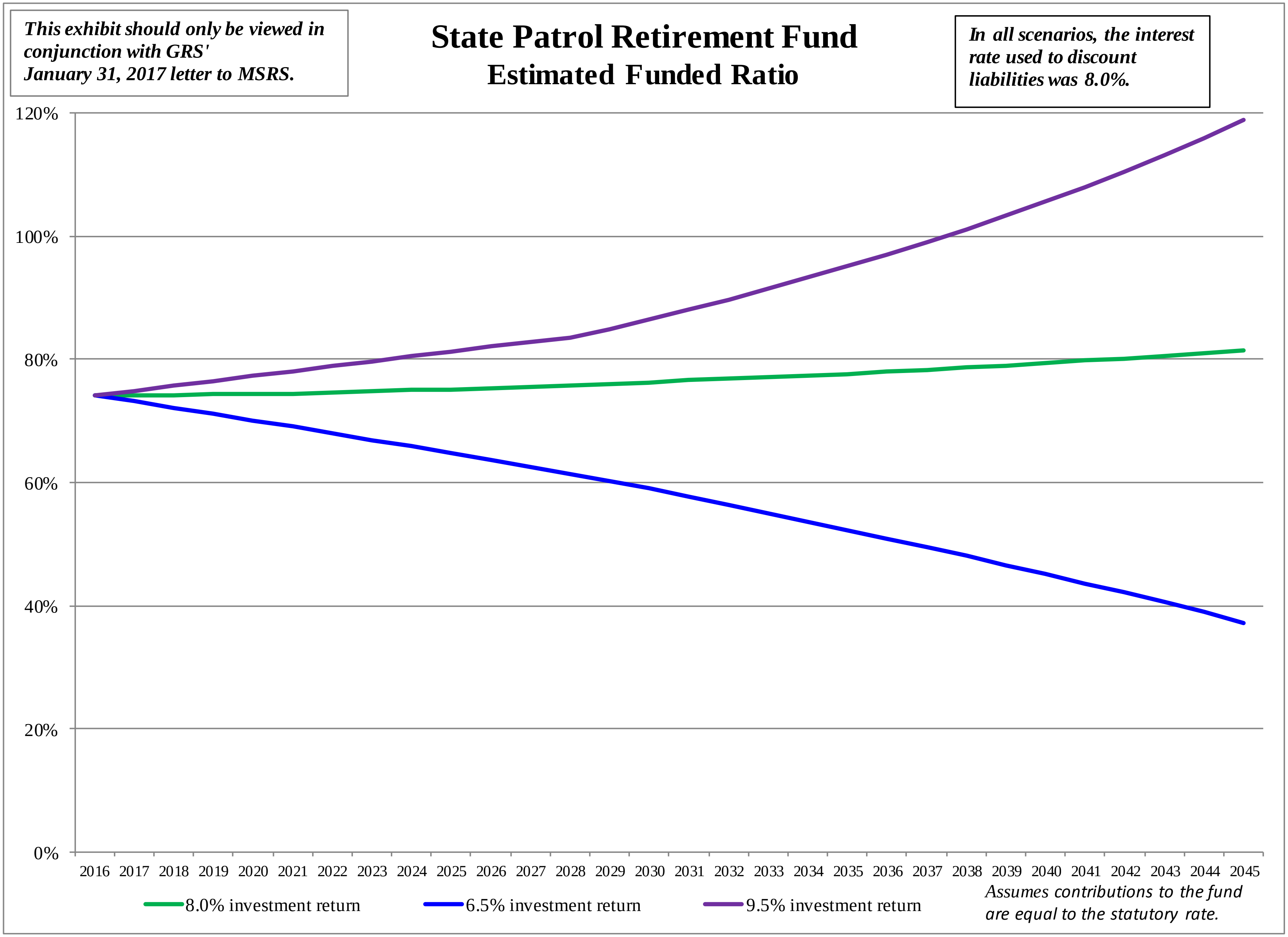
Discount Rate Assumption

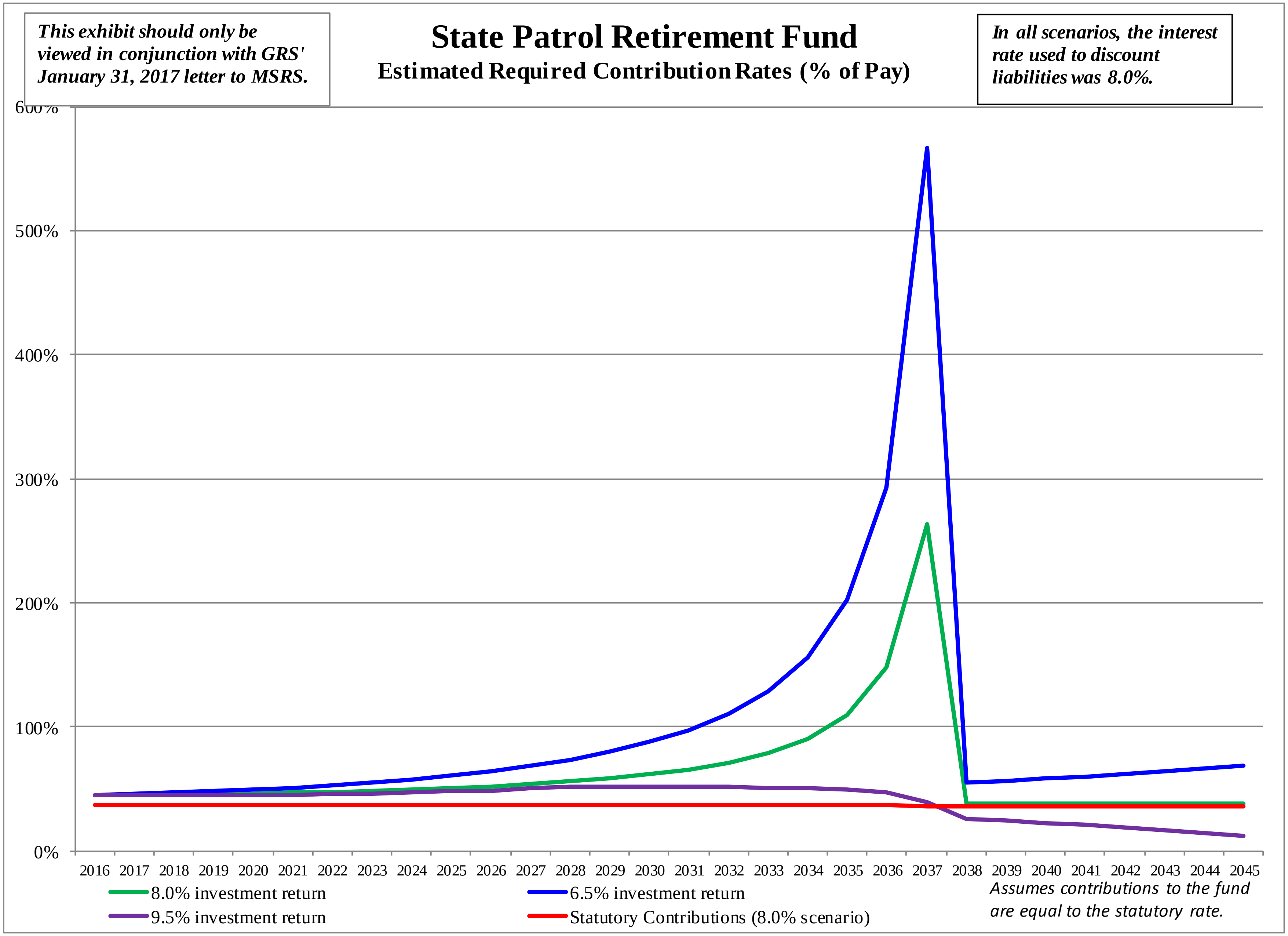
In a 2015 analysis of long-term rate of investment return and inflation assumptions, GRS suggested that an investment return assumption in the range of 7.00% to 8.00% would be reasonable. The current assumed rate, which is mandated by Minnesota Statutes, is 8.00% and is at the upper end of the reasonable 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 the July 1, 2016 valuation instead of 8.00%, we estimate that the unfunded liability would be approximately $39 million higher than estimated in the 2016 valuation report. 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% post-retirement benefit increases.


This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.
State Patrol Retirement Fund
Estimated Funded Ratio
In all scenarios, the interest rate used to discount liabilities was 8.0%.
120%
100%
80%
60%
40%
20%
0%
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045
8.0% investment return
6.5% investment return
9.5% investment return
Assumes contributions to the fund are equal to the statutory rate.


This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.
State Patrol Retirement Fund
Estimated Required Contribution Rates (% of Pay)
In all scenarios, the interest rate used to discount liabilities was 8.0%.
600%
500%
400%
300%
200%
100%
0%
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045
8.0% investment return
6.5% investment return
9.5% investment return
Statutory Contributions (8.0% scenario)
Assumes contributions to the fund are equal to the statutory rate.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

State Patrol Retirement Fund

Scenario: 8.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Contributions (% of Payroll)										
Statutory - Chapter 352B	37.4%	37.3%	37.3%	37.2%	37.2%	37.1%	37.1%	37.0%	37.0%	37.0%
Required - Chapter 356 (MVA)	44.6%	44.9%	45.3%	45.7%	46.3%	46.9%	47.6%	48.5%	49.6%	50.8%
Sufficiency / (Deficiency)	(7.2)%	(7.6)%	(8.0)%	(8.5)%	(9.1)%	(9.8)%	(10.6)%	(11.5)%	(12.6)%	(13.9)%
Contributions										
Statutory - Chapter 352B	27,524	28,542	29,781	30,981	32,269	33,648	34,945	36,255	37,503	38,876
Required - Chapter 356 (MVA)	32,831	34,380	36,176	38,089	40,193	42,489	44,901	47,511	50,283	53,449
Sufficiency / (Deficiency)	(5,307)	(5,838)	(6,395)	(7,108)	(7,924)	(8,840)	(9,957)	(11,256)	(12,780)	(14,572)
Funding Ratios										
Current Assets (MVA)	629,992	648,020	667,057	687,422	709,238	732,682	758,093	785,295	814,233	844,722
Actuarial Accrued Liability (AAL)	848,704	873,047	898,525	925,329	953,699	983,794	1,015,925	1,050,003	1,085,958	1,123,618
Unfunded AAL	218,711	225,027	231,468	237,907	244,461	251,113	257,831	264,708	271,725	278,896
Funding Ratio	74%	74%	74%	74%	74%	74%	75%	75%	75%	75%
Benefit Payments	58,422	59,847	61,264	62,624	64,014	65,293	66,812	68,533	70,506	72,670

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

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State Patrol Retirement Fund

Scenario: 8.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.9%	36.9%	36.9%	36.8%	36.8%	36.8%	36.7%	36.7%	36.7%	36.7%
Required - Chapter 356 (MVA)	52.2%	54.0%	56.1%	58.7%	61.8%	66.0%	71.5%	79.2%	90.7%	110.0%
Sufficiency / (Deficiency)	(15.3)%	(17.1)%	(19.2)%	(21.8)%	(25.1)%	(29.2)%	(34.8)%	(42.5)%	(54.1)%	(73.3)%
Contributions										
Statutory - Chapter 352B	40,306	41,700	43,179	44,707	46,338	47,988	49,756	51,600	53,486	55,468
Required - Chapter 356 (MVA)	57,029	61,041	65,711	71,205	77,882	86,153	96,848	111,304	132,300	166,403
Sufficiency / (Deficiency)	(16,723)	(19,341)	(22,532)	(26,499)	(31,545)	(38,166)	(47,092)	(59,704)	(78,814)	(110,935)
Funding Ratios										
Current Assets (MVA)	876,815	910,657	946,104	983,160	1,021,874	1,062,441	1,104,733	1,149,127	1,195,997	1,245,604
Actuarial Accrued Liability (AAL)	1,162,997	1,204,258	1,247,295	1,292,075	1,338,641	1,387,175	1,437,600	1,490,242	1,545,440	1,603,449
Unfunded AAL	286,182	293,601	301,191	308,915	316,767	324,734	332,866	341,114	349,443	357,845
Funding Ratio	75%	76%	76%	76%	76%	77%	77%	77%	77%	78%
Benefit Payments	74,874	77,317	79,962	82,733	85,547	88,643	91,629	94,492	97,334	100,283

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

State Patrol Retirement Fund

Scenario: 8.0% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.6%	36.6%	36.6%	36.6%	36.6%	36.5%	36.5%	36.5%	36.5%	36.5%
Required - Chapter 356 (MVA)	148.5%	264.0%	38.0%	38.1%	38.1%	38.2%	38.3%	38.4%	38.5%	38.7%
Sufficiency / (Deficiency)	(111.9)%	(227.4)%	(1.4)%	(1.5)%	(1.6)%	(1.7)%	(1.8)%	(1.9)%	(2.1)%	(2.2)%
Contributions										
Statutory - Chapter 352B	57,506	59,696	61,830	63,965	66,292	68,575	71,052	73,592	76,132	78,755
Required - Chapter 356 (MVA)	233,142	430,379	64,180	66,564	69,143	71,753	74,563	77,459	80,424	83,544
Sufficiency / (Deficiency)	(175,637)	(370,683)	(2,350)	(2,598)	(2,851)	(3,178)	(3,511)	(3,866)	(4,292)	(4,789)
Funding Ratios										
Current Assets (MVA)	1,298,157	1,353,903	1,413,302	1,476,504	1,543,290	1,613,849	1,688,103	1,766,300	1,848,790	1,935,434
Actuarial Accrued Liability (AAL)	1,664,434	1,728,632	1,796,421	1,867,995	1,943,147	2,021,976	2,104,466	2,190,754	2,281,159	2,375,555
Unfunded AAL	366,278	374,729	383,118	391,491	399,858	408,127	416,362	424,454	432,369	440,121
Funding Ratio	78%	78%	79%	79%	79%	80%	80%	81%	81%	81%
Benefit Payments	103,275	106,221	109,250	112,784	116,599	120,737	125,113	129,519	134,388	139,828

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

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State Patrol Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Contributions (% of Payroll)										
Statutory - Chapter 352B	37.4%	37.3%	37.3%	37.2%	37.2%	37.1%	37.1%	37.0%	37.0%	37.0%
Required - Chapter 356 (MVA)	44.6%	45.8%	46.9%	48.3%	49.7%	51.3%	53.2%	55.5%	58.1%	61.1%
Sufficiency / (Deficiency)	(7.2)%	(8.4)%	(9.7)%	(11.1)%	(12.6)%	(14.2)%	(16.1)%	(18.4)%	(21.1)%	(24.2)%
Contributions										
Statutory - Chapter 352B	27,524	28,542	29,781	30,981	32,269	33,648	34,945	36,255	37,503	38,876
Required - Chapter 356 (MVA)	32,831	35,000	37,495	40,200	43,204	46,532	50,134	54,298	58,919	64,300
Sufficiency / (Deficiency)	(5,307)	(6,458)	(7,713)	(9,219)	(10,936)	(12,883)	(15,190)	(18,043)	(21,416)	(25,423)
Funding Ratios										
Current Assets (MVA)	629,992	638,803	647,758	657,100	666,873	677,165	688,217	699,747	711,589	723,443
Actuarial Accrued Liability (AAL)	848,704	872,776	897,862	924,107	951,704	980,756	1,011,511	1,044,691	1,079,600	1,116,046
Unfunded AAL	218,711	233,973	250,105	267,006	284,830	303,591	323,294	344,944	368,011	392,603
Funding Ratio	74%	73%	72%	71%	70%	69%	68%	67%	66%	65%
Benefit Payments	58,422	59,847	61,264	62,624	64,014	65,293	66,812	68,533	70,506	72,670

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

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State Patrol Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.9%	36.9%	36.9%	36.8%	36.8%	36.8%	36.7%	36.7%	36.7%	36.7%
Required - Chapter 356 (MVA)	64.6%	68.9%	73.9%	80.1%	87.7%	97.6%	110.7%	129.0%	156.5%	202.1%
Sufficiency / (Deficiency)	(27.7)%	(32.0)%	(37.1)%	(43.3)%	(50.9)%	(60.9)%	(74.0)%	(92.3)%	(119.8)%	(165.4)%
Contributions										
Statutory - Chapter 352B	40,306	41,700	43,179	44,707	46,338	47,988	49,756	51,600	53,486	55,468
Required - Chapter 356 (MVA)	70,564	77,861	86,599	97,218	110,480	127,434	149,964	181,320	228,094	305,756
Sufficiency / (Deficiency)	(30,258)	(36,161)	(43,420)	(52,512)	(64,142)	(79,446)	(100,208)	(129,720)	(174,609)	(250,288)
Funding Ratios										
Current Assets (MVA)	735,238	746,987	758,405	769,348	779,705	789,499	798,422	806,652	814,348	821,540
Actuarial Accrued Liability (AAL)	1,154,020	1,193,665	1,234,854	1,277,528	1,321,702	1,367,532	1,414,911	1,464,134	1,515,507	1,569,250
Unfunded AAL	418,782	446,678	476,450	508,180	541,998	578,033	616,490	657,482	701,159	747,710
Funding Ratio	64%	63%	61%	60%	59%	58%	56%	55%	54%	52%
Benefit Payments	74,874	77,317	79,962	82,733	85,547	88,643	91,629	94,492	97,334	100,283

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

State Patrol Retirement Fund

Scenario: 6.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.6%	36.6%	36.6%	36.6%	36.6%	36.5%	36.5%	36.5%	36.5%	36.5%
Required - Chapter 356 (MVA)	293.4%	566.7%	55.2%	56.8%	58.3%	60.1%	62.0%	64.0%	66.3%	68.7%
Sufficiency / (Deficiency)	(256.8)%	(530.0)%	(18.6)%	(20.2)%	(21.8)%	(23.6)%	(25.5)%	(27.5)%	(29.8)%	(32.3)%
Contributions										
Statutory - Chapter 352B	57,506	59,696	61,830	63,965	66,292	68,575	71,052	73,592	76,132	78,755
Required - Chapter 356 (MVA)	460,546	923,887	93,323	99,268	105,811	112,853	120,612	129,060	138,262	148,399
Sufficiency / (Deficiency)	(403,041)	(864,191)	(31,494)	(35,303)	(39,520)	(44,277)	(49,560)	(55,468)	(62,130)	(69,644)
Funding Ratios										
Current Assets (MVA)	828,184	834,257	839,924	845,016	848,977	851,637	852,534	851,509	848,483	842,859
Actuarial Accrued Liability (AAL)	1,625,488	1,684,416	1,746,368	1,811,492	1,879,529	1,950,518	2,024,386	2,101,208	2,181,248	2,264,322
Unfunded AAL	797,304	850,159	906,444	966,476	1,030,553	1,098,881	1,171,852	1,249,699	1,332,765	1,421,463
Funding Ratio	51%	50%	48%	47%	45%	44%	42%	41%	39%	37%
Benefit Payments	103,275	106,221	109,250	112,784	116,599	120,737	125,113	129,519	134,388	139,828

Numbers may not add due to rounding.

The interest rate used to discount liabilities was 8.0%.

This exhibit should only be viewed in conjunction with GRS' January 31, 2017 letter to MSRS.

State Patrol Retirement Fund

Scenario: 9.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Contributions (% of Payroll)										
Statutory - Chapter 352B	37.4%	37.3%	37.3%	37.2%	37.2%	37.1%	37.1%	37.0%	37.0%	37.0%
Required - Chapter 356 (MVA)	44.6%	44.6%	44.7%	44.9%	45.1%	45.4%	45.9%	46.4%	47.2%	48.0%
Sufficiency / (Deficiency)	(7.2)%	(7.3)%	(7.4)%	(7.7)%	(8.0)%	(8.3)%	(8.8)%	(9.4)%	(10.2)%	(11.0)%
Contributions										
Statutory - Chapter 352B	27,524	28,542	29,781	30,981	32,269	33,648	34,945	36,255	37,503	38,876
Required - Chapter 356 (MVA)	32,831	34,150	35,706	37,359	39,183	41,174	43,246	45,475	47,808	50,471
Sufficiency / (Deficiency)	(5,307)	(5,608)	(5,924)	(6,378)	(6,914)	(7,526)	(8,301)	(9,220)	(10,304)	(11,595)
Funding Ratios										
Current Assets (MVA)	629,992	657,236	686,633	718,625	753,477	791,522	833,274	878,748	928,099	981,368
Actuarial Accrued Liability (AAL)	848,704	876,714	906,814	939,348	974,728	1,013,304	1,055,594	1,101,741	1,151,931	1,206,267
Unfunded AAL	218,711	219,477	220,181	220,723	221,251	221,782	222,320	222,993	223,833	224,899
Funding Ratio	74%	75%	76%	77%	77%	78%	79%	80%	81%	81%
Benefit Payments	58,422	59,847	61,264	62,624	64,014	65,293	66,812	68,533	70,506	72,670

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State Patrol Retirement Fund

Scenario: 9.5% investment return for all years

Fiscal year beginning July 1

$ in Thousands	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.9%	36.9%	36.9%	36.8%	36.8%	36.8%	36.7%	36.7%	36.7%	36.0%
Required - Chapter 356 (MVA)	49.0%	50.2%	51.7%	51.7%	51.7%	51.6%	51.5%	51.1%	50.4%	49.2%
Sufficiency / (Deficiency)	(12.1)%	(13.3)%	(14.9)%	(14.9)%	(14.9)%	(14.9)%	(14.7)%	(14.4)%	(13.7)%	(13.2)%
Contributions										
Statutory - Chapter 352B	40,306	41,700	43,179	44,707	46,338	47,988	49,756	51,600	53,486	54,468
Required - Chapter 356 (MVA)	53,462	56,766	60,581	62,803	65,106	67,397	69,680	71,791	73,508	74,406
Sufficiency / (Deficiency)	(13,157)	(15,066)	(17,401)	(18,097)	(18,769)	(19,409)	(19,924)	(20,191)	(20,022)	(19,938)
Funding Ratios										
Current Assets (MVA)	1,038,855	1,100,979	1,167,694	1,239,114	1,315,592	1,397,658	1,485,551	1,580,048	1,681,970	1,791,566
Actuarial Accrued Liability (AAL)	1,265,072	1,328,844	1,397,641	1,457,749	1,520,588	1,586,403	1,655,185	1,727,327	1,803,242	1,882,763
Unfunded AAL	226,217	227,865	229,948	218,635	204,995	188,746	169,634	147,279	121,273	91,197
Funding Ratio	82%	83%	84%	85%	87%	88%	90%	91%	93%	95%
Benefit Payments	74,874	77,510	80,535	83,698	86,917	90,432	93,852	97,163	100,949	105,334

Numbers may not add due to rounding.

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State Patrol Retirement Fund
Scenario: 9.5% investment return for all years
Fiscal year beginning July 1

$ in Thousands	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**
Contributions (% of Payroll)										
Statutory - Chapter 352B	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%
Required - Chapter 356 (MVA)	46.9%	39.5%	26.4%	24.7%	22.9%	21.0%	19.0%	16.8%	14.5%	12.1%
Sufficiency / (Deficiency)	(10.9)%	(3.5)%	9.6%	11.3%	13.1%	15.0%	17.0%	19.2%	21.5%	23.9%
Contributions										
Statutory - Chapter 352B	56,506	58,696	60,830	62,965	65,292	67,575	70,052	72,592	75,132	77,755
Required - Chapter 356 (MVA)	73,564	64,434	44,617	43,189	41,520	39,381	36,905	33,916	30,327	26,165
Sufficiency / (Deficiency)	(17,058)	(5,739)	16,213	19,777	23,772	28,195	33,147	38,677	44,805	51,591
Funding Ratios										
Current Assets (MVA)	1,907,990	2,032,904	2,167,271	2,311,796	2,466,872	2,633,350	2,811,872	3,003,477	3,209,386	3,430,421
Actuarial Accrued Liability (AAL)	1,965,605	2,051,988	2,142,276	2,236,640	2,334,847	2,436,975	2,542,977	2,652,964	2,767,224	2,885,599
Unfunded AAL	57,615	19,084	(24,994)	(75,156)	(132,025)	(196,375)	(268,895)	(350,513)	(442,162)	(544,822)
Funding Ratio	97%	99%	101%	103%	106%	108%	111%	113%	116%	119%
Benefit Payments	109,809	114,285	118,888	124,041	129,527	135,391	141,547	147,787	154,539	161,917

Numbers may not add due to rounding.

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