Commonwealth

Actuarial Valuation Report

January 1, 2016

PUBLIC EMPLOYEE RETIREMENT ADMINISTRATION COMMISSION
COMMONWEALTH OF MASSACHUSETTS

COMMONWEALTH ACTUARIAL VALUATION REPORT

January 1, 2016

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1. INTRODUCTION & CERTIFICATION

This report presents the results of the actuarial valuation of the pension benefits that are the obligation of the Commonwealth of Massachusetts. The four components are:

- State Employees' Retirement System (SRS)
- Massachusetts Teachers' Retirement System (TRS)
- Boston Teachers
- Cost of Living Allowance Reimbursements to Local Systems

The valuation was performed as of January 1, 2016 pursuant to Chapter 32 of the General Laws of the Commonwealth of Massachusetts, and is based on the plan provisions in effect at that time. The actuarial assumptions used to calculate the actuarial accrued liability and the normal cost reflect our latest experience studies of SRS and TRS and our analysis of retiree mortality from 2012 to 2014.

This valuation is based on member data as of December 31, 2015, which was supplied by the State, Massachusetts Teachers', and Boston Retirement Boards. We performed a number of tests on the data to ensure reasonableness and made specific assumptions for a number of Massachusetts Teacher data items. Asset information as of December 31, 2015 was provided by the Pension Reserves Investment Management (PRIM) Board. We reviewed both the membership data and financial information for reasonableness but we did not audit this information.

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 natural operation of the methodology used for these measurements such as additional contribution requirements based on the plan's funded status; and changes in plan provisions or applicable law. As part of this valuation, we have not performed an analysis of the potential range of future measurements.

I am a member of the American Academy of Actuaries and meet the Qualification Standards of the Academy to render the actuarial opinion contained in this report. In my opinion, the actuarial assumptions used in this report are reasonable, are related to plan experience and expectations, and represent my best estimate of anticipated experience. I believe this report represents an accurate appraisal of the actuarial status of the Commonwealth's total pension obligation performed in accordance with generally accepted actuarial principles and practices relating to pension plans.

Respectfully submitted,
Public Employee Retirement Administration Commission

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Joseph E. Connarton
Joseph E. Connarton
Executive Director

August 17, 2016

2. EXECUTIVE SUMMARY

PART A | PRINCIPAL VALUATION RESULTS

The provisions of Chapter 32, Section 22C mandate the establishment of a funding schedule for the Commonwealth of Massachusetts pension obligation. The SRS, TRS, liabilities for Boston teachers, and State reimbursements to local systems to reflect COLAs granted from 1982 through 1996 are the components of the Commonwealth schedule. The schedule, as mandated by law, calls for payment of the Normal Cost plus an amortization payment on the Unfunded Actuarial Liability (UAL).

The Commonwealth's current funding schedule was filed in January, 2014 and was based on the results of the January 1, 2013 Commonwealth Actuarial Valuation. The FY16 appropriation under the schedule is $1.972 billion (which was later increased by $29.1 million to reflect the 2015 Early Retirement Incentive (ERI) - see page 4). This scheduled amount will increase 10% in FY17 to $2.169 billion. With the additional $29.1 million ERI payment, the total appropriation for FY17 is $2.198 billion. Beginning in FY18, the base total appropriations under the schedule increase 7% each year until FY35 with a final amortization payment in FY36. We expect the amortization of the ERI to be completed in the next 10-13 years.

We indicated last year that if a revised schedule were adopted based on the results of the 2015 Commonwealth valuation, the 7.0% annual appropriation increases would be required for two additional years with a final amortization payment in FY38. This extension was primarily due to the adoption of the fully generational mortality assumption, as actuarial gains since January 1, 2013 essentially offset the cost increase for the reduction in investment return assumption from 8.0% to 7.75%. The next Commonwealth schedule will be adopted in 2017 based on the results of this valuation. If the current schedule were maintained, we expect the 7.0% annual increases would now extend to FY40 (due to the 2016 reduction in the investment return assumption from 7.75% to 7.5% - see page 4 for further details) unless changes are made to amortize the UAL more rapidly.

In the 2014 and prior actuarial valuations, the Annual Required Contribution (ARC) was developed under GASB 27 for accounting purposes. The ARC was developed using the minimum allowable schedule for local systems under Chapter 32 (UAL amortized on a 4.0% annual increasing basis to FY40). This ARC calculation is no longer applicable for GASB purposes, but we show it for comparison. Using the ARC basis and the January 1, 2016 valuation results, the FY17 appropriation would be approximately $3.06 billion. Therefore, the FY17 appropriation is approximately 72% of the ARC ($2.198B/$3.06B). In 2015 this figure was about 76%. The percentage decrease primarily reflects the assumption and plan changes outlined in this report that increased plan liabilities. Going forward we expect this percentage to increase each year until ultimately the appropriation exceeds the ARC.

The principal results of the January 1, 2016 actuarial valuation are as follows (in thousands):

Total Normal Cost	$1,794,659
Expected Employee Contributions	1,212,634
Net Normal Cost	$582,025

Total Actuarial Liability	$87,401,722
Assets	49,535,323
Unfunded Actuarial Liability	$37,866,399

2. EXECUTIVE SUMMARY *(continued)*

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS

A comparison of the results of the current valuation and the January 1, 2015 valuation is shown below. (Dollars in thousands)

	1/1/16	1/1/15	Increase (Decrease)	Increase (Decrease)
Total Normal Cost	$1,794,659	$1,589,683	$204,976	12.9%
Expected Employee Contributions	1,212,634	1,158,258	54,376	4.7%
Net Normal Cost	$582,025	$431,425	$150,600	34.9%
Actuarial Liability				
Actives	$36,535,981	$34,798,600	$1,737,381	5.0%
Retirees and Inactives	50,865,741	46,736,403	4,129,338	8.8%
Total	$87,401,722	$81,535,003	$5,866,719	7.2%
Assets (Actuarial Value)	49,535,323	48,105,862	1,429,461	3.0%
Unfunded Actuarial Liability	$37,866,399	$33,429,141	$4,437,258	13.3%
Funded Ratio	56.7%	59.0%	(2.3%)	

Gain/(Loss) and Change in Unfunded Actuarial Liability (UAL)
The development of the actuarial gain/(loss) is shown in Section 4. During 2015, there was an overall actuarial loss of $296 million. There was a non-investment loss on actuarial liability of approximately $30 million and a loss on assets (on an actuarial value basis) of approximately $266 million. The return on assets was approximately 7.2% on an AVA basis compared to 1.2% on a market value basis.

The systems use an asset smoothing technique which spreads gains and losses over five years and employs a “corridor” so that the actuarial value of assets (AVA) is always within a set percentage of the market value of assets. The current corridor is 10% so that the AVA is never less than 90% nor greater than 110% of the market value of assets. The calculated actuarial value of assets as of January 1, 2016 is 101.2% of the market value. This figure was 95.7% as of January 1, 2015.

The UAL increased from $33.4 billion as of January 1, 2015 to $37.9 billion as of January 1, 2016. This increase reflects a change in the investment return assumption from 7.75% to 7.50%. It also reflects plan amendments including the adoption of the Early Retirement Incentive for SRS employees and the net liability increase for members who transferred from the Optional Retirement Plan and became members of the SRS.

2. EXECUTIVE SUMMARY *(continued)*

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS *(continued)*

Actuarial Assumptions
The January 1, 2016 report uses a 7.50% investment return assumption. The actuarial liability increased by $2.2 billion (2.5%) to reflect the change from the 7.75% assumption used as of January 1, 2015. This change reflects the third decrease in this assumption in the past four years. We used an 8.25% investment return assumption in actuarial valuations prepared prior to January 1, 2013. The January 1, 2013 valuation reflected an 8.0% investment return assumption.

In our 2011 actuarial valuation, we began reflecting future mortality improvement (increasing life expectancy). Each year we modified this assumption as we moved closer to a fully generational mortality assumption (a two dimensional table based on a member's age and calendar year that includes all expected future mortality improvements). Based on our analysis (in early 2015) of State and Teacher retiree mortality during 2012, 2013, and 2014, we adopted a fully generational assumption in the 2015 valuation. No change was made to the 2015 assumption in this valuation. We will continue to review this assumption each year.

The total normal cost and net normal cost include administrative expenses and net Section 3(8)(c) additions. Section 3(8)(c) reflects receipts from or disbursements to other systems for credited service with those systems. For SRS, the amount for administrative expenses and net 3(8)(c) additions has increased significantly from the 2015 amount of $16 million to $45.5 million. For TRS the amount increased from $15 million to $28 million. The main reason for the SRS increase is the addition of $17.5 million for the amount transferred by statute as an employer contribution from the SRS to the Optional Retirement Plan for higher education employees. This amount was not included in prior valuations as we were not aware of these annual transfers until late last year. By including this transfer in the normal cost, we have treated it as a reimbursement to the pension trust fund. In addition, expenses now reflect 100% (phase-in completed, was 50% last year) of regular administrative expenses ($16 million for SRS, $24 million for TRS) based on the fiscal year 2015 annual statement. Finally, the SRS total includes $12 million for amounts transferred to other systems under Section 3(8)(c). The TRS amount is $4 million. Historically, Section 3(8)(c) receipts have been transferred to the State's general account. Adding the Section 3(8)(c) disbursements to normal cost determines a net Section 3(8)(c) cash flow of zero for funding purposes.

Early Retirement Incentive
Chapter 19 of the Acts of 2015 established an Early Retirement Incentive (ERI) program for SRS employees. The law provided that eligible members who elected to participate had their retirement allowances determined by adding 5 years to age and/or creditable service (any combination in full years). All members retiring under the ERI had a date of retirement of June 30, 2015. The ERI was taken by 2,487 members who retired during 2015. The increase in actuarial liability due to the ERI was $230 million based in the 7.75% investment return assumption used in the 2015 valuation. The full ERI report is available on our website (mass.gov/perac).

Optional Retirement Plan transfers
Chapter 176 of the Acts of 2011, *An Act Providing for Pension Reform and Benefit Modernization* made a number of changes to the Chapter 32 pension law. One of the changes concerns the Optional Retirement Plan (ORP), a defined contribution plan for higher education employees. The law provided a one-time opportunity for ORP members (and former ORP members) to transfer to the SRS and purchase service for the period while subject to the ORP. The amount of payments required is the greater of the ORP balance less employer funded contributions and the amount that would have otherwise been paid into the SRS had these employees been members of the SRS plus interest for the period spent as an active member of the ORP.

2. EXECUTIVE SUMMARY *(continued)*

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS *(continued)*

Due to concerns regarding potential plan qualification issues with respect to this provision, the State requested a private letter ruling from the Internal Revenue Service (IRS) on issues concerning the taxation of the transferred assets, transfer of participation, and treatment of future employee contributions in both plans. In September, 2013, the IRS responded favorably to the request and the process of transfers began.

In the 2016 valuation, approximately 1,450 members formerly in the ORP were included in the data provided to us (most are on the active file). SRS has indicated that ultimately approximately 1,600 will be included. The data provided for the most part reflects only SRS service and Annuity Savings Fund (ASF) balances since the recent transfer to SRS. We estimated the actuarial liability for the 1,450 members by recalculating service based on the date of hire provided. The actuarial liability increased by approximately $350 million. Based on this result, we then estimated the additional liability for the 150 members who presumably will be included in the 2017 file as $50 million. Therefore, we estimate the total increase in actuarial liability for ORP transfers to be $400 million.

Other than the relatively few retirees and a small portion of active members whose ORP assets have been transferred, this valuation does not reflect most assets that will ultimately be transferred to the members' ASF balances. If this total amount were known and reflected, the overall unfunded liability would be somewhat lower. To date, approximately $30 million has been transferred to the ASF balances of 245 members. Based on an initial extrapolation of these figures, we expect ultimately $170-$200 million may be transferred. We hope to have more accurate data regarding these amounts in the 2017 actuarial valuation.

Job groups
We noted several issues relating to job group as part of the valuation data we received from SRS. A number of members are coded as Job Group 1 but we believe these members should be coded as Job Group 2. These members were coded as Group 2 in the 2014 data provided to us. This list consists of approximately 2,000 members in Department of Mental Health (DMH) and 40 members of the University of Massachusetts Police (only UMass Dartmouth police were coded as Group 2 in the data submission this year). In addition, it appears there are approximately 400 State Police who are coded as Group 1 but should be coded as Group 3. Based on our questions, SRS provided us the mechanism for how job group codes are generated on its system. We adjusted the job group for DMH and UMass Police in our files. This change increased the actuarial liability by approximately $40 million. Based on discussions with SRS and information provided directly from the State Police with respect to the number of State troopers, we adjusted the job group codes for the 400 members in question. We note, however, that these members are not contributing at the 12% contribution rate we would expect for State Police hired after July 1, 1996. The actuarial liability increased approximately $39 million from this correction in job group membership.

Other Chapter 176 issues
There are several other changes under Chapter 176 that we have discussed in previous valuations that have the most impact on decreasing plan liabilities over the longer term. These include an increase in the normal retirement age by two years (for example, from age 65 to age 67 for Group 1 members), an increase in the age (early retirement) reduction factor for ages below the maximum age (from a 4.0% to a 6.0% annual reduction), and an increase in the period for determining a member's average annual compensation (from 3

2. EXECUTIVE SUMMARY *(continued)*

PART B | COMPARISON WITH PRIOR VALUATION AND EXPERIENCE ANALYSIS *(continued)*

years to 5 years). Since these changes are effective only for members hired after April 1, 2012, this is the fourth actuarial valuation to reflect these changes.

As of January 1, 2016, there were approximately 42,500 members hired after April 1, 2012. Since these members have less than four years of service and are generally young, there is still relatively little impact on plan costs (on a percentage basis) in this valuation. The employer normal cost is approximately $64 million lower than it would have been if the prior provisions were in place for these members. The actuarial liability is approximately $136 million lower than it would have been if the prior provisions were in place.

Teachers
We have detailed a number of the assumptions we made for missing or questionable data for active members of the TRS in Part C of Section 7.

TRS implemented a new system with the data submission for the January 1, 2014 valuation. As part of the 2014 and 2015 valuations, we identified several issues that TRS subsequently reviewed prior to the January 1, 2016 data submission. The data submission for the January 1, 2016 valuation has once again improved.

Boston Teachers
The Boston Retirement System (BRS) also implemented a new system with the data submission for the January 1, 2014 valuation. As part of the 2014 valuation, we identified several issues that BRS subsequently reviewed prior to the January 1, 2015 data submission. The data submission for the January 1, 2016 has once again improved.

2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS

The UAL and funded ratio are measures of the plan's funded status. These measures reflect the plan's position as of January 1, 2016. We believe these measures alone are not appropriate for assessing the sufficiency of assets to cover the estimated cost of settling the Commonwealth's benefit obligations or assessing the need for or the amount of future contributions. However, we believe these measures, in conjunction with maintaining the appropriations required under the Commonwealth funding schedule, are appropriate for assessing the amount of future contributions.

The nature of actuarial funding is that assets gradually catch up to the actuarial liability. When pension funding was adopted in 1987, the initial amortization period was established as 40 years. Based on the amortization basis of the schedules adopted, the UAL was expected to increase for a period of time. However, due to actual investment returns significantly exceeding the expected return in the 1990's, the UAL actually decreased until January 1, 2000.

It is important to note that plan assets have grown faster than plan liabilities, despite recent assumption changes and plan amendments outlined on the next page that have increased plan liabilities. As of January 1, 1990, the actuarial liability was $20.0 billion and assets were $7.8 billion. The difference of $12.2 billion was the UAL. As of January 1, 2016, the actuarial liability is $87.4 billion and the actuarial value of assets is $49.5 billion. The difference of $37.9 billion is the UAL. The actuarial liability has grown 4.4 times over this period ($87.4B / $20.0B). But assets have grown 6.3 times over this same period ($49.5B / $7.8B).

For this reason, we believe the funded ratio represents a better measure of the Commonwealth's progress. If you draw a straight line from the 1990 funded ratio of 39.0% to the January 1, 2016 amount of 56.7%, the line is moving upward to the right. This demonstrates the funding progress to date. Although the funded ratio reached 85.2% on January 1, 2000, this was the result of average annual returns from 1985-1999 that exceeded 12.5% and attaining such a high level of funding so quickly was not expected. Over the past 16 years (2000-2016), the average annual return on assets on a market value basis is approximately 5.8%. Over a 10-year and 5-year period, the returns have been 5.9% and 7.5% respectively. The 31 year return is 9.5%.

2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*

Impact of assumption and plan changes since 2009
We indicated on pages 4 and 5 that the actuarial liability as of January 1, 2016 increased $2.2 billion to reflect a reduction in the investment return assumption from 7.75% to 7.50% and $630 million due to the adoption of the ERI and the transfer of the active members from ORP to the SRS. There have been a number of other plan and assumption changes since 2009 that have increased the Commonwealth actuarial liability. These changes include three separate reductions in the investment return assumption and annual adjustments to the mortality assumption from 2012 to 2015 including adopting a fully generational assumption in 2015. Other changes include the adoption of a $13,000 COLA base, the transfer of active members of sheriff departments in six counties to the SRS, legislation with respect to the funding of Boston Teachers, and the transfer of former members of the Massachusetts Turnpike Authority Retirement System to the SRS. Including the changes as of January 1, 2016, the unfunded actuarial liability is approximately $9.7 billion greater than it would have been using the 2009 valuation assumptions and plan provisions. Therefore, on a comparable basis with 2009, the UAL on January 1, 2016 would be $28.2 billion and the funded ratio would be 63.7%.

The chart below provides further detail on these changes.

Change in Unfunded Actuarial Liability since 2009 Valuation
(Dollars in billions)

	State	Mass. Teachers	Boston Teachers	Total
Assumption Changes	$2.82	$5.01	$0.42	$8.25
Plan Amendments	1.13	0.15	0.14	1.42
Total	$3.95	$5.16	$0.56	$9.67

Assumption changes (with valuation date reflected)	(In millions)
Reduction in investment return assumption from 8.25% to 8.0% (2013)	$1,670
Reduction in investment return assumption from 8.0% to 7.75% (2015)	1,947
Reduction in investment return assumption from 7.75% to 7.50% (2016)	2,218
Adoption of fully generational mortality assumption (2015)	1,700
Other mortality adjustments (2012, 2013, 2014)	1,050
Other experience study changes (2013)	(335)

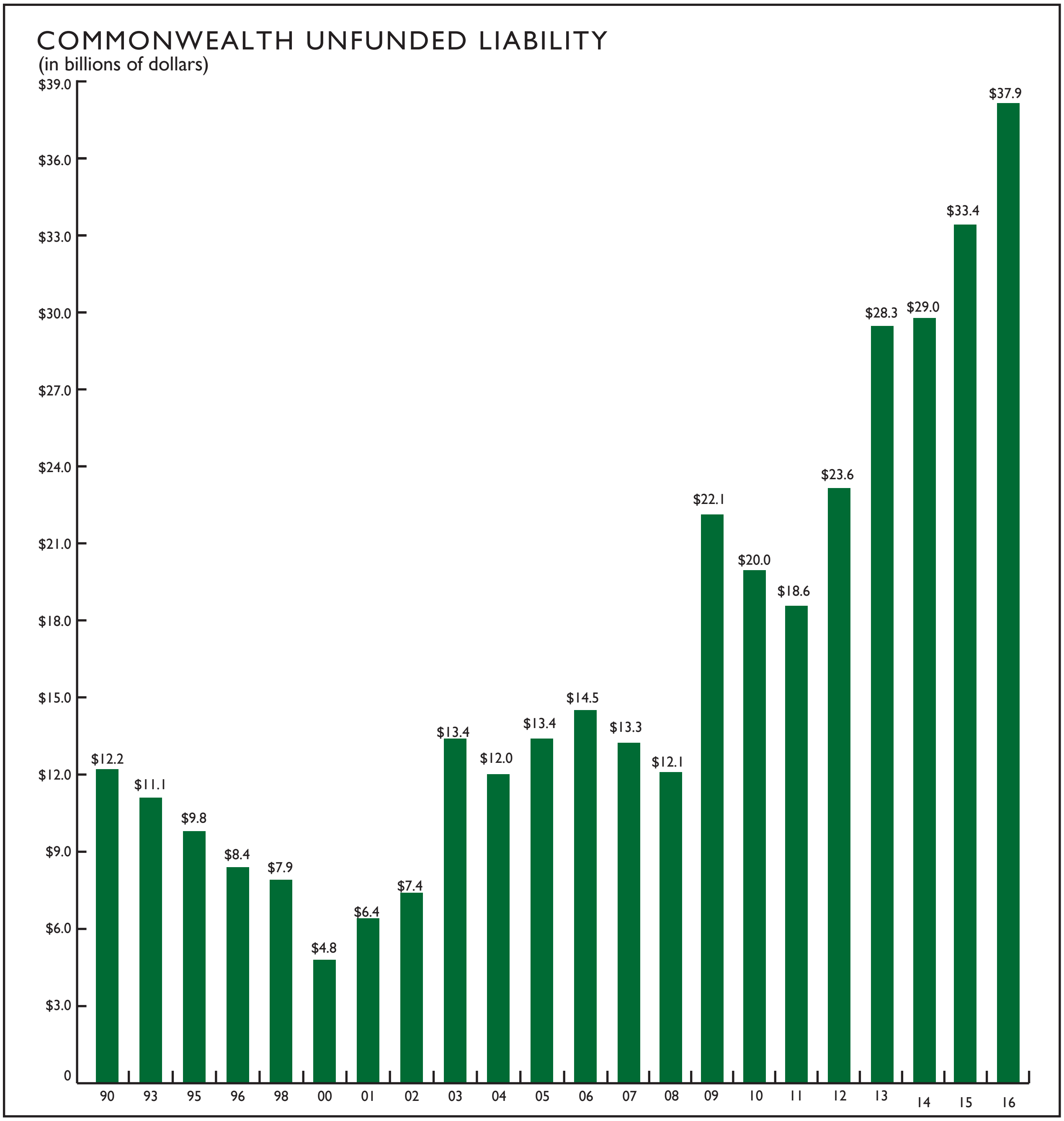
Plan amendments (with valuation date reflected)	
Transfer of Massachusetts Turnpike Authority (2010)	$136
Transfer of sheriff departments (2011)	225
Boston Teachers (2011)	127
$13,000 COLA base (2012)	298
Early Retirement Incentive (2016)	230
Transfer of ORP members (2016)	400

PART C | FUNDING PROGRESS *(continued)*

UNFUNDED LIABILITY

The chart below shows the Commonwealth's unfunded actuarial accrued liability (UAL) since 1990. The UAL represents the actuarial accrued liability less the actuarial value of plan assets. When there is no UAL, a system is said to be "fully funded." In this exhibit, for years prior to 2000, the figures were estimated to reflect implementation of updated actuarial software.

On a market value basis, the UAL is $38.5 billion.



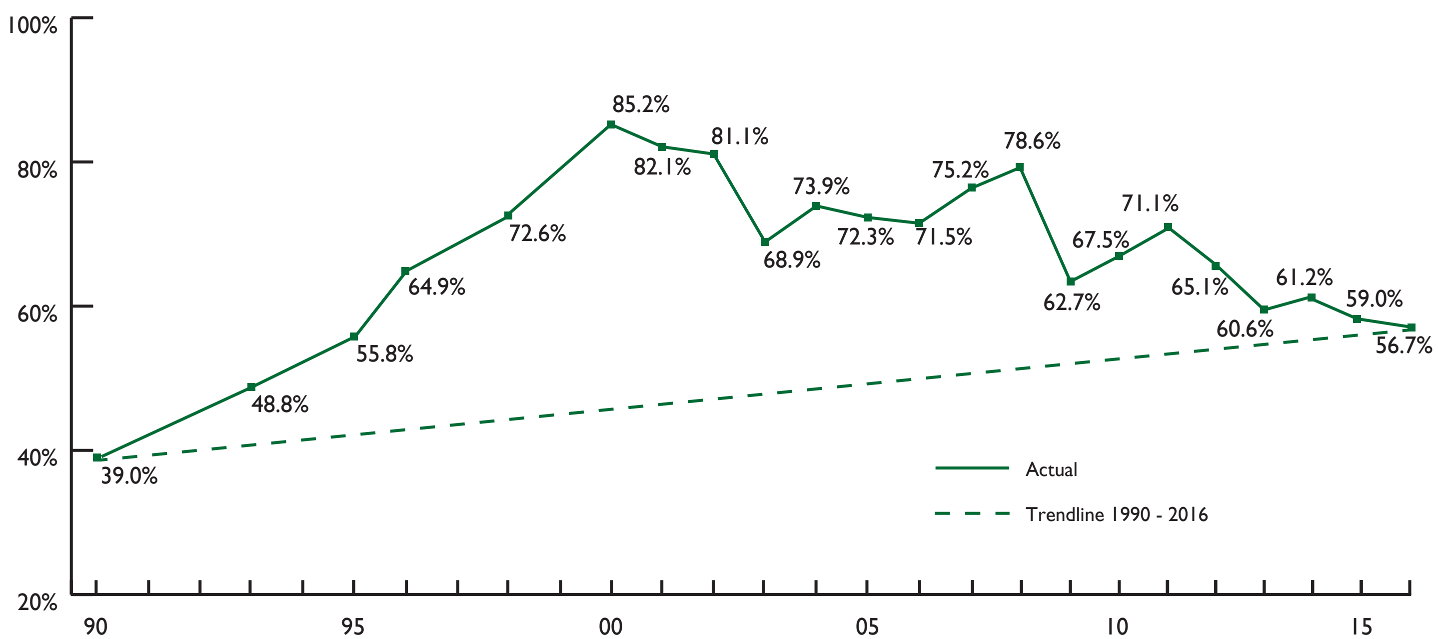
PART C | FUNDING PROGRESS *(continued)*

FUNDED RATIO

The chart below shows the Commonwealth's funded ratio progress since 1990. The funded ratio represents the actuarial value of plan assets divided by the actuarial accrued liability. When the funded ratio reaches 100%, a system is said to be "fully funded." In this exhibit, for years prior to 2000, the figures were estimated to reflect implementation of updated actuarial software.

On a market value basis, the funded ratio is 56.0%.

COMMONWEALTH FUNDED RATIO

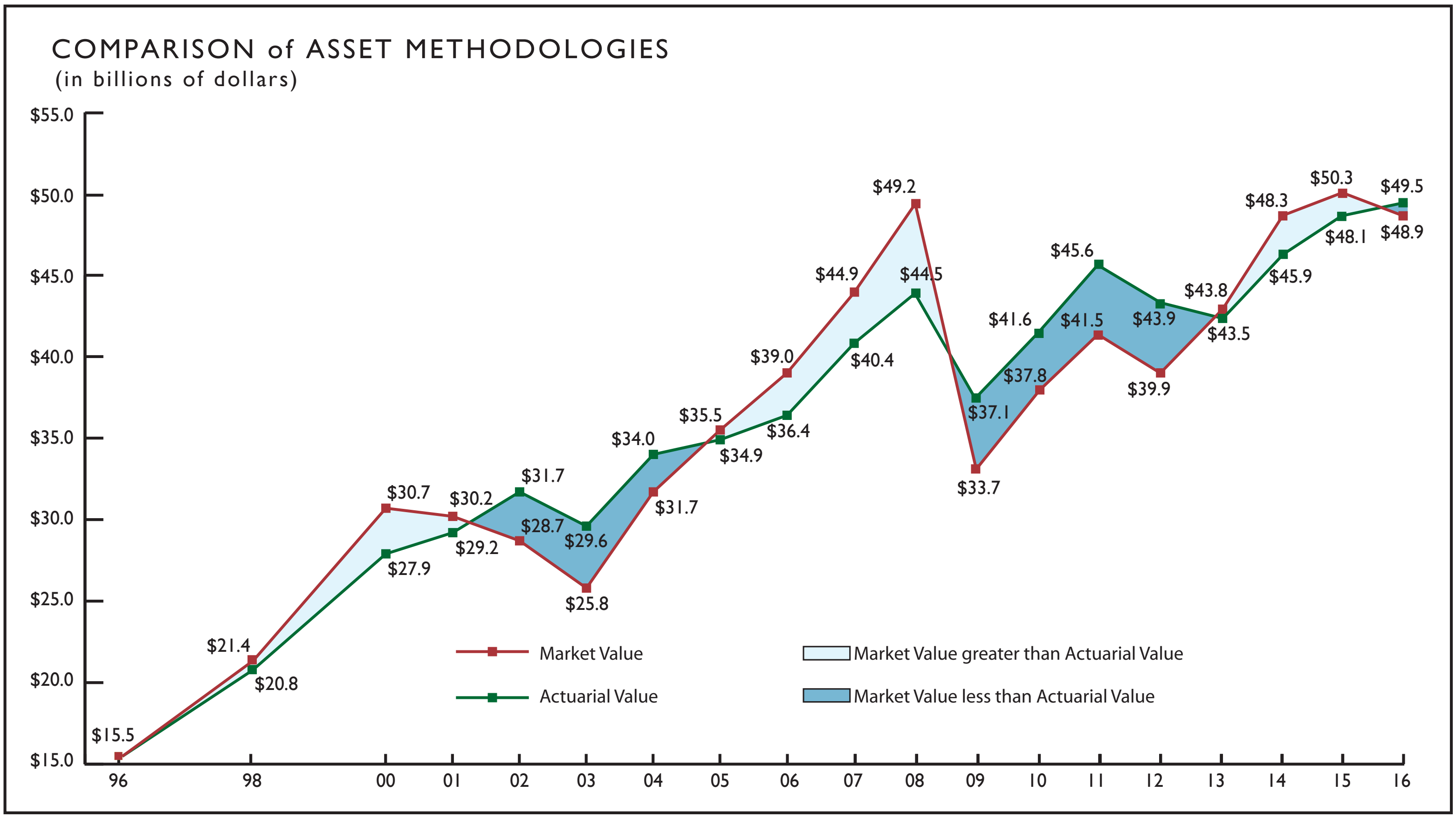


2. EXECUTIVE SUMMARY *(continued)*

PART C | FUNDING PROGRESS *(continued)*

COMPARISON OF MARKET AND ACTUARIAL VALUE OF ASSETS

In valuations prior to 1998, plan assets were determined at market value. As part of the 1998 valuation, this methodology was adjusted to reduce the potential volatility in the market value approach from year to year. The actuarial value of assets smoothes investment gains and losses over a five-year period. Investment gains and losses are not fully recognized until five years have elapsed. Therefore, in some years the actuarial value will be less than the market value, and in other years, the actuarial value will exceed the market value.



3. SUMMARY OF VALUATION RESULTS

(Dollars in thousands)

A. Number of Members	State	Mass. Teachers	Boston Teachers	Local COLA	Total
Active	88,081	91,059	6,192		185,332
Vested Terminated	4,350	0	0		4,350
Retired/ Beneficiaries	61,377	63,744	4,593		129,714
Total	153,808	154,803	10,785		319,396
B. Total Payroll	$5,792,288	$6,388,732	$521,707		$12,702,727
C. Normal Cost					
Superannuation	$611,784	$747,333	$63,367		$1,422,484
Death	61,800	29,471	2,291		93,562
Disability	87,959	10,358	805		99,122
Termination	82,983	88,237	8,271		179,491
Total Normal Cost	$844,526	$875,399	$74,734		$1,794,659
Expected Employee Contributions	517,446	642,712	52,476		1,212,634
Net Employer Normal Cost	$327,080	$232,687	$22,258		$582,025
D. Actuarial Liability					
Active					
Superannuation	$15,250,782	$17,946,316	$1,306,177		$34,503,275
Death	353,454	221,493	17,200		592,147
Disability	452,476	97,417	7,383		557,276
Termination	386,132	459,259	37,892		883,283
Total Active	$16,442,844	$18,724,485	$1,368,652		$36,535,981
Vested Terminated (a)	789,852	625,000	80,000		1,494,852
Non-Vested Terminated	212,379	0	0		212,379
Retirees and Survivors	19,521,203	27,213,322	2,262,685	161,300	49,158,510
Total Actuarial Liability	$36,966,278	$46,562,807	$3,711,337	$161,300	$87,401,722
E. Actuarial Value of Assets	23,465,963	24,593,787	1,475,573	0	49,535,323
F. Unfunded Actuarial Liability	$13,500,315	$21,969,020	$2,235,764	$161,300	$37,866,399
G. Funded Ratio: E/D	63.5%	52.8%	39.8%	0.0%	56.7%

(a) Massachusetts Teachers' and Boston teachers' amounts are estimated and includes non-vested terminated members.

4. DEVELOPMENT OF THE ACTUARIAL GAIN OR LOSS *(in millions)*

		State	Mass. Teachers	Boston Teachers	Local COLA	Total
A.	Gain/(loss) on Actuarial Liability					
1.	Actuarial Liability 1/1/15	33,679	44,116	3,554	186	81,535
2.	Total Normal Cost 1/1/15	727	798	65	0	1,590
3.	Interest on (1) and (2) at 7.75%	2,666	3,481	280	14	6,441
4.	Benefits paid during 2015 [a]	1,900	2,700	230	26	4,856
5.	Interest on (4) assuming mid year payment	74	105	9	1	189
6.	Expected Actuarial Liability before adjustments: (1)+(2)+(3)-(4)-(5)	35,099	45,590	3,661	173	84,523
7.	Increase due to changes in assumptions	933	1,190	93	2	2,218
8.	Increase due to plan amendment (ERI)	230				230
9.	Increase due to plan amendment (ORP transfers)	400				400
10.	Expected Actuarial Liability 1/1/16: (6)+(7)+(8)+(9)	36,662	46,780	3,754	175	87,371
11.	Actuarial Liability 1/1/16	36,966	46,563	3,711	161	87,401
12.	Gain/(loss): (10)-(11)	(304)	217	43	14	(30)
B.	Gain/(loss) on assets					
13.	Actuarial Value of Assets (AVA) 1/1/15	22,720	23,947	1,439		48,106
14.	Interest on (13) at 7.75%	1,761	1,856	112		3,729
15.	Net Receipts [b]	640	727	120		1,487
16.	Net Disbursements [b]	1,487	1,767	185		3,439
17.	Net Cash Flow: (15)-(16)	(847)	(1,040)	(65)		(1,952)
18.	Interest on (17) [c]	(33)	(40)	(7)		(80)
19.	Expected AVA 1/1/16: (13)+(14)+(17)+(18)	23,601	24,723	1,478		49,802
20.	AVA 1/1/16	23,466	24,594	1,476		49,536
21.	Gain/(loss): (20)-(19)	(135)	(129)	(2)		(266)
C.	Total Gain/(loss): (12)+(21)	(439)	89	40	14	(296)

Figures may not add due to rounding.

[a] Estimated

[b] Amounts actually received or disbursed by the fund.

[c] Assumes time weighting based on monthly cash flow. Boston Teachers assumed mid-year.

5. AUDIT INFORMATION

The Commonwealth valuation reports prior to 2015 included information required under Governmental Accounting Standards Board (GASB) Statement No. 27 (GASB 27). The Commonwealth began implementing GASB 27 in Fiscal Year 1996. GASB 27 has been replaced by GASB 68. In addition, GASB 67 replaces the requirements under GASB 25.

GASB 67 reflects plan financial statement reporting and was first effective for the plan year ending June 30, 2014. GASB 68 reflects employer financial statement reporting and was first effective for the fiscal year ending June 30, 2015.

We have not provided any GASB 67 or GASB 68 exhibits in this valuation report. These exhibits are provided under separate cover.

6. ASSETS

PART A | STATE AND MASSACHUSETTS TEACHERS'

(Dollars in thousands)

	State	Mass. Teachers
Pension Reserves Investment Trust		
Market Value	$23,176,451	$24,308,553
Actuarial Value	$23,465,963	$24,593,787
Actuarial Value as a Percentage of Market Value	101.2%	101.2%

The Market Value of Assets for the State includes $171.5 million for former members of the Massachusetts Turnpike Authority Employees' Retirement System.

The actuarial value of assets (AVA) is determined so that 20% of the investment gain and loss in a given year is recognized annually for the next five years. Therefore, these investment gains and losses are fully recognized after five years. In addition to this treatment of gains and losses, we use a "corridor" approach so that the actuarial value of assets can never be too far from the market value of assets. Under our approach for the Commonwealth, the actuarial value cannot be less than 90% nor greater than 110% of the market value.

PART B | BOSTON TEACHERS

Based on the enactment of Chapter 112 of the Acts of 2010, the assets of the Boston Teachers are maintained by PRIM. The transfer of these assets occurred during 2010. We set the actuarial value of assets to 101.2% of the market value based on the results for State and Massachusetts Teachers.

Market Value	$1,458,076
Actuarial Value	$1,475,573

6. ASSETS *(continued)*

PART C | DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS

(Dollars in thousands)

A. Development of 12/31/15 expected actuarial value of assets (AVA)	State	Mass. Teachers	Total
1. Market Value (MV) 12/31/14	23,739,487	25,046,692	48,786,179
2. Actuarial Value 12/31/14 (as calculated)	22,720,160	23,946,759	46,666,919
3. Net Receipts 2015	639,618	726,997	1,366,615
4. Net Disbursements 2015	1,486,727	1,767,248	3,253,975
5. Net Cash Flow: (3)-(4)	(847,109)	(1,040,251)	(1,887,360)
6. Expected Investment Return on (2): 0.0775 x (2)	1,760,812	1,855,874	3,616,686
7. Expected Investment Return on (5): ½x 0.0775 x (5)	(32,825)	(40,310)	(73,135)
8. Expected AVA 12/31/15: (2)+(5)+(6)+(7)	23,601,038	24,722,072	48,323,110
B. Previous differences not yet amortized			
1. Unrecognized amount of 12/31/14 difference			
a. .2 x 2011 Gain/(loss)	(349,936)	(364,840)	(714,776)
b. .4 x 2012 Gain/(loss)	346,578	373,322	719,900
c. .6 x 2013 Gain/(loss)	896,201	956,660	1,852,861
d. .8 x 2014 Gain/(loss)	126,484	134,790	261,274
e. Total	1,019,327	1,099,933	2,119,260
C. Gain/(loss) from 2015			
1. Market Value 12/31/15	23,176,451	24,308,553	47,485,004
2. Expected Market Value 12/31/15: A(8)+B(1e)	24,620,365	25,822,005	50,442,370
3. Gain/ (loss) from 2015 investment: (1)-(2)	(1,443,914)	(1,513,452)	(2,957,366)
D. Development of AVA 12/31/15			
1. 2015 Gain/(loss)	(1,443,914)	(1,513,452)	(2,957,366)
2. 2014 Gain/(loss)	158,105	168,488	326,593
3. 2013 Gain/(loss)	1,493,668	1,594,433	3,088,101
4. 2012 Gain/(loss)	866,444	933,306	1,799,750
5. 2011 Gain/(loss)	(1,749,678)	(1,824,198)	(3,573,876)
6. 20% of 2015 Gain/(loss)	(288,783)	(302,690)	(591,473)
7. 20% of 2014 Gain/(loss)	31,621	33,698	65,319
8. 20% of 2013 Gain/(loss)	298,734	318,887	617,621
9. 20% of 2012 Gain/(loss)	173,289	186,661	359,950
10. 20% of 2011 Gain/(loss)	(349,936)	(364,840)	(714,776)
11. Total	(135,075)	(128,285)	(263,360)
12. Actuarial Value 12/31/15: A(8)+D(11)	23,465,963	24,593,787	48,059,750
13. Percentage of Market Value	101.2%	101.2%	101.2%
14. Actuarial Value: (12) but not less than 90% or greater than 110% of C(1)	23,465,963	24,593,787	48,059,750

7. SYSTEM MEMBERSHIP

PART A | STATE ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the State Retirement System.

	Actives	Vested Terminations
Number of Members	88,081	4,350
Average Age	46.9	53.7
Average Service	12.6	15.7
Average Salary	$65,761	$56,277
Average Annuity Savings Fund Balance	$59,774	$62,190

Age by Service Distribution of Active Members

	Years of Service							
Present Age	0 – 4	5 -9	10 - 14	15 - 19	20 – 24	25 - 29	30+	Total
0 - 24	2,192	7						2,199
25 - 29	6,597	862	8					7,467
30 - 34	5,279	3,019	822	10				9,130
35 - 39	3,410	2,440	2,120	697	5			8,672
40 - 44	2,592	2,002	1,894	2,294	611	24		9,417
45 - 49	2,526	1,978	2,018	2,416	2,055	1,064	70	12,127
50 - 54	2,254	1,846	1,797	1,950	1,830	2,350	1,223	13,250
55 - 59	1,717	1,566	1,719	1,744	1,587	1,908	2,395	12,636
60 - 64	924	1,089	1,238	1,297	1,091	1,181	1,823	8,643
65+	343	563	645	656	541	565	1,227	4,540
Total	27,834	15,372	12,261	11,064	7,720	7,092	6,738	88,081

7. SYSTEM MEMBERSHIP *(continued)*

PART A | STATE ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	2,199	$80,721,692	$36,708
25 - 29	7,467	$354,657,613	$47,497
30 - 34	9,130	$509,262,559	$55,779
35 - 39	8,672	$534,008,370	$61,578
40 - 44	9,417	$627,871,690	$66,674
45 - 49	12,127	$843,950,451	$69,593
50 - 54	13,250	$937,519,621	$70,756
55 - 59	12,636	$906,385,760	$71,730
60 - 64	8,643	$647,296,887	$74,893
65+	4,540	$350,613,443	$77,228
Total	88,081	$5,792,288,086	$65,761

7. SYSTEM MEMBERSHIP *(continued)*

PART B | STATE RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	50,965	642	3,274	6,496	61,377
Average Age	71.7	64.9	63.9	75.2	71.6
Average Annual Benefit	$34,294	$19,820	$39,066	$17,652	$32,636

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$333,991,968	$2,039,504	$9,734,915	$17,602,957	$363,369,344
Pension	$1,413,787,208	$10,684,722	$118,167,602	$97,063,223	$1,639,702,755
Total	$1,747,779,176	$12,724,226	$127,902,517	$114,666,180	$2,003,072,099

7. SYSTEM MEMBERSHIP *(continued)*

PART B | STATE RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	131	$3,197,472	$24,408
40 – 44	209	$6,814,076	$32,603
45 – 49	865	$29,798,912	$34,450
50 – 54	1,706	$58,412,733	$34,240
55 – 59	4,472	$154,402,680	$34,527
60 – 64	8,880	$330,629,555	$37,233
65 – 69	13,295	$491,742,900	$36,987
70 – 74	10,617	$364,872,276	$34,367
75 – 79	7,569	$234,979,006	$31,045
80 – 84	6,007	$163,156,998	$27,161
85 – 89	4,477	$105,725,491	$23,615
90+	3,149	$59,340,003	$18,844
Totals	61,377	$2,003,072,099	$32,636

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the TRS. We made several assumptions about missing, questionable, or unavailable data.

Until the January 1, 2006 actuarial valuation, we had estimated the total creditable service for each member for the actuarial valuation. The estimate was based on either the employment date (date of hire as a teacher) or the adjusted employment date and was set equal to the greater of the two calculated service amounts. We used this methodology, which we believed was conservative, because we had no way to assess additional costs for members who buy back service near retirement. In 2006, we compared the service estimated for valuation purposes with actual service for over 6,800 members who retired in 2004 and 2005. We found that, in total, our methodology slightly understated service. To estimate this additional cost, we increased the plan liabilities as of January 1, 2006. We have continued using this methodology in each valuation.

For members with a date of birth and/or date of hire that seemed questionable, we assumed (based on credited service or date of birth) the member was hired at age 30 (or at a younger age, if the member was under 30).

Based on our experience with prior years' data, buyback issues, and questions to TRS regarding specific members, we made several adjustments. Members whose pay was less than $5,000 were assumed to be inactive. For members with pay between $5,000 and $10,000, we used an estimated pay of $50,000. For members with submitted pay over $150,000, we compared this year's figure to the pay used in last year's valuation. We adjusted this year's figure based on the amount contributed if we believed it was overstated.

Determining valuation pay for members with reported pay less than $10,000 is difficult. Although we make the assumptions outlined above, we know there will always be a significant number of members that fall into this category for a variety of reasons including leaves of absence and part time employment. We believe our overall assumption is reasonable but know some members that we have deemed inactive are active members. To reflect this uncertainty, we made an additional increase to the calculated plan liabilities consistent with last year.

We increased the normal cost by 2.0% and the active actuarial liability by 1.0% to reflect the service buyback and various data issues.

Pay for all members hired in 2015 was annualized.

Because we could not determine the number of vested terminations, we estimated a combined inactive (terminated vested plus terminated with an ASF balance) liability. This is the same methodology we have used in prior valuations.

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS *(continued)*

	Actives
Number of Members	91,059
Average Age	43.7
Average Service	12.9
Average Salary	$70,160
Average Annuity Savings Fund Balance	$68,761

Age by Service Distribution of Active Members

Years of Service

Present Age	0 – 4	5 -9	10 - 14	15 - 19	20 – 24	25 - 29	30+	Total
0 - 24	2,177							2,177
25 - 29	8,318	1,575						9,893
30 - 34	4,543	6,415	1,970	6				12,934
35 - 39	2,099	3,017	5,996	1,522	12			12,646
40 - 44	1,564	1,576	3,005	5,181	989	25		12,340
45 - 49	1,409	1,657	2,197	3,367	3,172	602	19	12,422
50 - 54	933	1,351	2,056	2,022	1,542	1,976	608	10,489
55 - 59	490	854	1,625	2,082	1,325	1,364	2,108	9,848
60 - 64	210	410	860	1,352	1,027	833	1,843	6,535
65+	52	108	224	311	260	193	627	1,775
Total	21,795	16,963	17,933	15,843	8,327	4,993	5,205	91,059

7. SYSTEM MEMBERSHIP *(continued)*

PART C | MASSACHUSETTS TEACHERS' ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	2,177	$95,904,859	$44,054
25 - 29	9,893	$500,539,844	$50,595
30 - 34	12,934	$782,268,294	$60,482
35 - 39	12,646	$890,971,054	$70,455
40 - 44	12,340	$921,883,680	$74,707
45 - 49	12,422	$939,806,475	$75,657
50 - 54	10,489	$805,946,732	$76,837
55 - 59	9,848	$778,568,101	$79,058
60 - 64	6,535	$526,045,893	$80,497
65+	1,775	$146,797,283	$82,703
Total	91,059	$6,388,732,216	$70,160

7. SYSTEM MEMBERSHIP *(continued)*

PART D | MASSACHUSETTS TEACHERS' RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	59,367	413	318	3,646	63,744
Average Age	71.7	67.9	70.9	78.1	72.0
Average Annual Benefit	$44,514	$21,602	$40,080	$19,185	$42,895

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$499,781,154	$1,566,220	$1,096,067	$12,205,828	$514,649,269
Pension	$2,142,895,252	$7,355,608	$11,649,214	$57,743,876	$2,219,643,950
Total	$2,642,676,406	$8,921,828	$12,745,281	$69,949,704	$2,734,293,219

7. SYSTEM MEMBERSHIP *(continued)*

PART D | MASSACHUSETTS TEACHERS' RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	27	$317,684	$11,766
40 – 44	47	$482,950	$10,276
45 – 49	86	$1,318,507	$15,331
50 – 54	184	$3,911,207	$21,257
55 – 59	1,696	$67,913,983	$40,044
60 – 64	10,186	$504,061,227	$49,486
65 – 69	19,658	$960,317,837	$48,851
70 – 74	13,189	$587,983,996	$44,581
75 – 79	7,329	$282,843,281	$38,592
80 – 84	5,329	$177,911,941	$33,386
85 – 89	3,544	$97,105,804	$27,400
90+	2,469	$50,124,801	$20,302
Totals	63,744	$2,734,293,219	$42,895

7. SYSTEM MEMBERSHIP *(continued)*

PART E | BOSTON TEACHERS' ACTIVE MEMBERS

A critical element of an actuarial valuation is accurate and up-to-date membership information. As part of this valuation, PERAC analyzed the member data provided by the Boston Retirement System.

	Actives
Number of Members	6,192
Average Age	42.7
Average Service	11.9
Average Salary	$84,255
Average Annuity Savings Fund Balance	$79,640

Age by Service Distribution of Active Members

Years of Service

Present Age	0 – 4	5 –9	10 – 14	15 - 19	20 - 24	25 – 29	30+	Total
0 - 24	124							124
25 - 29	668	87						755
30 - 34	473	468	91	1				1,033
35 - 39	192	311	398	82	2			985
40 - 44	127	145	236	257	43	8		816
45 - 49	111	94	133	180	173	61	10	762
50 - 54	55	62	98	103	92	134	45	589
55 - 59	50	46	78	100	88	121	117	600
60 - 64	16	30	48	69	78	68	78	387
65+	6	14	16	25	25	17	38	141
Total	1,822	1,257	1,098	817	501	409	288	6,192

7. SYSTEM MEMBERSHIP *(continued)*

PART E | BOSTON TEACHERS' ACTIVE MEMBERS *(continued)*

Salary by Age Distribution of Active Members

Present Age	Number of Members	Total Salary	Average Salary
0 - 24	124	$6,740,717	$54,361
25 - 29	755	$48,109,273	$63,721
30 - 34	1,033	$80,014,840	$77,459
35 - 39	985	$84,533,565	$85,821
40 - 44	816	$73,139,966	$89,632
45 - 49	762	$68,842,895	$90,345
50 - 54	589	$54,346,267	$92,269
55 - 59	600	$55,504,042	$92,507
60 - 64	387	$37,176,715	$96,064
65+	141	$13,298,344	$94,314
Total	6,192	$521,706,624	$84,255

7. SYSTEM MEMBERSHIP *(continued)*

PART F | BOSTON TEACHERS' RETIREES AND SURVIVORS

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Number of Members	4,172	44	77	300	4,593
Average Age	72.0	67.7	71.8	79.6	72.4
Average Annual Benefit	$52,448	$24,519	$45,461	$21,878	$50,066

Benefit by Retirement Type

	Superannuation	Ordinary Disability	Accidental Disability	Survivors	Total
Annuity	$42,158,433	$215,728	$346,926	$1,133,896	$43,854,983
Pension	$176,653,584	$863,096	$3,153,593	$5,429,446	$186,099,719
Total	$218,812,017	$1,078,824	$3,500,519	$6,563,342	$229,954,702

7. SYSTEM MEMBERSHIP *(continued)*

PART F | BOSTON TEACHERS' RETIREES & SURVIVORS *(continued)*

Benefit by Age Distribution

Present Age	Number of Members	Total Benefits	Average Benefits
Less than 40	0	$0	$0
40 - 44	1	$14,691	$14,691
45 - 49	0	$0	$0
50 - 54	20	$510,787	$25,539
55 - 59	109	$5,275,573	$48,400
60 - 64	685	$40,023,200	$58,428
65 - 69	1,372	$79,276,012	$57,781
70 - 74	998	$51,215,444	$51,318
75 - 79	542	$24,732,028	$45,631
80 - 84	366	$13,866,882	$37,888
85 - 89	303	$10,017,194	$33,060
90+	197	$5,022,889	$25,497
Totals	4,593	$229,954,702	$50,066

8. VALUATION COST METHODS

PART A | ACTUARIAL COST METHOD

The Actuarial Cost Method which was used to determine pension liabilities in this valuation is known as the *Entry Age Normal Cost Method***.** Under this method, the *Normal Cost* for each active member on the valuation date is determined as the level percent of salary, which, if paid annually from the date the employee first became a retirement system member, would fully fund by retirement, death, disability or termination, the projected benefits which the member is expected to receive. The *Actuarial Liability* for each member is determined as the present value as of the valuation date of all projected benefits which the member is expected to receive, minus the present value of future annual Normal Cost payments expected to be made to the fund. Since only active members have a Normal Cost, the Actuarial Liability for inactives, retirees, and survivors is simply equal to the present value of all projected benefits. The *Unfunded Actuarial Liability* is the Actuarial Liability less current assets.

The Normal Cost for a member will remain a level percent of salary for each year of membership, except for changes in provisions of the plan or the actuarial assumptions employed in projection of benefits and present value determinations. The Normal Cost for the entire system will also be changed by the addition of new members or the retirement, death, disability, or termination of members. The Actuarial Liability for a member will increase each year to reflect the additional accrual of Normal Cost. It will also change if the plan provisions or actuarial assumptions change.

Differences each year between the actual experience of the plan and the experience projected by the actuarial assumptions are reflected by adjustments to the Unfunded Actuarial Liability. An experience difference which increases the Unfunded Actuarial Liability is an *Actuarial Loss* and one which decreases the Unfunded Actuarial Liability is called an *Actuarial Gain.*

PART B | ASSET VALUATION METHOD

In valuations prior to 1998, plan assets were determined at market value. As part of the 1998 valuation this methodology was adjusted so that investment gains and losses for a given year would not be fully recognized until five years have passed. This calculation recognizes 20% of the gain or loss occurring in the prior year, 40% of those gains or losses occurring two years ago, etc., so that 100% of the gain or loss occurring 5 or more years ago is recognized. This approach reduces the potential volatility in the market value approach from year to year. Under our corridor approach, the actuarial value of assets cannot be less than 90% nor greater than 110% of market value. The actuarial value of assets as of January 1, 2016 is 101.2% of the market value.

9. ACTUARIAL ASSUMPTIONS

Investment Return

7.50% per year net of investment expenses *(prior assumption 7.75%)*

The investment return assumption is a long term assumption and is based on capital market expectations by asset class, historical returns, and professional judgment. We considered analysis prepared by PRIM's investment advisor using a building block approach which included expected returns by asset class, risk analysis, and the determination of a 30 year expected target rate of return.

Interest Rate Credited to the Annuity Savings Fund

3.5% per year

Assumed Rate of Cost of Living Increases (COLA)

3.0% per year (on the first $13,000 of an allowance)

Mortality

State: Pre-retirement mortality reflects RP-2000 Employees table projected generationally with Scale BB and a base year of 2009 (gender distinct).

Teachers: Pre-retirement mortality reflects RP-2014 Employees table projected generationally with Scale BB and a base year of 2014 (gender distinct).

State: Post-retirement mortality reflects RP-2000 Healthy Annuitant table projected generationally with Scale BB and a base year of 2009 (gender distinct).

Teachers: Post-retirement mortality reflects RP-2014 Healthy Annuitant table projected generationally with Scale BB and a base year of 2014 (gender distinct).

State: For disabled members, the mortality rate is assumed to be in accordance with the RP-2000 Healthy Annuitant Table projected generationally with Scale BB and a base year of 2015 (gender distinct).

Teachers: For disabled members, the mortality rate is assumed to be in accordance with the RP-2014 Healthy Annuitant Table projected generationally with Scale BB and a base year of 2014 set forward 4 years.

It is assumed that 75% of pre-retirement deaths are job-related for Group 1 and 2 members and 90% are job-related for Group 4 members. For members retired under an Accidental Disability, 40% of deaths are assumed to be from the same cause as the disability.

The mortality assumptions reflect our recent experience analysis published in 2014 (based on the years 2006-2011), updated to reflect data through January 1, 2015 for post-retirement mortality, and professional judgment. As such, this assumption reflects observed current mortality as well as expected mortality improvement. The pre-retirement mortality and disabled member assumptions reflect both the prior analysis and the more recent work.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Salary Increase

Based on an analysis of past experience. Annual rates are shown below.

Increases for State employees are 3.5% for 2013, 3.75% for 2014 and 4.0% for 2015. Increases before 2013 and after 2015 are based on service as shown below.

For Teachers, increases are based on service as shown below.

Service	Groups 1& 2	Group 3	Group 4
0	7.00%	7.00%	9.00%
1	6.50%	7.00%	8.00%
2	6.00%	7.00%	7.50%
3	5.50%	7.00%	7.00%
4	5.50%	6.75%	6.75%
5	5.25%	6.25%	6.25%
6	5.00%	5.25%	5.75%
7	4.75%	4.75%	5.25%
8-12	4.75%	4.75%	4.75%
13-15	4.50%	4.75%	4.75%
16-19	4.25%	4.75%	4.75%
20+	4.00%	4.50%	4.50%

Service	Teachers
0	7.50%
1	7.10%
2	7.00%
3	6.90%
4	6.80%
5	6.70%
6	6.60%
7	6.50%
8	6.30%
9	6.10%
10	5.90%
11	5.70%
12	5.20%
13	4.70%
14	4.35%
15-16	4.20%
17-19	4.10%
20+	4.00%

The salary increase assumption reflects both prior experience (2014 study) and professional judgment.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Retirement

	Group 1		Group 2	Group 3	Group 4
Age	Male	Female			
45	0.000	0.000	0.000	0.020	0.060
46	0.000	0.000	0.000	0.020	0.060
47	0.000	0.000	0.000	0.050	0.060
48	0.000	0.000	0.000	0.050	0.060
49	0.000	0.000	0.000	0.050	0.060
50	0.030	0.030	0.020	0.050	0.060
51	0.030	0.030	0.020	0.060	0.060
52	0.030	0.030	0.020	0.070	0.060
53	0.030	0.030	0.030	0.080	0.075
54	0.030	0.035	0.040	0.090	0.150
55	0.035	0.050	0.075	0.100	0.250
56	0.035	0.050	0.075	0.100	0.150
57	0.040	0.055	0.080	0.110	0.150
58	0.050	0.060	0.100	0.110	0.150
59	0.060	0.065	0.120	0.120	0.150
60	0.090	0.075	0.150	0.140	0.200
61	0.110	0.100	0.150	0.150	0.200
62	0.150	0.150	0.150	0.150	0.200
63	0.150	0.150	0.150	0.150	0.200
64	0.160	0.150	0.200	0.250	0.300
65	0.200	0.200	0.200	0.250	0.500
66	0.200	0.200	0.200	0.250	0.250
67	0.200	0.200	0.200	0.250	0.250
68	0.200	0.200	0.200	0.250	0.250
69	0.200	0.200	0.200	0.250	0.250
70	1.000	1.000	1.000	1.000	1.000

9. ACTUARIAL ASSUMPTIONS *(continued)*

Teachers

Males

	Not in Retirement Plus	
	Less than 20	20+
47	0.000	0.000
48	0.000	0.000
49	0.000	0.000
50	0.000	0.020
51	0.000	0.020
52	0.000	0.020
53	0.000	0.020
54	0.000	0.030
55	0.035	0.030
56	0.035	0.035
57	0.050	0.040
58	0.055	0.050
59	0.060	0.060
60	0.075	0.150
61	0.120	0.250
62	0.140	0.300
63	0.140	0.300
64	0.140	0.300
65	0.300	0.300
66	0.300	0.250
67	0.300	0.250
68	0.300	0.250
69	0.300	0.250
70+	1.000	1.000

	Retirement Plus		
	Less than 20	20-30	30+
47	0.00	0.000	0.00
48	0.00	0.000	0.00
49	0.00	0.000	0.00
50	0.00	0.010	0.02
51	0.00	0.010	0.02
52	0.00	0.010	0.02
53	0.00	0.015	0.02
54	0.00	0.025	0.02
55	0.05	0.030	0.06
56	0.05	0.060	0.20
57	0.05	0.100	0.40
58	0.05	0.150	0.50
59	0.10	0.200	0.50
60	0.10	0.250	0.40
61	0.20	0.300	0.40
62	0.20	0.350	0.35
63	0.25	0.400	0.35
64	0.25	0.400	0.35
65	0.25	0.400	0.35
66	0.30	0.300	0.40
67	0.30	0.300	0.40
68	0.30	0.300	0.40
69	0.30	0.300	0.40
70+	1.00	1.000	1.00

9. ACTUARIAL ASSUMPTIONS *(continued)*

Teachers

Females

	Not in Retirement Plus	
	Less than 20	20+
47	0.000	0.000
48	0.000	0.000
49	0.000	0.000
50	0.000	0.010
51	0.000	0.010
52	0.000	0.015
53	0.000	0.020
54	0.000	0.020
55	0.035	0.040
56	0.035	0.040
57	0.035	0.040
58	0.050	0.060
59	0.065	0.080
60	0.085	0.150
61	0.100	0.200
62	0.120	0.200
63	0.120	0.250
64	0.200	0.300
65	0.300	0.400
66	0.300	0.300
67	0.300	0.300
68	0.300	0.300
69	0.300	0.300
70+	1.000	1.000

	Retirement Plus		
	Less than 20	20-30	30+
47	0.00	0.00	0.000
48	0.00	0.00	0.000
49	0.00	0.00	0.000
50	0.00	0.01	0.015
51	0.00	0.01	0.015
52	0.00	0.01	0.015
53	0.00	0.01	0.015
54	0.00	0.01	0.020
55	0.03	0.03	0.050
56	0.03	0.05	0.150
57	0.04	0.08	0.350
58	0.08	0.10	0.350
59	0.08	0.15	0.350
60	0.10	0.20	0.350
61	0.12	0.25	0.350
62	0.12	0.30	0.350
63	0.15	0.30	0.350
64	0.20	0.30	0.350
65	0.25	0.40	0.350
66	0.25	0.30	0.350
67	0.30	0.30	0.300
68	0.30	0.30	0.300
69	0.30	0.30	0.300
70+	1.00	1.00	1.000

9. ACTUARIAL ASSUMPTIONS *(continued)*

Disability

Based on an analysis of past experience. Sample annual rates are shown below.

Age	Group 1	Group 2	Group 3	Group 4
20	0.00010	0.00052	0.0010	0.0020
30	0.00010	0.00072	0.0016	0.0021
40	0.00068	0.00210	0.0036	0.0071
50	0.00133	0.00420	0.0094	0.0110
60	0.00120	0.00500	0.0430	0.0080

It is also assumed that 75% of disabilities will be job-related for Group 1 and 2 members (other than Teachers), and 95% will be job-related for Group 3 and 4 members, and 35% will be job-related for Teachers.

Disability rates are based on our most recent experience analysis (2014) which reviewed age, gender and job group. Final assumptions reflect this analysis as well as professional judgment.

Withdrawal

Based on an analysis of past experience. For Groups 1 and 2, rates are both age and service based for service up to 10 years. After 10 years of service, rates are age based. In addition to being age and service based, Teacher rates are also gender based. For Groups 3 and 4, rates are service based. Sample annual rates are shown below.

Groups 1 & 2

Age	Service		
	0	5	10+
20	0.270	0.000	0.000
30	0.230	0.100	0.045
40	0.160	0.080	0.030
50	0.180	0.060	0.030

Groups 3 & 4

Service	Group 3	Group 4
0	0.007	0.090
5	0.007	0.060
10	0.005	0.035
15	0.005	0.020
20+	0.005	0.015

Teachers

Age	Service					
	0		5		10+	
	Male	Female	Male	Female	Male	Female
20	0.130	0.100	0.055	0.070	0.015	0.050
30	0.150	0.150	0.054	0.088	0.015	0.045
40	0.133	0.105	0.052	0.050	0.017	0.022
50	0.162	0.098	0.070	0.050	0.023	0.020

Members Hired on or After April 2, 2012

Chapter 176 of the Acts of 2011 changed the retirement eligibility for the different job groups. For example, Group 1 eligibility changed from 55 years old with 10 years of service to 60 years old with 10 years of service (Chapter 176 removed the provision that allowed retirement at any age with 20 years of service). Our software system is programmed such that at any given age, a member is assumed to either retire or terminate, but not both. Therefore, we adjusted the retirement and termination rates for members impacted by Chapter 176. For example, for Group 1 members, we removed retirement rates for ages 50-59. Termination rates remain in effect for those years. We will monitor these assumptions going forward.

Family Composition

It is assumed that 80% of plan participants are married and that the male spouse in 3 years older than the female spouse.

Loading and Administrative Expenses

State

We increased the normal cost by 2% and the actuarial accrued liability of active members by $110 million to account for certain Chapter 32 benefits that cannot be readily valued with our software system. Such benefits include, but are not limited to, benefits provided under Sections10, 28M, 28N, 65D, and 100. An additional $50 million was added to the actuarial liability to reflect expected ORP transfers in future years and adjustments for certain members of job group 3. An amount of $45.5 million has been included in the normal cost to reflect administrative expenses paid by the fund, net Section 3(8)(c) disbursements and transfers from SRS plan assets to the ORP.

Teachers

We increased the total normal cost by 2% and the actuarial accrued liability of active members by 1% to account for buybacks at retirement and various data issues including the status of members with reported pay of less than $10,000. In addition, an amount of $28 million has been included in the normal cost to reflect a portion of administrative and other expenses paid by the fund and net Section 3(8)(c) cash flow.

9. ACTUARIAL ASSUMPTIONS *(continued)*

Boston Teachers

We increased the total normal cost by 2% and the actuarial accrued liability of active members by 1%. In addition, an amount of $6 million has been included in the normal cost to reflect a portion of administrative and other expenses paid by the fund.

10. SUMMARY OF PLAN PROVISIONS

ADMINISTRATION

There are 105 contributory retirement systems for public employees in Massachusetts. Each system is governed by a retirement board and all boards, although operating independently, are governed by Chapter 32 of the Massachusetts General Laws. This law in general provides uniform benefits, uniform contribution requirements and a uniform accounting and funds structure for all systems.

PARTICIPATION

Participation is mandatory for all full-time employees. Eligibility with respect to part-time, provisional, temporary, seasonal or intermittent employment is governed by regulations promulgated by the retirement board, and approved by PERAC. Membership is optional for certain elected officials.

There are 4 classes of membership in the retirement system:

Group 1:

General employees, including clerical, administrative, technical and all other employees not otherwise classified.

Group 2:

Certain specified hazardous duty positions.

Group 3:

Officers and inspectors of the Department of State Police.

Group 4:

Police Officers, firefighters, corrections officers, and other specified hazardous positions.

MEMBER CONTRIBUTIONS

Member contributions vary depending on the most recent date of membership:

Date of Membership	Contribution Rate
Prior to 1975:	5% of regular compensation
1975 - 1983:	7% of regular compensation
1984 to 6/30/96:	8% of regular compensation
7/1/96 to present:	9% of regular compensation
7/1/96 to present:	12% of regular compensation (State Police)
7/1/01 to present:	11% of regular compensation (for teachers hired after 7/1/01 and those accepting provisions of Chapter 114 of the Acts of 2000)
1979 to present:	an additional 2% of regular compensation in excess of $30,000.

In addition, members of Group 1 who join the system on or after April 2, 2012 will have their withholding rate reduced to 6% after achieving 30 years of creditable service.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

RATE OF INTEREST

Interest on regular deductions made after January 1, 1984 is at a rate established by PERAC in consultation with the Commissioner of Banks. The rate is obtained from the average rates paid on individual savings accounts by a representative sample of at least 10 financial institutions.

RETIREMENT AGE

The mandatory retirement age for some Group 2 and Group 4 employees is age 65. Most Group 2 and Group 4 members may remain in service after reaching age 65. Group 2 and Group 4 members who are employed in certain public safety positions are required to retire at age 65. There is no mandatory retirement age for employees in Group 1.

SUPERANNUATION RETIREMENT

A person who became a member before April 2, 2012 is eligible for a superannuation retirement allowance (service retirement) upon meeting the following conditions:

- completion of 20 years of service, or
- attainment of age 55 if hired prior to 1978, or if classified in Group 4, or
- attainment of age 55 with 10 years of service, if hired after 1978, and if classified in Group 1 or 2

A person who became a member on or after April 2, 2012 is eligible for a superannuation retirement allowance (service retirement) upon meeting the following conditions:

- attainment of age 60 with 10 years of service if classified in Group 1, or
- attainment of age 55 with 10 years of service if classified in Group 2, or
- attainment of age 55 if hired prior to 1978, or if classified in Group 4.

AMOUNT OF BENEFIT

A member's annual allowance is determined by multiplying average salary by a benefit rate related to the member's age and job classification at retirement, and the resulting product by his or her creditable service. The amount determined by the benefit formula cannot exceed 80% of the member's highest three-year (or five-year salary as discussed below) average salary. For veterans as defined in G.L. c. 32, s. 1, there is an additional benefit of $15 per year for each year of creditable service, up to a maximum of $300.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

• Salary is defined as gross regular compensation. For employees who become members after January 1, 2011, regular compensation is limited to 64% of the federal limit found in 26 U.S.C. 401(a)(17). In addition, regular compensation for members who retire after April 2, 2012 will be limited to prohibit "spiking" of a member's salary to increase the retirement benefit.

• For persons who became members prior to April 2, 2012, average salary is the average annual rate of regular compensation received during the three consecutive years that produce the highest average, or, if greater, during the last three years (whether or not consecutive) preceding retirement.

• For persons who became members on or after April 2, 2012, average salary is the average annual rate of regular compensation received during the 5 consecutive years that produce the highest average, or, if greater, during the last 5 years (whether or not consecutive) preceding retirement.

• The benefit rate varies with the member's retirement age. For persons who became members prior to April 2, 2012 the highest rate of 2.5% applies to Group 1 employees who retire at or after age 65, Group 2 employees who retire at or after age 60, and Group 4 employees who retire at or after age 55. A .1% reduction is applied for each year of age under the maximum age for the member's group. For Group 2 employees who terminate from service under age 55, the benefit rate for a Group 1 employee shall be used.

• For persons who became members on or after April 2, 2012 and retire with less than 30 years of creditable service, the highest rate of 2.5% applies to Group 1 employees who retire at or after age 67, Group 2 employees who retire at or after age 62, and to Group 4 employees who retire at or after age 57. A .15% reduction is applied for each year of age under the maximum age for the member's group.

• For persons who became members on or after April 2, 2012 and retire with more than 30 years of creditable service, the highest rate of 2.5% applies to Group 1 employees who retire at or after age 67, Group 2 employees who retire at or after age 62, and Group 4 employees who retire at or after age 55. A .125% reduction is applied for each year of age under the maximum age for the member's group.

• For a teacher who is subject to the provisions of Chapter 114 of the Acts of 2000 and who has completed at least 30 years of creditable service, the benefit rate is multiplied by the creditable service and the resulting percentage is increased by 2% per year for each year of service in excess of 24. The amount determined cannot exceed 80% of the average salary.

The allowance of state police officers is calculated using a slightly different formula. Information regarding this formula can be obtained directly from the State Retirement Board.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

DEFERRED VESTED BENEFIT

A participant who has attained the requisite years of creditable service can elect to defer his or her retirement until a later date. Group 4 employees cannot defer beyond age 65. All participants must begin to receive a retirement allowance or withdraw their accumulated deductions no later than April 15 of the calendar year following the year they reach age 70½.

WITHDRAWAL OF CONTRIBUTIONS

Member contributions may be withdrawn upon termination of employment. The interest rate for employees who first become members on or after January 1, 1984 who voluntarily withdraw their contributions with less than 10 years of service will be 3%. Interest payable on all other withdrawals will be set at regular interest.

DISABILITY RETIREMENT

The Massachusetts Retirement Plan provides two types of disability retirement benefits:

ORDINARY DISABILITY

Eligibility: Non-veterans who become totally and permanently disabled by reason of a non-job related condition with at least ten years of creditable service.

Veterans with ten years of creditable service who become totally and permanently disabled by reason of a non-job related condition prior to reaching "maximum age". "Maximum age" applies only to employees classified in Group 4 who are subject to mandatory retirement.

Retirement Allowance: For persons who became members prior to April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 55. If the member is a veteran, the benefit is 50% of the member's final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 55, he or she will receive not less than the superannuation allowance to which he or she is entitled.

For persons in Group 1 who became members on or after April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 60. If the member is a veteran, the benefit is 50% of the member's final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 60, he or she will receive not less than the superannuation allowance to which he or she would have been entitled had they retired for superannuation.

For persons in Group 2 and Group 4 who became members on or after April 2, 2012, the benefit is equal to the accrued superannuation retirement benefit as if the member was age 55. If the member is a veteran, the benefit is 50% of the member's final rate of salary during the preceding 12 months, plus an annuity based upon accumulated member contributions plus credited interest. If the member is over age 55, he or she will receive not less than the superannuation allowance to which he or she is entitled.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

ACCIDENTAL DISABILITY

Eligibility: Applies to members who become permanently incapacitated from the essential duties of the position as a result of a personal injury sustained or hazard undergone while in the performance of duties. There are no minimum age or service requirements.

Retirement Allowance: 72% of salary plus an annuity based on accumulated member contributions, with interest. This amount is not to exceed 100% of pay. However, for those who became members in service after January 1, 1988 or who have not been members in service continually since that date, the amount is limited to 75% of pay. There is an additional pension of $846.12 per year, per child who is under 18 at the time of the member's retirement, with no age limitation if the child is mentally or physically incapacitated from earning. The additional pension may continue up to age 22 for any child who is a full time student at an accredited educational institution. Veterans, as defined in G.L. c. 32, s. 1, receive an additional benefit of $15 per year for each year of creditable service, up to a maximum of $300.

ACCIDENTAL DEATH

Eligibility: Applies to members who die as a result of a work-related injury or if the member was retired for accidental disability and the death was the natural and proximate result of the injury or hazard undergone on account of which such member was retired.

Allowance: An immediate payment to a named beneficiary equal to the accumulated deductions at the time of death, plus a pension equal to 72% of current salary and payable to the surviving spouse, dependent children or the dependent parent, plus a supplement of $846.12 per year, per child, payable to the spouse or legal guardian until all dependent children reach age 18 or 22 if a full time student, unless mentally or physically incapacitated.

The surviving spouse of a member of a police or fire department or any corrections officer who, under specific and limited circumstances detailed in the statute, suffers an accident and is killed or sustains injuries resulting in his death, may receive a pension equal to the maximum salary for the position held by the member upon his death.

In addition, an eligible family member of a firefighter, public prosecutor, police officer or corrections officer killed in the line of duty may receive a one-time payment of $150,000 from the State Retirement Board.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

DEATH AFTER ACCIDENTAL DISABILITY RETIREMENT

Effective November 7, 1996, Accidental Disability retirees were allowed to select Option C at retirement and provide a benefit for an eligible survivor. For Accidental Disability retirees prior to November 7, 1996, who could not select Option C, if the member's death is from a cause unrelated to the condition for which the member received accidental disability benefits, a surviving spouse will receive an annual allowance of $12,000.

DEATH IN ACTIVE SERVICE

Allowance: An immediate allowance equal to that which would have been payable had the member retired and selected Option C on the day before his or her death. For a member who became a member prior to April 2, 2012 whose death occurred prior to the member's superannuation retirement age, the age 55 benefit rate is used. For a member classified in Group 1 who became a member on or after April 2, 2012 whose death occurred prior to the member's superannuation retirement age, the age 60 benefit rate is used. If the member died after age 60, the actual age is used. The minimum annual allowance payable to the surviving spouse of a member-in-service who dies with at least two years of creditable service is $9,000, provided that the member and the spouse were married for at least one year and living together on the member's date of death.

The surviving spouse of such a member-in-service receives an additional allowance equal to the sum of $1,440 per year for the first child and $1,080 per year for each additional child until all dependent children reach age 18 or 22 if a full-time student, unless mentally or physically incapacitated.

COST OF LIVING

A cost of living adjustment (COLA) is determined based upon the increase in the Consumer Price Index (CPI) used for indexing Social Security benefits, but cannot exceed 3.0% on the first $13,000 of a retiree's benefit.

10. SUMMARY OF PLAN PROVISIONS *(continued)*

METHODS OF PAYMENT

A member may elect to receive his or her retirement allowance in one of 3 forms of payment.

Option A: Total annual allowance, payable in monthly installments, commencing at retirement and terminating at the member's death.

Option B: A reduced annual allowance, payable in monthly installments, commencing at retirement and terminating at the death of the member, provided, however, that if the total amount of the annuity portion received by the member is less than the amount of his or her accumulated deductions, including interest, the difference or balance of his accumulated deductions will be paid in a lump sum to the retiree's beneficiary or beneficiaries of choice.

Option C: A reduced annual allowance, payable in monthly installments, commencing at retirement. At the death of the retired employee, 2/3 of the allowance is payable to the member's designated beneficiary (who may be the spouse, or former spouse who remains unmarried for a member whose retirement becomes effective on or after February 2, 1992, child, parent, sister, or brother of the employee) for the life of the beneficiary. For members who retired on or after January 12, 1988, if the beneficiary predeceases the retiree, the benefit payable increases (or "pops up") based on the factor used to determine the Option C benefit at retirement. For members who retired prior to January 12, 1988, if the System has accepted Section 288 of Chapter 194 of the Acts of 1998 and the beneficiary predeceases the retiree, the benefit payable "pops up" in the same fashion. The Option C became available to accidental disability retirees on November 7, 1996.

ALLOCATION OF PENSION COSTS

If a member's total creditable service was partly earned by employment in more than one retirement system, the cost of the "pension portion" is allocated between the different systems pro rata based on the member's service within each retirement system. If a member received regular compensation concurrently from two or more systems on or after January 1, 2010, and was not vested in both systems as of January 1, 2010, such a pro-ration will not be undertaken. This is because such a person will receive a separate retirement allowance from each system.

11. GLOSSARY OF TERMS

ACTUARIAL ACCRUED LIABILITY

That portion of the Actuarial Present Value of pension plan benefits which is not provided by future Normal Costs or employee contributions. It is the portion of the Actuarial Present Value attributable to service rendered as of the Valuation Date.

ACTUARIAL ASSUMPTIONS

Assumptions, based upon past experience or standard tables, used to predict the occurrence of future events affecting the amount and duration of pension benefits, such as: mortality, withdrawal, disablement and retirement; changes in compensation; rates of investment earnings and asset appreciation or depreciation; and any other relevant items.

ACTUARIAL COST METHOD (OR FUNDING METHOD)

A procedure for allocating the Actuarial Present Value of all past and future pension plan benefits to the Normal Cost and the Actuarial Accrued Liability.

ACTUARIAL GAIN OR LOSS (OR EXPERIENCE GAIN OR LOSS)

A measure of the difference between actual experience and that expected based upon the set of Actuarial Assumptions, during the period between two Actuarial Valuation dates.

Note: The effect on the Accrued Liability and/or the Normal Cost resulting from changes in the Actuarial Assumptions, the Actuarial Cost Method or pension plan provisions would be described as such, rather than an Actuarial Gain (Loss).

ACTUARIAL PRESENT VALUE

The dollar value on the valuation date of all benefits expected to be paid to current members based upon the Actuarial Assumptions and the terms of the Plan.

AMORTIZATION PAYMENT

That portion of the pension plan appropriation which represents payments made to pay interest on and reduce the Unfunded Accrued Liability.

11. GLOSSARY OF TERMS *(continued)*

ANNUAL STATEMENT

The statement submitted to PERAC each year that describes the asset holdings and Fund balances as of December 3l as well as the transactions during the calendar year that affected the financial condition of the retirement system.

ANNUITY RESERVE FUND

The fund into which total accumulated deductions, including interest, are transferred at the time a member retires, and from which annuity payments are made.

ANNUITY SAVINGS FUND

The fund in which employee contributions plus interest credited are held for active and inactive members.

ASSETS

The value of securities held by the plan.

COST OF BENEFITS

The estimated payment from the pension system for benefits for the fiscal year.

FUNDING SCHEDULE

The schedule, based upon the most recently approved actuarial valuation, which sets forth the amount which would be appropriated to the pension system in accordance with Section 22C of M.G.L. Chapter 32.

GASB

Governmental Accounting Standards Board

11. GLOSSARY OF TERMS *(continued)*

NORMAL COST

Total Normal Cost is that portion of the Actuarial Present Value of pension plan benefits, which is to be paid in a single fiscal year. The Employee Normal Cost is the amount of the expected employee contributions for the fiscal year. The Employer Normal Cost is the difference between the Total Normal Cost and the Employee Normal Cost.

PENSION FUND

The fund into which appropriation amounts, as determined by PERAC are paid and from which pension benefits are paid.

PENSION RESERVE FUND

The fund that shall be credited with all amounts set aside by a system for the purpose of establishing a reserve to meet future pension liabilities. These amounts would include excess interest earnings.

SPECIAL FUND FOR MILITARY SERVICE CREDIT

The fund which is credited with an amount paid by the retirement board equal to the amount which would have been contributed by a member during a military leave of absence as if the member had remained in active service of the retirement board. In the event of retirement or a non-job related death, such amount is transferred to the Annuity Reserve Fund. In the event of termination prior to retirement or death, such amount shall be transferred to the Pension Fund.

UNFUNDED ACCRUED LIABILITY

The excess of the Actuarial Accrued Liability over the Assets.

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