Boston Retirement System

Actuarial Valuation and Review as of
January 1, 2016

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December 23, 2016

Retirement Board
Boston Retirement System
City Hall, Room 816
Boston, MA 02201

Dear Board Members:

We are pleased to submit this Actuarial Valuation and Review as of January 1, 2016. It summarizes the actuarial data used in the valuation, establishes the funding requirements for fiscal 2017 and later years and analyzes the preceding two years' experience.

This report shows the results for the valuation for the Boston Retirement System as a whole, and separately for the Teachers and the Boston Retirement System excluding the Teachers.

This report was prepared in accordance with generally accepted actuarial principles and practices at the request of the Board to assist in administering the Retirement System. The census information and financial information on which our calculations were based was prepared by the staff of the Boston Retirement System. That assistance is gratefully acknowledged.

The measurements shown in this actuarial valuation may not be applicable for other purposes. 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); and changes in plan provisions or applicable law.

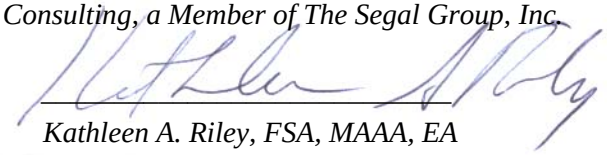
An actuarial valuation is a measurement at a specific date – it is not a prediction of a plan's future financial condition. We have not been retained to perform an analysis of the potential range of financial measurements, except where otherwise noted.

The actuarial calculations were directed under my supervision. I am a member of the American Academy of Actuaries and I meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. To the best of my knowledge, the information supplied in the actuarial valuation is complete and accurate. Further, in my opinion, the assumptions as approved by the Board are reasonably related to the experience of and the expectations for the Plan.

We look forward to reviewing this report at your next meeting and to answering any questions.

Sincerely,

Segal Consulting, a Member of The Segal Group, Inc.

By: 

Kathleen A. Riley, FSA, MAAA, EA
Senior Vice President and Actuary

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SECTION 2

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Purpose

This report has been prepared by Segal Consulting to present a valuation of the Boston Retirement System as of January 1, 2016. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits. The contribution requirements presented in this report are based on:

- The benefit provisions of Massachusetts General Law, Chapter 32;
- The characteristics of covered active participants, inactive participants, and retired participants and beneficiaries as of January 1, 2016;
- The assets of the System as of December 31, 2015;
- Economic assumptions regarding future salary increases and investment earnings; and
- Other actuarial assumptions, regarding employee terminations, retirement, death, etc.

Certain disclosure information required by Governmental Accounting Standards Board Statements (GASB) Numbers 67 and 68 as of December 31, 2015 for the Boston Retirement System, a cost-sharing multiple-employer defined benefit pension plan, is provided in a separate report.

Significant Issues in Valuation Year

The following key findings were the result of this actuarial valuation:

1. The actuarial valuation report as of January 1, 2016 is based on financial information as of that date. Changes in the value of assets subsequent to that date are not reflected.
2. The report shows the results of the valuation for the Boston Retirement System (BRS) as a whole and separately for the Teachers and the BRS excluding Teachers.
3. In accordance with Chapter 112 of the Acts of 2010, the assets attributable to Teachers (27% of the market value of assets) were transferred to the PRIT Fund in 2010. The obligation to fund the liabilities of the Teachers and a share of the administrative cost of the BRS related to the Teachers remains an obligation of the Commonwealth. Beginning in December 2010, appropriations have been received by the BRS from the Commonwealth for the Teachers and have been transferred to the PRIT Fund. Transfers are made from the PRIT Fund on a monthly basis to cover the excess of benefit payments to the Teachers and a share of administrative expenses over the Teachers' employee contributions.

4. During the plan years ended 2014 and 2015, the market value rates of return for the BRS were 5.21% and -0.28%, respectively. Because the actuarial value of assets gradually recognizes market value fluctuations, the actuarial rates of return for the plan years ended 2014 and 2015 were 7.72% and 6.12%, respectively. The actuarial value of assets as of December 31, 2015 was $5.941 billion, or 106.9% of the market value of assets of $5.559 billion (as reported in the Annual Statement). As of December 31, 2013, the actuarial value of assets was 98.0% of the market value.
5. The total unrecognized investment loss as of December 31, 2015 is $382,090,277. This investment loss will be recognized in the determination of the actuarial value of assets in the next few years, to the extent it is not offset by recognition of investment gains derived from future experience. This implies that earning the assumed rate of investment return (net of investment expenses) on a market value basis will result in investment losses on the actuarial value of assets in the next few years. The funding schedule for the BRS excluding Teachers shown in this report reflects the deferred investment losses in accordance with the asset valuation method adopted by the Board.
6. Based on past experience and future expectations, the following actuarial assumptions were changed:
   - Mortality assumption for BRS excluding Teachers:
     - The mortality assumption for healthy participants was changed from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale AA to the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009.
     - The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Mortality Table set forward three years for males only projected generationally with Scale AA to the RP-2000 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2015.
   - Mortality assumption for Teachers:
     - The pre-retirement mortality assumption was changed from the RP-2000 Combined Healthy White Collar Mortality Table projected 22 years using Scale AA to the RP-2014 Employee Mortality Table projected generationally using Scale BB2D from 2014.
     - The mortality assumption for non-disabled retirees was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table projected 17 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2014.

- The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table set forward three years for males only projected 7 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table set forward four years projected generationally with Scale BB2D from 2014.

- The investment return assumption for the Teachers was lowered from 8.0% to 7.5%.
- The salary increase assumption for the BRS excluding Teachers was lowered from 4.50% per year for Group 1 members, 4.75% per year for Group 2 members, and 5.00% per year for Group 4 members, including an allowance for inflation of 4.50% per year, to 4.00% per year for Group 1 members, 4.25% per year for Group 2 members, and 4.50% per year for Group 4 members, including an allowance for inflation of 3.25% per year.
- The percentage of pre-retirement deaths assumed to be job-related accidental deaths for the Teachers was increased from 55% to 75%.
- The administrative expense assumption was changed from $8,417,000 for calendar 2014 to $9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers, and 30%, or $2,850,000, assigned to the Teachers.

The changes in assumptions decreased the unfunded liability by $44.3 million and decreased the normal cost by $7.6 million for the BRS excluding Teachers. These changes increased the unfunded liability by $269.9 million and increased the normal cost by $9.9 million for the Teachers.

7. The recommended contributions for the BRS excluding Teachers are based on a funding schedule that fully funds the liabilities of the BRS excluding Teachers by June 30, 2025 with total increases in the appropriation of 8.85% per year. The fiscal 2017 appropriation is $235,770,904 and the fiscal 2018 appropriation is $256,636,629. The fiscal 2017 and later appropriations reflect the additional payment of $12.0 million that was made on September 1, 2016 and applied to fiscal 2016. The funding schedule for the BRS excluding Teachers is shown in Chart 2 – 17.
8. The Commonwealth appropriation for the Teachers is $132,477,000 for fiscal 2017 and is expected to increase by 7% for fiscal 2018.
9. Section 2 shows participant and asset information, the experience analysis, liabilities and a funding schedule for the BRS excluding Teachers, with comparisons to 2014. Section 3 shows the same information for the Teachers with comparisons to 2014. Section 4 shows participant and asset information for all employees of the BRS.
10. On a market value basis, the funded ratio has decreased from 60.64% as of January 1, 2014 to 57.62%. On an actuarial basis, the funded ratio has increased from 59.46% as of January 1, 2014 to 61.58% as of January 1, 2016.

Summary of Key Valuation Results – BRS excluding Teachers

	2016	2014
Contributions for fiscal year beginning July 1:		
Recommended for fiscal 2017 and 2015	$235,770,904	$203,074,621
Recommended for fiscal 2018 and 2016	256,636,629	218,812,904
Recommended for fiscal 2019 and 2017	279,348,971	235,770,904
Funding elements for plan year beginning January 1:		
Normal cost, including administrative expenses	$137,364,499	$135,877,055
Market value of assets (MVA)	4,108,995,185	4,044,721,329
Actuarial value of assets (AVA)	4,440,479,851	3,989,921,913
Actuarial accrued liability	5,924,067,033	5,682,673,119
Unfunded actuarial accrued liability	1,483,587,182	1,692,751,206
Funded ratio based on MVA	69.36%	71.18%
Funded ratio based on AVA	74.96%	70.21%
Demographic data for plan year beginning January 1:		
Number of retired participants and beneficiaries	9,856	9,925
Number of inactive participants entitled to a return of their employee contributions	6,784	6,194
Number of inactive participants with a vested right to a deferred or immediate benefit	765	557
Number of active participants	14,288	14,235
Total payroll[1]	$909,132,900	$869,004,192
Average payroll[1]	63,629	61,047

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. Calendar year 2013 payroll figures were increased by 7.7% for police officers, plus a one-time $2,000 parity increase for approximately 83% of police officers and by 6.1% for firefighters to reflect bargaining contracts that were settled in 2014. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

Summary of Key Valuation Results - Teachers

	2016	2014
Funding elements for plan year beginning January 1:		
Normal cost, including administrative expenses	$69,488,163	$57,478,566
Market value of assets (MVA)	1,450,298,185	1,446,475,671
Actuarial value of assets (AVA)	1,500,903,796	1,393,969,313
Actuarial accrued liability	3,724,758,237	3,372,057,014
Unfunded actuarial accrued liability	2,223,854,441	1,978,087,701
Funded ratio based on MVA	38.94%	42.90%
Funded ratio based on AVA	40.30%	41.34%
Demographic data for plan year beginning January 1:		
Number of retired participants and beneficiaries	4,629	4,416
Number of inactive participants entitled to a return of their employee contributions	1,906	1,789
Number of inactive participants with a vested right to a deferred or immediate benefit	285	251
Number of active participants	6,210	6,043
Total payroll[1]	$525,856,865	$510,053,668
Average payroll[1]	84,679	84,404

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

Summary of Key Valuation Results – All BRS Employees

	2016	2014
Funding elements for plan year beginning January 1:		
Normal cost, including administrative expenses	$206,852,662	$193,355,621
Market value of assets (MVA)	5,559,293,370	5,491,197,000
Actuarial value of assets (AVA)	5,941,383,647	5,383,891,226
Actuarial accrued liability	9,648,825,270	9,054,730,133
Unfunded actuarial accrued liability	3,707,441,623	3,670,838,907
Funded ratio based on MVA	57.62%	60.64%
Funded ratio based on AVA	61.58%	59.46%
Demographic data for plan year beginning January 1:		
Number of retired participants and beneficiaries	14,485	14,341
Number of inactive participants entitled to a return of their employee contributions	8,690	7,983
Number of inactive participants with a vested right to a deferred or immediate benefit	1,050	808
Number of active participants	20,498	20,278
Total payroll[1]	$1,434,989,766	$1,379,057,860
Average payroll[1]	70,006	68,008

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. Calendar year 2013 payroll figures were increased by 7.7% for police officers, plus a one-time $2,000 parity increase for approximately 83% of police officers and by 6.1% for firefighters to reflect bargaining contracts that were settled in 2014. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

Important Information About Actuarial Valuations

An actuarial valuation is a budgeting tool with respect to the financing of future projected obligations of a pension plan. It is an estimated forecast – the actual long-term cost of the plan will be determined by the actual benefits and expenses paid and the actual investment experience of the plan.

In order to prepare a valuation, Segal Consulting ("Segal") relies on a number of input items. These include:

- **Plan of benefits** Plan provisions define the rules that will be used to determine benefit payments, and those rules, or the interpretation of them, may change over time. Even where they appear precise, outside factors may change how they operate. It is important to keep Segal informed with respect to plan provisions and administrative procedures, and to review the plan summary included in our report to confirm that Segal has correctly interpreted the plan of benefits.
- **Participant data** An actuarial valuation for a plan is based on data provided to the actuary by the Boston Retirement System. Segal does not audit such data for completeness or accuracy, other than reviewing it for obvious inconsistencies compared to prior data and other information that appears unreasonable. It is important for Segal to receive the best possible data and to be informed about any known incomplete or inaccurate data.
- **Assets** The valuation is based on the market value of assets as of the valuation date, as provided by the Boston Retirement System. The Boston Retirement System uses an "actuarial value of assets" that differs from market value to gradually reflect year-to-year changes in the market value of assets in determining the contribution requirements.
- **Actuarial assumptions** In preparing an actuarial valuation, Segal projects the benefits to be paid to existing plan participants for the rest of their lives and the lives of their beneficiaries. This projection requires actuarial assumptions as to the probability of death, disability, withdrawal, and retirement of each participant for each year. In addition, the benefits projected to be paid for each of those events in each future year reflect actuarial assumptions as to salary increases and cost-of-living adjustments. The projected benefits are then discounted to a present value, based on the assumed rate of return that is expected to be achieved on the plan's assets. There is a reasonable range for each assumption used in the projection and the results may vary materially based on which assumptions are selected. It is important for any user of an actuarial valuation to understand this concept. Actuarial assumptions are periodically reviewed to ensure that future valuations reflect emerging plan experience. While future changes in actuarial assumptions may have a significant impact on the reported results, that does not mean that the previous assumptions were unreasonable.

The user of Segal's actuarial valuation (or other actuarial calculations) should keep the following in mind:

- The actuarial valuation is prepared at the request of the Boston Retirement System. Segal is not responsible for the use or misuse of its report, particularly by any other party.
- An actuarial valuation is a measurement of the plan's assets and liabilities at a specific date. Accordingly, except where otherwise noted, Segal did not perform an analysis of the potential range of future financial measures. The actual long-term cost of the plan will be determined by the actual benefits and expenses paid and the actual investment experience of the plan.
- Sections of this report may include actuarial results that are not rounded, but that does not imply precision.
- If the Boston Retirement System is aware of any event or trend that was not considered in this valuation that may materially change the results of the valuation, Segal should be advised, so that we can evaluate it.
- Segal does not provide investment, legal, accounting, or tax advice. Segal's valuation is based on our understanding of applicable guidance in these areas and of the plan's provisions, but they may be subject to alternative interpretations. The Boston Retirement System should look to their other advisors for expertise in these areas.

As Segal Consulting has no discretionary authority with respect to the management or assets of the Plan, it is not a fiduciary in its capacity as actuaries and consultants with respect to the Plan.

A. PARTICIPANT DATA

The Actuarial Valuation and Review considers the number and demographic characteristics of covered participants, including active participants, inactive participants, retired participants and beneficiaries.

This section presents a summary of significant statistical data on these participant groups for the BRS excluding Teachers.

More detailed information for this valuation year and the preceding valuation can be found in Chart 2 – 2 and Section 4, Exhibit A.

A historical perspective of how the participant population has changed over the past five valuations can be seen in this chart.

CHART 2 - 1

Participant Population: 2007 – 2015

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries
2007	15,943	4,959	10,246
2009	14,449	6,189	10,044
2011	13,951	6,823	10,000
2013	14,235	6,751	9,925
2015	14,288	7,549	9,856

Participant Data

Below is a summary of the participant data used in this valuation for the BRS excluding Teachers.

CHART 2 - 2

Table of Plan Coverage

Category	Year Ended December 31 2015	2013	Change From Prior Year
Active participants in valuation:			
Number	14,288	14,235	0.4%
Average age	46.5	46.4	N/A
Average years of service	14.0	14.7	N/A
Total payroll[1]	$909,132,900	$869,004,192	4.6%
Average payroll[1]	63,629	61,047	4.2%
Member contributions	943,744,521	874,477,977	7.9%
Number with unknown age	16	3	433.3%
Number of inactive participants entitled to a return of their employee contributions	765	557	37.3%
Number of inactive participants with a vested right to a deferred or immediate benefit	6,784	6,194	9.5%
Retired participants:			
Number in pay status	6,077	6,028	0.8%
Average age	74.3	74.3	N/A
Average monthly benefit	$2,727	$2,529	7.8%
Number in suspended status	0	1	-100.0%
Disabled participants:			
Number in pay status	1,742	1,749	-0.4%
Average age	67.9	67.4	N/A
Average monthly benefit	$3,945	$3,682	7.1%
Beneficiaries in pay status:			
Number in pay status	2,037	2,147	-5.1%
Average age	77.4	77.3	N/A
Average monthly benefit	$1,650	$1,508	9.4%

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. Calendar year 2013 payroll figures were increased by 7.7% for police officers, plus a one-time $2,000 parity increase for approximately 83% of police officers and by 6.1% for firefighters to reflect bargaining contracts that were settled in 2014. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

Active Participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 14,288 active participants with an average age of 46.5, average years of service of 14.0 years and average payroll of $63,629. The 14,235 active participants in the prior valuation had an average age of 46.4, average service of 14.7 years and average payroll of $61,047.

Among the active participants, there were 16 participants with unknown age. The actuarial calculations were adjusted for the missing information by assuming that it was the same as information provided for other active participants with similar known characteristics.

Inactive Participants

In this year's valuation, there were 765 participants with a vested right to a deferred or immediate vested benefit and 6,784 participants entitled to a return of their employee contributions.

These graphs show a distribution of active participants by age and by years of service.

CHART 2 - 3

Distribution of Active Participants by Age as of December 31, 2015

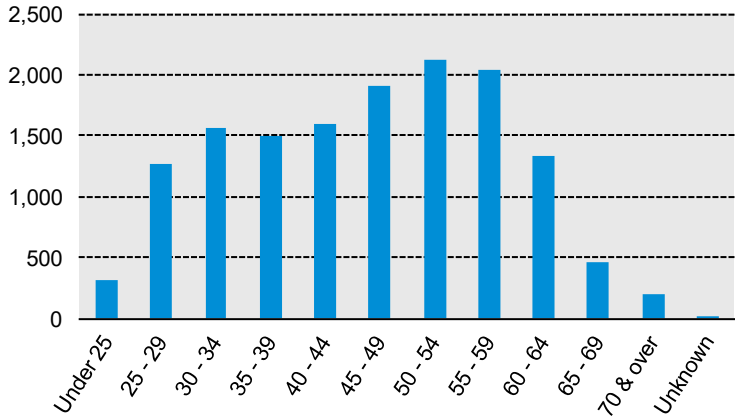
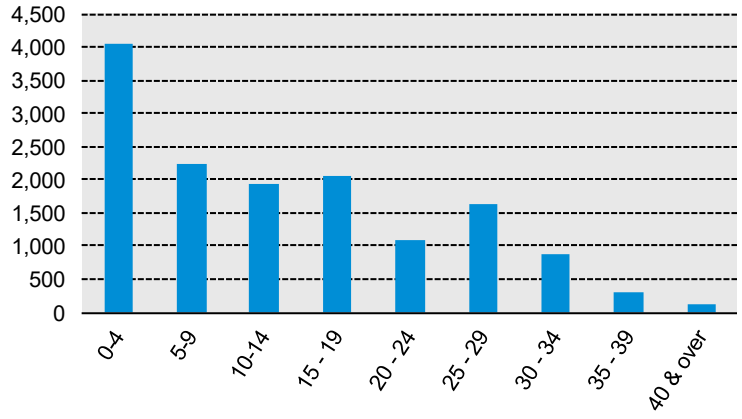


CHART 2 - 4

Distribution of Active Participants by Years of Service as of December 31, 2015



Retired Participants and Beneficiaries

As of December 31, 2015, 7,819 retired participants and 2,037 beneficiaries were receiving total monthly benefits of $26,805,492, excluding COLAs reimbursed by the Commonwealth. For comparison, in the previous valuation, there were 7,777 retired participants and 2,147 beneficiaries receiving monthly benefits of $24,920,835, excluding COLAs reimbursed by the Commonwealth. There were no retired participants in suspended status this year and one in the prior valuation.

These graphs show a distribution of the current retired participants and beneficiaries based on their monthly amount and age, by type of pension.

CHART 2 - 5

Distribution of Retired Participants and Beneficiaries by Type and by Monthly Amount as of December 31, 2015

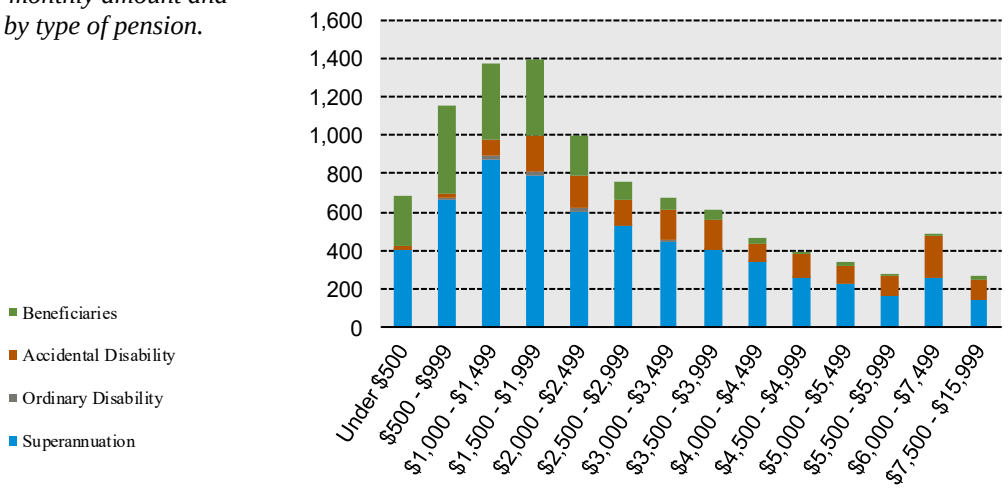
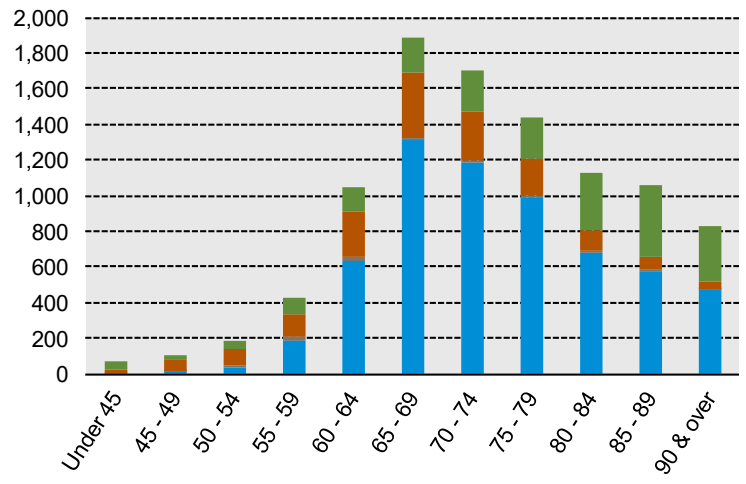


CHART 2 - 6

Distribution of Retired Participants and Beneficiaries by Type and by Age as of December 31, 2015



B. FINANCIAL INFORMATION

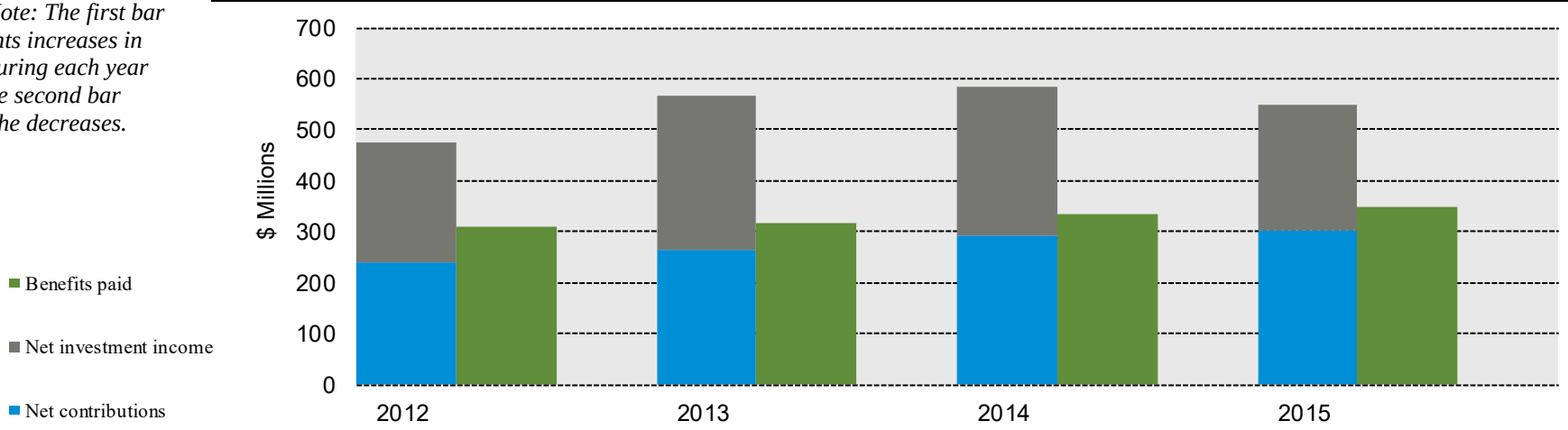
Retirement plan funding anticipates that, over the long term, both contributions (less administrative expenses) and net investment earnings (less investment fees) will be needed to cover benefit payments.

Retirement plan assets change as a result of the net impact of these income and expense components. Additional financial information, including a summary of these transactions for the valuation year, is presented in Section 4, Exhibit B.

The chart depicts the components of changes in the actuarial value of assets over the last four years. Note: The first bar represents increases in assets during each year while the second bar details the decreases.

CHART 2 - 7

Comparison of Increases and Decreases in the Actuarial Value of Assets for Years Ended December 31, 2012 – 2015



It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a result, the asset value and the plan costs are more stable.

The amount of the adjustment to recognize market value is treated as income, which may be positive or negative. Realized and unrealized gains and losses are treated equally and, therefore, the sale of assets has no immediate effect on the actuarial value.

The chart shows the determination of the actuarial value of assets as of the valuation date.

CHART 2 - 8

Determination of Actuarial Value of Assets

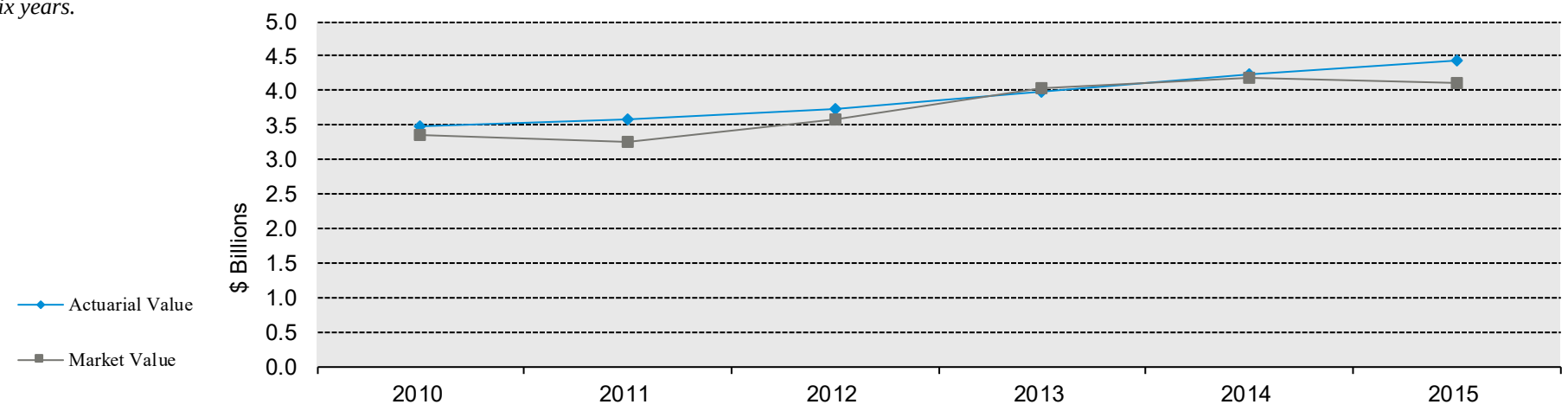
	Year Ended	
	December 31, 2015	December 31, 2014
1. Actuarial value of assets at the beginning of the year	$4,240,389,786	$3,989,921,913
2. Contributions, less benefit payments and expenses during the year	-43,965,320	-42,056,001
3. Average actuarial value of assets: (1) + 50% of (2)	4,218,407,126	3,968,893,912
4. Expected investment income: .0775 x (3)	326,926,552	307,589,278
5. Preliminary actuarial value of assets at the end of the year: (1) + (2) + (4)	4,523,351,018	4,255,455,190
6. Market value of assets at the end of the year	4,108,995,185	4,180,128,172
7. Adjustment toward market value: 20% of [(6) - (5)]	-82,871,167	-15,065,404
8. Adjustment to be within 20% corridor	0	0
9. Final actuarial value of assets: (5) + (7) + (8)	$4,440,479,851	$4,240,389,786
10. Actuarial value as a percentage of market value: (9) ÷ (6)	108.1%	101.4%

Both the actuarial value and market value of assets are representations of the financial status of the BRS. As investment gains and losses are gradually taken into account, the actuarial value of assets tracks the market value of assets. The actuarial asset value is significant because liabilities are compared to these assets to determine what portion, if any, remains unfunded. Amortization of the unfunded actuarial accrued liability is an important element in determining the contribution requirement.

This chart shows the change in the actuarial value of assets versus the market value over the past six years.

CHART 2 - 9

Actuarial Value of Assets vs. Market Value of Assets as of December 31, 2010 – 2015



C. ACTUARIAL EXPERIENCE

To calculate the required contribution, assumptions are made about future events that affect the amount and timing of benefits to be paid and assets to be accumulated. Each year actual experience is measured against the assumptions. If overall experience is more favorable than anticipated (an actuarial gain), the contribution requirement will decrease from the previous year. On the other hand, the contribution requirement will increase if overall actuarial experience is less favorable than expected (an actuarial loss).

Taking account of experience gains or losses in one year without making a change in assumptions reflects the belief that the single year's experience was a short-term development and that, over the long term, experience will return to the original assumptions. For contribution requirements to remain stable, assumptions should approximate experience.

If assumptions are changed, the contribution requirement is adjusted to take into account a change in experience anticipated for all future years.

The total experience gain for the two-year period ended December 31, 2015 is $91,618,324. A discussion of the major components of the actuarial experience is on the following pages.

This chart provides a summary of the actuarial experience over the past two years.

CHART 2 - 10

Actuarial Experience for Two-Year Period Ended December 31, 2015

1.	Net loss from investments*	-$97,936,571
2.	Net loss from administrative expenses	-1,680,104
3.	Net gain from other experience**	191,234,999
4.	Net experience gain: (1) + (2) + (3)	$91,618,324

* *Details in Chart 2 - 11*

** *Details in Chart 2 - 14*

Investment Rate of Return

A major component of projected asset growth is the assumed rate of return. The assumed return should represent the expected long-term rate of return, based on the investment policy of the BRS. For valuation purposes, the assumed rate of return on the actuarial value of assets is 7.75%. The actual rates of return on an actuarial basis for the 2015 and 2014 plan years were 5.79% and 7.37%, respectively.

Since the actual return for the two-year period was less than the assumed return, there was an actuarial loss of $97,936,571 during the two-year period ending December 31, 2015 with regard to its investments.

This chart shows the gain/(loss) due to investment experience.

CHART 2 - 11

Actuarial Value Investment Experience

	Year Ended December 31, 2015	Year Ended December 31, 2014
1. Actual return	$244,055,385	$292,523,874
2. Average value of assets	4,218,407,126	3,968,893,912
3. Actual rate of return: (1) ÷ (2)	5.79%	7.37%
4. Assumed rate of return	7.75%	7.75%
5. Expected return: (2) x (4)	$326,926,552	$307,589,278
6. Actuarial gain/(loss): (1) – (5)	-$82,871,167	-$15,065,404

Because actuarial planning is long term, it is useful to see how the assumed investment rate of return has followed actual experience over time. The chart below shows the rate of return on an actuarial basis compared to the market value investment return for the last six years, including a six-year average.

Based upon this experience and future expectations, we have maintained the assumed rate of return of 7.75% for the BRS excluding Teachers.

CHART 2 - 12

Investment Return – Actuarial Value vs. Market Value: 2010 - 2015

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2010	$227,907,602	7.08%	$331,718,631	11.07%
2011	195,775,161	5.71	-843,146	-0.03
2012	236,215,344	6.67	398,647,225	12.36
2013	301,559,400	8.12	508,811,061	14.28
2014	292,523,874	7.37	177,462,844	4.41
2015	244,055,385	5.79	-27,167,667	-0.65
Total	$1,498,036,766		$1,388,628,948	
	Six-year average return	6.78%		6.53%

Note: Each year's yield is weighted by the average asset value in that year.

Subsection B described the actuarial asset valuation method that gradually takes into account fluctuations in the market value rate of return. The effect of this is to stabilize the actuarial rate of return, which contributes to leveling pension plan costs.

Administrative Expenses

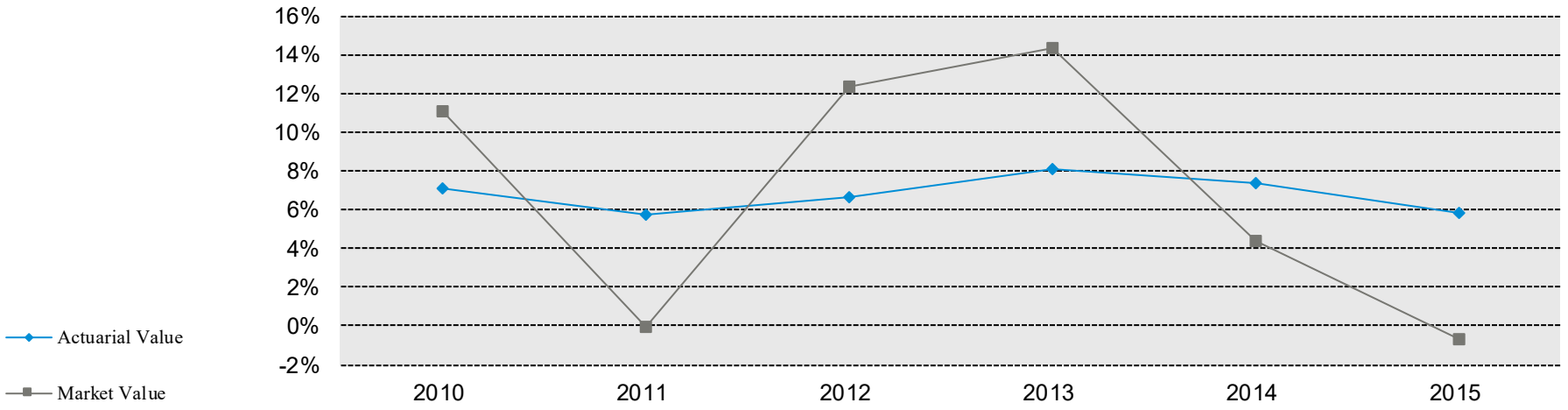
Administrative expenses for the years ended December 31, 2014 and 2015 were $7,305,895 and $6,302,302, respectively, compared to the assumption of $5,891,900 for calendar 2014 and $6,157,036 for calendar 2015. This resulted in a loss of $1,680,104 for the two-year period, including an adjustment for interest.

Based on discussions with the staff of the BRS, we have increased the assumption for the BRS from $8,417,000 for calendar 2014 to $9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers.

This chart illustrates how this leveling effect has actually worked over the years 2010 - 2015.

CHART 2 - 13

Market and Actuarial Rates of Return for Years Ended December 31, 2010 - 2015



Other Experience

There are other differences between the expected and the actual experience that appear when the new valuation is compared with the projections from the previous valuation. These include:

- the extent of turnover among the participants,
- retirement experience (earlier or later than expected),
- mortality (more or fewer deaths than expected),
- the number of disability retirements, and
- salary increases different than assumed.

The net gain from this other experience for the two-year period ending December 31, 2015 amounted to $191,234,999, which is 3.2% of the actuarial accrued liability.

A brief summary of the demographic gain/(loss) experience of the BRS excluding Teachers for the two-year period ending December 31, 2015 is shown in the chart below.

We have reviewed the experience of the BRS excluding Teachers for the two-year period ending December 31, 2015 and recommend the following changes in actuarial assumptions:

- The mortality assumption for healthy participants was changed from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale AA to the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009.
- The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Mortality Table set forward three years for males only projected generationally with Scale AA to the RP-2000 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2015.
- The salary increase assumption was lowered from 4.50% per year for Group 1 members, 4.75% per year for Group 2 members, and 5.00% per year for Group 4 members, including an allowance for inflation of 4.50% per year, to 4.00% per year for Group 1 members, 4.25% per year for Group 2 members, and 4.50% per year for Group 4 members, including an allowance for inflation of 3.25% per year.

The chart shows elements of the experience gain/(loss) for the most recent years.

CHART 2 - 14

Experience Due to Changes in Demographics for Two-Year Period Ended December 31, 2015

1.	More deaths than expected among retired members and beneficiaries	$992,515
2.	Salary increases less than expected for continuing actives	72,872,572
3.	Service increases less than expected for continuing actives	81,211,089
4.	Miscellaneous gain	36,158,823
5.	Net experience gain	$191,234,999

- The administrative expense assumption was changed from $8,417,000 for calendar 2014, with 70%, or $5,891,900, assigned to the BRS excluding Teachers, to $9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers.

The changes in assumptions decreased the unfunded liability by $44.3 million and decreased the normal cost by $7.6 million.

Chart 2 – 15 below provides a reconciliation of the unfunded liability from the prior valuation to the current valuation.

The unfunded liability was expected to decrease from $1.693 billion as of January 1, 2014 to $1.620 billion as of January 1, 2016 if there were no experience gains or losses. The actual unfunded liability as of January 1, 2016 of $1.484 billion is $135.9 million lower than expected as detailed in Chart 2 – 15 below.

CHART 2 - 15

Development of Unfunded Actuarial Accrued Liability and (Gain)/Loss

	Year Ended	
	December 31, 2015	**December 31, 2014**
1. Unfunded actuarial accrued liability at beginning of year	$1,659,425,329	$1,692,751,206
2. Normal cost at beginning of year	141,991,522	135,877,055
3. Total contributions	-309,500,919	-299,322,861
4. Interest		
(a) For whole year on (1) + (2)	$139,609,806	$141,718,690
(b) For half year on (3)	-11,993,161	-11,598,761
(c) Total interest	127,616,645	130,119,929
5. Expected unfunded actuarial accrued liability	$1,619,532,577	$1,659,425,329
6. Changes due to:		
(a) Experience gain	-$91,618,324	- -
(b) Assumption changes	-44,327,071	- -
(c) Total changes	-135,945,395	- -
7. Unfunded actuarial accrued liability at end of year: (5) + (6c)	$1,483,587,182	- -

D. RECOMMENDED CONTRIBUTION

The amount of annual contribution required to fund the System is comprised of an employer normal cost payment and a payment on the unfunded actuarial accrued liability.

Chart 2 – 16 compares the actuarial cost factors for the current and prior valuations. The contribution for fiscal 2017 is equal to the previously budgeted amount of $235,770,904. This amount does not include the additional payment of $12.0 million that was made on September 1, 2016 and applied to fiscal 2016.

The funding schedule shown in Chart 2 – 17 fully funds the liabilities of the BRS excluding Teachers by June 30, 2025 with total increases in the appropriation of 8.85% per year and annual recognition of the deferred investment losses. The fiscal 2018 appropriation is $256,636,629.

CHART 2 - 16

Recommended Contribution

	Year Beginning January 1			
	2016		2014	
	Amount	% of Payroll	Amount	% of Payroll
1. Total normal cost	$130,714,499	13.82%	$129,985,155	14.31%
2. Administrative expenses	6,650,000	0.70%	5,891,900	0.65%
3. Expected employee contributions	-91,050,581	-9.63%	-86,122,777	-9.48%
4. Employer normal cost: (1) + (2) + (3)	$46,313,918	4.90%	$49,754,278	5.48%
5. Actuarial accrued liability	5,924,067,033		5,682,673,119	
6. Actuarial value of assets	4,440,479,851		3,989,921,913	
7. Unfunded actuarial accrued liability: (5) - (6)	$1,483,587,182		$1,692,751,206	
8. Employer normal cost projected to July 1, 2016 and 2014	47,060,502	4.90%	50,861,431	5.48%
9. Projected unfunded actuarial accrued liability	1,540,003,515		1,757,121,413	
10. Payment on projected unfunded actuarial accrued liability	188,710,402	19.63%	152,213,190	16.38%
11. Budgeted appropriation for fiscal 2017 and 2015: (8) + (10)	$235,770,904	24.53%	$203,074,621	21.86%
12. Projected payroll for fiscal 2017 and 2015	$961,060,499		$928,882,815	

Note: Contributions are assumed to be paid on July 1.

CHART 2 - 17

Funding Schedule

(1) Fiscal Year Ended June 30	(2) Employer Normal Cost	(3) Amortization of Unfunded Inactive Sheriff Liability	(4) Amortization of Remaining Unfunded Liability	(5) Crossover Payment Savings	(6) Savings from Additional Payment in Fiscal 2011	(7) Total Employer Contributions: (2) + (3) + (4) + (5) + (6)	(8) Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(9) Percent Increase in Total Cost
2017	$47,060,502	$3,874,532	$208,964,617	-$14,679,118	-$9,449,629	$235,770,904	$1,540,003,515	7.75%
2018	48,795,675	3,874,533	228,095,168	-14,679,118	-9,449,629	256,636,629	1,522,019,369	8.85%
2019	50,594,246	3,874,533	249,008,939	-14,679,118	-9,449,629	279,348,971	1,484,765,124	8.85%
2020	52,458,513	3,874,533	271,867,056	-14,679,118	-9,449,629	304,071,355	1,413,463,194	8.85%
2021	54,390,858	3,874,533	296,845,026	-14,679,118	-9,449,629	330,981,670	1,304,598,792	8.85%
2022	56,393,749	3,874,533	324,134,013	-14,679,118	-9,449,629	360,273,548	1,154,027,742	8.85%
2023	58,469,742	3,874,533	353,942,229	-14,679,118	-9,449,629	392,157,757	956,935,161	8.85%
2024	60,621,483	3,874,533	386,496,449	-14,679,118	-9,449,629	426,863,718	707,784,502	8.85%
2025	62,851,720	3,874,533	420,511,756	-14,679,118	-9,449,629	463,109,262	400,257,538	8.49%
2026	65,163,293	0	0	0	0	65,163,293	0	-85.93%
2027	67,559,148	0	0	0	0	67,559,148	0	3.68%
2028	70,042,335	0	0	0	0	70,042,335	0	3.68%
2029	72,616,015	0	0	0	0	72,616,015	0	3.67%
2030	75,283,463	0	0	0	0	75,283,463	0	3.67%

Notes: Recommended contributions are assumed to be paid on July 1.
Fiscal 2017 appropriation is budgeted amount determined with prior valuation.
Item (2) reflects 3.25% growth in payroll and 0.15% adjustment to total normal cost to reflect the effect of mortality improvements due to generational mortality assumption.
Projected normal cost does not reflect the future impact of pension reform for new hires.
Projected unfunded actuarial accrued liability reflects deferred investment losses.
Payment of $12.0 million made on September 1, 2016 for fiscal 2016 is reflected in the unfunded actuarial accrued liability as of July 1, 2017.

A. PARTICIPANT DATA

The Actuarial Valuation and Review considers the number and demographic characteristics of covered participants, including active participants, inactive participants, retired participants and beneficiaries.

This section presents a summary of significant statistical data on these participant groups for the Teachers of the BRS.

More detailed information for this valuation year and the preceding valuation can be found in Chart 3-2 and Section 4, Exhibit C.

A historical perspective of how the participant population has changed over the past five valuations can be seen in this chart.

CHART 3 - 1

Participant Population: 2007 – 2015

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries
2007	5,805	1,281	3,693
2009	5,566	1,424	3,914
2011	5,448	1,964	4,189
2013	6,043	2,040	4,416
2015	6,210	2,191	4,629

Participant Data

Below is a summary of the participant data used in this valuation for Teachers.

CHART 3 – 2

Table of Plan Coverage

Category	Year Ended December 31 2015	2013	Change From Prior Year
Active participants in valuation:			
Number	6,210	6,043	2.8%
Average age	42.7	43.2	N/A
Average years of service	11.9	13.0	N/A
Total payroll[1]	$525,856,865	$510,053,668	3.1%
Average payroll[1]	84,679	84,404	0.3%
Member contributions	494,546,077	466,027,611	6.1%
Number with unknown age	27	2	N/A
Inactive participants with a vested right to a deferred or immediate benefit	285	251	13.5%
Inactive participants entitled to a return of their employee contributions	1,906	1,789	6.5%
Retired participants:			
Number in pay status	4,201	4,015	4.6%
Average age	71.9	71.2	N/A
Average monthly benefit	$4,362	$4,188	4.2%
Disabled participants:			
Number in pay status	121	113	7.1%
Average age	70.3	69.9	N/A
Average monthly benefit	$3,089	$2,940	5.1%
Beneficiaries in pay status:			
Number in pay status	307	288	6.6%
Average age	75.0	74.4	N/A
Average monthly benefit	$1,755	$1,606	9.3%

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

Active Participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 6,210 active participants with an average age of 42.7, average years of service of 11.9 years and average payroll of $84,679. The 6,043 active participants in the prior valuation had an average age of 43.2, average service of 13.0 years and average payroll of $84,404.

Among the active participants, there were 27 participants with unknown age. The actuarial calculations were adjusted for the missing information by assuming that it was the same as information provided for other active participants with similar known characteristics.

Inactive Participants

In this year's valuation, there were 285 participants with a vested right to a deferred or immediate vested benefit and 1,906 participants entitled to a return of their employee contributions.

These graphs show a distribution of active participants by age and by years of service.

CHART 3 – 3

Distribution of Active Participants by Age as of December 31, 2015

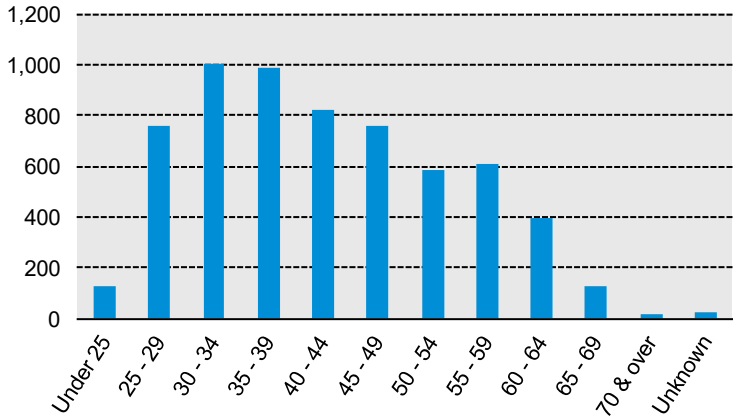
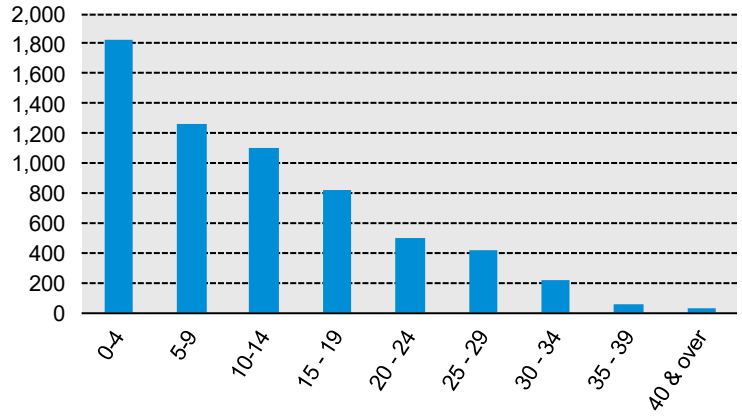


CHART 3 – 4

Distribution of Active Participants by Years of Service as of December 31, 2015



Retired Participants and Beneficiaries

As of December 31, 2015, 4,322 retired participants and 307 beneficiaries were receiving total monthly benefits of $19,238,758. For comparison, in the previous valuation, there were 4,128 retired participants and 288 beneficiaries receiving monthly benefits of $17,608,811.

These graphs show a distribution of the current retired participants and beneficiaries based on their monthly amount and age, by type of pension.

CHART 3 – 5

Distribution of Retired Participants and Beneficiaries by Type and by Monthly Amount as of December 31, 2015

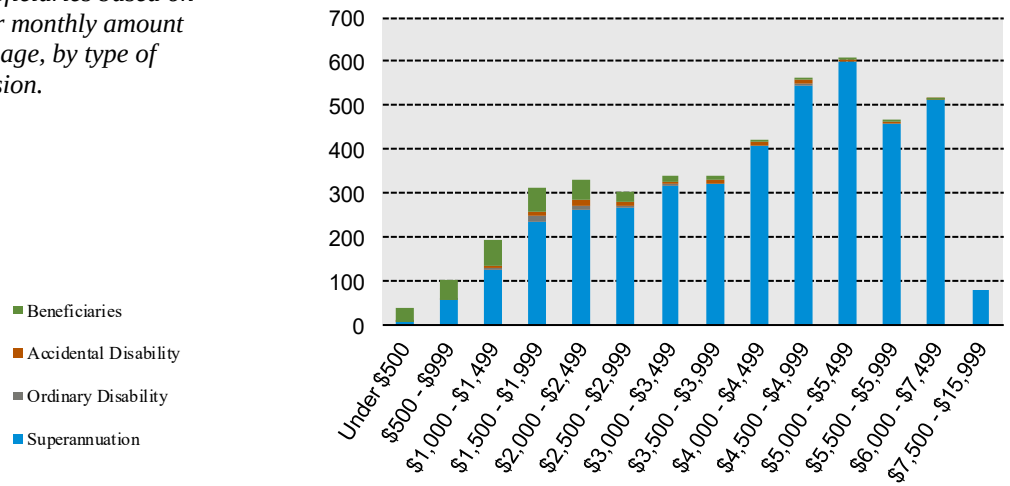
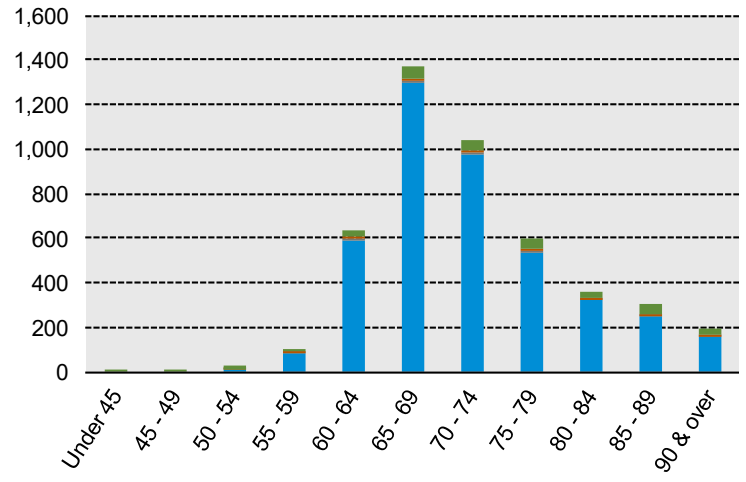


CHART 3 – 6

Distribution of Retired Participants and Beneficiaries by Type and by Age as of December 31, 2015



B. FINANCIAL INFORMATION

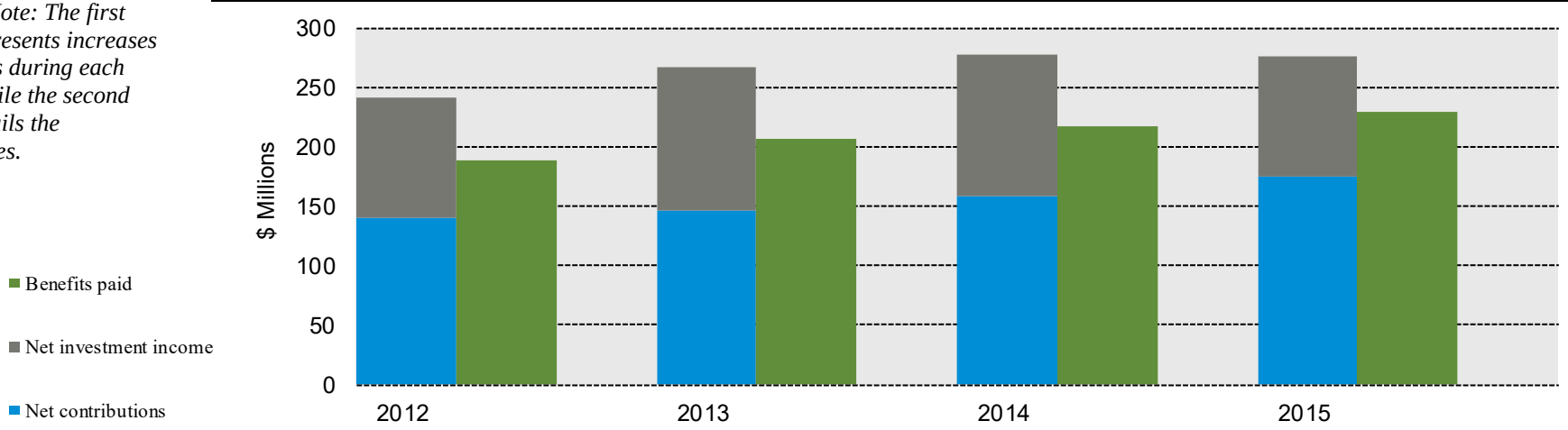
Retirement plan funding anticipates that, over the long term, both contributions (less administrative expenses) and net investment earnings (less investment fees) will be needed to cover benefit payments.

Retirement plan assets change as a result of the net impact of these income and expense components. Additional financial information, including a summary of these transactions for the valuation year, is presented in Section 4, Exhibit D.

The chart depicts the components of changes in the actuarial value of assets over the last four years. Note: The first bar represents increases in assets during each year while the second bar details the decreases.

CHART 3 – 7

Comparison of Increases and Decreases in the Actuarial Value of Assets for Years Ended December 31, 2012 – 2015



It is desirable to have level and predictable plan costs from one year to the next. For this reason, the Board has approved an asset valuation method that gradually adjusts to market value. Under this valuation method, the full value of market fluctuations is not recognized in a single year and, as a result, the asset value and the plan costs are more stable.

The chart shows the determination of the actuarial value of assets as of the valuation date.

CHART 3 – 8

Determination of Actuarial Value of Assets

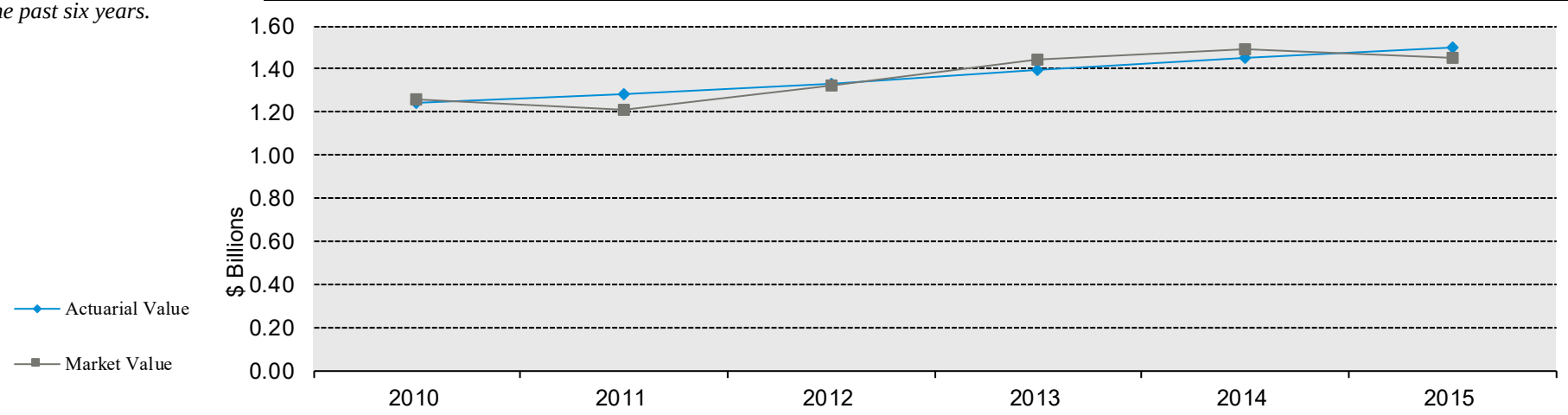
	Year Ended	
	December 31, 2015	**December 31, 2015**
1. Actuarial value of assets at the beginning of the year	$1,454,657,393	$1,393,969,313
2. Contributions, less benefit payments and expenses during the year	-55,264,217	-58,336,369
3. Average actuarial value of assets: (1) + 50% of (2)	1,427,025,285	1,364,801,128
4. Expected investment income: .08 x (3)	114,162,023	109,184,090
5. Preliminary actuarial value of assets at the end of the year: (1) + (2) + (4)	1,513,555,199	1,444,817,034
6. Market value of assets at the end of the year	1,450,298,185	1,494,018,828
7. Adjustment toward market value: 20% of [(6) - (5)]	-12,651,403	9,840,359
8. Adjustment to be within 20% corridor	0	0
9. Final actuarial value of assets: (5) + (7) + (8)	$1,500,903,796	$1,454,657,393
10. Actuarial value as a percentage of market value: (9) ÷ (6)	103.5%	97.4%

Both the actuarial value and market value of assets are representations of the financial status of the BRS. As investment gains and losses are gradually taken into account, the actuarial value of assets tracks the market value of assets. The actuarial asset value is significant because liabilities are compared to these assets to determine what portion, if any, remains unfunded. Amortization of the unfunded actuarial accrued liability is an important element in determining the contribution requirement.

This chart shows the change in the actuarial value of assets versus the market value over the past six years.

CHART 3 – 9

Actuarial Value of Assets vs. Market Value of Assets as of December 31, 2010 – 2015



C. ACTUARIAL EXPERIENCE

To calculate the required contribution, assumptions are made about future events that affect the amount and timing of benefits to be paid and assets to be accumulated. Each year actual experience is measured against the assumptions. If overall experience is more favorable than anticipated (an actuarial gain), the contribution requirement will decrease from the previous year. On the other hand, the contribution requirement will increase if overall actuarial experience is less favorable than expected (an actuarial loss).

Taking account of experience gains or losses in one year without making a change in assumptions reflects the belief that the single year's experience was a short-term development and that, over the long term, experience will return to the original assumptions. For contribution requirements to remain stable, assumptions should approximate experience.

If assumptions are changed, the contribution requirement is adjusted to take into account a change in experience anticipated for all future years.

The total experience gain for the two-year period ended December 31, 2015 is $119,877,628. A discussion of the major components of the actuarial experience is on the following pages.

This chart provides a summary of the actuarial experience over the past two years.

CHART 3 – 10

Actuarial Experience for Two-Year Period Ended December 31, 2015

1.	Net loss from investments*	-$2,811,044
2.	Net gain from administrative expenses	138,906
3.	Net gain from other experience**	122,549,766
4.	Net experience gain: (1) + (2) + (3)	$119,877,628

* *Details in Chart 3 - 11*

** *Details in Chart 3 - 14*

Investment Rate of Return

A major component of projected asset growth is the assumed rate of return. The assumed return should represent the expected long-term rate of return, based on the investment policy of the PRIM Board. For valuation purposes, the assumed rate of return on the actuarial value of assets was 8.00% for 2015 and 2014. The actual rates of return on an actuarial basis for the 2015 and 2014 plan years were 7.11% and 8.72%, respectively.

Since the actual return for the two-year period was less than the assumed return, there was an actuarial loss of $2,811,044 during the two-year period ending December 31, 2015 with regard to its investments.

This chart shows the gain/(loss) due to investment experience.

CHART 3 – 11

Actuarial Value Investment Experience

	Year Ended December 31, 2015	Year Ended December 31, 2014
1. Actual return	$101,510,620	$119,024,449
2. Average value of assets	1,427,025,285	1,364,801,128
3. Actual rate of return: (1) ÷ (2)	7.11%	8.72%
4. Assumed rate of return	8.00%	8.00%
5. Expected return: (2) x (4)	$114,162,023	$109,184,090
6. Actuarial gain/(loss): (1) – (5)	-$12,651,403	$9,840,359

Because actuarial planning is long term, it is useful to see how the assumed investment rate of return has followed actual experience over time. The chart below shows the rate of return on an actuarial basis compared to the market value investment return for the last six years, including a six-year average.

We have decreased the assumed rate of return assumption from 8.00% to 7.50% for the Teachers of the BRS to be consistent with the assumptions used in the January 1, 2016 Actuarial Valuation Report of the Massachusetts Teachers' Retirement System dated October 13, 2016.

CHART 3 – 12

Investment Return – Actuarial Value vs. Market Value: 2010 - 2015

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2010	$95,270,615	8.64%	$154,709,657	14.59%
2011	83,285,518	6.84	-2,647,747	-0.21
2012	101,068,635	8.05	159,649,908	13.45
2013	120,630,899	9.26	183,271,929	14.17
2014	119,024,449	8.72	105,879,526	7.47
2015	101,510,620	7.11	11,543,574	0.79
Total	$620,790,736		$612,406,847	
	Six-year average return	8.09%		8.00%

Note: Each year's yield is weighted by the average asset value in that year.

Subsection B described the actuarial asset valuation method that gradually takes into account fluctuations in the market value rate of return. The effect of this is to stabilize the actuarial rate of return, which contributes to leveling pension plan costs.

Administrative Expenses

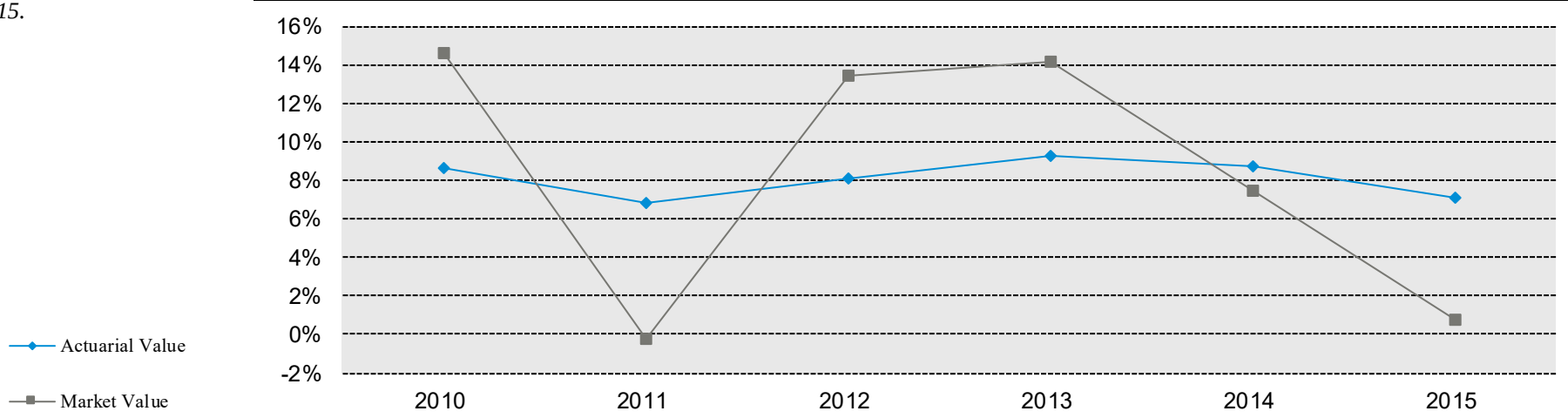
Administrative expenses for the years ended December 31, 2014 and 2015 were $2,909,600 and $2,323,147, respectively, compared to the assumption of $2,525,100 for calendar 2014 and $2,638,730 for calendar 2015. This resulted in a gain of $138,906 for the two-year period, including an adjustment for interest.

Based on discussions with the staff of the BRS, we have increased the assumption for the BRS from $8,417,000 for calendar 2014 to $9,500,000 for calendar 2016, with 30%, or $2,850,000, assigned to the Teachers.

This chart illustrates how this leveling effect has actually worked over the years 2010 - 2015.

CHART 3 - 13

Market and Actuarial Rates of Return for Years Ended December 31, 2010 - 2015



Other Experience

There are other differences between the expected and the actual experience that appear when the new valuation is compared with the projections from the previous valuation. These include:

- the extent of turnover among the participants,
- retirement experience (earlier or later than expected),
- mortality (more or fewer deaths than expected),
- the number of disability retirements, and
- salary increases different than assumed.

The net gain from this other experience for the two-year period ending December 31, 2015 amounted to $122,549,766, which is 3.3% of the actuarial accrued liability.

A brief summary of the demographic gain/(loss) experience of the Teachers of the BRS for the two-year period ending December 31, 2015 is shown in the chart below.

The following changes in actuarial assumptions were made to be consistent with the assumptions used in the January 1, 2016 Actuarial Valuation Report of the Massachusetts Teachers' Retirement System dated October 13, 2016:

- The investment return assumption was lowered from 8.0% to 7.5%.
- The pre-retirement mortality assumption was changed from the RP-2000 Combined Healthy White Collar Mortality Table projected 22 years using Scale AA to the RP-2014 Employee Mortality Table projected generationally using Scale BB2D from 2014.
- The mortality assumption for non-disabled retirees was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table projected 17 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2014.
- The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table set forward three years for males only projected 7 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table set forward four years projected generationally with Scale BB2D from 2014.

The chart shows elements of the experience gain/(loss) for the most recent years.

CHART 3 – 14

Experience Due to Changes in Demographics for Two-Year Period Ended December 31, 2015

1.	Fewer deaths than expected among retired members and beneficiaries	-$14,273,110
2.	Salary increases less than expected for continuing actives	69,818,657
3.	Service increases less than expected for continuing actives	50,205,713
4.	Miscellaneous gain	16,798,506
5.	Net experience gain	$122,549,766

- The percentage of pre-retirement deaths assumed to be job-related accidental deaths was increased from 55% to 75%.
- The administrative expense assumption was changed from $8,417,000 for calendar 2014, with 30%, or $2,525,100, assigned to the Teachers, to $9,500,000 for calendar 2016, with 30%, or $2,850,000, assigned to the Teachers.

These changes increased the unfunded liability by $269.9 million and increased the normal cost by $9.9 million for the Teachers.

Chart 3 – 15 below provides a reconciliation of the unfunded liability from the prior valuation to the current valuation.

The unfunded liability was expected to increase from $1.978 billion as of January 1, 2014 to $2.074 billion as of January 1, 2016. The actual unfunded liability as of January 1, 2016 of $2.224 billion is $150.0 million higher than expected as detailed in Chart 3 – 15 below.

CHART 3 – 15

Development of Unfunded Actuarial Accrued Liability and (Gain)/Loss

	Year Ended	
	December 31, 2015	December 31, 2014
1. Unfunded actuarial accrued liability at beginning of year	$2,030,467,513	$1,978,087,701
2. Normal cost at beginning of year	60,065,101	57,478,566
3. Total contributions	-176,836,436	-161,484,669
4. Interest		
(a) For whole year on (1) + (2)	$167,242,609	$162,845,302
(b) For half year on (3)	-7,073,457	-6,459,387
(c) Total interest	160,169,152	156,385,915
5. Expected unfunded actuarial accrued liability	$2,073,865,330	$2,030,467,513
6. Changes due to:		
(a) Experience loss	-$119,877,628	- -
(b) Assumption and method changes	269,866,739	- -
(c) Total changes	149,989,111	- -
7. Unfunded actuarial accrued liability at end of year: (5) + (6c)	$2,223,854,441	- -

D. RECOMMENDED CONTRIBUTION

The amount of annual contribution required to fund the System is comprised of an employer normal cost payment and a payment on the unfunded actuarial accrued liability.

The fiscal 2017 appropriation for the Teachers has already been budgeted at $132,477,000 by the Commonwealth. The fiscal 2018 appropriation is expected to increase by 7% and the pension obligations of the Commonwealth are expected to be fully funded by June 30, 2040.

CHART 3 – 16

Recommended Contribution

	Year Beginning January 1			
	2016		2014	
	Amount	% of Payroll	Amount	% of Payroll
1. Total normal cost	$66,638,163	12.05%	$54,953,466	10.25%
2. Administrative expenses	2,850,000	0.52%	2,525,100	0.47%
3. Expected employee contributions	-58,977,399	-10.67%	-56,736,062	-10.59%
4. Employer normal cost: (1) + (2) + (3)	$10,510,764	1.90%	$742,504	0.14%
5. Actuarial accrued liability	3,724,758,237		3,372,057,014	
6. Actuarial value of assets	1,500,903,796		1,393,969,313	
7. Unfunded actuarial accrued liability: (5) - (6)	$2,223,854,441		$1,978,087,701	
8. Employer normal cost projected to July 1, 2016 and 2014, adjusted for timing	11,140,294	1.97%	788,803	0.14%
9. Projected unfunded actuarial accrued liability	2,305,741,360		2,055,689,041	
10. Payment on projected unfunded actuarial accrued liability, adjusted for timing	121,336,706	21.47%	108,696,197	19.84%
11. Budgeted appropriation for fiscal 2017 and 2015: (8) + (10)	$132,477,000	23.44%	$109,485,000	19.98%
12. Projected payroll for fiscal 2017 and 2015	$565,259,211		$547,920,611	

Note: Contributions are assumed to be paid on December 31.

EXHIBIT A

Participants in Active Service as of December 31, 2015 – BRS excluding Teachers
By Age, Years of Service, and Average Payroll

		Years of Service								
Age	Total	0-4	5-9	10-14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 & over
Under 25	306	302	4	- -	- -	- -	- -	- -	- -	- -
	$35,361	$35,221	$45,861	- -	- -	- -	- -	- -	- -	- -
25 - 29	1,266	1,094	162	10	- -	- -	- -	- -	- -	- -
	$49,194	$48,103	$55,581	$65,032	- -	- -	- -	- -	- -	- -
30 - 34	1,569	819	558	182	10	- -	- -	- -	- -	- -
	$60,601	$53,464	$69,573	$65,304	$58,840	- -	- -	- -	- -	- -
35 - 39	1,501	517	407	418	156	3	- -	- -	- -	- -
	$63,688	$46,358	$69,050	$76,372	$72,939	$74,241	- -	- -	- -	- -
40 - 44	1,601	362	280	330	459	148	22	- -	- -	- -
	$65,215	$40,217	$57,755	$69,271	$80,511	$81,496	$82,019	- -	- -	- -
45 - 49	1,903	338	224	262	429	281	326	43	- -	- -
	$68,495	$42,161	$46,560	$57,540	$78,107	$88,920	$88,228	$77,514	- -	- -
50 - 54	2,115	256	213	252	328	244	556	252	13	1
	$70,992	$39,519	$44,954	$49,045	$64,400	$78,197	$97,256	$89,539	$89,848	$88,223
55 - 59	2,035	186	182	233	321	188	433	342	134	16
	$69,104	$39,323	$43,780	$42,710	$57,354	$65,466	$87,651	$95,043	$94,175	$99,800
60 - 64	1,326	100	124	155	198	157	206	187	136	63
	$66,871	$34,901	$44,796	$49,647	$53,514	$55,935	$74,817	$87,549	$106,564	$99,625
65 - 69	454	48	60	58	92	49	66	43	18	20
	$49,806	$24,643	$40,676	$45,919	$49,591	$54,809	$59,984	$56,087	$70,641	$71,746
70 & over	196	15	17	29	47	18	28	12	6	24
	$39,443	$23,447	$25,479	$24,935	$40,411	$40,871	$52,657	$47,373	$42,444	$53,762
Unknown	16	16	- -	- -	- -	- -	- -	- -	- -	- -
	$50,787	$50,787	- -	- -	- -	- -	- -	- -	- -	- -
Total	14,288	4,053	2,231	1,929	2,040	1,088	1,637	879	307	124
	$63,629	$45,175	$57,681	$60,024	$68,147	$74,321	$87,623	$88,457	$97,089	$86,182

Note: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll.

EXHIBIT B

Summary Statement of Income and Expenses on an Actuarial Value Basis – BRS excluding Teachers

	Year Ended December 31, 2015		Year Ended December 31, 2014	
Net assets at actuarial value at the beginning of the year		$4,240,389,786		$3,989,921,913
Contribution income:				
Employer contributions	$218,812,904		$207,925,006	
Employee contributions	90,688,015		91,397,855	
Less administrative expenses	-6,302,302		-7,305,895	
Net contribution income		303,198,617		292,016,966
Net investment income		244,055,385		292,523,874
Total income available for benefits		$547,254,002		$584,540,840
Net benefit payments		-$347,163,937		-$334,072,967
Change in reserve for future benefits		$200,090,065		$250,467,873
Net assets at actuarial value at the end of the year		$4,440,479,851		$4,240,389,786

EXHIBIT C

Participants in Active Service as of December 31, 2015 - Teachers
By Age, Years of Service, and Average Payroll

		Years of Service								
Age	**Total**	**0-4**	**5-9**	**10-14**	**15 - 19**	**20 - 24**	**25 - 29**	**30 - 34**	**35 - 39**	**40 & over**
Under 25	123	123	- -	- -	- -	- -	- -	- -	- -	- -
	$58,804	$58,804	- -	- -	- -	- -	- -	- -	- -	- -
25 - 29	757	671	86	- -	- -	- -	- -	- -	- -	- -
	$65,473	$64,050	$76,572	- -	- -	- -	- -	- -	- -	- -
30 - 34	1,006	447	468	90	1	- -	- -	- -	- -	- -
	$78,614	$69,511	$84,611	$92,853	$59,367	- -	- -	- -	- -	- -
35 - 39	990	194	315	398	81	2	- -	- -	- -	- -
	$85,629	$69,595	$84,430	$92,537	$94,458	$97,256	- -	- -	- -	- -
40 - 44	818	128	146	237	256	44	7	- -	- -	- -
	$89,253	$70,177	$88,198	$91,655	$95,569	$97,066	$98,611	- -	- -	- -
45 - 49	761	111	94	133	180	172	61	10	- -	- -
	$90,542	$72,183	$82,486	$89,857	$95,941	$98,658	$98,247	$95,398	- -	- -
50 - 54	588	56	60	95	105	93	134	45	- -	- -
	$92,404	$66,830	$84,024	$89,264	$93,553	$100,665	$100,511	$98,133	- -	- -
55 - 59	604	50	46	77	100	88	124	97	21	1
	$92,932	$64,573	$82,718	$90,100	$94,241	$94,246	$99,147	$101,579	$104,407	$101,466
60 - 64	392	18	30	48	70	79	69	46	25	7
	$95,557	$67,287	$87,124	$93,431	$94,550	$96,667	$100,033	$102,072	$103,742	$100,339
65 - 69	125	5	12	14	24	20	19	15	4	12
	$95,497	$57,605	$87,542	$92,579	$90,414	$97,766	$96,599	$106,795	$111,533	$107,819
70 & over	19	1	2	3	1	5	- -	1	1	5
	$85,521	$40,140	$45,605	$65,317	$108,110	$88,911	- -	$90,792	$106,144	$109,600
Unknown	27	27	- -	- -	- -	- -	- -	- -	- -	- -
	$66,939	$66,939	- -	- -	- -	- -	- -	- -	- -	- -
Total	6,210	1,831	1,259	1,095	818	503	414	214	51	25
	$84,679	$66,683	$84,203	$91,556	$94,852	$97,667	$99,478	$100,987	$104,674	$105,827

Note: Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year.

EXHIBIT D

Summary Statement of Income and Expenses on an Actuarial Value Basis - Teachers

	Year Ended December 31, 2015		Year Ended December 31, 2014	
Net assets at actuarial value at the beginning of the year		$1,454,657,393		$1,393,969,313
Contribution income:				
Employer contributions	$120,434,000		$109,485,000	
Employee contributions	56,402,436		51,999,669	
Less administrative expenses	-2,323,147		-2,909,600	
Net contribution income		174,513,289		158,575,069
Net investment income		101,510,620		119,024,449
Total income available for benefits		$276,023,909		$277,599,518
Net benefit payments		-$229,777,506		-$216,911,438
Change in reserve for future benefits		$46,246,403		$60,688,080
Net assets at actuarial value at the end of the year		$1,500,903,796		$1,454,657,393

A historical perspective of how the participant population has changed over the past ten valuations can be seen in this chart.

EXHIBIT E

Participant Population – All Employees: 1996 – 2015

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries
1996	18,651	3,703	13,492
1999	19,953	1,459	13,381
2001	22,003	3,560	13,144
2003	20,456	5,294	14,034
2005	20,917	6,178	13,783
2007	21,748	6,240	13,939
2009	20,015	7,613	13,958
2011	19,399	8,787	14,189
2013	20,278	8,791	14,341
2015	20,498	9,740	14,485

EXHIBIT F

Table of Plan Coverage – All Employees

Category	Year Ended December 31 2015	Year Ended December 31 2013	Change From Prior Year
Active participants in valuation:			
Number	20,498	20,278	1.1%
Average age	45.3	45.4	N/A
Average years of service	13.3	14.2	N/A
Total payroll[1]	$1,434,989,765	$1,379,057,860	4.1%
Average payroll[1]	70,006	68,008	2.9%
Member contributions	1,438,290,598	1,340,505,588	7.3%
Number with unknown age	43	5	N/A
Number of inactive participants with a vested right to a deferred or immediate benefit	1,050	808	30.0%
Inactive participants entitled to a return of their employee contributions	8,690	7,983	8.9%
Retired participants:			
Number in pay status	10,278	10,043	2.3%
Average age	73.3	73.1	N/A
Average monthly benefit	$3,395	$3,192	6.4%
Number in suspended status	0	1	-100.0%
Disabled participants:			
Number in pay status	1,863	1,862	0.1%
Average age	68.1	67.5	N/A
Average monthly benefit	$3,889	$3,637	6.9%
Beneficiaries in pay status:			
Number in pay status	2,344	2,435	-3.7%
Average age	77.1	77.0	N/A
Average monthly benefit	$1,664	$1,520	9.5%

[1] *Payroll figures are for the prior calendar year and reflect annualized salaries for participants hired during the year. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. Calendar year 2013 payroll figures were increased by 7.7% for police officers, plus a one-time $2,000 parity increase for approximately 83% of police officers and by 6.1% for firefighters to reflect bargaining contracts that were settled in 2014. Calendar year 2013 payroll figures were reduced to reflect retroactive payments that were included in the salary data. Payments made as part of grievance settlements were assumed to be one-time payments and were removed from reported salaries. For non-grievance retroactive amounts, salaries were reduced by the lesser of the retroactive amount provided or 1% of salary.*

EXHIBIT G

Investment Return – Actuarial Value vs. Market Value – All Assets: 2006 – 2015

Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2006	$335,622,622	8.79%	$506,115,642	13.43%
2007	368,013,791	8.95	403,369,820	9.53
2008	-330,344,896	-7.44	-1,167,563,433	-25.41
2009	251,082,864	6.17	635,296,107	18.76
2010	323,178,217	7.48	486,428,288	11.99
2011	279,060,679	6.00	-3,490,893	-0.08
2012	337,283,979	7.03	558,297,133	12.65
2013	422,190,300	8.41	692,082,990	14.26
2014	411,548,325	7.72	283,342,371	5.21
2015	345,566,005	6.12	-15,624,093	-0.28
Total	$2,743,201,886		$2,378,253,932	
	Five-year average return	7.06%		6.09%
	Ten-year average return	5.94%		5.30%

Note: Each year's yield is weighted by the average asset value in that year.

EXHIBIT H

Market and Actuarial Rates of Return for Years Ended December 31, 2006 – 2015 – All Assets

This chart illustrates how this leveling effect has actually worked over the years 2010 - 2015.

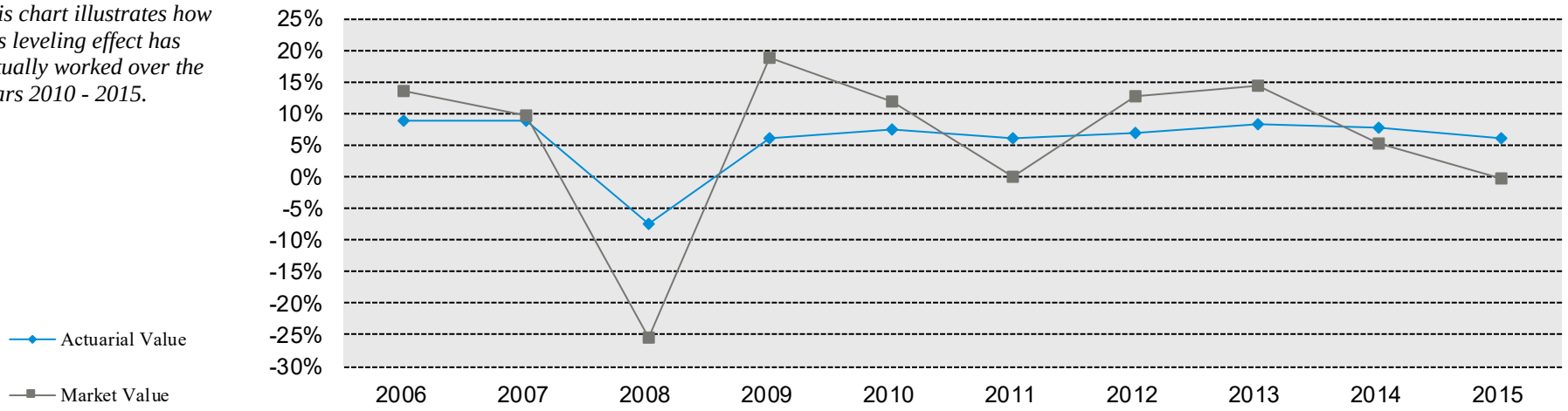


EXHIBIT I

Definitions of Pension Terms

The following list defines certain technical terms for the convenience of the reader:

Assumptions or actuarial assumptions: The estimates on which the cost of the Plan is calculated including:

(a) Investment return — the rate of investment yield that the Plan will earn over the long-term future;

(b) Mortality rates — the death rates of employees and pensioners; life expectancy is based on these rates;

(c) Retirement rates — the rate or probability of retirement at a given age;

(d) Withdrawal rates — the rates at which employees of various ages are expected to leave employment for reasons other than death, disability, or retirement.

Normal cost: The amount of contributions required to fund the benefit allocated to the current year of service.

Actuarial accrued liability for actives: The equivalent of the accumulated normal cost allocated to the years before the valuation date.

Actuarial accrued liability for pensioners: The single-sum value of lifetime benefits to existing pensioners. This sum takes account of life expectancies appropriate to the ages of the pensioners and the interest that the sum is expected to earn before it is entirely paid out in benefits.

Unfunded actuarial accrued liability: The extent to which the actuarial accrued liability of the Plan exceeds the assets of the Plan. There are many approaches to paying off the unfunded actuarial accrued liability, from meeting the interest accrual only to amortizing it over a specific period of time.

Amortization of the unfunded actuarial accrued liability:	Payments made over a period of years equal in value to the Plan's unfunded actuarial accrued liability.
Investment return:	The rate of earnings of the Plan from its investments, including interest, dividends and capital gain and loss adjustments, computed as a percentage of the average value of the fund. For actuarial purposes, the investment return often reflects a smoothing of the capital gains and losses to avoid significant swings in the value of assets from one year to the next.

EXHIBIT I

Summary of Actuarial Valuation Results

The valuation was made with respect to the following data supplied to us:		
1. Retired participants as of the valuation date (including 2,344 beneficiaries in pay status)		14,485
2. Participants active during the year ended December 31, 2015 (including 43 participants with unknown age) with total accumulated contributions of $1,438,290,598 and projected 2016 payroll of $1,503,110,106		20,498
3. Inactive participants entitled to a return of their employee contributions as of December 31, 2015		8,690
4. Inactive participants with a vested right to a deferred or immediate benefit as of December 31, 2015		1,050

The actuarial factors as of January 1, 2016 are as follows:		
1. Total normal cost		$197,352,662
2. Administrative expenses		9,500,000
3. Expected employee contributions		-150,027,980
4. Employer normal cost: (1) + (2) + (3)		$56,824,682
5. Actuarial accrued liability		9,648,825,270
Retired participants and beneficiaries	$5,314,883,481	
Active participants	4,128,102,301	
Inactive participants	205,839,488	
6. Actuarial value of assets ($5,559,293,370 at market value)		5,941,383,647
7. Unfunded actuarial accrued liability: (5) – (6)		3,707,441,623

The actuarial factors projected to July 1, 2016 are as follows:	
1. Projected employer normal cost, adjusted for timing	$58,200,796
2. Projected unfunded actuarial liability	3,845,744,875
3. Budgeted appropriation	368,247,904
4. Projected payroll	1,526,319,710

Note: Contributions for the BRS excluding Teachers are assumed to be paid on July 1.
Contributions for the Teachers are assumed to be paid on December 31.

EXHIBIT II

Funded Ratio

A critical piece of information regarding the System's financial status is the funded ratio. This ratio compares the actuarial value of assets to the actuarial accrued liabilities of the System as calculated. High ratios indicate a well-funded plan with assets sufficient to cover the plan's actuarial accrued liabilities. Lower ratios may indicate recent changes to benefit structures, funding of the plan below actuarial requirements, poor asset performance, or a variety of other factors.

These measurements are not necessarily appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling the System's benefit obligation or the need for or the amount of future contributions.

The chart below depicts a history of the funded ratios for this plan. On a market value basis, the funded ratio has decreased from 60.64% as of January 1, 2014 to 57.62% as of January 1, 2016. On an actuarial value basis, the funded ratio has increased from 59.46% as of January 1, 2014 to 61.58% as of January 1, 2016.

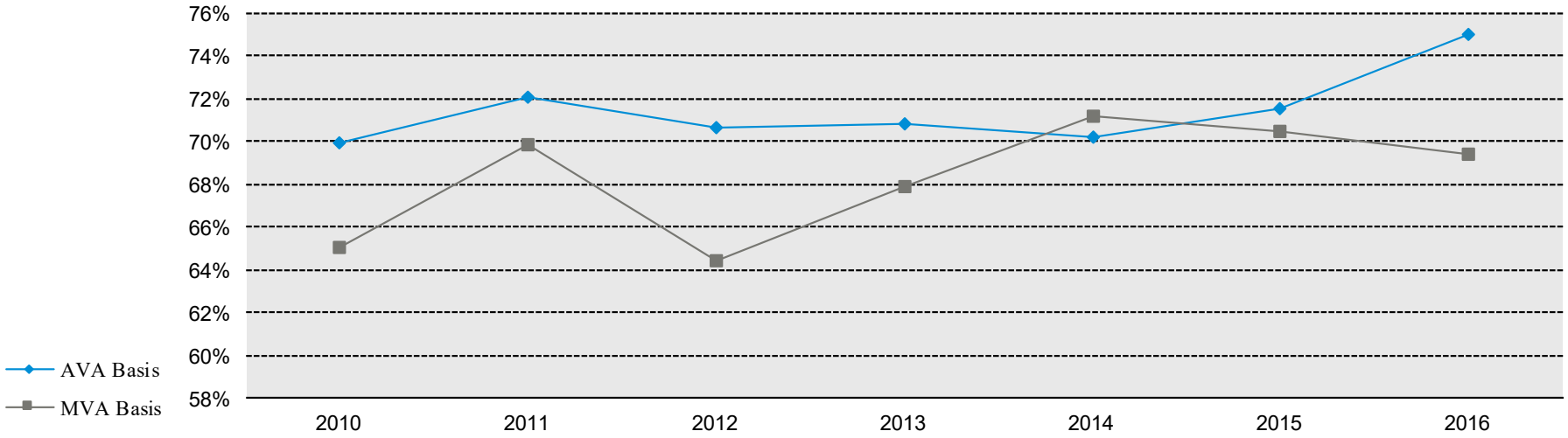


EXHIBIT III

Actuarial Assumptions and Actuarial Cost Method

Rationale for Demographic and Noneconomic Assumptions for Teachers:	The assumptions for the Teachers are the same as used in the Massachusetts Teachers' Retirement System Actuarial Valuation Report as of January 1, 2016, dated October 13, 2016. These assumptions were used because there is a larger experience base to rely on and because the liabilities of the Boston Teachers are funded by the Commonwealth of Massachusetts. We have reviewed these demographic assumptions and have no reason to doubt their reasonableness.
Mortality Rates:	
BRS excluding Teachers	
Healthy:	RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009 (Previously, RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale AA)
Disabled:	RP-2000 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2015 (Previously, RP-2000 Healthy Annuitant Mortality Table set forward three years for males only projected generationally with Scale AA)
	The underlying tables with generational projection to the ages of the participants as of the measurement date reflect the projected mortality experience of the Plan as of the measurement date based on historical and current demographic data. As part of the analysis, a comparison was made between the actual number of retiree deaths and the projected number based on the prior years' assumptions over the three most recent valuations. The mortality tables were then adjusted to future years using a generational projection under Scale BB2D to reflect future mortality improvement.

Teachers

Healthy: RP-2014 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2014 (Previously, RP-2000 Combined Healthy White Collar Mortality Table projected 22 years with Scale AA for employees and RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table projected 17 years with Scale AA for healthy annuitants)

Disabled: RP-2014 Healthy Annuitant Mortality Table set forward four years projected generationally with Scale BB2D from 2014. (Previously, RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table set forward three years for males only projected 7 years with Scale AA)

Termination Rates before Retirement:

Groups 1 and 2 - Rate (%) – BRS Excluding Teachers

	Mortality			
Age	**Male**	**Female**	**Disability**	**Withdrawal**
20	0.03	0.02	0.03	6.58
25	0.04	0.02	0.04	5.27
30	0.04	0.03	0.06	4.83
35	0.08	0.05	0.07	4.47
40	0.11	0.07	0.11	3.84
45	0.15	0.11	0.18	3.21
50	0.21	0.17	0.30	1.52
55	0.30	0.25	0.50	0.33
60	0.49	0.39	0.81	0.00

Notes: Mortality rates do not reflect generational projection.
50% of the disability rates shown represent accidental disability.
20% of the accidental disabilities will die from the same cause as the disability.
20% of the death rates shown represent accidental death.

Group 4 - Rate (%), BRS Excluding Teachers

Age	Mortality Male	Mortality Female	Disability	Withdrawal
20	0.03	0.02	0.15	0.00
25	0.04	0.02	0.21	0.00
30	0.04	0.03	0.28	0.00
35	0.08	0.05	0.37	0.00
40	0.11	0.07	0.55	0.00
45	0.15	0.11	0.90	0.00
50	0.21	0.17	1.51	0.00
55	0.30	0.25	2.52	0.00
60	0.49	0.39	0.00	0.00

Notes: Mortality rates do not reflect generational projection.
90% of the disability rates shown represent accidental disability.
60% of the accidental disabilities will die from the same cause as the disability.
50% of the death rates shown represent accidental death.

The termination rates and disability rates for the BRS excluding Teachers were based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment. As part of the analysis, a comparison was made between the actual number of terminations and disability retirements and the projected number based on the prior years' assumptions over the three most recent valuations.

Termination Rates before Retirement:

Rate (%) – Teachers

	Mortality				
	Current		Previous		
Age	Male	Female	Male	Female	Disability
20	0.04	0.02	0.02	0.01	0.04
25	0.05	0.02	0.03	0.02	0.05
30	0.05	0.02	0.03	0.02	0.06
35	0.05	0.03	0.05	0.04	0.06
40	0.06	0.04	0.07	0.05	0.10
45	0.10	0.07	0.10	0.07	0.30
50	0.17	0.11	0.13	0.11	0.50
55	0.28	0.17	0.22	0.22	0.70
60	0.47	0.24	0.39	0.42	0.70

Notes: *Mortality rates do not reflect generational projection.*
35% of the disability rates shown represent accidental disability.
40% of the accidental disabilities will die from the same cause as the disability.
75% of the death rates shown represent accidental death (previously, 55%).

Withdrawal Rates:

Rate (%) - Teachers

	Years of Service									
	0 - 1		2		3		4		5	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
20	13.0	10.0	11.5	10.5	8.3	7.5	6.6	7.3	5.5	7.0
30	15.0	15.0	11.0	11.5	8.9	10.0	7.0	10.0	5.4	8.8
40	13.3	10.5	13.0	8.5	7.1	6.6	7.5	5.2	5.2	5.0
50	16.2	9.8	12.2	12.0	8.8	7.0	9.0	6.6	7.0	5.0

	Years of Service									
	6		7		8		9		10+	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
20	4.0	5.0	4.0	6.0	3.3	7.0	1.5	7.0	1.5	5.0
30	4.5	7.3	4.0	6.0	3.3	7.0	1.5	6.0	1.5	4.5
40	5.5	5.0	3.0	4.5	3.4	3.5	2.5	3.0	1.7	2.2
50	6.5	3.0	5.0	4.0	2.2	2.4	2.5	3.0	2.3	2.0

Retirement Rates:

Rate (%) – BRS excluding Teachers			
Age	Groups 1 and 2	Age	Group 4
55	3.0	50	1.0
56	3.0	51	1.0
57	3.0	52	1.0
58	3.0	53	1.0
59	3.0	54	1.0
60	8.0	55	10.0
61	8.0	56	5.0
62	15.0	57	5.0
63	10.0	58	5.0
64	10.0	59	5.0
65	35.0	60	10.0
66	20.0	61	15.0
67	20.0	62	15.0
68	20.0	63	15.0
69	20.0	64	25.0
70	100.0	65	100.0

The retirement rates for the BRS excluding Teachers were based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment. As part of the analysis, a comparison was made between the actual number of retirements by age and the projected number based on the prior years' assumptions over the three most recent valuations.

Retirement Rates:

	Rate (%) – Non-TARP Teachers			
	Years of Service			
	Less than 20		20 or more	
Age	Male	Female	Male	Female
50	0.0	0.0	2.0	1.0
51	0.0	0.0	2.0	1.0
52	0.0	0.0	2.0	1.5
53	0.0	0.0	2.0	2.0
54	0.0	0.0	3.0	2.0
55	3.5	3.5	3.0	4.0
56	3.5	3.5	3.5	4.0
57	5.0	3.5	4.0	4.0
58	5.5	5.0	5.0	6.0
59	6.0	6.5	6.0	8.0
60	7.5	8.5	15.0	15.0
61	12.0	10.0	25.0	20.0
62	14.0	12.0	30.0	20.0
63	14.0	12.0	30.0	25.0
64	14.0	20.0	30.0	30.0
65	30.0	30.0	30.0	40.0
66	30.0	30.0	25.0	30.0
67	30.0	30.0	25.0	30.0
68	30.0	30.0	25.0	30.0
69	30.0	30.0	25.0	30.0
70	100.0	100.0	100.0	100.0

Retirement Rates:

Rate (%) – TARP Teachers						
	Years of Service					
	Less than 20		20 – 29		30 or more	
Age	Male	Female	Male	Female	Male	Female
50	0.0	0.0	1.0	1.0	2.0	1.5
51	0.0	0.0	1.0	1.0	2.0	1.5
52	0.0	0.0	1.0	1.0	2.0	1.5
53	0.0	0.0	1.5	1.0	2.0	1.5
54	0.0	0.0	2.5	1.0	2.0	2.0
55	5.0	3.0	3.0	3.0	6.0	5.0
56	5.0	3.0	6.0	5.0	20.0	15.0
57	5.0	4.0	10.0	8.0	40.0	35.0
58	5.0	8.0	15.0	10.0	50.0	35.0
59	10.0	8.0	20.0	15.0	50.0	35.0
60	10.0	10.0	25.0	20.0	40.0	35.0
61	20.0	12.0	30.0	25.0	40.0	35.0
62	20.0	12.0	35.0	30.0	35.0	35.0
63	25.0	15.0	40.0	30.0	35.0	35.0
64	25.0	20.0	40.0	30.0	35.0	35.0
65	25.0	25.0	40.0	40.0	35.0	35.0
66	30.0	25.0	30.0	30.0	40.0	35.0
67	30.0	30.0	30.0	30.0	40.0	30.0
68	30.0	30.0	30.0	30.0	40.0	30.0
69	30.0	30.0	30.0	30.0	40.0	30.0
70	100.0	100.0	100.0	100.0	100.0	100.0

Retirement Age for Inactive Vested Participants:

Age 60 for Group 1 and Group 2 members and age 55 for Group 4 members hired prior to April 2, 2012. For members hired April 2, 2012 or later, age 60 for Group 1 members, age 55 for Group 2 members and age 50 for Group 4 members.

	The retirement age for inactive vested participants was based on historical and current demographic data, adjusted to reflect economic conditions of the area and estimated future experience and professional judgment.
Inactive Vested Participants:	Inactive vested participants whose present value of future benefits is less than their member contributions balance, including those for whom no final average salary information has been reported, are assumed to elect to receive an immediate refund of their member contributions.
Loading:	For the Teachers, the total normal cost was increased by 2% and the actuarial accrued liability of active members by 1% to account for buybacks at retirement and other unvalued benefits.
Unknown Data for Participants:	Same as those exhibited by participants with similar known characteristics.
Family Composition:	75% of participants are assumed to be married for BRS excluding Teachers, 80% for Teachers. None are assumed to have dependent children. Females are assumed to be three years younger than their male spouses.
Benefit Election:	All participants are assumed to elect Option A. Benefit elections reflect the fact that all benefit options are actuarially equivalent.
Net Investment Return:	7.75% for BRS excluding Teachers and 7.50% for Teachers (previously, 8.00% for Teachers) The net investment return assumption for BRS excluding Teachers is a long-term estimate derived from historical data, current and recent market expectations, and professional judgment. As part of the analysis, a building block approach was used that reflects inflation expectations and anticipated risk premiums for each of the portfolio's asset classes, as well as the Plan's target asset allocation.

Salary Increases:

Years of Service	Teachers	BRS Excluding Teachers					
		Group 1		Group 2		Group 4	
		Current	Previous	Current	Previous	Current	Previous
0	7.50%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
1	7.10%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
2	7.00%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
3	6.90%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
4	6.80%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
5	6.70%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
6	6.60%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
7	6.50%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
8	6.30%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
9	6.10%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
10	5.90%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
11	5.70%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
12	5.20%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
13	4.70%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
14	4.35%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
15-16	4.20%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
17-19	4.10%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%
20 and later	4.00%	4.00%	4.50%	4.25%	4.75%	4.50%	5.00%

Includes allowance for inflation of 3.25% for BRS excluding Teachers and 4.50% for Teachers (previously, 4.50% for all)

The salary scale assumption for BRS excluding Teachers is a long-term estimate derived from historical data, current and recent market expectations, and professional judgment.

Interest on Employee Contributions: 3.5%

Administrative Expenses:	$9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers and 30%, or $2,850,000, assigned to Teachers (previously, $8,417,000 for calendar 2014, with 70%, or $5,891,900, assigned to the BRS excluding Teachers and 30%, or $2,525,100, assigned to Teachers). The administrative expense assumption is based on information on expenses provided by the Retirement System.
2015 Salary:	2015 salary equal to salaries provided in the January 1, 2015 data, except salaries for new hires were annualized. Calendar year 2015 payroll figures were increased by 14.3% for members of the Police Detectives Benevolent Society, plus a one-time $2,000 parity increase, to reflect bargaining contracts that were settled in December 2015 and first reflected in 2016 payroll. For participants hired in December 2015, salaries were set equal to $35,000 for Group 1 and $50,000 for Group 4 and Teachers.
Total Service:	Total creditable service reported in the data (previously, total creditable service reported in the data, except for those with greater than 40 years of service and those for whom the difference between age and service reported was less than 16 years, where total creditable service was based on date of hire.)
Net 3(8)(c) Liability:	No liability is valued for benefits paid or received from other municipal systems.
Actuarial Value of Assets:	A preliminary actuarial value is first determined by taking the actuarial value of assets at the beginning of the year and adding assumed investment earnings (at the assumed actuarial rate of return) and the net new money during the year (contributions less benefit payments and administrative expenses). Twenty percent of the difference between the market value of assets and the preliminary actuarial value of assets is added to the preliminary actuarial value. In order that the actuarial value not differ too significantly from the market value of assets, the final actuarial value of assets must be within 20% of the market value of assets.
Actuarial Cost Method:	Entry Age Normal Actuarial Cost Method. Entry Age is the age of the participant less total creditable service. Normal Cost and Actuarial Accrued Liability are calculated on an individual basis and are allocated by salary. Normal Cost is determined by using the plan of benefits applicable to each participant.

Justification for Changes in Assumptions:

Based on past experience and future expectations, the following actuarial assumptions were changed for BRS excluding Teachers:

- The mortality assumption for healthy participants was changed from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale AA to the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally with Scale BB2D from 2009.
- The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Mortality Table set forward three years for males only projected generationally with Scale AA to the RP-2000 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2015.
- The salary increase assumption was lowered from 4.50% per year for Group 1 members, 4.75% per year for Group 2 members, and 5.00% per year for Group 4 members, including an allowance for inflation of 4.50% per year, to 4.00% per year for Group 1 members, 4.25% per year for Group 2 members, and 4.50% per year for Group 4 members, including an allowance for inflation of 3.25% per year.
- The administrative expense assumption was changed $8,417,000 for calendar 2014 to $9,500,000 for calendar 2016, with 70%, or $6,650,000, assigned to the BRS excluding Teachers.

The following changes in actuarial assumptions were made to be consistent with the assumptions used in the January 1, 2016 Actuarial Valuation Report of the Massachusetts Teachers' Retirement System dated October 13, 2016:

- The pre-retirement mortality assumption was changed from the RP-2000 Combined Healthy White Collar Mortality Table projected 22 years using Scale AA to the RP-2014 Employee Mortality Table projected generationally using Scale BB2D from 2014.
- The mortality assumption for non-disabled retirees was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table projected 17 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table projected generationally with Scale BB2D from 2014.

- The mortality assumption for disabled participants was changed from the RP-2000 Healthy Annuitant Large Benefit Amount Mortality Table set forward three years for males only projected 7 years using Scale AA to the RP-2014 Healthy Annuitant Mortality Table set forward four years projected generationally with Scale BB2D from 2014.
- The investment return assumption was lowered from 8.0% to 7.5%.
- The percentage of pre-retirement deaths assumed to be job-related accidental deaths was increased from 55% to 75%.
- The administrative expense assumption was changed $8,417,000 for calendar 2014 to $9,500,000 for calendar 2016, with 30%, or $2,850,000, assigned to the Teachers.

EXHIBIT IV

Summary of Plan Provisions

This exhibit summarizes the major provisions of Chapter 32 of the Laws of Massachusetts.

Plan Year: January 1 through December 31

Retirement Benefits

Employees covered by the Contributory Retirement Law are classified into one of four groups depending on job classification. Group 1 comprises most positions in state and local government. It is the general category of public employees. Group 4 comprises mainly police and firefighters. Group 2 is for other specified hazardous occupations. (Officers and inspectors of the State Police are classified as Group 3.)

For employees hired prior to April 2, 2012, the annual amount of the retirement allowance is based on the member's final three-year average salary multiplied by the number of years and full months of creditable service at the time of retirement and multiplied by a percentage according to the following table based on the age of the member at retirement:

	Age Last Birthday at Date of Retirement		
Percent	**Group 1**	**Group 2**	**Group 4**
2.5	65 or over	60 or over	55 or over
2.4	64	59	54
2.3	63	58	53
2.2	62	57	52
2.1	61	56	51
2.0	60	55	50
1.9	59	--	49
1.8	58	--	48
1.7	57	--	47
1.6	56	--	46
1.5	55	--	45

TARP – Chapter 114 of the Acts of 2000 provides enhanced retirement benefits to teachers who elect to participate in the program and to all teachers hired on or after July 1, 2001. The retirement allowance of a participating teacher with 30 or more years of service is increased by an additional 2 percent for each full year of creditable service in excess of 24 years, up to the statutory maximum of 80 percent of the member's three-year salary average.

A member's final three-year average salary is defined as the greater of the highest consecutive three-year average annual rate of regular compensation and the average annual rate of regular compensation received during the last three years of creditable service prior to retirement.

For employees hired on April 2, 2012 or later, the annual amount of the retirement allowance is based on the member's final five-year average salary multiplied by the number of years and full months of creditable service at the time of retirement and multiplied by a percentage according to the following tables based on the age and years of creditable service of the member at retirement:

For members with less than 30 years of creditable service:

Age Last Birthday at Date of Retirement

Percent	Group 1	Group 2	Group 4
2.50	67 or over	62 or over	57 or over
2.35	66	61	56
2.20	65	60	55
2.05	64	59	54
1.90	63	58	53
1.75	62	57	52
1.60	61	56	51
1.45	60	55	50

For members with 30 years of creditable service or greater:

Age Last Birthday at Date of Retirement

Percent	Group 1	Group 2	Group 4
2.500	67 or over	62 or over	57 or over
2.375	66	61	56
2.250	65	60	55
2.125	64	59	54
2.000	63	58	53
1.875	62	57	52
1.750	61	56	51
1.625	60	55	50

A member's final five-year average salary is defined as the greater of the highest consecutive five-year average annual rate of regular compensation and the average annual rate of regular compensation received during the last five years of creditable service prior to retirement.

For employees who became 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 all employees, the maximum annual amount of the retirement allowance is 80 percent of the member's final average salary. Any member who is a veteran also receives an additional yearly retirement allowance of $15 per year of creditable service, not exceeding $300. The veteran allowance is paid in addition to the 80 percent maximum.

Employee Contributions

Date of Hire	Contribution Rate
Prior to January 1, 1975	5%
January 1, 1975 – December 31, 1983	7%
January 1, 1984 – June 30, 1996	8%
July 1, 1996 onward	9%

In addition, employees hired after December 31, 1978 contribute an additional 2 percent of salary in excess of $30,000.

Employees hired after 1983 who voluntarily withdraw their contributions with less than 10 ten years of credited service receive 3% interest on their contributions.

Employees in Group 1 hired on or after April 2, 2012 with 30 years of creditable service or greater will pay a base contribution rate of 6%.

Retirement Benefits (Superannuation)

Members of Group 1, 2 or 4 hired prior to April 2, 2012 may retire upon the attainment of age 55. For retirement at ages below 55, twenty years of creditable service is required.

Members hired prior to April 2, 2012 who terminate before age 55 with ten or more years of creditable service are eligible for a retirement allowance upon the attainment of age 55 (provided they have not withdrawn their accumulated deductions from the Annuity Savings Fund of the System).

Members of Group 1 hired April 2, 2012 or later may retire upon the attainment of age 60. Members of Group 2 or 4 hired April 2, 2012 or later may retire upon the attainment of age 55. Members of Group 4 may retire upon attainment of age 50 with ten years of creditable service.

Members hired April 2, 2012 or later who terminate before age 55 (60 for members of Group 1) with ten or more years of creditable service are eligible for a retirement allowance upon the attainment of age 55 (60 for members of Group 1) provided they have not withdrawn their accumulated deductions from the Annuity Savings Fund of the System.

Ordinary Disability Benefits

A member who is unable to perform his or her job due to a non-occupational disability will receive a retirement allowance if he or she has ten or more years of creditable service and has not reached age 55. The annual amount of such allowance shall be determined as if the member retired for superannuation at age 55 (age 60 for Group 1 members hired on or after April 2, 2012), based on the amount of creditable service at the date of disability. For veterans, there is a minimum benefit of 50 percent of the member's most recent year's pay plus an annuity based on his or her own contributions.

Accidental Disability Benefit

For a job-connected disability, the benefit is 72 percent of the member's most recent annual pay plus an annuity based on his or her own contributions, plus additional amounts for surviving children. Benefits are capped at 75 percent of annual rate of regular compensation for employees who become members after January 1, 1988.

Death Benefits

In general, the beneficiary of an employee who dies in active service will receive a refund of the employee's own contributions. Alternatively, if the employee were eligible to retire on the date of death, a spouse's benefit will be paid equal to the amount the employee would have received under Option C. The surviving spouse of a member who dies with two or more years of credited service has the option of a refund of the employee's contributions or a monthly benefit regardless of eligibility to retire, if they were married for at least one year. There is also a minimum widow's pension of $500 per month, and there are additional amounts for surviving children.

If an employee's death is job-connected, the spouse will receive 72 percent of the member's most recent annual pay, in addition to a refund of the member's accumulated deductions, plus additional amounts for surviving children. However, in accordance with Section 100 of Chapter 32, the surviving spouse of a police officer, firefighter or corrections officer is killed in the line of duty will be eligible to receive an annual benefit equal to the maximum salary held be the member at the time of death.

	Upon the death of a job-connected disability retiree who retired prior to November 7, 1996 and could not elect an Option C benefit, a surviving spouse will receive an allowance of $12,000 per year if the member dies for a reason unrelated to cause of disability.
"Heart And Lung Law" And Cancer Presumption	
	Any case of hypertension or heart disease resulting in total or partial disability or death to a uniformed fireman, permanent member of a police department, or certain employees of a county correctional facility is presumed to have been suffered in the line of duty, unless the contrary is shown by competent evidence. Any case of disease of the lungs or respiratory tract resulting in total disability or death to a uniformed fireman is presumed to have been suffered in the line of duty, unless the contrary is shown by competent evidence. There is an additional presumption for uniformed firemen that certain types of cancer are job-related if onset occurs while actively employed or within five years of retirement.
Options	
	Members may elect to receive a full retirement allowance payable for life under Option A. Under Option B a member may elect to receive a lower monthly allowance in exchange for a guarantee that at the time of death any contributions not expended for annuity payments will be refunded to the beneficiary. Option C allows the member to take a lesser retirement allowance in exchange for providing a survivor with two-thirds of the lesser amount. Option C pensioners will have benefits converted from a reduced to a full retirement if the beneficiary predeceases the retiree.
Post-Retirement Benefits	
	The Board has adopted the provisions of Section 51 of Chapter 127 of the Acts of 1999, which provide that the Retirement Board may approve an annual COLA in excess of the Consumer Price Index but not to exceed a 3% COLA on the first $13,000 of a retirement allowance. Cost-of-living increases granted prior to July 1, 1998 are reimbursed by the Commonwealth and not reflected in this report.
Changes in Plan Provisions	None as of December 31, 2015.