# City of Worcester Retirement System

## Actuarial Valuation and Review as of January 1, 2018

This report has been prepared at the request of the Retirement Board to assist in administering the City of Worcester Retirement System. This valuation report may not otherwise be copied or reproduced in any form without the consent of the Retirement Board and may only be provided to other parties in its entirety. The measurements shown in this actuarial valuation may not be applicable for other purposes.

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May 30, 2018

Retirement Board
City of Worcester Retirement System
City Hall, Room 103, 455 Main Street
Worcester, MA 01608

Dear Board Members:

We are pleased to submit this Actuarial Valuation and Review as of January 1, 2018. It summarizes the actuarial data used in the valuation, analyzes the preceding year's experience, and establishes the funding requirements for fiscal 2019 and later years.

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 City of Worcester Retirement System. That assistance is gratefully acknowledged.

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 this 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 City of Worcester Retirement System.

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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**City of Worcester Retirement System Actuarial Valuation and Review as of January 1, 2018**

# Section 1: Actuarial Valuation Summary

## Purpose and Basis

This report was prepared by Segal Consulting to present a valuation of the City of Worcester Retirement System as of January 1, 2018. The valuation was performed to determine whether the assets and contributions are sufficient to provide the prescribed benefits. The measurements shown in this actuarial valuation may not be applicable for other purposes. In particular, the measures herein are not necessarily appropriate for assessing the sufficiency of System assets to cover the estimated cost of settling the System's benefit obligations. 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; and changes in plan provisions or applicable law.

Certain disclosure information required by GASB Statements No. 67 and 68 as of January 1, 2018 for the City of Worcester Retirement System is provided in a separate report.

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 December 31, 2017, provided by the staff of the Retirement System;
- The assets of the System as of December 31, 2017, provided by the staff of the Retirement System;
- Economic assumptions regarding future salary increases and investment earnings; and
- Other actuarial assumptions regarding employee terminations, retirement, death, etc.

## Significant Issues

1. Segal Consulting ("Segal") strongly recommends an actuarial funding method that targets 100% funding of the actuarial accrued liability. Generally, this implies payments that are ultimately at least enough to cover normal cost, interest on the unfunded actuarial accrued liability and the principal balance. The funding policy adopted by the City of Worcester Retirement System meets this standard and funds the unfunded actuarial accrued liability of the plan by June 30, 2034.
2. The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 63.48%, compared to the prior year funded ratio of 65.71%. This ratio is one measure of funding status, and its history is a measure of funding progress. Using the market value of assets, the funded ratio is 65.13%, compared to 62.20% as of the prior valuation date. These measurements are not necessarily appropriate for assessing the sufficiency of assets to cover the estimated cost of settling the City of Worcester Retirement System's benefit obligation or the need for or the amount of future contributions.
3. During the plan year ended 2017, the market value rate of return was 16.27%, compared to the assumed rate of return of 7.375%. Because the actuarial value of assets gradually recognizes market value fluctuations over a five-year period, the actuarial rate of return was 7.23%. The actuarial value of assets as of December 31, 2017 was $928.3 million, or 97.5% of the market value of assets of $952.4 million reported in the Annual Statement. As of December 31, 2016, the actuarial value of assets was 105.6% of the market value.
4. As indicated in Section 2 of this report, the total unrecognized investment gain as of December 31, 2017 is $24,157,946. This investment gain will be recognized in the determination of the actuarial value of assets for funding purposes in the next few years, to the extent it is not offset by recognition of investment losses derived from future experience. This implies that earning the assumed rate of investment return (net of expenses) on a market value basis will result in investment gains on the actuarial value of assets in the next few years. The funding schedule shown in Section 2 does not reflect the deferred investment gains in accordance with the asset valuation method used in this valuation.
5. The actuarial valuation report as of January 1, 2018 is based on financial information as of that date. Changes in the value of assets subsequent to that date are not reflected.
6. The following actuarial assumptions were changed with this valuation:
   - The investment return assumption was lowered from 7.375% to 7.0%.
   - The mortality assumption for non-disabled participants was updated from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally from 2009 with Scale BB2D to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2017.

- The mortality assumption for disabled participants was updated from the RP-2000 Healthy Annuitant Mortality Table projected generationally from 2015 with Scale BB2D to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017.
- The salary increase assumption was changed from 4.5% per year to 3.5% per year for 2018 and 2019 and 4.5% per year thereafter.

Changing these assumptions increased the unfunded liability by approximately $68.5 million and increased the employer normal cost by approximately $2.6 million. In addition, the liability for anticipated net 3(8)(c) payments was increased by approximately $4.5 million to reflect the average net 3(8)(c) benefits paid in 2016 and 2017 and the average age of retired participants.

7. The unfunded liability has increased from $461.7 million as of January 1, 2017 to $534.1 million as of January 1, 2018. The unfunded liability was expected to decrease to $461.1 million. The increase of $73.0 million from the expected unfunded liability is primarily due to the assumption changes described above. Other sources of gains and losses are discussed in Section 2.
8. The funding schedule included in this report reflects the increase in the unfunded liability due to the assumption changes. Although the prior funding schedule reflected the deferred investment losses, the funding schedule in this report does not reflect the deferred investment gains. The 2010 ERI is amortized in level dollar amounts for three years. The fiscal 2019 total appropriation has been set equal to $49,098,344 as determined with the prior valuation. For fiscal 2020 and later years, each year's total appropriation increases 6.33% so that the System will be fully funded by June 30, 2034, if all assumptions are met. In the prior funding schedule, the System was projected to be fully funded in fiscal 2033.
9. Since the actuarial valuation results are dependent on a given set of assumptions, there is a risk that emerging results may differ significantly as actual experience proves to be different from the assumptions. We have included a discussion of various risks that may affect the plan in Section 2.

## Summary of Key Valuation Results

| | | 2018 | 2017 |
|---|---|---|---|
| **Contributions for fiscal year beginning July 1:** | • Actuarially Determined Contributions for fiscal year 2019 and 2018 | $49,098,344 | $46,188,470 |
| | • Actuarially Determined Contributions as a percent of payroll | 25.13% | 24.95% |
| **Actuarial accrued liability for plan year beginning January 1:** | • Retired participants and beneficiaries | $835,591,903 | $777,664,492 |
| | • Inactive vested participants | 13,658,647 | 12,577,126 |
| | • Active participants | 609,380,894 | 552,375,163 |
| | • Inactive participants due a refund of employee contributions | 3,739,568 | 3,649,324 |
| | • Total | 1,462,371,012 | 1,346,266,105 |
| | • Normal cost including administrative expenses for plan year beginning January 1 | 33,831,538 | 29,444,823 |
| **Assets for plan year beginning January 1:** | • Market value of assets (MVA) | $952,444,071 | $837,344,711 |
| | • Actuarial value of assets (AVA) | 928,286,125 | 884,576,848 |
| | • Actuarial value of assets as a percentage of market value of assets | 97.46% | 105.64% |
| **Funded status for plan year beginning January 1:** | • Unfunded actuarial accrued liability on market value of assets | $509,926,941 | $508,921,394 |
| | • Funded percentage on MVA basis | 65.13% | 62.20% |
| | • Unfunded actuarial accrued liability on actuarial value of assets | $534,084,887 | $461,689,257 |
| | • Funded percentage on AVA basis | 63.48% | 65.71% |
| **Key assumptions:** | • Net investment return | 7.00% | 7.375% |
| | • Long-term inflation rate[1] | 3.50% | 3.50% |
| **Demographic data for plan year beginning January 1:** | • Number of retired participants and beneficiaries | 2,707 | 2,728 |
| | • Number of inactive vested participants | 95 | 96 |
| | • Number of active participants | 3,455 | 3,342 |
| | • Number of inactive participants entitled to a refund of employee contributions | 632 | 659 |
| | • Total payroll[2] | $186,825,267 | $177,059,965 |
| | • Average payroll | 54,074 | 52,980 |

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1 For the 2018 valuation, the inflation assumption is 2.50% per year for 2018 and 2019 and 3.50% per year thereafter. For the 2017 valuation, the inflation assumption was 2.50% for 2017 and 3.50% per year thereafter.

2 Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year. Calendar year 2017 salaries for firefighters were reduced by 5.8% to reflect retroactive payments that were included in the salary data. Calendar year 2016 salaries for certain police officials were reduced by 6.4% to reflect retroactive payments that were included in the salary data. Calendar year 2016 salaries for firefighters were increased by 6.1% to reflect unsettled bargaining agreements.

## 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 City of Worcester 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 City of Worcester Retirement System. The City of Worcester 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 City of Worcester 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.
- Actuarial results in this report are not rounded, but that does not imply precision.
- If the City of Worcester 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 City of Worcester 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 System, it is not a fiduciary in its capacity as actuaries and consultants with respect to the System.

# Section 2: Actuarial Valuation Results

## 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.

More detailed information for this valuation year and the preceding valuation can be found in *Section 3, Exhibits A* and *B*.

### PARTICIPANT POPULATION: 2008 – 2017

| Year Ended December 31 | Active Participants | Inactive Participants | Retired Participants and Beneficiaries | Total Non-Actives | Ratio of Non-Actives to Actives |
|---|---|---|---|---|---|
| 2008 | 3,352 | 910 | 2,792 | 3,702 | 1.10 |
| 2009 | 3,262 | 770 | 2,774 | 3,544 | 1.09 |
| 2010 | 3,208 | 753 | 2,798 | 3,551 | 1.11 |
| 2011 | 3,178 | 759 | 2,776 | 3,535 | 1.11 |
| 2012 | 3,260 | 720 | 2,754 | 3,474 | 1.07 |
| 2013 | 3,293 | 712 | 2,734 | 3,446 | 1.05 |
| 2014 | 3,262 | 771 | 2,717 | 3,488 | 1.07 |
| 2015 | 3,275 | 787 | 2,722 | 3,509 | 1.07 |
| 2016 | 3,342 | 755 | 2,728 | 3,483 | 1.04 |
| 2017 | 3,455 | 727 | 2,707 | 3,434 | 0.99 |

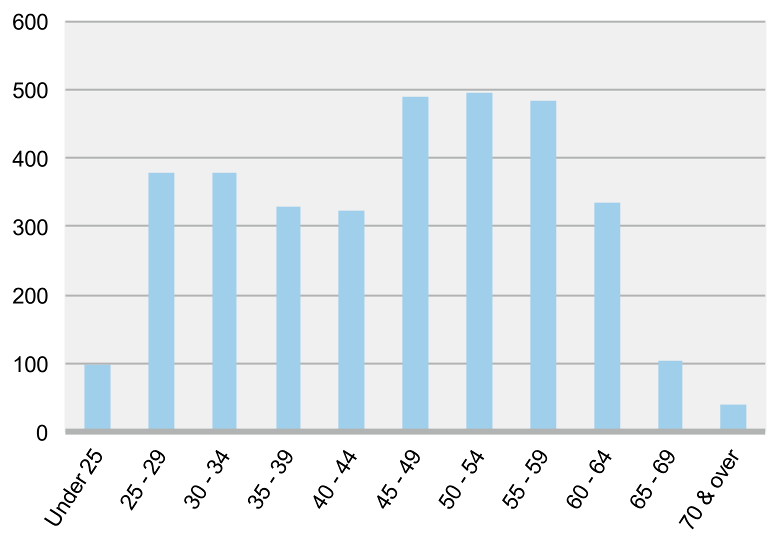
## Active Participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 3,455 active participants with an average age of 46.0, average years of service of 12.8 years and average payroll of $54,074. The 3,342 active participants in the prior valuation had an average age of 46.3, average service of 13.1 years and average payroll of $52,980.

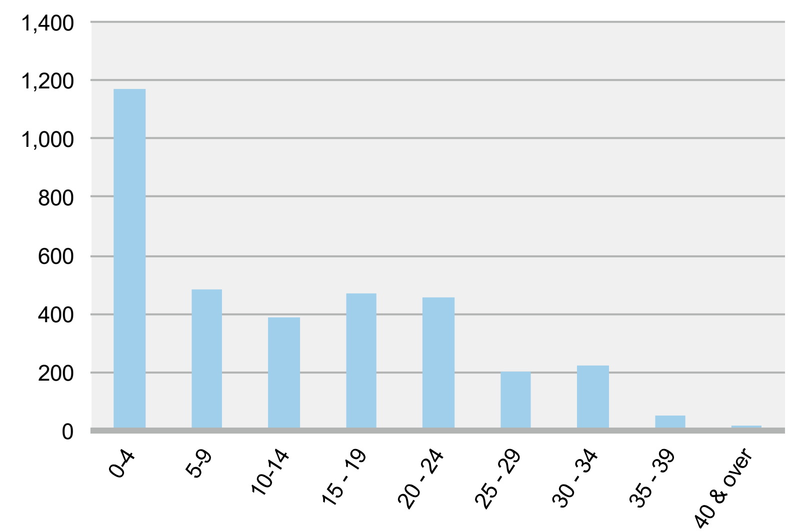
Among the active participants, there were none with unknown age and/or service information.

### Distribution of Active Participants as of December 31, 2017

**BY AGE**




**BY YEARS OF SERVICE**




## Inactive Participants

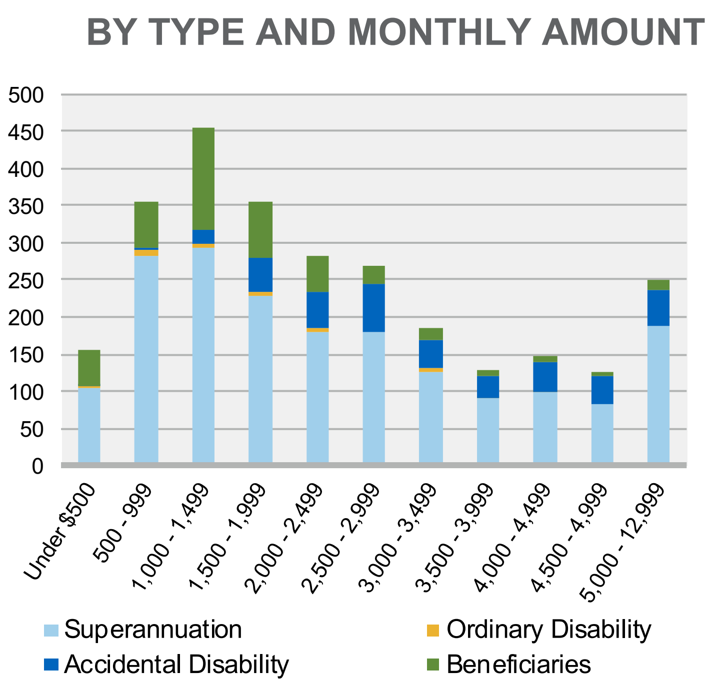
In this year's valuation, there were 95 participants with a vested right to a deferred or immediate vested benefit and 632 participants entitled to a return of their employee contributions.

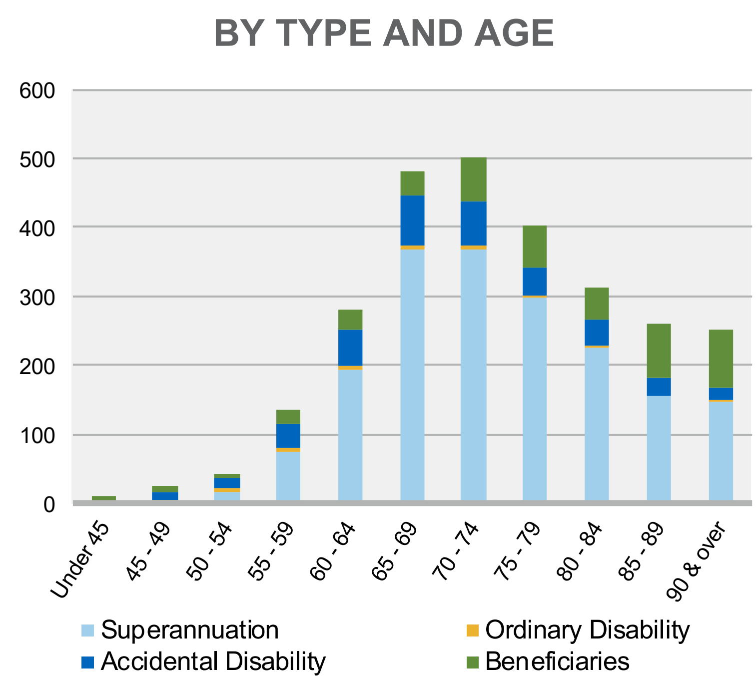
## Retired Participants and Beneficiaries

As of December 31, 2017, 2,261 retired participants and 446 beneficiaries were receiving total monthly benefits of $6,671,164, excluding COLAs reimbursed by the Commonwealth. For comparison, in the previous valuation, there were 2,282 retired participants and 445 beneficiaries receiving monthly benefits of $6,516,176, excluding COLAs reimbursed by the Commonwealth. There were no retired participants in suspended status this year compared to 1 retired participant in suspended status the prior valuation.

As of December 31, 2017, the average monthly benefit for retired participants is $2,464, compared to $2,390 in the previous valuation. The average age for retired participants is 74.0 in the current valuation, compared with 73.8 in the prior valuation.

### Distribution of Retired Participants and Beneficiaries as of December 31, 2017



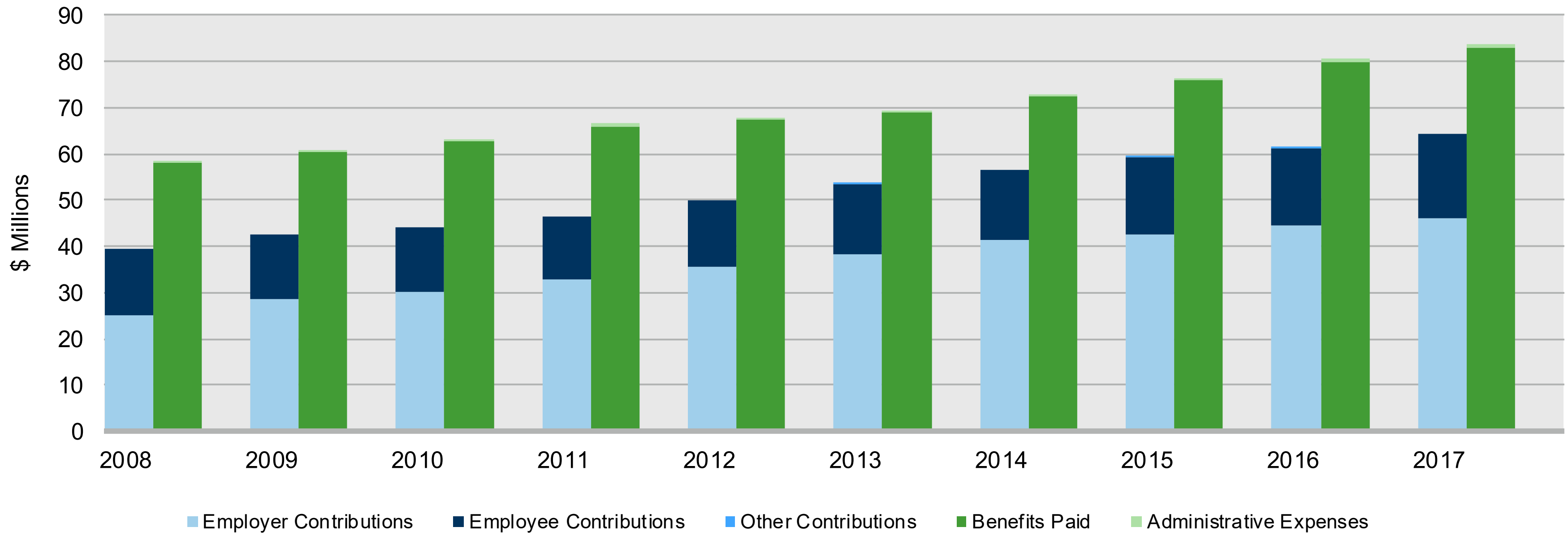



## Financial Information

Retirement plan funding anticipates that, over the long term, both contributions (less administrative expenses) and 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 transactions for the valuation year, is presented in *Section 3, Exhibits C and D.*

### COMPARISON OF CONTRIBUTIONS WITH BENEFITS AND EXPENSES FOR YEARS ENDED DECEMBER 31, 2008 – 2017



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.

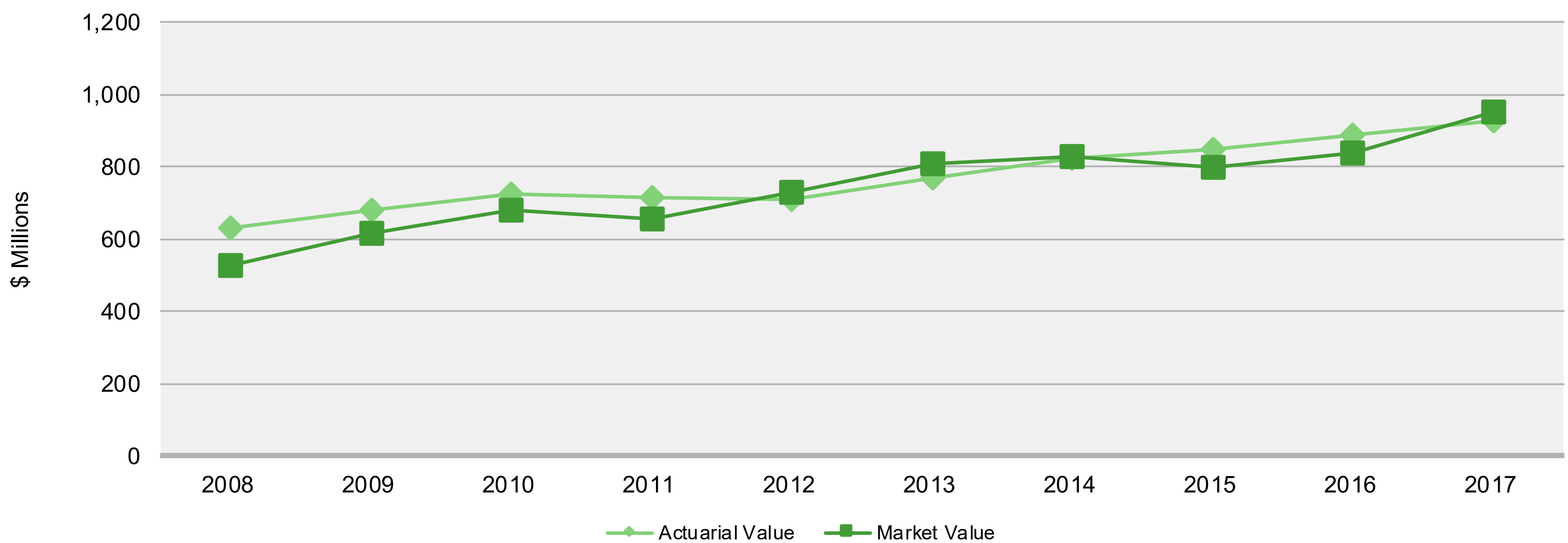
## DETERMINATION OF ACTUARIAL VALUE OF ASSETS FOR YEAR ENDED DECEMBER 31, 2017

| | | | | | |
|---|---|---|---|---|---|
| 1. | Market value of assets, December 31, 2017 | | | | $952,444,071 |
| 2. | Calculation of unrecognized return | Gain/(Loss) on Market Value of Assets | Percent Remaining | Deferred Gain/(Loss)[1] | |
| | (a) Year ended December 31, 2017 | $73,613,455 | 80% | $58,890,764 | |
| | (b) Year ended December 31, 2016 | -378,488 | 60% | -227,094 | |
| | (c) Year ended December 31, 2015 | -72,784,493 | 40% | -29,113,798 | |
| | (d) Year ended December 31, 2014 | -26,959,628 | 20% | -5,391,926 | |
| | (e) Year ended December 31, 2013 | 37,626,006 | 0% | 0 | |
| | (f) Total unrecognized return | | | | 24,157,946 |
| 3. | Preliminary actuarial value: (1) - (2f) | | | | $928,286,125 |
| 4. | Adjustment to be within 10% corridor | | | | 0 |
| 5. | Final actuarial value of assets as of December 31, 2017: (3) + (4) | | | | $928,286,125 |
| 6. | Actuarial value as a percentage of market value: (5) ÷ (1) | | | | 97.5% |
| 7. | Amount deferred for future recognition: (1) - (5) | | | | $24,157,946 |

1 Recognition at 20% per year over five years.

Both the actuarial value and market value of assets are representations of the System's financial status. 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 the System's 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.

## ACTUARIAL VALUE OF ASSETS VS. MARKET VALUE OF ASSETS AS OF DECEMBER 31, 2008 – 2017




Note: Effective with the 2010 valuation, the corridor around market value was reduced from 20% to 10%.

## Actuarial Experience

To calculate the actuarially determined 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 net experience gain for the year ended December 31, 2017 is $10,240, which includes a loss of $1,260,000 from investments and a gain of $1,270,240 from all other sources. The net experience variation from individual sources other than investments was 0.1% of the actuarial accrued liability. A discussion of the major components of the actuarial experience is on the following pages.

### ACTUARIAL EXPERIENCE FOR YEAR ENDED DECEMBER 31, 2017

| | | |
|---|---|---|
| 1 | Net loss from investments | -$1,260,000 |
| 2 | Net gain from administrative expenses | 17,820 |
| 3 | Net gain from other experience | 1,252,420 |
| 4 | Net experience gain: 1 + 2 + 3 | $10,240 |

## Investment Experience

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 System's investment policy. The rate of return on the market value of assets was 16.27% for the year ended December 31, 2017.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 7.375% for the 2017 plan year. The actual rate of return on an actuarial basis for the 2017 plan year was 7.23%. Since the actual return for the year was less than the assumed return, the System experienced an actuarial loss during the year ended December 31, 2017 with regard to its investments.

### INVESTMENT EXPERIENCE

| | | Year Ended December 31, 2017 | |
|---|---|---|---|
| | | Market Value | Actuarial Value |
| 1 | Net investment income | $134,646,815 | $63,256,730 |
| 2 | Average value of assets | 827,570,983 | 874,803,122 |
| 3 | Rate of return: 1 ÷ 2 | 16.27% | 7.23% |
| 4 | Assumed rate of return | 7.375% | 7.375% |
| 5 | Expected investment income: 2 x 4 | $61,033,360 | $64,516,730 |
| 6 | Actuarial gain/(loss): 1 – 5 | $73,613,455 | -$1,260,000 |

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 actual market value investment return for the last 19 years, including averages over select time periods.

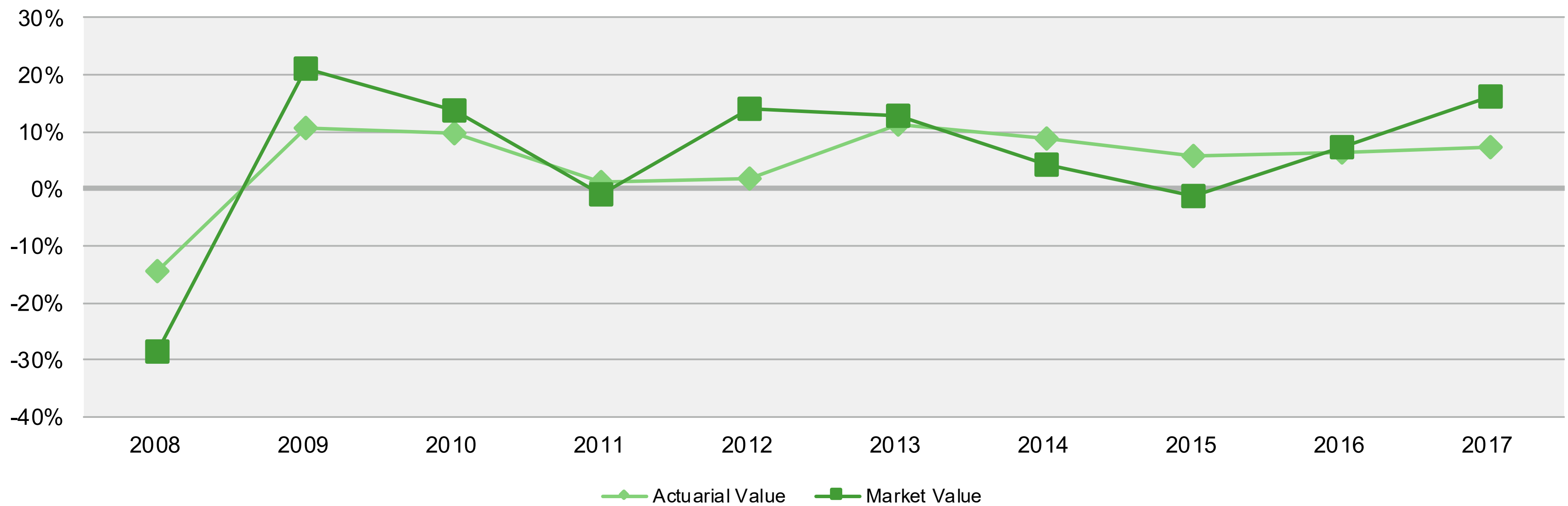
## INVESTMENT RETURN – ACTUARIAL VALUE VS. MARKET VALUE: 1999 - 2017

| Year Ended December 31 | Actuarial Value Investment Return | | Market Value Investment Return | | Year Ended December 31 | Actuarial Value Investment Return | | Market Value Investment Return | |
|---|---|---|---|---|---|---|---|---|---|
| | Amount | Percent | Amount | Percent | | Amount | Percent | Amount | Percent |
| 1999 | $101,149,011 | 19.38% | $101,149,011 | 19.38% | 2008 | -$108,338,166 | -14.45% | -$213,653,832 | -28.49% |
| 2000 | 35,128,309 | 5.80 | 2,494,022 | 0.41 | 2009 | 65,765,691 | 10.56 | 109,307,722 | 21.12 |
| 2001 | 8,897,926 | 1.43 | -29,978,425 | -5.09 | 2010 | 64,588,917 | 9.64 | 83,265,908 | 13.69 |
| 2002 | -46,582,424 | -7.63 | -67,436,801 | -12.50 | 2011 | 7,371,682 | 1.03 | -5,640,269 | -0.84 |
| 2003 | 41,670,173 | 7.65 | 115,476,574 | 25.52 | 2012 | 12,627,028 | 1.80 | 91,252,263 | 14.10 |
| 2004 | 47,848,351 | 8.43 | 66,406,965 | 12.09 | 2013 | 79,399,464 | 11.36 | 93,539,099 | 12.97 |
| 2005 | 55,470,778 | 9.29 | 55,470,778 | 9.29 | 2014 | 66,681,548 | 8.75 | 34,950,210 | 4.38 |
| 2006 | 91,535,234 | 14.42 | 91,535,234 | 14.42 | 2015 | 45,891,163 | 5.65 | -10,490,025 | -1.28 |
| 2007 | 61,690,401 | 8.72 | 61,690,401 | 8.72 | 2016 | 54,513,780 | 6.49 | 58,737,894 | 7.45 |
| Total | $396,807,759 | | $396,807,759 | | 2017 | 63,256,730 | 7.23 | 134,646,815 | 16.27 |
| | | | | | Total | $351,757,837 | | $375,915,785 | |
| | | | | | | Most recent five-year average return | 7.77% | | 7.88% |
| | | | | | | Most recent ten-year average return | 4.72% | | 5.26% |
| | | | | | | Most recent 15-year average return | 6.19% | | 7.60% |
| | | | | | | Most recent 19-year average return | 5.82% | | 6.26% |

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

The actuarial asset valuation method gradually recognizes fluctuations in the market value rate of return. The goal of this is to stabilize the actuarial rate of return and to produce more level pension plan costs.

## MARKET AND ACTUARIAL RATES OF RETURN FOR YEARS ENDED DECEMBER 31, 2008 - 2017



## Administrative Expenses

Administrative expenses for the year ended December 31, 2017 totaled $583,404 compared to the assumption of $600,000, payable at the beginning of the year. This resulted in a gain of $17,820 for the year. Based on information on expected expenses provided by the Retirement System, we have maintained the assumption of $600,000 for the current year.

## 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 participants,
- retirement experience (earlier or later than projected),
- mortality (more or fewer deaths than projected),
- the number of disability retirements (more or fewer than projected), and
- salary increases (greater or smaller than projected).

The net gain from this other experience for the year ended December 31, 2017 amounted to $1,252,420, which is 0.1% of the actuarial accrued liability.

### LIABILITY CHANGES DUE TO DEMOGRAPHIC EXPERIENCE FOR YEAR ENDED DECEMBER 31, 2017

| | |
|---|---|
| Deaths at later ages than expected amongst retired members and beneficiaries | -$2,427,611 |
| Salary increases more than expected for continuing actives | -621,976 |
| Fewer disability pensions awarded than expected | 3,649,074 |
| Miscellaneous experience gain, including pre-retirement mortality experience and employee turnover | 652,933 |
| Total | $1,252,420 |

## Changes in the Actuarial Accrued Liability

The actuarial accrued liability as of January 1, 2018 is $1,462,371,012, an increase of $116,104,907, or 8.6%, from the actuarial accrued liability as of the prior valuation date. The liability is expected to grow each year with normal cost and interest, and to decline due to benefit payments made. Additional fluctuations can occur due to actual experience that differs from expected (as discussed in the previous subsection).

## Actuarial Assumptions

The following actuarial assumptions were changed with this valuation:

- The investment return assumption was lowered from 7.375% to 7.0%.
- The mortality assumption for non-disabled participants was updated from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally from 2009 with Scale BB2D to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2017.
- The mortality assumption for disabled participants was updated from the RP-2000 Healthy Annuitant Mortality Table projected generationally from 2015 with Scale BB2D to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017.
- The salary increase assumption was changed from 4.5% per year to 3.5% per year for 2018 and 2019 and 4.5% per year thereafter.

  Changing these assumptions increased the unfunded liability by approximately $68.5 million and increased the employer normal cost by approximately $2.6 million. In addition, the liability for anticipated net 3(8)(c) payments was increased by approximately $4.5 million to reflect the average net 3(8)(c) benefits paid in 2016 and 2017 and the average age of retired participants.

Details on actuarial assumptions and methods are in *Section 4, Exhibit I*.

## Plan Provisions

There were no changes in plan provisions since the prior valuation.

A summary of plan provisions is in *Section 4, Exhibit II*.

## Development of Unfunded Actuarial Accrued Liability

### DEVELOPMENT FOR YEAR ENDED DECEMBER 31, 2017

| | | | |
|---|---|---|---|
| 1 | Unfunded actuarial accrued liability at beginning of year | | $461,689,257 |
| 2 | Normal cost at beginning of year | | 29,444,823 |
| 3 | Total contributions | | -64,158,570 |
| 4 | Interest | | |
| | • For whole year on 1 + 2 | $36,221,138 | |
| | • For half year on 3 | -2,140,833 | |
| | Total interest | | 34,080,305 |
| 5 | Expected unfunded actuarial accrued liability | | $461,055,815 |
| 6 | Changes due to: | | |
| | • Net loss from investments | $1,260,000 | |
| | • Net gain from other experience | -1,270,240 | |
| | • Change in assumptions | 73,039,312 | |
| | Total changes | | 73,029,072 |
| 7 | Unfunded actuarial accrued liability at end of year | | $534,084,887 |

## Actuarially Determined Contribution

The actuarially determined contribution is equal to the employer normal cost payment and a payment on the unfunded actuarial accrued liability.

The actuarially determined contribution for fiscal 2019 is equal to the previously budgeted amount of $49,098,344. The detail of this calculation for the current and prior year is shown below.

### ACTUARIALLY DETERMINED CONTRIBUTION FOR YEAR BEGINNING JANUARY 1

| | | 2018 | | 2017 | |
|---|---|---|---|---|---|
| | | Amount | % of Projected Payroll | Amount | % of Projected Payroll |
| 1. | Total normal cost | $33,231,538 | 17.22% | $28,844,823 | 15.77% |
| 2. | Administrative expenses | 600,000 | 0.31% | 600,000 | 0.33% |
| 3. | Expected employee contributions | -18,535,210 | -9.60% | -17,444,893 | -9.54% |
| 4. | Employer normal cost: (1) + (2) + (3) | $15,296,328 | 7.93% | $11,999,930 | 6.56% |
| 5. | Actuarial accrued liability | 1,462,371,012 | | 1,346,266,105 | |
| 6. | Actuarial value of assets | 928,286,125 | | 884,576,848 | |
| 7. | Unfunded actuarial accrued liability: (5) - (6) | $534,084,887 | | $461,689,257 | |
| 8. | Employer normal cost projected to July 1, 2018 and 2017 | 15,486,352 | 7.93% | 12.149,003 | 6.56% |
| 9. | Projected unfunded actuarial accrued liability | 522,461,703 | | 478,411,221 | |
| 10. | Payment on projected unfunded actuarial accrued liability | 33,611,992 | 17.20% | 34,039,467 | 18.39% |
| 11. | Actuarially Determined Contribution: (8) + (10) | $49,098,344 | 25.13% | $46,188,470 | 24.95% |
| 12. | Projected payroll as of July 1 | $195,354,230 | | $185,103,477 | |

Notes: Recommended contributions are assumed to be paid at the beginning of the fiscal year.
Recommended contributions are set equal to the budgeted amounts determined with the prior valuation.

The funding schedule included in this report reflects the increase in the unfunded liability due to the assumption changes. Although the prior funding schedule reflected the deferred investment losses, the funding schedule in this report does not reflect the deferred investment gains. The 2010 ERI is amortized in level dollar amounts for three years. The fiscal 2019 total appropriation has been set equal to $49,098,344 as determined with the prior valuation. For fiscal 2020 and later years, each year's total appropriation increases 6.33% so that the System will be fully funded by June 30, 2034, if all assumptions are met. Because the total appropriation will increase faster than projected payroll, the total appropriation is expected to increase as a percent of payroll.

In the prior valuation, the System was projected to be fully funded by June 30, 2033 with appropriations that increased 6.30% per year.

The following page shows the recommended contributions through fiscal 2035 based on this funding schedule. In projecting the unfunded actuarial accrued liability for future fiscal years, approximately $24 million in net deferred investment gains have been not reflected in accordance with the asset valuation method approved by the Board.

## Funding Schedule

| (1) Fiscal Year Ended June 30 | (2) Employer Normal Cost | (3) Amortization of 2010 ERI Liability | (4) Amortization of Remaining Unfunded Actuarial Accrued Liability | (5) Total Plan Cost: (2) + (3) + (4) | (6) Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year | (7) Percent Increase in Appropriation |
|---|---|---|---|---|---|---|
| 2019 | $15,486,352 | $544,441 | $33,067,551 | $49,098,344 | $552,461,703 | - - |
| 2020 | 15,925,239 | 544,441 | 35,736,589 | 52,206,269 | 555,169,191 | 6.33% |
| 2021 | 16,456,162 | 544,441 | 38,510,323 | 55,510,926 | 555,210,332 | 6.33% |
| 2022 | 17,087,437 | 0 | 41,937,330 | 59,024,767 | 552,286,458 | 6.33% |
| 2023 | 17,742,829 | 0 | 45,018,206 | 62,761,035 | 546,073,567 | 6.33% |
| 2024 | 18,423,255 | 0 | 48,310,554 | 66,733,809 | 536,129,236 | 6.33% |
| 2025 | 19,129,668 | 0 | 51,828,391 | 70,958,059 | 521,965,990 | 6.33% |
| 2026 | 19,863,058 | 0 | 55,586,646 | 75,449,704 | 503,047,231 | 6.33% |
| 2027 | 20,624,450 | 0 | 59,601,220 | 80,225,670 | 478,782,826 | 6.33% |
| 2028 | 21,414,909 | 0 | 63,889,046 | 85,303,955 | 448,524,318 | 6.33% |
| 2029 | 22,235,543 | 0 | 68,468,152 | 90,703,695 | 411,559,741 | 6.33% |
| 2030 | 23,087,498 | 0 | 73,357,741 | 96,445,239 | 367,108,000 | 6.33% |
| 2031 | 23,971,966 | 0 | 78,578,257 | 102,550,223 | 314,312,777 | 6.33% |
| 2032 | 24,890,182 | 0 | 84,151,470 | 109,041,652 | 252,235,937 | 6.33% |
| 2033 | 25,843,432 | 0 | 90,100,557 | 115,943,989 | 179,850,380 | 6.33% |
| 2034 | 26,833,046 | 0 | 96,032,311 | 122,865,357 | 96,032,311 | 5.97% |
| 2035 | 27,860,406 | 0 | 0 | 27,860,406 | 0 | -77.32% |

Notes: Fiscal 2019 contribution set at budgeted amount.
Recommended contributions are assumed to be paid at the beginning of the fiscal year.
Item (2) reflects 2.5% growth in payroll for 2018 and 2019 and 3.5% growth in payroll thereafter, as well as a 0.15% adjustment to total normal cost to reflect the effects of mortality improvements due to the generational mortality assumption.
Projected normal cost does not reflect the future impact of pension reform for future hires.
Projected unfunded actuarial accrued liability does not reflect deferred investment gains.

## Risk

Since the actuarial valuation results are dependent on a given set of assumptions and data as of a specific date, there is a risk that emerging results may differ significantly as actual experience differs from the assumptions.

This report does not contain a detailed analysis of the potential range of future measurements, but does include a brief discussion of some risks that may affect the Plan. Upon request, a more detailed assessment of the risks can be provided to enable a better understanding of the risks specific to your Plan.

- Investment Risk (the risk that returns will be different than expected)

  The market value rate of return over the last 19 years has ranged from a low of -28.49% to a high of 25.52%.

- Longevity Risk (the risk that mortality experience will be different than expected)

  The actuarial valuation includes an expectation of future improvement in life expectancy. Emerging plan experience that does not match these expectations will result in either an increase or decrease in the actuarially determined contribution.

- Contribution Risk (the risk that actual contributions will be different from actuarially determined contribution)

  Massachusetts General Law Chapter 32 requires payment of the actuarially determined contribution. If future experience matches current assumptions, we project the unfunded actuarial accrued liability will be paid off in 16 years.

- Demographic Risk (the risk that participant experience will be different than assumed)

  Examples of this risk include:

  - Actual retirements occurring earlier or later than assumed.
  - Disability retirement experience different than assumed.
  - More or less active participant turnover than assumed.
  - Salary increases greater or less than projected.

- Actual Experience Over the Last 10 Years and Implications for the Future

  Past experience can help demonstrate the sensitivity of key results to the Plan's actual experience. Over the past ten years:

  - The investment gain(loss) for a year has ranged from a loss of $275,514,085 to a gain of $73,613,455. If all investment returns were equal to the assumed return over the last ten years, the market value of assets as of the current valuation date would be approximately $1,354,901,166 as opposed to the actual value of $952,444,071.
  - The non-investment gain(loss) for a year has ranged from a loss of $12,290,038 to a gain of $28,472,239.
  - The funded percentage on the actuarial value of assets has ranged from a low of 63.3% to a high of 70.7% since 2009.

- Maturity Measures

  As pension plans mature, the cash need to fulfill benefit obligations will increase over time. Therefore, cash flow projections and analysis should be performed to assure that the Plan's asset allocation is aligned to meet emerging pension liabilities.

# Section 3: Supplemental Information

## EXHIBIT A – TABLE OF PLAN COVERAGE

| Category | Year Ended December 31 2017 | Year Ended December 31 2016 | Change From Prior Year |
|---|---|---|---|
| **Active participants in valuation:** | | | |
| • Number | 3,455 | 3,342 | 3.4% |
| • Average age | 46.0 | 46.3 | -0.3 |
| • Average years of service | 12.8 | 13.1 | -0.3 |
| • Total payroll | $186,825,267 | $177,059,965 | 5.5% |
| • Average payroll | 54,074 | 52,980 | 2.1% |
| • Member contributions | 188,729,534 | 180,506,028 | 4.6% |
| • Total active vested participants | 2,043 | 2,007 | 1.8% |
| **Inactive participants in valuation:** | | | |
| • Inactive participants due a refund of employee contributions | 632 | 659 | -4.1% |
| • Inactive participants with a vested right to a deferred or immediate benefit | 95 | 96 | -1.0% |
| **Retired participants:** | | | |
| • Number in pay status | 1,850 | 1,859 | -0.5% |
| • Average age | 74.1 | 74.1 | 0.0 |
| • Average monthly benefit | $2,488 | $2,411 | 3.2% |
| • Number in suspended status | 0 | 1 | -100.0% |
| **Disabled participants:** | | | |
| • Number in pay status | 411 | 423 | -2.8% |
| • Average age | 69.7 | 69.8 | -0.1 |
| • Average monthly benefit | $3,208 | $3,100 | 3.5% |
| **Beneficiaries:** | | | |
| • Number in pay status | 446 | 445 | 0.2% |
| • Average age | 77.7 | 77.4 | 0.3 |
| • Average monthly benefit | $1,682 | $1,623 | 3.6% |

Notes: Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year.
Calendar year 2017 salaries for firefighters were reduced by 5.8% to reflect retroactive payments that were included in the data.
Calendar year 2016 salaries for certain police officials were reduced by 6.4% to reflect retroactive payments that were included in the data. Calendar year 2016 salaries for firefighters were increased by 6.1% to reflect unsettled bargaining agreements.

## EXHIBIT B – PARTICIPANTS IN ACTIVE SERVICE AS OF DECEMBER 31, 2017
## 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 | 97 | 97 | - - | - - | - - | - - | - - | - - | - - | - - |
| | $29,005 | $29,005 | - - | - - | - - | - - | - - | - - | - - | - - |
| 25 - 29 | 378 | 336 | 42 | - - | - - | - - | - - | - - | - - | - - |
| | $43,612 | $42,004 | $56,476 | - - | - - | - - | - - | - - | - - | - - |
| 30 - 34 | 378 | 221 | 118 | 37 | 2 | - - | - - | - - | - - | - - |
| | $52,918 | $43,358 | $66,430 | $65,976 | $70,403 | - - | - - | - - | - - | - - |
| 35 - 39 | 328 | 125 | 93 | 86 | 22 | 2 | - - | - - | - - | - - |
| | $56,702 | $41,643 | $63,018 | $68,511 | $68,841 | $62,839 | - - | - - | - - | - - |
| 40 - 44 | 323 | 98 | 62 | 55 | 75 | 32 | 1 | - - | - - | - - |
| | $56,321 | $33,618 | $48,022 | $77,452 | $73,402 | $66,449 | $28,354 | - - | - - | - - |
| 45 - 49 | 490 | 120 | 54 | 63 | 100 | 115 | 35 | 3 | - - | - - |
| | $60,316 | $37,390 | $48,847 | $56,405 | $65,436 | $82,232 | $76,759 | $63,292 | - - | - - |
| 50 - 54 | 497 | 66 | 49 | 49 | 102 | 106 | 65 | 58 | 2 | - - |
| | $60,000 | $35,462 | $42,074 | $49,464 | $49,797 | $72,057 | $80,139 | $84,509 | $83,198 | - - |
| 55 - 59 | 484 | 70 | 24 | 44 | 87 | 105 | 48 | 90 | 14 | 2 |
| | $55,853 | $36,603 | $54,104 | $38,439 | $42,742 | $54,625 | $68,754 | $85,130 | $68,805 | $50,785 |
| 60 - 64 | 335 | 29 | 34 | 32 | 58 | 69 | 32 | 49 | 24 | 8 |
| | $51,710 | $39,987 | $42,684 | $48,409 | $41,186 | $51,053 | $52,224 | $61,585 | $77,533 | $87,734 |
| 65 - 69 | 105 | 5 | 6 | 17 | 17 | 19 | 15 | 15 | 8 | 3 |
| | $51,118 | $28,171 | $39,795 | $53,972 | $36,672 | $54,123 | $67,470 | $46,564 | $65,811 | $60,487 |
| 70 & over | 40 | 2 | 1 | 5 | 5 | 8 | 7 | 6 | 1 | 5 |
| | $40,890 | $29,100 | $51,106 | $36,308 | $46,024 | $37,082 | $33,799 | $35,231 | $60,255 | $61,951 |
| Total | 3,455 | 1,169 | 483 | 388 | 468 | 456 | 203 | 221 | 49 | 18 |
| | $54,074 | $39,142 | $55,461 | $59,045 | $55,009 | $65,636 | $69,675 | $75,478 | $73,004 | $71,925 |

# EXHIBIT C – SUMMARY STATEMENT OF INCOME AND EXPENSES ON A MARKET VALUE BASIS

| | Year Ended December 31, 2017 | | Year Ended December 31, 2016 | |
|---|---|---|---|---|
| Net assets at market value at the beginning of the year | | $837,344,711 | | $797,830,070 |
| **Contribution income:** | | | | |
| • Employer contributions | $46,188,470 | | $44,411,990 | |
| • Employee contributions | 17,970,100 | | 16,871,256 | |
| • Less administrative expenses | -583,404 | | -565,669 | |
| Net contribution income | | 63,575,166 | | 60,717,577 |
| Net investment income | | 134,646,815 | | 58,737,894 |
| Total income available for benefits | | $198,221,981 | | $119,455,471 |
| **Less benefit payments:** | | | | |
| • Pensions, annuities, refunds and net transfers | -$80,765,397 | | -$77,614,593 | |
| • Net 3(8)(c) reimbursements | -2,357,224 | | -2,326,237 | |
| Net benefit payments | | -$83,122,621 | | -$79,940,830 |
| Change in reserve for future benefits | | $115,099,360 | | $39,514,641 |
| Net assets at market value at the end of the year | | $952,444,071 | | $837,344,711 |

## EXHIBIT D – DEVELOPMENT OF THE FUND THROUGH DECEMBER 31, 2017

| Year Ended December 31 | Employer Contributions | Employee Contributions | Net Investment Return | Admin. Expenses | Benefit Payments | Market Value of Assets at Year-End | Actuarial Value of Assets at Year-End | Actuarial Value as a Percent of Market Value |
|---|---|---|---|---|---|---|---|---|
| 2008 | $24,947,158 | $14,428,460 | -$213,653,832 | $554,276 | $57,999,513 | $526,578,330 | $631,893,995 | 120.0% |
| 2009 | 28,505,066 | 14,190,598 | 109,307,722 | 538,983 | 60,306,394 | 617,736,339 | 679,509,973 | 110.0% |
| 2010 | 30,196,905 | 13,960,465 | 83,265,908 | 557,170 | 62,701,268 | 681,901,180 | 724,997,822 | 106.3% |
| 2011 | 32,706,347 | 13,602,407 | -5,640,269 | 569,245 | 65,998,653 | 656,001,767 | 712,110,360 | 108.6% |
| 2012 | 35,409,140 | 14,720,475 | 91,252,263 | 528,845 | 67,387,464 | 729,467,335 | 706,950,694 | 96.9% |
| 2013 | 38,148,683 | 15,370,951 | 93,539,099 | 562,729 | 68,973,056 | 806,990,282 | 770,334,007 | 95.5% |
| 2014 | 41,200,578 | 15,514,691 | 34,950,210 | 587,157 | 72,435,431 | 825,633,173 | 820,708,236 | 99.4% |
| 2015 | 42,703,837 | 16,513,772 | -10,490,025 | 572,743 | 75,957,944 | 797,830,070 | 849,286,321 | 106.4% |
| 2016 | 44,411,990 | 16,871,256 | 58,737,894 | 565,669 | 79,940,830 | 837,344,711 | 884,576,848 | 105.6% |
| 2017 | 46,188,470 | 17,970,100 | 134,646,815 | 583,404 | 83,122,621 | 952,444,071 | 928,286,125 | 97.5% |

# EXHIBIT E – TABLE OF AMORTIZATION BASES

| Type | Annual Payment | Years Remaining | Outstanding Balance |
|---|---|---|---|
| 2010 ERI | $544,441 | 3 | $1,528,801 |
| Remaining unfunded liability | 33,067,551 | 16 | 550,932,902 |
| **Total** | **$33,611,992** | | **$552,461,703** |

Notes: Recommended contributions are assumed to be paid at the beginning of the fiscal year.
The 2010 ERI liability is amortized in level payments.
Payment on remaining unfunded liability reflects adjustment to set fiscal 2019 appropriation to budgeted amount.

## EXHIBIT F – DEPARTMENT ALLOCATIONS OF 2010 ERI AMORTIZATION PAYMENTS

The total recommended employer contribution for fiscal 2019, excluding the ERI amortization, is $48,553,903. This amount will be allocated to each department based on September 30 payroll. The ERI amortization is allocated to each department based on actual ERI participants and is shown below.

| Department | Allocation of 2010 ERI Amortization |
|---|---|
| Airport | $20,482 |
| Auditing | 20,024 |
| Clerk | 5,403 |
| DPW – Other | 121,579 |
| DPW - Parks | 11,465 |
| DPW – Sewer | 32,281 |
| DPW – Water | 123,392 |
| Health | 6,534 |
| Inspectional Services | 30,958 |
| Library | 50,524 |
| Police | 13,214 |
| Public Schools | 104,255 |
| Treasury | 4,330 |
| Total Fiscal Year 2019 Payment | $544,441 |

# EXHIBIT G – DEFINITIONS OF PENSION TERMS

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

| | |
|---|---|
| **Actuarial Accrued Liability for Actives:** | The equivalent of the accumulated normal costs allocated to the years before the valuation date. |
| **Actuarial Accrued Liability for Pensioners and Beneficiaries:** | The single-sum value of lifetime benefits to existing pensioners and beneficiaries. This sum takes account of life expectancies appropriate to the ages of the annuitants and the interest that the sum is expected to earn before it is entirely paid out in benefits. |
| **Actuarial Cost Method:** | A procedure allocating the Actuarial Present Value of Future Benefits to various time periods; a method used to determine the Normal Cost and the Actuarial Accrued Liability that are used to determine the actuarially determined contribution. |
| **Actuarial Gain or Loss:** | A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. Through the actuarial assumptions, rates of decrements, rates of salary increases, and rates of fund earnings have been forecasted. To the extent that actual experience differs from that assumed, Actuarial Accrued Liabilities emerge which may be the same as forecasted, or may be larger or smaller than projected. Actuarial gains are due to favorable experience, e.g., assets earn more than projected, salary increases are less than assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, actuarial losses are the result of unfavorable experience, i.e., actual results yield in actuarial liabilities that are larger than projected. Actuarial gains will shorten the time required for funding of the actuarial balance sheet deficiency while actuarial losses will lengthen the funding period. |
| **Actuarially Equivalent:** | Of equal actuarial present value, determined as of a given date and based on a given set of Actuarial Assumptions. |
| **Actuarial Present Value (APV):** | The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions. Each such amount or series of amounts is:<br>Adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.)<br>Multiplied by the probability of the occurrence of an event (such as survival, death, disability, withdrawal, etc.) on which the payment is conditioned, and<br>Discounted according to an assumed rate (or rates) of return to reflect the time value of money. |

| | |
|---|---|
| **Actuarial Present Value of Future Plan Benefits:** | The Actuarial Present Value of benefit amounts expected to be paid at various future times under a particular set of Actuarial Assumptions, taking into account such items as the effect of advancement in age, anticipated future compensation, and future service credits. The Actuarial Present Value of Future Plan Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive members entitled to either a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would provide sufficient assets to pay all projected benefits and expenses when due. |
| **Actuarial Valuation:** | The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial Valuation for a governmental retirement system typically also includes calculations of items needed for compliance with GASB, such as the Actuarially Determined Contribution (ADC) and the Net Pension Liability (NPL). |
| **Actuarial Value of Assets (AVA):** | The value of the Fund's assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets, but commonly plans use a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the ADC. |
| **Actuarially Determined:** | Values that have been determined utilizing the principles of actuarial science. An actuarially determined value is derived by application of the appropriate actuarial assumptions to specified values determined by provisions of the law. |
| **Actuarially Determined Contribution (ADC):** | The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation, determined under the Plan's funding policy. The ADC consists of the Employer Normal Cost and the Amortization Payment. |
| **Amortization Method:** | A method for determining the Amortization Payment. The most common methods used are level dollar and level percentage of payroll. Under the Level Dollar method, the Amortization Payment is one of a stream of payments, all equal, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the Amortization Payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the stream of payments increases at the assumed rate at which total covered payroll of all active members will increase. |
| **Amortization Payment:** | The portion of the pension plan contribution, or ADC, that is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability. |
| **Assumptions or Actuarial Assumptions:** | The estimates upon which the cost of the Fund is calculated, including:<br>Investment return - the rate of investment yield that the Fund will earn over the long-term future;<br>Mortality rates - the death rates of employees and pensioners; life expectancy is based on these rates;<br>Retirement rates - the rate or probability of retirement at a given age or service;<br>Disability rates – the probability of disability retirement at a given age;<br>Withdrawal rates - the rates at which employees of various ages are expected to leave employment for reasons other than death, disability, or retirement;<br>Salary increase rates - the rates of salary increase due to inflation and productivity growth. |

| | |
|---|---|
| **Closed Amortization Period:** | A specific number of years that is counted down by one each year, and therefore declines to zero with the passage of time. For example, if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc. See Open Amortization Period. |
| **Decrements:** | Those causes/events due to which a member's status (active-inactive-retiree-beneficiary) changes, that is: death, retirement, disability, or withdrawal. |
| **Defined Benefit Plan:** | A retirement plan in which benefits are defined by a formula applied to the member's compensation and/or years of service. |
| **Defined Contribution Plan:** | A retirement plan, such as a 401(k) plan, a 403(b) plan, or a 457 plan, in which the contributions to the plan are assigned to an account for each member, the plan's earnings are allocated to each account, and each member's benefits are a direct function of the account balance. |
| **Employer Normal Cost:** | The portion of the Normal Cost to be paid by the employer. This is equal to the Normal Cost less expected member contributions. |
| **Experience Study:** | A periodic review and analysis of the actual experience of the Fund that may lead to a revision of one or more actuarial assumptions. Actual rates of decrement and salary increases are compared to the actuarially assumed values and modified as deemed appropriate by the Actuary. |
| **Funded Ratio:** | The ratio of the actuarial value of assets (AVA) to the actuarial accrued liability (AAL). Plans sometimes calculate a market funded ratio, using the market value of assets (MVA), rather than the AVA. |
| **GASB 67 and GASB 68:** | Governmental Accounting Standards Board (GASB) Statements No. 67 and No. 68. These are the governmental accounting standards that set the accounting rules for public retirement systems and the employers that sponsor or contribute to them. Statement No. 68 sets the accounting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 67 sets the rules for the systems themselves. |
| **Investment Return:** | The rate of earnings of the Fund 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. |
| **Net Pension Liability (NPL):** | The Net Pension Liability is equal to the Total Pension Liability minus the Plan Fiduciary Net Position. |
| **Normal Cost:** | That portion of the Actuarial Present Value of pension plan benefits and expenses allocated to a valuation year by the Actuarial Cost Method. Any payment in respect of an Unfunded Actuarial Accrued Liability is not part of Normal Cost (see Amortization Payment). For pension plan benefits that are provided in part by employee contributions, Normal Cost refers to the total of employee contributions and employer Normal Cost unless otherwise specifically stated. |
| **Open Amortization Period:** | An open amortization period is one which is used to determine the Amortization Payment but which does not change over time. If the initial period is set as 30 years, the same 30-year period is used in determining the Amortization Period each year. In theory, if an Open Amortization Period with level percentage of payroll is used to amortize the Unfunded Actuarial Accrued Liability, the UAAL will never decrease, but will become smaller each year, in relation to covered payroll, if the actuarial assumptions are realized. |

| | |
|---|---|
| **Plan Fiduciary Net Position:** | Market value of assets. |
| **Total Pension Liability (TPL):** | The actuarial accrued liability under the entry age normal cost method and based on the blended discount rate as described in GASB 67 and 68. |
| **Unfunded Actuarial Accrued Liability:** | The excess of the Actuarial Accrued Liability over the Actuarial Value of Assets. This value may be negative, in which case it may be expressed as a negative Unfunded Actuarial Accrued Liability, also called the Funding Surplus. |
| **Valuation Date or Actuarial Valuation Date:** | The date as of which the value of assets is determined and as of which the Actuarial Present Value of Future Plan Benefits is determined. The expected benefits to be paid in the future are discounted to this date. |

# Section 4: Actuarial Valuation Basis

## EXHIBIT I – ACTUARIAL ASSUMPTIONS AND ACTUARIAL COST METHOD

| | |
|---|---|
| **Net Investment Return:** | 7.00% (previously, 7.375%).<br>The net investment return assumption 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:** | 3.50% per year for 2018 and 2019, with an allowance for inflation of 2.50%, and 4.50% per year thereafter, with an allowance for inflation of 3.50%. (previously, 3.50% for 2017, with an allowance for inflation of 2.50%, and 4.50% per year thereafter, with an allowance for inflation of 3.50%)<br>The salary scale assumption 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:** | $600,000 for calendar 2018, increasing 2.50% per year for 2018 and 2019 and 3.50% per year thereafter (previously, $600,000 for calendar 2017, increasing 2.50% for 2017 and 3.50% per year thereafter)<br>The administrative expense assumption is based on information on expected expenses provided by the Retirement System. |
| **Mortality Rates:** | *Pre-Retirement:* RP-2014 Blue Collar Employee Mortality Table projected generationally with Scale MP-2017 (previously, RP-2000 Employee Mortality Table projected generationally from 2009 with Scale BB2D)<br>*Healthy Retiree:* RP-2014 Blue Collar Healthy Annuitant Mortality Table projected generationally with Scale MP-2017 (previously, RP-2000 Healthy Annuitant Mortality Table projected generationally from 2009 with Scale BB2D)<br>*Disabled Retiree:* RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017 (previously, RP-2000 Healthy Annuitant Mortality Table projected generationally from 2015 with Scale BB2D)<br>The mortality tables reasonably 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 year's assumptions over the most recent five years. The mortality tables were then adjusted to future years using generational projection under Scale MP-2017 to reflect future mortality improvement. |

**Termination Rates before Retirement:**

| | Groups 1 and 2 - Rate (%) | | | | | |
|---|---|---|---|---|---|---|
| | Mortality | | | | | |
| | Current | | Previous | | | |
| Age | Male | Female | Male | Female | Disability | Withdrawal |
| 20 | 0.05 | 0.02 | 0.03 | 0.02 | 0.01 | 12.00 |
| 25 | 0.06 | 0.02 | 0.04 | 0.02 | 0.03 | 8.78 |
| 30 | 0.06 | 0.02 | 0.04 | 0.03 | 0.04 | 5.55 |
| 35 | 0.07 | 0.03 | 0.08 | 0.05 | 0.07 | 3.93 |
| 40 | 0.08 | 0.04 | 0.11 | 0.07 | 0.13 | 2.31 |
| 45 | 0.13 | 0.07 | 0.15 | 0.11 | 0.18 | 1.89 |
| 50 | 0.22 | 0.12 | 0.21 | 0.17 | 0.24 | 1.46 |
| 55 | 0.36 | 0.19 | 0.30 | 0.25 | 0.30 | 0.00 |
| 60 | 0.61 | 0.27 | 0.49 | 0.39 | 0.35 | 0.00 |

Notes: Mortality rates do not reflect generational projection.
55% of the disability rates shown represent accidental disability.
20% of the accidental disabilities will die from the same cause as the disability.
55% of the death rates shown represent accidental death.

| | Group 4 - Rate (%) | | | | | |
|---|---|---|---|---|---|---|
| | Mortality | | | | | |
| | Current | | Previous | | | |
| Age | Male | Female | Male | Female | Disability | Withdrawal |
| 20 | 0.05 | 0.02 | 0.03 | 0.02 | 0.13 | 2.10 |
| 25 | 0.06 | 0.02 | 0.04 | 0.02 | 0.25 | 1.88 |
| 30 | 0.06 | 0.02 | 0.04 | 0.03 | 0.38 | 1.65 |
| 35 | 0.07 | 0.03 | 0.08 | 0.05 | 0.38 | 1.11 |
| 40 | 0.08 | 0.04 | 0.11 | 0.07 | 0.38 | 0.56 |
| 45 | 0.13 | 0.07 | 0.15 | 0.11 | 1.25 | 0.28 |
| 50 | 0.22 | 0.12 | 0.21 | 0.17 | 1.56 | 0.00 |
| 55 | 0.36 | 0.19 | 0.30 | 0.25 | 1.50 | 0.00 |
| 60 | 0.61 | 0.27 | 0.49 | 0.39 | 1.06 | 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.
90% of the death rates shown represent accidental death.

The termination rates and disability rates 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 year's assumptions over the past five years.

**Retirement Rates:**

| Age | Rate per year (%) Groups 1 and 2 | Group 4 |
|---|---|---|
| 50 | 3.0 | 5.0 |
| 51 – 54 | 1.0 | 1.0 |
| 55 | 2.0 | 16.0 |
| 56 | 2.0 | 9.0 |
| 57 | 3.0 | 9.0 |
| 58 | 3.0 | 12.0 |
| 59 | 3.0 | 11.0 |
| 60 | 8.0 | 24.0 |
| 61 | 7.0 | 14.0 |
| 62 | 15.0 | 20.0 |
| 63 | 11.0 | 13.0 |
| 64 | 10.0 | 19.0 |
| 65 | 36.0 | 100.00 |
| 66 | 22.0 | |
| 67 | 22.0 | |
| 68 | 22.0 | |
| 69 | 25.0 | |
| 70 | 100.0 | |

The retirement rates 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 year's assumptions over the past five years.

**Retirement Rates for Inactive Vested Participants:**

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

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.

| | |
|---|---|
| **Unknown Data for Participants:** | Same as those exhibited by participants with similar known characteristics. If not specified, participants are assumed to be male. |
| **Family Composition:** | 80% of participants are assumed to be married. 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. The benefit election reflects the fact that all benefit options are actuarially equivalent. |
| **2017 Salary:** | 2017 salary equal to salaries provided in the data.<br>Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year. Calendar year 2017 salaries for firefighters were reduced by 5.8% to reflect retroactive payments that were included in the data. |
| **Total Service:** | Total creditable service reported in the data. If missing, total creditable service estimated from date of hire. |
| **Net 3(8)(c) Liability:** | Estimated liability of $23.2 million (previously, $18.7 million) based on the average annual net 3(8)(c) benefits of the prior two years and the average demographics of retired participants. |
| **Actuarial Value of Assets:** | Market value of assets as reported in the System's Annual Statement less unrecognized return in each of the last five years. Unrecognized return is equal to the difference between the actual market value return and the expected market value return and is recognized over a five-year period, further adjusted, if necessary, to be within 10% of the market value. |
| **Actuarial Cost Method:** | Entry Age Normal Actuarial Cost Method. Entry Age is the attained age of the participant less Total Service as defined above. Normal Cost and Actuarial Accrued Liability are calculated on an individual basis and are allocated by salary. Normal Cost is determined using the plan of benefits applicable to each participant. |
| **Justification for Change in Actuarial Assumptions:** | Based on past experience and future expectations, the following actuarial assumption were changed as of January 1, 2018:<br>• The investment return assumption was lowered from 7.375% to 7.0%.<br>• The mortality assumption for non-disabled participants was updated from the RP-2000 Employee and Healthy Annuitant Mortality Tables projected generationally from 2009 with Scale BB2D to the RP-2014 Blue Collar Employee and Healthy Annuitant Mortality Tables projected generationally with Scale MP-2017.<br>• The mortality assumption for disabled participants was updated from the RP-2000 Healthy Annuitant Mortality Table projected generationally from 2015 with Scale BB2D to the RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017.<br>• The salary increase assumption was changed from 4.5% per year to 3.5% per year for 2018 and 2019 and 4.5% per year thereafter. |

# EXHIBIT II – SUMMARY OF PLAN PROVISIONS

This exhibit summarizes the major provisions of the Plan included in the valuation. It is not intended to be, nor should it be interpreted as, a complete statement of all plan provisions.

**Plan Year:** January 1 through December 31

**Plan Status:** Ongoing

**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 |

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 Benefit:**

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 $250 per month, and there are additional amounts for surviving children.<br><br>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 by the member at the time of death.<br><br>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:** | There have been no changes in plan provisions since the last valuation. |