

# City of Worcester Retirement System

**Actuarial Valuation and Review as of January 1, 2021**



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, unless expressly authorized by Segal. The measurements shown in this actuarial valuation may not be applicable for other purposes.

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May 28, 2021

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, 2021. It summarizes the actuarial data used in the valuation, analyzes the preceding year's experience, and establishes the funding requirements for fiscal 2022 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 the supervision of Kathleen A. Riley, FSA, MAAA, EA. She is a member of the American Academy of Actuaries and she meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein. To the best of her knowledge, the information supplied in this actuarial valuation is complete and accurate. Further, in her 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

A handwritten signature in blue ink, appearing to read "Kathleen A. Riley", is written over a horizontal line.

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

A handwritten signature in black ink, appearing to read "Andrew R. Luongo", is written over a horizontal line.

Andrew R. Luongo  
Associate Actuarial Consultant

# Table of Contents

Section 1: Actuarial Valuation Summary.....	4
Purpose and basis.....	4
Valuation highlights .....	5
Summary of key valuation results.....	7
Important information about actuarial valuations .....	8
Section 2: Actuarial Valuation Results .....	10
Participant data.....	10
Financial information .....	13
Actuarial experience .....	16
Actuarially determined contribution .....	22
Risk.....	24
Section 3: Supplemental Information .....	26
Exhibit A: Table of Plan Demographics .....	26
Exhibit B: Participants in Active Service as of December 31, 2020 by Age, Years of Service, and Average Payroll.....	27
Exhibit C: Summary Statement of Income and Expenses on a Market Value Basis.....	28
Exhibit D: Development of the Fund through December 31, 2020 .....	29
Exhibit E: Table of Amortization Bases .....	30
Exhibit F: Department Results as of January 1, 2021 .....	31
Exhibit G: Definition of Pension Terms.....	32
Section 4: Actuarial Valuation Basis .....	36
Exhibit I: Actuarial Assumptions, Actuarial Cost Method and Models .....	36
Exhibit II: Summary of Plan Provisions.....	41

# Section 1: Actuarial Valuation Summary

## Purpose and basis

This report was prepared by Segal to present a valuation of the City of Worcester Retirement System as of January 1, 2021. 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.

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, 2020, provided by the staff of the Retirement System;
- The assets of the Plan as of December 31, 2020, provided by the Retirement System;
- Economic assumptions regarding future salary increases and investment earnings; and
- Other actuarial assumptions regarding employee terminations, retirement, death, etc.

Certain disclosure information required by GASB Statements No. 67 and 68 as of January 1, 2021 for the City of Worcester Retirement System is provided in a separate report.

## Section 1: Actuarial Valuation Summary

### Valuation highlights

1. 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 67.13%, compared to the prior year funded ratio of 63.92%. 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 71.17%, compared to 66.48% as of the prior valuation date. These measurements are not necessarily appropriate for assessing the sufficiency of System 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. The rate of return on the market value of assets was 11.41% for the 2020 plan year, compared to the assumed rate of return of 6.90%. The return on the actuarial value of assets was 9.38% for the same period due to the recognition of prior years' investment gains and losses. This resulted in an actuarial gain when measured against the assumed rate of return. Given the low fixed income interest rate environment, target asset allocation and expectations of future investment returns for various classes, we advise the Board to continue to monitor actual and anticipated investment returns relative to the assumed long-term rate of return on investments of 6.90%.
4. The actuarial value of assets as of December 31, 2020 was \$1.07 billion, or 94.33% of the market value of assets of \$1.13 billion reported in the Annual Statement. As of December 31, 2019, the actuarial value of assets was 96.16% of the market value.
5. The investment experience in the past years has only been partially recognized in the actuarial value of assets. As the deferred net gain of \$64.35 million is recognized in future years, the cost of the Plan is likely to decrease unless the net gain is offset by 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 unrecognized investment gains are not reflected in the funding schedule shown in *Section 2*.
6. The unfunded liability has decreased from \$560.90 million as of January 1, 2020 to \$523.71 million as of January 1, 2021. The unfunded liability was expected to decrease to \$559.07 million. The decrease of \$35.36 million from the expected unfunded liability is primarily due to the investment gain described above. Other sources of gains and losses are discussed in *Section 2*.
7. The funding schedule included in this report projects the Actuarially Determined Contribution through fiscal 2035. The fiscal 2022 total appropriation has been set equal to \$59,024,767 as determined with the prior valuation. For fiscal 2023 and later years, each year's total appropriation increases 6.33%, with a smaller payment in fiscal 2034, so that the System will be fully funded by June 30, 2034, if all assumptions are met. In the prior valuation, the System was also projected to be fully funded by June 30, 2034 with appropriations that increased 6.33% per year and a larger increase in fiscal 2034.

## Section 1: Actuarial Valuation Summary

8. It is important to note that this actuarial valuation is based on plan assets as of December 31, 2020. The plan's funded status does not reflect short-term fluctuations of the market, but rather is based on the market values on the last day of the plan year. Moreover, this actuarial valuation does not include any possible short-term or long-term impacts on mortality of the covered population that may emerge after December 31, 2020 due to the COVID-19 pandemic. While it is impossible to determine how the pandemic will affect market conditions and other demographic experience of the plan in future valuations, Segal is available to prepare projections of potential outcomes upon request.
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 not been engaged to perform a detailed analysis of the potential range of the impact of risk relative to the System's future financial condition, but have included a brief discussion of some risks that may affect the System in *Section 2*. A more detailed assessment would provide the Board with a better understanding of the inherent risks. This could be important because relatively small changes in investment performance can produce large swings in the contribution requirements.

## Section 1: Actuarial Valuation Summary

### Summary of key valuation results

		2021	2020
<b>Contributions for fiscal year beginning July 1:</b>	<ul style="list-style-type: none"> <li>Actuarially Determined Contribution for fiscal year 2022 and 2021</li> <li>Actuarially Determined Contribution as a percent of payroll</li> </ul>	\$59,024,767 28.12%	\$55,510,926 26.77%
<b>Actuarial accrued liability for plan year beginning January 1:</b>	<ul style="list-style-type: none"> <li>Retired participants and beneficiaries</li> <li>Inactive participants with a vested right to a deferred or immediate benefit</li> <li>Inactive participants due a refund of employee contributions</li> <li>Active participants</li> <li>Total</li> <li>Normal cost including administrative expenses for plan year beginning January 1</li> </ul>	\$946,089,443 22,550,342 6,540,293 618,228,044 1,593,408,122 35,196,663	\$915,307,098 17,387,442 5,663,970 616,415,898 1,554,774,408 34,878,842
<b>Assets for plan year beginning January 1:</b>	<ul style="list-style-type: none"> <li>Market value of assets (MVA)</li> <li>Actuarial value of assets (AVA)</li> <li>Actuarial value of assets as a percentage of market value of assets</li> </ul>	\$1,134,047,305 1,069,701,047 94.33%	\$1,033,591,998 993,870,483 96.16%
<b>Funded status for plan year beginning January 1:</b>	<ul style="list-style-type: none"> <li>Unfunded actuarial accrued liability on market value of assets</li> <li>Funded percentage on MVA basis</li> <li>Unfunded actuarial accrued liability on actuarial value of assets</li> <li>Funded percentage on AVA basis</li> </ul>	\$459,360,817 71.17% \$523,707,075 67.13%	\$521,182,410 66.48% \$560,903,925 63.92%
<b>Key assumptions:</b>	<ul style="list-style-type: none"> <li>Net investment return</li> <li>Long-term wage inflation rate</li> </ul>	6.90% 3.00%	6.90% 3.00%
<b>Demographic data for plan year beginning January 1:</b>	<ul style="list-style-type: none"> <li>Number of retired participants and beneficiaries</li> <li>Number of inactive participants with a vested right to a deferred or immediate benefit</li> <li>Number of inactive participants due a refund of employee contributions</li> <li>Number of active participants</li> <li>Total payroll<sup>1</sup></li> <li>Average payroll</li> </ul>	2,724 135 986 3,411 \$199,137,147 58,381	2,738 116 833 3,506 \$196,970,554 56,181

<sup>1</sup> Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year. Calendar year 2019 salaries were reduced by 3.0% for police hired before December 31, 2017 and 1.0% for police hired during 2018 to reflect retroactive payments that were included in the salary data, except for certain police officials for whom the salaries were increased by 5.0% to estimate the impact of salary increases on July 1, 2017, 2018, and 2019 attributable to unsettled bargaining contracts.

## Section 1: Actuarial Valuation Summary

### 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 relies on a number of input items. These include:

<b>Plan of benefits</b>	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.
<b>Participant data</b>	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.
<b>Assets</b>	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.
<b>Actuarial assumptions</b>	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.



## Section 1: Actuarial Valuation Summary

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

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The actuarial valuation is prepared at the request of the Retirement Board. Segal is not responsible for the use or misuse of its report, particularly by any other party.

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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.

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Actuarial results in this report are not rounded, but that does not imply precision.

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If the Retirement Board 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.

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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.

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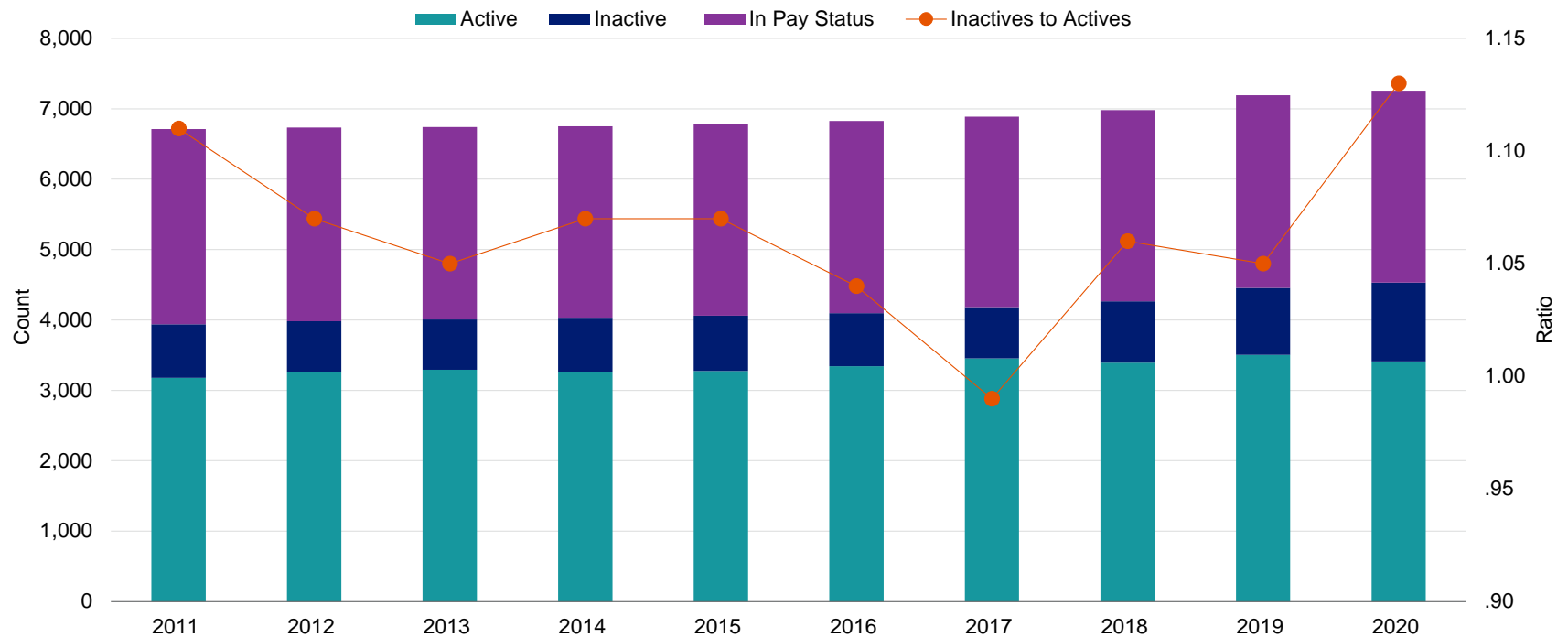
As Segal has no discretionary authority with respect to the management or assets of the System, it is not a fiduciary in its capacity as actuaries and consultants with respect to the System.

# Section 2: Actuarial Valuation Results

## Participant data

This section presents a summary of significant statistical data on covered participants.

Participant Population: 2011 – 2020



In Pay Status	2,776	2,754	2,734	2,717	2,722	2,728	2,707	2,717	2,738	2,724
Inactive <sup>1</sup>	759	720	712	771	787	755	727	872	949	1,121
Active	3,178	3,260	3,293	3,262	3,275	3,342	3,455	3,393	3,506	3,411
Ratio of Inactives to Actives	1.11	1.07	1.05	1.07	1.07	1.04	0.99	1.06	1.05	1.13

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

<sup>1</sup> Includes terminated participants due a refund of employee contributions.

## Section 2: Actuarial Valuation Results

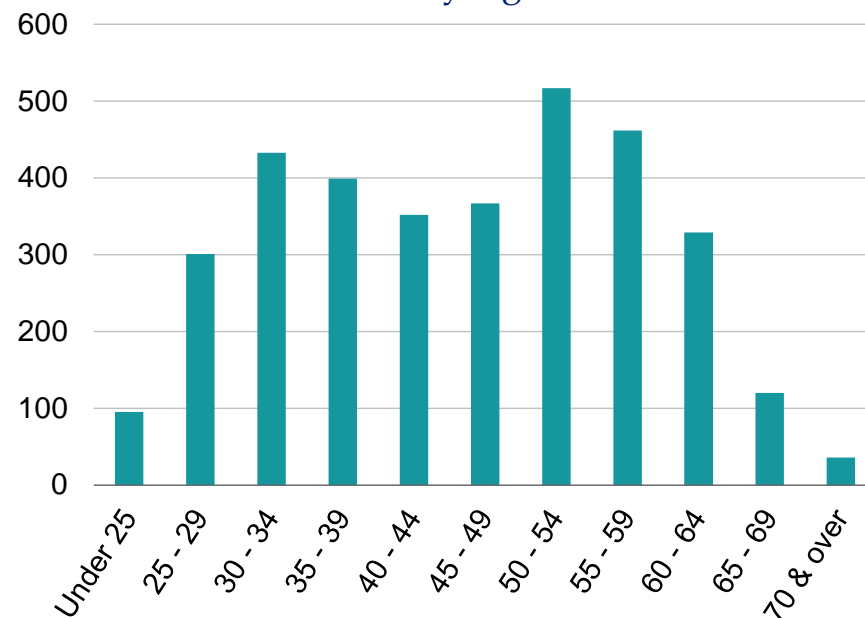
### Active participants

As of December 31,	2020	2019	Change
Active participants	3,411	3,506	-2.7%
Average age	45.9	45.8	0.1
Average years of service	12.3	12.2	0.1
Average compensation	\$58,381	\$56,181	3.9%

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

#### Distribution of Active Participants as of December 31, 2020

##### By Age



##### By Years of Service



### Inactive participants

In this year's valuation, there were 135 participants with a vested right to a deferred or immediate vested benefit and 986 participants entitled to a return of their employee contributions.

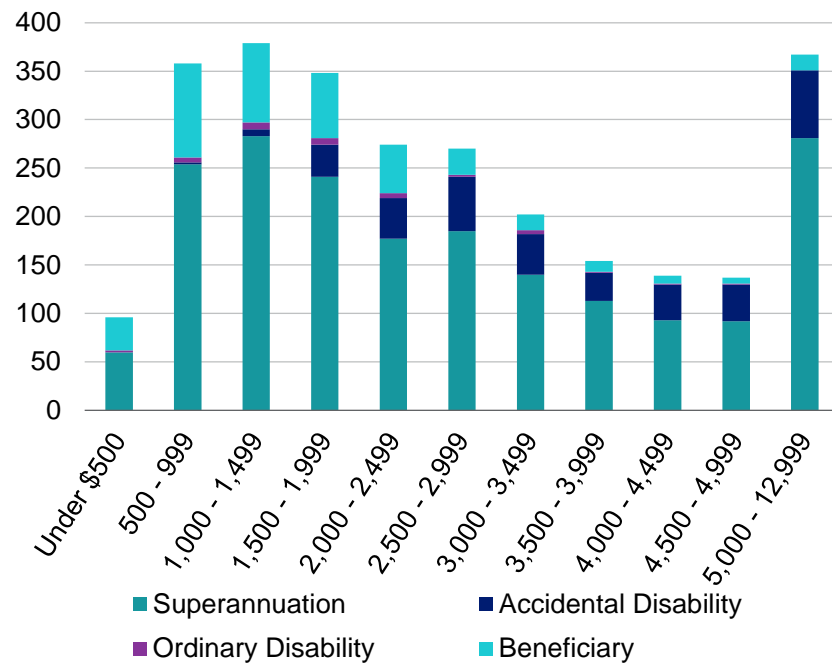
## Section 2: Actuarial Valuation Results

### Retired participants and beneficiaries

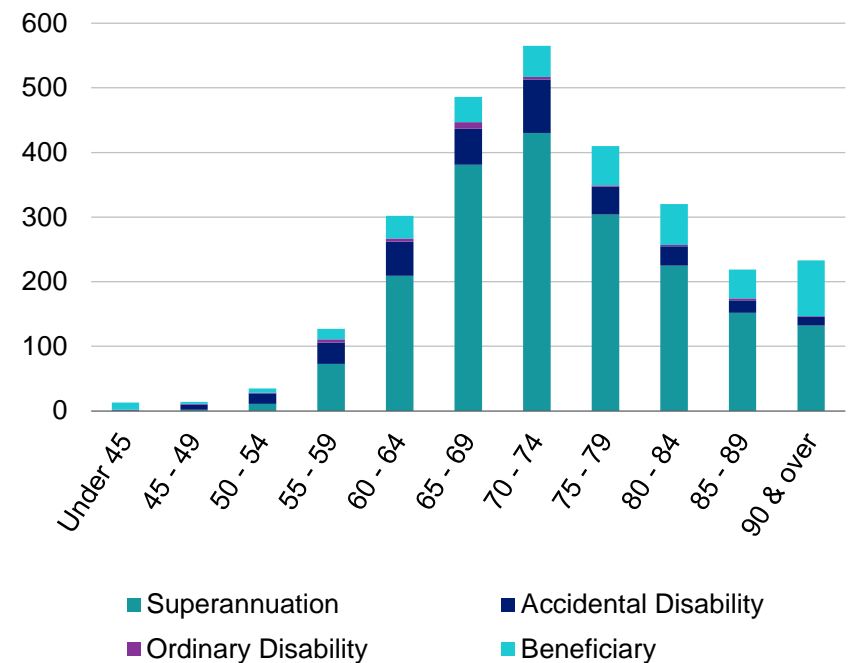
As of December 31,	2020	2019	Change
Retirees	2,311	2,304	0.3%
Beneficiaries	413	434	-4.8%
Average age	73.3	73.9	-0.6
Average amount	\$2,901	\$2,637	10.0%
Total monthly amount <sup>1</sup>	\$7,459,513	\$7,219,528	3.3%

#### Distribution of Retired Participants as of December 31, 2020

##### By Type and Monthly Amount



##### By Type and Age



<sup>1</sup> Excludes COLAs reimbursed by the Commonwealth.

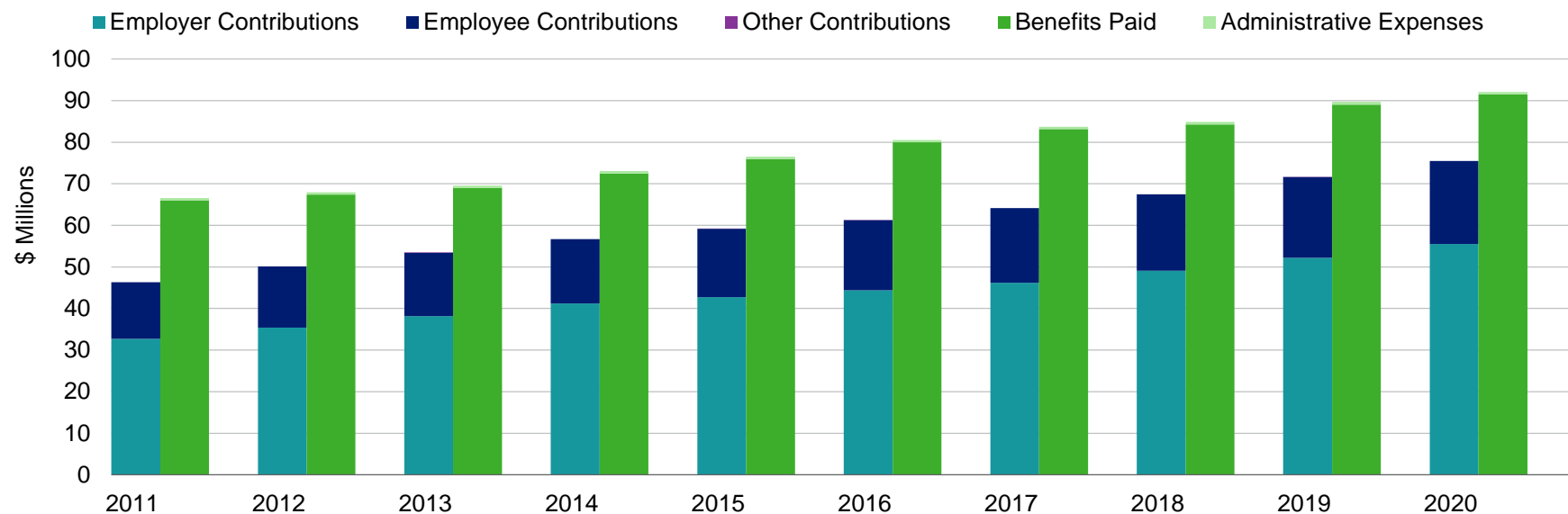
## Section 2: Actuarial Valuation Results

### 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, 2011 – 2020



## Section 2: Actuarial Valuation Results

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, 2020

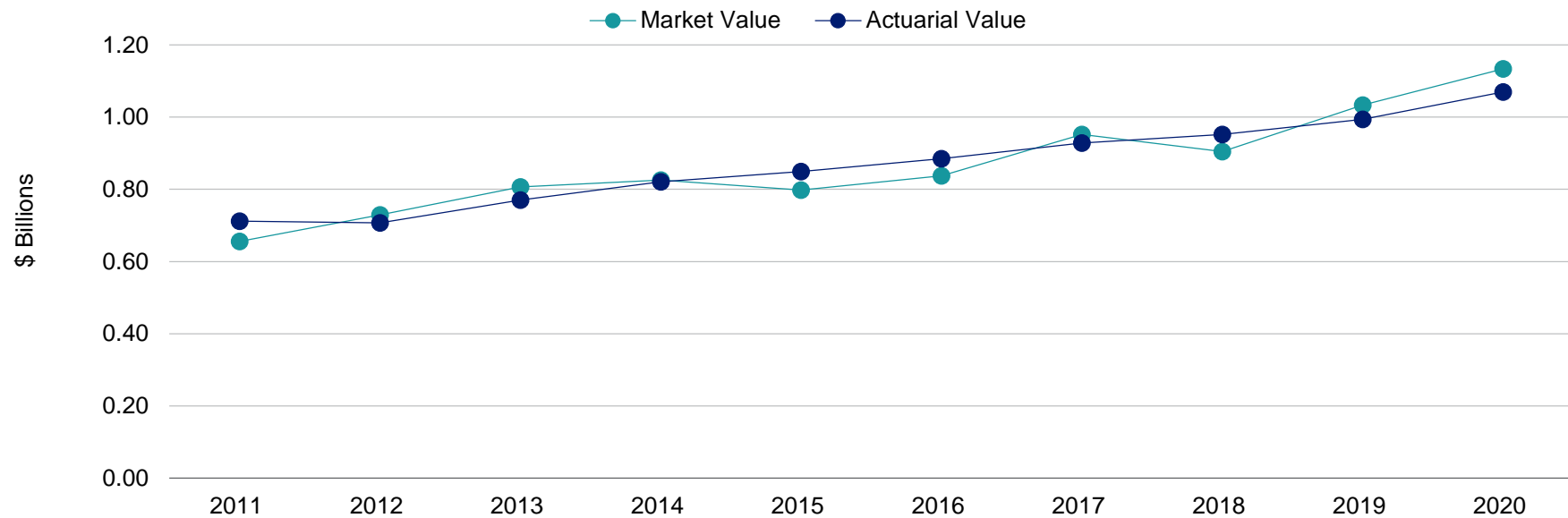
<b>1</b>	Market value of assets, December 31, 2020			\$1,134,047,305
<b>2</b>	Calculation of unrecognized return	<b>Gain/(Loss) on Market Value of Assets</b>	<b>Percent Remaining</b>	<b>Deferred Gain/(Loss)<sup>1</sup></b>
<b>(a)</b>	Year ended December 31, 2020	\$46,286,489	80%	\$37,029,191
<b>(b)</b>	Year ended December 31, 2019	85,397,341	60%	51,238,404
<b>(c)</b>	Year ended December 31, 2018	-96,610,073	40%	-38,644,028
<b>(d)</b>	Year ended December 31, 2017	73,613,455	20%	14,722,691
<b>(e)</b>	Year ended December 31, 2016	-378,488	0%	0
<b>(f)</b>	Total unrecognized return			64,346,258
<b>3</b>	Preliminary actuarial value: <b>(1) - (2f)</b>			\$1,069,701,047
<b>4</b>	Adjustment to be within 10% corridor			0
<b>5</b>	Final actuarial value of assets as of December 31, 2020: <b>(3) + (4)</b>			1,069,701,047
<b>6</b>	Actuarial value as a percentage of market value: <b>(5) ÷ (1)</b>			94.3%
<b>7</b>	Amount deferred for future recognition: <b>(1) - (5)</b>			\$64,346,258

<sup>1</sup> Recognition at 20% per year over five years.

## Section 2: Actuarial Valuation Results

Both the actuarial value and market value of assets are representations of the City of Worcester Retirement 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 City of Worcester Retirement 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.

Market Value of Assets vs. Actuarial Value of Assets



Market Value <sup>1</sup>	\$0.66	\$0.73	\$0.81	\$0.83	\$0.80	\$0.84	\$0.95	\$0.90	\$1.03	\$1.13
Actuarial Value <sup>1</sup>	0.71	0.71	0.77	0.82	0.85	0.88	0.93	0.95	0.99	1.07

<sup>1</sup> In \$ billions

## Section 2: Actuarial Valuation Results

### Actuarial experience

To calculate any 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), any contribution requirement will decrease from the previous year. On the other hand, any 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, 2020 is \$35,362,575, which includes \$24,402,530 from investment gains and \$10,960,045 in gains from all other sources. The net experience variation from individual sources other than investments was 0.7% 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, 2020

<b>1</b>	Net gain from investments	\$24,402,530
<b>2</b>	Net gain from administrative expenses	146,672
<b>3</b>	Net gain from other experience	<u>10,813,373</u>
<b>4</b>	Net experience gain: <b>1 + 2 + 3</b>	\$35,362,575



## Section 2: Actuarial Valuation Results

### 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 City of Worcester Retirement System's investment policy. The rate of return on the market value of assets was 11.41% for the year ended December 31, 2020.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 6.90% for the 2020 plan year. The actual rate of return on an actuarial basis for the 2020 plan year was 9.38%. Since the actual return for the year was greater than the assumed return, the City of Worcester Retirement System experienced an actuarial gain during the year ended December 31, 2020 with regard to its investments.

#### Investment Experience

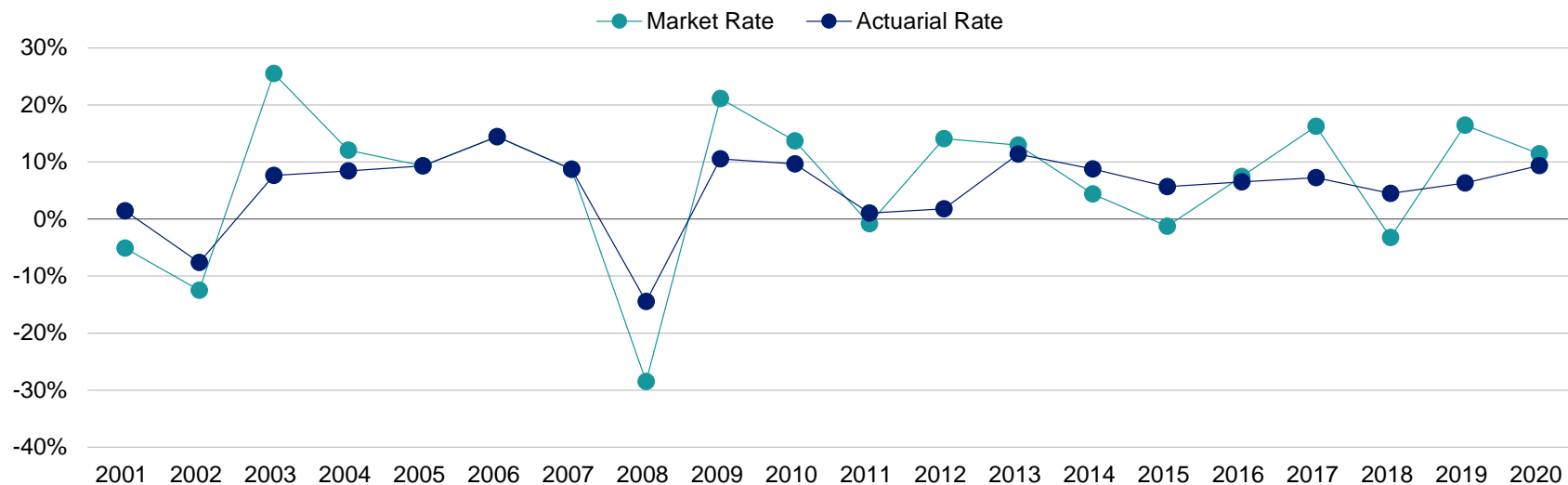
		Year Ended December 31, 2020	
		Market Value	Actuarial Value
<b>1</b>	Net investment income	\$117,032,426	\$92,407,683
<b>2</b>	Average value of assets	1,025,303,439	985,581,924
<b>3</b>	Rate of return: <b>1 ÷ 2</b>	11.41%	9.38%
<b>4</b>	Assumed rate of return	6.90%	6.90%
<b>5</b>	Expected investment income: <b>2 x 4</b>	70,745,937	68,005,153
<b>6</b>	Actuarial gain/(loss): <b>1 - 5</b>	<u>\$46,286,489</u>	<u>\$24,402,530</u>

## Section 2: Actuarial Valuation Results

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 20 years, including averages over select time periods.

As described earlier in this section, 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, 2001 - 2020



Market rate	-5.09%	-12.50%	25.52%	12.09%	9.29%	14.42%	8.72%	-28.49%	21.12%	13.69%	-0.84%	14.10%	12.97%	4.38%	-1.28%	7.45%	16.27%	-3.24%	16.44%	11.41%
Actuarial rate	1.43%	-7.63%	7.65%	8.43%	9.29%	14.42%	8.72%	-14.45%	10.56%	9.64%	1.03%	1.80%	11.36%	8.75%	5.65%	6.49%	7.23%	4.51%	6.32%	9.38%
Assumed rate	8.5%	8.5%	8.5%	8.5%	8.5%	8.25%	8.25%	8.25%	8.25%	8.25%	8.0%	8.0%	7.75%	7.75%	7.625%	7.5%	7.375%	7.0%	6.9%	6.9%

Average Rates of Return	Actuarial Value	Market Value
Most recent five-year average return:	6.82%	9.53%
Most recent ten-year average return:	6.34%	7.75%
Most recent 15-year average return:	6.00%	6.72%
Most recent 20-year average return:	5.53%	6.41%

## Section 2: Actuarial Valuation Results

### Non-investment experience

#### Administrative expenses

- Administrative expenses for the year ended December 31, 2020 totaled \$556,040, as compared to the assumption of \$675,000, payable at the beginning of the year. This resulted in a gain of \$146,672 for the year, including an adjustment for interest. Based on information on expenses provided by the Retirement System, we have reset the assumption to \$675,000 for the current year.

#### Mortality experience

- Mortality experience (more or fewer than expected deaths) yields actuarial gains or losses.
- The average number of deaths for nondisabled pensioners over the past 3 years was 83.0 deaths per year compared to 72.3 projected deaths per year. The average number of deaths for disabled pensioners over the past 3 years was 19.0 deaths per year compared to 14.3 projected deaths per year. The average number of deaths for beneficiaries over the past 3 years was 31.0 deaths per year compared to 26.1 projected deaths per 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),
- 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, 2020 amounted to \$10,813,373, which is 0.7% of the actuarial accrued liability.

#### Liability Changes Due to Demographic Experience for Year Ended December 31, 2020

Gain due to salaries increasing less than expected for continuing actives	\$4,399,543
Gain due to mortality experience among retired members and beneficiaries	1,056,450
Loss due to increase in estimated liability for net 3(8)(c) payments	-2,120,017
Miscellaneous gain	<u>7,477,397</u>
Total	\$10,813,373

## Section 2: Actuarial Valuation Results

### Actuarial assumptions

Other than resetting the administrative expense assumption, there are no assumption changes reflected in this report.

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*.

## Section 2: Actuarial Valuation Results

### Development of Unfunded Actuarial Accrued Liability for Year Ended December 31, 2020

1	Unfunded actuarial accrued liability at beginning of year	\$560,903,925
2	Normal cost at beginning of year	34,878,842
3	Total contributions	<u>-75,464,319</u>
4	Interest on 1, 2 & 3	<u>38,751,202</u>
5	Expected unfunded actuarial accrued liability	\$559,069,650
6	Changes due to:	
(a)	Net gain from investments	<u>-\$24,402,530</u>
(b)	Net gain from other experience	<u>-10,960,045</u>
	Total changes	<u>-35,362,575</u>
7	Unfunded actuarial accrued liability at end of year	\$523,707,075

## Section 2: Actuarial Valuation Results

### Actuarially determined contribution

The actuarially determined contribution is equal to the employer normal cost payment and a payment on the unfunded actuarial accrued liability. For fiscal 2022, the actuarially determined contribution has been set equal to the previously budgeted amount of \$59,024,767. The detail of the Actuarially Determined Contribution is shown below.

The funding schedule included in this report projects the Actuarially Determined Contribution through fiscal 2035. For fiscal 2022 and later years, each year's total appropriation increases 6.33%, with a lower payment in fiscal 2034, so that the System will be fully funded by June 30, 2034, if all assumptions are met. The projected unfunded actuarial accrued liability for future fiscal years does not reflect approximately \$64.3 million in net deferred investment gains. In the prior valuation, the System was also projected to be fully funded by June 30, 2034 with appropriations that increased 6.33% per year and a higher increase in fiscal 2034.

#### Actuarially Determined Contribution for Year Beginning January 1

		2021		2020	
		Amount	% of Projected Payroll	Amount	% of Projected Payroll
1	Total normal cost	\$34,521,663	16.69%	\$34,203,842	16.74%
2	Administrative expenses	675,000	0.33%	675,000	0.33%
3	Expected employee contributions	<u>-20,264,315</u>	<u>-9.80%</u>	<u>-19,872,400</u>	<u>-9.72%</u>
4	Employer normal cost: (1) + (2) + (3)	\$14,932,348	7.22%	\$15,006,442	7.35%
5	Actuarial accrued liability	1,593,408,122		1,554,774,408	
6	Actuarial value of assets	<u>1,069,701,047</u>		<u>993,870,483</u>	
7	Unfunded actuarial accrued liability : (5) - (6)	\$523,707,075		\$560,903,925	
8	Employer normal cost projected to July 1, 2021 and 2020	15,154,678	7.22%	15,229,875	7.35%
9	Projected unfunded actuarial accrued liability	541,473,609		579,932,344	
10	Payment on projected unfunded actuarial accrued liability	<u>43,870,089</u>	<u>20.90%</u>	<u>40,281,051</u>	<u>19.43%</u>
11	Actuarially determined contribution: (8) + (10)	\$59,024,767	28.12%	\$55,510,926	26.77%
12	Projected payroll as of July 1	\$209,876,800		\$207,331,556	

Notes:

Actuarially Determined Contributions are assumed to be paid at the beginning of the fiscal year.

Actuarially Determined Contributions are set equal to the budgeted amounts determined with the prior valuation.

## Section 2: Actuarial Valuation Results

### Funding Schedule

(1) Fiscal Year Ended June 30	(2) Employer Normal Cost	(3) Amortization of Special Legislations	(4) Amortization of Remaining Unfunded Liability	(5) Actuarially Determined Contribution (ADC): (2) + (3) + (4)	(6) Unfunded Actuarial Accrued Liability at Beginning of Fiscal Year	(7) Percent Increase in ADC Over Prior Year
2022	\$15,154,678	\$171,827	\$43,698,262	\$59,024,767	\$541,473,609	- -
2023	15,663,449	171,827	46,925,759	62,761,035	531,938,163	6.33%
2024	16,189,190	171,827	50,372,792	66,733,809	518,294,576	6.33%
2025	16,732,465	171,827	54,053,767	70,958,059	500,024,704	6.33%
2026	17,293,855	171,827	57,984,022	75,449,704	476,559,249	6.33%
2027	17,873,961	171,827	62,179,882	80,225,670	447,273,234	6.33%
2028	18,473,404	171,827	66,658,724	85,303,955	411,481,110	6.33%
2029	19,092,824	171,827	71,439,044	90,703,695	368,431,447	6.33%
2030	19,732,885	171,827	76,540,527	96,445,239	317,301,196	6.33%
2031	20,394,269	171,827	81,984,127	102,550,223	257,189,471	6.33%
2032	21,077,684	171,827	87,792,141	109,041,652	187,110,830	6.33%
2033	21,783,859	171,827	93,988,303	115,943,989	105,987,996	6.33%
2034	22,513,549	171,827	12,472,161	35,157,537	12,643,988	-69.68%
2035	23,267,533	0	0	23,267,533	0	-33.82%

**Notes:**

Fiscal 2022 Actuarially Determined Contribution set at budgeted amount.

Actuarially Determined Contributions are assumed to be paid at the beginning of the fiscal year.

Item (2) reflects 3.0% growth in payroll, 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.

## Section 2: Actuarial Valuation Results

### 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 System. We recommend a more detailed assessment to provide the Board with a better understanding of the risks inherent in the System. This assessment may include scenario testing, sensitivity testing, stress testing and stochastic modeling.

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

The market value rate of return over the last 20 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 13 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.
- More or less active participant turnover than assumed.
- Disability retirement experience different 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 \$96.6 million to a gain of \$85.4 million

The non-investment gain(loss) for a year has ranged from a loss of \$1.5 million to a gain of \$14.5 million.

Since 2012, the funded percentage on the actuarial value of assets has ranged from a low of 63.22% as of January 1, 2019 to a high of 67.74% as of January 1, 2012.



## Section 2: Actuarial Valuation Results

- 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.

Currently the Plan has a non-active to active participant ratio of 1.13. For the prior year benefits paid and administrative expenses were \$16,577,119 more than contributions received. In future years, more cash may be needed from the investment portfolio to meet benefit payments with contributions increasing 6.33% the gap may decrease, at least until 2035.

# Section 3: Supplemental Information

## Exhibit A: Table of Plan Demographics

Category	Year Ended December 31		Change From Prior Year
	2020	2019	
Active participants in valuation:			
• Number	3,411	3,506	-2.7%
• Average age	45.9	45.8	0.1
• Average years of service	12.3	12.2	0.1
• Total payroll	\$199,137,147	\$196,970,554	1.1%
• Average payroll	58,381	56,181	3.9%
• Account balances	198,410,901	194,956,841	1.8%
• Total active vested participants	1,894	1,937	-2.2%
Inactive participants:			
Inactive participants due a refund of their employee contributions	986	833	18.4%
Inactive participants with a vested right to a deferred or immediate benefit	135	116	16.4%
Retired participants:			
• Number in pay status	1,919	1,904	0.8%
• Average age	73.9	73.9	0.0
• Average monthly benefit	\$2,772	\$2,670	3.8%
Disabled participants:			
• Number in pay status	392	400	-2.0%
• Average age	69.8	69.6	0.2
• Average monthly benefit	\$3,531	\$3,434	2.8%
Beneficiaries:			
• Number in pay status	413	434	-4.8%
• Average age	77.5	77.8	-0.3
• Average monthly benefit	\$1,831	\$1,757	4.2%

### Notes:

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

Calendar year 2019 salaries were reduced by 3.0% for police hired before December 31, 2017 and 1.0% for police hired during 2018 to reflect retroactive payments that were included in the salary data, except for certain police officials for whom the salaries were increased by 5.0% to estimate the impact of salary increases on July 1, 2017, 2018, and 2019 attributable to unsettled bargaining contracts.

## Section 3: Supplemental Information

### Exhibit B: Participants in Active Service as of December 31, 2020 by Age, Years of Service, and Average Payroll

Age	Years of Service									
	Total	0-4	5-9	10-14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 & over
Under 25	95	94	1	--	--	--	--	--	--	--
	\$33,314	\$33,113	\$52,188	--	--	--	--	--	--	--
25 - 29	301	267	34	--	--	--	--	--	--	--
	\$47,946	\$46,602	\$58,503	--	--	--	--	--	--	--
30 - 34	433	252	157	24	--	--	--	--	--	--
	\$58,984	\$52,834	\$64,615	\$86,728	--	--	--	--	--	--
35 - 39	399	159	120	96	23	1	--	--	--	--
	\$60,856	\$45,648	\$62,576	\$81,100	\$73,863	\$29,883	--	--	--	--
40 - 44	352	120	62	72	61	37	--	--	--	--
	\$58,396	\$39,058	\$50,917	\$67,259	\$87,206	\$68,895	--	--	--	--
45 - 49	367	85	56	40	66	94	23	3	--	--
	\$65,794	\$38,054	\$57,991	\$50,656	\$83,302	\$83,898	\$85,708	\$94,209	--	--
50 - 54	517	95	75	47	52	95	107	43	3	--
	\$63,804	\$40,832	\$47,043	\$49,746	\$63,958	\$73,648	\$86,300	\$81,453	\$60,800	--
55 - 59	462	78	44	43	51	86	69	71	19	1
	\$61,578	\$44,126	\$49,933	\$48,179	\$50,097	\$55,095	\$78,829	\$87,350	\$91,504	\$65,635
60 - 64	329	35	36	35	36	71	51	40	22	3
	\$53,422	\$42,702	\$43,480	\$45,543	\$45,047	\$44,499	\$61,611	\$79,629	\$71,634	\$79,144
65 - 69	120	12	6	13	15	30	22	12	5	5
	\$52,630	\$36,047	\$68,148	\$57,437	\$55,354	\$42,013	\$54,501	\$58,848	\$68,921	\$77,401
70 & over	36	1	2	3	5	9	4	6	1	5
	\$46,953	\$24,340	\$33,061	\$39,505	\$37,863	\$42,396	\$57,291	\$51,333	\$64,852	\$61,684
Total	3,411	1,198	593	373	309	423	276	175	50	14
	\$58,381	\$44,509	\$57,108	\$63,284	\$68,085	\$63,833	\$76,866	\$81,064	\$78,128	\$71,321

## Section 3: Supplemental Information

### Exhibit C: Summary Statement of Income and Expenses on a Market Value Basis

	Year Ended December 31, 2020	Year Ended December 31, 2019
Net assets at market value at the beginning of the year	\$1,033,591,998	\$904,465,776
<b>Contribution income:</b>		
• Employer contributions	\$55,510,926	\$52,206,269
• Employee contributions	19,953,393	19,388,692
• Federal Grant Reimbursement and Other contributions	0	24,356
• Less administrative expenses	<u>-556,040</u>	<u>-658,258</u>
Net contribution income	\$74,908,279	\$70,961,059
Net investment income	<u>117,032,426</u>	<u>147,182,537</u>
<b>Total income available for benefits</b>	<b>\$191,940,705</b>	<b>\$218,143,596</b>
<b>Less benefit payments:</b>		
• Pensions	<u>-\$89,223,547</u>	<u>-\$86,303,251</u>
• Net 3(8)(c) reimbursements	<u>-2,261,851</u>	<u>-2,714,122</u>
Net benefit payments	<u>-\$91,485,398</u>	<u>-\$89,017,374</u>
<b>Change in reserve for future benefits</b>	<b>\$100,455,307</b>	<b>\$129,126,222</b>
<b>Net assets at market value at the end of the year</b>	<b>\$1,134,047,305</b>	<b>\$1,033,591,998</b>

## Section 3: Supplemental Information

### Exhibit D: Development of the Fund through December 31, 2020

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
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%
2018	49,098,344	18,336,273	-30,549,013	587,936	84,275,963	904,465,776	952,294,056	105.3%
2019	52,206,269	19,413,048	147,182,537	658,258	89,017,374	1,033,591,998	993,870,483	96.2%
2020	55,510,926	19,953,393	117,032,426	556,040	91,485,398	1,134,047,305	1,069,701,047	94.3%

## Section 3: Supplemental Information

### Exhibit E: Table of Amortization Bases

Type	Annual Payment	Years Remaining	Outstanding Balance
Stomski Special Legislation	\$83,704	13	\$752,094
Roy Special Legislation	55,138	13	495,425
Carroll Special Legislation	32,985	13	296,381
Remaining unfunded liability	<u>43,698,262</u>	13	<u>539,929,709</u>
<b>Total</b>	<b>\$43,870,089</b>		<b>\$541,473,609</b>

Notes:

Actuarially Determined Contributions are assumed to be paid at the beginning of the fiscal year.

The Special Legislation liabilities are amortized in level payments.

Payment on remaining unfunded liability reflects adjustment to set fiscal 2022 appropriation to budgeted amount.

## Section 3: Supplemental Information

### Exhibit F: Department Results as of January 1, 2021

Category	DPW	Fire	Police	Schools	Housing	Other	All Department Total
<b>Active participants in valuation</b>							
• Number	302	413	483	1,441	197	575	3,411
• Average age	49.3	41.7	44.1	47.4	41.3	46.6	45.9
• Average service	13.9	14.1	17.6	10.8	7.6	11.4	12.3
• Total payroll	\$17,460,938	\$37,150,972	\$42,536,664	\$54,155,701	\$10,979,935	\$36,852,937	\$199,137,147
• Average payroll	57,818	89,954	88,068	37,582	55,736	64,092	58,381
<b>Inactive participants entitled to a return of their employee contributions</b>							
	39	7	13	623	130	174	986
<b>Inactive participants with a vested right to a deferred or immediate benefit</b>							
	8	3	5	69	15	35	135
<b>Retired participants and beneficiaries in pay status</b>							
• Retired participants	228	233	231	677	75	475	1,919
– Average age	73.1	69.7	70.8	74.8	74.5	76.7	73.9
• Disabled participants	36	142	112	56	10	36	392
– Average age	69.9	70.5	70.8	68.3	64.1	67.9	69.8
• Beneficiaries	63	112	91	70	14	63	413
– Average age	76.7	77.7	79.7	73	77.9	79.5	77.5
• Total number in pay status	327	487	434	803	99	574	2,724
• Total monthly benefits	\$835,273	\$2,099,223	\$1,681,573	\$1,282,989	\$245,422	\$1,315,033	\$7,459,513
• Average monthly benefit	2,554	4,311	3,875	1,598	2,479	2,291	2,738
<b>Department Results</b>							
1. Total normal cost	\$2,622,904	\$7,745,902	\$8,344,514	\$8,725,940	\$1,581,082	\$5,501,321	\$34,521,663
2. Administrative expenses	51,285	151,455	163,160	170,618	30,915	107,567	675,000
3. Expected employee contribution	<u>-1,764,425</u>	<u>-3,911,766</u>	<u>-4,391,525</u>	<u>-5,280,658</u>	<u>-1,123,327</u>	<u>-3,792,614</u>	<u>-20,264,315</u>
4. Employer normal cost:	\$909,764	\$3,985,591	\$4,116,149	\$3,615,900	\$488,670	\$1,816,274	\$14,932,348
5. Employer normal cost as a percent of payroll	5.01%	10.33%	9.31%	6.43%	4.30%	4.75%	7.22%
6. Actuarial accrued liability	\$157,081,086	\$408,586,780	\$399,964,870	\$315,633,744	\$54,399,458	\$257,742,184	\$1,593,408,122
7. Actuarial value of assets	<u>105,453,085</u>	<u>274,296,146</u>	<u>268,508,008</u>	<u>211,894,079</u>	<u>36,519,933</u>	<u>173,029,796</u>	<u>1,069,701,047</u>
8. Unfunded actuarial accrued liability: (6) – (7)	\$51,628,001	\$134,290,634	\$131,456,862	\$103,739,665	\$17,879,525	\$84,712,388	\$523,707,075

Notes:

Actuarial value of assets allocated in proportion to the actuarial accrued liability.

Administrative expenses allocated in proportion to total normal cost.

Average age of retired participants and beneficiaries does not include surviving children collecting temporary annuities.

## Section 3: Supplemental Information

### Exhibit G: Definition of Pension Terms

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

<b>Actuarial Accrued Liability for Actives:</b>	The equivalent of the accumulated normal costs allocated to the years before the valuation date.
<b>Actuarial Accrued Liability for Retirees and Beneficiaries:</b>	Actuarial Present Value of lifetime benefits to existing retirees 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.
<b>Actuarial Cost Method:</b>	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.
<b>Actuarial Gain or Loss:</b>	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. 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 actuarial liabilities that are larger than projected.
<b>Actuarially Equivalent:</b>	Of equal Actuarial Present Value, determined as of a given date and based on a given set of Actuarial Assumptions.
<b>Actuarial Present Value (APV):</b>	<p>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:</p> <p>Adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.)</p> <p>Multiplied by the probability of the occurrence of an event (such as survival, death, disability, withdrawal, etc.) on which the payment is conditioned, and</p> <p>Discounted according to an assumed rate (or rates) of return to reflect the time value of money.</p>
<b>Actuarial Present Value of Future Benefits:</b>	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 Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive members entitled to either a refund of member contributions 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.



## Section 3: Supplemental Information

<b>Actuarial Valuation:</b>	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, as well as Actuarially Determined Contributions.
<b>Actuarial Value of Assets (AVA):</b>	The value of the Plan'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 Actuarially Determined Contribution.
<b>Actuarially Determined:</b>	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 Plan.
<b>Actuarially Determined Contribution (ADC):</b>	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.
<b>Amortization Method:</b>	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 Unfunded Actuarial Accrued Liability. 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 Unfunded Actuarial Accrued Liability. 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.
<b>Amortization Payment:</b>	The portion of the pension plan contribution, or ADC, that is intended to pay off the Unfunded Actuarial Accrued Liability.
<b>Assumptions or Actuarial Assumptions:</b>	The estimates upon which the cost of the Plan is calculated, including: <u>Investment return</u> - the rate of investment yield that the Plan will earn over the long-term future; <u>Mortality rates</u> - the rate or probability of death at a given age for employees and retirees; <u>Retirement rates</u> - the rate or probability of retirement at a given age or service; <u>Disability rates</u> - the rate or probability of disability retirement at a given age; <u>Withdrawal rates</u> - the rate or probability at which employees of various ages are expected to leave employment for reasons other than death, disability, or retirement; <u>Salary increase rates</u> - the rates of salary increase due to inflation, real wage growth and merit and promotion increases.
<b>Closed Amortization Period:</b>	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 20 years, it is 19 years at the end of one year, 18 years at the end of two years, etc. See Open Amortization Period.
<b>Decrements:</b>	Those causes/events due to which a member's status (active-inactive-retiree-beneficiary) changes, that is: death, retirement, disability, or withdrawal.

## Section 3: Supplemental Information

<b>Defined Benefit Plan:</b>	A retirement plan in which benefits are defined by a formula based on the member's compensation, age and/or years of service.
<b>Defined Contribution Plan:</b>	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.
<b>Employer Normal Cost:</b>	The portion of the Normal Cost to be paid by the employer. This is equal to the Normal Cost less expected member contributions.
<b>Experience Study:</b>	A periodic review and analysis of the actual experience of the Plan 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 based on recommendations from the Actuary.
<b>Funded Ratio:</b>	The ratio of the Actuarial Value of Assets AVA to the Actuarial Accrued Liability (AAL). Plans sometimes also calculate a market funded ratio, using the Market Value of Assets (MVA), rather than the AVA.
<b>GASB 67 and GASB 68:</b>	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.
<b>Investment Return:</b>	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.
<b>Net Pension Liability (NPL):</b>	The Net Pension Liability is equal to the Total Pension Liability minus the Plan Fiduciary Net Position.
<b>Normal Cost:</b>	The portion of the Actuarial Present Value of Future Benefits and expenses allocated to a valuation year by the Actuarial Cost Method. Any payment with respect to an Unfunded Actuarial Accrued Liability is not part of the Normal Cost (see Amortization Payment). For pension plan benefits that are provided in part by employee contributions, Normal Cost refers to the total of member contributions and employer Normal Cost unless otherwise specifically stated.
<b>Open Amortization Period:</b>	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 each future year in determining the Amortization Period.
<b>Plan Fiduciary Net Position:</b>	Market value of assets.
<b>Total Pension Liability (TPL):</b>	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.

## Section 3: Supplemental Information

<b>Unfunded Actuarial Accrued Liability:</b>	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 or an Overfunded Actuarial Accrued Liability.
<b>Valuation Date or Actuarial Valuation Date:</b>	The date as of which the value of assets is determined and as of which the Actuarial Present Value of Future 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, Actuarial Cost Method and Models

<b>Net Investment Return:</b>	6.90%  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.
<b>Salary Increases:</b>	4.00% per year, with an allowance for wage inflation of 3.00%.  The salary scale assumption is a long-term estimate derived from historical data, current and recent market expectations, and professional judgment.
<b>Cost-of-Living Adjustments (COLA):</b>	3.00% increase on the first \$13,000 of retirement allowance. For recipients of Section 100 and Special Legislation benefits, 3.00% per year.
<b>401(a)(17) Salary Limit Projection:</b>	3.00% per year.
<b>Interest on Employee Contributions:</b>	3.5%
<b>Administrative Expenses:</b>	\$675,000 for calendar 2021, increasing 3.00% per year (previously, \$675,000 for 2020 increasing 3.00% per year).  The administrative expense assumption is based on information on expected expenses provided by the Retirement System.
<b>Mortality Rates:</b>	Pre-Retirement: RP-2014 Blue Collar Employee Mortality Table projected generationally with Scale MP-2017 Healthy Retiree: RP-2014 Blue Collar Healthy Annuitant Mortality Table projected generationally with Scale MP-2017 Disabled Retiree: RP-2014 Blue Collar Healthy Annuitant Mortality Table set forward one year and projected generationally with Scale MP-2017  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 years' 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.

## Section 4: Actuarial Valuation Basis

### Termination Rates before Retirement:

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

## Section 4: Actuarial Valuation Basis

Age	Group 4 - Rate (%)			
	Mortality		Disability	Withdrawal
	Male	Female		
20	0.05	0.02	0.13	2.10
25	0.06	0.02	0.25	1.88
30	0.06	0.02	0.38	1.65
35	0.07	0.03	0.38	1.11
40	0.08	0.04	0.38	0.56
45	0.13	0.07	1.25	0.28
50	0.22	0.12	1.56	0.00
55	0.36	0.19	1.50	0.00
60	0.61	0.27	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 years' assumptions over the past five years.

## Section 4: Actuarial Valuation Basis

### 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 years' assumptions over the past five years.

### Retirement Age 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.

## Section 4: Actuarial Valuation Basis

<b>Unknown Data for Participants:</b>	Same as those exhibited by participants with similar known characteristics. If not specified, participants are assumed to be male.
<b>Family Composition:</b>	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.
<b>Benefit Election:</b>	All participants are assumed to elect Option A. The benefit election reflects the fact that all benefit options are actuarially equivalent.
<b>2020 Salary:</b>	2020 salary equal to salaries provided in the data. Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year.
<b>Total Service:</b>	Total creditable service reported in the data. If missing, total creditable service estimated from date of hire.
<b>Net 3(8)(c) Liability:</b>	Estimated liability of \$25.1 million (previously, \$22.9 million) based on the average annual net 3(8)(c) benefits of the prior two years and the average demographics of retired participants.
<b>Actuarial Value of Assets:</b>	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.
<b>Actuarial Cost Method:</b>	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.
<b>Actuarial Models:</b>	Segal valuation results are based on proprietary actuarial modeling software. The actuarial valuation models generate a comprehensive set of liability and cost calculations that are presented to meet regulatory, legislative and client requirements. Our Actuarial Technology and Systems unit, comprised of both actuaries and programmers, is responsible for the initial development and maintenance of these models. The models have a modular structure that allows for a high degree of accuracy, flexibility and user control. The client team programs the assumptions and the plan provisions, validates the models, and reviews test lives and results, under the supervision of the responsible actuary.
<b>Justification for Change in Actuarial Assumptions:</b>	The administrative expense assumption was reset to \$675,000 for 2021.



## Section 4: Actuarial Valuation Basis

### 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:	<p>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.)</p> <p>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:</p> <table><tr><th colspan="4">Age Last Birthday at Date of Retirement</th></tr><tr><th>Percent</th><th>Group 1</th><th>Group 2</th><th>Group 4</th></tr><tr><td>2.5</td><td>65 or over</td><td>60 or over</td><td>55 or over</td></tr><tr><td>2.4</td><td>64</td><td>59</td><td>54</td></tr><tr><td>2.3</td><td>63</td><td>58</td><td>53</td></tr><tr><td>2.2</td><td>62</td><td>57</td><td>52</td></tr><tr><td>2.1</td><td>61</td><td>56</td><td>51</td></tr><tr><td>2.0</td><td>60</td><td>55</td><td>50</td></tr><tr><td>1.9</td><td>59</td><td>--</td><td>49</td></tr><tr><td>1.8</td><td>58</td><td>--</td><td>48</td></tr><tr><td>1.7</td><td>57</td><td>--</td><td>47</td></tr><tr><td>1.6</td><td>56</td><td>--</td><td>46</td></tr><tr><td>1.5</td><td>55</td><td>--</td><td>45</td></tr></table> <p>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.</p>				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
Age Last Birthday at Date of Retirement																																																								
Percent	Group 1	Group 2	Group 4																																																					
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1.8	58	--	48																																																					
1.7	57	--	47																																																					
1.6	56	--	46																																																					
1.5	55	--	45																																																					

## Section 4: Actuarial Valuation Basis

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.

## Section 4: Actuarial Valuation Basis

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.

## Section 4: Actuarial Valuation Basis

<b>Ordinary Disability Benefit:</b>	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.
<b>Accidental Disability Benefit:</b>	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.
<b>Death Benefits:</b>	<p>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.</p> <p>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.</p> <p>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.</p>
<b>"Heart And Lung Law" And Cancer Presumption:</b>	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.
<b>Special Legislation Benefits:</b>	<p>The following pensioners are receiving special legislation benefits:</p> <ul style="list-style-type: none"><li>• Brian Carroll (disabled firefighter): Awarded a pension of 80% of the compensation, increased annually with salary-related COLAs through maximum retirement age, at which point the benefit is converted to a standard accidental disability benefit. Upon death prior to maximum retirement age, 67% of the benefit at time of death is payable to his surviving spouse.</li></ul>

## Section 4: Actuarial Valuation Basis

- Mark Stomski (disabled firefighter): Awarded a pension of 100% of the compensation, increased annually with salary-related COLAs through maximum retirement age, at which point the benefit is converted to a standard accidental disability benefit. Upon death prior to maximum retirement age, 75% of the benefit at time of death is payable to his surviving spouse.
- Ava Roy (daughter of fallen firefighter Christopher Roy): Annual pension amount that otherwise would have been paid to a surviving spouse pursuant to Section 100 of Chapter 32 (increased annually with salary-related COLAs) until she attains the age of 26.

### 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.