

Barnstable County Retirement Association

Actuarial Valuation and Review

As of January 1, 2020



This report has been prepared at the request of the Retirement Board to assist in administering the Barnstable County Retirement Association. 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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July 20, 2020

Retirement Board
Barnstable County Retirement Association
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Dear Board Members:

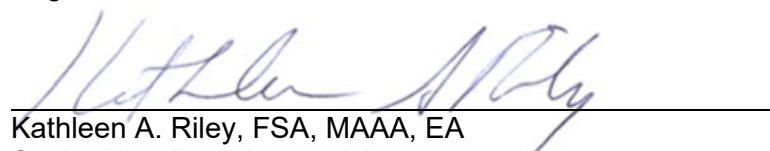
We are pleased to submit this Actuarial Valuation and Review as of January 1, 2020. It summarizes the actuarial data used in the valuation, analyzes the preceding two years' experience, and establishes the funding requirements for fiscal 2021 and later years.

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 Association. The census information and financial information on which our calculations were based was prepared by the staff of the Barnstable County Retirement Association. That assistance is gratefully acknowledged.

The actuarial calculations were directed under my supervision. I am a member of the American Academy of Actuaries and 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 Barnstable County Retirement Association.

We look forward to reviewing this report with you and to answering any questions.

Sincerely,
Segal



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

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Section 1: Actuarial Valuation Summary

Purpose and basis

This report was prepared by Segal to present a valuation of the Barnstable County Retirement Association as of January 1, 2020. 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 Association assets to cover the estimated cost of settling the Association'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, 2019, provided by the staff of the Retirement Association;
- The assets of the Association as of December 31, 2019, provided by the staff of the Retirement Association;
- 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 December 31, 2019 for the Retirement Association is provided in a separate report.

Section 1: Actuarial Valuation Summary

Valuation highlights

1. It is important to note that this actuarial valuation is based on plan assets as of December 31, 2019. Due to the COVID-19 pandemic, market conditions have changed significantly since the valuation date. The Association's actuarial 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. While it is impossible to determine how the markets will perform over the next several months, and how that will affect the results of next year's valuation, Segal is available to prepare projections of potential outcomes upon request.
2. 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 Barnstable County Retirement Board meets this standard and funds the unfunded actuarial accrued liability by June 30, 2037.
3. The funded ratio (the ratio of the actuarial value of assets to actuarial accrued liability) is 60.76%, compared to the prior valuation funded ratio of 59.50%. 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 62.34%, compared to 61.86% 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 Barnstable County Retirement Association's benefit obligation or the need for or the amount of future contributions.
4. The rate of return on the market value of assets was -2.37% and 16.04% for the plan years ended December 31, 2018 and December 31, 2019, respectively. The rate of return on the actuarial value of assets (which gradually recognizes market fluctuations) was 6.20% and 8.08% for the plan years ended December 31, 2018 and December 31, 2019, respectively. This resulted in an actuarial loss when measured against the assumed rate of return of 7.375%. Given the low fixed income interest rate environment, target asset allocation and expectations of future investment returns for various classes, the Board has lowered the assumed long-term rate of return on investments to 7.15%.
5. The actuarial value of assets as of December 31, 2019 was \$1.21 billion, or 97.46% of the market value of assets of \$1.24 billion reported in the Annual Statement. As of December 31, 2017, the actuarial value of assets was 96.20% of the market value.
6. The investment experience in the past years has only been partially recognized in the actuarial value of assets. As the deferred net gain of \$31.6 million is recognized in future years, the cost of the Association 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 deferred investment gains are not recognized in the projection of the unfunded actuarial accrued liability in the funding schedule shown in *Section 2*.

Section 1: Actuarial Valuation Summary

7. The following actuarial assumptions were changed with this valuation:

- The net investment return assumption was lowered from 7.375% to 7.15%.
- The administrative expense assumption was changed from \$1,500,000 for calendar 2018, increasing 3.25% per year, to \$1,850,000 for calendar 2020, increasing 3.25% per year.

Changing these assumptions increased the unfunded liability by approximately \$47.8 million and increased the employer normal cost by approximately \$2.5 million.

8. The unfunded liability was expected to increase by \$6.2 million from \$722.4 million as of January 1, 2018 to \$728.6 million as of January 1, 2020. The actual unfunded actuarial accrued liability as of January 1, 2020 is \$782.8 million, \$54.2 million more than expected. The increase is primarily due to the assumption changes described above. Other sources of gains and losses are discussed in *Section 2*.

9. The funding schedule included in this report is projected to fully fund the Association by June 30, 2037 with appropriations that increase 5.80% per year, if all assumptions are met and there are no changes in the plan of benefits or actuarial assumptions. The prior funding schedule was projected to fully fund the Association by June 30, 2035 with appropriations that increase 5.28% per year.

In the funding schedule in this report, the 2010 ERI is amortized in level payments through fiscal year 2022, the 2002 and 2003 ERI are amortized in 4.0% increasing payments through June 30, 2037 and the Retired Sheriff liability is amortized in 5.15% increasing payments through June 30, 2037. In the prior funding schedule the 2010 ERI was amortized in level payments through fiscal 2022, the 2002 and 2003 ERI was amortized in 4.0% increasing payments through June 30, 2035 and the Retired Sheriff liability was amortized in 6.30% increasing payments per year through June 30, 2035.

10. 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 Association's future financial condition, but have included a brief discussion of some risks that may affect the Association in *Section 2*. A more detailed assessment would provide the Board with a better understanding of the inherent risks.

Section 1: Actuarial Valuation Summary

Summary of key valuation results

		2020	2018
Contributions for fiscal year beginning July 1:	• Actuarially Determined Contributions for fiscal year 2021 and 2019	\$70,396,205	\$63,512,249
	• Actuarially Determined Contributions for fiscal year 2022 and 2020	74,479,185	66,865,696
	• Actuarially Determined Contributions for fiscal year 2023 and 2021	78,798,978	70,396,205
Actuarial accrued liability for plan year beginning January 1:	• Retired participants and beneficiaries	\$1,093,208,896	\$940,532,571
	• Inactive vested participants	19,765,605	20,102,987
	• Inactive participants due a refund of employee contributions	5,239,270	4,673,413
	• Active participants	876,734,111	818,628,315
	• Total	1,994,947,882	1,783,937,286
Assets for plan year beginning January 1:	• Normal cost including administrative expenses for plan year beginning January 1	49,113,294	43,552,752
	• Market value of assets (MVA)	\$1,243,664,647	\$1,103,493,815
	• Actuarial value of assets (AVA)	1,212,111,231	1,061,514,465
Funded status for plan year beginning January 1:	• Actuarial value of assets as a percentage of market value of assets	97.46%	96.20%
	• Unfunded actuarial accrued liability on market value of assets	\$751,283,235	\$680,443,471
	• Funded percentage on MVA basis	62.34%	61.86%
	• Unfunded actuarial accrued liability on actuarial value of assets	\$782,836,651	\$722,422,821
Key assumptions:	• Funded percentage on AVA basis	60.76%	59.50%
	• Net investment return	7.15%	7.375%
Demographic data for plan year beginning January 1:	• Long-term wage inflation rate	3.25%	3.25%
	• Number of retired participants and beneficiaries	3,326	3,117
	• Number of inactive vested participants	133	130
	• Number of inactive participants due a refund of employee contributions	654	564
	• Number of active participants	4,799	4,633
	• Total payroll ¹	\$293,746,441	\$271,510,348
	• Average payroll	61,210	58,604

¹ Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year.

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:

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 Retirement Association. 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 Retirement Association. The Retirement Association 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.

Section 1: Actuarial Valuation Summary

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 Retirement Board. 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 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.

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 Retirement Board should look to their other advisors for expertise in these areas.

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

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: 2003 – 2019

Year Ended December 31	Active Participants	Inactive Participants	Retired Participants and Beneficiaries	Total Non-Actives	Ratio of Non-Actives to Actives
2003	5,031	834	2,125	2,959	0.59
2005	5,269	765	2,201	2,966	0.56
2006	5,314	787	2,267	3,054	0.57
2008	5,290	748	2,368	3,116	0.59
2009	4,786 ¹	772	2,422	3,194	0.67
2011	4,670	637	2,556	3,193	0.68
2013	4,696	651	2,729	3,380	0.72
2015	4,699	622	2,937	3,559	0.76
2017	4,633	694	3,117	3,811	0.82
2019	4,799	787	3,326	4,113	0.86

¹ Reflects transfer of County Sheriffs to the State Retirement System.

Section 2: Actuarial Valuation Results

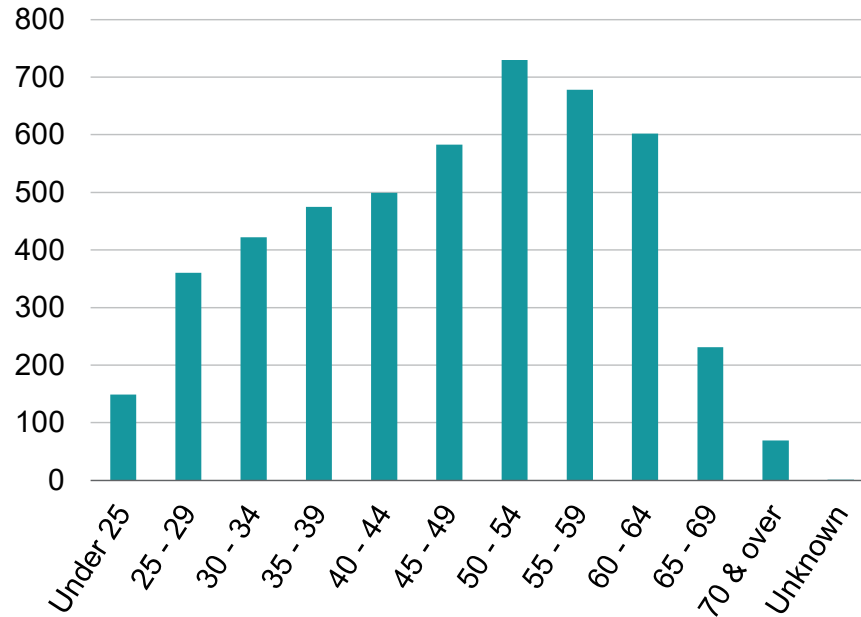
Active participants

Plan costs are affected by the age, years of service and payroll of active participants. In this year's valuation, there were 4,799 active participants with an average age of 47.8, average years of service of 11.4 years and average payroll of \$61,210. The 4,633 active participants in the prior valuation had an average age of 48.4, average service of 12.0 years and average payroll of \$58,604.

Among the active participants, there was one with unknown age and none with unknown service information. The actuarial calculations were adjusted for the missing information by assuming that it was the same as information provided for other active participants with similar known characteristics.

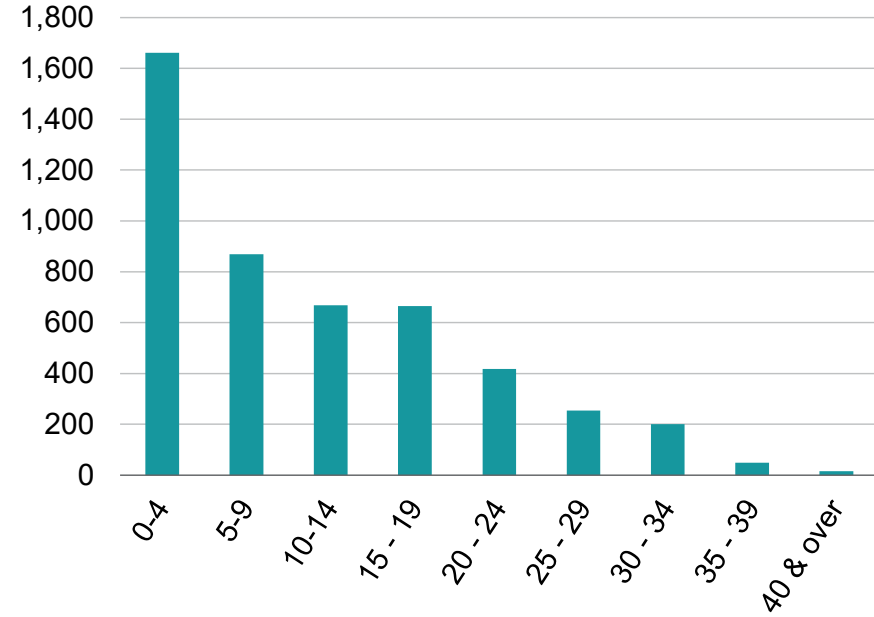
Distribution of Active Participants as of December 31, 2019

by Age



Average age	47.8
Prior year average age	48.4
Difference	-0.6

by Years of Service



Average years of service	11.4
Prior year average years of service	12.0
Difference	-0.6

Inactive participants

In this year's valuation, there were 133 participants with a vested right to a deferred or immediate vested benefit and 654 participants entitled to a return of their employee contributions.

Section 2: Actuarial Valuation Results

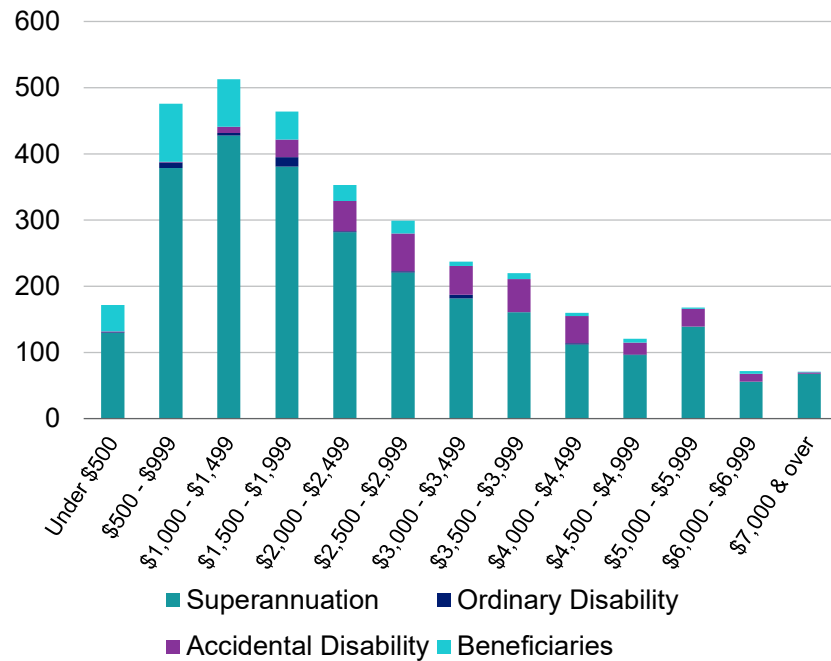
Retired participants and beneficiaries

As of December 31, 2019, 3,008 retired participants and 318 beneficiaries were receiving total monthly benefits of \$8,261,268, excluding COLAs reimbursed by the Commonwealth. For comparison, in the previous valuation, there were 2,807 retired participants and 310 beneficiaries receiving monthly benefits of \$7,152,307, excluding COLAs reimbursed by the Commonwealth.

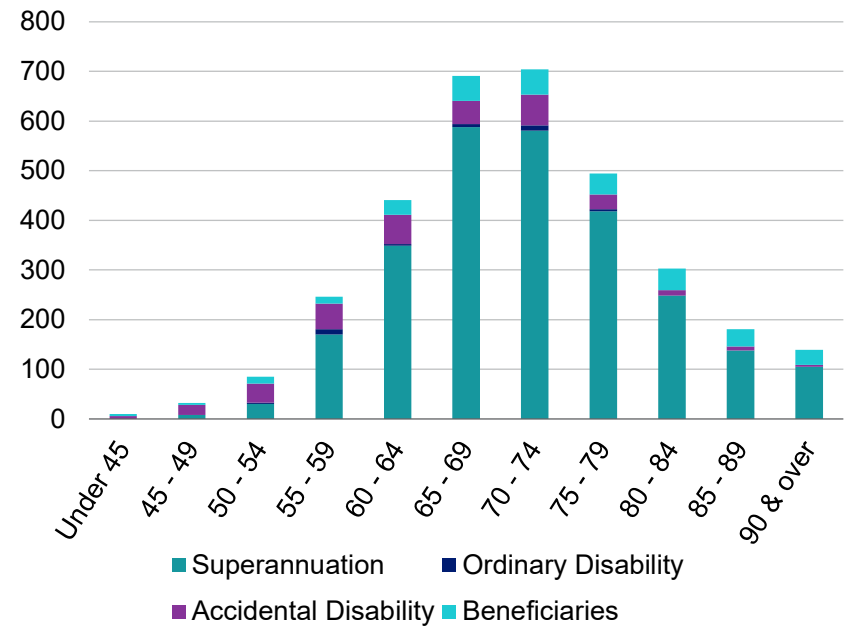
As of December 31, 2019, the average monthly benefit for retired participants and beneficiaries is \$2,484, compared to \$2,295 in the previous valuation. The average age for retired participants and beneficiaries is 71.1 in the current valuation, compared with 70.7 in the prior valuation.

Distribution of Pensioners and Beneficiaries as of December 31, 2019

by Type and Monthly Amount



by Type and Age



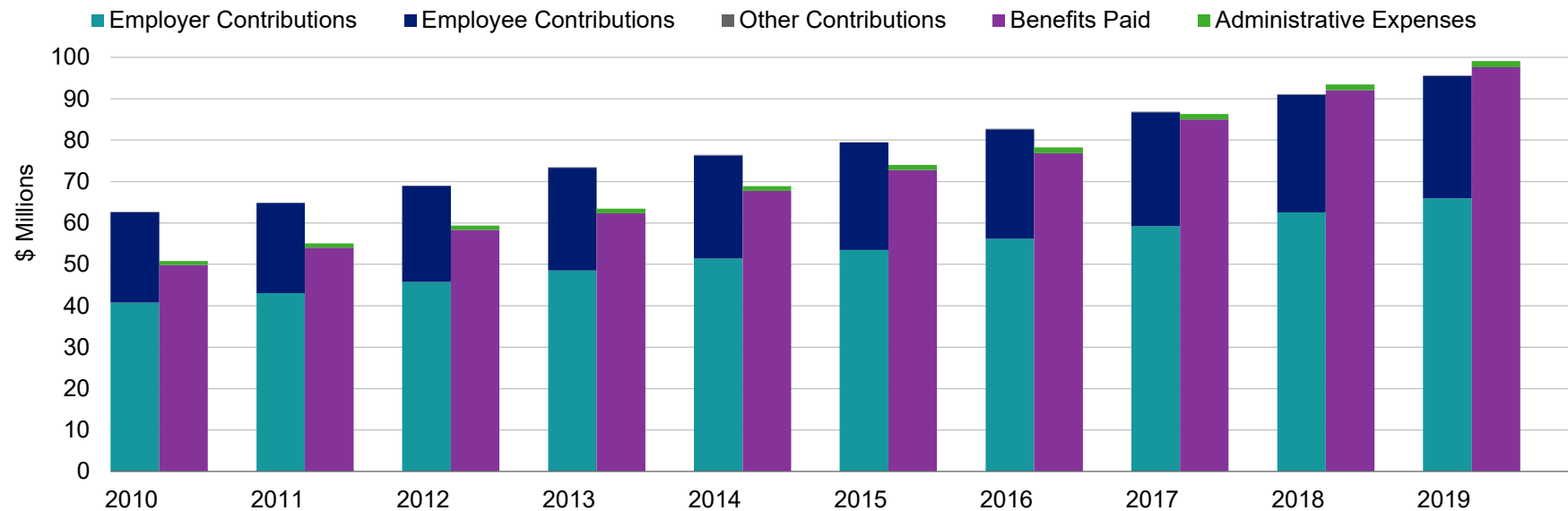
Section 2: Actuarial Valuation Results

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, Exhibit C*.

Comparison of Contributions with Benefits and Expenses
for Years Ended December 31, 2010 – 2019



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.

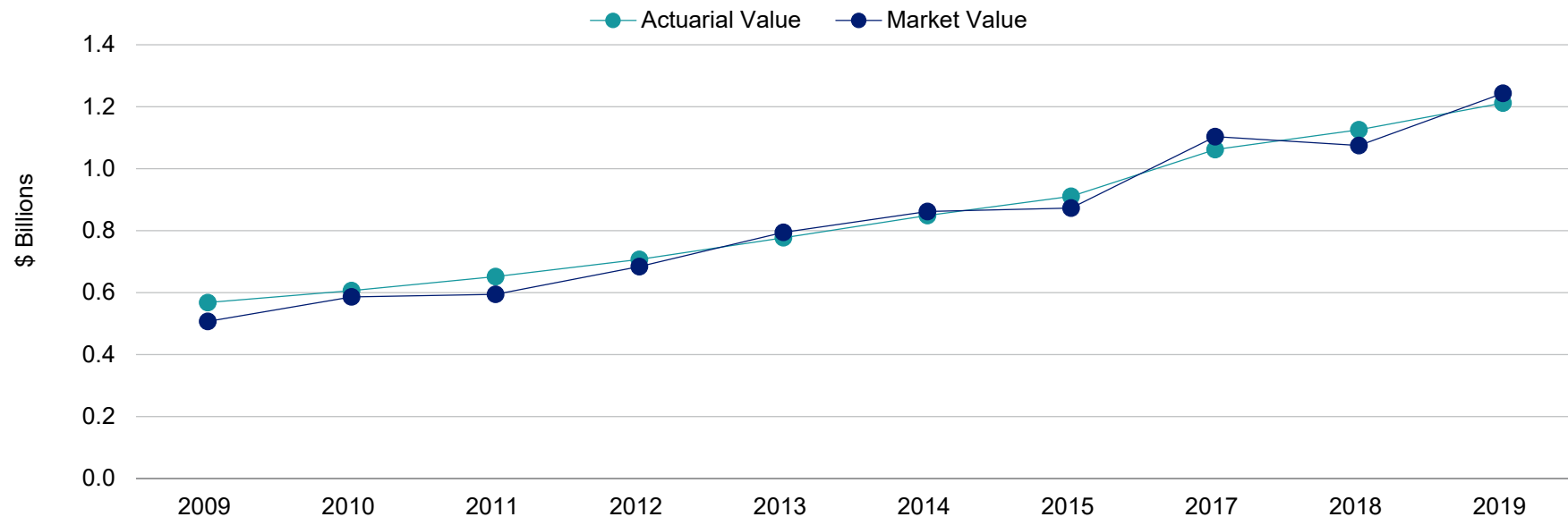
Determination of Actuarial Value of Assets

		Year Ended	
		December 31, 2019	December 31, 2018
1	Actuarial value of assets at the beginning of the year	\$1,124,908,687	\$1,061,514,465
2	Contributions, less benefit payments and expense during the year	-3,518,096	-2,331,998
3	Average actuarial value: (1) + [50% of (2)]	1,123,149,639	1,060,348,466
4	Expected investment income: 7.375% x (3)	82,832,286	78,200,699
5	Preliminary actuarial value of assets at the end of the year: (1) + (2) + (4)	1,204,222,877	1,137,383,166
6	Market value of assets at the end of the year	1,243,664,647	1,075,010,769
7	Adjustment toward market value: 20% of [(6) – (5)]	7,888,354	-12,474,479
8	Adjustment to be within 20% corridor	<u>0</u>	<u>0</u>
9	Final actuarial value of assets at the end of the year: (5) + (7) + (8)	\$1,212,111,231	\$1,124,908,687
10	Actuarial value as a percentage of market value: (9) ÷ (6)	97.46%	104.64%

Section 2: Actuarial Valuation Results

Both the actuarial value and market value of assets are representations of the Association'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 Association'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, 2009 – 2019



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 loss over the two-year period is \$6,474,436, which includes \$4,586,126 from investment losses and \$1,888,310 in losses 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 Two-Year Period Ended December 31, 2019

1	Net loss from investments	-\$4,586,126
2	Net gain from administrative expenses	250,906
3	Net loss from other experience	-2,139,216
4	Net experience loss: 1 + 2 + 3	-\$6,474,436

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 Association's investment policy. The rate of return on the market value of assets for the 2019 and 2018 plan years was 16.04% and -2.37%, respectively.

For valuation purposes, the assumed rate of return on the actuarial value of assets was 7.375% for the 2019 and 2018 plan years. The actual rates of return on an actuarial basis for the 2019 and 2018 plan years were 8.08% and 6.20%, respectively. The Association experienced an actuarial loss during the two-year period ending December 31, 2019 with regard to its investments due to the 2018 actual return being less than the assumed return, partially offset by the 2019 return being more than the assumed return.

Investment Experience

	Year Ended December 31, 2019		Year Ended December 31, 2018	
	Market Value	Actuarial Value	Market Value	Actuarial Value
1 Net investment income	\$172,171,974	\$90,720,640	-\$26,151,048	\$65,726,219
2 Average value of assets	1,073,251,721	1,123,149,639	1,102,327,816	1,060,348,466
3 Rate of return: 1 + 2	16.04%	8.08%	-2.37%	6.20%
4 Assumed rate of return	7.375%	7.375%	7.375%	7.375%
5 Expected investment income: 2 x 4	\$79,152,314	\$82,832,286	\$81,296,676	\$78,200,699
6 Actuarial gain/(loss): 1 - 5	\$93,019,660	\$7,888,354	-\$107,447,724	-\$12,474,480

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 14 years, including the average over that time period.

Based on this experience and future expectations, we have lowered the assumed rate of return from 7.375% to 7.15%.

Investment Return – Actuarial Value vs. Market Value: 2006 - 2019

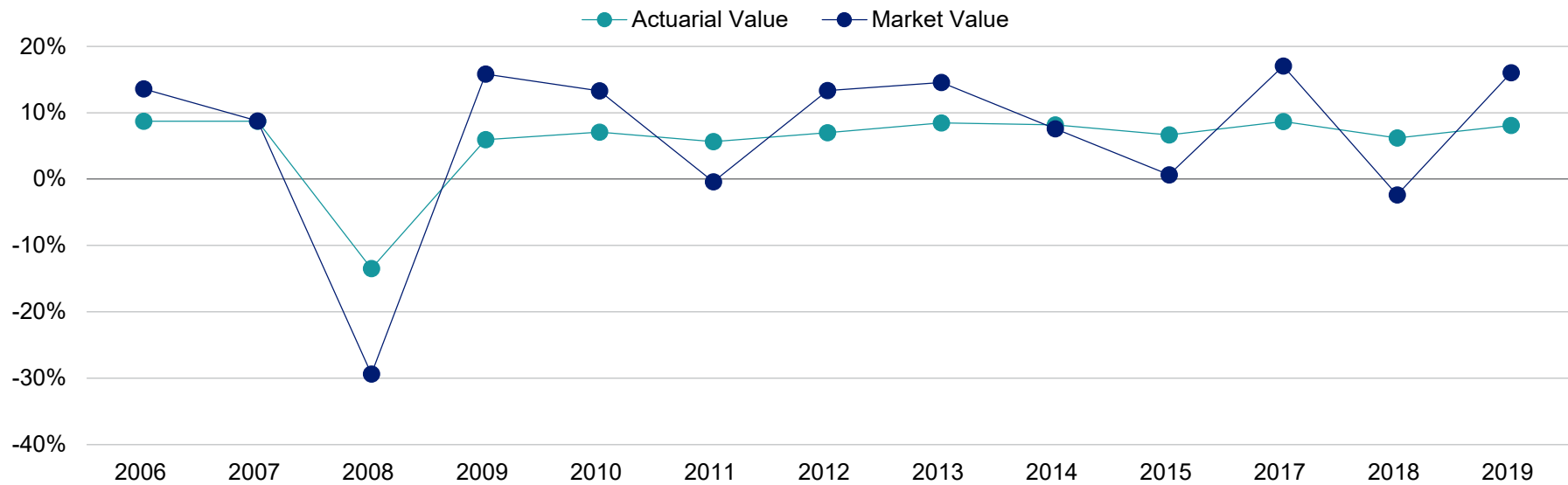
Year Ended December 31	Actuarial Value Investment Return		Market Value Investment Return	
	Amount	Percent	Amount	Percent
2006	\$41,126,626	8.73%	\$62,425,689	13.61%
2007	45,884,534	8.73%	46,934,182	8.78%
2008	-79,377,767	-13.47%	-176,200,834	-29.39%
2009	31,460,127	5.96%	69,758,113	15.81%
2010	39,828,569	7.10%	68,065,161	13.28%
2011	34,646,341	5.67%	-2,301,715	-0.39%
2012	45,883,414	7.00%	79,901,995	13.34%
2013	60,295,420	8.47%	100,382,552	14.58%
2014	63,924,668	8.19%	60,589,023	7.60%
2015	56,598,880	6.65%	5,470,561	0.63%
2016	61,119,464	6.70%	64,678,207	7.39%
2017	84,938,964	8.70%	160,812,944	17.06%
2018	65,726,219	6.20%	-26,151,048	-2.37%
2019	90,720,640	8.08%	172,171,974	16.04%
Most recent five-year average return		7.29%		7.76%
Most recent ten-year average return		7.32%		8.50%
Most recent 14-year average return		6.21%		6.81%

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

Section 2: Actuarial Valuation Results

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, 2006 - 2019



Section 2: Actuarial Valuation Results

Non-investment experience

Administrative expenses

- Administrative expenses for the years ended December 31, 2018 and 2019 totaled \$1,385,432 and \$1,481,838,, respectively, as compared to the assumption of \$1,500,000 for calendar year 2018 and \$1,548,750 for calendar year 2019. This resulted in a gain of \$250,906 for the two-year period, including an adjustment for interest. Based on information on expenses provided by the Retirement Association, we have increased the assumption to \$1,850,000 for calendar year 2020.

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 2 years was 73 per year compared to 73 projected deaths per year. The average number of deaths for disabled pensioners over the past 2 years was 13 per year compared to 8 projected deaths per year. The average number of deaths for beneficiaries over the past 2 years was 12 per year compared to 12 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 loss from this other experience for the two-year period ending December 31, 2019 amounted to \$2,139,216, which is 0.1% of the actuarial accrued liability.

Liability Changes Due to Demographic Experience for Two-Year Period Ended December 31, 2019

Gain due to mortality experience	\$62,438
Loss due to salaries increasing more than expected	-3,527,494
Miscellaneous experience gain, including transfers in with high service	1,325,840
Total	-\$2,139,216

Section 2: Actuarial Valuation Results

Actuarial assumptions

The assumption changes reflected in this report are:

- The net investment return assumption was lowered from 7.375% to 7.15%.
- The administrative expense assumption was changed from \$1,500,000 for calendar 2018, increasing 3.25% per year, to \$1,850,000 for calendar 2020, increasing 3.25% per year.

Changing these assumptions increased the unfunded liability by approximately \$47.8 million and increased the employer normal cost by approximately \$2.5 million.

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

	Year Ended	
	December 31, 2019	December 31, 2018
1 Unfunded actuarial accrued liability at beginning of year	\$726,912,553	\$722,422,821
2 Normal cost at beginning of year	45,035,669	43,552,752
3 Total contributions	-95,558,850	-91,063,563
4 Interest		
• For whole year on 1 + 2	\$56,931,181	\$56,490,698
• For half year on 3	<u>-4,717,029</u>	<u>-4,490,155</u>
Total interest	<u>52,214,152</u>	<u>52,000,543</u>
5 Expected unfunded actuarial accrued liability	\$728,603,524	\$726,912,553
6 Changes due to:		
• Investment loss	\$4,586,126	--
• Other experience loss	1,888,310	--
• Assumptions	<u>47,758,691</u>	--
Total changes	<u>54,233,127</u>	--
7 Unfunded actuarial accrued liability at end of year	\$782,836,651	--

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 2021, the actuarially determined contribution has been set equal to the previously budgeted amount of \$70,396,205. The detail of the Actuarially Determined Contribution is shown below.

The funding schedule included in this report is projected to fully fund the Association by June 30, 2037 with appropriations that increase 5.80% per year, if all assumptions are met and there are no changes in the plan of benefits or actuarial assumptions. The prior funding schedule was projected to fully fund the Association by June 30, 2035 with appropriations that increase 5.28% per year.

In the funding schedule in this report the 2010 ERI is amortized in level payments through fiscal year 2022, the 2002 and 2003 ERI are amortized in 4.0% increasing payments through June 30, 2037 and the Retired Sheriff liability is amortized in 5.15% increasing payments through June 30, 2037. In the prior funding schedule the 2010 ERI was amortized in level payments through fiscal 2022, the 2002 and 2003 ERI was amortized in 4.0% increasing payments through June 30, 2035 and the Retired Sheriff liability was amortized in 6.30% increasing payments per year through June 30, 2035.

Actuarially Determined Contribution for Year Beginning January 1

	2020		2018	
	Amount	% of Projected Payroll	Amount	% of Projected Payroll
1 Total normal cost	\$47,263,294	15.43%	\$42,052,752	14.85%
2 Administrative expenses	1,850,000	0.60%	1,500,000	0.53%
3 Expected employee contributions	<u>-30,358,516</u>	<u>-9.91%</u>	<u>-27,757,674</u>	<u>-9.80%</u>
4 Employer normal cost: (1) + (2) + (3)	\$18,754,778	6.12%	\$15,795,078	5.58%
5 Actuarial accrued liability	\$1,994,947,882		\$1,783,937,286	
6 Actuarial value of assets	<u>1,212,111,231</u>		<u>1,061,514,465</u>	
7 Unfunded actuarial accrued liability: (5) - (6)	\$782,836,651		\$722,422,821	
8 Employer normal cost projected to July 1, 2020 and 2018, adjusted for timing	19,388,982	6.23%	16,337,763	5.68%
9 Projected unfunded actuarial accrued liability	810,339,928		748,588,317	
10 Payment on projected unfunded actuarial accrued liability, adjusted for timing	<u>51,007,223</u>	16.38%	<u>47,174,486</u>	16.40%
11 Actuarially determined contribution: (8) + (10)	\$70,396,205	22.61%	\$63,512,249	22.08%
12 Projected payroll as of July 1	\$311,342,217		\$287,710,185	

Notes:

Actuarially Determined Contributions are assumed to be paid on July 1 and December 31.

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 ERI (2002) Liability	(4) Amortization of ERI (2003) Liability	(5) Amortization of ERI (2010) Liability	(6) Amortization of Remaining Liability	(7) Plan Cost without Retired Sheriff Liability: (2)+(3)+(4)+ (5)+(6)	(8) Amortization of Retired Sheriff Liability	(9) Actuarially Determined Contribution (ADC): (7)+(8)	(10) Total UAL at Beginning of Fiscal Year	(11) Percent Increase in ADC Over Prior Year
2021	\$19,388,982	\$456,043	\$214,563	\$260,972	\$48,373,335	\$68,693,895	\$1,702,310	\$70,396,205	\$810,339,928	--
2022	20,094,798	474,285	223,146	260,972	51,639,952	72,693,153	1,786,032	74,479,185	814,560,494	5.80%
2023	20,826,130	493,256	232,071	0	55,369,509	76,920,966	1,878,012	78,798,978	815,526,138	5.80%
2024	21,583,894	512,986	241,354	0	59,056,355	81,394,589	1,974,730	83,369,319	812,781,604	5.80%
2025	22,369,041	533,506	251,008	0	62,974,757	86,128,312	2,076,428	88,204,740	805,825,584	5.80%
2026	23,182,554	554,846	261,049	0	67,138,802	91,137,251	2,183,364	93,320,615	794,106,624	5.80%
2027	24,025,452	577,040	271,491	0	71,563,420	96,437,403	2,295,808	98,733,211	777,018,685	5.80%
2028	24,898,791	600,121	282,350	0	76,264,433	102,045,695	2,414,042	104,459,737	753,896,338	5.80%
2029	25,803,662	624,126	293,644	0	81,258,605	107,980,037	2,538,365	110,518,402	724,009,564	5.80%
2030	26,741,200	649,091	305,390	0	86,563,697	114,259,378	2,669,091	116,928,469	686,558,118	5.80%
2031	27,712,575	675,055	317,606	0	92,198,535	120,903,771	2,806,549	123,710,320	640,665,448	5.80%
2032	28,719,003	702,057	330,310	0	98,183,063	127,934,433	2,951,086	130,885,519	585,372,095	5.80%
2033	29,761,741	730,140	343,522	0	104,538,409	135,373,812	3,103,067	138,476,879	519,628,567	5.80%
2034	30,842,092	759,345	357,263	0	111,286,963	143,245,663	3,262,875	146,508,538	442,287,634	5.80%
2035	31,961,405	789,719	371,554	0	118,452,442	151,575,120	3,430,913	155,006,033	352,095,988	5.80%
2036	33,121,077	821,308	386,416	0	126,059,977	160,388,778	3,607,605	163,996,383	247,685,238	5.80%
2037	34,322,556	854,144	401,879	0	124,734,218	160,312,797	3,793,396	164,106,193	127,562,166	0.07%
2038	35,567,341	0	0	0	0	35,567,341	0	35,567,341	0	-78.33%

Notes:

Actuarially Determined Contributions are assumed to be paid on July 1 and December 31.

Actuarial Determined Contribution for fiscal year 2021 is set to the budgeted amount determined with the prior valuation.

Item (2) reflects 3.25% growth in payroll as well as 0.15% adjustment to total normal cost to reflect the effects of mortality improvement due to generational mortality assumption.

Projected normal cost does not reflect the impact of pension reform for new hires.

2002 and 2003 ERI amortization payments calculated to increase 4.0% per year and 2010 ERI amortizations are level.

Payment on Retired County Sheriff Liability (item (8)) increases 5.15% per year and includes the 2002 ERI payment.

Projected unfunded actuarial accrued liability does not reflect deferred investment gains and losses.

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 Retirement Association. We recommend a more detailed assessment to provide the Board with a better understanding of the risks inherent in the Retirement Association. 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 14 years has ranged from a low of -29.39% to a high of 17.06%.
- 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 17 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 experience greater or less than expected.
 - Salary increases greater or less than projected.

Section 2: Actuarial Valuation Results

- Actual Experience and Implications for the Future

Past experience can help demonstrate the sensitivity of key results to the Retirement Association's actual experience.

Over the last 14 years, the investment gain/(loss) on the market value of assets for a year has ranged from a loss of \$225.7 million to a gain of \$93.0 million.

Over the past seven valuations, the non-investment gain/(loss) has ranged from a loss of \$7.2 million to a gain of \$34.2 million.

Since 2009, the funded percentage on the actuarial value of assets has ranged from a low of 53.81% as of January 1, 2009 to a high of 60.76% as of January 1, 2020.

- 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 Retirement Association's asset allocation is aligned to meet emerging pension liabilities.

In 2019, benefits paid plus expenses were \$3.5 million more than contributions received. As the Retirement Association matures, more cash will be needed from the investment portfolio to meet benefit payments.

Section 3: Supplemental Information

Exhibit A: Table of Plan Coverage

Category	Year Ended December 31		Change From Prior Year
	2019	2017	
Active participants in valuation:			
• Number	4,799	4,633	3.6%
• Average age	47.8	48.4	-0.6
• Average years of service	11.4	12.0	-0.6
• Total payroll ¹	\$293,746,441	\$271,510,348	8.2%
• Average payroll	61,210	58,604	4.5%
• Account balances	269,546,417	255,150,662	5.6%
• Number with unknown age	1	1	0.0%
Inactive participants in valuation:			
Inactive participants with a vested right to a deferred or immediate benefit	133	130	2.3%
Inactive participants due a refund of employee contributions	654	564	16.0%
Retired participants:			
• Number in pay status	2,635	2,428	8.5%
• Average age	71.7	71.5	0.2
• Average monthly benefit	\$2,487	\$2,297	8.3%
Disabled participants:			
• Number in pay status	373	379	-1.6%
• Average age	64.4	63.9	0.5
• Average monthly benefit	\$3,271	\$3,042	7.5%
Beneficiaries:			
• Number in pay status	318	310	2.6%
• Average age	73.7	73.1	0.6
• Average monthly benefit	\$1,535	\$1,363	12.6%

¹ Payroll figures are for the prior year and reflect annualized salaries for participants hired during the year.

Section 3: Supplemental Information

Exhibit B: Participants in Active Service as of December 31, 2019 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	149	147	2	--	--	--	--	--	--	--
	\$41,678	\$41,424	\$60,324	--	--	--	--	--	--	--
25 - 29	360	313	45	2	--	--	--	--	--	--
	\$49,137	\$46,945	\$63,871	\$60,533	--	--	--	--	--	--
30 - 34	422	234	145	41	2	--	--	--	--	--
	\$58,735	\$49,980	\$67,700	\$76,914	\$60,377	--	--	--	--	--
35 - 39	475	185	125	113	52	--	--	--	--	--
	\$62,086	\$46,180	\$68,116	\$72,113	\$82,698	--	--	--	--	--
40 - 44	499	195	88	81	111	24	--	--	--	--
	\$64,245	\$45,779	\$62,830	\$75,023	\$83,920	\$92,108	--	--	--	--
45 - 49	583	163	109	75	99	92	42	3	--	--
	\$64,706	\$43,544	\$54,392	\$66,361	\$74,527	\$87,675	\$95,670	\$85,860	--	--
50 - 54	730	160	125	104	95	89	80	71	6	--
	\$68,346	\$43,648	\$56,129	\$58,823	\$73,386	\$84,319	\$95,884	\$98,616	\$104,490	--
55 - 59	678	128	98	110	129	68	57	64	23	1
	\$62,855	\$46,992	\$45,235	\$58,379	\$60,605	\$73,156	\$81,949	\$88,779	\$109,317	\$85,961
60 - 64	602	91	87	84	118	94	56	48	15	9
	\$61,141	\$41,495	\$54,124	\$64,747	\$59,025	\$58,910	\$67,698	\$87,976	\$86,127	\$119,417
65 - 69	231	31	35	43	47	42	16	9	3	5
	\$55,652	\$43,004	\$53,316	\$55,548	\$55,859	\$53,165	\$61,753	\$75,320	\$94,411	\$92,087
70 & over	69	13	9	15	12	9	3	5	2	1
	\$51,531	\$42,436	\$37,596	\$53,769	\$49,341	\$61,336	\$70,650	\$53,755	\$68,562	\$97,087
Unknown	1	1	--	--	--	--	--	--	--	--
	\$47,770	\$47,770	--	--	--	--	--	--	--	--
Total	4,799	1,661	868	668	665	418	254	200	49	16
	\$61,210	\$45,606	\$58,924	\$65,345	\$69,303	\$74,350	\$84,059	\$90,553	\$99,051	\$107,390

Section 3: Supplemental Information

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

	Year Ended December 31, 2019	Year Ended December 31, 2018
Net assets at market value at the beginning of the year	\$1,075,010,769	\$1,103,493,815
Contribution income:		
• Employer contributions	\$65,893,245	\$62,518,733
• Employee contributions	29,546,720	28,391,646
• Other contributions	118,885	153,184
• Less administrative expenses	<u>-1,481,838</u>	<u>-1,385,432</u>
Net contribution income	\$94,077,012	\$89,678,131
Net investment income	<u>172,171,974</u>	<u>-26,151,048</u>
Total income available for benefits	\$266,248,986	\$63,527,083
Less benefit payments:		
• Pensions, annuities, refunds and net transfers	<u>-\$97,740,653</u>	<u>-\$91,888,655</u>
• Net 3(8)(c) reimbursements	<u>145,545</u>	<u>-121,474</u>
<i>Net benefit payments</i>	<i>-\$97,595,108</i>	<i>-\$92,010,129</i>
Change in reserve for future benefits	\$168,653,878	-\$28,483,046
Net assets at market value at the end of the year	\$1,243,664,647	\$1,075,010,769

Section 3: Supplemental Information

Exhibit D: Table of Amortization Bases as of July 1, 2020

Type	Annual Payment	Years Remaining	Outstanding Balance
2002 ERI liability	\$456,043	17.00	\$6,066,187
2003 ERI liability	214,563	17.00	2,854,076
2010 ERI liability	260,972	2.00	495,894
Retired county sheriffs liability	1,702,310	17.00	24,517,799
Remaining unfunded liability	<u>48,373,335</u>	17.00	<u>776,405,972</u>
Total	\$51,007,223		\$810,339,928

Notes:

Payments assumed to be made on July 1 and December 31.

ERI amortization payments are calculated to increase 4.0% per year, except for 2010 ERI amortization payments, which are level.

Payments on retired county sheriffs liability increase 5.15% per year.

Payment on remaining unfunded liability reflects adjustment to set fiscal 2021 appropriation to budgeted amount.

Section 3: Supplemental Information

Exhibit E: Unit Allocation of ERI Amortizations for Fiscal 2021

Unit	2002 ERI	2003 ERI	2010 ERI	Total
Barnstable County	\$94,926	\$29,970	\$0	\$124,896
Barnstable Fire	4,593	0	0	4,593
Barnstable Housing Authority	4,125	0	0	4,125
Bourne Recreation	18,154	0	0	18,154
Bourne Water	5,262	0	0	5,262
C.O.M.M. Fire	0	5,259	0	5,259
Cape Cod Mosquito	2,880	0	0	2,880
County Hospital	8,171	0	0	8,171
Dennis Housing	2,750	0	0	2,750
Hyannis Fire	1,817	0	0	1,817
Mashpee Water	0	4,577	0	4,577
Town of Barnstable	109,796	0	105,271	215,067
Town of Bourne	85,302	0	0	85,302
Town of Brewster	18,023	0	0	18,023
Town of Chatham	0	0	100,373	100,373
Town of Eastham	25,290	0	0	25,290
Town of Mashpee	40,368	0	0	40,368
Town of Nantucket	0	127,114	0	127,114
Town of Truro	14,737	0	0	14,737
Town of Wellfleet	15,435	0	0	15,435
Town of Yarmouth	0	43,215	55,328	98,543
Veterans District	4,414	0	0	4,414
Yarmouth Housing	<u>0</u>	<u>4,428</u>	<u>0</u>	<u>4,428</u>
Total	\$456,043	\$214,563	\$260,972	\$931,578

Section 3: Supplemental Information

Exhibit F: Definition 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):	<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>

Section 3: Supplemental Information

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: <u>Investment return</u> - the rate of investment yield that the Fund will earn over the long-term future; <u>Mortality rates</u> - the death rates of employees and pensioners; life expectancy is based on these rates; <u>Retirement rates</u> - the rate or probability of retirement at a given age or service; <u>Disability rates</u> - the probability of disability retirement at a given age; <u>Withdrawal rates</u> - the rates 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 and productivity growth.

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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.

Section 3: Supplemental Information

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: 7.15% (previously, 7.375%)
 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:	Years of Service	Group 1	Group 2	Group 4
	0	6.00%	6.00%	7.00%
	1	5.50%	5.50%	6.50%
	2	5.50%	5.50%	6.00%
	3	5.25%	5.25%	5.75%
	4	5.25%	5.25%	5.25%
	5	4.75%	4.75%	5.25%
	6	4.75%	4.75%	4.75%
	7	4.50%	4.50%	4.75%
	8	4.50%	4.50%	4.50%
	9	4.25%	4.25%	4.50%
	10	4.25%	4.25%	4.50%
	11	4.00%	4.25%	4.50%
	12+	4.00%	4.25%	4.50%

Includes an allowance for wage inflation of 3.25%.
 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: \$1,850,000 for calendar 2020, increasing 3.25% per year (previously, \$1,500,000 for calendar 2018, increasing 3.25% per year).
 The administrative expense assumption is based on information on expenses provided by the Retirement Association.

Section 4: Actuarial Valuation Basis

Mortality Rates:

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 ten 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:

Age	Groups 1 and 2 - Rate (%)		
	Mortality		
	Male	Female	Disability
20	0.05	0.02	0.01
25	0.06	0.02	0.02
30	0.06	0.02	0.03
35	0.07	0.03	0.06
40	0.08	0.04	0.10
45	0.13	0.07	0.15
50	0.22	0.12	0.19
55	0.36	0.19	0.24
60	0.61	0.27	0.28

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		
	Male	Female	Disability
20	0.05	0.02	0.10
25	0.06	0.02	0.20
30	0.06	0.02	0.30
35	0.07	0.03	0.30
40	0.08	0.04	0.30
45	0.13	0.07	1.00
50	0.22	0.12	1.25
55	0.36	0.19	1.20
60	0.61	0.27	0.85

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.

Section 4: Actuarial Valuation Basis

Withdrawal Rates:

		Rate per year (%)	
Years of Service	Groups 1 and 2	Years of Service	Group 4
0	15.0	0 – 10	1.5
1	12.0	11+	0.0
2	10.0		
3	9.0		
4	8.0		
5	7.6		
6	7.5		
7	6.7		
8	6.3		
9	5.9		
10	5.4		
11	5.0		
12	4.6		
13	4.1		
14	3.7		
15	3.3		
16 – 20	2.0		
21 – 29	1.0		
30+	0.0		

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 ten years.

Section 4: Actuarial Valuation Basis

Retirement Rates:

Age	Rate per year (%)		
	Groups 1 and 2		Group 4
	Male	Female	
45 – 49	--	--	1.0
50 – 51	1.0	1.5	2.0
52	1.0	2.0	2.0
53	1.0	2.5	5.0
54	2.0	2.5	7.5
55	2.0	5.5	15.0
56 – 57	2.5	6.5	10.0
58	5.0	6.5	10.0
59	6.5	6.5	15.0
60	12.0	5.0	20.0
61	20.0	13.0	20.0
62	30.0	15.0	25.0
63	25.0	12.5	25.0
64	22.0	18.0	30.0
65	40.0	15.0	100.0
66 – 67	25.0	20.0	--
68	30.0	25.0	--
69	30.0	20.0	--
70	100.0	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' assumption over the most recent ten years.

Section 4: Actuarial Valuation Basis

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:	75% of participants are assumed to be married. None are assumed to have dependent children. Females are assumed to be three years younger than their spouses.
Benefit Election:	All participants are assumed to elect Option A. The benefit election reflects the fact that all benefit options are actuarially equivalent.
2019 Salary:	2019 salaries are equal to salaries provided in the data, annualized for new hires.
Total Service:	Total creditable service reported in the data. If missing, total creditable service estimated from date of hire.
Net 3(8)(c) Liability:	No liability is valued for benefits paid to or received from other municipal retirement systems.
Actuarial Value of Assets:	A preliminary actuarial value is first determined by taking the actuarial value of assets at the beginning of the year and adding assumed investment earnings (at the assumed actuarial rate of return) and the net new money during the year (contributions less benefit payments and administrative expenses). Twenty percent of the difference between the market value of assets as reported in the Association's Annual Statement and the preliminary actuarial value of assets is added to the preliminary actuarial value. In order that the actuarial value not differ too significantly from the market value of assets, the final actuarial value of assets must be within 20% of the market value of assets.
Actuarial Cost Method:	Entry Age Normal Actuarial Cost Method. Entry Age is the attained age of the participant minus total creditable service. 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.
Expected Remaining Service Lives:	The average of the expected service lives of all employees is determined by: <ul style="list-style-type: none">• Calculating each active employee's expected remaining service life as the present value of \$1 per year of future service at zero percent interest.• Setting the remaining service life to zero for each nonactive or retired member.• Dividing the sum of the above amounts by the total number of active employee, nonactive, and retired members.• This amount was then rounded up to the nearest whole number.

Section 4: Actuarial Valuation Basis

Justification for Change in Actuarial Assumptions:

Based on past experience and future expectations, the following actuarial assumption were changed as of January 1, 2020:

- The investment return assumption was lowered from 7.375% to 7.15%.
- The administrative expense assumption was changed from 1,500,000 for calendar 2018, increasing 3.25% per year, to \$1,850,000 for calendar 2020, increasing 3.25% per year.

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: 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.

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

Section 4: Actuarial Valuation Basis

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 Association).

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 Association.

Section 4: Actuarial Valuation Basis

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:	<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 \$500 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>
"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.

Section 4: Actuarial Valuation Basis

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 \$18,000 of a retirement allowance. Cost-of-living increases granted prior to July 1, 1998 are reimbursed by the Commonwealth and not reflected in this report.
Changes in Plan Provisions:	None.