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District of Columbia Retirement Board

Teachers' Retirement Plan and
Police Officers & Firefighters'
Retirement Plan

Thirty-Year Projection Study
as of October 1, 2017

www.CavMacConsulting.com

February 22, 2018

The Board of Trustees
District of Columbia Retirement Board
900 7th Street, NW, 2nd Floor
Washington, DC 20001

Dear Trustees:

We are pleased to present the results of a 30-year open group projection to the District of Columbia Retirement Board (DCRB) for the District of Columbia Teachers' Retirement Plan and the District of Columbia Police Officers and Firefighters' Retirement Plan. The purpose of the projection study was to develop a picture of each Plan's funding progress over time and to estimate the future assets, liabilities, contributions and benefit payments for each of the Plans.

In performing the projection study, we relied on the census data as provided by DCRB, the District Government and the U.S. Department of the Treasury and the actuarial assumptions and methods adopted by the DCRB Board from the five-year experience study ended September 30, 2015. The projections used the October 1, 2017 valuation as a baseline. Membership was projected over a 30-year period from that date and actuarial valuations were performed annually for each year of the 30 years to estimate each Plan's future funding progress.

Please note that future actuarial results may differ significantly from the projected results presented in this report due to factors such as plan experience differing from that anticipated by the economic and demographic assumptions, changes in economic or demographic assumptions; and changes in plan provisions or applicable law. As with any projection analysis, this report should not be viewed for absolute results but should be focused on trends in the financial measurements.

This is to certify that the independent consulting actuaries are members of the American Academy of Actuaries, are qualified to make the actuarial opinions contained herein, and have experience in performing valuations and projections for public retirement systems.

The Executive Summary provides a synopsis of the main projection results.

Sincerely,

Edward J. Koebel, EA, FCA, MAAA
Principal and Consulting Actuary

Jonathan T. Craven, ASA, EA, FCA, MAAA
Consulting Actuary

EJK/JTC:bvb

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SECTION I – EXECUTIVE SUMMARY

The following report is being provided to the Board of Trustees of DCRB to provide a forecast of the funding progress over time, demonstrate the estimated future contribution rates and benefit payments for each of the Plans and to review funding goals and benchmarks of the funding policy that were adopted in 2012 and revised in 2017 to include a change in the asset smoothing period from seven years to five years and a change to the amortization methodology. The overall purpose of this report is to be used as a board and staff planning tool to help guide investment decisions and assist Trustees in estimating any potential liquidity needs in the future to ensure that enough cash is on hand to pay benefits.

The objective of the funding policy is to accumulate sufficient assets during a member's employment to fully finance the benefit the member receives throughout retirement. In order to meet the funding goals and benchmarks, projections are beneficial to determine whether the funding ratio target of 100% can be maintained and whether employer contribution rates are projected to be stable or declining.

Therefore, we have produced separate 30-year projections for each of the Teachers', Police Officers' and Firefighters' Retirement Plans, which are shown in the next seven sections of the report.

Regular actuarial valuations measure DCRB's present financial position and contribution adequacy by calculating and financing the liabilities created by the present benefit program. This process involves discounting to present values the future benefit payments on behalf of present active members, retired members and their survivors. However, valuations do not produce information regarding future changes in the makeup of the covered group or the amounts of benefits to be paid or investment income to be received – actuarial projections do.

Whereas valuations provide a snapshot of DCRB as of a given date, projections provide a moving picture. Projected active and retired groups are developed from year to year by the application of assumptions regarding pre-retirement withdrawal from service, retirements, deaths, disabilities, and the addition of new members. Projected information regarding the retired life group leads to assumed future benefit payouts. Performing actuarial valuations every year during the projection period generates expected contribution rates and funded ratios. Combining future benefit payments with assumed contributions based on periodic valuations of the projected membership and expected investment earnings produces the net cash flow of the Plan each year, and thus end of year asset levels. Finally, the projected valuation results permit the development of the funding ratio trend line for the entire projection period.

Projections are used for many purposes. Among them are (i) developing cash flow patterns for investment policy and asset mix consideration, (ii) exploring the effect of alternative assumptions about future experience, and (iii) analyzing the impact on plan funding progress of changes in the workforce.

Projection results are useful in demonstrating changing relationships among key elements affecting plan financial activity (e.g., how benefits payable and plan assets will grow in future decades). Projections are not predictions of specific future events and do not provide numeric precision in absolute terms. For instance, cash flow projected to occur 10 years in the future will not be exact

(except by coincidence), but understanding the changed relationship between future benefit payout and future investment income can be very useful.

The projection of Plan finances over 30 years requires an assumption regarding future new entrants to the Plans as well as the regular valuation assumptions used to estimate the timing of future events for existing members. As members are assumed to terminate service for any reason, they are replaced with a sufficient number of new entrants to keep the active population number constant. Valuations are then performed on the projected active and retired membership for each of the thirty years of the study.

It must be kept in mind that projections do not purport to show exact numerical results over the entire period under study. They do however, provide a good basis for drawing conclusions about the likely position of the Plans and the relative impact changes over the years will have on Plan finances.

The main results from the baseline projections are noted on the following pages. For each of the baseline deterministic projections, we utilized the actuarial assumptions and methods adopted by the DCRB Board from the October 1, 2010 – September 30, 2015 experience study, including an investment rate of return assumption of 6.50% and an inflation assumption of 3.50%. Deterministic projections assume that all future actuarial, demographic and economic, assumptions are projected to occur according to the adopted valuation assumptions. These assumptions can be found in the Appendix.

For the projection study, we have calculated the actuarially determined contribution (ADC) rates, the funded ratio and the cash flow as a percentage of assets for each plan. The ADC rates are calculated each year of the projection period using the methods as outlined in the DCRB funding policy. The ADC to the Plan consist of normal cost contributions and the amortization of the Unfunded Actuarial Accrued Liability (UAAL) contributions. The normal cost is the annual cost of accruing benefits for active members and is calculated using the Entry Age Normal (EAN) actuarial cost method. The amortization period to pay off the Plan's expected 2017 UAAL will be a closed 15-year period. All subsequent changes in the UAAL will be amortized over 20 year closed periods. Each valuation during the projection period will produce an amortization base which will take 20 years to fully amortize. The amortization of the UAAL bases will be developed using the level dollar methodology.

The funded ratio is the primary measure of funded status of a pension plan and, thereby, the most common measurement used for drawing conclusions on funding progress. The funded ratio is the ratio of the actuarial value of assets to the actuarial or accrued liability of the system as calculated by the funding method used in developing system contribution levels. When using the funded ratio in assessing trends over several valuations, we recommend that the basis for determining both the assets and liabilities in the ratio are taken into consideration and reasonable efforts are made to adjust the ratio to reflect these differences when they are known. On a consistent basis, an increasing funded ratio would typically indicate progress in meeting the obligations of the system. In most cases, other measures should also be considered in a trend assessment. These may include the trend in the length of the amortization period, the required contribution rate, percentage of required contributions funded, and the unfunded actuarial liability as a percentage of payroll.

Focusing solely on any one measure as the indication of funding progress is an over simplification of a complex and dynamic system. Therefore, another metric to measure is an outlook on the cash flow as a percentage of assets for the System. Most retirement systems are funded with an advance-funding mechanism, meaning contributions and investment earnings are earned during a member's active lifetime in order to pay for the benefit payments during his retirement years. Since the Plans under DCRB are fairly new (only paying retirement benefits for the past 20 years), each Plan currently has a positive cash flow as a percentage of assets where contributions being collected by employers and employees are more than the benefit payments that are paid out of the trust to retirees.

For the fiscal year ending September 30, 2017, the Teachers' Retirement Plan had a positive cash flow of approximately $12.9 Million (benefit payments of $78.2 Million and total contributions of $91.1 Million). With market value of assets of $1.822 Million as of October 1, 2016, the cash flow as a percentage of assets is positive 0.7% for this valuation. While market value of assets is assumed to earn 6.50% each year, the difference between the investment return assumption and the negative cash flow percentage is positive, meaning assets are projected to grow for the 2018 fiscal year. When assets do not earn a positive return enough to cover any negative cash flow percentage, assets are expected to decline for the year. As long as the negative cash flow percentage does not grow more than the assumed investment return assumption, the System's assets will continue to increase and sustainability of the plan may be achieved.

The tables on the following pages provide the expected actuarially determined contribution (ADC) rates, the funded ratio and the cash flow as a percentage of assets for each of the Plans based on deterministic projections.

Teachers' Retirement Plan

Valuation Year	Actuarially Determined Contribution	Funded Ratio	Cash Flow as a Percentage of Assets
2017	11.09%	92.5%	0.7%
2018	10.65	93.5	0.6
2019	10.34	95.0	0.2
2020	10.30	96.4	0.0
2021	10.00	97.6	(0.2)
2022	10.09	97.9	(0.4)
2023	10.20	98.2	(0.5)
2024	10.28	98.4	(0.5)
2025	10.36	98.7	(0.6)
2026	10.42	98.9	(0.6)
2027	10.49	99.1	(0.6)
…			
2037	9.42	100.0	(1.1)
…			
2047	10.44	100.0	(1.4)

Police Officers' Retirement Plan

Valuation Year	Actuarially Determined Contribution	Funded Ratio	Cash Flow as a Percentage of Assets
2017	19.05%	111.2%	0.8%
2018	18.21	111.2	0.1
2019	17.95	110.9	(0.2)
2020	17.95	110.5	(0.3)
2021	17.92	110.1	(0.5)
2022	18.96	108.8	(0.7)
2023	19.96	107.5	(0.9)
2024	20.81	106.3	(0.9)
2025	21.68	105.3	(1.0)
2026	22.44	104.2	(1.1)
2027	23.19	103.3	(1.2)
…			
2037	35.76	100.0	(1.3)
…			
2047	37.25	100.0	(1.6)

Firefighters' Retirement Plan

Valuation Year	Actuarially Determined Contribution	Funded Ratio	Cash Flow as a Percentage of Assets
2017	25.39%	109.9%	3.8%
2018	24.22	109.8	1.7
2019	24.46	109.8	0.9
2020	24.08	109.6	0.7
2021	23.92	109.4	0.4
2022	25.02	108.3	0.1
2023	26.19	107.1	(0.1)
2024	26.96	106.1	(0.2)
2025	27.89	105.2	(0.3)
2026	28.77	104.3	(0.4)
2027	29.17	103.6	(0.5)
…			
2037	40.33	100.0	(1.4)
…			
2047	42.66	100.0	(1.5)

As can be seen from the tables above, the ADC employer contribution rates as a percentage of payroll are expected to decrease for each of the three Plans over the short-term due to the smoothed recognition of the investment gains that occurred in 2016/2017. Once these investment gains are fully recognized, ADC contribution rates as a percentage of payroll are expected to increase for each Plan as the current UAAL are amortized away. Once each Plan reaches a 100% funded ratio, the ADC contribution rates will consist of only the employer normal cost rates.

In addition, the results demonstrate that under the baseline projections, the cash flow as a percentage of assets never gets less than negative 1.6% for each of these Plans. So, if investment returns meet expectations of 6.50%, assets in the trust fund will continue to grow and the sustainability of each Plan will be guaranteed. This metric should be monitored under the baseline assumptions to ensure the continued growth of DCRB assets during the projection period.

In the sections that follow, we provide background tables and graphs to support the calculations shown in these tables. We conclude with a sensitivity analysis on the investment rate of return assumption.

SECTION II – SPECIAL ASSUMPTIONS

In addition to the regular valuation assumptions and methods used in performing the annual actuarial valuations of DCRB, including using the entry age normal cost method (all assumptions utilized in the projection study are outlined in the Appendix), additional assumptions must be made that are unique to projections. The first of these is what, if any, change in the overall active membership will be anticipated. For this projection study baseline, it was assumed that the number of active members would remain static over the 30 year projection period.

Since we assume active members will leave the Plan through termination, death, disability or retirement, we need to make some assumptions as to the composition of new hires that will replace departing members in order to maintain the membership at a constant number. The new entrant profiles we developed were based on the new hires over the 3-year period prior to the projection start date of October 1, 2017. These profiles are summarized in the tables below.

Teachers' Retirement Plan

Age	Average Pay	Percent Male	Weight
24	$55,500	17%	9%
28	61,250	23	26
32	71,300	26	23
37	78,600	24	14
43	81,600	33	11
47	80,100	35	8
53	81,500	27	4
57	80,300	19	3
62	83,450	30	2

Police Officers' Retirement Plan

Age	Average Pay	Percent Male	Weight
24	$56,800	76%	33%
27	57,000	80	40
32	58,650	83	16
37	61,800	74	5
42	66,100	65	4
48	80,150	85	2

Firefighters' Retirement Plan

Age	Average Pay	Percent Male	Weight
20	$50,850	80%	4%
22	52,150	84	31
27	54,850	88	31
32	60,850	87	16
37	69,600	79	7
42	88,100	69	4
48	91,200	71	5
52	86,200	100	2

SECTION II – SPECIAL ASSUMPTIONS

The special assumptions for the Teachers' Retirement Plan include pay increases from the recently approved collective bargaining agreement. As provided by DCRB staff, we increased pay for teachers according to the following table:

Date	Pay Increase
FYE 2017	4.0%
FYE 2018	3.0%
FYE 2019	2.0%

In addition, special assumptions for the Firefighters' Retirement Plan included proposed pay increases for the next collective bargaining agreement. We included the following proposed pay increases for firefighters during the projection period:

Date	Pay Increase
FYE 2016	4.0%
FYE 2017	4.0%
FYE 2018	3.0%
FYE 2019	2.0%
FYE 2020	3.0%
FYE 2021	3.0%

Lastly, for the projection results presented in this report, it was further assumed that the benefit structure as it exists on October 1, 2017 would remain in place for the following 30 years. For the baseline projections, the DCRB assets (with the exception of the gains and losses already scheduled to be recognized in the next 5 years) would earn the assumed return of 6.50% annually, thus generating no further gains or losses over the projection period.

The following tables and graphs show the headcounts of District active participants and District inactive members (retired and terminated vested) over the projection period. The actives are broken down into those existing as of October 1, 2017 and those who are hired after October 1, 2017. We have assumed the active membership will continue at its current population for each Plan over the projected period for the baseline. By the end of the projection period we estimate that about 99% of those active employees will have been hired after October 1, 2017.

Teachers' Retirement Plan

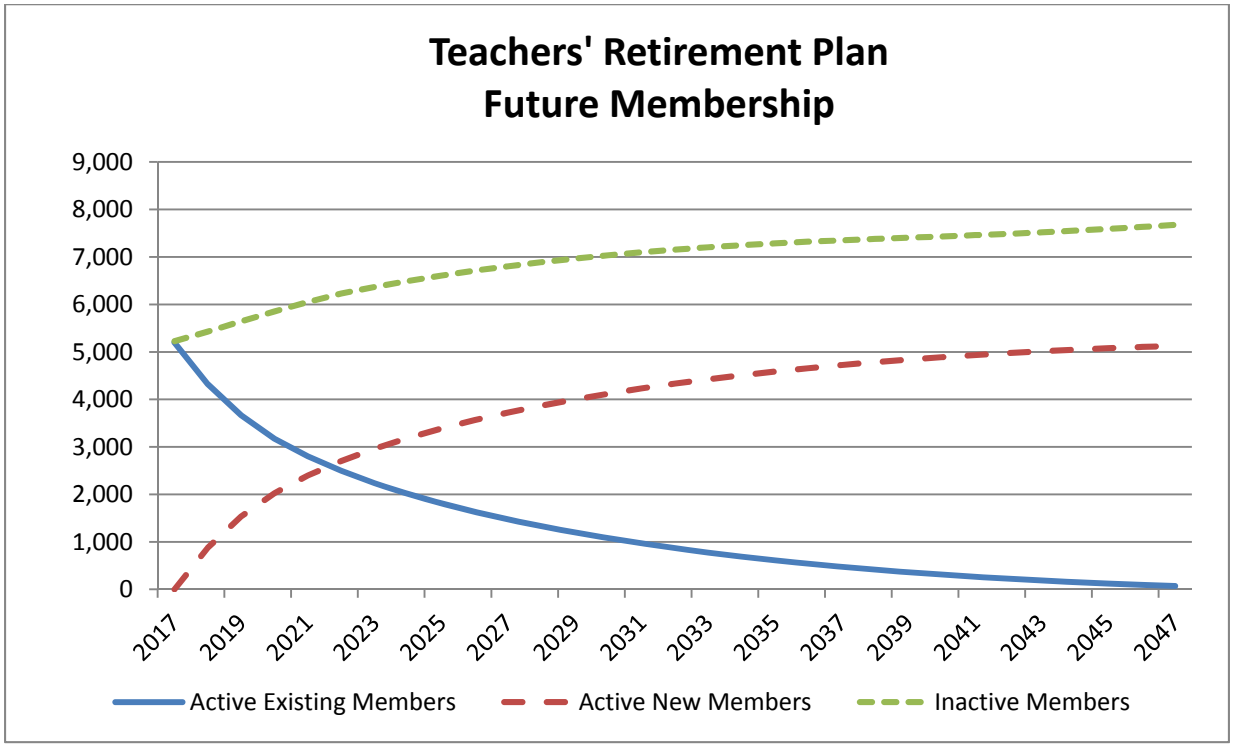
Member	2017	2022	2027	2037	2047
Active – Existing Employees	5,199	2,497	1,474	474	70
Active – New Entrants	0	2,702	3,725	4,725	5,129
Inactive Members	5,229	6,232	6,805	7,352	7,678
Total	10,428	11,431	12,004	12,551	12,877

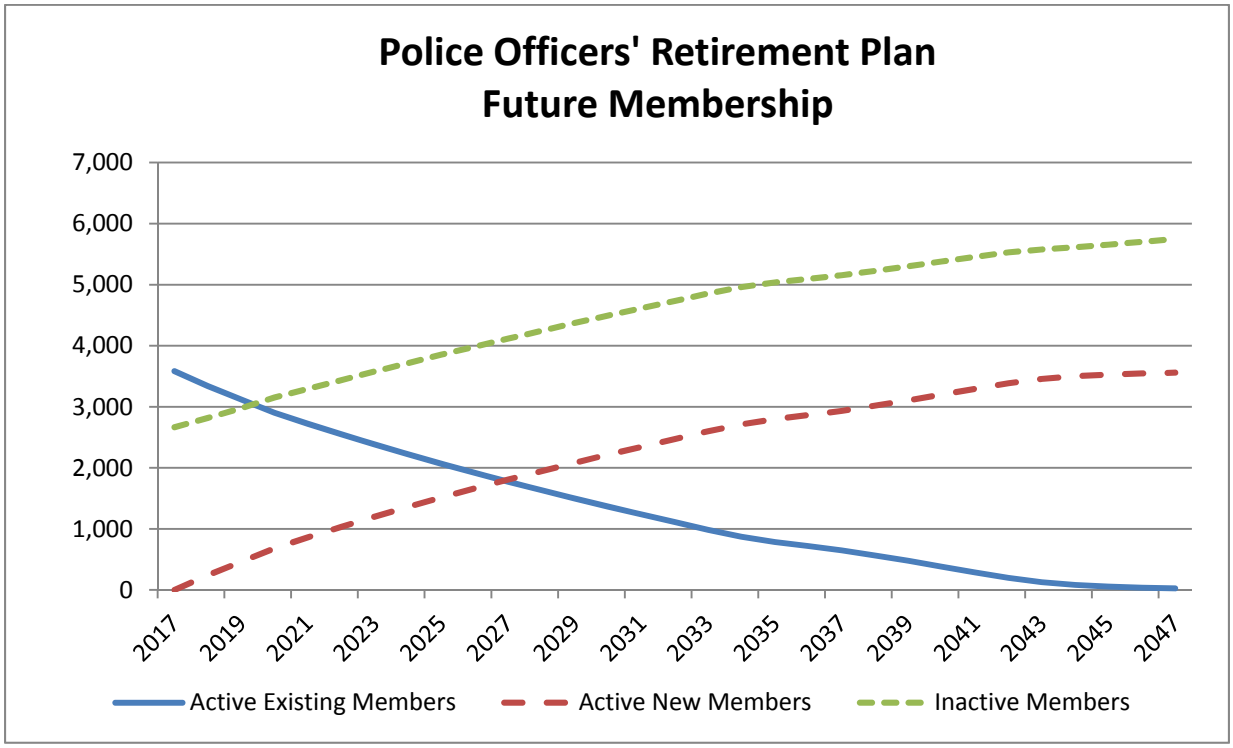
Police Officers' Retirement Plan

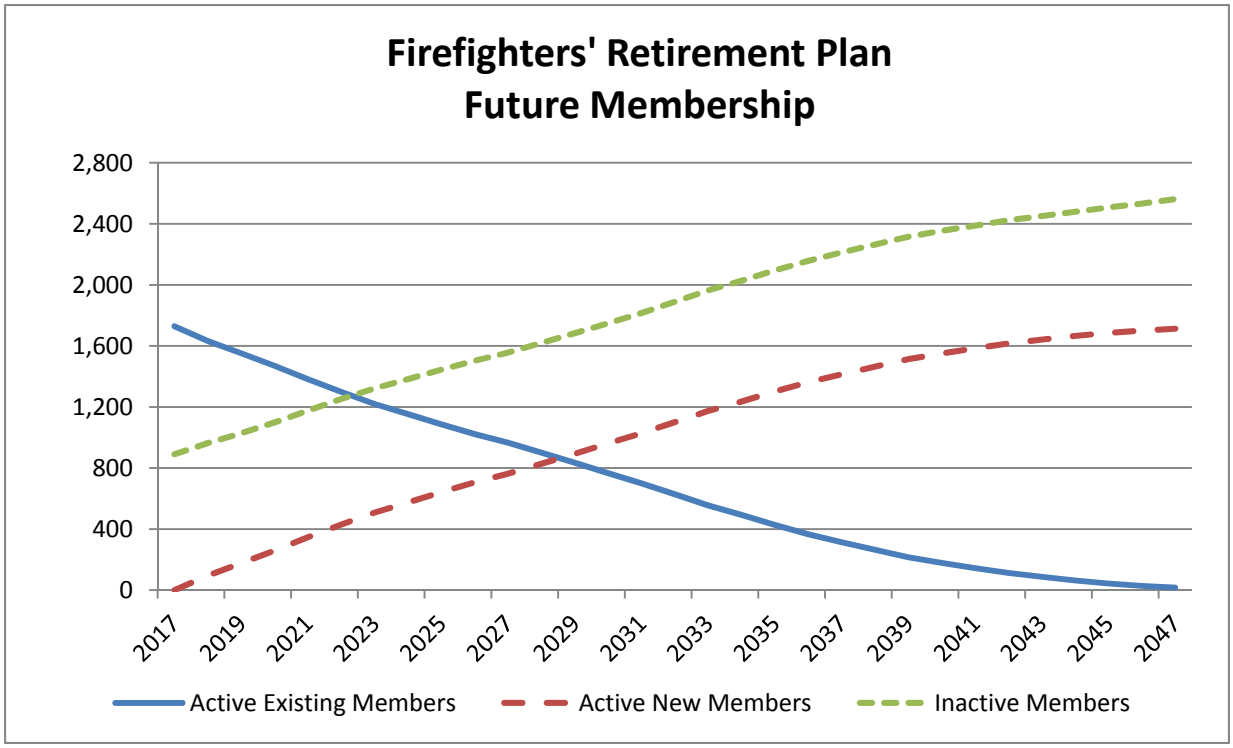
Member	2017	2022	2027	2037	2047
Active – Existing Employees	3,583	2,551	1,773	649	23
Active – New Entrants	0	1,032	1,810	2,934	3,560
Inactive Members	2,665	3,437	4,117	5,155	5,749
Total	6,248	7,020	7,700	8,738	9,332

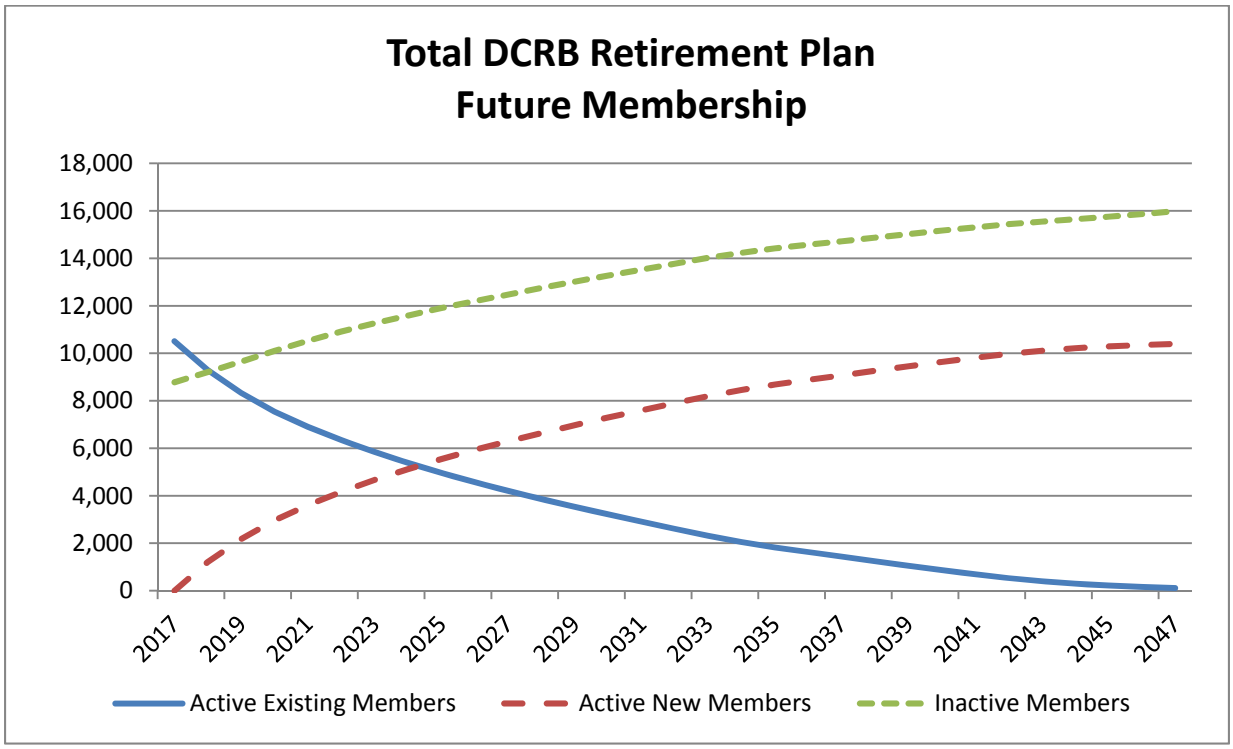
Firefighters' Retirement Plan

Member	2017	2022	2027	2037	2047
Active – Existing Employees	1,729	1,299	966	314	16
Active – New Entrants	0	430	763	1,415	1,713
Inactive Members	890	1,253	1,557	2,213	2,563
Total	2,619	2,982	3,286	3,942	4,292


Teachers' Retirement Plan
Future Membership
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Active Existing Members
Active New Members
Inactive Members


Police Officers' Retirement Plan
Future Membership
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Active Existing Members
Active New Members
Inactive Members


Firefighters' Retirement Plan
Future Membership
2,800
2,400
2,000
1,600
1,200
800
400
0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Active Existing Members
Active New Members
Inactive Members


Total DCRB Retirement Plan
Future Membership
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Active Existing Members
Active New Members
Inactive Members

In addition to the projection of employer contribution rates, it is very important to understand the relationship between expected benefit payments and contributions. The fundamental retirement funding equation is:

$$C + I = B + E$$

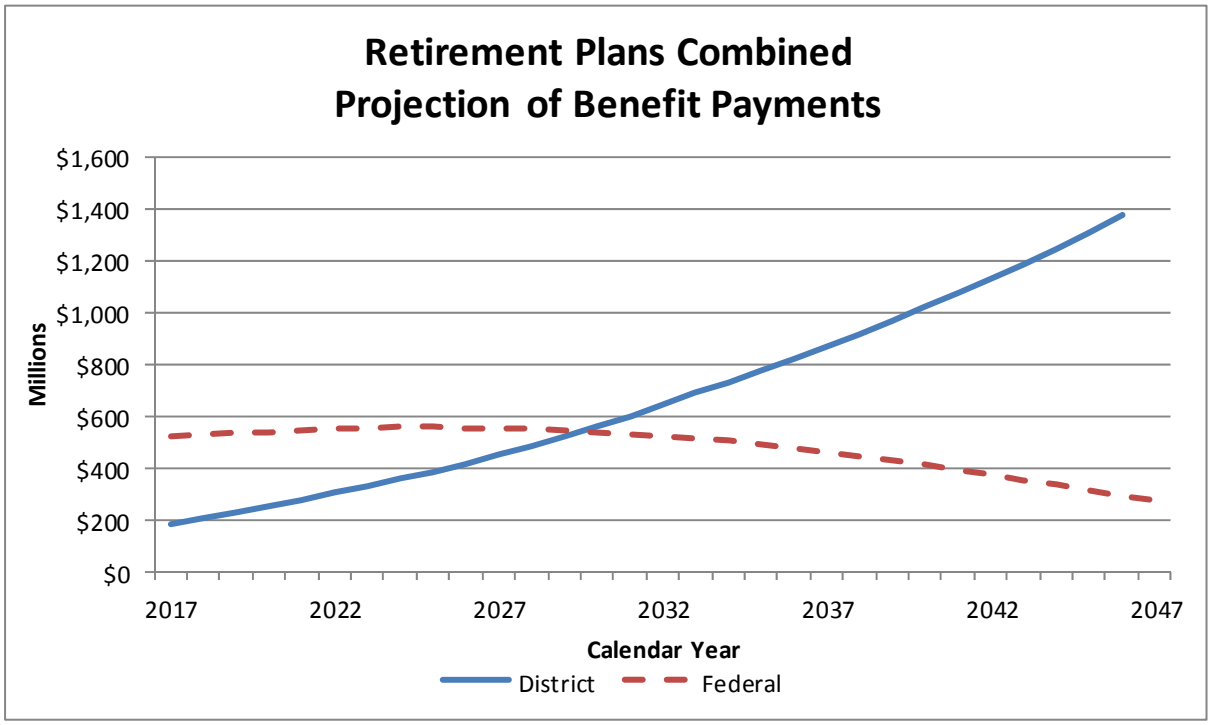
where C = Contributions
I = Investment Income
B = Benefit Payments
E = Expenses

The equation basically states that the dollars that come into the Fund (Contributions and Investment Income) are equal to the dollars that leave the Fund (Benefit Payments and Expenses). This is the main purpose for advance funding a Pension Plan. As a Fund and Plan matures, most of the benefit payments that will be paid out to retirees will be from Investment Income.

Since 1997, the District has been responsible for the payment of benefits to retirees. The current majority of benefit payments is paid by the Treasury for accruals of Federal benefits. However, the District is becoming more and more responsible for an increasing portion of benefits. The following table shows when District benefit payments are expected to exceed Federal benefit payments and when District benefit payments are expected to exceed Contributions:

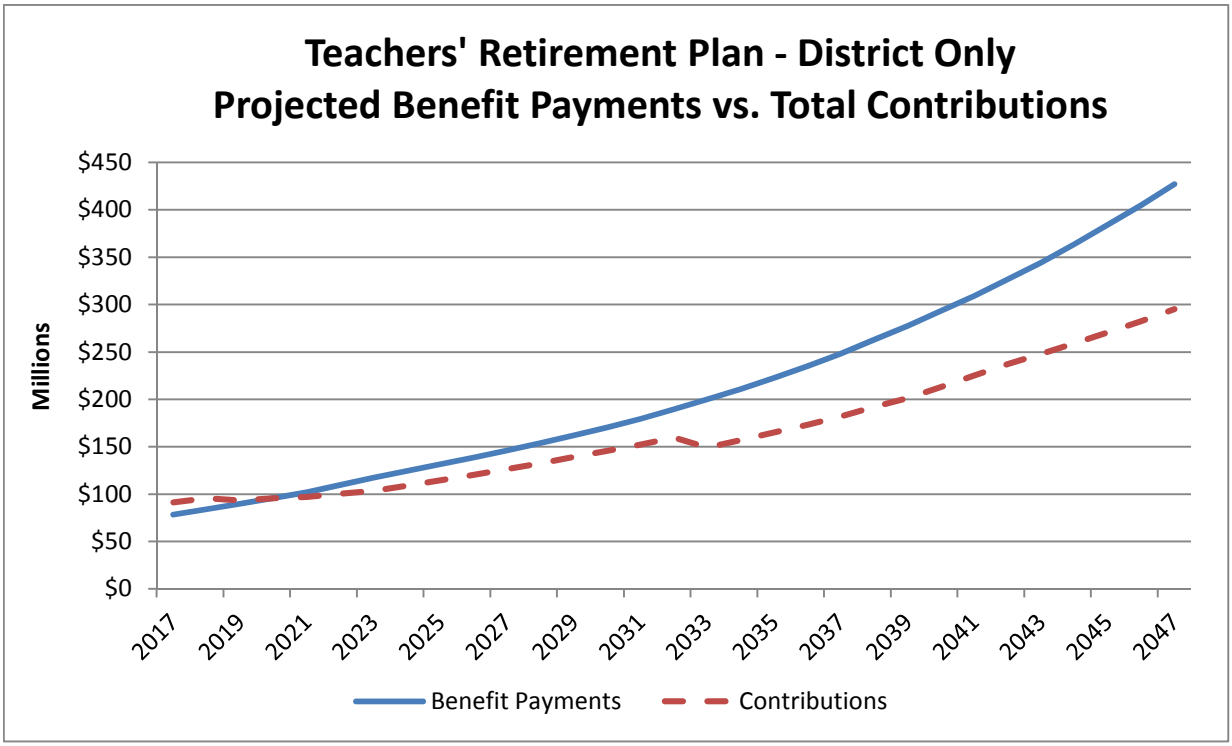
Expected Calendar Year		
Plan	**District Benefit Payments Exceed Federal Benefit Payments**	**District Benefit Payments Exceed Contributions**
Teachers	2032	2021
Police	2032	2019
Fire	2030	2023
All Plans Combined	2031	2021

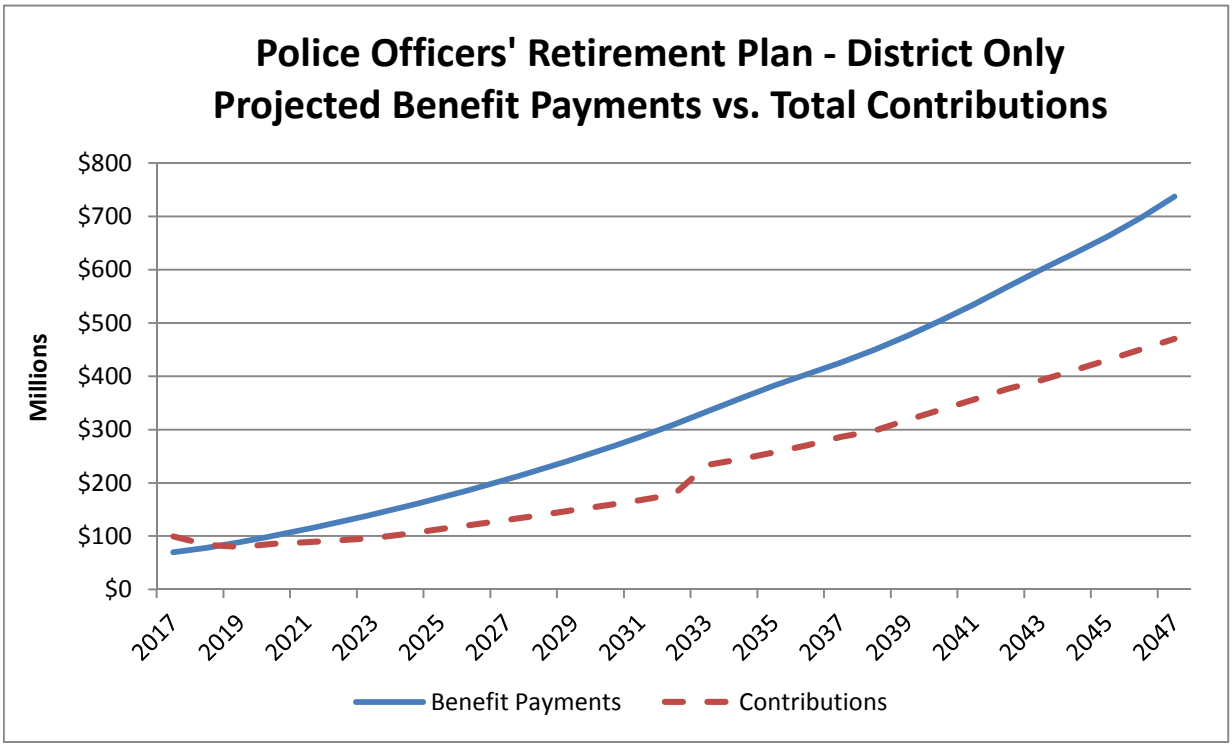
The following graph shows the projection of expected District Benefit Payments and Federal Benefit Payments and when that crossover will be when all plans are combined.

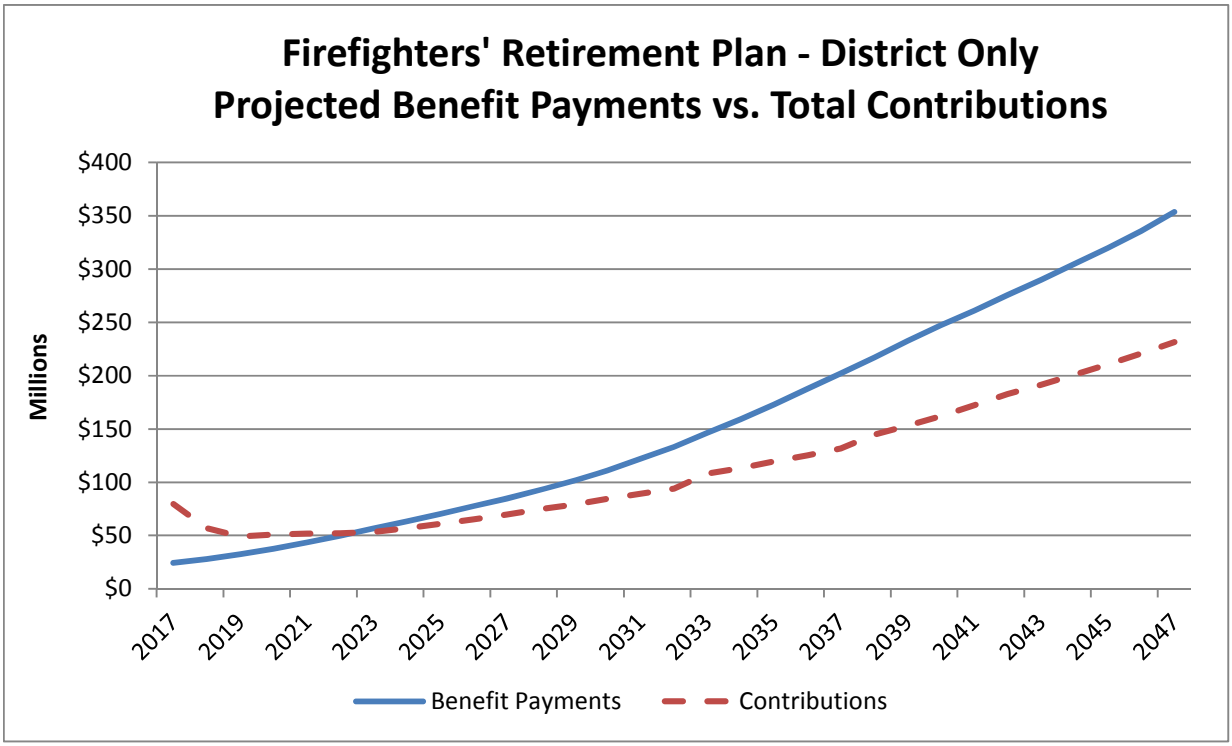


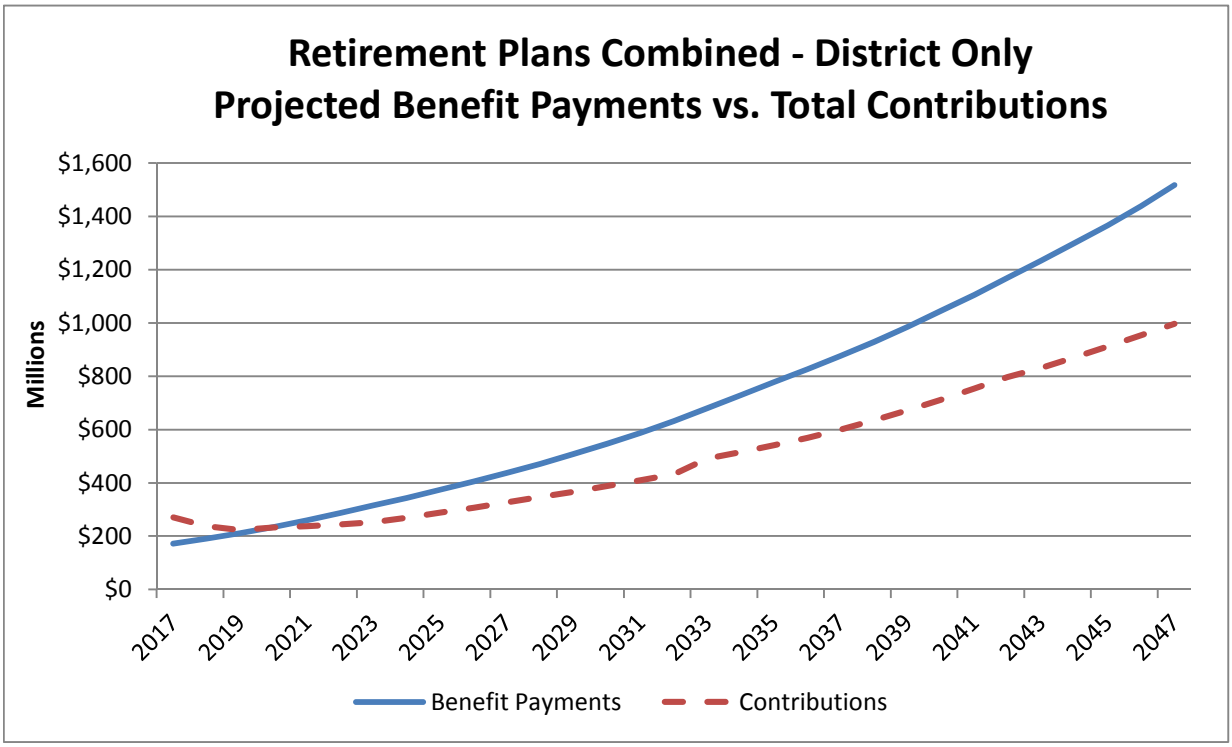
The last column of the table on the previous page is the expected calendar year when benefit payments will exceed total contributions. This is a natural result of the maturation of an advance-funded retirement plan. All such plans eventually reach a point where benefit payments exceed contributions, with the cash flow difference being met by investment income. As was discussed in the Executive Summary, one of the metrics that we will continue to monitor is the cash flow as a percentage of assets. The following graphs show the expected projection of total contributions and District Benefit Payments.

In the Appendix, we include the breakdown of the projection of benefit payments by membership, retirees, current active members and future active members.


Teachers' Retirement Plan - District Only
Projected Benefit Payments vs. Total Contributions
Millions
$450
$400
$350
$300
$250
$200
$150
$100
$50
$0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Benefit Payments
Contributions

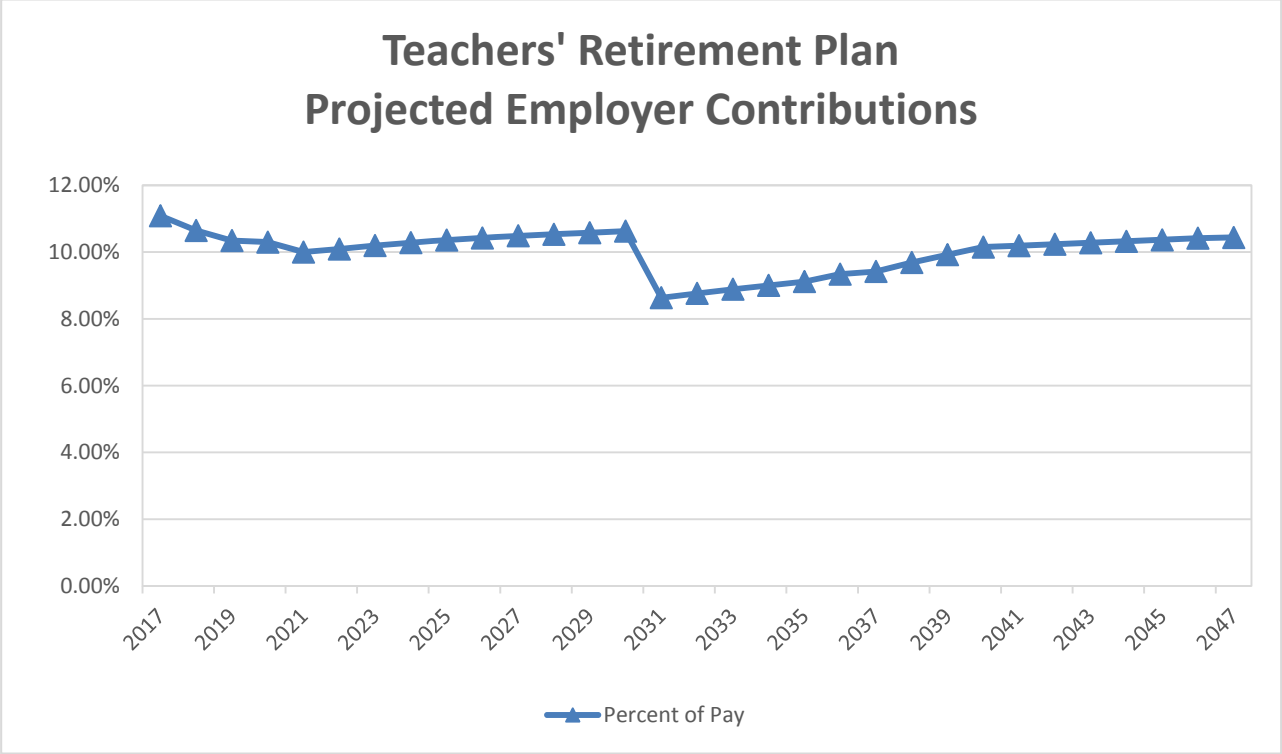

Police Officers' Retirement Plan - District Only
Projected Benefit Payments vs. Total Contributions
Millions
$800
$700
$600
$500
$400
$300
$200
$100
$0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Benefit Payments
Contributions

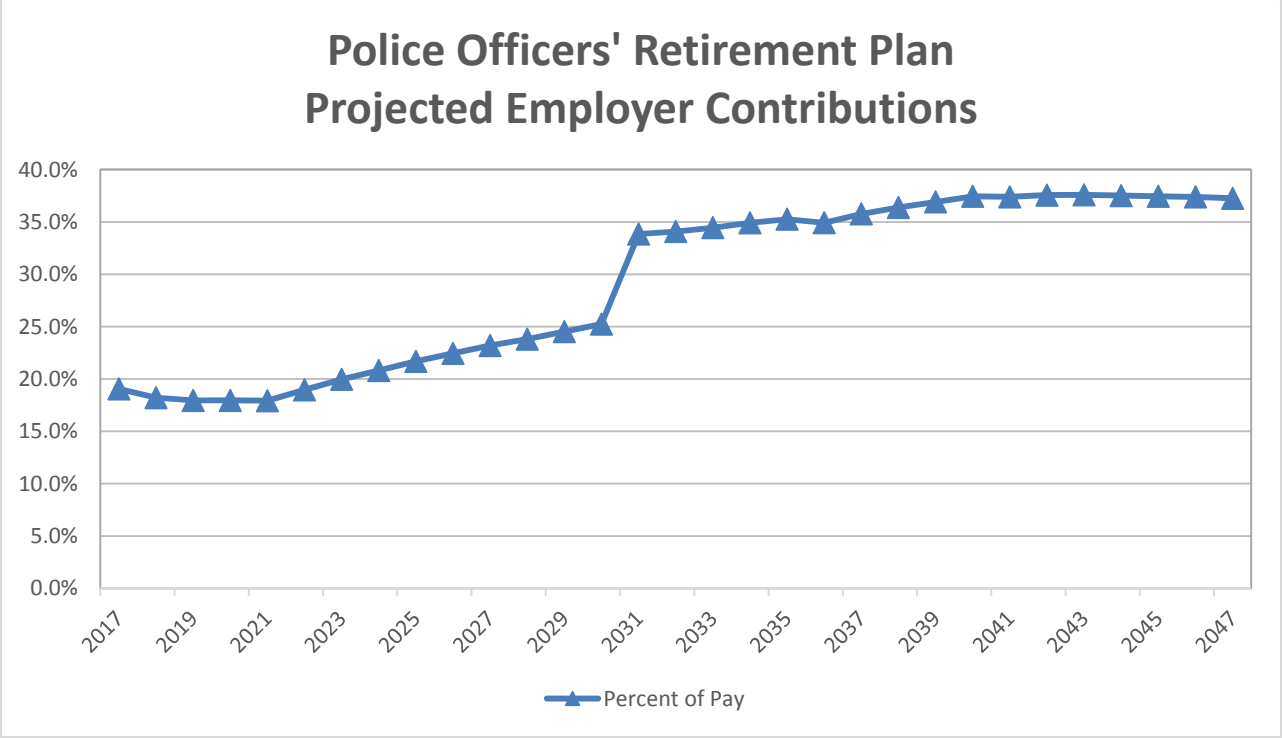

Firefighters' Retirement Plan - District Only
Projected Benefit Payments vs. Total Contributions
Millions
$400
$350
$300
$250
$200
$150
$100
$50
$0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Benefit Payments
Contributions

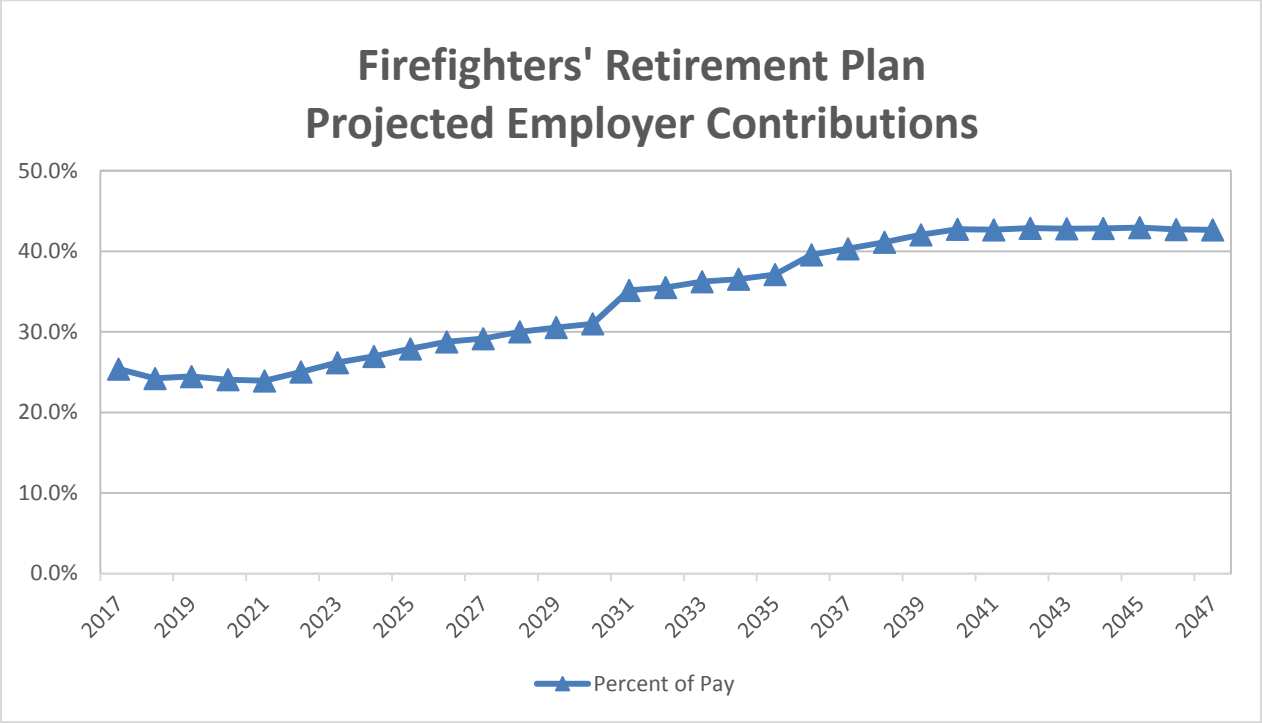

Retirement Plans Combined - District Only
Projected Benefit Payments vs. Total Contributions
Millions
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Benefit Payments
Contributions

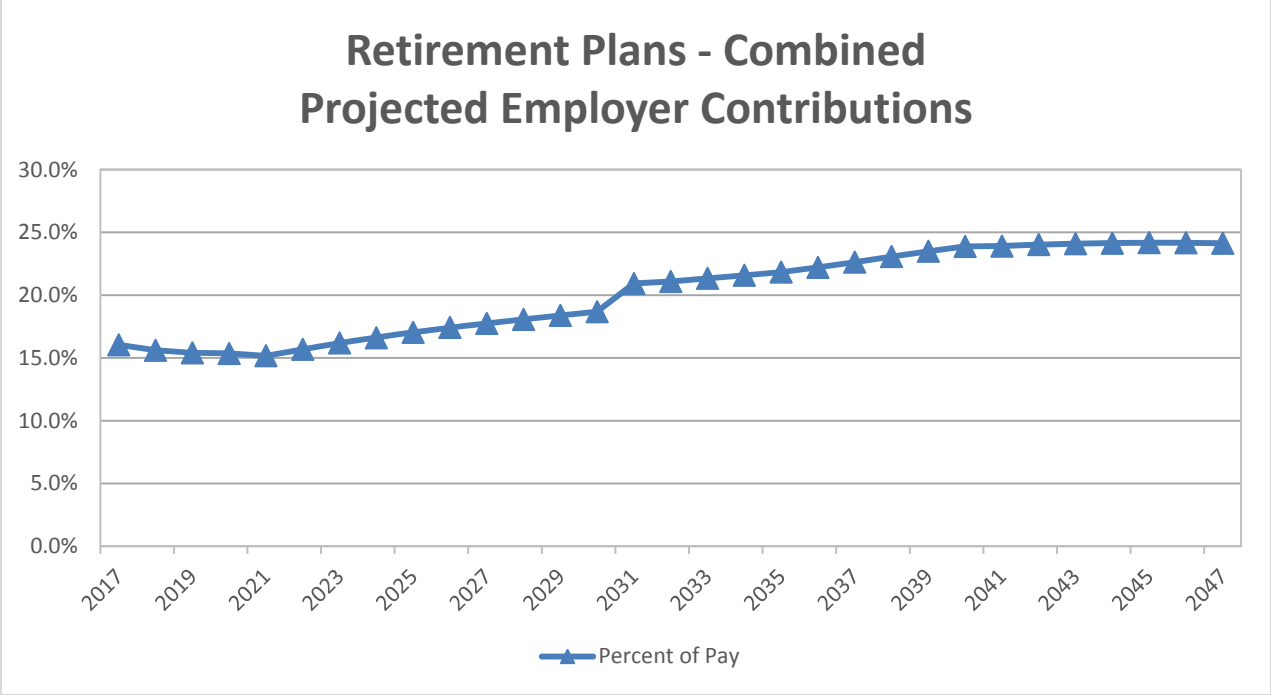
SECTION V – BASELINE PROJECTIONS

The following projection graphs provide the results of the baseline projections pertaining to the expected Actuarially Determined Employer Contribution rates for each of the three Retirement Plans under DCRB. The ADC rates are calculated each year of the projection period using the methods as outlined in the DCRB funding policy. The ADC to the Plan consist of normal cost contributions and the amortization of the Unfunded Actuarial Accrued Liability (UAAL) contributions. The normal cost is the annual cost of accruing benefits for active members and is calculated using the Entry Age Normal (EAN) actuarial cost method. The amortization period to pay off the Plan's expected 2017 UAAL will be a closed 15-year period. All subsequent changes in the UAAL will be amortized over 20 year closed periods. Each valuation during the projection period will produce an amortization base which will take 20 years to fully amortize. The amortization of the UAAL bases will be developed using the level dollar methodology.


Teachers' Retirement Plan
Projected Employer Contributions
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Percent of Pay


Police Officers' Retirement Plan
Projected Employer Contributions
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
2041
2043
2045
2047
Percent of Pay

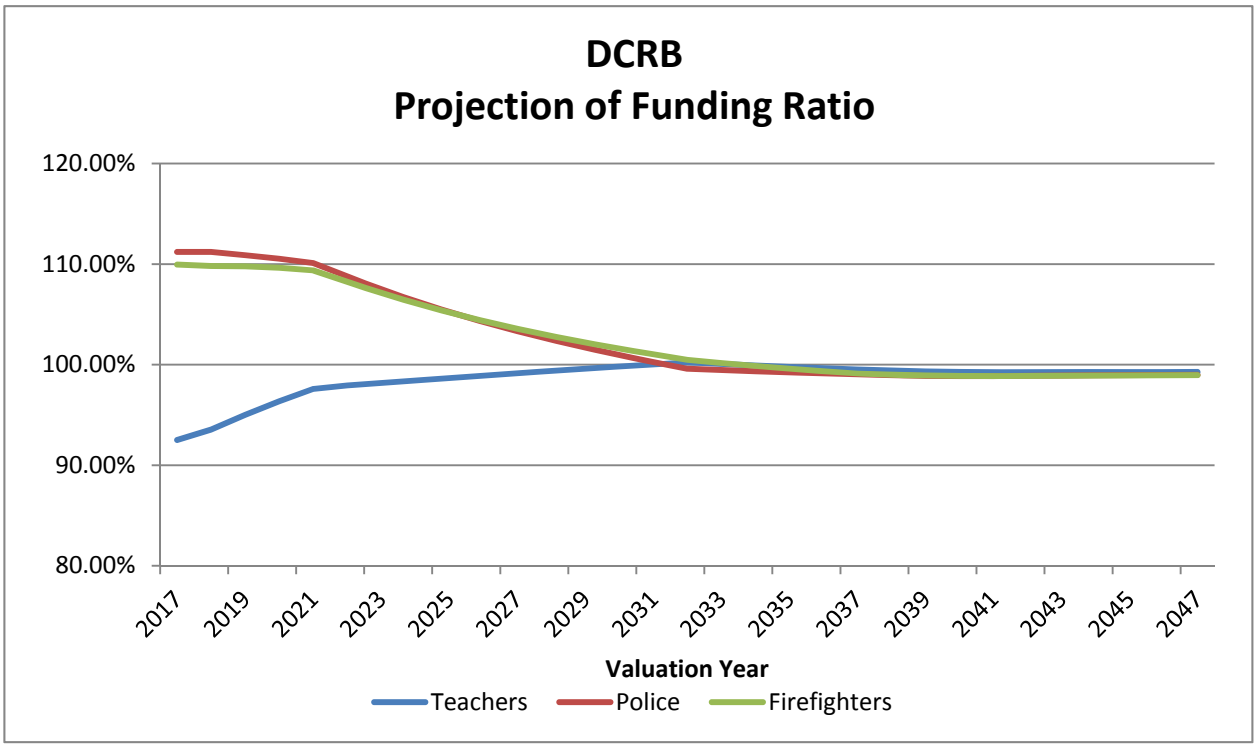




The overall employer contribution rates are expected to decrease for each of the three Plans over the short-term due to the smoothed recognition of the investment gains that occurred in 2016/2017.

Once these investment losses are fully recognized, contribution rates as a percentage of payroll are expected to increase steadily over the next 15 years as the initial UAAL bases are amortized.

In addition, we have provided a graph that shows the projection of funded ratios of each group.



The funding policy of the plan is designed to achieve a 100% funded ratio over the UAAL amortization period. This can be seen in the graph above with the funded ratios of all three groups approaching 100%.

SECTION VI – ASSET RETURN SENSITIVITY

As mentioned earlier in the report, the intended purpose of the Projection Report is to help assess the Plan's funding progress and to provide information to decision makers to help ensure that the applicable pension liabilities and funding mechanisms are managed in a manner that promotes sustainability. The Projection Report process should be viewed as an enhancement to the actuarial valuation control cycle by providing additional evaluation metrics to assess the need for further, in-depth analysis of the risks to the Plan's sustainability. The actuarial valuation control cycle is a key component of managing a long-term liability whose ultimate value is based upon uncertain future events. As the ultimate value of future cash flows cannot be predicted with certainty, pension liabilities are managed in the short-term through the continuous monitoring of economic and demographic assumptions, with a keen eye on the identification, measurement, and management of risks.

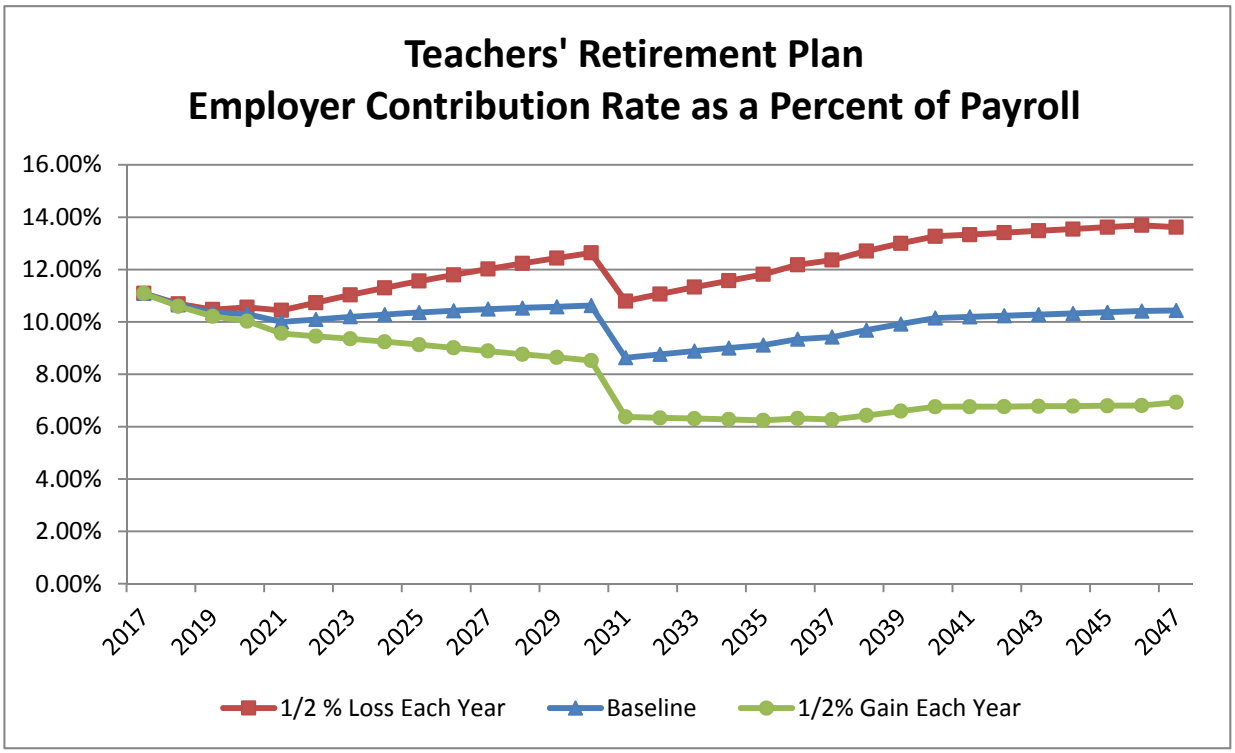
The Projection Report process, like other actuarial modeling, is not intended to provide absolute results. The intended purpose of the Projection Report process is to identify anticipated trends and to compare various outcomes, under a given methodology, rather than predicting certain future events. The results produced by the Projection Report process do not predict the financial condition of the Plan or the Plan's ability to pay benefits in the future and do not provide any guarantee of future financial soundness of the Plan. Because actual experience will not unfold exactly as expected, actual results can be expected to differ from the results presented herein. To the extent actual experience deviates significantly from the assumptions, results could be significantly better or significantly worse than the expected outcome indicated in this report.

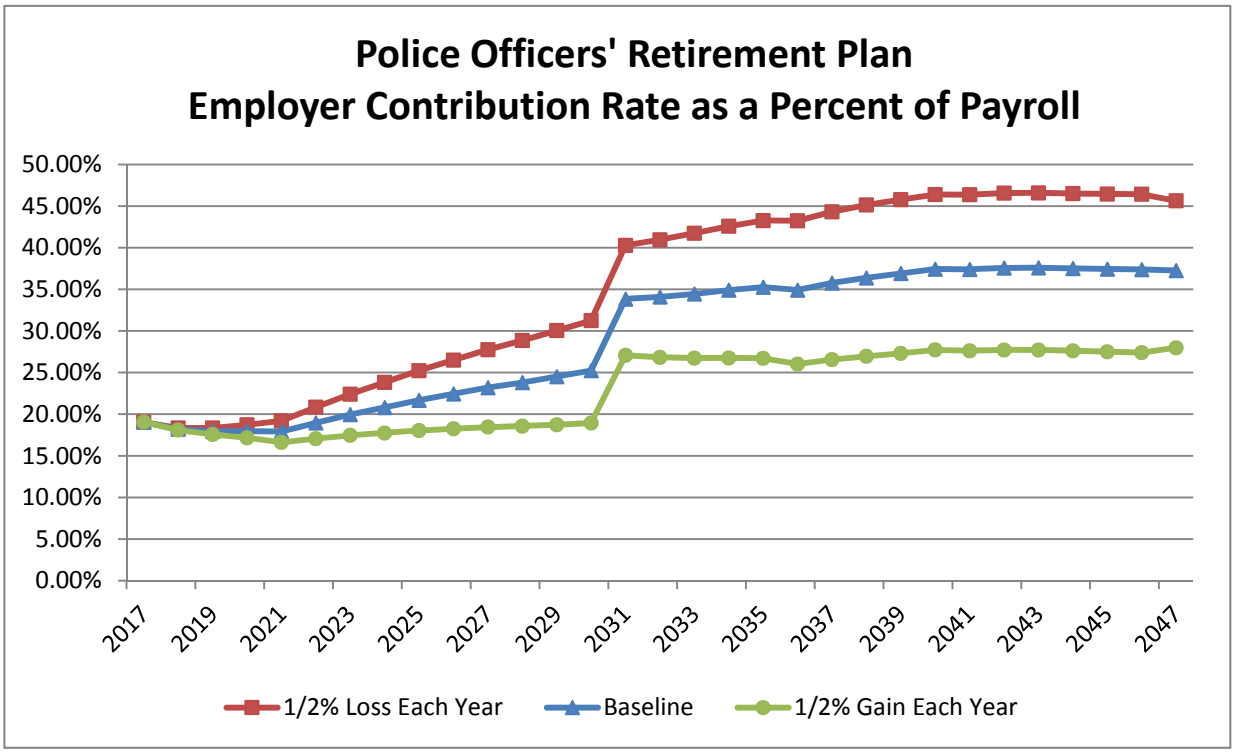
Actuarial assumptions are a key component of both the snapshot measurements in the actuarial valuation process and the projection of future valuation results. Actual experience can be expected to vary from year to year, even if the actuarial assumptions are met over the long term. The variability of certain key measures can have a significant impact on the date the Plan will reach full funding (actuarial value of assets equal to or greater than the actuarial accrued liability). The key variables include:

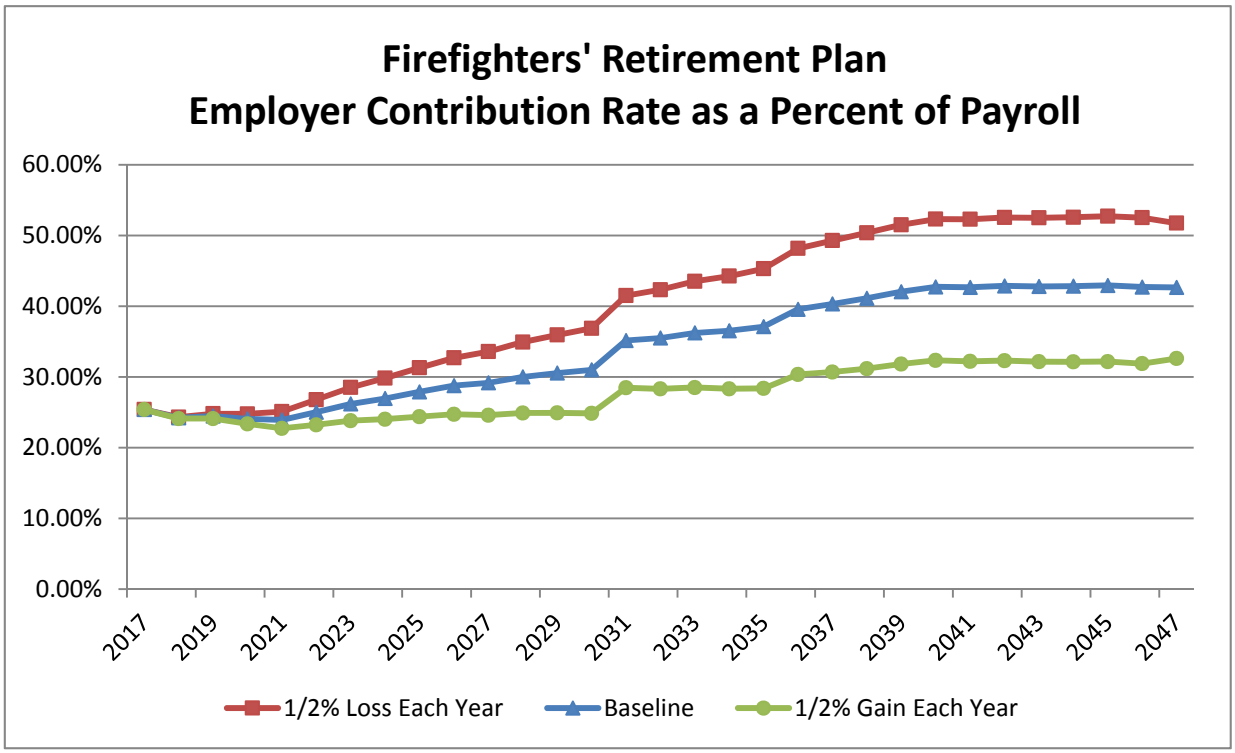
- Investment return
- Active membership growth
- Individual pay increases for active members

Of these variables, investment return is, by far, the most significant variable and the most volatile. The active membership growth and pay increase variables are also very important, but not nearly as significant as the investment return variable.

In addition to the baseline projections where all actuarial assumptions are as expected, we also performed projections where the asset returns were less than expected and more than expected. The baseline asset return assumption is 6.50%. We ran projections that modeled 6.00% returns for the less than expected scenario and 7.00% for the more than expected scenario. The results compared with the baseline projections and seen in the following charts:







As might be expected, under the better than expected asset return scenario, the continuous gains cause the employer contribution rates to decline and the less than expected asset return scenarios cause the employer contribution rates to increase.

SECTION VII - CONCLUSIONS

TEACHERS

Following the current funding policy will reduce the expected unfunded actuarial accrued liability from $160.5 million in 2017 to less than zero by 2031. The employer contribution rate is expected to decline from the current rate of 11.09% of payroll to less the 9.0% by 2031 and remain in an approximate range of 9.0% - 10.5% after that.

POLICE OFFICERS

The actuarial value of assets exceeded the actuarial accrued liability by $382.4 million as of October 1, 2017. This surplus is being amortized and reduces the current employer contribution rate to less than the employer normal cost rate (the cost of accruals for the upcoming year). The employer contribution rate is expected to increase from the current rate of 19.05% of payroll to approximate range of 37% - 38% over the 30 year period. The increase is due mostly to the elimination of the surplus by 2032.

FIREFIGHTERS

The actuarial value of assets exceeded the actuarial accrued liability by $145.7 million as of October 1, 2017. This surplus is being amortized and reduces the current employer contribution rate to less than the employer normal cost rate (the cost of accruals for the upcoming year). The employer contribution rate is expected to increase from the current rate of 25.39% of payroll to an approximate range of 42% - 43% over the 30 year period. The increase is due mostly to the elimination of the surplus by 2034.

APPENDIX A – ACTUARIAL ASSUMPTIONS AND METHODS

VALUATION DATE: All assets and liabilities are computed as of October 1, 2017. Demographic information was collected as of June 30, 2017.

INVESTMENT RATE OF RETURN: 6.50% per annum, compounded annually (net of administrative expenses).

INFLATION ASSUMPTION: 3.50% per year.

PAYROLL GROWTH ASSUMPTION: 4.25% per year.

PERCENT MARRIED: 64% of Teachers are assumed to be married and 80% of Police Officers and Firefighters are assumed to be married, with the wife 3 years younger than the husband. Active members are assumed to have one dependent child aged 10.

ACTUARIAL METHOD: Entry Age Normal Cost Method. The amortization of the unfunded actuarial accrued liability uses a level dollar basis.

ASSETS: The method of valuing assets is intended to recognize a "smoothed" market value of assets. Under this method, the difference between actual return on market value from investment experience and the expected return on market value is recognized over a five-year period. The actuarial value of assets is constrained to an 80% to 120% corridor around market value of assets. In addition, there is an adjustment made for the effect of the adjustment pursuant to D.C. Code §1-907.02(c).

WITHDRAWAL ASSUMPTION: For Teachers and Firefighters, it was assumed that 55% of the vested members who terminate elect to withdraw their contributions while the remaining 85% elect to leave their contributions in the plan in order to be eligible for a benefit at their retirement date. For Police Officers, it was assumed that 25% of the vested members who terminate elect to withdraw their contributions while the remaining 75% elect to leave their contributions in the plan.

OTHER ASSUMPTIONS: To value the pre-retirement death benefit for Police Officers and Firefighters, the benefit form for all retirements (normal or disabled) is assumed to be a 67.8% Joint and Survivor annuity for all participants (based on 40% of average pay survivor benefits). One-fourth of all Police Officer and Firefighter active deaths are assumed to occur in the line of duty.

COST OF LIVING ADJUSTMENT: The cost of living as measured by the Consumer Price Index (CPI) will increase at the rate of 3.50% per year.

MILITARY SERVICE: All Police and Fire members assumed to have 0.40 years of military service at retirement.

ADMINISTRATIVE EXPENSES: For Teachers, budgeted administrative expenses of 1.20% of payroll are added to the normal cost rate. For Police Officers and Firefighters, budgeted administrative expenses of 2.10% of payroll are added to the normal cost rate.

TEACHERS

SALARY INCREASES: Representative values of the assumed annual rates of future salary increases are as follows and include inflation at 4.25% per annum:

	Pay Increase Assumptions for an Individual Member		
Years of Service	Merit & Seniority	Inflation & Productivity (Economy)	Total Increase (Next Year)
5	4.20%	4.25%	8.63%
10	3.20	4.25	7.59
15	1.20	4.25	5.50
20	1.20	4.25	5.50
25	1.20	4.25	5.50
30	1.20	4.25	5.50
35	1.20	4.25	5.50

SEPARATIONS FROM ACTIVE SERVICE: Representative values of the assumed annual rates of withdrawal, service retirement, and disability are shown in the following tables:

	Percent of Members Separating Within the Next Year				
	Withdrawal		Service Retirement		
Sample Ages	5 years of service and up [1]		Under 30 yrs service	30 & up yrs service	Disability Retirement
	Male	Female			
25	18.00%	18.00%			0.01%
30	16.00	16.00			0.02
35	12.00	10.00			0.03
40	12.00	8.00			0.07
45	8.00	6.50			0.12
50	8.00	6.50	5.00%	5.00%	0.20
55	8.00	6.50	9.00	22.00	0.25
60			27.00	28.00	0.30
62			22.00	25.00	
65			25.00	35.00	
70			30.00	30.00	
71			25.00	30.00	
75			100.00	100.00	

[1] Members of any age with less than 5 years of service have withdrawal rates of 18% to 26% for males, and 16% to 23% for females

MORTALITY: The RPH-2014 Blue Collar Mortality Table projected generationally with Scale BB, set back 1 year for males is used for healthy active members, retirees, and beneficiaries. The RPH-2014 Disabled Mortality Table set back 6 years for males and set forward 1 year for females is used for disabled retirees. Mortality improvement is anticipated under these assumptions.

POLICE OFFICERS

SALARY INCREASES: Police Officers are assumed to receive a longevity increases applied to individual base pay after 15, 20, 25, and 30 years of service. Representative values of the assumed annual rates of future salary increases are as follows and include inflation at 4.25% per annum:

	Pay Increase Assumptions for an Individual Member		
Years of Service	Merit & Seniority	Inflation & Productivity (Economy)	Total Increase (Next Year)
5	2.00%	4.25%	6.34%
10	2.00	4.25	6.34
15	2.00	4.25	6.34
20	1.75	4.25	6.07
25	0.75	4.25	5.03
30	0.00	4.25	4.25

SEPARATIONS FROM ACTIVE SERVICE: Representative values of the assumed annual rates of withdrawal, service retirement, and disability are shown in the following tables:

	Percent of Members Separating Within the Next Year					
	Withdrawal					
Sample Ages	(5 years of service & up)[1]		Disability Retirement[2]		Years of Service	Service Retirement[3]
	Males	Females	Males	Females		
20	5.00%	5.00%	0.03%	0.02%	20	15.0%
25	5.00	5.00	0.06	0.05	25	22.0
30	4.25	4.50	0.11	0.10	30	38.0
35	2.75	3.50	0.16	0.15	35	18.0
40	1.50	1.50	0.23	0.30	40	16.0
45	1.50	1.50	0.32	0.40		
50	1.50	1.50	0.42	0.60		
55	1.50	1.50	0.44	0.70		
60	1.50	1.50	0.51	1.00		

[1] Members of any age with less than 5 years of service have a withdrawal rates of 6% to 13% for males, and 5% to 11% for females
[2] It is assumed that 75% of the disabilities are due to accidents in the line of duty and the 'percent of disability" is assumed to be 100%.
[3] 100% of active members are assumed to retire at age 65, regardless of service.

MORTALITY: The RPH-2014 Blue Collar Mortality Table projected generationally with Scale BB, set back 1 year for males is used for healthy active members, retirees, and beneficiaries. The RPH-2014 Disabled Mortality Table set back 6 years for males and set forward 1 year for females is used for disabled retirees. Mortality improvement is anticipated under these.

FIREFIGHTERS

SALARY INCREASES: Firefighters are assumed to receive longevity increases applied to individual base pay after 15, 20, 25, and 30 years of service. Representative values of the assumed annual rates of future salary increases are as follows and include inflation at 4.25% per annum:

	Pay Increase Assumptions for an Individual Member		
Years of Service	Merit & Seniority	Inflation & Productivity (Economy)	Total Increase (Next Year)
5	3.00%	4.25%	7.38%
10	3.00	4.25	7.38
15	3.00	4.25	7.38
20	1.25	4.25	5.55
25	1.25	4.25	5.55
30	1.25	4.25	5.55
35	1.25	4.25	5.55

SEPARATIONS FROM ACTIVE SERVICE: Representative values of the assumed annual rates of withdrawal, service retirement, and disability are shown in the following tables:

	Percent of Members Separating Within the Next Year			
Sample Ages	Withdrawal (5 years of service & up)[1]	Disability Retirement[2]	Years of Service	Service Retirement[3]
20	3.00%	0.01%	20	12.5%
25	3.00	0.05	25	12.5
30	2.60	0.18	30	22.0
35	1.80	0.25	35	40.0
40	1.40	0.30	40	40.0
45	1.20	0.35		
50	1.20	0.40		
55	0.80	0.45		
60	0.60	0.50		

[1] Members of any age with less than 5 years of service have a withdrawal rates of 4.0% to 7.5%.

[2]It is assumed that 75% of the disabilities are due to accidents in the line of duty and the "percent of disability" is assumed to be 100%.

[3]100% of active members are assumed to retire at age 60, regardless of service.

MORTALITY: The RPH-2014 Blue Collar Mortality Table projected generationally with Scale BB, set back 1 year for males is used for healthy active members, retirees, and beneficiaries. The RPH-2014 Disabled Mortality Table set back 6 years for males and set forward 1 year for females is used for disabled retirees. Mortality improvement is anticipated under these.

DISTRICT OF COLUMBIA TEACHERS' RETIREMENT PLAN

Effective Date — Established on July 1, 1997. The Treasury Department is responsible for paying all benefits accrued before this date.

DEFINITIONS

Affiliated Employers — District of Columbia Public Schools

Covered Members — Permanent, temporary, part-time and probationary teachers for the District of Columbia public day schools become members automatically on their date of employment. Other employees covered by the Retirement of Public School Teachers Act – including librarians, principals, and counselors – also become members on their date of employment. Substitute teachers and employees of the Department of School Attendance and Work Permits are not covered. Some former D.C teachers working at charter schools are eligible to remain in the Program.

Service Credit — One year of school service is given for each year of employment with DCPS. After five years of service are accrued, additional service may be purchased or credited for service outside of DCPS. For purposes of eligibility and benefit accrual, Federal service is included in the calculation of the normal retirement benefit.

Average Salary — Highest 36 consecutive months of pay, divided by three.

Vested — Members who accrue five or more years of Service Credit are vested for benefits. If these members leave service they may leave their Member Contribution Accounts with the Plan for a future benefit when reaching eligibility (deferred vested in this report).

CONTRIBUTIONS

Member Contributions — Members hired before November 1, 1996 are required to contribute 7% of annual pay. Members hired on or after November 1, 1996 contribute 8% of annual pay. Interest is not credited to each Member's accumulated contributions.

Refund of Member Contributions — In the event a member leaves service for a reason other than death or retirement, member contribution accounts are refunded upon request.

SERVICE RETIREMENT

Eligibility

The Age and Service Credit requirements to be eligible for a full Service Retirement are listed below:

- **Members hired before November 1, 1996**

Age	Service Credit
55	30, including 5 years school service
60	20, including 5 years school service
62	5 years school service

- **Members hired on and after November 1, 1996**

Age	Service Credit
Any Age	30, including 5 years school service
60	20, including 5 years school service
62	5 years school service

Benefit

For members hired before November 1, 1996:

- 1.5% of Average Salary times service up to 5 years, plus
- 1.75% of Average Salary times service between 5 and 10 years, plus
- 2.0% of Average Salary times service over 10 years.

For members hired on or after November 1, 1996:

- 2.0% of Average Salary times service.

All members receive a minimum benefit of 1.0% of Average Salary plus $25 for each year of service.

INVOLUNTARY SERVICE RETIREMENT

Eligibility

The Age and Service Credit requirements to be eligible for a Reduced Retirement are listed below:

- **All Members, regardless of date of hire**

Age	Service Credit
Any Age	25, including 5 years school service
50	20, including 5 years school service

Benefit

Service Retirement Benefit reduced by 1/6% per month (or 2% per year) that date of retirement precedes age 5

DISABILITY RETIREMENT

Eligibility Active members with five or more years of school service credit are covered (vested) for disability retirement. To be eligible, the member must be found to be incapable of satisfactorily performing the duties of his/her position.

Benefit Equal to Service Retirement benefit. Minimum benefit is the lesser of a) or b):

a) 40% of Average Salary
b) Calculated benefit amount by projecting service to age 60.

SURVIVOR BENEFITS

LUMP SUM

Eligibility Death before completion of 18 months of school service or death without an eligible spouse, child or parent.

Benefit Refund of member contributions.

SPOUSE/DOMESTIC PARTNER ONLY

Eligibility Death before retirement and married/registered domestic partnership for at least two years, or have a child by the marriage.

Benefit 55% of Service Retirement benefit. Minimum benefit is the lesser of a) or b):

a) 55% of 40% of Average Salary
b) 55% of the calculated benefit amount by projecting service to age 60.

SPOUSE/DOMESTIC PARTNER & DEPENDENT CHILDREN

Eligibility Death before retirement and married/registered domestic partnership for at least two years, or have a child by the marriage. Children must be unmarried and under age 18, or 22 if full-time student. Also, any dependent child because of a disability incurred before age 18. Death does not have to occur before retirement for the children's benefit.

Spouse/Domestic Partner

Benefit 55% of Service Retirement benefit. Minimum benefit is the lesser of a) or b):

a) 55% of 40% of Average Salary
b) 55% of the calculated benefit amount by projecting service to age 60.

Child Benefit A benefit per child equal to the smallest of a) or b) or c):

a) 60% of Average Salary divided by the number of eligible children
b) $6,931* (if hired before 1/1/1980), $6,693* (if hired between 1/1/1980 and 10/31/1996), or $6,518* (if hired on or after 11/1/1996) per child

c) $20,958* (if hired before 1/1/1980), $20,240* (if hired between 1/1/1980 and 10/31/1996), or $19,710* (if hired on or after 11/1/1996) divided by the number of children.

DEPENDENT CHILDREN ONLY

Eligibility Children must be unmarried and under age 18, or 22 if full-time student. Also, any dependent child because of a disability incurred before age 18. Death does not have to occur before retirement for the children's benefit.

Benefit A benefit per child equal to the smallest of a) or b) or c):

a) 75% of Average Salary divided by the number of eligible children
b) $8,470* (if hired before 1/1/1980), $8,157* (if hired between 1/1/1980 and 10/31/1996), or $7,097* (if hired on or after 11/1/1996) per child
c) $25,612* (if hired before 1/1/1980), $24,667* (if hired between 1/1/1980 and 10/31/1996), or $23,910* (if hired on or after 11/1/1996) divided by the number of children.

PARENTS ONLY

Eligibility Death before retirement and no eligible spouse/domestic partner or children, and parents must receive at least one-half of their total income from member.

Benefit 55% of Service Retirement benefit. Minimum benefit is the lesser of a) or b):

a) 55% of 40% of Average Salary
b) 55% of the calculated benefit amount by projecting service to age 60.

*Survivor benefit amounts are as of March 2017, and are subject to annual inflation adjustments.

DEFERRED VESTED RETIREMENT

Eligibility Active members with five or more years of school service credit .

Benefit Benefit is calculated in the same manner as Service Retirement benefit and may be collected starting at age 62.

OPTIONS

Retirement and disability benefits are payable for the life of the retired member. Optional reduced benefits may be elected at the time of retirement to provide for continuation of a reduced benefit amount to a designated beneficiary. Optional forms include:

a) Reduced Annuity with a Maximum Survivor Annuity (to Spouse or Registered Domestic Partner)
Reduced benefit paid to member so that upon member's death, the spouse/domestic partner will receive 55% of the unreduced normal life annuity. Member's benefit is reduced by 2.5% of retirement benefit, up to $3,600, plus 10% of any retirement benefit over $3,600.

b) Reduced Annuity with a Partial Survivor Annuity (to Spouse or Registered Domestic Partner)
Reduced benefit paid to member so that upon member's death, the spouse/domestic partner will receive a partial annuity that can range from $1 up to 55% of the unreduced normal life annuity amount. Member's benefit is reduced by the same amount as option a, multiplied by the ratio of the chosen benefit percent to the maximum benefit percent (55%).

c) Reduced Annuity with a Life Insurance Benefit
Member elects a life insurance amount, payable in a lump sum to designated beneficiary upon member's death.

d) Reduced Annuity with a Survivor Annuity to a Person with an Insurable Interest
A 55% joint and survivor annuity where the original benefit is reduce by 10% plus an additional 5% for each full 5 years, up to 25 years, that the designated beneficiary is younger than the member. Maximum reduction is 40% for any beneficiary who is 25 or more years younger than the member.

COST OF LIVING ADJUSTMENTS

Each year on March 1st, benefits which have been paid for at least twelve months proceeding March 1st are increased. The increase is equal to the annual CPI. COLA's are included in benefit payments on and after April 1st. If member's retirement is effective after March 1 of the preceding year, the COLA amount will be prorated.

For members hired on or after November 1, 1996, the cost of living increase is limited to 3% per year.

DISTRICT OF COLUMBIA POLICE OFFICERS' & FIREFIGHTERS' RETIREMENT PLAN

Effective Date

Established on July 1, 1997. The Treasury Department is responsible for paying all benefits accrued before this date.

DEFINITIONS

Affiliated Employers

The District of Columbia Metropolitan Police Department (MPD) and the District of Columbia Department of Fire and Emergency Medical Services (FEMS).

Covered Members

Sworn Police Officers and Firefighters become members on their first day of active duty (cadets are not eligible). Membership is not automatic for uniformed EMT Firefighters.

Service Credit

One year of service is given for each year of employment with MPD or FEMS. Additional service may be purchased or credited for lateral transfer service, EMT service, prior military service, and certain civilian service. For purposes of eligibility and benefit accrual, Federal service is included in the calculation of the normal retirement benefit.

Average Salary

For members hired before February 15, 1980, the highest 12 consecutive months of pay. For members hired on or after February 15, 1980, the highest 36 consecutive months of pay, divided by 3. Base pay does not include overtime, holiday or military pay.

Vested

Members who accrue five or more years of Service Credit are vested for benefits. If these members leave service they may leave their Member Contribution Accounts with the Plan for a future benefit when reaching eligibility (deferred vested in this report).

CONTRIBUTIONS

Member Contributions

Members hired before November 10, 1996 contribute 7.0% of salary. Members hired on or after November 10, 1996 contribute 8.0% of salary. Member contributions, together with any purchased service credit payments, are credited to individual Member Contribution Accounts. No interest is accrued on contributions.

Refund of Member Contributions

In the event a member leaves service for a reason other than death or retirement, member contribution accounts are refunded upon request.

SERVICE RETIREMENT

Eligibility

The Age and Service Credit requirements to be eligible for a full Service Retirement are listed below:

- **Members hired before November 10, 1996**

Age	Service Credit
Any age	20 (only if hired before 2/15/1980)
50	25 years departmental service
60	5 years departmental service

- **Members hired on and after November 10, 1996**

Age	Service Credit
Any Age	25 years departmental service
60	5 years

Benefit

For members hired before November 10, 1996:

- 2.5% of Average Salary times departmental service up to 25 years (20 years if hired before 2/15/1980), plus
- 3.0% of Average Salary times departmental service over 25 years (or 20), plus
- 2.5% of Average Salary times purchased or credited service.

For members hired on or after November 10, 1996:

- 2.5% of Average Salary times total service.

All members are subject to a maximum benefit of 80% of Average Salary.

SERVICE-RELATED DISABILITY RETIREMENT

Eligibility

Disabled as a result of an illness or injury in the line of duty.

Benefit

For members hired before February 15, 1980:
2.5% of Average Salary times total years of service, subject to a minimum of 66-2/3% of Average Salary and a maximum of 70% of Average Salary.

For members hired on or after February 15, 1980:
70% of final pay times percentage of disability, subject to a minimum of 40% of final pay.

NONSERVICE-RELATED DISABILITY RETIREMENT

Eligibility Active members with five or more years of departmental service are covered (vested) for disability retirement. The member is eligible if found that the disability precludes further service with his/her department.

Benefit

For members hired before February 15, 1980:
2.0% of Average Salary times total years of service, subject to a minimum of 40% of Average Salary and a maximum of 70% of Average Salary.

For members hired on or after February 15, 1980:
70% of final pay times percentage of disability, subject to a minimum of 30% of final pay.

SURVIVOR BENEFITS

LUMP SUM
Eligibility Death before retirement without an eligible spouse or child.

Benefit Refund of member contributions according to plan order of precedence.

LUMP SUM – DEATH IN LINE OF DUTY
Eligibility Death occurring in the line of duty, not resulting from willful misconduct.

Benefit $50,000

SPOUSE ONLY – DEATH IN LINE OF DUTY
Eligibility Member killed in line of duty, after December 29, 1993.

Benefit 100% of final pay.

SPOUSE ONLY – DEATH NOT IN LINE OF DUTY
Eligibility Member death, not in line of duty, after December 29, 1993. If retired, must be married for at least one year or have a child by the marriage.

Benefit 40% of the greater of a) or b):

a) Average Salary
b) Salary for step 6 salary class 1 of the DC Police and Fireman's Salary Act in effect, adjusted for cost-of-living increases if death occurs after retirement.

Benefit cannot be higher than rate of pay at death (or retirement if death occurs after retirement).

SPOUSE & DEPENDENT CHILDREN

Eligibility Member death, not in line of duty, after December 29, 1993. If retired, must be married for at least one year or have a child by the marriage. Children must be unmarried and under age 18, or 22 if full-time student. Also, any dependent child because of a disability incurred before age 18. Death does not have to occur before retirement for the children's benefit.

Spouse Benefit 40% of the greater of a) or b):

a) Average Salary
b) Salary for step 6 salary class 1 of the DC Police and Fireman's Salary Act in effect, adjusted for cost-of-living increases if death occurs after retirement.

Benefit cannot be higher than rate of pay at death (or retirement if death occurs after retirement).

Child Benefit A benefit per child equal to the smallest of a) or b) or c):

a) 60% of Average Salary divided by the number of eligible children
b) $4,077* (if hired before 11/1/1996) or $3,989* (if hired on or after 11/1/1996) per child
c) $12,232* (if hired before 11/1/1996) or $11,967* (if hired on or after 11/1/1996) divided by the number of children.

DEPENDENT CHILDREN ONLY

Eligibility Children must be unmarried and under age 18, or 22 if full-time student. Also, any dependent child because of a disability incurred before age 18. Death does not have to occur before retirement for the children's benefit.

Benefit 75% of Average Salary divided by the number of eligible children, adjusted for cost-of-living increases.

*Survivor benefit amounts are as of March 2017, and are subject to annual inflation adjustments.

DEFERRED VESTED RETIREMENT

Eligibility Active members with five or more years of departmental service.

Benefit Benefit is calculated in the same manner as Service Retirement benefit and may be collected starting at age 55.

OPTIONS

Retirement and disability benefits are payable for the life of the retired member. This includes an unreduced joint and survivor annuity as defined above in the "Survivor Benefits – Spouse and Dependent Children" section.

An optional reduced benefit may be elected at the time of retirement to provide for an additional survivor benefit to a designated beneficiary. Member's original annuity is reduced by 10% and that amount is added to the survivor's benefit. If the designated beneficiary is more than five years younger than the member, the additional amount will be reduced by 5% for each full five years that the beneficiary is younger than the member, subject to a maximum of 40%.

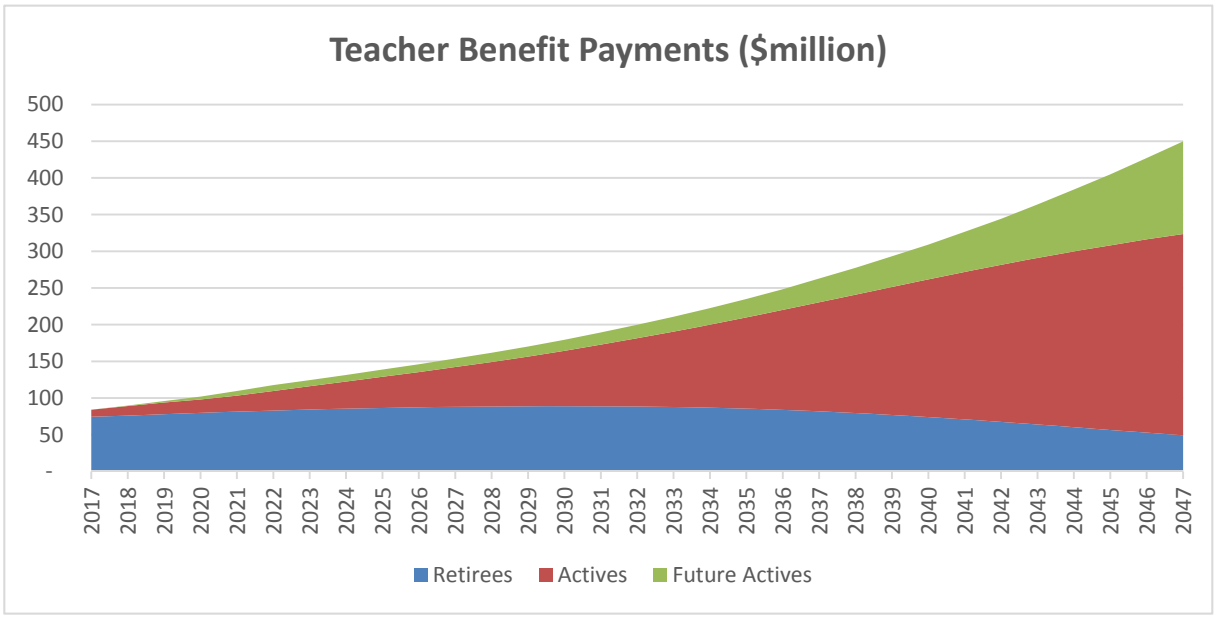
COST OF LIVING ADJUSTMENTS

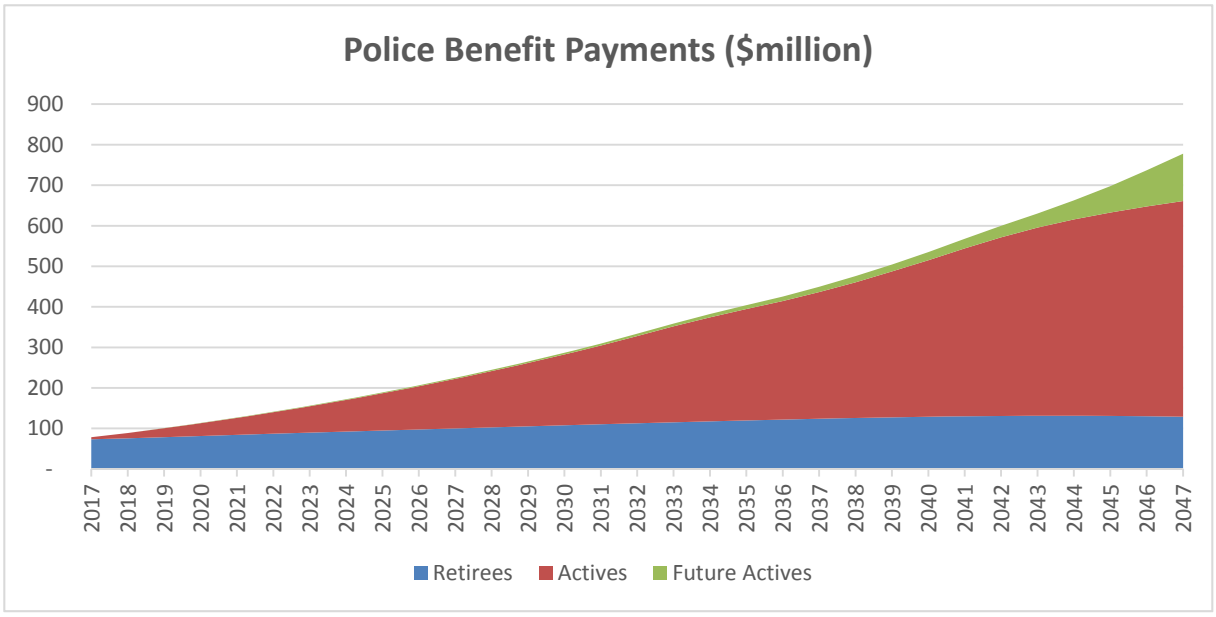
Each year on March 1st, benefits which have been paid for at least twelve months proceeding March 1st are increased. The increase is equal to the annual CPI. COLA's are included in benefit payments on and after April 1st. If member's retirement is effective after March 1 of the preceding year, the COLA amount will be prorated.

For members hired on or after November 10, 1996, the cost of living increase is limited to 3% per year. Members hired before February 15, 1980, receive equalization pay, which is defined as the percentage increase as active employees' salary increases. Equalization increases are not paid to beneficiaries.

APPENDIX C – ADDITIONAL GRAPHS

The following charts show the projected benefit payments broken down by retirees, actives, and future members for all three groups as well as total.





APPENDIX C – ADDITIONAL GRAPHS