

JOINT ADDENDUM TO FINAL INITIAL RISK SHARING VALUATION STUDY

Pursuant to §13C(c)(2)(B)(ii) of Texas Revised Civil Statutes 6243e.2(1), the Executive Director for the Houston Firefighters’ Relief and Retirement Fund (“Fund”) and the Finance Director for the City of Houston (the “Municipality”) do hereby execute this joint addendum to the respective Fund and Municipality final initial risk sharing valuation studies (“RSVS”) reflecting the arithmetic average for each fiscal year in which difference between the Fund and Municipality’s estimated contribution rate is greater than two percentage points.

Fiscal Year	Estimated Contribution Rate from the Fund	Estimated Contribution Rate from the Municipality	Arithmetic Average of Estimated Contribution Rate
2018	36.80%	26.98%	31.89%
2019	36.80%	26.98%	31.89%
2020	36.80%	26.98%	31.89%
2021	36.80%	26.98%	31.89%
2022	36.80%	26.98%	31.89%
2023	36.80%	26.98%	31.89%
2024	36.80%	26.98%	31.89%
2025	36.80%	26.98%	31.89%
2026	36.80%	26.98%	31.89%
2027	36.80%	26.98%	31.89%
2028	36.80%	26.98%	31.89%
2029	36.80%	26.98%	31.89%
2030	36.80%	26.98%	31.89%
2031	36.80%	26.98%	31.89%
2032	36.80%	26.98%	31.89%
2033	36.80%	26.98%	31.89%
2034	36.80%	26.98%	31.89%
2035	36.80%	26.98%	31.89%
2036	36.80%	26.98%	31.89%
2037	36.80%	26.98%	31.89%
2038	36.80%	26.98%	31.89%
2039	36.80%	26.98%	31.89%
2040	36.80%	26.98%	31.89%
2041	36.80%	26.98%	31.89%
2042	36.80%	26.98%	31.89%
2043	36.80%	26.98%	31.89%
2044	36.80%	26.98%	31.89%
2045	36.80%	26.98%	31.89%
2046	36.80%	26.98%	31.89%
2047	36.80%	26.98%	31.89%
2048	17.10%	14.74%	15.92%

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HOUSTON FIREFIGHTERS' RELIEF AND RETIREMENT FUND

Ralph D Marsh 9/6/17
Executive Director

CITY OF HOUSTON

Kerry Dene 9/22/17
Finance Director



August 25, 2017

Mr. Ralph D. Marsh
Executive Director
Houston Firefighters' Relief and Retirement Fund
4225 Interwood North Parkway
Houston, Texas 77032

Re: Initial Risk Sharing Valuation Study

Dear Ralph:

As required under Senate Bill 2190¹, we are providing the Initial Risk Sharing Valuation Study for the Houston Firefighters' Relief and Retirement Fund (the Fund). This study provides the July 1, 2016 actuarial valuation results and a 31-year projection of the city's actuarially determined contribution rate under the provisions of the Fund as amended by Senate Bill 2190.

Actuarial Valuation Results at July 1, 2016

(\$000)	Initial Risk Sharing Valuation Results ¹
Present Value of Future Benefits	\$5,422,107
Actuarial Accrued Liability	\$4,629,893
Actuarial Value of Assets ²	\$3,729,670
Unfunded Accrued Liability	\$900,223
Funded Ratio	80.6%
City Normal Cost Rate ³	17.1%
City Accrued Liability Rate	19.7%
Total City Contribution Rate ⁴	36.8%
Estimated City Contribution Rate for Fiscal Year Ending 2018	\$100,628
Employee Contribution Rate	10.5%

¹This Initial Risk Sharing Valuation Study has been provided in accordance with Senate Bill 2190, assuming that the bill is determined to be constitutional.

²Re-set to market value of assets under the initial risk sharing valuation study.

³Contains an allowance for administrative expenses equal to 1.25% of payroll.

⁴as a percentage of pensionable compensation



Amortization Schedule of July 1, 2016 Unfunded Actuarial Accrued Liability

Fiscal Year Ending	Outstanding Unfunded Liability	Payment	Payroll	Payment as a Percentage of Payroll
2017	900,223		269,139	
2018	963,239	54,685	277,213	19.7%
2019	974,099	56,325	285,530	19.7%
2020	984,022	58,015	294,095	19.7%
2021	992,892	59,756	302,918	19.7%
2022	1,000,583	61,548	312,006	19.7%
2023	1,006,958	63,395	321,366	19.7%
2024	1,011,869	65,297	331,007	19.7%
2025	1,015,157	67,255	340,937	19.7%
2026	1,016,648	69,273	351,165	19.7%
2027	1,016,157	71,351	361,700	19.7%
2028	1,013,481	73,492	372,551	19.7%
2029	1,008,404	75,697	383,728	19.7%
2030	1,000,691	77,968	395,240	19.7%
2031	990,089	80,307	407,097	19.7%
2032	976,326	82,716	419,310	19.7%
2033	959,107	85,197	431,889	19.7%
2034	938,116	87,753	444,846	19.7%
2035	913,011	90,386	458,191	19.7%
2036	883,426	93,097	471,937	19.7%
2037	848,965	95,890	486,095	19.7%
2038	809,203	98,767	500,678	19.7%
2039	763,682	101,730	515,698	19.7%
2040	711,910	104,782	531,169	19.7%
2041	653,356	107,925	547,104	19.7%
2042	587,452	111,163	563,517	19.7%
2043	513,586	114,498	580,423	19.7%
2044	431,099	117,933	597,836	19.7%
2045	339,285	121,471	615,771	19.7%
2046	237,385	125,115	634,244	19.7%
2047	124,582	128,868	653,271	19.7%
2048	0			

Projection of the Actuarially Determined City Contribution Rate

Fiscal Year Ending	Projected City Contribution Rate	Fiscal Year Ending	Projected City Contribution Rate
2018	36.8%	2034	36.8%
2019	36.8%	2035	36.8%
2020	36.8%	2036	36.8%
2021	36.8%	2037	36.8%
2022	36.8%	2038	36.8%
2023	36.8%	2039	36.8%
2024	36.8%	2040	36.8%
2025	36.8%	2041	36.8%
2026	36.8%	2042	36.8%
2027	36.8%	2043	36.8%
2028	36.8%	2044	36.8%
2029	36.8%	2045	36.8%
2030	36.8%	2046	36.8%
2031	36.8%	2047	36.8%
2032	36.8%	2048	17.1%
2033	36.8%		

Actuarial Certification

We certify that the information contained in this Initial Risk Sharing Valuation Study has been prepared in accordance with the appropriate Actuarial Standards of Practice. To the best of our knowledge, the information fairly presents the actuarial position of the Houston Firefighters' Relief & Retirement Fund as of July 1, 2016 on the basis of the actuarial assumptions, methods and plan provisions set forth herein.

The Board of Trustees of the Fund may use this report for discussing and reaching consensus with the City of Houston on the Actuarial City Contribution Rate. Use of this report for any other purpose or by anyone other than the Board or the City of Houston may not be appropriate and may result in mistaken conclusions because of failure to understand applicable assumptions, methods, or inapplicability of the report for that purpose. Because of the risk of misinterpretation of actuarial results, Conduent recommends requesting an advance review of any statement, document, or filing to be based on information contained in this report. Conduent will accept no liability for any such statement, document or filing made without prior review by Conduent.

Future actuarial measurements may differ significantly from current measurements due to plan experience differing from that anticipated by the economic and 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. An analysis of the potential range of such future differences is beyond the scope of this valuation.

Where presented, references to “funded ratio” and “unfunded accrued liability” typically are measured on an actuarial value of assets basis. It should be noted that the same measurements using market value of assets could result in different funded ratios and unfunded accrued liabilities. Moreover, the funded ratio presented is appropriate for evaluating the need and level of future contributions but makes no assessment regarding the funded status of the plan if the plan were to settle (i.e., purchase annuities) to cover a portion or all of its liabilities.

In preparing the actuarial results, we have relied upon information provided by the Board of Trustees regarding plan provisions, plan participants, plan assets, contribution rates and other matters used in the actuarial valuation. Specifically, a market value of assets equal to \$3,729,670,000 has been provided by the Fund representatives. A summary of the actuarial assumptions, major plan provisions, and plan participant data used to calculate the results of this study can be found in the appendices. Although we did not audit the data, we reviewed the data for reasonableness and consistency with the prior year’s information. The results of the valuation are dependent on the accuracy of the data.

Except as prescribed in Senate Bill 2190 (as noted in Appendix A), the Board of Trustees has sole authority to determine the actuarial assumptions and has selected the actuarial methods and assumptions used in this valuation. In our opinion, those actuarial assumptions selected by the Board are reasonably related to the experience of the Fund and to reasonable long-term expectations. The actuarial assumptions prescribed by Senate Bill 2190 have been included in the valuation in accordance with SB 2190.

Given the reconciliation process and the municipal actuary’s concern regarding Actuarial data, we have conformed our use of census data to that which the municipal actuary has. In the preliminary correspondence concerning census data, we answered the municipal actuary’s six questions completely and believed we were agreed on the immateriality of assumed months of member start dates. We were surprised to see this very minor and resolved issue re-raised by the municipal actuary. We believe there is compliance with all requirements concerning the supply of Actuarial data to the municipal actuary.

Based on the statutory requirements of Senate Bill 2160 it is our understanding that the actual City contribution rate may be established as an average of the contribution rates shown in this report and those shown in the Initial Risk Sharing Valuation Study prepared by the City’s actuary. If future contributions are established in this manner at levels below those presented in this report, the plan may not be expected to achieve a fully funded position over the 30-year time horizon shown in this report based on the data, assumptions and methods set forth on the attached pages.

We are Members of the American Academy of Actuaries and meet the Qualification Standards of the Academy to render the actuarial opinions contained in this report. This report has been prepared in accordance with all applicable Actuarial Standards of Practice, and we are available to answer questions about it.

Mr. Ralph D. Marsh
August 25, 2017



If you have any questions concerning this information, please let us know.

Respectfully submitted,

A handwritten signature in black ink that reads "David L. Driscoll".

David L. Driscoll, FSA, EA, MAAA, FCA
Principal, Consulting Actuary

A handwritten signature in black ink that reads "Aaron Shapiro".

Aaron Shapiro, FSA, EA, MAAA, FCA
Principal, Consulting Actuary

Appendix A: Summary of Actuarial Methods and Assumptions

Basis for Assumptions

The economic and demographic assumptions used in the study (except for the investment return assumption) were adopted by the Board in consultation with Conduent Human Resource Services (Conduent). Senate Bill 2190 requires that an actuarial experience study be performed in order to review the experience of the Fund at least once every four years to determine if any changes to the valuation assumptions are warranted. In general, the assumptions used in the valuation are based on recommendations made and approved by the Board as part of an Experience Study covering plan years from July 1, 2009 through June 30, 2013. The mortality assumption used in this study is based on the most recent study published by the Society of Actuaries and was approved by the Board on June 27, 2017. Senate Bill 2190 requires the use of an investment return assumption of not more than 7.00%.

Actuarial Methods

Actuarial Value of Assets

Senate Bill 2190 requires the use of an asset valuation method that recognizes gains and losses on the market value of assets (based on the difference between the actual rate of return and the assumed rate of return) over five years. Past gains and losses were fully recognized in the Actuarial Value of Assets at July 1, 2016. New gains and losses will be recognized over five years beginning July 1, 2017.

Actuarial Cost Method

Senate Bill 2190 requires the use of the Ultimate Entry Age Method with liabilities allocated from date of entry to expected payment of benefit. Under the Ultimate Entry Age Method, future normal cost for active employees is calculated based on the plan provisions in effect for the most recently hired employees.

Senate Bill 2190 also requires the use of a 30-year, closed, level percent of payroll amortization period, in which new gain/loss amortization bases are established each year. The Unfunded Actuarial Accrued Liability at July 1, 2016 was amortized as a level percentage of payroll over a closed amortization period of 30 years with payments effective for fiscal year beginning July 1, 2017. Additional actuarial experience losses will be amortized over a closed amortization period of 30 years in future valuations. If in any given year the Fund experiences an actuarial gain, any such gain will be used to offset the largest outstanding loss amortization base, if applicable.

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

Key Economic Assumptions

Investment Return

Real Rate of Return	4.0%
Price Inflation	<u>3.0%</u>
Total Nominal Rate	7.0%

Expected future investment returns are assumed to be net of investment expenses.

Wage and Price Inflation

3.0%

Payroll Growth Rate

3.0%

Normal Cost Load for Administrative Expenses

1.25% of pensionable payroll*

* required by Senate Bill 2190

Individual Pay Increase Rate

Age	(Nominal = Merit + Wage Inflation)	
	Nominal	Merit
20	7.00%	4.00%
25	6.25%	3.25%
30	5.50%	2.50%
35	5.00%	2.00%
40	4.00%	1.00%
45	3.70%	0.70%
50	3.40%	0.40%
55	3.00%	0.00%

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

Key Demographic Assumptions

Retirement Rates

Number of Years of Service	Probability of Retiring Within One Year
Less than 25	1%
25	5%
26	5%
27	5%
28	5%
29	5%
30	15%
31	15%
32	15%
33	15%
34	15%
35	25%
36	25%
37	30%
38	35%
39	40%
40+	100%

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

DROP Duration

Duration of DROP at Retirement	Percentage of Participants Electing Retirement at the Specified Duration
0	0%
3	0
5	5
8	30
10	65

DROP balances for active members are assumed to be paid out over 15 years and are discounted at the future DROP return assumption from the date payments begin. The liability for DROP balances of members who have left active service is assumed to be equal to the total of all of the DROP balances. This conservative assumption is used because individual DROP balances were not available for inactive members, and evidence was provide that members have been withdrawing their entire balance earlier and more often.

Sample Rates

Number of Years of Service at Actual Retirement	Percentage of Participants Retiring with Specific Drop Durations				
	0 yr.	3 yrs.	5 yrs.	8 yrs.	10 yrs.
20	0%	0%	0%	0%	0%
25	0	0	100	0	0
30	0	0	5	30	65
35	0	0	5	30	65
40	0	0	0	0	100

Mortality Rates

Active participants and nondisabled pensioners

Based on the RP-2014 Mortality Table with Blue Collar Adjustment with generational improvement using MP-2016. Changes have been applied by adjusting RP-2014 backward to 2006 with MP-2014, and then applying generational projection from 2006 using MP-2016.

Note: These mortality rates are used to determine the mortality assumptions for the plan, including the probability of ceasing active service due to death.

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

Disabled pensioners

Based on the RP-2014 Total Data Set for Disabled Lives Mortality Table with generational improvement using MP-2016. Changes have been applied by adjusting RP-2014 backward to 2006 with MP-2014, and then applying generational projection from 2006 using MP-2016.

Disability Rates

Graduated rates (see table below for sample rates).

Percentage of Deaths and Disabilities in the Line of Duty

Age	Death	Disability ¹
25	100%	60%
35	100	60
45	42	34
55	20	25

Termination Rates

Age	Termination Rate
20	1.30%
25	1.30
30	1.18
35	0.70
40	0.40
45	0.45
50	0.00

For members hired prior to July 1, 2017 who are terminating with at least 10 years but less than 20 years of service:

- 50% will elect a contribution refund
- 50% will elect a deferred monthly pension benefit

¹ 1% of firefighters who become disabled in the line of duty are assumed to be incapable of performing any substantial gainful activity.

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

Marital Status at Benefit Eligibility

Percentage married

90% of participants are assumed to be married.

No beneficiaries other than the spouse assumed.

Age difference

Husbands assumed to be three years older than wives.

Adjustment to Reflect Definition of Average Monthly Salary

For members hired prior to July 1, 2017, active liabilities and normal costs were increased 5% to account for differences between the plan's definition of average monthly salary, the average of the highest 78 pay periods, and the compensation data available for the valuation.

Adjustment to Reflect Definition of Pensionable Compensation after July 1, 2017

Pensionable compensation for years after July 1, 2017 is assumed to represent 91% of gross compensation.

Development of Valuation Pay

Valuation pay is developed by increasing the prior year's pay with the nominal individual pay increase rate.

Age at which Benefits End for Child Beneficiaries

Benefits are assumed to end once the child beneficiary reaches age 23.

Future DROP Returns

Future DROP interest crediting rates are assumed to be equal to 4.55% (65% of the assumed asset return of 7%)

Future Cost-of-Living Adjustments

COLAs paid in October 2017 and 2018 are assumed to be equal to 2% (the assumed asset return of 7% less 5%). COLAs paid after October 2018 are assumed to be equal to 2.25% (the assumed asset return of 7% less 4.75%).

Census Dates

All dates in the census used to calculate liabilities are set as July 1st in the year of the event.

Appendix A: Summary of Actuarial Methods and Assumptions (continued)

Missing Data Assumptions

Pay for New Hires

None were missing.

Employee Contributions

Based on the prior year's contributions and current year's pay.

Age at First Payment for Vested Terminations:

50

Benefits Not Valued

The proportional retirement program between the Houston municipal, police and fire pension funds which allows for combining service credit from two or more City of Houston pension plans was not valued because its impact is expected not to be material.

Sample Rates

Sample Rates per 100 Participants	
Age	Disability
20	0.75
25	0.75
30	0.75
35	1.50
40	1.50
45	1.50
50	1.50
55	1.50
60	3.00

Appendix B: Summary of Plan Provisions

Membership

Any firefighter who has not reached the age of 36 at the time he or she first enters employment shall automatically become a participant in the Fund upon completing the training period. Before October 1, 1990, the eligibility age was age 31. Before 1984, participants entered the Fund on January 1 or July 1.

Average Salary

For members hired prior to July 1, 2017, the average of the highest 36 months of pensionable pay (or 78 pay periods). For members hired on or after July 1, 2017, the average of the final 36 months of pensionable pay (or 78 pay periods).

Pensionable Pay

Pensionable pay prior to July 1, 2017 includes base pay and overtime, before reduction for pre-tax employee contributions and salary deferrals. Pensionable pay after July 1, 2017 includes base pay, before reduction for pre-tax employee contributions and salary deferrals.

Appendix B: Summary of Plan Provisions (continued)

Standard Service Pension – Members hired prior to July 1, 2017

Eligibility

20 years of service

Benefit

For retirement on or after November 1, 1997 and applicable for service accrued prior to July 1, 2017, 50% of average monthly salary; plus 3% of average monthly salary per year of service in excess of 20 years. For service accrued after July 1, 2017, 2.75% of average monthly salary per year of service for the member's first 20 years of service; plus 2.00% of average monthly salary per year of service in excess of 20 years.

For retirement on or after November 1, 1996 and prior to November 1, 1997, 48.334% of average monthly salary, plus 2.834% of average monthly salary per year of service in excess of 20 years.

For retirement on or after November 1, 1995 and prior to November 1, 1996, 46.667% of average monthly salary, plus 2.667% of average monthly salary per year of service in excess of 20 years.

For retirement on or after September 1, 1991 and prior to November 1, 1995, 45% of average monthly salary, plus 2.5% of average monthly salary per year of service in excess of 20 years, up to 30 years, plus 1.0% of average monthly salary in excess of 30 years.

For retirement on or after September 1, 1989 and prior to September 1, 1991, 45% of average monthly salary, plus 2.5% of average monthly salary per year of service in excess of 20 years.

For retirement on or after September 1, 1987 and prior to September 1, 1989, 45% of average monthly salary, plus 2% of average monthly salary per year of service in excess of 20 years.

For retirement on or after July 1, 1986 and prior to September 1, 1987, 40% of average monthly salary plus 2% of average monthly salary per year of service in excess of 20 years.

For retirement on or after January 1, 1970 and prior to July 1, 1986, 35% of average monthly salary plus 3% of average monthly salary per year of service in excess of salary per year of service in excess of 25 years.

Appendix B: Summary of Plan Provisions (continued)

Standard Service Pension – Members hired prior to July 1, 2017 (continued)

Maximum

For retirement on or after July 1, 2017, none.

For retirement on or after September 1, 1991, 80% of average monthly salary.

For retirement on or after September 1, 1989 and prior to September 1, 1991, 70% of average monthly salary.

For retirement on or after September 1, 1987 and prior to September 1, 1989, 65% of average monthly salary.

For retirements on or after January 1, 1970 and prior to September 1, 1987, 60% of average monthly salary.

In addition, a member will receive a \$5,000 lump sum payment upon retirement.

Standard Service Pension – Members hired on or after July 1, 2017

Eligibility

Age at which the sum of the member's age and service equals 70.

Benefit

2.25% of average monthly salary per year of service for the member's first 20 years of service; plus 2.00% of average monthly salary per year of service in excess of 20 years.

Maximum

80% of average monthly salary.

In addition, a member will receive a \$5,000 lump sum payment upon retirement.

Alternate Service Pension

Eligibility

Firefighters who became participants prior to September 1, 1987 and who attain age 50 with 20 years of service will receive the greater of the standard or alternate pension.

Benefit

50% of average monthly salary plus 1% of average monthly salary per year of service after becoming eligible to retire on an alternate pension.

Maximum

65% of average monthly salary.

Appendix B: Summary of Plan Provisions (continued)

Supplemental Bonus Check

Supplemental payments totaling up to \$5 million will be payable on a prorated basis determined by the Board of Trustees to all retirees and survivors.

Deferred Retirement Option Plan (DROP)

Eligibility

20 years of service. Members hired on or after July 1, 2017 are not eligible to enter DROP.

Benefit

Effective July 1, 2000, eligible participants may elect to participate in the DROP. The member's standard or alternate service pension (whichever is greater) will be calculated based on service and earnings at the time the DROP is elected.

A notional account will be maintained for each DROP participant. This account will be credited with the following amounts while the member is a participant of the DROP:

- The member's monthly retirement pension, including applicable cost-of-living adjustments (no cost-of living adjustments will be granted while a member is a participant in DROP after July 1, 2017),
- The member's contributions to the Retirement Fund contributed prior to July 1, 2017, and
- Investment earnings/losses at the rate of the Retirement Fund's earnings/losses averaged over a five-year period. Effective July 1, 2017, investment earnings will be contributed to a member's DROP account at the rate of 65% of the Retirement Fund's earnings/losses averaged over a five-year period.

A benefit equal to the DROP account balance would be paid at the time the member leaves active service. The payment would be made as a single lump sum or as the member chooses.

Effective on July 1, 2000, a three-year back DROP is available for all eligible participants. The DROP account would be recalculated based on what the account balance would have been had the participant elected the DROP up to 3 years earlier than he/she actually did. The initial DROP entry date cannot be backdated prior to September 1, 1995, or prior to 20 years of credited service, and must be on the first of the month selected.

The monthly benefit for a participant at actual retirement will increase 2% for every year of DROP participation, not to exceed 10 years.

Members can remain in the DROP for 13 years. If a member remains in active service after 13 years in DROP, no further deposits other than unused leave pay will be made to the DROP account, but the DROP account will continue to accrue interest.

If a DROP participant suffers an on-duty disability resulting in the inability to perform any gainful activity or dies in the line of duty, the death or disability annuity benefit would be calculated as though the participant had not entered the DROP. In addition, the DROP account would be payable to the participant or beneficiary.

Appendix B: Summary of Plan Provisions (continued)

Service-Connected Disability Pension

Eligibility

No age or service requirements.

Benefit

50% of average monthly salary or service pension if greater and eligible. Firefighters who are not capable of performing any substantial gainful activity will receive 75% of average monthly salary, or service pension, if greater and eligible.

In addition, a member will receive a \$5,000 lump sum.

Non-Service-Connected Disability Pension

Eligibility

No age or service requirements.

Benefit

25% of average monthly salary, plus 2.5% of average monthly salary per year of service.

Maximum

50% of average monthly salary or service pension, if greater and eligible.

In addition, a member will receive a \$5,000 lump sum

Vested Pension

Eligibility

At least 10 but less than 20 years of service and hired prior to July 1, 2017.

Benefit

1.7% of average monthly salary per year of service, payable beginning at age 50 or optional refund of contributions with interest at a flat rate of 5% not compounded.

Appendix B: Summary of Plan Provisions (continued)

Death Benefits

Payable as specified below if survived by a spouse, dependent children, or dependent parents.

Effective November 1, 1997 dependent children can continue to receive benefits between the ages of 18 and 22 if they are in college.

Non-service-connected

Monthly benefit that would have been payable had the participant retired for non-service-connected disability on the date of his or her death (or service pension if greater).

Postretirement

Monthly benefit payable to the participant prior to his or her death. Effective July 1, 1998, a "graded" postretirement death benefit is payable to a surviving spouse if the retiree was not married at the time of retirement. This "graded" benefit is equal to 20% of the postretirement death benefit for each year of marriage to a maximum 100% after five years of marriage.

Preretirement

In the case of the death of an active firefighter in the line of duty, eligible survivor will receive a benefit equal to 100% of the decedent's average monthly salary. Refund of contributions made if no eligible survivors. If death occurs after 10 years of service, interest is credited on the contributions at the flat rate of 5% not compounded. If death occurs before 10 years of service, no interest is credited.

Lump sum

A one-time \$5,000 lump sum death benefit for any active or retired firefighter. This benefit applies to active members, current retirees, and disabled participants.

Additional Benefit

Effective on or after July 1, 2001, an extra monthly benefit of \$150 is payable for life to any retired or disabled member or to an eligible survivor of a deceased member. This benefit is not subject to the postretirement adjustment.

Excess Benefit

Benefit equal to the excess of any members' standard service pension benefit over the limit imposed by Section 415 of the code.

Appendix B: Summary of Plan Provisions (continued)

Postretirement Adjustment

Prior to October 1, 1990

Pensions adjusted each year based on changes in the CPI-U, but not below original amount or above original amount increased 3% each year, not compounded.

Pension adjustments for participants who retire after March 1, 1982 begin at age 55.

Pension adjustments begin immediately for participants whose benefits become payable on or after July 1, 1986 and are based upon 30 or more years of service.

On or after October 1, 1990 and prior to November 1, 1997

Pensions adjusted each year based on changes in the CPI-U. The adjustment is based on the amount of benefits payable at the time of adjustment. The maximum annual increase shall be 3% of the benefits payable at the time of adjustment.

Pension adjustments begin immediately for participants whose benefits become payable on or after July 1, 1986 and are based upon 30 or more years of service.

On or after November 1, 1997 and prior to October 1, 2017

Pensions adjusted each year at a fixed rate of 3%. The adjustment is based on the amount of benefits payable at the time of adjustment.

Pension adjustments for participants who retire or terminate with a vested benefit after March 1, 1982 begin at age 48. Pension adjustments begin immediately for participants who become disabled and cannot perform any substantial gainful activity (current and future) and qualify for general on-duty disability benefits. Participants whose benefits become payable on or after July 1, 1986 and are based upon 30 or more years of service are also eligible for pension adjustments to begin immediately.

On or after October 1, 2017 and prior to October 1, 2019

Pensions adjusted each year at a rate equal to the Fund's most recent five fiscal years' smoothed return minus 5% (but not less than 0% nor greater than 4%). The adjustment is based on the amount of benefits payable at the time of adjustment. Pension adjustments only paid to members who are at least 70 years old.

On or after October 1, 2019

Pensions adjusted each year at a rate equal to the Fund's most recent five fiscal years' smoothed return minus 4.75% (but not less than 0% nor greater than 4%). The adjustment is based on the amount of benefits payable at the time of adjustment. Pension adjustments only paid to members who are at least 70 years old in October 2019. Pension adjustments only paid to members who are at least 55 years old after October 2019.

Appendix B: Summary of Plan Provisions (continued)

Contribution Rates

Members

10.5% of salary effective July 1, 2017. Members receive a refund of contributions without interest in the event of termination before 10 years of service. Members who elect a refund of contributions after attaining 10 years of service receive interest only on contributions made prior to July 1, 2017.

City

Effective for fiscal year ending 2018, city contribution rates will be made in accordance with the annual risk sharing valuation study. The city contribution rate in any fiscal year will not be greater than the city contribution rate projected in the initial risk sharing valuation study for that fiscal year plus 5%. The city contribution rate in any fiscal year will not be less than the city contribution rate projected in the initial risk sharing valuation study for that fiscal year minus 5%.

Appendix C: Participant Information

Summary of Active Participants as of July 1, 2016

Attained Age	Under 1	1 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 & up	Total		
Under 25	41	55	-	-	-	-	-	-	-	-	96		
Avg. Pay	11,938	46,576	-	-	-	-	-	-	-	-	31,783		
25 to 29	72	328	68	-	-	-	-	-	-	-	468		
Avg. Pay	8,821	51,992	64,878	-	-	-	-	-	-	-	47,223		
30 to 34	48	274	315	110	-	-	-	-	-	-	747		
Avg. Pay	10,244	51,531	66,794	75,827	-	-	-	-	-	-	58,892		
35 to 39	13	73	207	484	45	-	-	-	-	-	822		
Avg. Pay	10,270	52,820	66,433	74,871	79,220	-	-	-	-	-	70,004		
40 to 44	-	2	81	342	198	38	-	-	-	-	661		
Avg. Pay	-	62,542	65,927	73,398	84,982	88,653	-	-	-	-	76,797		
45 to 49	-	-	1	154	212	53	5	-	-	-	425		
Avg. Pay	-	-	74,679	74,315	84,452	97,324	113,950	-	-	-	82,708		
50 to 54	-	-	-	4	76	14	4	-	-	-	98		
Avg. Pay	-	-	-	69,576	84,655	83,990	97,629	-	-	-	84,474		
55 to 59	-	-	-	-	-	3	1	-	-	-	4		
Avg. Pay	-	-	-	-	-	90,297	75,190	-	-	-	86,520		
60 to 64	-	-	-	-	-	-	-	-	-	-	-		
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-		
65 to 69	-	-	-	-	-	-	-	-	-	-	-		
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-		
70 & up	-	-	-	-	-	-	-	-	-	-	-		
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-		
Total	174	732	672	1,094	531	108	10	-	-	-	3,321		
Avg. Pay	10,056	51,524	66,396	74,409	84,235	92,349	103,545	-	-	-	66,614		
Average Age:				37.14				Average Service:				9.7	



Appendix C: Participant Information (continued)

Summary of DROP Participants as of July 1, 2016

Attained Age	Under 1	1 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 & up	Total
Under 25	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
25 to 29	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
30 to 34	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
35 to 39	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
40 to 44	-	-	-	-	-	14	1	-	-	-	15
Avg. Pay	-	-	-	-	-	89,722	96,497	-	-	-	90,173
45 to 49	-	-	-	-	-	104	72	2	-	-	178
Avg. Pay	-	-	-	-	-	84,013	90,047	115,910	-	-	86,812
50 to 54	-	-	-	-	-	82	110	77	1	-	270
Avg. Pay	-	-	-	-	-	83,749	86,977	88,123	76,279	-	86,284
55 to 59	-	-	-	-	-	29	56	131	59	-	275
Avg. Pay	-	-	-	-	-	82,053	83,166	88,230	89,611	-	86,844
60 to 64	-	-	-	-	-	-	-	14	17	2	33
Avg. Pay	-	-	-	-	-	-	-	81,223	85,914	74,675	83,243
65 to 69	-	-	-	-	-	-	-	-	-	2	2
Avg. Pay	-	-	-	-	-	-	-	-	-	89,095	89,095
70 & up	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	229	239	224	77	4	773
Avg. Pay	-	-	-	-	-	84,019	87,049	88,003	88,622	81,885	86,558
Average Age:				53.37		Average Service:				28.32	

Appendix C: Participant Information (continued)

Summary of Active and DROP Participants as of July 1, 2016

Attained Age	Under 1	1 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 & up	Total		
Under 25	41	55	-	-	-	-	-	-	-	-	96		
Avg. Pay	11,938	46,576	-	-	-	-	-	-	-	-	31,783		
25 to 29	72	328	68	-	-	-	-	-	-	-	468		
Avg. Pay	8,821	51,992	64,878	-	-	-	-	-	-	-	47,223		
30 to 34	48	274	315	110	-	-	-	-	-	-	747		
Avg. Pay	10,244	51,531	66,794	75,827	-	-	-	-	-	-	58,892		
35 to 39	13	73	207	484	45	-	-	-	-	-	822		
Avg. Pay	10,270	52,820	66,433	74,871	79,220	-	-	-	-	-	70,004		
40 to 44	-	2	81	342	198	52	1	-	-	-	676		
Avg. Pay	-	62,542	65,927	73,398	84,982	88,941	96,497	-	-	-	77,094		
45 to 49	-	-	1	154	212	157	77	2	-	-	603		
Avg. Pay	-	-	74,679	74,315	84,452	88,507	91,599	115,910	-	-	83,919		
50 to 54	-	-	-	4	76	96	114	77	1	-	368		
Avg. Pay	-	-	-	69,576	84,655	83,784	87,351	88,123	76,279	-	85,802		
55 to 59	-	-	-	-	-	32	57	131	59	-	279		
Avg. Pay	-	-	-	-	-	82,826	83,026	88,230	89,611	-	86,839		
60 to 64	-	-	-	-	-	-	-	14	17	2	33		
Avg. Pay	-	-	-	-	-	-	-	81,223	85,914	74,675	83,243		
65 to 69	-	-	-	-	-	-	-	-	-	2	2		
Avg. Pay	-	-	-	-	-	-	-	-	-	89,095	89,095		
70 & up	-	-	-	-	-	-	-	-	-	-	-		
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-		
Total	174	732	672	1,094	531	337	249	224	77	4	4,094		
Avg. Pay	10,056	51,524	66,396	74,409	84,235	86,689	87,711	88,003	88,622	81,885	70,380		
Average Age:				40.20				Average Service:				13.22	

Appendix C: Participant Information (continued)

Summary of Inactive Participants as of July 1, 2016

	Number	Annual Benefits (\$000)	Average Annual Benefits
Benefits in Pay Status			
Retirees	2,232	\$ 111,348	\$ 49,887
Beneficiaries	591	23,281	39,392
Disabled Participants	<u>315</u>	<u>15,376</u>	<u>48,814</u>
Total	3,138	\$ 150,005	\$ 47,803
Deferred Benefits			
Vested Terminated Participants	43	\$ 100 ²	\$ 2,334
Beneficiaries	N/A	N/A	N/A
Disabled Participants	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Total	43	\$ 100	\$ 2,334

² Does not include \$561,000 in pending refunds.



City of Houston
HFRRF
Final Initial Risk Sharing
Valuation Study
As of July 1, 2016

August 25, 2017



August 25, 2017

Mr. Kelly Dowe
Chief Business Officer and Finance Director
City of Houston
611 Walker
Houston, TX 77002

Re: HFRRF Final Initial Risk Sharing Valuation Study

Dear Kelly:

Texas Revised Statutes article 6243e.2(1) (the Article) sets forth requirements for an initial Risk Sharing Valuation Study (RSVS) of the Houston Firefighters' Relief and Retirement Fund (HFRRF). The purpose of this study is to determine the City Contribution Rate for Fiscal Year 2018. The initial Study will also be used to set the Risk Sharing Corridor Midpoint, Minimum Contribution Rate, and Maximum Contribution Rate for the next 31 years. Retirement Horizons Inc. (RHI) was engaged by the City of Houston to perform this initial Risk Sharing Valuation Study as the municipal actuary.

The HFRRF actuary conducted a proposed initial RSVS dated June 27, 2017. That report was then provided to RHI on the same day by the HFRRF's executive director. RHI subsequently received some but not all Actuarial Data as defined in Section 1-a of the Article and required by Section 13C(b) of the Article. RHI conducted our proposed initial RSVS dated July 28, 2017 using the Actuarial Data provided and plan provisions described therein.

Pursuant to the reconciliation and finalization process described in Section 13C(c) of the Article, RHI has updated its forecast of the Corridor Midpoint, Minimum Contribution Rate, and Maximum Contribution Rate in the initial RSVS.

During the reconciliation process, we determined that the primary reason for the differences in the results of the two Proposed Initial Risk Sharing Valuation Studies was differences in the underlying assumptions. After further discussions regarding the basis for the assumptions, no agreement was made between the Fund's actuary and RHI to revise any existing assumptions.

As described in the Article, results of the Final Initial Risk Sharing Valuation Study performed by the HFRRF actuary will be compared to the results in this report. If the results for any fiscal year in the Final Initial RSVS by the HFRRF actuary are greater than two percentage points different from RHI's results, a mathematical average will be used. If the results for any fiscal year are within two percentage points, then the HFRRF actuary's results for that fiscal year will be used.

Mr. Kelly Dowe
August 25, 2017

The actual costs, City Contribution Rates, and other results could be materially different from those described in this letter in the future if actual plan experience differs significantly from the underlying valuation basis. Differences could occur for a number of reasons such as plan experience differing from the underlying demographic and economic assumptions or changes in plan provisions. Due to the limited scope of this report, analysis of the potential range of such future measurements has not been performed.

The results in this letter and any measures of funded status are predicated on the notion of the Fund's ongoing operation and should not be relied upon for assessing the sufficiency of plan assets for settlement of plan termination liabilities.

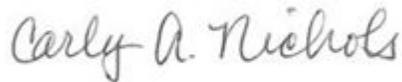
The information contained in this letter was prepared as requested by the City of Houston and solely for the purpose of satisfying the Final Initial RSVS requirements of the Article, and should not be used for any other purpose. As significantly different results from those contained in this letter may be needed for other purposes, this letter should only be provided to other parties in its entirety.

The signing actuaries for this letter are members of the Society of Actuaries and other professional actuarial organizations and meet the "Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion." The undersigned are available to answer questions regarding the information contained in this letter or to provide further explanations or details as needed.

Respectfully submitted by Retirement Horizons Inc.



David A. Sawyer, FSA EA MAAA
Senior Consultant



Carly A. Nichols, FSA EA MAAA
Actuarial Consultant

Forecast of Corridor Midpoint

Forecast of Corridor Midpoint - 7% Interest Rate

The table below contains a forecast of the Corridor Midpoint, along with the corresponding Minimum and Maximum Contribution Rates using a 5% Corridor Margin as specified in the Article. Based on the initial RSVS results, the City Contribution Rate is 26.98% of pensionable payroll.

FY	City Normal Cost Rate	Admin. Expenses	Amort. of Legacy Liability	Corridor Midpoint	Minimum Contribution Rate	Maximum Contribution Rate
2018	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2019	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2020	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2021	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2022	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2023	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2024	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2025	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2026	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2027	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2028	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2029	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2030	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2031	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2032	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2033	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2034	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2035	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2036	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2037	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2038	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2039	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2040	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2041	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2042	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2043	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2044	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2045	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2046	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2047	13.49%	1.25%	12.24%	26.98%	21.98%	31.98%
2048	13.49%	1.25%	0.00%	14.74%	9.74%	19.74%

Actuarial Exhibits

3.1. Actuarial Value of Assets

1. Market Value of Assets at beginning of year	N/A
2. Net Cash Flow	
a. Contributions	N/A
b. Disbursements	N/A
c. Net Cash Flow [2.a. - 2.b.]	N/A
3. Expected Investment Return [1. x 0.07] + [2.c. x 0.035]	N/A
4. Expected Market Value of Assets at end of year [1. + 2.c. + 3.]	N/A
5. Market Value of Assets at end of year	\$ 3,729,670,000
6. Investment Gain/(Loss) [5. - 4.]	N/A

Schedule of Actuarial Investment Gains (Losses)

Fiscal Year End	Initial Actuarial Gain (Loss)	Five-Year Recognition	Gain (Loss) As of July 1, 2016
2016	N/A	N/A	N/A
2017	N/A	N/A	N/A
2018	N/A	N/A	N/A
2019	N/A	N/A	N/A
2020	N/A	N/A	N/A
Total	\$ -	\$ -	\$ -

Market Value as of July 1, 2016	\$ 3,729,670,000
(Gain) Loss to be Recognized in Future Years	\$ -
Actuarial Value as of July 1, 2016	\$ 3,729,670,000

Actuarial Exhibits

3.2. Actuarial Accrued Liability

	<u>July 1, 2016</u>
A. Discount Rate	7.0%
B. Actuarial Accrued Liability	
1. Active	\$1,504,876,227
2. Terminated Vested	\$1,473,695
3. Disabled	\$203,184,724
4. Retired	\$2,621,867,347
5. Total	<u>\$4,331,401,993</u>
C. Change in Actuarial Accrued Liability	
1. Benefits Accumulated	N/A
2. Benefits Paid	N/A
3. Decrease in Discount Period	N/A
4. Plan Experience	N/A
5. Actuarial Assumptions	N/A
6. Actuarial Methods	N/A
7. Plan Amendments	N/A
8. Net Change	N/A
D. Actuarial Value of Assets	<u>\$ 3,729,670,000</u>
E. Unfunded Actuarial Liability	<u>\$601,731,993</u>
F. Total Normal Cost % of Payroll	23.99%
G. Member Contribution % of Payroll	10.50%
H. City Normal Cost Rate [F - G]	13.49%

Actuarial Exhibits

3.3. Gain/Loss Analysis

	Liability	Assets	Unfunded
A. Values at Prior Year Beginning	N/A	N/A	N/A
B. Expected Changes During Year			
1. Normal Cost	N/A	N/A	N/A
2. Contributions	N/A	N/A	N/A
3. Benefits Paid	N/A	N/A	N/A
4. Interest on			
a. Item A	N/A	N/A	N/A
b. Item B.1	N/A	N/A	N/A
c. Item B.2	N/A	N/A	N/A
d. Item B.3	N/A	N/A	N/A
5. Total Expected Changes	\$0	\$0	\$0
C. Expected Values at Prior Year End	N/A	N/A	N/A
D. Other Changes			
1. Plan Experience	N/A	N/A	N/A
2. Actuarial Assumptions	N/A	N/A	N/A
3. Actuarial Methods	N/A	N/A	N/A
4. Plan Amendments	N/A	N/A	N/A
5. Total Other Changes	\$0	\$0	\$0
E. Actual Values as of Current Year Beginning	\$4,331,401,993	\$ 3,729,670,000	\$601,731,993

Actuarial Exhibits

3.4. Liability Layers

Fiscal Year	Initial Amount of Liability Layer (BOY)	Liability Layer to be Amortized (EOY)	Amortization Period	Payoff Year	Amortization Amount	Level Percent of Payroll Amortization Rate
2016	\$601,731,993	\$581,893,105	30	2047	\$33,035,167	12.24%
Total						12.24%

Summary of Plan Provisions

Eligibility and Participation

Any firefighter shall automatically become a participant in the plan upon completing the training period, as long as he or she has not reached age 36.

Final Average Pay (FAP)

For members hired prior to July 1, 2017, the average of the highest 78 bi-weekly payroll periods of salary, before reduction for pre-tax employee contributions and salary deferrals. Overtime and any excess of the salary earned on the basis of the member's appointed position over the salary of the member's highest tested rank are excluded for pay periods after July 1, 2017. For members hired after July 1, 2017, the average of the highest 78 bi-weekly payroll periods of salary, before reduction for pre-tax employee contributions and salary deferrals, and excluding overtime and any excess of the salary earned on the basis of the member's appointed position over the salary of the member's highest tested rank.

Credited Service

Elapsed time from date of hire, for all periods of service classified as full-time, fully paid, active duty employment with the City of Houston Fire Department.

Retirement Benefit

Eligibility

20 years of service if hired prior to July 1, 2017. Attainment of age plus service of at least seventy (Rule of 70) for those hired on or after July 1, 2017.

Amount

Prior to July 1, 2017, 2.5% of FAP times credited service up to 20 years of service, plus 3.0% of FAP for credited service in excess of 20 years, up to a maximum pension of 80% of FAP. In addition, the member will receive a \$5,000 lump sum.

On or after July 1, 2017, 2.75% per year prior to 20 years of service and 2.00% thereafter for those hired prior to July 1, 2017 (no maximum). For those hired on or after that date, 2.25% per year up to 20 years of service and 2.00% thereafter, up to a maximum of 80% of FAP. Percentages earned prior to July 1, 2017 are retained. \$5,000 lump sum payable upon retirement if member has completed 20 years of service, regardless of date of hire.

Summary of Plan Provisions

Termination Benefit

Eligibility	Termination of employment prior to satisfying the retirement eligibility requirements.
Amount	Hired prior to July 1, 2017 with less than 10 years of service: Lump sum refund of member contributions without interest. Hired prior to July 1, 2017 with at least 10 but less than 20 years of service: Choice of <ul style="list-style-type: none">• Refund of contributions (with 5% interest, not compounded, on contributions made prior to July 1, 2017), or• Monthly benefit of 1.7% of final average pay per year of service, payable at age 50 Hired on or after July 1, 2017: Lump sum refund of member contributions without interest.

On-Duty Disability

Eligibility	No age or service requirements.
Amount	Firefighters who are not capable of performing their normal and customary firefighter duties receive the greater of their accrued retirement benefit or 50% of FAP (75% of FAP for firefighters not capable of performing any substantial gainful activity). In addition, the member will receive a \$5,000 lump sum. This benefit was assumed to be payable immediately, even if the member does not yet meet retirement eligibility.

Off-Duty Disability

Eligibility	No age or service requirements.
Benefit	Firefighters who are not capable of performing their normal and customary firefighter duties receive the greater of their accrued retirement benefit or 25% of FAP plus 2.5% of FAP per year of service (up to a maximum of 50% of FAP). In addition, the member will receive a \$5,000 lump sum. This benefit was assumed to be payable immediately, even if the member does not yet meet retirement eligibility.

Summary of Plan Provisions

Active Member Death

Eligibility	No age or service requirements.
Duty Related Benefit	100% of FAP. In addition, the beneficiary will receive a \$5,000 lump sum.
Non-Duty Related Benefit	Greater of the accrued retirement benefit or Off-Duty Disability benefit. In addition, the beneficiary will receive a \$5,000 lump sum.
Allocation to Beneficiaries	The benefit amount above is payable to a surviving spouse, or allocated 50% to the surviving spouse with the remaining 50% divided equally among any eligible children, or if no surviving spouse divided equally among any eligible children, or otherwise paid to any eligible parents if no surviving spouse or eligible children. An eligible child enrolled in college must be unmarried.

Please Note: Members who become disabled or die from heart or lung disease or cancer must have at least six years of service to receive a disability or death benefit. They must also have passed a physical upon beginning employment or prior to the claimed disability or death which did not reveal evidence of the condition.

Retired Member Death

Eligibility	Retired and receiving monthly pension.
Amount	100% of monthly pension the retired member was receiving.
Allocation to Beneficiaries	The benefit amount above is payable to a surviving spouse, or allocated 50% to the surviving spouse with the remaining 50% divided equally among any eligible children, or if no surviving spouse divided equally among any eligible children, or otherwise paid to any eligible parents if no surviving spouse or eligible children. An eligible child enrolled in college must be unmarried.

Supplemental Annuity

An extra monthly benefit of \$150 is payable for life to any retired or disabled member or to an eligible survivor of a deceased member.

Supplemental Bonus Checks

Annual payments of up to \$5 million are provided to retirees and beneficiaries.

Summary of Plan Provisions

Cost of Living Adjustment

Beginning at age 55, a retired member or beneficiary will receive an adjustment reflecting the Fund's 5-year average investment return less 4.75%, with a floor of 0% and a cap of 4%. Prior to July 1, 2020, no COLA is provided to members under age 70. Notwithstanding the foregoing, prior to July 1, 2019, COLA provided to members who are at least 70 years of age is the Fund's 5-year average investment return less 5%, with a floor of 0% and a cap of 4%.

DROP

Hired prior to July 1, 2017: Upon reaching retirement eligibility, members may enter the Deferred Retirement Option Plan (DROP). The member's monthly annuity is added to a notional account. Interest is credited on the account using 65% of the 5-year average of the Fund's rate of return, with a minimum of 2.5%. COLAs are not applied to the monthly benefit until the member exits DROP, and member contributions are not credited to the DROP account.

For those eligible to retire prior to July 1, 2017, upon exiting the DROP for retirement, the member's monthly benefit is increased by 2% of the original monthly benefit for each year the member remained in DROP, up to 10 years.

Please note: for accumulation to the valuation date, DROP accounts include the value of COLAs after age 48 at 3.0% per year, as well as member contributions of 9% of total pay.

Hired on or after July 1, 2017: not available.

PROP

Prior to July 1, 2017, a member could elect to have all or a portion of his or her monthly annuity credited to the Post Retirement Option Plan (PROP) account, along with interest. On and after July 1, 2017, the interest credit is 65% of the 5-year average of the Fund's rate of return, with a minimum of 2.5% (same as DROP crediting rate). Additionally, no new amounts are eligible for deferral into the PROP.

Contribution Rates

Members

10.50% of pensionable pay.

City

The City Contribution Rate from the RSVS applied to pensionable payroll.

Actuarial Assumptions and Methods

Actuarial Cost Methods

Measurement Date	Census data as of July 1, 2016. Plan changes assumed to take effect July 1, 2016, with changes to City Budget Cost Rate effective July 1, 2017 (Fiscal Year 2018). Impact of plan changes measured on future accruals only; no impact to accruals through the valuation date, including for back-DROP accruals based on dates before the valuation date.
Actuarial Value of Assets	Fair market value of assets as of June 30, 2016, with five-year smoothing of future gains and losses (that is, initial Actuarial Value equal to Fair Market Value with smoothing thereafter). 20% of each gain or loss will be recognized each year.
Actuarial Cost Method	<u>The Ultimate Entry Age Normal Actuarial Cost Method</u> As used in the City Funding Policy, a method under which the actuarial present value of all potential future projected benefits of each individual included in the valuation is calculated, assuming continued service and pay increases. The <i>normal cost</i> is calculated as the average uniform percentage of payroll which, if applied to the compensation of each participant during the entire period of anticipated covered service, would meet the cost of all benefits payable based on benefits provisions for new hires. The portion of the actuarial present value of future benefits not provided for at the valuation date by the present value of future normal costs is called the <i>actuarial accrued liability</i> .

Key Economic Assumptions

Interest Rate	7.0%, as prescribed by law
Inflation	2.25%
Wage Inflation	3.00%
Payroll Growth	3.00%
Cost of Living Adjustment	2.00%

Actuarial Assumptions and Methods

Individual Pay Increase Rate

Age	Assumed Increase
20	7.00%
25	6.25%
30	5.50%
35	5.00%
40	4.00%
45	3.70%
50	3.40%
55	3.00%

DROP Interest Crediting Rate

4.75%. Please note: 8.50% was assumed to be credited prior to the valuation date. This reflects the historical expected rate of return on the trust, since actual rates of return on DROP balances were not provided.

Demographic Assumptions

Mortality Rates

Active and nondisabled members

RP-2000 Combined Healthy Mortality Tables with longevity improvement projected generationally using Scale AA.

Disabled pensioners

RP-2000 Disabled Mortality Tables with longevity improvement projected generationally using Scale AA.

Actuarial Assumptions and Methods

Retirement Rates

<i>Years of Service</i>	<i>Probability of Retiring Within One Year</i>
20 - 24	1%
25 - 29	5%
30 - 34	15%
35 - 36	25%
37	30%
38	35%
39	40%
40+	100%

These rates apply to members hired on or after July 1, 2017 once they are eligible to retire.

Members currently in DROP are assumed to retire according to the retirement rates, with 100% retirement assumed after ten years in DROP.

The following table shows, for sample years of service, the assumed probability of the active members not currently in DROP having been in the DROP for a certain number of years at retirement:

Years of Service at Retirement	Percent Electing Specified DROP Period at Retirement				
	0 Years	3 Years	5 Years	8 Years	10 Years
20	0%	0%	0%	0%	0%
25	0%	0%	100%	0%	0%
30	0%	0%	5%	30%	65%
35	0%	0%	5%	30%	65%
40	0%	0%	0%	0%	100%

Actuarial Assumptions and Methods

Disability Rates

<i>Disability per 100</i>	
<i>Age</i>	<i>All</i>
20	0.75
25	0.75
30	0.75
35	1.50
40	1.50
45	1.50
50	1.50
55	1.50
60	3.00

Percentage of Disabilities in the Line of Duty

- Deaths 50%
- Disabilities 50%

All Deaths are assumed to occur in the Line of Duty.

Actuarial Assumptions and Methods

Termination Rates

Sample Rates

Age	Termination Rate
20	1.30%
25	1.30%
30	1.18%
35	0.70%
40	0.40%
45	0.45%
50	0.00%

For participants hired prior to July 1, 2017 with at least 10 years of service but not yet eligible to retire, 50% are assumed to elect a contribution refund, and 50% are assumed to elect a deferred monthly benefit.

Percentage married

90% of participants are assumed to be married.

No beneficiaries other than the spouse assumed.

Age difference

Husbands assumed to be three years older than wives.

Administrative Expenses

1.25% of payroll

Development of Valuation Pay

Valuation pay is projected by increasing the prior year's pay with the individual pay increase rate. Historical valuation pay was regressed with the individual pay increase rate where it was not available. Because overtime pay is no longer included in the definition of pensionable pay, the valuation pay was reduced 9% for future years. The 9% was based on input from the City of Houston and the HFRRF actuary.

Load for Nature of Average Salaries

Benefits for active members with at least ten years of service by July 1, 2017 were increased 5% to account for difference between the plan's definition of average monthly salary and the average of the most recent 78 pay periods.

Actuarial Assumptions and Methods

Payment of DROP Balances	Installments over 15 years for active members and 10 years for inactive members. A factor of 0.8654 was applied to active DROP balances and a factor of 0.9105 was applied to inactive DROP balances to account for the difference between the 4.75% DROP interest crediting rate and the 7.00% interest rate assumption.
Funding Policy	The City is assumed to contribute the City Contribution Rate from the prior year. This actuarially determined rate is measured as the normal cost rate, plus the administrative expenses rate, plus 30-year amortization rate of the Unfunded Actuarial Accrued Liability (UAAL) less the firefighter contribution rate, adjusted with interest to mid-year. The 30-year closed amortization rate of the UAAL is calculated as a level percent of pay.
Benefits Not Valued	Due to limitations of the data received, no adjustment has been made for the difference between pay based on the appointed position and pay based on the highest tested rank. Additionally, no marital status was provided for child beneficiaries, so the provision against married children in college receiving a survivor benefit was not valued. All child beneficiaries were assumed to receive benefits until age 23.

Summary of Valuation Data

July 1, 2016

A. Active Members Not in DROP

1. Number	3,321
2. Valuation payroll	\$201,194,698
3. Average pay	\$60,583
4. Average age	37.1
5. Average service	9.7

B. Active Members in DROP

1. Number	773
2. Valuation payroll	\$60,887,278
3. Average pay	\$78,768
4. Average age	53.4
5. Average service	28.3

C. Terminated Vested

1. Number	14
2. Total benefits	\$100,362
3. Average Annual benefits	\$7,169

D. Disabled

1. Number	315
2. Total benefits	\$15,376,486
3. Average Annual benefits	\$48,814

E. Retired

1. Number	2,232
2. Total benefits	\$111,347,825
3. Average Annual benefits	\$49,887

F. Beneficiaries

1. Number	591
2. Total benefits	\$23,280,755
3. Average Annual benefits	\$39,392

Notes:

1. DROP Balance values not shown.
2. Terminated Vested count does not include 29 members due refunds totaling \$561,000.
3. Payroll and Pay values exclude overtime.
4. Date fields provided to RHI by HFRRF only included the year (no month or day). Based on information provided by HFRRF, the Fund's RSVS was prepared using more specific dates for some of the longer service members.

Data Sources

Data and inputs used in this report were provided from the following sources:

- Census data for all members was provided on July 10, 2017. We understand this data is substantially the same as that used by the HFRRF actuary for their initial Risk Sharing Valuation Study dated June 27, 2017 and received by RHI on June 30, 2017. However, the data provided to RHI does not contain the month for any dates. We have assumed all dates are July 1st of the respective year. Because we do not have the month for each date, we are unable to verify the accuracy of the data compared to the summaries in the HFRRF actuary's report.
- The fair value of assets of \$3,729,670,000 as of June 30, 2016 was provided in the HFRRF GASB 67 Accounting Information Report dated September 21, 2016. This report was provided to RHI by the City of Houston Finance Department on November 11, 2016.
- The Fiscal Year 2017 payroll used was \$262,081,976, which was based on the census data as of July 1, 2016, reduced by 9.00% to account for the removal of overtime.
- The provisions of the Article are contained in the enrolled text of Senate Bill 2190, which was signed by the Governor on May 31, 2017.