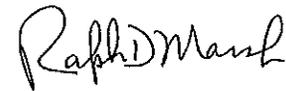


**JOINT ADDENDUM TO FINAL RISK SHARING VALUATION STUDY FOR FY 2020**

Pursuant to §13B(f)(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 risk sharing valuation studies ("RSVS") reflecting the arithmetic average for fiscal year 2020 in which the difference between the Fund and Municipality's estimated contribution rate was 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
2020	37.16%	27.52%	32.34%

**HOUSTON FIREFIGHTERS' RELIEF AND RETIREMENT FUND**

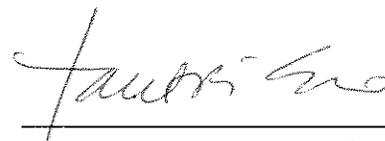


Executive Director

December 28, 2018

Date

**CITY OF HOUSTON**



Finance Director

1/7/2019

Date

December 28, 2018

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

**Re: Risk Sharing Valuation Study**

Dear Ralph:

Pursuant to our engagement to provide actuarial services to the Houston Firefighters' Relief and Retirement Fund (Fund), we have prepared this Risk Sharing Valuation Study, as required under Senate Bill 2190<sup>1</sup>, for the Fund as of July 1, 2018. This reflects the benefit provisions of the Fund as amended by, as well as funding policies mandated by, Senate Bill 2190.

**Risk Sharing Valuation Results<sup>1</sup>**

(\$000)	2018 Risk Sharing Valuation Results	2017 Risk Sharing Valuation Results
Present Value of Future Benefits	\$ 5,742,810	\$ 5,623,339
Actuarial Accrued Liability	\$ 4,948,133	\$ 4,827,721
Actuarial Value of Assets	\$ 4,027,079	\$ 3,883,807
Unfunded Accrued Liability	\$ 921,054	\$ 943,914
Funded Ratio	81.4%	80.4%
City Normal Cost Rate <sup>2</sup>	17.09%	17.21%
City Accrued Liability Rate	20.07%	20.44%
Total City Contribution Rate <sup>3</sup>	37.16%	37.65%
Estimated City Contribution for following Fiscal Year	\$ 101,331	\$ 101,556
Employee Contribution Rate	10.50%	10.50%

<sup>1</sup> This Risk Sharing Valuation Study has been provided without waiving the Fund's right to litigate the constitutionality of SB2190.

<sup>2</sup> Contains an allowance for administrative expenses equal to 1.25% of payroll.

<sup>3</sup> As a percentage of pensionable compensation

**Development of the Actuarial Value of Assets (\$000)****Actuarial Investment Gain (Loss)**

	<b>Fiscal Year End June 30, 2018</b>
Market Value of Assets at beginning of year	\$ 4,025,090
Net Cash Flow	
Contributions	\$ 118,632
Disbursements	<u>295,674</u>
Net Cash Flow	\$ (177,042)
Expected Investment Return	\$ 275,665
Expected Market Value of Assets at end of year	\$ 4,123,713
Market Value of Assets at end of year	\$ 4,170,354
Investment Gain / (Loss)	\$ 46,641

**Schedule of Actuarial Investment Gains (Losses)**

<b>Plan Year Ending</b>	<b>Initial Actuarial Gain (Loss)</b>	<b>Current Year Recognized Gain (Loss)</b>	<b>Unrecognized Gain (Loss) As of July 1, 2018</b>
June 30, 2017	\$ 176,604	\$ 35,321	\$ 105,962
June 30, 2018	46,641	9,328	<u>37,313</u>
			\$ 143,275

**Actuarial Value of Assets**

Market Value as of July 1, 2018	\$ 4,170,354
(Gain) Loss to be Recognized in Future Years	<u>(143,275)</u>
Actuarial Value as of July 1, 2018	\$ 4,027,079

**(Gain) Loss Sources (\$000)**

<b>(Gain) Loss Source</b>	<b>Amount</b>
Actuarial Value of Assets	\$ (54,539)
Actuarial Accrued Liability	9,837
Contributions	<u>12,334</u>
Total	\$ (32,368)

**Change in Key Results since the Prior Valuation (\$000)**

<b>Analysis of Change in Unfunded Liability</b>	<b>2017/2018</b>
Unfunded at Beginning of Period	\$ 943,914
Estimated Change Due to Normal Operation	
Normal Cost	\$ 69,304
Contributions	(118,632)
Administrative Expenses	6,567
Interest	<u>64,603</u>
Net Change	\$ 21,842
Estimated Change due to Actuarial Experience	
Actuarial (gain) loss from asset sources	\$ (54,539)
Actuarial (gain) loss from liability sources	<u>9,837</u>
Net change	\$ (44,702)
Unfunded Actuarial Accrued Liability at End of Period	\$ 921,054

**Amortization Schedule as of July 1, 2018 (\$000)**

<b>Plan Year Ending</b>	<b>Initial Liability Layer</b>	<b>Liability Layer as of July 1, 2018</b>	<b>Remaining Amortization Payments as of July 1, 2018</b>	<b>Payment for Fiscal Year 2020</b>	<b>As a % of Fiscal Year 2020 Payroll</b>
June 30, 2016	\$ 900,223	\$ 974,099	28	\$ 58,015	21.27%
June 30, 2017	(19,325)	(20,677)	28	(1,231)	(0.45)%
June 30, 2018	(32,368)	<u>(32,368)</u>	28 <sup>1</sup>	<u>(2,042)</u>	<u>(0.75)%</u>
Total		\$ 921,054		\$ 54,742	20.07%

<sup>1</sup> Per SB 2190, the amortization period for a new liability gain layer is equal to the remaining amortization period on the largest remaining liability loss layer.

### **Actuarial Certification**

We certify that the information contained in this 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, 2018 on the basis of the actuarial assumptions, methods and Fund 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 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, Buck recommends requesting an advance review of any statement, document, or filing to be based on information contained in this report. Buck will accept no liability for any such statement, document or filing made without prior review by Buck.

Future actuarial measurements may differ significantly from current measurements due to Fund 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 Fund 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 Fund if the Fund 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 as of July 1, 2018 regarding Fund provisions, Fund participants, Fund assets, contribution rates and other matters used in the actuarial valuation. Specifically, a market value of assets equal to \$4,170,353,965 has been provided by the Fund representatives. A summary of the actuarial assumptions, major Fund provisions, and Fund 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 accuracy of the results of this valuation is 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 reflected in this valuation.

Based on the statutory requirements of Senate Bill 2190 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 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 Fund may not be expected to achieve a fully funded position over the 30-year time horizon as contemplated in the statute based on the data, assumptions and methods set forth on the attached pages.

Mr. Ralph D. Marsh

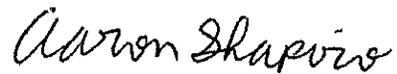
December 2018

I am a Member 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 I am available to answer questions about it.

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

Respectfully submitted,

Buck Global, LLC

A handwritten signature in cursive script that reads "Aaron Shapiro".

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

AS/jac  
Houston Fire 101018 AS\_2018 RSVsv2

# 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 Buck. 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 base mortality table published by the Society of Actuaries and the projection scale MP-2017, which was published in 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 Fund 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.

## 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%

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

### 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%

### 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 provided 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-2017. Changes have been applied by adjusting RP-2014 backward to 2006 with MP-2014, and then applying generational projection from 2006 using MP-2017.

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

#### Disabled pensioners

Based on the RP-2014 Total Data Set for Disabled Lives Mortality Table with generational improvement using MP-2017. Changes have been applied by adjusting RP-2014 backward to 2006 with MP-2014, and then applying generational projection from 2006 using MP-2017.

## Disability Rates

Graduated 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

## Percentage of Deaths and Disabilities in the Line of Duty

Age	Death	Disability <sup>1</sup>
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

For members hired on or after July 1, 2017 who terminate with at least 10 years of service, but who whose age plus service is not at least 70, they are assumed to elect a monthly pension benefit deferred to the year in which their age plus service equals 70.

<sup>1</sup> 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 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.

### **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 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 1<sup>st</sup> 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.

### **Summary of Changes from the July 1, 2017 Valuation**

- The mortality improvement scale applied to healthy and disabled lives was updated from the MP-2016 projection scale to the MP-2017 projection scale to reflect additional information published by the Society of Actuaries subsequent to the initial publication of the RP-2014 and MP-2014 tables and subsequent studies. This change decreased the actuarial accrued liability by approximately \$17.0M.

## **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.

### **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)**

### 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.

### **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.

## Appendix B: Summary of Plan Provisions (continued)

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 completion of 20 years of credited service, and must be on the first day 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.

### 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.

## **Appendix B: Summary of Plan Provisions (continued)**

### **Vested Pension**

#### **Eligibility**

For members hired prior to July 1, 2017, at least 10 but less than 20 years of service. For members hired on or after July 1, 2017, at least ten years of service but less than the age at which the sum of the member's age and service equals 70.

#### **Benefit**

For members hired prior to July 1, 2017, 1.7% of average monthly salary per year of service payable beginning at age 50. For members hired on or after July 1, 2017, the benefit is equal to their accrued service pension benefit deferred to the age at which the sum of the member's age and service equals 70. Members may also receive an optional refund of contributions with interest credited at a flat rate of 5% not compounded on contributions made prior to July 1, 2017.

### **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.

### 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, 2018

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	7	67	-	-	-	-	-	-	-	-	74
Avg. Pay	38,443	48,332	-	-	-	-	-	-	-	-	47,396
25 to 29	8	320	75	-	-	-	-	-	-	-	403
Avg. Pay	38,216	52,156	60,533	-	-	-	-	-	-	-	53,438
30 to 34	4	362	203	108	3	-	-	-	-	-	680
Avg. Pay	37,939	52,157	62,333	69,153	68,029	-	-	-	-	-	57,880
35 to 39	4	127	164	328	104	-	-	-	-	-	727
Avg. Pay	37,836	52,947	62,760	68,668	71,277	-	-	-	-	-	64,792
40 to 44	-	2	80	313	302	27	-	-	-	-	724
Avg. Pay	-	60,957	62,339	68,013	70,634	81,556	-	-	-	-	68,965
45 to 49	-	-	4	142	232	78	-	1	-	-	457
Avg. Pay	-	-	66,406	67,111	71,193	79,638	-	72,464	-	-	71,327
50 to 54	-	-	-	3	83	41	-	1	-	-	128
Avg. Pay	-	-	-	75,181	69,214	75,189	-	96,088	-	-	71,478
55 to 59	-	-	-	-	1	4	-	-	-	-	5
Avg. Pay	-	-	-	-	49,478	75,234	-	-	-	-	70,083
60 to 64	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
65 to 69	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
70 & up	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	23	878	526	894	725	150	-	2	-	-	3,198
Avg. Pay	38,171	51,999	62,241	68,272	70,703	78,650	-	84,276	-	-	63,644
Average Age:				37.56		Average Service:				10.04	

# Appendix C: Participant Information (continued)

## Summary of DROP Participants as of July 1, 2018

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	-	-	-	-	-	21	-	-	-	-	21	
Avg. Pay	-	-	-	-	-	76,743	-	-	-	-	76,743	
45 to 49	-	-	-	-	-	155	52	-	-	-	207	
Avg. Pay	-	-	-	-	-	79,213	82,615	-	-	-	80,067	
50 to 54	-	-	-	-	-	131	118	24	1	-	274	
Avg. Pay	-	-	-	-	-	76,252	79,458	82,424	84,591	-	78,204	
55 to 59	-	-	-	-	-	45	79	49	52	1	226	
Avg. Pay	-	-	-	-	-	76,651	76,046	83,022	82,420	96,820	79,238	
60 to 64	-	-	-	-	-	-	12	8	22	4	46	
Avg. Pay	-	-	-	-	-	-	75,362	79,568	71,866	82,143	75,011	
65 to 69	-	-	-	-	-	-	-	1	1	1	3	
Avg. Pay	-	-	-	-	-	-	-	67,980	95,790	77,250	80,340	
70 & up	-	-	-	-	-	-	-	-	-	-	-	
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-	
<b>Total</b>	-	-	-	-	-	352	261	82	76	6	777	
Avg. Pay	-	-	-	-	-	77,636	78,866	82,326	79,569	83,773	78,781	
		Average Age:			52.53			Average Service:			26.59	

## Appendix C: Participant Information (continued)

### Summary of Active and DROP Participants as of July 1, 2018

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
<b>Under 25</b>	7	67	-	-	-	-	-	-	-	-	74
Avg. Pay	38,443	48,332	-	-	-	-	-	-	-	-	47,396
<b>25 to 29</b>	8	320	75	-	-	-	-	-	-	-	403
Avg. Pay	38,216	52,156	60,533	-	-	-	-	-	-	-	53,438
<b>30 to 34</b>	4	362	203	108	3	-	-	-	-	-	680
Avg. Pay	37,939	52,157	62,333	69,153	68,029	-	-	-	-	-	57,880
<b>35 to 39</b>	4	127	164	328	104	-	-	-	-	-	727
Avg. Pay	37,836	52,947	62,760	68,668	71,277	-	-	-	-	-	64,792
<b>40 to 44</b>	-	2	80	313	302	48	-	-	-	-	745
Avg. Pay	-	60,957	62,339	68,013	70,634	79,450	-	-	-	-	69,184
<b>45 to 49</b>	-	-	4	142	232	233	52	1	-	-	664
Avg. Pay	-	-	66,406	67,111	71,193	79,355	82,615	72,464	-	-	74,052
<b>50 to 54</b>	-	-	-	3	83	172	118	25	1	-	402
Avg. Pay	-	-	-	75,181	69,214	75,999	79,458	82,971	84,591	-	76,062
<b>55 to 59</b>	-	-	-	-	1	49	79	49	52	1	231
Avg. Pay	-	-	-	-	49,478	76,535	76,046	83,022	82,420	96,820	79,040
<b>60 to 64</b>	-	-	-	-	-	-	12	8	22	4	46
Avg. Pay	-	-	-	-	-	-	75,362	79,568	71,866	82,143	75,011
<b>65 to 69</b>	-	-	-	-	-	-	-	1	1	1	3
Avg. Pay	-	-	-	-	-	-	-	67,980	95,790	77,250	80,340
<b>70 &amp; up</b>	-	-	-	-	-	-	-	-	-	-	-
Avg. Pay	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	23	878	526	894	725	502	261	84	76	6	3,975
Avg. Pay	38,171	51,999	62,241	68,272	70,703	77,939	78,866	82,372	79,569	83,773	66,603
		Average Age: 40.49				Average Service: 13.28					

## Appendix C: Participant Information (continued)

### Summary of Inactive Participants as of July 1, 2018

	Number	Annual Benefits (\$000)	Average Annual Benefits
<b>Benefits in Pay Status</b>			
Retirees	2,402	\$ 127,306	\$ 53,000
Beneficiaries	603	26,194	43,440
Disabled Participants	<u>307</u>	<u>16,101</u>	<u>52,446</u>
Total	3,312	\$ 169,601	\$ 51,208
<b>Deferred Benefits</b>			
Vested Terminated Participants	89	\$ 241 <sup>1</sup>	\$ 10,957
Beneficiaries	N/A	N/A	N/A
Disabled Participants	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Total	89	\$ 241	\$ 10,957

<sup>1</sup> Does not include \$1,367,478 in pending refunds.  
Buck

## Appendix C: Participant Information (continued)

### Participant Data Reconciliation

	Active	DROP	Deferred Vested	Retired	Total
Number of members as of July 1, 2017	3,277	817	53	3,250	7,397
Change in status during the plan year:					
Actives who retired	(3)	(88)		91	0
Actives who terminated	(50)		50		0
Actives who entered DROP	(54)	54			0
Inactives who returned to service	4		(2)		2
Inactives who retired			(1)	1	0
Participants who became disabled	(4)	(4)		8	0
No longer members due to:					
Death	(3)	(2)		(79)	(84)
Non-vested terminations					0
Child attained cut-off age				(8)	(8)
Benefits no longer due	(53)		(11)	(1)	(65)
New member due to:					
Initial membership	84				84
Death of another member				50	50
Correction					0
Number of members as of July 1, 2018	3,198	777	89	3,312	7,376

## Appendix C: Participant Information (continued)

### Retiree and Beneficiaries Added to and Removed from Rolls

Period Ended	Added to Rolls		Removed from Rolls		Rolls at the End of the Year			Percentage Increase in Annual Benefits	Average Annual Benefit
	Number	Benefits (\$000)	Number	Annual Benefits (\$000)	Number	Annual Benefits (\$000)	Annual Benefits		
December 31, 1978	72	719	23	76	794	4,294	15.8%	5,408	
December 31, 1979	67	719	21	83	840	5,008	16.6	5,962	
December 31, 1980	33	473	23	84	850	5,498	9.8	6,468	
December 31, 1981	61	862	38	159	873	6,097	10.9	6,983	
December 31, 1982	63	644	26	171	910	6,772	11.1	7,442	
December 31, 1983	54	605	39	207	925	7,403	9.3	8,003	
June 30, 1984 <sup>1</sup>	41	619	17	98	949	3,952	6.8	8,328	
June 30, 1985	75	968	53	290	971	8,432	6.7	8,684	
June 30, 1986	54	752	38	243	987	9,550	13.3	9,676	
June 30, 1987	76	1,101	33	235	1,030	10,522	10.2	10,215	
June 30, 1988	121	2,002	38	311	1,113	12,754	21.2	11,459	
June 30, 1989	74	1,306	42	299	1,145	14,032	10.0	12,255	
June 30, 1990	111	1,996	37	288	1,219	16,428	17.1	13,477	
June 30, 1991	129	1,784	38	401	1,310	17,888	8.9	13,665	
June 30, 1992	78	1,588	44	401	1,344	19,866	11.1	14,781	
June 30, 1993	82	1,717	48	585	1,378	21,516	8.3	15,614	
June 30, 1994	112	2,006	58	660	1,432	23,297	8.3	16,269	
June 30, 1995	87	1,728	28	353	1,491	25,142	7.9	16,863	
June 30, 1996	67	1,402	56	660	1,502	26,379	4.9	17,563	

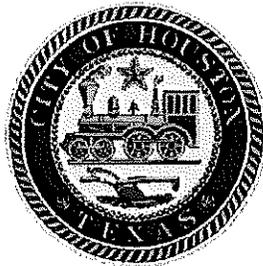
<sup>1</sup> Six-month period

## Appendix C: Participant Information (continued)

### Retirees and Beneficiaries Added to and Removed from Rolls (continued)

Period Ended	Added to Rolls		Removed from Rolls		Rolls at the End of the Year			Average Annual Benefit
	Number	Annual Benefits (\$000)	Number	Annual Benefits (\$000)	Number	Annual Benefits (\$000)	Percentage Increase in Annual Benefits	
June 30, 1997	56	1,050	37	487	1,521	27,581	4.6	18,133
June 30, 1998	54	1,064	43	477	1,532	28,675	4.0	18,717
June 30, 1999	64	1,840	28	551	1,568	30,233	5.4	19,281
June 30, 2000	95	2,364	71	1,167	1,592	34,583	14.4	21,723
June 30, 2001	127	3,581	47	775	1,672	38,347	10.9	22,935
June 30, 2002	172	5,493	61	998	1,783	44,300	15.5	24,846
June 30, 2004 <sup>1</sup>	377	N/A	109	N/A	2,051	57,676	30.2	28,121
June 30, 2005	135	4,353	53	1,107	2,133	62,882	9.0	29,481
June 30, 2006	195	7,231	60	1,437	2,268	70,420	12.0	31,050
June 30, 2007	106	3,822	59	1,407	2,315	74,948	6.4	32,375
June 30, 2008	166	9,334	21	828	2,460	98,216	31.0	39,925
June 30, 2009	133	3,369	43	2,081	2,550	94,536	-3.7	37,073
June 30, 2010	162	7,159	103	2,886	2,609	96,580	2.2	37,018
June 30, 2011	181	8,905	64	1,489	2,726	106,832	10.6	39,190
June 30, 2012	141	7,042	77	2,398	2,790	114,176	6.8	40,923
June 30, 2013	170	8,286	54	1,837	2,906	124,080	8.7	42,698
June 30, 2014	162	7,772	70	1,401	2,998	132,749	7.0	44,279
June 30, 2015	147	7,273	85	383	3,060	140,629	5.9	45,957
June 30, 2016	138	7,496	60	2,302	3,138	150,005	6.7	47,803
June 30, 2017	207	11,829	95	3,667	3,250	162,671	8.4	50,053
June 30, 2018	150	8,353	88	2,546	3,312	169,601	4.3	51,208

<sup>1</sup> Two-year period  
Buck



City of Houston  
HFRRF  
Final Risk Sharing  
Valuation Study  
As of July 1, 2018

**December 27, 2018**



December 27, 2018

Ms. Tantri Emo  
Director, Finance Department  
City of Houston  
611 Walker  
Houston, TX 77002

**Re: HFRRF Final Risk Sharing Valuation Study as of July 1, 2018**

Dear Tantri:

Texas Revised Statutes article 6243e.2(1) (the Article) sets forth requirements for a 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 the following fiscal year. Retirement Horizons Inc. (RHI) was engaged by the City of Houston to perform this Risk Sharing Valuation Study as of July 1, 2018 as the Municipal Actuary. This report provides the results of the Study and is organized as follows:

- Section 1 – Risk Sharing Valuation Study Results
- Section 2 – Actuarial Exhibits
- Section 3 – Summary of Plan Provisions
- Section 4 – Actuarial Methods and Assumptions
- Section 5 – Summary of Valuation Data
- Section 6 – Data Sources

RHI received Actuarial Data as defined in Section 1-a of the Article and required by Section 13C(b) of the Article. RHI conducted our RSVS using the Actuarial Data provided and plan provisions as summarized in this report. The analysis presented in this report is based on the interest rate assumption and actuarial cost and asset methods prescribed by the Article. All other actuarial methods and assumptions summarized in this report were adopted by the City of Houston Finance Department with review and concurrence by RHI and based on existing assumptions used in the July 1, 2016 Risk Sharing Valuation Study as required by the Article.

The HFRRF actuary conducted a proposed RSVS dated November 21, 2018. That report was then provided to RHI on the same day by the HFRRF actuary. RHI conducted our proposed RSVS dated November 27, 2018 using the Actuarial Data provided and plan provisions described therein.

During the reconciliation process, we determined that the primary reason for the differences in the results of the two 2018 Proposed Risk Sharing Valuation Studies continues to be differences in the underlying assumptions. As the 2018 RSVS assumptions must align with those used in the 2016 RSVS until the recommendations from the next experience study are adopted, there were no changes to the assumptions made for the 2018 RSVS. Please note the HFRRF actuary updated the mortality improvement assumption from MP-2016 to MP-2017. The City does not concede that HFRRF or its actuary have acted within the scope of their lawful authority.

Ms. Tantri Emo  
December 27, 2018

As described in the Article, results of the Risk Sharing Valuation Study performed by the HFRRF actuary will be compared to the results in this report. Since it is anticipated the results will be greater than two percentage points different, a mathematical average of the municipal and Fund actuary's results will be used.

The actual costs, City Contribution Rates, and other results could be materially different from those described in this report 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 report 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 report was prepared as requested by the City of Houston and solely for the purpose of satisfying the RSVS requirements of the Article, and should not be used for any other purpose. As significantly different results from those contained in this report may be needed for other purposes, this report should only be provided to other parties in its entirety.

The signing actuary for this report is a member of the Society of Actuaries and other professional actuarial organizations and meets the "Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion." The undersigned is available to answer questions regarding the information contained in this report or to provide further explanations or details as needed.

Respectfully submitted by Retirement Horizons Inc.



David A. Sawyer, FSA EA MAAA  
Senior Consultant

## Risk Sharing Valuation Study Results

### Corridor Midpoint

The table below contains the Corridor Midpoint, along with the corresponding Minimum and Maximum Contribution Rates using a 5% Corridor Margin as specified in the Article. Based on RHI's proposed RSVS results, the City Contribution Rate for FY 2020 would be 27.52% of pensionable payroll, which is within the Corridor.

FY	Corridor Midpoint	Corridor Minimum	Corridor Maximum	RHI Calculated City Contribution Rate	Final City Contribution Rate *
2018	31.89%	26.89%	36.89%	26.98%	31.89%
2019	31.89%	26.89%	36.89%	28.33%	32.99%
2020	31.89%	26.89%	36.89%	27.52%	
2021	31.89%	26.89%	36.89%		
2022	31.89%	26.89%	36.89%		
2023	31.89%	26.89%	36.89%		
2024	31.89%	26.89%	36.89%		
2025	31.89%	26.89%	36.89%		
2026	31.89%	26.89%	36.89%		
2027	31.89%	26.89%	36.89%		
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2039	31.89%	26.89%	36.89%		
2040	31.89%	26.89%	36.89%		
2041	31.89%	26.89%	36.89%		
2042	31.89%	26.89%	36.89%		
2043	31.89%	26.89%	36.89%		
2044	31.89%	26.89%	36.89%		
2045	31.89%	26.89%	36.89%		
2046	31.89%	26.89%	36.89%		
2047	31.89%	26.89%	36.89%		
2048	15.92%	10.92%	20.92%		

\* Final City Contribution Rates for FY 2018 – 2019 were based on an average of Municipal and Fund Actuaries' RSVS

## Risk Sharing Valuation Study Results

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### City Contribution Rate

The City Contribution Rate is equal to the sum of the Employer Normal Cost Rate and the Amortization Rate from any Liability Layers. The Employer Normal Cost Rate is equal to the Gross Normal Cost Rate plus Administrative Expense Rate less the Member Contribution Rate.

FY	Employer Normal Cost Rate	Liability Layer Amortization Rate	Estimated City Contribution Rate
2018	14.74%	12.24%	26.98%
2019	14.72%	13.61%	28.33%
2020	14.68%	12.84%	27.52%
2021			
2022			
2023			
2024			
2025			
2026			
2027			
2028			
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2048			

## Actuarial Exhibits

### 2.1. Fair Value of Assets

	July 1, 2017	July 1, 2018
<b>A. Fair Value of Plan Assets</b>		
1. Cash & Short Term Investments	\$ 75,531,237	\$ 226,425,134
2. Fixed Income	1,096,640,070	896,354,249
3. Equity Securities	1,981,027,963	2,104,607,067
4. Alternative Investments	629,037,826	738,200,028
5. Real Estate	194,666,779	191,331,517
6. Land, Building, Etc.	5,351,239	4,942,825
7. Accrued Interest & Dividends	8,807,917	6,930,667
8. Accrued City Contributions	3,623,511	3,371,776
9. Accrued Member Contributions	982,278	1,705,318
10. Other	29,420,847	(3,514,616)
11. Total Fair Value	\$ 4,025,089,667	\$ 4,170,353,965
 <b>B. Change in Fair Value</b>		
	<b>Change</b>	
1. Contributions		
a. Members	\$ 35,621,787	
b. City	83,010,066	
c. Total	\$ 118,631,853	
2. Disbursements		
a. Benefit Payments	\$ (289,107,432)	
b. Administrative Expenses	(6,566,644)	
c. Total	\$ (295,674,076)	
3. Investment Return		
a. Interest and Dividends	\$ 30,605,718	
b. Realized and Unrealized Gain/(Loss)	298,599,894	
c. Plan Investment Expenses	(6,899,091)	
d. Total Return	\$ 322,306,521	
4. Net Change	\$ 145,264,298	
5. Average Rate of Return		
a. Average Asset Value	\$3,936,568,556	
b. Income Net of Investment Expenses	\$ 322,306,521	
c. Annual Rate of Return - Net of Investment Expenses	8.19%	
d. Annual Rate of Return - Gross	8.37%	

## Actuarial Exhibits

### 2.2. Actuarial Value of Assets

1. Market Value of Assets at beginning of year	\$ 4,025,089,667
2. Net Cash Flow	
a. Contributions	\$ 118,631,853
b. Benefit Disbursements	(289,107,432)
c. Administrative Expenses	(6,566,644)
d. Net Cash Flow [2.a. + 2.b. + 2.c.]	\$ (177,042,223)
3. Expected Investment Return [1. x 0.07] + [2.d. x ((1.07) <sup>5</sup> -1)]	\$ 275,664,600
4. Expected Market Value of Assets at end of year [1. + 2.d. + 3.]	\$ 4,123,712,044
5. Market Value of Assets at end of year	\$ 4,170,353,965
6. Investment Gain/(Loss) [5. - 4.]	\$ 46,641,921
7. Schedule of Actuarial Investment Gains (Losses)	

Fiscal Year End	Initial Actuarial Gain (Loss)	Five-Year Recognition	Deferred Gain (Loss) As of July 1, 2018
2017	\$ 176,603,306	\$70,641,322	\$ 105,961,984
2018	\$ 46,641,921	\$ 9,328,384	\$ 37,313,537
2019	N/A	N/A	N/A
2020	N/A	N/A	N/A
2021	N/A	N/A	N/A
Total	\$ 223,245,227	\$79,969,706	\$ 143,275,521

8. Market Value as of July 1, 2018	\$ 4,170,353,965
(Gain) Loss to be Recognized in Future Years	(143,275,521)
Actuarial Value as of July 1, 2018	\$ 4,027,078,444
9. Actuarial Value of Assets, Prior Year	\$ 3,883,807,022
10. Rate of Return on Actuarial Value of Assets (Net of Investment Expenses)	8.4%

## Actuarial Exhibits

### 2.3. Actuarial Accrued Liability

	July 1, 2017	July 1, 2018
A. Discount Rate	7.0%	7.0%
B. Actuarial Accrued Liability		
1. Active	\$1,422,535,541	\$1,411,960,040
2. Terminated Vested	\$1,915,864	\$3,782,903
3. Disabled	\$211,992,718	\$220,443,201
4. Retired	\$2,876,789,437	\$2,982,855,332
5. Total	\$4,513,233,560	\$4,619,041,476
C. Change in Actuarial Accrued Liability	<u>2018 Fiscal Year</u>	
1. Benefits Accumulated	\$62,966,854	
2. Benefits Paid	(\$289,107,432)	
3. Decrease in Discount Period	\$308,145,294	
4. Plan Experience	\$23,803,200	
5. Actuarial Assumptions	\$0	
6. Actuarial Methods	\$0	
7. Plan Amendments	\$0	
8. Net Change	\$105,807,916	
D. Actuarial Value of Assets	\$ 3,883,807,022	\$ 4,027,078,444
E. Unfunded Actuarial Liability	\$629,426,538	\$591,963,032
F. Total Normal Cost % of Payroll <sup>1</sup>	25.22%	25.18%
G. Member Contribution % of Payroll	10.50%	10.50%
H. Employer Normal Cost Rate [F - G]	14.72%	14.68%

<sup>1</sup> Includes administrative expense load

## Actuarial Exhibits

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### 2.4. Liability Layers

Valuation Date Base Established	Initial Amount of Liability Layer (BOY)	Remaining Liability to be Amortized as of 7/1/2018	Remaining Amortization Period as of 7/1/2018	Amortization Amount for FY 2020
7/1/2016	\$601,731,984	\$588,453,780	28	\$35,047,009
7/1/2017	\$47,533,433	\$50,860,773	29	\$2,887,462
7/1/2018	(\$47,351,521)	<u>(\$47,351,521)</u>	28	<u>(\$2,900,128)</u>
Total		\$591,963,032		\$35,034,342
Projected Payroll for Fiscal Year +1				\$272,769,996
Amortization Payments as a % of Projected Payroll				12.84%

## Summary of Plan Provisions

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### **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 final 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

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### **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"><li>• Refund of contributions (with 5% interest, not compounded, on contributions made prior to July 1, 2017), or</li><li>• Monthly benefit of 1.7% of final average pay per year of service, payable at age 50</li></ul> 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

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### **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

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### **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 July 1, 2017, 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 Methods and Assumptions

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### Actuarial Cost Methods

Measurement Date	Census data as of July 1, 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	Five-year smoothing of future gains and losses. 20% of each gain or loss will be recognized each year. Gains and losses are based on the difference between the actual and expected fair market value each year. The expected value is based on the assumed rate of return on investments and is net of investment expenses.
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 required by Senate Bill 2190
Inflation	2.25%
Wage Inflation	3.00%
Payroll Growth	3.00%
Cost of Living Adjustment	2.00%

## Actuarial Methods and Assumptions

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### Individual Pay Increase Rate

<i>Age</i>	<i>Assumed Increase</i>
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 Methods and Assumptions

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### Retirement Rates

<b>Years of Service</b>	<b>Probability of Retiring Within One Year</b>
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:

<b>Years of Service at Retirement</b>	<b>Percent Electing Specified DROP Period at Retirement</b>				
	<b>0 Years</b>	<b>3 Years</b>	<b>5 Years</b>	<b>8 Years</b>	<b>10 Years</b>
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 Methods and Assumptions

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### 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 Methods and Assumptions

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### Termination Rates

### Sample Rates

<i>Age</i>	<i>Termination Rate</i>
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 payable at age 55.

### 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.

### 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 Methods and Assumptions

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### 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. The actuarially determined City Contribution 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) from the initial RSVS, plus the amortization rates of all subsequently-determined Liability Layers, less the member contribution rate, adjusted with interest to mid-year. The closed amortization rates for the Liability Layers are calculated as a level percent of pay. The initial amortization period for a Liability Loss Layer is 30 years. The initial amortization period for a Liability Gain Layer is equal to the remaining amortization period for the largest Liability Loss Layer.

### 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.

## Data Sources

	July 1, 2017	July 1, 2018
<b>A. Active Members Not in DROP</b>		
1. Number	3,277	3,198
2. Valuation payroll	\$198,088,640	\$203,532,265
3. Average pay	\$60,448	\$63,644
4. Average age	36.9	37.6
5. Average service	9.4	10.0
<b>B. Active Members in DROP</b>		
1. Number	817	777
2. Valuation payroll	\$64,592,349	\$61,292,974
3. Average pay	\$79,060	\$78,884
4. Average age	52.4	52.5
5. Average service	26.6	26.6
<b>C. Terminated Vested</b>		
1. Number	13	22
2. Total benefits	\$93,582	\$250,572
3. Average Annual benefits	\$7,199	\$11,390
<b>D. Disabled</b>		
1. Number	307	307
2. Total benefits	\$15,464,455	\$16,020,000
3. Average Annual benefits	\$50,373	\$52,182
<b>E. Retired</b>		
1. Number	2,352	2,402
2. Total benefits	\$122,666,940	\$127,416,000
3. Average Annual benefits	\$52,154	\$53,046
<b>F. Beneficiaries</b>		
1. Number	591	603
2. Total benefits	\$24,540,000	\$26,328,000
3. Average Annual benefits	\$41,523	\$43,662

**Notes:**

1. DROP Balance values not shown.
2. Terminated Vested count does not include 40 members due refunds totaling \$946,560 for July 1, 2017 and 67 members due refunds totaling \$1,367,478 for July 1, 2018.
3. Payroll and Pay values exclude overtime.
4. Date fields provided to RHI by HFRRF only included the year (no month or day).

## Data Sources

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

- Census data for all members was provided on November 13, 2018. We understand this data is substantially the same as that used by the HFRRF actuary for their Risk Sharing Valuation Study. As 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 the benefit provisions differ by the date of hire, some members will be measured under the wrong provisions. RHI is following the provisions of the Article, but we are unable to determine the magnitude of this difference without more precise data.
- The fair value of assets of \$4,170,353,965 as of June 30, 2018 was provided in the audited HFRRF financials. These were provided to RHI by HFRRF on November 19, 2018.
- The Fiscal Year 2019 payroll used was \$264,825,239, which was based on the census data as of June 30, 2018 increased with one year of salary scale. The Fiscal Year 2020 payroll is equal to the Fiscal Year 2019 payroll increased with one year of payroll growth.
- 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.