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Minnesota Legislative Commission on Pensions and Retirement

Replication of the July 1, 2018 Actuarial Valuation of the Public Employees Retirement Association of Minnesota Public Employees Police & Fire Plan

Prepared by Deloitte Consulting LLP

February 2019

Contents

Actuarial Valuation Opinion

This report presents the results of the actuarial valuation replication of the Public Employees Retirement Association of Minnesota ("PERA") Public Employees Police & Fire Plan ("the Plan" or "the PERA P&F Plan") as of July 1, 2018 in accordance with Minnesota Statutes, Section 356.214, Subdivision 4, as directed by the Minnesota Legislative Commission on Pensions and Retirement ("LCPR" or "the Commission").

This actuarial valuation replication has been prepared based upon participant data and financial information provided by PERA and their retained actuary as of July 1, 2018. We have analyzed the data and other information provided for reasonableness, but we have not independently audited the data. We have no reason to believe the data or other information provided is not complete and accurate, and know of no further information that is essential to the preparation of the actuarial valuation.

All costs, liabilities, rates of interest, and other factors underlying these actuarial computations have been determined on the basis of the same actuarial assumptions and methods used by the retained actuary. It is our opinion that these assumptions and methods are reasonable (or consistent with authoritative guidance) for the purposes described herein.

Future actuarial measurements may differ significantly from current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operations of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.

Our scope for this replication report did not include analyzing the potential range of such future measurements, and we did not perform that analysis.

This report is prepared solely for the benefit of the LCPR and the State of Minnesota. This report is not intended for the benefit of any other party and may not be relied upon by any third party for any purpose, and Deloitte Consulting accepts no responsibility or liability with respect to any party other than the LCPR and the State of Minnesota in accordance with its statutory and regulatory requirements.

The undersigned with actuarial credentials collectively meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

To the best of our knowledge, no employee of the Deloitte U.S. Firms (Deloitte & Touche LLP, Deloitte Consulting LLP, Deloitte Financial Advisory Service LLP, and Deloitte Tax LLP) is an officer or director of PERA. In addition, we are not aware of any relationship between the Deloitte U.S. Firms and PERA that may impair or appear to impair the objectivity of the work detailed in this report.

DELOITTE CONSULTING LLP

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Executive Summary

Replication Overview

Process and Scope

This actuarial replication report has been prepared per Minnesota Statute Section 356.214, Subdivision 4. The LCPR has engaged Deloitte Consulting, LLP to perform a replication of the July 1, 2018 actuarial valuation of the Public Employees Police & Fire Plan administered by PERA.

The primary purpose of this report is to test the census and financial data, plan provisions, and actuarial assumptions and methods being used by the retained actuary in its July 1, 2018 valuation report by independently performing an actuarial valuation based on the same source data and the statutory plan provisions.

The replication valuation is initially performed without consideration of the retained actuary's report or sample lives. We program the valuation model based on our understanding of applicable assumptions and plan provisions. Once complete, we compare our liability and normal cost results to those of the retained actuary. We also request detailed sample life output to reconcile any differences in the results. If appropriate, we made modifications to our valuation model based on this analysis.

The result of our calculations and the retained actuary's are compared in this report. Because actuarial valuations are complex and rely upon the actuary's chosen actuarial valuation software, differences are expected. Differences greater than 2% of Present Value of Benefits or 5% of Actuarial Accrued Liability are specifically addressed; although some differences that do not meet this threshold are also discussed. We understand, as noted above, that the valuation process is sufficiently complex as to result in variations of this magnitude among actuaries valuing identical benefits and assumptions.

In addition to our independent determination of liabilities and costs, we reviewed the retained actuary's report for completeness and potential improvements. The process by which actuarial valuations are completed is highly technical and not every step can be documented in a valuation report. Where we believe additional documentation may be beneficial to the reader, we've suggested a more robust disclosure. In addition to process-oriented commentary, we've considered industry best practices in communicating complex financial concepts to key stakeholders. Additional recommendations have been made based on our research with the goal of providing information that would be valuable to the reader within acknowledged time and resource constraints.

All of the steps above have been completed in accordance with the requirements of Minnesota Statutes and the Standards for Actuarial Work adopted by the LCPR. Our work is also governed by applicable actuarial standards of practice published by the Actuarial Standards Board.

Replication Overview

Summary of Key Findings

In general, we found the actuarial liability and contribution calculations completed by the retained actuary to be consistent with ours within a reasonable threshold. Minor differences are identified below. We are satisfied with the aggregate July 1, 2018 actuarial valuation results as reported by the retained actuary. We believe that they represent a reasonable estimate of the present value of future benefits, accrued liability, and normal cost of the Plan.

The following key findings were identified during the process of our review:

- Census Data: PERA directly provided us with the census data. We made modifications that we deemed necessary and appropriate. We also received the retained actuary's modified database, which matched our counts with some small differences in average pay and benefits. Key differences and explanations are noted below

    - The retained actuary uses prior year salary as a minimum salary value for current active participants. This assumption is reasonable, but prevents the valuation salary, individual compensation values, and active liability and normal cost values from being precisely matched based upon the system's data.

    - Consistent with our 2017 review we found that the retained actuary uses its historical data to question and correct some inconsistencies within the system's census data. We note that the number of data questions and corrections appear to have decreased significantly since our 2017 valuation review, indicating the system has cleaned up its internal data since that time.

- Plan Provisions: The plan provisions as identified in state statute were programmed into our valuation software and compared to those valued by the retained actuary. All benefits appear consistent with state statute and documented provisions.

- Actuarial Assumptions and Methods: The actuarial assumptions and methods prescribed by state statute were programmed into our valuation software along with those assumptions chosen by the Fund and disclosed in the report. The assumptions used in the valuation were based on the 2016 experience study. All assumptions appear consistent with state statute and documented assumptions.

- Actuarial Value of Assets: We calculated the Fund's Actuarial Value of Assets independent of the retained actuary, and our results matched.

- Liability Results: Our valuation results were reasonably close to the retained actuary's valuation results. We were 0.4% higher on the basis of Present Value of Future Benefits (PVFB) and 0.3% lower on the basis of the Actuarial Accrued Liability (AAL). In general, we consider PVFB results within 2.0%, and AAL results within 5.0% to be a reasonable replication.

  As is typical, differences also exist in how those liabilities are split by decrement and status group. The actuarial software used by the retained actuary allocates liabilities differently between decrements than our system. As an example, the retained actuary's system considers disabled participants after Normal Retirement Age to be retirees. Our system considers these participants disabled. The result is that our liability attributable to the disability benefit is higher (and retirement benefit lower) than the retained actuary's report. Note that when these two decrements are summed, our results are within 0.6% of the retained actuary.

- Normal Cost Results: Our valuation results produced a normal cost that is 0.4% higher than that of the retained actuary. As a percent of pay, our normal cost rate was within 0.3% of the retained actuary. The Normal Cost represents the value of benefits earned during the current period by active participants and may vary due to attribution method – the way in which benefits are allocated across an employee's working lifetime (e.g., partial year or full year in the year of hire and the year of termination or retirement).

- Valuation Report: The actuarial valuation was reviewed in its entirety, and we have found the report to satisfy the requirements of ASOP No. 41 and Minnesota Statutes, Section 356.215.

- We note that the actuary complied with the additional sensitivity disclosure requirement for the valuations enacted by the Commission. We also note that the actuary complied with the new risk disclosures associated with ASOP 51.

Summary of Results

The following table displays a summary of the replication valuation performed by Deloitte as of June 30, 2018.

Table 1

	As of July 1, 2018		
	PERA P&F Valuation	Deloitte Replication Valuation	Percent Difference
Contributions (% of Payroll)			
Statutory Contributions – Chapter 353	30.51%	30.51%	0.00%
Required Contributions – Chapter 356	28.20%	28.27%	0.07%
Sufficiency / (Deficiency)	2.31%	2.24%	(0.07%)
Funding Ratio (Dollars in Thousands)			
Assets			
Current assets (AVA)	$8,320,094	$8,320,095	0.00%
Actuarial accrued liability	$9,552,804	$9,521,493	(0.33%)
Funding ratio (AVA)	87.10%	87.38%	0.28%
Participant Data			
Active Participants			
Number	11,673	11,673	0.00%
Projected annual earnings (Dollars in Thousands)*	$1,000,474	$1,001,107	0.06%
Average projected annual earnings	$85,738	$85,792	0.06%
Average age	40.5	40.5	0.00%
Average service	12.5	12.5	0.00%
Service Retirements	7,534	7,534	0.00%
Survivors	1,875	1,875	0.00%
Disability Retirements	1,347	1,347	0.00%
Deferred Retirements	1,580	1,580	0.00%
Terminated Other Non-Vested	1,188	1,188	0.00%
Total	25,197	25,197	0.00%

*The projected annual earnings value excludes 4 members who were merged into PERA P&F in 2012 from the Minneapolis Police and Minneapolis Fire Retirement Funds whose benefits are not pay related.

Asset Information

Statement of Fiduciary Net Position as of June 30, 2018

Table 2 (Dollars in Thousands)

	Market Value as of June 30, 2018	
	PERA P&F Valuation	Deloitte Replication Valuation
Assets in Trust		
Cash, equivalents , short term securities	$ 90,015	$ 90,015
Fixed income	2,060,635	2,060,635
Equity	5,150,491	5,150,491
SBI alternative	1,172,591	1,172,591
Other	-	-
Total Assets in Trust	$ 8,473,732	$ 8,473,732
Assets receivable	$ 18,731	$ 18,731
Amounts payable	$ (5,556)	$ (5,556)
Net Assets Held in Trust for Pension Benefits	$ 8,486,907	$ 8,486,907

Reconciliation of Plan Assets as of June 30, 2018

Table 3 (Dollars in Thousands)

	PERA P&F Valuation	Deloitte Replication Valuation
Change in Assets		
1. Fund balance at market value at beginning of year	**$ 7,918,879**	**$ 7,918,879**
2. Contributions		
a. Member	$ 105,479	$ 105,479
b. Employer	170,781	170,781
c. Other sources (State contribution)	9,000	9,000
d. Total contributions	$ 285,260	$ 285,260
3. Investment Income		
a. Investment income/(loss)	$ 822,887	$ 822,887
b. Investment Expenses	(8,921)	(8,921)
c. Net subtotal	$ 813,966	$ 813,966
4. Other	$ 58	$ 58
5. Total Income: (2d) + (3c) + (4)	**$ 1,099,284**	**$ 1,099,284**
6. Benefits Paid		
a. Annuity Benefits	$ (528,468)	$ (528,468)
b. Refunds	(1,902)	(1,902)
c. Total benefits paid	$ (530,370)	$ (530,370)
7. Expenses		
a. Other	$ -	$ -
b. Administrative	(886)	(886)
c. Total expenses	$ (886)	$ (886)
8. Total disbursements: (6c) + (7c)	**$ (531,256)**	**$ (531,256)**
9. Fund balance at market value at end of year: (1) + (5) + (8)	**$ 8,486,907**	**$ 8,486,907**

Actuarial Asset Value as of June 30, 2018

Table 4 (Dollars in Thousands)

			PERA P&F Valuation	Deloitte Replication Valuation
1.	Market value of assets available for benefits		$ 8,486,907	$ 8,486,907
2.	Determination of average balance			
	a.	Total assets available at beginning of year	$ 7,918,879	$ 7,918,879
	b.	Total assets available at end of year	8,486,907	8,486,907
	c.	Net investment income for fiscal year	813,966	813,966
	d.	Average balance: [(2a) + (2b) - (2c)] / 2	$ 7,795,910	$ 7,795,910
3.	Expected Return: 8.0% x (2d)		$ 623,673	$ 623,673
4.	Actual Return		$ 813,966	$ 813,966
5.	Current year asset Gain / (Loss): (4) – (3)		$ 190,293	$ 190,293
6.	Unrecognized asset returns			

Period Ending	Gain / (Loss)	Portion Not Recognized	Amount Not Recognized	Amount Not Recognized
6/30/2018	$ 190,293	80%	$ 152,235	$ 152,234
6/30/2017	500,621	60%	300,372	300,373
6/30/2016	(587,179)	40%	(234,871)	(234,872)
6/30/2015	(254,614)	20%	(50,923)	(50,923)
6/30/2014	659,930	0%	-	-
Total			$ 166,813	$ 166,812

		PERA P&F Valuation	Deloitte Replication Valuation
7.	Actuarial Value of Assets as of June 30, 2018: (1) – (6)	$ 8,320,094	$ 8,320,095
8.	Approximate actual rate of return on the Actuarial Value of Assets	9.40%	9.40%
9.	Ratio of actuarial value of assets to market value of assets	0.98	0.98

Membership Data

Membership Data – Active Members

The following table displays the distribution of active participants valued by Deloitte by age and years of service and includes average compensation (in dollars) as of June 30, 2018.

Table 5

Years of Service	<3		3-4		5-9		10-14		15-19		20-24		25-29		30-34		35+		Total*	
Age Group	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings	No.	Avg. Annual Earnings
0 – 24	320	46,219	14	67,210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	334	47,099
25 – 29	785	55,737	401	71,219	145	73,391	-	-	-	-	-	-	-	-	-	-	-	-	1,331	62,324
30 – 34	438	54,853	361	71,828	705	77,854	281	81,977	-	-	-	-	-	-	-	-	-	-	1,785	71,640
35 – 39	227	54,143	223	70,862	449	79,456	949	85,490	190	87,210	-	-	-	-	-	-	-	-	2,038	79,229
40 – 44	88	53,093	91	71,189	189	77,131	528	85,047	803	91,214	164	94,918	-	-	-	-	-	-	1,863	85,585
45 – 49	46	58,392	63	68,307	130	72,963	293	84,030	617	91,681	850	97,497	104	100,558	-	-	-	-	2,103	90,819
50 – 54	26	67,796	22	78,837	47	81,595	124	85,133	286	91,812	495	100,312	448	103,322	111	108,058	-	-	1,559	97,552
55 – 59	14	38,972	10	61,319	20	75,650	44	90,848	97	90,809	143	95,847	107	105,583	74	107,244	8	104,909	517	95,274
60 – 64	3	43,220	3	65,443	7	62,057	12	70,067	21	90,648	26	91,749	23	106,884	14	121,052	8	122,251	117	94,200
65 - 69	1	17,470	-	-	4	24,306	2	98,180	6	104,901	2	94,566	1	97,857	2	107,932	3	115,530	21	85,234
70 +	1	4,523	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4,523
Total	1,949	53,708	1,188	71,176	1,696	77,327	2,233	84,766	2,020	91,080	1,680	97,842	683	103,367	201	108,662	19	113,888	11,669	81,637

* This exhibit excludes 4 members who were merged into PERA P&F in 2012 from the Minneapolis Police and Minneapolis Fire Retirement Funds whose benefits are not pay related.

Membership Data – Service Retirements

The following table displays the distribution of service retirees valued by Deloitte by age and years retired and includes average annual benefit (in dollars) as of June 30, 2018.

Table 6

Years Retired	< 1		1-4		5-9		10-14		15-19		20-24		25+		Total	
Age Group	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.
<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50-54	76	48,155	262	45,369	-	-	-	-	-	-	-	-	-	-	338	45,996
55 – 59	166	65,522	682	58,574	389	50,291	1	61,615	-	-	-	-	-	-	1,238	56,905
60 – 64	39	56,611	340	60,555	593	59,816	391	48,896	-	-	-	-	-	-	1,363	56,776
65 – 69	15	42,829	119	49,357	278	54,343	578	54,438	454	50,485	2	54,583	2	65,939	1,448	52,659
70 – 74	-	-	17	37,652	107	48,395	187	48,736	770	55,472	202	49,562	2	65,939	1,285	52,754
75 – 79	-	-	2	2,622	14	26,491	39	33,343	314	55,294	428	62,488	41	48,955	838	57,030
80 – 84	-	-	-	-	4	33,835	5	54,280	133	53,465	231	62,203	167	54,250	540	57,308
85 – 89	-	-	-	-	3	31,669	-	-	37	55,958	98	57,916	182	55,900	320	56,297
90+	-	-	-	-	2	26,890	-	-	20	63,976	39	55,027	103	57,182	164	57,129
Total	296	58,739	1,422	55,515	1,390	54,658	1,201	51,066	1,728	54,084	1,000	59,056	497	55,119	7,534	54,890

Membership Data – Survivors

The following table displays the distribution of survivors valued by Deloitte by age and years since death and includes average benefits (in dollars) as of June 30, 2018.

Table 7

Years Since Death	<1		1-4		5-9		10-14		15-19		20-24		25+		Total	
Age Group	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit	No.	Avg. Annual Benefit
< 45	8	15,332	36	17,023	59	15,651	25	14,124	3	25,945	1	6,359	-	-	132	15,880
45 – 49	2	38,147	5	36,926	6	26,162	8	37,709	-	-	2	31,812	-	-	23	34,052
50 – 54	2	30,108	7	44,350	7	33,879	6	39,313	4	41,572	1	48,105	2	25,148	29	38,220
55 – 59	3	38,791	12	36,785	19	43,421	14	33,882	2	20,646	4	44,871	5	37,704	59	38,414
60 – 64	9	31,863	27	32,228	25	31,824	24	32,629	13	33,191	10	43,892	6	40,292	114	33,752
65 – 69	17	31,709	50	31,916	39	35,037	26	33,007	20	32,815	7	52,231	22	36,628	181	34,183
70 – 74	13	32,233	57	32,498	53	35,782	47	31,075	50	34,500	25	39,667	26	31,741	271	33,839
75 – 79	13	30,815	63	34,876	49	31,225	32	31,596	55	37,312	24	31,977	27	35,745	263	33,930
80 – 84	25	34,181	53	33,430	60	32,047	36	34,449	43	32,855	29	31,500	28	32,638	274	32,954
85 – 89	13	41,535	37	33,935	49	30,133	41	33,352	62	30,518	43	31,849	33	29,942	278	31,975
90+	7	34,864	21	30,502	32	33,690	35	25,196	55	34,410	51	27,232	50	27,581	251	29,900
Total	112	32,674	368	31,882	398	30,674	294	30,501	307	33,706	197	33,163	199	31,949	1,875	31,897

Membership Data – Disability Retirements

The following table displays the distribution of service disability retirements valued by Deloitte by age and years disabled and includes average annual benefit as of June 30, 2018.

Table 8

Years Disabled	<1		1-4		5-9		10-14		15-19		20-24		25+		Total	
Age Group	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.	No.	Avg. Ben.
< 45	14	43,327	76	39,008	26	33,641	9	31,573	1	28,208	-	-	-	-	126	37,763
45 – 49	16	42,547	61	45,168	22	38,247	20	33,456	3	22,447	1	34,751	-	-	123	41,046
50 – 54	6	54,698	58	52,142	44	41,706	30	40,244	14	35,259	7	33,634	1	41,690	160	44,785
55 – 59	22	53,533	54	43,997	6	42,382	35	41,491	39	37,749	11	40,507	1	27,367	168	42,888
60 – 64	5	48,267	28	50,966	16	40,432	68	48,656	58	41,636	15	45,055	-	-	190	45,866
65-69	5	34,831	9	42,359	6	42,935	79	48,941	107	51,363	29	48,665	1	30,726	236	49,225
70-74	-	-	6	57,567	4	57,637	21	46,930	115	52,819	59	56,705	5	49,359	210	53,467
75+	-	-	-	-	2	51,078	4	63,238	25	46,556	62	56,228	41	51,084	134	52,982
Total	68	47,187	292	45,457	126	40,021	266	45,211	362	47,542	184	52,362	49	49,817	1,347	46,650

Membership Data – Terminated Members

Table 9

	Deferred Retirement		Other Non-Vested		Total	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Number	1,580	1,580	1,188	1,188	2,768	2,768
2. Average age	45.0	45.0	44.6	44.8	44.8	44.9
3. Average service	7.2	7.2	0.8	0.8	4.4	4.4
4. Average annual benefit, with augmentation to December 31, 2018 and 33% CSA load	$20,137	$20,069	N/A	N/A	$20,137	$20,069
5. Average refund value, with 33% CSA load (2% CSA load for Non-Vested)	$40,779	$40,779	$2,722	$2,722	$24,446	$24,446

Special Groups – Minneapolis Police Relief Association

Table 10

	Number		Annual Benefits (Dollars in Thousands)		Average Age	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Service Retirements	410	410	26,014	26,014	76.2	76.2
2. Disability Retirements	16	16	911	911	73.6	73.6
3. Survivors	203	203	7,196	7,196	80.4	80.4
4. Total	629	629	$ 34,121	$ 34,121	77.5	77.5

Special Groups – Minneapolis Firefighters' Relief Association

Table 11

	Number		Annual Benefits (Dollars in Thousands)		Average Age	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Active Members	4	4	N/A	N/A	62.0	62.0
2. Service Retirements	246	246	16,008	16,008	76.4	76.4
3. Disability Retirements	36	36	2,263	2,263	75.1	75.1
4. Survivors	161	161	5,785	5,785	80.9	80.9
5. Total	447	447	$ 24,056	$ 24,056	77.8	77.8

Special Groups – Virginia Fire Department Relief Association

Table 12

	Number		Annual Benefits (Dollars in Thousands)		Average Age	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Service Retirements	5	5	141	141	84.7	84.7
2. Survivors	3	3	46	46	89.2	89.2
3. Total	8	8	187	187	86.4	86.4

Special Groups – Fairmont Police Department Relief Association

Table 13

	Number		Annual Benefits (Dollars in Thousands)		Average Age	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Service Retirements	7	7	460	460	73.9	73.9
2. Survivors	3	3	119	119	80.1	80.1
3. Total	10	10	579	579	75.8	75.8

Development of Costs

Determination of Unfunded Actuarial Accrued Liability (UAAL) and Supplemental Contribution Rate

Table 14 (Dollars in Thousands)

	Actuarial Present Value of Projected Benefits		Actuarial Present Value of Future Normal Costs		Actuarial Accrued Liability	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Determination of Actuarial Accrued Liability (AAL)						
a. Active Members						
i. Retirement annuities	$ 4,623,218	$ 4,503,626	$ 1,372,609	$ 1,426,508	$ 3,250,609	$ 3,077,119
ii. Disability benefits	516,924	668,976	310,798	331,147	206,126	337,828
iii. Survivor's benefits	100,051	100,695	58,608	52,925	41,443	47,770
iv. Deferred retirements	180,744	193,835	143,265	163,683	37,479	30,152
v. Refunds	6,531	4,464	11,061	2,235	(4,530)	2,229
vi. Total	$ 5,427,468	$ 5,471,595	$ 1,896,341	$ 1,976,498	$ 3,531,127	$ 3,495,097
b. Deferred retirements with future augmentation	239,465	239,297	-	-	239,465	239,297
c. Former members without vested rights	1,622	1,609	-	-	1,622	1,609
d. Annuitants	5,780,590	5,785,489	-	-	5,780,590	5,785,489
f. Total	$ 11,449,145	$ 11,497,991	$ 1,896,341	$ 1,976,498	$ 9,552,804	$ 9,521,493
2. Determination of Unfunded Actuarial Accrued Liability (UAAL)						
a. Actuarial accrued liability					$ 9,552,804	$ 9,521,493
b. Current assets (AVA)					8,320,094	8,320,095
c. Unfunded actuarial accrued liability					$ 1,232,710	$ 1,201,398
3. Determination of Supplemental Contribution Rate						
a. Present value of future payrolls through the amortization date of June 30, 2048					$ 17,085,951	$ 16,635,926
b. Supplemental contribution rate					7.21%	7.22%

Determination of Contribution Sufficiency

Table 15 (Dollars in Thousands)

	Percent of Payroll		Dollar Amount	
	PERA P&F Valuation	Deloitte Replication Valuation	PERA P&F Valuation	Deloitte Replication Valuation
1. Statutory contributions – Chapter 353				
a. Employee contributions	11.05%	11.05%	$110,552	$110,622
b. Employer contributions	16.58%	16.58%	165,829	165,984
c. Minneapolis Police contributions	0.99%	0.99%	9,892	9,892
d. Minneapolis Fire contributions	0.54%	0.54%	5,416	5,416
e. Virginia Fire contributions	0.00%	0.00%	30	30
f. State contributions	1.35%	1.35%	13,500	13,500
g. Total	30.51%	30.51%	$305,219	$305,444
2. Required contributions – Chapter 356				
a. Normal Cost				
i. Retirement benefits	15.17%	15.10%	$151,771	$151,140
ii. Disability benefits	3.45%	3.53%	34,516	35,316
iii. Survivors	0.67%	0.59%	6,703	5,875
iv. Deferred retirement benefits	1.50%	1.73%	15,007	17,304
v. Refunds	0.11%	0.02%	1,101	212
vi. Total	20.90%	20.96%	$209,098	$209,847
b. Supplemental contribution amortization of Unfunded Actuarial Accrued Liability by June 30, 2048	7.21%	7.22%	72,134	72,297
c. Allowance for expenses	0.09%	0.09%	900	900
d. Total	28.20%	28.27%	$282,132	$283,044
3. Contribution Sufficiency/(Deficiency): (1g) – (2d)	2.31%	2.24%	$23,087	$22,400

Actuarial Methods and Assumptions

Statement of Actuarial Methods

The actuarial methods below are documented by the retained actuary, and we agree with their application without any changes. They are documented here for illustrative purposes only and reflect exactly what was provided in the retained actuary's report.

Actuarial Cost Method

An actuarial cost method is a set of techniques used by the actuary to develop contribution levels under a retirement plan. The actuarial cost method used in this valuation for all purposes is the Entry Age Actuarial Cost Method. Under this method, a normal cost is developed by amortizing the actuarial value of benefits expected to be received by each active participant (as a level percentage of pay) over the total working lifetime of that participant, from hire to termination. Age as of the valuation date was calculated based on the dates of birth provided by the Fund. Entry age for valuation purposes was calculated as the age on the valuation date minus the provided years of service on the valuation date.

To the extent that current assets and future normal costs do not support participants' expected future benefits, an Unfunded Actuarial Accrued Liability ("UAAL") develops. The UAAL is amortized over the statutory amortization period using level percent-of-payroll assuming payroll increases. The total contribution developed under this method is the sum of normal cost, expenses, and the payment toward the UAAL.

Funding Objective

The fundamental financing objective of the Plan is to establish contribution rates which, when expressed as a percentage of active member payroll, will remain approximately level from generation to generation and meet the required deadline for full funding.

Asset Valuation Method

The assets are valued based on a five-year moving average of expected and market values (five-year average actuarial value) determined as follows:

- At the end of each plan year, an average asset value is calculated as the average of the market asset value at the beginning and end of the fiscal year net of investment income for the fiscal year;
- The investment gain or (loss) is taken as the excess of actual investment income over the expected investment income based on the average asset value as calculated above;
- The investment gain or (loss) so determined is recognized over five years at 20% per year; and
- The asset value is the sum of the market asset value plus the scheduled recognition of investment gains or (losses) during the current and the preceding four fiscal years.

Payment on the Unfunded Actuarial Accrued Liability

Payment equals a level percentage of payroll each year to the statutory amortization date of June 30, 2048 assuming payroll increases of 3.25% per annum. If there is a negative Unfunded Actuarial Accrued Liability, the surplus amount is amortized over 30 years as a level percentage of payroll. If the unfunded liability increases due to changes in benefits, assumptions, or methods, the statutory amortization date may be extended.

As required by the Standards for Actuarial Work, projected payroll is 1) determined by increasing reported payroll for each member by one full year's assumed pay increase according to the actuarial salary scale and 2) multiplied by 0.962 in the determination of the present value of future payroll to account for timing differences.

Changes in Methods Since Prior Valuation

The amortization period was reset to 30 years, ending in 2048.

Summary of Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All assumptions are prescribed by Statutes, the LCPR, or the Board of Trustees. Unless noted elsewhere, the assumptions are based on the experience study dated August 30, 2016 and Deloitte's Combined Service Annuity Study dated October 2016.

Investment return	7.50% per annum.
Salary Increases	Reported salary at valuation date increased according to the rate table provided later in this section, to current fiscal year and annually for each future year. Prior fiscal year salary is annualized for members with less than one year of service earned during the year.
Inflation	2.50% per year.
Payroll growth	3.25% per year.
Mortality Rates	**Pre-retirement:** RP-2014 employee generational mortality table projected with mortality improvement scale MP-2017 from a base year of 2006. **Post-retirement:** RP-2014 annuitant generational mortality table projected with mortality improvement scale MP-2017 from a base year of 2006. Male rates are adjusted by a factor of 0.96. **Disabled:** RP-2014 annuitant generational mortality table projected with mortality improvement scale MP-2017 from a base year of 2006. Male rates are adjusted by a factor of 0.96. **Notes:** The RP-2014 employee mortality table as published by the Society of Actuaries (SOA) contains mortality rates for ages 18 to 80 and the annuitant mortality table contains mortality rates for ages 50 to 120. The retained actuary noted that the published employee table was extended for older ages and the published annuitant table was extended for younger ages. This extension methodology is reasonable, and we relied upon the provided mortality rates for extended ages provided by the retained actuary for this valuation.
Retirement	Members retiring from active status are assumed to retire according to the age-related rates shown in the rate table provided later in this section. Members who have attained the highest assumed retirement age are assumed to retire in one year.
Withdrawal	Select and Ultimate rates are based on actual experience. Ultimate rates after the third year are shown in rate table provided later in this section. Select rates in the first three years are:
Disability	Age-related rates are based on experience. Sample rates are provided in the rate table later in this section. All incidences are assumed to be duty-related.
Allowance for combined service annuity	33.0% load on liabilities for former vested members. 2.0% load on liabilities for former non-vested members

Year	Select Withdrawal Rates
1	3.00%
2	3.00%
3	3.00%

Administrative expenses	Prior year administrative expenses expressed as percentage of prior year projected payroll.
Refund of contributions	Account balances accumulate interest until normal retirement date and are discounted back to the valuation date. All employees withdrawing after becoming eligible for a deferred benefit are assumed to take the larger of contributions accumulated with interest or the value of the deferred benefit.
Commencement of deferred benefits	Members receiving deferred annuities, including the current terminated deferred members, are assumed to begin receiving benefits at age 55.
Percentage married	85% of male and 60% of female active members are assumed to be married. Actual marital status is used for members in payment status.
Age of spouse	Males are assumed to be two years older than females. For members in payment status, actual spouse date of birth is used, if provided.
Eligible children	Retiring members are assumed to have no dependent children.
Form of payment	Married members retiring from active status are assumed to elect a subsidized joint and survivor form of annuity as follows: **Males:** • 10% elect 25% Joint & Survivor option • 20% elect 50% Joint & Survivor option • 20% elect 75% Joint & Survivor option • 35% elect 100% Joint & Survivor option The remaining 15% of married male members are assumed to elect the Straight Life option **Females:** • 20% elect 25% Joint & Survivor option • 20% elect 50% Joint & Survivor option • 10% elect 75% Joint & Survivor option • 20% elect 100% Joint & Survivor option The remaining 30% of married female members are assumed to elect the Straight Life option Unmarried members are assumed to elect the Straight Life option. Members receiving deferred annuities, including current terminated deferred members, are assumed to elect the Straight Life option.
Eligibility testing	Eligibility for benefits is determined based upon the age nearest birthday and service on the date the decrement is assumed to occur.
Decrement operation	Withdrawal decrements do not operate during retirement eligibility. Decrements are assumed to occur mid-fiscal year.
Service credit accruals	It is assumed that members accrue one year of service credit per year.
Pay increases	Pay increases are assumed to happen at the beginning of the fiscal year.

Unknown Data for Certain Members	In cases where the submitted data was missing or incomplete, the following assumptions were applied: <u>Data for active members:</u> There were 41 members reported with a salary less than $100. We used prior year salary (26 members), if available; otherwise high-five salary with a 10% load to account for salary increases (15 members). If neither prior year salary nor high five salary was available, we assumed a value of $35,000. Note that the four active members previously part of Minneapolis Fire are excluded from these salary counts since their benefit is not pay related. There were 133 members reported without a gender. We assumed male gender. There were 9 members reported without a date of birth. We assumed a date of birth of July 1, 1985. <u>Data for terminated members:</u> We estimated benefits for these members using the reported Average Salary and credited service. If Average Salary was not reported (1 member), we assumed a value of $24,000. If credited service was not reported (13 members), we used elapsed time from hire date to termination date (6 members); if elapsed time was not available, we assumed nine years of service. If termination date was invalid or not reported (7 members), we assumed the termination date was equal to the hire date plus credited service, otherwise the valuation date. If the reported termination date occurs prior to the reported hire date, the two dates were swapped. There were 8 members reported without a gender; male was assumed. There were no members reported without a date of birth. <u>Data for members in pay status:</u> There were no members with missing or invalid dates of birth. There were 18 beneficiaries, 4 retirees and 1 disabled member reported without a gender. We assumed retirees and disableds are male and beneficiaries are female. Per the retained actuary's report, there were 13 members that were active last year and retirement eligible and not on the retiree data file this year. It was noted that the retained actuary included these members in the 2018 valuation as retirees with estimated life only monthly benefit at the direction of PERA. We verified the 13 members were added as retirees in the valuation and relied upon the retained actuary's provided estimated monthly benefit amounts for these individuals for the valuation. Because PERA reclassifies disabled members as retirees once the member reaches Normal Retirement Age, the retained actuary noted that they compare the members that PERA reports as retirees to the disabled group from the last valuation. If a member was disabled in the valuation, they reclassify that member as a disabled retiree in this year's valuation. The retained actuary reclassified 205 retirees as disabled retirees in this valuation. We verified that 205 retirees were reclassified as disableds in the retained actuary's valuation data versus the census data provided by PERA. We relied upon the retained actuary's determination of disability status for these individuals and did not analyze census data from prior valuation dates for purposes of the valuation.
Changes in Actuarial Assumptions	The assumed investment return was lowered from 8.0% to 7.5%. The assumed rate of inflation decreased from 2.75% to 2.50%. The assumed payroll growth rate decreased from 3.50% to 3.25%. Salary increase rates were reduced by 0.25% at each year of service. The mortality projection scale was changed from MP-2016 to MP-2017.

Sample Rate Tables

	Percentage of Members Dying Each Year					
	Healthy Post-Retirement Mortality		Healthy Pre-Retirement Mortality		Disability Mortality	
Age in 2018	Males	Females	Males	Females	Males	Females
20	0.04%	0.02%	0.04%	0.02%	0.04%	0.02%
25	0.06%	0.03%	0.05%	0.02%	0.06%	0.03%
30	0.09%	0.07%	0.05%	0.02%	0.09%	0.07%
35	0.13%	0.12%	0.06%	0.03%	0.13%	0.12%
40	0.19%	0.17%	0.07%	0.05%	0.19%	0.17%
45	0.27%	0.22%	0.10%	0.07%	0.27%	0.22%
50	0.39%	0.27%	0.17%	0.11%	0.39%	0.27%
55	0.56%	0.38%	0.28%	0.18%	0.56%	0.38%
60	0.78%	0.58%	0.49%	0.27%	0.78%	0.58%
65	1.12%	0.85%	0.88%	0.39%	1.12%	0.85%
70	1.67%	1.31%	1.43%	0.64%	1.67%	1.31%
75	2.66%	2.16%	2.39%	1.11%	2.66%	2.16%
80	4.49%	3.69%	4.06%	1.95%	4.49%	3.69%
85	7.87%	6.60%	7.99%	5.15%	7.87%	6.60%
90	13.83%	11.75%	14.57%	11.33%	13.83%	11.75%

Withdrawal Rates After Third Year		
Age	Males	Females
20	3.00%	3.00%
25	2.60%	2.60%
30	2.10%	2.10%
35	1.60%	1.60%
40	1.25%	1.25%
45	1.25%	1.25%
50	0.00%	0.00%
55	0.00%	0.00%
60	0.00%	0.00%

Rates of Disability Retirement		
Age	Males	Females
20	0.11%	0.11%
25	0.13%	0.13%
30	0.16%	0.16%
35	0.19%	0.19%
40	0.29%	0.29%
45	0.54%	0.54%
50	1.04%	1.04%
55	2.03%	2.03%
60	0.00%	0.00%

Sample Rate Tables (continued)

Age	Rates of Service Retirement
50	10.00%
51	7.00%
52	7.00%
53	10.00%
54	10.00%
55	25.00%
56	22.50%
57	22.50%
58	22.50%
59	20.00%
60	22.50%
61	25.00%
62	30.00%
63	30.00%
64	30.00%
65	50.00%
66	50.00%
67	50.00%
68	50.00%
69	50.00%
70+	100.00%

Salary Scale	
Year	Increase
1	12.25%
2	10.50%
3	8.75%
4	7.75%
5	6.25%
6	5.75%
7	5.25%
8	5.00%
9	4.75%
10	4.50%
11	4.25%
12	4.15%
13	4.05%
14	3.95%
15	3.85%
16	3.75%
17	3.75%
18	3.75%
19	3.75%
20	3.75%
21	3.65%
22	3.55%
23	3.45%
24	3.35%
25+	3.25%

Summary of Plan Provisions

This summary of provisions reflects our understanding of the of applicable Statutes for purposes of preparing this valuation and are consistent with the provisions used in the valuation prepared by PERA P&F's retained actuary. The provisions summarized below are not intended to provide a basis for administering the Plan.

The retained actuary's valuation report also includes plan provisions for the special participant groups Minneapolis Police Relief Association and Minneapolis Firefighters' Relief Association. For purposes of this valuation, we have valued members from these special groups using the same plan provisions as the larger PERA Police & Fire Plan, rather than programming the additional benefit provisions. For this reason, the special group plan provisions have not been summarized in this report.

<table>
<tr><td>Plan year</td><td>July 1 through June 30.</td></tr>
<tr><td>Eligibility</td><td>All full-time and certain part-time police officers and fire fighters, and certain paramedics, who are not contributing to any other local retirement fund.</td></tr>
<tr><td>Contributions</td><td>Contributions shown as a percent of salary:
<table>
<tr><th>Effective</th><th>Member</th><th>Employer</th><th>Total</th></tr>
<tr><td>Prior to January 1, 2019</td><td>10.80%</td><td>16.20%</td><td>27.00%</td></tr>
<tr><td>January 1, 2019</td><td>11.30%</td><td>16.95%</td><td>28.25%</td></tr>
<tr><td>January 1, 2020 and later</td><td>11.80%</td><td>17.70%</td><td>29.50%</td></tr>
</table></td></tr>
<tr><td>State contributions</td><td>$9 million paid annually on October 1 until both PERA P&F and MSRS State Patrol become 90% funded (on a Market Value of Assets basis), or July 1, 2048, if earlier.

In addition, $4.5 million in fiscal years 2019 and 2020, and $9.0 million thereafter, until the plan reaches 100% funding, or July 1, 2048, if earlier.</td></tr>
<tr><td>Allowable service</td><td>Police and Fire service during which member contributions were made. May also include certain leaves of absence and military service.</td></tr>
<tr><td>Salary</td><td>Includes amounts deducted for deferred compensation or supplemental retirement plans, net income from fees and sick leave payments funded by the employer. Excludes unused annual leaves and sick leave payments, severance payments, Workers' Compensation benefits and employer-paid flexible spending accounts, cafeteria plans, healthcare expense accounts, day-care expenses, fringe benefits and the cost of insurance coverage.</td></tr>
<tr><td>Average salary</td><td>Average of the five highest successive years of salary. Average Salary is based on all Allowable Service if less than five years.</td></tr>
</table>

Vesting

	Vesting Percent if First Hired		
Years of Service	Prior to 7/1/2010	After 6/30/2010 & Prior to 7/1/2014	After 6/30/2014
<3	0%	0%	0%
3 - 4	100%	0%	0%
5	100%	50%	0%
6	100%	60%	0%
7	100%	70%	0%
8	100%	80%	0%
9	100%	90%	0%
10	100%	100%	50%
11	100%	100%	55%
12	100%	100%	60%
13	100%	100%	65%
14	100%	100%	70%
15	100%	100%	75%
16	100%	100%	80%
17	100%	100%	85%
18	100%	100%	90%
19	100%	100%	95%
20+	100%	100%	100%

Retirement

a. Normal retirement benefit

I. Age/service requirement

Age 55 and at least partially vested. Proportionate Retirement Annuity is available at age 65 and one year of Allowable Service.

II. Amount

3.00% of Average Salary for each year of Allowable Service (up to 33 years if hired after June 30, 2014), pro-rata for completed months, adjusted for partial vesting if applicable. A pro-rata share of member contributions will be refunded at retirement for excess service.

b. Early retirement benefit

I. Age/service requirement

Age 50 and at least partially vested.

II. Amount

Normal Retirement Benefit based on Allowable Service and Average Salary at retirement date and 0.10% (0.20% for members enrolled in the plan after June 30, 2007) reduction for each month the member is under age 55. If the effective date of retirement is after June 30, 2019, the reduction is 5/12% for each month that the member is under age 55 at the time of retirement. The change in early retirement factors will be phased in over a five-year period for retirements occurring between July 1, 2014 and June 30, 2019.

III. Form of payment	Life annuity with return on death of any balance of contributions over aggregate monthly payments. Actuarially equivalent options are: 25%, 50%, 75% or 100% Joint and Survivor with bounce back feature. The Joint and Survivor options are determined on an actuarially equivalent basis, but with no actuarial reduction for the bounce back feature.
IV. Benefit increases	Benefit recipients receive a future annual 1.00% post-retirement benefit increase. A benefit recipient who has been receiving a benefit for at least 12 full months as of June 30 will receive a full increase. Members receiving benefits for at least one month but less than 12 full months as of June 30 will receive a pro rata increase. For retirements after May 31, 2014, the first increase will be delayed two years. Members retired under laws in effect before July 1, 1973 receive an additional lump sum payment each year. In 1989, this lump sum payment is the greater of $25 times each full year of Allowable Service or the difference between $400 times each full year of Allowable Service and the sum of benefits paid from any Minnesota public pension plan plus cash payments from the Social Security Administration for the preceding fiscal year July 1, 1988 through June 30, 1989. In each following year, the lump sum payment will increase by the same percentage increase that is applied to regular annuities paid from the Fund. Effective January 1, 2002, annual lump sum payment is divided by 12 and paid as a monthly life annuity in the annuity form elected.
Disability	
a. Duty disability benefit	
I. Age/service requirement	Physically or mentally unable to perform normal duties as a police officer or fire fighter as a direct result of an act of duty specific to protecting property and personal safety of others. Members age 55 or older with 20 or more years of Allowable Service are not eligible to apply for duty disability benefits.
II. Amount	60.00%, plus an additional 3.00% for each year of service in excess of 20 years, of Average Salary paid until Normal Retirement Age, or for 60 months, whichever is later. The retirement benefit is then recalculated but is never lower than the disability benefit. If a member became disabled prior to July 1, 1997 but did not commence their benefit before July 1, 1997, the benefit is calculated under the laws in effect before July 1, 1997, and an actuarial increase shall be made for the change in post-retirement interest rates from 5.00% to 6.00%.
b. Regular disability benefit	
I. Age/service requirement	Physically or mentally unable to perform normal duties as a police officer or fire fighter with one year of Allowable Service. Members age 55 or older with 15 or more years of Allowable Service are not eligible to apply for regular disability benefits.
II. Amount	45.00% of Average Salary, paid until Normal Retirement Age, or for 60 months, whichever is later. The retirement benefit is then recalculated but is never lower than the disability benefit. Benefits for total and permanent regular disability are calculated as 3.00% of Average Salary for each year of Allowable Service, with a minimum of 45.00% of Average Salary.

II. Amount (continued)	If a member became disabled prior to July 1, 1997 but did not commence his or her benefit before July 1, 1997, the benefit payable is calculated under the laws in effect before July 1, 1997, and an actuarial increase shall be made for the change in post-retirement interest rates from 5.00% to 6.00%.
III. Benefit increases	Same as for retirement.
c. Retirement benefit	
I. Age/service requirement	Upon cessation of disability benefits.
II. Amount	Any optional annuity continues. Otherwise, the larger of the disability benefit paid before age 55 or the normal retirement benefit available at age 55, or an actuarially equivalent optional annuity.
III. Form of payment	Same as for retirement.
IV. Benefit increases	Same as for retirement.
Death	
a. Surviving spouse benefit	
I. Age/service requirements	Death of active member or regular disabled member with surviving spouse whose disability benefit accrued before July 1, 2007, who is vested at death (service requirement is waived if death occurs in the line of duty).
II. Amount	50.00% of salary (60.00% if death occurs in the line of duty after June 30, 2007) averaged over last six months. Benefit paid until spouse's death but no payments while spouse is remarried prior to July 1, 1991. If a member becomes deceased prior to July 1, 1997 and the beneficiary was not eligible to commence their survivor benefits before July 1, 1997, the benefit payable is calculated under the laws in effect before July 1, 1997, and an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
III. Benefit Increases	Same as for retirement.
b. Surviving dependent children's benefit	
I. Age/service requirements	Non-duty related death of active member or regular disabled member with eligible dependent child.
II. Amount	10.00% of salary averaged over last six months for each child. Family benefit minimum (including spouse's benefit) of 50.00% of salary and maximum of 70.00% of salary. Benefits paid until child marries, dies, or attains age 18 (age 23 if full-time student).
c. Duty disability surviving spouse benefit	
I. Age/service requirement	Member who is totally and permanently disabled who dies before age 55 or within five years of the effective date of the disability benefit, whichever is later.

II. Amount	60.00% of salary averaged over last six months. Benefits paid until spouse's death but no payments while spouse is remarried prior to July 1, 1991.
III. Benefit increases	Same as for retirement.
d. Duty disability surviving dependent children's benefit	
I. Age/service requirement	Death of a member with an eligible dependent child who was disabled in the line of duty and died as a direct result of the disability.
II. Amount	10.00% of salary averaged over last six months for each child. Family benefit minimum (including spouse's benefit) of 60.00% of salary and maximum of 80.00% of salary. Benefits paid until child marries, dies, or attains age 18 (age 23 if full-time student). If a member became deceased prior to July 1, 1997 and the beneficiary was not eligible to commence their survivor benefits before July 1, 1997, the benefit payable is calculated under the laws in effect before July 1, 1997, and an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
e. Surviving spouse optional annuity	
I. Age/service requirement	Active member dies before age 55. Benefits commence when member would have been age 55 or as early as age 50 if qualified for early retirement, benefits commence immediately if member had 30 years of service.
II. Amount	Survivor's payment of the 100% joint and survivor benefit the member could have elected if terminated. Alternatively, spouse may elect refund of deceased's contributions with interest if there are no dependent children. If a member became deceased prior to July 1, 1997 and the beneficiary was not eligible to commence their survivor benefits before July 1, 1997, the benefit payable is calculated under the laws in effect before July 1, 1997, and an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
III. Benefit increases	Same as for retirement.
Termination	
a. Refund of contributions	
I. Age/service requirement	Termination of public service.
II. Amount	Member's contributions with 6.00% interest through June 30, 2011, compounded daily. Beginning July 1, 2011, a member's contributions increase at 4.00% interest compounded daily. Beginning July 1, 2018, a member's contributions increase at 3.00% interest compounded daily. If a member is vested, a deferred annuity may be elected in lieu of a refund.
b. Deferred benefit	
I. Age/service requirements	Partially or fully vested.

II. Amount	Benefit computed under law in effect at termination and increased by the following percentage (augmentation) compounded annually for terminations prior to 2012: • 0.00% before July 1, 1971; • 5.00% from July 1, 1971 to January 1, 1981; • 3.00% (2.50% if hired after June 30, 2006) thereafter until the earlier of January 1 of the year following attainment of age 55 and January 1, 2012; • 5.00% (2.50% if hired after June 30, 2006) thereafter until the earlier of the date the annuity begins and January 1, 2012; • 1.00% from January 1, 2012 through December 31, 2018; and • 0.00% from January 1, 2019, thereafter. Members who terminate after 2011 will receive no future augmentation. If a member terminated employment prior to July 1, 1997 but was not eligible to commence their pension before July 1, 1997, the benefit payable is calculated under the laws in effect before July 1, 1997 and an actuarial increase shall be made for the change in the post-retirement interest rates from 5.00% to 6.00%.
III. Form of payment	Same as for retirement.
Actuarial equivalent factors	Effective July 1, 2019, actuarially equivalent factors based on the RP-2014 mortality table for healthy annuitants for a member turning age 55 in 2021, reflecting projected mortality improvements using Scale MP-2017, male rates multiplied by 0.96, blended 90% males, and 6.50% interest.
Combined service annuity	Members are eligible for combined service benefits if they: • Meet minimum retirement age for each plan participated in and total public service meets the vesting requirements of each plan; or • Have three or more years of service under PERA and the covered fund(s) (if hired prior to July 1, 2010). Other requirements for combined service include: • Member must have at least six months of allowable service credit in each plan worked under; and • Member may not be in receipt of a benefit from another plan. Members who meet the above requirements must have their benefits based on the following: • Allowable service in all covered plans is combined in order to determine eligibility for early retirement. • Average salary is based on the high five consecutive years during their entire service in all covered plans.

Change in plan provisions	Post-retirement benefit increases were changed to 1.0% for all years, with no trigger. An end date of July 1, 2048 was added to the existing $9.0 million state contribution. New annual state aid will equal $4.5 million in fiscal years 2019 and 2020, and $9.0 million thereafter until the plan reaches 100% funding, or July 1, 2048, if earlier. Member contributions were changed from 10.8% to 11.3% of pay, effective January 1, 2019 and 11.8% of pay, effective January 1, 2020. Employer contributions were changed from 16.20% to 16.95% of pay, effective January 1, 2019 and 17.70% of pay, effective January 1, 2020. Interest credited on member contributions decreased from 4.0% to 3.0%, beginning July 1, 2018. Deferred augmentation was changed to 0.00%, effective January 1, 2019. Augmentation that has already accrued for deferred members will still apply. Actuarial equivalent factors were updated to reflect revised mortality and interest assumptions.