Segal Consulting

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June 13, 2019

Mr. Ron Baker
Executive Director
Public Employees' Retirement Association of Colorado
1301 Pennsylvania Street
Denver, CO 80203

Re: Transition of Actuarial Services for the Public Employees' Retirement Association of Colorado (PERA)

Dear Ron:

We are pleased to present the results of the actuarial replication audit performed in connection with the transition of actuarial services for the Public Employees' Retirement Association of Colorado (PERA). The purpose of this letter is to show details of Segal's replication of the results of the December 31, 2017, actuarial valuations to comment on the appropriateness of the assumptions used to perform the valuations.

The transition of actuarial services was conducted under the supervision of Matt Strom and Tanya Dybal, both Fellows of the Society of Actuaries, members of the American Academy of Actuaries and Enrolled Actuaries under ERISA. Retiree medical valuation transition services were conducted under the supervision of Thomas Bergman, Associate of the Society of Actuaries and member of the American Academy of Actuaries and Melissa Krumholz, Fellow of the Society of Actuaries and member of the American Academy of Actuaries. This review was conducted in accordance with the standards of practice prescribed by the Actuarial Standards Board.

We appreciate the opportunity to serve as actuarial advisors for PERA and we are available to answer any questions you may have on this report.

Segal's replication of the December 31, 2017, actuarial valuations indicate that the calculations performed by Cavanaugh Macdonald Consulting were reasonable. Actuarial firms each have their own software programs for calculating normal costs and liabilities. Even with the same actuarial assumptions and cost method, it is unlikely that any two firms will perform calculations in exactly the same way.

For the Division Trust Funds, Segal's calculation of the total Actuarial Present Value of Projected Benefits was within 0.4%. However, the replication of the Normal Cost was 10.1% higher and the replication of the total Actuarial Accrued Liability was 0.1% lower. Given the very close match of the Actuarial Present Value of Projected Benefits, we consider the overall match results to be reasonable.

For the Health Care Trust Funds, the Actuarial Present Value of Projected Benefits and the Actuarial Accrued Liability were 1.9% and 2.7% higher, respectively, and the Normal Cost was 0.9% lower. We consider all of these results to be within a reasonable tolerance.

Segal determined that the data used by CMC were reasonable, were able to closely match benefit and valuation asset amounts, and determined that the actuarial methods and assumptions applied were in conformity with the Actuarial Standards of Practice. Segal found no grounds on which to suggest a revision of the previous year's actuarial valuations.

Sincerely,

Kim Nicholl, FSA, FCA, MAAA, EA
Senior Vice President and Actuary

Matthew Strom, FSA, MAAA, EA
Vice President and Actuary

Tanya Dybal, FSA, MAAA, EA
Consulting Actuary

Thomas Bergman, ASA, MAAA, EA
Retiree Health Actuary

Melissa Krumholz, FSA, MAAA
Healthcare Actuary

cc: Ms. Koren Holden, Public Employees' Retirement Association of Colorado

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Introduction

The Public Employees' Retirement Association of Colorado (PERA) retained Segal Consulting (Segal) to serve as actuarial consultants in the Fall of 2018. As part of the transition from the prior actuary, Cavanaugh Macdonald Consulting (CMC), Segal has replicated the results on the December 31, 2017, actuarial valuations performed by CMC.

The main steps of the transition of actuarial services are as follows:

1. A review of the "scrubbed" data provided by the prior actuary, to determine if the data could be used to replicate the statistical data tables presented in the December 31, 2017 valuation report;

2. A review of the assumptions used by the prior actuary in order to determine the cost of benefits presented in the valuation report;

3. A comparison of the plan provisions described in the valuation report to the statutes governing the administration of the Plan;

4. Programming valuation software based on the assumptions and provisions described in the valuation report to replicate the prior actuary's determination of the Present Value of Future Benefits, Actuarial Accrued Liability, and Normal Cost on an aggregate basis;

5. Review of "test life" liabilities provided by the prior actuary to determine if the assumptions and plan provisions described in the valuation report were applied as expected to individual records with varying demographic characteristics and plan eligibilities; and

6. Replication of cost calculations, the determination of the actuarial value of assets, the actuarially determined contribution, and the funding period.

Liability Replication

In replicating the results of the PERA valuations as of December 31, 2017, we matched the valuation results and the test life output within an acceptable range. A comparison of the valuation results for all Division Trust Funds is displayed on the next page, with results by Division shown on the subsequent pages. A comparison of the valuation results for the Health Care Trust Funds follows. Differences less than 5% are generally considered a reasonable match. Most of the results are well within that tolerance.

Actuarial firms each have their own software programs for calculating normal costs and liabilities. Even with the same actuarial assumptions and cost method, it is unlikely that any two firms will perform calculations in exactly the same way. As can be seen in the chart on the next page, the replication of the total Actuarial Present Value of Projected Benefits for the Division Trust Funds was within 0.4%. However, the replication of the Normal Cost was 10.1% higher and the replication of the total Actuarial Accrued Liability was 0.1% lower. Given the very close match of the Actuarial Present Value of Projected Benefits, we consider the overall match results to be reasonable. For the Health Care Trust Funds, the Actuarial Present Value of Projected Benefits and the Actuarial Accrued Liability were 1.9% and 2.7% higher, respectively, and the Normal Cost was 0.9% lower. We consider all of these results to be within a reasonable tolerance.

Pointing out software differences should not be construed as an indication that one firm or the other is “correct.” We do so only to provide complete disclosure.

Replication Results – Division Trust Funds

Total of All Division Funds

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$31,558,170,365	$31,434,321,402	-0.39%
– Retirement	26,916,464,265	26,745,181,259	-0.64%
– Withdrawal	3,858,720,179	3,850,622,640	-0.21%
– Disability	506,030,752	506,425,901	0.08%
– Death	276,955,169	332,091,602	19.91%
• Normal Cost (%)	11.14%	12.28%	
– Retirement	7.84%	7.84%	
– Withdrawal	2.87%	3.99%	
– Disability	0.29%	0.29%	
– Death	0.14%	0.16%	
• Normal Cost ($)	$1,003,282,415	$1,104,614,316	10.10%
– Retirement	706,161,677	705,100,813	-0.15%
– Withdrawal	258,387,055	358,743,479	38.84%
– Disability	26,169,582	26,008,169	-0.62%
– Death	12,564,101	14,761,855	17.49%
• Actuarial Accrued Liability (AAL)	$23,430,582,867	$22,938,759,360	-2.10%
– Retirement	21,768,733,262	21,285,207,464	-2.22%
– Withdrawal	1,160,470,731	1,129,950,492	-2.63%
– Disability	310,629,090	302,064,521	-2.76%
– Death	190,749,784	221,536,883	16.14%
Retired Members	$48,338,026,719	$48,771,135,104	0.90%
Survivors	$470,228,696	$474,253,592	0.86%
Inactive	$2,152,028,026	$2,169,374,955	0.81%
Total:			
• Actuarial Present Value of Projected Benefits	$82,518,453,806	$82,849,085,053	0.40%
• Actuarial Accrued Liability (AAL)	74,390,866,308	74,353,523,011	-0.05%

State Division

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$9,721,323,102	$9,714,665,616	-0.07%
– Retirement	8,278,707,696	8,248,729,802	-0.36%
– Withdrawal	1,129,464,313	1,135,090,731	0.50%
– Disability	211,363,880	210,726,159	-0.30%
– Death	101,787,213	120,118,924	18.01%
• Normal Cost (%)	10.32%	11.90%	
– Retirement	7.10%	7.25%	
– Withdrawal	2.70%	4.10%	
– Disability	0.37%	0.37%	
– Death	0.15%	0.18%	
• Normal Cost ($)	$299,507,549	$345,156,364	15.24%
– Retirement	205,922,817	210,095,324	2.03%
– Withdrawal	78,356,351	118,981,359	51.85%
– Disability	10,750,390	10,868,574	1.10%
– Death	4,477,991	5,211,107	16.37%
• Actuarial Accrued Liability (AAL)	$7,386,662,201	$7,183,229,936	-2.75%
– Retirement	6,858,135,281	6,695,154,674	-2.38%
– Withdrawal	323,190,690	278,373,897	-13.87%
– Disability	133,151,998	127,285,203	-4.41%
– Death	72,184,232	82,416,162	14.17%
Retired Members	$16,531,495,521	$16,698,901,653	1.01%
Survivors	$208,954,343	$210,459,703	0.72%
Inactive	$654,973,073	$671,870,966	2.58%
Total:			
• Actuarial Present Value of Projected Benefits	$27,116,746,039	$27,295,897,938	0.66%
• Actuarial Accrued Liability (AAL)	24,782,085,138	24,764,462,258	-0.07%

School Division

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$17,618,811,337	$17,529,077,448	-0.51%
– Retirement	15,131,896,542	14,987,740,459	-0.95%
– Withdrawal	2,134,931,591	2,160,044,048	1.18%
– Disability	219,485,149	217,741,938	-0.79%
– Death	132,498,055	163,551,003	23.44%
• Normal Cost (%)	11.60%	12.67%	
– Retirement	8.33%	8.23%	
– Withdrawal	2.90%	4.06%	
– Disability	0.24%	0.23%	
– Death	0.13%	0.15%	
• Normal Cost ($)	$544,813,480	$594,190,112	9.06%
– Retirement	391,069,350	385,817,340	-1.34%
– Withdrawal	136,654,436	190,339,189	39.29%
– Disability	11,100,957	10,897,470	-1.83%
– Death	5,988,737	7,136,113	19.16%
• Actuarial Accrued Liability (AAL)	$13,108,675,209	$12,871,441,380	-1.81%
– Retirement	12,221,497,203	11,946,498,298	-2.25%
– Withdrawal	661,720,214	685,007,095	3.52%
– Disability	134,874,326	130,689,267	-3.10%
– Death	90,583,466	109,246,720	20.60%
Retired Members	$25,668,690,627	$25,864,669,652	0.76%
Survivors	$193,295,430	$194,612,375	0.68%
Inactive	$1,075,553,236	$1,079,961,288	0.41%
Total:			
• Actuarial Present Value of Projected Benefits	$44,556,350,630	$44,668,320,763	0.25%
• Actuarial Accrued Liability (AAL)	40,046,214,502	40,010,684,695	-0.09%

Local Government Division

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$2,056,698,008	$2,065,166,485	0.41%
– Retirement	1,732,265,493	1,730,952,766	-0.08%
– Withdrawal	267,276,207	272,739,193	2.04%
– Disability	34,755,588	34,806,850	0.15%
– Death	22,400,720	26,667,676	19.05%
• Normal Cost (%)	9.82%	11.50%	
– Retirement	6.63%	6.90%	
– Withdrawal	2.77%	4.14%	
– Disability	0.27%	0.28%	
– Death	0.15%	0.18%	
• Normal Cost ($)	$65,111,755	$76,124,866	16.91%
– Retirement	43,961,327	45,655,364	3.85%
– Withdrawal	18,315,529	27,409,871	49.65%
– Disability	1,809,319	1,863,891	3.02%
– Death	1,025,580	1,195,740	16.59%
• Actuarial Accrued Liability (AAL)	$1,563,405,980	$1,525,046,488	-2.45%
– Retirement	1,441,767,701	1,403,981,916	-2.62%
– Withdrawal	83,749,637	81,955,100	-2.14%
– Disability	22,030,803	20,867,531	-5.28%
– Death	15,857,839	18,241,941	15.03%
Retired Members	$3,137,299,022	$3,186,762,481	1.58%
Survivors	$40,252,167	$40,543,085	0.72%
Inactive	$304,974,846	$306,209,357	0.40%
Total:			
• Actuarial Present Value of Projected Benefits	$5,539,224,043	$5,598,681,408	1.07%
• Actuarial Accrued Liability (AAL)	5,045,932,015	5,058,561,411	0.25%

Judicial Division

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$218,556,029	$219,705,828	0.53%
– Retirement	203,933,194	204,147,283	0.10%
– Withdrawal	4,714,708	5,364,653	13.79%
– Disability	5,245,241	5,156,888	-1.68%
– Death	4,662,886	5,037,004	8.02%
• Normal Cost (%)	16.63%	16.05%	
– Retirement	14.38%	13.83%	
– Withdrawal	1.06%	1.17%	
– Disability	0.73%	0.58%	
– Death	0.46%	0.47%	
• Normal Cost ($)	$8,467,950	$8,180,110	-3.40%
– Retirement	7,322,536	7,045,162	-3.79%
– Withdrawal	539,312	595,761	10.47%
– Disability	372,029	297,586	-20.01%
– Death	234,073	241,601	3.22%
• Actuarial Accrued Liability (AAL)	$150,566,567	$151,862,387	0.86%
– Retirement	145,450,327	145,995,116	0.37%
– Withdrawal	21,038	221,235	951.60%
– Disability	2,177,796	2,521,393	15.78%
– Death	2,917,406	3,124,643	7.10%
Retired Members	$271,205,025	$274,306,353	1.14%
Survivors	$3,595,149	$3,616,720	0.60%
Inactive	$2,741,458	$2,754,892	0.49%
Total:			
• Actuarial Present Value of Projected Benefits	$496,097,661	$500,383,793	0.86%
• Actuarial Accrued Liability (AAL)	428,108,199	432,540,352	1.04%

Denver Public Schools Division

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits	$1,942,781,889	$1,905,706,025	-1.91%
– Retirement	1,569,661,340	1,573,610,949	0.25%
– Withdrawal	322,333,360	277,384,015	-13.94%
– Disability	35,180,894	37,994,066	8.00%
– Death	15,606,295	16,716,995	7.12%
• Normal Cost (%)	12.29%	11.68%	
– Retirement	8.33%	8.15%	
– Withdrawal	3.53%	3.09%	
– Disability	0.31%	0.30%	
– Death	0.12%	0.14%	
• Normal Cost ($)	$85,381,681	$80,962,864	-5.18%
– Retirement	57,885,647	56,487,623	-2.42%
– Withdrawal	24,521,427	21,417,299	-12.66%
– Disability	2,136,887	2,080,648	-2.63%
– Death	837,720	977,294	16.66%
• Actuarial Accrued Liability (AAL)	$1,221,272,910	$1,207,179,169	-1.15%
– Retirement	1,101,882,750	1,093,577,460	-0.75%
– Withdrawal	91,789,152	84,393,165	-8.06%
– Disability	18,394,167	20,701,127	12.54%
– Death	9,206,841	8,507,417	-7.60%
Retired Members	$2,729,336,524	$2,746,494,965	0.63%
Survivors	$24,131,607	$25,021,709	3.69%
Inactive	$113,785,413	$108,578,452	-4.58%
Total:			
• Actuarial Present Value of Projected Benefits	$4,810,035,433	$4,785,801,151	-0.50%
• Actuarial Accrued Liability (AAL)	4,088,526,454	4,087,274,295	-0.03%

Replication Results – Total of All Health Care Trust Funds

All Health Care Trust Funds

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits			
– Active Employees	$559,428,663	$541,770,710	-3.2%
• Actuarial Accrued Liability (AAL)	422,558,153	415,375,468	-1.7%
• Normal Cost	20,748,567	20,558,709	-0.9%
Non-Active Members			
• Actuarial Present Value of Projected Benefits	$1,228,955,981	$1,281,197,100	4.3%
– Retirees	1,184,446,408	1,234,127,377	4.2%
– Survivors	5,177,439	5,614,371	8.4%
– Inactive Vested	39,332,134	41,455,352	5.4%
Total			
• Actuarial Present Value of Projected Benefits	$1,788,384,644	$1,822,974,810	1.9%
• Actuarial Accrued Liability (AAL)	1,651,514,170	1,696,572,567	2.7%

Health Care Trust Fund

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits			
– Active Employees	$529,684,987	$511,970,861	-3.3%
• Actuarial Accrued Liability (AAL)	403,061,971	394,914,080	-2.0%
• Normal Cost	19,328,484	19,143,200	-1.0%
Non-Active Members			
• Actuarial Present Value of Projected Benefits	$1,178,159,704	$1,232,504,900	4.6%
– Retirees	1,134,547,686	1,186,513,528	4.6%
– Survivors	5,177,439	5,614,371	8.4%
– Inactive Vested	38,434,579	40,377,001	5.1%
Total			
• Actuarial Present Value of Projected Benefits	$1,707,844,691	$1,744,475,761	2.1%
• Actuarial Accrued Liability (AAL)	1,581,221,675	1,627,418,979	2.9%

DPS Health Care Trust Fund

	CMC	Segal	Ratio of Segal/CMC
Active Members			
• Actuarial Present Value of Projected Benefits			
– Active Employees	$29,743,676	$29,806,849	0.2%
• Actuarial Accrued Liability (AAL)	19,496,182	20,461,388	5.0%
• Normal Cost	1,420,083	1,415,509	-0.3%
Non-Active Members			
• Actuarial Present Value of Projected Benefits	$50,796,277	$48,692,200	-4.3%
– Retirees	49,898,722	47,613,849	-4.8%
– Survivors	0	0	N/A
– Inactive Vested	897,555	1,078,351	20.1%
Total			
• Actuarial Present Value of Projected Benefits	$80,539,953	$78,499,049	-2.5%
• Actuarial Accrued Liability (AAL)	70,292,459	69,153,588	-1.6%

Replication Results - Test Life Output

We requested specific test lives in order to compare the benefit amounts projected in the valuation against our understanding of the PERA benefits summarized in the valuation report and to assist in the matching of the overall results. A review of test lives generally permits the new actuary to understand the prior actuary's valuation programming on a micro basis.

For the Division Trust Funds, we were provided with results for 12 test lives, including seven active members and five retirees. For the Health Care Trust Funds, we were provided with results for nine test lives, including seven active members and two retirees. A comparison of the Actuarial Present Value of Projected Benefits between CMC and Segal is summarized below.

We were able to replicate most test life results within a reasonable tolerance, as shown in the charts below.

Active Division Trust Fund Test Lives

Division / Description	CMC PVB	Segal PVB	Percent Difference
• State, Non-Trooper	$304,980	$317,335	4.05%
• State Trooper	1,002,395	1,000,351	-0.20%
• School	81,326	79,218	-2.59%
• Local	195,425	197,679	1.15%
• Judicial	618,455	618,478	0.00%
• DPS, DPS Structure	312,321	300,974	-3.63%
• DPS, PERA Structure	42,027	37,183	-11.52%
Total Active Test Life Suite:	$2,556,929	$2,551,219	-0.22%

Pay Status Division Trust Fund Test Lives

Description	CMC	Segal	Percent Difference
• State (Retiree)	$197,716	$198,872	0.58%
• School (Retiree)	585,429	588,854	0.58%
• Local (Retiree)	269,202	270,777	0.59%
• Judicial (Retiree)	225,000	227,853	1.27%
• DPS (Disabled Retiree)	532,483	536,366	0.73%
Total Pay Status Test Life Suite:	$1,809,830	$1,822,722	0.71%

We note that the total pay status test life suite matched within 0.71% and that the individual test lives within this suite matched within 0.58% and 1.27%, compared to a 0.90% match for all retirees.

Active Health Care Trust Fund Test Lives

Division / Description	CMC PVB	Segal PVB	Percent Difference
• State, Non-Trooper	$3,811	$3,689	-3.20%
• State Trooper	10,549	10,203	-3.28%
• School	836	758	-9.33%
• Local	2,324	2,282	-1.81%
• Judicial	4,821	5,068	5.12%
• DPS, DPS Structure	2,586	2,232	-13.69%
• DPS, PERA Structure	549	500	-8.93%
Total Active Test Life Suite:	$25,476	$24,732	-2.92%

Pay Status Health Care Trust Fund Test Lives

Description	CMC	Segal	Percent Difference
• School (Retiree)	$15,117	$17,438	15.35%
• Local (Retiree)	9,264	9,264	0.00%
Total Pay Status Test Life Suite:	$24,381	$26,702	9.52%

We note that the percent difference in the pay status test life suite is 9.5%; with a limited sample and limited details available from CavMac, we assessed the overall match to all retirees to consider the replication satisfactory.

Findings from the Replication Process

The results presented throughout this section represent the Segal's match of CMC's valuation results based on our reading of CMC's valuation report, the statutes governing PERA, and the test life information provided. We noted the following pertaining to CMC's calculation of projected benefits, the data provided to us for matching CMC's valuation, and potential future requests that Segal may make of PERA for future valuation data:

1. Based on the replication of liabilities for retirees in pay status, we noted that it appears that the pop-up provisions of each Division were not being valued by CMC. Segal's aggregate liability for retirees is 0.9% higher than CMC's. Also, Segal calculated an individual liability for the Judicial Retiree test life that is 1.3% higher than CMC's. This individual was reported with data that is consistent with a pop-up form of payment, as confirmed by PERA.

2. The "scrubbed" data provided by CMC excluded the RBA amounts payable in 2017. We assume this means that these additional benefits were not valued by CMC, thus understating the retiree liability. Segal determined these benefit amounts based on the raw 2017 data provided by PERA, and included the value of the benefits in our replication.

3. The "scrubbed" data provided by CMC excluded the data field that flags participants who were eligible to retire as of January 1, 2011, and are thus eligible for more generous early retirement factors. We assume this means that these records were undervalued by CMC. Segal identified the members eligible to retire as of January 1, 2011, based on the raw 2017 data provided by PERA, and included the value of the correct early retirement factors for these individuals in our replication.

4. Regarding data files for future valuations, Segal will provide a "wish list" of data items that will streamline the software programming necessary to determine the cost of future benefits payable. In particular, we have determined that a data field containing the first Actuarial Increase payment that will be made to current retirees and survivors in pay status will assist us in valuing the plan appropriately for retirees who commenced benefits early and are subject to a waiting period prior to receiving their first Actuarial Increase.

5. For the Health Care Trust Funds, we applied the health care participation rates from CMC's valuation report based on the attained age at retirement. Segal requested confirmation of CMC's application of future participation. Our interpretation of that response and our match within the 5% tolerance on actives indicates this is a reasonable interpretation.

Appropriateness of Assumptions

In the course of replicating the December 31, 2017 valuation, Segal has reviewed the demographic and economic assumptions used to develop the liabilities. We have also reviewed the most recent Experience Study for the four-year period ended December 31, 2015, upon which most of the actuarial assumptions used in the December 31, 2017 valuation were based.

While we have not replicated the experience study, we believe, based on the Experience Study report and additional details provided in the most recent valuations, that the methodology used to

develop the demographic and economic assumptions is sound, that the assumptions are reasonable, and are consistent with the Actuarial Standards of Practice. Segal will continue to review demographic statistics and liability gains and losses on an annual basis to ascertain how well the assumptions are predicting each Division Trust Fund's experience. Segal will perform an experience study for the four-year period ending December 31, 2019 to determine if any assumptions need to be adjusted.