

Proposed Amortization Periods and Smoothing Policies: A Historical Look

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1 Report in brief

At the 19 March meeting of the Pension and Health Benefits Committee, new policies were proposed for determining employer contributions [Milligan]. The proposal evaluated the policies using forecasts of future outcomes based on Monte Carlo simulations. This report takes a different approach, using historical data from the City of Sunnyvale's pension plans to evaluate what the outcome would be had the proposed policies been in place.

Sunnyvale has two pension plans administered by CalPERS, for Miscellaneous and Safety employees respectively. This report looks at the history of those plans for the seventeen-year period of July 1994 to June 2011. I chose this time period because it happens that the city's staff was able to provide copies of the actuarial valuation reports for each of those seventeen years. It also happens that the period makes an ideal case study: the plans started the period fully funded, with a near-exact match between asset values and liabilities; and the average annual investment return on plan assets over the period was a good match to what was assumed.

At the end of the period, June 2011, Sunnyvale's plans had a combined unfunded liability of \$243M. For perspective, that's 279% of the city's annual payroll – an unsettling number to many of its citizens. So I posed the question: how would the unfunded liability have evolved under the proposed policies? To answer it, I pulled out the relevant year-by-year data from the valuations: payroll amount, normal rate, benefit payouts, investment return, etc. Then I applied the proposed policies to calculate the year-by-year contributions along with the resulting market value of assets (MVA). The result is an empirical statement about what would have happened had the proposed policies been in effect during the seventeen-year period.

The result, unfortunately, is that the policies would not have improved the status of Sunnyvale's plans. In fact, they make it somewhat worse, increasing the unfunded liability by \$32M as of June 2011. This is illustrated in Figure 1, which shows the MVA under the proposed policies lagging the historical MVA.

It should be noted that the actual investment return over the seventeen-year period was a near-exact match to what was assumed. The PERF fund realized an average annual return of 8.08%. CalPERS assumed returns of 8.5% in early years, dropping in steps to 7.75% in later years;¹ these average out to an annual return of 8.15%. So regarding investment return, the period studied here is right on the mark. It seems reasonable to believe that the investment results here are typical of what to expect in a forward-looking forecast.

The result of the study suggests that CalPERS might find it worthwhile to conduct its own historical evaluation before adopting the proposed policies. If the policies been in place since 1994, with no other changes, it's a good bet that the discussion now would be about what they need to be replaced by.

¹ These are the rates assumed when determining contributions during the period. CalPERS has recently adopted a lower assumption, 7.5%, but this takes effect for contributions beginning July 2013.

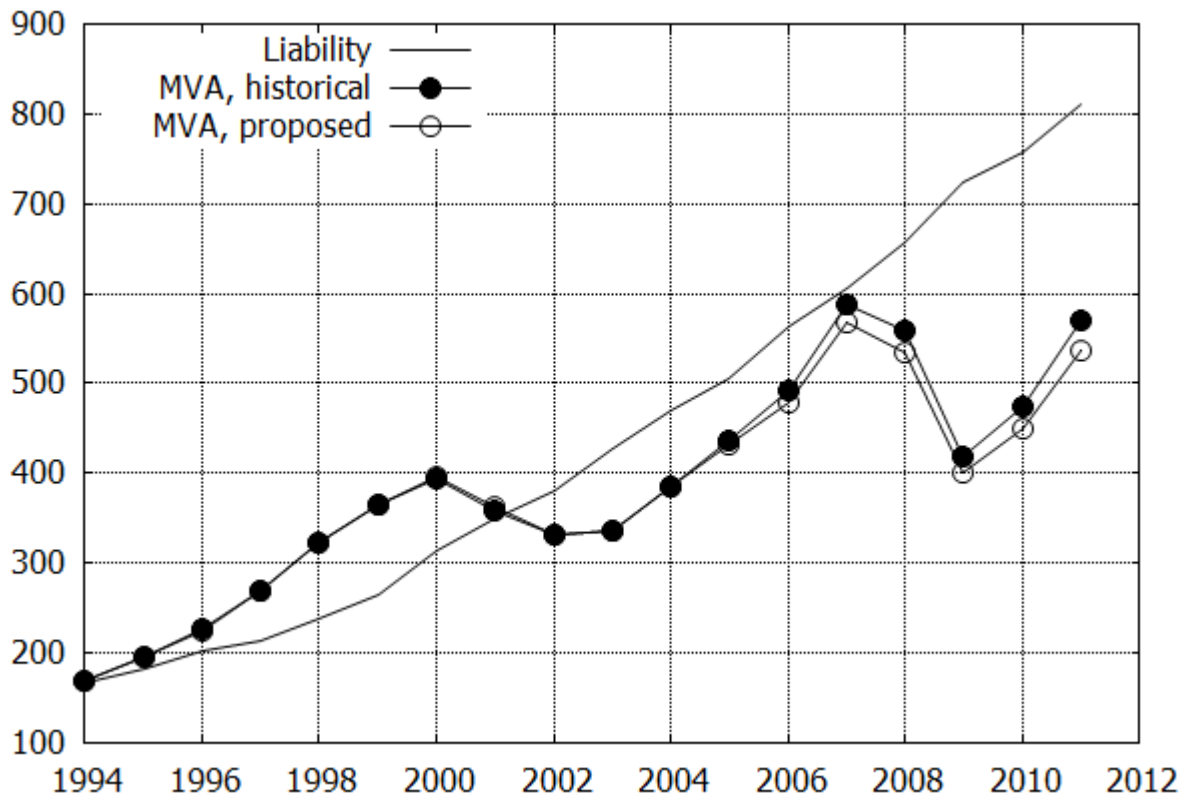


Figure 1: Historical market value of assets, market value of assets under proposed policies, and accrued liability. Miscellaneous + Safety plans (\$M).

Acknowledgment

Thanks to the Finance Department of the City of Sunnyvale for digging deep into their archives to find seventeen years of actuarial valuations. (City staff did not participate in or endorse this study. This report and its findings are solely due to the author.)

2 Details of calculation

The proposal in [Milligan] presented several alternatives. In this report, “proposed policies” refers to that proposal’s “Method 5,” which is the alternative recommended by staff. Method 5 is detailed in Attachment 9 of the proposal.

The task here is to calculate the year-by-year contributions that would have been made under the proposed policies, along with the year-by-year market value of assets (MVA) that results. It’s a straightforward task, but it involves many steps with many intermediate results. Each of the two plans, Miscellaneous and Safety, is handled individually. Details are deferred to appendices. The intent is to provide enough detail that anyone wishing to check or replicate the results is able to do so. This report and the actuarial valuations are available online for anyone wishing to extract data; see Section 4.

Here is a quick summary of the appendices.

- Appendix A: This top-level spreadsheet calculates MVA under the proposed policies. It does this by replacing the historical contribution with one calculated under the proposed policies, and it applies the plan's realized investment return to calculate MVA.
- Appendix B: This spreadsheet calculates the plan's realized investment return used in Appendix A. The calculation is based on historical cash flows and asset values.
- Appendix C: This is a table of amortization factors for the different amortization schedules in the proposed policies. The factors are obtained by applying the assumed investment return and payroll growth to the schedules in Attachment 9 of [Milligan].
- Appendices D and E: This is the heavy lifting. These track the amortization bases as they evolve under the proposed policies. The bases for assumption, method, and benefit changes have initial balances taken from the historical data. Each year an additional base for gain or loss is created. All bases evolve according to the amortization schedules of the policies. The payment on a base is computed using the amortization factor in Appendix C. The output of the calculation is the amortization rate used to compute the contribution in Appendix A.

3 Fresh start

The proposed policies give CalPERS the discretion to apply a fresh start. In this study, a single fresh start was used in each plan, as follows:

- For the Miscellaneous plan, a fresh start was used at valuation date 6/30/02. The unfunded liability at this date turned positive, but without a fresh start the amortization payment for the contribution year FY04/05 would have been negative.
- For the Safety plan, a fresh start was used at valuation date 6/30/01. The unfunded liability at this date turned positive, but without a fresh start the amortization payment for the contribution year FY03/04 would have been negative.

These seemed like obvious choices for fresh-start years, but it is conceivable a plan actuary could decide differently. A different decision would result in a different outcome.

4 References

Note: this report and the actuarial valuations are available at <http://sagedrive.com/calpers>.

[val YYYY misc] CalPERS. Actuarial Valuation as of June 30, YYYY for the Miscellaneous Plan of the City of Sunnyvale. The year YYYY ranges from 1994 to 2011, inclusive.

[val YYYY safety] CalPERS. Actuarial Valuation as of June 30, YYYY for the Safety Plan of the City of Sunnyvale. The year YYYY ranges from 1995 to 2011, inclusive.

[Milligan]. Alan Milligan. "Amortization Periods and Smoothing Methods for Retirement Trust Funds (First Reading)." Meeting of Pension and Health Benefits Committee, CalPERS Board of Administration, 19 March 2013, Agenda Item 7. Available at <http://www.calpers.ca.gov>.

Appendix A: MVA

The spreadsheets on the following pages show calculation of the MVA under the proposed policies for the Miscellaneous and Safety plans.

Explanation of spreadsheet calculations

Note: The valuation for a fiscal year is dated on the closing day, June 30, of that year. It measures assets and liabilities as of its dated date, and it determines contributions for the fiscal year that begins two years after its dated date. For example, the valuation dated 6/30/00 is for the fiscal year FY99/00 and determines contributions for FY02/03.

1. **Start-of-year MVA** for FY94/95 is from historical information included in the valuation for FY94/95. For other years, it equals end-of-year MVA for the preceding year, from line [11].
2. **Investment return** is from the spreadsheet in Appendix B.
3. **Payroll** for a fiscal year is from the valuation for that year.
4. **Normal rate** for a fiscal year is from the valuation that determines contributions for that year.
5. **Amortization rate** is from the spreadsheet in Appendix D or E, “Total” line, last column, for the valuation date that determines contributions for that year.
6. **Normal contribution** = [3] * [4].
7. **Amortization contribution** = [3] * [5].
8. **Total contribution** = [6] + [7].
9. **Benefits and refunds** for a fiscal year is from the valuation for that year.
10. **Transfers and adjustments** for a fiscal year is from the valuation for that year.
11. **End-of-year MVA** = [1] * (1 + [2]) + ([8] – [9] + [10]) * sqrt(1 + [2]).
12. **End-of-year accrued liability** for a fiscal year is the entry age normal accrued liability from the valuation for that year.
13. **End-of-year unfunded liability** = [12] – [11].
14. **Employee rate** for a fiscal year is from the valuation that determines contributions for that year.
15. **Total rate** = [4] + [5]
16. **Employer rate** = [15] – [14].

In Figure 1, the y-coordinate of the plot of MVA is obtained by summing the end-of-year MVA values of the two plans. The x-coordinate is the calendar year in which the fiscal year closes – for example, 2000 for FY99/00. Plot of liability is similar. Plot of historical MVA is similar, with data from Appendix B, “End-of-year MVA.”

MISCELLANEOUS

	FY93/94	FY94/95	FY95/96	FY96/97	FY97/98	FY98/99	FY99/00	FY00/01	FY01/02
1) MVA, start of year (\$M)		77.49	91.34	105.57	126.44	151.77	171.97	187.77	172.27
2) Investment return (%)		16.16	14.77	19.13	20.01	13.31	9.65	-7.29	-6.26
3) Payroll (\$M)		29.53	27.16	29.13	30.24	32.76	37.32	40.28	47.28
4) Normal rate (%)		13.91	13.91	14.60	14.57	15.03	13.93	13.83	14.72
5) Amortization rate (%)					-0.33	-0.97	-2.54	-4.74	-6.98
6) Normal contribution (\$M)		4.11	3.78	4.25	4.41	4.92	5.20	5.57	6.96
7) Amortization contribution (\$M)					-0.10	-0.32	-0.95	-1.91	-3.30
8) Total contribution (\$M)		4.11	3.78	4.25	4.31	4.61	4.25	3.66	3.66
9) Benefits and refunds paid (\$M)		2.88	3.09	3.63	4.28	4.63	4.99	5.52	6.04
10) Transfers and adjustments (\$M)		0.00	0.00	0.00	0.00	0.03	-0.03	-0.02	0.19
11) MVA, end of year (\$M)	77.49	91.34	105.57	126.44	151.77	171.97	187.77	172.27	159.35
12) Accrued liability, end of year (\$M)	77.68	84.32	93.36	97.15	106.44	115.84	130.72	149.24	164.61
13) Unfunded liability, end of year (\$M)	0.19	-7.02	-12.21	-29.29	-45.32	-56.13	-57.05	-23.02	5.26
14) Employee rate (%)		8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
15) Total rate (%)		13.91	13.91	14.60	14.25	14.06	11.39	9.09	7.74
16) Employer rate (%)		5.91	5.91	6.60	6.25	6.06	3.39	1.09	-0.26

	FY02/03	FY03/04	FY04/05	FY05/06	FY06/07	FY07/08	FY08/09	FY09/10	FY10/11
1) MVA, start of year (\$M)	159.35	161.87	184.58	208.34	232.53	277.82	261.34	197.42	223.57
2) Investment return (%)	3.53	16.63	12.81	11.46	19.38	-5.04	-24.64	14.16	21.64
3) Payroll (\$M)	54.36	53.38	52.93	54.99	54.17	52.93	57.07	55.33	55.42
4) Normal rate (%)	15.06	15.01	15.08	15.56	15.53	15.50	17.73	17.73	17.77
5) Amortization rate (%)	-8.13	-7.96	0.16	1.17	2.16	2.97	6.66	6.51	6.72
6) Normal contribution (\$M)	8.18	8.01	7.98	8.55	8.41	8.21	10.12	9.81	9.85
7) Amortization contribution (\$M)	-4.42	-4.25	0.09	0.65	1.17	1.57	3.80	3.60	3.72
8) Total contribution (\$M)	3.76	3.76	8.07	9.20	9.58	9.78	13.92	13.41	13.57
9) Benefits and refunds paid (\$M)	6.80	7.80	8.23	8.84	9.56	12.30	13.54	14.93	16.67
10) Transfers and adjustments (\$M)	-0.02	0.14	0.28	-0.06	0.19	-0.02	0.14	-0.17	-0.07
11) MVA, end of year (\$M)	161.87	184.58	208.34	232.53	277.82	261.34	197.42	223.57	268.43
12) Accrued liability, end of year (\$M)	195.32	215.70	233.12	272.67	291.62	321.87	362.08	379.47	408.58
13) Unfunded liability, end of year (\$M)	33.46	31.13	24.78	40.14	13.80	60.53	164.66	155.90	140.14
14) Employee rate (%)	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
15) Total rate (%)	6.92	7.05	15.24	16.73	17.69	18.48	24.39	24.24	24.48
16) Employer rate (%)	-1.08	-0.95	7.24	8.73	9.69	10.48	16.39	16.24	16.48

Note: For FY95/96, the valuation that determined normal rate was not available (valuation date 30 June 1993), but the normal rate was included in historical data in the valuation dated 30 June 1994. For FY94/95, the normal rate was unavailable, so the value for FY95/96 was used.

SAFETY

	FY93/94	FY94/95	FY95/96	FY96/97	FY97/98	FY98/99	FY99/00	FY00/01	FY01/02
1) MVA, start of year (\$M)		91.04	105.19	120.31	143.80	171.51	193.22	209.13	190.43
2) Investment return (%)		15.80	14.82	19.84	19.83	13.19	9.52	-7.26	-6.32
3) Payroll (\$M)		14.59	15.04	16.32	16.87	18.35	19.28	21.39	21.77
4) Normal rate (%)		22.77	22.77	22.77	22.84	23.36	20.57	22.10	22.20
5) Amortization rate (%)					-0.68	-1.60	-4.16	-7.47	-10.55
6) Normal contribution (\$M)		3.32	3.42	3.72	3.85	4.29	3.97	4.73	4.83
7) Amortization contribution (\$M)					-0.12	-0.29	-0.80	-1.60	-2.30
8) Total contribution (\$M)		3.32	3.42	3.72	3.74	3.99	3.16	3.13	2.54
9) Benefits and refunds paid (\$M)		3.53	3.86	4.07	4.46	4.89	5.52	6.70	7.54
10) Transfers and adjustments (\$M)		0.00	0.00	0.00	0.00	0.04	-0.03	-0.09	-0.06
11) MVA, end of year (\$M)	91.04	105.19	120.31	143.80	171.51	193.22	209.13	190.43	173.50
12) Accrued liability, end of year (\$M)	90.05	97.91	110.10	116.25	132.99	148.41	183.68	199.89	215.55
13) Unfunded liability, end of year (\$M)	-0.99	-7.28	-10.22	-27.55	-38.53	-44.81	-25.45	9.47	42.05
14) Employee rate (%)		11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25
15) Total rate (%)		22.77	22.77	22.77	22.16	21.76	16.41	14.62	11.66
16) Employer rate (%)		11.52	11.52	11.52	10.91	10.51	5.16	3.37	0.41

	FY02/03	FY03/04	FY04/05	FY05/06	FY06/07	FY07/08	FY08/09	FY09/10	FY10/11
1) MVA, start of year (\$M)	173.50	175.20	201.40	224.31	246.88	290.58	272.56	202.40	226.18
2) Investment return (%)	3.73	16.81	13.00	11.58	19.26	-5.11	-24.76	14.49	21.87
3) Payroll (\$M)	23.82	26.42	26.75	26.13	28.14	29.84	31.42	31.03	31.53
4) Normal rate (%)	27.37	27.08	27.20	26.75	26.92	26.76	26.83	27.01	27.12
5) Amortization rate (%)	-10.25	0.65	3.49	6.70	8.90	11.33	13.39	11.09	10.42
6) Normal contribution (\$M)	6.52	7.16	7.28	6.99	7.58	7.99	8.43	8.38	8.55
7) Amortization contribution (\$M)	-2.44	0.17	0.93	1.75	2.50	3.38	4.21	3.44	3.29
8) Total contribution (\$M)	4.08	7.33	8.21	8.74	10.08	11.37	12.64	11.82	11.84
9) Benefits and refunds paid (\$M)	8.81	10.28	11.28	11.87	13.51	14.62	15.96	16.91	17.96
10) Transfers and adjustments (\$M)	0.03	-0.04	-0.02	-0.08	-0.09	-0.01	0.23	-0.09	-0.02
11) MVA, end of year (\$M)	175.20	201.40	224.31	246.88	290.58	272.56	202.40	226.18	268.88
12) Accrued liability, end of year (\$M)	233.13	254.79	272.42	291.11	314.25	334.09	362.84	376.79	403.21
13) Unfunded liability, end of year (\$M)	57.94	53.39	48.11	44.23	23.68	61.52	160.44	150.61	134.33
14) Employee rate (%)	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25
15) Total rate (%)	17.13	27.73	30.69	33.46	35.82	38.09	40.22	38.11	37.54
16) Employer rate (%)	5.88	16.48	19.44	22.21	24.57	26.84	28.97	26.86	26.29

Note: For FY96/97, the valuation that determined normal rate was not available (valuation date 30 June 1994), but the normal rate was included in historical data in the valuation dated 30 June 1995. For FY94/95 and FY95/96, the normal rate was unavailable, so the value for FY96/97 was used.

Appendix B: Calculation of historical investment return

The spreadsheet on the following page details the calculation of historical investment return for the Miscellaneous and Safety plans.

The calculated investment return for the two plans are close to each other and to the corresponding values for the PERF fund [val 2011 misc, p. 21], but they are not an exact match. An exact match would not be expected because each plan and the PERF have different cash-flow timings into and out of the funds.

Explanation of spreadsheet calculations

1. **Start-of-year MVA** for FY94/95 is from historical information included in the valuation for FY94/95. For other years, For other years, it equals end-of-year MVA for the preceding year, from line [5].
2. **Contributions** for a fiscal year is from the valuation for that year.
3. **Benefits and refunds** for a fiscal year is from the valuation for that year.
4. **Transfers and adjustments** for a fiscal year is from the valuation for that year.
5. **End-of-year MVA** for a fiscal year is from the valuation for that year.
6. **Investment return** is solution for x to the equation $[4] = [1] * (1 + x) + ([2] - [3] + [4]) * \text{sqrt}(1 + x)$.

Average annual returns

The average annual investment return for each plan is computed by taking the geometric mean of the terms $(1 + x_{\text{year}})$, where x_{year} is the investment return for each year in line [6], then subtracting 1. This works out to:

- Miscellaneous plan, 8.011%.
- Safety plan, 8.056%.

The average annual return for the PERF fund over the period is computed similarly, with x_{year} taken from the data from [val 2011 misc, p. 21]:

- PERF fund, 8.083%.

The assumed average annual return is computed similarly, with x_{year} taken as the investment rate that was assumed when the contribution for the year was determined. The assumed rates were: 8.5% for FY94/95 to FY98/99; 8.25% for FY99/00 to FYFY04/05; and 7.75%, for FY05/06 to FY10/11. This works out to:

- Assumed, 8.147%.

MISCELLANEOUS

	FY93/94	FY94/95	FY95/96	FY96/97	FY97/98	FY98/99	FY99/00	FY00/01	FY01/02
1) MVA, start of year (\$M)		77.49	90.81	106.35	127.46	153.10	173.03	187.44	171.93
2) Contributions (\$M)		3.61	5.08	4.34	4.41	4.18	2.83	3.63	3.52
3) Benefits and refunds paid (\$M)		2.88	3.09	3.63	4.28	4.63	4.99	5.52	6.04
4) Transfers and adjustments (\$M)		0.00	0.00	0.00	0.00	0.03	-0.03	-0.02	0.19
5) MVA, end of year (\$M)		90.81	106.35	127.46	153.10	173.03	187.44	171.93	158.90
6) Investment return (%)		16.16	14.77	19.13	20.01	13.31	9.65	-7.29	-6.26

	FY02/03	FY03/04	FY04/05	FY05/06	FY06/07	FY07/08	FY08/09	FY09/10	FY10/11
1) MVA, start of year (\$M)	158.90	161.66	185.00	210.36	237.92	288.30	276.78	209.49	237.76
2) Contributions (\$M)	4.01	4.38	9.52	12.17	13.29	15.41	14.43	13.79	14.61
3) Benefits and refunds paid (\$M)	6.80	7.80	8.23	8.84	9.56	12.30	13.54	14.93	16.67
4) Transfers and adjustments (\$M)	-0.02	0.14	0.28	-0.06	0.19	-0.02	0.14	-0.17	-0.07
5) MVA, end of year (\$M)	161.66	185.00	210.36	237.92	288.30	276.78	209.49	237.76	286.84
6) Investment return (%)	3.53	16.63	12.81	11.46	19.38	-5.04	-24.64	14.16	21.64

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	FY93/94	FY94/95	FY95/96	FY96/97	FY97/98	FY98/99	FY99/00	FY00/01	FY01/02
1) MVA, start of year (\$M)		91.04	104.93	119.97	143.03	169.96	191.39	206.07	187.05
2) Contributions (\$M)		3.08	3.38	3.39	3.16	3.92	2.16	2.56	4.53
3) Benefits and refunds paid (\$M)		3.53	3.86	4.07	4.46	4.89	5.52	6.70	7.54
4) Transfers and adjustments (\$M)		0.00	0.00	0.00	0.00	0.04	-0.03	-0.09	-0.06
5) MVA, end of year (\$M)		104.93	119.97	143.03	169.96	191.39	206.07	187.05	172.26
6) Investment return (%)		15.80	14.82	19.84	19.83	13.19	9.52	-7.26	-6.32

	FY02/03	FY03/04	FY04/05	FY05/06	FY06/07	FY07/08	FY08/09	FY09/10	FY10/11
1) MVA, start of year (\$M)	172.26	174.37	200.64	226.79	253.53	300.40	282.58	208.76	235.95
2) Contributions (\$M)	4.53	7.52	11.36	12.42	11.81	12.09	11.28	14.15	13.28
3) Benefits and refunds paid (\$M)	8.81	10.28	11.28	11.87	13.51	14.62	15.96	16.91	17.96
4) Transfers and adjustments (\$M)	0.03	-0.04	-0.02	-0.08	-0.09	-0.01	0.23	-0.09	-0.02
5) MVA, end of year (\$M)	174.37	200.64	226.79	253.53	300.40	282.58	208.76	235.95	282.38
6) Investment return (%)	3.73	16.81	13.00	11.58	19.26	-5.11	-24.76	14.49	21.87

Appendix C: Amortization factors

The following table shows the factor for computing a payment on an amortization base. A description follows the table.

	smooth30			smooth20			flat20		
	8.5%	8.25%	7.75%	8.5%	8.25%	7.75%	8.5%	8.25%	7.75%
30	0.01326	0.01406	0.01406						
29	0.02588	0.02733	0.02732						
28	0.03833	0.04034	0.04034						
27	0.05111	0.05364	0.05362						
26	0.06471	0.06775	0.06772						
25	0.06645	0.06946	0.06942						
24	0.06836	0.07133	0.07129						
23	0.07046	0.07340	0.07335						
22	0.07279	0.07568	0.07563						
21	0.07537	0.07823	0.07817						
20	0.07826	0.08107	0.08101	0.01830	0.01906	0.01905	0.07270	0.07558	0.07553
19	0.08150	0.08427	0.08419	0.03589	0.03723	0.03720	0.07527	0.07812	0.07806
18	0.08515	0.08788	0.08780	0.05369	0.05550	0.05545	0.07814	0.08095	0.08088
17	0.08932	0.09200	0.09191	0.07270	0.07493	0.07485	0.08137	0.08413	0.08405
16	0.09409	0.09673	0.09662	0.09409	0.09673	0.09662	0.08501	0.08772	0.08763
15	0.09962	0.10221	0.10209	0.09962	0.10221	0.10209	0.08915	0.09182	0.09172
14	0.10609	0.10864	0.10850	0.10609	0.10864	0.10850	0.09390	0.09652	0.09641
13	0.11377	0.11626	0.11610	0.11377	0.11626	0.11610	0.09940	0.10196	0.10184
12	0.12301	0.12544	0.12526	0.12301	0.12544	0.12526	0.10583	0.10834	0.10820
11	0.13434	0.13671	0.13650	0.13434	0.13671	0.13650	0.11346	0.11591	0.11575
10	0.14855	0.15085	0.15061	0.14855	0.15085	0.15061	0.12263	0.12502	0.12483
9	0.16687	0.16910	0.16881	0.16687	0.16910	0.16881	0.13387	0.13618	0.13597
8	0.19138	0.19352	0.19317	0.19138	0.19352	0.19317	0.14795	0.15018	0.14993
7	0.22581	0.22786	0.22743	0.22581	0.22786	0.22743	0.16609	0.16822	0.16792
6	0.27768	0.27963	0.27907	0.27768	0.27963	0.27907	0.19031	0.19232	0.19197
5	0.36465	0.36650	0.36575	0.36465	0.36650	0.36575	0.22426	0.22612	0.22569
4	0.43230	0.43384	0.43292	0.43230	0.43384	0.43292	0.27526	0.27690	0.27634
3	0.53382	0.53489	0.53372	0.53382	0.53489	0.53372	0.36033	0.36164	0.36087
2	0.70306	0.70337	0.70179	0.70306	0.70337	0.70179	0.53060	0.53126	0.53008
1	1.04163	1.04043	1.03803	1.04163	1.04043	1.03803	1.04163	1.04043	1.03803

- “Smooth30” and “smooth20” refer to the 30-year and 20-year smooth amortization schedules. “Flat20” refers to the 20-year unsmoothed schedule. The schedules are defined in Attachment 9 of [Milligan].
- 8.5%, 8.25%, and 7.75% refer to the assumed interest rate. The assumed payroll growth that goes along with each are 4.5%, 3.75%, and 3.25%, respectively. These are from the valuations.
- The first column is the amortization period remaining.
- An entry is the factor that relates payment on an amortization base to its balance. Example: Suppose an amortization base has a current balance of \$10M, and the assumed interest rate is 8.25%, and the schedule is smooth30, and the period remaining is 18. Then the payment is $0.08788 * 10 = \$0.8788M$.

Appendix D: Amortization bases, Miscellaneous plan

Calculation of the amortization bases is done in a manner similar to those in the valuations. Familiarity with the valuations is assumed.

The valuation date is the closing day of the fiscal year, e.g. 6/30/03. The contribution year is the fiscal year that begins two years after the valuation date, e.g. FY05/06.

Assumption and method changes

The following table lists assumption and method changes that were enacted by CalPERS during the study period. These data are from the valuations. Values are \$M.

Reason for base	Date established	Starting balance	Payment 1	Payment 2
Assumption change	6/30/97	-5.069	0	0
Assumption change	6/30/03	11.109	-0.170	-0.175
Method change	6/30/04	-0.853	0	0
Assumption change	6/30/09	14.791	-0.045	-0.047
Assumption change	6/30/11	7.429	-0.207	-0.213

An assumption or method change is implemented in three parameters:

- A starting balance as of the valuation date, e.g., 6/30/03.
- An implied payment 1 for the first fiscal year following the valuation date, e.g., FY03/04.
- An implied payment 2 for the second fiscal year following the valuation date, e.g., FY04/05.

It is named according to the year and type, e.g. “1997assu” or “2004meth”. It is amortized using the 20-year smoothed schedule.

Benefit changes

The following table lists assumption and method changes that were implemented during the study period. These data are from the valuations. Values are \$M.

Reason for base	Date established	Starting balance	Payment 1	Payment 2
Benefit change	6/30/06	22.175	-1.774	1.944

A benefit change is implemented in three parameters, similar to an assumption change. It is named according to the year, e.g., “2006bene”. It is amortized using the 20-year flat schedule.

Gain or loss

At each valuation date, a gain or loss is established to account for the difference between the unfunded liability and the sum of all amortization bases. It is named according to the year and sign, e.g.,

“1995gain” or “2003loss”. It is amortized using the 30-year smoothed schedule.

Schedule of amortization bases

The tables on the following pages calculate the schedule of amortization bases in a manner similar to those in the valuations.

In each table, the data in the first row are from the valuation:

- **valDate** is the valuation date, e.g., 6/30/03.
- **iRate** is the assumed interest rate, e.g., 7.75%.
- **payGrowth** is the assumed payroll growth rate, e.g., 3.25%.
- **payroll** is the assumed payroll for the contribution year, e.g., \$59.837M for contribution year FY05/06.

The data in the subsequent rows, excluding the Totals row, are as follows:

1. The name of the amortization base.
2. Date established.
3. Amortization period remaining.
4. Balance on the valuation date, e.g., 6/30/03.
5. Amortization payment for the first fiscal year following the valuation, e.g., FY03/04.
6. Balance one year after the valuation date, e.g., 6/30/04. Calculated as $[4] * (1 + iRate) - [5] * \text{sqrt}(1 + iRate)$.
7. Amortization payment for the second year following the valuation, e.g., FY04/05.
8. Balance two years after the valuation date, e.g., 6/30/05. Calculated as $[6] * (1 + iRate) - [7] * \text{sqrt}(1 + iRate)$.
9. Amortization payment for the contribution year, e.g., FY05/06. Calculated as $[8] * aFactor$, where $aFactor$ is from Appendix C.
10. Amortization payment as a percentage of payroll for the contribution year. Calculated as $[9] / \text{payroll}$.

The **Totals** row sums the entries in a column. Column 4 matches the unfunded liability as of the valuation date; this is accomplished by creating a new gain or loss of appropriate initial balance, e.g., “2003loss”. Column 10 is the amortization rate for the contribution year, e.g., 1.095% of payroll for FY05/06.

Fresh start

In this study, a fresh start was implemented at the valuation date 6/30/02. At this valuation, the unfunded liability turned positive, but the amortization payment for the contribution year FY04/05 would have been negative. The fresh start eliminated all existing amortization bases and replaced them with a single loss with a fresh amortization schedule.

valDate=06/30/08 iRate=7.750% payGrowth=3.250% payroll=58.261										valDate=06/30/10 iRate=7.750% payGrowth=3.250% payroll=60.899									
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
2002loss	6/30/02	24	7.246	0.491	7.298	0.507	7.338	0.523	0.898%	2002loss	6/30/02	22	7.338	0.523	7.364	0.540	7.374	0.558	0.916%
2003assu	6/30/03	15	14.871	1.113	14.868	1.437	14.529	1.483	2.546%	2003assu	6/30/03	13	14.529	1.483	14.115	1.531	13.620	1.581	2.596%
2003loss	6/30/03	25	22.324	1.197	22.812	1.545	22.976	1.595	2.738%	2003loss	6/30/03	23	22.976	1.595	23.101	1.647	23.182	1.700	2.792%
2004gain	6/30/04	26	-5.498	-0.222	-5.693	-0.305	-5.818	-0.394	-0.676%	2004gain	6/30/04	24	-5.818	-0.394	-5.860	-0.407	-5.892	-0.420	-0.690%
2004meth	6/30/04	16	-1.088	-0.060	-1.109	-0.083	-1.109	-0.107	-0.184%	2004meth	6/30/04	14	-1.109	-0.107	-1.084	-0.111	-1.053	-0.114	-0.188%
2005gain	6/30/05	27	-10.918	-0.298	-11.454	-0.462	-11.862	-0.636	-1.092%	2005gain	6/30/05	25	-11.862	-0.636	-12.121	-0.821	-12.209	-0.848	-1.392%
2006bene	6/30/06	18	25.711	1.942	25.688	2.005	25.597	2.070	3.553%	2006bene	6/30/06	16	25.597	2.070	25.432	2.138	25.184	2.207	3.624%
2006gain	6/30/06	28	-9.299	-0.131	-9.884	-0.270	-10.369	-0.418	-0.718%	2006gain	6/30/06	26	-10.369	-0.418	-10.739	-0.576	-10.974	-0.743	-1.220%
2007gain	6/30/07	29	-32.298	0.000	-34.801	-0.489	-36.990	-1.011	-1.735%	2007gain	6/30/07	27	-36.990	-1.011	-38.808	-1.565	-40.191	-2.155	-3.539%
2008loss	6/30/08	30	49.479	0.000	53.314	0.000	57.445	0.808	1.387%	2008loss	6/30/08	28	57.445	0.808	61.059	1.668	64.059	2.584	4.243%
Total			60.531	4.032	61.037	3.883	61.737	3.913	6.717%	2009assu	6/30/09	19	15.985	-0.047	17.272	0.329	18.269	0.680	1.116%
										2009loss	6/30/09	29	95.718	0.000	103.136	1.451	109.623	2.995	4.919%
										2010gain	6/30/10	30	-17.538	0.000	-18.898	0.000	-20.362	-0.286	-0.470%
										Total			155.901	3.867	163.969	5.825	170.631	7.739	12.708%
valDate=06/30/09 iRate=7.750% payGrowth=3.250% payroll=62.816										valDate=06/30/11 iRate=7.500% payGrowth=3.000% payroll=60.563									
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
2002loss	6/30/02	23	7.298	0.507	7.338	0.523	7.364	0.540	0.860%	2002loss	6/30/02	21	7.364	0.540	7.356	0.558	7.329	0.573	0.946%
2003assu	6/30/03	14	14.868	1.437	14.529	1.483	14.115	1.531	2.438%	2003assu	6/30/03	12	14.115	1.531	13.586	1.581	12.966	1.623	2.680%
2003loss	6/30/03	24	22.812	1.545	22.976	1.595	23.101	1.647	2.622%	2003loss	6/30/03	22	23.101	1.647	23.126	1.700	23.097	1.746	2.884%
2004gain	6/30/04	25	-5.693	-0.305	-5.818	-0.394	-5.860	-0.407	-0.648%	2004gain	6/30/04	23	-5.860	-0.407	-5.877	-0.420	-5.883	-0.431	-0.712%
2004meth	6/30/04	15	-1.109	-0.083	-1.109	-0.107	-1.084	-0.111	-0.176%	2004meth	6/30/04	13	-1.084	-0.111	-1.050	-0.114	-1.011	-0.117	-0.194%
2005gain	6/30/05	26	-11.454	-0.462	-11.862	-0.636	-12.121	-0.821	-1.307%	2005gain	6/30/05	24	-12.121	-0.821	-12.179	-0.848	-12.214	-0.871	-1.437%
2006bene	6/30/06	17	25.688	2.005	25.597	2.070	25.432	2.138	3.403%	2006bene	6/30/06	15	25.432	2.138	25.123	2.207	24.719	2.266	3.742%
2006gain	6/30/06	27	-9.884	-0.270	-10.369	-0.418	-10.739	-0.576	-0.917%	2006gain	6/30/06	25	-10.739	-0.576	-10.947	-0.743	-10.998	-0.763	-1.260%
2007gain	6/30/07	28	-34.801	-0.489	-36.990	-1.011	-38.808	-1.565	-2.492%	2007gain	6/30/07	26	-38.808	-1.565	-40.096	-2.155	-40.868	-2.767	-4.569%
2008loss	6/30/08	29	53.314	0.000	57.445	0.808	61.059	1.668	2.656%	2008loss	6/30/08	27	61.059	1.668	63.908	2.584	66.023	3.539	5.844%
2009assu	6/30/09	20	14.791	-0.045	15.985	-0.047	17.272	0.329	0.524%	2009assu	6/30/09	18	17.272	0.329	18.226	0.680	18.889	1.047	1.729%
2009loss	6/30/09	30	88.833	0.000	95.718	0.000	103.136	1.451	2.309%	2009loss	6/30/09	28	103.136	1.451	109.367	2.995	114.464	4.617	7.623%
Total			164.662	3.838	173.439	3.867	182.867	5.825	9.272%	2010gain	6/30/10	29	-18.898	0.000	-20.315	-0.286	-21.542	-0.589	-0.972%
										2011assu	6/30/11	20	7.429	-0.207	8.201	-0.213	9.038	0.172	0.284%
										2011gain	6/30/11	30	-31.257	0.000	-33.601	0.000	-36.121	-0.508	-0.839%
										Total			140.142	5.617	144.828	7.525	147.888	9.537	15.747%

Appendix E: Amortization bases, Safety plan

The tables on the following pages calculate the schedule of amortization bases in a manner identical to what was done for the Miscellaneous plan. Refer to the description for the Miscellaneous plan in Appendix D.

Fresh start

In this study, a fresh start was implemented at the valuation date 6/30/01. At this valuation, the unfunded liability turned positive, but the amortization payment for the contribution year FY03/04 would have been negative. The fresh start eliminated all existing amortization bases and replaced them with a single loss with a fresh amortization schedule.

valDate=06/30/09 iRate=7.750% payGrowth=3.250% payroll=34.582										
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	
2001loss	6/30/01	22	13.253	0.945	13.300	0.976	13.318	1.007	2.913%	
2002loss	6/30/02	23	44.089	3.061	44.329	3.160	44.484	3.263	9.435%	
2003assu	6/30/03	14	-3.424	-0.331	-3.346	-0.342	-3.251	-0.353	-1.020%	
2003loss	6/30/03	24	20.141	1.364	20.287	1.408	20.397	1.454	4.205%	
2004gain	6/30/04	25	-11.646	-0.624	-11.900	-0.806	-11.986	-0.832	-2.406%	
2005gain	6/30/05	26	-10.799	-0.436	-11.184	-0.600	-11.428	-0.774	-2.238%	
2006gain	6/30/06	27	-7.132	-0.195	-7.483	-0.302	-7.750	-0.416	-1.202%	
2007gain	6/30/07	28	-24.722	-0.348	-26.277	-0.718	-27.568	-1.112	-3.215%	
2008loss	6/30/08	29	42.534	0.000	45.830	0.645	48.713	1.331	3.849%	
2009assu	6/30/09	20	7.124	-0.391	8.082	-0.403	9.127	0.174	0.503%	
2009loss	6/30/09	30	91.024	0.000	98.078	0.000	105.679	1.486	4.298%	
Total			160.444	3.046	169.716	3.019	179.736	5.229	15.122%	

valDate=06/30/10 iRate=7.750% payGrowth=3.250% payroll=34.150										
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	
2001loss	6/30/01	21	13.300	0.976	13.318	1.007	13.304	1.040	3.045%	
2002loss	6/30/02	22	44.329	3.160	44.484	3.263	44.544	3.369	9.865%	
2003assu	6/30/03	13	-3.346	-0.342	-3.251	-0.353	-3.136	-0.364	-1.066%	
2003loss	6/30/03	23	20.287	1.408	20.397	1.454	20.468	1.501	4.396%	
2004gain	6/30/04	24	-11.900	-0.806	-11.986	-0.832	-12.051	-0.859	-2.516%	
2005gain	6/30/05	25	-11.184	-0.600	-11.428	-0.774	-11.510	-0.799	-2.340%	
2006gain	6/30/06	26	-7.483	-0.302	-7.750	-0.416	-7.919	-0.536	-1.570%	
2007gain	6/30/07	27	-26.277	-0.718	-27.568	-1.112	-28.550	-1.531	-4.483%	
2008loss	6/30/08	28	45.830	0.645	48.713	1.331	51.107	2.061	6.036%	
2009assu	6/30/09	19	8.082	-0.403	9.127	0.174	9.653	0.359	1.052%	
2009loss	6/30/09	29	98.078	0.000	105.679	1.486	112.327	3.069	8.987%	
2010gain	6/30/10	30	-19.107	0.000	-20.588	0.000	-22.183	-0.312	-0.914%	
Total			150.610	3.019	159.148	5.229	166.054	6.999	20.494%	

valDate=06/30/11 iRate=7.500% payGrowth=3.000% payroll=34.456										
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	
2001loss	6/30/01	20	13.318	1.007	13.272	1.040	13.189	1.068	3.100%	
2002loss	6/30/02	21	44.484	3.263	44.437	3.369	44.277	3.460	10.041%	
2003assu	6/30/03	12	-3.251	-0.353	-3.129	-0.364	-2.986	-0.374	-1.085%	
2003loss	6/30/03	22	20.397	1.454	20.419	1.501	20.394	1.542	4.475%	
2004gain	6/30/04	23	-11.986	-0.832	-12.022	-0.859	-12.033	-0.882	-2.561%	
2005gain	6/30/05	24	-11.428	-0.774	-11.483	-0.799	-11.515	-0.821	-2.382%	
2006gain	6/30/06	25	-7.750	-0.416	-7.900	-0.536	-7.936	-0.551	-1.599%	
2007gain	6/30/07	26	-27.568	-1.112	-28.483	-1.531	-29.032	-1.966	-5.705%	
2008loss	6/30/08	27	48.713	1.331	50.986	2.061	52.673	2.824	8.195%	
2009assu	6/30/09	18	9.127	0.174	9.631	0.359	9.981	0.553	1.606%	
2009loss	6/30/09	28	105.679	1.486	112.064	3.069	117.287	4.730	13.729%	
2010gain	6/30/10	29	-20.588	0.000	-22.132	-0.312	-23.468	-0.641	-1.861%	
2011assu	6/30/11	20	6.890	-0.182	7.595	-0.187	8.359	0.159	0.462%	
2011gain	6/30/11	30	-31.708	0.000	-34.086	0.000	-36.643	-0.515	-1.496%	
Total			134.331	5.048	139.172	6.812	142.547	8.586	24.920%	