VIA ACTUARIAL SOLUTIONS

Minnesota Legislative Commission on Pensions and Retirement

Replication of July 1, 2022 St. Paul Teachers' Retirement Fund Association Actuarial Valuation Report

June 26, 2023




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Minnesota Legislative Commission on Pensions and Retirement
600 State Office Building
100 Rev. Dr. Martin Luther King, Jr. Blvd.
St. Paul, MN 55155

Attn: Susan Lenczewski, Executive Director

Re: Replication of July 1, 2022 SPTRFA Actuarial Valuation Report

This report presents our replication of the July 1, 2022 actuarial valuation report for the St. Paul Teachers' Retirement Fund Association (SPTRFA). It provides various exhibits illustrating the degree to which we were able to replicate both (1) the retained actuary's liability calculations and (2) their use of those liabilities to determine contribution rates and sufficiency.

> **In our professional opinion, we were able to reasonably match the retained actuary's data inputs, liability calculations, and contribution determinations. We did not find any meaningful differences or deficiencies in their calculations, and we provide commentary on the few areas where subsets of our results diverged from the retained actuary. In general, these instances were very limited.**

Purpose of the Study

This study was prepared at the request of the Legislative Commission on Pensions and Retirement (LCPR). Its sole purpose is to replicate the July 1, 2022 SPTRFA actuarial valuation calculations for reasonability, accuracy, and compliance with applicable Minnesota Statutes; LCPR standards for actuarial work; and relevant Actuarial Standards of Practice (ASOPs).

The report is intended to comply with Minnesota Statute 356.214 Subd. 4(b) which states that the auditing actuary shall:

> "audit the valuation reports submitted by the actuary retained by each governing or managing board or administrative official, and provide an assessment of the reasonableness, reliability, and areas of concern or potential improvement in the specific reports reviewed, the procedures utilized by any particular reporting actuary, or general modifications to standards, procedures, or assumptions that the commission may wish to consider."

This report may not be used for any other purpose, and VIA Actuarial Solutions is not responsible for the consequences of any unauthorized use. Its content may not be modified, incorporated into or used in other material, or otherwise provided, in whole or in part, to any other person or entity, without our permission.

Data Used in the Analysis

The results in this report are based on the following data sources:

- July 1, 2022 actuarial valuation report prepared by the SPTRFA's retained actuary;
- July 1, 2022 census data files provided by SPTRFA, and "scrubbed" census files provided by the retained actuary; and

Although we reviewed all data sources for reasonability, we have not audited the underlying data and are relying on its substantial accuracy. If any data supplied are not accurate and complete, then our conclusions in this actuarial valuation replication may differ significantly. Note that we did not receive a copy of SPTRFA's FY2022 audited financial statements. Although we would normally use the audit report to validate the actuarial valuation's market value of assets we have no reason to doubt that this amount is correct as presented in the report.

We wish to thank all the involved parties for providing information in a timely manner and for answering our questions. We are particularly grateful to the staff at GRS for their help answering questions about their valuation system's technical calculations.

Actuarial Certification

To the best of our knowledge, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices.

Upon receipt of the report, the LCPR should notify us if you disagree with any information contained in the report or if you are aware of any information that would affect the results that has not been communicated to us. The report will be deemed final and acceptable to the LCPR unless you immediately notify us otherwise.

The undersigned credentialed actuaries are members of the American Academy of Actuaries and meet the Academy's Qualification Standards to render the actuarial opinion contained herein. We are available to answer questions on the material contained in the report or to provide explanations or further detail, as may be appropriate. We are not aware of any financial interest or relationship that could create a conflict of interest or impair the objectivity of our work.

Mark W. Schulte, FSA, EA, MAAA
Consulting Actuary

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L/D/C/R:5/mjc/emk/mws

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Executive Summary

This report summarizes our replication of the July 1, 2022 St. Paul Teachers' Retirement Fund Association actuarial valuation report. We conclude that the retained actuary reasonably determined the system's July 1, 2022 actuarial liabilities and contribution sufficiency/(deficiency).

The next section of this report describes our process for replicating and evaluating the retained actuary's calculations. It is followed by separate sections addressing different components of the replication process (e.g., validating census data and liability calculations), along with appendices that summarize many of the technical calculations.

We did not find any meaningful differences or deficiencies in the retained actuary's data or calculations. Overall liabilities and contributions were matched with sufficient accuracy, and we provide commentary on the few areas where subsets of our results diverged from the retained actuary. In general, these instances were very limited.

	SPTRFA Actuarial Valuation	VIA Replication	Difference[1]
Participant data			
Active members	3,400	3,400	0.0%
Service retirements	3,856	3,859	0.1%
Survivors	375	371	-1.1%
Disability retirements	22	22	0.0%
Deferred retirements	2,514	2,514	0.0%
Other non-vested terminations	2,915	2,915	0.0%
Total	**13,082**	**13,081**	0.0%
System assets *($1,000's)*			
Market value of assets	$ 1,154,427	$ 1,154,427	0.0%
Actuarial Value of Assets	1,203,096	1,203,096	0.0%
System liabilities *($1,000's)*			
Present Value of Future Benefits (PFVB)	1,971,549	1,973,121	0.1%
Present Value of Future Normal Costs (PVFNC)	221,128	218,680	-1.1%
Actuarial Accrued Liability (AAL)	1,750,421	1,754,441	0.2%
Normal Cost (NC)	26,173	25,121	-4.0%
System contributions *(% of payroll)*			
Normal cost rate	8.34%	8.07%	-0.27%
UAAL amortization payment	11.31%	11.48%	0.17%
Expenses	0.31%	0.31%	0.00%
Total required contribution (Chapter 356)	19.96%	19.86%	-0.10%
Statutory contribution rate (Chapter 354A)	25.13%	25.17%	0.04%
Contribution sufficiency/(deficiency)	5.17%	5.31%	0.14%

[1] The system contribution comparisons are absolute differences presented as a percent of payroll. All other comparisons are the relative differences between our replication results and the retained actuary.

Process Overview

The purpose of this report is to replicate (1) the technical calculation of the plan's actuarial liabilities and (2) the contribution rates and sufficiency results based on those liabilities.

Our report focuses on replicating the following items:

1. Census data summaries;
2. Actuarial Value of Assets calculation;
3. Calculation of plan liabilities;
4. Calculation of contribution sufficiency/(deficiency);
5. Confirmation of actuarial assumptions, methods, and plan provisions; and
6. Review of additional compliance items.

The table below summarizes how our valuation replication report incorporates each of these items.

Census data	▪ Compare participant category counts and summary statistics for the retained actuary vs. system census data files ▪ Compare detailed participant distributions for the retained actuary's census file vs. the valuation report summaries
Plan assets[2]	▪ Replicate retained actuary's Actuarial Value of Assets calculations
Plan liabilities	▪ Replicate technical liability calculations, including Present Value of Future Benefits (PVFB), Present Value of Future Normal Costs (PVFNC), Actuarial Accrued Liability (AAL), and Normal Cost (NC) ▪ Compare liability calculations for various member status groups
Contribution sufficiency/(deficiency)	▪ Replicate the required normal cost and supplemental contribution rate calculations ▪ Replicate retained actuary's contribution sufficiency/(deficiency) determination
Assumptions, methods, and plan provisions	Verify that the actuarial assumptions, methods, and plan provisions used in the July 1, 2022 actuarial valuation are consistent with applicable Minnesota Statutes and the System's recent actuarial experience studies.
Additional compliance requirements	Confirm that other aspects of the valuation report comply with applicable Minnesota Statutes, the LCPR's Standards for Actuarial Work, and relevant actuarial standards of practice (ASOPs).

[2] Note that we did not receive a copy of SPTRFA's FY2022 audited financial statements. Although we would normally use the audit report to validate the actuarial valuation's market value of assets, we have no reason to doubt that this amount is correct as presented in the report.

Census Data

Census data is one of the foundational inputs for actuarial calculations. While it is not practical for data to be perfect, it should be reviewed for overall accuracy and reasonability.

Guidance on actuarial data is provided by Actuarial Standard of Practice No. 23, Data Quality (ASOP 23). It provides, in summary, that "The actuary should use available data that, in the actuary's professional judgment, allow the actuary to perform the desired analysis. However, if material data limitations are known to the actuary, the actuary should disclose those limitations and their implications".

To validate the census data used in the July 1, 2022 actuarial valuation report, we used the following process:

- Request separate census files from the retained actuary and the System;
- Compare overall census counts and summary statistics for various member classes (e.g., active members, service retirements, etc.); and
- Prepare detailed participant statistical distribution tables and compare them to those found in the retained actuary's July 1, 2022 actuarial valuation report.

Overall, we found that the census data used by the retained actuary was consistent with the census data provided by the System. Our census data comparisons and tables can be found in **Appendix A**. These exhibits are described below, along with some brief commentary.

Summary of participant statistics: This table summarizes and compares participant counts and high-level participant category statistics for the retained actuary and System census files. It shows that the two files were very closely aligned.
Distribution of active members: This table summarizes the retained actuary's active member data by classifying them in various age/service categories, along with the average pay for each classification. We found that this data was consistent with a similar summary table on page 16 of the July 1, 2022 actuarial valuation report.
Distributions of service retirements, survivors, and disability retirements: These tables summarize the retained actuary's inactive member data by classifying them by age and service since retirement/death/disability, along with the average annual benefit for each classification. We found that the data in each of these tables was consistent with similar tables found on pages 17, 18 and 19 of the July 1, 2022 actuarial valuation report, except as noted below.

We do highlight two items related to the census data files and data summaries presented in the actuarial valuation report.

- During the reconciliation process, we noticed that the System data has some inconsistencies between form of payment and survivor benefits. GRS and SPTRFA have been working to reconcile these items over the past few years and the data has improved. GRS and SPTRFA indicated they would continue these efforts and anticipate having the issues resolved for the 2023 valuation.
- During the replication process, it was discovered that the census tables on pages 17 and 19 of the actuarial valuation report used incorrect ages for some records. However, GRS confirmed that the correct ages were used to calculate the valuation liabilities so the actuarial results are unaffected by the incorrect tables.

Plan Assets

Asset data is another of the foundational inputs for actuarial calculations. In addition to the Market Value of Assets, many public sector pension plans also use a smoothed Actuarial Value of Assets (AVA). The purpose of AVA methods is to stabilize contribution rates by smoothing investment returns – generally over a five-year period.

Guidance on asset smoothing methods is provided by Actuarial Standard of Practice No. 44, Selection and Use of Asset Valuation Methods for Pension Plans (ASOP 44). It provides considerations for selecting an actuarial asset method, including:

- Purpose of the measurement;
- Objectives of the employer and/or retirement system;
- Use of different methods/assumptions and adjustment for timing differences; and
- Other considerations such as the plan's expected future cash flows and liquidity needs.

Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions (ASOP 4) also provides guidance, but generally defers to ASOP 44. The specific methodology for determining the AVA is prescribed in Minnesota Statutes, Section 356.215, Subd.1(f).

We were able to replicate the AVA calculation prepared by the retained actuary and confirm it follows the methods prescribed in Minnesota Statutes. The AVA replication can be found in Appendix B.

Plan Liabilities

Actuarial liabilities are calculated by programming actuarial software with a retirement system's data, assumptions, methods, and plan provisions. This is a complex process which involves substantial effort and actuarial programming experience.

For the replication, we independently programmed our valuation software based on our understanding of the data, assumptions, methods, and plan provisions used in the July 1, 2022 actuarial valuation report, Minnesota Statutes, and the LCPR's standards for actuarial work. The primary results we replicated are:

- **Present Value of Future Benefits (PVFB):** plan liability equal to the discounted value of all projected future benefit payments (based on current participant group with projected compensation and service accruals).
- **Normal Cost (NC):** the portion of the PVFB allocated to the valuation year based on current compensation levels.
- **Present Value of Future Normal Costs (PVFNC):** the portion of the PVFB allocated to future years based on the present value of projected participant compensation.
- **Actuarial Accrued Liability (AAL):** the portion of the PFVB allocated to prior years based on each participant's historical and projected compensation.

We expect some liability calculation differences even if we used the exact same inputs as the retained actuary. This is because each actuarial software program may have slightly different ways of applying actuarial formulas. As a general rule, we would like to match the overall PVFB and AAL within 2% and PVFNC and Normal Cost within 5% of the retained actuary's results.

Results for member subgroups or split by benefit source may differ by larger magnitudes depending on how each actuary interprets and programs their actuarial software. We believe these differences are acceptable as long as they are small relative to the overall plan.

The tables in **Appendix C** summarize and compare the liability measurements for different membership groups. **Our overall results are very close to those presented in the July 1, 2022 actuarial valuation, and we believe that the retained actuary is reasonably calculating plan liabilities.**

Contribution Sufficiency/(Deficiency)

SPTRFA's statutory pension contribution rates are defined in Chapter 354A of Minnesota Statues, but the retained actuary is also required to calculate "required contributions" per Chapter 356 of Minnesota Statutes. The required contribution rates are those which are expected to fully fund the pension plan by the statutory full funding date.

We replicated the contribution sufficiency/(deficiency) calculations as follows:

- **Statutory contributions:** We calculated the estimated dollar value of the statutory normal cost contributions based on the retained actuary's blended statutory normal cost contribution rates applied to our replication of projected payroll. These amounts are added to the statutory supplemental contribution rates to determine the total statutory contribution rate.
- **Required contributions:** We calculated the estimated "percent of payroll" and dollar value of the contributions required to fully fund the plan based on the system's stated funding policy. These consist of normal cost contributions plus the required supplemental contribution rate. The normal cost and supplemental components of the required contributions were based on our replication of the Plan's normal cost, actuarial accrued liability, and projected payroll through the statutory June 30, 2048 full funding date.
- **Contribution sufficiency/(deficiency):** We compare our contribution sufficiency calculation (i.e., difference between the statutory and required contributions) to those determined by the retained actuary in the July 1, 2022 actuarial valuation report.

The tables in **Appendix D** summarize and compare our calculations. **Our overall results are close to those calculated by the retained actuary, and we believe that the retained actuary is reasonably calculating the contribution sufficiency/(deficiency).**

Assumptions, Methods, and Plan Provisions

The retained actuary's July 1, 2022 actuarial valuation report contains a detailed description of the actuarial assumptions, methods, and plan provisions used to prepare their results. These items are summarized in their report on pages 25 through 32, 38 through 42 and 48 through 52. We do not reprint all the assumptions, methods, and plan provisions in this replication report, but we do provide a high-level commentary below.

Actuarial Methods
Actuarial Cost Method: Minnesota Statutes, Section 356.215 Subd.1(b) and (d) require that SPTRFA use the Entry Age Normal level percent of pay actuarial cost method. In this method, the actuarial Present Value of Future Benefits (PVFB) for each individual is allocated as a level percent of pay from entry age (hire age, for most employees) to decrement age (e.g., expected age at termination or retirement). The portion of the PVFB allocated to the valuation year is called the Normal Cost (NC). The portion of the PVFB allocated to past years is called the Actuarial Accrued Liability (AAL). The retained actuary documents using this cost method in their report, and the closeness of our replication liabilities (Appendix D) indicate that it was applied appropriately.
Asset valuation method: The asset valuation method is used to smooth market fluctuations over time to create contribution stability. Minnesota Statutes, Section 356.215 Subd.1(f) requires using an Actuarial Value of Assets that smooths investment gains and losses over a five-year period. We confirmed that the retained actuary described and used the statutory asset smoothing method, and our replication calculations can be found in Appendix C of this report.
Contribution method: The contribution method specifies a process for funding the current year incurred liabilities (the Normal Cost) plus paying down/amortizing a portion of unfunded past liabilities (the Unfunded Actuarial Accrued Liability, or UAAL amortization). These contribution parameters are defined in Minnesota Statutes, Section 356.215 Subd.5 and Subd.11. They specify that (1) the Normal Cost must be expressed as a level percent of payroll and (2) the required supplemental contribution must be calculated by amortizing the UAAL as a level percent of projected payroll over the closed period ending June 30, 2048. We confirmed that pages 21-24 of the July 1, 2022 actuarial valuation report describes the correct contribution calculation process, and our replication calculations (Appendix D of this report) indicate that the retained actuary applied the methods and assumptions appropriately.

Actuarial Assumptions

Demographic assumptions: We verified that the demographic assumptions described in the July 1, 2022 actuarial valuation report were based on those developed in the 2011-2016 actuarial experience study dated March 1, 2018. The allowance for Combined Service Annuity assumptions are based on the LCPR prior actuary's report dated October 2016.

Economic assumptions: We verified that the economic assumptions described in the July 1, 2022 actuarial valuation report were based on those developed in the 2018 experience study, with an investment return assumption and discount rate per Minnesota Statute, Section 356.215 Subd.8(a). They also include the COLA, salary scale, payroll growth, and other assumptions described in 356.215 Subd.8(b)-(d) and Subd.9

We also confirmed that demographic and economic assumptions used in the valuation are consistent with those described in Appendix A (effective July 1, 2021) to the LCPR's Standards for Actuarial Work. These assumptions include 2.50% price inflation, 3.00% payroll growth, service-based salary increase table, and RP-2014 mortality tables.

Plan Provisions

Minnesota Statutes, Chapter 354A describe the retirement benefits provided to SPTRFA members, and the primary service annuity formulas. We reviewed the plan provisions summarized in the July 1, 2022 actuarial valuation report and believe they are consistent with our understanding of the benefits described in Minnesota Statutes.

Additional Compliance Requirements

In addition to correctly summarizing and applying the assumptions, methods, and plan provisions, the actuarial valuation report must comply with other statutory requirements and professional standards. We reviewed the SPTRFA July 1, 2022 actuarial valuation report for compliance with applicable Minnesota Statutes, LCPR Actuarial Standards, and relevant Actuarial Standards of Practice. We found that the report complied with all major requirements in these guidance sources. The primary items we reviewed, along with any relevant observations, are summarized in the tables below.

Minnesota Statute Compliance	
The applicable Minnesota Statutes include Sections 356.214 (actuarial valuation preparation) and 356.215 (actuarial valuations and experience studies). We confirmed compliance with the following requirements as described below.	
Normal cost	Calculated as a level percentage of payroll per 356.215 Subd.5
Amortization of unfunded liabilities	Amortized as a level percent of payroll ending June 30, 2048 per 356.215 Subd.11
Measurement of actuarial gains and losses	Required gain/loss items measured per 356.215 Subd.12
Report contents	Consistent with the remaining requirements of 356.215 Subd.4 through 18. These include presentation of the accrued liability, membership tabulations, and summary of plan provisions.

LCPR Actuarial Standards Compliance	
In addition to specific actuarial assumptions (described earlier in this report), the LCPR's Standards for Actuarial Work and its Appendix A specify actuarial cost methods and detailed report contents. We confirmed compliance with these requirements as described below.	
Actuarial cost methods	Entry age cost method, benefits recognized, and contribution rates calculated per Standards, Section III
Report contents	All required elements included per Standards, Section IV

Actuarial Standards of Practice Compliance

Actuarial Standards of Practice (ASOPs) provide broad standards that all actuaries must follow as part of our professional standards. The relevant ASOPs for pension actuarial reports include:

- ASOP 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions
- ASOP 23, Data Quality
- ASOP 27, Selection of Economic Assumptions for Measuring Pension Obligations
- ASOP 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations
- ASOP 41, Actuarial Communications
- ASOP 44, Selection and Use of Asset Valuation Methods for Pension Valuations
- ASOP 51, Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions
- ASOP 56, Modeling

We reviewed the report and believe that it adequately complies with all relevant Actuarial Standards of Practice, including ASOPs 4, 23, 27, 35, 41, 44, 51, and 56.

We specifically note GRS' compliance with ASOP 27 on page 1 of the report cover letter where they identify assumptions "that significantly conflicts with what, in the actuary's professional judgement, is reasonable for the purpose of the measurement."

Appendix A – Census Data Comparisons

The exhibits below compare the participant counts and certain data statistics between the "raw" system data and the "scrubbed" actuarial data.

Summary of Participant Statistics

	Retained Actuary	System Data	Difference
Active members	**3,400**	**3,400**	**0**
Average age	44.6	44.6	0.0%
Average service	12.0	12.0	0.0%
Average salary[3]	$ 83,084	$ 82,504	-0.7%
Members on Leave of Absence	128	128	
Service retirements[4]	**3,856**	**3,859**	**3**
Average age	74.2	74.2	0.0%
Average annual annuity	$ 28,360	$ 28,341	-0.1%
Survivors[4]	**375**	**371**	**(4)**
Average age	78.3	78.5	0.3%
Average annual annuity	$ 31,985	$ 32,300	1.0%
Disability retirements	**22**	**22**	**0**
Average age	58.8	58.8	0.0%
Average annual annuity	$ 18,766	$ 18,766	0.0%
Deferred retirements	**2,514**	**2,514**	**0**
Average age	49.4	49.4	0.0%
Other non-vested terminations	2,915	2,915	0
Total	**13,210**	**13,209**	**(1)**

[3] The average salary for active members from the System Data does not include the data adjustments described in the assumption section of the 2022 valuation report that are applied in the Retained Actuary valuation data. The retained actuary's data file included some of these adjustments.

[4] There are three in-payment participants that were listed as survivors in the actuary's data that we would set as retirees based on certain data fields in the System's file. There was also one record in the actuary's file that we could not locate in the system file. However, it is normal and reasonable to have some data corrections made as part of the actuary's process of reviewing and reconciling the data.

Distribution of Active Member Data

The table below summarizes the retained actuary's active member data by age and years of service, and it also includes the average earnings for each grouping. It can be compared to the similar summary table on page 16 from the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years of Service as of June 30, 2022								
Age	**<5**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35+**	**Total**
<25	29								**29**
Avg pay	$47,829								**$47,829**
25-29	231	20							**251**
Avg pay	$54,915	$66,784							**$55,861**
30-34	240	173	25						**438**
Avg pay	$60,693	$74,272	$85,298						**$67,461**
35-39	169	150	137	17					**473**
Avg pay	$67,051	$81,007	$89,059	$91,533					**$78,731**
40-44	129	118	122	150	24				**543**
Avg pay	$69,426	$85,595	$91,029	$95,000	$99,102				**$86,169**
45-49	85	81	67	100	191	21	1		**546**
Avg pay	$72,537	$82,417	$87,699	$92,156	$98,676	$101,395	$98,629		**$89,758**
50-54	60	58	48	57	155	172	12		**562**
Avg pay	$70,959	$90,692	$89,501	$96,477	$99,269	$101,367	$99,679		**$94,895**
55-59	37	25	33	35	84	114	56	8	**392**
Avg pay	$62,668	$92,347	$85,678	$89,876	$99,176	$98,242	$107,123	$114,969	**$94,514**
60-64	25	17	12	25	54	43	40	16	**232**
Avg pay	$51,348	$91,181	$83,018	$84,066	$95,066	$99,426	$103,316	$94,378	**$90,445**
65+	5	7	5	6	7	13	8	11	**62**
Avg pay	$37,044	$56,062	$67,034	$77,860	$89,475	$100,414	$114,989	$108,765	**$87,549**
Total	**1,010**	**649**	**449**	**390**	**515**	**363**	**117**	**35**	**3,528**
Avg pay	**$62,512**	**$81,083**	**$88,574**	**$92,911**	**$98,452**	**$100,123**	**$105,523**	**$103,606**	**$83,556**

Note that the average pay in this table does not match the average pay for active members from the System Data on the prior page because the amounts shown above include all data adjustments as described in the assumption section of the 2022 valuation report.

Distribution of Service Retirements

The table below summarizes the retained actuary's service retirement data by age and years since retirement, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table on page 17 from the July 1, 2022 actuarial report.

Although some age bands align well with the valuation exhibits, there are some age bands that are different from the valuation report. GRS discovered that there was an error in the calculation of some participant ages in their service retirement membership tables. GRS confirmed that the correct ages were used to calculate the valuation liabilities so the actuarial results are unaffected by the incorrect service retirement tables.

Years Retired as of June 30, 2022

Age	<5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Total
<45										
Avg benefit										
45-49	2				1					**3**
Avg benefit	$6,130				$5,942					**$6,067**
50-54					1					**1**
Avg benefit					$5,942					**$5,942**
55-59	89	1								**90**
Avg benefit	$30,264	$29,698								**$30,258**
60-64	265	88	2							**355**
Avg benefit	$27,054	$19,619	$2,158							**$25,071**
65-69	324	305	116							**745**
Avg benefit	$21,377	$23,215	$23,116							**$22,400**
70-74	87	351	356	210	1					**1,005**
Avg benefit	$14,832	$20,304	$28,708	$37,311	$5,942					**$26,347**
75-79	11	75	244	315	173	1				**819**
Avg benefit	$26,412	$16,155	$25,502	$35,343	$32,068	$20,742				**$29,824**
80-84	2	8	26	117	198	97	1			**449**
Avg benefit	$69,634	$2,380	$20,624	$28,915	$36,513	$40,029	$70,020			**$33,986**
85-89		4	6	12	84	130	26			**262**
Avg benefit		$8,378	$9,797	$24,672	$39,307	$43,040	$32,122			**$38,628**
90+				3	4	47	35	36	2	**127**
Avg benefit				$1,408	$16,987	$50,466	$31,777	$31,670	$19,390	**$37,285**
Total	**780**	**832**	**750**	**657**	**462**	**275**	**62**	**36**	**2**	**3,856**
Avg benefit	**$23,746**	**$20,706**	**$26,298**	**$34,477**	**$34,989**	**$43,166**	**$32,539**	**$31,670**	**$19,390**	**$28,360**

Distribution of Survivors

The table below summarizes the retained actuary's survivor data by age and years since death, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table on page 19 of the July 1, 2022 actuarial report.

Although the total counts match the valuation exhibits, there are some age bands that are substantially different from the valuation report. GRS discovered that there was an error in the calculation of some participant ages in their survivor membership tables. GRS confirmed that the correct ages were used to calculate the valuation liabilities so the actuarial results are unaffected by the incorrect survivor tables.

Years Since Death as of June 30, 2022

Age	<5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Total
<45	11	3	1							**15**
Avg benefit	$12,237	$6,913	$7,720							**$10,871**
45-49	3	2	1							**6**
Avg benefit	$5,817	$7,283	$7,720							**$6,623**
50-54	3			1						**4**
Avg benefit	$5,511			$558						**$4,273**
55-59	7	1								**8**
Avg benefit	$5,745	$1,999								**$5,277**
60-64	6	3	2							**11**
Avg benefit	$9,353	$44,976	$9,703							**$19,132**
65-69	15	4	4		5	1			1	**30**
Avg benefit	$26,421	$27,554	$14,218		$8,498	$50,900			$3,350	**$22,005**
70-74	9	8	1	4	3	2	2		1	**30**
Avg benefit	$26,349	$26,009	$52,306	$42,485	$22,826	$27,454	$43,551		$21,205	**$29,972**
75-79	30	12	2	8	13	4	2			**71**
Avg benefit	$30,143	$43,449	$26,225	$23,573	$23,581	$40,506	$20,483			**$30,651**
80-84	18	11		3	8	17	3	3	2	**65**
Avg benefit	$43,058	$41,709		$17,479	$49,561	$40,975	$29,549	$33,975	$22,550	**$40,231**
85-89	24	16			8	11	15	5	1	**80**
Avg benefit	$32,145	$48,217			$30,704	$45,291	$37,974	$29,298	$18,159	**$37,763**
90+	14	8				4	8	13	8	**55**
Avg benefit	$43,709	$39,711				$53,247	$41,255	$33,960	$29,517	**$39,096**
Total	**140**	**68**	**11**	**16**	**37**	**39**	**30**	**21**	**13**	**375**
Avg benefit	**$28,294**	**$37,645**	**$17,861**	**$25,720**	**$28,639**	**$42,964**	**$37,212**	**$32,852**	**$24,919**	**$31,985**

Distribution of Disability Retirements

The table below summarizes the retained actuary's disability retirement data by age and years since disability retirement, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table on page 18 of the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Years Disabled as of June 30, 2022

Age	<5	5-9	10-14	15-19	20-24	25+	Total
<45							
Avg benefit							
45-49		1					1
Avg benefit		$3,596					$3,596
50-54	2	1					3
Avg benefit	$5,076	$35,046					$15,066
55-59	4	3	3				10
Avg benefit	$20,799	$22,871	$14,384				$19,496
60-64	2	2	1	1		1	7
Avg benefit	$38,245	$20,161	$17,010	$25,671		$5,866	$23,623
65-69	1						1
Avg benefit	$3,745						$3,745
70-74							
Avg benefit							
75+							
Avg benefit							
Total	**9**	**7**	**4**	**1**		**1**	**22**
Avg benefit	**$19,287**	**$21,083**	**$15,040**	**$25,671**		**$5,866**	**$18,766**

Appendix B – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's July 1, 2022 AVA calculation (see pages 13 and 14 in the July 1, 2022 valuation report) to our replication. The calculations match and are consistent with relevant Minnesota Statutes, Section 356.215, Subd.1(f) so we believe they were prepared correctly. All amounts shown are in $1,000's.

				Retained Actuary	VIA Match
1.	**Market value of assets available for benefits**			1,154,427	1,154,427
2.	Determination of average asset balance				
	a. Total assets at beginning of year			1,295,064	1,295,064
	b. Total assets at end of year			1,154,427	1,154,427
	c. Net investment income for fiscal year			(95,988)	(95,988)
	d. Average balance (a. + b. - c.)/2			1,272,740	1,272,740
3.	Expected return (7.50% x 2.d.)			95,456	95,456
4.	Actual return			(95,988)	(95,988)
5.	Current year asset gain/(loss) (4. - 3.)			(191,444)	(191,444)
6.	Unrecognized asset returns	Original amounts	Unrecognized percent	Unrecognized amounts	Unrecognized amounts
	a. FYE 2022	(191,444)	80%	(153,155)	(153,155)
	b. FYE 2021	229,203	60%	137,522	137,522
	c. FYE 2020	(73,490)	40%	(29,396)	(29,396)
	d. FYE 2019	(18,200)	20%	(3,640)	(3,640)
	e. FYE 2018		0%	N/A	N/A
	f. Total unrecognized amount			(48,669)	(48,669)
7.	**AVA at end of year (1. - 6.f.)**			**1,203,096**	**1,203,096**

Appendix C – Plan Liability Replications

The exhibits below compare our replication of the plan liabilities to those calculated by the retained actuary. **We believe that the overall closeness of the results indicates the July 1, 2022 actuarial valuation report liabilities are reasonable.** There are a couple of small benefit subclasses with larger differences (e.g., survivor benefits, deferred retirements and refunds for active members) but these are very small relative to the overall plan. All amounts shown are in $1,000's.

Present Value of Benefits (PVB) Liability	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 635,891	$ 632,482	$ (3,409)	-0.5%
Disability benefits	16,606	17,076	470	2.8%
Survivor benefits	6,818	6,642	(176)	-2.6%
Deferred retirements	47,490	49,608	2,118	4.5%
Refunds	2,697	3,700	1,003	37.2%
Subtotal	$ 709,502	$ 709,508	$ 6	0.0%
Deferred retirements	97,741	96,275	(1,466)	-1.5%
Former members without vested rights	2,946	2,927	(19)	-0.6%
Annuitants	1,161,360	1,164,411	3,051	0.3%
Total	**$ 1,971,549**	**$ 1,973,121**	**$ 1,572**	**0.1%**

Present Value of Future Normal Costs (PVFNC)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 141,856	$ 149,053	$ 7,197	5.1%
Disability benefits	5,306	5,659	353	6.7%
Survivor benefits	1,903	1,928	25	1.3%
Deferred retirements	53,848	46,916	(6,932)	-12.9%
Refunds	18,215	15,124	(3,091)	-17.0%
Total	**$ 221,128**	**$ 218,680**	**$ (2,448)**	**-1.1%**

Actuarial Accrued Liability (AAL)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 494,035	$ 483,429	$ (10,606)	-2.1%
Disability benefits	11,300	11,417	117	1.0%
Survivor benefits	4,915	4,714	(201)	-4.1%
Deferred retirements	(6,358)	2,692	9,050	N/A
Refunds	(15,518)	(11,424)	4,094	-26.4%
Subtotal	$ 488,374	$ 490,828	$ 2,454	0.5%
Deferred retirements	97,741	96,275	(1,466)	-1.5%
Former members without vested rights	2,946	2,927	(19)	-0.6%
Annuitants	1,161,360	1,164,411	3,051	0.3%
Total	**$ 1,750,421**	**$ 1,754,441**	**$ 4,020**	**0.2%**

Normal Cost	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 17,323	$ 17,553	$ 230	1.3%
Disability benefits	596	621	25	4.2%
Survivor benefits	220	223	3	1.4%
Deferred retirements	5,963	5,039	(924)	-15.5%
Refunds	2,071	1,685	(386)	-18.6%
Total	**$ 26,173**	**$ 25,121**	**$ (1,052)**	**-4.0%**

Appendix D – Contribution Sufficiency/(Deficiency) Replication

The exhibit below compares our replication of the contribution calculations to the retained actuary's results. We begin by replicating the Supplemental Contribution Rate and then determine the Contribution Sufficiency/(Deficiency). We believe that the overall closeness of the results indicates the July 1, 2022 actuarial valuation report calculations are reasonable. All amounts shown are in $1,000's.

Supplemental Contribution Rate	Retained Actuary	VIA Replication	$ Difference	% Difference
1. Determination of Unfunded Actuarial Accrued Liability (UAAL)				
a. Actuarial accrued liability	$ 1,750,421	$ 1,754,441	$ 4,020	0.2%
b. Current assets (AVA)	1,203,096	1,203,096	-	0.0%
c. Unfunded actuarial accrued liability	$ 547,325	$ 551,345	$ 4,020	0.7%
2. Determination of Supplemental Contribution Rate				
a. Present value of future payrolls through the amortization date of June 30, 2048	$ 4,839,539	$ 4,800,824	$(38,715)	-0.8%
b. Supplemental contribution rate: (1.c. / 2.a.)	11.31%	11.48%		

(continued on next page)

	Retained Actuary		VIA Replication		$ Difference
Projected annual payroll for FY2022-2023		$ 313,824		$ 311,314	$ (2,510)
	% of Payroll	**$ Amount**	**% of Payroll**	**$ Amount**	**% of Payroll Difference**
1. Statutory Contributions - Chapter 354A					
a. Employee contributions	7.50%	$ 23,537	7.50%	$ 23,349	0.00%
b. Employer contributions					
i. Regular	8.80%	27,617	8.80%	27,396	0.00%
ii. Additional	3.84%	12,051	3.84%	11,954	0.00%
c. Supplemental contribution[5]					
i. 1996 Legislation	0.27%	838	0.27%	838	0.00%
ii. 1997 Legislation	0.90%	2,827	0.91%	2,827	0.01%
iii. 2014 Legislation	2.23%	7,000	2.25%	7,000	0.02%
iv. 2018 Legislation	1.59%	5,000	1.61%	5,000	0.02%
d. Total	25.13%	$ 78,870	25.17%	$ 78,364	0.04%
2. Required Contributions - Chapter 356					
a. Normal cost					
i. Retirement benefits	5.52%	$ 17,323	5.64%	$ 17,553	0.12%
ii. Disability benefits	0.19%	596	0.20%	621	0.01%
iii. Survivors	0.07%	220	0.07%	223	0.00%
iv. Deferred retirement benefits	1.90%	5,963	1.62%	5,039	-0.28%
v. Refunds	0.66%	2,071	0.54%	1,685	-0.12%
vi. Total	8.34%	$ 26,173	8.07%	$ 25,121	-0.27%
b. Supplemental Contribution Amortization of Unfunded Actuarial Accrued Liability	11.31%	$ 35,493	11.48%	$ 35,752	0.17%
c. Allowance for Expenses	0.31%	973	0.31%	965	0.00%
d. Total	19.96%	$ 62,639	19.86%	$ 61,838	-0.10%
3. Contribution Sufficiency/(Deficiency)	5.17%	$ 16,231	5.31%	$ 16,526	0.14%

[5] Supplemental contributions are dollar amounts defined in State statutes and converted to percent of payroll based on actuarial payroll projections..