

Minnesota Legislative Commission on Pensions and Retirement

Replication of July 1, 2022 MSRS Correctional Employees Retirement Plan Actuarial Valuation Report

June 5, 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 MSRS Correctional Plan Actuarial Valuation Report

This report presents our replication of the July 1, 2022 actuarial valuation report for the Minnesota State Retirement System Correctional Employees Retirement Plan (MSRS Correctional Plan). 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 MSRS Correctional Plan 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 MSRS Correctional Plan's retained actuary;
- July 1, 2022 census data files provided by MSRS, and "scrubbed" census files provided by the retained actuary; and
- July 1, 2022 asset and financial data found in the system's audited financial statements.

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.

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



Emily M. Knutson, FSA, EA, MAAA
Consulting Actuary

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

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Executive Summary

This report summarizes our replication of the July 1, 2022 MSRS Correctional Employees Retirement Plan 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.

	MSRS Correctional Plan Actuarial Valuation	VIA Replication	Difference ¹
Participant data			
Active members	4,420	4,420	0.0%
Service retirements	3,294	3,294	0.0%
Survivors	290	290	0.0%
Disability retirements	330	330	0.0%
Deferred retirements	1,475	1,475	0.0%
Other non-vested terminations	1,169	1,169	0.0%
Total	10,978	10,978	0.0%
System assets (\$1,000's)			
Market value of assets	\$ 1,473,921	\$ 1,473,921	0.0%
Actuarial Value of Assets	1,498,885	1,498,885	0.0%
System liabilities (\$1,000's)			
Present Value of Future Benefits (PFVB)	2,211,188	2,221,201	0.5%
Present Value of Future Normal Costs (PVFNC)	332,739	338,182	1.6%
Actuarial Accrued Liability (AAL)	1,878,449	1,883,019	0.2%
Normal Cost (NC)	47,386	45,915	-3.1%
System contributions (% of payroll)			
Normal cost rate	15.77%	15.23%	-0.54%
UAAL amortization payment	8.19%	8.26%	0.07%
Expenses	0.31%	0.31%	0.00%
Total required contribution (Chapter 356)	24.27%	23.80%	-0.47%
Statutory contribution rate (Chapter 352)	28.45%	28.45%	0.00%
Contribution sufficiency/(deficiency)	4.18%	4.65%	0.47%

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. Market asset data and Actuarial Value of Assets calculations;
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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ Compare market asset values in the valuation report to those in the system’s audited financial statements ▪ Replicate retained actuary’s Actuarial Value of Assets calculations
Plan liabilities	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ 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).

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 14 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 15, 16 and 17 of the July 1, 2022 actuarial valuation report.

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).

To validate the asset data and AVA calculations used in the July 1, 2022 actuarial valuation report, we used the following process:

- Review audited financial data and compare it to the information disclosed in the actuarial valuation report; and
- Replicate the AVA calculations shown in the July 1, 2022 actuarial valuation report.

We found that the asset data used by the retained actuary was consistent with the system's audited asset information. We were also able to replicate the AVA calculation prepared by the retained actuary and confirm it follows the methods prescribed in Minnesota Statutes. Our asset data comparison can be found in Appendix B, and the AVA replication can be found in Appendix C.

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 PVFB 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 D** 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.**

During our replication process we noticed that the liability amounts for disability retirements and survivors were swapped on page 19 of the July 1, 2022 actuarial valuation. We have confirmed this with GRS. This does not have a material effect on any funded status or contribution amounts in the report.

Contribution Sufficiency/(Deficiency)

MSRS's statutory pension contribution rates are defined in Chapter 352 of Minnesota Statutes, 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, Unfunded 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 E** 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 23 through 35. 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 MSRS 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 20-22 of the July 1, 2022 actuarial valuation report describes the correct contribution calculation process, and our replication calculations (Appendix E 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 2015-2019 actuarial experience study dated June 30, 2020. 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 2020 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 2.25% price inflation, 3.00% payroll growth, service-based salary increase table, and PUB-2010 mortality tables.

Plan Provisions

Minnesota Statutes, Chapter 352 describe the retirement benefits provided to MSRS 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 MSRS Correctional Plan 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 and page 1 of the valuation report 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	4,420	4,420	0
Average age	41.8	41.8	0.0%
Average service	9.5	9.5	0.0%
Average salary ²	\$ 64,939	\$ 62,581	-3.6%
Service retirements	3,294	3,294	0
Average age	67.2	67.2	0.0%
Average annual annuity	\$ 23,321	\$ 23,325	0.0%
Survivors	290	290	0
Average age	67.7	67.7	0.0%
Average annual annuity	\$ 17,549	\$ 17,578	0.2%
Disability retirements	330	330	0
Average age	60.2	60.2	0.0%
Average annual annuity	\$ 21,543	\$ 21,543	0.0%
Deferred retirements	1,475	1,475	0
Average age	47.1	47.1	0.0%
Average annual annuity ²	\$ 11,054	\$ 10,917	-1.2%
Other non-vested terminations	1,169	1,169	0
Total	10,978	10,978	0

² The average salary for active members and average annual annuity for deferred retirements from the system data does not include the data adjustments described in the assumption section of the 2022 valuation report.

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 14 from the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years of Service as of June 30, 2022									Total
	<3	3-4	5-9	10-14	15-19	20-24	25-29	30-34	35+	
<25	168	23	2							193
Avg pay	\$42,234	\$53,828	\$53,099							\$43,729
25-29	241	126	54							421
Avg pay	\$45,799	\$58,335	\$55,796							\$50,833
30-34	171	111	249	36						567
Avg pay	\$47,987	\$57,357	\$60,439	\$66,485						\$56,464
35-39	121	87	246	190	69					713
Avg pay	\$51,942	\$63,455	\$64,191	\$68,303	\$72,256					\$63,899
40-44	125	69	156	151	236	26				763
Avg pay	\$51,157	\$65,090	\$64,347	\$71,896	\$74,348	\$81,527				\$67,426
45-49	84	51	103	96	163	104	13			614
Avg pay	\$55,918	\$68,612	\$70,411	\$68,209	\$76,239	\$83,770	\$91,437			\$72,190
50-54	54	37	100	70	125	107	94	11		598
Avg pay	\$52,223	\$64,404	\$68,987	\$72,559	\$75,243	\$81,496	\$85,366	\$89,062		\$74,098
55-59	38	28	70	54	64	36	30	7		327
Avg pay	\$51,843	\$65,242	\$66,552	\$70,266	\$78,305	\$77,771	\$85,776	\$86,748		\$71,075
60-64	13	16	56	37	24	13	4	2		165
Avg pay	\$59,631	\$68,409	\$71,329	\$73,673	\$85,765	\$82,200	\$74,904	\$86,680		\$73,879
65-69	7	3	20	8	8	3		1	1	51
Avg pay	\$36,733	\$90,928	\$70,094	\$77,317	\$81,349	\$70,751		\$89,163	\$137,518	\$71,374
70+	3		2	1	1				1	8
Avg pay	\$18,675		\$76,251	\$79,934	\$161,461				\$14,440	\$58,045
Total	1,025	551	1,058	643	690	289	141	21	2	4,420
Avg pay	\$48,384	\$61,784	\$64,609	\$70,099	\$75,719	\$81,773	\$85,716	\$88,069	\$75,979	\$64,939

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 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 15 from the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Retired as of June 30, 2022							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<50	1			1				2
Avg benefit	\$4,041			\$9,204				\$6,623
50-54	21	17	3					41
Avg benefit	\$18,384	\$17,428	\$5,655					\$17,056
55-59	122	296	65	2				485
Avg benefit	\$35,407	\$33,080	\$17,978	\$3,918				\$31,521
60-64	47	236	412	74		1	1	771
Avg benefit	\$25,363	\$27,576	\$28,467	\$21,137		\$6,224	\$30,080	\$27,275
65-69	30	135	278	328	54			825
Avg benefit	\$17,858	\$16,382	\$19,038	\$21,709	\$21,256			\$19,768
70-74	3	31	101	133	292	33		593
Avg benefit	\$13,776	\$16,962	\$15,178	\$15,213	\$22,588	\$20,577		\$19,221
75-79		1	23	78	72	188	2	364
Avg benefit		\$1,646	\$10,539	\$10,941	\$17,361	\$24,045	\$7,438	\$18,908
80-84			3	11	28	41	35	118
Avg benefit			\$5,406	\$15,477	\$12,263	\$23,768	\$31,083	\$21,968
85-89			2		4	24	41	71
Avg benefit			\$8,043		\$22,840	\$23,799	\$32,068	\$28,076
90+					1	1	22	24
Avg benefit					\$3,034	\$8,331	\$28,075	\$26,209
Total	224	716	887	627	451	288	101	3,294
Avg benefit	\$28,924	\$27,004	\$22,564	\$18,738	\$20,912	\$23,471	\$30,349	\$23,325

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 16 of the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Since Death as of June 30, 2022							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<45	2	3	11		1			17
Avg benefit	\$8,946	\$10,220	\$4,920		\$0			\$6,039
45-49	1	6	3	2				12
Avg benefit	\$8,946	\$7,311	\$11,633	\$4,972				\$8,138
50-54	1	3	6		1			11
Avg benefit	\$25,363	\$7,284	\$20,548		\$830			\$15,576
55-59	1	4	6	1	3	2		17
Avg benefit	\$23,691	\$25,211	\$11,674	\$17,812	\$9,985	\$9,485		\$15,372
60-64	4	9	7	3	1	2	2	28
Avg benefit	\$17,826	\$26,262	\$15,714	\$16,292	\$26,033	\$10,040	\$12,209	\$19,181
65-69	6	15	13	10	10	2	1	57
Avg benefit	\$19,981	\$20,886	\$19,811	\$19,499	\$14,646	\$13,631	\$8,892	\$18,742
70-74	8	19	9	4	13	4	4	61
Avg benefit	\$22,654	\$16,629	\$21,144	\$6,935	\$13,366	\$27,022	\$11,110	\$17,074
75-79	3	9	8	7	8	5	4	44
Avg benefit	\$24,337	\$13,498	\$21,510	\$22,891	\$18,708	\$14,867	\$16,412	\$18,556
80-84	2	10		2	2	2	1	19
Avg benefit	\$14,535	\$23,730		\$15,898	\$18,970	\$35,098	\$11,193	\$21,973
85-89		4	2	4	2	3	1	16
Avg benefit		\$22,927	\$35,743	\$35,903	\$15,916	\$15,396	\$11,856	\$24,793
90+	1	3	1	2		1		8
Avg benefit	\$43,324	\$18,525	\$42,973	\$13,612		\$18,063		\$23,395
Total	29	85	66	35	41	21	13	290
Avg benefit	\$20,473	\$18,458	\$17,072	\$18,921	\$14,548	\$18,247	\$12,804	\$17,578

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 17 of the July 1, 2022 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Disabled as of June 30, 2022							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<45	2	7	6	3				18
Avg benefit	\$21,820	\$24,837	\$15,178	\$16,753				\$19,935
45-49	1	6	6	3	2			18
Avg benefit	\$36,237	\$22,311	\$20,748	\$19,886	\$18,426			\$21,728
50-54	7	15	8	14	6	7		57
Avg benefit	\$25,121	\$24,461	\$24,308	\$19,713	\$18,543	\$22,790		\$22,526
55-59	1	13	22	6	14	7	3	66
Avg benefit	\$24,455	\$20,599	\$20,708	\$21,322	\$23,495	\$20,024	\$37,072	\$22,061
60-64	1	9	16	19	11	6	2	64
Avg benefit	\$6,235	\$15,000	\$15,933	\$22,571	\$22,501	\$24,282	\$32,521	\$20,051
65-69		2	7	14	13	8	4	48
Avg benefit		\$10,099	\$23,152	\$19,164	\$22,593	\$24,524	\$21,036	\$21,346
70-74			4	6	17	12	3	42
Avg benefit			\$18,786	\$17,283	\$22,610	\$20,426	\$27,644	\$21,220
75+				1	7	7	2	17
Avg benefit				\$16,545	\$22,429	\$25,703	\$33,338	\$24,715
Total	12	52	69	66	70	47	14	330
Avg benefit	\$23,868	\$21,108	\$19,677	\$20,170	\$22,280	\$22,694	\$29,287	\$21,543

Appendix B – Market Value of Assets Comparison

The exhibit below compares the market value of assets from the system’s annual financial report to the amounts used by the retained actuary (see page 10 in the July 1, 2022 valuation report). We find that the entries compare well, which indicates that the market asset data used in the valuation report was correct. All amounts shown are in \$1,000’s.

	<u>Retained Actuary</u>	<u>System Financials</u>
Assets in Trust		
Cash, equivalents, short term securities	28,370	28,370
Fixed income	335,521	335,521
Equity and private equity	1,107,395	1,107,395
Other	75,986	75,986
Total Assets in Trust	1,547,272	1,547,272
Assets Receivable	5,768	5,768
Amounts Payable	(79,119)	(79,119)
Net Assets Held in Trust for Pension Benefits	1,473,921	1,473,921

Appendix C – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's July 1, 2022 AVA calculation (see page 12 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	1,473,921	1,473,921		
2.	Determination of average asset balance				
a.	Total assets at beginning of year	1,580,953	1,580,953		
b.	Total assets at end of year	1,473,921	1,473,921		
c.	Net investment income for fiscal year	(99,155)	(99,155)		
d.	Average balance (a. + b. - c.)/2	1,577,015	1,577,015		
3.	Expected return (7.50% x 2.d.)	118,276	118,276		
4.	Actual return	(99,155)	(99,155)		
5.	Current year asset gain/(loss) (4. - 3.)	(217,431)	(217,431)		
6.	Unrecognized asset returns	Original amounts	Unrecognized percent	Unrecognized amounts	Unrecognized amounts
a.	FYE 2022	(217,431)	80%	(173,945)	(173,945)
b.	FYE 2021	274,922	60%	164,953	164,953
c.	FYE 2020	(38,814)	40%	(15,526)	(15,526)
d.	FYE 2019	(2,231)	20%	(446)	(446)
e.	FYE 2018	23,925	0%	N/A	N/A
f.	Total unrecognized amount			(24,964)	(24,964)
7.	AVA at end of year (1. - 6.f.)			1,498,885	1,498,885

Appendix D – 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., 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	\$ 920,830	\$ 926,164	\$ 5,334	0.6%
Disability benefits	56,398	56,617	219	0.4%
Survivor benefits	9,186	9,226	40	0.4%
Deferred retirements	56,918	61,490	4,572	8.0%
Refunds	5,808	6,010	202	3.5%
Subtotal	\$ 1,049,140	\$ 1,059,507	\$ 10,367	1.0%
Deferred retirements	140,871	141,341	470	0.3%
Former members without vested rights	4,463	4,441	(22)	-0.5%
Benefit recipients	1,016,714	1,015,912	(802)	-0.1%
Total	\$ 2,211,188	\$ 2,221,201	\$ 10,013	0.5%
Present Value of Future Normal Costs (PVFNC)	Retained Actuary	VIA Replication	\$ Difference	% Difference
Active members				
Retirement annuities	\$ 226,806	\$ 229,630	\$ 2,824	1.2%
Disability benefits	34,003	34,714	711	2.1%
Survivor benefits	2,900	2,924	24	0.8%
Deferred retirements	48,192	52,384	4,192	8.7%
Refunds	20,838	18,530	(2,308)	-11.1%
Total	\$ 332,739	\$ 338,182	\$ 5,443	1.6%
Actuarial Accrued Liability (AAL)	Retained Actuary	VIA Replication	\$ Difference	% Difference
Active members				
Retirement annuities	\$ 694,024	\$ 696,534	\$ 2,510	0.4%
Disability benefits	22,395	21,903	(492)	-2.2%
Survivor benefits	6,286	6,302	16	0.3%
Deferred retirements	8,726	9,106	380	4.4%
Refunds	(15,030)	(12,520)	2,510	-16.7%
Subtotal	\$ 716,401	\$ 721,325	\$ 4,924	0.7%
Deferred retirements	140,871	141,341	470	0.3%
Former members without vested rights	4,463	4,441	(22)	-0.5%
Benefit recipients	1,016,714	1,015,912	(802)	-0.1%
Total	\$ 1,878,449	\$ 1,883,019	\$ 4,570	0.2%

Appendix D – Plan Liability Replications

Normal Cost	Retained Actuary	VIA Replication	\$ Difference	% Difference
Active members				
Retirement annuities	\$ 32,722	\$ 31,550	\$ (1,172)	-3.6%
Disability benefits	5,078	4,942	(136)	-2.7%
Survivor benefits	391	375	(16)	-4.1%
Deferred retirements	6,250	6,561	311	5.0%
Refunds	2,945	2,487	(458)	-15.6%
Total	\$ 47,386	\$ 45,915	\$ (1,471)	-3.1%

