

**Minnesota  
Legislative Commission on  
Pensions and Retirement**

**Replication of July 1, 2020  
PERA General Plan Actuarial Valuation Report**

June 24, 2021

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Minnesota Legislative Commission on Pensions and Retirement  
55 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, 2020 PERA General Plan Actuarial Valuation Report**

Commission Members:

This report presents our replication of the July 1, 2020 actuarial valuation report for the Public Employees Retirement Association of Minnesota General Employees Retirement Plan (PERA General 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.

**Purpose of the Study**

This study was prepared at the request of the LCPR. Its sole purpose is to replicate the July 1, 2020 PERA General Plan actuarial valuation report for reasonability, accuracy, and compliance with applicable Minnesota Statutes, LCPR standards of 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.”

A valuation “replication” is similar to a valuation “review” except that a replication focuses on the valuation's technical aspects and less on the presentation of those results.

This report may not be used for any other purpose, and Van Iwaarden Associates 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

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

- July 1, 2020 actuarial valuation report prepared by the PERA General Plan's retained actuary;
- July 1, 2020 census data files provided by PERA and "scrubbed" census files provided by the retained actuary; and
- July 1, 2020 asset and financial data provided by PERA.

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

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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, 2020 PERA General Employees Retirement Plan actuarial valuation report. We conclude that the retained actuary reasonably determined the system's July 1, 2020 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.

Our Normal Cost is approximately 5.6% lower than the retained actuary's results. We worked with the retained actuary to understand the difference and determined that the majority of the discrepancy is due to a difference in actuarial valuation software methods. The retained actuary's software calculates benefits at the middle of the year, while ours calculates benefits at the beginning of the year and adjusts for middle of year decrement timing.

|  | PERA General Plan<br>Actuarial Valuation | VIA Replication | Difference <sup>1</sup> |
|--|--|-----------------|-------------------------|
| <b>Participant data</b>                      |  |                 |                         |
| Active members                               | 153,741                                  | 153,741         | 0.0%                    |
| Service retirements                          | 95,830                                   | 98,126          | 2.4%                    |
| Survivors                                    | 8,981                                    | 8,982           | 0.0%                    |
| Disability retirements                       | 3,681                                    | 1,385           | -62.4%                  |
| Deferred retirements                         | 64,672                                   | 64,659          | 0.0%                    |
| Other non-vested terminations                | 79,069                                   | 79,070          | 0.0%                    |
| <b>Total</b>                                 | <b>405,974</b>                           | <b>405,963</b>  | <b>0.0%</b>             |
| <b>System assets (\$1,000's)</b>             |  |                 |                         |
| Market value of assets                       | \$ 22,631,459                            | \$ 22,631,459   | 0.0%                    |
| Actuarial Value of Assets                    | 22,792,333                               | 22,792,333      | 0.0%                    |
| <b>System liabilities (\$1,000's)</b>        |  |                 |                         |
| Present Value of Benefits (PVB)              | 32,507,634                               | 32,562,419      | 0.2%                    |
| Present Value of Future Normal Costs (PVFNC) | 3,880,718                                | 3,963,761       | 2.1%                    |
| Actuarial Accrued Liability (AAL)            | 28,626,916                               | 28,598,658      | -0.1%                   |
| <b>System contributions (% of payroll)</b>   |  |                 |                         |
| Normal cost rate                             | 7.68%                                    | 7.25%           | -0.43%                  |
| UAAL amortization payment                    | 5.27%                                    | 5.23%           | -0.04%                  |
| Expenses                                     | 0.18%                                    | 0.18%           | 0.00%                   |
| Total required contribution (Chapter 356)    | 13.13%                                   | 12.66%          | -0.47%                  |
| Statutory contribution rate (Chapter 353)    | 14.53%                                   | 14.53%          | 0.00%                   |
| Contribution sufficiency/(deficiency)        | 1.40%                                    | 1.87%           | 0.47%                   |

<sup>1</sup> 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

Pension actuarial calculations involve two main phases:

- Calculating the present value of future retiree benefits (i.e., plan liabilities) for a specific purpose; and
- Using the actuarial liabilities and plan assets to determine various results that fulfill the purpose (e.g., actuarial contributions or accounting disclosures).

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. Note that we are not providing commentary on the presentation/formatting of results in the retained actuary's report since that topic is covered in a separate actuarial valuation *review*.

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); and
5. Confirmation of actuarial assumptions, methods, and plan provisions.

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

|  |   |
|--|---|
| <b>Census data</b>                               | <ul style="list-style-type: none"> <li>▪ Compare participant category counts and summary statistics for the retained actuary vs. system census data files</li> <li>▪ Compare detailed participant distributions for the retained actuary's census file vs. the valuation report summaries</li> </ul>      |
| <b>Plan assets</b>                               | <ul style="list-style-type: none"> <li>▪ Compare market asset values in the valuation report to those in the system's audited financial statements</li> <li>▪ Replicate retained actuary's Actuarial Value of Assets calculations</li> </ul>  |
| <b>Plan liabilities</b>                          | <ul style="list-style-type: none"> <li>▪ Replicate technical liability calculations, including Present Value of Benefits (PVB), Present Value of Future Normal Costs (PVFNC), and Actuarial Accrued Liability (AAL)</li> <li>▪ Compare liability calculations for various member status groups</li> </ul> |
| <b>Contribution sufficiency/(deficiency)</b>     | <ul style="list-style-type: none"> <li>▪ Replicate the required normal cost and supplemental contribution rate calculations</li> <li>▪ Replicate retained actuary's contribution sufficiency/(deficiency) determination</li> </ul>  |
| <b>Assumptions, methods, and plan provisions</b> | Verify that the actuarial assumptions, methods, and plan provisions used in the July 1, 2020 actuarial valuation are consistent 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, 2020 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 to those in the retained actuary’s July 1, 2020 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, with the exception of reclassification of Service Retirements vs. Disability Retirements and some very slight differences that are likely due to refinements during the retained actuary’s data collection process.

**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, 2020 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 18, 22 and 26 of the July 1, 2020 actuarial valuation report.

During the replication process, GRS discovered a small typo on page 43 of their report. It was originally disclosed that nine years of service was assumed for terminated vested members where this information was not provided by the system. However, the liability calculations actually used six years of service for this purpose. We used six years of service for our liability replication.

## 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, 2020 actuarial valuation report, we used the following process:

- Request audited financial data from the system and compare it to the information disclosed in the actuarial valuation report; and
- Replicate the AVA calculations shown in the July 1, 2020 actuarial valuation report.

**We found that the asset data used by the retained actuary was consistent with the audited asset information provided by the system. 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 usually a complex process which involves substantial effort and actuarial programming experience. All inputs and parameters must be calibrated correctly, or the modeling software will produce inaccurate results.

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, 2020 actuarial valuation report, Minnesota Statutes, and the LCPR's standards for actuarial work. The primary results we replicated are:

- **Present Value of Benefits (PVB):** projected plan liability equal to the discounted value of all future expected benefit payments
- **Present Value of Future Normal Costs (PVFNC):** discounted value of active member benefits attributable to future service (i.e., not yet earned), when expressed as a level percent of pay
- **Actuarial Accrued Liability (AAL):** portion of the PVB attributable to past service (i.e., benefits already earned); also equal to the PVB minus PVFNC.

The tables in Appendix D summarize and compare these liability measurements for different membership groups. **Our overall results are very close to those presented in the July 1, 2020 actuarial valuation report, and we believe that the retained actuary is reasonably calculating plan liabilities.**

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 PVB and AAL within 2% and PVFNC within 5% of the retained actuary's results.

Our Normal Cost is approximately 5.6% lower than the retained actuary's results. We worked with the retained actuary to understand the difference and determined that the majority of the discrepancy is due to a difference in actuarial valuation software methods. The retained actuary's software calculates benefits at the middle of the year, while ours calculates benefits at the beginning of the year and adjusts for middle of year decrement timing.

Result 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. Our opinion is that any differences between our replicated liabilities and those produced by the retained actuary are reasonable and can be explained by slightly different programming methods and actuarial valuation systems.

## Contribution Sufficiency/(Deficiency)

PERA's statutory pension contribution rates are defined in Chapter 353 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:

- **Required supplemental contribution rate:** We calculated the required supplemental contribution rate based on our replication of the Unfunded Actuarial Accrued Liability and projected payroll through the statutory June 30, 2048 full funding date.
- **Statutory contributions:** We calculated the estimated dollar value of the statutory normal cost contributions based on the blended statutory contribution rates calculated by the retained actuary and applied to our replication of projected payroll. These amounts are added to the statutory supplemental contribution rates.
- **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.
- **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, 2020 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, 2020 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 39 through 69. 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 PERA use the Entry Age Normal level percent of pay actuarial cost method. In this method, the actuarial Present Value of Benefits (PVB) 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 PVB allocated to the valuation year is called the Normal Cost (NC). The portion of the PVB 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 35-38 of the July 1, 2020 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.

## Assumptions, Methods, and Plan Provisions (continued)

### Actuarial Assumptions

**Demographic assumptions:** We verified that the demographic assumptions described in the July 1, 2020 actuarial valuation report were based on those developed in the 2014-2018 actuarial experience study dated June 27, 2019. The allowance for Combined Service Annuity assumptions are based on the LCPR prior actuary's report dated October 2016.

Several of the assumptions are no longer in agreement with those described in the 2018 Appendix to the LCPR's Standards for Actuarial Work. We recommend the appendix be updated to be less prescriptive.

**Economic assumptions:** We verified that the economic assumptions described in the July 1, 2020 actuarial valuation report were based on those developed in the 2019 experience study, with an investment return assumption and discount rate per Minnesota Statute, Section 356.215 Subd.8(a).

### Plan Provisions

Minnesota Statutes, Chapter 353 describe the retirement benefits provided to PERA members, and the primary service annuity formulas. We reviewed the plan provisions summarized in the July 1, 2020 actuarial valuation report and believe they are consistent with our understanding of the benefits described in Minnesota Statutes.

## 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. The notable differences are reasonable and the actuary’s data updates appear appropriate.

### Summary of Participant Statistics

|   | <b>Retained Actuary</b> | <b>System Data</b> | <b>Difference</b> |
|---|-------------------------|--------------------|-------------------|
| <b>Active members</b>                     | <b>153,741</b>          | <b>153,741</b>     | <b>0</b>          |
| Average age                               | 46.3                    | 46.3               | 0.0%              |
| Average service                           | 9.54                    | 9.58               | 0.3%              |
| Average salary                            | \$ 41,298               | \$ 40,986          | -0.8%             |
| <b>Service retirements<sup>2</sup></b>    | <b>95,830</b>           | <b>98,126</b>      | <b>2,296</b>      |
| Average age                               | 73.1                    | 73.1               | 0.0%              |
| Average yearly annuity                    | \$ 14,921               | \$ 14,914          | 0.0%              |
| <b>Survivors</b>                          | <b>8,981</b>            | <b>8,982</b>       | <b>1</b>          |
| Average age                               | 76.4                    | 76.4               | 0.0%              |
| Average yearly annuity                    | \$ 15,893               | \$ 15,892          | 0.0%              |
| <b>Disability retirements<sup>2</sup></b> | <b>3,681</b>            | <b>1,385</b>       | <b>(2,296)</b>    |
| Average age                               | 68.3                    | 59.7               | -12.5%            |
| Average yearly annuity                    | \$ 14,065               | \$ 13,148          | -6.5%             |
| <b>Deferred retirements</b>               | <b>64,672</b>           | <b>64,659</b>      | <b>(13)</b>       |
| Average age                               | 50.6                    | 50.6               | 0.0%              |
| <b>Other non-vested terminations</b>      | <b>79,069</b>           | <b>79,070</b>      | <b>1</b>          |
| Average age                               | 50.9                    | 48.8               | -4.1%             |
| <b>Total</b>                              | <b>405,974</b>          | <b>405,963</b>     | <b>(11)</b>       |

<sup>2</sup> PERA reclassifies disabled members as service retirees once they reach Normal Retirement Age. Therefore, the retained actuary adjusted the status for 2,296 service retirees to be disabled retirees based on their historical classification as disabled retirees.

## Appendix A – Census Data Comparisons (continued)

### 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, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

| Age            | Years of Service as of June 30, 2020 |                 |                 |                 |                 |                 |                 |                 |                 | Total           |
|----------------|--------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                | <3                                   | 3-4             | 5-9             | 10-14           | 15-19           | 20-24           | 25-29           | 30-34           | 35+             |                 |
| <25            | 7,650                                | 560             | 68              |                 |                 |                 |                 |                 |                 | 8,278           |
| Avg pay        | \$17,861                             | \$28,196        | \$32,462        |                 |                 |                 |                 |                 |                 | \$18,680        |
| 25-29          | 7,872                                | 2,970           | 1,625           | 12              |                 |                 |                 |                 |                 | 12,479          |
| Avg pay        | \$29,059                             | \$39,238        | \$43,945        | \$42,192        |                 |                 |                 |                 |                 | \$33,432        |
| 30-34          | 6,496                                | 3,286           | 4,467           | 863             | 21              |                 |                 |                 |                 | 15,133          |
| Avg pay        | \$31,969                             | \$44,798        | \$52,097        | \$53,635        | \$50,734        |                 |                 |                 |                 | \$41,958        |
| 35-39          | 6,179                                | 3,110           | 4,698           | 2,492           | 814             | 41              |                 |                 |                 | 17,334          |
| Avg pay        | \$29,983                             | \$44,661        | \$53,842        | \$62,930        | \$61,871        | \$62,526        |                 |                 |                 | \$45,394        |
| 40-44          | 4,957                                | 2,672           | 4,186           | 2,373           | 1,962           | 757             | 16              |                 |                 | 16,923          |
| Avg pay        | \$30,420                             | \$39,516        | \$49,268        | \$60,752        | \$70,230        | \$69,555        | \$72,250        |                 |                 | \$47,177        |
| 45-49          | 3,954                                | 2,193           | 4,046           | 2,579           | 2,039           | 1,893           | 480             | 18              |                 | 17,202          |
| Avg pay        | \$28,766                             | \$38,484        | \$43,196        | \$52,782        | \$65,502        | \$74,373        | \$70,918        | \$66,250        |                 | \$47,588        |
| 50-54          | 3,311                                | 1,866           | 3,701           | 3,175           | 2,615           | 2,256           | 1,568           | 704             | 31              | 19,227          |
| Avg pay        | \$31,261                             | \$39,131        | \$41,087        | \$45,600        | \$54,777        | \$66,819        | \$73,217        | \$71,791        | \$67,424        | \$48,619        |
| 55-59          | 2,931                                | 1,658           | 3,184           | 3,138           | 3,330           | 3,045           | 2,041           | 1,654           | 641             | 21,622          |
| Avg pay        | \$26,840                             | \$37,187        | \$39,905        | \$41,993        | \$46,369        | \$54,985        | \$67,095        | \$75,270        | \$71,644        | \$47,561        |
| 60-64          | 2,271                                | 1,250           | 2,371           | 1,987           | 2,482           | 2,655           | 1,960           | 1,226           | 1,066           | 17,268          |
| Avg pay        | \$23,057                             | \$33,260        | \$38,386        | \$42,533        | \$45,191        | \$47,972        | \$54,852        | \$68,866        | \$74,295        | \$45,178        |
| 65-69          | 1,231                                | 523             | 974             | 699             | 652             | 624             | 456             | 266             | 283             | 5,708           |
| Avg pay        | \$14,736                             | \$22,093        | \$28,973        | \$36,860        | \$41,017        | \$43,464        | \$48,960        | \$60,128        | \$73,351        | \$34,447        |
| 70+            | 694                                  | 362             | 611             | 315             | 218             | 128             | 91              | 60              | 88              | 2,567           |
| Avg pay        | \$10,288                             | \$14,744        | \$15,569        | \$23,980        | \$28,006        | \$40,567        | \$39,928        | \$54,085        | \$60,629        | \$20,668        |
| <b>Total</b>   | <b>47,546</b>                        | <b>20,450</b>   | <b>29,931</b>   | <b>17,633</b>   | <b>14,133</b>   | <b>11,399</b>   | <b>6,612</b>    | <b>3,928</b>    | <b>2,109</b>    | <b>153,741</b>  |
| <b>Avg pay</b> | <b>\$26,978</b>                      | <b>\$39,196</b> | <b>\$45,042</b> | <b>\$49,809</b> | <b>\$54,160</b> | <b>\$59,116</b> | <b>\$63,583</b> | <b>\$71,257</b> | <b>\$72,691</b> | <b>\$42,953</b> |

Note that the average pay in this table does not match the average pay for active members on the prior page because the amounts shown above include data adjustments as described in the assumption section of the 2020 valuation report.

## Appendix A – Census Data Comparisons (continued)

### 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 18 from the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

| Age         | Years Retired as of June 30, 2020 |          |          |          |          |          |          | Total    |
|-------------|-----------------------------------|----------|----------|----------|----------|----------|----------|----------|
|             | <1                                | 1-4      | 5-9      | 10-14    | 15-19    | 20-24    | 25+      |          |
| <50         |                                   |          |          |          |          |          |          |          |
| Avg benefit |                                   |          |          |          |          |          |          |          |
| 50-54       | 2                                 | 10       |          |          |          |          |          | 12       |
| Avg benefit | \$11,269                          | \$8,154  |          |          |          |          |          | \$8,673  |
| 55-59       | 535                               | 1,307    | 37       | 1        |          |          |          | 1,880    |
| Avg benefit | \$18,090                          | \$12,651 | \$12,343 | \$13,582 |          |          |          | \$14,193 |
| 60-64       | 1,466                             | 5,495    | 2,489    | 74       | 12       |          |          | 9,536    |
| Avg benefit | \$17,866                          | \$16,623 | \$14,245 | \$21,617 | \$37,152 |          |          | \$16,258 |
| 65-69       | 2,029                             | 11,754   | 8,277    | 2,552    | 191      | 11       |          | 24,814   |
| Avg benefit | \$15,955                          | \$15,292 | \$15,946 | \$13,637 | \$31,870 | \$34,677 |          | \$15,531 |
| 70-74       | 263                               | 3,643    | 11,313   | 6,021    | 2,715    | 166      | 10       | 24,131   |
| Avg benefit | \$13,430                          | \$13,781 | \$14,663 | \$15,220 | \$14,947 | \$42,494 | \$41,572 | \$14,890 |
| 75-79       | 67                                | 541      | 2,648    | 5,635    | 4,293    | 2,159    | 18       | 15,361   |
| Avg benefit | \$10,091                          | \$9,913  | \$11,658 | \$12,969 | \$14,360 | \$15,473 | \$44,502 | \$13,400 |
| 80-84       | 17                                | 194      | 586      | 1,216    | 3,708    | 3,540    | 1,027    | 10,288   |
| Avg benefit | \$6,826                           | \$5,961  | \$8,929  | \$10,070 | \$11,443 | \$15,278 | \$21,438 | \$13,344 |
| 85-89       | 5                                 | 52       | 185      | 304      | 665      | 2,620    | 2,294    | 6,125    |
| Avg benefit | \$8,265                           | \$6,114  | \$5,790  | \$6,035  | \$8,808  | \$13,487 | \$21,687 | \$15,381 |
| 90+         | 3                                 | 5        | 39       | 72       | 168      | 416      | 2,980    | 3,683    |
| Avg benefit | \$6,837                           | \$2,257  | \$5,538  | \$5,717  | \$6,706  | \$10,752 | \$20,073 | \$17,941 |
| Total       | 4,387                             | 23,001   | 25,574   | 15,875   | 11,752   | 8,912    | 6,329    | 95,830   |
| Avg benefit | \$16,560                          | \$14,989 | \$14,514 | \$13,583 | \$13,460 | \$15,119 | \$20,983 | \$14,921 |

## Appendix A – Census Data Comparisons (continued)

### 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 22 of the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

| Age         | Years Since Death as of June 30, 2020 |          |          |          |          |          |          | Total    |
|-------------|---------------------------------------|----------|----------|----------|----------|----------|----------|----------|
|             | <1                                    | 1-4      | 5-9      | 10-14    | 15-19    | 20-24    | 25+      |          |
| <45         | 16                                    | 94       | 51       | 23       | 7        | 10       | 2        | 203      |
| Avg benefit | \$6,074                               | \$8,157  | \$4,968  | \$5,219  | \$4,331  | \$10,305 | \$14,583 | \$6,896  |
| 45-49       | 8                                     | 22       | 21       | 15       | 5        | 4        | 7        | 82       |
| Avg benefit | \$7,395                               | \$9,734  | \$8,447  | \$6,271  | \$3,915  | \$8,925  | \$14,705 | \$8,573  |
| 50-54       | 18                                    | 53       | 42       | 26       | 13       | 7        | 6        | 165      |
| Avg benefit | \$11,310                              | \$8,223  | \$6,323  | \$5,093  | \$8,814  | \$9,568  | \$7,007  | \$7,642  |
| 55-59       | 31                                    | 104      | 82       | 36       | 12       | 8        | 15       | 288      |
| Avg benefit | \$10,351                              | \$11,931 | \$7,636  | \$8,789  | \$4,324  | \$13,466 | \$12,887 | \$9,921  |
| 60-64       | 64                                    | 220      | 184      | 81       | 40       | 20       | 15       | 624      |
| Avg benefit | \$12,463                              | \$13,348 | \$11,724 | \$9,565  | \$8,689  | \$15,461 | \$11,434 | \$12,011 |
| 65-69       | 95                                    | 344      | 264      | 159      | 87       | 43       | 36       | 1,028    |
| Avg benefit | \$12,373                              | \$13,149 | \$12,020 | \$12,341 | \$12,045 | \$16,753 | \$20,236 | \$12,968 |
| 70-74       | 104                                   | 394      | 340      | 201      | 123      | 55       | 48       | 1,265    |
| Avg benefit | \$13,505                              | \$13,127 | \$13,462 | \$12,819 | \$12,646 | \$21,231 | \$20,741 | \$13,794 |
| 75-79       | 105                                   | 343      | 319      | 199      | 126      | 77       | 114      | 1,283    |
| Avg benefit | \$13,879                              | \$14,623 | \$13,461 | \$12,392 | \$13,139 | \$16,527 | \$20,588 | \$14,426 |
| 80-84       | 87                                    | 365      | 336      | 181      | 162      | 108      | 172      | 1,411    |
| Avg benefit | \$13,908                              | \$15,119 | \$15,806 | \$17,167 | \$15,275 | \$20,935 | \$25,853 | \$17,242 |
| 85-89       | 60                                    | 279      | 276      | 183      | 146      | 118      | 219      | 1,281    |
| Avg benefit | \$18,351                              | \$18,633 | \$21,101 | \$16,943 | \$20,040 | \$19,786 | \$23,717 | \$20,046 |
| 90+         | 38                                    | 195      | 240      | 209      | 179      | 135      | 355      | 1,351    |
| Avg benefit | \$25,378                              | \$21,633 | \$21,488 | \$18,808 | \$21,538 | \$21,818 | \$24,361 | \$21,998 |
| Total       | 626                                   | 2,413    | 2,155    | 1,313    | 900      | 585      | 989      | 8,981    |
| Avg benefit | \$14,043                              | \$14,604 | \$14,764 | \$14,152 | \$15,643 | \$19,358 | \$23,154 | \$15,893 |



## Appendix A – Census Data Comparisons (continued)

### 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 26 of the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

| Age         | Years Disabled as of June 30, 2020 |          |          |          |          |          |          | Total    |
|-------------|------------------------------------|----------|----------|----------|----------|----------|----------|----------|
|             | <1                                 | 1-4      | 5-9      | 10-14    | 15-19    | 20-24    | 25+      |          |
| <45         | 2                                  | 7        | 8        | 3        |          |          |          | 20       |
| Avg benefit | \$15,007                           | \$6,288  | \$7,343  | \$2,965  |          |          |          | \$7,084  |
| 45-49       | 2                                  | 20       | 19       | 1        | 3        |          |          | 45       |
| Avg benefit | \$21,975                           | \$12,852 | \$9,669  | \$12,676 | \$3,482  |          |          | \$11,285 |
| 50-54       | 9                                  | 43       | 35       | 17       | 10       |          |          | 114      |
| Avg benefit | \$15,284                           | \$11,147 | \$9,421  | \$6,887  | \$4,628  |          |          | \$9,737  |
| 55-59       | 28                                 | 134      | 87       | 59       | 28       | 5        | 7        | 348      |
| Avg benefit | \$20,524                           | \$15,737 | \$11,276 | \$9,156  | \$7,166  | \$5,647  | \$7,280  | \$12,886 |
| 60-64       | 25                                 | 213      | 193      | 126      | 89       | 38       | 22       | 706      |
| Avg benefit | \$21,860                           | \$17,081 | \$15,355 | \$11,522 | \$9,861  | \$6,517  | \$6,836  | \$13,988 |
| 65-69       | 168                                | 570      | 57       | 48       | 11       | 8        | 3        | 865      |
| Avg benefit | \$14,099                           | \$14,629 | \$16,563 | \$10,999 | \$8,845  | \$7,959  | \$9,909  | \$14,300 |
| 70-74       |                                    | 120      | 592      | 13       | 3        | 7        | 15       | 750      |
| Avg benefit |                                    | \$11,216 | \$13,942 | \$12,412 | \$8,008  | \$40,536 | \$26,166 | \$13,948 |
| 75+         | 1                                  |          | 66       | 400      | 205      | 104      | 57       | 833      |
| Avg benefit | \$11,866                           |          | \$9,956  | \$13,844 | \$16,284 | \$18,375 | \$24,005 | \$15,395 |
| Total       | 235                                | 1,107    | 1,057    | 667      | 349      | 162      | 104      | 3,681    |
| Avg benefit | \$15,801                           | \$14,645 | \$13,596 | \$12,530 | \$13,165 | \$15,644 | \$19,152 | \$14,065 |

## 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 11 in the July 1, 2020 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> |
|--|-------------------------|--------------------------|
| <b>Assets in Trust</b>                               |                         |                          |
| Cash, equivalents, short term securities             | 968,024                 | 968,024                  |
| Fixed income   | 4,605,517               | 4,605,517                |
| Equity   | 13,486,107              | 13,486,107               |
| Private Markets                                      | 3,536,096               | 3,536,096                |
| Other  | 5,997                   | 5,997                    |
| <b>Total Assets in Trust</b>                         | <b>22,601,741</b>       | <b>22,601,741</b>        |
| Assets Receivable                                    | 39,659                  | 39,659                   |
| Amounts Payable                                      | (9,941)                 | (9,941)                  |
| <b>Net Assets Held in Trust for Pension Benefits</b> | <b>22,631,459</b>       | <b>22,631,459</b>        |

## Appendix C – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's July 1, 2020 AVA calculation (see page 13 in the July 1, 2020 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<br>Actuary     | VIA Match               |
|---|---------------------|-------------------------|-------------------------|
| <b>1. Market value of assets available for benefits</b> |                     | 22,631,459              | 22,631,459              |
| 2. Determination of average asset balance               |                     |                         |                         |
| a. Total assets at beginning of year                    |                     | 22,440,968              | 22,440,968              |
| b. Total assets at end of year                          |                     | 22,631,459              | 22,631,459              |
| c. Net investment income for fiscal year                |                     | 931,041                 | 931,041                 |
| d. Average balance (a. + b. - c.)/2                     |                     | 22,070,693              | 22,070,693              |
| 3. Expected return (7.50% x 2.d.)                       |                     | 1,655,302               | 1,655,302               |
| 4. Actual return  |                     | 931,041                 | 931,041                 |
| 5. Current year asset gain/(loss) (4. - 3.)             |                     | (724,261)               | (724,261)               |
| 6. Unrecognized asset returns                           | Original<br>amounts | Unrecognized<br>percent | Unrecognized<br>amounts |
| a. FYE 2020   | (724,261)           | 80%                     | (579,409)               |
| b. FYE 2019   | (44,547)            | 60%                     | (26,728)                |
| c. FYE 2018   | 479,963             | 40%                     | 191,985                 |
| d. FYE 2017   | 1,266,388           | 20%                     | 253,278                 |
| e. FYE 2016   | (1,484,753)         | 0%                      | N/A                     |
| f. Total unrecognized amount                            |                     |                         | (160,874)               |
| <b>7. AVA at end of year (1. - 6.f.)</b>                |                     | <b>22,792,333</b>       | <b>22,792,333</b>       |

## 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, 2020 actuarial valuation report liabilities are reasonable. There are a couple of small benefit subclasses with larger differences (e.g., active deferred retirements and refunds), but these are very small relative to the overall plan and we believe they're due to different benefit classification interpretations. All amounts shown are in \$1,000's.

| Present Value of Benefits (PVB) Liability    | Retained<br>Actuary  | VIA<br>Replication   | \$<br>Difference   | %<br>Difference  |
|--|----------------------|----------------------|--------------------|------------------|
| Active members                               |                      |                      |                    |                  |
| Retirement annuities                         | \$ 12,712,929        | \$ 12,702,971        | \$ (9,958)         | -0.1%            |
| Disability benefits                          | 301,682              | 297,813              | (3,869)            | -1.3%            |
| Survivor benefits                            | 167,932              | 163,083              | (4,849)            | -2.9%            |
| Deferred retirements                         | 824,909              | 857,557              | 32,648             | 4.0%             |
| Refunds                                      | 91,078               | 121,321              | 30,243             | 33.2%            |
| Subtotal                                     | \$ 14,098,530        | \$ 14,142,745        | \$ 44,215          | 0.3%             |
| Deferred retirements                         | 2,012,753            | 2,015,520            | 2,767              | 0.1%             |
| Former members without vested rights         | 30,274               | 29,984               | (290)              | -1.0%            |
| Benefit recipients (retirees and survivors)  | 16,366,077           | 16,374,170           | 8,093              | 0.0%             |
| <b>Total</b>                                 | <b>\$ 32,507,634</b> | <b>\$ 32,562,419</b> | <b>\$ 54,785</b>   | <b>0.2%</b>      |
| Present Value of Future Normal Costs (PVFNC) | Retained<br>Actuary  | VIA<br>Replication   | \$<br>Difference   | %<br>Difference  |
| Active members                               |                      |                      |                    |                  |
| Retirement annuities                         | \$ 2,613,738         | \$ 2,744,085         | \$ 130,347         | 5.0%             |
| Disability benefits                          | 106,017              | 107,815              | 1,798              | 1.7%             |
| Survivor benefits                            | 47,382               | 44,673               | (2,709)            | -5.7%            |
| Deferred retirements                         | 841,308              | 756,876              | (84,432)           | -10.0%           |
| Refunds                                      | 272,273              | 310,312              | 38,039             | 14.0%            |
| Subtotal                                     | \$ 3,880,718         | \$ 3,963,761         | \$ 83,043          | 2.1%             |
| Deferred retirements                         | -                    | -                    | -                  | 0.0%             |
| Former members without vested rights         | -                    | -                    | -                  | 0.0%             |
| Benefit recipients (retirees and survivors)  | -                    | -                    | -                  | 0.0%             |
| <b>Total</b>                                 | <b>\$ 3,880,718</b>  | <b>\$ 3,963,761</b>  | <b>\$ 83,043</b>   | <b>2.1%</b>      |
| Actuarial Accrued Liability (AAL)            | Retained<br>Actuary  | VIA<br>Replication   | \$<br>Difference   | %<br>Difference  |
| Active members                               |                      |                      |                    |                  |
| Retirement annuities                         | \$ 10,099,191        | \$ 9,958,886         | \$ (140,305)       | -1.4%            |
| Disability benefits                          | 195,665              | 189,998              | (5,667)            | -2.9%            |
| Survivor benefits                            | 120,550              | 118,410              | (2,140)            | -1.8%            |
| Deferred retirements                         | (16,399)             | 100,681              | 117,080            | N/A <sup>3</sup> |
| Refunds                                      | (181,195)            | (188,991)            | (7,796)            | 4.3%             |
| Subtotal                                     | \$ 10,217,812        | \$ 10,178,984        | \$ (38,828)        | -0.4%            |
| Deferred retirements                         | 2,012,753            | 2,015,520            | 2,767              | 0.1%             |
| Former members without vested rights         | 30,274               | 29,984               | (290)              | -1.0%            |
| Benefit recipients (retirees and survivors)  | 16,366,077           | 16,374,170           | 8,093              | 0.0%             |
| <b>Total</b>                                 | <b>\$ 28,626,916</b> | <b>\$ 28,598,658</b> | <b>\$ (28,258)</b> | <b>-0.1%</b>     |

<sup>3</sup> The percent difference is not shown in situations comparing negative and positive liability amounts.

## Appendix E – 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, 2020 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   | \$ 28,626,916    | \$ 28,598,658   | \$ (28,258)   | -0.1%        |
| b. Current assets (AVA)  | 22,792,333       | 22,792,333      | -             | 0.0%         |
| c. Unfunded actuarial accrued liability  | \$ 5,834,583     | \$ 5,806,325    | \$ (28,258)   | -0.5%        |
| 2. Determination of Supplemental Contribution Rate                                 |                  |                 |               |              |
| a. Present value of future payrolls through the amortization date of June 30, 2048 | \$ 110,807,906   | \$ 111,004,824  | \$196,918     | 0.2%         |
| b. Supplemental contribution rate: (1.c. / 2.b.)                                   | 5.27%            | 5.23%           |               |              |

|  | Retained Actuary      | VIA Replication       | \$ Difference       |
|--|-----------------------|-----------------------|---------------------|
| Projected annual payroll for FY2020-2021   | \$6,907,861           | \$6,920,137           | \$ 12,276           |
|  | <u>% of Payroll</u>   | <u>\$ Amount</u>      | <u>% of Payroll</u> |
|  | <u>\$ Amount</u>      | <u>\$ Difference</u>  |                     |
| 1. Statutory Contributions - Chapter 353   |                       |                       |                     |
| a. Employee contributions  | 6.50%<br>\$ 449,035   | 6.50%<br>\$ 449,809   | \$ 774              |
| b. Employer contributions  | 7.50%<br>518,113      | 7.50%<br>519,010      | 897                 |
| c. Employer supplemental contributions   | 0.30%<br>21,000       | 0.30%<br>21,000       | -                   |
| d. State contributions   | 0.23%<br>16,000       | 0.23%<br>16,000       | -                   |
| e. Total   | 14.53%<br>\$1,004,148 | 14.53%<br>\$1,005,819 | \$ 1,671            |
| 2. Required Contributions - Chapter 356  |                       |                       |                     |
| a. Normal cost   |                       |                       |                     |
| i. Retirement benefits   | 5.41%<br>\$ 373,713   | 5.26%<br>\$ 363,929   | \$ (9,784)          |
| ii. Disability benefits  | 0.19%<br>13,138       | 0.18%<br>12,506       | (632)               |
| iii. Survivors   | 0.09%<br>6,217        | 0.08%<br>5,557        | (660)               |
| iv. Deferred retirement benefits   | 1.48%<br>102,247      | 1.20%<br>82,931       | (19,316)            |
| v. Refunds   | 0.51%<br>\$ 35,232    | 0.53%<br>36,591       | \$ 1,359            |
| vi. Total  | 7.68%<br>\$ 530,547   | 7.25%<br>\$ 501,514   | \$ (29,033)         |
| b. Supplemental Contribution Amortization of Unfunded Actuarial Accrued Liability by June 30, 2048 | 5.27%<br>\$ 364,044   | 5.23%<br>\$ 361,971   | \$ (2,073)          |
| c. Allowance for Expenses  | 0.18%<br>12,434       | 0.18%<br>12,456       | 22                  |
| d. Total   | 13.13%<br>\$ 907,025  | 12.66%<br>\$ 875,942  | \$ (31,083)         |
| 3. Contribution Sufficiency/(Deficiency)   | 1.40%<br>\$ 97,123    | 1.87%<br>\$ 129,878   | \$ 32,755           |