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Minnesota Legislative Commission on Pensions and Retirement

Actuarial Review of Retirement Systems as of July 1, 2016

Prepared by Deloitte Consulting LLP

April 2017

Contents

Actuarial Opinion

This report presents the results of the actuarial review performed by Deloitte Consulting, LLP of the July 1, 2016 actuarial valuations of selected statewide and major local Minnesota public retirement plans in accordance with Minnesota Statutes, Section 356.214, Subdivision 4, as directed by the Minnesota Legislative Commission on Pensions and Retirement ("LCPR" or "the Commission").

Our review was based on participant data and financial information provided by the systems and their actuaries. We assumed the data to be complete and accurate. Any subsequent changes to the data could change the results of our review. We did not independently audit the data and other information provided.

In our opinion, the July 1, 2016 actuarial valuations of the plans included in our analysis were performed in compliance with Minnesota Statutes, Section 356.215, with the Standards for Actuarial Work of the Commission, and with the applicable actuarial standards of practice issued by the Actuarial Standards Board. It is also our opinion that the actuarial liabilities and contribution rates developed are reasonable and reliable.

Future actuarial measurements may differ significantly from current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operations of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law.

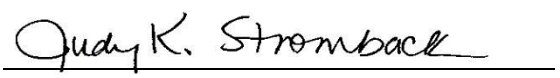
Our scope for this actuarial review did not include analyzing the potential range of such future measurements, and we did not perform that analysis.

This report is prepared solely for the benefit and internal use of the LCPR and the State of Minnesota. This report is not intended for the benefit of any other party and may not be relied upon by any third party for any purpose. Deloitte Consulting accepts no responsibility or liability with respect to any party other than the LCPR and the State of Minnesota in accordance with its statutory and regulatory requirements.

The undersigned with actuarial credentials collectively meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

To the best of our knowledge, no employee of the Deloitte U.S. Firms is an officer or director of the systems. In addition, we are not aware of any relationship between the Deloitte U.S. Firms and the systems that may impair or appear to impair the objectivity of the work detailed in this report.

DELOITTE CONSULTING LLP



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Executive Summary

Intent

The intent of this report is to provide an assessment of the reasonableness and reliability of July 1, 2016 actuarial reports prepared by Minnesota retirement systems' retained actuaries and to review the compliance of those reports with Minnesota Statutes, Section 356.215, the Standards for Actuarial Work of the LCPR, and the applicable actuarial standards of practice.

Process

To achieve the above-stated goals, we have reviewed both system-provided and actuary-provided census data, high-level asset information, detailed sample life output from each actuary's valuation software and the July 1, 2016 actuarial reports themselves.

A detailed description of our process is contained in the Process Description section of our report.

Results and Recommendations

As stated in the previous section, it is our opinion that the July 1, 2016 actuarial valuations of the plans included in our analysis were performed in compliance with Minnesota Statutes, Section 356.215, with the Standards for Actuarial Work of the LCPR, and with the applicable actuarial standards of practice. It is also our opinion that the actuarial liabilities and contribution rates developed are reasonable and reliable.

The assumptions used in the MSRS and PERA valuations were updated as recommended in the 2015 experience studies for those systems and approved by the Commission for the July 1, 2016 valuations. The updated assumptions were appropriately updated based on our review of the reports and sample lives.

We did not find any issues that rose to the level of serious concern; however, we have made recommendations that in our opinion may more accurately estimate the liabilities and appropriate contribution levels.

We have also noted potential changes to the reports that could be made to improve understanding of the actuarial work performed. In addition to clarifications for certain assumptions and plan provisions being valued, we recommend providing sensitivity analysis associated with certain assumptions.

These recommendations are discussed further in our Summary of Key Findings section as well as the detailed sections that follow.

Other Considerations

The following topics of significant importance to the Commission were not included in the scope of this review:

- Expected Return on Investments
- Funding Policy

While we touch briefly on these items in this report, we did not perform a detailed analysis of these issues. These topics may be included in the scope of future reports and presentations we will

deliver to the Commission in the future. It is important to understand that while we state that it is our opinion that the valuation results are reasonable and reliable based on the statutory assumptions and funding policy, changes to those underlying items could significantly impact the funded status of the plans and projected contributions.

Summary of Key Findings and Recommendations by System

Deloitte Consulting performed an actuarial review of the July 1, 2016 actuarial valuation reports of the Minnesota State Retirement System (MSRS), the Minnesota Public Employees Retirement Association (PERA), and the St. Paul Teachers' Retirement Association (STPRFA).

The plans reviewed within each system are summarized below. Please note that the Minnesota Teachers Retirement Association (TRA) Plan was excluded from this review because a separate replication valuation is being completed as of July 1, 2016 for that plan.

MSRS	PERA	SPTRFA
General	General	SPTRFA
State Patrol	Correctional	
Judges	Police & Fire	
Legislators		
Correctional		

The assumptions used in the MSRS and PERA valuations were updated as recommended in the 2015 experience studies for those systems and approved by the Commission for the July 1, 2016 valuations. The updated assumptions were appropriately updated based on our review of the reports and sample lives.

For all systems, we recommend the following changes be considered:

- We recommend that the Commission consider revising the Standards for Actuarial Work to provide that the actuarial assumptions regarding employee contribution refunds be based on actual experience. Although not necessarily the participant's best financial decision, empirical evidence suggests that participants often choose a refund of their employee contributions with interest, even when less than the present value of the annuity benefits for which they are eligible. The retained actuaries are correctly following the current State of Minnesota Standards for Actuarial Work, which require that the benefits valued be based on the larger of the member's contributions accumulated with interest or the present value of the annuity benefits for which they are eligible determined using the valuation actuarial assumptions. We recommend that actual experience of each system be studied to establish the best estimate for valuing the liability for this benefit feature.

- Several recent studies and papers have been published that draw focus to public plan funding methods, by entities including the Society of Actuaries Blue Ribbon Panel, Government Finance Officers Association, "Big 7" State and Local government associations, California Actuarial Advisory Panel and American Academy of Actuaries. We recommend that the Commission review these studies and consider whether any changes should be made to the current funding policy.

- Minnesota statutes require that the actuarial factors used to adjust benefits for early retirement and optional benefit forms be consistent with the results of the most recent experience study. The early retirement factors and optional benefit form actuarial equivalent factors used to measure each system's actuarial liabilities for valuation purposes were based on the plan factors in effect on the valuation date, which have not yet been updated to reflect the most recent experience studies (excluding SPTRFA, which is on a different experience study cycle). We understand that MSRS has initiated the process of updating their actuarial equivalence factors for benefit administration purposes to reflect the updated valuation assumptions. We recommend that the other systems also consider updating these factors.

The tables below summarize the key issues identified and estimated impact of any changes recommended for each specific system. In the sections that follow we provide the details supporting these findings and recommendations. Unless otherwise noted, the issue identified applies to all plans within the system noted. *We recommend the actuary consider changes to address each of the issues noted below.*

Minnesota State Retirement System (MSRS)			
Area of Review	**Issues Identified**	**Impact of Change**	**Other Comments**
Actuarial Report	Similar to our findings in the July 1, 2014 Review, because the Legislators plan is unfunded, we recommend disclosing undiscounted cash flows.	This information summarizes the outlay required by the plan, because it cannot rely on investment earnings.	Although not required, we believe this to be useful information in the case of an unfunded plan.

Public Employees Retirement Association (PERA)			
Area of Review	**Issues Identified**	**Impact of Change**	**Other Comments**
Compliance with State Statutes – Actuarial Assumptions	Similar to our findings in the July 1, 2014 Review, the Police & Fire plan is currently phasing-in early retirement factors (ERFs) for some participants based on valuation year instead of decrement year.	Because the changes in ERFs are not directionally consistent, liability differences are not easy to estimate but would be minimal.	Given that the phase-in schedule is known, it should be applied to all participants based on assumed decrement date.

St. Paul Teachers' Retirement Fund Association (SPTRFA)			
Area of Review	**Issues Identified**	**Impact of Change**	**Other Comments**
Data Validity	In comparison to the MSRS and PERA data provided to the actuary, the SPTRFA data process appears to necessitate additional questions and adjustments by the actuary.	Significant questions were posed by the actuary based on the data provided by the system and the prior year's valuation. The system relied on the actuary to identify inconsistencies between the 2016 and 2015 database, which we are unable to confirm.	In the July 1, 2014 Review we had a similar note, but attributed it to the first year of an administrative software replacement. Improving the system's data format and quality prior to being provided to the actuary could streamline the data process and limit adjustments by the actuary.

Process Description

In accordance with Minnesota Statutes, Section 356.214, Subdivision 4(b), our role as the Commission's actuary is to "audit[1] 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."

Below is a description of the areas of review our analysis covered and the processes followed to achieve the directives set forth in the statute above.

- **Review of Census Data** – There are typical and anticipated adjustments made to census data in preparing an actuarial valuation. This section assesses the reasonableness of the retained actuary's reconciliation and data adjustment procedures, including their documentation in the valuation report. By comparing summary statistics from the valuation reports to our data analysis, we can highlight differences in the underlying processed data and the likely impact on cost. This section also determines the completeness, quality, and consistency of the data delivered by the system to the retained actuary, and aims to identify potential improvements in the current data collection process.
- **Review of Financial Data** - Adjustments are made to the systems' market value of assets to determine the actuarial value of assets. These adjustments impact valuation results and potential contribution rates. We reviewed the methods and calculations performed to determine the actuarial value of assets.
- **Review Compliance with State Statutes** – The plan provisions and some actuarial assumptions and methods are prescribed by State Statute. Our review identifies the applicable statutes, and compares their requirements against the provisions, assumptions, and methods valued and disclosed in the report by the systems' retained actuary. Certain federal statutes, primarily the maximum benefit limits and maximum compensation limits as defined in Internal Revenue Code (IRC) Sections 415(b) and 401(a)(17) respectively, are also applicable. The applicable statutes are identified within our review of each component below.
- **Validation of Liabilities and Contribution Rates** – The liabilities reported in the actuarial valuations are an aggregation of the liability calculated for each individual participant. In this section, we review targeted Sample Lives to determine that the retained actuaries have reasonably calculated liabilities and contribution rates for each plan.
- **Review of Actuarial Report for completeness and correctness –** In this section, we review the content of the actuarial report for required disclosures and accuracy of information. We provide a summary of any inaccuracies contained within the report and areas of potential improvement.

[1] For purposes of this report, the term "audit" refers to an actuarial review of the work performed by the systems' actuaries. It does not refer to an audit under generally accepted government auditing standards.

These areas of review are conducted in accordance with applicable Actuarial Standards of Practice (ASOPs) and the Standards for Actuarial Work established by the State of Minnesota LCPR. The specific standards applicable to each review area are identified within each subsection.

Review of Census Data

Applicable ASOPs and State Statutes

Actuarial Standard of Practice No. 23, Data Quality, provides general guidance for determining if data is appropriate for its intended purpose and whether it is sufficiently reasonable, consistent, and comprehensive. Section 3.1 of the ASOP effective for the July 1, 2016 actuarial valuation reports states:

> Data that are completely accurate, appropriate, and comprehensive are frequently not available. 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.

The purpose of this section is to determine the completeness, quality, and consistency of the data and the data transfer process from the system to the retained actuary.

Section 3.5 of this Standard also addresses the actuary's responsibilities in reviewing data upon which they rely and states that in such cases:

> …the actuary should review the data for reasonableness and consistency, unless, in the actuary's professional judgment, such review is not necessary or not practical. In exercising such professional judgment, the actuary should take into account the extent of any checking, verification, or auditing that has already been performed on the data, the purpose and nature of the assignment, and relevant constraints.

And Section 3.7c. of this Standard states:

> …judgmental adjustments or assumptions can be applied to the data that allow the actuary to perform the analysis.

Therefore, this section also assesses the reasonableness of the retained actuary's reconciliation and data adjustment procedures.

We note that a revised edition of ASOP No. 23 was adopted by the Actuarial Standards Board in December 2016, which will be effective for any actuarial work product for which data were provided to or developed by the actuary on or after April 30, 2017. This guidance will apply for the July 1, 2017 and future years' actuarial valuation reports. No significant changes were made in the revised standard. Therefore, we do not expect that any significant changes to the retained actuaries' census data procedures will be required to comply with the revised guidance.

Minnesota State Retirement System (MSRS)

Quality of census data and the data transfer process by the system:
Census files provided to the retained actuary were reviewed to assess quality and consistency. The data counts and field values appear consistent, using prior valuations as a baseline. The data clearly identifies the applicable retirement plan and eligible benefits for each record. The method used by the actuary to obtain system data has been consistent over the last several years, and consists of the system providing a dataset containing all records in its data, which is processed by the actuary.

Records that were excluded were explainable. Thousands of participants from the system's data were excluded from the plan actuarial valuations, the majority of which are terminated Unclassified Participants. These participants may have been eligible to transfer to the MSRS General Plan while they were employed, depending on their date of hire and years of service, but are now certainly ineligible because they have terminated employment. Therefore, they have appropriately been excluded from any valuation. Exclusions were also made for participant records with certain status codes, indicating death and refund of employee contributions.

Overall, we believe the data received is of sufficient quality and completeness to perform the actuarial valuation. It contains both the information necessary to value benefits and exclude participants that are ineligible for benefits.

Data reconciliation and adjustment process performed by the actuary:
We have reviewed adjustments and assumptions that the actuary deemed necessary to create a valuation database for each plan. The actuary lists in their final reports the data adjustments and assumptions made in their data reconciliation. We have found the adjustments to be minimal, consistent, and reasonable.

The following tables provide a summary comparing the demographic statistics for each plan between the system data and the actuary's data as disclosed in the valuation report. As illustrated, very few adjustments were required, and our review did not reveal any additional adjustments that we would recommend.

Minnesota State Retirement System (Continued)

General State Employees Retirement Plan

	System Data	Actuary Data	Difference
Active Members	49,472	49,472	-
Average Age	47.0	47.0	-
Average Service	11.6	11.6	-
Service Retirements	32,241	32,241	-
Average Monthly Annuity	$ 1,620	$ 1,621	0.06%
Survivors	3,874	3,868	-0.15%
Average Monthly Annuity	$ 1,475	$ 1,477	0.14%
Disability Retirements	1,843	1,843	-
Average Monthly Annuity	$ 1,186	$ 1,186	-
Deferred Retirements	17,019	17,019	-
Average Age	50.8	50.7	-0.20%
Average Monthly Annuity (at NRD)	$ 873	$ 871	-0.23%
Terminated Other Non-Vested	7,571	7,571	-
Total	112,020	112,014	-0.01%

No differences above necessitated further investigation. All adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes to the adjustments being made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

State Patrol

	System Data	Actuary Data	Difference
Active Members	892	892	-
Average Age	40.7	40.7	-
Average Service	11.1	11.1	-
Service Retirements	844	844	-
Average Monthly Annuity	$ 4,944	$ 4,944	-
Survivors	151	151	-
Average Monthly Annuity	$ 2,802	$ 2,802	-
Disability Retirements	53	53	-
Average Monthly Annuity	$ 3,747	$ 3,747	-
Deferred Retirements	55	55	-
Average Age	44.5	44.5	-
Average Monthly Annuity (at NRD)	$ 1,758	$ 1,774	0.91%
Terminated Other Non-Vested	20	20	-
Total	2,015	2,015	-

Minnesota State Retirement System (Continued)

State Patrol (Continued)

No differences above necessitated further investigation. All adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes to the adjustments being made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Judges

	System Data	Actuary Data	Difference
Active Members	311	311	-
Average Age	56.9	56.9	-
Average Service	9.7	9.9	2.06%
Service Retirements	250	250	-
Average Monthly Annuity	$ 5,671	$ 5,671	-
Survivors	80	80	-
Average Monthly Annuity	$ 4,117	$ 4,117	-
Disability Retirements	20	20	-
Average Monthly Annuity	$ 5,891	$ 5,891	-
Deferred Retirements	17	17	-
Average Age	58.7	58.6	-0.17%
Average Monthly Annuity (at NRD)	$ 3,146	$ 3,239	2.96%
Terminated Other Non-Vested	-	-	-
Total	678	678	-

The difference of greater than 1% for the average service of active judges is related to the applicable 24-year service cap. The system service data provided for 11 actives appears to be capped at 24 years, while the actuary service data appears uncapped. No further differences above necessitated further investigation.

The difference of greater than 1% for the average monthly annuity (at NRD) for deferred retirements is due to adjustments for missing benefit information made by the actuary. We have reviewed the assumptions noted in the actuary's valuation report for these adjustments and find them to be reasonable, but have not replicated the benefit estimates.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes to the adjustments being made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Minnesota State Retirement System (Continued)

Legislators

	System Data	Actuary Data	Difference
Active Members	23	23	-
Average Age	68.2	68.2	-
Average Service	29.2	29.2	-
Service Retirements	302	302	-
Average Monthly Annuity	$ 1,994	$ 1,994	-
Survivors	70	70	-
Average Monthly Annuity	$ 1,583	$ 1,583	-
Disability Retirements	-	-	-
Average Monthly Annuity	$ -	$ -	-
Deferred Retirements	52	52	-
Average Age	60.0	59.9	-0.17%
Average Monthly Annuity (at NRD)	$ 1,418	$ 1,850	30.47%
Terminated Other Non-Vested	-	-	-
Total	447	447	-

The difference of greater than 1% for the average monthly annuity (at NRD) for deferred retirements is due to adjustments for missing benefit information made by the actuary. We have reviewed the assumptions noted in the actuary's valuation report for these adjustments and find them to be reasonable, but have not replicated the benefit estimates.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes in adjustments be made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Minnesota State Retirement System (Continued)

Correctional

	System Data	Actuary Data	Difference
Active Members	4,521	4,521	-
Average Age	41.5	41.4	-0.24%
Average Service	8.7	8.7	-
Service Retirements	2,426	2,426	-
Average Monthly Annuity	$ 1,768	$ 1,770	0.11%
Survivors	208	208	-
Average Monthly Annuity	$ 1,278	$ 1,278	-
Disability Retirements	284	284	-
Average Monthly Annuity	$ 1,637	$ 1,644	0.43%
Deferred Retirements	1,316	1,316	-
Average Age	45.6	45.6	-
Average Monthly Annuity (at NRD)	$ 761	$ 784	3.02%
Terminated Other Non-Vested	661	661	-
Total	9,416	9,416	-

The difference of greater than 1% for the average monthly annuity (at NRD) for deferred retirements is due to adjustments for missing benefit information made by the actuary. We have reviewed the assumptions noted in the actuary's valuation report for these adjustments and find them to be reasonable, but have not replicated the benefit estimates.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes to the adjustments being made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Public Employees Retirement Association of Minnesota (PERA)

Quality of census data and the data transfer process by the system:
Census files provided to the retained actuary were reviewed to assess quality and consistency. The data counts and field values appear consistent, using prior valuations as a baseline. The data clearly identifies the applicable retirement plan and eligible benefits for each record. The method used by the actuary to obtain system data has been consistent over the last several years, and consists of the system providing a dataset containing all records in its data, which is processed by the actuary.

Records that were excluded were explainable. Thousands of participants are excluded from the plans' actuarial valuations, primarily for participant records with certain status codes indicating death and refund of employee contributions. As noted in the report, all participants active on the day prior to an employer privatizing are eligible for a deferred vested benefit in PERA. Therefore, active records indicated as participating in a Privatized Plan were excluded, while their record reflecting prior vested service in the prior PERA Plan has been retained.

Public Employees Retirement Association of Minnesota (Continued)

We also note that for this system, nearly all Vested Deferred participant benefits are calculated by the actuary based on earnings and salary information provided by the system. This is unlike other systems, which provide a benefit amount for Vested Deferred participants. There is a potential for individual participant benefit amounts to be calculated inaccurately; however, we have no reason to believe that this method would result in a conservative or aggressive bias in actuarial valuation results. Our July 1, 2016 replication valuation for the PERA General Plan did not find inaccuracies in these calculations.

Overall, we believe the data received is of sufficient quality and completeness to perform the actuarial valuation. It contains both the information necessary to value benefits and exclude participants that are ineligible for benefits.

Data reconciliation and adjustment process performed by the actuary:
We have reviewed adjustments and assumptions that the actuary deemed necessary to create a valuation database for each plan. The actuary lists in their final reports the data adjustments and assumptions made in their data reconciliation. We have found the adjustments to be minimal, consistent, and reasonable.

The following tables provide a summary comparing the demographic statistics between the system and the actuary's data for each plan. As illustrated, very few adjustments were required, and our review did not reveal any additional adjustments that we would recommend.

General Employees Retirement Plan

	System Data	Actuary Data	Difference
Active Members	148,745	148,745	-
Average Age	46.5	46.5	-
Average Service	10.1	10.1	-
Service Retirements	83,976	81,911	-2.46%
Average Monthly Annuity	1,205	1,205	-
Survivors	8,548	8,547	-0.01%
Average Monthly Annuity	1,370	1,363	-0.51%
Disability Retirements	1,768	3,830	116.63%
Average Monthly Annuity	997	1,105	10.83%
Deferred Retirements	52,515	52,516	0.00%
Average Age	51.0	51.0	-
Average Monthly Annuity (at NRD)	N/A	N/A	N/A
Terminated Other Non-Vested	132,419	132,416	0.00%
Total	427,971	427,965	0.00%

Public Employees Retirement Association of Minnesota (Continued)

The two count line items with differences greater than 1% are related to disabled individuals who reached full retirement age in FY 2016. The system classifies these individuals as part of the Service Retirement group, while the actuary reclassified these individuals as disability retirements to accurately capture the increased mortality rates associated with this population. We agree with the adjustment in status for these participants and have confirmed the number of people in the plan that move from Service Retirement to Disability Retirement is appropriate.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes in adjustments be made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Police & Fire

	System Data	Actuary Data	Difference
Active Members	11,398	11,398	-
Average Age	40.4	40.4	-
Average Service	12.4	12.4	-
Service Retirements	7,409	7,222	-2.52%
Average Monthly Annuity	$ 4,448	$ 4,462	0.31%
Survivors	1,873	1,873	-
Average Monthly Annuity	$ 2,577	$ 2,577	-
Disability Retirements	1,076	1,257	16.82%
Average Monthly Annuity	$ 3,820	$ 3,839	0.50%
Deferred Retirements	1,490	1,490	-
Average Age	44.7	44.7	-
Average Monthly Annuity (at NRD)	N/A	N/A	N/A
Terminated Other Non-Vested	1,059	1,059	-
Total	24,305	24,299	-0.02%

Consistent with the General Plan, we understand that the status corrections from Service Retirements to Disability Retirements were also made as noted above. We agree with the correction in status for these participants, and have confirmed that the number of people in the plan that moved from Service Retirement to Disability Retirement is appropriate.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes in adjustments be made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Public Employees Retirement Association of Minnesota (Continued)

Correctional

	System Data	Actuary Data	Difference
Active Members	3,827	3,827	-
Average Age	39.4	39.4	-
Average Service	7.5	7.5	-
Service Retirements	794	749	-5.67%
Average Monthly Annuity	$ 788	$ 748	-5.08%
Survivors	49	49	-
Average Monthly Annuity	$ 690	$ 690	-
Disability Retirements	124	169	36.29%
Average Monthly Annuity	$ 1,400	$ 1,416	1.14%
Deferred Retirements	2,755	2,755	-
Average Age	41.9	41.9	-
Average Monthly Annuity (at NRD)	N/A	N/A	N/A
Terminated Other Non-Vested	2,359	2,359	-
Total	9,908	9,908	-

Consistent with the General Plan, we understand that the status corrections from Service Retirements to Disability Retirements were also made as noted above. We agree with the correction in status for these participants, and have confirmed that the number of people in the plan that moved from Service Retirement to Disability Retirement is appropriate.

All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes in adjustments be made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

St. Paul Teachers' Retirement Fund Association (SPTRFA)

Quality of census data and the data transfer process by the system:
Census files provided to the retained actuary were reviewed to assess quality and consistency.

Through the actuary's data reconciliation, they asked a variety of clarifying questions to the system due to these inconsistencies. We were provided these questions and answers, and applied the corrections to the system data prior to comparison to the actuary data. While we can confirm that data was updated appropriately per this additional information from the system, we cannot confirm that all inconsistencies between the July 1, 2016 and July 1, 2015 datasets were identified. It should be noted that in comparison to the MSRS and PERA data provided to the actuary, the SPTRFA data process appears to necessitate additional questions and adjustments by the actuary.

In spite of the potential shortcomings above, we believe the data received is of sufficient quality and completeness to perform the actuarial valuation. It contains both the information necessary to value benefits and exclude participants that are ineligible for benefits.

St. Paul Teachers' Retirement Fund Association (Continued)

Data reconciliation and adjustment process performed by the actuary:
We have reviewed adjustments and assumptions that the actuary deemed necessary to create a valuation database for each plan. The actuary lists in their final reports the data adjustments and assumptions made in their data reconciliation. We have found the adjustments to be minimal, consistent, and reasonable.

The following table provides a summary comparing the demographic statistics between the system and the actuary's data for each plan. As illustrated, very few adjustments were required, and our review did not reveal any additional adjustments that we would recommend.

	System Data	Actuary Data	Difference
Active Members	3,457	3,455	-0.06%
Average Age	44.8	44.8	-
Average Service	12.8	12.7	-0.78%
Leave of Absence Members	77	79	2.60%
Service Retirements	3,360	3,363	0.09%
Average Monthly Annuity	$ 2,507	$ 2,508	0.04%
Survivors	328	328	-
Average Monthly Annuity	$ 2,777	$ 2,777	-
Disability Retirements	32	32	-
Average Monthly Annuity	$ 1,620	$ 1,620	-
Deferred Retirements	2,020	2,020	-
Average Age	48.6	48.6	-
Average Monthly Annuity (at NRD)	N/A	N/A	N/A
Terminated Other Non-Vested	2,915	2,915	-
Total	12,189	12,192	0.02%

In our July 1, 2014 Review, we noted that there were a small number of deferred vested participants for whom only estimated contributions were valued due to unavailable earnings information. In the July 1, 2016 valuation, the Actuary has updated their valuation methodology to assume a final average salary in order to calculate an annuity benefit for these participants, and has disclosed this assumption in their valuation report. We agree with this updated process.

We understand that the small differences shown above were resolved between the system and the actuary through additional email communication during the data reconciliation process. All other adjustments made by the actuary were replicated within a reasonable margin and we would suggest no changes in adjustments be made. Very few gaps in data existed in the data provided by the system, and assumptions used to populate those gaps were reasonable.

Review of Financial Data

Applicable ASOPs and State Statutes

Actuarial Standard of Practice No. 44, Selection and Use of Asset Valuation Methods for Pension Valuations, governs the asset valuation method for pension valuations, which is used to develop the actuarial value of assets (AVA). In short, the Standard does not take issue with using Market Value of Assets (MVA) as a Plan's Actuarial Value of Assets (AVA).

When a plan opts to use a smoothing method, the ASOP provides that the actuary should select an asset valuation method that is designed to produce actuarial values of assets that bear a reasonable relationship to the corresponding market values. In making that determination, the Standard indicates that such a method would be likely to produce:

- AVAs that are sometimes greater than and sometimes less than the corresponding market values
- AVAs that fall within a reasonable range of market values
- Recognition of differences between a plan's AVA and MVA within a reasonable period of time

All three requirements above are considered to be met if in the actuary's professional judgment the asset valuation method:

- Produces AVAs within a sufficiently narrow range of market values; and/or
- Recognizes differences between AVA and MVA in a sufficiently short period

The intent of this section of our report is to identify the asset valuation method prescribed by State Statute, confirm it has been implemented correctly by the retained actuary, and identify whether it conforms to ASOP No. 44.

In accordance with Minnesota Statutes, Section 356.215, Subdivision 1(f), the actuarial value is calculated by adjusting the market value to remove 80% of the prior year's investment gain or loss, 60% of the gain or loss from two years ago, 40% of the gain or loss from three years ago, and 20% of the gain or loss from four years ago. The gain or loss is measured by comparing actual returns on a market value basis to those expected using the 8.00% assumption in 2016. The actuarial value of assets is not constrained by a range of the market value of assets.

We believe the statutory method results in an AVA that bears a reasonable relationship to MVA, although we note that the trend within the industry is toward shorter recognition periods and increased use of corridors, the latter of which is lacking from the current method.

Our match of each retained actuary's AVA calculation can be found in Appendix B. Below is a summary of our findings.

Minnesota State Retirement System (MSRS)

Based on our review the statutory method is being applied accurately.

General State Employees Retirement Plan

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

State Patrol

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

Judges

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

Legislators

The Legislators plan assets were exhausted in 2016, and thus the plan is now funded solely on a pay-as-you-go basis.

Correctional

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

Public Employees Retirement Association of Minnesota (PERA)

Based on our review the statutory method is being applied accurately.

General Employees Retirement Plan

As shown in AVA calculation in Appendix B, there is a $240,000 difference between the MVA reported by the actuary and the MVA reported by the system. Per the system, this difference is due to a reclassification of a piece of equipment from an expense to equipment. This ultimately results in a $248,000 difference in AVA calculations, which rounds to 0.0%. Overall, we were able to replicate the retained actuary's AVA calculation process for the actuarial value of Assets.

Police & Fire

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

Correctional

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

St. Paul Teachers' Retirement Fund Association (SPTRFA)

Based on our review the statutory method is being applied accurately. Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets.

Compliance with State Statutes – Plan Provisions

Applicable ASOPs and State Statutes

Eligibility for and determination of retirement benefits payable from the reviewed systems are stipulated by Minnesota statutes. Benefit provisions are found primarily in Minnesota Statutes, Sections 352 (MSRS), 353 (PERA), and certain sections of 354A (SPTRFA). Certain federal statutes, primarily the maximum benefit limits and maximum compensation limits as defined in Internal Revenue Code (IRC) Sections 415(b) and 401(a)(17) respectively, are also applicable.

MSRS, PERA, and SPTRFA

We have reviewed the sample life calculations noted in Appendix A for compliance with State Statute Sections referenced above. Participant benefit amounts were matched at every potential future decrement age and, if applicable, benefit amounts currently being paid were matched. No benefits provided by State Statute were identified as having been omitted from the valuation and the calculations reasonably reflect the benefits provided.

IRC Section 415(b) and IRC Section 401(a)(17) appear to be appropriately applied as described in the actuarial reports. The sample life calculations reviewed comply with these IRC sections.

Additional details of the specific sample life calculations can be found in Appendix A.

Compliance with State Statutes – Actuarial Assumptions

Applicable ASOPs and State Statutes

Minnesota Statutes, Section 356.215 provides certain required actuarial assumptions that must be used in performing systems' annual valuations. The explicitly prescribed actuarial assumptions include:

- Discount rate
- Salary scale
- Payroll growth
- Projected changes in Cost of Living Adjustments (COLA)

Section 356.215 also stipulates that other assumptions must be set at levels consistent with those determined in the most recent quadrennial experience study completed, including:

- Mortality
- Disability
- Retirement
- Withdrawal
- Other relevant demographic and economic assumptions

The purpose of this section of our report is to review the assumptions as summarized in the actuarial valuations and applied in sample life calculations to confirm compliance with the above-referenced statutes. In addition, we reviewed the assumptions for general reasonableness. A more detailed analysis of these assumptions is outside the scope of this report and was performed during our review of the MSRS General, PERA General and TRA quadrennial experience studies published in May 2016.

To review the reasonableness of the assumptions, we relied on the actuarial standards below and addressed prescribed and non-prescribed assumptions individually.

Actuarial Standards of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries in selecting economic assumptions. Generally stated, economic assumptions should be unbiased and be based on a combination of the actuary's professional judgment, historical and current economic data, and expected long-term future trends.

Actuarial Standard of Practice No. 35, Selection of Demographic and other Noneconomic Assumptions for Measuring Pension Obligations, provides guidance to actuaries in selecting demographic and other assumptions not covered by ASOP No. 27. The selection process is similar to ASOP No. 27.

We have reviewed the assumptions for reasonableness within the context of the standards and statutes above.

We have the following recommendation that applies to all systems:

- Participants are assumed to elect the greater of their Employee Contributions with interest or their deferred annuity upon termination. This is the most conservative valuation method of Employee Contributions, consistent with the State of Minnesota Standards for Actuarial Work and perhaps the most reasonable without information indicating otherwise. Although this situation was considered in the most recent experience studies performed for MSRS General, PERA General and TRA, we recommend analyzing actual experience in the next Experience Study to determine if a significant portion of employees are electing a refund of contributions when it is not the greater benefit.

Minnesota State Retirement System (MSRS)

We have reviewed the sample lives noted in Appendix A for compliance with the state statutes listed above. Assumptions including decrement rates, early retirement adjustment factors and percent married were confirmed at each decrement age. Overall, we found the assumptions prescribed by statute and elected based on experience studies to be applied correctly.

Public Employees Retirement Association (PERA)

We have reviewed the sample lives noted in Appendix A for compliance with the state statutes listed above. Assumptions including decrement rates, early retirement adjustment factors and percent married were confirmed at each decrement age. Overall, we found the assumptions prescribed by statute and elected based on experience studies to be applied correctly. We did identify one topic that we believe the retained actuary should review during the next valuation cycle:

- Similar to our findings during the July 1, 2014 review, in the Police and Fire Plan, the phase-in of early retirement factors appears to be based on valuation year, instead of decrement year, for at least some participants. The result is that the new early retirement factors remain only partially phased in for this group of participants. The overall changes in early retirement factors are not large and the retained actuary indicated the affected participants were a subset of active employees. Therefore, while we recommend the error be corrected, we do not believe the result would significantly change the Plan's overall funding position.

St. Paul Teachers' Retirement Fund Association (SPTRFA)

We have reviewed the sample lives noted in Appendix A for compliance with the state statutes listed above. Assumptions including decrement rates, early retirement adjustment factors and percent married were confirmed at each decrement age. Overall, we found the assumptions prescribed by statute and elected based on the previous experience study to be applied correctly.

Validation of Liabilities and Contribution Rates

Applicable State Statutes – Actuarial Methods

Actual employee and employer contribution rates are determined by the State of Minnesota Legislature, and fall outside the scope of this review. However, Minnesota Statutes, Section 356.215 requires that each plan's Normal Cost (NC), Actuarial Accrued Liability (AAL), and amortization of the Unfunded Actuarial Accrued Liability (UAAL) be calculated and disclosed using specified actuarial techniques. Additionally, it requires that the Annual Required Contribution (ARC) determined using this method be compared to statutory contribution rates to calculate the contribution sufficiency/(deficiency) that exists.

The components of a plan's Annual Required Contribution are its normal cost, and amortization of its UAAL. The amortization component is referred to as the Supplemental Contribution.

In order to determine a plan's normal cost, a replication valuation would be required. Matching Actuarial Accrued Liabilities and Normal Costs across plans also falls outside the scope of this review. However, representative sample lives have been selected and reviewed as summarized in Appendix A. By confirming decrement rates, benefit amounts, and select Present Value of Benefit calculations, we have determined the reasonableness of stated liabilities within each report.

Therefore, the intent of this portion of our review is to confirm the retained actuary's determination of the amortization of the Unfunded Actuarial Accrued Liability, or Supplemental Contribution as per State Statute. For each plan, we have summarized our verification below (in $000's), including the impact of any differences on funding sufficiency/(deficiency).

Minnesota State Retirement System (MSRS)

All calculations were matched within a reasonable threshold, as summarized below.

	Minnesota State Retirement System (MSRS)				
	General	Correctional	Legislators	State Patrol	Judges
Retained Actuary Suppplemental Contribution	$ 171,343	$ 26,919	$ 21,851	$ 12,798	$ 11,801
Deloitte Supplemental Contribution	$ 171,529	$ 26,928	$ 21,851	$ 12,805	$ 11,895
Dollar Difference in ARC	$ 186	$ 9	$ -	$ 7	$ 94
Projected Payroll for fiscal year beginning on valuation date	$ 2,889,433	$ 247,876	$ 895	$ 73,134	$ 48,070
Difference in ARC (as a % of payroll)	0.01%	0.00%	0.00%	0.01%	0.20%

The results above confirm that the actuary's calculation is consistent with the method described in the valuation report. For both the Judges and General Plan, the amortization period listed in state statute is slightly different than used by the retained actuary. We understand that the most recent statutes do not reflect the full funding periods developed in this valuation. We agree with the actuary's methodology.

Public Employees Retirement Association (PERA)

All calculations were matched within a reasonable threshold, as summarized below.

	Public Employees Retirement Association (PERA)		
	General	Correctional	Police & Fire
Retained Actuary Suppplemental Contribution	$ 513,303	$ 2,203	$ 68,412
Deloitte Supplemental Contribution	$ 513,557	$ 2,208	$ 68,501
Dollar Difference in ARC	$ 254	$ 5	$ 89
Projected Payroll for fiscal year beginning on valuation date	$ 5,906,821	$ 202,134	$ 915,827
Difference in ARC (as a % of payroll)	0.00%	0.00%	0.01%

The results above confirm that the actuary's calculation is consistent with the method described in the valuation report. For both the Police & Fire and General Plan, the amortization period listed in state statute is slightly different than used by the retained actuary. We understand that the most recent statutes do not reflect the full funding periods developed in this valuation. We agree with the actuary's methodology.

St. Paul Teachers' Retirement Fund Association (SPTRFA)

All calculations were matched within a reasonable threshold, as summarized below.

	SPTRFA
Retained Actuary Suppplemental Contribution	$ 36,147
Deloitte Supplemental Contribution	$ 36,004
Dollar Difference in ARC	$ (143)
Projected Payroll for fiscal year beginning on valuation date	$ 271,781
Difference in ARC (as a % of payroll)	-0.05%

Review of Actuarial Valuations

Applicable ASOPs and State Statutes

Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions**,** provides guidance regarding nearly all aspects of the actuarial valuation method, including several cross-references to other ASOPs cited in this review.

Actuarial Standard of Practice No. 41, Actuarial Communications, provides guidance for any written, electronic, or oral communication issued by an actuary with respect to actuarial services. The standard specifically identifies disclosures that must be made within Actuarial Reports like the annual valuations provided by the retirement systems.

A general rule applied to pension valuations is to make disclosures necessary to allow a qualified actuary to approximate the results, if required data were provided.

Minnesota Statutes, Section 356.215 provides additional information that retained actuaries must disclose in their annual actuarial valuations specific to Minnesota Retirement Plans.

The standards and statutes above identify what must be reported within the reviewed valuations. We have recommended additional disclosure where we judged its value to be worth the effort of production.

MSRS, PERA, and SPTRFA

For all plans, we recommend demonstrating the sensitivity of the discount rate assumption by providing the following key metrics using a discount rate 1% higher and 1% lower than the prescribed rate:

- Actuarial Accrued Liability
- Unfunded Actuarial Accrued Liability
- Funded Ratio
- Contribution Sufficiency/Deficiency

We recommend also showing the sensitivity of the threshold year for higher post-retirement benefit increases by showing the same metrics listed above if the threshold was reached immediately and if the threshold was never reached.

We note that for the PERA and MSRS valuation reports, an additional discount rate sensitivity section was added in which the unfunded actuarial accrued liability under a 7.50% discount rate is discussed. We commend the addition of this section, while still recommending more robust sensitivity analysis as noted above.

Minnesota State Retirement System (MSRS)

Each plan's actuarial valuation was reviewed in its entirety, and we have found each report to satisfy the requirements of ASOP No. 41 and Minnesota Statutes, Section 356.215.

Although no corrections are noted, similar to our July 1, 2014 Review we recommend the system and actuary consider making the following additions to the report:

- For the Legislators Plan specifically, we believe disclosing undiscounted cash flows would be a beneficial tool for understanding the financial obligation presented by the plan.

Public Employees Retirement Association (PERA)

Each plan's actuarial valuation was reviewed in its entirety, and we have found each report to satisfy the requirements of ASOP No. 41 and Minnesota Statutes, Section 356.215.

Although no corrections are noted, similar to our July 1, 2014 Review we recommend the system and actuary consider making the following additions to the report:

- We recommend the five-year phase in of the revised Early Retirement reduction factors be summarized in the Police & Fire plan report.

St. Paul Teachers' Retirement Fund Association (SPTRFA)

The plan's actuarial valuation was reviewed in its entirety, and we have found it to satisfy the requirements of ASOP No. 41 and Minnesota Statutes, Section 356.215.

Appendix A – Sample Lives Reviewed

Summary of Reviewed Sample Lives

Sample Life output is used by actuaries to confirm the actuarial assumptions, plan provisions, and actuarial methods used in actuarial valuations. The tables below summarize by system and plan the Sample Lives that Deloitte reviewed, as referenced throughout this report. While differences in actuarial valuation software prevent absolute matches of both liabilities and sample life output, we have reviewed representative participant sample lives and matched them within an acceptable threshold to confirm the reasonableness of stated liabilities within each report.

For all sample lives listed below, detailed output provided by the retained actuary was analyzed. Decrement rates for all benefits, early retirement adjustment factors, augmentation factors, monthly benefit amounts, optional form conversion rates and actuarial equivalence were tested and confirmed within a reasonable threshold. Participants were targeted to spread across benefit tiers to maximize the breadth of our review. Specific attention was spent verifying the assumption updates outlined in the MSRS General and PERA General Experience Studies that were published in June 2015.

For select Plans, each of the components above along with survival and discount rates were compiled to match the present value of benefits for each inactive participant, and decrement detail for active participants. Plans were selected based primarily on size. This method was chosen to maximize the percentage of the liability that has been validated more thoroughly.

Minnesota State Retirement System (MSRS)

		Minnesota State Retirement System (MSRS)			
	General	State Patrol	Judges	Legislators	Correctional
Active	5	4	4	2	4
Deferred Vested	2	2	2	2	2
Retired	2	2	2	3	2
Disabled	1	1	1	0	1
Survivor	1	1	1	2	1

Public Employees Retirement Association (PERA)

	Public Employees Retirement Association (PERA)		
	General	Police & Fire	Correctional
Active	5	4	4
Deferred Vested	2	2	2
Retired	2	2	2
Disabled	1	1	1
Survivor	1	1	1

Teacher Systems

	St. Paul Teachers' Retirement Fund Association (SPTRFA)
Active	5
Deferred Vested	3
Retired	2
Disabled	1
Survivor	1

Appendix B – Actuarial Value of Asset (AVA) Confirmations

Overall, we were able to replicate the retained actuary's calculation of the actuarial value of Assets as summarized below.

Minnesota State Retirement System (MSRS)

General Plan

	(In thousands of $'s)	Retained Actuary	Deloitte
		6/30/2016	**6/30/2016**
1	**MVA**	11,223,065	11,223,065
2	**Avg. Bal. Calc.**		
	a Total assets, BOY	11,638,319	11,638,319
	b Total assets, EOY	11,223,065	11,223,065
	c Net Investment Income	(9,633)	(9,633)
	d Avg. Balance (a+b-c)/2	11,435,509	11,435,509
3	**Expected Return (8.0% * 2.d.)**	914,841	914,841
4	**Actual Return**	(9,633)	(9,633)
5	**Current Year G/(L) (4-3)**	(924,474)	(924,474)
6	**Unrecognized asset returns**	Unrecognized AMT	Unrecognized AMT
	a FYE 2016	80% (739,579)	80% (739,579)
	b FYE 2015	60% (242,547)	60% (242,547)
	c FYE 2014	40% 416,610	40% 416,610
	d FYE 2013	20% 112,211	20% 112,211
	e FYE 2012	0% -	0% -
		(453,305)	(435,305)
7	**AVA at EOY**	11,676,370	11,676,370
8	**AVA / MVA =**	1.04	1.04

Minnesota State Retirement System (Continued)

State Patrol

	(*In thousands of $'s*)	Retained Actuary		Deloitte	
		6/30/2016		**6/30/2016**	
1	**MVA**		629,992		629,992
2	**Avg. Bal. Calc.**				
	a Total assets, BOY		664,530		664,530
	b Total assets, EOY		629,992		629,992
	c Net Investment Income		(774)		(774)
	d Avg. Balance (a+b-c)/2		647,648		647,648
3	**Expected Return (8.0% * 2.d.)**		51,812		51,812
4	**Actual Return**		(774)		(774)
5	**Current Year G/(L) (4-3)**		(52,586)		(52,586)
6	**Unrecognized asset returns**	Unrecognized AMT		Unrecognized AMT	
	a FYE 2016	80%	(42,069)	80%	(42,069)
	b FYE 2015	60%	(13,930)	60%	(13,930)
	c FYE 2014	40%	24,421	40%	24,421
	d FYE 2013	20%	6,728	20%	6,728
	e FYE 2012	0%	-	0%	-
			(24,850)		(24,850)
7	**AVA at EOY**		654,842		654,842
8	**AVA / MVA =**		1.04		1.04

Minnesota State Retirement System (Continued)

Judges

	(In thousands of $'s)	Retained Actuary	Deloitte
		6/30/2016	**6/30/2016**
1	**MVA**	165,905	165,905
2	**Avg. Bal. Calc.**		
	a Total assets, BOY	174,580	174,580
	b Total assets, EOY	165,905	165,905
	c Net Investment Income	(186)	(186)
	d Avg. Balance (a+b-c)/2	170,336	170,336
3	**Expected Return (8.0% * 2.d.)**	13,627	13,627
4	**Actual Return**	(186)	(186)
5	**Current Year G/(L) (4-3)**	(13,813)	(13,813)
6	**Unrecognized asset returns**	Unrecognized AMT	Unrecognized AMT
	a FYE 2016	80% (11,050)	80% (11,050)
	b FYE 2015	60% (3,679)	60% (3,679)
	c FYE 2014	40% 6,357	40% 6,357
	d FYE 2013	20% 1,752	20% 1,752
	e FYE 2012	0% -	0% -
		(6,620)	(6,620)
7	**AVA at EOY**	172,525	172,525
8	**AVA / MVA =**	1.04	1.04

Minnesota State Retirement System (Continued)

Correctional

	(In thousands of $'s)	Retained Actuary		Deloitte	
		6/30/2016		**6/30/2016**	
1	**MVA**		899,592		899,592
2	**Avg. Bal. Calc.**				
	a Total assets, BOY		909,002		909,002
	b Total assets, EOY		899,592		899,592
	c Net Investment Income		(195)		(195)
	d Avg. Balance (a+b-c)/2		904,395		904,395
3	**Expected Return (8.0% * 2.d.)**		72,352		72,352
4	**Actual Return**		(195)		(195)
5	**Current Year G/(L) (4-3)**		(72,547)		(72,547)
6	**Unrecognized asset returns**	Unrecognized AMT		Unrecognized AMT	
	a FYE 2016	80%	(58,038)	80%	(58,038)
	b FYE 2015	60%	(18,764)	60%	(18,764)
	c FYE 2014	40%	31,222	40%	31,222
	d FYE 2013	20%	8,172	20%	8,172
	e FYE 2012	0%	-	0%	-
			(37,408)		(37,408)
7	**AVA at EOY**		937,000		937,000
8	**AVA / MVA =**		1.04		1.04

Public Employees Retirement Association of Minnesota (PERA)

General Plan

	(In thousands of $'s)		Retained Actuary		Deloitte
			6/30/2016		**6/30/2016**
1	**MVA**		17,994,909		17,995,149
2	**Avg. Bal. Calc.**				
	a Total assets, BOY		18,581,795		18,581,795
	b Total assets, EOY		17,994,909		17,995,149
	c Net Investment Income		(20,851)		(20.851)
	d Avg. Balance (a+b-c)/2		18,298,777		18,298,898
3	**Expected Return (8.0% * 2.d.)**		1,463,902		1,463,912
4	**Actual Return**		(20,851)		(20,851)
5	**Current Year G/(L) (4-3)**		(1,484,753)		(1,484,763)
6	**Unrecognized asset returns**		Unrecognized AMT		Unrecognized AMT
	a FYE 2016	80%	(1,187,802)	80%	(1,187,810)
	b FYE 2015	60%	(378,517)	60%	(378,517)
	c FYE 2014	40%	628,684	40%	628,684
	d FYE 2013	20%	166,681	20%	166,681
	e FYE 2012	0%	-	0%	-
			(770,954)		(770,962)
7	**AVA at EOY**		18,765,863		18,766,111
8	**AVA / MVA =**		1.04		1.04

Public Employees Retirement Association of Minnesota (Continued)

Police & Fire

	(In thousands of $'s)	Retained Actuary		Deloitte	
		6/30/2016		**6/30/2016**	
1	**MVA**		7,098,090		7,098,090
2	**Avg. Bal. Calc.**				
	a Total assets, BOY		7,348,704		7,348,704
	b Total assets, EOY		7,098,090		7,098,090
	c Net Investment Income		(8,949)		(8,949)
	d Avg. Balance (a+b-c)/2		7,227,871		7,227,872
3	**Expected Return (8.0% * 2.d.)**		578,230		578,230
4	**Actual Return**		(8,949)		(8,949)
5	**Current Year G/(L) (4-3)**		(587,179)		(587,179)
6	**Unrecognized asset returns**	Unrecognized AMT		Unrecognized AMT	
	a FYE 2016	80%	(469,743)	80%	(469,743)
	b FYE 2015	60%	(152,768)	60%	(152,768)
	c FYE 2014	40%	263,972	40%	263,972
	d FYE 2013	20%	70,852	20%	70,852
	e FYE 2012	0%	-	0%	-
			(287,687)		(287,687)
7	**AVA at EOY**		7,385,777		7,385,777
8	**AVA / MVA =**		1.04		1.04

Public Employees Retirement Association of Minnesota (Continued)

Correctional

	(In thousands of $'s)	Retained Actuary		Deloitte	
		6/30/2016		**6/30/2016**	
1	**MVA**		507,783		507,783
2	**Avg. Bal. Calc.**				
	a Total assets, BOY		490,731		490,731
	b Total assets, EOY		507,783		507,783
	c Net Investment Income		209		209
	d Avg. Balance (a+b-c)/2		499,152		499,153
3	**Expected Return (8.0% * 2.d.)**		39,932		39,932
4	**Actual Return**		209		209
5	**Current Year G/(L) (4-3)**		(39,723)		(39,723)
6	**Unrecognized asset returns**	Unrecognized AMT		Unrecognized AMT	
	a FYE 2016	80%	(31,778)	80%	(31,778)
	b FYE 2015	60%	(9,943)	60%	(9,943)
	c FYE 2014	40%	15,772	40%	15,772
	d FYE 2013	20%	3,853	20%	3,853
	e FYE 2012	0%	-	0%	-
			(22,096)		(22,096)
7	**AVA at EOY**		529,879		529,879
8	**AVA / MVA =**		1.04		1.04

St. Paul Teachers' Retirement Fund Association (SPTRFA)

	(*In thousands of $'s*)	Retained Actuary	Deloitte
		6/30/2016	**6/30/2016**
1	**MVA**	959,666	959,666
2	**Avg. Bal. Calc.**		
	a Total assets, BOY	1,014,969	1,014,969
	b Total assets, EOY	959,666	959,666
	c Net Investment Income	1,475	1,475
	d Avg. Balance (a+b-c)/2	986,580	986,580
3	**Expected Return (8.0% * 2.d.)**	78,926	78,926
4	**Actual Return**	1,475	1,476
5	**Current Year G/(L) (4-3)**	(77,451)	(77,450)
6	**Unrecognized asset returns**	Unrecognized AMT	Unrecognized AMT
	a FYE 2016	80% (61,961)	80% (61,961)
	b FYE 2015	60% (33,377)	60% (33,377)
	c FYE 2014	40% 38,305	40% 38,305
	d FYE 2013	20% 9,339	20% 9,339
	e FYE 2012	0% -	0% -
		(47,694)	(47,694)
7	**AVA at EOY**	1,007,360	1,007,360
8	**AVA / MVA =**	1.05	1.05