Public Employees' Retirement Board
February 12, 2015

Topic: **Actuarial Audit Report – Cavanaugh Macdonald**

Board Motion

☐ Approve the actuarial audit report prepared by Cavanaugh Macdonald for the audit of the PERB's FY2014 actuarial valuation

☐ Other:

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REPORT OF THE ACTUARIAL AUDIT

OF THE JUNE 30, 2014 ACTUARIAL VALUATION

OF THE

PUBLIC EMPLOYEES' RETIREMENT SYSTEM DEFINED BENFIT PLAN

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February 4, 2015

Mr. Dore Schwinden
Executive Director
Montana Public Employees' Retirement Administration
100 North Park Avenue, Suite 200
Helena, MT 59620

Subject: Report of the Audit of the Services of the Consulting Actuary

Dear Mr. Schwinden:

Cavanaugh Macdonald Consulting, LLC was selected by the Montana Public Employee Retirement Administration (MPERA) to provide this independent actuarial audit of the work performed by MPERA's actuary, Cheiron. The audit was limited to reviewing Cheiron's work in preparing the June 30, 2014 actuarial valuation for the Public Employees' Retirement System Defined Benefit Plan (PERS-DB).

The scope of the requested audit was limited to the in-depth review of a sample set of individual calculations selected rather than a complete replication of the results. In addition, we were tasked with reviewing the soundness of the actuarial procedures utilized and conformity with accepted practices; the validity of the census data used by Cheiron for the valuation; the appropriateness of the actuarial assumptions and methods; the reasonableness of the actuarial cost method and actuarial asset valuation method; verification of the mathematical calculations, plan liabilities and plan assets; and the review of the method used to determine the actuarial factors used in administering the programs. Our findings are outlined in this report's executive summary with the details of our findings and recommendations provided in the section applicable to each audit task.

We would like to thank the MPERA staff for their responsiveness in providing all items we requested during the course of our review. We look forward to presenting our report to the Board of Trustees and to answering any questions concerning the information provided herein.

3550 Busbee Pkwy, Suite 250, Kennesaw, GA 30144
Phone (678) 388-1700 • Fax (678) 388-1730
www.CavMacConsulting.com
Offices in Englewood, CO • Kennesaw, GA • Bellevue, NE

The undersigned are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained in this report.

Sincerely,

John J. Garrett, ASA, FCA, MAAA
Principal and Consulting Actuary

Todd B. Green, ASA, FCA, MAAA
Principal and Consulting Actuary

JG/TG:kc

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1. EXECUTIVE SUMMARY

As an independent auditing actuary, Cavanaugh Macdonald Consulting, LLC (CMC) has been selected to provide an actuarial audit. MPERA has periodic audits performed to monitor the quality of actuarial services performed on behalf of the pension plan; to enhance the credibility of the actuarial valuation process; to increase public trust in how the pension plan is being governed; to help plan fiduciaries assess whether the plan is meeting its funding objectives; to remedy errors, if discovered; and to acquire recommendations for improving the actuarial valuation process.

Specifically, the following scope for the audit was identified in the request for proposals:

a. Determine if the Consulting Actuary's valuation procedures are technically sound and based on generally accepted actuarial standards.

b. Determine if the census data used by the Consulting Actuary is valid, complete and contains the necessary data elements.

c. Determine if the Consulting Actuary's determinations of demographic and economic actuarial assumptions are reasonable and are based on generally accepted actuarial standards.

d. Determine if the actuarial cost method and actuarial asset valuation method used by the Consulting Actuary are reasonable, including whether different methods may be more appropriate.

e. Determine if the Consulting Actuary's valuation results can be verified, including:
   i. verification that appropriate mathematical calculations are being made accurately; and
   ii. verification that plan liabilities and assets are being appropriately valued.

f. Evaluate the adequacy of the Consulting Actuary's method used to establish the actuarial factors provided to MPERA to calculate the following: service and disability retirement, service purchases, early retirement, non-increasing annuities and survivorships. This evaluation shall include a review of the variables or assumptions used by the Consulting Actuary to establish these factors.

The scope of the requested audit was limited to reviewing the work performed pertaining to the Public Employees' Retirement System Defined Benefit Plan (PERS-DB). We were provided full participant and financial data pertaining to the PERS-DB along with reports, plan descriptions, actuarial factors and applicable statutes pertaining to the plans. We also requested from Cheiron the participant data as reconciled for the June 30 2014 valuation as well as complete descriptions of all assumptions, methods and valuation procedures. Once we had reviewed the initial

information provided, we requested a set of detailed individual calculations of PERS-DB participants from Cheiron, called test cases, with specific attributes to allow for in-depth review of the accuracy of benefit calculations, the development of the present value of future benefits, the normal cost and the actuarial accrued liability, as well as the correct application of the assumptions.

In reporting this audit, we attempt to limit discussions concerning matters of opinions and focus primarily on the accuracy of calculations and factors, the completeness and reliability of reporting, and the compliance with acceptable actuarial principles and standards in all of the work reviewed. We attempt to make recommendations that are intended to improve the valuation process and minimize discussions on technical differences in the actuarial process which result in immaterial differences in the work produced.

We summarize our findings for each major audit task listed by the applicable section of this report and in the order of the requested scope of the audit, as follows:

1. **Determine if the Consulting Actuary's valuation procedures are technically sound and based on generally accepted actuarial standards.**

   We find that Cheiron's actuarial valuation work is technically sound and complies with generally accepted actuarial standards. Our findings are based on a review of the valuation procedures (Section 2 of this report); census data (Section 3 of this report) and the financial data; our review of the demographic and economic assumptions (Section 4 of this report); our review of the actuarial cost method and actuarial asset valuation method utilized (Section 5 of this report); our in-depth review of test lives (Section 6 of this report); and the general review of the development and reporting of the valuation results.

2. **Determine if the census data used by the Consulting Actuary is valid, complete and contains the necessary data elements**.

   We confirm the census data used by Cheiron for PERS-DB is valid, complete and contains sufficient data elements necessary for performing the June 30, 2014 actuarial valuation. We received and reviewed both the data provided to Cheiron from MPERA and the data as used in the valuation by Cheiron. We were able to independently reconstruct the valuation data and found no differences in the results. Further, we found the data fields provided were sufficient to perform the necessary calculations for the valuation of PERS-DB. We have no recommended changes to the data elements or the data processing steps performed by Cheiron.

3. **Determine if the Consulting Actuary's determinations of demographic and economic actuarial assumptions are reasonable and are based on generally accepted actuarial standards.**

   We find the demographic and economic assumptions are consistent, reasonable and developed based on generally accepted actuarial standards. Our finding is based on our general review of the experience study for the six-year period ending June 30, 2009 as this study is the basis for the assumptions used in the performance of the 2014 actuarial valuation. We also reviewed the presentation of the Economic Experience Study as of June 30, 2013. We confirm that the recommendations presented by Cheiron are reasonable and were developed in conformity with guidance provided to actuaries under the appropriate Actuarial Standards of Practice.

4. **Determine if the actuarial cost method and actuarial asset valuation method used by the Consulting Actuary are reasonable, including whether different methods may be more appropriate.**

   We find that the utilization of the entry age normal cost method (as a level percentage of salary) and the 4-year smoothing of the difference between actual and expected market return on investments are both reasonable and appropriate for the actuarial valuation of PERS-DB. The entry age normal cost method is the most common actuarial cost method used in performing actuarial valuations of large public sector retirement systems. We do not feel an alternative method would be more appropriate. The four-year asset smoothing method meets the guidelines of acceptable methods as provided in the Actuarial Standards of Practice (ASOP) although five-year smoothing of assets is the most prevalent method in use by large public plans. We do not feel that alternative smoothing methods offer a more appropriate result, but rather a different balance between smoothness and fit.

5. **Determine if the Consulting Actuary's valuations results can be verified, including:**
   i. **verification that appropriate mathematical calculations are being made accurately; and**
   ii. **verification that plan liabilities and assets are being appropriately valued.**

   Based on our review of the summarized calculations of individual participants provided by Cheiron, we find that the calculations of the present value of future benefits, the normal cost, and the actuarial accrued liability are generally reasonable, in aggregate, but we cannot verify their accuracy due to the limited and incomplete information we were provided by Cheiron. The differences we identified in our review are noted in our findings (see Section 6). Based on the summarized information provided, we can infer that the calculation of total plan liabilities is appropriately valued.

There are material differences between some of our calculations on the individual test cases and the summarized information provided by Cheiron. We discuss each material source of difference in Section 6 of this report. Due to being provided with significantly fewer than the number of requested test cases and the limited details included in those test cases supplied by Cheiron, we cannot verify the accuracy of the calculations. However, we believe that the results are reasonable, in aggregate. These calculations are very complex and minor differences in actuarial valuation programing of the same benefit by different actuaries can often result in material differences in the calculations for individual members. Based on the detailed information provided for retirees and beneficiaries receiving benefits, we have verified the accuracy of the calculations performed by Cheiron for these test cases. Due to the lack of sufficient detailed information contained in the calculations provided for the active participants and inactive participants with deferred benefits, we cannot verify the accuracy of the calculations of these test cases. As discussed above, we find that our calculations reasonably agree with the summarized results provided by Cheiron and, and as a result, we expect that the differences in the calculations noted would not result in a materially different value of plan liabilities.

6. **Evaluate the adequacy of the Consulting Actuary's method used to establish the actuarial factors provided to MPERA to calculate the following: service and disability retirement, service purchases, early retirement, non-increasing annuities and survivorships. This evaluation shall include a review of the variables or assumptions used by the Consulting Actuary to establish these factors.**

   Based on our review of the actuarial factors provided, we find that the factors are reasonably determined and adequate for their intended purposes. We have reviewed and reconstructed a sufficient sample of factors used in optional form of payment conversions, service purchases, early retirement reductions, non-increasing annuity conversions and for determining survivor benefits.

Conclusion

We satisfied the scope of the audit to the best of our abilities based on the information provided, our understanding of the PERS-DB System, and the applicable statutory provisions. We determined that the census data is valid, complete, and contains the necessary elements and that Cheiron's data procedures in preparing the data for the valuation are reasonable. As a result of our review of the demographic and economic assumptions, we believe they are reasonable and based on generally accepted actuarial standards. Futhermore, we find that the actuarial cost method and the actuarial asset valuation method are appropriate for use in the valuation of PERS-DB and the valuation assets are appropriately valued.

Although we cannot fully verify the accuracy of the actuarial calculations on all of the test lives we received, we find the aggregate results provided to be within a reasonable difference with our calculations and can, therefore, conclude that the plan liabilities, in total, are appropriately valued. We recommend that Cheiron further investigate the source of differences to assess the need for refinements to their current programming and procedures.

Finally, we have evaluated the methodology and assumptions used to develop the actuarial factors provided to MPERS for retirement, service purchase, early retirement, non-increasing annuities and survivorships and find that they are appropriately determined and based on reasonable parameters and assumptions.

As our final comment on the audit, we recommend that as an initial step of any future audits, MPERA determine the degree of detailed information the System's actuary will provide in support of the audit. As we noted in our RFP response, an audit based on a review of sample individual calculations relies heavily on the degree to which the System's actuary provides details of those calculations. This is especially true where material differences in calculations occur and require additional research to reconcile the results.

The remainder of this report provides the basis for our findings and recommendations for each of the six major audit tasks.

2. REVIEW OF VALUATION PROCEDURES

This section provides our findings and recommendations for the first item in the scope of the audit which provides a determination as to whether Cheiron's actuarial valuation procedures are technically sound and based on generally accepted actuarial standards. Although this is the first audit task item in the order of the scope of the audit, it relies somewhat upon the overall findings of other scope items which follow.

The actuarial calculations required to produce an actuarial valuation are extremely complex; even on the individual participant level. Acceptable actuarial principles and standards provide actuaries with guidance and a framework for performing the calculations, but there often exist differences as to precisely how the calculations are performed by different actuaries. Some of these differences are due to differing opinions and judgment while other differences exist within the details of the highly complex calculations and programming routines of valuation software. Where measurable differences occurred in our review of these calculations, we have attempted to reconcile these differences and assess whether each noted difference is material to the results. Where a material difference is noted, we recommend further review by Cheiron to determine if a change in the valuation procedures is necessary.

Based on the actuarial calculation of plan liabilities and the normal cost rate as provided in the valuation, we have verified the calculation of the funding period, the funded ratio and the contribution rates as a percentage of payroll as presented in the report. Through the review of the census and financial data provided to Cheiron, our understanding of PERS-DB provisions, the assumptions and methods utilized in the valuation, the reasonableness of the aggregate results of sample calculations provided, the calculation of the actuarial value of assets, and the development of the actuarial valuation results, we find that the valuation procedures utilized by Cheiron are technically sound and are based on generally accepted actuarial standards.

Our primary recommendations for improvements to the valuation procedures utilized by Cheiron are focused on our findings based on the review of individual calculations sampled during the audit which are discussed in detail in Section 6 of this report.

We note that the actuarial valuation report contains additional liability measures required by the Financial Accounting Standard Board (FASB) which are not applicable to public plans and are not necessary or informative in the valuation of an ongoing public retirement system. With the additional liability measures required under the applicable GASB statements, it is our opinion that providing the additional and unnecessary FASB measures may contribute to the confusion as to which liability measurement and which funded ratio of the plan should be the focus of the valuation results.

3. Review of Census Information

We received the participant and financial data as transmitted by MPERA to Cheiron for the plan year ending June 30, 2014. Cheiron also supplied us with PERS-DB census data as reconciled and prepared for use in the June 30, 2014 valuation. The data provided by MPERA appears to be accurate and complete with a few exceptions. We independently applied typical data handling processes and exactly matched with the headcounts presented by Cheiron in the valuation. The table below provides the results of the data reconciliation for PERS-DB.

Summary of June 30, 2014 Census Data Reconciliation for PERS-DB

	Cheiron	CMC
Active Records	28,229	28,229
Vested Inactive Records	2,825	2,825
Non-Vested Inactive Records	7,666	7,666
Service Retirees	17,073	17,073
Disabled Retirees	742	742
Beneficiaries	2,247	2,247
Total	58,782	58,782

In instances where there was missing data, we believe the assumptions used by Cheiron are appropriate. In summary, the data provided by MPERA is of high quality and the reconciliation process utilized by Cheiron is appropriate for preparing the data for the valuation.

As part of this audit task, we also verified the financial information provided to Cheiron and their use of the information in the valuation. We agree with the market value of assets as presented in the valuation report, based on the financial information provided, and its utilization in the development of the actuarial value of assets as of June 30, 2014.

4. Review of Demographic and Economic Actuarial Assumptions

This section provides our findings and recommendations concerning our review of demographic and economic actuarial assumptions for consistency, reasonableness and conformity with generally accepted actuarial practices. In performing this task we reviewed the report entitled "The Experience Study Results and Recommendations covering the period from July 1, 2003 to June 30, 2009". We also reviewed the "Economic Experience Study as of June 30, 2013" which contained recommendations which were not adopted by the Board.

We reviewed all of the recommended assumptions and methods presented in the experience study report with particular attention to the most material assumptions which include the investment rate of return, salary increases, retirement rates, and post-retirement mortality assumptions.

We find the development of the economic and demographic assumptions contained in the experience study report conforms with generally accepted actuarial principles and the applicable Actuarial Standards of Practice (ASOPs) in effect at that time. In our opinion, the recommendations presented in the experience study report are reasonable and consistent and the report provides sufficient discussion of Cheiron's analysis and findings to support their recommendations.

In our experience, an experience study would typically include a discussion and/or analysis of the current actuarial methods, but this was not included in Cheiron's report. As part of the experience study, the appropriateness of the current methods should be validated and analysis presented to the Board to consider alternative methods, if appropriate. We recommend future experience studies include the review and analysis of the current actuarial methods employed and consideration of appropriate alternatives.

5. Review of the Actuarial Cost Method and the Actuarial Asset Valuation Method

In this section we provide our findings and recommendations pertaining to the review of the actuarial cost method and the actuarial asset valuation method in use and whether other methods would be more appropriate for PERS-DB actuarial valuations.

Actuarial Cost Method

The actuarial cost method is a procedure in the actuarial calculations that allocates the present value of future benefits over the expected years of service of active participants. The actuarial cost method used in the PERS-DB valuation is the traditional entry age normal (EAN) actuarial cost method which is the most widely used cost method among large public pension plans. The latest information from the Public Funds Survey shows that approximately 80% of the 126 large public plans surveyed utilize this cost method. We would expect more plans in the future to use the entry age normal cost method as it is the only actuarial cost method which complies with the applicable GASB statements for the financial reporting of public sector pension plans.

Cheiron's implementation of the funding method determines the normal cost for each individual active participant as a level percentage of salary that, if contributed over the expected career of the members, would satisfy the expected present value of future benefits at their expected retirement age. In our opinion, the use of the entry age normal cost method (as a level percentage of salary) in the actuarial valuation of PERS-DB is both reasonable and appropriate. Further, it is our opinion that this method, as implemented by Cheiron, is the most appropriate cost method for use by large, ongoing public pension plans.

Actuarial Asset Valuation Method

A primary objective of most large public employee retirement systems is to have contribution requirements which will remain approximately level as a percent of active member payroll from year to year. Significant fluctuations in the market value of assets make this difficult to achieve. Thus, most actuaries recommend the utilization of an asset valuation method which smoothes out these fluctuations to enhance the year to year stability of valuation results. This is a question of balancing fit (measured against market value) and smoothness of results.

Desirable characteristics of an actuarial asset valuation method include the following:

- The method should be simple to operate and transparent in operation.
- The actuarial value of assets should be reasonably related to the market value.
- The method should be effective in smoothing the effect of typical market fluctuations.

5. Review of the Actuarial Cost Method and the Actuarial Asset Valuation Method

The four-year asset valuation smoothing method utilized by Cheiron is used by other large public employee retirement systems although a five-year smoothing period is the most common. Under this method, the difference between the actual return and the expected return, based on the market value of assets, is determined each year. Twenty-five percent of this difference is then recognized in the actuarial value of assets each year over a four-year period. The method, as utilized by Cheiron, does not place a corridor around the market value of assets that restricts the degree to which the actuarial value can vary from the market value. In addition, the smoothing method utilized is unbiased, meaning it is not expected to favor understating or overstating market value.

In accordance with Actuarial Standard of Practice No. 44 "Selection and Use of Asset Valuation Methods for Pension Valuations", the asset smoothing method utilized should be expected to return to market value in a reasonable period and expected to remain within a reasonable range of the market value. In our opinion, the method in use in the PERS-DB valuation satisfies the ASOP guidance.

In October of 2014, the Conference of Consulting Actuaries (CCA) published a white paper titled, "Actuarial Funding Policies and Practices for Public Pension Plans", which provides guidance to actuaries and plan administrators for the selection of actuarial valuation methods. The current method utilized by MPERA in the PERS-DB valuation is listed as an "acceptable method" under the guidance provided.

A "model practice" as presented in the CCA's white paper would include in the smoothing method a 50% corridor around market value such that the resulting smoothed actuarial value would remain between 50% and 150% of the market value of assets. We feel that a 50% market value corridor would only impact the calculation of the actuarial value of assets under extreme market conditions and we do not feel that inclusion of a corridor is necessary for a system that uses a five-year or less smoothing period. We only discuss the corridor to point out that the current method would be an "acceptable practice", but not considered a "model practice" under the guidance presented in the CCA's white paper.

In our opinion, the actuarial asset valuation method as used in the June 30, 2014 actuarial valuation of PERS-DB is reasonable and appropriate.

6. Accuracy of Calculations and Verification of Valuation Results

In this section of the report we provide results of our review of the calculations performed by Cheiron for the June 30, 2014 actuarial valuation of PERS-DB. After our initial review of information provided to us by MPERA and Cheiron, we requested a sample set of individual calculations, called test cases, in order to verify the accuracy of the calculations performed during the valuation. We constructed the sample set of test cases based on specific demographic attributes that were selected in order to test the correct application of the benefit and eligibility provisions for various categories of PERS-DB participants. Our sample set included 50 active participants, 2 deferred vested participants, 17 service retirees, 13 disabled retirees and 9 beneficiaries. For these test cases, we requested both the summarized calculations of present value of future benefits, normal cost and actuarial accrued liability as well as the detailed output of the calculations produced by the valuation software for the June 30, 2014 actuarial valuation.

The scope of the audit required our "verification of appropriate mathematical calculations are made accurately; and verification that plan liabilities and assets are appropriately valued". As noted in on page 4 of our response to the RFP:

> "A sampling review, which is the approach requested by MPERA in the RFP, does not duplicate the valuation results but allows the auditing actuary to review test lives and benefit calculations provided by the retained actuary. Through this review of sample calculations, the reviewing actuary can provide an opinion concerning the reasonableness and adequacy of the actuarial technical work of the retained actuary.
>
> The requested scope of services relies heavily on the retained actuary providing authentic, complete and detailed calculations of a sampling of individual participants produced directly by their valuation software. If the auditing actuary is limited to reviewing less than authentic, complete and detailed information for each sample life, it will be difficult to infer an opinion as to the reasonableness of the actuarial valuation results. "

In response to our request of test cases, we were initially supplied requested summarized information only. After discussion with MPERA and Cheiron, we were provided sufficient detailed information on retirees, disabled retirees and beneficiaries, but limited information for the terminated vested test cases and limited information for only 10 of the 50 active members requested in our sample set. We do not feel that the information provided by Cheiron allows us to successfully verify the accuracy of the calculations on the individual active members and terminated vested members. We can, however, evaluate the information provided to ascertain whether the individual calculations are a reasonable estimate of the liabilities. Based on this, we can infer whether the calculations contained in the valuation are reasonable, in the aggregate.

Based on our review of the information we were provided, a summary comparison of individual calculations performed by Cheiron and our calculation is shown in the table of the next page.

6. Accuracy of Calculations and Verification of Valuation Results

Summary of the Comparison of Test Case Calculations			
	Cheiron	**CMC**	**CMC/ Cheiron**
Present Value of Future Benefits			
Actives Participants by Decrement			
- Retirement	780,187	798,837	2.39%
- Termination	44,348	44,867	1.17%
- Death	28,652	32,906	14.85%
- Disability	20,094	20,473	1.89%
Subtotal	873,281	897,083	2.73%
Inactive Participants			
- Retirees	2,298,188	2,301,469	0.14%
- Beneficiaries	323,170	323,136	(0.01%)
- Disabled Retirees	1,258,986	1,249,094	(0.79%)
- Terminated Vested	64,838	60,671	(6.43%)
Subtotal	3,945,182	3,934,370	(0.27%)
Total Present Value of Future Benefits	4,818,463	4,831,453	0.27%
Actuarial Accrued Liability			
Actives Participants by Decrement			
- Retirement	524,175	531,425	1.38%
- Termination	(15,792)	(16,453)	(4.19%)
- Death	17,534	20,210	15.26%
- Disability	10,666	10,704	0.36%
Subtotal	536,583	545,886	1.73%
Inactive Participants (Same as above)	3,945,182	3,934,370	(0.27%)
Total Actuarial Accrued Liability	4,481,765	4,480,256	(0.03%)
Normal Cost (Beginning of Year)			
Actives Participants by Decrement			
- Retirement	32,645	33,646	3.07%
- Termination	6,840	6,839	(0.01%)
- Death	1,441	1,608	11.59%
- Disability	1,011	1,036	2.47%
Total Normal Cost	41,937	43,129	2.84%

6. Accuracy of Calculations and Verification of Valuation Results

In assessing the reasonableness of Cheiron's calculations, we first focused on the calculation of the present value of future benefits as this amount is not affected by the application of the actuarial cost method in the programming and, thus, we would expect only a minor difference between Cheiron's and our calculations. As will be noted from the table on the previous page, our present value of future benefit calculations differed from Cheiron's, in aggregate for all of the test cases provided, by a very minor amount (0.27%). However, our calculation of the present value of future benefits for active members was higher, on average, by 2.73%. Please note that this difference is based only on the 10 active test cases supplied which is too small a sample set to evaluate the overall accuracy of the present value of benefits for all of PERS-DB.

A primary source of consistent differences in the calculations for active members is attributable to the liability for active member pre-retirement death benefits. Our results for the 10 test cases are, on average, 14.85% higher. We note that the pre-retirement death benefits account for less than 4% of total present value of future benefits for the active member test cases reviewed.

Another area of consistent differences is noted in the present value of retirement benefits for active participants hired prior to July 1, 2011, apparently due to the application of early retirement reduction factors for these members. As we understand the plan provisions, the early retirement benefits for members hired prior to July 1, 2011 are reduced from the earlier of age 60 or the age at which they would have completed 30 years of service. We suspect that the benefits for members who retire with 25 years of service are being reduced only from age 60 and not from the earlier of age 60 or the age at which they would otherwise complete 30 years of service. However, we could not directly verify this due to the limited information provide on the active member test cases by Cheiron.

We further suspect the minor differences in active member present value of future benefit calculations for retirement, termination and disability benefits is also primarily due to Cheiron's application of the early retirement reduction factors used to actuarially reduce benefits commencing prior to normal retirement age. Since the test case information (although requested) did not provide the derivation of the projected benefit payment stream we could not further define the source of the difference. We recommend Cheiron further review their calculations for active members to assess the need for refinement.

The only other area where a material difference in the present value of future benefits of individual test cases were noted is the calculation of liability for terminated vested members. For these members the present value of future benefits is equal to the greater of the annuitized present value of two times the member's account balance at retirement age or the member's accrued retirement benefit at termination. We find Cheiron's calculation of the value of the annuitized present value of the member's account balance is higher than our calculation. Cheiron confirmed the difference is due to the use of the prior assumed interest rate credited on the member's account balance of 5.0% instead of the 3.5% interest credit rate prescribed by the current assumptions. The differences in the actuarial accrued liability and the normal cost calculations are primarily attributable to the difference in the present value of future benefit calculations identified above.

We note other, less material differences, in the calculations as follows:

The normal form of payment for a retiree of PERS-DB is a life annuity with a refund of any remaining member contribution account balance. When a member elects an alternate form of payment, the member's benefit amount is actuarially reduced to "offset" for the alternative benefit elected. The 100% Joint and Survivor and the 50% Joint and Survivor benefit options include a "pop-up" feature where, in the event the contingent annuitant pre-deceases the retired member, the member's benefit amount reverts back to the benefit amount payable under the normal form of payment (the pop–up). When Cheiron values the liabilities for these retired members who elected the joint and survivor option they use a constant, across the board, factor to reflect the value of the pop-up feature for all individuals. It would not be difficult to use the appropriate individual factors for the pop-up feature and doing so would enhance the accuracy of the calculations. We would not expect this to have a material impact on the valuation calculations, but recommend that it be considered as a possible refinement of the valuation calculations.

Similarly, for active members expected to terminate with vested benefits in the future, a pre-retirement death benefit is valued for spouses. This calculation requires an actuarial equivalent reduction factor for the post-death spousal benefit. Cheiron uses a 90% reduction factor (reducing the benefit by 10%) for all members regardless of age. Since the marriage assumption is 100% and males are assumed to be three years older than females, it would not be difficult to determine the appropriate reduction for actuarial equivalence purposes. We do not expect this change would have a material impact on the valuation calculations, but recommend its consideration as a refinement to the valuation process.

Lastly, in the development of the entry age actuarial accrued liability for active participants, member contributions are projected backward to the individual's entry age. In our review of the active test lives provided, we noticed that the member contribution accounts for members hired on or after July 1, 2011 were being projected back to entry age inconsistently compared to the other active members. This is a very immaterial and technical difference, but we recommend further assessment by Cheiron for possible refinement of the calculations.

As discussed above, the limited details we received on the test cases we were provided do not allow us to provide a verification of the accuracy of the individual mathematical calculations for active participants and terminated vested participants. However, based on the comparison of the summarized results we find that the calculations pertaining to the individuals, in aggregate, appear reasonable. Based on the information supplied, we conclude that the plan liabilities as presented in the actuarial valuation are appropriately valued. We also confirm that the actuarial value of assets is appropriately calculated under the asset smoothing method utilized in the valuation. As noted above, we recommend further review of our findings by Cheiron and their assessment of any cost impact that procedural refinements may have on the June 30, 2014 actuarial valuation of PERS-DB.

7. Adequacy of Methods for Determining Actuarial Factors

In this section we provide our opinion concerning the development of the various actuarial factors used in the administration of the PERS-DB System. We reviewed the factors supplied to us by MPERA as used for the determination of: optional forms of payment for service and disabled retirees, service purchases, early retirement reductions, non-increasing annuity conversions, and survivor benefit determinations. The descriptions of the actuarial basis used to determine each of the factors is consistent with the applicable actuarial assumptions and using that actuarial basis, we were able to match all of the factors we tested.

We conclude that the factors provided are accurately established and are appropriate for the purposes intended.

7. CONCLUSION

As stated in the RFP, the purpose of this audit is to "provide independent assurances the Consulting Actuary's work was performed in accordance with actuarial standards of practice; that the procedures used are appropriate and reliable to properly determine the system's liability, to help plan fiduciaries assess whether the plan is meeting its funding objectives; to increase public trust in how the plan is being governed; to discover errors; and provide recommendations for improving the actuarial valuation process." The sections contained in our report cover the various tasks required of the audit in detail. We find the work performed by Cheiron to be reasonable overall and based on generally accepted actuarial standards. In each section, we have noted the source of any material findings and our recommendations for improvement to the valuation process.

To reiterate, we have no findings of material discrepancies with generally accepted actuarial standards and our recommendations are limited to suggesting minor improvements to the valuation process to be considered in the 2015 valuation.