Actuarial Review of the 2019 Accounting Disclosures for the North Carolina Office of the State Auditor

December 2019

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800.521.0498 | P: 248.799.9000 | F: 248.799.9020 | www.grsconsulting.com

December 4, 2019

Ms. Amy Senogles, CPA
Financial Audit Supervisor
Office of the State Auditor
2 S. Salisbury St.
20601 Mail Service Center
Raleigh, North Carolina 27699-0600

Re: North Carolina Actuarial Review of 2019 Accounting Disclosures

Dear Ms. Senogles:

Gabriel, Roeder, Smith & Company (GRS) is pleased to present this report of an Actuarial Review of the 2019 Accounting Disclosures related to the North Carolina Retirement System. We are grateful to the Office of the State Auditor for their responsiveness and assistance throughout the actuarial review process. In addition, we wish to thank the consultants of Cavanaugh Macdonald Consulting (CavMac) and Segal Consulting for their cooperation and assistance with this project.

This project is separated into two engagements. This is a report covering the work of the first engagement. A report covering the work of the second engagement will be issued in early 2020. The first engagement is described as follows:

> Evaluate the actuarial valuations of the following plans used in the State's financial statements for the period ended June 30, 2019:
>
> - The Teachers and State Employees Retirement System of North Carolina (TSERS);
> - The Local Governmental Employees Retirement System of North Carolina (LGERS);
> - The Register of Deeds Supplemental Pension Fund of North Carolina (RODSPF);
> - The North Carolina Retiree Health Benefits Plan (RHB); and
> - The Disability Income Plan of North Carolina (DIPNC).
>
> The Contractor will conduct a review of all assumptions, procedures, and methodology utilized by the actuary of the TSERS, LGERS, RODSPF, RHB and DIPNC plans. This review should include:
>
> 1. A review of the valuation report and results and how they comply with actuarial standards, and whether such valuation reflects appropriate disclosure information under required reporting.
> 2. An analysis and benchmarking of the actuarial assumptions, and a review of the actuarial methods used in determining the pension liability for compliance with generally accepted actuarial principles.
> 3. An analysis of the procedures used to validate the participant data, a test of select test lives from the membership group (active and retired) to validate key components, and a detailed review of the results.

One Towne Square | Suite 800 | Southfield, Michigan 48076-3723

The purpose of this report is to provide the results of our actuarial review, described above, including:

- An opinion regarding the reasonableness and accuracy of the actuarial assumptions, actuarial cost methods, procedures, and valuation results; and
- Certification that the plans' actuarial valuation was prepared in accordance with pronouncements issued by the Governmental Accounting Standards Board (GASB), principles and practices prescribed by the Actuarial Standards Board, and that the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures.

This report was prepared at the request of the Office of the State Auditor of North Carolina (OSA) for the purposes stated above. It may not be suitable for other purposes. This report may be shared with parties other than the OSA, but only with the OSA's permission and only in its entirety. GRS is not responsible for unauthorized use of this report.

In our opinion, the assumptions and methods used in the 2018 valuations of the aforementioned plans are reasonable and comply with the Governmental Accounting Standards Board (GASB) Statement Nos. 67 and 74 and are in compliance with practices promulgated by the Actuarial Standards. The intended audience is the OSA. The authors of this report are available to answer questions.

The signing individuals are independent of the plan sponsor.

Abra D. Hill and Jeffrey T. Tebeau are Members of the American Academy of Actuaries (MAAA) as indicated, and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

Respectfully submitted,

Kenneth G. Alberts

Kenneth G. Alberts, Project Manager
Consultant

Abra D. Hill

Abra D. Hill, ASA, MAAA
Consultant

Jeffrey T. Tebeau, FSA, EA, MAAA
Consultant

KGA/ADH/JTT:sc

EXECUTIVE SUMMARY

Executive Summary

Background

Gabriel, Roeder, Smith & Company (GRS) was engaged by the Office of the State Auditor to review calculations related to the 2019 disclosures the State will include in its Comprehensive Annual Financial Report (CAFR).

This report covers the work of the first engagement. A report covering the work of the second engagement will be issued in early 2020. The first engagement is described as follows:

> Evaluate the actuarial valuations of the following plans used in the State's financial statements for the period ended June 30, 2019:
>
> - The Teachers and State Employees Retirement System of North Carolina (TSERS);
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> The Contractor will conduct a review of all assumptions, procedures, and methodology utilized by the actuary of the TSERS, LGERS, RODSPF, RHB and DIPNC plans. This review should include:
>
> 1. A review of the valuation report and results and how they comply with actuarial standards, and whether such valuation reflects appropriate disclosure information under required reporting.
> 2. An analysis and benchmarking of the actuarial assumptions, and a review of the actuarial methods used in determining the pension liability for compliance with generally accepted actuarial principles.
> 3. An analysis of the procedures used to validate the participant data, a test of select test lives from the membership group (active and retired) to validate key components, and a detailed review of the results.

The purpose of this report is to provide the results of our actuarial review, described above, including:

- An opinion regarding the reasonableness and accuracy of the actuarial assumptions, actuarial cost methods, procedures, and valuation results; and
- Certification that the plans' actuarial valuation was prepared in accordance with pronouncements issued by the Governmental Accounting Standards Board (GASB), principles and practices prescribed by the Actuarial Standards Board, and that the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures.

The balance of this report is organized as follows:

Section 1 – Experience Study Review

- Review of Recommended Demographic Assumptions
- Review of Recommended Actuarial Methods

Section 2 – Review of Economic Assumptions

Section 3 – Review of the Respective Valuation Reports Containing the Underlying Calculations for the GASB Valuations

- Test Lives Exhibits
- Comments Regarding Test Lives Review

Section 4 – Review of the Respective GASB Reports

- Content Review
- Calculations Review

Section 5 – Comments and Conclusions

- Comments
- Conclusions
- Recommendations for future years

Conclusion

In our opinion, the assumptions and methods used in the 2018 valuations of the aforementioned plans are reasonable and comply with the Governmental Accounting Standards Board (GASB) Statement Nos. 67 and 74 and are in compliance with practices promulgated by the Actuarial Standards.

Based on our test lives review and our review of the funding and GASB reports, we certify that the plans' actuarial valuation was prepared in accordance with pronouncements issued by the Governmental Accounting Standards Board (GASB), principles and practices prescribed by the Actuarial Standards Board, and that the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures (with the exception of the disclosure requirements discussed herein).

SECTION 1

EXPERIENCE STUDY REVIEW

Experience Study

The Experience Studies appear to be on a five-year cycle and have not changed since we reviewed them in our 2018 report (with the exception of a few specific health insurance related assumptions addressed in the RHB section). We are therefore incorporating our comments regarding the demographic assumptions from our 2018 report, largely unchanged. Any changes in assumptions that were made in the valuations outside of the Experience Study process will be commented on in Section 2. Section 2 will specifically address the changes to the assumptions used in the RHB valuation.

Review of Recommended Demographic Assumptions

TSERS

The TSERS experience study appears to be on a five-year cycle with the next cycle expected to be January 1, 2015 through December 31, 2019. We were provided the most recently completed experience study, dated October 22, 2015, covering the period January 1, 2010 through December 31, 2014. TSERS has since updated their economic assumptions. We have therefore only reviewed the demographic assumptions recommended from this study that are currently in use for the funding and GASB valuations.

Non-Mortality Demographic Assumptions

The non-mortality demographic assumptions were reviewed in the experience study dated October 22, 2015 and covering the five-year period ending on December 31, 2014. We have reviewed that report and find that the recommended assumptions are reasonable, based on TSERS actual experience (as detailed in that report). When reviewing demographic experience, actuaries are guided by Actuarial Standards of Practice (ASOP) Statement Number 35. ASOP 35 provides that non-mortality demographic assumptions should take into consideration historical experience, future expectations, the actuary's professional judgement, the purpose of the measurement and should not result in significant bias (unless a bias is explicitly intended to cover adverse risk or plan provisions that are difficult to model). The experience study report reviewed demonstrates that these guidelines were followed in the development of the recommended assumptions. ASOP 35 also discusses non-decrement demographic assumptions such as assumptions related to option elections and/or option factors that are based on interest and mortality that differs from valuation assumptions. The experience study was silent on this aspect of the plan (as is the funding valuation). We recommend that future experience studies include an analysis of whether or not a liability adjustment is needed related to option elections/factors.

We find the recommended assumptions (which were in use for the December 31, 2018 funding valuation) to be reasonable for use in the funding and GASB valuations.

Mortality Assumptions

ASOP 35 states that the actuary should generally consider at least the following when setting mortality assumptions: pre- and post-mortality; potentially different mortality for different employee classifications (if appropriate); adjustments for mortality improvement that occurs from the period studied (in the experience study) to the measurement period (the date of the valuation); and mortality improvements after the measurement date. The experience study started with nationally published mortality tables and made adjustments based on TSERS actual experience. The common industrial conventional is, that for any group's actual mortality experience to be given full credibility, there should be enough covered participants to result in at least 1,000 actual deaths during the five-year period studied. The experience study demonstrates that the teachers and general employees groups were large enough to give their experience full credibility. In addition, the report demonstrates that considerations for setting mortality assumptions promulgated in ASOP 35 were followed.

We find the recommended assumptions (which were in use for the December 31, 2018 funding valuation) to be reasonable for use in the funding and GASB valuations.

LGERS

The LGERS experience study appears to be on a five-year cycle with the next cycle expected to be January 1, 2015 through December 31, 2019. We were provided the most recently completed experience study, dated October 22, 2015, covering the period January 1, 2010 through December 31, 2014. LGERS has since updated their economic assumptions. We have therefore only reviewed the demographic assumptions recommended from this study that are currently in use for the funding and GASB valuations.

Non-Mortality Demographic Assumptions

The non-mortality demographic assumptions were reviewed in the experience study dated October 22, 2015 and covering the five-year period ending on December 31, 2014. We have reviewed that report and find that the recommended assumptions are reasonably based on LGERS actual experience (as detailed in that report). The experience study report reviewed, demonstrates that these ASOP 35 guidelines were followed in the development of the recommended assumptions. We recommend that future experience studies include an analysis or whether or not a liability adjustment is needed related to option elections/factors.

We find the recommended assumptions (which were in use for the December 31, 2018 funding valuation) to be reasonable for use in the funding and GASB valuations.

Mortality Assumptions

The experience study started with nationally published mortality tables and made adjustments based on LGERS actual experience when the group size was large enough to warrant credible experience. The experience study demonstrates that the general employees groups were large enough to give their experience full credibility and that the Male Firefighters and Rescue Squad Workers were not large enough to give their experience credibility. The report is silent as to the process used to assign credibility for the Male Law Enforcement Officers, which was large enough for partial credibility, but not full credibility. For beneficiaries, the report indicates that LGERS and TSERS beneficiaries were combined to provide additional credibility. In general, the report demonstrates that considerations for setting mortality assumptions promulgated in ASOP 35 were followed. We recommend that future experience studies address how partial credibility is assigned for the Male Law Enforcement Officers.

We find the recommended assumptions (which were in use for the December 31, 2018 funding valuation) to be reasonable for use in the funding and GASB valuations.

RODSPF and DIPNC

The RODSPF and DIPNC experience study appears to be on a five-year cycle with the next cycle expected to be January 1, 2015 through December 31, 2019. We were provided the most recently completed experience study, dated January 1, 2016, covering the period January 1, 2010 through December 31, 2014.

The demographic assumptions for the RODSPF are the same as those for LGERS. Please see our aforementioned comments.

Except for rates of disability and recovery or death from disabled status, the demographic assumptions for the DIPNC are the same as those for TSERS. Please see our aforementioned comments.
Disability and recovery or death from disabled status for DIPNC

The report provided to us for review showed neither the details of the current assumptions nor the actual experience. There were brief comments regarding the credibility of the experience and a qualitative description of how the proposed assumptions were set based on a weighted average of a national table and actual experience using a 35% credibility factor for rates of disability (rates of termination of disability are indicated to be from a nationally published table). While the process to determine these proposed rates that was described is reasonable and in compliance with ASOPs, there is insufficient detail in the reports to determine if the recommended rates are reasonable. We recommend that future experience studies include the level of detail that compares actual, expected and proposed rates by age so that another actuary can opine on the reasonability of the recommendations.

RHB

Non-health related demographic assumptions are the same as those used for the pension valuations. Specific health related demographic assumptions, such as participation, enrollment and migration assumptions are disclosed in the GASB 74 reports. These assumptions are reported to be based on actual experience as well as future plan sponsor expectation as disclosed in the most recent financial report.

We find these assumptions to be reasonable for use in the GASB valuation. Currently, no funding valuation for the RHB is performed.

Review of Recommended Actuarial Methods

TSERS, LGERS, RODSPF

The funding and GASB valuations both use the Entry Age Actuarial Cost method. The asset method is a five-year smoothed market related value with a 20% corridor around the market for funding. The asset method for GASB is market value.

We find the methods used for the funding valuation to be in compliance with the ASOPs and reasonable for funding. We find the methods used for the GASB valuation to those prescribed by the GASB pronouncements.

DIPNC

The funding uses the Aggregate Actuarial Cost method. The asset method is a five-year smoothed market related value with a 20% corridor around the market for funding. The funding method for GASB valuation is the Entry Age Actuarial Cost method. The asset method used for the GASB valuation is market value.

We find the methods used for the funding valuation to be in compliance with the ASOPs and reasonable for funding. We find the methods used for the GASB valuation to those prescribed by the GASB pronouncements.

RHB

The actuarial cost method for the GASB valuation is the Entry Age Actuarial Cost method. The asset method is the market value.

We find the methods used for the GASB valuation to be in accordance with those prescribed by the GASB pronouncements.

In summary, we find the demographic assumptions used for the funding and GASB valuations to be reasonable.

SECTION 2

REVIEW OF ECONOMIC ASSUMPTIONS

The key economic assumptions are:

1. **Assumed Rate of Inflation** – The rate of price inflation (as measured by the Consumer Price Index for all Urban consumers) which underlies the remainder of the economic assumptions.
2. **Assumed Rate of Investment Return** – The expected annual rate of return on System assets, net of expenses, over a long-term period. This is also the rate at which projected future benefits under the system are discounted to the present.
3. **Assumed Rate of Increase in Compensation** – The rate at which a member's annual salary is assumed to increase each year, which impacts the level of member benefits.

ASOP No. 27

Pension actuaries are required to comply with Actuarial Standard of Practice No. 27 (ASOP No. 27) in setting economic assumptions, including the assumed investment return rate.

According to the ASOP No. 27 applicable to actuarial valuations with a measurement date on or after September 30, 2014, each economic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

- It is appropriate for the purpose of the measurement;
- It reflects the actuary's professional judgment;
- It takes into account historical and current economic data that is relevant as of the measurement date;
- It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and
- It has no significant bias (i.e., it is not significantly optimistic or pessimistic).

Also according to ASOP No. 27, the actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a narrow range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

Inflation

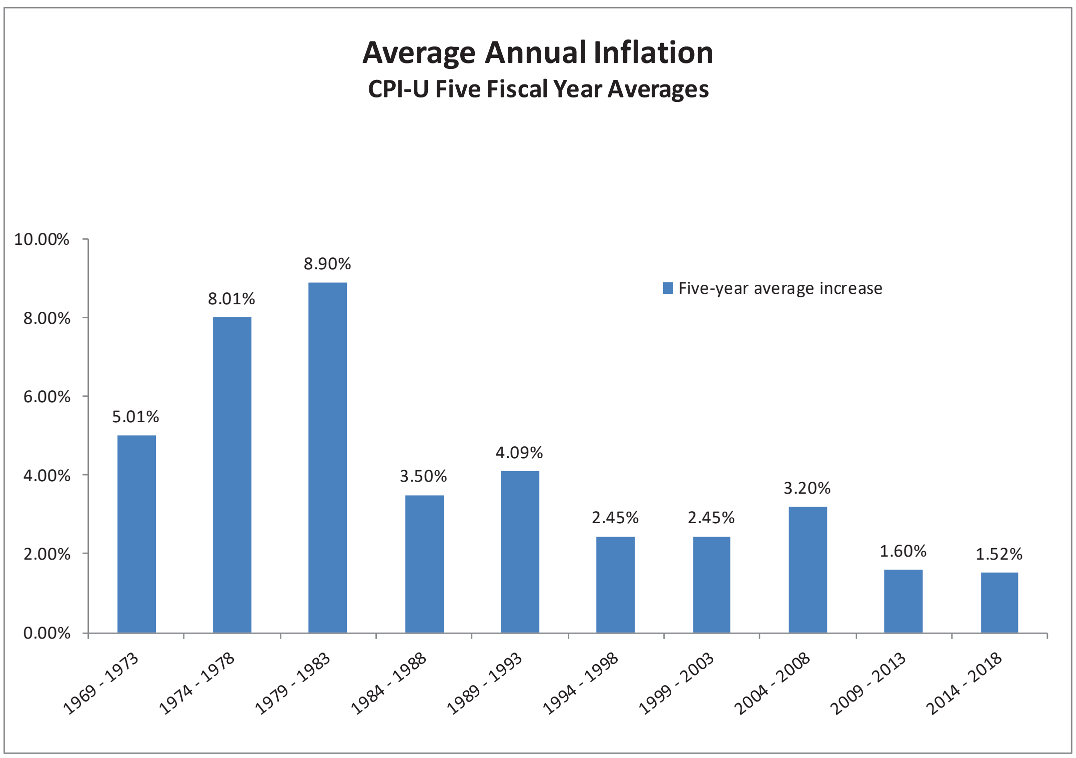
By "inflation," we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies all of the other economic assumptions. It not only impacts investment return, but also salary increases.

Over the five-year period from 2014 through 2018, the CPI-U has increased at an average rate of 1.52 percent.

The table on the following page shows the average inflation over various periods, ending December 31, 2018.

Calendar Year	Average Annual Increase in CPI-U
2014	1.62 %
2015	0.12 %
2016	1.26 %
2017	2.13 %
2018	2.44 %
3-Year Average	1.94 %
5-Year Average	1.52 %
10-Year Average	1.55 %
20-Year Average	2.18 %
30-Year Average	2.54 %
40-Year Average	3.43 %
50-Year Average	4.03 %

The following graph shows the average inflation over five-year periods over the last 50 years:



As the above graph illustrates, the high inflation of the 1970s and 1980s is well in the past. The geometric average price inflation was 2.54% per year over the last 30 years, ending December 31, 2018; 2.18 percent over the last 20 years and 1.55 percent over the last 10 years.

Future Inflation Expectations

Since price inflation is relatively volatile and is subject to a number of influences not based on recent history, economic assumptions are less reliably based on recent past experience than are the demographic assumptions. Therefore, it is important not to give undue weight to recent experience. We must also consider future expectations for inflation as well.

One measure of future inflation is the spread between yields on U.S. Treasuries and U.S. TIPS. (Treasury Inflation-Protected Securities, or TIPS, provide protection against inflation. The principal of a TIPS increases with inflation and decreases with deflation, as measured by the Consumer Price Index. When a TIPS matures, you are paid the adjusted principal or original principal, whichever is greater.)

The spread between yields on U.S. Treasuries and U.S. TIPS varies depending on the maturity selected. Moreover, there may be other influences on the result such as a risk premium on Treasuries and a liquidity premium on TIPS.

For 30-year Treasuries as of January 1, 2019, this measure of inflation expectation is 1.98 percent.

We also surveyed the inflation assumption used by a number of well-known independent investment consulting firms. In our sample of fourteen firms, the inflation assumption ranged from 1.70 percent to 2.50 percent, with an average of 2.18 percent.

Another point of reference is the Social Security Administration's (SSA) 2018 Trustees Report, in which the Office of the Chief Actuary is projecting a long-term ultimate intermediate annual inflation rate assumption of 2.6 percent. The Social Security Trustees report uses the ultimate rates for their 75-year projections, much longer than the longest horizon we can discern from Treasuries and TIPS.

The table on the following page presents a summary of inflation rate forecasts from various professional experts.

Forward-Looking Price Inflation Forecasts[a]	
Congressional Budget Office[b]	
5-Year Annual Average	2.46%
10-Year Annual Average	2.38%
Federal Reserve Bank of Philadelphia[c]	
5-Year Annual Average	2.25%
10-Year Annual Average	2.21%
Federal Reserve Bank of Cleveland[d]	
10-Year Expectation	1.97%
20-Year Expectation	2.13%
30-Year Expectation	2.25%
Federal Reserve Bank of St. Louis[e]	
10-Year Breakeven Inflation	1.71%
20-Year Breakeven Inflation	1.82%
30-Year Breakeven Inflation	1.85%
U.S. Department of the Treasury[f]	
10-Year Breakeven Inflation	1.77%
20-Year Breakeven Inflation	1.78%
30-Year Breakeven Inflation	1.95%
50-Year Breakeven Inflation	1.98%
100-Year Breakeven Inflation	2.01%
Social Security Trustees[g]	
Ultimate Intermediate Assumption	2.60%

[a] Version 2019-02-28 by Gabriel, Roeder, Smith & Company.

[b] *The Budget and Economic Outlook: 2019 to 2029*, Consumer Price Index (CPI-U), Percentage Change from Fourth Quarter to Fourth Quarter, 5-Year Annual Average (2019 - 2023), 10-Year Annual Average (2019 - 2028).

[c] *Fourth Quarter 2018 Survey of Professional Forecasters*, Release Date: November 13, 2018, Headline CPI, 5-Year Annual Average (2018 - 2022), 10-Year Annual Average (2018 – 2027).

[d] Inflation Expectations, Model output date: February 13, 2019.

[e] The breakeven inflation rate represents a measure of expected inflation derived from X-Year Treasury Constant Maturity Securities and X-Year Treasury Inflation-Indexed Constant Maturity Securities. Observation date: January 1, 2019.

[f] *The Treasury Breakeven Inflation (TBI) Curve*, Monthly Average Rates, January, 2019.

[g] *The 2018 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds*, June 5, 2018, Long-range assumptions, Intermediate, Consumer Price Index (CPI-W), for 2021 and later.

Taking all of this information into consideration, we believe that the 3.0% price inflation assumption currently used in the funding and GASB valuations is too high. We believe that a price inflation assumption in the range of 1.75% to 2.50% is supportable by historical experience and future expectations. That being said, price inflation is the starting point for the other economic assumptions, such as the investment rate of return, wage increases, and health trend rates. If a price inflation assumption is too high and it results in an investment rate of return that is also too high, the resulting valuations can be too optimistic and/or contributions that may be too low (if using a level percent of pay contribution determination method). However, if the investment rate of return assumption is not too high, then a price inflation that is higher than future expectations support can actually add a margin for adverse experience when measuring liabilities. It is important not to just look at this assumption in isolation.

Investment Return

The investment return assumption, also referred to as the valuation interest rate, is one of the principal assumptions in any actuarial valuation. It is used to discount future expected benefit payments back to the valuation date, which ultimately determines the liability (i.e., present value of benefits) of the retirement plan. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates.

For TSER and LGERS, this assumption was adjusted after the respective experience studies. For RODSPF and DIPNC, this assumption was set in the respective experience studies. For the RHB, this assumption is set by the State (and is currently the same as TSERS and LGERS). However, because the RHB is not a funded plan, this assumption is not the discount rate. Rather, the discount rate is based on the Bond Buyer 20-year GO index.

The assumed rate of investment return for TSERS and LGERS December 31, 2018 funding valuations was 7.0%. Based on the reported asset allocation (and the target allocation shown in the CAFR) and a 2.50% price inflation assumption (an assumption in GRS' preferred range), we believe this assumption is reasonable for use as the assumed rate of return for the funding valuations and the expected long-term rate of return for the GASB valuations, based on the information provided for this review. We have tested this assumption using our 2019 Capital Markets Assumption Model and the reported asset allocation in the December 31, 2018 reports. It is important to note that for both LGERS and TSERS, a large portion (approximately 30%, each) of their asset allocation (as reported in the December 31, 2018 valuations) is in the "other" category. This category is footnoted to indicate it covers real estate, alternatives, inflation and credit. We recommend this category be further subdivided since these categories do not all have the same future expectations. Subdividing this category would allow an auditor (or other user of the report) to perform a more robust analysis to determine if the assumption continues to be appropriate. RODSPF and DIPNC use an assumed of investment return of 3.75%. Since these funds are primarily invested in fixed income vehicles, we believe this is a reasonable assumption for funding and for the long expected rated of return for GASB, based on a 2.50% inflation assumption (an assumption in GRS' preferred range).

Wage inflation, Payroll Growth and Pay Increases

These items were studied as part of the TSERS and LGERS experience studies. These respective experience studies provide enough detail to demonstrate that the recommended assumptions (which were used in the December 31, 2018 funding valuations) are reasonable. However, given the above comments on price inflation, we recommend that the payroll growth assumption be lowered for future valuations.

RHB Trend Rates

The trend rates used for the GASB valuation of the RHB are similar to the trend rates that GRS currently uses, but end in an ultimate rate higher than what GRS currently uses. However, we believe they are reasonable.

RHB Miscellaneous Assumption Changes

For the June 30, 2019 GASB 74 calculations (and the underlying December 31, 2018 valuation) certain RHB assumptions were adjusted. One of the adjustments was related to the application of retirement assumptions for consistency with the Pension valuations and the others appear to mostly making the model consistent with current plan administration. We find these changes reasonable. These changes, in total, resulted in a change in the OPEB Liability that is below the tolerance testing that we would use for a full replication valuation (5% for accrued liability – see comments in test life section). We therefore believe these changes do not result in a material change to the results.

Summary

In summary, except for the price inflation assumption used for the pension valuations, we find the economic assumptions to be reasonable for funding and GASB. With regard to the price inflation assumption, we find that when considering the other economic assumptions, this assumption adds conservatism and a margin for adverse experience which is acceptable under the ASOPs for the development of the liabilities.

SECTION 3

A REVIEW OF THE RESPECTIVE VALUATION REPORTS CONTAINING THE UNDERLYING CALCULATIONS FOR THE GASB VALUATIONS

Test Lives Review

TSERS

Actives

GRS requested test life information on 10 active cases. One case was listed as a non-vested terminated member and another case was listed as disabled (valued with active). In addition, one of the requested terminated vested cases was indicated as disabled (valued with active). The active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	CavMac	% Diff
1	30.8415	1.2500	$ 53,279.78	M	**EAAL**	$ 5,740	$ 5,387	6.55%
General					**PVB**	54,351	53,819	0.99%
					NC	5,160	4,776	8.04%
					PVFS	500,832	508,552	-1.52%
2	43.2132	8.9848	14,650.79	F	**EAAL**	20,719	17,463	18.65%
Teacher					**PVB**	39,948	44,161	-9.54%
					NC	1,817	2,292	-20.72%
					PVFS	164,615	171,127	-3.81%
3	53.1107	1.6667	1,073,482.94	M	**EAAL**	91,959	83,005	10.79%
General					**PVB**	323,110	357,346	-9.58%
					NC	37,355	34,846	7.20%
					PVFS	6,874,147	8,152,828	-15.68%
4	30.4045	3.4545	43,286.05	F	**EAAL**	16,980	16,313	4.09%
Teacher					**PVB**	71,514	71,845	-0.46%
					NC	4,841	4,641	4.31%
					PVFS	507,276	503,944	0.66%
5	58.1189	3.1667	98,287.48	M	**EAAL**	58,444	53,380	9.49%
General					**PVB**	129,192	128,674	0.40%
					NC	14,927	13,990	6.70%
					PVFS	468,121	507,202	-7.71%
6	55.7801	23.5000	26,785.36	F	**EAAL**	125,722	120,740	4.13%
General					**PVB**	135,411	135,839	-0.32%
					NC	2,089	2,990	-30.13%
					PVFS	125,477	132,106	-5.02%
7	39.6831	16.8333	63,205.42	F	**EAAL**	172,447	175,273	-1.61%
General					**PVB**	211,712	222,427	-4.82%
					NC	4,552	5,025	-9.41%
					PVFS	560,606	579,975	-3.34%
8	55.7746	17.0000	41,914.36	M	**EAAL**	119,522	123,880	-3.52%
Teacher					**PVB**	148,789	157,740	-5.67%
					NC	4,900	5,106	-4.03%
					PVFS	260,523	275,273	-5.36%
Total Test Cases					**EAAL**	611,533	595,441	2.70%
					PVB	1,114,027	1,171,851	-4.93%
					NC	75,641	73,666	2.68%
					PVFS	9,461,597	10,831,007	-12.64%

We were not able to replicate the active TSERS calculations for the cases that were reported as currently receiving DPNIC benefits, since the underlying salary information was not available on the data file. We have therefore excluded those cases.

TSERS

Retirees

GRS requested test life information on 11 retiree cases. The retiree cases are shown below:

Test Case	Age	Option Code	Current Monthly Benefit	Sex	Valuation Result	GRS	CavMac	% Diff
1 - Law Enforcement	82.71	OPT3	$1,051.79	M	**EAAL/PVB**	$ 90,375	$ 89,736	0.71%
2 - General	73.04	MAX	281.00	F	**EAAL/PVB**	31,076	31,247	-0.55%
3 - General	81.54	OPT63	1,610.64	F	**EAAL/PVB**	142,716	145,737	-2.07%
4 - Teacher	61.46	MAX	3,499.43	F	**EAAL/PVB**	506,071	509,420	-0.66%
5 - General	75.62	OPT62	718.35	F	**EAAL/PVB**	91,908	91,806	0.11%
6 - General	64.88	MAX	365.78	F	**EAAL/PVB**	49,067	48,991	0.16%
7 - General	54.88	OPT62	1,621.65	M	**EAAL/PVB**	263,777	254,245	3.75%
8 - Teacher	67.38	MAX	1,476.94	M	**EAAL/PVB**	183,780	185,651	-1.01%
9 - Teacher	65.29	OPT62	1,795.69	M	**EAAL/PVB**	265,231	265,854	-0.23%
10 - Teacher (disabled	58.88	OPT2	1,656.99	F	**EAAL/PVB**	258,918	255,876	1.19%
11 - Teacher (disabled	66.04	OPT62	1,231.57	M	**EAAL/PVB**	173,992	173,117	0.51%
Total Test Cases					**EAAL/PVB**	2,056,911	2,051,680	0.25%

TSERS

Terminated Vested

GRS requested test life information on 12 terminated vested cases. CavMac indicated that one of those members was active (on short-term disability), and another was also disabled (and should be valued as active). The remaining terminated vested cases, and a non-vested terminated case originally requested with the actives, are shown below:

Test Case	Age	Service	Accumulated Contributions	Sex	Valuation Result	GRS	CavMac	% Diff
1	60.2159	14.1665	$ 36,003.01	M	**EAAL/PVB**	$ 72,006	$ 72,006	0.00%
2	37.3470	9.7727	29,764.90	M	**EAAL/PVB**	59,530	59,530	0.00%
3	47.1886	8.9166	37,173.70	F	**EAAL/PVB**	74,347	74,347	0.00%
4	64.1025	5.9165	36,070.33	F	**EAAL/PVB**	72,141	72,141	0.00%
5	56.4906	11.5833	64,436.49	M	**EAAL/PVB**	128,873	128,873	0.00%
6	50.6490	5.8636	10,552.94	F	**EAAL/PVB**	21,106	21,106	0.00%
7	50.1831	16.250	59,297.08	M	**EAAL/PVB**	118,594	118,594	0.00%
8	43.5246	16.0000	106,032.11	F	**EAAL/PVB**	212,064	212,064	0.00%
9	38.1381	11.8455	33,793.26	F	**EAAL/PVB**	67,587	67,587	0.00%
10	37.1995	5.0122	13,243.76	F	**EAAL/PVB**	26,488	26,488	0.00%
11	21.7555	3.0000	3,546.01	F	**EAAL/PVB**	7,092	7,092	0.00%
Total Test Cases					**EAAL/PVB**	859,828	859,828	0.00%

Total TSERS

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	CavMac	% Diff
EAAL	$3,528,272	$3,506,949	0.61%
PVB	4,030,766	4,083,359	-1.29%

LGERS

Actives

GRS requested test life information on 10 active cases. Those 10 active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	CavMac	% Diff	CavMac Normal Cost As a % of 12/31 Pay 2017	2018
1	32.7132	11.4167	$48,970.18	M	**EAAL**	$ 88,947	$ 82,188	8.22%		
Law Enforcement					**PVB**	146,943	149,687	-1.83%		
					NC	5,554	6,029	-7.88%	11.56%	12.31%
					PVFS	537,504	543,308	-1.07%		
2	91.1627	22.5833	45,245.14	M	**EAAL**	87,292	82,668	5.59%		
Law Enforcement					**PVB**	87,292	82,668	5.59%		
					NC	0	0		n/a	n/a
					PVFS	0	0			
3	31.2077	11.0000	45,319.96	M	**EAAL**	73,967	71,943	2.81%		
Law Enforcement					**PVB**	130,357	132,040	-1.27%		
					NC	5,178	5,463	-5.22%	12.24%	12.05%
					PVFS	519,139	494,063	5.08%		
4	72.4468	16.8333	61,011.00	M	**EAAL**	158,215	156,727	0.95%		
Fire & Rescue					**PVB**	175,809	177,996	-1.23%		
					NC	9,669	10,400	-7.03%	16.76%	17.05%
					PVFS	97,621	104,026	-6.16%		
5	73.1354	23.3833	42,603.77	F	**EAAL**	155,831	148,101	5.22%		
General					**PVB**	163,977	158,674	3.34%		
					NC	5,969	6,154	-3.01%	14.30%	14.44%
					PVFS	53,428	63,877	-16.36%		
6	38.3854	12.7500	74,790.29	F	**EAAL**	143,445	153,573	-6.59%		
Fire & Rescue					**PVB**	244,650	250,006	-2.14%		
					NC	9,549	8,830	8.14%	12.39%	11.81%
					PVFS	834,296	811,959	2.75%		
7	44.4127	24.5000	77,445.76	M	**EAAL**	359,089	384,114	-6.51%		
Fire & Rescue					**PVB**	404,701	435,165	-7.00%		
					NC	7,757	8,271	-6.21%	10.56%	10.68%
					PVFS	470,915	470,781	0.03%		
8	53.8321	19.0833	52,219.81	M	**EAAL**	168,635	170,767	-1.25%		
Fire & Rescue					**PVB**	210,780	214,960	-1.94%		
					NC	6,691	6,851	-2.34%	12.62%	13.12%
					PVFS	342,633	330,581	3.65%		
9	34.3799	8.6667	52,812.80	U	**EAAL**	61,919	67,925	-8.84%		
Fire & Rescue					**PVB**	140,999	143,884	-2.01%		
					NC	6,536	6,111	6.95%	12.04%	11.57%
					PVFS	680,671	654,315	4.03%		
10	58.7187	13.4167	30,044.23	F	**EAAL**	75,913	72,714	4.40%		
General					**PVB**	95,339	95,139	0.21%		
					NC	4,003	4,509	-11.22%	13.45%	15.01%
					PVFS	151,939	147,195	3.22%		
Total Test Cases					**EAAL**	1,373,253	1,390,720	-1.26%		
					PVB	1,800,847	1,840,219	-2.14%		
					NC	60,906	62,618	-2.73%		

LGERS

Retirees

GRS requested test life information on 10 retiree cases. Those 10 retiree cases are shown below:

Test Case	Age	Option Code	Current Monthly Benefit	Sex	Valuation Result	GRS	CavMac	% Diff
1 - Law Enforcement	68.62	MAX	$1,129.62	M	**EAAL/PVB**	$ 131,772	$ 130,424	1.03%
2 - General	71.04	OPT62	2,451.86	F	**EAAL/PVB**	344,061	346,071	-0.58%
3 - General	69.21	MAX	1,279.95	F	**EAAL/PVB**	157,312	158,031	-0.45%
4 - General	71.88	OPT62	861.66	F	**EAAL/PVB**	112,845	112,850	0.00%
5 - General	80.79	MAX	1,943.90	F	**EAAL/PVB**	158,238	156,298	1.24%
6 - General	65.12	MAX	360.39	F	**EAAL/PVB**	48,164	48,271	-0.22%
7 - Law Enforcement	57.38	OPT63	2,943.97	M	**EAAL/PVB**	450,534	449,973	0.12%
8 - General	68.96	MAX	1,101.97	F	**EAAL/PVB**	136,444	136,257	0.14%
9 - General	55.21	OPT4	3,038.30	M	**EAAL/PVB**	333,850	336,363	-0.75%
10 - Law Enforcement	53.12	OPT62	4,792.63	M	**EAAL/PVB**	789,318	786,248	0.39%
Total Test Cases					**EAAL/PVB**	2,662,538	2,660,786	0.07%

Terminated Vested

GRS requested test life information on 11 Terminated Vested cases. Those 11 cases are shown below:

Test Case	Age	Service	Accumulated Contributions	Sex	Valuation Result	GRS	CavMac	% Diff
1 - Law Enforcement	30.8415	5.1665	$14,855.89	M	**EAAL/PVB**	$ 29,712	$ 29,712	0.00%
2 - Fire & Rescue	57.2719	18.4166	84,381.66	M	**EAAL/PVB**	168,763	168,763	0.00%
3 - Fire & Rescue	38.4605	7.7500	21,059.68	M	**EAAL/PVB**	42,119	42,119	0.00%
4 - Fire & Rescue	35.2801	8.3333	30,238.08	M	**EAAL/PVB**	60,476	60,476	0.00%
5 - Fire & Rescue	37.4127	7.4166	24,882.21	F	**EAAL/PVB**	49,764	49,764	0.00%
6 - Fire & Rescue	64.0411	10.5000	32,595.52	M	**EAAL/PVB**	65,191	65,191	0.00%
7 - General	41.1025	7.4167	15,656.11	F	**EAAL/PVB**	31,312	31,312	0.00%
8 - General	51.3799	10.3332	33,625.02	F	**EAAL/PVB**	67,250	67,250	0.00%
9 - General	59.3580	8.2500	31,548.94	M	**EAAL/PVB**	63,098	63,098	0.00%
10 - General	52.7351	12.0000	50,400.54	F	**EAAL/PVB**	100,801	100,801	0.00%
11 - General*	63.0602	0.4166	889.79	M	**EAAL/PVB**	1,780	1,780	0.00%
Total Test Cases					**EAAL/PVB**	680,266	680,266	0.00%

** Non-vested termination with LGERS, but also valued as active with TSERS (disability case).*

Total LGERS

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	CavMac	% Diff
EAAL	$4,716,057	$4,731,772	-0.33%
PVB	5,143,651	5,181,271	-0.73%

RODSPF

Actives

GRS requested test life information on 10 active cases. Those 10 active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	CavMac	% Diff
1	77.7050	32.2500	$54,570.48	F	**EAAL**	$ 167,587	$ 167,587	0.00%
					PVB	167,587	167,587	0.00%
					NC	0	0	
					PVFS	0	0	
2	40.9659	13.9167	55,177.52	F	**EAAL**	9,987	17,657	-43.44%
					PVB	62,877	117,689	-46.57%
					NC	3,998	8,205	-51.27%
					PVFS	729,032	672,078	8.47%
3	55.3212	18.5833	85,189.68	F	**EAAL**	171,660	151,998	12.94%
					PVB	233,519	228,135	2.36%
					NC	9,839	11,269	-12.69%
					PVFS	550,086	571,651	-3.77%
4	52.1244	28.5000	61,111.87	F	**EAAL**	255,241	233,206	9.45%
					PVB	289,908	291,585	-0.58%
					NC	8,729	14,361	-39.22%
					PVFS	222,737	202,850	9.80%
5	75.4018	8.0000	72,030.73	M	**EAAL**	87,966	79,329	10.89%
					PVB	117,808	104,639	12.59%
					NC	10,248	8,880	15.41%
					PVFS	225,146	206,085	9.25%
6	37.0548	2.0833	48,232.42	F	**EAAL**	10,318	9,965	3.54%
					PVB	66,196	65,336	1.32%
					NC	4,138	3,931	5.27%
					PVFS	668,191	638,431	4.66%
7	64.0329	14.0833	50,650.82	M	**EAAL**	47,069	48,232	-2.41%
					PVB	117,670	106,975	10.00%
					NC	8,923	8,376	6.53%
					PVFS	412,175	354,378	16.31%
8	61.9495	11.1667	43,532.46	U	**EAAL**	83,695	59,911	39.70%
					PVB	162,341	135,049	20.21%
					NC	12,038	10,562	13.97%
					PVFS	299,149	310,501	-3.66%
9	35.6831	7.4167	93,926.23	M	**EAAL**	43,016	46,054	-6.60%
					PVB	107,131	112,683	-4.93%
					NC	4,171	4,165	0.14%
					PVFS	1,515,732	1,523,405	-0.50%
10	54.6804	0.0833	2,279.42	F	**EAAL**	3	0	
					PVB	57,098	51,233	11.45%
					NC	8,071	6,847	17.88%
					PVFS	190,464	386,992	-50.78%
Total Test Cases					**EAAL**	876,542	813,939	7.69%
					PVB	1,382,135	1,380,911	0.09%
					NC	70,155	76,596	-8.41%
					PVFS	4,812,712	4,866,371	-1.10%

RODSPF

Retirees

GRS requested test life information on 10 retiree cases. CavMac indicated that one of the member ID's was not valid; the likely reason for this is that the member appears to have refunded during the year. The remaining retiree cases are shown below:

Test Case	Age	Option Code*	Current** Monthly Benefit	Sex	Valuation Result	GRS	CavMac	% Diff
1	73.12	MAX	$1,903.46	F	**EAAL/PVB**	$ 210,203	$ 211,167	-0.46%
2	65.29	MAX	5,145.26	M	**EAAL/PVB**	238,432	240,287	-0.77%
3	71.46	MAX	3,994.53	F	**EAAL/PVB**	224,104	227,500	-1.49%
4	70.54	MAX	1,645.20	F	**EAAL/PVB**	231,491	227,500	1.75%
5	74.38	MAX	3,985.87	F	**EAAL/PVB**	199,814	202,763	-1.45%
6	64.88	MAX	794.63	F	**EAAL/PVB**	273,798	272,438	0.50%
7	85.62	MAX	2,208.26	M	**EAAL/PVB**	87,775	85,102	3.14%
8	76.71	MAX	4,357.65	M	**EAAL/PVB**	151,403	148,517	1.94%
9	60.71	MAX	3,954.55	F	**EAAL/PVB**	301,075	298,899	0.73%
Total Test Cases					**EAAL/PVB**	1,918,095	1,914,173	0.20%

** ROD benefits are paid for the life of the member only, regardless of beneficiary/option election for benefits paid from other plans.*

*** Benefit listed is LGERS benefit; ROD benefits are valued at $1,500 monthly.*

Terminated Vested

GRS requested test life information for one terminated vested case. CavMac indicated that the "benefit ended" for this case.

Total RODSPF

(Actives and Retirees)

Valuation Result	GRS	CavMac	% Diff
EAAL	$2,794,637	$2,728,112	2.44%
PVB	3,300,230	3,295,084	0.16%

DIPNC

Actives

GRS requested test life information on 10 active cases. Those 10 active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	CavMac	% Diff
1	66.9906	n/a	$270,262.46	M	**EAAL**	(138)	$ (501)	-72.46%
					PVB	602	688	-12.50%
					NC	162	320	-49.38%
					PVFS	985,619	899,238	9.61%
2	48.2159	19.3000	20,171.04	F	**EAAL**	133	196	-32.14%
					PVB	392	452	-13.27%
					NC	29	26	11.54%
					PVFS	187,963	199,158	-5.62%
3	28.9961	4.4545	46,185.50	M	**EAAL**	54	78	-30.77%
					PVB	362	280	29.29%
					NC	20	13	53.85%
					PVFS	745,291	734,850	1.42%
4	25.0861	2.4545	37,267.06	F	**EAAL**	50	27	85.19%
					PVB	323	181	78.45%
					NC	20	11	81.82%
					PVFS	527,061	513,276	2.69%
5	52.3157	13.5556	37,067.15	F	**EAAL**	338	556	-39.21%
					PVB	1,103	1,349	-18.24%
					NC	81	79	2.53%
					PVFS	366,943	371,146	-1.13%
6	34.7406	9.8484	24,530.00	F	**EAAL**	208	112	85.71%
					PVB	492	358	37.43%
					NC	20	16	25.00%
					PVFS	367,224	376,000	-2.33%
7	23.5465	1.2727	39,057.64	M	**EAAL**	28	22	27.27%
					PVB	207	132	56.82%
					NC	13	8	62.50%
					PVFS	1,219,027	546,568	123.03%
8	46.9550	16.4545	69,856.88	M	**EAAL**	536	724	-25.97%
					PVB	1,261	1,413	-10.76%
					NC	68	63	7.94%
					PVFS	780,892	765,665	1.99%
9	76.5794	38.5000	70,727.86	F	**EAAL**	0	375	-100.00%
					PVB	0	375	-100.00%
					NC	0	0	
					PVFS	0	0	
10	66.2433	8.9167	30,082.11	M	**EAAL**	(138)	(49)	181.63%
					PVB	0	372	-100.00%
					NC	37	102	-63.73%
					PVFS	104,592	112,447	-6.99%
Total Test Cases					**EAAL**	1,071	1,540	-30.45%
					PVB	4,742	5,600	-15.32%
					NC	450	638	-29.47%
					PVFS	5,284,612	4,518,348	16.96%

DIPNC

Retirees

GRS requested test life information on 10 retiree cases. CavMac indicated that one of the members was receiving short-term disability and was ineligible for long-term disability. The remaining retiree cases are shown below:

Test Case		Age	Disability Start Date	Current Monthly Benefit	Sex	Valuation Result	GRS	CavMac	% Diff
1		55.82	3/2001	1,610.87	M	**EAAL/PVB**	6,633	6,730	-1.44%
2	3	58.99	11/2003	1,258.07	F	**EAAL/PVB**	4,609	4,773	-3.44%
3	4	60.44	4/2008	2,734.17	M	**EAAL/PVB**	6,154	7,210	-14.65%
4	5	58.61	8/2009	2,661.25	F	**EAAL/PVB**	20,758	21,084	-1.55%
5	7	50.35	11/2012	1,840.77	F	**EAAL/PVB**	64,741	63,033	2.71%
6		48.35	2/2018	2,171.35	F	**EAAL/PVB**	56,689	58,086	-2.41%
7		66.54	4/1981	702.90	F	**EAAL/PVB**	96,181	94,431	1.85%
8		51.54	1/2011	3,172.86	F	**EAAL/PVB**	162,631	155,619	4.51%
9		58.27	6/2007	1,197.37	F	**EAAL/PVB**	17,318	27,878	-37.88%
Total Test Cases						**EAAL/PVB**	435,714	438,844	-0.71%

Terminated Vested

Terminated vested members of TSERS are not eligible for DIPNC benefits, therefore none were requested.

Total DIPNC

(Actives and Retirees)

Valuation Result	GRS	CavMac	% Diff
EAAL	$436,785	$440,384	-0.82%
PVB	440,456	444,444	-0.90%

RHB

GRS requested test life information on 10 active, 10 retiree and 10 terminated vested cases. Segal indicated that they do not run valuations seriatim. Instead, they group the data into smaller categories, run each group as if it was an individual record, and then gross the results up by the number in the group. Segal was very helpful and worked with us to identify testing that GRS would be comfortable in using instead of individual records. Each test record in the following displays actually represents a group of members.

Actives

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	Segal	% Diff
1	57.46	22.58	$ 52,182	F	**EAAL**	$ 73,583	$ 84,322	-12.74%
Teachers					**PVB**	96,445	108,898	-11.44%
					NC	5,251	5,147	2.02%
					PVFS	227,056	249,159	-8.87%
2	53.69	13.00	41,128	M	**EAAL**	43,263	47,637	-9.18%
General					**PVB**	84,167	87,647	-3.97%
					NC	4,727	4,390	7.67%
					PVFS	361,362	374,832	-3.59%
3	34.39	13.90	47,623	M	**EAAL**	122,393	118,122	3.62%
General					**PVB**	242,901	239,372	1.47%
					NC	9,841	9,507	3.51%
					PVFS	587,980	607,350	-3.19%
4	65.97	30.75	81,584	F	**EAAL**	30,715	30,757	-0.14%
General					**PVB**	42,895	43,202	-0.71%
					NC	3,219	3,349	-3.88%
					PVFS	275,341	303,182	-9.18%
5	29.44	4.50	39,649	M	**EAAL**	39,544	37,504	5.44%
Other					**PVB**	167,439	154,659	8.26%
					NC	7,588	6,946	9.25%
					PVFS	675,386	668,696	1.00%
6	54.26	15.30	17,394	F	**EAAL**	45,691	49,859	-8.36%
Other					**PVB**	85,256	92,329	-7.66%
					NC	5,091	4,949	2.88%
					PVFS	138,124	149,281	-7.47%
7	48.99	3.27	19,045	F	**EAAL**	9,921	9,368	5.90%
Other					**PVB**	42,589	39,703	7.27%
					NC	2,701	2,480	8.90%
					PVFS	232,794	232,995	-0.09%
8	32.68	8.25	63,703	F	**EAAL**	77,097	75,483	2.14%
Other					**PVB**	173,570	166,451	4.28%
					NC	6,226	5,826	6.87%
					PVFS	1,004,475	994,665	0.99%
Total Test Cases					**EAAL**	442,207	453,052	-2.39%
					PVB	935,263	932,261	0.32%
					NC	44,645	42,594	4.81%
					PVFS	3,502,518	3,580,160	-2.17%

RHB

Retirees

	Test Case	Age	Sex	Valuation Result	GRS	Segal	% Diff
1	General	89.59	F	EAAL/PVB	$ 10,192	$ 10,811	-5.73%
2	General	82.02	F	EAAL/PVB	18,233	19,423	-6.13%
3	General	74.76	M	EAAL/PVB	30,924	31,861	-2.94%
4	General	70.04	F	EAAL/PVB	37,992	39,578	-4.01%
5	General	70.29	M	EAAL/PVB	39,602	41,824	-5.31%
6	Teachers	61.53	M	EAAL/PVB	89,933	85,629	5.03%
7	General	65.77	F	EAAL/PVB	48,901	50,083	-2.36%
8	General	64.62	M	EAAL/PVB	52,310	49,394	5.90%
9	General	65.09	M	EAAL/PVB	37,668	39,289	-4.13%
10	General	72.20	F	EAAL/PVB	39,674	41,769	-5.02%
	Total Test Cases			EAAL/PVB	405,429	409,661	-1.03%

Terminated Vested

	Test Case	Age	Service	Sex	Valuation Result	GRS	Segal	% Diff
1	Teacher	40.27	8.0	F	EAAL/PVB	$ 117,481	$ 118,353	-0.74%
2	Teacher	34.17	7.6	F	EAAL/PVB	15,616	15,297	2.08%
3	Teacher	49.81	7.9	F	EAAL/PVB	10,546	10,664	-1.10%
4	Teacher	45.61	18.4	M	EAAL/PVB	103,525	106,487	-2.78%
5	Law Enforcement	44.70	18.4	M	EAAL/PVB	112,951	118,541	-4.72%
6	General	61.61	6.2	F	EAAL/PVB	75,722	75,826	-0.14%
7	General	61.01	13.4	M	EAAL/PVB	45,271	45,876	-1.32%
	Total Test Cases				EAAL/PVB	481,111	491,044	-2.02%

Total RHB

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	Segal	% Diff
EAAL	$1,328,747	$1,353,757	-1.85%
PVB	1,821,803	1,832,966	-0.61%

Test Lives Comments

We believe that the test lives are close enough to state that the liabilities shown in the funding valuations are reasonable and an appropriate representation of the liabilities, based on the current assumptions. When performing a full replication valuation, we generally consider replication a successful match if the replication is within the following tolerances (in plan total):

Total Present Value of Benefits	2%
Total Accrued Liability	5%
Normal Cost	5%
Present Value of Future Pay	2%

When looking at individual test life cases, difference may be much larger due to differences in rounding between actuarial software. For this reason it is also important to consider the variance between the sums of the test cases, which will generally dampen the effect of differences due to rounding. However, the smaller the group of test cases, the larger the acceptable tolerances should be. We have found that the sums of the test cases (actives, retirees and terminated vested) for each of the plans we have reviewed are all within or acceptably close to the tolerance we would have applied to the plan totals when performing a full replication. We therefore believe the plan total results for TSERS, LGERS, RODSPF, DIPNC and RHB are reasonable.

This is our second year performing this analysis. As such, we attempted to request some of the same test life cases this year as we did last year, so we could review how the results changed from year to year. For the inactives (all groups) we find the reported year-to-year results to be very consistent. With regard to the actives, the changes in the TSERS group made this analysis difficult this year: of the 4 continuing actives, one had a date of birth correction, one has a salary well in excess of the pensionable salary limits, one was a new hire last year with fractional service (which can skew results), and the last one is receiving a DIPNC benefit. For the other groups, except LGERS, the results appear consistent from year to year. For the LGERS group, we noticed that in most cases, the normal cost as a percent of pay only remained approximately level for 2 of the cases (when just comparing the CAVMAC results from last year to this year). For the other cases, the normal cost as a percent of pay changed between 0.25% and 1.50% of pay (note the GRS results for these cases were approximately level from year to year). This is an unexpected result and we recommend this result be reviewed by CavMac.

We have the following comments regarding the valuation reports and the current actuaries' calculations:

- We recommend CavMac review the calculation of the LGERS test life entry age normal cost for consistency between the 2017 and 2018 actuarial valuations.
- We recommend the North Carolina Retirement Systems (NCRS) provide their actuary with more complete information regarding terminated vested members. CavMac has previously indicated that they are working with NCRS on this point. CavMac also indicates that liabilities are estimated to be twice the members' accumulated contributions. Test life information indicates that this was also the case for non-vested members. We recommend that liabilities be set equal to members' accumulated contributions for non-vested members, as a measure of the outstanding refund. Alternately, if CavMac has rationale for estimating liabilities for terminated vested members to be twice the members' accumulated contributions, disclose the rationale for the assumption.

- The test life information indicates that in certain circumstances, data was modified before being used (as allowed for under ASOP 23). However, ASOP 23, section 4.1 requires disclosure of such modifications, the general data review process, any and any "significant judgmental adjustments or assumptions". We recommend that CavMac increase the documentation regarding their data processing. Specifically, we suggest that documentation/commentary include:
    - How members receiving DIPNC benefits are valued in TSERS (specifically, how is the pay data determined)
    - How valuation pay and reported pay differ (there is a vague comment in the report that we suggest expanding)
    - What pay limitations are valued and how that might differ from other assumptions (TSERS test case 3 implies that the reported pays are capped at the 401(a)(17) limit in the valuation and that limit is increased at 3.5% per year)
    - How members with reported sex of U are valued (male or female)
- Review whether or not it would be appropriate to set the member's accrued contributions as a floor on the liabilities (for TSERS test case 4 from our 2017 review, CavMac's total and accrued liability calculation are lower than the member's current accumulated contributions shown on the data file)
- Disclose that the timing of retirement changes from mid-year to beginning of year at the end of the retirement pattern (this is illustrated in the results for LGERS test case 2). Note page 76 of the TSERS report contains a statement on timing that timing for all assumptions is mid-year when this is actually not the case for the last age of the retirement pattern
- Identify how RODSPF service is determined/maintained (see comment below)

We have the following comments regarding future audits:

- In reviewing the RODSPF actives, it became clear that the reported service on the file was not RODSPF service in all cases (it was most likely total LGERS service). We were able to find RODSPF start dates based on internet searches of public data to better match calculations. We suspect that CavMac must have had additional data regarding RODSPF service for active members (as searching public databases would not be practical for the entire RODSPF active population). We recommend that such additional information be included in data provided to the auditor.

Section 4

A Review of the Respective GASB Reports

Content Review

The GASB 67/74 letters combined with the schedules in the funding valuation appear to have all of the actuarial schedules required by Statement Nos. 67/74.

For the reports prepared by CavMac, there are separate GASB letters issued with the main results. However, the information in these letters appears to be replicated in the funding valuation with additional GASB schedules. We believe that all of the actuarial schedules and actuarial disclosures required by GASB 67/74 are detailed in the funding valuation report.

For the report prepared by Segal, there is no funding valuation (in accordance with the plan sponsor's decisions). The report that Segal provided for December 31, 2018 contained the underlying valuation results. In addition, Segal provided a separate document discussing the changes implemented with this year's calculations. We believe that the Segal GASB 74 report contains all the actuarial schedules and disclosures required by GASB 74.

Calculations Review

While our review affirmed the December 31, 2018 calculations of liabilities, the following chart shows our attempt at replicating the roll forward to June 30, 2019. Since the exact calculations were not provided and certain elements had to be estimated, we did not expect to exactly reproduce the June 30, 2019 numbers. As the schedules show, our estimates were extremely close.

		TSERS	LGERS	RODSPF	DIPNC	RHB
	Data					
1	December 31, 2018 AAL	82,105,943,131	29,223,126,652	30,558,606	345,399,709	31,993,220,405
2	Employee Contribs during 12 months, ending 6/30/19	951,566,000	420,437,000	-	-	-
3	Employer Normal Cost Rate (Excl Admin Exp) as of 1/1/19	5.08%	11.59%	16.44%	22,567,000	1,824,174,672
4	Payroll as of 12/31/18	14,436,435,848	6,225,257,140	6,539,270	1	1
5	Benefits Paid during 12 months ending 6/30/19	4,835,144,000	1,472,856,000	1,754,000	61,946,000	1,030,956,211
	GRS' approximation of numbers needed for roll forward					
6	Change in Benefit Terms (not already included in 12/31/2018 AAL)	-	-	-	-	-
7	Service Cost from 12/31/18 to 6/30/19: (3)*(4)/2	366,685,471	360,685,229	537,482	11,283,500	912,087,336
8	Benefit Payments from 12/31/18 to 6/30/19: (5)/2	2,417,572,000	736,428,000	877,000	30,973,000	515,478,106
	GRS' approximation of 6/30/19 TPL/OBEP Liab (roll forward)					
9	12/31/18 TPL: (1)+(6)	82,105,943,131	29,223,126,652	30,558,606	345,399,709	31,993,220,405
10	Service Cost: (2)/2 + (7)	842,468,470.54	570,903,729.40	537,481.55	11,283,500.00	912,087,336.00
11	Benefit Payments	2,417,572,000	736,428,000	877,000	30,973,000	515,478,106
12	Interest: (1)*7%/2 + [(10)-(11)]*7%/4[#]	2,846,143,698	1,019,912,758	569,791	6,291,655	622,906,009
13	TPL/OPEB Liab 6/30/19: (9) + (10) - (11) + (12)	83,376,983,299	30,077,515,139	30,788,878	332,001,864	33,012,735,645
14	TPL/OPEB Liab 6/30/18 developed by CavMac/Segal	83,326,405,000	29,866,869,000	30,794,000	331,978,000	33,095,182,920
15	Ratio of GRS approximation to CavMac/Segal Calculation	100.1%	100.7%	100.0%	100.0%	99.8%

[#] *For RODSPF and DIPNC, 7% is replaced with 3.75%; 3.87% for RHB.*

SECTION 5

COMMENTS AND CONCLUSIONS

Comments

We would like to thank Segal and CavMac for their cooperation in the completion of this review. However, we would like to specifically recognize Segal for going above and beyond expectations in their efforts to ensure that we had the information necessary to complete our assignment.

While we have indicated we believe the assumed rate of return of 7.00% was reasonable for TSERS and LGERS (based on the information provided for this review) capital market expectations have continued to decrease. If this trend continues, this assumption may need to be lowered for future valuations. In addition, at the lower end of our preferred price inflation assumption, the current 7.00% investment return assumption becomes harder to defend.

Prior Year's Recommendations

We have reviewed the reports with regard to our recommendations from last year and have not found implementation of any of our recommendations (except the recommendation for GRS and CavMac to determine if the DIPNC test case differences can be improved).

While most of our recommendations can be considered our opinion of best practices, one recommendation is related to the documentation of data processing and is a relatively new Actuarial Standard of Practice (ASOP 23). It is not clear to GRS that the valuation reports meet this ASOP as it relates to disclosure requirements.

Conclusions

We believe the actuarial assumptions, actuarial cost methods, procedures, and valuation results are reasonable and based on our test life review, the valuation results are of reasonable accuracy.

We certify that the plans' actuarial valuation was prepared in accordance with pronouncements issued by the Governmental Accounting Standards Board (GASB), principles and practices prescribed by the Actuarial Standards Board, and that the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures (with the exception of the disclosure requirements discussed above).

Recommendations for Future Years

We have the following recommendations for future valuations:

- Lower the price inflation assumption to within the range of 2.0% to 2.5%;
- Consider lowering the long-term expected return for TSERS and LGERS in the future;
- Increase the documentation in the valuation regarding data processing/preparations;
- We recommend the North Carolina Retirement Systems (NCRS) provide their actuary with more complete information regarding terminated vested members, and that either liabilities be set equal to members' accumulated contributions for non-vested members or the rationale for setting equal to twice the non-vested members' accumulated contributions be disclosed;

- We recommend that CavMac increase the documentation regarding their data processing. Specifically, we suggest that documentation/commentary include:
    - How members receiving DIPNC benefits are valued in TSERS
    - How valuation pay and reported pay differ (there is a vague comment in the report that we suggest expanding)
    - What pay limitations are valued and how that might differ from other assumptions (such as the 401(a)(17) limit compensation limit)
    - How members with reported sex of U are valued (male or female)
    - Ensure compliance with ASOP 23
    - How RODSPF service is determined/maintained
- Setting a floor on liabilities equal to members' accrued contributions;
- Disclose that the timing of retirements changes from mid year to beginning of year at the end of the retirement pattern; and
- Providing any additional data files used in the valuation to the actuarial auditor (such as RODSPF service for active members).